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2015-2036

MMM – City Wide Integrated Public Transport Plan

VOLUME 3B

MANGAUNG
AT THE HEART OF IT ALL

INTEGRATED
PUBLIC
TRANSPORT
NETWORK

MMM IPTN Team
21 October 2019
Revision 7.0

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DIAGRAMS

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ABBREVIATIONS

Abbreviation	Full Description
ACSA	Airports Company South Africa
ADN	Airport Development Node
ADP	Airport Development Plan
AFC	Automated Fare Collection
AFCA	Automated Fare Collection Agent
APTMS	Advanced Public Transport Management System
ATC	Adaptive Traffic Control
BATHA	Botshabelo Amalgamated Taxi Association
BEPP	Built Environment Performance Plan
BOC	Bus Operating Company
BRT	Bus Rapid Transit
CBD	Central Business District
CBO	Community-based Organization
CCC	Centralized Control Centre
CCTV	Closed-circuit Television
CITP	Comprehensive Integrated Transport Plan
CM	Carbon Monoxide
CNG	Compressed Natural Gas
COGTA	Cooperative Governance and Traditional Affairs
CPI	Consumer Price Index
CPTR	Current Public Transport Record
CRM	Customer Relationship Management
DETEA	Department of Environmental Tourism Economic Affairs
ECE	Economic Commission of Europe
EM	Executive Mayor
EMF	Environmental Management Framework
EMV	Euro-Mastercard-VISA
FINMOD	Financial Model
GBTA	Greater Bloemfontein Taxi Association
GIS	Geographic Information System
GPRS	General Packet Radio Service
GPS	Global Positioning System
ha	Hectare
HC	Hydrocarbons
HHS	Household Survey
HOD	Head of Department
HR	Human Resources
ICE	Internal Combustion Engine
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
IMC	Integrated Marketing and Communication
IPTN	Integrated Public Transport Network
IRPTN	Integrated Rapid Public Transport Network
ITP	Integrated Transport Plan
ITS	Intelligent Transport System
VT	In-Vehicle Time (IVT) (in Minutes)
JOC	Joint Organizing Committee
JSC	Joint Steering Committee
km	Kilometre
LAN	Local Area Network
LED	Light Emitting Diode
LIM	Linear Induction Motor
MFMA	Municipal Financial Management Act

ABBREVIATIONS

Abbreviation	Full Description
MITP	Mangaung Integrated Transport Plans
MMC	Member of Mayoral Committee
MMM	Mangaung Metropolitan Municipality
MOU	Memorandum of Understanding
MRE	Municipal Regulatory Entity
MSA	Municipal Systems Act
NATMAP	National Transport Master Plan
NDOT	National Department of Transport
NDP	National Development Plan
NEMA	National Environmental Management Act
NGO	Non-governmental Organization
NLTA	National Land Transport Act
NLTTA	National Land Transport Transition Act
NMT	Non-Motorised Transport
NOX	Nitrogen Oxide
NT	Number of Transfers (NT)
OCR	Optical Character Recognition
OD	Origin-Destination
OLS	Operating Licenses Strategy
OOP	Office of the Premier
PDM	Patronage Demand Model
PDOT	Provincial Department of Transport
PDP	Professional Driver Permit
PLTF	Provincial Land Transport Framework
PM	Particulate Matter
PMU	Project Management Unit
POS	Point of Sale
PRASA	Passenger Rail Agency of South Africa
PT	Public Transport
PTIG	Public Transport Infrastructure Grant
PTIS	Public Transport Infrastructure and Systems Grant
PTNOG	Public Transport Network Operational Grant
PTOG	Public Transport Operational Grant
PTZ	Pan-Tilt-Zoom
PvT	Private Transport
PWCSN	PWCSN: Person with category of special need
RoW	Right of Way
RTPI	Real-time Passenger Information
SABS	South African Bureau of Standards
SAC	Schedule Adherence and Controlling
SANRAL	South African National Road Agency Limited
SANS	South African National Standards
SANTACO	South Africa National Taxi Council
SDA	Service Delivery Agreement
SDF	Spatial Development Framework
SIP	Strategic Integrated Projects
SMME	Small Medium and Micro Enterprise
SP	Stated Preference
SVMS	Strategic Variable Message Signs
SWOT	Strength Weakness Opportunity Threat
THALSDTA	Thaba Nchu Long and Short Distance Taxi Association
TIMS	Traffic Management and Information System
TIS	Traveller Information System

ABBREVIATIONS

Abbreviation	Full Description
TOM	Ticket Operating Machines
TSP	Traffic Signal Priority
UA	Universal Access
UD	Universal Design
UDAP	Universal Design Access Plan
ULSD	Ultra Low Sulphur Diesel
UTC	Urban Traffic Control
VDM	Vehicle Docking Manager
VMS	Variable Message Sign
VOC	Vehicle Operating Company
VOIP	Voice Over Internet Protocol
VTTS	Value of Travel Time Savings (VTTS) (in Rand/hour)
VWTS	Value of Waiting Time Savings (VWTS) (Rand/hour)
WAN	Wide Area Network
WP	Work Package
WT	Waiting Time (WT) (in Minutes)
WULA	Water Use License Application

12 IPTN and System Alternative Analysis

12.1 Introduction

Given the unique customer profile, land use mix, road network, existing operator and the identified minor, secondary and primary movements it is evident that to implement an integrated, sustainable and financially viable public transport system is not a one size fit all solution. To this end, a public transport system alternative analysis is required to determine the optimum system scenario to be implemented citywide and per individual corridor. The alternative analysis process sets out to define alternatives in order to determine the most likely design that will be suitable in a corridor and enable integration between corridors in a sustainable and feasible manner. The development of alternatives and selecting the optimum system scenario for implementation need to realise the vision, goals, objectives and level of service that the city envisaged for the citywide IPTN and associated systems.

The approach to the design and selection of alternatives for the implementation of the Mangaung IPTN is to incrementally develop an integrated public transport system where road and rail based modes has a specific role and function, and where existing public transport operations can transform from informal operations (unscheduled, without specific route) to formalised (scheduled, route based) operations or variations thereof. A scheduled, route-based system provides an environment where public transport can be regulated and optimised to implement a sustainable, safe, reliable and affordable public transport system.

The purpose of the alternative analysis is thus to compare alternatives and select one or a combination of these alternatives that will be sustainable in the long term and accessible to all categories of users.

The IPTN derived in preceding sections is presented in Figure 13-1 and represent the geographical extent of the network considered in the alternative analysis process.

12.2 Methodology

The methodology applied for the alternative analysis process is presented in Diagram 12-1 and comprise of:

- Define operational alternatives (Section 13):
  - Alternative patronage scenarios to accommodate rationalisation of the system taking cognisance of industry transformation,
  - Route and service alternatives that will allow an incremental transformation-, rationalisation of existing operations and implementation of a citywide integrated transport network and systems.
- Determine the infrastructure and systems requirements to facilitate the defined operational alternatives, and determine how the infrastructure can be the incremental implementation to align with the operational alternatives(Section 14),
- Determine the operational and capital cost of the above alternatives for the base-,10- and 20-year horizon (Section 15),
- Define Implementation Strategies to roll-out the IPT network and system to align the capital and operational requirement with the available funding (Section 16). In the development of these strategies, the impact on customer experience, financial aspects and business aspects are considered and the advantages and disadvantages compared.
- These implementation strategies and the combination of strategies need to be evaluated in terms of financial sustainability and practical implement ability thereof. This evaluation is done through an iterative process where conceptual operational plans(routes, services, infrastructure, systems, compensation, etc.) and roll-out programs are defined and financially compared to each other. This comparison is made through the development of a business model that quantifies the cost, revenue and available funding per conceptual operational alternative and implementation program for a 25-year period. The result of the process is the recommendation of the optimum IPTN (routes), operational model, systems, infrastructure and strategies to develop and implement. These recommendations underpin the public transport improvement program (implementation program/roll-out) for the 5-, 10- and 20-year horizon and individual implementation programs per functional public transport corridor (Section 18).

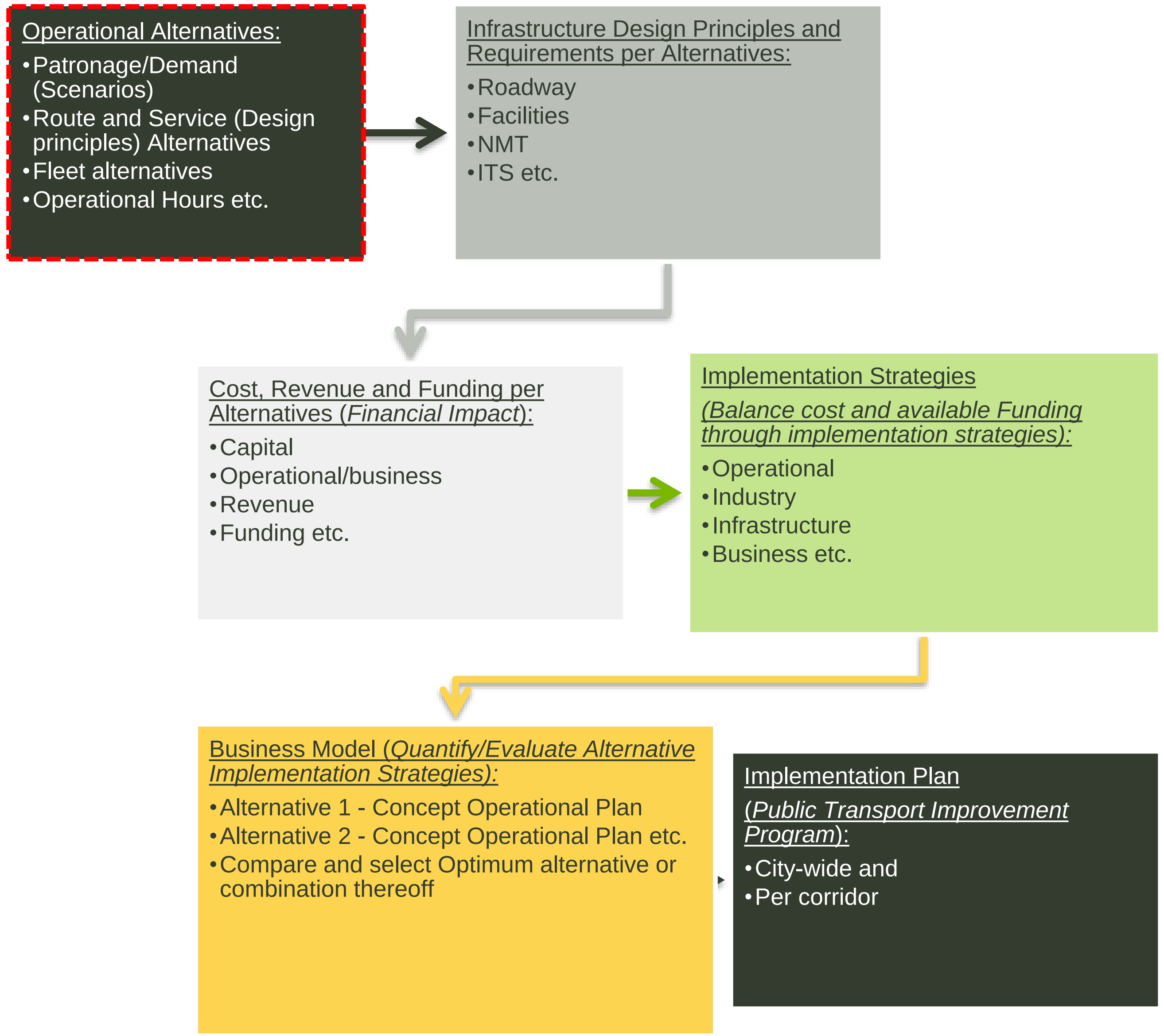


Diagram 12-1: Alternative Analysis Process and Components

13 Operational Alternatives

Operational aspect of an IPTN system includes estimation of patronage, routes, service types, service frequency, operational hours and the vehicle capacity deployment per route. To realise the goals and objectives of the IPTN system, design guidelines and principles were developed to guide the selection of alternatives for the mentioned elements. Alternatives are developed and compared to the guidelines to determine the design that meets these and in return, realises the goals and objectives set for the IPTN system. The financial impact of the alternatives is evaluated through the application of the business model.

Operational alternatives were developed for the following operational aspects:

- Patronage (demand);
- Transport Mode;
- Route design;
- Services frequency;
- Vehicle capacity.

13.1 Patronage Scenarios

The patronage estimation per functional public transport corridor was based on the objective that 85% of the population will be within 500m of a scheduled public transport service. The scenarios align with the land use model and public transport matrix estimation, that reflect the base year scenario, 10-year horizon and a 20-year horizon.

The estimation of patronage for a public transport system is key to the system design, sizing and can influence the selection of the type of system and components to facilitate the estimated demand. Furthermore, to evaluate the sensitivity of the system, to change and accuracy of estimated patronage, two patronage scenarios were developed with subsets that represent a conservative and optimistic approach respectively for the base year and two future year scenarios. The two patronage scenarios are:

- IPTN patronage comprises of existing subsidised bus services demand and existing minibus taxi demand; and
- IPTN demand comprise of only exiting minibus taxi demand.

These two scenarios were defined given the process that needs to be followed to incorporate existing provincial subsidised bus services into the jurisdiction of the municipal.

For these two main scenarios, two sub scenarios were developed for the base year. A conservative where only 70% of the estimated passenger demand realise and optimistic where 1005 of demand realises. The passenger demand was estimated through the passenger demand matrix estimation process presented in Volume 3A. The scenarios and subsets are:

- Patronage Scenario1 – Including subsidised bus service demand):
  - 2017 Low (70% PT matrix);
  - 2017 high (full PT matrix);
  - 2025 high;
  - 2036 high.
- Patronage Scenario - 2 Excluding Subsidised bus demand:
  - 2017 Low (70% PT matrix);
  - 2017 high (full PT matrix);
  - 2025 high;
  - 2036 high.

The estimated daily patronage per functional public transport inclusive of subsidised bus demand is presented in Table 13-1, and Table 13-2 presents demand per scenario excluding subsidised bus service demand. The total demand for the city-wide system is 30% less when the subsidised bus service demand for the local corridors are excluded. The rural corridor and cross-border demand are not included in these scenarios. The patronage associated with these corridors represent 4% of the total demand and will be accommodated as separated contracts and evaluated when contracts are up for renewal. Diagram 13-1 presents the comparison of the patronage scenarios. The inclusion of the subsidised bus service demand is notable in the Botshabelo and Thaba Nchu corridors.

The patronage growth factor is derived from the macro-economic study and land-use scenarios developed for the project. The land-use scenarios aligned with the BEPP and approved SDF. The population growth and economic growth is estimated to be marginal for the 10- and 20-year horizon. The selection of a system option needs to accommodate this marginal increase in population and allow for the system to be expanded when demand realises rather than designing for the ultimate population estimated.

The patronage estimation was utilised for the route design to determine patronage per route and service of the city-wide network and system. The impact of the two patronage scenarios on vehicle fleet and affordability is provided as part of each component in subsequent sections.

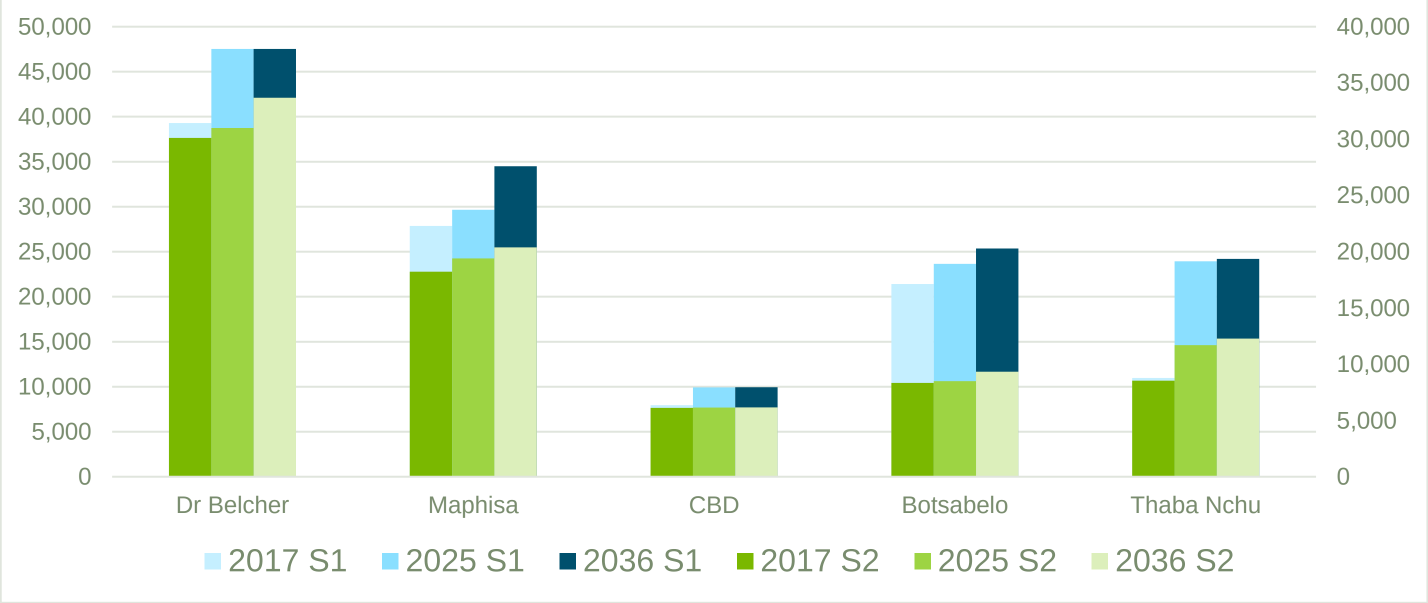
Table 13-1: Patronage Scenario1 (*Including* Subsidised Bus Demand) per Corridor 2017, 2035, 2036

Daily Pax	2017 - Daily Pax	Distribute in Bloemfontein	2017 - Daily Pax (High)	Distributed in Bloemfontein	2025 - Daily Pax	Distribute in Bloemfontein	2036 - Daily Pax	Distribute in Bloemfontein
Dr Belcher	39,303		51,650		47,527		47,527	
Maphisa	13,350		13,790		14,209		16,528	
OR Tambo	14,520		14,520		15,455		17,977	
CBD	6,121	57,678	9,657	90,992	9,926	93,530	9,949	93,742
Botshabelo	21,414		22,179		23,654		25,362	
Thaba Nchu	8,541		28,032		23,942		24,200	
	103,249	57678	139,827	90,992	134,715	93,530	141,543	93,742

Table 13-2: : Patronage Scenario 2 (Subsidised Bus Demand *Excluded*) per Corridor 2017, 2035, 2036

Daily Pax	2017 - Daily Pax	Distributed in Bloemfontein	2017 - Daily Pax (High)	Distributed in Bloemfontein	2025 - Daily Pax	Distribute in Bloemfontein	2036 - Daily Pax	Distribute in Bloemfontein
Dr Belcher	30,116		30,801		30,994		33,683	
Maphisa	8,732		8,798		9,294		9,766	
OR Tambo	9,497		11,758		10,109		10,622	
CBD	6,121	35,760	5,987	56,415	6,154	57,989	6,168	58,120
Botshabelo	8,345		8,641		8,491		9,334	
Thaba Nchu	10,973		13,555		11,701		12,273	
	73,784	35,760	79,540	56,415	76,742	57,989	81,845	58,120

Diagram 13-1: Patronage Scenario Compared



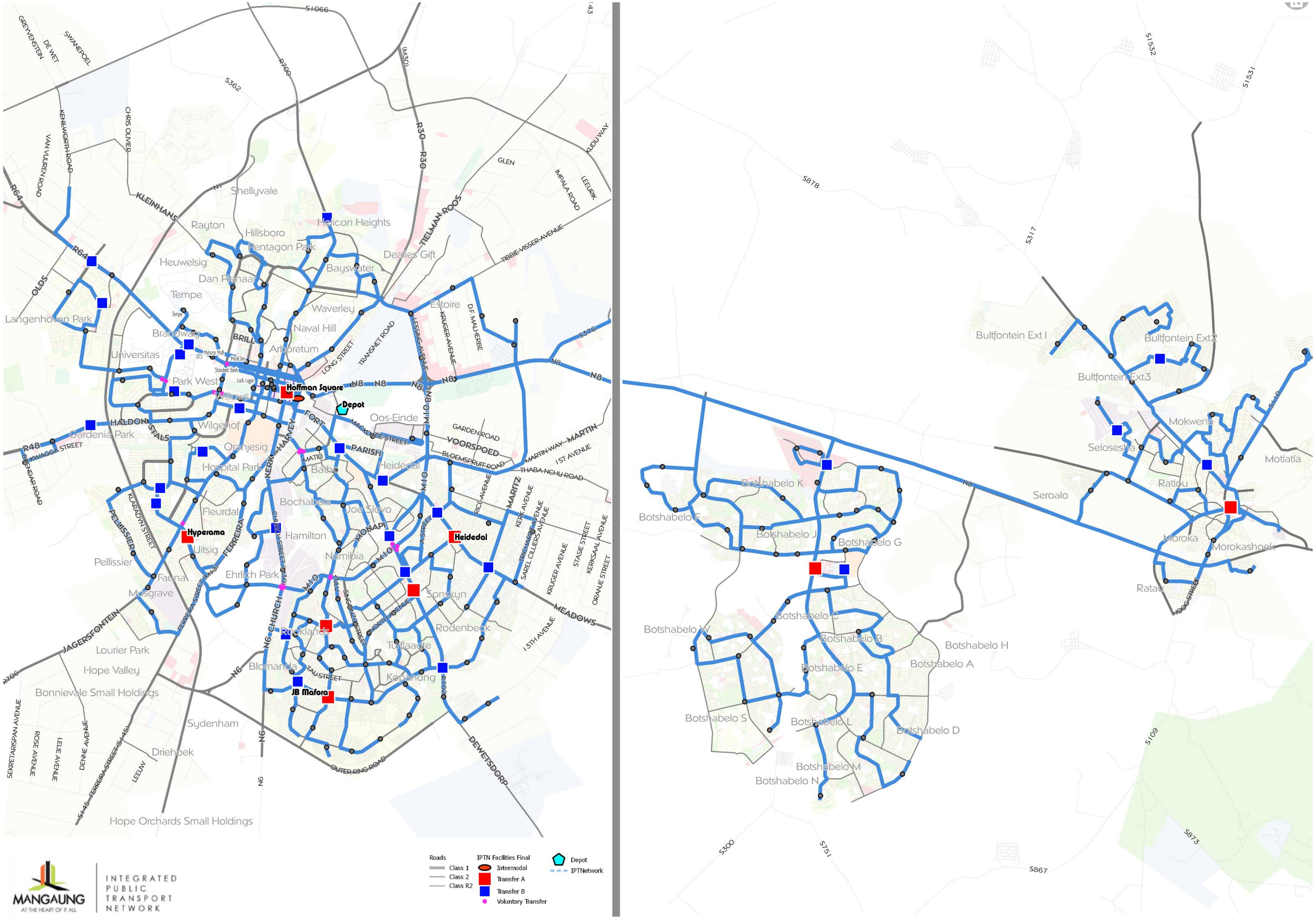


Figure 13-1: IPTN City-wide Network

13.2 Mode

Mangaung is known as the walking city given the compact nature of certain parts of the metro, the distance that people, in general, is willing to walk and the topography of the area. The mode strategy is based on the selection of the optimum mode taking into consideration distance and number of passengers along a defined route. The mode selection relies on the route design and the identification of primary and secondary movements. Where more than 50 passengers in the peak hour will travel for more than 3 km, a motorised mode will be implemented and was the principle for selecting the primary and secondary corridors. The mode strategy and catchment area per mode is presented in **Figure 13-2**.

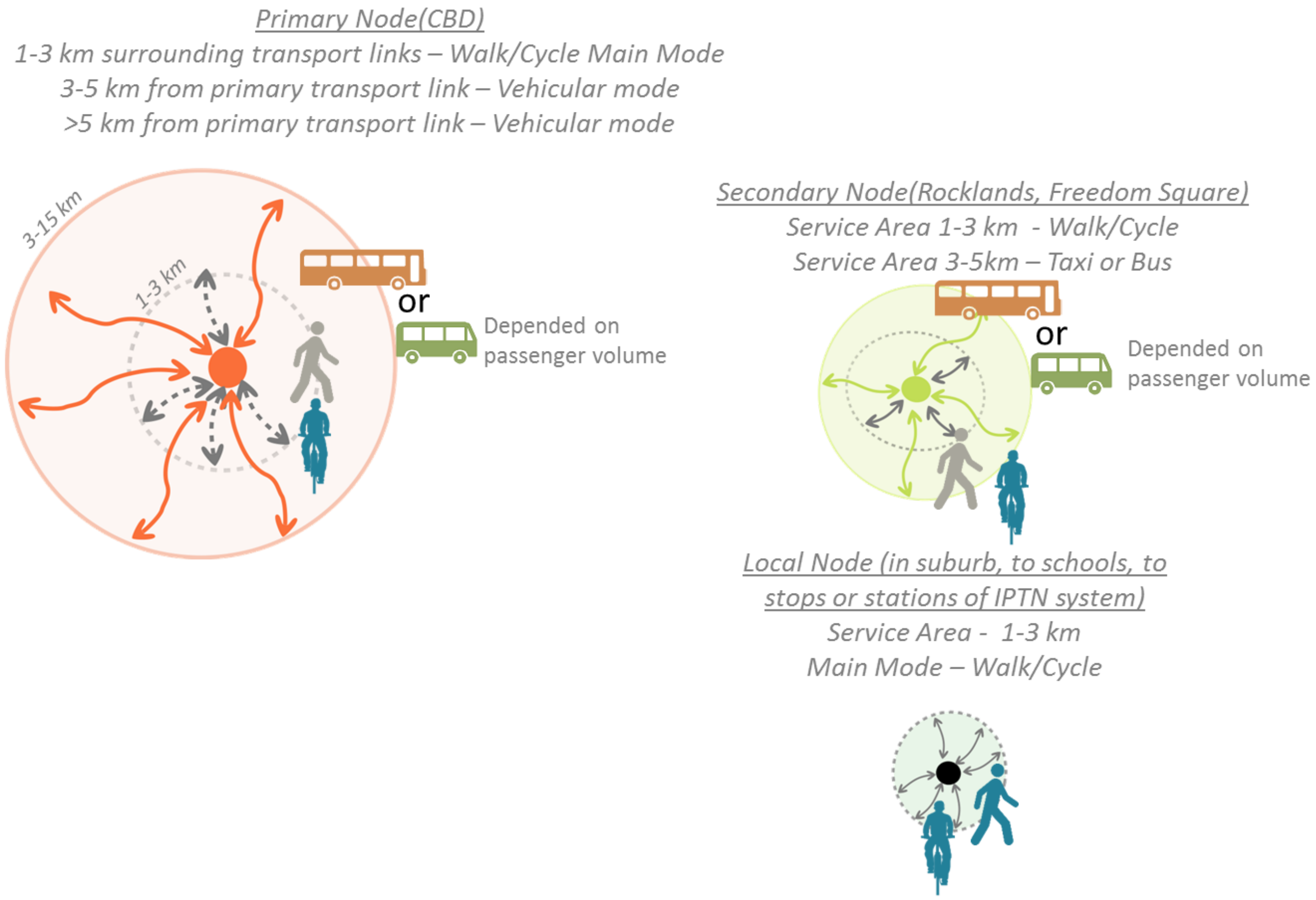


Figure 13-2: Node hierarchy and associated mode strategy

However, to start the design process the total passenger volumes generated by each corridor, traffic volume per lane along the trunk routes within the corridor and length of corridor were compared to the guidelines in terms of passengers volume per hour and the recommended mode, vehicle capacity and right-of-way presented in Table 13-3. Table 13-4 present the right-of-way, mode and vehicle capacity per corridor per design year for Patronage Scenario 1 (full public transport matrix). The detail data summarised in Table 13-4 is presented in Annexure S.

Two of the functional public transport corridors trigger the implementation of dedicated lanes during the peak hours of the day. The implementation of dedicated lanes during the peak hours are subjected to detail capacity analysis and will be confirmed in subsequent sections. This first-order mode selection is the departure point for the selection of vehicle capacity per route and right-of-way.

Table 13-3: Mode Capacities

Mode Description		Peak Hour Passengers	Distance One Direction
	Non-motorised	<50	1 -3 km
	Mini-bus Taxi - Mixed Traffic	<500	< 5 km
	Bus –conventional - Mixed Traffic (kerb-side loading)	500 to 1,500	< 50 km
	Quality Bus Service - With signal priority measures	2,500 to 6,000	< 50 km
	BRT - Exclusive Right of Way kerb lane	3,000 to 6,000	< 35 km
	BRT - Exclusive Right of Way Median/Separate Bus Way Express service (one lane)	8,000 to 15,000	< 35 km
	[1] BRT - Mixed traffic with exclusive lane use in peak hours (one lane)	2,000 to 6,000	< 35 km
	Heavy Rail - Exclusive Right of way	20,000 to 80,000	>15 km

Table 13-4: First Order Mode Strategy City-wide

Daily Pax	Distance (km)*	Peak Hour 2017 (low Scenario)	First Order Mode selection	Peak Hour 2017 (High Scenario)	First Order Mode selection	Peak Hour (2025)	First Order Mode selection	Peak Hour (2036)	First Order Mode selection
Dr Belcher	14 km	2836		3726		3429		3429	
Dr Belcher Meadows	11 km	1946		2557		2353		2353	
Dr Belcher Direct routes	10-16 km	778		1023		941		941	
Maphisa	11 km	1869		1672		1989		2314	
OR Tambo	14 km	2033		2033		2164		2517	
CBD (Nelson Mandel, Zastron, Harvey and Hanger Streets)	6 -18 km	857		1352		1390		1393	
Botshabelo	55 km	2998		3105		3312		3551	
Thaba Nchu	68 km	3488		3924		3352		3388	

*Trunk of corridor to CBD Hoffman Square/Intermodal Facility at Rail station

Mini-bus Taxi - Mixed Traffic

Quality Bus Service - With signal priority measures

Bus –conventional - Mixed Traffic (kerb-side loading)

Quality bus Service - Mixed traffic with exclusive lane use in peak hours (one lane)

13.3 System Design

To include 85% of the metro's population into the IPTN system is one of the objectives of the system as well as designing a system that is financially sustainable. With these objectives in mind, the approach to the design of the system is to provide services for the identified primary and secondary movements in the city. These movements allow for between 70-80% of origin-destination pairs to be accommodated by main routes of the system and thus represent the financial lucrative routes in the city.

However, the remainder of OD pairs, minor movements, also need to be accommodated within the IPTN system to ensure an inclusive system. These minor movements will be accommodated through the provision of voluntary transfer points in the system. A voluntary transfer point is where a passenger can transfer between routes if no main route is provided between origin and destination or at identified main transfer points in the system. Thus, as part of the design of the system, the route design will be evaluated to ensure that transfers are provided to allow for directional change in the system between main routes and thus accommodate minor movements. The network of routes and the main and voluntary transfers are presented in Figure 13-1. The detail of routes that will operate along the network is defined and alternatives tested in the route design and service section.

13.4 Routes

To ensure long term sustainability in the IPTN system, routes and service will be provided where 50 or more passengers travel between origin-destination pairs or a combination of these. These represent the primary and secondary movements in the city. The process followed to design alternative route options to accommodate the primary and secondary movements per corridor are:

1. Define route types and concepts for design;
2. Primary and secondary movements identified per corridor provide the demand, main destinations and origins;
3. Divide demand corridors into sub-corridors given existing public transport operational areas if different from the primary and secondary movements identified. This approach will allow for the incremental transformation of exiting operators and rationalisation of existing services;
4. Refine origin-destination pairs and demand between OD's after subdivision into sub-corridors utilising public transport matrix;
   a. Use identified IPTNetwork (roads) to determine where route alignment can be implemented to facilitate the demand between identified OD pairs;
   b. Refine route alignment based on land use and existing public transport service providers on-board surveys;
   c. Validate the inclusion of minor OD pairs.
5. Design route alternatives per corridor or sub-corridor per route design principles and route options under considered.

13.4.1 Route Types

The route types that will be considered during the design process are trunk routes, complementary routes, direct routes and feeder routes (refer to **Figure 13-3)**. The purpose of feeder routes is to collect passengers from an area surrounding a specific node and bring passengers to the nearest stop or station where passengers then transfer to services operating along complementary or trunk routes.

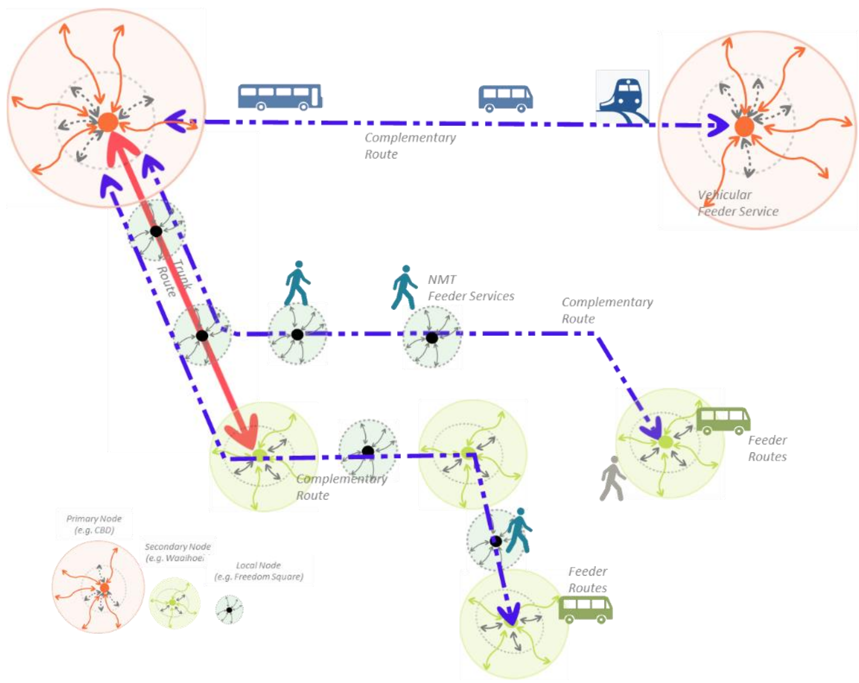


Figure 13-3: Route Types

The selection of alternatives needs to be considered carefully given the impact of a specific design on the passenger journey time. Therefore, thou a feeder trunk service can be the optimum solution from a financial point the impact on the passenger journey time, and the number of transfers needs to be considered.

Therefore, the main objective in a feeder-trunk system is to collect/distribute passengers from the main trunks to final destination with feeder vehicles and through this improve the vehicle utilisation rate per vehicle in the fleet. Figure 13-4 indicates that the maximum advantage will be gained when several feeders feed into a trunk, but of importance is the time that will be spend on the feeder route versus the time spends on the trunk. If the origin-destination travel time of a passenger is divided into half, the advantages can be limited to implement a feeder-trunk design.

A guiding principle is that a third of travel time needs to be spend on the feeder versus two thirds on the trunk portion of the route. Thus, if the trunk portion of the route is 10km the feeder preferably must not be longer than 3-3.5km one direction travel distance, given that the travel speed is the same along both portions of the route.

This principle was applied in the design of alternative design for the system and acknowledge travel speed along feeders and trunks where applicable.

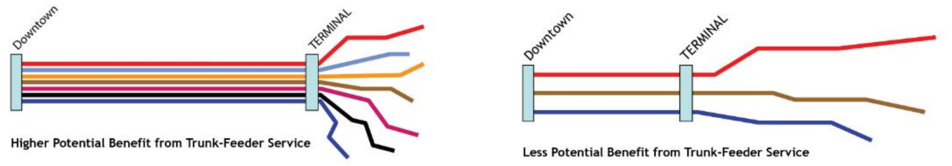


Figure 13-4: Optimum Scenario for Implementation of Feeder -Trunk Route Configuration

13.4.2 Service Types

Two types of services will be utilised during the design, and these include express and local services. Figure 13-5 illustrates service concepts. The services in relation to route types and transfer points are presented in **Figure 13-6**.

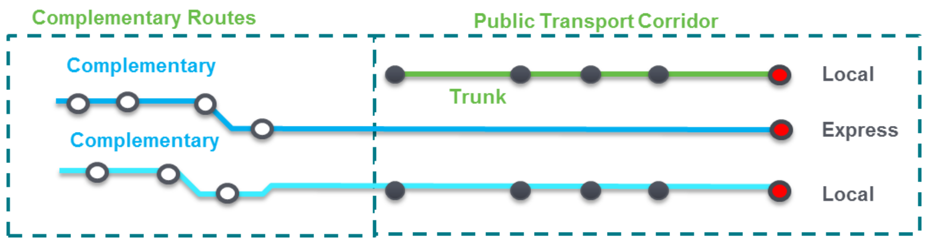


Figure 13-5: Service Design

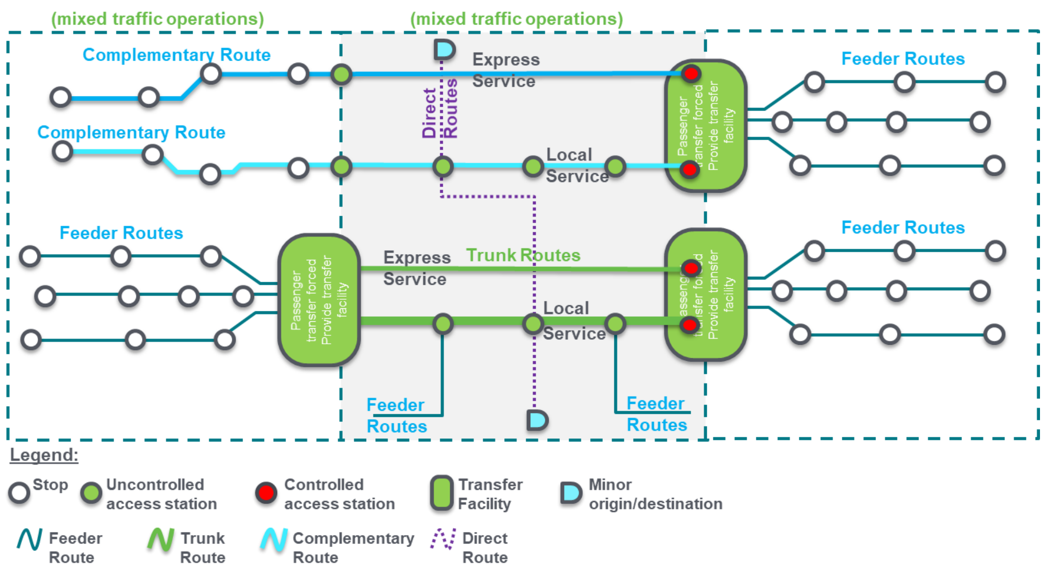


Figure 13-6: Route Design Options/Alternatives

13.4.3 Primary and Secondary Movement per Corridor

Refer to Annexure R for detail pertaining to primary and secondary movement per corridor. These are summarised in Figure 13-7.

13.4.4 Functional Public Transport Corridors and Sub-corridors

The functional public transport corridors extend across several mini-bus taxi operational areas and subsidised bus route operational areas. To streamline the industry transition process, the approach of clear the corridor was adopted, and the IPTN operational areas were defined based on mini-bus operating licenses (operational areas). These IPTN operational areas were used to subdivide the functional public corridors. The mini-bus operational areas are detailed in the transport register and summarised in Figure 13-8. Subsidised bus service contracts and associated routes transverse the identified functional public transport corridors in such a manner that the rationalisation of all contracts will be required, and it is not possible to rationalise these services on a contract by contract manner. The subsidised bus contract operational areas were omitted in the delineation of sub-corridors.

The functional local corridors were divided as follows:

- Maphisa/Moshoeshoe/OR Tambo:
  - Sub-corridor 1- Mafora West operational areas
  - Sub-corridor 2 – Ipopeng, Mafora Central, Mafora East operational areas
- Dr Belcher:
  - Sub-corridor 1 – Turflaagte, Freedom Square, Namibia, Ooseinde;
  - Sub-corridor 2 – Heidedal; Grassland.
- CBD :
  - Sub-corridor 1- Brandwag,
  - Sub-corridor 2- Universitas,
  - Sub-corridor 3- Langenhoven Park,
  - Sub-corridor 4- Hyperama;
  - Sub-corridor 5 – Estiore, Airport.
- Botshabelo: No, sub-corridors. Based on CPTR data, 5 routes are operated within Botshabelo, one to Thaba Nchu and one to Bloemfontein. Detailed market research and analysis of operating licenses are required to define sub-corridors for the area.
- Thaba Nchu – No sub-corridors. Based on CPTR data several (8) long-distance and cross border routes operate from Thaba Nchu and at least 4 routes to nearby villages, one to Bloemfontein, one to Botshabelo and 3 local distribution services in Thaba Nchu. Detailed market research and analysis of operational licenses are required to define sub-corridors.

The option analysis was geographically divided according to the functional corridors defined as part of the public transport demand estimation process. The geographic area per corridor is presented in Figure 13-9.

13.4.5 Refinement of OD-Pairs and Demand Per Functional Public Transport Corridor

The 10 functional corridors, sub-corridors and first-order mode selection were the departure point for the definition of alternative route design per corridor and sub-corridor. For each of these sub-corridors, the primary, secondary and minor movements were validated and refined through the following methodology:

- MMM was divided into 250 Traffic Analysis Zone(TAZ) during the development of the public transport matrix estimation process. Each of these zones represents an origin or/and destination these and were used in the refinement of the origin-destination pairs and volumes.
- Origin-Destination (OD) pairs with 50 or more passengers per hour in AM peak hour was included in the design as a dedicated origin-destination pair.
  - 50 or more person trips per hour between a specific origin-destination is equal to 3 (three) 15 passenger capacity vehicle trips in an hour. Three trips provide a service frequency of 18 minutes. The selected level of service for the IPTN is at least a 20-minute service frequency per peak hour and thus origin-destination pairs with at least 50 passengers per hour need to be incorporated in the IPTN system.
- If an OD pair yield less than 50 passengers, the following process was triggered to provide services to the specific origin or destination:
  - Determine if a route that service an OD pair with 50 or more trips, transverse the origin zone and this route ends after or at the destination of the OD pair with less than 50 passenger trips per hour. If this principle is met, the passenger trips are added to the patronage of this route. Figure 13-10 illustrate the principle.
  - In the instance where peak period demand between a specific OD pair is more than 150, a direct route or route with one transfer was opted as an alternative design.
- Long-distance and cross border corridors (excluding Botshabelo and Thaba Nchu) was not considered in this process, and the rationalisation and incorporation of these origin-destination pairs will be addressed as part of non-contracted non-scheduled services.

- Figure 13-11 and Figure 13-12 present the percentage of trips ending and originate per area group. 4% of trips generated in the metro originate from rural zones, and 11% of trips generated in the metro ends in rural zones. Providing scheduled routes to these areas per demand and not on a fixed schedule is deemed to be a sustainable solution. A detailed financial assessment will be required to determine the rationalisation of these services and the optimum schedule and mode.

- Each of the selected OD pairs or grouping of pairs were assigned to a specific route. The route alignment was selected based on roads identified as part of the IPT network and validated through comparing with existing public transport operator routes. The route start- and end point were determined to align with main transfer points identified in the system and points of interest, for example, hospitals, shopping centres, clinic and others.

13.4.6 Route Alternatives Per Corridor

The route options defined to guide the development of alternative route designs are:

- Scheduled Trunk routes, with direct routes;
- Scheduled Feeder-Trunk,
- Scheduled Feeder-Trunk and Complementary
- Scheduled Direct routes – Direct scheduled service between origin and destinations.

13.4.6.1 Trunk Only Routes and Services

- Concept of Operations:
  - Scheduled trunk routes and services with unscheduled feeder services are provided.
  - Feeder services are provided by Hauweng branded feeder vehicles collecting passengers in the suburbs and provide access to the trunk routes and services at one or two main transfer facilities. The feeder routes are designed to be maximum of 7km given that the trunk route is between 20 -30 km round trip distance. The position and size of the main transfer depend on the number of feeder routes and vehicles that integrate with the trunk services at the particular transfer.
  - Direct/Diagonal routes from one corridor to the other corridor will be provided. These will operate between identified stops, main transfer or high capacity public transport stops.

13.4.6.2 Feeder-Trunk Route Design

- Concept of Operations:
  - Trunk and feeder routes are scheduled, and route alignment fixed. Feeder services are designed according to the same design principles as trunk only services pertaining.
  - Direct/Diagonal routes from one corridor to the other corridor will be provided. These will operate between identified stops, main transfer or high capacity public transport stops.

13.4.6.3 Feeder-Trunk and Complementary

- Concept of Operations:
  - Trunk and feeder routes are scheduled, and route alignment fixed. Feeder services are designed according to the same design principles as trunk only services pertaining.
  - Where rationalisation of trunk feeder route into complementary, where patronage along feeder is more than 450 passengers per hour. This rationalisation will enhance passenger experience and omit one transfer in the full journey of a passenger. This rationalisation, however, needs to be financially feasible and sustainable.
  - Direct/Diagonal routes from one corridor to the other corridor will be provided. These will operate between identified stops, main transfer or high capacity public transport stops.

The route design per defined alternative for the OR Tambo are discussed to illustrate design principles and outcomes of the process:

- **Direct Routes –** The selected origin-destination pair was linked with a route when more than 150 trips or a combination of origins and destination resulted in more than 150 trips in the peak hour. **Figure 13-14** present the direct route design option for the OR Tambo sub-corridor. From a commuter point of view, this route design is ideal given that the origin and destination are linked without any transfers. However, the cost and fleet implication need to be addressed of all options to have a sustainable and financial solution. Subsequent sections consider these aspects of routes and services design.
- **Feeder-Trunk route design –** Feeder routes feed from the suburbs to a transfer point in the suburban area. From this transfer point, the trunk service/route facilitate movement to a transfer point in the CBD. Passengers are forced to transfer in the CBD to distribution/feeder routes to the final destination. The trunk portion within a corridor is derived based on several principles on time spend on feeder versus time spend on the trunk and the number of feeders to a transfer point that will be integrating/feeding to the trunk services. The Feeder-Trunk Route design is presented in **Figure 13-16**. The existing public transport operations force passengers to transfer in the CBD. Thus, with this route design, an additional transfer is added to the current experience or operational model in the city. Sustainability and financial impact will be considered subsequently.
- **Feeder-trunk and Complementary route design** – Where the patronage along a feeder route is more than 450 per hour a complementary route opted. The principle is that where more than 450 passengers per hour are collected in a service area, the bus (80 seat capacity) will most like be fully occupied when it reaches the trunk route. Thus, express service can be provided for these passengers from the point where the service joins the trunk route to the destination in the CBD. The complementary route design is presented in **Figure 13-15.** This route design nearly mimics the existing operational model of existing public transport operators, and thus passengers will be familiar with this operational model. However, operational cost and journey time needs to be considered before complementary routes are implemented.

The route length, operating speed, service frequency and other parameters and results are presented in Table 13-5 for OR Tambo corridor. Annexure T provides a summary of route design parameters and maps for the remainder of the defined corridors. These route designs are the basis for selecting an alternative to be implemented.

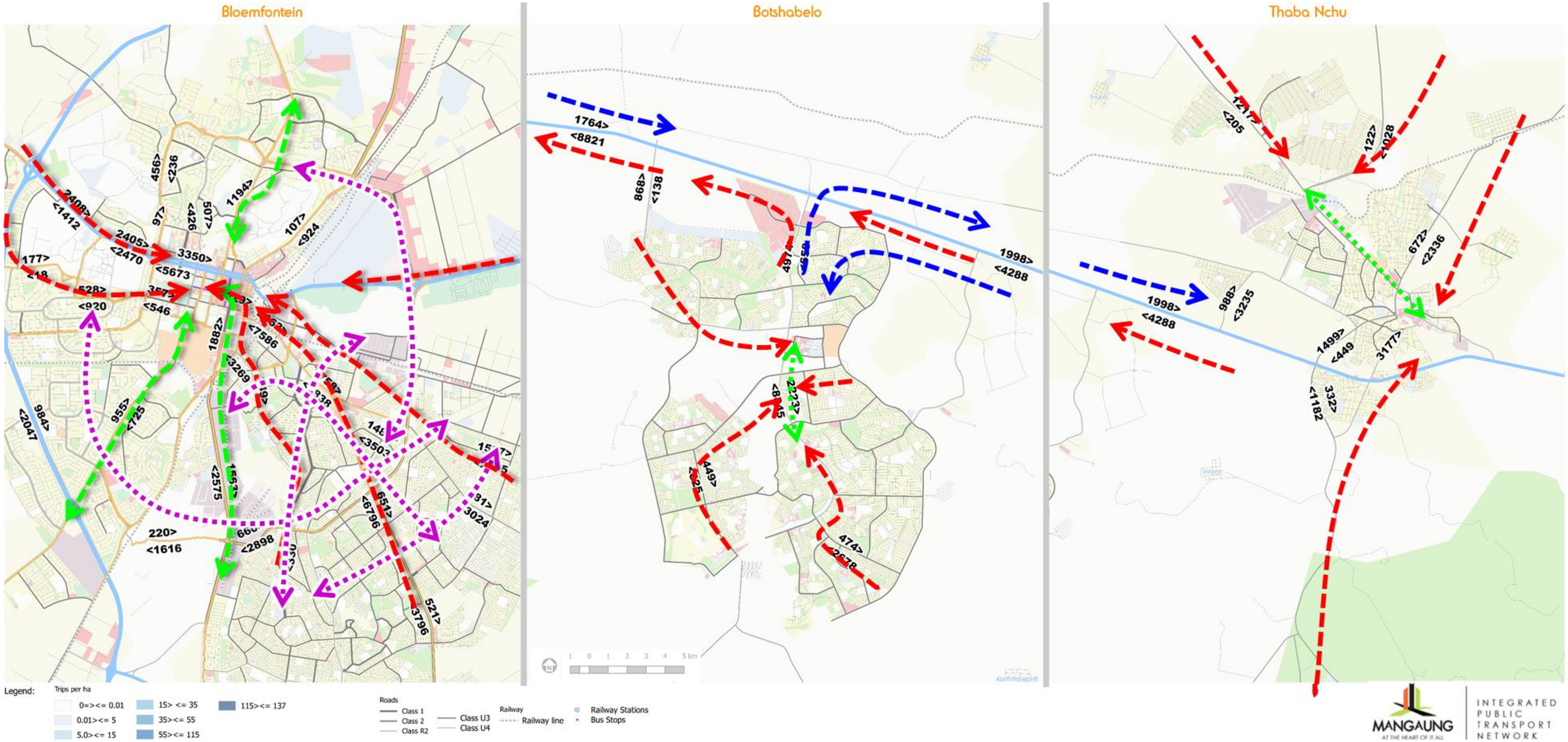


Figure 13-7: Primary and Secondary Movement Bloemfontein

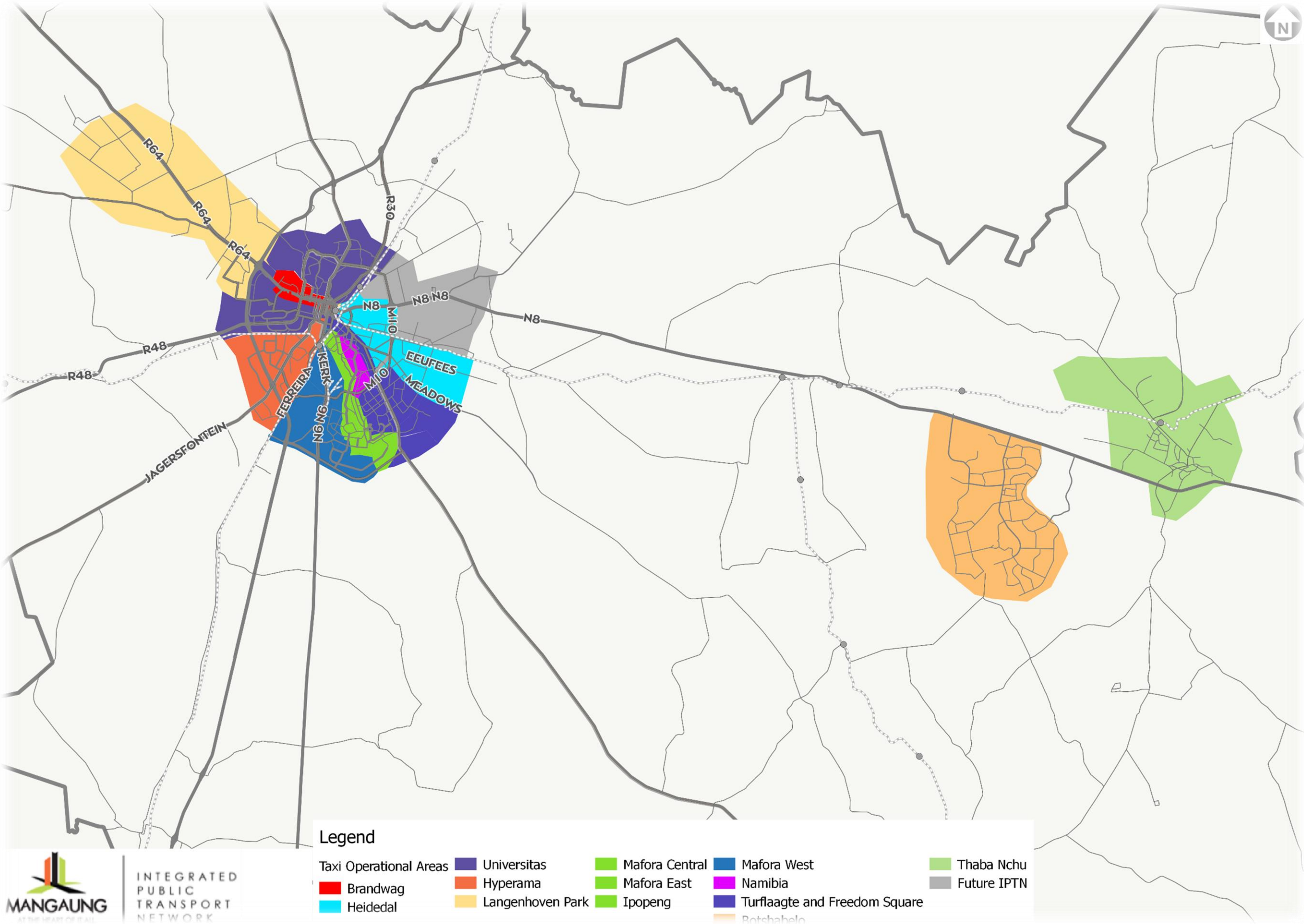


Figure 13-8: Mini-taxi Operator Operational Areas

Figure 13-9: Functional Public Transport Corridors

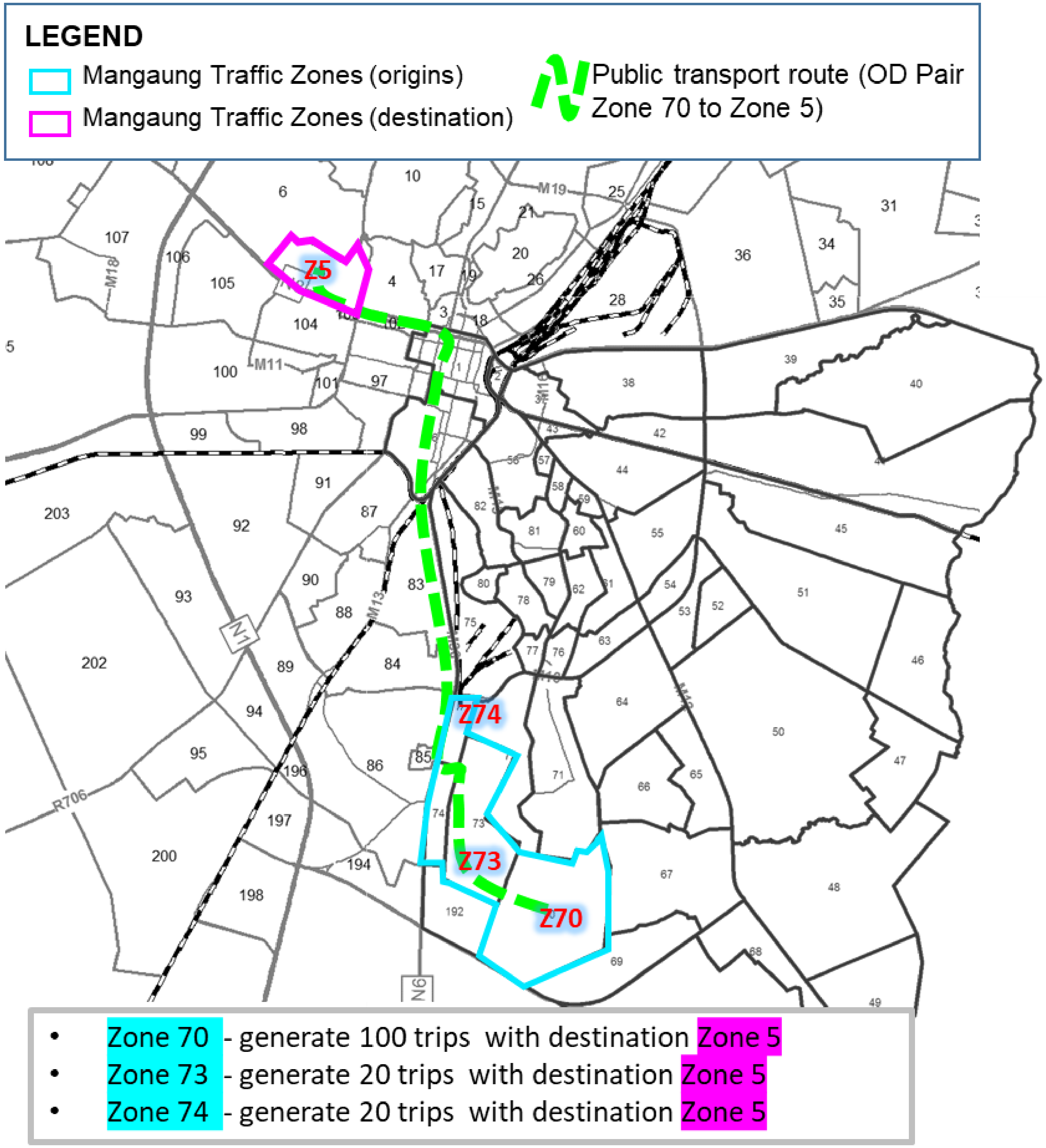


Figure 13-10: Origin-Destination Pair – Less than 50 Passengers per Hour Incorporation Illustration

Bloemfontein Area **Botshabelo and Thaba Nchu Areas** **Rural Areas**

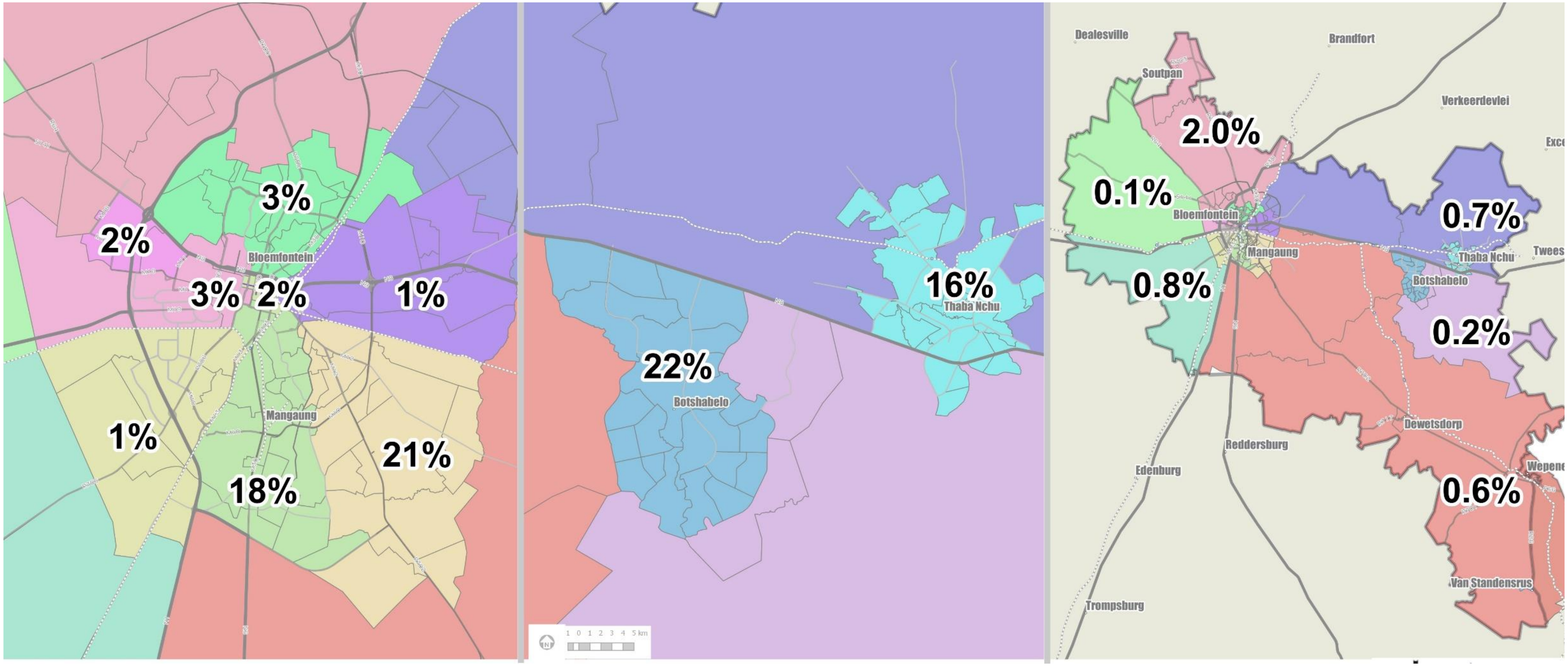


Figure 13-11: Percentage Peak Hour Trips Distribution per Origin Area (2017)

Bloemfontein Area **Botshabelo and Thaba Nchu Areas** **Rural Areas**

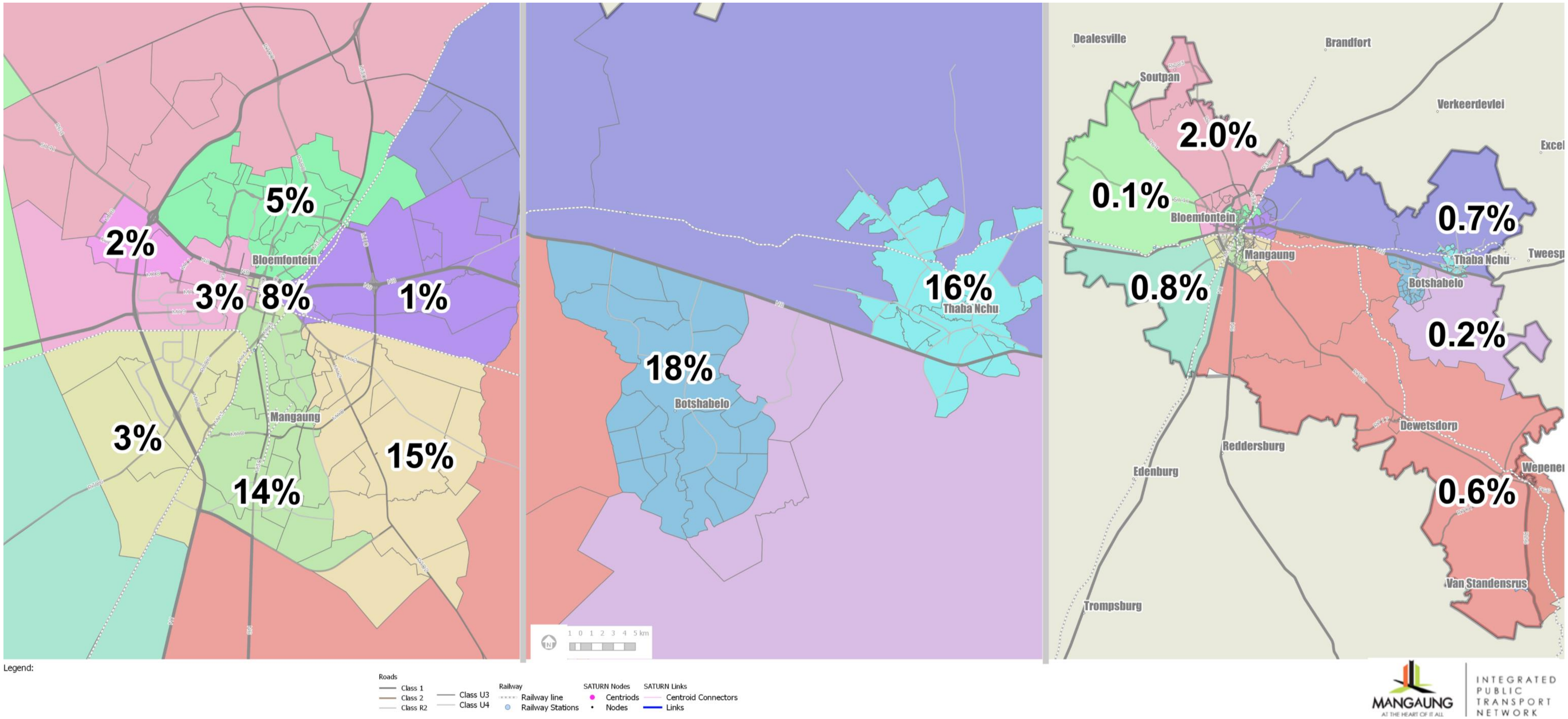


Figure 13-12: Percentage Peak Hour Trips Distribution per Destination Area (2017)

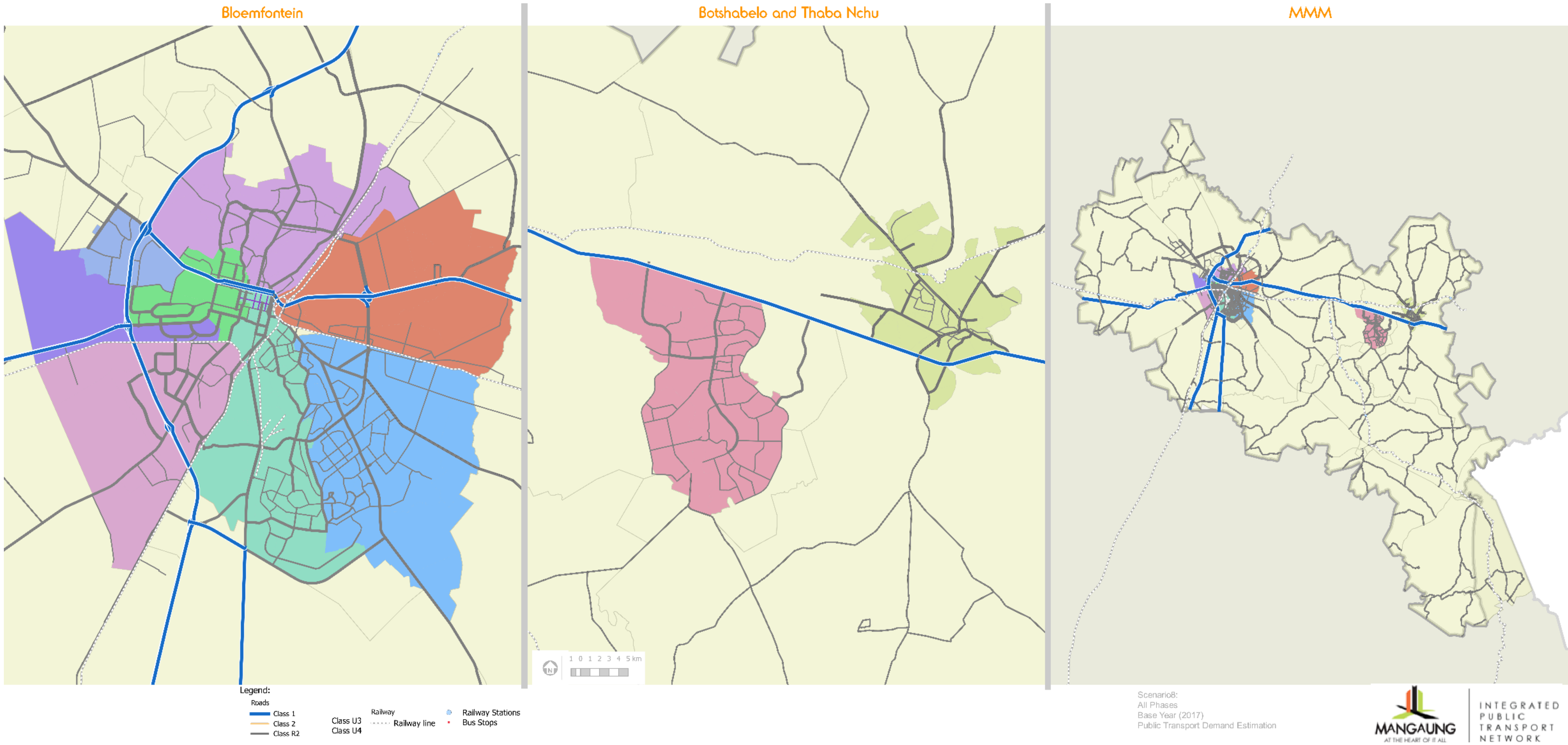


Figure 13-13: Operational Areas

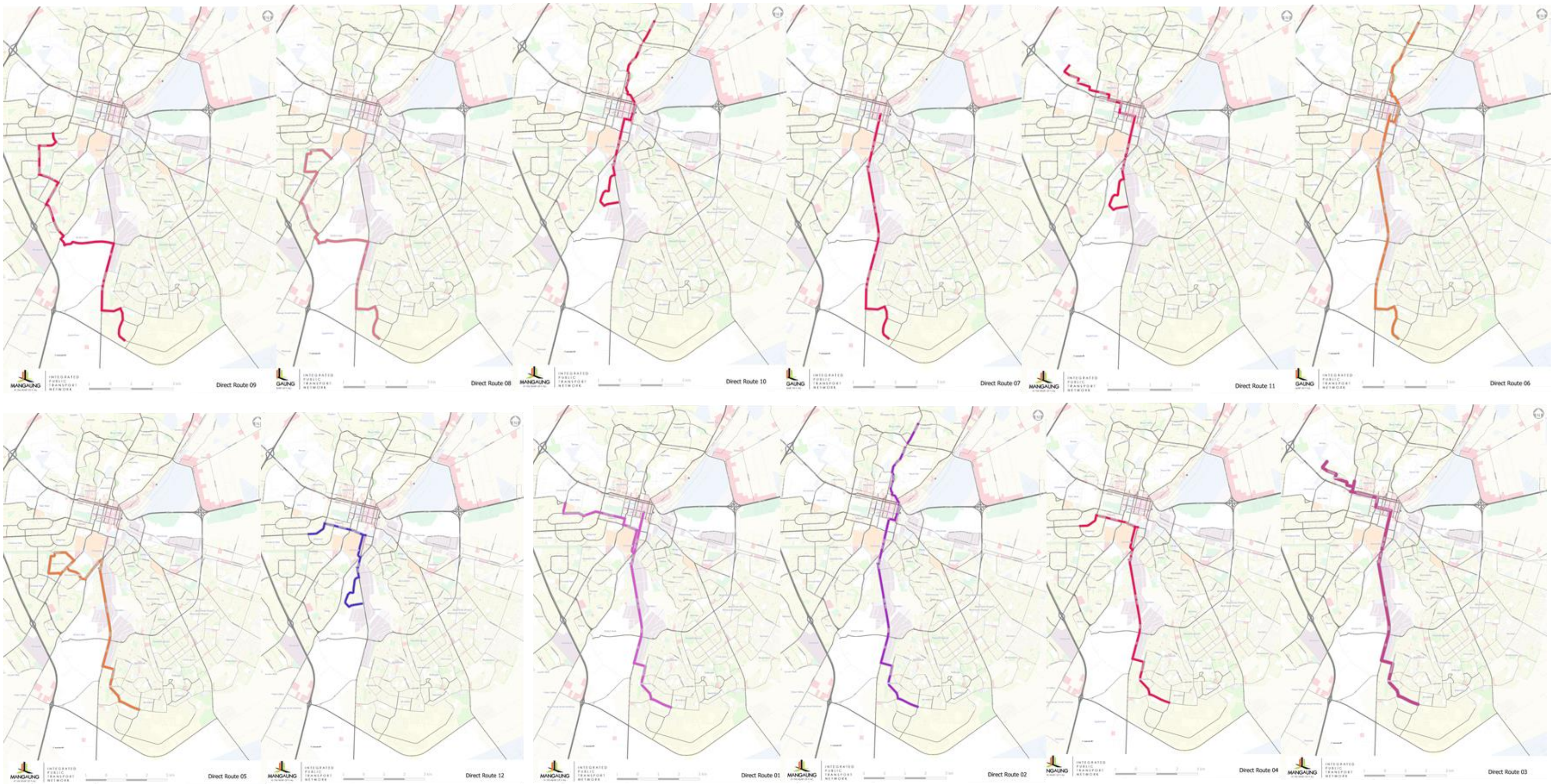


Figure 13-14: Direct routes – OR Tambo

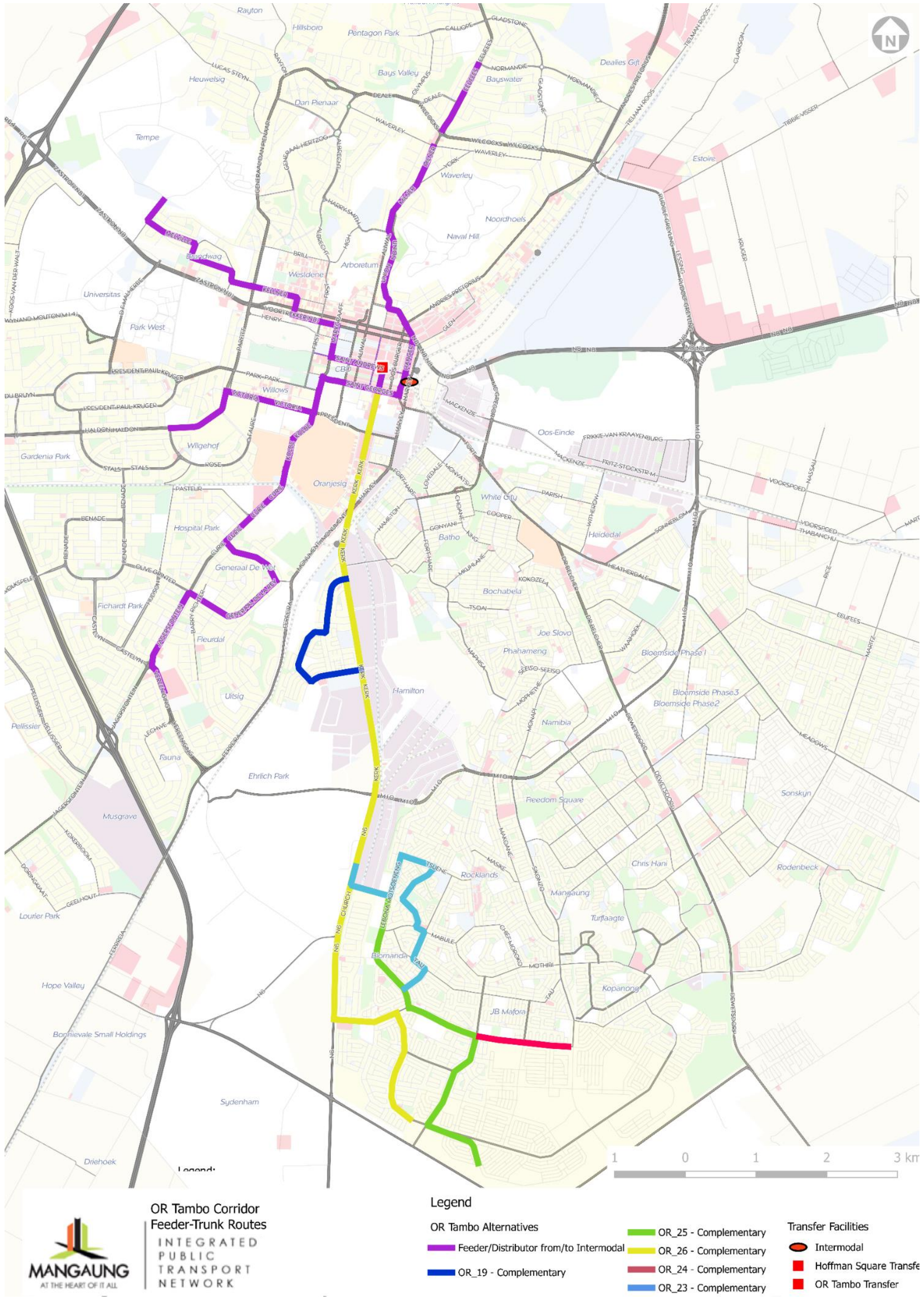


Figure 13-15: Complementary route design OR Tambo

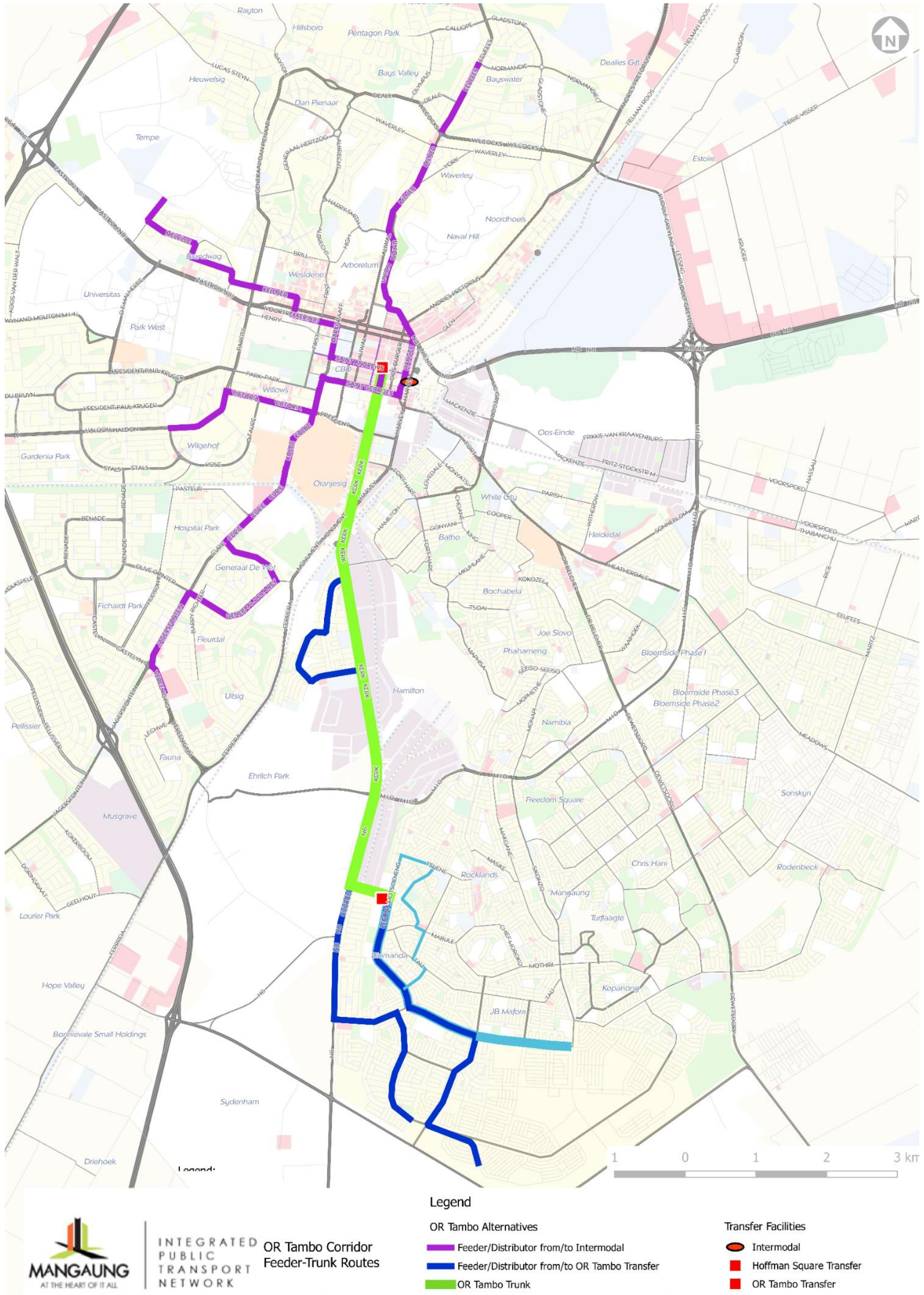


Figure 13-16: Feeder Trunk Route Design – OR Tambo

Table 13-5: OR Tambo Route and Service Design Options Summary

Option 1	Feed	Destination	Peak Hour Pax	Speed Local	Vehicle Capacity	Service Freq(min)	Fleet	Vehicle Trips per 60min	Distance One dir.	Travel Time One Direction	Round Trip Travel Time
Direct Route	Blomanda	Oranjesig/Waaihoek, Old Zoo/Willows, University of the Free State	315	19.0	22	3.8	24	16	14.3	53	92
Direct Route	Blomanda	Bayswater,Buitesig,Navalsig	278	19.0	22	4.3	21	14	14.3	52	90
Direct Route	Blomanda	Westdene,CBD,Brandwag - Densification	251	19.0	22	4.7	19	13	14.3	51	90
Direct Route	Blomanda	Hospitaalpark,Wilgehof	228	19.0	22	5.2	14	12	14.3	43	75
Direct Route	Blomanda	Hospitaalpark,Wilgehof	280	19.0	22	4.2	19	14	14.3	47	82
Direct Route	Hillside View x35	Bayswater,Buitesig,Navalsig	96	19.0	22	12.3	8	5	14.3	60	105
Direct Route	Hillside View x35	Westdene,CBD,Brandwag - Densification	69	19.0	22	17.2	5	3	14.3	53	92
Direct Route	Hillside View x35	Oranjesig/Waaihoek,Old Zoo/Willows,University of the Free State	109	19.0	22	10.9	8	6	14.3	47	82
Direct Route	Hillside View x35	Hospitaalpark,Wilgehof	176	19.0	22	6.8	12	9	14.3	48	83
Direct Route	Ehrlich Park	Bayswater,Buitesig,Navalsig	64	19.0	22	18.5	3	3	14.3	35	60
Direct Route	Ehrlich Park	Westdene,CBD,Brandwag - Densification	67	19.0	22	17.7	3	3	14.3	34	59
Direct Route	Ehrlich Park	Hospitaalpark,Wilgehof	53	19.0	15	15.4	3	4	14.3	25	44
Direct Route	Ehrlich Park	Hospitaalpark,Wilgehof	65	19.0	22	18.4	2	3	14.3	25	44
Option 2	**Origin**	**Destination**	**Peak Hour Pax**	**Speed Local**	**Vehicle Capacity**	**Service Freq(min)**	**Fleet**	**Vehicle Trips per 60min**	**Distance One dir**	**Travel Time One Direction**	**Round Trip Travel Time**
Complementary			433	20.0	80	10.0	8	6	14.3	45	79
Complementary			433	20.0	80	10.0	8	6	14.3	45	79
Complementary			433	20.0	80	10.0	7	6	14.3	42	74
Complementary			450	20.0	80	9.6	8	6	14.3	42	74
Complementary			300	20.0	80	14.4	4	4	14.3	32	55
Option 3	**Origin**	**Destination**	**Peak Hour Pax**	**Speed Local**	**Vehicle Capacity**	**Service Freq(min)**	**Fleet**	**Vehicle Trips per 60min**	**Distance One dir**	**Travel Time One Direction**	**Round Trip Travel Time**
Trunk	Blomanda,Hillside View x35,Ehrlich Park	Trunk Feeder Option	2050	20.0	120	3.2	15	19	14.3	27	47
Feeder To Trunk Suburb	Blomanda	Feeder to Trunk	347	19.0	80	12.5	3	5	14.3	22	39
Feeder To Trunk Suburb	Blomanda	Feeder to Trunk	347	19.0	80	12.5	2	5	14.3	13	22
Feeder To Trunk Suburb	Blomanda	Feeder to Trunk	347	19.0	80	12.5	2	5	14.3	13	22
Feeder To Trunk Suburb	Hillside View x35	Feeder to Trunk	360	19.0	80	12.0	2	5	14.3	13	23
Feeder To Trunk Suburb	Ehrlich Park	Feeder to Trunk	240	19.0	80	18.0	1	3	14.3	8	15

13.5 Service Frequency

The design principle for service frequency is to provide services at a maximum of 20-minute frequency or less if demand along a route required more frequent service. The 20-minute service frequency was selected as the minimum service level for the system and is provided as one of the measures of effectiveness for the IPTN. Vehicle capacity will be optimised during the design process to ensure that the frequencies presented in Table 13-6 are adhered to. The assumed operational hours to align with existing public transport operational hours is presented in Table 13-6. The introduction of a new system with operational hours less than the existing system will negatively impact on the utilisation of the system and will open the door for unregulated operations. The feasibility of these hours will be determined as part of the operational cost where a decision will be made on the feasibility and sustainability to implement the system, without impact on the utilisation of the system.

Table 13-6: Operational Hours and Service Frequency Guideline

	Operational Hours	Service Frequency
Weekdays	05:00 – 20:00	15-minute frequency **peak hours** 3 routes will alternate
		30-minutes Off-peak hours
Saturdays	05:00 – 16:00	30 minutes - all day
Sunday/Public Holidays	06:00 – 15:00	60 minutes - all day

Given the route design options and patronage scenarios, the service frequency per route was determined. Where the minimum frequency could not be achieved the vehicle, capacity was adapted to reach the selected service frequency. The detail pertaining to the route design, vehicle capacity per route are presented per route design option in Annexure T**.**

Given the detail, in Annexure T the percentage of routes with less or equal to 20-minute service frequencies for Patronage Scenario 1 is presented in **Table 13-7,** and for Patronage Scenario 2 is presented in **Table 10-8**. The implementation of trunk route services only with optimised vehicle capacity yield service frequencies of 20-minutes or less along all trunk routes for both patronage scenarios.

The implementation of scheduled feeder routes or complementary routes did not yield the same result for several of the corridors. Patronage Scenario 2, without subsidised bus services patronage, with lower patronage than Patronage Scenario 1, yield a large number of routes that will not be provided at the minimum frequency for the feeder-trunk or feeder-trunk, complementary route design options.

The results yield for the service frequency options analysis emphasises the importance of the selection of route design that fit the demand and the importance to incrementally rationalise and transform routes from unscheduled to scheduled services at a set frequency.

From a service design perspective and given the results yield the implementation of trunk only services flowed by incremental rationalisation and transformation of routes to scheduled feeder or complementary routes when demand materialises is recommended for the development of the implementation plan.

Table 13-7: Patronage Scenario 1 – Percentage of routes with 20-minute or less peak frequency

Feeder-Trunk, Complementary	Percentage of routes with <= 20 min service Frequency				
	Total Routes	2017 Low	2017 High	2025	2036
Botshabelo	17	94%	94%	100%	100%
Thaba Nchu	9	67%	67%	100%	100%
OR Tambo	11	91%	100%	100%	100%
Phase 1 _Maphisa	16	75%	81%	81%	88%
Phase 2	18	100%	100%	100%	100%
CBD	16	100%	100%	100%	100%
Feeder-Trunk	**Total Routes**	**2017 Low**	**2017 High**	**2025**	**2036**
Botshabelo	17	94%	94%	100%	100%
Thaba Nchu	9	67%	67%	67%	67%
OR Tambo	11	91%	100%	100%	100%
Phase 1 _Maphisa	16	75%	81%	81%	88%
Phase 2	18	100%	100%	100%	100%
CBD	16	100%	100%	100%	100%
Trunk Only Services	**Total Routes**	**2017 Low**	**2017 High**	**2025**	**2036**
Botshabelo	2	100%	100%	100%	100%
Thaba Nchu	1	100%	100%	100%	100%
OR Tambo	1	100%	100%	100%	100%
Phase 1 _Maphisa	1	100%	100%	100%	100%
Phase 2	2	100%	100%	100%	100%
Direct Routes	Total Routes	2017 Low	2017 High	2025	2036
OR Tambo	13	92%			
Phase 1 _Maphisa	28	43%			
Phase 2	78	56%			

Table 13-8: Patronage Scenario 2 – Percentage of routes with 20-minute or less peak frequency

Feeder-Trunk, Complementary	Percentage of routes with <= 20 min service Frequency				
	Total Routes	2017 Low	2017 High	2025	2036
Botshabelo	17	24%	29%	29%	29%
Thaba Nchu	9	44%	44%	44%	44%
OR Tambo	11	55%	64%	64%	82%
Phase 1 _Maphisa	16	69%	69%	69%	75%
Phase 2	18	100%	100%	100%	100%
CBD	16	100%	100%	100%	100%
Feeder-Trunk	**Total Routes**	**2017 Low**	**2017 High**	**2025**	**2036**
Botshabelo	17	24%	29%	29%	29%
Thaba Nchu	9	44%	44%	44%	44%
OR Tambo	11	55%	64%	64%	82%
Phase 1 _Maphisa	16	69%	69%	69%	75%
Phase 2	18	100%	100%	100%	100%
CBD	16	100%	100%	100%	100%
Trunk Only Services	**Total Routes**	**2017 Low**	**2017 High**	**2025**	**2036**
Botshabelo	2	100%	100%	100%	100%
Thaba Nchu	1	100%	100%	100%	100%
OR Tambo	1	100%	100%	100%	100%
Phase 1 _Maphisa	1	100%	100%	100%	100%
Phase 2	2	100%	100%	100%	100%

13.6 Operational Hours

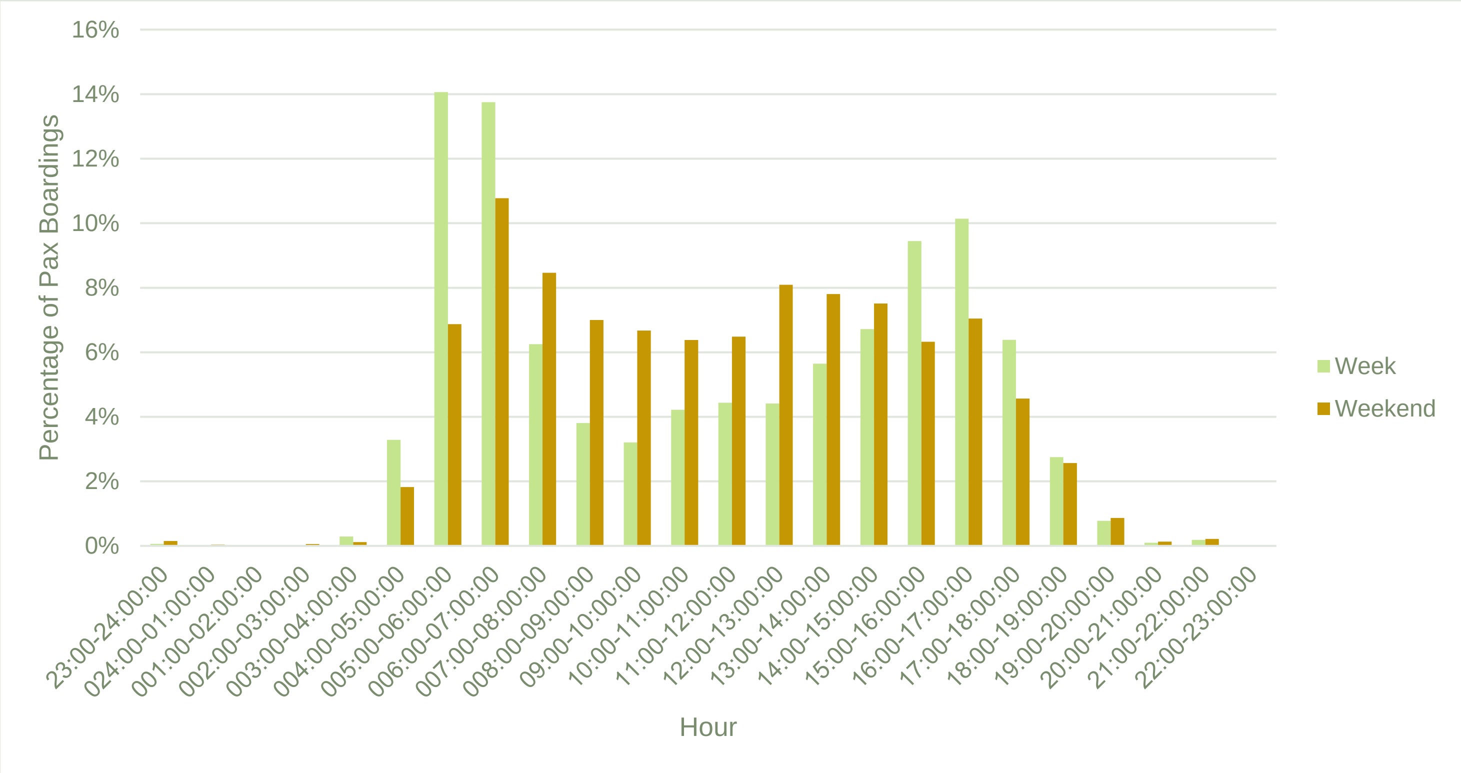
The operational hours impact directly on the operational cost of services but also on the quality of the system. Table 13-9 present the hours that the Hauweng services will be provided. Diagram 13-2 presents the percentage of mini-bus passengers boarding per hour for all days surveyed in Bloemfontein. The majority (99%) of passenger boarding occurs between 04:00 and 20:00; thus, the proposed operating hours are near to the existing mini-bus services. However, subsidised bus services are provided according to specific timetable per route after 20:00 to 04:00.

Service between 20:00 and 24:00 will be considered based on the demand, and these services will not necessarily be operated to minimum service frequencies that apply for the rest of the day. The financial viability and sustainability of these services need to be determined before a decision is taken to implement. The impact of these alternatives will be considered in the alternative analysis.

Table 13-9: Operational Hours and Service Frequency Guideline

	Alternative 1 - High Demand	Alternative 2 - Existing Service operational hours
Week days	05:00 – 20:00	05:00 – 20:00
Saturdays	05:00 – 16:00	
Sunday/Public Holidays	06:00 – 15:00	

Diagram 13-2: Percentage of Total Boarding per Hour – Full On-board taxi Survey



13.7 Vehicle Capacity

This section pertains to vehicle capacity only and determines the vehicle seat capacity per route to provide services per route design alternatives given the set maximum of a 20-minutes service frequency in the peak hours of the day.

The minimum level of service for the IPTN system relating to service frequency is 20-minutes. In order to provide services at this frequency, the number of seats per vehicles will be optimised/adjusted to ensure that services are provided at the selected frequency.

The vehicle fleet considered for implementation as part of the IPTN system will be universal accessible vehicles (refer to vehicle specification in **Annexure U)**.

The vehicle fleet comprises of a variety of vehicle capacity to align with demand per route and will comply with all standards per grant requirement. The transformation/replacement of existing public transport vehicles with vehicles that comply with universal accessibility standards, AFC and APTMS requirements form part of the incremental approach associated with the implementation of the system and the impact of this replacement on cost will be addressed as part of the impact of implementation strategies.

Vehicles considered as part of the fleet are:

- Articulated bus – 120 passenger capacity;
- Rigid bus - 80 passenger capacity;
- Smaller vehicle for feeders and direct/diagonal routes and services – 22 passenger capacity. The detail specification of these vehicles needs to be finalised. These vehicles will comply with standards and requirements per IPTN grant conditions and will be universally accessible;

The vehicle fleet that will be required for the implementation of trunk only routes is presented in Diagram 13-3, trunk-feeder route design is presented in Diagram 13-4 and trunk-feeder with selected complementary routes are presented in Diagram 13-5. These diagrams per route design present the fleet per design year patronage for Patronage Scenario 1 with subsidised bus demand included. The trunk route design requires the least vehicles for all design years; however, it needs to be noted that fewer passengers will be transported with this option and the revenue can thus be lower. It can, however, be the first increment of implementation to be followed by implementing feeder services with the ultimate system where trunks are extended to complementary routes. The fleet requirement for trunk-feeder and complementary routes are between the trunk only and trunk-feeder only option. Thus, a hybrid approach to suit the specific corridor will be required.

The impact on the passenger experience in the provision of services needs to be acknowledged in conjunction with financial considerations. This comparison of the alternatives in terms of financial impact will be addressed on the options analysis.

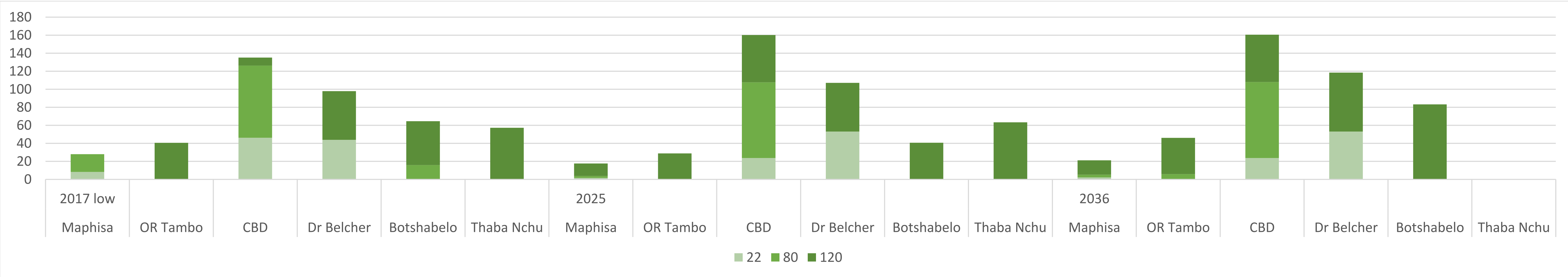


Diagram 13-3: Trunk Only Route Design - Vehicle Fleet Requirement per design year

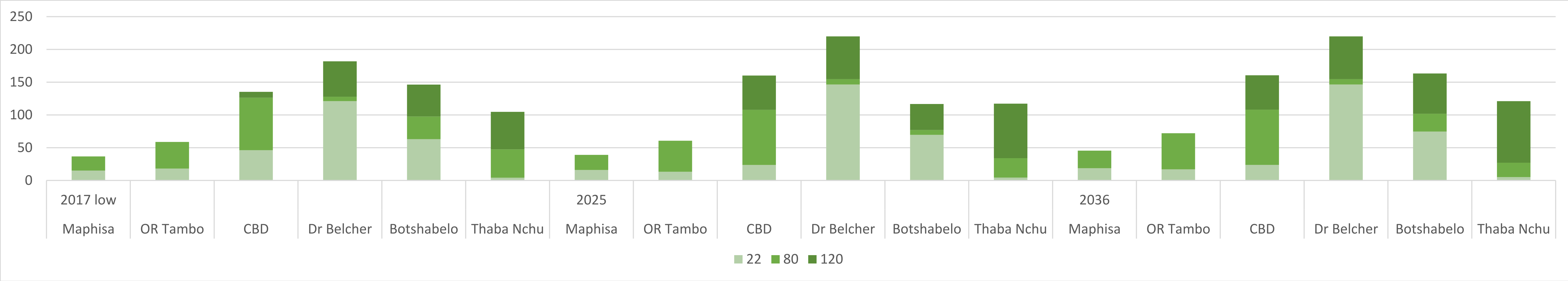


Diagram 13-4- Feeder and Trunk Route Design - Vehicle Fleet Requirement per design year

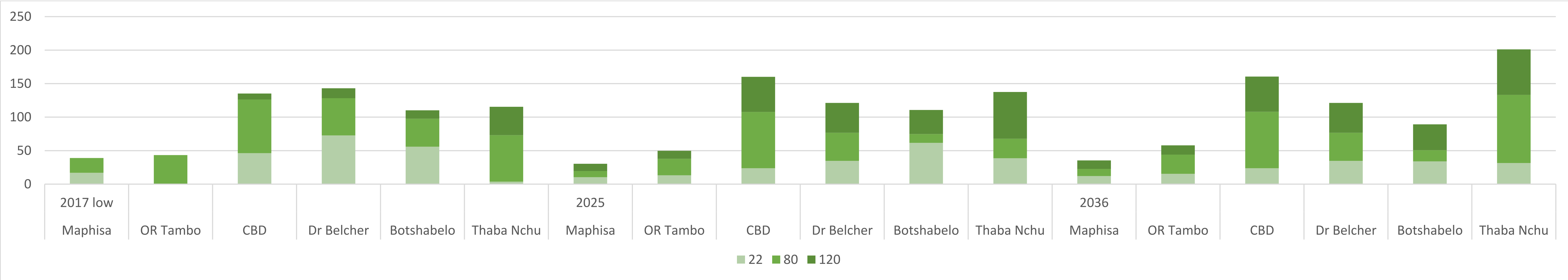


Diagram 13-5: Feeder, Trunk and Complementary Route Design - Vehicle Fleet Requirement per design year

14 Infrastructure Design, Characteristics and Sizing

The purpose of the "*Infrastructure Design, Characteristics and Sizing*" chapter is to quantify the facilities, roadways, and systems required to implement the Hauweng system per the alternative route design presented in the preceding sections.

The design and sizing approach are to incrementally implement the infrastructure that complies with geometric design standards and universal access design standards. The size or capacity provided will be increased incrementally when demand trigger increase in capacity.

The design principles for roadways, stops, stations, depot and other elements indicate the implementation modules per element and the demand that trigger an increase in capacity.

The design principles are provided per element of the system, and the infrastructure is quantified per route design options for the 2017,2025 and 2036 design years.

The size of the system per route design option defined is quantified citywide to indicate the difference between route design options and the infrastructure required. The design principles per element of infrastructure are provided, and the outcome per element is summarised on a corridor level.

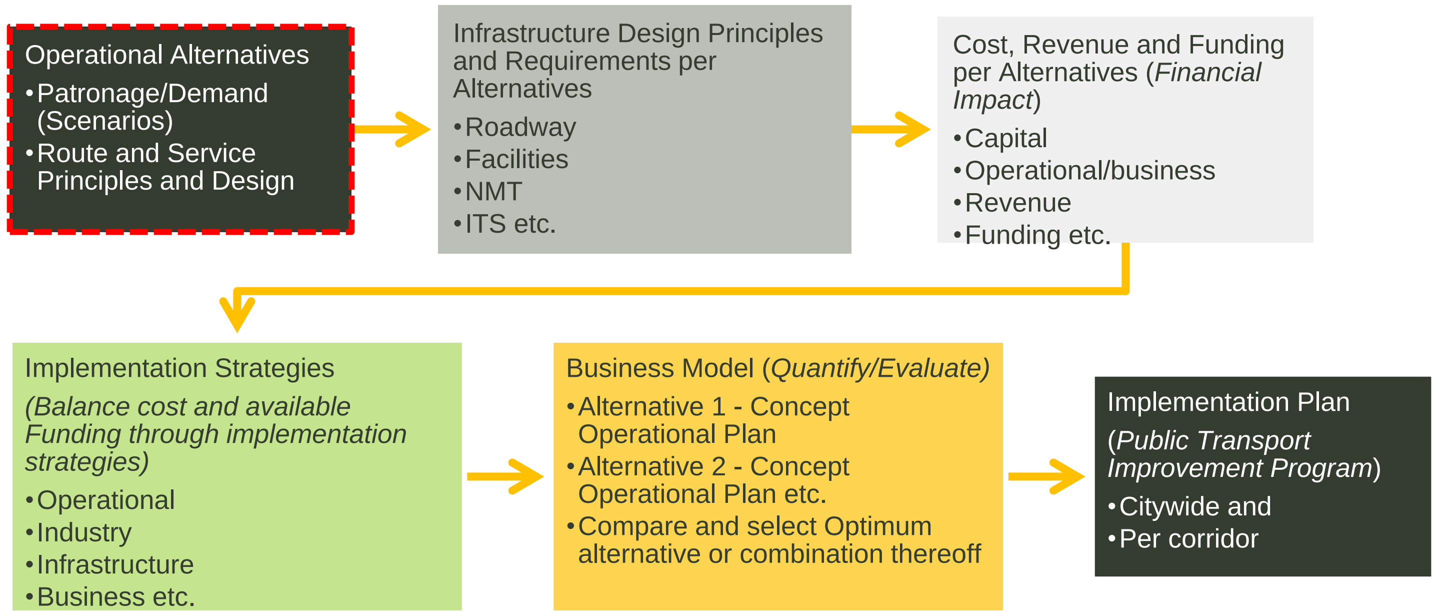


Diagram 14-1: Alternative Analysis Process and Components

14.1 Right-of-Way

14.1.1 Design Principles

A right of way is defined as a strip of land with pavement or rail tracks on which public transport units operate. The public transport units/vehicles that form part of the city's strategy were defined in **Section 13.2**.

The right of way that will be implemented as part of the IPTN will be ROW A to C. The right-of-way needs to be selected based on the demand and mode required within the specific corridor.

The hierarchy of ROW's are:

- ROW A – fully separated and controlled by specific agency;
- ROW B – partially separated with painted or physical demarcated lanes operating in the median or on the kerbside; and
- ROW C – common streets with general traffic.

A transport system comprises a range of demand corridors that vary from minor to major demand corridors. In the MMM context, the demand corridors vary from 500 to 10 000 passengers per hour. To effectively service this range of demand corridors, a range of mode capacities and ROW are required.

The selection of a specific mode for a demand corridor is furthermore influenced by the distance of the demand corridor and the selection of a ROW. In **Figure 14-1,** a comparison is made between vehicle capacity and a range of right of way per vehicle. It is apparent that the right of way and the priority settings at intersections influence the capacity of the system. When selecting a specific mode for a corridor, the capacity and thus, the ROW and intersection configuration need to be specified carefully.

The first-order mode selecting in **Section 13.2** indicated that the hourly volume call for a system where public transport operators in mixed-traffic with intersection priority for public transport vehicles like queue jump lanes. **Table 14-1** summarise the public transport demand per corridor, adjacent mixed traffic volumes, distance per corridor and the recommended ROW. These guidelines are applied in selection of ROW and road infrastructure upgrades required to implement the IPTN per design years (2017, 2025, 2036).

Table 14-1: Right-of-way

Mode	ROW	Hourly Passenger Demand per Direction		One Direction Corridor Distance	Adjacent traffic volume per lane per hour
	Non-motorised Facilities	0	50	< 3km	N.A.
Road Based	Mixed Traffic	0	450	3 -10 km	<550
	Mixed Traffic (kerb-side loading)	500	1 500	10 - 50 km	<550
	With signal priority measures	1 500	6 000	10 - 50 km	>750
	Mixed traffic with exclusive lane use in peak hours (one lane)	2 500	6 000	10 - 35 km	>850
	Exclusive Right of Way kerb lane	4 000	6 000	10 - 35 km	>1000
Road based modes or light rail	Exclusive Right of Way Median/Separate Bus Way Express service (one lane)	8 000	15 000	10 - 35 km	>1000
Rail	Exclusive Right of way	20 000	80 000	>15 km	>2500

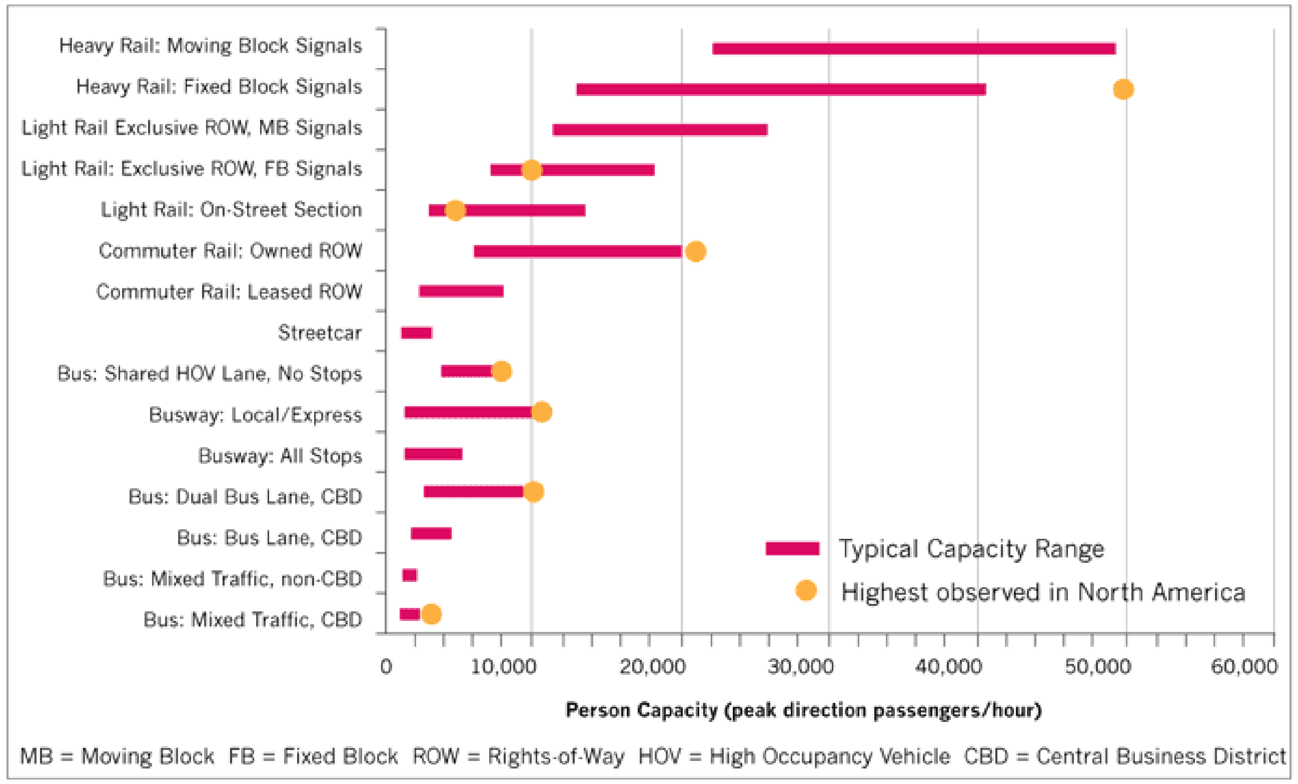


Figure 14-1: Comparison of Mode Capacity Based on Right of Way

Mixed traffic operations imply that no dedicated lane is provided or constructed for public transport operations only. A typical mixed-traffic public transport environment is presented in **Figure 14-3**. Mixed-traffic operating in general traffic lanes is suitable for operation with relatively low congestion but may still result in buses being subjected to delays caused by private traffic. Where congestion impact journey time significantly kerbside dedicated lanes can be implemented during peak periods of the day. **Figure 14-2** show options for the implementation of dedicated lanes during peak hours of the day.

The typical station and stop configurations that can be implemented as part of the mixed traffic operational model are presented for different intersection and road classes:

- Figure 14-4 - Far-Side Large Stations -Bus Stop in Lane;
- Figure 14-5 - Far-Side-Uncontrolled Station-Bus layby;
- Figure 14-6 - Near-Side Uncontrolled Station –Bus Stop in Lane; and
- Figure 14-7 - Near side – Uncontrolled Station (Queue Jump).

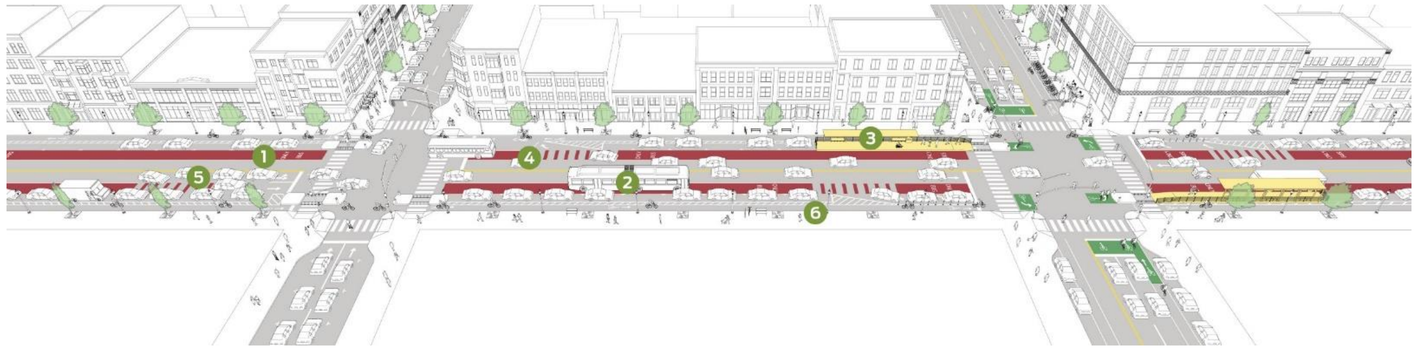
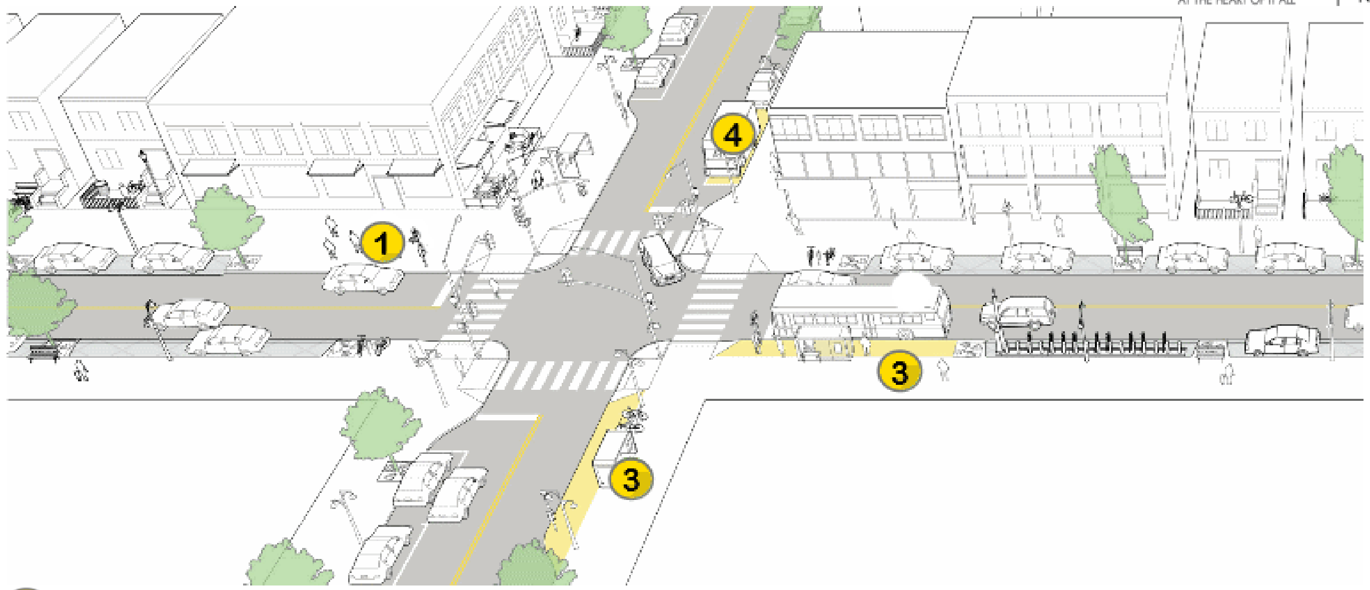


Figure 14-2: Temporary demarcation of exclusive public transport lanes



1 **Bus Stop - Near-side, Bus stop in traffic lane**
No shelter/seating, Rubbish bin, Way finding information.

2 **Uncontrolled Station - Near-side, Bus stop in traffic lane**
Shelter and seating, Rubbish bin, Way finding information.

3 **Uncontrolled Station - Far-side, Bus stop in traffic lane**
Shelter and seating, Rubbish bin, Way finding information.

4 **Loading for delivery vehicles.**

Figure 14-3: Typical Mixed Traffic Environment for Quality Public Transport Service

Figure 14-4: Far-Side Large Stations -Bus Stop in Lane

Figure 14-5: Near-Side Uncontrolled Station –Bus Stop in Lane

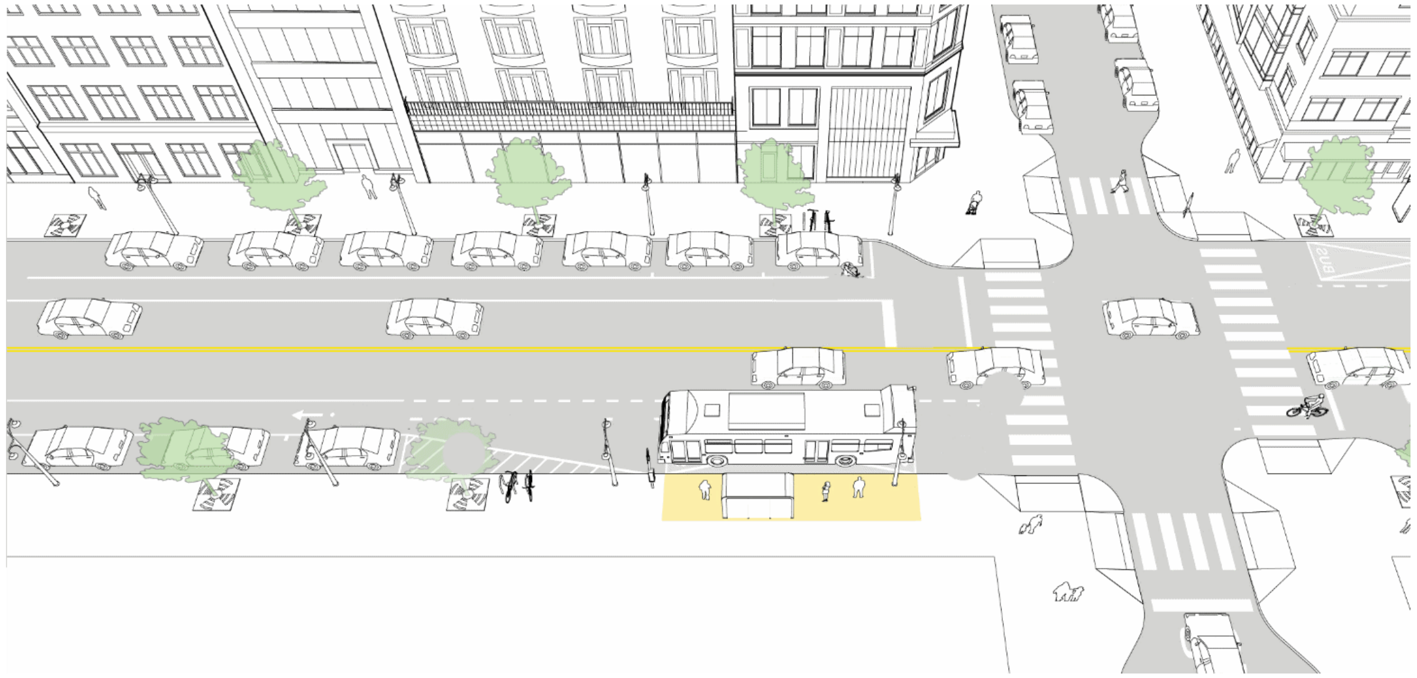


Figure 14-6: Far-Side-Uncontrolled Station-Bus Pull-Out

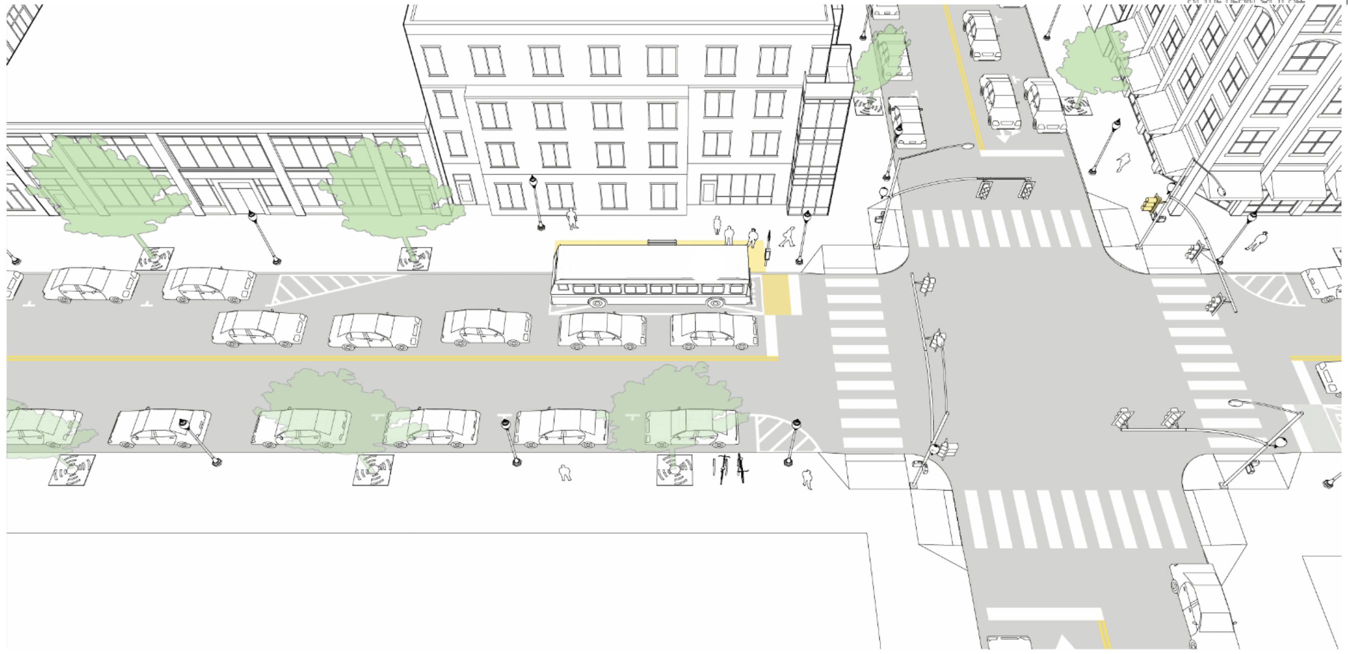


Figure 14-7: Near side – Uncontrolled Station (Queue Jump)

14.1.2 Right of Way Requirement

The full public transport matrix assignment for the three design years are presented in Figure 14-8, Figure 14-9, Figure 14-10. Table 14-2 presents the recommended ROW per corridor per design year. The implementation of the ROW is subjected to detail analysis through a traffic and transport study for the specific corridor. The ROW recommended per year can be required earlier or later given the growth rate of private and heavy vehicle volumes in the corridor. The recommended ROW, however, provide a long term horizon and the development of roadmaster plans can take these recommendations into account. Comparing the assigned volumes with the private and heavy vehicle traffic along the corridors (refer to **Annexure J**) the recommended ROW per corridor and the intersections that potentially will required queue jump lanes are presented in Figure 14-11.

Table 14-2: Right-of-Way per Corridor (Patronage Scenario 1) per Design Year

	Peak Hour Passenger per direction									Veh Volume Peak Direction Peak Hour (Private and Heavy Exclude PT)		
Daily Pax	2017 (low)	ROW	2017 (high)	ROW	2025	ROW	2036	ROW	Lanes	2017	2025	2036
Dr Belcher	2836		3726		3429		3429		2	900	1054	1311
Dr Belcher Meadows	1946		2557		2353		2353		2	900	1054	1311
Dr Belcher Direct routes	778		1023		941		941			<20 0	250	250
Maphisa	1869		1672		1989		2314		2	800	937	1165
OR Tambo	2033		2033		2164		2517		2	1200	1406	1748
CBD	857		1352		1390		1393		2	700	820	1020
Represent 8 distribution corridors	8075		12739		13094		13124					
Botshabelo	2998		3105		3312		3551		1	250	293	364
Thaba Nchu	3488		3924		3352		3388		1	300	351	437

Mixed Traffic

Mixed With signal priority measures

Mixed traffic with exclusive lane use in peak hours (one lane)

14.1.3 Road Master Plan

Several roadmaster plans were developed for sections of the city. The proposed roads and road classification are presented in **Figure 14-12**. Given the mixed traffic operations and implementation of dedicated lanes during peak hours given the outcome of detailed traffic impact studies per implementation phase of the IPTN the capacity within the network will be enhanced by the implementation of the IPTN and rationalisation and formalisation of existing public transport providers.

14.1.4 Roadway Requirement

A desktop assessment of the IPTN network was done. The roads were categorised based on the existing road surface and the jurisdiction that the road resides in. The roads that form part of the IPTN were categorised as follow:

- Gravel roads that need to be surfaced or links required to be constructed;
- Roads that are foreseen to be maintained as part of the city road maintenance program
- Roads under the jurisdiction of Free State province
- Rehabilitation and maintenance that will be funded by Public Transport Network Grant
- Future road links
- Roads under the jurisdiction of SANRAL

The desktop study resulted in:

- All roads part of the IPTN within the Bloemfontein area was allocated to the city maintenance and rehabilitation category.
- Class 3 and Class 4 roads part of the IPTN in the South Eastern Quadrant was allocated to the IPTN rehabilitation and maintenance category.
- All roads in Botshabelo and Thaba Nchu that will be utilised by the PTN were allocated to the IPTN maintenance and rehabilitation program.
- Roads that require surfacing (existing gravel roads) were allocated to IPTN infrastructure required.

The classified roads are presented in Figure 14-13. To determine the quantities per category, the length of roads per category was determined from the cities road network centrelines. The existing number of lanes and lane widths were obtained from the 2014 MMM aerial photos. The extent of road upgrade, maintenance or surfacing are presented in Table 14-3, and the details are provided in Annexure Y.

No dedicated lane will be required in the next 12-years although in some areas(CBD corridor) partially dedicated lanes will be required. The cost of implementation of this arrangement and the date of implementation need to be quantified in the detail operational plan for the corridor.

Table 14-3: Estimated Roadway Upgrades and Maintenance

Corridor	Additional Lane m^2	Resurfacing/ rehab road sections (Part of city maintenance program) m^2	Resurfacing/ rehab section (PTNG) m^2	Resurfacing/ rehab section (Provincial) m^2	Resurfacing /rehab section (SANRAL) m^2	Future Links m^2
Botshabelo	83,721	-	564,873	-	-	-
CBD	19,369	1,486,068	40,696	-	-	40,617
Dr Belcher	109,977	320,393	157,168	76,590	-	-
Maphisa	37,193	132,905	195,036	-	-	-
OR Tambo	-	156,067	73,306	45,770	-	-
Ring Road (M10)	-	193,402	-	-	-	-
SANRAL	-	31,681	-	-	977,821	-
Thaba Nchu	55,043	-	422,226	-	-	-
Future Links (Vista Park	-	-	-	-	-	30,907

*** m^2 length of road X number of lanes. Lane width=existing lane width**

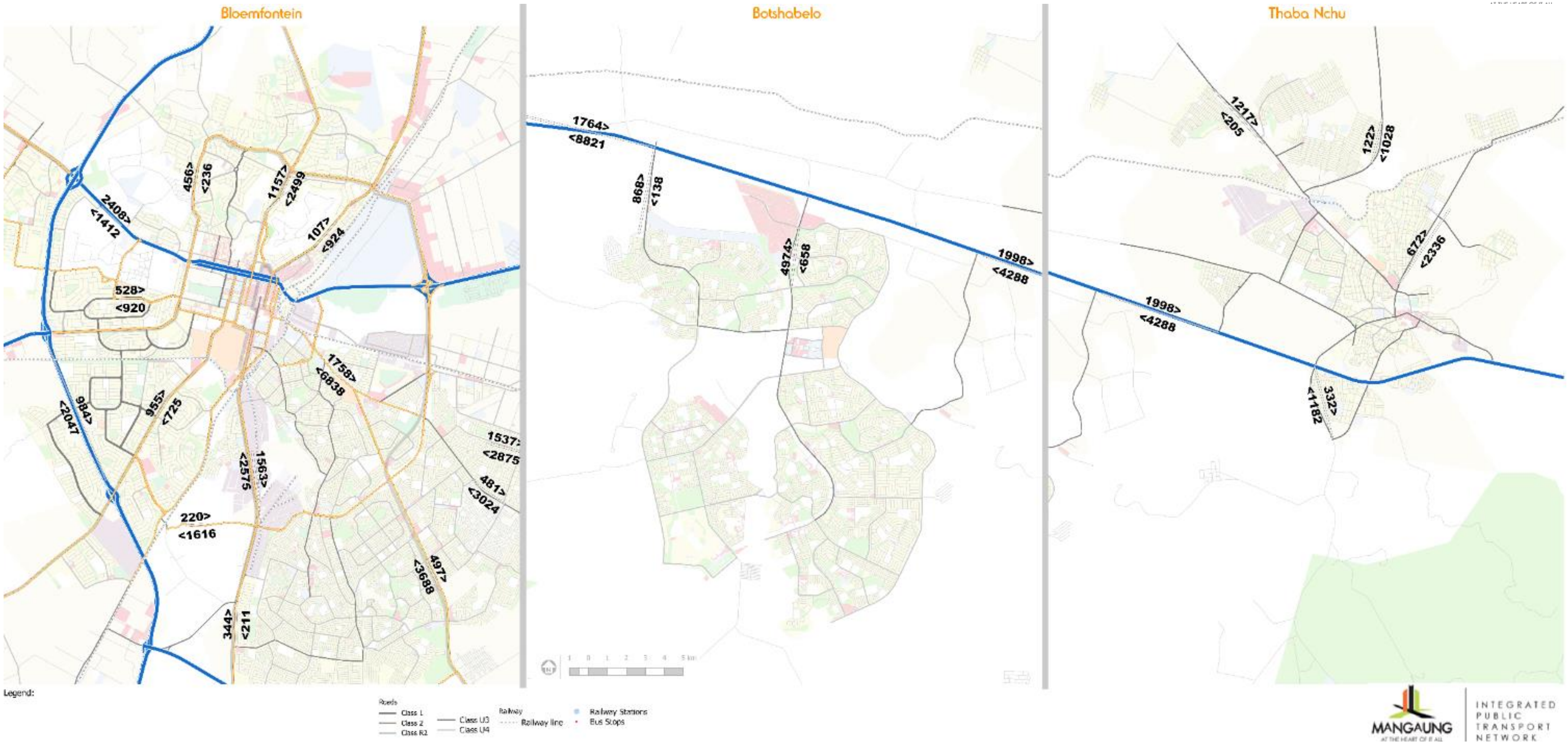


Figure 14-8: Base Year Public Transport AM Peak Hour Link Flows (person trips)

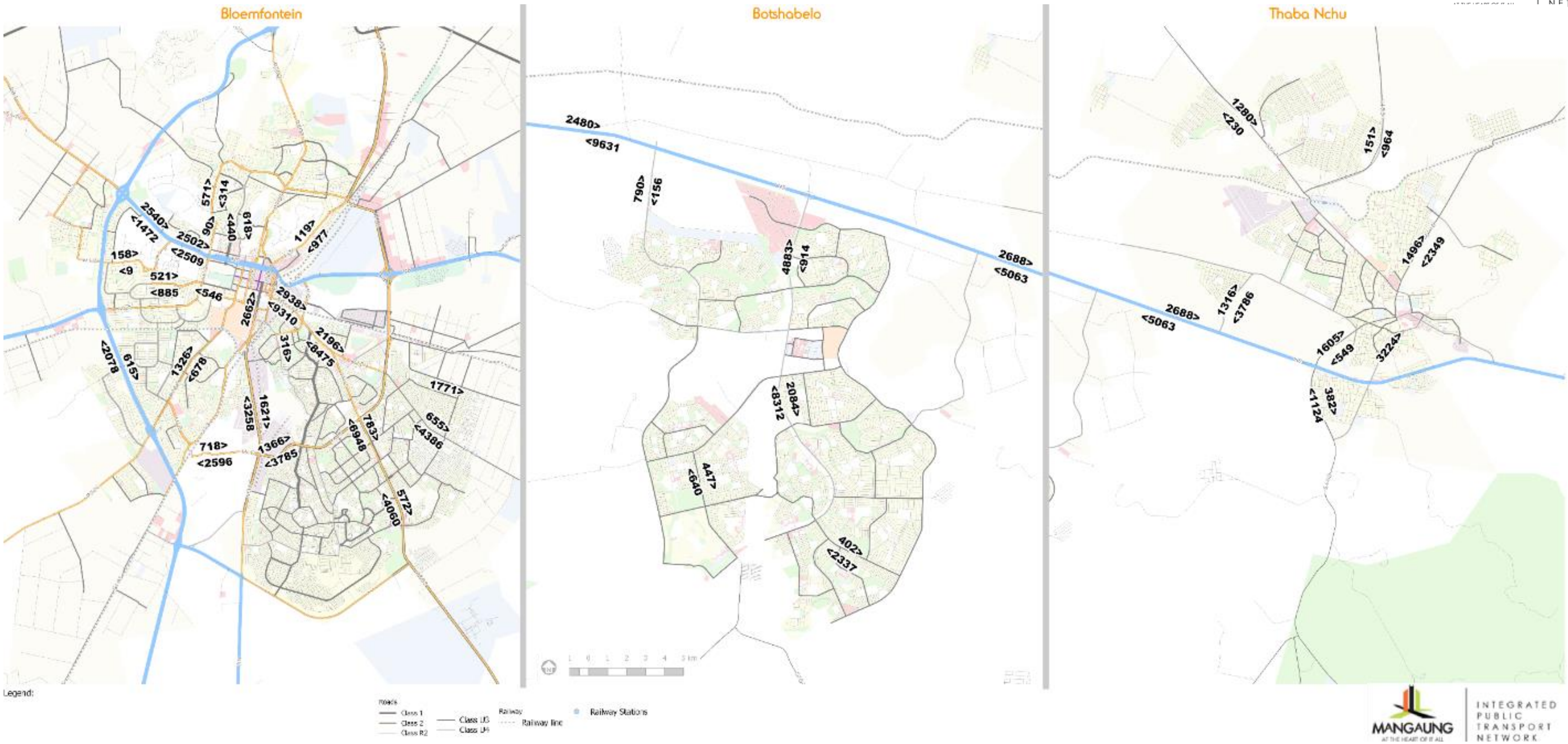


Figure 14-9: 2025 Full Implementation with long distance trips - AM Peak Hour Person Trips

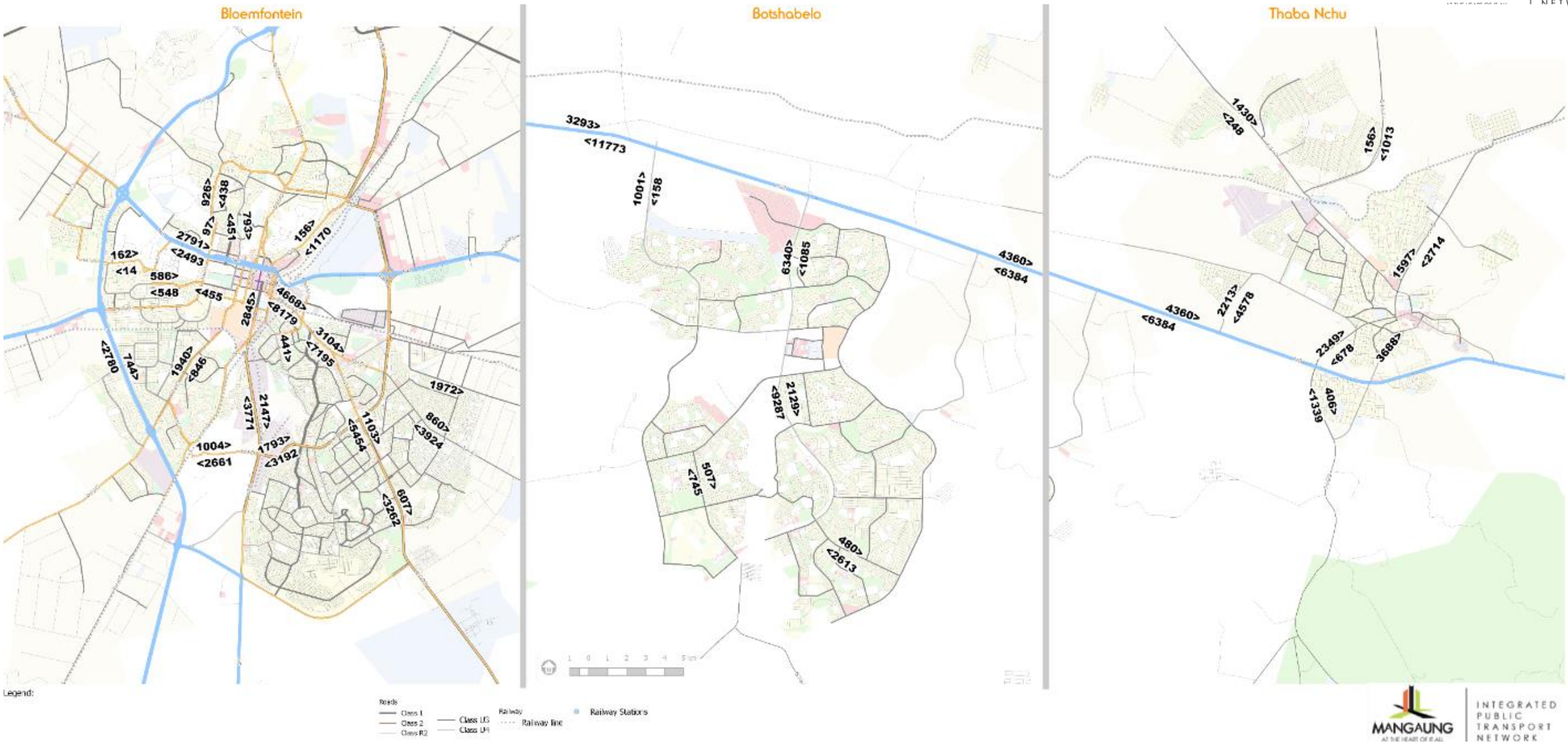


Figure 14-10: 2036 Full Implementation with long distance trips AM Peak Hour Person Trips

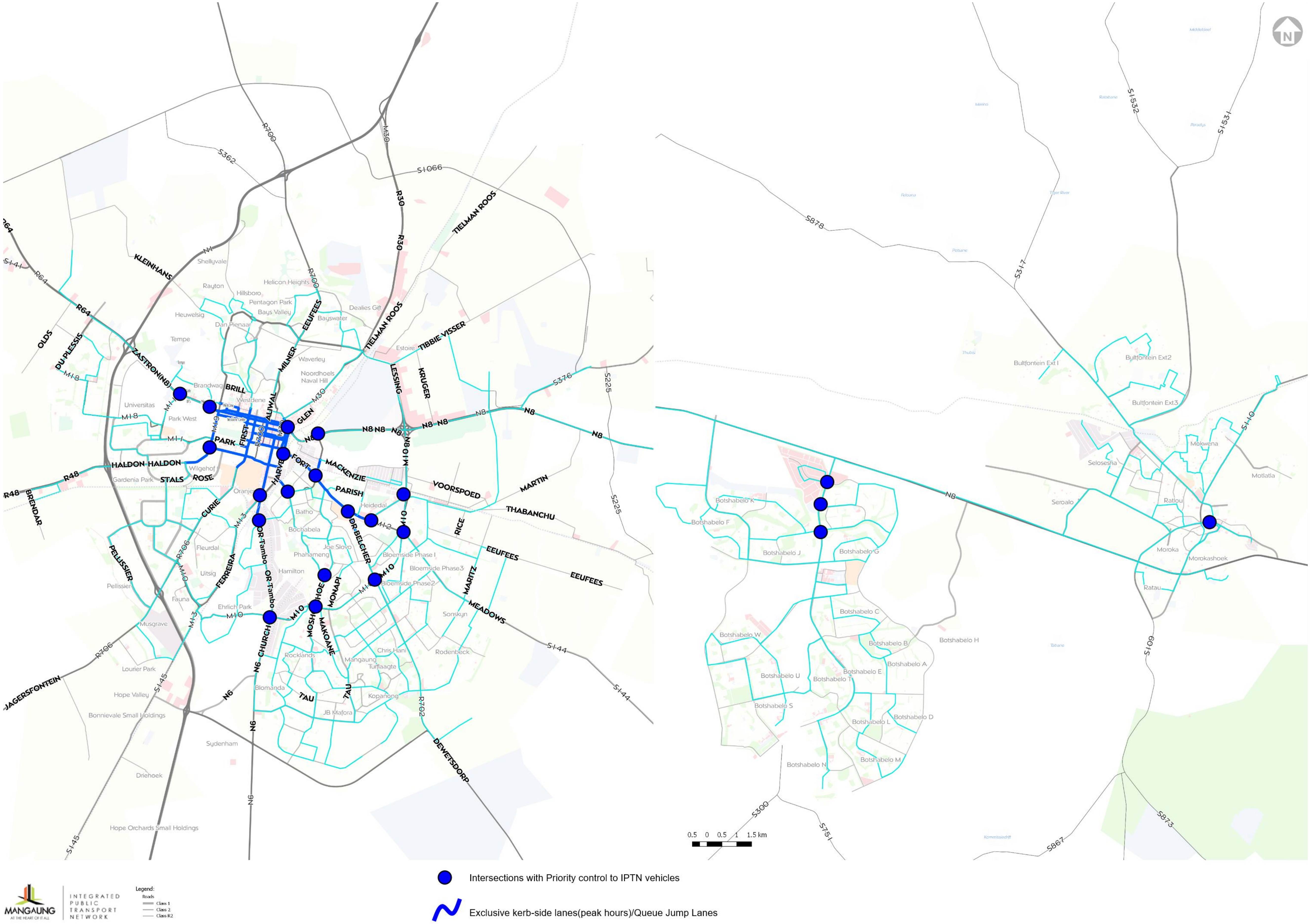


Figure 14-11: Corridor Right-of-Way at Full Implementation Stage 2036

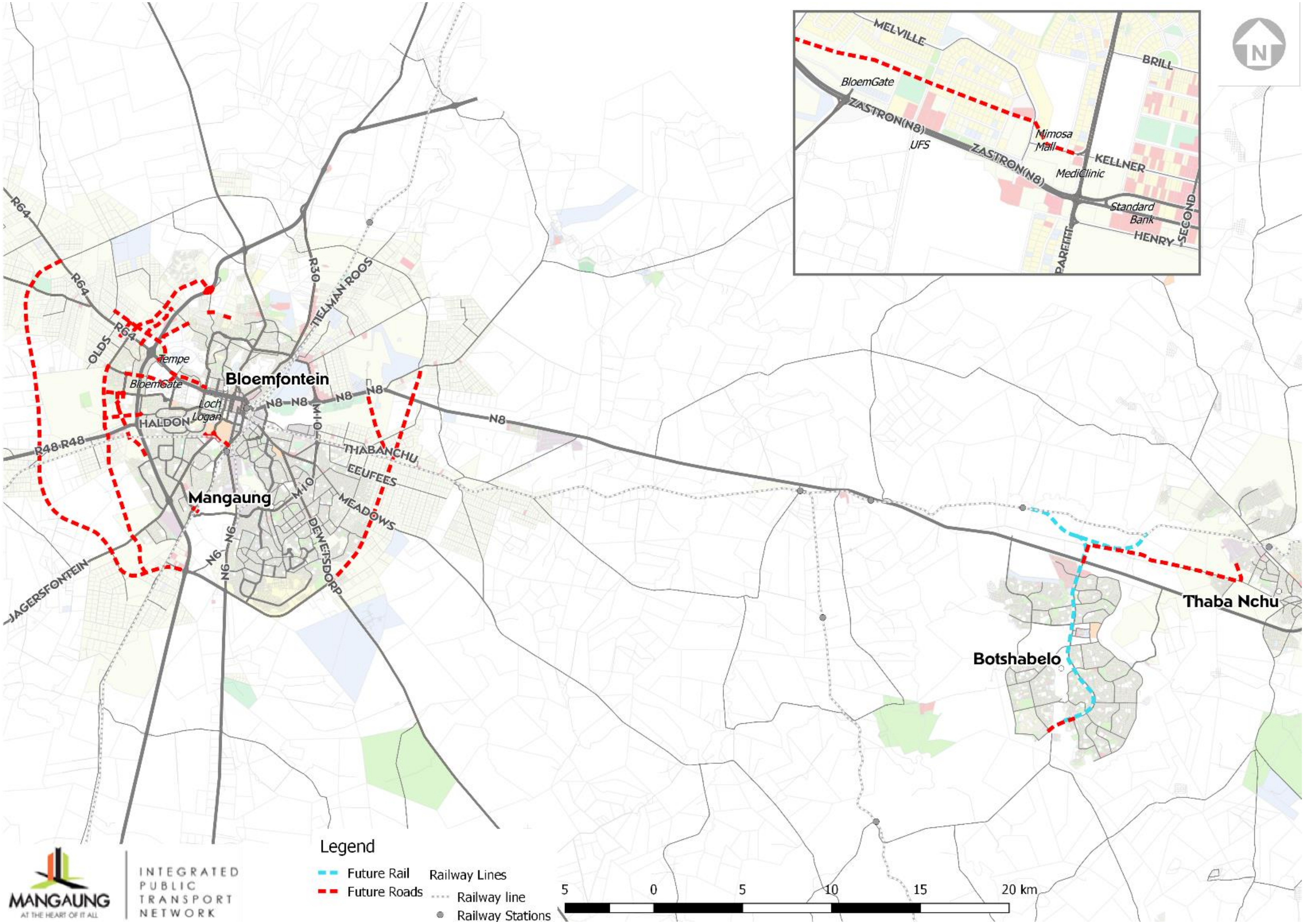


Figure 14-12: Road Hierarchy and Future Road Links

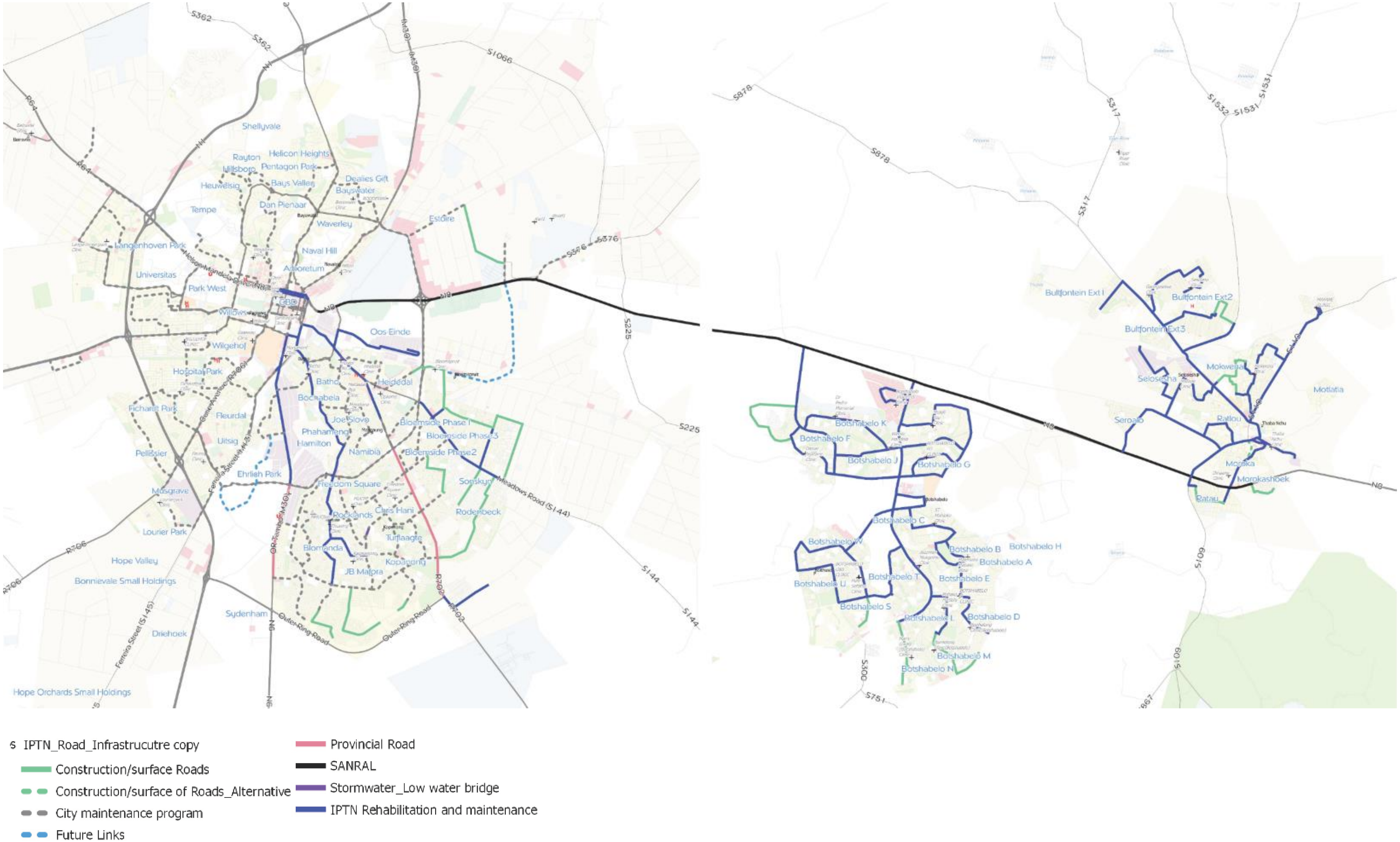


Figure 14-13: Road Infrastructure Requirement Full Implementation Stage

14.2 Stops and Stations

14.2.1 Design Principles

Public transport stops, stations, and terminals come in many sizes, with differing levels of activity and passenger amenities, but all serve as points where public transport passengers begin, end, or continue their trips. The quality of the passenger environment at stops, stations, and transfers are important elements of a public transport system and the perception of passengers of a public transport system.

Stops, stations, and transfers can include a number of elements, like, waiting areas, walkways, doors, stairs, escalators, elevators, fare gates, ticket machines, information displays, and bicycle storage facilities. Station and stop element design involve a combination of estimating passenger flows and providing sufficient space for passengers, as determined by a selected design level of service.

Station and stop design must accommodate passengers with categories of special needs, but attention should be given to designs that are convenient to passengers with categories of special needs (e.g., elevators co-located with stairways), rather than merely Universal Accessible compliant (e.g., an elevator provided in a remote location).

The selection of a stop or station type depends on the route design and whether the facility will be an end destination or a transfer point. The function of a facility is determined by the number of routes that pass the facility or pass near to the facility. To this end, facilities are planned to allow passengers to have choices to transfer voluntarily between routes or are forced to transfer due to the design of the system. The forced transfer provided access to routes to varies destinations in the city and can thus be convenient if a passenger missed the first bus of the day but are aware that access can be gained at a main transfer to several routes that pass close or near to the final destination.

To allow for options within the system where passengers can transfer and allow for loading and offloading near main points of interest such as hospitals, retail, universities and other a hierarch if facilities form part of the IPTN. A six-tire hierarchy was developed for the IPTN and comprise of:

- Controlled Access Stations;
- Uncontrolled Access Stations (Stop with Shelters);
- Transfers (Main);
- High capacity public transport stops
- Stops;
- Low Capacity Transfer (Voluntary Transfer).

The selection of the type of facility design that needs to be used per stop point along routes was derived from:

- Estimated number of passengers that will board/alight at the point;
- Land-use in the direct vicinity of the station;
- First or the last station along trunk routes are controlled access station to function as a gateway to the system; and
- Only stops will be provided along feeder, direct, diagonal and complementary routes.

Design principles for:

- Controlled access stations are provided in Table 14-5,
- Uncontrolled access stations and stops design principles are listed in Table 14-6**;**
- Stop design principles are detailed in Table 14-7;
- Main transfers design principles and implementation scenarios are presented in Table 14-13;
- High capacity public transport stop design principles are presented in
- **Table** 14-8;
- Low Capacity Transfer (Voluntary Transfer) design principles are provided in **Table 14-9**.

The design level of service for each element of the station or stop are provided per facility type and the LOS needs to be determined per station through applying evaluation methodologies provided in "Transit Capacity and Quality of Service Manual—2nd Edition "when patronage estimation per station is available during the development of Operational Plans per implementation phase.

14.2.2 Design Approach

The approach to the design of stops and stations are that all of the facilities will be implemented modularly, and when demand realises and trigger a capacity upgrade, the upgrade will be implemented. To quantify the size of facilities and increments of implementation, the facilities were sized for the base year, 2025 and 2035 for patronage scenario 1, including subsidised bus demand.

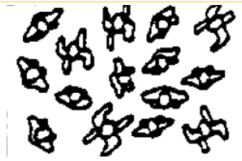
14.2.3 Levels of Service for Queuing and Waiting Areas at Facilities

An illustration of the Level of Service (LOS) concept for passenger queuing and waiting area is reflected in **Table 14-4**. The thresholds were developed based on average pedestrian space, personal comfort, and degrees of internal mobility. LOS is presented in terms of average area per person and average interpersonal space (distance between people). It needs to be noted that it is assumed that a dedicated area for wheelchair users will form part of all facilities. Note the design principles pertaining to cross-cutting elements such as universal accessibility, design standards for geometric design and environmental aspects.

The LOS required for waiting within a facility is a function of time spent waiting, the number of people waiting, and a desired level of comfort. Typically, the longer the wait, the greater the space per person required. A person's tolerance of a level of crowding will vary with time. People will accept being tightly packed on an elevator for 30 seconds, but not in a waiting area for 15 minutes.

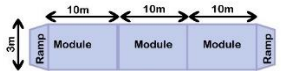
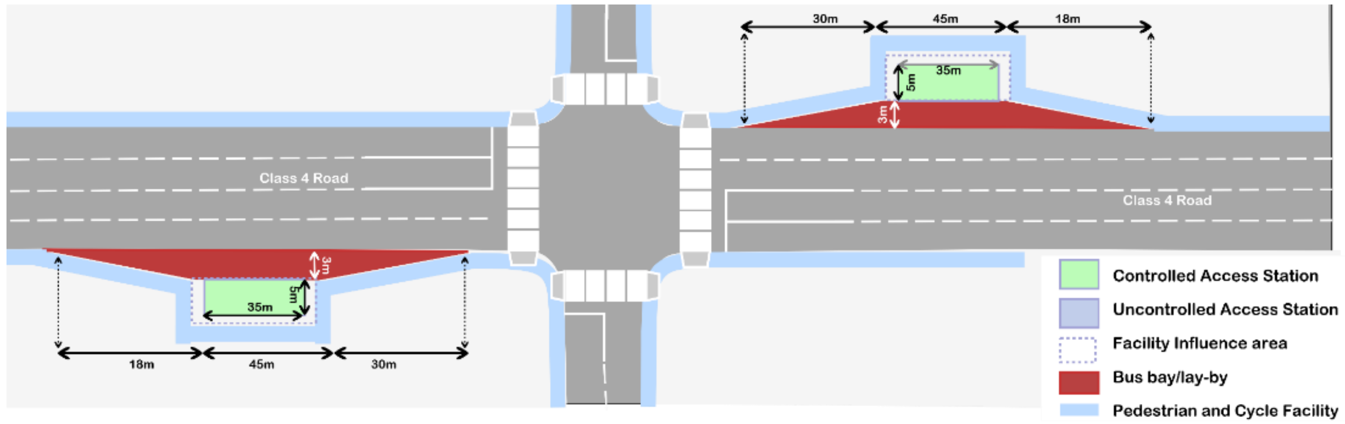
A person's acceptance of limited personal spacing will also depend on the characteristics of the population, the weather conditions, and the type of facility. For example, commuters may be willing to accept higher levels or longer periods of crowding than inner-city and recreational travellers. The guidelines for the design of waiting areas for the IPTN is attached in **Annexure Z** .

Table 14-4: Levels of Service for Queuing Areas

LOS	Average Pedestrian Area	Average Inter-Person Spacing		LOS Description
	(m2/p)	(m)		
A	1.2	>=1.2		Standing and free circulation through the queuing area possible without disturbing others within the queue.
B	0.9-1.2	1.1-1.2		Standing and partially restricted circulation to avoid disturbing others within the queue is possible.
C	0.7-0.9	0.9-1.1		Standing and restricted circulation through the queuing area by disturbing others is possible; this density is within the range of personal comfort.
D	0.3-0.7	0.6-0.9		Standing without touching is impossible; circulation is severely restricted within the queue and forward movement is only possible as a group; long-term waiting at this density impacts on personal comfort.
E	0.2-0.3	<0.6		Standing in physical contact with others is unavoidable; circulation within the queue is not possible; queuing at this density can only be sustained for a short period without serious discomfort.
F	<0.2	Variable		Virtually all persons within the queue are standing in direct physical contact with others; this density is extremely discomforting; no movement is possible within the queue; the potential for pushing and panic exists.

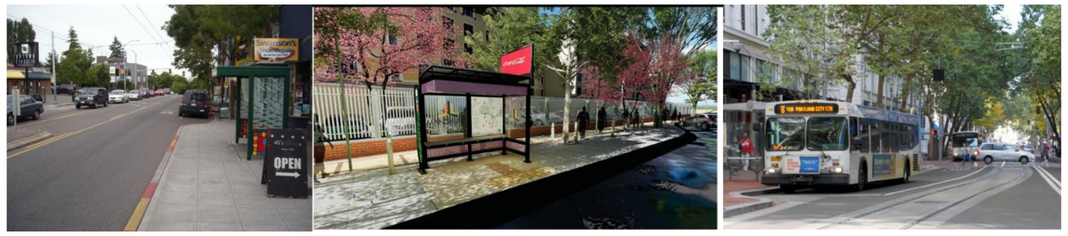
Source: *Part 7/STOP, STATION, AND TERMINAL CAPACITY- Transit Capacity and Quality of Service Manual—2nd Edition*

Table 14-5: Design Principles for Controlled Access Stations

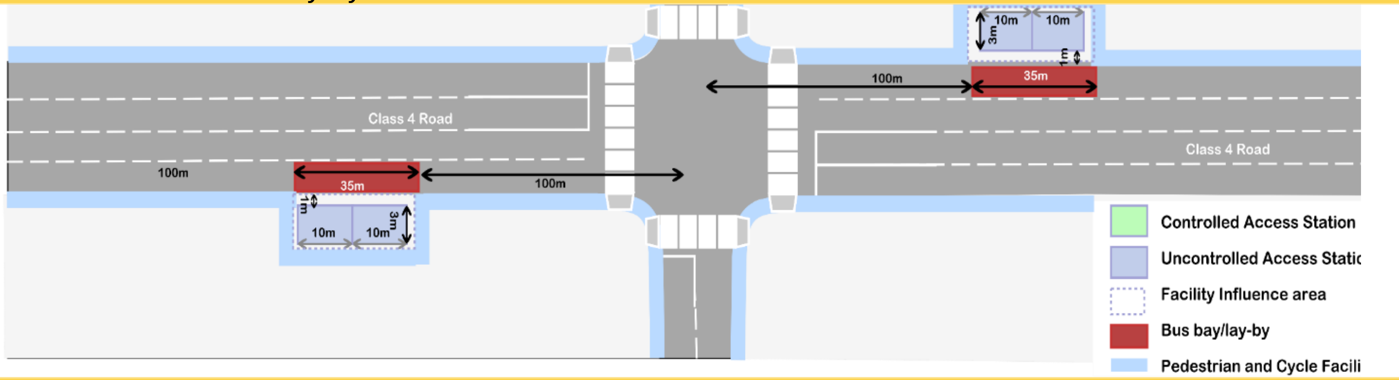
Function/ Equipment/Capacity	Controlled Access Station
Passenger Volumes per peak 15 minutes: >400 per hour The station capacity/passenger waiting area can be increased modularly. The full module and the half module extension are shown below.  Refer to **Annexure AA** for detail pertaining to incremental implementation and sizing of infrastructure.	
Station Placement and Intersection Configuration: **Class 4 Roads – Bus lay-by – Controlled Access**	
 	
Level of Services: • **Determine size of waiting are/number of turnstiles and other station elements. The selected LOS per design element is indicated.**	• Pedestrian waiting area: • LOS D-F • Pedestrian Walkways: • LOS C-D • Staircase: • LOS C-D • Station Access Points/Gates: • LOS C-D
Station Sizing:	• 35 Metre long station x 5 metres deep in • Stations to be manufactured in 10-metre modules to cater for varied demand at different locations • 45 x 3-metre kerbside layby • Situated right-up to layby roadway with Kassel Kerb docking • Station floor needs to be raised to match low-entry bus. Low entry bus, entry level is 340mm; • Comply with Universal Access requirements • Station can be increased in modules of 10metre to allow for increase in passenger demand.
Station Doors	• Two automated doors to align with left front door and middle door on left side of bus, • Usually, 1100 mm wide with 30mm clearance for door handles each side when door is open. Height is 1900mm. • One lockable manual roller door at entrance • One emergency exit at other end of station
Stainless steel cubicles inside station building	• 1 Metre for electricity • 1 Metre for ITS • 1 Toilet and washbasin • Closable recess in wall for comms, e.g. microphone & IP phone • 500 mm for cleaning equipment
Signalling and signage	• Pedestrian phase required at signals nearest to controlled access station or pedestrian crossing at priority controlled intersections • Signalling to be upgraded at relevant intersections to include voice and visual signalling in the long term after detailed universal surveys completed • Median to facilitate crossing on trunk, where more than 4-lanes need to be crossed

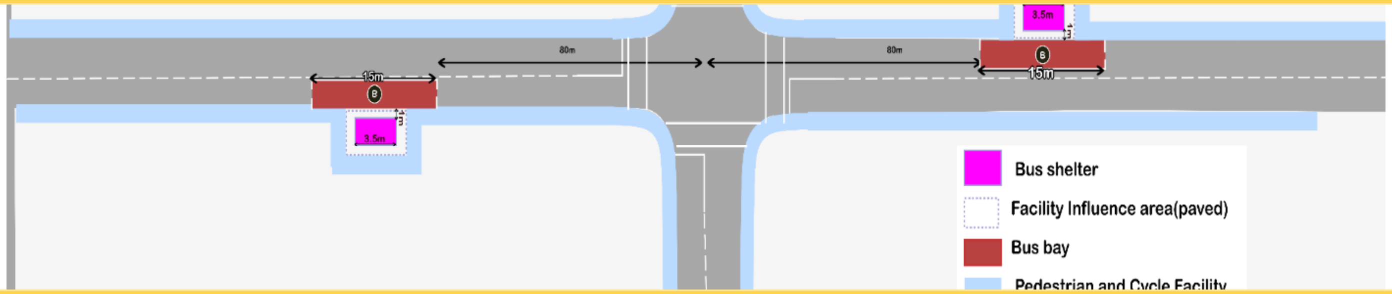
Amenities				
Seating	**Shelter**	**Bicycle parking**	**Refuse removal**	**Fare Collection Equipment**
• Seating rails • Lockers under seating rails • 4 fold-down seats attached to a seating rail in paid area • Guardrails to facilitate correct passenger flow	• Enclosed no direct access.	• Yes	• Local collection; • Bins to be provided in station	• Fare gates - 3 gates per station - One of 3 for wheelchair
Municipal Services				
Electricity	**Sewerage & water**	**Lighting**	**Safety**	**Signage and Information**
• Connected to grid with backup as above • Electricity backup: Generator at each station to run light, doors and ITS, or cavity under floor at cubicle to house backup batteries	• Sewerage required for access controlled stations • Water required for access controlled stations	• LED	• Fire fighting equipment under seating rails • First Aid equipment	• Static passenger travel information only
APTMS equipment:	• Two CCTV cameras per station – at fare gates and from other end - preference for initial WiFi • Automated door openers on buses and in stations • Sleeves for optic cable provided for all stations, not for stops off trunk - cabling to follow when demand requires • Communication and fare collection equipment to be supplied to vendors around stations, • City pay points and customer care facility • PA System in box in cubicle with IP phone			
Universal access:	Take note of compliance on: • Tactile requirements at access through to boarding doors • Level entry to buses • Slope limit of 1:15 at access ramp			

Table 14-6: Design Principles for Uncontrolled Access Stations

Function/ Equipment/Capacity	Uncontrolled Access Station
Passenger Volumes per peak 15 minutes: 100><400	  *Note designs presented are illustrative*

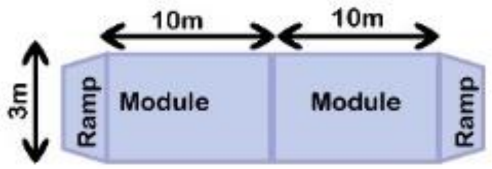
Station Placement and Intersection Configuration:
Class 4 Roads – Bus lay-by – Uncontrolled Access





Incremental Implementation

The capacity/passenger waiting area can be increased modularly. The full module and the half module extension are shown below.



Level of Services:	• Pedestrian waiting area: • Pedestrian Walkways: • No controlled station access points/gates • Dedicated bay for wheelchair	• LOS C-D • LOS C-D • LOS C-D
Station Sizing:	• 10 Metre long x 3 metres deep open station in 35 x 3-metre layby. Average configuration should require ± 2 modules • Stations to be manufactured in 10-metre modules to cater for varied demand at different locations • Station set back ± 1 metre from Kassel kerb to facilitate quick boarding only through left front door	
Station Doors	• No doors - largely enclosed with open doorways through which to board • Open doorways to be at least 1 100 mm wide	
Cubicles	• No cubicles	
Signalling and signage	• Pedestrian phase required at signals nearest to controlled access station or pedestrian crossing at priority controlled intersections, • Signalling to be upgraded at relevant intersections to voice and lit signals • Median to facilitate crossing	

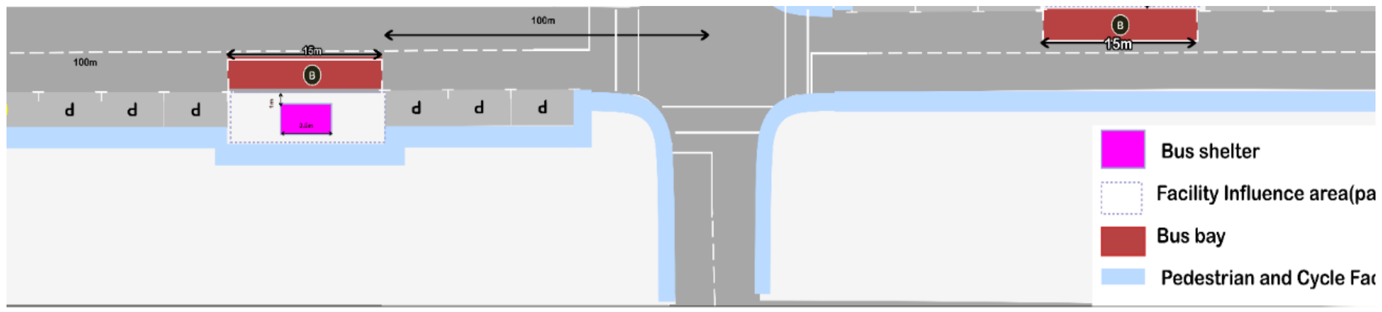
Amenities and Support hardware				
Seating	Shelter	Bicycle parking	Refuse removal	Fare Collection Equipment
• Seating rail at back • Guardrails to facilitate correct passenger flow	• Direct access • Only roof with limited side panelling	• Yes, at selected stations	• Local collection; • Bins to be provided in station	• No equipment - fare control when boarding bus only through left front door

Municipal Services				
Electricity	Sewerage & Water	Lighting	Safety	Signage and Information
• LED preferred at stops, to illuminate static passenger info. Not required-nice to have item. Solar system prone to be stolen • Electricity backup: No	• No water or sewerage required	• LED if possible	• Fire fighting equipment under bum rails • First Aid equipment	• Room for advertising • Room for static passenger information, e.g. service map and timetables
APTMS equipment:	• No APTMS equipment (Need to update according to David revised spec to make UA compliant) • Sleeves for optic cable required for all stations when roadways are constructed, even for open stations - later cable supply if demand warrants) • Provision for Limited ICT Equipment at stations • Comms to be supplied to AFC vendors around stations, City pay points and customer care facility			
Universal access:	• Take note of compliance on: • Tactile requirements at access through to boarding doors • Level entry to buses • Slope limit of 1:15 at access ramp			

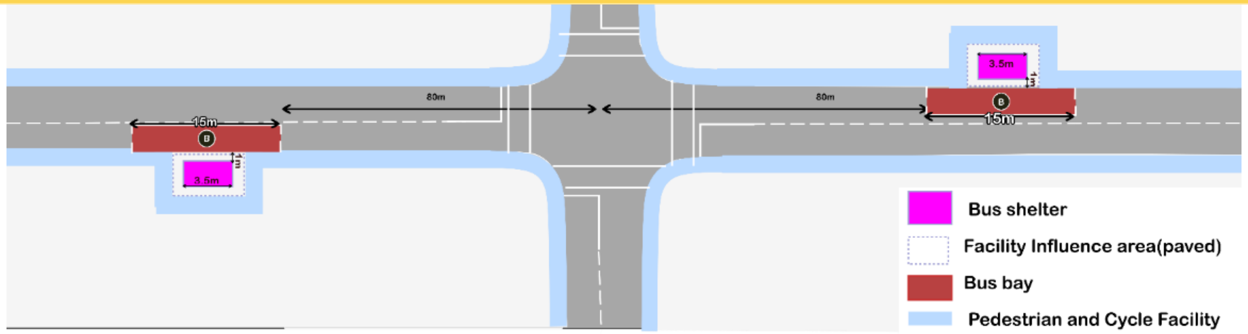
Table 14-7: Stop Design Principles

Function/ Equipment/Capacity	Stop
Passenger Volumes per peak 15 minutes: <100	
Provided along all routes depending on demand at stop. Stop can have a shelter depending on location along route and space availability Where no dedicated sidewalk is provided before implementation side-walks will be provided along the identified non-motorised network leading to the stop.	*Note design presented is illustrative*

Station Placement and Intersection Configuration:
Class 5 Roads – Bulb out (kerb extension) Station



Class 5 Roads – Next to Road



Stop Sizing - Incremantal implementation

- 7,5 x 3 metre stop area set back ± 1 metre from Kassel kerb to facilitate quick boarding only through left front door

Passenger landing with pole and NMT

Passenger land bulb with pole or shelter depending on space

Figure 3-24 Example of Bus Stop at Curb Extension

Note designs presented are illustrative

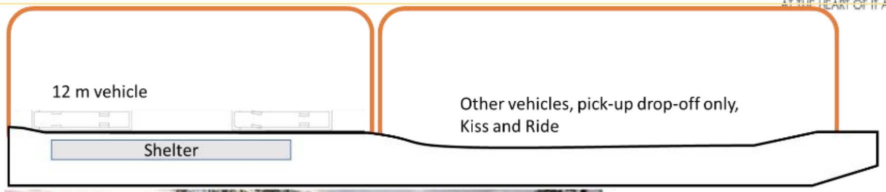
- Stop:
  - Basic requirement for implementation along routes, provides access to the system
  - Landing area for passenger UA compliant
  - NMT facilities along the road
  - Stop with pole, moveable
  - Bus stop in the traffic lane, no bay unless traffic flow or other road safety aspect call for bay
- Stops with Shelters implement at:
  - Locations identified with potentially high demand like - Shopping centres, Educational facilities, Offices parks or other commercial and residential areas that attract a high number of people,
  - To demarcate the IPTN corridor, start/end points. Provide basic information about the system.
- Design parameters:
  - 7,5mX3m paved area for waiting area, part of NMT infrastructure
  - Where not possible at least 3m wide walkway need to be provided
  - Moveable – allow for infrastructure built and operate scenario

Level of Services:	• Pedestrian waiting area: • Pedestrian Walkways:	• LOS C-D • LOS C-D

Amenities

Seating - Yes	**Shelter** - Yes	**Bicycle parking** - No	**Refuse removal** - Yes	**Fare Collection Equipment** - No

Table 14-8: High Capacity Public Transport Stop

Function/ Equipment/Capacity	High Capacity Public Transport Stop – Transfer facility
• Provide transfer between routes in the network. • Size depending on the number of feeder routes and vehicle fleet servicing the feeder routes.	
Forced transfer from trunk to feeder route.	
• Implemented where short term route design is trunk-feeder and long term route strategy will be a complementary route and selective feeder route implementation model.	  *St Albans City Station bus stop islands, pedestrian walkways, taxi rank, 'Kiss & Drop' point and bicycle parking*

- In each corridor, an allowance was made for several high capacity public transport stops. At these stops allowance is made for integration between feeder and trunk services and to allow for:
  - holding of smaller vehicles and
  - trunk and complementary service vehicle lay-overs.
- Several of these stops were included in the system design; this decreases the need for only one large transfer facility in a corridor and provides transfer opportunities at main points of interest in the city.
- to increase capacity and become transfer facilities where holding for vehicles, long-distance, trading and other services will be allowed.
- Furthermore, the approach allows that a corridor can be operationalised while a formal transfer facility is constructed or till demand trigger a main transfer facility in a corridor. Other for feeder trunk operations, integration at main trip generators and attractors, hospitals, shopping centres etc.

Placement and Intersection Configuration:

- The placement and configuration to be determined based on site selected, patronage, number routes to be accommodated and a number of feeder vehicles.

Level of Services:	• Pedestrian waiting area: • Pedestrian Walkways:	• LOS C-D • LOS C-D
Sizing:	• Shelter set back ± 1 metre from Kassel kerb to facilitate quick boarding only through left front door • The number of shelters will vary depending on the number of passengers, routes and feeder vehicles that need to be accommodated at the facility.	

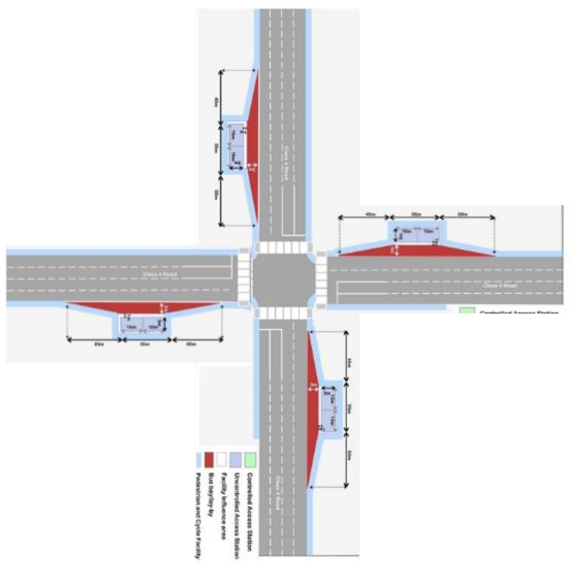
Amenities

Seating	**Shelter**	**Bicycle parking**	**Refuse removal**	**Fare Collection Equipment**
• Seating rail at back • Guardrails to facilitate correct passenger flow	• Direct access • Only roof with limited side panelling	• Yes, at selected stations	• Local collection; • Bins to be provided in station	• No equipment - fare control when boarding bus only through left front door

Municipal Services

Electricity	**Sewerage & Water**	**Lighting**	**Safety**	**Signage and Information**
LED preferred at stops, to illuminate static passenger info. Solar system prone to be stolen Electricity backup: No	No water or sewerage required	LED if possible	Fire fighting equipment under bum rails First Aid equipment	Room for advertising Room for static passenger information, e.g. service map and timetables Add tactile signage at stops

Table 14-9: Low Capacity Transfer – Voluntary Transfer

Low Capacity Transfer				
• Provide transfer opportunities to passengers within system. These transfers are positioned where main corridors or routes intersect. • The number of transfers between these corridors or routes needs to be determined once the system is operational. • However, implementation of these facilities allows passengers that travel between origin and destination where less than 50 people were modelled the opportunity to transfer between main routes to reach the final destination. • These transfer geographically positions where corridors and routes intersect or cross diagonally.		Low Capacity Transfer/Voluntary Transfer 		
Level of Services:	• Pedestrian waiting area: • Pedestrian Walkways:		• LOS C-D • LOS C-D	
Station Sizing:	• No shelters initially, shelters can be provided at later stages.			
Amenities				
Seating - No	Shelter - No	Bicycle parking - No	Refuse removal - Yes	Fare Collection Equipment - No

14.2.4 Waiting Area at Stops Sizing and Characterising per corridor

The route design selected for the implementation impact on the facility type and size. The three alternatives defined in the preceding sections are:

- Trunk Only routes and services
- Trunk-Feeder Routes and Services;
- Trunk-feeder and complementary routes and services.

14.2.4.1 Trunk Only Routes and Services

- Concept of Operations:
  - Scheduled trunk routes and services with unscheduled feeder services. Feeder services are provided by Hauweng branded feeder vehicles collecting passengers in the suburbs and provide access to the trunk routes and services at one or two main transfer facilities. The feeder routes are designed to be maximum of 7km given that the trunk route is between 20 -30 km round trip distance. The position and size of the main transfer depend on the number of feeder routes and vehicles that integrate with the trunk services at the particular transfer.
  - Direct/Diagonal routes from one corridor to the other corridor will be provided. These will operate between identified stops, main transfer or high capacity public transport stops.
- Transfers:
  - The main transfer can also be replaced by a high capacity public transport stop along the trunk route. This optimises the size of the main transfer and land requirement for implementation.
  - Layover facility - Where a main transfer is replaced with several high capacity public transport stops an additional area needs to be provided where feeder vehicles can refuel, drivers can rest and maintain feeder vehicles. This facility can be a shared facility where the feeder vehicles can utilise the facility during the day, whiles the facility is utilised as a sleeping grounds for the trunk service fleet.
- Stops:
  - Will be implemented along the trunk routes to provide direct access to the services thus not required to use a feeder service. The size of the stops is determined on the number of passengers that will gain access to the services at the particular stop. The stop can also be an uncontrolled access station depending on the number of passengers and other criteria presented in the design principles.
  - Will **NOT** be implemented along feeder routes and integration with trunk routes and services will only be at the main transfer or high capacity public transport stops. Refer to the design principles of a high capacity public transport stop above.
- Advantages:
  - The corridor can operationalise when main transfer and stops/stations along trunk are available. Given that one transfer is replaced by several high capacity public transport stops, the land requirement can be minimised, and implementation optimise.
- Disadvantage;
  - Access to the trunk services relies on feeder services to bring passengers to the trunk. If information and access to feeder services are not convenient and known to passengers, it can impact on the number of passengers and the passenger experience of the system.

14.2.4.2 Feeder-Trunk Route Design

- Concept of Operations:
  - Trunk and feeder routes are scheduled, and route alignment fixed. Feeder services are designed according to the same design principles as trunk only services.
  - Direct/Diagonal routes from one corridor to the other corridor will be provided. These will operate between identified stops, main transfer or high capacity public transport stops.
- Transfer:
  - One transfer is not required; feeder vehicles can integrate at several high capacity public transport stops. This allows for flexibility in the system and the high capacity public transport stops do not require significant land availability in one location.
  - A lay-over or sleeping ground where ablution facilities will be available for feeder services is however required. This facility can be divided into several smaller facilities and assist in the implementation and land requirement.
- Stops will be implemented:
  - Along feeder routes and integration with trunk routes and services will only be at the main transfer or high capacity public transport stops. Refer to the design principles of a high capacity public transport stop above.
  - Along the trunk routes to provide direct access to the services thus not required to use a feeder service. The size of the stops is determined on the number of passengers that will gain access to the services. The stop can also be an uncontrolled access station depending on the number of passengers and other criteria presented in the design principles.
- Advantages:
  - The corridor can operationalise when main transfer and stops/stations along trunk are available. Given that one transfer is replaced by several high capacity public transport stops, the land requirement can be minimised, and implementation optimise.
  - Access to the system along feeder routes increases the quality of service and information relating to the service can be within the suburbs.
- Disadvantage;
  - The implementation of stops along feeder services increases the capital cost.
  - Access to the trunk services relies on feeder services to bring passengers to the trunk. If information and access to feeder services are not convenient and known to passengers, it can impact on the number of passengers and the passenger experience of the system.

14.2.4.3 Feeder Trunk and Complementary

- Concept of Operations:

- Trunk and feeder routes are scheduled, and route alignment fixed. Feeder services are designed according to the same design principles as trunk only services.
- Where rationalisation of a trunk-feeder route into complementary routes, where patronage along feeder is more than 450 passengers per hour. This rationalisation will enhance passenger experience and omit one transfer in the full journey of a passenger. This rationalisation, however, needs to be financially feasible and sustainable.
- Direct/Diagonal routes from one corridor to the other corridor will be provided. These will operate between identified stops, main transfer or high capacity public transport stops.

- Transfer:
  - One transfer is not required; feeder vehicles can integrate at several high capacity public transport stops. This allows for flexibility in the system and the high capacity public transport stops do not require significant land availability in one location.
  - A lay-over or sleeping ground where ablution facilities will be available for feeder services is however required. This facility can be divided into several smaller facilities and assist in the implementation and land requirement.
- Stops will be implemented:
  - Along feeder routes and integration with trunk routes and services will only be at the main transfer or high capacity public transport stops. Refer to the design principles of a high capacity public transport stop above.
  - Along the trunk routes to provide direct access to the services thus not required to use a feeder service. The size of the stops is determined on the number of passengers that will gain access to the services. The stop can also be an uncontrolled access station depending on the number of passengers and other criteria presented in the design principles.
- Advantages:
  - The corridor can operationalise when main transfer and stops/stations along trunk are available. Given that one transfer is replaced by several high capacity public transport stops the land requirement can be minimised, and implementation optimise.
  - Access to the system along feeder routes increases the quality of service and information relating to the service can be within the suburbs.
- Disadvantage;
  - The implementation of stops along feeder services increases the capital cost.
  - Access to the trunk services relies on feeder services to bring passengers to the trunk. If information and access to feeder services are not convenient and known to passengers, it can impact on the number of passengers and the passenger experience of the system.

Given the above description, the facility requirement does not differ significantly between trunk only and the other two alternatives, feeder-trunk and complementary. The main difference will be that stops along the feeders will not be implemented for the trunk only service option. The sizing of the stations was based on patronage Scenario 1 where subsidised bus service demand was included given that this is the model that the city in the long term would like to implement.

The position of the transfers, stops and stations as part of the network design and route design principles are presented in Figure 14-14. The number of passengers during the highest 15-minutes of the peak hour per station along the routes in each phase was determined per route design alternative. The detailed number of passengers per route is presented in **Annexure W**. The assumption was made that passengers, will be evenly distributed between stops and stations along routes. However, to determine the effect if passengers were not evenly distributed is was modelled for the 2036 horizon year when 4 times the passenger volume will gain access to the system at a particular station, thus inflating the passenger volumes. This allows for stations/stops that will be located at retail centres, education facilities or other high demand points, but caution that not ALL stops can be designed to this capacity along the routes in the corridor. This will be an over design. These calculations do not reflect the capacity that will be required at the main transfers in the CBD of Bloemfontein, Botshabelo or Thaba Nchu, capacity calculations to this end are provided in **Section 14.3**.

Table 14-10 provides the number of stops and waiting area modules per corridor and route design alternative. These are required to accommodate the highest number of passengers in 15-minutes at a Level of Service C (refer to waiting area design principles in Section 14.2.3). The design guidelines reflecting the sizing of modules per LOS and associated dimensions are presented in Annexure Z.

Note that the majority of route designs will require one or two modules for the base and 2036 design years. Along Phase 2 trunk routes, stops with more than 2 modules will be required to accommodate passengers. The high scenario (2036, 4 X estimated passengers) trigger the implementation of full-size controlled access stations, 45m station with pre-boarding validation. Table 14-11 reflect the number and type of facility that is required to be implemented for the feeder-trunk and complementary route design scenario and Table14-12 for a trunk only route design, no stops provided along feeders. Note that given the kerb-side operations that a stop per travel direction is required, thus on the map, only one position will be reflected, but two stops will be indicated in the mentioned table to reflect quantities.

Table 14-10: Summary of city-wide network facilities – Trunk and Feeder Route Design

2017	Module width 5m				Module width 3m			
Module length (m)	7	14	28	45	12	23	47	70
Botshabelo	70	0			70	0		
Circular Routes	12	0			12	0		
OR Tambo	26	0			26	0		
Phase 1 _Maphisa	24	6			24	6		
Phase 2	47	10			47	10		
Thaba Nchu	39	0			39	0		
2025	**5m**				**3m**			
Botshabelo	70	0			70	0		
Circular Routes	12	0			12	0		
OR Tambo	26	0			26	0		
Phase 1 _Maphisa	30	0			30	0		
Phase 2	48	9			48	9		
Thaba Nchu	32	7			32	7		
2036	**5m**				**3m**			
Botshabelo	70	0			70	0		
Circular Routes	12	0			12	0		
OR Tambo	26	0			26	0		
Phase 1 _Maphisa	30	0			30	0		
Phase 2	48	9			48	9	57	
Thaba Nchu	32	7			32	7		
2036 - x4 passengers per station	**5m**				**3m**			
Botshabelo	70				70			
Circular Routes	12				12			
OR Tambo	20	6			20	6		
Phase 1 _Maphisa	20	4	6		20	4	6	
Phase 2	15	27	12	3	15	27	12	3
Thaba Nchu	25	9	5		25	9	5	

*refer to design criteria for length of modules per width (Annexure Z)

Table 14-11: Summary of city-wide network facilities – Trunk- Feeder and Complementary Route Design

Facility Type	Maphisa	OR Tambo	CBD	Dr Belcher	Botshabelo	Thaba Nchu
Stops	32	28	170	74	120	62
Controlled Access Stations	-	-	-	-	-	-
Uncontrolled Access Stations (Stop with Shelters)	10	10	22	16	16	14
Transfers High Capacity	6	6	11	10	4	6
Transfers Low Capacity (Voluntary Transfer)	8	8	6	4	0	0

Table 14-12: Summary of city-wide network facilities – Trunk Only Route Design

Facility Type	Maphisa	OR Tambo	CBD	Dr Belcher	Botshabelo	Thaba Nchu
Stops			170			
Controlled Access Stations	-	-	-	-	-	-
Uncontrolled Access Stations (Stop with Shelters)	10	10	22	16	16	14
Transfers High Capacity	6	6	11	10	4	6
Transfers Low Capacity (Voluntary Transfer)	8	8	6	4	0	0

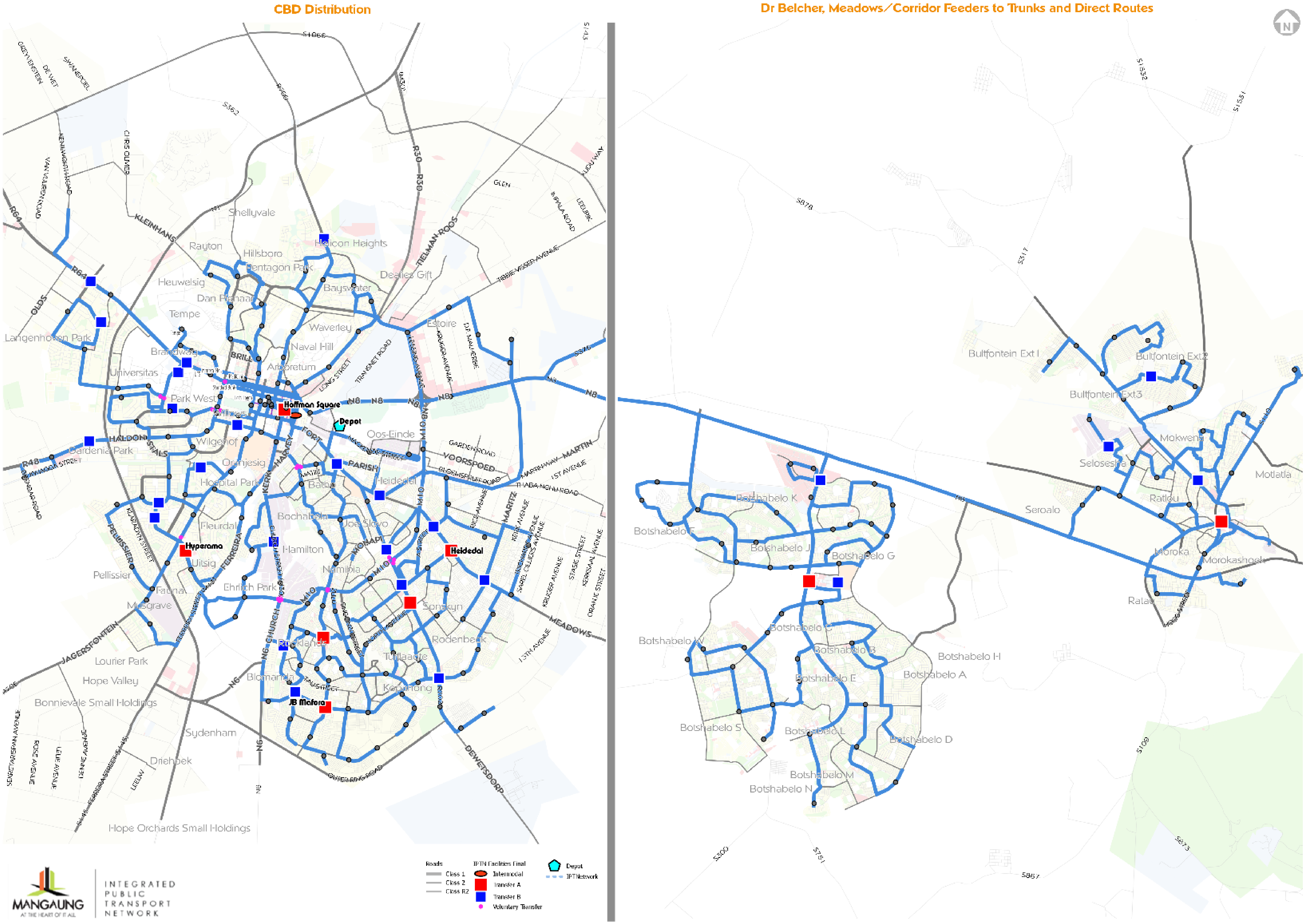


Figure 14-14: IPTN Facilities

14.3 Transfer Facilities

The route design alternatives all require a transfer facility in the CBD of Bloemfontein, Botshabelo and Thaba Nchu. These facilities will be the main integration points between modes and services in the areas and to other areas. Long-distance- and cross border public transport services will integrate with the local corridors at these points. The capacity for the four design years was determined to compare the capacity that can be provided at these facilities can accommodate the demand associated full development stage of the system.

Passenger experience of the new system will depend on the knowledge of the new system and the alignment of the new system operations with the existing system while the system is implemented year on year. With this in mind, it is to the advantage of the implementation of the transformed system to have reference points that coin side between the existing system and new system. The main transfers will be these points and will be upgraded and built environment improves to indicate transformation.

The transfer facilities selected for the system comprise of:

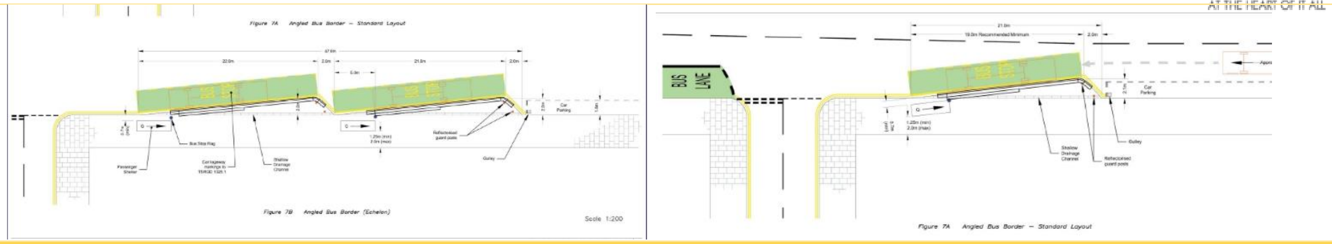
- The intermodal facility, next to Bloemfontein rail station;
- Hoffman Square in the CBD;
- Blue Rank in Blotshabelo; and
- Thaba Nchu main taxi and bus rank (Van Riebeeck Street).

The transfer facilities will facilitate the transfers from Trunk to Trunk (Intermodal and Hoffman Square) or from feeders to trunk to/from Botshabelo and Thaba Nchu and Bloemfontein.

The intention is that these facilities need to be developed per phase of the system that will be operationalised. To construct these facilities to full capacity per the full development stage design will lead to extensive capital cost and low utilisation. The approach to the design and development of these facilities are to provide infrastructure and systems per the estimated demand per phase to be operationalised. The triggers set in the design principles below indicate the stage when capacity increase needs to be considered.

Table 14-13: Main Transfer Facility

Function/ Equipment/Capacity	Transfer Facility
• Facilitate transfer from feeders to trunk and trunk to feeders. • Where the long-term implementation model within a corridor is a trunk-feeder route design, a transfer facility is implemented. • The size, layout and configuration of a transfer facility will depend on the demand in the corridor; the number of routes that integrate at the facility and the function of the facility according to the land-use planning for the area. • Transfer facilities will be implemented in an incremental manner where capacity is triggered by demand.	
• Initial implementation: – Open stop with shelter concept, – Allow for queue lanes/areas, informal queueing, – When loading of vehicles >5 minutes per vehicle, trigger the implementation of dedicated queue lanes/area • Queue lanes/areas: – Demarcated queue lane – Hand held validators for pre-boarding validation – Marshals required to facilitate and minimise fare evasion – With this approach the area required for a facility and the construction cost of transfer facility is optimised – **Note** if demand increase to >400 in peak 15 minutes, **upgrade to closed station is triggered**	



Placement and Intersection Configuration:	
• The placement and configuration to be determined based on a site selected, patronage, number routes to be accommodated and number of feeder vehicles. Concept and detail design id required per site when patronage is confirmed through detailed market surveys • The convenience of passengers at these facilities is critical, thus in calculating the capacity it needs to be noted that the facility cannot be upgraded constantly or year-on-year. This will be inconvenient to users. For this purpose, the platforms will be designed and constructed to enable the implementation of structure such as shelters and queue lane without major disruption of operations and users.	
Level of Services:	• Pedestrian waiting area: • LOS C-D • Pedestrian Walkways: • LOS C-D
Sizing:	• Station set back ± 1 metre from Kassel kerb to facilitate quick boarding only through left front door • The number of stations and shelters will vary depending on the number of passengers and the routes and feeder vehicles that need to be accommodated at the facility. • The initial shelters will be upgraded to controlled access station when passenger demand require pre-boarding validation. • The facility will allow for holding area for feeder vehicles, ablution and other facilities for feeder vehicle operations.

Amenities				
Seating	Shelter	Bicycle parking	Refuse removal	Fare Collection Equipment
• Seating rail at back • Guardrails to facilitate correct passenger flow	• Direct access • Only roof with limited side panelling •	• Yes, at selected stations	• Local collection; • Bins to be provided in station	• No equipment - fare control when boarding bus only through left front door • Where demand trigger, hand held validators will be used to ensure that boarding time is optimised

Municipal Services				
Electricity	Sewerage & Water	Lighting	Safety	Signage and Information
• LED preferred at stops, to illuminate static passenger info. • Solar system prone to be stolen • Electricity backup: No	• Water and sewerage required	• LED if possible	• Fire fighting equipment under bum rails • First Aid equipment	• Room for advertising • Room for static passenger information, e.g. service map and timetables

14.3.1 Sizing and Characterising

The capacity required at these facilities were derived from the number of routes and services that will integrate at these facilities at full development stage. It is envisaged that due to demand and routes integrating at these facilities, controlled access stations will be required at full development stage. The number of access controlled stations and the number of transfers per corridor is presented in **Table 14-14**.Total of four transfer facilities are required, and it is estimated that at full development stage 2036 demand 10 controlled access stations will be required at these facilities.

Table 14-14: Transfer Facilities

	Maphisa	OR Tambo	CBD	Dr Belcher	Botshabelo	Thaba Nchu
Transfers (Main)	0	0	2	0	1	1
Controlled Access Stations at transfer facilities or in corridor	1	1	3	3	1	1

The concept design and capacity required per main transfer facility are detailed below to assist in costing and to indicate the capacity required associated per phase that will be operationalised.

14.3.1.1 Hoffman Square Main Transfer Facility

14.3.1.1.1 Design Principles

Hoffman Square is situated in the CBD 500m walking distance from the Intermodal Facility and Central Park are existing transfer points between bus and taxi service in the city. It provides an urban space with several amenities and retail development. Hoffman Square integrates with the predestination of Floreat Avenue where informal trading facilities are provided and a direct pedestrian link to Wes Burger and Charles Streets. **Figure 14-15** present the environment surrounding Hoffman Square and related aspects. For the space to be utilised as a transfer facility, the on-street parking along the square will be required for the provision of public transport bays. On-street parking will remain along the rest of St Andrews and Charlotte Maxeke Road. Given the ITP 2008 objective to promote public transport in the city the reduction in on-street parking is supported by this objective of the city.

The capacity that needs to be provided at the transfer relates to the passenger waiting time, stop and station type based on demand and the number of public transport bays required to facilitate route integration.

Hoffman Square extends 185m along St Andrew and Charlotte Maxeke Street and 56m between the mentioned roads. Applying the design guideline of 24mX 3m required per public transport bay a total of 20 bays can be implemented on the perimeter of the square.

The public transport bay capacity required at Hoffman Square is derived through determining the dwell time of a vehicle to load and off-load passengers. This is called the vehicle dwell time and depend on the payment method implemented as part of the system and the number of doors or channels part of the vehicle design. The time assumed for boarding and alighting per passenger per payment method and the number of channels is presented in **Table 14-5**. The time savings incurred for pre-payment (pre-validation) are significant and can minimise the number of bays required.

The design approach was to allocate at least one bay per functional public transport corridor of the city. The number of bays required was derived through determining the vehicle dwell time per route per service frequency for the 2017,2025 and 2036 years. Some routes required more than one bay given that the service frequency is less than the dwell time. Where service frequency was significantly more than the dwell time, the bay was allocated to another route to operate from the bay. This optimises the number of bays required.

The routes that will integrate at Hoffman Square from Bloemfontein south-eastern suburbs, Botshabelo and Thaba Nchu are presented in Table 14-16, and the routes that will distribute these passengers into the CBD of Bloemfontein are listed in Table 14-17. The detail pertaining to route service and dwell time are presented in Annexure BB. The routes and required bays per payment method and the number of doors per vehicle are presented in Table 14-18. The highest number of bays required is 27 and the lowest 21 to facilitate transfers between 37 routes. The maximum number of bays that can be provided at the square is 20. Thus, the minimum cannot be accommodated at the facility, and additional transfer stations will be required to facilitate transfers between routes. It is envisaged that 5 bays will be provided at the intermodal facility approximately 500m from Hoffman Square. With this addition, the sufficient number of bays can be provided for transfer in the city. Utilising the design principles presented the bay layout is presented in Figure 14-16.

For the long-term full implementation, it is foreseen that long-distance taxi and bus services will integrate with the system at the intermodal facility. Furthermore, the route design allows for integration between the facilities in such that the majority of routes from suburbs pass via the intermodal and Hoffman Square. Some express services might only link to one of the two transfer facilities but will be indicated as part of route descriptions and route numbering. A CBD circulation route can be implemented when demand and passenger surveys trigger the implementation thereof. The alignment of the BD circulation route is presented in Figure 14-17.

Table 14-15: Passenger Service Time (s/p) - Boarding

Payment method	Service Time (second per passenger)	Alighting – One door Channel	Alighting – two-door Channel	Total Boarding and Alighting per Vehicle One Door Channel	Total Boarding and Alighting per Vehicle two Door Channel
Pre-payment	2.5	2.5	1.5	5	4
Single ticket or token	3.5	2.5	1.5	6	5
Exact change	4	2.5	1.5	6.5	5.5
Swipe or dip card	4.2	2.5	1.5	6.7	5.7
Smart card	3.5	2.5	1.5	6	5

Table 14-16: Routes Integrating at Hoffman Square

Area	Route Description	Route Type	Vehicle Type	2036 Service Freq(min)
Dr.Belcher/Meadows	Namibia to CBD	Complementary	Rigid	3.1
Dr.Belcher/Meadows	Freedom Square	Complementary	Rigid	5.8
Dr.Belcher/Meadows	Heidedal	Complementary	Rigid	10.5
Dr.Belcher/Meadows	Phase 2	Complementary	Rigid	9.8
Dr.Belcher/Meadows	Meadows	Trunk	Articulated	8.9
Dr.Belcher/Meadows	Dr Belcher	Trunk	Articulated	5.0
Dr.Belcher/Meadows	Turflaagte	Complementary	Rigid	6.8
Maphisa/Moshoeshoe	Dr Rantlai Stadium	Complementary	Midi-bus	5.4
Maphisa/Moshoeshoe	Dr Rantlai Stadium Makoena St	Complementary	Midi-bus	4.9
Maphisa/Moshoeshoe	Maphisa/Moshoeshoe	Trunk	Rigid	2.6
OR Tambo	OR Tambo	Trunk	Rigid	4.1
OR Tambo	Ipopeng	Complementary	Rigid	9.4
OR Tambo	Bloemanda	Complementary	Rigid	16.0
OR Tambo	VTEF college	Complementary	Rigid	9.4
OR Tambo	Elrich Park	Complementary	Midi-bus	4.2
Thaba Nchu	Thaba Nchu to Bloemfontein	Trunk	Articulated	10.3
Botshabelo	Botshabelo H	Complementary	Articulated	11.8
Botshabelo	Botshabelo C	Complementary	Articulated	9.1
Botshabelo	Botshabelo R,U,S	Complementary	Rigid	7.7
Botshabelo	Blue Rank	Trunk	Articulated	6.0
Botshabelo	Botshabelo K,F	Trunk	Rigid	6.7

Table 14-17: CBD Distribution Routes

Route No	Route Description	Vehicle Type	2036 Service Freq(min)
Rt1	Rt1_HofSq_Uitsig_Hyperama	Articulated	4.0
Rt10	Rt10HofS_UniverHospital	Rigid	3.9
Rt11	Rt11_HofSq_Estiore	Midi-bus	11.2
Rt12	Rt12_HofSq_Airport	Midi-bus	4.3
Rt13	Rt13_HofSq_Tempe	Rigid	5.0
Rt14	Rt14_HofSq_Heuwelsig	Rigid	4.8
Rt15	Rt15_HofSq_Bays Valley	Midi-bus	4.3
Rt16	Rt16_HofSq_Northridge Mall	Rigid	4.9
Rt17	Rt17_HofSq_Bayswater	Articulated	4.5
Rt2	Rt2_HofSq_LourierPark	Articulated	4.2
Rt3	Rt3_HofSq_LangenhPark via Mimosa	Rigid	6.9
Rt4	Rt4_HofSq_LangenhPark via Universitas Hospital	Rigid	5.6

Route No	Route Description	Vehicle Type	2036 Service Freq(min)
Rt5	Rt5_HofSq_Pelissier	Rigid	12.3
Rt6	Rt6_HofSq_UFS	Articulated	2.7
Rt7	Rt7_HofSq_Makro_Dist	Rigid	4.2
Rt9	Rt9HofSq_UniversitasArea_Dist003	Rigid	12.9

Table 14-18: Public Transport Bays Required per design year Hoffman Square

Corridors	Number of Routes/ Destinations	One Door Channel						Two Door					
		Smart card			Pre-Payment			Smart card			Pre-Payment		
		2017	2025	2036	2017	2025	2036	2017	2025	2036	2017	2025	2036
Maphisa/ Moshoeshoe	3	2	1	2	1	2	1	2	1	2	2	2	2
OR Tambo	5	2	2	2	2	2	2	2	2	2	2	2	2
Dr Belcher	7	7	5	7	5	6	5	7	5	7	5	7	5
Botshabelo	5	3	3	3	3	3	3	3	3	3	3	3	3
Thaba Nchu	1	1	1	1	1	1	1	1	1	1	1	1	1
CBD Distribution	16	14	9	12	10	12	10	12	10	12	10	12	10
	37	29	21	27	22	26	22	27	22	27	23	27	23

Figure 14-15:Hoffman Square

Figure 14-16: Hoffman Square Concept Design

Figure 14-17: Long-term CBD Circulation Route (Hoffman Square and Intermodal Facility)

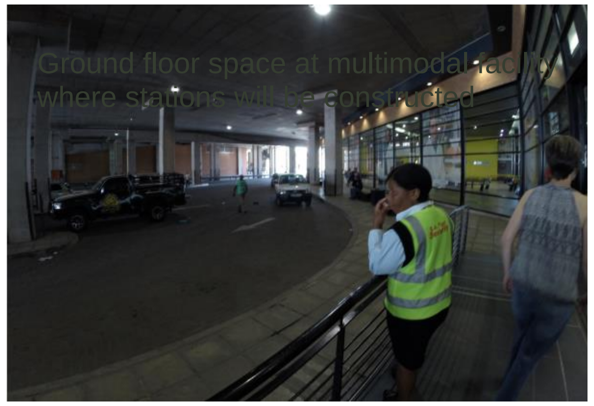
14.3.1.1.2 Functions

The functions which will be performed by the Hoffman Square facility will consist of the following, namely:

- Serves as distribution and collection hub for incoming and distribution services, both taxi and bus (local services only)
- Allows easy access to top-ups and the resolution of fare collection, concession procurement, and service problems
- Stations/stops will be constructed along the edges of the square, and the size and type will be initial stop with shelters to be upgraded to full controlled access stations when demand triggers the implementation of these. It is foreseen that this will be required when more than half of the system is transformed from the new system.

14.3.1.2 Multimodal Facility

The intermodal is situated between the rail station and the main transfer facility of subsidised bus service, Central Park. Central Park is privately owned, and service integration between the multimodal facility and Central Park is via a pedestrian bridge.



14.3.1.2.1 Design Principles

The intermodal facility comprises of three floors that include:

- The stations are adjacent to IPTN Customer Care Centre that is also situated in the Multimodal Facility, making access to travel assistance user-friendly
- Ground floor, street level, access to the facility designed to accommodate buses.
- Existing through lanes forms part of the urban access roads which needs to provide continuous access to the city from the South to the North and vice versa. These access roads will at the same time provide access to the inter-modal facility for the use by private vehicles, Buses and Taxi's alike.
- Offices, ablution facilities and spaces suitable for retail activity is taken up by the balance of the ground floor space.
- Additional office space is also available on the first floor.
- The remainder of the first floor is earmarked for the loading and off-loading of taxi passengers and informal trade spaces
- The top floor is designed to be used for washing taxis and serve as a vehicle stacking area. Ablution facilities and vendor storage are also available on this floor
- Lifts are available to carry passengers with special needs between floors
- The facility is linked to the Central City bus station and railway station. A dedicated pedestrian bridge links the Central City bus station with the intermodal facility. The link from the intermodal facility to the rail station concourse still needs to be constructed but provision was made in the layout of the facility to construct the required pedestrian overpass.

14.3.1.2.2 Sizing and Characteristics

The capacity required at the intermodal facility:

- Two Controlled Access Stations will be constructed in this area when demand triggers the implantation of a controlled access station. The initial deployment will be, stops with shelters and related amenities associated with uncontrolled access station. The concept layout and allocation of routes per bay are presented in Figure 14-19.
- These two stations will both face south due to the flow of traffic around the semi-integrated multimodal loading areas. Two stations will be required to make provision for trunk arrivals and departures, as well as other collection and distribution services required to make access to the various destinations beyond this facility possible within the IPTN service network
- The stations will be designed to also allow for docking by all categories of buses in the IPTN contracted service environment
- The planned redesigned traffic flow will facilitate quick boarding, transfers and disembarking for other connection services and modes. Refer to the detailed traffic impact study for the area attached in
- The successful integration of the Intermodal Transport facility with other existing modes of transport should form part of a more strategic approach by the MMM. The facilitation of negotiations with IBL, the taxi industry and other role players form an integral part of the successful use and integration of the facility.
- Furthermore, the integration of passenger rail should be discussed on a provincial level with Praza and Intersite. The viability to introduce a passenger rail service should be investigated between Thaba Nchu and Botshabelo as an alternative service to the currently subsidised service delivered.

14.3.1.2.3 Functions

The functions which will be performed by the Multi-modal facility will consist of the following, namely:

- Serves as distribution and collection hub for incoming and distribution services, both taxi and bus
- Allows easy access to other integrated modes of public transport such as rail, subsidised bus services, Long Distance taxi services, and taxi services not yet integrated into the IPTN
- Allows easy access to Customer Care Centre for the purchase of fare smartcards, top-ups and the resolution of fare collection, concession procurement, and service problems
- Stations/stops will be constructed on the ground floor to allow integration between modes at the facility. The size of the stops and stations depend on the passenger demand and the number of phases of the IPTN that is operational.

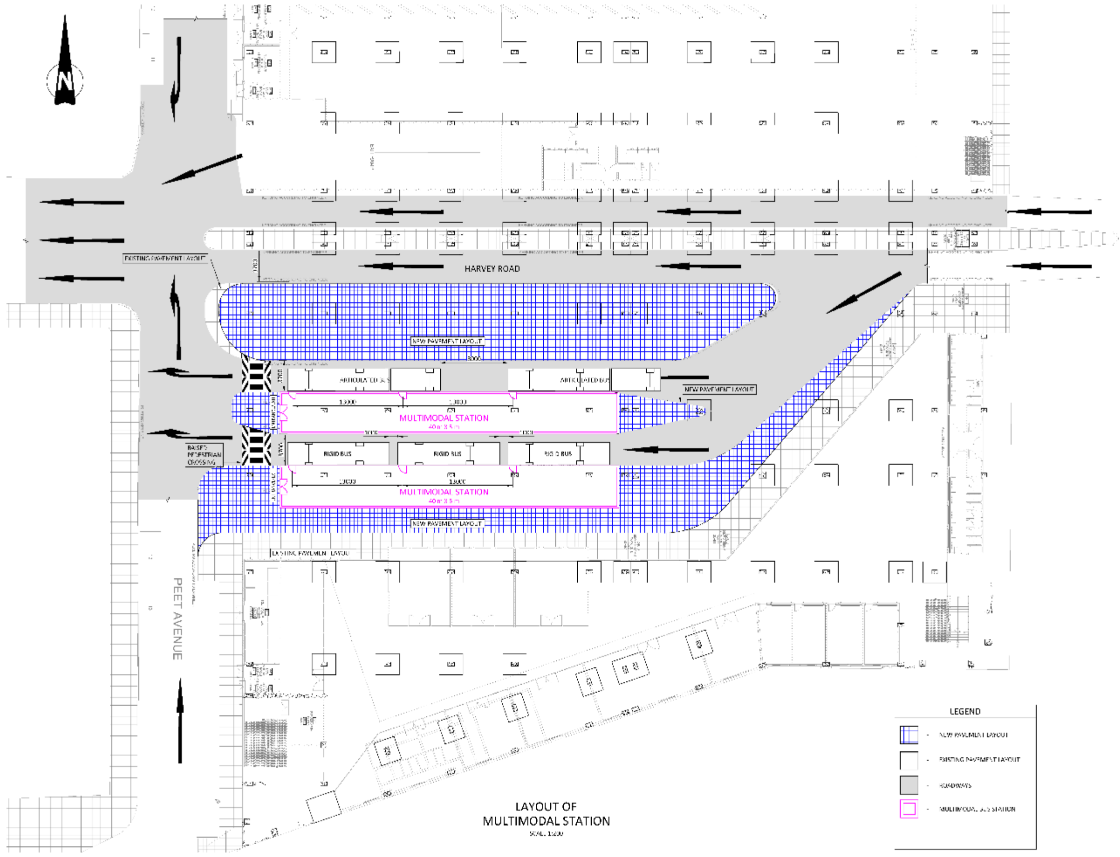


Figure 14-18: Concept Lay-out Intermodal Facility

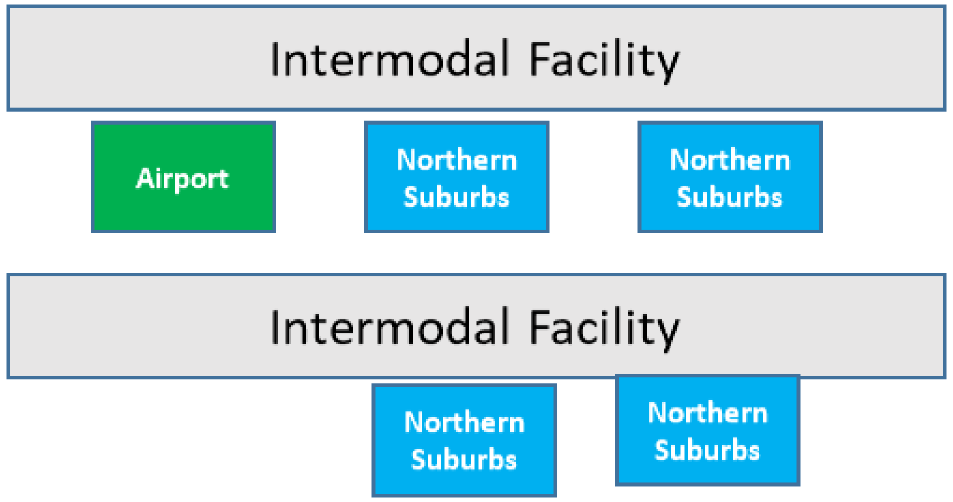


Figure 14-19: Intermodal Facility Concept Layout

14.3.2 Botshabelo and Thaba Nchu Transfer Facilities

The main transfer facility in Botshabelo is envisaged to be at the existing Blue Rank. The rank is an existing integration point between bus and taxi services and is presented in Figure 14-20. These modes integrate at the rank and a detailed precinct plan needs to be developed to ensure that integration will be achieved between existing public transport services and service already incorporated into the IPTN system. A detailed analysis and implementation plan will be required before the Botshabelo corridor is operationalised.

Figure 14-20: Blue Rank Botshabelo

The Thaba Nchu rejuvenation project allowed for the provision of dedicated lanes through the CBD of Thaba Nchu. Given the incremental approach of implementation and the change from dedicated lanes to mixed-use operations it is the intention to allow integration between local services and IPTN services at the proposed rank part of the rejuvenation proposals. Figure 14-21 presents the strategic design of Thaba Nchu CBD. The integration between existing services and the IPTN services is proposed to be at the proposed new rank. If the IPTN is implemented before the rejuvenation of the CNB project is implemented the rank will be required to be upgraded to accommodate the IPTN services. A detailed assessment of the existing facilities will be required before the operationalisation of the Thaba Nchu corridor.

Figure 14-21: Thaba Nchu Rejuvenation Project

14.4 Depot and Sleeping Ground

14.4.1 Concepts and Approach

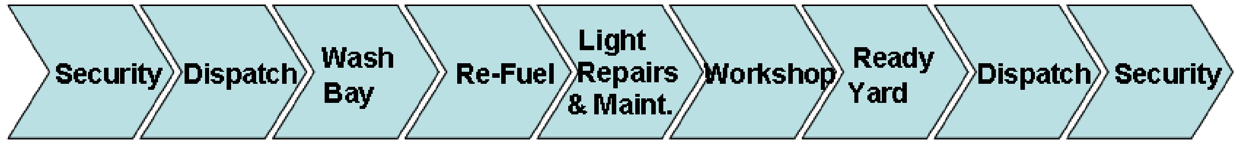
Before continuing with the explanation of the approach followed, it is important to define depots and sleeping grounds as concepts for further discussion.

14.4.2 Depot

A depot is defined as a facility which houses the full fleet function, inclusive of the administrative, financial, human resource, technical/maintenance and operational disciplines. Depending on the exact circumstances of the particular public transport service, there might be more than one depot for a single operation, in which case there will be a hierarchy of depots. The headquarter functions will typically be fulfilled by one such depot, while the others will fulfil more regional-type functions.

In order to determine the size, extent and possible layout of depots, it is important to have an in-depth look at the various functions that take place within a depot and for which provision needs to be made. The activities which a vehicle goes through, from the point of entering the depot gate, till departure from the depot, can be described in the process flow diagram in Figure 14-22 below.

Figure 14-22: Vehicle Flow Diagram



A sleeping ground can be defined as a secure area where buses are kept, when not needed for operation. Such facilities are usually strategically located near the trunk and main routes, to reduce operating hours and minimise dead and empty kilometres. The term sleeping ground traditionally refers to the staging of vehicles, properly surrounded with a secure electric fence, is well lit with high mast lighting and guarded by security personnel, mainly overnight, with the main purpose of positioning vehicles so that they are located close or near operational starting points. It is very seldom that facilities are provided at sleeping grounds for drivers to sleep over or rest, i.e. the "sleeping" thus refers solely to the vehicles and not the drivers. The only building needed is a guardhouse building, with toilet facilities. Given the feeder trunk operations and the optimisation of transfer facilities the function of the sleeping ground can be adapted to provide limited facilities for feeder service vehicles during day times.

The functioning of a sleeping ground is based on the principle that bus drivers book-off at night at the sleeping ground, leave the buses over-night, and resume duties in the early morning, on the following day, again. Dispatchers dispatch buses in the morning and receive buses back in the afternoons or evenings. Facilities needed for dispatching is dispatching office, which can be housed next to the security guard office, at the gate to the sleeping ground. Dispatching occurs on a shift basis and no full-time occupation of the office is required. Bus cleaning after hours is required.

Coupled to the purpose of the positioning of buses, the added exclusive advantage is that of the saving of dead kilometres between staging facility and route starting points. These facilities are necessary to maximize operational efficiencies by reducing, amongst others, dead- and empty kilometres, as well as driver pay hours, which in turn minimises the operating expenses.

The working of a sleeping ground is also furthermore based on purely practical considerations, i.e. because of most bus drivers normally residing within the vicinity of the origin-end of the route or within the hinterland, feeding the origin-side of the bus route. Security is of the essence and for this reason proper lighting and security fencing is of the utmost importance.

14.4.2.1.1 Destination Considerations

The South African history of the past Apartheid System prior to 1994 brought about the phenomenon of residential townships being located quite some distance away from work opportunities. This system is at present being perpetuated on pure economic principles due to both the availability and the cost of land for residential purposes, being much more favourable further away from job opportunities in CBDs. Very little work opportunities exist in the traditional township residential areas and likewise, very little residential settlements are located in an "in-filled fashion" in the vicinity of work opportunities in CBDs.

Different types of facilities at end/start points within the IPTN, serve different purposes and thus fulfils different functions. Under scrutiny will be the full depot function on the destination-end (as per the AM-peak) of the IPTN route network and secondly, the sleeping ground function at the origin-side (as per the AM-peak) of the IPTN routes.

- Bus Depot at Destination-end

  Due to the above, the demand for services is largely one-directional in the AM peak and just the opposite during the PM peak. Given the current settlement patterns, this "tidal movement" of an approximate 1 to 2-hour AM peak period and an approximate 2 to 3-hour PM peak period, with very little or no passenger demand during the off-peak, is not foreseen to change overnight. Even during the off-peak, only single-directional demand is foreseen to exist. In order to save operational expenses, as well as from a practical consideration point of view, it might be preferred to locate the main bus depot(s) on the destination-side of the IPTN main and trunk route(s) or –service(s). Here is where the majority of buses will be stationary during the largest portion in the middle of the day.

  This depot will comprise of facilities and amenities to enable the washing, refuelling and servicing of buses, all services which can more effectively be executed during normal working hours, without incurring unnecessary overtime expenses. Fully equipped workshop facilities, driver rest area and management offices are usually also provided.

- Sleeping Ground at Origin

  Following from the functional discussion of sleeping grounds above, as well as the reasoning in favour of locating bus depots on the destination-side of the trip (AM), it is evident that sleeping grounds for buses are more suitably placed at the origin-end (AM) of IPTN routes and services and where possible within a feeder route service area that can service several feeder route service areas.

  Apart from the primary "sleeping" function of buses, the sleeping ground at the origin-end of the IPTN routes can also have all other facilities and amenities such as offices, workshops, wash bays, refuelling facilities, etc. Due to the ad-hoc nature of maintenance requirements at sleeping grounds, mobile workshop units on an as-and-when required basis could serve this and to facilitate feeder vehicle requirements.

14.4.3 Sizing and Characteristics

The total number of vehicles that will be required to be hosted at the depots per design year and route design option is presented in Table 14-19. The total number of vehicles differ from year to year given the optimisation of the vehicle capacity per route and route design. The above approach and the extent of the full network and to minimise dead kilometres the position for depots and sleeping grounds presented in Figure 14-23**.**

The depots and sleeping grounds need to accommodate at least 400 to 600 vehicles at full development stage. An incremental approach that aligns with the implementation plan needs to be followed given that the highest number of vehicles presented in the table below relates to the full development stage in 2036 with a feeder trunk route design throughout the city. This might not be financially feasible to implement. Note that these alternatives are for comparison purpose in order to develop an implementation plan where the existing system will be transformed incrementally.

These facilities required for full implementation stage are:

- One depot in Bloemfontein that can accommodate 300 vehicles – Main depot
- Additional depot required when Botshabelo and Thaba Nchu is incorporated into the system.
- Sleeping grounds required close to the starting point in Mangaung Botshabelo and Thaba Nchu

Table 14-19: Fleet Size per Route Design Option and Implementation Year

Design Year	Feeder Trunk and Complementary	Feeder Trunk	Trunk Only
2017	522	664	424
2025	629	714	516
2036	576	853	443

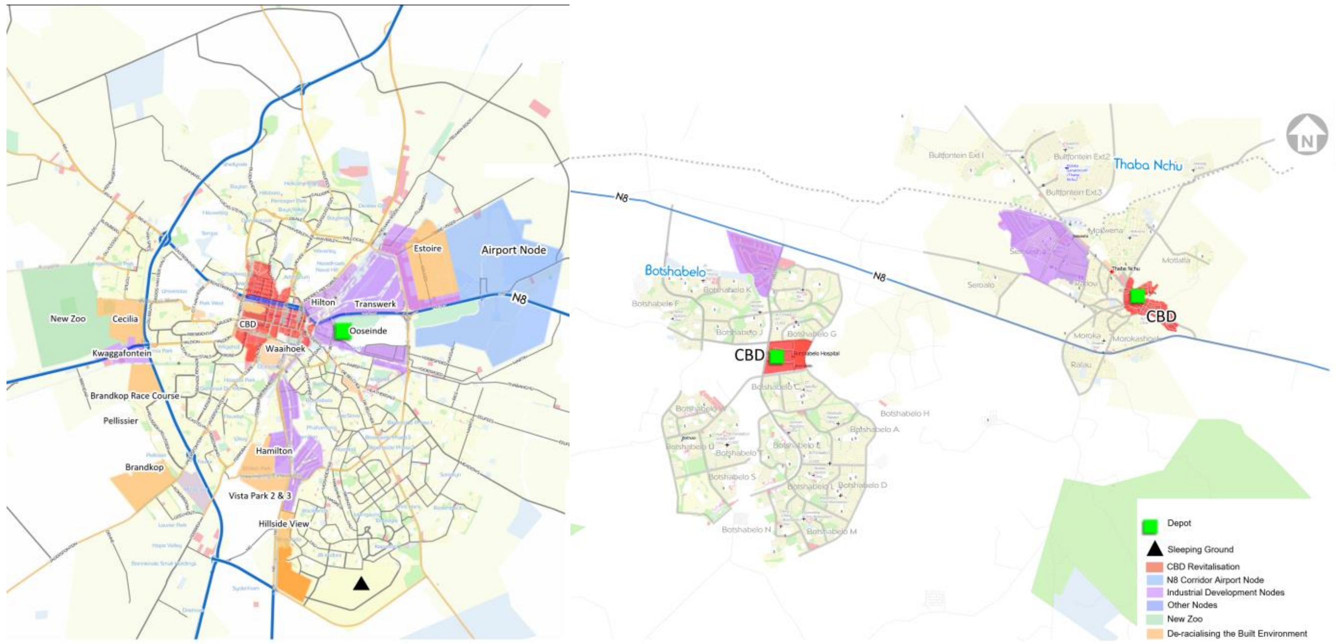


Figure 14-23: Depot and Sleeping Ground Sites

14.4.4 Design principles

- Design principles of the Depot and Holding areas will consider the following, namely:
- The depot design will consist of:
  - A hard water-resistant surface for the parking of buses whilst the parking area will be equipped for data downloads and electrical charging of batteries, if required (Bitumen surface is subject to damage by diesel and at bus turning points surface damage appear, re-enforced concrete is the proven method for bus depot surfaces)
  - Fuelling bays will be integrated with internal depot flow to facilitate ease of access to fuelling points.
  - Vehicle wash bay with green reticulation and water storage integrated into the depot traffic flow

- A workshop with service and checking pits, body and paint shop, tyre bay and store, spares and specialised equipment store, bulk oil dispensing and oil waste storage, technical admin offices, bus dispatching, staff canteen, admin offices, driver restroom, ITS backup facility for MMM systems and equipment, gate security, staff parking
- The construction of the depot will be phased to alleviate further pressure on the already limited funding. The phased constructed will be designed in two phases to match the growth of the IPTN services
- Green issues such as water collection and reticulation, natural airflow and lighting, judicious use of materials will be addressed
- Depot buildings will be universal accessibility compliant
- The first phase of implementation will not require the provision of holding areas as routes are short with limited positioning kilometres
- It may however be necessary to create minimum temporary facilities on a portion of the site while building of the first phase is in progress, depending on the final go-live decision.

The Depot will incorporate the following functions in its operations, namely:

- All structured contracted IPTN services will operate from the depot
- Functions will include:
  - Bus servicing and maintenance would probably be contracted to the Original Equipment supplier for an initial period to allow for training of the Vehicle Operating Company (VOC) staff. Maintenance includes both the bus chassis and body which will not be supplied by the same supplier
  - Bus washing and cleaning to ensure clean buses always
  - Operational functions such as driver recruitment, allocation of drivers to services and buses, continuous driver training, bus despatching and penalty management
  - VOC admin and financial reporting
  - Support of the MMM business unit in the maintenance of on-bus equipment owned by the MMM
  - Downloading of data such as fare control when bus is in the depot
- When holding areas are required, the MMM will supply such holding areas, fence them and supply minimum equipment such as a driver restroom and a possible cleaning station. The VOC will staff, operate and maintain such a holding area.

14.5 Customer Care

The customer care centre will be integrated with existing city services. The city has an extensive customer care centre footprint in the city and the IPTN customer care centre will be integrated through the provision of required infrastructure t these centres. For the long term planning a dedicated customer care centre is planned at the multi-modal(intermodal facility at the rail station) or at Hoffman Square. The design principles for the stand-alone centre are presented below.

The design principles of the formal customer care centre will consider the following factors, namely:

- Requires communication with back office, banking partner, call centre and IPTN Business Unit
- Furniture includes counter and customer service cubicles
- Requires cashier booth with fare top-up and card verification equipment connected to back office
- Open weekdays and Saturdays.

14.5.1.1 Functions

The function that would predominantly be performed by the Customer Care Centre (CCC) include the following:

- The facility will be manned by customer care consultants, a cashier, and banking partner representative;
- The CCC will first and foremost deal with general day-to-day customer queries between operational hours;
- The CCC will further address fare and fare media-related customer queries;
- Facilitate fare smartcard sales and replacement;
- Perform top-up of funds on fare smartcards;
- Will address fare and payment customer queries - includes banking partner presence;
- Assist with the registration of customers on the IPTN system;
- Issue of concession cards with photographs;
- Reimbursements to passengers in respect of faulty system, fare cards and claims;
- Dissemination of and transfer of service information to passengers and the public at large;
- Operates in close relationship with Call Centre and Customer Care function situated in the MMM Business Unit.

14.6 Control Centre

14.6.1.1 Design principles

- The following design principles of the MMM Control Centre will apply:
  - The current design of the MMM IPTN Concept of Operations does not require a stand-alone Control Centre, or an unnecessarily large area from which to operate. An office-type area that can house 5 workstations with 2 screens each and no video wall will suffice
  - The ideal location for the Control Centre is in the same general location in which the Operations functionaries employed by the MMM IPTN Business Unit are accommodated
  - The primary back-office and server room should be adjacent to the Control Centre
  - A backup workstation and servers will be included in the depot design to function as an off-site backup facility. Alternative placement at the Multimodal Facility remains an option with the proviso that back-up equipment is not housed at the same site as the primary system
  - Provision is made for an equipment and system maintenance supplier in the Control Centre to ensure maximum uptime of this critical component
  - The Control Centre will be linked for communication with the VOC depot facility, Controlled Access Stations, all CCTV cameras outside of stations, operations components of the MMM Business Unit, including scheduling, supervisory staff, backup facilities, and security. Initial communication could be supported by WiFi that could be upgraded when optic cabling is installed at a later stage when growth demands, and funding becomes available
  - No UTC function is foreseen for the MMM IPTN environment due to the relative lower traffic congestion experienced in the operating area.

14.6.1.2 Functions

- The Control Centre functions will include:
  - Oversight over general quality of real-time service delivery to passengers, including covering of trips, sufficient bus and driver supply, clean buses, customer care, driving habits, etc
  - Real-time contracted vehicle tracking by Control Centre staff as part of the APTMS component
  - Monitoring of contracted services for compliance with service specifications and VOC requirements
  - Input into penalty regime and verification of service variations and service-related VOC transgressions
  - Keeping of system-integrated incident log for attention and follow-up of critical service delivery deviations during office hours when service levels are relatively low
  - Real time management of service deviations to ensure that service delivery remains as close to the prescribed timetables as possible
  - Communication with drivers, Controlled Access Stations, security, MMM supervision, and the VOC to ensure the smooth running of services during operating times
  - Monitoring and ensuring that scheduled buses are on time
  - Alerting correct Business Unit, MMM, VOC, station management, Metro Police and other stakeholders in case of emergencies
  - Monitoring of station CCTVs and triggering specific actions as required to mitigate deviations and incidents
  - Support of service design and bus scheduling function regarding salient information, demand variances and station performance.

14.7 Intelligent Transport Systems

In general, Intelligent Transport Systems (ITS) is a term used when describing the application of technology to vehicles, infrastructure and transport users to make transport safer, more efficient, more resilient and safer for the environment. The use of ITS technologies is growing significantly in popularity as, in many cases, the implementation of relatively inexpensive systems results in notable transport system improvements.

The IPTN aims to improve on the City's current public transport offering by providing modern and reliable services that would retain current public transport users, as well as to encourage current private vehicle users to start using public transport. The use of ITS in the IPTN is considered a vital managing mechanism to enable users to move seamlessly, reliable, quickly, safely and efficiently within the system.

As illustrated in the figure below, IPTN ITS are largely divided into 5 solution areas, with a brief description of the main ones provided after.

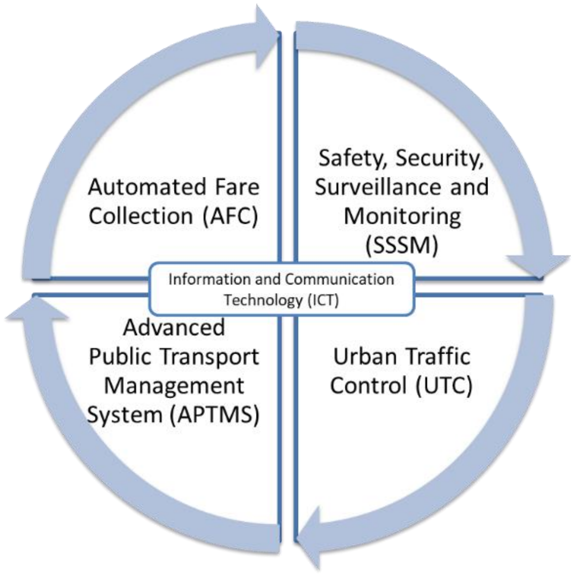


Figure 14-24: Public Transport related ITS Solutions

- **Advanced Public Transport Management System (APTMS)** – An APTMS consists of ITS and communications technology which support the IPTN to be reliable, efficient and safe. Located within a Control Centre (CC), the APTMS manages the scheduling of the IPT, provide real time and static user information, manage and monitor safety and security, etc.
- **Automated Fare Collection (AFC)** – A fare collection solution that is automated, addressing the difficulties experienced with out-dated paper-based fare collection systems. AFCs are efficient at eliminating fare evasion, and contribute towards the provision of an improved, more accessible, public transport system.
- **Urban Traffic Control (UTC)** – A UTC system consists of mechanisms by which traffic can be managed remotely within the vicinity of the IPTN. Traffic management is required to increase the road network's efficiency, especially where the IPTN may impact on the road network's current capacity. Additionally, the UTC system is invaluable in managing incidences (accidents, etc.) along the IPTN to reduce the impact thereof on the IPTN services and the road network.

As is indicated within the figure below, the successful functioning of ITS implementations is dependent on four distinct processes. The ITS solutions will gather, and process data related to the transport network and infrastructure, for use by the customers and operators.

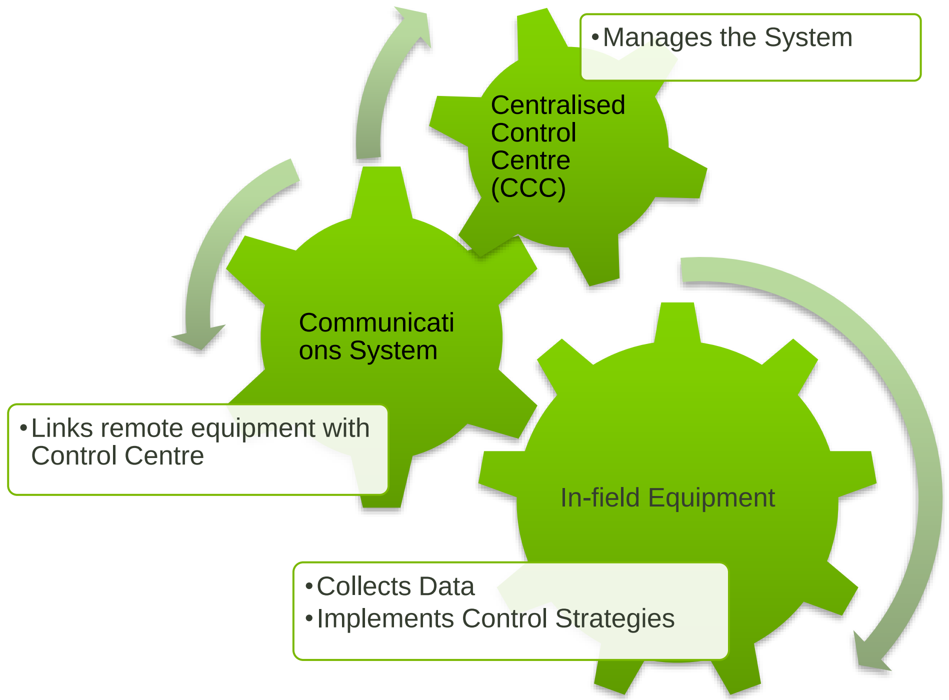


Figure 14-25: Typical ITS Technology Modules

All ITS solutions provided needs to be integrated, modular and based on open IT standards, meeting local and international standards. This will ensure that, as far as possible, the solutions will be upgradable, extendable and not dependent on a single supplier for future development. The procurement must involve extensive training for the personnel that will operate the system, to ensure that they are fully aware of the systems requirements, potentials and parameters within which they need to operate.

14.7.1 SIZING AND CHARACTERISTICS

The ITS solutions planned for deployment will comprise of ICT, AFC, APTMS and SSSM. It is not planned to implement any UTC in the foreseeable future, as the return on investment within a mixed traffic IPTN environment would not be feasible.

For the initial phase of the IPTN, the ITS Go-Live milestone is envisaged to be the following ITS solutions:

- Information Communication Technologies (ICT);
- Automated Fare Collection (AFC);

Followed by a staggered deployment of the remainder of the ITS solutions, that include:

- Scalable Automated Fare Collection (AFC) to be EMV Compliant;
- Scalable Advanced Public Transport Management Systems (APTMS);
- Scalable Safety, Security, Surveillance, and Monitoring (SSSM);

The above mentioned ITS solutions and their equipment will be deployed within the following infrastructure:

- Allocated BRT Buses;
- Allocated Mini-Buses (Feeders);
- Open Stations (Stations with limited Access Control);
- Closed Stations (Stations with full Access Control);
- Depots (Bus Layover / Bus Parking Area);
- Control Centre (CC) / Interim Control Centre (ICC);
- Selective deployment along the Bus Route.

14.7.1.1 STATIONS, STOPS AND DEPOT

Due to the investment costs related to the implementation of bus stations, the principle of "Closed Access" vs "Open Access" stations have been adopted. From an ITS perspective, the following difference needs to be catered for:

Closed Access Stations	Open Access Stations
• Normally station with high volumes of commuters, and/or stations that must handle the transfer of commuters.	• Normally stations with low volumes of commuters, and/or stations that normally serve as originating or destination stations.
• Stations will normally be equipped with pre-enter EMV compliant fare gates.	• Station will normally be equipped with pre-boarding EMV compliant validators with barricaded queue management infrastructure.
• Stations will normally be equipped with CCTV cameras to monitor for fare evasion and for commuter presence.	• Stations will normally be equipped with CCTV cameras to only monitor for commuter presence.

With regards to Bus Stations, Bus Stops and Bus Depots, the following ITS solutions and their equipment will be deployed through an incremental approach:

Bus Stations − First Increment of implementation	**Closed Access Stations:** • Pre-Enter Fare Gates; • CCTV Cameras for Passenger Presence Detection; • CCTV Cameras for Fare Evasion Monitoring; • Limited CCTV cameras at strategic intersections to monitor bus behaviour; • Static Passenger Information Displays (PID); **Open Access Stations:** • Pre-Boarding Validators with Barricaded Que Management; • CCTV Cameras for Passenger Presence Detection; • Limited CCTV cameras at strategic intersections to monitor bus behaviour; • Static Passenger Information Displays (PID);
Bus Stations − Second Increment of implementation	**Closed Access Stations:** • Automatic Passenger Announcement System; • Automatic Passenger Information Displays (PID); • Door Alignment Systems; • Cash-Collector, Kiosks or Ticket Vending Machines; **Open Access Stations:** • Ticket Vending Machines where needed; • Private Vendors for top-ups;
Bus Stops	− No, ITS infrastructure will be deployed at bus stops. The bus stops will however be configured within the ITS systems (APTMS & AFC), as part of the functionality requirements.
Bus Depots	• Apart from, limited CCTV cameras an interim control centre (ICC) ITS equipment (see ICC elsewhere), no additional ITS infrastructure will be deployed. • Limited CCTV cameras to only monitor bus behaviour.

14.7.1.2 CC, ICT AND DEPARTMENTS

With regards to Control Centre (CC) / Interim Control Centre (ICC), Information Communication Technologies (ICT) Infrastructure and Municipal Departments, the following ITS solution and their equipment will be deployed through an incremental approach:

CC/ICC and ICT First Increment of implementation	• ITS solutions like APTMS and AFC would be hosted solutions, only CCTV video footage would be downloaded to CC. • All fibre backbone between bus stations that are on the trunk routes will be provided by the Municipals fibre Service Provider (SP); • All communications with buses and minibuses for data will be done via the Cellular Networks (GPRS /3G/4G); • Where fibre not available, communications with bus depots, bus station and route CCTV cameras will be via Cellular Networks (3G/4G); • The CC would be located within the bus depot facilities; • The ITS server room will be hosted in the CC environment; • IPTN services (scheduling and route monitoring, and fare collection adherence) will be monitored from CC; • Each Operator at the CC will have a workstation with two screens; • There will be no Video Wall at the CC, only 2 big-screen displays.
CC/ICC and ICT Second Increment of implementation	• ITS Equipment for Disaster Recovery / Backup Site, only of-site backups; • ITS Equipment for Backup Operations Site.
Municipal Department	• The following ITS solution can after implementation be managed by existing Municipal departments: • All helpdesk related calls will be handled by existing Municipal helpdesk / customer care; • All retail and sales will be handled by existing Municipal retail outlets and infrastructure; and • Monitoring of all CCTV Cameras will be done by the existing Municipal Security Department.

14.7.1.3 BUSES AND MINIBUSES

With regards to Buses and Minibusses, the following ITS solution and their equipment will be deployed through an incremental approach:

Buses and Minibuses First Increment of implementation	• Fare Collection Validator (Bus and Mini-Bus); • Advanced Tracking System / Vehicle Location (AVL) (Mini-Bus); •
Buses and Minibuses Second Increment of implementation	• Driver Terminal for Route and Scheduling adherence / On-Board Unit (OBU) (Bus); • On-Board (next stop) Information Displays (Bus); • Automatic Passenger Counters (Bus); • On-Board (next stop) Automatic Audio Announcements (Bus and Mini-Bus); • CCTV Cameras for the purpose of Passenger or Driver Monitoring (Bus and Mini-Bus); • Door Alignment Systems (Bus and Mini-Bus)
Bus Suppliers	• The following Equipment will be provided by the Bus Supplier / Manufacturer (Forms part of the ITS solution, but is not provided by the ITS Service Provider): • On-Board Monitoring Cameras (Part of the CAN bus system and Insurance); • Driver Panic Button (Bus); • Next Stop Request Buttons (Bus); • External Information Displays – Showing Destination (Bus); • Microphone and Speakers for Announcements (Bus).

14.8 Non-Motorised Transport

The development of a Non-Motorised Transport (NMT) network for the City, forms part of the CITP. However, with the implementation of an Integrated Public Transport Network (IPTN), some areas will be prioritised due to the implementation of the system. Specific universal access design criteria are required for the implementation of NMT infrastructure within 500 m walking distance from the IPTN routes and facilities implemented through the Public Transport Infrastructure Grant (PTIG).

As part of the development of an IPTN for the Mangaung Metropolitan Municipality (MMM), an NMT Plan is to be developed, with the intention to support and facilitate access between significant land-uses, as well as to public transit stops and stations by means of walking or cycling.

Areas identified for IPTN implementation Mangaung Township Area, Bloemfontein CBS, Botshabelo and Thaba Nchu will be the main focus of the network planning.

The Non-Motorised Transport Network Plan is to be developed in a phased approach, informed by the development of the Integrated Public Transport Network Plan, currently underway. The development of NMT plans will thus follow the implementation phasing of the IPTN. For this purpose, the development of the IPTN NMT network was divided into five strategic sections:

- (CBD) Central business district;
- Maphisa/Moshoeshoe;
- Dr Belcher/Meadows;
- Botshabelo; and
- Thaba Nchu.

The focus on Botshabelo and Thaba Nchu are due to the existing bus service that will be incorporated into the IPTN system in a later stage. NMT facilities are thus required in the short term to ensure that passengers can gain access to these existing services till their incorporation into the IPTN.

The latest NMT network developed for the City is presented in the Comprehensive Integrated Transport Plan (CITP) 2006 and enhanced for the areas identified for IPTN implementation in the IPTN Draft Operational Plan 2014. The networks identified in the 2006 CITP and 2014 IPTN Operational Plan. These networks were the departure point for the development of the NMT network that will facilitate movement to and from Phase 1 of the IPTN.

14.8.1 Walking and Cycling Design Guidelines

14.8.1.1 NMT Guidelines

To inform and guide the design of the non-motorised transport projects that form part of the NMT Plan per area, generic, high-level conceptual proposals have been developed in line with the National Department of Transport's (NDoT) NMT Facility Guidelines (2014), as well as local and international best practice.

The implementation of these standards, however, needs to be enforced where new developments are approved along the IPTN identified corridors. Where new development is established along an IPTN route, the provision of pedestrian and cycling facilities needs to adhere to the proposed design concepts and the design standards that are developed as part of the Phase 1 Operational Plan.

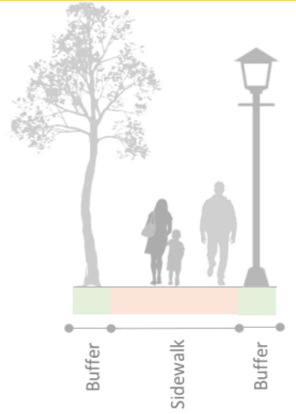
The five concept NMT cross-sections that have been developed are as follows:

- **Cross-Section A:** Pedestrians Only. The cross-section comprises of a pedestrian sidewalk for the exclusive use of pedestrians, which is constructed within the road reserve along the alignment of a street but may also be constructed within its own reserve.
- **Cross-Section B:** Cyclists Only. The cross-section comprises an off-street cycle lane for the exclusive use of cyclists. These facilities typically do not follow the road alignment and are constructed within their own reserve.
- **Cross-Section C:** Shared-Use Path. The cross-section accommodates both pedestrians and cyclists off-street with no physical separation between the two modes. The shared use path may be constructed either within the road reserve or within a dedicated reserve. The UADP states that, should there be insufficient demand for cyclists, then it is possible to have shared pedestrian and cyclist paths, though this is not always the preferred solution.
- **Cross-Section D:** Parallel Facility – Cyclists Off-Street. The cross-section includes segregated facilities for pedestrians and cyclists where both modes are physically separated from the road. These may be constructed either within the road reserve or within a dedicated reserve.
- **Cross-Section E:** Parallel Facility – Cyclists On-Street. The cross-section includes a pedestrian sidewalk and class 3 cycle lanes, i.e. cycle facilities that are demarcated within the road surface by means of road markings that follow the alignment of the road.

Details of the respective cross-sections are outlined in **Table 14-20** to **Table 14-24**

Table 14-20: Cross-Section A: Pedestrians Only

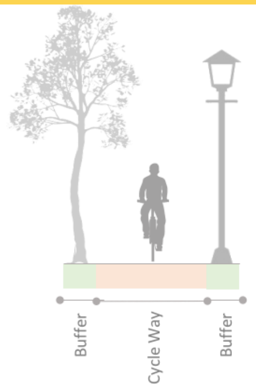
Cross Section A: Pedestrians Only



Element	Minimum Width	Preferred Width	General Comment
Sidewalk	1,5 m	2,0 m	Where large pedestrian demands are expected, wider walkway widths may be provided, i.e. as wide as practically possible. Wider walkway widths may require a separating barrier to prevent motorised vehicles from using the facility. Within business centres, wider sidewalk widths should typically be provided, i.e. 2,5 m – 3,0 m. All walkways should accommodate users with special needs.
Buffer	0,6 m	1,0 m	The buffer should be wide enough to accommodate lighting, signage and any other required road side furniture. Within business centres, the buffer is typically paved.

Table 14-21: Cross-Section B: Cyclists Only

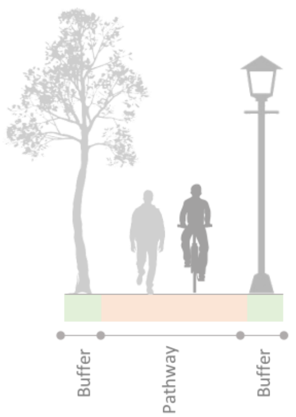
Cross Section B: Cyclists Only



Element	Minimum Width	Preferred Width	General Comment
Cycleway (1-Way)	1,8 m	2,0 m	
Cycleway (2-Way)	2,5 m	3,5 m	
Buffer	0,6 m	1,0 m	The buffer should be wide enough to accommodate lighting, signage and any other required road side furniture.

Table 14-22: Cross-Section C: Shared Use Path

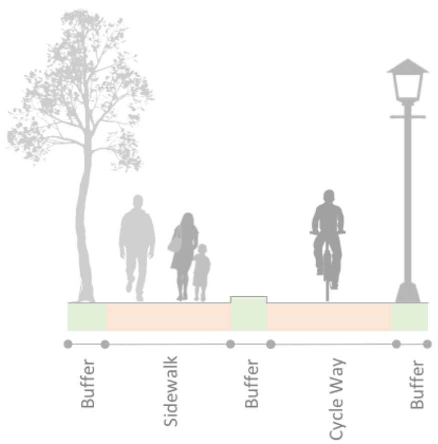
Cross Section C: Shared Use Path



Element	Minimum Width	Preferred Width	General Comment
Pathway	2,5 m	3,0 m	Where shared use paths facilitate two-way bicycle traffic, wider widths are to be applied, i.e. 3,0 m – 3,5 m. Pathways should accommodate users with special needs. The pathway must be signed to allow for the use of cycling.
Buffer	0,6 m	1,0 m	The buffer should be wide enough to accommodate lighting, signage and any other required road side furniture.

Table 14-23: Parallel Facilities: Cyclists Off-Street

Cross Section D: Parallel Facilities – Cyclists Off-Street



Element	Minimum Width	Preferred Width	General Comment
Sidewalk	1,5 m	2,0 m	All walkways should accommodate users with special needs.
Cycleway (1-Way)	1,5 m	1,8 m	
Cycleway (2-Way)	1,8 m	2,5 m	
Buffer	0,6 m	1,0 m	The buffer should be wide enough to accommodate lighting, signage and any other required road side furniture. At locations where there is limited reserve available, the buffer between the sidewalk and cycle way could be 0 m, but the separation should be demarcated. If the demarcation is not done by means of road markings, then care should be taken that there should be no level difference which could cause pedestrians to trip or cyclists to lose control.

Table 14-24: Typical Cross-Section D: Parallel Facilities - Cyclists Off-Street

Cross Section E: Parallel Facilities – Cyclists On-Street

Element	Minimum Width	Preferred Width	General Comment
Sidewalk	1,5 m	2,0 m	All walkways should accommodate users with special needs.
Cycleway (1-Way)	1,5 m	1,8 m	
Cycleway (2-Way)	1,8 m	2,5 m	
Buffer	0,6 m	1,0 m	The buffer should be wide enough to accommodate lighting, signage etc.

As a principle, where high order cycle routes have been identified within the NMT plan, shared-use paths are recommended, given that the cycling volumes are low.

Proposed cross-sections have been applied to each project link, to indicate if the facility should be: non-motorised transport only facility, one side of the roadway, or both sides of the roadway. A combination of cross-sections may therefore be considered, for example shared-use paths (Cross-Section C) may be considered on both sides of the roadway (i.e. a cross-section combination CC). For the purposes of presentation, 6 unique NMT types (cross-section combinations) have been identified, as depicted in **Table 14-25**.

Table 14-25: Generic Non-Motorised Transport Cross-Section Combinations

NMT Type	NMT Cross-Section Combination	NMT Type	NMT Cross-Section Combination
1	A	5	E
2	B	6	AD
3	C	7	AE
4	D		

As part of the development of the larger NMT network plan, an NMT Design Guideline is to be drafted. The guideline is to be an interpretation of the Department of Transport's NMT Facility Guidelines (2014) within the specific context of Mangaung. The guideline will build upon the cross-sections identified above and will include further details about surface treatments, edge of kerb offsets, edge treatments, buffer strips and barriers, lighting, signage and road markings, appropriate intersection controls (crossings), universal access considerations, etc. In the interim, it is recommended that the NDoT NMT Facility Guidelines (2014) be referenced for additional detail, as well as the typical drawings that form part of the City of Johannesburg's Complete Streets Manual.

14.8.2 Universal Access Guidelines

'Inclusive Design' or 'Universal Access' take everybody into consideration trying to get from point A to point B in any environment, be it rural or urban. This includes all people, people pushing a trolley or a pram, people with a temporary illness or injury and people with any kind of impairment or disability, be it visually, mobility or hearing.

A universal design approach to the built environment and or IRPTN System results in the necessity to totally remove obstacles that can hinder the progress of people, regardless of their age, ability or status in life, people pushing a trolley or a pram/people with a temporary illness or injury/people with any kind of disability, be it visual, mobility or hearing. This can be any trip hazard, level difference between two surfaces, a flight of stairs or even a single stair or step, ramped surfaces or station circulation spaces. Uneven footways, kerbs, bollards or street clutter also hinder movement.

The application of kerb ramps assists access onto footways for everybody, including people with disabilities. The inclusion of Tactile Ground Surface Indicators (TGSI's) on pedestrian ramps at road crossings assist the mobility of visually impaired by providing information about the approaching road and direction of travel to cross the road safely as well as from what direction the traffic is approaching in the case of controlled crossings. The designed or building of an intersection or a rapid transit system for example, that is for some reason or the other not accessible by someone; then this has discriminated against the person according to the Equality and Prevention of Unfair Discrimination Act (2000).

14.8.2.1 Accessibility of an NMT System

Accessibility of an NMT system, incorporates consideration of walkways, intersection geometric design, pedestrian, cyclist crossings facilities, tactile ground surface indicator design, implementation, route integration and continuity. It includes detail such as choice of surface used for walking and cycling, illumination of the route, contrast of adjoining surfaces as well as gradients, obstacles, landscaping and maintenance. NMT is only a portion of the travel chain. It is very important as, generally, the first and last miles of public transport trips are done on foot. People use the built environment's roads and footways, not in isolation, but always as a whole. It is the complete road environment that is used. How everything is put together in relationship with one another, the location, the sizes, shapes, colour, contrast, lighting, quality of workmanship, materials used etc.

NMT related trips, generally cycling or walking trips, fall within the full travel chain. This travel chain will also include any pedestrian bridge structure.

Usually, each kerb ramp shall have an opposite kerb ramp, directly in line with the path of travel. This supports provision of an effective continuous accessible path of travel and ease of access, particularly for a person using a wheelchair or other mobility aid. It also assists a person with vision impairment to find their way through an area more easily.

14.8.2.2 Accessible Paths

A continuous accessible path of travel for people with disabilities begins at the car park or building entrances and / or public transport drop off area. This route can consist of pathways, roadways, ramps, etc. The routes have to be safe, comfortable, convenient for all users. Key access features include a wide, level, firm, slip-resistant surface in both wet and dry conditions. The provision of any street furniture, etc. located clear of the path of travel with an effective contrast, clear concise signage, adequate continual vertical clearance, tactile ground surface indicators at changes in direction, prior to ramps and kerb ramps, handrails on ramps, appropriate seating, colour contrasting edges and appropriate lighting for night time use.

Landmarks can be used as guiding features, both internally and externally. For example, statues, fences, open spaces, water fountains, seating, water features as well as other audible and identifiable noises along a route.

14.8.2.2.1 Ground Surfaces

Firm, level, slip resistant floor and ground surfaces are required to and through a pedestrianised area. This includes footways, walkways, paths, footbridges etc. These surfaces need to be suitable in both wet and dry conditions and provide an effective contrast to adjoining surfaces. Surfaces should not include cobbles (fixed or loose), gravel, sand, raised finishes etc. Slip resistant, is any surface that provides traction for a wheelchair or a person walking, in both wet and dry situations. Serious injury can occur in the event that a person using a mobility aid like a walking frame or crutches, puts all their weight for example on a crutch, and a slip occurs.

14.8.2.2.2 Colour and Textures

Colour, tone and luminance contrast should be used to aid the identification of critical surfaces. Externally, critical surfaces include guiding walls, steps, rails and textured guidance surfaces.

14.8.2.2.3 Lighting

Lighting is normally provided on urban routes and pedestrianised areas where walking and cycling can be expected after dark. Lighting helps users detect potential hazards, discourages crime and helps users to feel safe, especially on a pedestrian bridge.

14.8.2.2.4 Cross Gradients

Cross Gradient or Camber should not be steeper than the prescribed 1:50. Adequate water drainage is required and can be achieved between 1:50 to 1:60. Steeper gradients result in wheelchairs being dragged down the slope by gravitational forces and it is very hard for a user to continually fight the gravitational force to stay on track. Even a short distance is cumbersome, for example crossing an incorrectly constructed kerb ramp or driveway.

14.8.2.3 Footpath Widths

It is important to note that the footway or walkway surface width is also a function of the demand on that surface and the width required to provide an appropriate level of service. Walkway widths should automatically be increased around intersections and mid-block crossing points. Increasing footway width around corners, to allow for the required landing spaces, gradient requirements of the pedestrian ramps, as well as stacking space required for congregating pedestrians, waiting to cross the road.

When the walking surface traverse over a pedestrian bridge, the NMT Guidelines 2014, recommends a minimum width of 2 m. This includes cycle usage.

The following minimum standards apply as per the NMT Facility Guideline document:

Table 14-26: NMT Widths along Pedestrian and Cycle Ways

Facility	Parameter	Accepted Minimum	Recommended Minimum	Optimal
Pedestrian walkway - total separation	Min width	1.2 m	1.5 m	2.0 m subject to capacity requirements
Pedestrian walkway - partial separation	Min width	1.2 m	1.5 m	3.0 m subject to capacity requirements
Bicycle lane - total separation - two way	Min width	1.5 m[1] (assure adjacent walkway space)	1.8 m	2.0 m subject to capacity requirements
Bicycle lane - partial separation - two way	Min width	1.5 m[1] (check sight distances)	1.8 m	2.5 m subject to capacity requirements
Bicycle lane - marked separation - one way	Min width	1.5 m	1.8 m	1.8 m subject to capacity requirements
Pedestrian walkway	Max gradient	1:15	1:20	1:25
Bicycle lane - Animal drawn	Max gradient	1:15	1:25	1:50
Pedestrian walkway	Min corner splay[2]	2 m	3 m	5 m
Bicycle lane	Min radius	3 m	5 m	5 m
Crossfall / Camber	Max gradient	1 : 50	1 :50	
Both	Total separation: Distance from shoulder beak point	120 km/h – 5 m 80 km/h – 2 m 60 km/h – 1 m	120 km/h – 7 m 80 km/h – 3 m 60 km/h – 1 m	120 km/h – 9 m 80 km/h – 4 m 60 km/h – 2 m

14.8.2.4 Vehicle Entrances

Vehicle entrances over the footway should be visible and as well marked as possible. The use of contrasting materials on these locations assist in identifying the facility.

The vehicle cross over should be constructed in such a way that a wheelchair can cross the vehicle access on a sufficient level (1:50-1:60) and wide (>1.2 m) walkway surface. In aspects where this cannot be achieved, the vehicle access/entrance will have to be built back beyond the property boundary to achieve the required gradients. This will mainly be achieved by providing cross-sections at all major entrance points which show the 2% gradient is achieved.

14.8.2.5 Effective and Practical Ramp Construction

When constructing pedestrian crossings with a kerb cut, whether it is controlled or uncontrolled, whether it is on a straight edge kerb or on a radius kerb, it is important to understand the following two concepts of effective and practical ramp construction. The surrounding footway has been shaped or "rolled" down to the practical ramp through the effective ramp area. This resulted in a smooth transition from the top of footway level down to the kerbcut incorporating all required gradients. In order to reach the required gradient, it may be easier to drop the entire sidewalk or crossing point on the approach to the crossing before reaching the crossing point, maintaining the 1:50 crossfall to enable water drainage. This is a particularly useful practice where the sidewalk is very narrow and there are physical constraints limiting width and the required landing space.

A landing of 1.5 m is required at the top of the kerb cut. This will require additional sidewalk space to be provided at intersections.

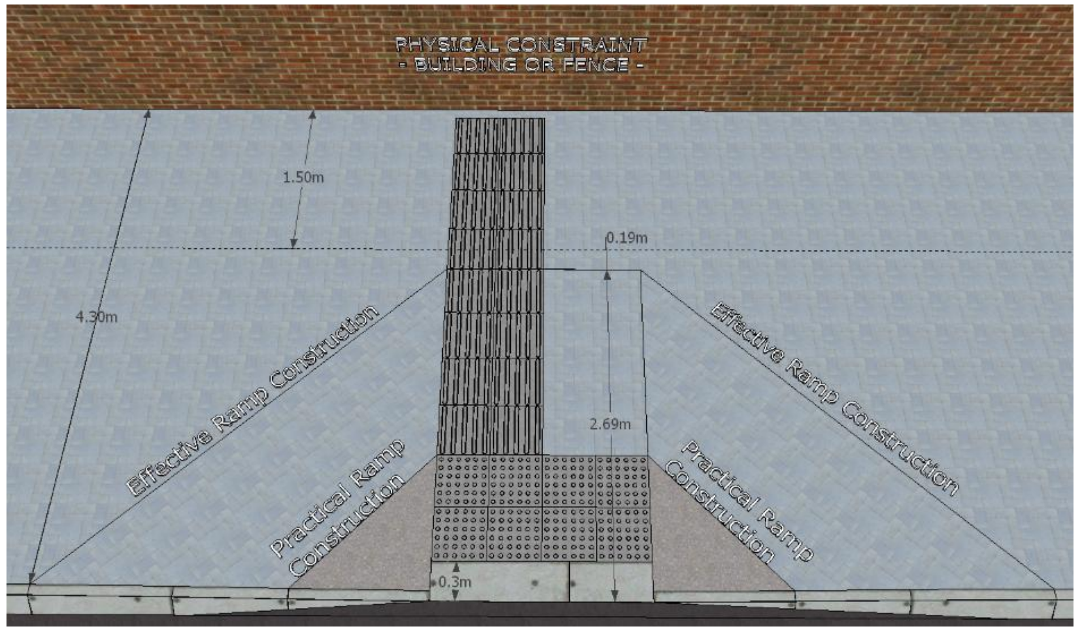


Figure 14-26: Effective and Practical Ramp Construction

14.8.2.6 Kerb Ramp Radius

Where wide radii have been incorporated into high volume pedestrian areas and where public transport is being introduced; or in any urban centres, it is strongly recommended that the radii of the kerb are reduced to as small as practically possible. This makes the crossing safer and uses the minimum number of TGSI tiles. Inserting more tiles into wide radii kerbs make wayfinding more confusing. The maximum kerb radius in a public transport environment is 10 m.

The bigger the radius, the more the location of the kerb ramp moves out of the direct line of travel for a pedestrian (green line,) and the more that happens, the less desirable the crossing becomes for a pedestrian.

It is required from a competent person to make more informed decisions with regards to the best placement. This generally becomes an issue of weighing up kerb ramp effectivity of locating the ramp as close as possible to the direct line of travel but balancing effective tactile layout and usability (information that is not confusing) to the end user. Sound engineering judgment is a necessity.

14.8.2.7 Tactile Pavers

Tactiles are blocks with small extrusions or raised tactile nodules with an embossed profile that translates into information and guidance to the visually impaired, underfoot or by using a cane, when combined with other environmental information on the safe crossing of the road. TGSI mainly serves two purposes and should be exclusively used for the reserved use and insistently be installed in the same manner as per the guidelines. These are used for warning and for guidance exclusively.

The placement of the warning tactiles on the ramp warns the pedestrian of the presence of the crossing and orientates the person in the correct direction to safely cross the road along the shortest path. Underfoot detection as well as the surface contrast between the tactiles and the surrounding footway is key.

14.8.2.7.1 Size and Layout of Tactile Pavers

The NDoT Position Paper on the layout of TGSI's, notes that the basic layout for tactile pavers is as such:

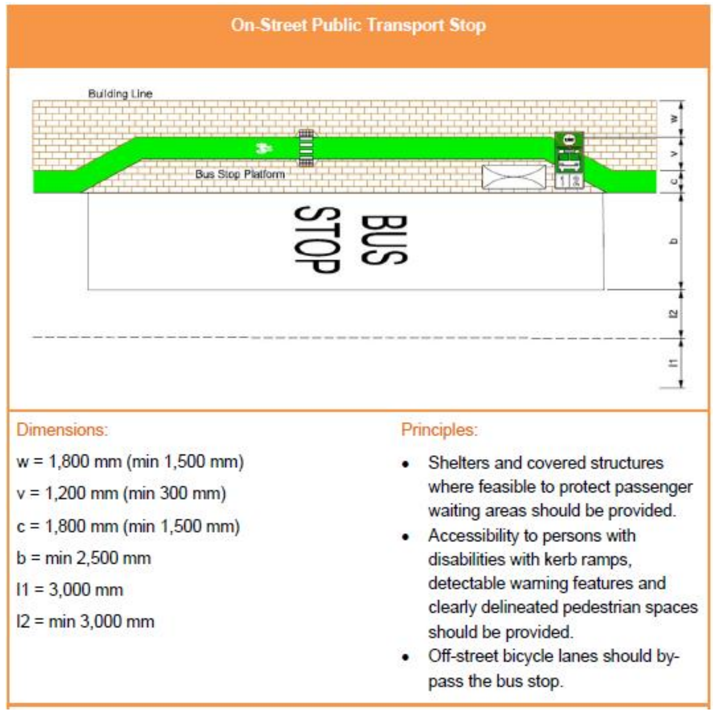
That an 'L' shaped layout is required at the crossings:

- The pedestrian push button control, synchronised with the traffic lights to be situated on controlled crossings, at the foot of the L;
- The stem of the L consists of directional tiles, and the base; warning tiles;
- On un-controlled crossings, the same basic L shape is required so that someone who is blind or partially sighted can find the correct crossing.

There are some circumstances where the tail of the L is not required. These are:

- Where there is a defined sidewalk with a distinct edge on each side, and where
- there is a crossing point in only one direction.

Where a low-use driveway crosses the sidewalk, no TGSI's are required if the driveway is raised to the same height as the sidewalk, as pedestrians have right of way. Vehicle access to a private property provides a visual example of how these areas can be treated.



On a kerbcut which is parallel to the road (where the intersection is at 90 degrees) and has a straight roadside edge, two rows of warning blocks are required, in line with the path of travel. This completes the base of the 'L' shape.

If an adapted TGSI layout is used, it may not result in more than 3 tiles used on one side and one tile on the other side of the kerbcut.

14.8.2.7.2 Tactile Pavers at Bus Stop Facilities

Bus stop facilities should be accessible in the broad sense and require all the key aspects of pedestrianised areas with regards to surfaces, street furniture, contrast, lighting and circulation spaces. TGSIs are also applied to guide a person that is blind or partially sighted to the door opening of the parked bus.

14.8.3 System Sizing and Characterising - CBD NMT Plan and Short-Term Intervention

A CBD NMT plan was developed during 2007 and several projects were identified for implementation and implemented since. The development of the NMT plan for the IPTN routes in the CBD was based on this plan but taking into consideration the implementation phases of the IPTN ad the specific universal access required associated with NMT implemented as par to the IPTN.

For detailed counts and infrastructure investigation the focus was on NMT facilities along the CBD distribution service that will provide services towards the southern areas of the CBD. Phase 1 implementation. Refer to Annexure CC for the detail pertaining to the CBD.

14.8.3.1 Recommended CBD Phase1 NMT Network and Minimum Design Criteria

The selected roads where NMT facilities will be implemented and the sidewalk widths are presented in Figure 14-27. The detail design report is available on request from MMM. The summary of the design criteria used for the development of the detail designs are provided in Section 14.8.3.1.1.

14.8.3.1.1 General Information and specifications.

Reference for design:

- NMT Transport Facility Guidelines manual
- SANS 784 P12-14
- SARTM – Vol 2

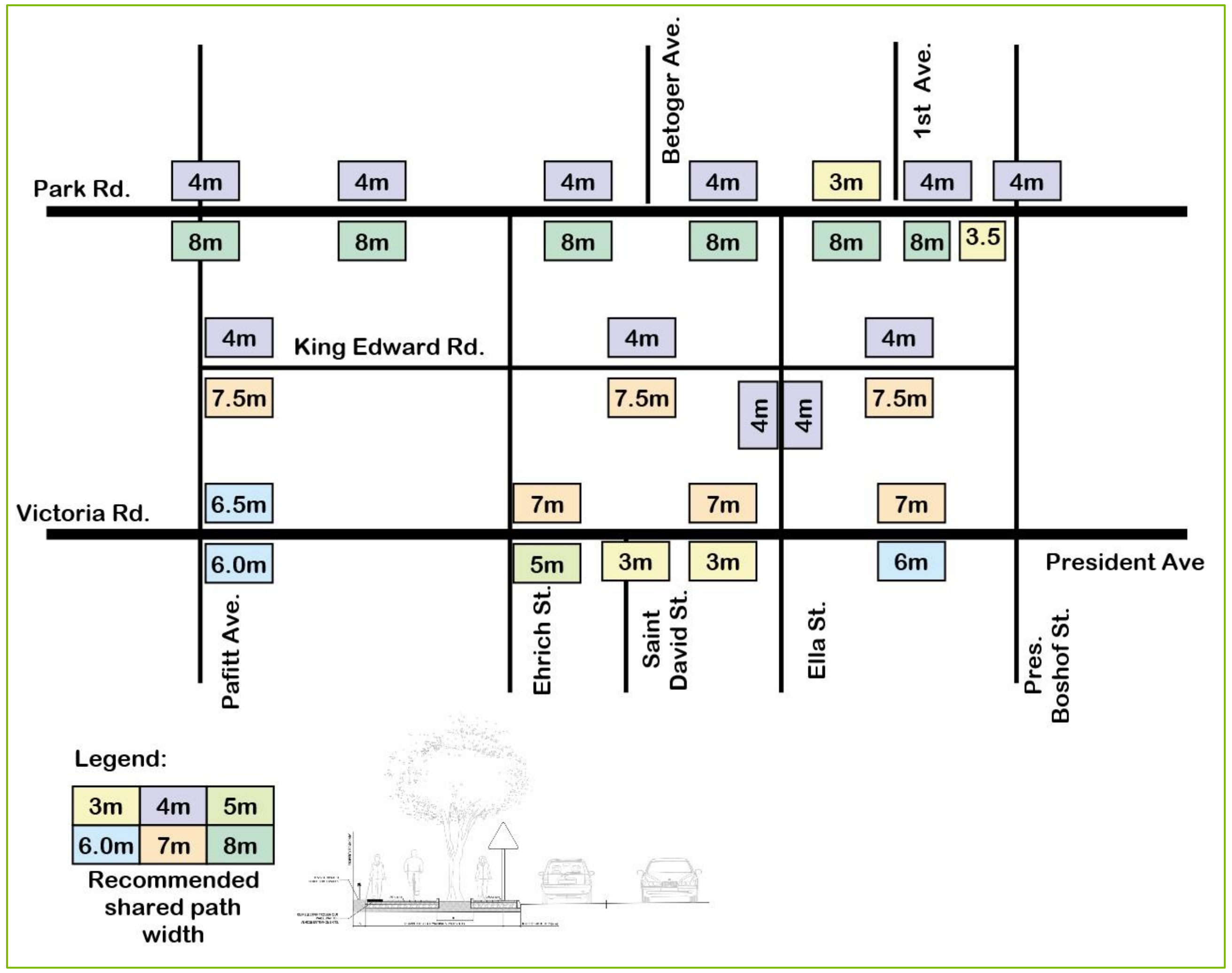


Figure 14-27: Recommended NMT Path Width

All NMT pathways will follow the same design philosophy in order to achieve consistency in standards and style. The following standard dimensions and specifications have been followed.

- **Kerb Ramp:**12 Pre-Cast 30Mpa concrete tactile pavers (400 x 400 x 65mm) to be installed on full width of drop kerb, sloping to the gradient of 1:15 or higher. Flared sides of transition to split kerb and ramp. The ramp must be flushed with carriage way by means of white thermoplastic strip. Kerb ramps must align to crossing and guidance strips laid to rear of pathway for guiding visually impaired to crossing.
- **Guidance strips**: 400 x 400 x 65mm guidance TGSI's blocks to be installed from dropped kerb ramp to rear of pathway.
- **Pathway**: 500mm buffer against property boundary will be dedicated to all services such as water meters, electrical boxes and valves. This buffer will be separated from the pathway by means of an edge beam. For pedestrian awareness, a rumble strip will be laid along the pathway next to the edge beam, this will also serve as a warning for the visually impaired to indicate the edge of pathway.
- **Trees:** Trees will be boxed in with 900 X 900mm kerbings extruding 120mm from ground level.
- **Universal Design:** A uniform slope of 1:50 (2%) will be used throughout NMT pathway to direct storm water. A second buffer of 700mm (preferred), 500mm (min) on the road side will be dedicated to signage and to serve as a safe distance from traffic for all pedestrians. Tactile paving will be laid at every controlled or uncontrolled crossing, including areas where the road level has been raised to the same level as pathway. Crossings must be raised to same level as pathway at every vehicle entry/exit to properties.

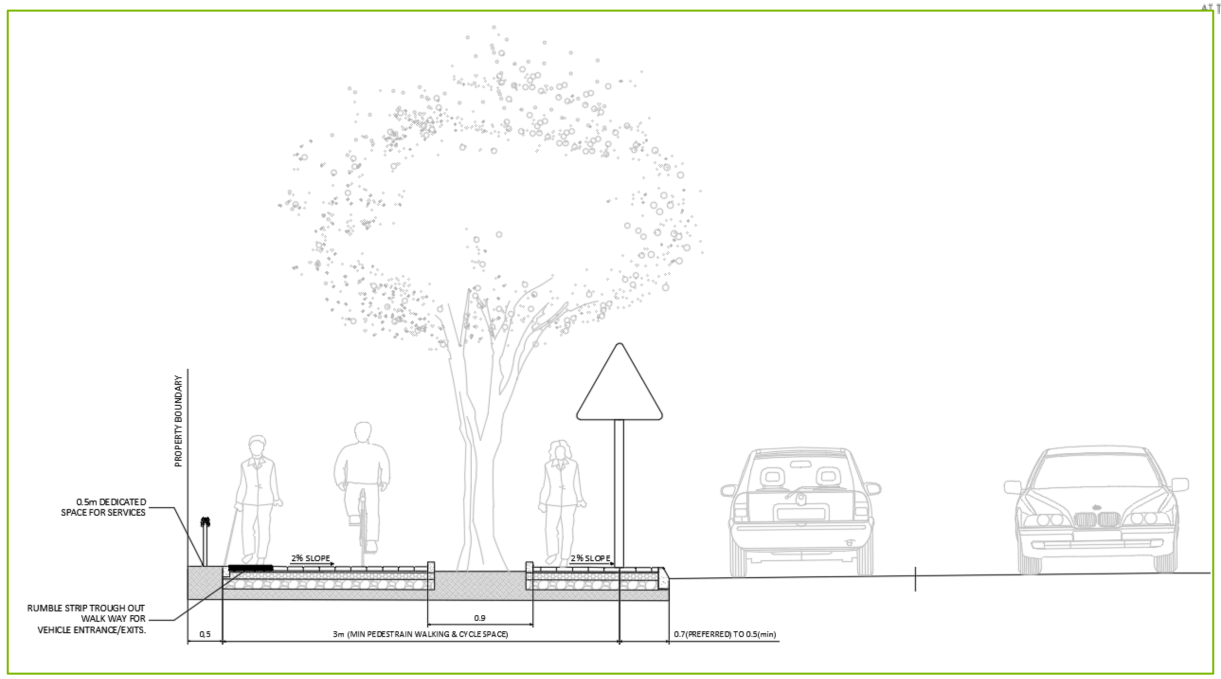


Figure 14-28: Shared Use Path

14.8.3.2 Ella Street (from Park Road)

Ella street will follow the design of the cross section (see figure Figure 14-28). The cross section has been modified to exclude the 500mm buffer for services at some parts of Ella. The detailed dimensions of the cross section comprise of the following:

- Buffer zone at property boundary - 0.5 m where applicable
- Buffer zone at road side - 0.7m and 0.5m where required
- Trees - 0.9m where applicable
- Walking & Cycle width - 3 m (min)
- Edge beam - 62mm
- Kerb ramp - 10 units
- Length of paving - 475m

14.8.3.3 Park Road (from Central University of Technology)

Park road will follow the design of the cross section (see Figure 14-28). The cross section was modified that all street lighting will be moved to the south pathway of Park road.

Where the NMT crosses the existing parking, the parking has been reconfigured such that the traffic does not intersect with the NMT for Pedestrian and Cyclist safety. The detailed dimensions of the cross section comprise of the following:

- Buffer zone at property boundary - 0.5 m where applicable
- Buffer zone at road side - 0.7m and 0.5m where required
- Trees - 0.9m where applicable
- Walking & Cycle width - 3 m (min)
- Edge beam - 62mm
- Kerb ramp - 40 units
- Length of paving - 1 169m

14.8.3.4 King Edward Road (from President Boshoff Street)

King Edward road will follow the design of the cross section (see Figure 14-28). The north side of King Edward road will be dedicated for pedestrians only due to pathway width. The south side of King Edward will be dedicated to pedestrians and cyclists. The detailed dimensions of the cross section comprise of the following:

- Buffer zone at property boundary - 0.5 m where applicable
- Buffer zone at road side - 0.7m and 0.5m where required

- Trees - 0.9m where applicable
- Walking & Cycle width - 3 m (min)
- Edge beam - 62mm
- Kerb ramp - 16 units
- Length of paving - 2 336m

14.8.3.5 Victoria Road (from Parfitt Ave)

Victoria Road will follow the design of the cross section (see Figure 14-28). adopted for the design of the right-hand side of Victoria road while cross-section A was used on the left-hand side. The detailed dimensions of the cross section comprise of the following:

- Buffer zone at property boundary - 0.5 m where applicable
- Buffer zone at road side - 0.7m and 0.5m where required
- Trees - 0.9m where applicable
- Walking & Cycle width - 3 m (min)
- Edge beam - 62mm
- Kerb ramp - 56 units
- Length of paving - 2 336m

14.8.4 System Sizing and Characterising - Maphisa NMT Plan and Short-Term Intervention

The detail pertaining to status quo, analysis and quantification of the recommend network is presented in

14.8.4.1 Recommended Maphisa NMT Design Criteria

It is recommended that a shared-use path of 3 m (cycleways and sidewalks) is implemented along Maphisa/Fort Hare corridor, refer to Figure 14-30 and Figure 14-29.

All NMT pathways will follow the same design philosophy in order to achieve consistency in standards and style. The following standard dimensions and specifications has been followed.

- **Kerb Ramp:**12 Pre-Cast 30 Mpa concrete tactile pavers (400 x 400 x 65 mm) to be installed on full width of drop kerb, sloping to gradient of 1:15 or higher. Flared sides of transition to split kerb and ramp. The ramp must be flushed with carriage way by means of white thermoplastic strip. Kerb ramps must align to crossing and guidance strips laid to rear of pathway for guiding visually impaired to crossing.
- **Guidance strips**: 400 x 400 x 65 mm guidance TGSI's blocks to be installed from dropped kerb ramp to rear of pathway.
- **Pathway**: 500 mm buffer against property boundary will be dedicated to all services such as water meters, electrical boxes and valves. This buffer will be separated from the pathway by means of an edge beam.
- **Trees:** Trees will be boxed in with 900 x 900 mm kerbings extruding 120 mm from ground level.
- **Universal Design:** A uniform slope of 1:50 (2%) will be used throughout NMT pathway to direct storm water. A second buffer of 700 mm (preferred), 500 mm (min) on the road side will be dedicated to signage and to serve as a safe distance from traffic for all pedestrians. Tactile paving will be laid at every controlled or uncontrolled crossing, including areas where the road level has been raised to the same level as pathway. Crossings must be raised to same level as pathway at every vehicle entry/exit to properties.

14.8.4.2 Maphisa / Fort Hare Street (from Moshoeshoe to Harvey Street)

Maphisa / Fort Hare Streets will follow the design of the cross section (see). The cross section has been modified to exclude the 500-mm buffer for services at some parts of Maphisa/Fort Hare. The detailed dimensions of the cross section comprise of the following:

- Buffer zone at property boundary - 0,5 m only where applicable
- Buffer zone at road side - 0,7 m and 0,5 m where required
- Trees - 0,9 m only where applicable
- Walking & cycle width - 3 m (min)
- Edge beam - 60mm
- Kerb ramp at intersections - 10 units
- Length of paving - 475 m

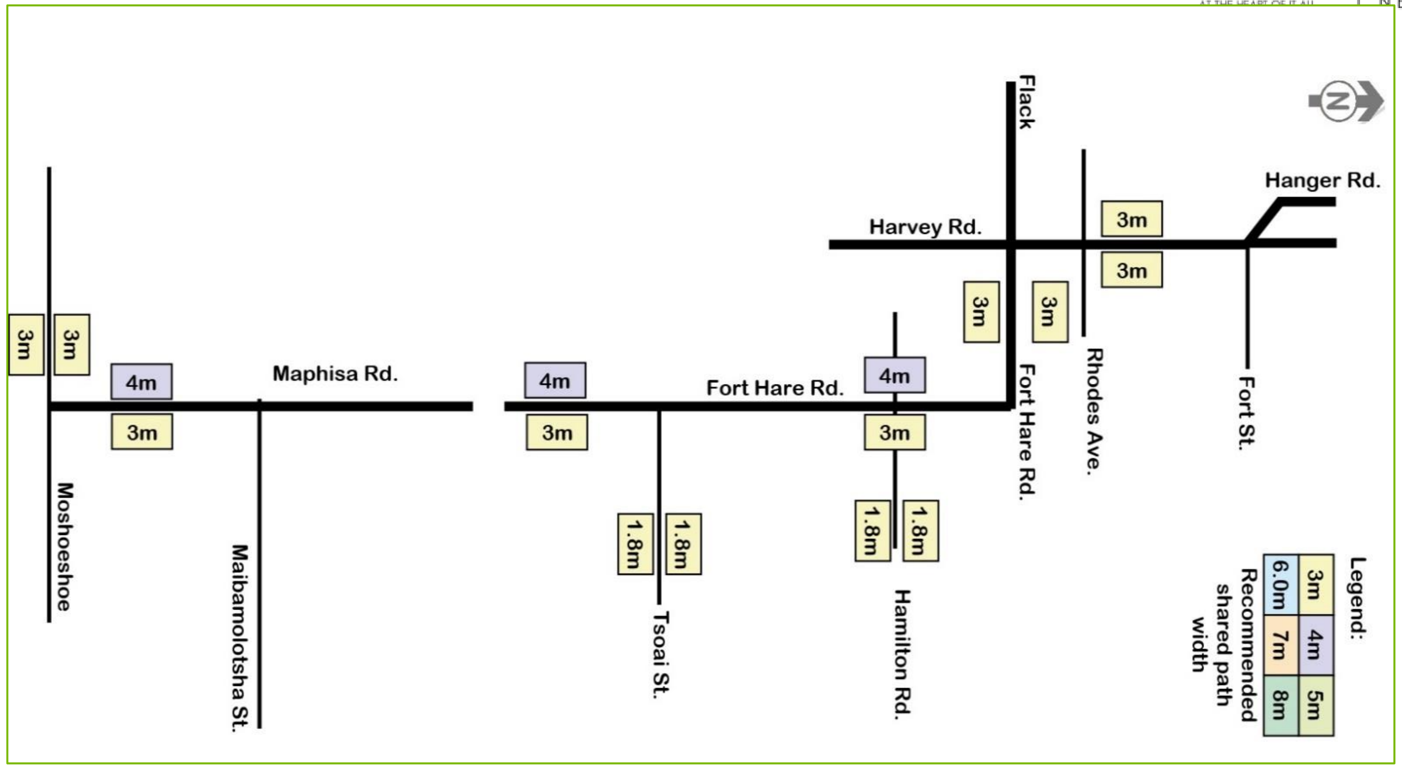


Figure 14-29: Recommended NMT Facility Widths

14.8.5 Moshoeshoe NMT Plan and Short-Term Intervention

14.8.5.1 Recommended Moshoeshoe NMT Network Design Criteria

14.8.5.1.1 Recommended NMT Facility Widths

It is recommended that a shared-use path of 3 m (cycleways and sidewalks) is implemented along Moshoeshoe Corridor, refer to Figure 14-31. However, in certain parts of Moshoeshoe Street, road reserve widths are minimal and the standard 3m sidewalk will not fit. The minimum sidewalk width can be reduced to 2,5 m as seen in Figure 14-31.

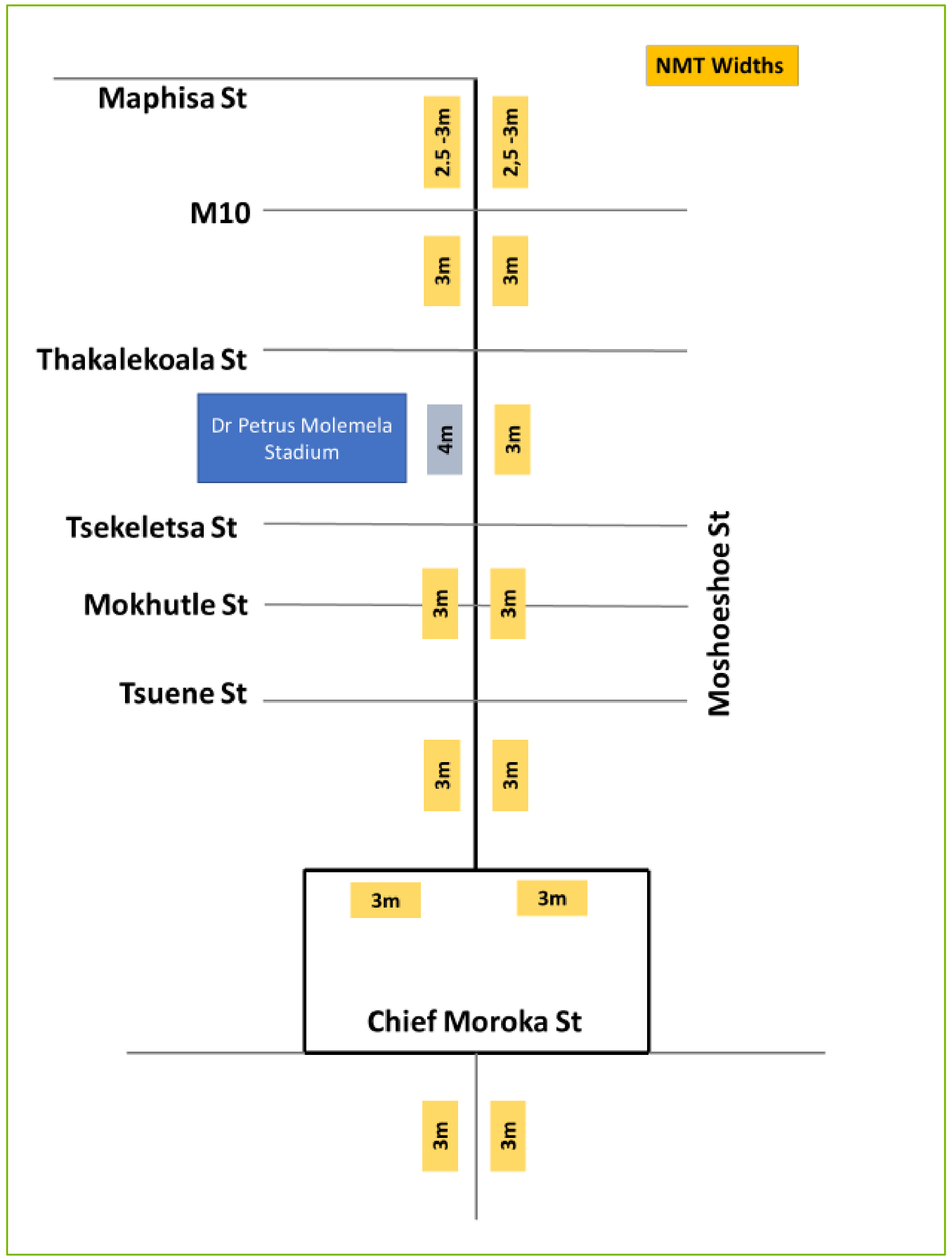


Figure 14-30: Recommended NMT Facility Widths

14.8.5.1.2 NMT Ways Along the Trunk Corridor

The cyclist path and the pedestrian path do not have to be physically separated through the use of an edge beam/kerb etc. Ideally a 500mm buffer against the property boundary will be dedicated to all services such as water meters, electrical boxes and valves (Option 1 of Figure 7-29). This buffer will be separated from the pathway by means of an edge beam. A second buffer of 700mm (preferred), on the road side will be dedicated to signage and to serve as a safe distance from traffic for all pedestrians, where space permits.

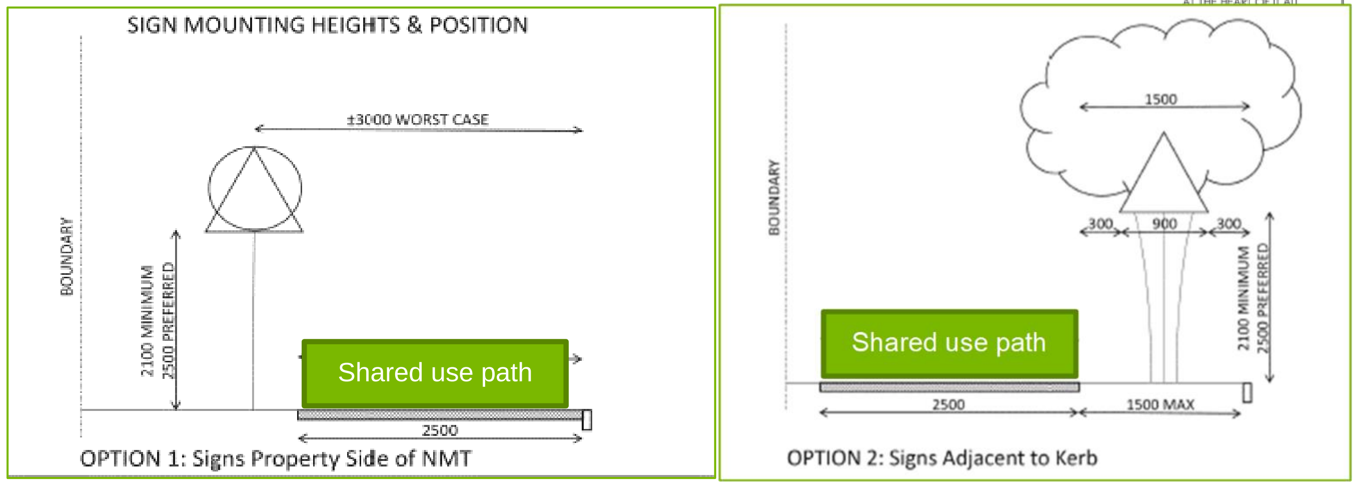


Figure 14-31: Recommended NMT Cross Sections

14.8.5.1.3 NMT Design Philosophy

All NMT pathways will follow the same design philosophy in order to achieve consistency in standards and style. The following standard dimensions and specifications has been followed.

- **Kerbing for Option 1:** If the designers choose the layout with the electrical poles/Telkom poles / signage being located within 500 mm of the road edge, then the NMT facility will be bounded by Figure 10 edge beams on either side of the facility.
- **Kerbing for Option 2:** Where the designers choose the layout with the electrical poles/Telkom poles / signage being located a maximum of 3 m away from the road edge, then the NMT facility will be bounded by Figure 10 edge beams on either side of the facility. Care must be taken that the facility will be able to drain any water away from the facility, and that residents will still be able to access their properties. The tie-in back into the natural ground level should be such to prevent any pile up of soil etc, on the NMT facility, in future years.
- **Kerb Ramp:**12 Pre-Cast 30 Mpa concrete tactile pavers (400 x 400 x 65 mm) to be installed on full width of drop kerb, sloping to gradient of 1:15 or higher. Flared sides of transition to split kerb and ramp. The ramp must be flushed with carriage way by means of white thermoplastic strip. Kerb ramps must align to the crossings and guidance strips laid to the rear of the pathway for guiding visually impaired to crossing. The minimum width for uncontrolled crossings is 2,4 m and 3 m is generally accepted for signalised crossings. In the event that the crossing is greater than 3 m, care must be taken in terms of sight distances for approaching vehicles. A maximum crossing distance of 5 m can be achieved. Anything over 5m, needs a review of the traffic signal settings at the intersection. In certain cases, it may be necessary to set back the crossing, to achieve the optimal layout for the tactile pavers – see Figure 14-32 below:

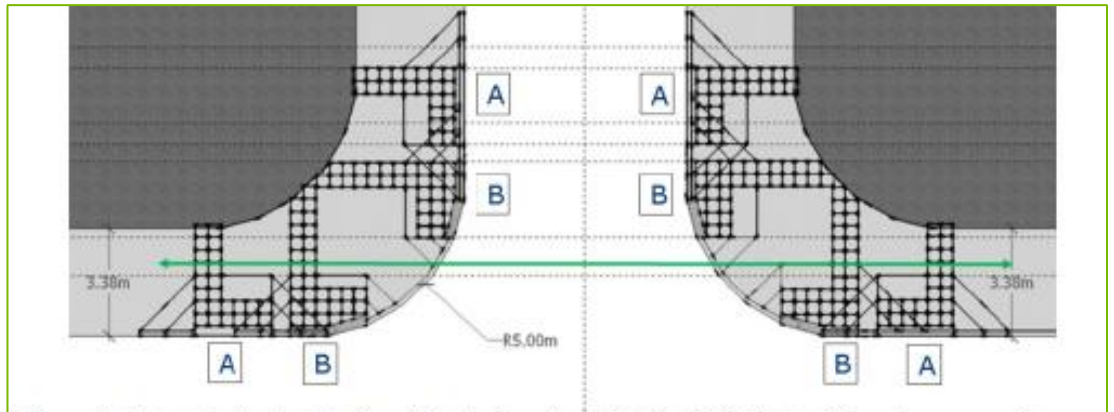


Figure 2; Regular kerbcut with a 5m kerb radius. Option B is the preferred compromise

Figure 14-32: Kerbcut radii and optimal placement on intersections

- **Guidance strips**: 400 x 400 x 65 mm guidance TGSI's blocks to be installed from dropped kerb ramp to rear of pathway.
- **Trees:** Trees will be boxed in with 900 x 900 mm kerbings extruding 120 mm from ground level. In places where trees inhibit the sidewalk effective width,

- **Universal Design:** A uniform slope of 1:50 (2%) will be used throughout NMT pathway to direct storm water. Tactile paving will be laid at every controlled or uncontrolled crossing, including areas where the road level has been raised to the same level as pathway. Crossings must be raised to same level as pathway at every vehicle entry/exit to properties.

14.8.6 Botshabelo NMT

14.8.6.1.1 Recommended NMT Facility Widths

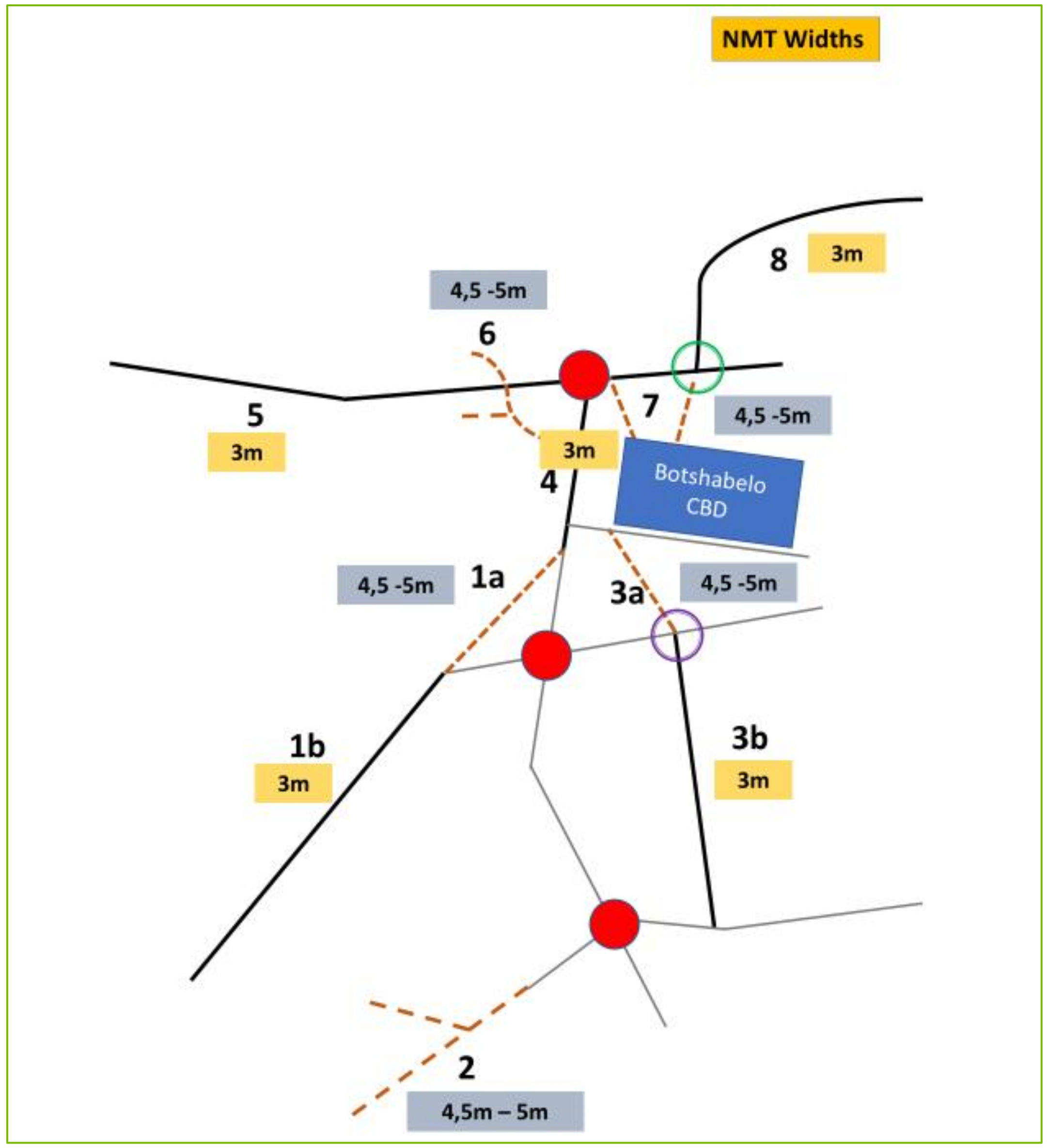


Figure 14-33: Recommended NMT Facility Widths

All NMT pathways will follow the same design philosophy in order to achieve consistency in standards and style. The following standard dimensions and specifications has been followed.

- **Kerb Ramp:**12 Pre-Cast 30 Mpa concrete tactile pavers (400 x 400 x 65 mm) to be installed on full width of drop kerb, sloping to gradient of 1:15 or higher. Flared sides of transition to split kerb and ramp. The ramp must be flushed with carriage way by means of white thermoplastic strip. Kerb ramps must align to crossing and guidance strips laid to rear of pathway for guiding visually impaired to crossing.
- **Guidance strips**: 400 x 400 x 65 mm guidance TGSI's blocks to be installed from dropped kerb ramp to rear of pathway.
- **Universal Design:** A uniform slope of 1:50 (2%) will be used throughout NMT pathway to direct stormwater. A second buffer of 700 mm (preferred), 500 mm (min) on the road side will be dedicated to signage and to serve as a safe distance from traffic for all pedestrians. Tactile paving will be laid at every controlled or uncontrolled crossing, including areas where the road level has been raised to the same level as pathway. Crossings must be raised to same level as pathway at every vehicle entry/exit to properties.

14.8.7 Thaba Nchu NMT

14.8.7.1 Existing Land Use

Thaba Nchu is located 60 km to the east of Bloemfontein. The main land uses are residential settlements, 42 rural villages and a central CBD area where commercial and retail activities are located. Figure 14-34 shows this in greater detail. The main corridors within Thaba Nchu are lined with schools (No name Street), the Dr JS Moroka Hospital, and various other social amenities.

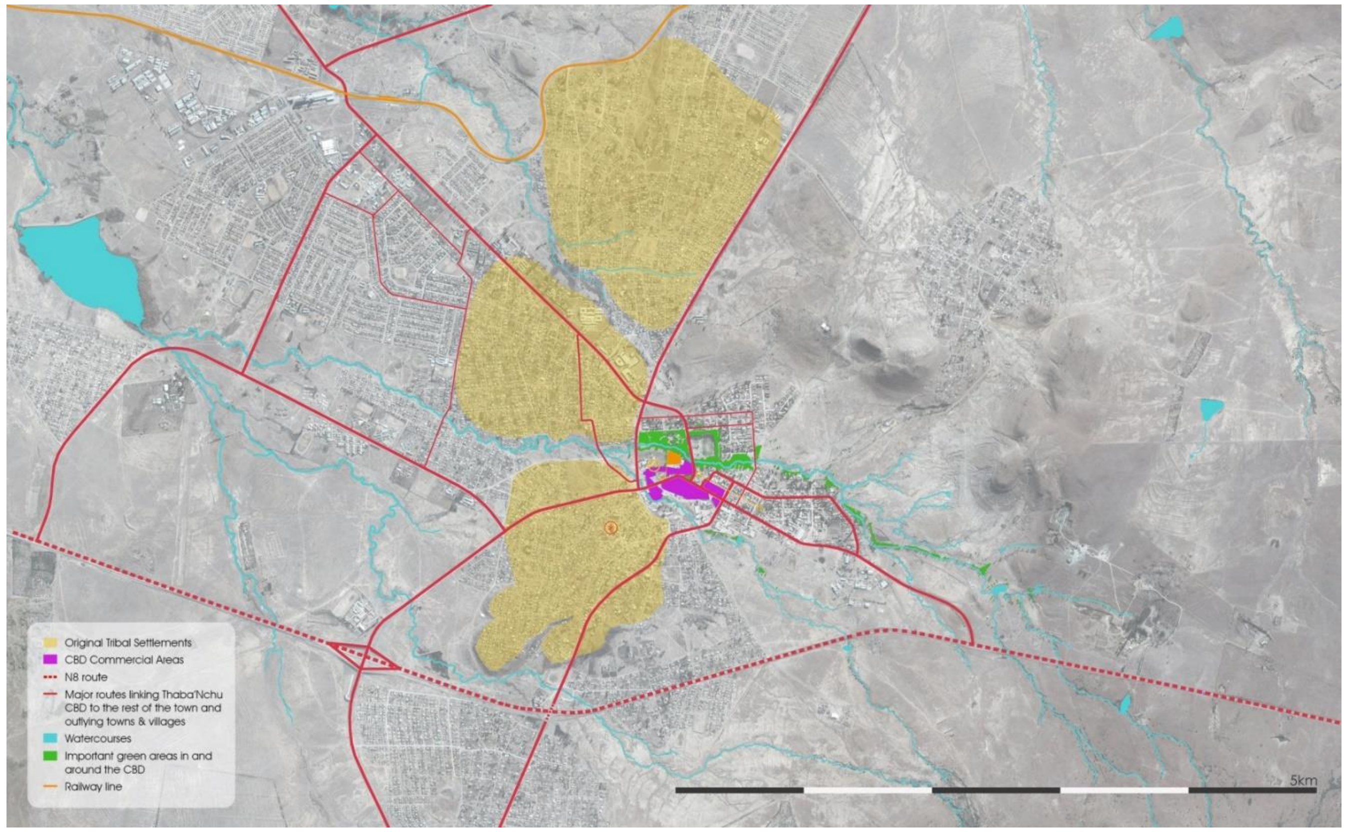


Figure 14-34: Thaba Nchu Land Use Patterns

14.8.7.2 Recommended NMT Cross Section and Widths

14.8.7.2.1 NMT Ways Along Provincial Roads

The NMT Facility Guidelines 2014, notes that one of the NMT ways along provincial roads (>80 km/hr) can be brought closer to the road, to lessen out the effects of rolling terrain, but should be separated with a guardrail, or kerbs and lighter barriers. Walkways along the edge of the road are always more popular due to security reasons and the closer access to public transport (refer to Figure 14-35). The designer will have a choice to position the NMT-ways closest to the road edge, where currently the lighting is found, but will have to introduce barrier kerbs along the roadway – or to locate the NMT-way away from the road, with a light guardrail/trees as a separator.

Figure 14-35: NMT Facilities along Provincial Roads

14.8.7.2.2 Recommended NMT Facility Widths

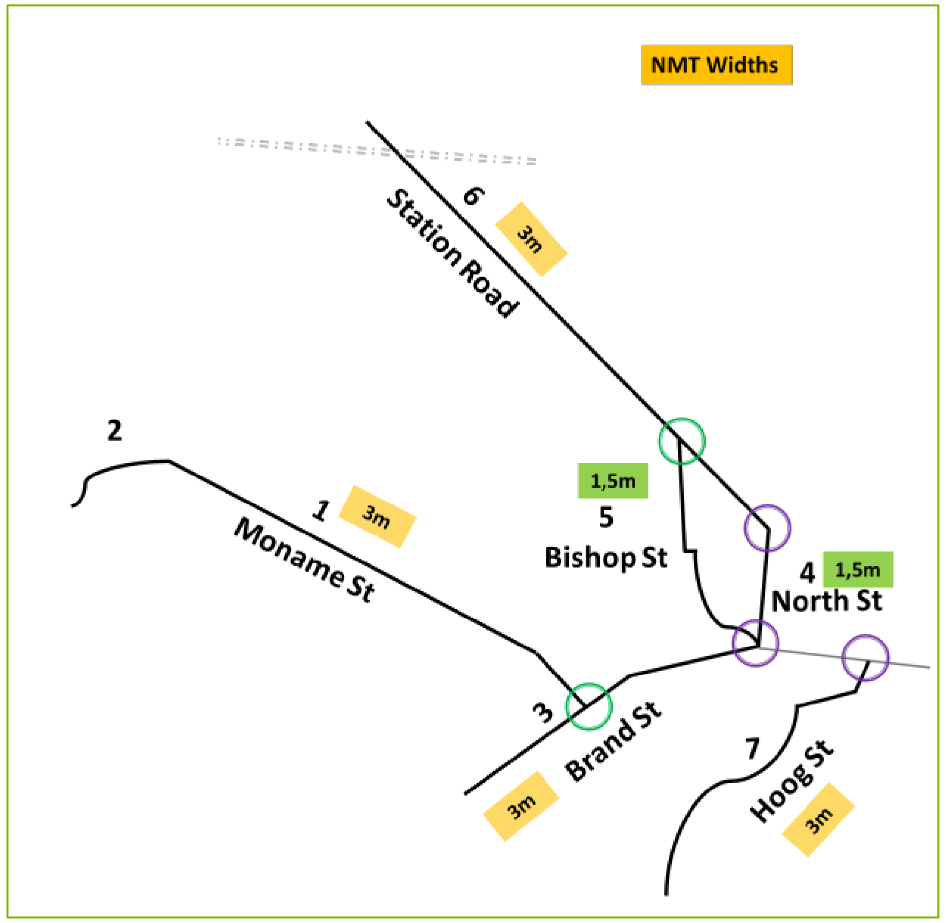


Figure 14-36: Recommended NMT Facility Widths

All NMT pathways will follow the same design philosophy in order to achieve consistency in standards and style. The following standard dimensions and specifications has been followed.

- **Kerb Ramp:**12 Pre-Cast 30 Mpa concrete tactile pavers (400 x 400 x 65 mm) to be installed on full width of drop kerb, sloping to gradient of 1:15 or higher. Flared sides of transition to split kerb and ramp. The ramp must be flushed with carriage way by means of white thermoplastic strip. Kerb ramps must align to crossing and guidance strips laid to rear of pathway for guiding visually impaired to crossing.
- **Guidance strips**: 400 x 400 x 65 mm guidance TGSI's blocks to be installed from dropped kerb ramp to rear of pathway.
- **Universal Design:** A uniform slope of 1:50 (2%) will be used throughout NMT pathway to direct storm water. A second buffer of 500 mm (min) on the road side will be dedicated to signage and to serve as a safe distance from traffic for all pedestrians. Tactile paving will be laid at every controlled or uncontrolled crossing, including areas where the road level has been raised to the same level as pathway. Crossings must be raised to same level as pathway at every vehicle entry/exit to properties.
- **Walkway Widths**: Where a 1,5 m walkway is proposed, the cyclists will have to travel on the street pavement as this will be a pedestrian-only environment, due to the limited space available.

15 Cost and Revenue Modelling

Part of the alternative analysis process (refer to Diagram 15-1) is the quantification of operational cost, capital cost, revenue and funding sources. This quantification provides the financial impact of the alternatives and can be compared to available resources. This comparison form part of the development of the Business Model for the IPTN. This section provides the input parameters to the financial estimations and total financial impact per operational or infrastructure alternative. All costs are presented as 2019 real values and include capital and operational cost.

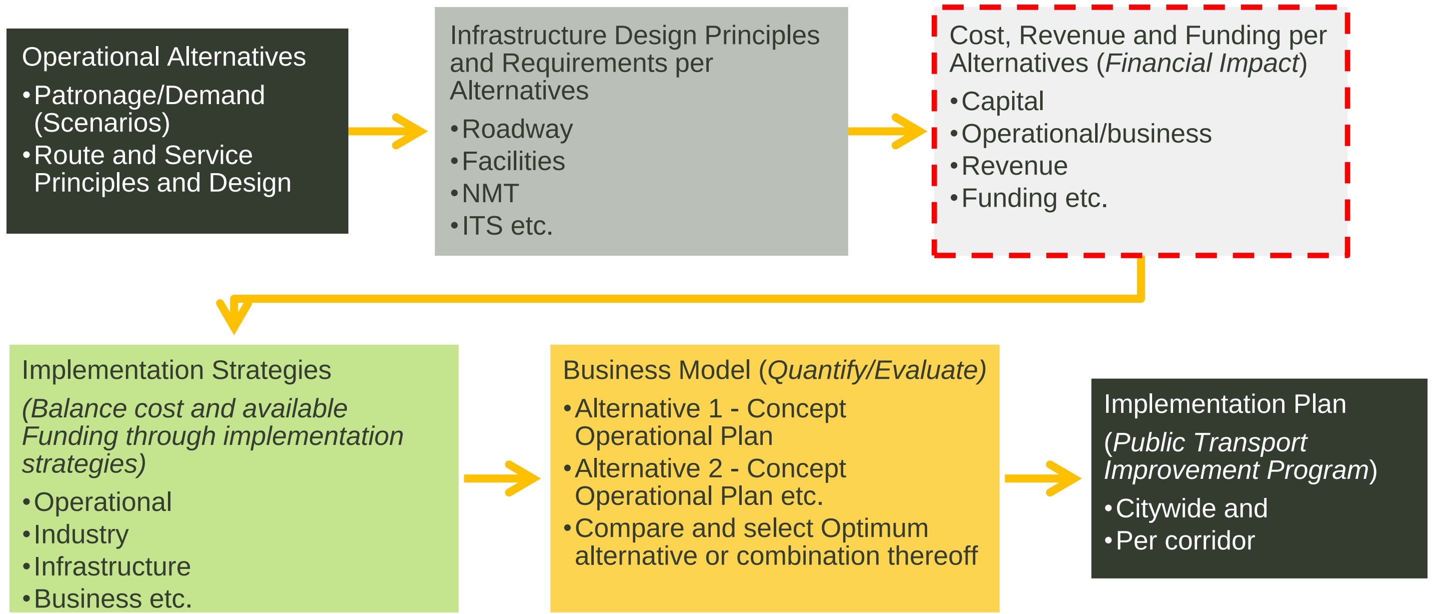


Diagram 15-1: Alternative Analysis Process and Components

15.1 Operational Cost

The operational cost was determined for the three route design alternatives per patronage scenario. These alternatives operational cost is determined for the base year (low and high), 2025 and 2036. These provide the premises wherefrom the implementation of the network is phase given the total cost versus available budget, revenue and grant allocation.

Operational cost is determined on a strategic level for the options analysis and stem from the detail business plan that provides the detail to the summary of operational cost presented. The deployment of the system the functions, contracting and other variables that have an impact on the operating cost are detailed in the business plan. The operating cost included in the comparison and costing of the system are:

- Vehicle Direct Running Cost
- Direct Vehicle Cost

15.1.1 Vehicle Operating Cost

The vehicle operating cost include:

- Fixed cost per vehicle, which include:
  - Driver salary;
  - Workshop personal;
  - General expenditure bus related.
- The vehicle running cost per km per vehicle.
- These cost parameters are presented in Table 15-1 per vehicle type.

Table 15-1: Vehicle Operating Cost Structure

Vehicle Capacity	Running Cost R/km	Vehicle Fixed Cost per day
120 seats	R20/km	120 seat – R 4110 per fleet vehicle per day
80 seats		80 seat - R 3836 per fleet vehicle per day
22 and 15 seat –	R5/km	R1781 per fleet vehicle per day

15.1.2 Vehicle Operating Company Cost

The cost was obtained from detail analysis for Phase 1 implementation. The cost was apportioned in three increments in the initial year and increase during the 2026/27 and 2032/33 implementation years when Botshabelo area will be operationalised and when all phases will be operationalised. The costs comprise of the overhead and management cost and include a profit margin of 15%.

The total fixed costs for the VOC are estimated at:

- 2019/20 – R 11.0 million;
- 2026/27 – R 16.0 million; and
- 2032/33 – R 19.0 million.

Allowance was made for other contracts including, station management, APTMS and others to the value of:

- 2019/20 – R 9.6 million and
- 2024/25 – R 28.5 million.

The total operational cost per patronage scenario and route design alternative for all corridors part of the IPTN are presented in **Diagram 15-2** and **Diagram 15-3**. The operational cost needs to be compared to the revenue expected per route design alternative for the IPTN system. The operational cost is a function of the patronage and the route design selected. The complementary route option can yield a lower operational cost depending on the patronage scenario. The selection of a feeder-trunk system needs to be considered carefully when patronage increase especially where high-density development occurs along a feeder route. The extension of the trunk to these areas will have a cost and travel time and passenger experience (fewer transfers) improvement. This, however, needs to be determined on a corridor by corridor level provided the unique circumstances per corridor.

Diagram 15-2: Patronage Scenario 1 Operational Cost per Route Design Alternative

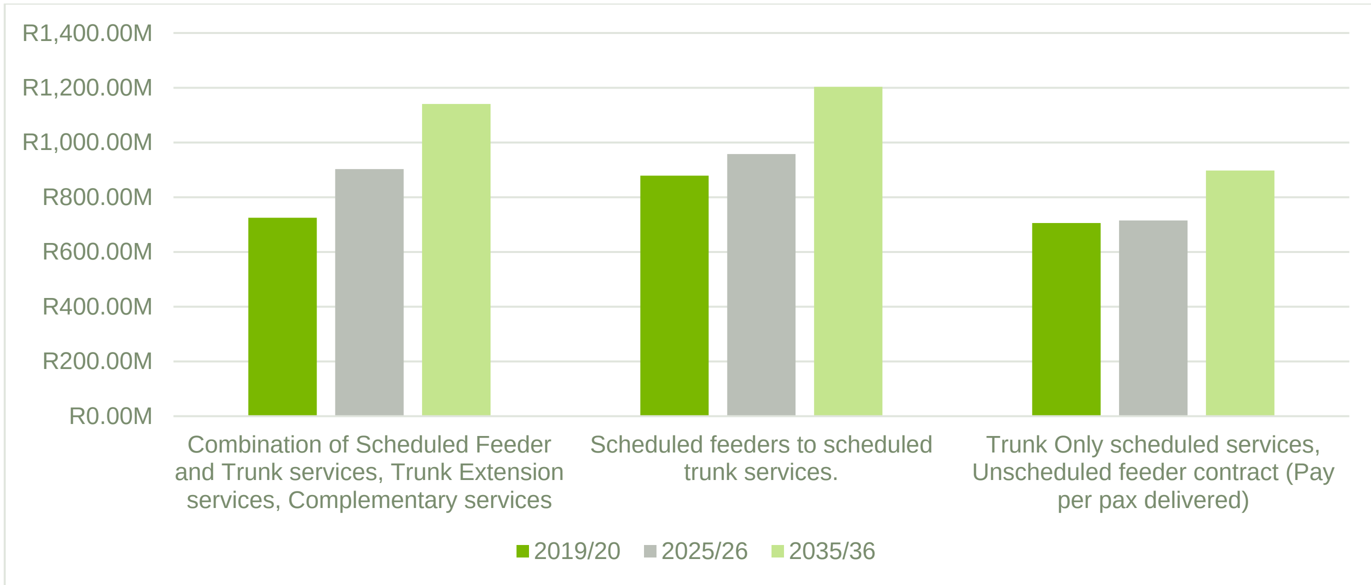
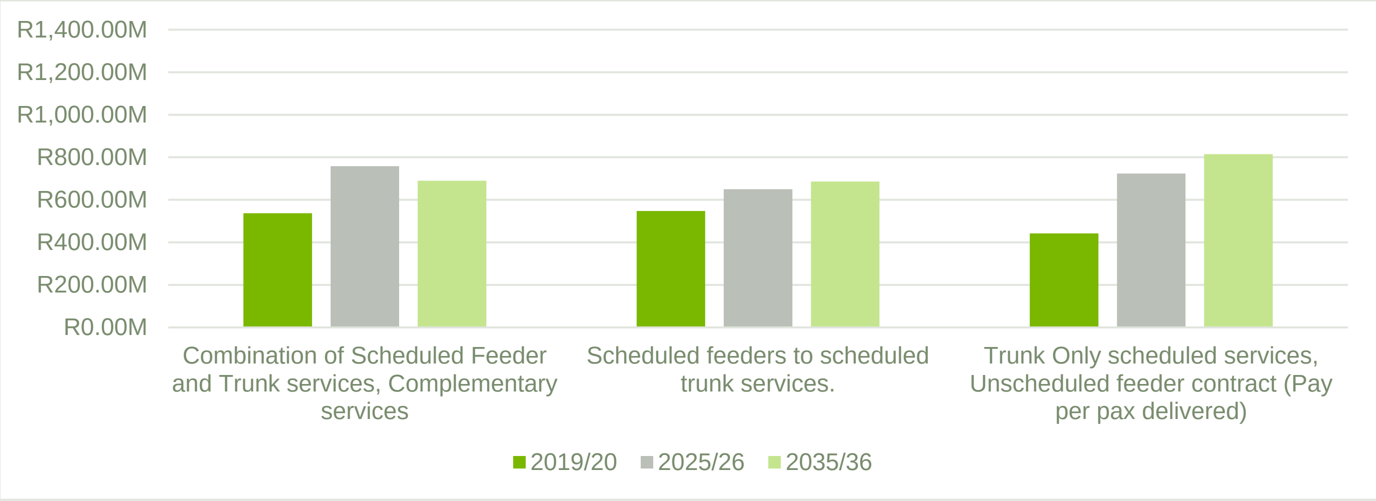


Diagram 15-3: Patronage Scenario 2 Operational Cost per Route Design



15.2 Capital Cost

Capital cost comprises of the cost associated with the right-of-way, roadways, intersection upgrades, non-motorise transport network, intelligent transport systems, facilities (stations, stops, depot etc.) and compensation of affected operators. In previous sections the IPTN network and envisage facilities required was presented.

15.2.1 Roadway Infrastructure

The unit cost for road maintenance and upgrade is R 500.00/m^2 and for implementation of an additional road lane is R 1500.00/m^2. The total cost without considering apportionment to other departments of the city or road authorities is presented in Table 15-13. The detail calculation and the cost thereof is presented in Section 14.

Table 15-2: Unit Cost per Facility Type

Item	Unit Cost
Depot	R260.00M
Sleeping Grounds	R0.75M
Stops	R0.16M
Controlled Access Stations	R6.50M
Uncontrolled Access Stations	R1.50M
Transfers	R15.00M
Transfers High Capacity	R0.50M
Transfers Low Capacity	R0.25M
Control Centre	R0.71M
Customer Care	R0.60M

15.2.2 Facilities

The unit cost per facilities type are presented in **Table 15-2** and total cost related to facilities are presented in Table 15-3 per functional public transport corridor**.** This cost reflects the capital required to implement the citywide IPTN. The implementation of this infrastructure is subjected to the funding available and thus might require an incremental implementation approach of the facilities that align with the capital budget available per year through the business model and proposed implementation strategies.

Table 15-3: First Order Cost per Facility Type citywide – Full Implementation Stage

Item	Maphisa/ Moshoeshoe	OR Tambo	CBD	Dr Belcher	Botshabelo	Thaba Nchu	Total
Depot							**R260.00M**
Sleeping Ground	R0.75M	R4.55M	R27.63M	R13.98M	R19.50M	R10.08M	**R76.48M**
Stops	R5.20M	R13.00M	R19.50M	R19.50M	R6.50M	R6.50M	**R70.20M**
Controlled Access Stations	R13.00M	R5.00M	R11.00M	R8.00M	R8.00M	R7.00M	**R52.00M**
Uncontrolled Access Stations (Stop with Shelters)	R5.00M	R0.00M	R15.00M	R0.00M	R15.00M	R15.00M	**R50.00M**
Transfers (Main)	R0.00M	R3.00M	R5.50M	R5.00M	R2.00M	R3.00M	**R18.50M**
Transfers High Capacity	R3.00M	R2.00M	R1.50M	R1.00M	R0.00M	R0.00M	**R7.50M**
Transfers Low Capacity (Voluntary Transfer)	R1.00M	R0.00M	R0.00M	R0.00M	R0.00M	R0.00M	**R1.00M**
Control Centre	R0.71M	R0.00M	R0.00M	R0.00M	R0.00M	R0.00M	**R0.71M**
Customer Care							**R0.60M**
	R28.66M	**R27.55M**	**R80.13M**	**R47.48M**	**R51.00M**	**R41.58M**	**R536.99M**

15.2.3 NMT Infrastructure

The NMT infrastructure cost was based on the projects identified per area and the detail of the infrastructure to be implemented is provided in Annexure CC and total capital cost per IPTN route type is presented in Table 15-4.

Table 15-4: Non-Motorised Transport Project List

IPTN Route Type	Botshabelo	CBD	Maphisa/ Moshoeshoe	Dr Belcher	Thaba Nchu	Grand Total
Feeder	R87.52M		R16.64M	R40.00M	R42.72M	R186.88M
Complementary					R9.00M	R9.00M
Trunk	R22.28M	R68.15M	R48.30M	R40.17M	R10.20M	R189.10M
Total	**R109.80M**	**R68.15M**	**R64.94M**	**R80.17M**	**R61.92M**	**R384.98M**

15.2.4 Industry Compensation

The estimated compensation for mini-bus operators/businesses per corridor is based on the market research for Maphisa/Moshoeshoe, OR Tambo and Brandwag functional public transport corridors. The total estimated compensation to clear the corridors is based on the average value obtained from the mentioned market research. The total compensation value per functional public transport corridor is presented in **Table 15-5.** Based on the market research two alternative scenarios were calculated given that the final compensation value depends on negotiation with affected operators. A high scenario was developed and resulted in nearly double the presented compensation values per corridor. The low scenario resulted in total compensation to be 25% less than indicated in **Table 15-5**. The average value is used for this strategic plan.

Table 15-5: Total Mini-bus Operators Compensation Cost per Corridor

Corridor	Total Compensation Cost Estimated
Maphisa and OR Tambo	R122.61M
CBD	R113.18M
Dr Belcher	R104.67M
Botshabelo	R28.67M
Thaba Nchu	R87.73M

15.2.5 ITS Cost

The total ITS capital cost for full implementation is presented in

Table 15-6. The ITS deployment included in the estimated cost is detailed in the ITS section of the report. Provision was made for the following APTMS capital expenditure and items excluded are indicated:

- No provision made for any Wi-Fi/Fiber Costs (ICT SoW)
- No provision made for any TSP/UTC Costs
- Provision made for 1xVMS in Bus (Outside must be part of Bus SoW)
- Provision made for 2xPassanger Counters
- Provision for Limited ICT Equipment at stations

Provision was made for the following AFC capital expenditure and items excluded are indicated:

- No provision for Ticket Vending Machines, Selling Points at Stations or Equipment at Open Stations,
- Provision was made for 5 hand-held devices as part of Back-Office.

Table 15-6: total Estimated ITS Capital Cost

ITS CAPEX	R318.68M
ITS OPS	R166.95M

15.3 Funding

Financial resources are dealt with in a further chapter and details below are aimed at an assessment of the impact of the funding sources on the overarching business plan.
Effectively, the more funding is constrained the more complex the business plan would become, to the extent that the options that may be exercised may be limited to the more simplistic options that may not be the desired outcome in the longer term, and more likely not the most preferred, optimum choice.
The extent of the financial resources is therefore paramount. The IPTN system is sourced financially from:

- Allocations from Treasury
- Allocations from local City resources and
- Fare revenues from Hauweng operations, which in turn are dependent on the fare policy and fare system that is employed, Refer to Fare Policy below and Section 15.4.2 for fare structure.
- Marginal revenues may also be expected from advertising and other such secondary sources, but it will always be minimal.
- Technically loan funding may also be considered a funding source, but in practice these loans all have to be serviced through the main sources of revenue listed above.

Conditions that are attached to the funding sources are important and will influence the extent to which these sources can be expected and exploited. For example, the Treasury allocations would be attached to performance levels such as the fare revenues must cover the variable costs of operations, etc. Capital grants will also be attached to the expected passenger volumes that can be served relative to the investment values.

The funding sources and associated detail are:

- City rate base contribution at 2% of rate base
  - Current rate base 2018 is R1,000.00M that will provide R20mil per annum to subsidised operational expenditure.
- PTNG allocation to the city
  - Current allocation used at real value of R241.95M.
- PTOG – Value of subsidised contracts metro is:
  - R180.69M in 2016,
  - This was escalated to represent 2019 values with 6% per annum. Total subsidy value escalated to 203.03M per annum.
- Total capital funding total to R241.95M per annum and operational funding including PTOG is in total R203.03M. the farebox per scenario is presented below.

15.4 Revenue

15.4.1 Fare Policy

Given the importance of fare revenues as one source of income, a fare policy is formulated, and the approval process is in motion via the annual City tariff setting process that includes public participation. This process needs to be repeated annually.

The pricing policy adopted for the Hauweng system is based on the following principles:

- The Hauweng system would offer a service that is of a higher quality as compared to both the taxi and the subsidised bus service system
- The only quality aspect that is the exception is the frequency of the service where the Hauweng system will not be as high as those offered by taxi services, but in the peak the difference is marginal that should not be of major concern to the passengers.
- The Hauweng bus system is generally at a higher level of quality as compared to the IBL system.
- In terms of fare targeting the Hauweng system will position itself between the IBL and taxi fare systems, i.e. about 10% – 15% lower than taxi fares, but with some concessions to allow for the subsidised tickets of IBL:
  - 2019 taxi fares are R12 per trip, with Hauweng single trip fare targeted at R11 per trip when a feeder transfer trip is also made, and R10 when no feeder trip is made
  - The starter service falls under the category of no feeder transfer trip and is all priced at R10 per single trip.
  - For single trip fares that include a feeder transfer (but excluding the discounts of multi-ticket bundle fares) taxis charge a passenger to and from the south to CBD at R12, and then from CBD to and from the suburbs in the north and elsewhere another R12. The total is therefore R24 for a passenger that requires a two-leg journey. In comparison the Hauweng system will charge the CBD leg at an R1 discount; therefore, a two-leg journey will be R21.
  - In addition to the above, the Hauweng system will offer discounts of 10% to 15% for multiple ticket sales for week tickets (10 trips) and month tickets (40 trips) respectively. Similar discounts are provided for the elderly travelling outside the peak periods. The total cost of a Hauweng trip will therefore be priced at between R17,35 and R18,90 depending on what multi-ticket bundle was purchased. Compare to the taxi trip of R24, the Hauweng fare is therefore between 21% and 28% cheaper than the taxi fare.
  - Social discounts fares for senior citizens are also offered at 15% below the single fare level and is applicable to senior citizens at the age of 65 and older which may be reduced to the age of 60, depending on the outcome of the public participation process. This social discount is however only applicable to off-peak periods.
  - When the starter service is extended to Phase 1 A and B, consideration can be given to the extension of the social discount fares to learners and students. The latter is however very difficult to administer. The only practical way is to allow any children under a certain age an automatic discount, provided proof of birth is provided.

15.4.2 Pricing Principles

The principles that apply to the revenue side are centred on the pricing policy, and in particular the fare structure itself.

The question about targeting Hauweng fare levels is closely related to the market position and quality of service of the system. The car market is used as an illustration: entry-level vehicles dominate the car sales, i.e. vehicles in the R150 000 to R250 000 price range. It is targeting the market that can afford this price range, whilst those that cannot reach this price tag, are captured public transport users. In contrast vehicles that are priced above the range of R1 million targets a very small portion of the market, generally less than 5%-10% of the market. The car market however is offering a very wide range of choices to all income levels of the market.

In the public transport sector, the choices are limited as the available modes in cities are generally limited to rail, taxi, bus and non-motorised transport. Within each mode the choices are also limited and in some cities all modes are not always available. Whilst taxi services are operated in all cities and even smaller towns and suburbs, two rail options are available only in Gauteng and in other cities such as Mangaung rail is not even an option. Similarly, some cities have an option of multiple bus solutions and in others the options are limited.

In Mangaung the public transport users are captive within two basic systems, namely the taxi services and a provincially contracted bus system (IBL), funded by Treasury. The bus system is provided in two forms, namely subsidised tickets and unsubsidised tickets. Furthermore, bus services dominate the long distance market, whilst taxi services dominate the short distance market. However, both modes operate both long and short distance trips.

Given this background, the taxi fares are generally about 20% higher than bus fares. However, unsubsidised bus fares over short distances are close but marginally cheaper than taxi fares. All subsidised bus fares are lower than taxi fares, but over long distances taxi fares are much higher than subsidised bus fares.

In comparison, the quality of the bus services is generally higher than taxi services, but only in some respects. From a safety point of view, buses are superior but in frequency terms the taxis are superior. However, in peak periods the high frequency of both systems are acceptable to the passengers. Nevertheless, during off-peak periods over long distances no bus services are provided and then taxis would operate few services at a much higher price, given the captive position of a few desperate passengers. Taxis would also not undertake a trip if the vehicle is not relatively full.

The pricing policy adopted for the Hauweng system is therefore based on the following facts and principles:

- The Hauweng system would offer a service that is of a higher quality as compared to both the taxi and the subsidised bus service system
- The only quality aspect that is the exception is the frequency of the service where the Hauweng system will not be as high as those offered by taxi services, but in the peak, it will be a marginal difference that should not be of major concern to the passengers.
- The Hauweng system is generally at a higher level of quality as compared to the subsidised bus service system.
- In terms of fare targeting the Hauweng system will position itself between the subsidised bus services- and taxi fare systems, i.e. about 10% – 15% lower than taxi fares, but with some concessions to allow for the subsidised bus tickets:
  - 2019 taxi fares are R12 per trip, with Hauweng single trip fare targeted at R11 per trip.
  - Taxis charge a passenger to and from the south to CBD at R12, and then from CBD to and from the suburbs in the north and elsewhere another R12. The total is therefore R24 for a passenger that requires a two-leg journey. In comparison the Hauweng system will charge the CBD leg at an R1 discount; therefore, a two-leg journey will be R21.
  - In addition to the above, the Hauweng system will offer discounts of 10% to 15% for multiple ticket sales for week tickets (10 trips) and month tickets (40 trips) respectively. Similar discounts are provided for the elderly travelling outside the peak periods.

15.4.3 Revenue/Farebox

The revenue for the citywide IPTN was calculated taking into account the above fare policy and existing public transport fare structure.

The existing fare structure of subsides bus services are presented in **Table 15-7** and mini-bus services are presented in **Table 15-8**. These were used to derive the fare structure for the IPTN system.

The fares structure applied in the calculation of the revenue for the IPTN system per area is presented in **Table 15-9**. No incentive was taken into account with different options of complementary versus direct or feeder-trunk-feeder service. Furthermore, no discounts for passengers with special categories of needs were included in the revenue calculation,

The estimated revenue per route design and patronage scenario for the three-design years are presented in Diagram 15-4. The trunk only option yield lower revenue than the other two options. This is a direct result of the number of passengers and that a percentage of passengers will use feeder services and not necessarily trunk services.

Table 15-7: Subsidised bus operator fare 2018

From	To	Multi ticket price	Number of Trips	Cost per Trip	Cash Fare
Botshabelo and Thaba Nchu	Central Park (Intermodal Facility)	R 140.5	8	17.56	
Hoffman Square and Central Park (Intermodal Facility)	Suburbs	R 69.2	8	8.65	
Hoffman Square and Central Park (Intermodal Facility)	Bainsvlei	R 98.6	8	12.33	
Thaba Nchu	Bainsvlei	R 160.6	8	20.08	

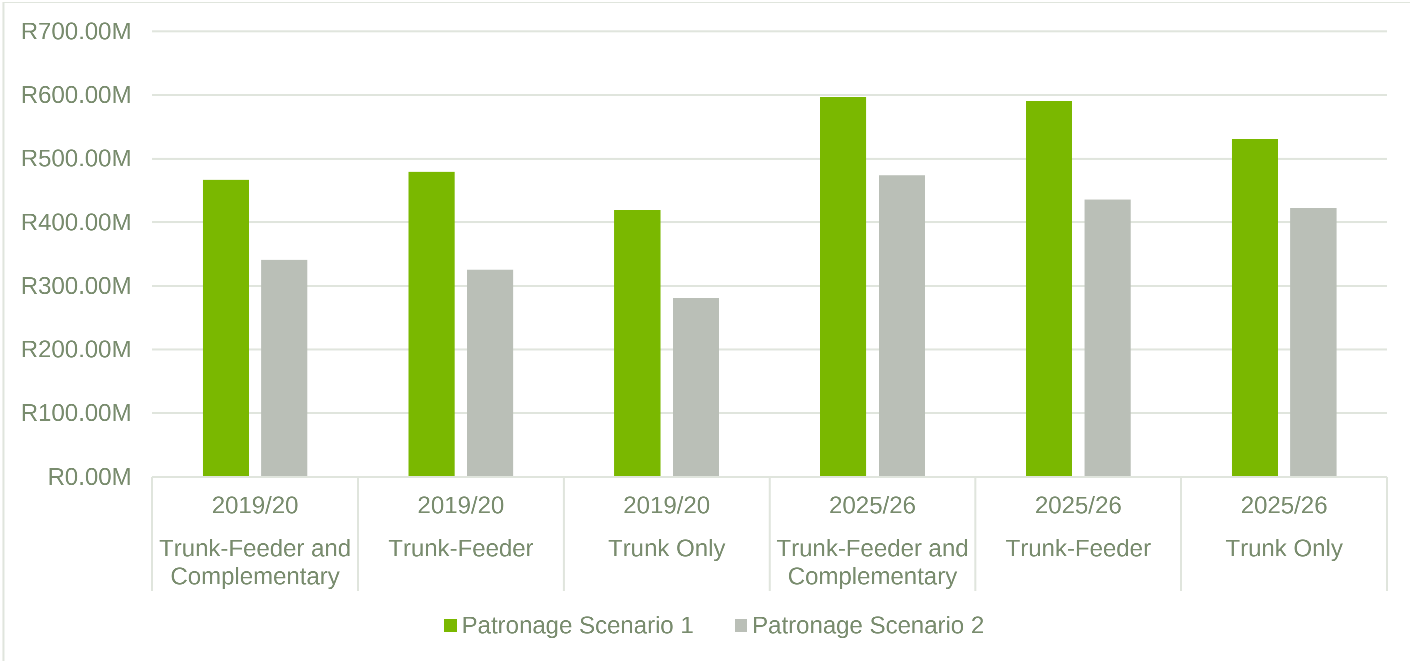
Table 15-8: Mini-bus taxi operator fares 2018

Corridor	Cost per trip
Bloemfontein CBD to Bloemfontein suburbs east of N1	R10.00
Bloemfontein CBD to Bloemfontein suburbs west of N1	R14.00
Bloemfontein CBD to South-eastern quadrant (Mafora, Turflaagte, Heidedal etc.)	R10.00
Bloemfontein CBD to Botshabelo	R25.00
Bloemfontein CBD to Thaba Nchu	R23.00

Table 15-9: IPTN Concept Fare Structure

Route Type	Area	Cost per trip
Feeder/Distribution	Botshabelo and Thaba Nchu	R5.00
Trunk to Bloemfontein CBD	Thaba Nchu	R19.00
Trunk to Bloemfontein CBD	Botshabelo	R16.00
Feeder	Bloemfontein	R3.00
Trunk to Bloemfontein CBD	Bloemfontein	R8.00
Feeder/Distribution CBD	Bloemfontein	R8.00
Complementary	Bloemfontein	R11.00

Diagram 15-4: Estimated Revenue per Route Option and Patronage Scenario



15.5 Capital and Operational Implications

The total capital funding available in 2018/19 is R 242.75M, taking the total required capital budget at R2,239.59M (Refer to Table 15-10) funding allocation at the same value will be required for the next 9-years to roll-out the IPTN system in the metro. Infrastructure optimisation and implementation strategies are thus critical to the implementation and development of an integrated public transport system in the metro.

Table 15-10: Total Capital Requirement to Implement City-wide IPTN

Item	Total
Roadways, NMT and Facilities	R869.54M
Maintenance and Upgrading of Facilities	R106.47M
Depot and Upgrade of existing depot facilities subsidised bus services	R260M
ITS CAPEX	R318.68M
ITS OPS	R166.95M
Vehicle Acquisition and Branding of Feeder Vehicles	R51.13M
Compensation	R466.82M
CAPITAL COST	**R2,239.59M**

The comparison between the available funding (PTOG) and estimated revenue for the full implementation of the IPTN indicate a shortfall that range between -R166 and -R90M per annum (Refer to **Table 15-11**). If the PTOG funding is excluded and the passenger demand associated with the subsidised bus services, the total shortfall increase to -R280M and -R170M (Refer to **Table 15-12**). It is thus imperative that the PTOG is utilised for the operational expenditure of the IPTN system. Through this approach an integrated system can be provided to the residents of the city.

Table 15-11: Patronage Scenario 1 Operational Shortfall per Route Design Option

Route Design	2019/20	2025/26	2035/36
Scheduled Feeder-Trunk and Complementary	-R9.30M	R9.66M	-R119.88M
Trunk Only (Pay per pax delivered)	-R9.30M	-R22.84M	-R92.45M
Scheduled Feeder Trunk	-R9.30M	-R58.01M	-R166.17M

Table 15-12: Patronage Scenario 2 Operational Shortfall per Route Design Option

Route Design	2019/20	2025/26	2035/36
Scheduled Feeder-Trunk and Complementary	R10.74M	-R79.72M	-R278.63M
Trunk Only (Pay per pax delivered)	R10.70M	-R69.19M	-R168.53M
Scheduled Feeder Trunk	R10.70M	-R95.83M	-R224.90M

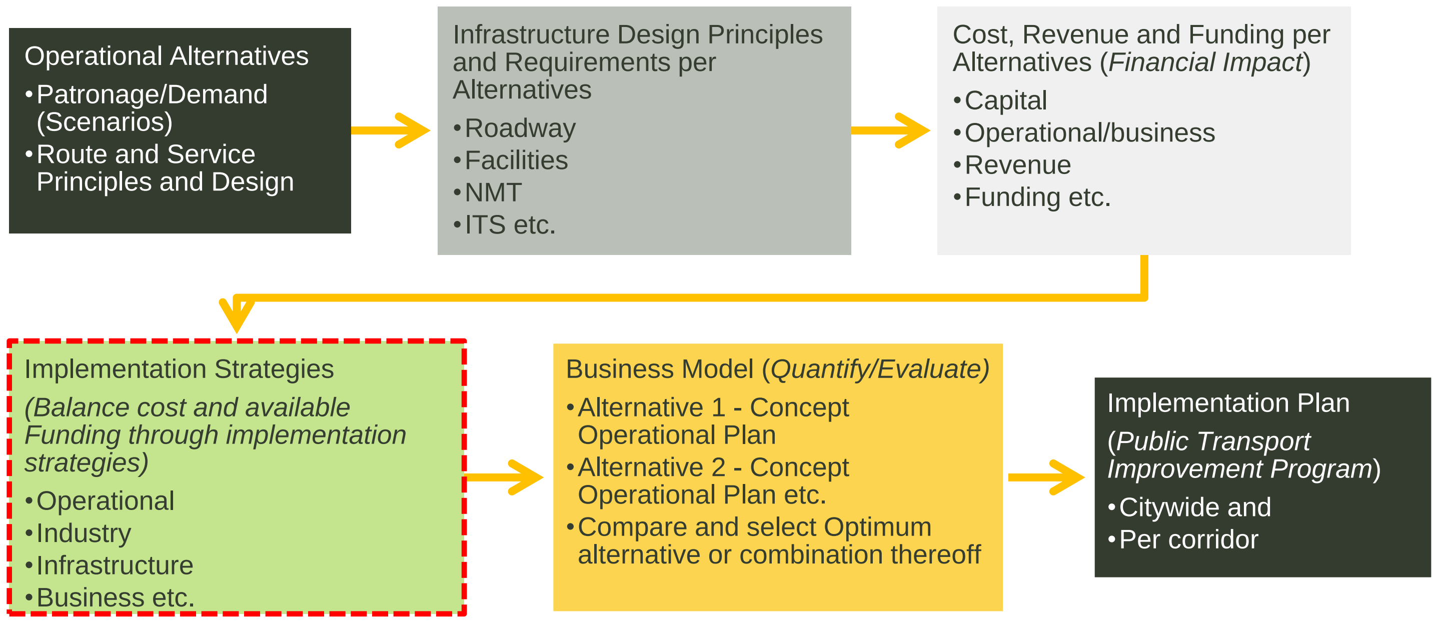
15.6 Conclusion

Implementation strategies are required to enhance the design guidelines and align available funding for capital to the intended roll-out of the IPTN system. It is, furthermore, necessary to identify the optimum route design and operational model to minimise operational shortfall in the short and long term to ensure financial sustainability.

Table 15-13: Estimated Roadway Upgrades and Maintenance

	Quantity (m2) m^2 length of road X number of lanes. Lane width=existing lane width								Estimated Cost ((R Million)						
Corridor	Additional Lane	Resurfacing /rehab road sections (Low Priority)	Resurfacing/ rehab section (High Priority)	Resurfacing/ rehab section (Provincial)	Resurfacing /rehab section (SANRAL)	Future Links	Additional Lane cost	Rehab Cost	Additional Lane	Resurfacing/ rehab road sections (Part of scheduled Maintenance)	Resurfacing/ rehab section (Prioritise Rehab and Maintenance)	Resurfacing/ rehab section (Provincial)	Resurfacing/ rehab section (SANRAL)	Future Links	Total Cost
Botshabelo	83,721	-	564,873	-	-	-	R1,500	R500	R125.5	R0.0	R282.4	R0.00	R0.00	R0.00	R408.0
CBD	19,369	1,486,068	40,696	-	-	40,617	R1,500	R500	R29.05	R743.0	R20.35	R0.00	R0.00	R60.9	R853.3
Dr Belcher	109,977	320,393	157,168	76,590	-	-	R1,500	R500	R164.9	R160.2	R78.58	R38.2	R0.00	R0.00	R442.0
Maphisa	37,193	132,905	195,036	-	-	-	R1,500	R500	R55.7	R66.45	R97.52	R0.00	R0.00	R0.00	R219.7
OR Tambo	-	156,067	73,306	45,770	-	-	R1,500	R500	R0.0	R78.03	R36.65	R22.8	R0.00	R0.00	R137.5
Ring Road (M10)	-	193,402	-	-	-	-	R1,500	R500	R0.0	R96.70	R0.00	R0.00	R0.00	R0.00	R96.70
SANRAL	-	31,681	-	-	977,821	-	R1,500	R500	R0.0	R15.84	R0.00	R0.00	R488.9	R0.00	R15.84
Thaba Nchu	55,043	-	422,226	-	-	-	R1,500	R500	R82.56	R0.00	R211.1	R0.00	R0.00	R0.00	R293.6
Vista Park	-	-	-	-	-	30,907	R1,500	R500	R0.00	R0.00	R0.00	R0.00	R0.00	R46.3	R46.36

16 Implementation Strategies



The preceding sections of the report indicate that the system cannot be implemented in one year given the extent of capital investment and operational cost. Strategies are required to implement the IPTN and related systems overtime within the available budget. These strategies however need to be evaluated to determine which strategy from a range of strategies will enable the implementation of the IPTN to realise the goals and objectives set for the system.

The elements identified that have a high impact on the implementation of the IPTN are listed below and thereafter the strategies to implementation are provided and the operational and capital cost of the strategies per element are compared. This comparison enables the selection of the strategy to implement the IPTN system. The result of this evaluation process is the Public Transport Improvement program.

High impact elements on the implementation of the network are:

- The incremental approach to implementation on all elements of the network and system;
- Network Phasing - Areas to include in Hauweng services versus areas to be operated according to the demand response principle.
- Route and Service implementation strategy
- Fleet strategy – Will existing or only new vehicles used and the selection of the optimum vehicle capacity per demand along route and services provided
- Industry transformation strategy -two existing public transport operators, bus and taxi.
  - Subsidised bus service rationalisation impact: lead to a significant increase in ridership, additional funding through PTOG funding, but also required capacity in the city to manage these contracts;
  - Mini-bus taxi operators rationalisation impact: Compensation for business high cost item. Distribution of compensation to operators in one year can delay operationalisation of the next phase, since capital for infrastructure is not available.
- Infrastructure roll-out strategy: Design for full demand scenario versus incremental implementation when demand warrants infrastructure capacity upgrades. Relate to roadway, stops, stations, depot, and ITS.
- Institutional Structure – Impact of number of VOC's contracted to provide services to IPTN on operational cost,
- Revenue – Fare Structure
- Funding sources – City contribution and other grants.

The evaluation of the impact of the above-mentioned strategies and variation in these strategies will be compared baring operational-, capital cost and available funding.

This concludes in the most optimum implementation model i.e. Public Transport Improvement Program.

16.1 Incremental Implementation Approach

The city will implement the IPTN system incrementally with the emphasis to implement the required infrastructure when demand/patronage warrant it. Thus, design for the low patronage scenario and allow to increase capacity at stations, stops and vehicle fleet when demand realises. The incremental approach is summarised as follows and will be detailed per aspect in subsequent sections:

- Phasing of IPT Network:
  - Phase 1 – 7;
  - Start with most densely populated areas and where a high number of public transport users already use the existing system.
  - Thus, focus on the most lucrative routes.
- Roadway (right of way):
  - Initial mixed traffic operations;
  - When ridership increase (i.e. more public transport vehicles per hour) or general traffic increase significantly in specific areas and impact on journey times of patrons, upgrades will be considered;
  - First implement queue jumping lanes, then dedicated lanes in peak periods and other methods to provide priority for public transport vehicles.
- Routes:
  - Only provide scheduled routes where passenger volumes are more than 450 passengers per peak hour;
  - Where demand is less than 450 passengers per hour regulated, unscheduled services will be provided as part of the IPTN brand.
- Stations and Stops:
  - Uncontrolled access stations to be implemented along trunk routes,
  - Stops to be implemented along complementary and feeder routes.
  - Based on demand scenarios determine loading area of stations and stops;
  - Stations provide more waiting area and provide mechanisms that enable quicker boarding and alighting (pre-validation), thus implementation at high demand stops.
- Depot:
  - Depot for purposes of providing shelter and maintenance of buses is required
  - Develop depot in phases linked to budget availability;
- ITS:
  - Fleet and passenger numbers increase - the sophistication of the system need to increase to accommodate passenger demand;
  - Design system in such a manner that it can grow in sophistication when warranted.

The incremental approach is detailed below to indicate the demand triggers that will warrant the increase of capacity or sophistication in systems.

16.2 Phasing of Network

The goal set for the implementation of the system is to provide a safe and reliable system to 85% of the population by 2036, which is financially sustainable and environmentally sensitive.

Given this objective the phasing of the system will incrementally roll-out to areas with a focus on area:

- Within BEPP identified integration zones and under serviced communities (first priority),
- With the highest population density. Higher population density leads to high demand and can result in lucrative routes;
- With mixed land use character – provide employment and residential activities. This land-use mix may result in bi-directional travel and not one-directional in peak periods of the day
- Where other residential densification initiatives already occurring followed by planned areas for densification.

Taking these guiding principles into account the functional public transport corridors were qualitatively evaluated and the result of the evaluation are presented in Table 16-1. The implementation sequence/phasing of corridors per table is presented in Figure 16-2. This phasing will enhance grant allocation in the city and implementation in high population density areas.

Table 16-1: Population Distribution per Corridor

Functional Public transport corridor	% of total MMM Population in Corridor	% of total MMM Jobs in corridor	Predominate land use	BEPP Integration Zone
Maphisa/Moshoeshoe OR Tambo	19.39%	12.31%	High Density social housing, Industrial, Residential	Yes
Dr Belcher	27.00%	8.86%	Industrial, Residential	Partially
CBD	14.56%	57.10%	Yes, High density housing	Partially
Botshabelo	21.95%	7.67%	Industrial, Low density residential	No
Thaba Nchu	9.04%	5.69%	Industrial, Low density residential	No

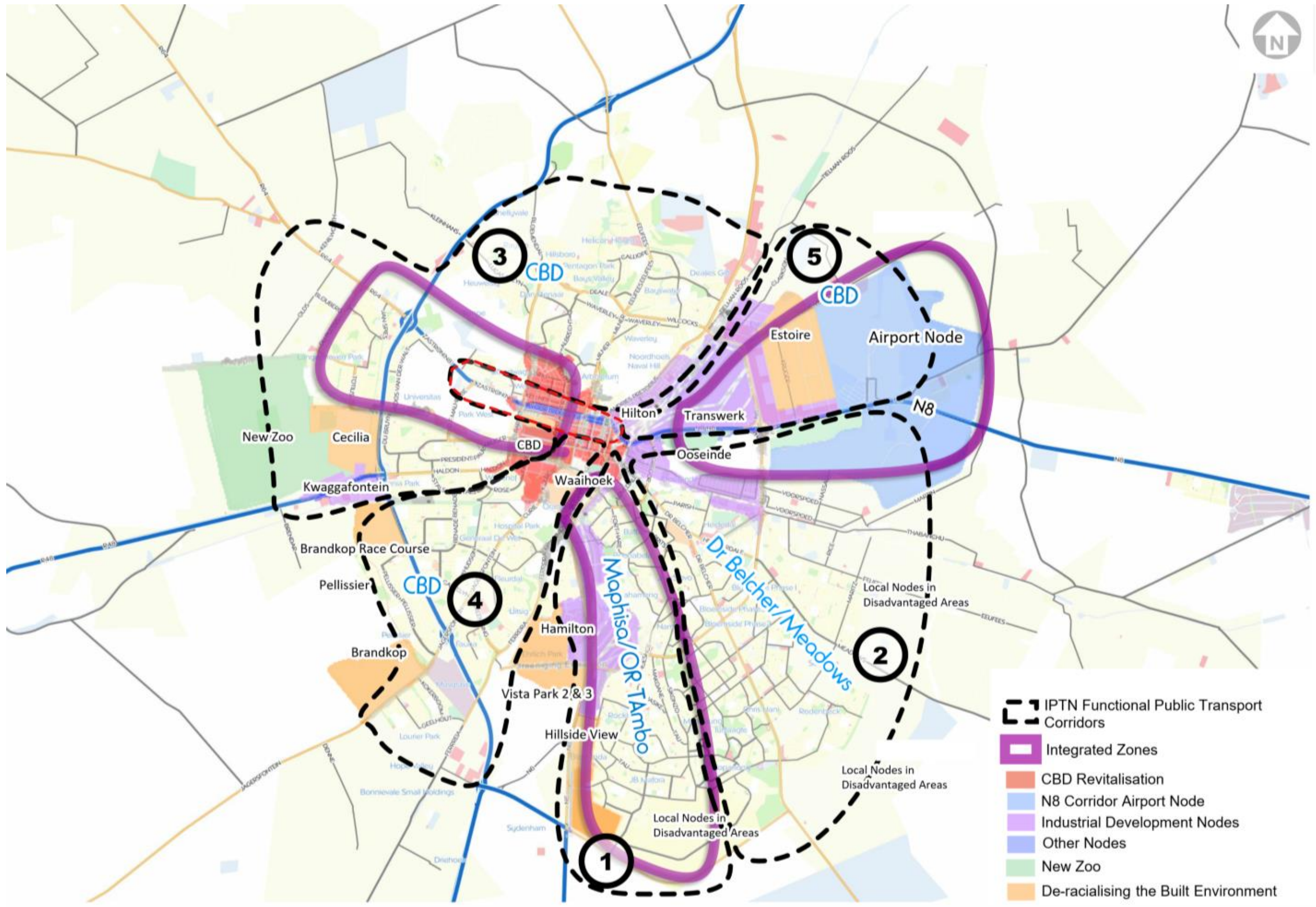


Figure 16-1: IPTN Corridor Implementation Phasing

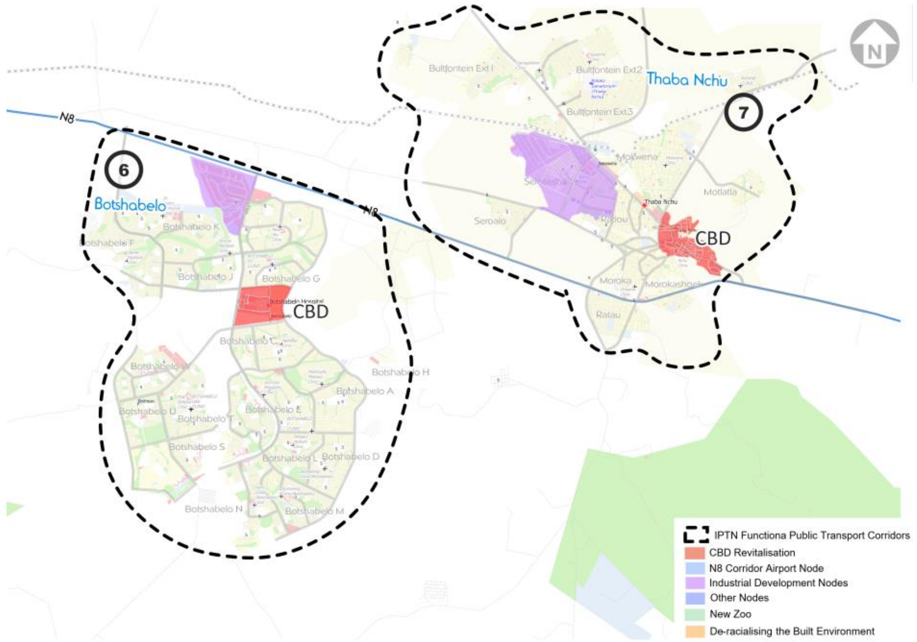


Figure 16-2: IPTN Corridor Implementation Phasing

16.3 Routes and Services

The objectives of the IPTN are to provide an affordable, long term financial sustainable service and convenient to passengers. The route design thus seeks to minimise the difference between revenue and direct operating cost and thus minimise the operational cost shortfall.

The alternative route designs that were defined and compared to each other in terms of operational cost and revenue collected are:

- Trunk routes and services only passengers to walk to the trunk or utilise unscheduled feeder services;
- Trunk-feeder routes and services;
- Trunk-feeder and complementary routes and services.

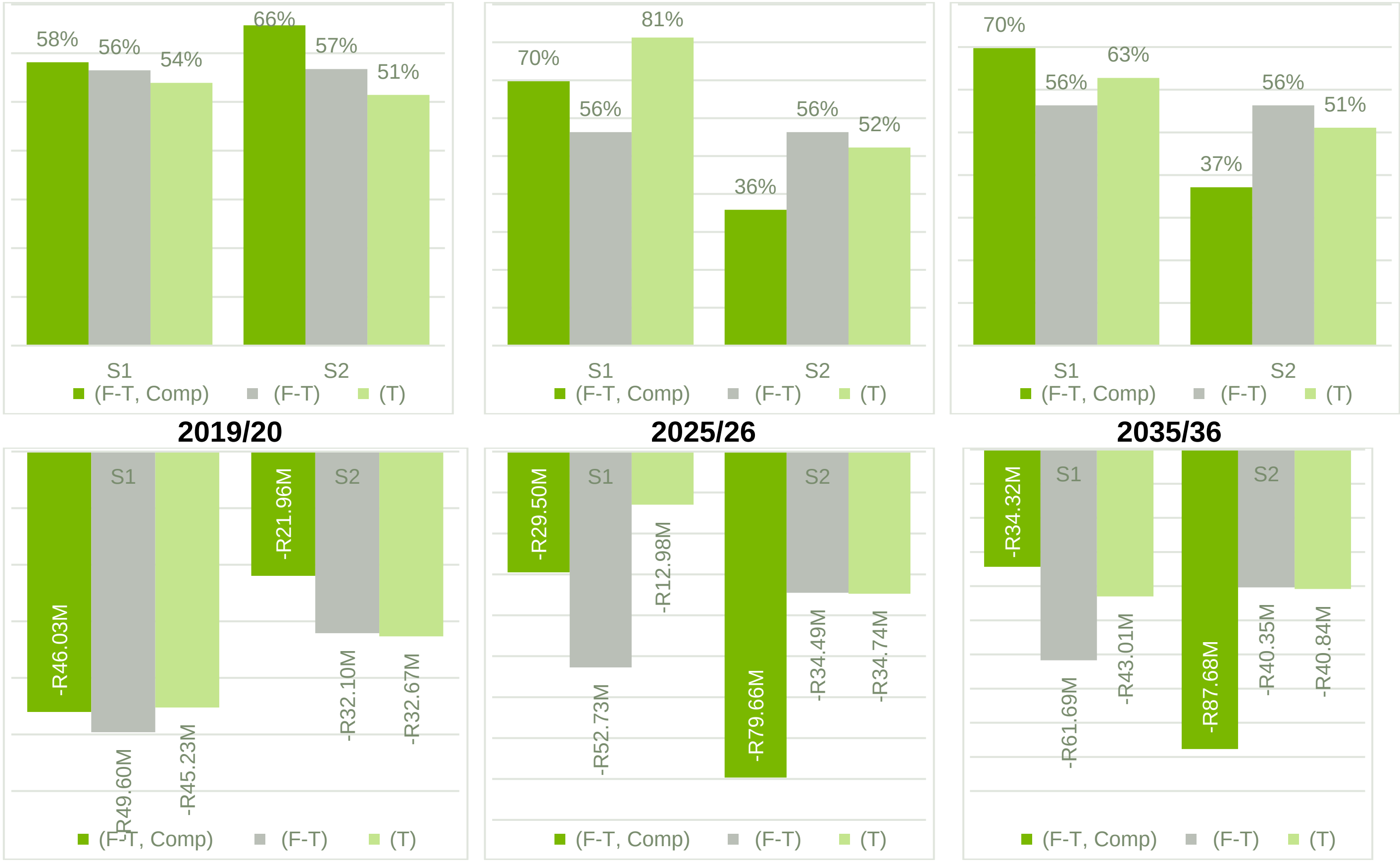
Refer to the design principles for the concept of operations and the advantages and disadvantages relating to the passenger experience.

Diagram 16-1 to Diagram 16-4 present, per functional public transport corridor the operational cost and estimated revenue in terms of route design alternatives, patronage scenarios per the 5-, 10- and 25-year design. These diagrams provide insight into the impact of the route design and patronage scenario on operational cost and revenue, per corridor.

The results presented in these diagrams can be divided into two groups:

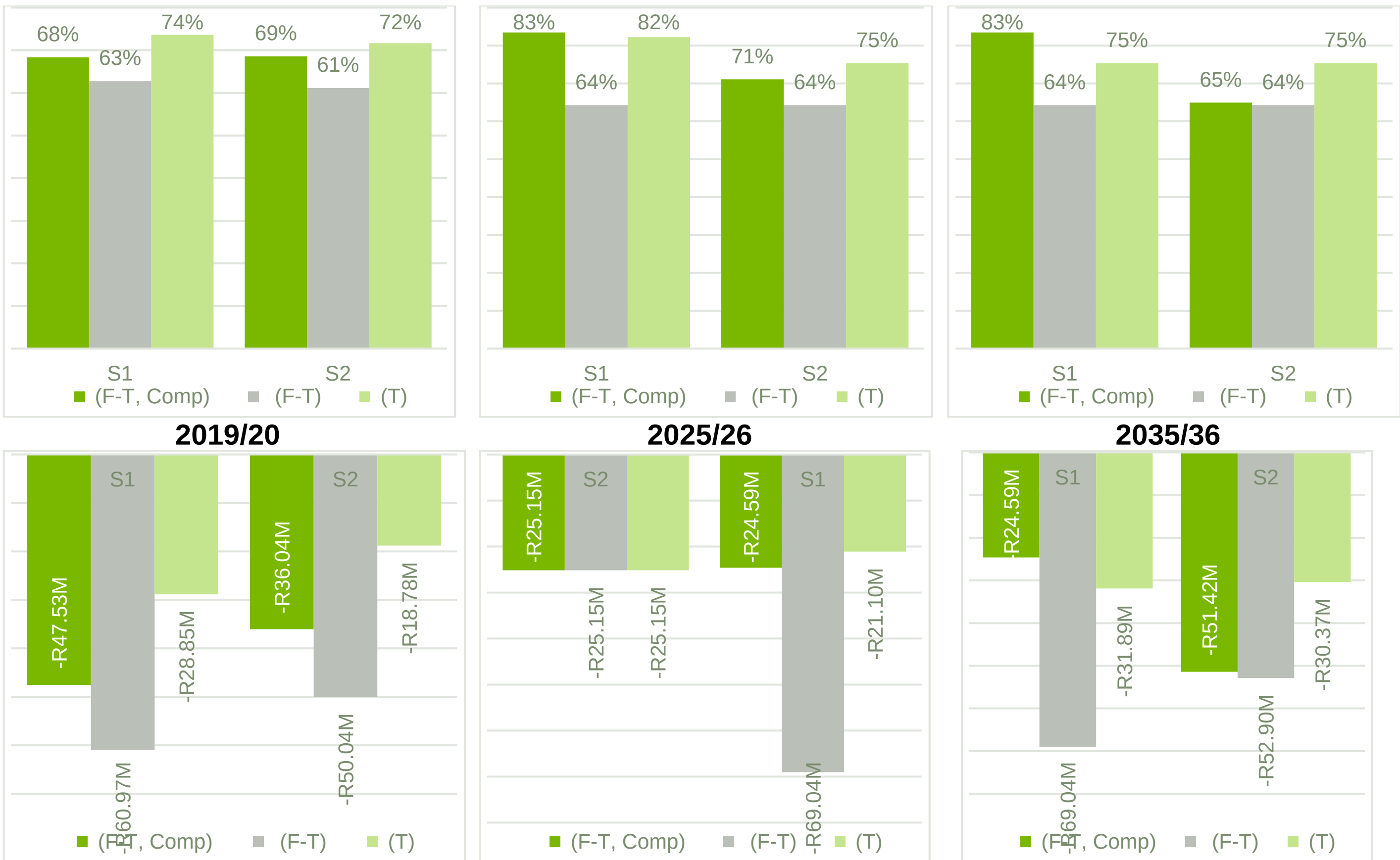
- Bloemfontein corridors where the one direction travel distance of the trunks is less than 15,0 km and the feeder route distances range between 2,0-6,0km.
  - These include the CBD, Maphisa/Moshoeshoe/OR Rambo and Dr Belcher functional public transport corridors.
  - Variables compared is farebox coverage that includes the direct operational cost and the revenue and the extent of the shortfall between the mentioned variables. The quantum of the shortfall needs to be tested against the available funding and thus influences the selection of the services that can be implemented.
  - Thus, it is important to select the route design by taking into consideration available funding for subsidising the operational cost. This is derived from the farebox coverage ratio and the total shortfall between the revenue and operational cost. Where limited funding is available for the financial year or years the route design option needs to be selected where the least shortfall will occur. Or where the feeder trunk option is near to the trunk shortfall it will benefit passenger experience and reliability of the system to implement scheduled feeders as well.
  - The funding required to subsidise a trunk only operation is the least. However, the farebox coverage and passenger experience and the risk that passenger will not have asses to the system is a disadvantaged and the implementation of scheduled feeders to the trunk service will minimise the risk.
  - It remains a balancing act between risk and affordability given the estimated patronage.

Diagram 16-1: Maphisa/Moshoeshoe/OR Tambo – % Farebox Coverage of Direct Operating Cost per Route Design Alternative



Note - (F-T, Comp) = Feeder-trunk and Complementary, (F-T) = Feeder-Trunk, (T) = Trunk Only

Diagram 16-2: Dr Belcher - % Farebox Coverage of Direct Operating Cost per Route Design Alternative



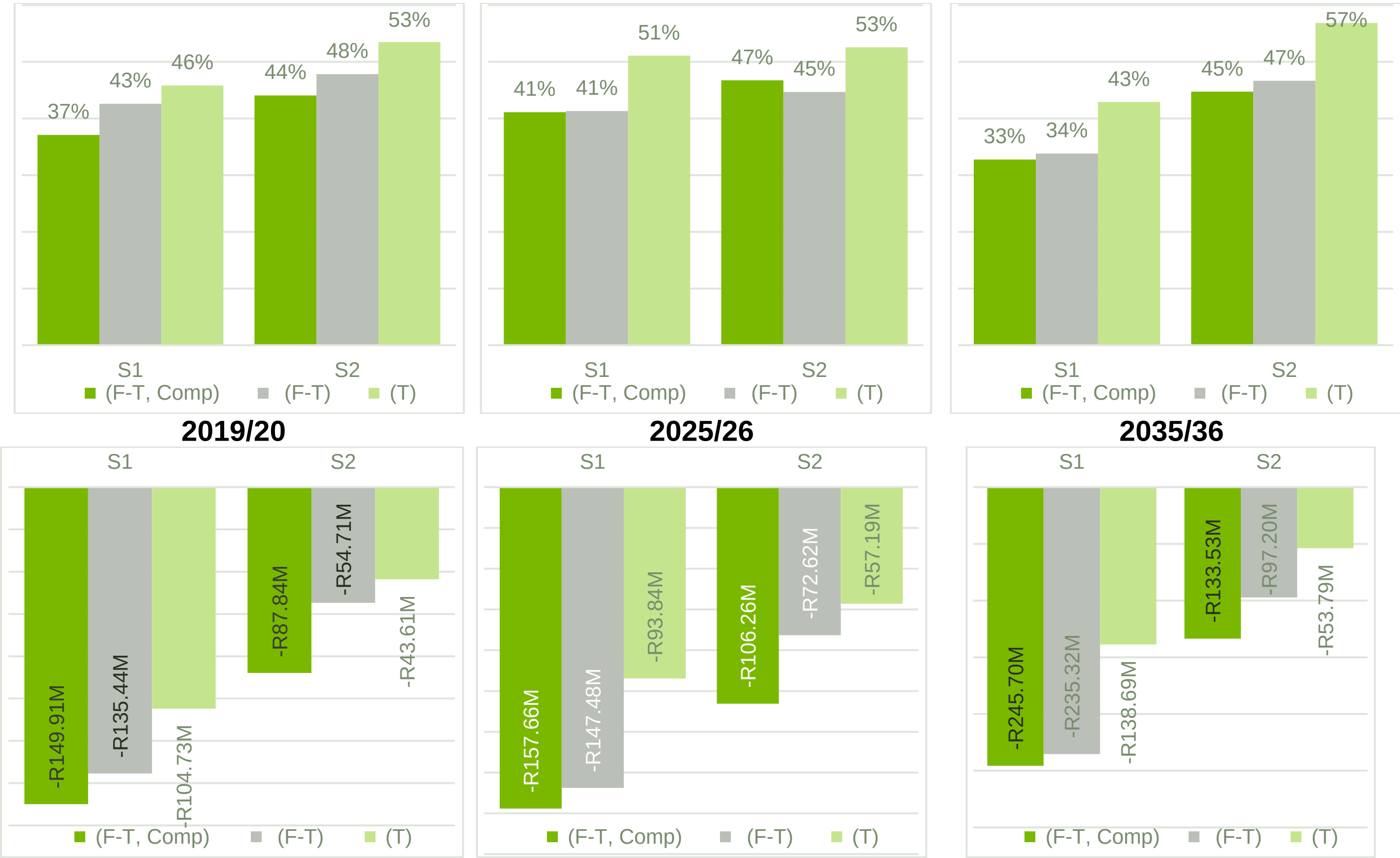
Note - (F-T, Comp) = Feeder-trunk and Complementary, (F-T) = Feeder-Trunk, (T) = Trunk Only

- Botshabelo and Thaba Nchu corridors where the one direction travel distance of the trunks is less than 70,0 km and the feeder routes range between 5,0-10,0km.
  - These include the Botshabelo and Thaba Nchu functional public transport corridors.
  - Variables compared are farebox coverage, the ratio of direct operational cost to revenue collect and the value of the shortfall between the mentioned variables. The value of the shortfall needs to be compared against the available funding for operations. If the funding for a specific route design is not available for a specific financial year the route design for which the funding is available need to be implemented. When the patronage increases the service can be increased to include more scheduled services.
  - Thus, it is important to select the route design by taking into consideration available funding for subsidising the operational cost. This is derived from the farebox coverage ratio and the total shortfall between the revenue and operational cost. Where limited funding is available for the financial year or years the route design option needs to be selected where the least shortfall will occur. Or where the feeder trunk option is near to the trunk shortfall it will benefit passenger experience and reliability of the system to implement scheduled feeders as well.
  - The funding required to subsidise a trunk only operation is the least. However, the farebox coverage and passenger experience and the risk that passenger will not have asses to the system is a disadvantaged and the implementation of scheduled feeders to the trunk service will minimise the risk.
  - It remains a balancing act between risk and affordability given the estimated patronage.

Diagram 16-3: Botshabelo - % Farebox Coverage of Direct Operating Cost per Route Design Alternative

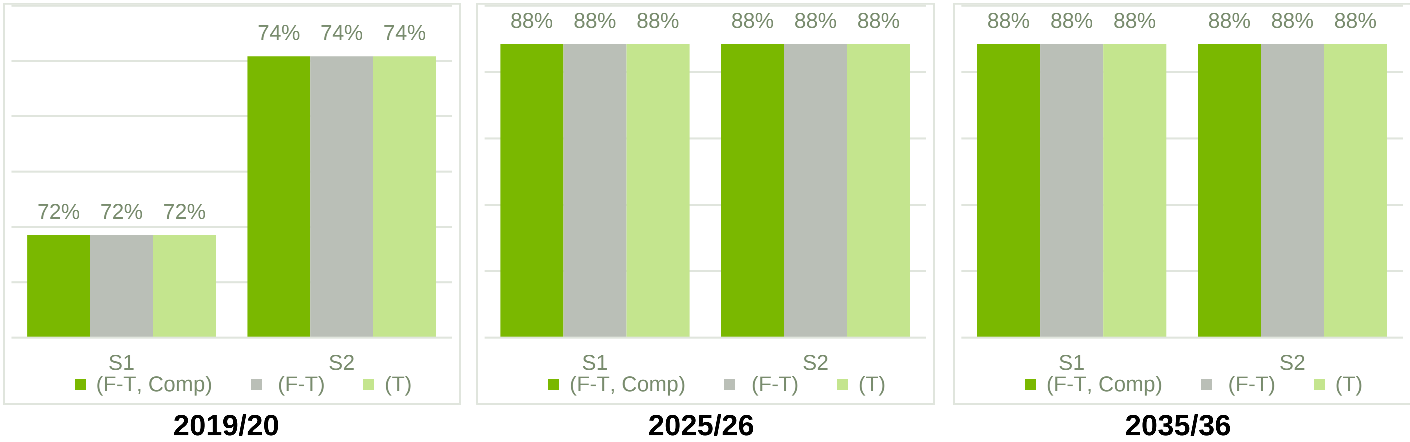
Note - (F-T, Comp) = Feeder-trunk and Complementary, (F-T) = Feeder-Trunk, (T) = Trunk Only

Diagram 16-4: Thaba Nchu - % Farebox Coverage of Direct Operating Cost per Route Design Alternative



Note - (F-T, Comp) = Feeder-trunk and Complementary, (F-T) = Feeder-Trunk, (T) = Trunk Only

Diagram 16-5: CBD – % Farebox Coverage of Direct Operating Cost per Route Design Alternative



Routes and Services Implementation Strategy:

- Operationalise with trunk only services with unscheduled feeder services.
- If funding is available to fund the shortfall for a trunk-feeder operational model this need to be implemented given that this minimise risk of passengers that do not have access to the system.
- As the trunk-feeder system will be implemented where demand and service area are appropriate for implementation,
- Feeder routes will collect passengers and interact with trunk services at transfer facilities. Feeders routes can also integrate with trunk routes at dedicated stations where facilities are provided for this integration.
- When passenger demand increases along feeders the implementation of a complementary route will be considered.
- Where passengers indicate complementary routes during certain hours of the day due to safety or other related matters a financially viable study need to be commissioned to determine cost of implementation. Thereafter a decision can be made for implementation.
- Where new developments are approved a public transport plan need to accompany the application to indicate estimated public transport ridership and the service required. Based on this study a financial evaluation will follow to determine the service type and the ramp-up of the services in the areas.

16.4 Service Frequency

Three service frequency alternatives were defined. These alternatives are:

- The **most optimum** service frequency is where a vehicle trip is only introduced when the demand at that point in time will fill the vehicle, i.e. optimum occupancy levels. In practice a certain percentage of unoccupied seats are allowed, i.e. 10% empty seats. This method will provide the absolute optimum cost efficiency level. This method does not always satisfy the passenger requirements or the minimum service frequency set to ensure the quality service envisaged for the IPTN.
- The second alternative service frequency refers to the **least financial optimum service frequency**, namely the one that leans over to the passenger needs, namely a fixed schedule of trips that is providing a high frequency of trips regardless of how empty the vehicle deployed along the route is. This method requires - for example - a service every 5 or 10 minutes in the peak and every 10 or 15 minutes in the off-peak and do not take the demand into account along the route. This can lead to empty seats that are however costly.
- Both of the above extreme examples are not practical in real life and a **hybrid service frequency** is probably the only practical solution. Accordingly, rather ensure that during the peak hours the service frequency at least meets the demand requirement, i.e. a seat or standing space is available to all passengers, and during the off-peak periods a minimum service frequency is introduced, i.e. a service will be available at regular intervals within reasonable cost limits. This service frequency principle is referred to as the hybrid scheduling approach.
- Diagram 16-6 and Diagram 16-7 illustrate the operational cost for a trunk-feeder, complementary route design option with service frequencies per the hybrid service frequency alternative and a fixed service frequency irrespective of the demand. Where the frequency yield more frequent service than the fix 20-minute frequency the service frequency was kept to the demand required frequency. Note that the operational cost for the 20-minute fixed schedule is near to the operational cost for the hybrid schedule. The fixed frequency of 10-minutes in the peak and 15-minutes in the off-peak increased the operational cost significantly. Furthered more note that the lower the total patronage per corridor the higher the financial impact will be when a fixed minimum service frequency is implemented.

Diagram 16-6: Fixed Service Frequency (20-minute) versus Hybrid Service Frequency.

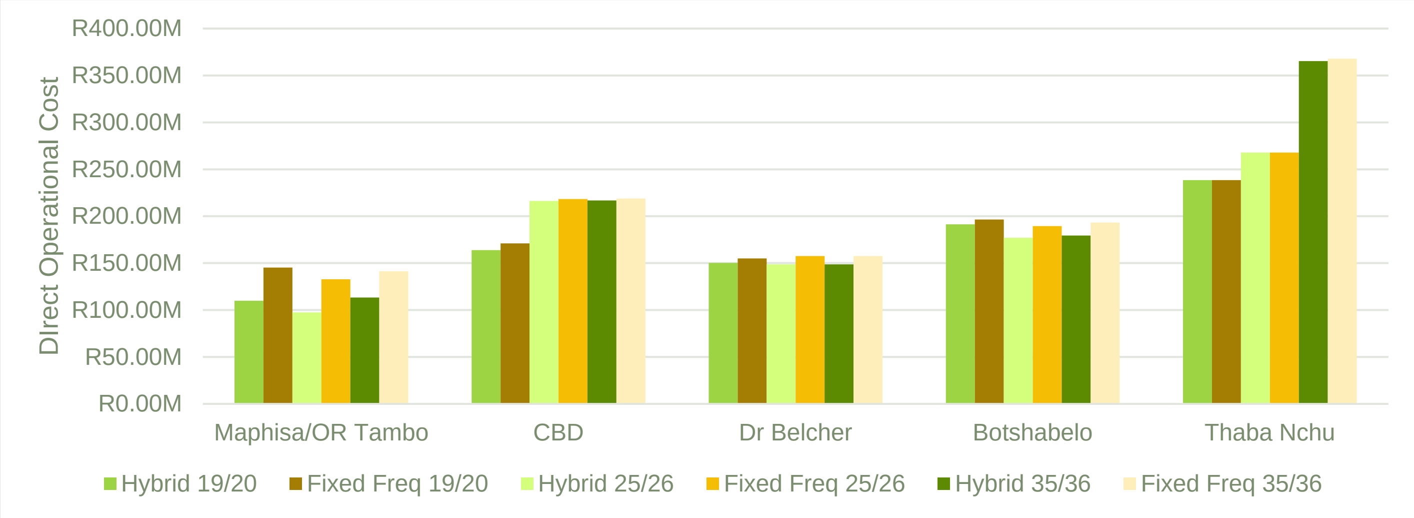
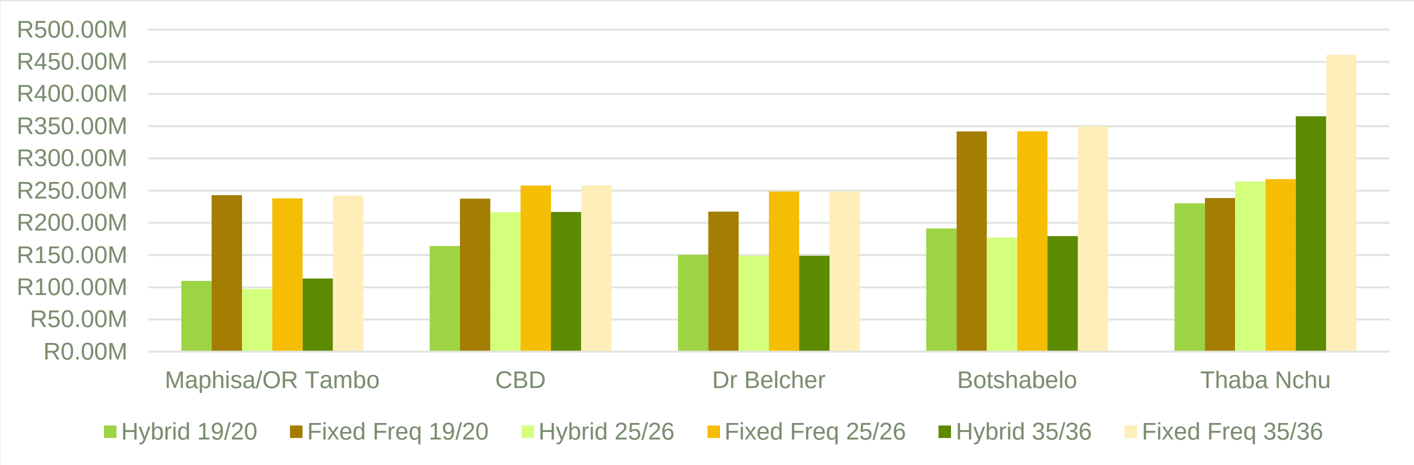


Diagram 16-7: Fixed Service Frequency (10-minutes,peak and 15 – minute, off-peak) versus Hybrid Service Frequency.



Services Frequency Implementation Strategy:

A hybrid service frequency methodology is selected for implementation, where during the peak hours the service frequency meet the demand requirement, given that it is not and a minimum of 20-minutes during the peak hours of the day and 30-minutes during off peak i.e. a seat or standing space is available to all passengers, and during the off-peak periods a minimum service frequency is introduced, thus reach middle ground between passenger preference and financial viability. The recommended service frequencies per operational hours of the day is presented in Table 17-2.

Table 16-2: Service Frequency Strategy

	Operational Hours	Service Frequency
Weekdays	05:00 – 09:00 and 15:00 -18:00	20-minute frequency **peak hours**
	09:00-15:00 and 18:00 - 20:00	30-minutes Off peak hours
Saturdays	05:00 – 16:00	30 minutes - all day
Sunday/Public Holidays	06:00 – 15:00	60 minutes - all day

16.5 Fleet Strategy

The fleet will comprise of a variety of vehicle capacity to suit demand per route and will comply with all standards per grant requirement. The strategy to the selection of the optimum vehicle fleet stems from optimising the vehicle capacity per route to ensure that a service frequency of 20-minutes or less is provided during the peak hours of the day and a frequency of 30-minutes during the off-peak periods of the day.

To determine the effect and impact of vehicle mix in a fleet, two alternative vehicle fleet mixes were developed and applied to the three route design options namely trunk only, feeder-trunk and the feeder-trunk and complementary route alternatives. The patronage scenario applied is Patronage Scenario 1 (all demand). The criteria compared between the two alternative fleet options are the operational cost and percentage of routes that yield a service frequency of 20-minutes or less during the peak hour of the day.

The two fleet alternatives are:

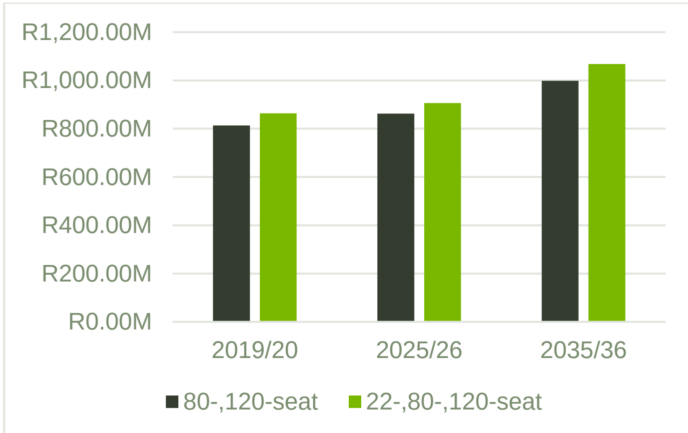
- Alternative 1 – fleet comprises of 22-, 80- and 120 seat capacity vehicles:
  - It is envisaged that the 22-seat vehicle will be existing vehicles for a period of 3-years where after it will be replaced by universal accessible (new) vehicle. The remainder of vehicles will be new universal accessible vehicles according to specifications attached in Annexure U.
  - The detail on route and services and the contracting of feeder vehicles is addressed in route and service strategy and industry transformation section of this report.
- Alternative 2 – fleet comprises of 80- and 120 seat vehicles only:
  - All vehicles will be new vehicles and universal compliant.
  - Specifications attached in Annexure U.

In Diagram 16-8 the operational cost and the percentage of routes that yield frequencies less than 20-minutes are presented for the two vehicle fleet alternatives per route design. The vehicle fleet with 80- and 120 seat capacity vehicles yield the most cost-effective vehicle fleet, optimising operational cost. However, for the feeder-trunk and feeder-trunk complementary route design options the routes with service frequencies more than 20-minutes are 28% more. Thus, the passenger service level will be lower. The selection of a vehicle fleet mix is furthermore, sensitive to patronage and thus for implementation purpose and with the uncertainty of patronage during the operationalisation of a corridor it is recommended that flexibility is also provided in the vehicle fleet mix i.e. that he fleet do not comprise of one capacity vehicles only but at least allow for variation to enable optimisation of operational cost. To this end it allows for operational cost optimisation if demand does not realise immediately when a corridor is operationalised.

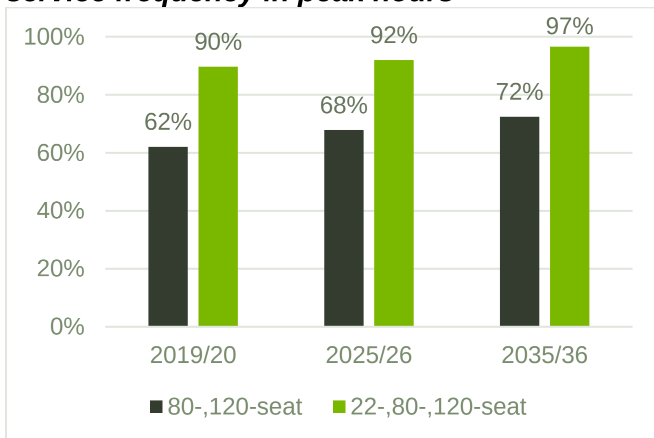
Diagram 16-8: Vehicle Fleet Mix per Route Design Option

Feeder-Trunk-Complementary

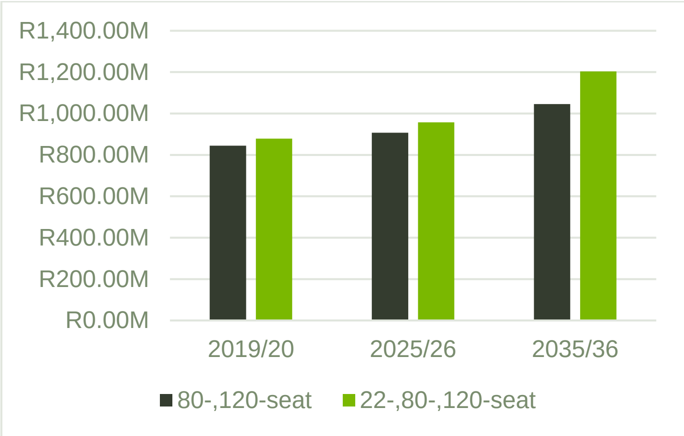
Direct Operational Cost

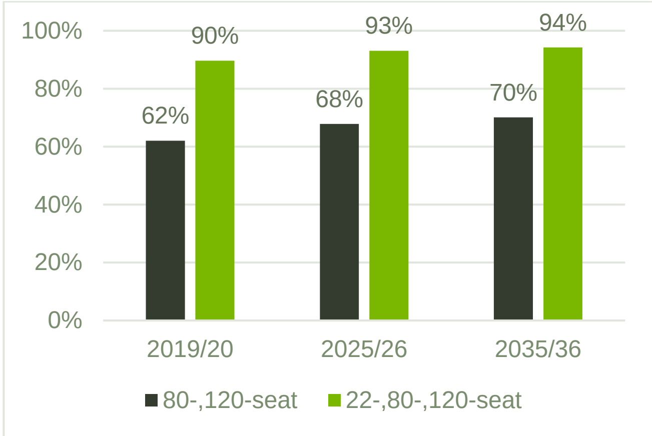


Percentage of routes with 20-minute or less service frequency in peak hours

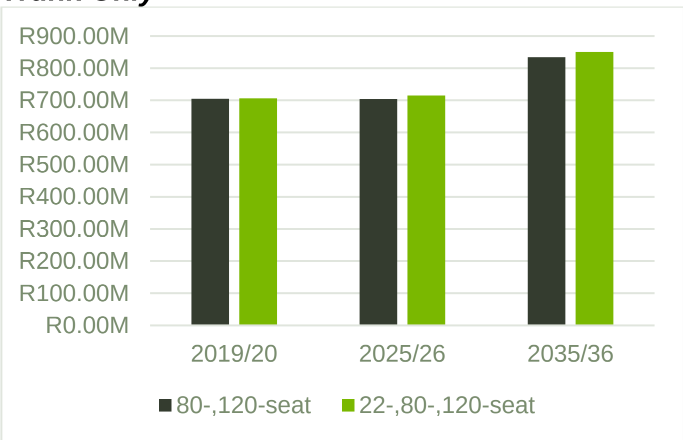


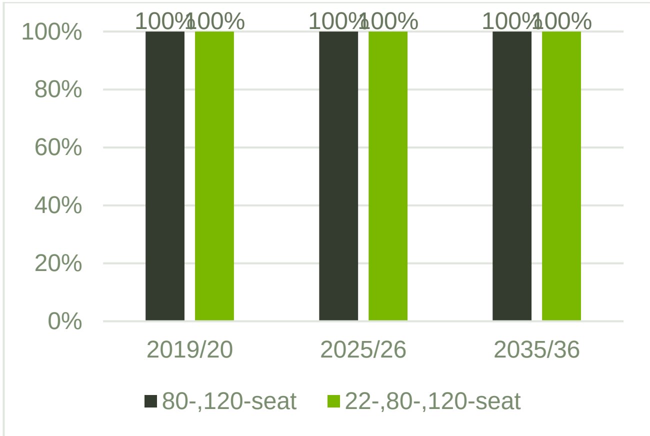
Feeder-Trunk





Trunk Only





Fleet Deployment Strategy:

- The fleet will comprise of 22-, 80- and 120 seat vehicles;
  - 19-metre articulated low entry (Euro V) diesel-powered (initially) – 120 passenger capacity;
  - 12-metre standard low entry (Euro V) diesel-powered (initially) - 80 passenger capacity;
  - Smaller vehicles for feeders. – 22 passenger capacity. The detail specification of these vehicles needs to be finalised and approved by universal access specialist;
  - Long distance standard and articulated – universal accessible but also suitable for rural road conditions;
  - Refer to sustainability action plan for long-term alternative fuel options to be implemented.
- The optimum vehicle capacity will be selected per route and demand to ensure a service frequency of at least 20-minutes during the peak hour of the day;
- The fleet mix will allow for two or more vehicle capacities when a corridor is operationalised to enable optimisation of operational cost and to implement incrementally and not for the ultimate estimated demand;
- 80-and 120 seat vehicles will be new universal accessible vehicles;
- 22-seat vehicles. Initially existing vehicle will be used for this part of the fleet. Three years after corridor is operationalised these vehicles will be replaced by universal accessible vehicles. Vehicles to be deployed need to be validated and evaluated according to minimum specifications. This will ensure road worthy and well-maintained vehicles to be part of the fleet. These services provided by these vehicles will be contracted and will not be an informal service. Vehicles will be branded and equipped with AFC.
- Long distance standard and articulated vehicles will be branded and equipped with AFC to ensure that fare collection system is the same on MMM services. This will enhance integration between services across the city.

16.6 Service Rationalisation Strategy

The IPTN will provide services in the local corridors within Bloemfontein, Botshabelo and Thaba Nchu. The rural- and cross-border services will remain with amendments to operating licences to allow for integration with Hauweng services at identified transfer facilities.

Currently three taxi associations collectively operate 230 routes within the local corridors of Bloemfontein, Botshabelo and Thaba Nchu. The subsidised bus services operate in the same jurisdiction areas with specific service areas per contracts. The operational areas per taxi route are presented in Figure 13-8 and the contract areas of the subsidised bus services are presented in Figure 16-5 for the Bloemfontein area and Figure 16-6 indicate the long-distance and cross-border services. The detailed routes and related information for subsidised bus services are provided in Annexure HH.

The rationalisation of existing services and the principles applied for the rationalisation process is important to the success of the new system and the provision of an integrated system, that is financially sustainable and can easily be managed and regulated after rationalisation. Rationalisation, however, needs to be accompanied by industry transformation to enable transformation of the industry to the new system and to minimise job losses.

The incremental approach to the rationalisation of services are presented in Figure 16-4. This process represents the rationalisation within one corridor. Corridors can be at different stages of the depending on the year that a specific corridor is operationalised. Bi-annually the rationalisation and transformation proposed are re-evaluated to determine progress with implementation and determine the next phase or increment of services to be incorporated into the system and how the new IPTN system services already implemented need to be changed or amended.

This process is underpinned by the following principles that enable the process:

- Demarcation of corridors/market areas
  - The subsequent principles rely on the demarcation of corridors or existing market areas to enable successful rationalisation and compensation of affected operator. These market areas are defined by minibus taxi routes that are grouped together based on land use and functional urban spaces. With this approach to demarcation the business and passenger perspectives are accommodated. Furthermore, the demarcation of the functional public transport corridor aligns with the spatial transformation agenda and BEPP integration zones. Refer to Section 13.4.4 for detail on the demarcation of the functional public transport corridors.
- "Clear the Corridor" – principle
  - Clear the corridor refers to the principle where the taxi and bus industries are removed in full and compensated for their current business stake. They are removed ("cleared") from the corridor where they currently operate comprehensively and permanently, except for the feeder service they may provide as indicated in the route design alternatives. The business rights are "purchased" through the negotiated compensation amount and a restraint of trade agreement is entrenched in the buy-out contract.
  - This principle is based on the need for cost efficiency, the optimisation of financial resources and system operational optimisation, i.e. to ensure buses are full and all seats are occupied as far as possible. As such the City cannot afford to compete with other operators, not along the same corridor, nor along alternative corridors parallel to the trunk routes. This is also applicable to some competing services that are also dependent on government financial support. Any such competition is not justified as it may lead to empty buses.
  - It means that a restraint of trade agreement is part and parcel of the negotiated contract for which they are compensated. In practice it means that the City needs to be in a position to regulate the issuance of current and future operating permits along the corridors under its jurisdiction.
  - With regards to the regulatory requirements, the City cannot afford to be in a position to be dependent on the decisions of another party, regardless of whether it is another government institution. The City needs to determine its own fate.
- Complete Withdrawal
  - Clear the corridor is also related to another associated principle, namely that when a corridor is cleared (removed), then the removal is complete and not partly. From a practical point of view, it is not possible to clear only half of the corridor.
  - The best way to illustrate the principle is that when one party acquires a particular fast food franchise, the entire franchise market value is acquired and not a portion of that. It is a matter concerning optimum

business sizes. In the taxi industry, the destabilisation of a business association consisting of numerous individuals is too complex when it is done in small steps. It requires a buy-out of the entire business or not at all. Hence the agreed principle to be adopted between the parties in the taxi industry is to remove a particular corridor (taxi route) completely at one specific point of time.

  - In some instances where the market areas of two parallel routes are overlapping to a large extent, then it is necessary to remove these two corridors at the same time. Brandwag and Universitas is one such example.

- Transformation of feeder services from unscheduled to scheduled services
  - The implementation of service when a corridor is operationalised will comprise of trunk only scheduled services with unscheduled feeder services. These feeder services will integrate with the trunk services at dedicated transfer points along the trunks.
  - These unscheduled feeders have an inerrant risk that passengers will not be served during off-peak periods and not at the same service frequency applicable to trunk services. For this reason, the rationalisation of feeder service to scheduled service remains the preferred option. The rationalisation of feeders' services to scheduled services is subjected to financial viability and sustainability. When a feeder route or service transport more than 450 passengers during a peak hour it needs to be considered for transformation to scheduled service. Irrespective of this volume vehicle will be replaced with universal accessible vehicles after 3-years after operationalisation even if a scheduled service cannot be implemented.

Service Rationalisation Strategy:

Taking these principles into consideration the implementation of the IPTN is recommended as follows:

- Rationalise corridors according to defined functional public transport corridors. Rationalisation include minibus and subsidised bus services in the corridor. Thus, rationalise subsidised bus contracts per corridor and do not take over all contracted routes at once.
- Note that the rural services and cross-borders service will remain separate contracts and the service frequency and route design will differ from the local corridors. Service in these corridors will be provided on demand and not subjected to minimum service frequencies per Hauweng system design. However, vehicles deployed as part of these contracts need to be universal accessible and the fare collection system need to be integrated with the Hauweng system.
- The rationalisation of contracted unscheduled feeder service to scheduled services will be based on financial viability.
- The rationalisation phasing and corridors for subsidised and minibus taxis are presented in Annexure S.
- The rationalisation phasing proposed depending on the funding availability is presented in Figure 17-7, Figure 17-8 and Figure 17-9.

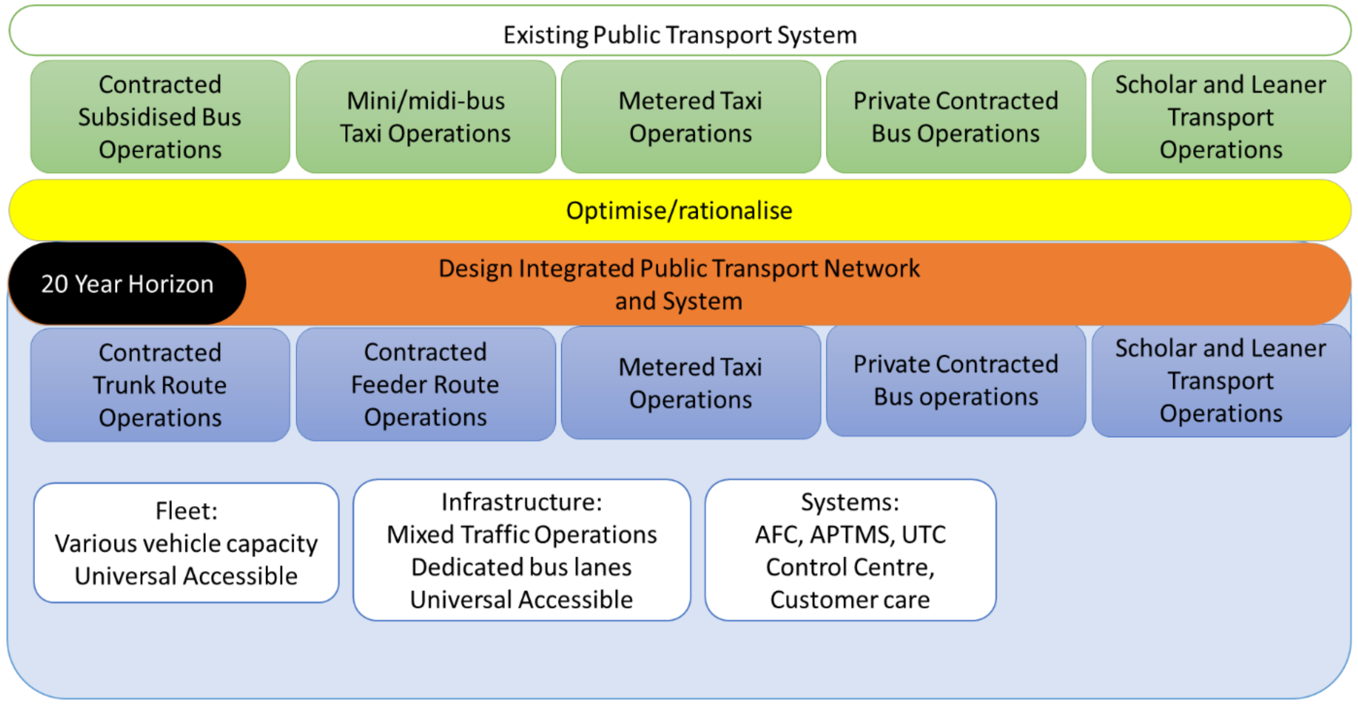


Figure 16-3: IPTN 20-year Rationalisation and transformation process

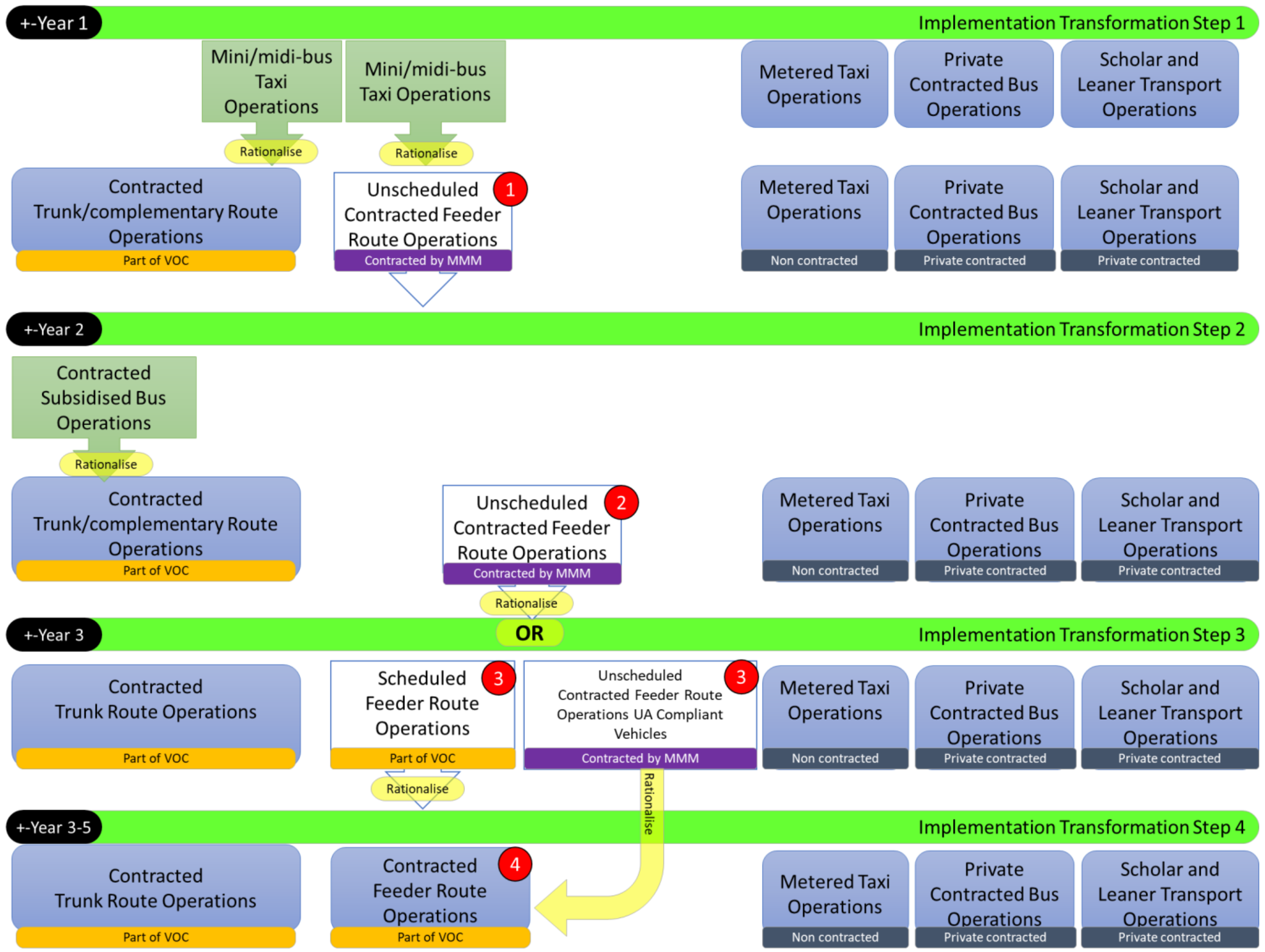


Figure 16-4: IPTN Rationalisation and transformation Increments/process

Figure 16-5: Existing Subsidised Bus Services per Network Phase

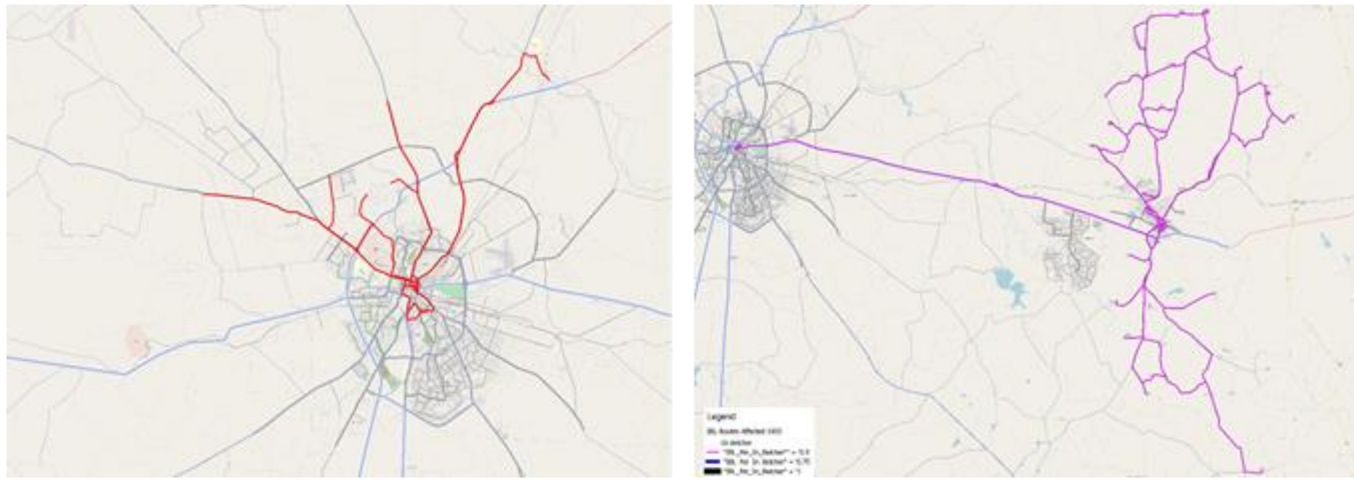


Figure 16-6: Long Distance and Cross-Border Existing Subsidised Bus Services

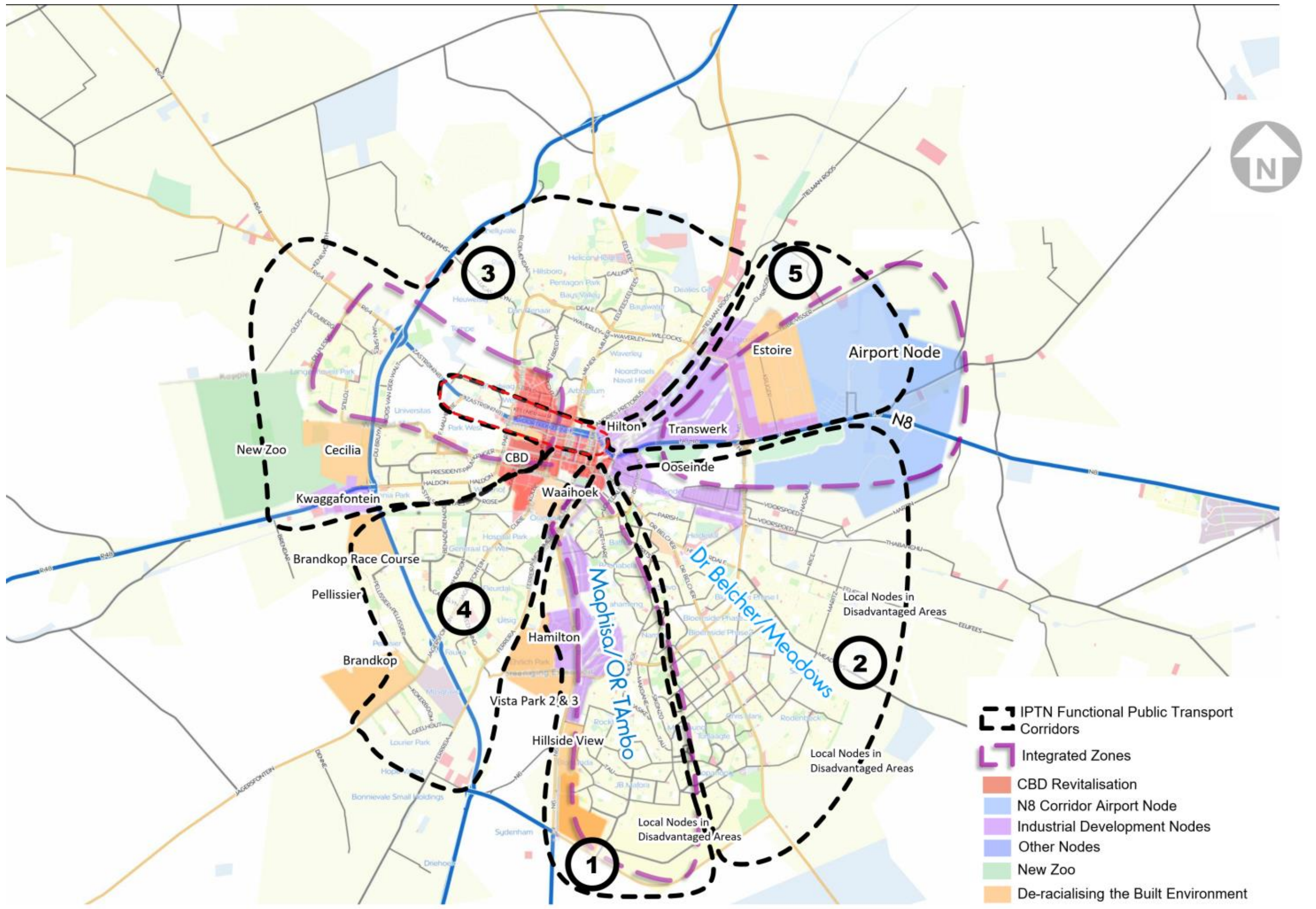


Figure 16-7: Service Rationalisation Strategy – Bloemfontein

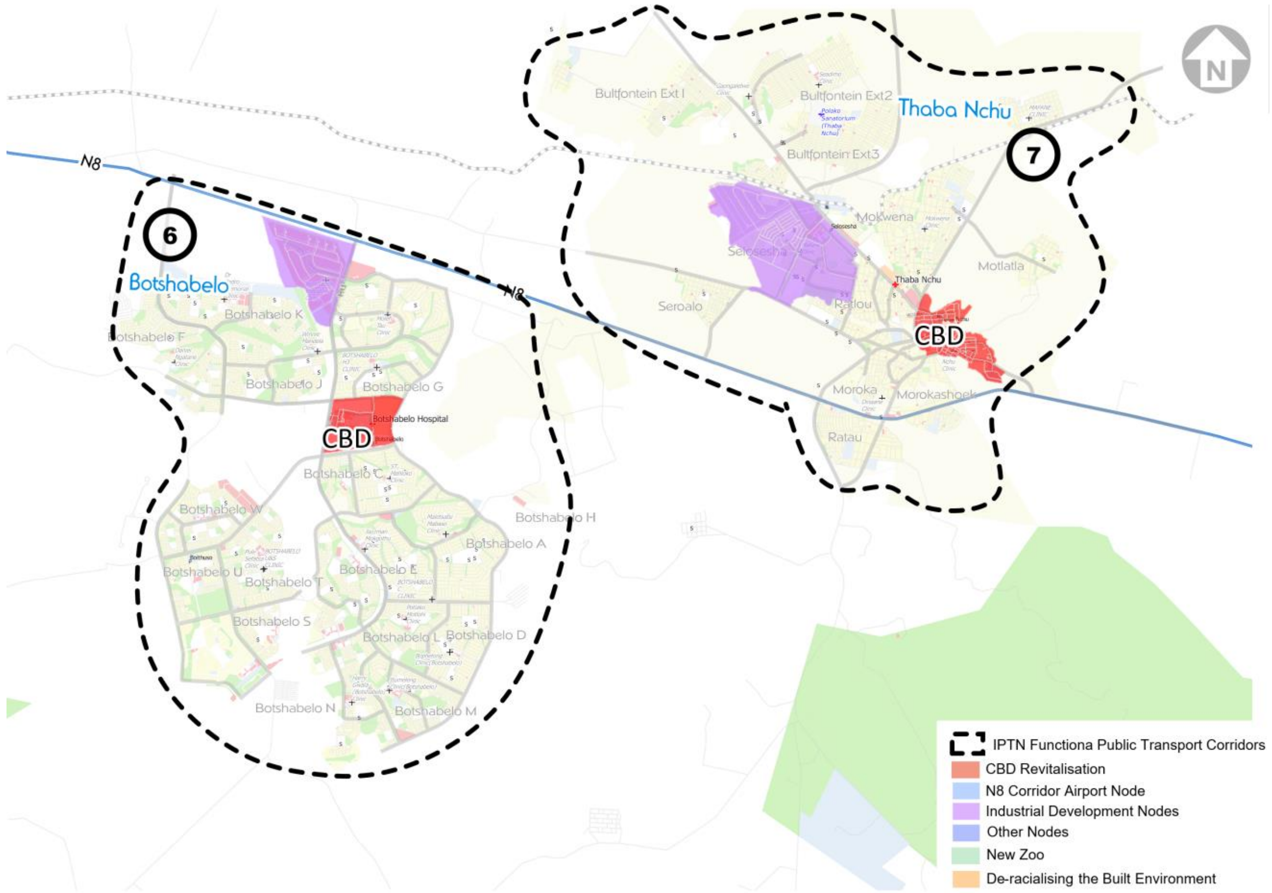


Figure 16-8: Service Rationalisation Strategy – Thaba Nchu and Botshabelo

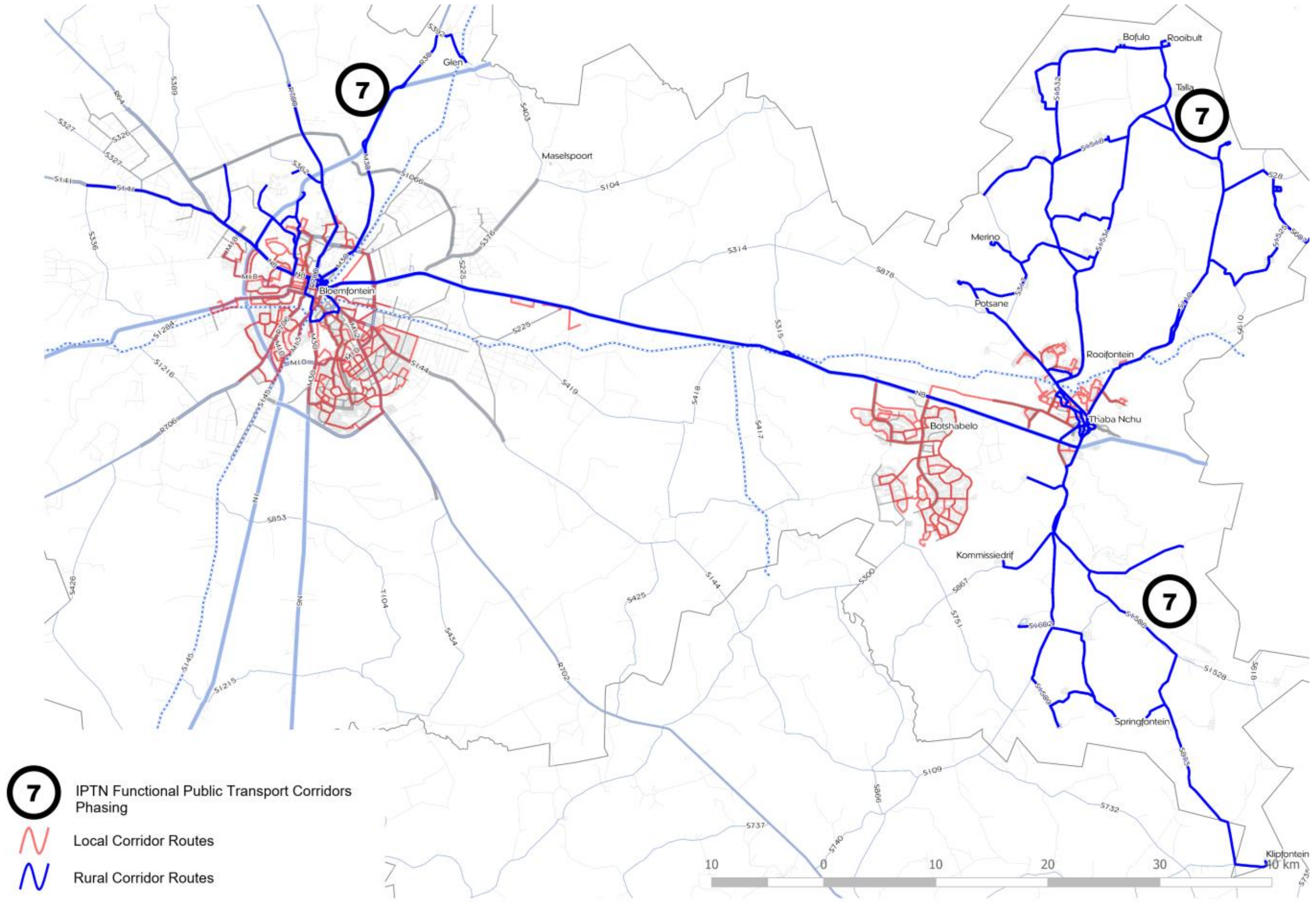


Figure 16-9: Service Rationalisation Strategy – Rural Corridors

16.7 Compensation Pay-Out Strategy

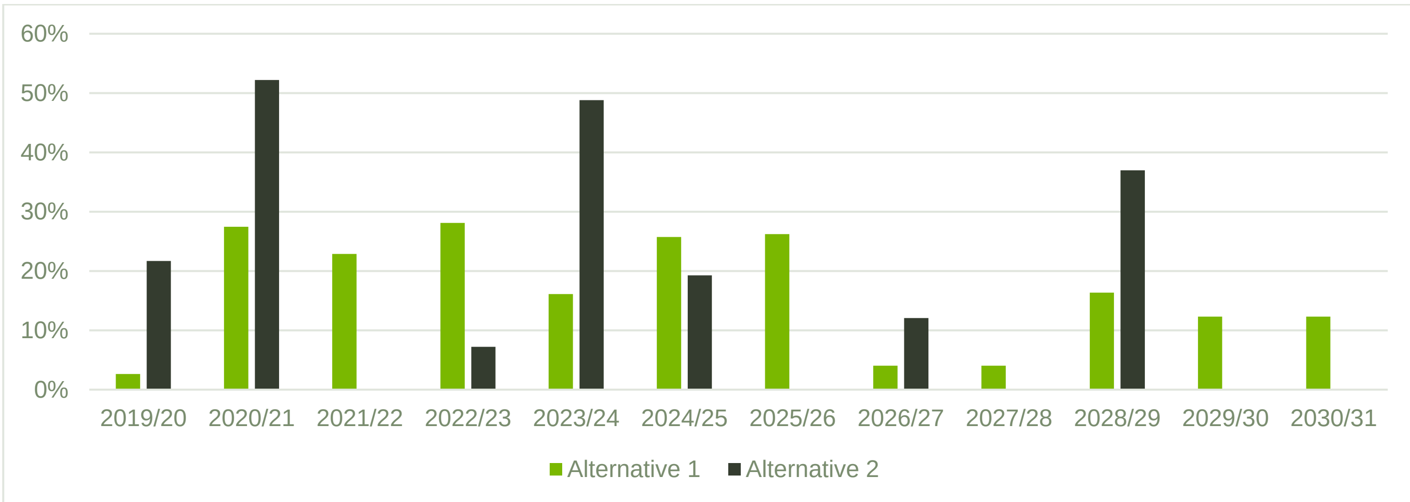
Two alternatives are considered to compensate the industry through once-off pay-out or through an incremental approach where the calculated value of the business is distributed to affected parties are distributed across three years. Thus, the compensation is divided into three pay-outs and spread across three years. The determination of the business value is assumed on and average value per discussion in Section and the Business Plan for Phase 1 attached in Annexure II.

- Alternative 1 - Three increment compensation:
  - Advantages:
    - *Capital required for compensation can be spread across years and operationalisation of the corridor can be earlier.*
    - *Second and third pay-out can be an incentive to withdraw completely from corridor operate in the corridor that the operator was compensated for*
  - Disadvantages:
    - *Can impact on negotiation that industry does not want to accept three pay-outs*
- Alternative 2 - Single compensation pay-out:
  - Advantages:
    - *Complete with drawl of operators from corridor once compensation is paid*
  - Disadvantages:
    - *If law enforcement id not done vigilantly operators can still operate in the corridor and thus have a negative impact on passenger demand.*
    - *Capital required for compensation is high when in one payment.*

The total capital cost estimated for the compensation of affected operators per functional corridor is presented in Table 15-5. These values range between R80M – R 10M per corridor. In comparison to the cities PTNG funding which is R230M per year the compensation of affected operators will utilise half of the allocation of a year's PTNG allocation in the year when the compensation needs to be paid. Diagram 16-9 presented the compensation as a percentage of the PTNG allocation in the year when the corridor will be operationalised as Alternative 2 and where the compensation is divided into three pay-outs in consecutive years (Alternative 1). The distribution of the pay-outs leads to a maximum of 25% of the allocation to be paid towards compensation in any given year of implementation. This allows for infrastructure implementation and the operationalisation of corridors each year or with only one year in between corridor operationalisation. The phasing and impact on the implementation will be evaluated in the Business Model Section of the report.

Compensation Pay-out Implementation Strategy:
The recommended compensation pay-out strategy is to pay-out affected operators in three instalments.

Diagram 16-9: Compensation Alternatives Pay-out Strategies - Percentage of PTNG Allocation



16.8 Infrastructure Strategy

The level of – and the speed of capital development impact significantly on the roll-out and implementation of the IPTN. In preceding sections detailed the incremental approach to the roll-out of roadways, facilities and systems and indicated how infrastructure implementation will be optimised to respond to demand rather than to implement for full implementation capacity. However, the capital cost for this optimised implementation need to be aligned to the available budget and the principles applied and used to define alternative implementation strategies are:

- **Affordability**: infrastructure development can only be executed within the limits of the available budget.
- **Value for money:** provide in the most cost-efficient manner and provide only for what is required within a specific framework of quality, sustainability and durability i.e. incremental approach.
- **Timing:** the network needs to be provided within an optimum period whereby the vested capital capacity would not be idle for a too long period. The operational system - for example – cannot wait until all phases of infrastructure development are completed before a first scheduled service is delivered. Essentially it means the optimised phasing of infrastructure development followed with phased service delivery.
- **The ratio between capital investment and operational expenditures:** In essence this principle preaches not to create the so-called "white elephants"; or do not provide for a luxurious vehicle if you can only afford an entry-level vehicle. Should this principle not be recognized, the infrastructure development period will never end, and services will never run. If you cannot afford to maintain a system, don't provide it or scale down.

Given the above principles the minimum infrastructure required to operationalise a corridor were defined and the triggers for upgrading. The sizing of the system is based on the 2019/20 demand but validated against the increments of capacity that can be added per facility type. Thus, where the size of a facility for the 2019 scenario did not allow for any spare capacity it was designed one increment bigger. Providing spare capacity and ensure that upgrading will not be required within a year from operationalisation. This approach assists in minimising passengers inconvenience.

The incremental approach to implementation presented in preceding sections are summarised as follows per infrastructure element:

- Roadways:
  - Initial will operate in mixed traffic, with kerbside stops and stations.
  - When passenger demand increases, or journey times are impacted by traffic congestion along routes or section of the network the following increment will be applied:
    - *First, implement queue jump lanes at intersections where Hauweng vehicles are delayed;*
    - *Followed by allocating lanes to public transport during peak periods; and*
    - *Constructing dedicated public transport lanes to provide priority for public transport vehicles part of the system*
- Stations and Stops:
  - Stations to be implemented along trunk routes, comprising of controlled access and uncontrolled access stations. The selection of controlled- or uncontrolled access station is determined on demand estimated at the station in 15 minutes during peak hours for the 0-5 year and +5-year scenarios. Based on the estimated demand for the base year and future years the loading area per scenario is determined. The outcome provides an incremental implementation plan per station. Refer to implementation strategies for detail on the incremental implementation of stations.
  - Controlled access stations to be implemented where high demand was modelled. High demand is expected at transfer facilities at Hoffman Square and the intermodal facility. Controlled access station provides a mechanism to ensure pre-validation and decreased the delay in passenger loading time.
  - Uncontrolled access stations will be implemented in modules of 6,0x3,0m. All full station design comprises of a 45mx5m covered area. However, with the incremental approach, the uncontrolled access station can be expanded stemming from passenger demand that realises . The waiting area required at a station is calculated based on the highest 15-minute expected passengers. Based on the calculated waiting area it is determined how many modules per station is required.
  - The above analysis is done for the base year and future year to determine where in the future land will be required if a full uncontrolled access will be required. This enables land acquisition processes to start and if triggers are met for station expansion land will be available.
  - High capacity bus stops will be provided where taxi feeders will integrate with bus trunk services,
  - Stops to be implemented along complementary and feeder routes when these are operationalised only.
- Transfer Facility:
  - Closed station at high demand points and at main transfer points in a system
  - Transfer facilities identified at:
    - *Hoffman Square,*
    - *Intermodal,*
    - *Botshabelo at Blue or Industrial Rank*
    - *Thaba Nchu at the CBD rank*
- Depot:
  - Depot for purposes of providing shelter and maintenance of buses is required
  - Develop depot in phases linked to budget availability;
  - Site options include greenfield sites and existing facilities while developing a fully operational depot
  - If depot not operationally ready for "Go live" use existing facilities for in term.
- Control Centre
  - The control centre will be hosted at the depot and will be phased and aligned with the increase of the fleet associated with the IPTN.
- Customer Care:
  - The customer care centre will be within an existing customer care facility of the city. Training will be provided to a dedicated operator for the purpose of IPTN customer relations.
- ITS:
  - The system needs to be designed in such a manner that the sophistication of the system can increase over time;
  - When the IPTN fleet and passenger numbers increase - the sophistication of the system needs to be adjusted to accommodate the increase in operations.
  - Design system in such a manner that it can be developed over time;
  - Fleet and passenger numbers increase - the sophistication of the system need to increase to accommodate passenger demand.
  - APTMS and AFC
  - UTC – Long term when capacity required at intersections.

Given these strategies the estimated capital per phase was kept the same between alternatives. The distribution of the required capital between years were varied to define the three alternatives. The impact of the distribution alternatives was evaluated in terms of:

- Percentage of capital allocated to infrastructure implementation as a ratio to the total capital budget
  - The aim was to allocate 70- 80% of the total capital budget to infrastructure implementation. This included Roadway, stations, stops, depot, ITS and vehicle fleet.
- Impact of distribution of capital between the financial years on the operationalisation of a phase.
  - Will the distribution between years impact on the year when phase can be operationalised, thus push-out the operationalisation year?

Three infrastructure capital distribution alternatives were defined:

- **Alternative 1:** The capital was distributed across several years to ensure that the budget stays between 70-80% and to operationalise the network within 10-years. With this approach the corridor will be operationalised in 12-years with the majority of financial year's budget allocation near to 75% of the total budget.
- **Alternative 2:** Capital is distributed to stay as close as possible to the 80% allocation per year and infrastructure is allocated to a maximum of two years before the corridor can be operationalised.

- Advantage – capital is distributed evenly between years and from a management point of view easier to monitor.
- Advantage - No construction after operationalisation, only for upgrading.
- Disadvantage of the implementation of the network is over 15-years.
- Disadvantage - capacity upgrades to facilities will be required in corridors that are operationalised before the last corridor is operationalised.

- **Alternative 3:** The capital was distributed to ensure that corridors are operationalised year-on-year with a maximum of one year between corridors that is operationalised.
  - Given that the minimum standard specified is that all bus stops, stations, transfer facilities and NMT facilities in the direct vicinity of stops and stations are required before a corridor can be operationalised;
  - Disadvantage is that roadway and other the infrastructure will be implemented after the corridor is operationalised and can impact on operations and passenger experience.
  - Advantage is that the network is rolled-out within 10-years of start. The upgrading and optimisation of facilities can occur as part of infrastructure implementation and can lead to optimisation and reduction in infrastructure cost specifically in relation to roadway and stations and stops.
  - In year 2027/28 and 2029/30 infrastructure spending is minimised to allow for compensation;
  - In year 2022/23 capital allocation is higher than the 80% target. This is to allow for the Dr Belcher corridor to operationalise in 2022/23, and in 2030/31 to allow for operationalisation of Thaba Nchu.

Diagram 16-10 presents the total infrastructure budget per year per alternative implementation presented above. Diagram 16-11the alternative infrastructure implementation options compared to 75% of the total PTNG budget allocated for infrastructure implementation. It is noted that all of the alternative infrastructure implementation models require more than 75% of the PTNG funding per year. Diagram 16-12 present the required capital per implementation alternative in relation to 80% of the PTNG allocated for capital investment. Note that the goal of Alternative 3 was to distribute capital expenditure across a number of years with the prerequisite that the total capital budget needs to be only 80% of total PTNG allocation. Diagram 16-3 presents the implementation alternatives and the year when a corridor can be operationalised given the implementation alternative. Note the change in the year of operationalisation of the last phase based on the different implementation alternatives. The implementation year per corridor where the corridors are defined as follows:

1. Starter Service – CBD Brandwag
2. Maphisa/Moshoeshoe, OR Tambo
3. Remainder of CBD
4. Dr Belcher/Meadows
5. Botshabelo
6. Thaba Nchu
9. All phases implemented

Infrastructure Capital Distribution Strategy:

Capital need to be allocated to infrastructure to allow for the IPTN to be implemented within 10-years. Capacity upgrades need to be accommodated from year 4 of first corridor operationalization with major capacity upgrades and quality improvement from year 10 onward.

Diagram 16-10: Total Infrastructure Budget Required per Alternative

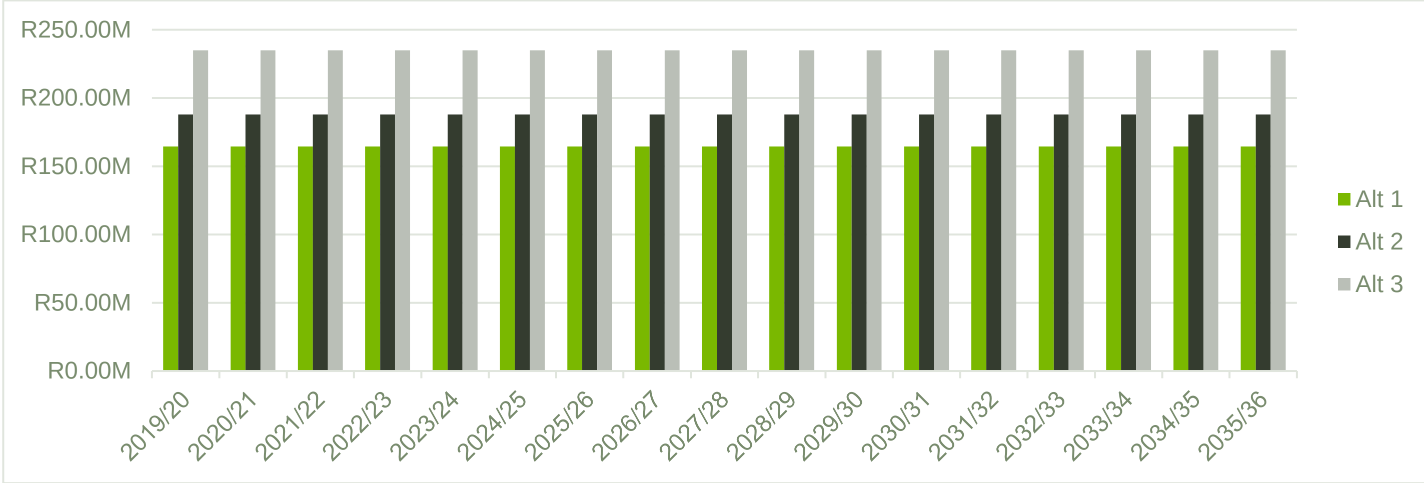


Diagram 16-11: 75% of Total Budget Allowed for Capital

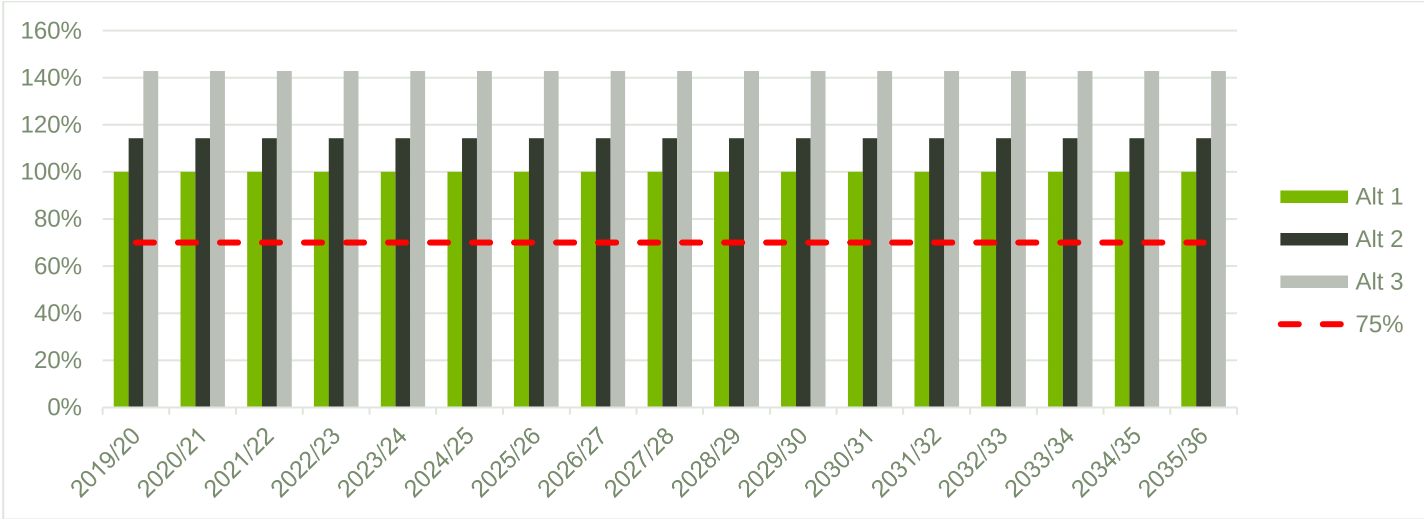


Diagram 16-12: 80% of Total Budget Allowed for Capital

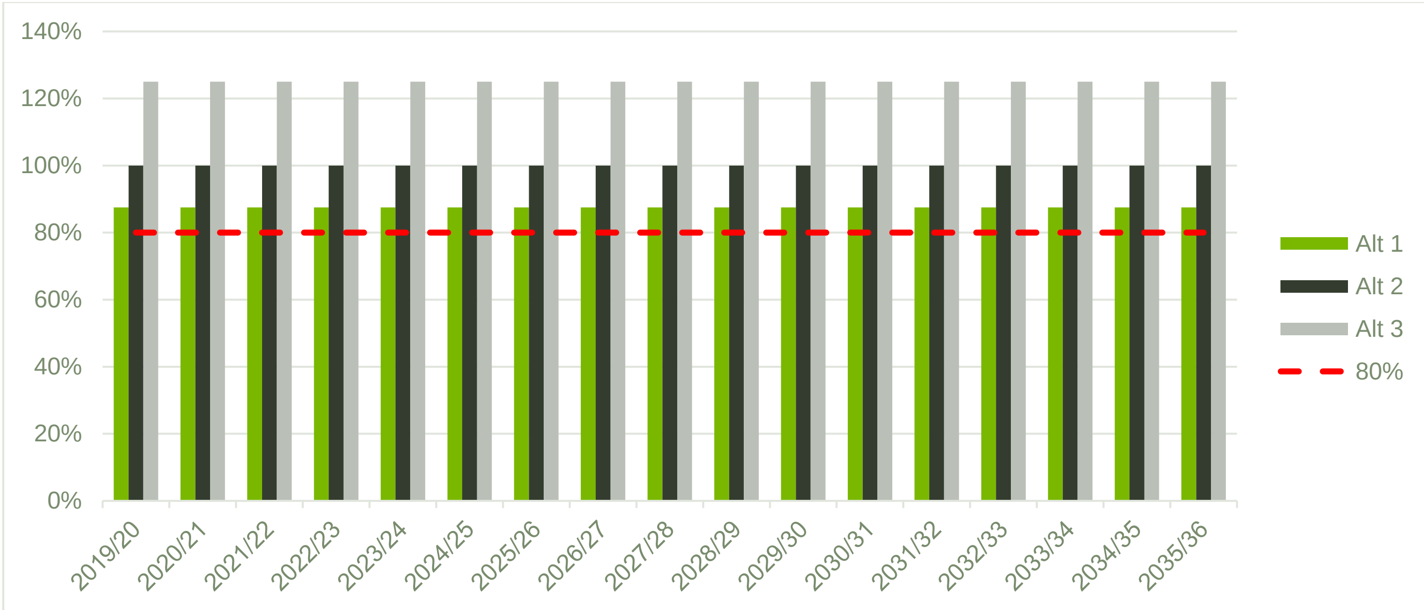
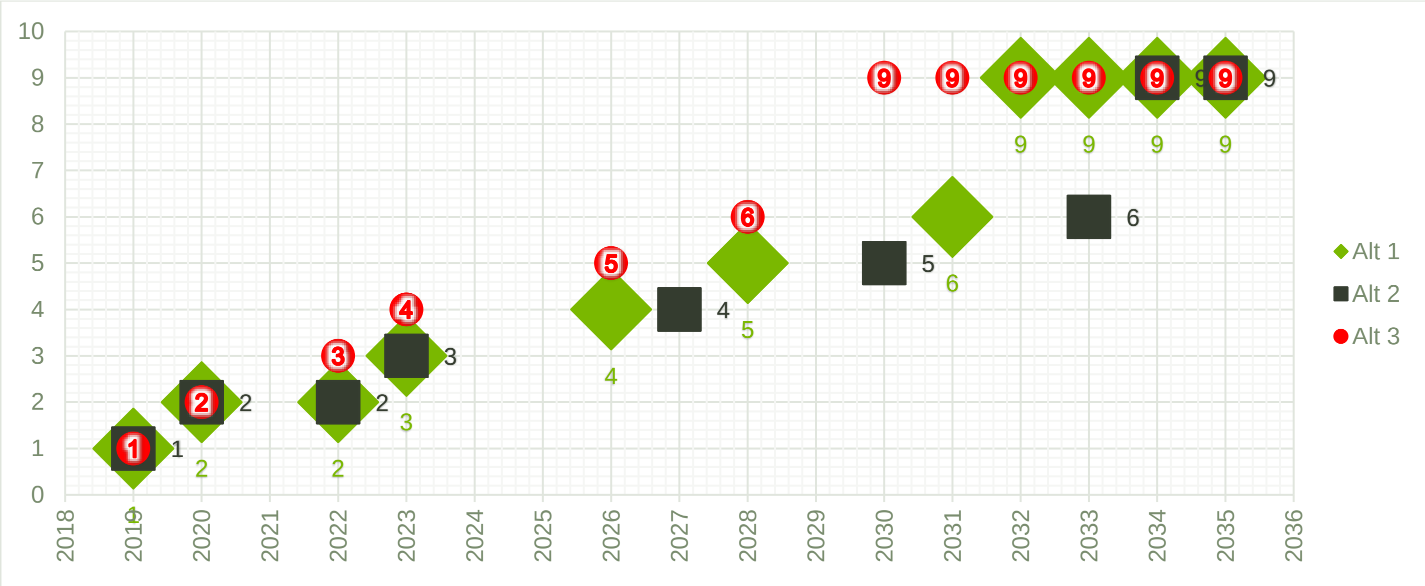
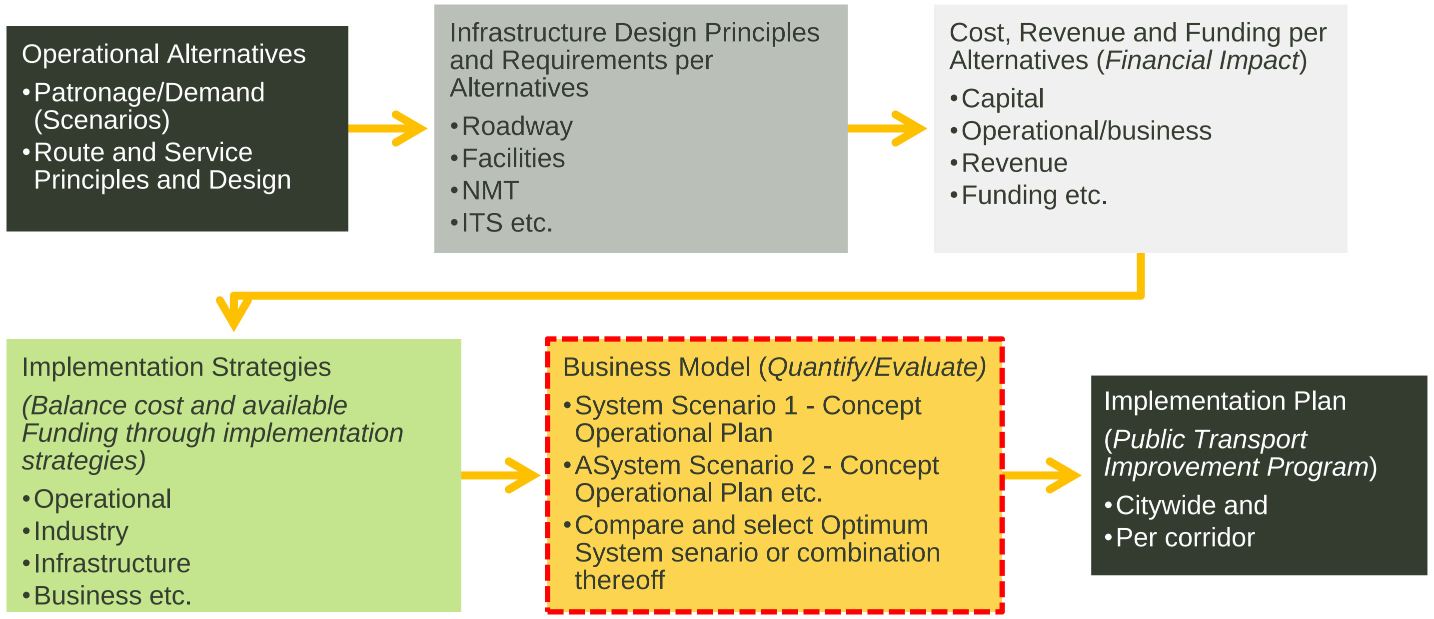


Diagram 16-13: Implementation Year Per Alternative



17 Selecting Preferred IPTN Alternative (Business Model)



17.1 Business Model and Associated Sub-models

The business model serves as a quantifying tool of the IPTN plan and reflects a quantified representation or simulation of alternative strategies (scenarios) that are considered for implementation.
The business model is designed on an MS Excel platform comprising various sub-models**.**

17.2 Business Model Components

The purpose of the business model is to quantify the IPTN in terms of financial and operational parameters, and thereby informs further decision making in terms of options, strategies, financial challenges, institutional and other technical considerations.

The business model evaluates system scenarios that comprise the combination of implementations strategies defined in preceding sections. The business model evaluates these system scenarios and inform the budget and make recommendations for decision making in terms of network roll-out, city contribution, budget shortfall and system implementation in general.

17.2.1.1 Outline of Business Model

The Business Model is a tool to quantify and assess the financial and operational outcome of any particular version of the operational plan. Accordingly, it provides the basis for the budgeting process. The Model comprises a number of modules designed on the Microsoft Excel platform, as follows:

i. **Input Parameters Module:** This module lists all assumptions and quantifying parameters that are used as standard values within the model, or version of the model. It specifies amongst others the base fare rate, the bus fleet seat capacity for all vehicle types, the service frequency and various other input parameters that characterize the scenario under assessment.

ii. **Demand Module:** Two demand scenarios were developed and are the input parameter for the demand module. The demand is assigned to routes per discussions in Section 13.4.6

iii. **Compensation Module**: The average value per vehicle was presented in Section 15.2.4 per corridor and provided the values incorporated as capital cost in the compensation module

iv. **The ITPN Network Module**: This module specifies the route design alternative per corridor, the classification of routes and implementation phase, the associated route lengths, average operating speed and round trip time, the fleet composition, the average fleet seat capacity, the spare bus factor and the prescribed service frequency (buses per hour). For each alternative operational concept that is tested, these parameters may change, and it will provide different results for each alternative.

v. **VOC Operating Costs**: This module contains the base year budget of a specific size of the intended Vehicle Operating Company, expressed in terms of fleet size. This preliminary budget is the basis to determine the HR content, and all associated cost elements of the VOC. The output of this module is expressed in three components:

   a. The **total corporate costs** per annum, i.e. the fixed cost component irrespective of the number of buses operated and the number of kilometres travelled;

   b. Secondly the **total fixed cost per bus** which will then determine the annual total cost depending on how many buses are deployed; and

   c. Finally, the total cost per kilometre, reflecting the variable direct running cost for each kilometre travelled.

   The total of these three cost components will provide the total cost budget for each alternative scenario that is simulated, given that each scenario may produce different fleet requirements (number of buses) and different direct operating costs (kilometres travelled). This module also uses standard parameters specified by the IPTN network module (route length, turnaround time and speed and the minimum service frequency). The main outputs are total bus fleet requirement (buses) and total kilometres travelled and ultimately the service capacity to be provided (trips and seats to be delivered).

vi. **Vehicle Scheduling Module**: This module applies the values from the IPTN network module (i.e. the bus fleet to be introduced and route lengths; as well as the demand module, i.e. the passenger volumes to be taken over from the taxis and/or subsidised bus services to be removed, and then applies a scheduling technique to determine the number of Hauweng buses that will be required to serve that particular demand. It takes into account the Hauweng route length, the average operating speed, the bus seat capacity assigned to that route and the average seat occupancy, the minimum service frequency that is required, and the average hourly distribution of the demand. The output is specified per route (trips per hour) in terms of:

   a. The total number of buses required for the peak period and other periods of the day

   b. The service frequency for peak, midday and off-peak periods based on the implementation strategy selected,

   c. Operational statistics including kilometres (/trip, /day, /month, /year); kilometres per bus per day; and annual passengers carried

   d. The above is then summarised per corridor or group of routes.

vii. **Capital Budget Module:** This module summarises the entire capital budget required for a specific period taken into account the implementation strategy selected. It summarises the total financial impact of the assessment scenario, together with all other financial and operational outputs.

viii. **Total Cost and Scenario Summary Module:** This module is the summarizing sheet that reports the main output values of the particular scenario that is simulated. The module's purpose is mainly to reflect the main model results for reporting purposes and as such summarizes only the main features of the scenario under assessment. This module summarises all detailed output values of a specific scenario. It reads the outputs from all other modules and duplicates the result in a collective sheet. It reflects all financial and operational features of the particular scenario under assessment.

17.3 System Scenarios

The business model can only evaluate a specific defined system scenario or scenarios. These scenarios stem from a combination of the route design alternatives and implementation strategies developed in the preceding section. The business model evaluates the combination of these strategies, route design option and patronage options and provides the capital and operational cost associated with each of the scenarios. These scenarios can then be compared, and an optimum implementation plan can be developed. This optimum plan is the 25-year Public Transport Improvement Program for the implementation of the IPTN.

The four system scenarios defined are presented in Table 17-1. The description per alternative within the system scenario is:

- **Infrastructure Alternatives:**
  - Refer to selected strategies for implementation for TIS, Compensation, Depot and stops, stations and transfer facilities and the incremental approach selected for implementation,
  - The effect of implementation while operating versus implement and then operate need to be compared against funding available for this purpose the two alternatives considered are:
  - **Build then operate:** All basic infrastructure per incremental approach will be implemented before a corridor can be operationalised.
  - **Build and Operate:** Stations, stops, transfer facilities and NMT facilities in the direct vicinity of the facilities is required before corridor can be operationalised.
- **Patronage Alternatives:**
  - Without subsidised bus demand:
    - *Exclude demand carried by subsidised bus services*
    - *Patronage scenario is lower BUT the PTOG associated with the demand is EXCLUDED from funding*
  - With subsidised bus demand:
    - *Include demand carried by subsidised bus services*
    - *Patronage scenario is lower BUT the PTOG associated with the demand is INCLUDED as operational funding source*
- **Route Design Alternatives:** The defined three alternatives were evaluated per system scenario:
  - Refer to service rationalisation strategy and vehicle deployment strategy for detail pertaining to the vehicle specification and contracting of route and service alternatives,
  - **Scheduled trunk routes** and services only with other vehicles providing unscheduled feeder services to dedicated high capacity bus stops.
  - **Scheduled trunk and feeder services** are provided;
  - **Scheduled trunk and feeder with complementary routes to end destinations.**
- The cost included in capital and operational cost are discussed in the system sizing section in detail;
- Funding included are PTNG, PTOG, City contribution and revenue earned from the farebox.
- Phase description:
  - 1 – Starter Service – CBD – Brandwag
  - 1.25 – Maphisa/Moshoeshoe corridor;
  - 1.5 - OR Tambo corridor;
  - 1.75 – Maphisa/Moshoeshoe and OR Tambo corridors;
  - 2 – CBD – Universitas, Langenhoven Park, Makro and Northern Suburbs of Bloemfontein,
  - 3 – Southern suburbs of Bloemfontein, Estiore and Airport corridors;
  - 4 – Dr Belcher and Meadows corridors;
  - 5 – Botshabelo corridor;
  - 6 – Thaba Nchu and Rural corridors.

Table 17-1: System Scenarios

System Scenario	Infrastructure Alternative	Demand Scenario	Funding/ Income	Route Design Alternative
1	Build Then Operate	Total Demand	• Revenue from system • **PTOG** • City contribution • PTNG	Scheduled Feeder-Trunk and Complementary routes
				Scheduled Feeder-Trunk
				Scheduled Trunk Routes Only
2		Excluding subsidised bus service demand	• Revenue from system • **PTOG excluded** • City contribution • PTNG	Scheduled Feeder-Trunk and Complementary routes
				Scheduled Feeder-Trunk
				Scheduled Trunk Routes Only

System Scenario	Infrastructure Alternative	Demand Scenario	Funding/ Income	Route Design Alternative
3	Operate and Build	Total Demand	• Revenue from system • **PTOG** • City contribution • PTNG	Scheduled Feeder-Trunk and Complementary routes
				Scheduled Feeder-Trunk
				Scheduled Trunk Routes Only
4		Excluding subsidised bus service demand	• Revenue from system • **PTOG excluded** • City contribution • PTNG	Scheduled Feeder-Trunk and Complementary routes
				Scheduled Feeder-Trunk
				Scheduled Trunk Routes Only

17.3.1 System Scenario 1 and 2 Results

Diagram 17-1 and Diagram 17-3 present the CAPEX, Direct OPEX, Revenue and available CAPEX funding for Scenario 1 and 2 respectively. Diagram 17-2 presents the operational shortfall taken into account city contribution of R 20M, PTOG currently paid to subsidised bs services and revenue collected from the fare collection. Diagram 17-4 presents the operational shortfall taken into account city contribution of R 20M and revenue collected from the fare collection.

- Capital Cost:
  - The year that the phase operationalises and the year before the capital requirement is high due to completion of infrastructure and compensation.
  - Even with the distribution over more than 10-years, to 13-years the PTNG allocation remains less than what is required to implement the optimised infrastructure.
  - The main contributors to this are the AFC, APTMS and depot cost. Even with the incremental approach these elements need to be optimised realistically without compromising the quality of the system. However, to optimise these cost an actual tender is required that confirm the cost of this infrastructure. Thus, as soon as actual optimised values can be obtained the AFC and APTMS cost can be reduced and the infrastructure can be provided within budget. This remains an option and not yet proven.
- Operational Cost:
  - The most notable is that the system will rely on total patronage thus including subsidised bus demand;
  - The PTOG funding is critical to the implementation of the system
  - The city contribution will be required if a feeder-trunk system is implemented,
  - Where only trunk services will be implemented the contribution from the city will be the least but will still require the PTOG subsidy, irrespective of route type design,
  - Revenue earned from the feeder services can assist in the long term and will improve the quality of the service when both trunk and feeder services are scheduled.
  - The operational cost advantage of Complementary route needs to be kept in mind when designing the system given the cost effectiveness and advantage to passengers to minimise transfers.

17.3.2 System Scenario 3 and 4 Results

Diagram 17-5 and Diagram 17-7 present the CAPEX, Direct OPEX, Revenue and available CAPEX funding for Scenario 1 and 2 respectively. Diagram 17-4 presents the operational shortfall taken into account city contribution of R 20M, PTOG currently paid to subsidised bs services and revenue collected from the fare collection. Diagram 17-8 presents the operational shortfall taken into account city contribution of R 20M and revenue collected from the fare collection.

- Capital Cost:
  - The capital requirement was distributed over a number of years to ensure that the phases can operationalise as soon as possible after each other.
  - This led to some shortfall where compensation needs to be pay-out and infrastructure implemented.
  - If the 10-year aim is omitted the infrastructure can be implemented within allocation BUT it needs to be noted that there will be constant construction in corridors for at least 4 to 5 years within a corridor.
  - The perception of the system will be negatively influenced and operations as well. Passenger information will also be compromised if routes need to be adapted to accommodate road maintenance and upgrade.
  - If this is not preferred and construction needs to occur outside of peak hours the cost of construction will increase due to limited working hours or work at night.
  - The additional cost to implement in the short run or above the allocated PTNG allocation might thus seem high but given the above considerations it will be a better investment to provide additional capital to implement in the 10-year span and reduce the duration of construction in corridors.
- Operational Cost:
  - The most notable is that the system will rely on total patronage thus including subsidised bus demand;
  - The PTOG funding is critical to the implementation of the system and minimises operational shortfall;
  - The city contribution will be required if a feeder-trunk or feeder-trunk and Complementary route design is implemented,
  - Where only trunk services will be implemented the contribution from the city will be the least but will still require the PTOG subsidy, irrespective of route type design,
  - Revenue earned from the feeder services can assist in the long-term and will improve the quality of the service when both trunk and feeder services are scheduled.
  - The operational cost advantage of Complementary needs to be kept in mind when designing the system given the cost effectiveness and advantage to passengers to minimise transfers.
  - The implementation of the IPTN will require at least R100M contribution from the city, which relate to +-10% of the existing rate base. The norm at full implementation stage is 8% of the rate base. This needs to be mitigated and there are several mechanisms to mitigate and to optimise operational cost. This shortfall can be shared between the city and national government through an increase in the PTOG subsidy or the fare can be increased. The increase of the fare will be evaluated as part of the social impact study to determine affordability to commuters.

Diagram 17-1: Scenario 1 - CAPEX, Direct OPEX and Revenue 2019 - 2036

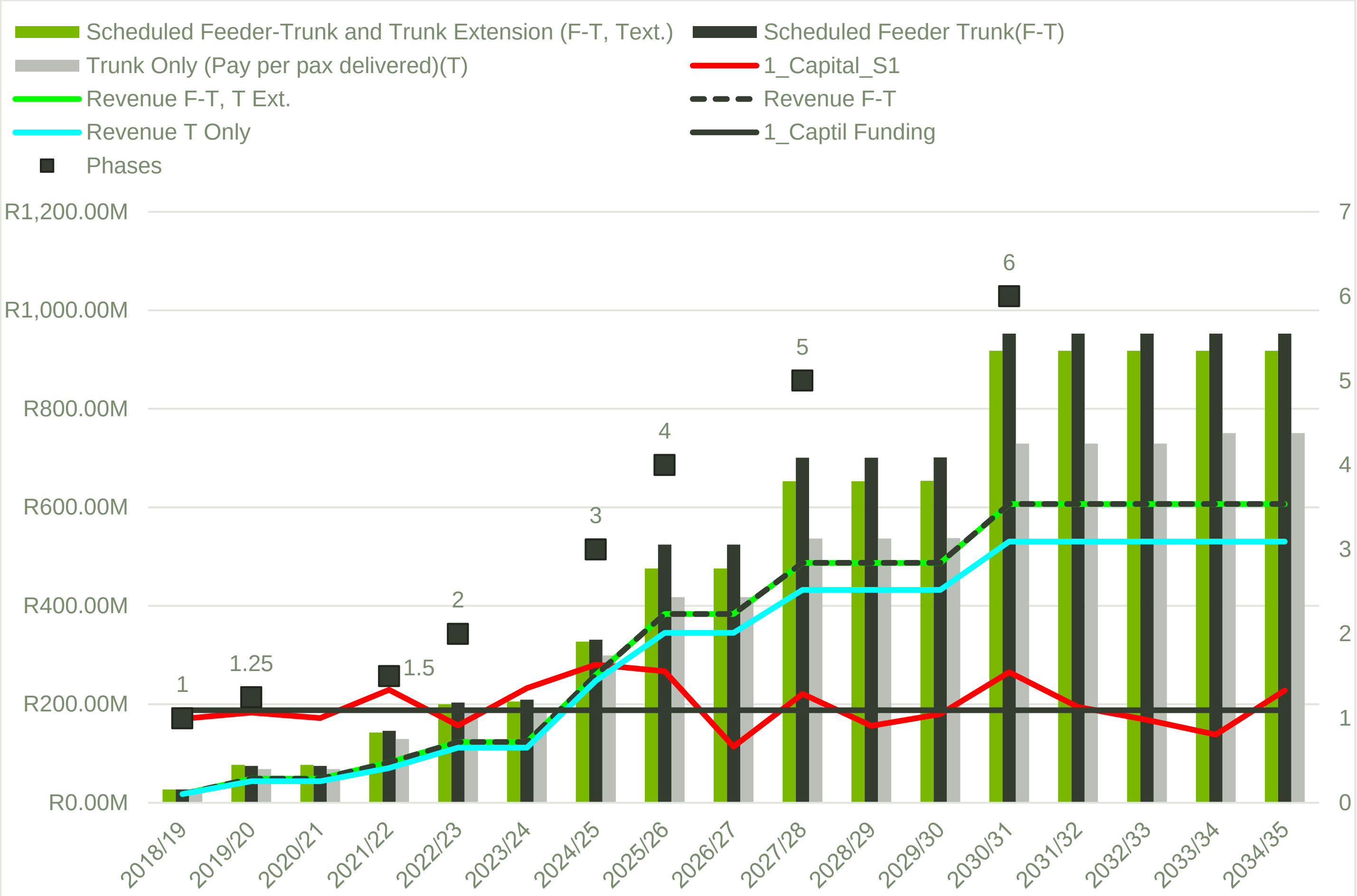


Diagram 17-2: Scenario 1 – Operational Shortfall 2019 - 2036

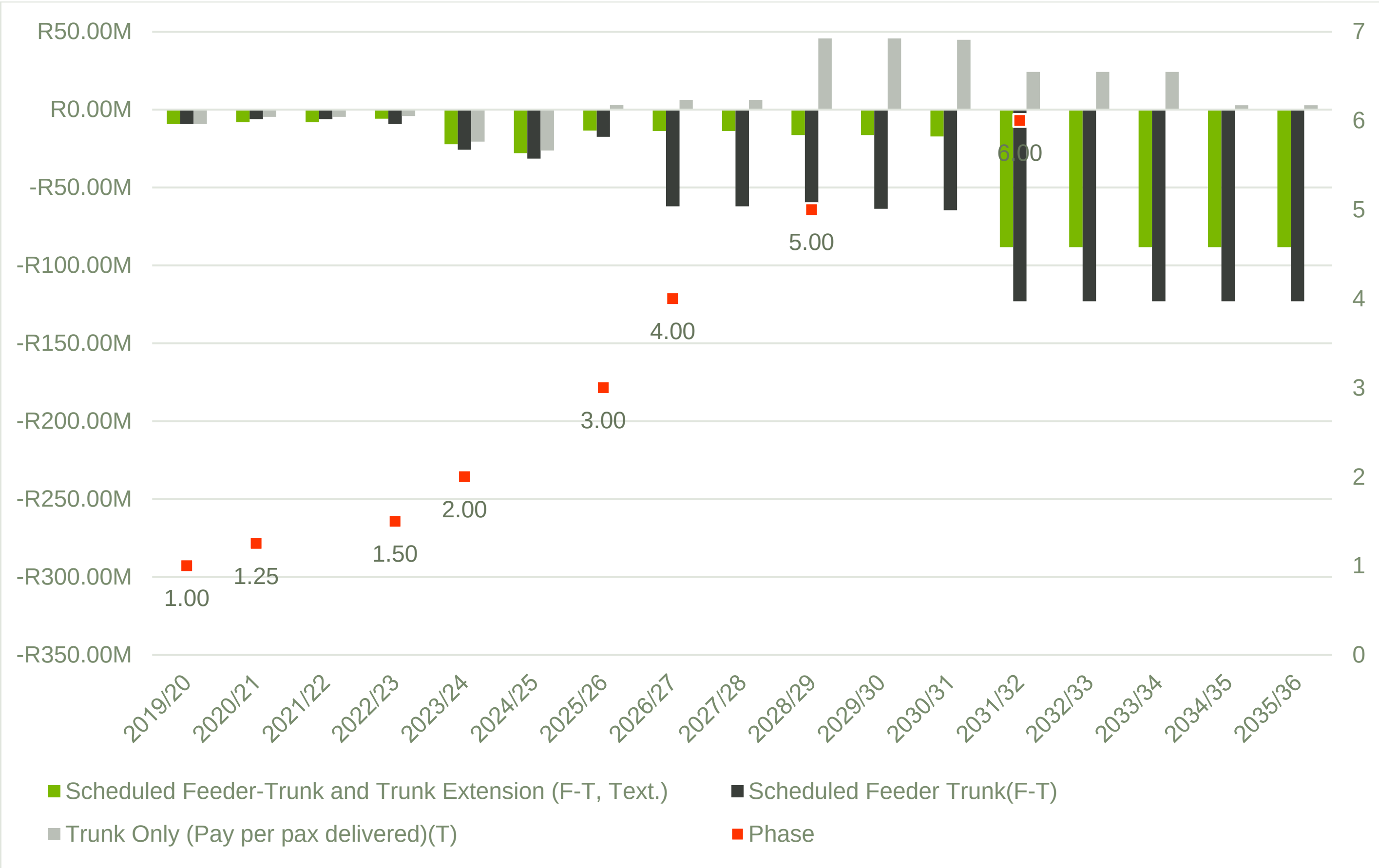


Diagram 17-3: Scenario 2 - CAPEX, Direct OPEX and Revenue 2019 - 2036

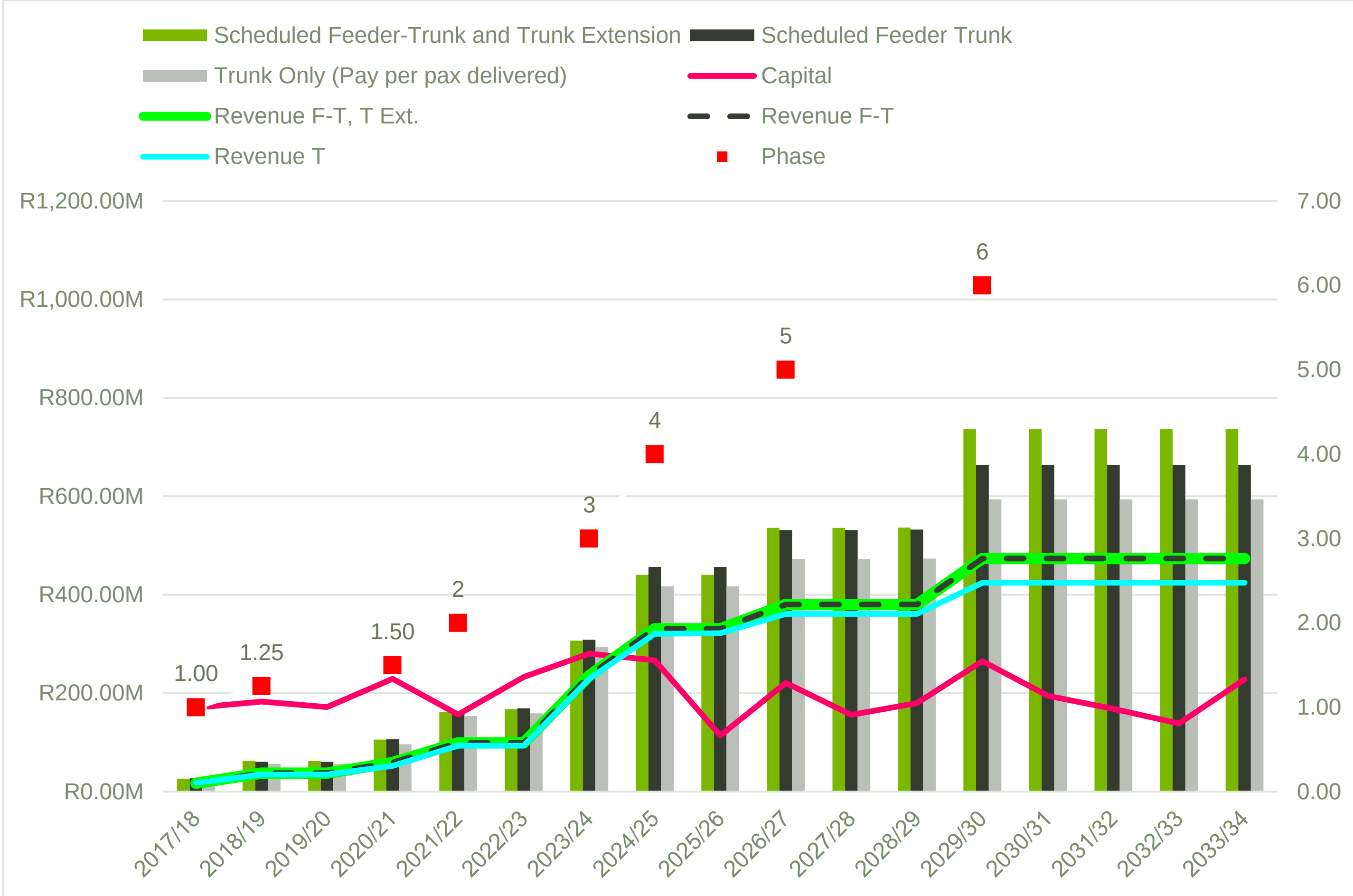


Diagram 17-4: Scenario 2 – Operational Shortfall 2019 - 2036

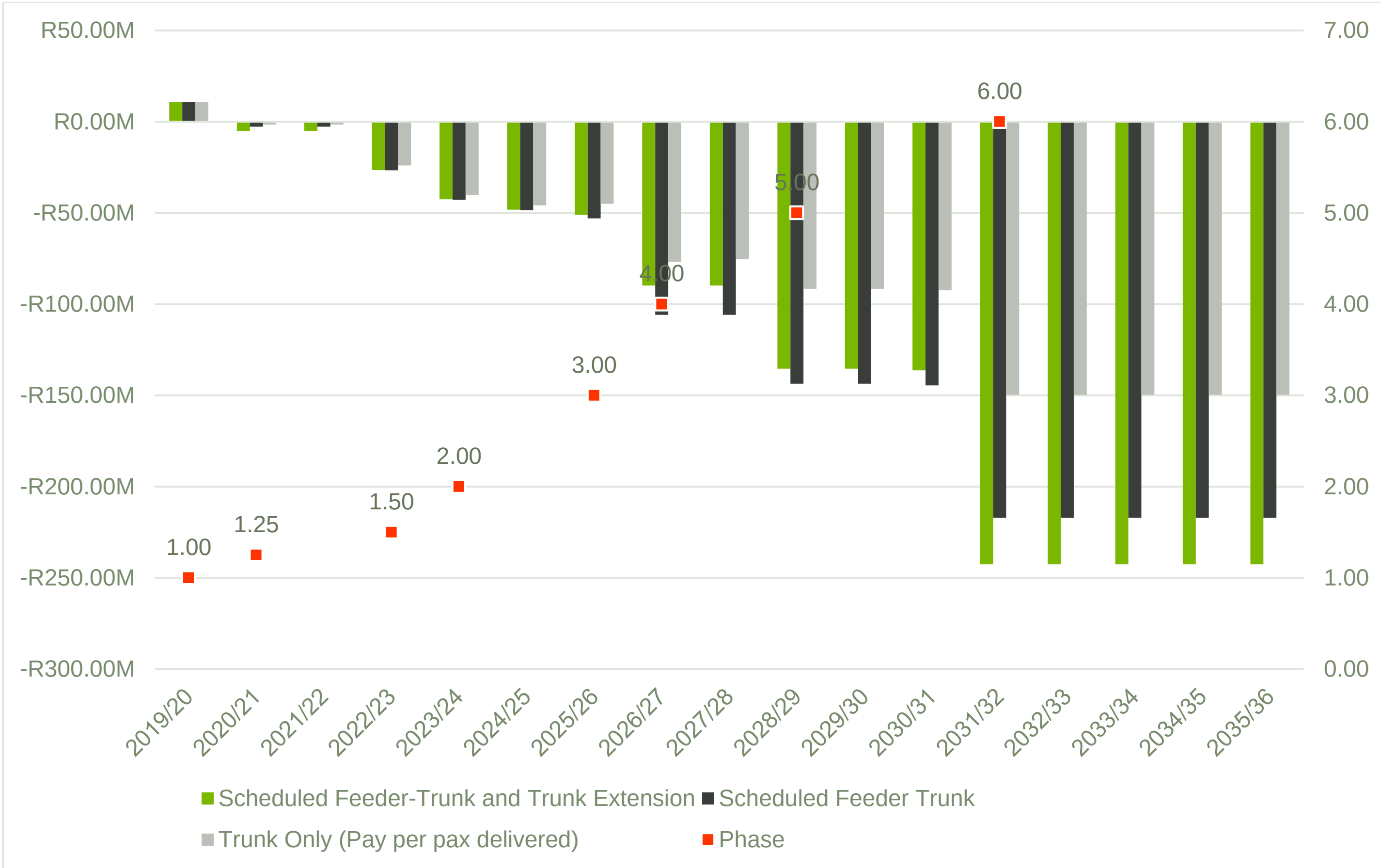


Diagram 17-5: Scenario 3 - CAPEX, Direct OPEX and Revenue 2019 - 2036

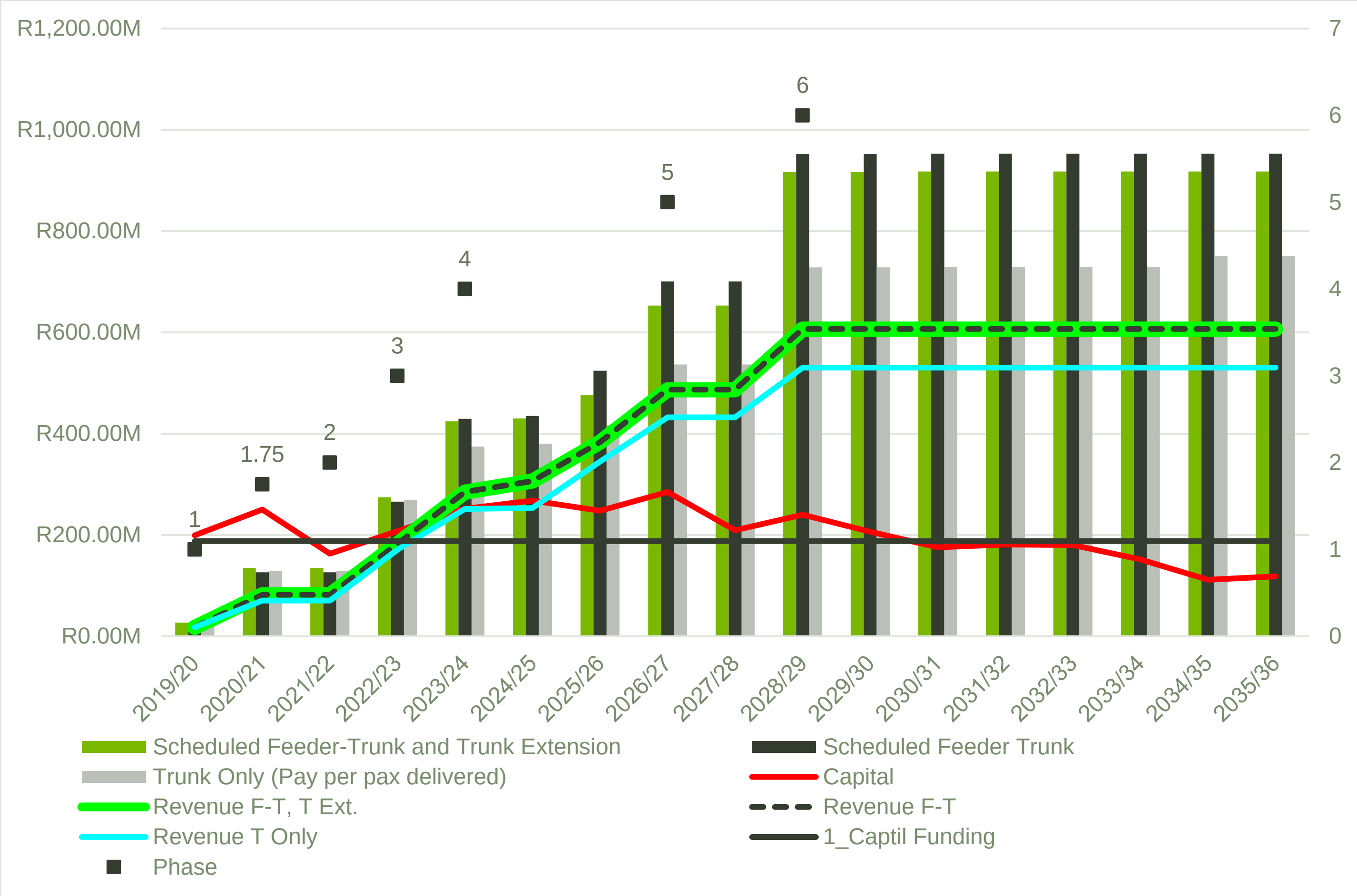


Diagram 17-7: Scenario 4 - CAPEX, Direct OPEX and Revenue 2019 - 2036

Diagram 17-6: Scenario 3 – Operational Shortfall 2019 - 2036

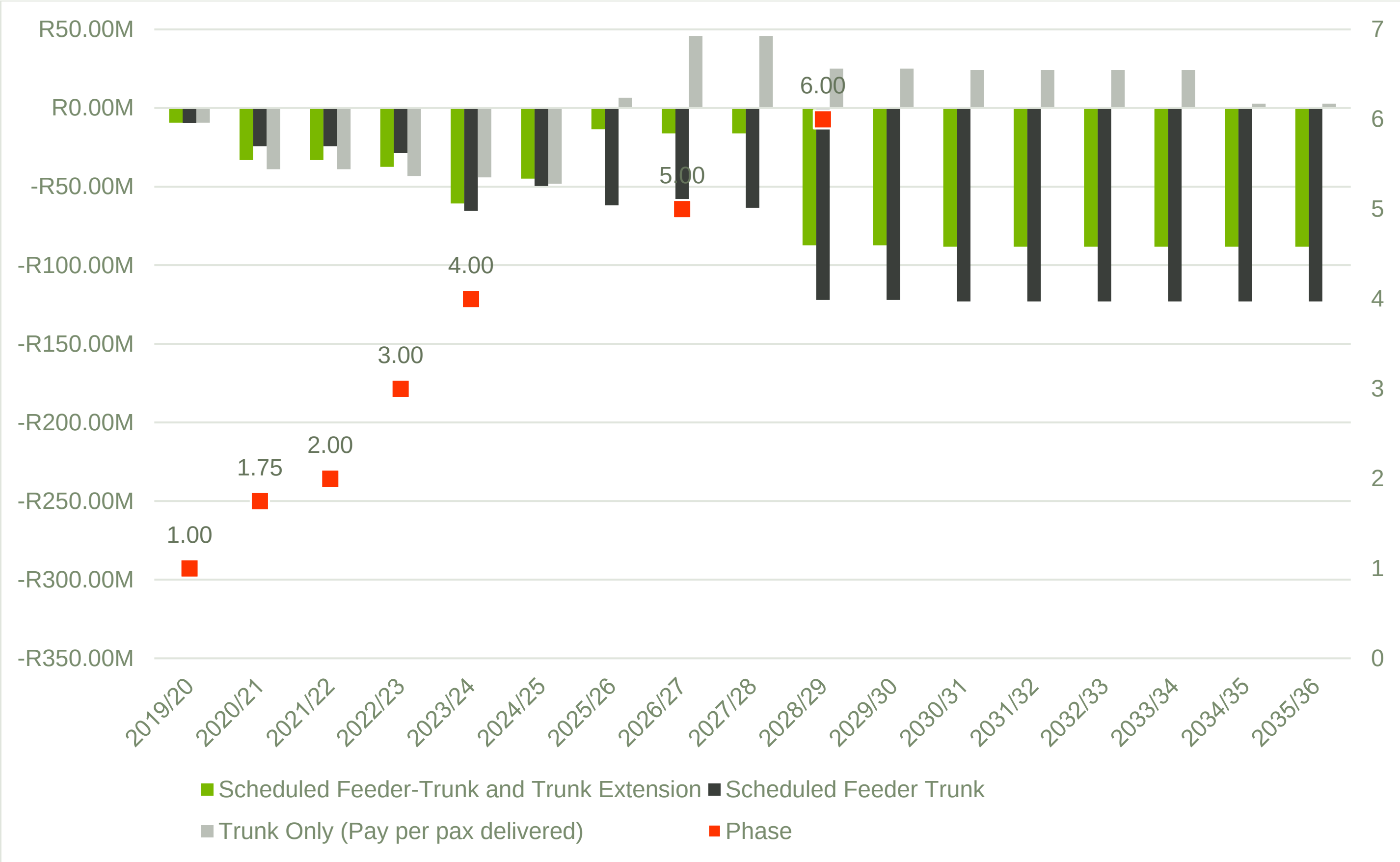
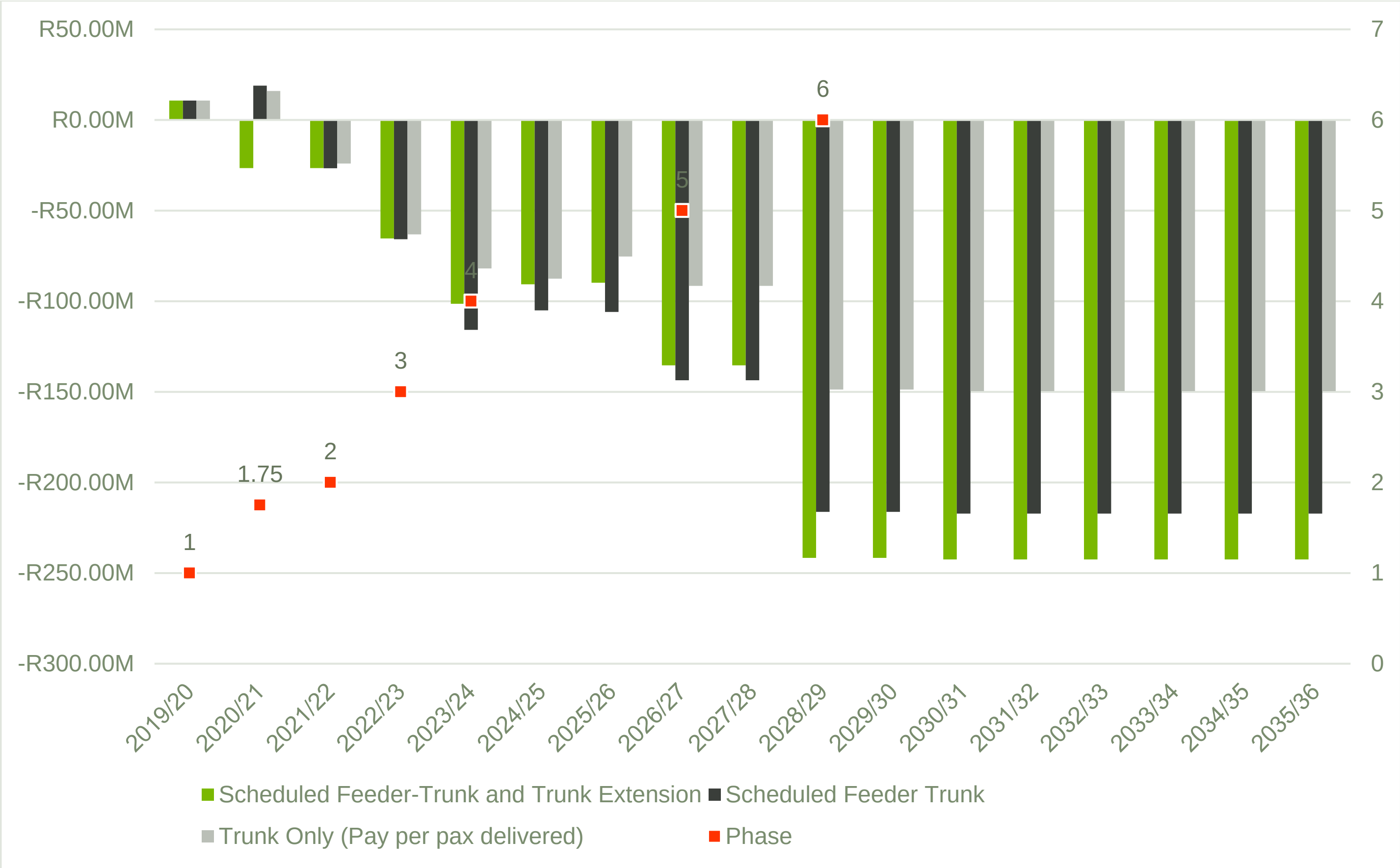


Diagram 17-8: Scenario 4 – Operational Shortfall 2019 - 2036



17.4 Recommended IPTN Alternative for Implementation

Given the above analysis the implementation of the IPTN needs detail analysis and market research per phase that will be implemented. Operational cost and capital cost need to be optimised to ensure the long-term sustainability of the system. However, the implementation plan is thus a combination of the system scenarios presented in the preceding sections.

17.4.1 Concept of Operations

The system needs to be implemented according to the increments defined in the design principles and the implementation strategies selected. The implementation of the system and the high-level increments per component are:

- Implementation Phases:
  - The defined phases and the operationalisation of these phasesand the start of infrastructure development per phase are presented in
- Roadways:
  - Initial will operate in mixed traffic, with kerbside stops and stations.
  - When passenger demand increases, or journey times are impacted by traffic congestion along routes or section of the network the following increment will be applied:
    - *First, implement queue jumping lanes at intersections where the delay is experienced by vehicles part of the system;*
    - *Followed by allocating lanes to public transport during peak periods; and*
    - *Constructing dedicated public transport lanes to provide priority for public transport vehicles part of the system*
- Stations and Stops:
  - Stations to be implemented along trunk routes, comprising of controlled access and uncontrolled access stations. The selection of controlled- or uncontrolled access station is determined on demand estimated at the station in 15 minutes during peak hours for the 0-5 year and +5-year scenarios. Based on the estimated demand for the base year and future years the loading area per scenario is determined. The outcome provides an incremental implementation plan per station. Refer to implementation strategies for detail on the incremental implementation of stations.
  - Controlled access stations to be implemented where high demand was modelled. The intermodal facility was identified as the first controlled access station where pre-validation will be required. Controlled access station provides a mechanism to ensure pre-validation and decreased the delay in passenger loading time.
  - Uncontrolled access stations will be implemented in modules of 7,5m. All full station design comprises of a 45mx5m covered area. However, with the incremental approach, the uncontrolled access station can be expanded stemming from passenger demand estimation. The waiting area required at a station is calculated based on the highest 15-minute expected passengers. Based on the calculated waiting area it is determined how many modules of the station is required.
  - The above analysis is done for the base year and future year to determine where in the future land will be required if a full uncontrolled access will be required. This enables land acquisition processes to start and if triggers are met for station expansion land will be available.
  - Transfer facilities will be provided where taxi feeders will integrate with bus trunk services,
  - Stops to be implemented along complementary and feeder routes.
- Depot, Control Centre and Customer Care:
  - Depot to be developed in phases linked to the implementation of routes and the associated fleet of the IPTN. The optimisation of the cost of the depot is critical to optimise capital requirement. The construction of a depot in advance will allocate capital to one specific infrastructure where it is required for stops and stations to give access to the system.
  - The control centre will be hosted at the depot and will be phased and aligned with the increase of the fleet associated with the IPTN.
  - The customer care centre will initially form part of the existing customer care facility of the city. Training will be provided to a dedicated operator for the purpose of IPTN customer relations.
  - When capacity required is more than can be accommodated in existing city facilities and budget is available a dedicated centre can be investigated.
  - Control Centre forms part of the depot design and infrastructure. It will be hosted at the depot in the long term.
- ITS:
  - The system is designed in such a manner that the sophistication of the system can increase over time;
  - When the IPTN fleet and passenger numbers increase - the sophistication of the system needs to be adjusted to accommodate the increase in operations.
  - It needs to be noted that the cost associated with AFC and APTMS needs to be optimised. Due to the existing capital allocated to this component several years will run over allocated funds for capital infrastructure.
- Routes and Services:
  - The optimal start point is to implement trunk only services with contracted feeder services where service providers are paid per passenger delivered. It needs to be noted that these contracted services will have the same AFC equipment as the trunk services to ensure one payment mechanism.
  - As the trunk-feeder system will be implemented where demand and service area are appropriate for implementation,
  - Routes where passenger demand is more than 1 500 per hour per direction and the corridor is at least 5 km was considered for trunk route implementation;
  - Complementary routes will be implemented where an origin-destination pair do not generate more than 1 500 passengers per day and do not join or transfers a trunk route;
  - Feeder routes will collect passengers and interact with trunk services at transfer facilities. Feeders routes can also integrate with trunk routes at dedicated stations where facilities are provided. Refer to Phase 1 implementation for detail on detail for taxi feeder services.
  - When passenger demand increases along feeders and complementary routes the implementation of a trunk route will be considered to ensure acceptable journey times.
- Fleet:
  - The fleet will comprise of a variety of vehicle capacity to suit demand per route and will comply with all standard per grant requirement. The transformation/replacement of existing public transport vehicles by vehicles that comply with all standards universal access, AFC and APTMS requirements form part of the incremental approach associated with the implementation of the system.
  - Vehicles considered as part of the fleet are:
    - *Articulated bus – 120 passenger capacity;*
    - *Rigid bus - 80 passenger capacity;*
    - *Small vehicles for feeders. – 22 passenger capacity. The detail specification of these vehicles needs to be finalised. These vehicles need to comply with standards and requirements per IPTN grant conditions and be universally accessible;*
    - *Existing taxis – These vehicles will be utilised for an interim period of 3-years. These vehicles will be validated and evaluated before these vehicles can provide feeder service. Vehicles will be branded and equipped with AFC. These services and vehicles will be contracted and will not be an informal service. Taxis to be replaced by universal access compliant vehicles.*
- Industry Transformation:
  - Compensation is paid in three instalments in consecutive years from phase is operationalised.
  - Subsidised bus services are rationalised into the new system from 2023/24 onward per implementation phase and the rural contracts are rationalised as part of Thaba Nchu phase.
  - The PTOG funding needs to be allocated to the city per the routes that will be rationalised into the IPTN.

17.4.2 Advantages of the implementation plan

- Phasing of corridors allows for system testing and adaption of the operational model. An incremental formalisation of the existing system.
- Incremental infrastructure implementation, all aspects, allow for capital cost phasing across several years and allow for flexibility/adaptability in system

17.4.3 Risks

- Given the strategic level of the plan the detail costing and assessment of roads and other road upgrades required to ensure acceptable journey times might be significantly higher than indicated.
- The actual demand on the system once the system is operationalised,
- Industry to agree to buy-out in instalments,
- Funding from national government to enable the city to implement the IPTN and the duration thereof.

Figure 17-1: Geographic Extent of IPTN Implementation Phases

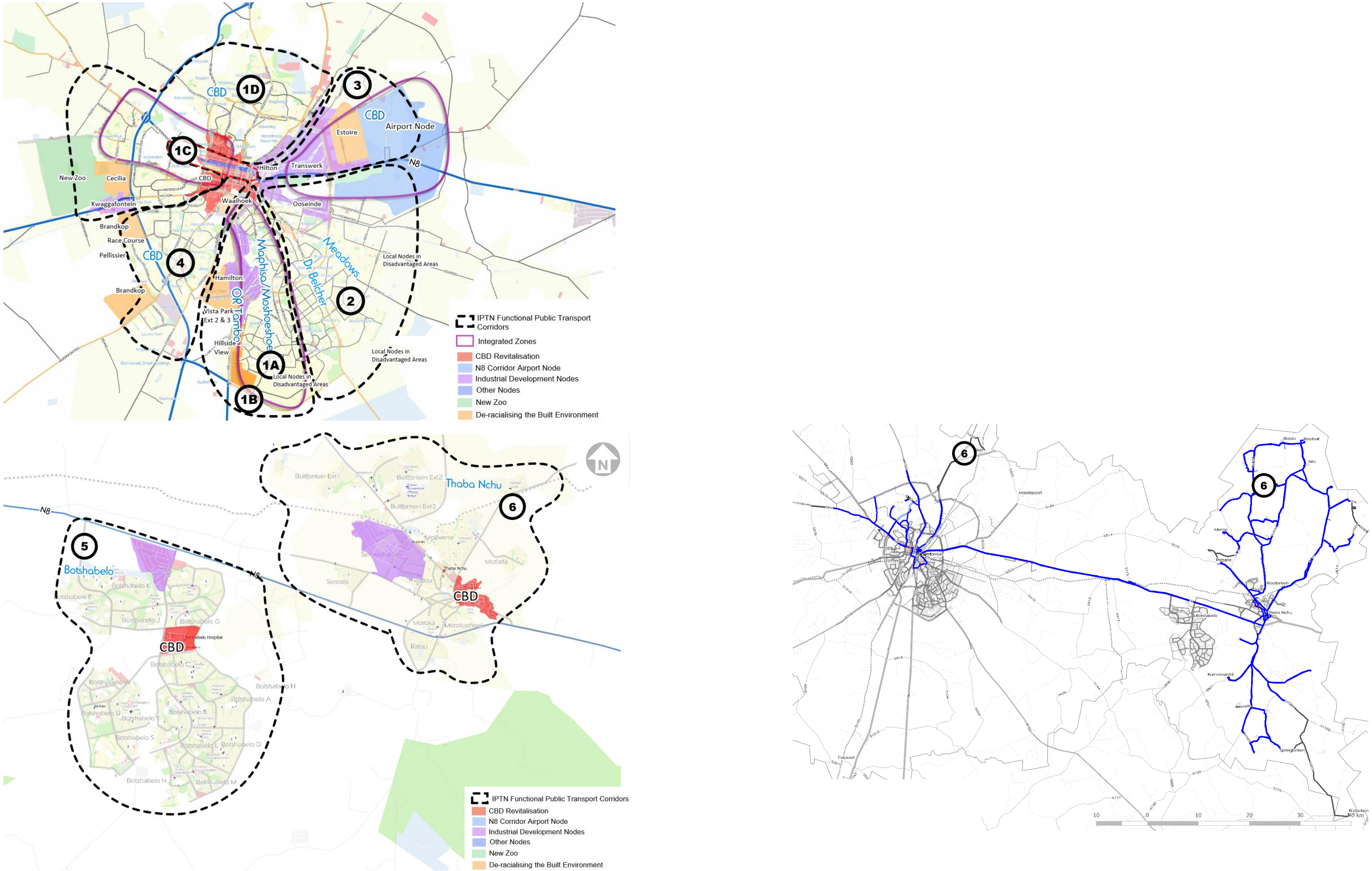
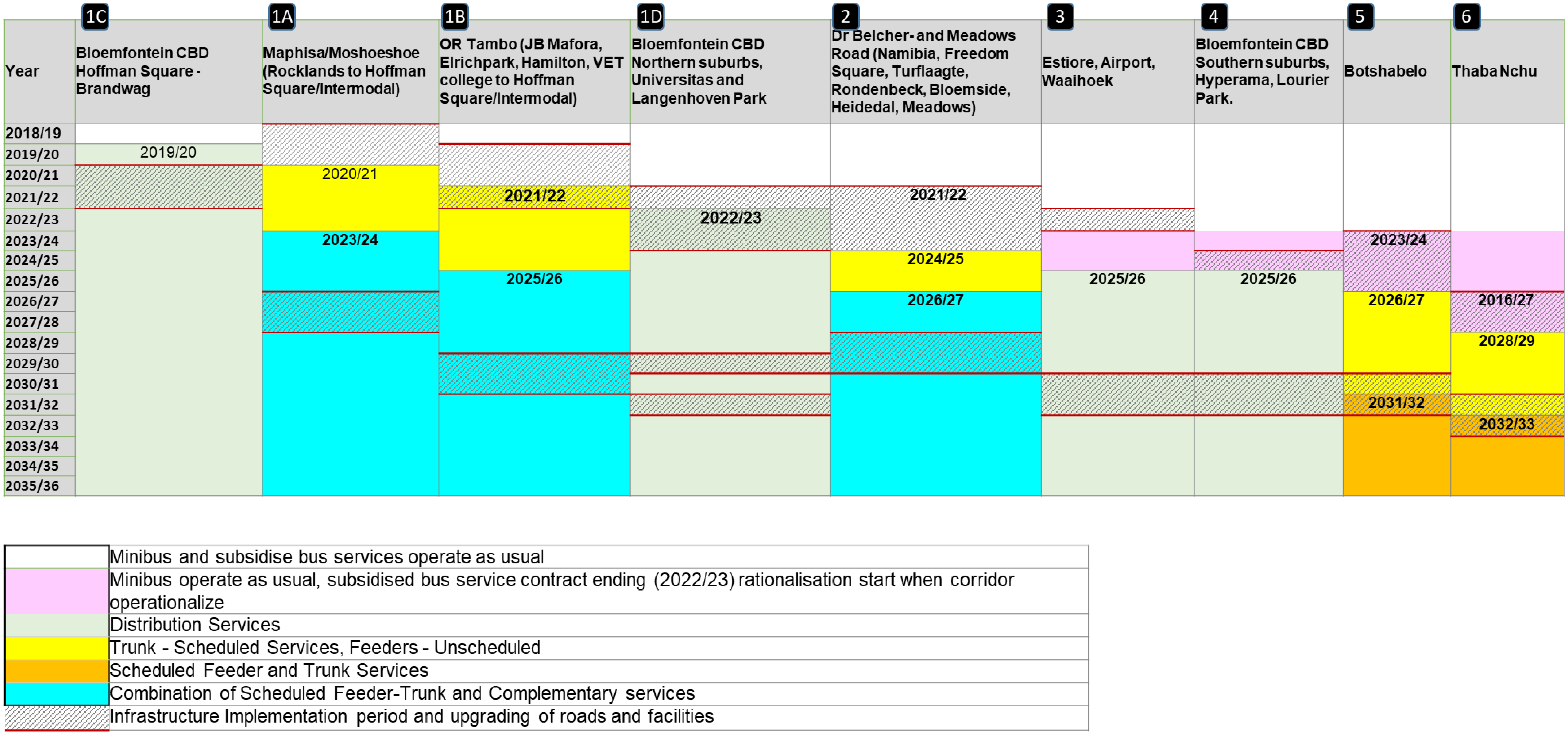
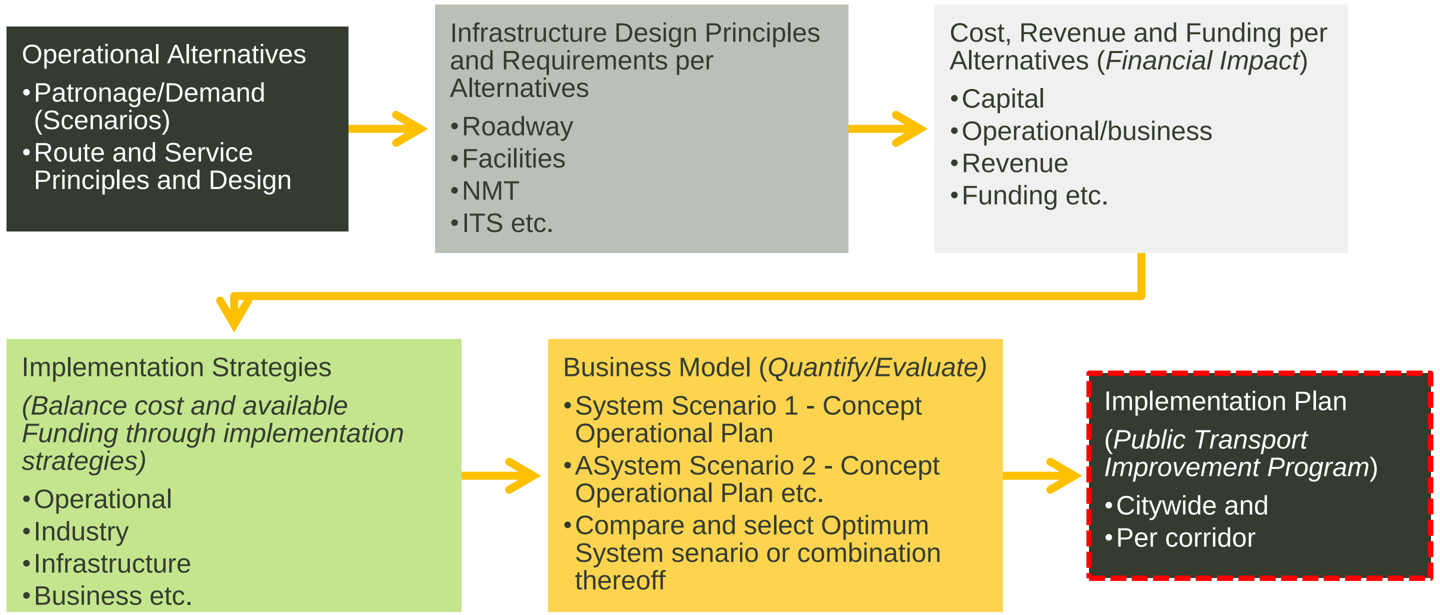


Table 17-2: IPTN Implementation TImeline



18 Public Transport Improvement Program



The recommended implementation option was used as the basis for the development of the Public Transport Improvement Program. The concept of operations and the related implementation strategies were applied to the citywide IPTN per corridor. The PTIP provide detail on a city level and then in detail per corridor. The citywide summary per financial year, 2019-2036, comprises of:

- Service Plan
- Infrastructure Plan
- Capital and Operational Cost Implication
- Funding and Revenue
- Financial Summary

18.1 Service Plan

The recommended services to be implemented and existing services to be rationalised are presented in Table 18-1. The MMM citywide IPTN will be incrementally implemented within 10-years from the operationalisation of the first corridor. The services will initially be trunk services only to be expanded to trunk services with scheduled feeders and complementary routes and services.

The estimated patronage per year per corridor is presented in Table 18-4 and the fleet required to facilitate this operation are presented in Table 18-5. The annual operational km per financial year and corridor are provided in Table 18-6.

The key performance indicators for the system are presented in:

- Diagram 18-1 – Revenue km per total fleet vehicles,
- Diagram 18-2 present the direct vehicle operating cost versus the revenue kilometres; and
- Diagram 18-3 presents the annual passenger journeys per peak bus.

Diagram 18-1: Revenue km/total fleet vehicles

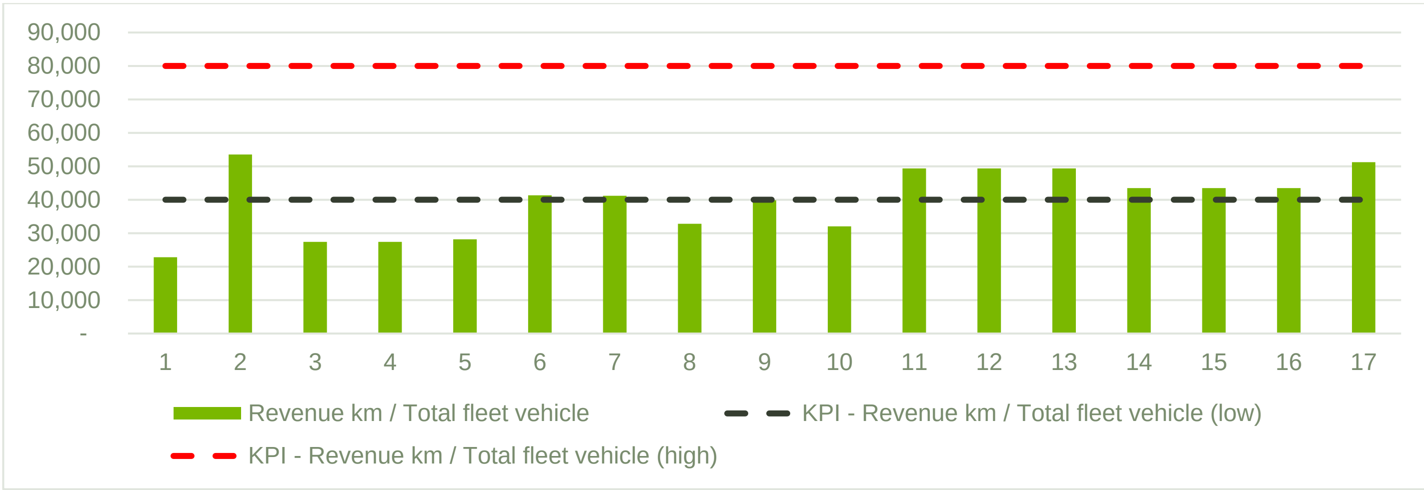


Diagram 18-2: Direct Vehicle Operating Cost/Revenue km

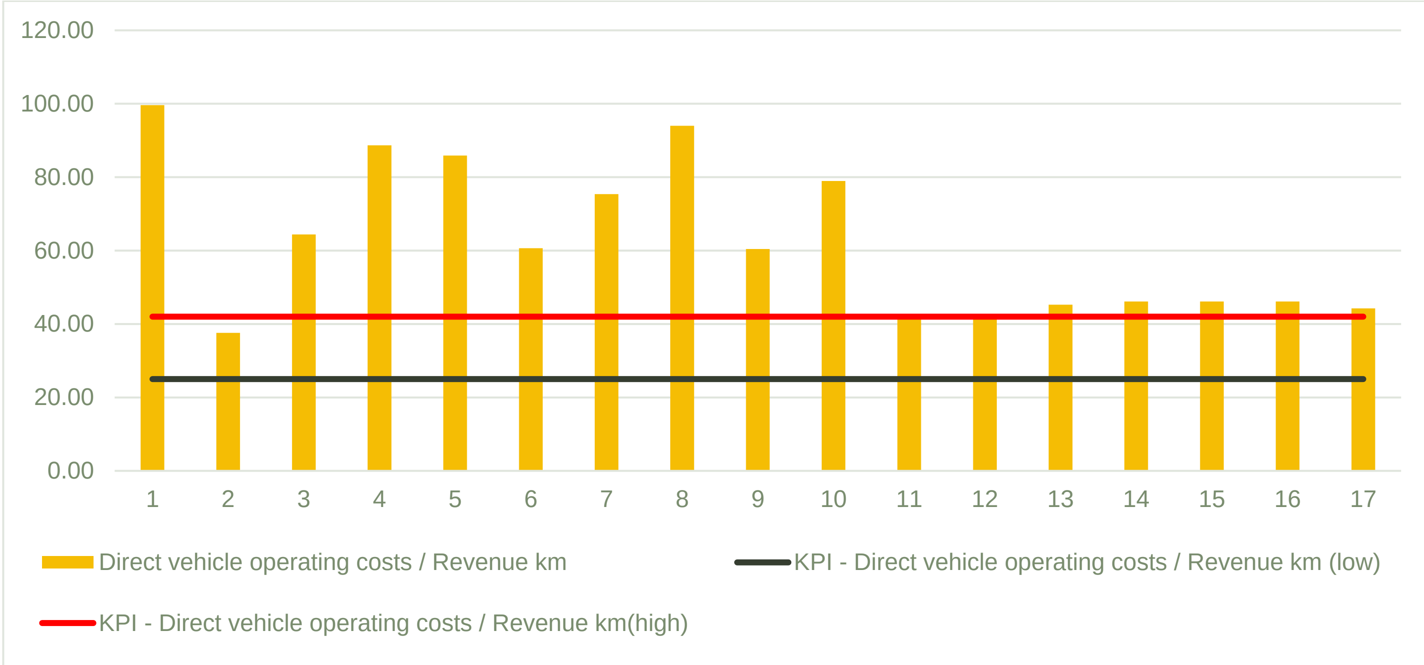


Diagram 18-3: Annual passenger journeys/peak bus

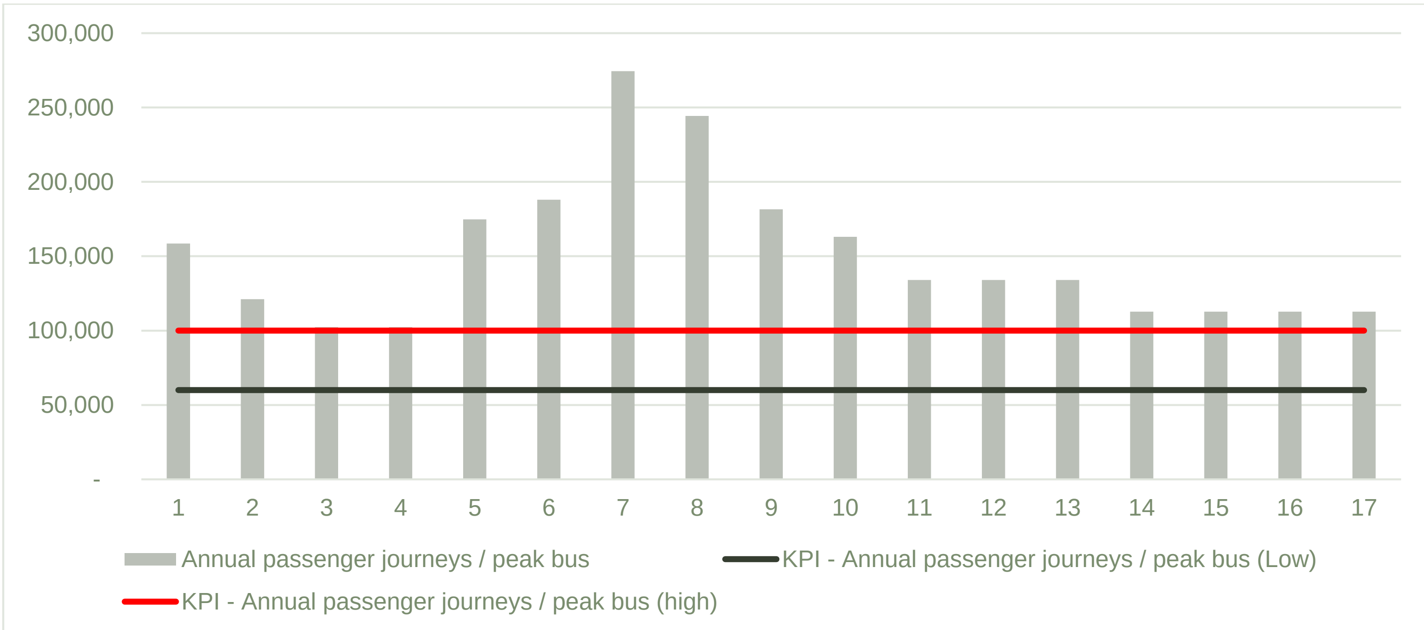


Table 18-1: Services Implementation Plan

Year	1C Bloemfontein CBD Hoffman Square - Brandwag	1A Maphisa/Moshoeshoe (Rocklands to Hofman Square/Intermodal)	1B OR Tambo (JB Mafora, Elrichpark, Hamilton, VET college to Hoffman Square/Intermodal)	1D Bloemfontein CBD Northern suburbs, Universitas and Langenhoven Park	2 Dr Belcher- and Meadows Road (Namibia, Freedom Square, Turflaagte, Rondenbeck, Bloemside, Heidedal, Meadows)	3 Estiore, Airport, Waaihoek	4 Bloemfontein CBD Southern suburbs, Hyperama, Lourier Park.	5 Botshabelo	6 Thaba Nchu
2018/19									
2019/20	2019/20								
2020/21		2020/21							
2021/22			2021/22						
2022/23				2022/23					
2023/24		2023/24							
2024/25					2024/25				
2025/26			2025/26			2025/26	2025/26		
2026/27					2026/27			2026/27	
2027/28									
2028/29									2028/29
2029/30									
2030/31									
2031/32								2031/32	
2032/33									2032/33
2033/34									
2034/35									
2035/36									

	Minibus and subsidise bus services operate as usual
	Minibus operate as usual, subsidised bus service contract ending (2022/23) rationalisation start when corridor operationalize
	Distribution Services
	Trunk - Scheduled Services, Feeders - Unscheduled
	Scheduled Feeder and Trunk Services
	Combination of Scheduled Feeder-Trunk and Complementary services

18.2 Infrastructure Plan

Infrastructure will be implemented incrementally based on realised demand. However, the base for the design was the 2025-year demand in comparison with the 2017 demand taking into consideration the two patronage scenarios. The sizing of infrastructure is based on a conservative approach to accommodate the lower estimated demand with capacity upgrading in later years. Refer to Section 19 for detail pertaining to the incremental implementation of infrastructure per corridor and the sizing of infrastructure.

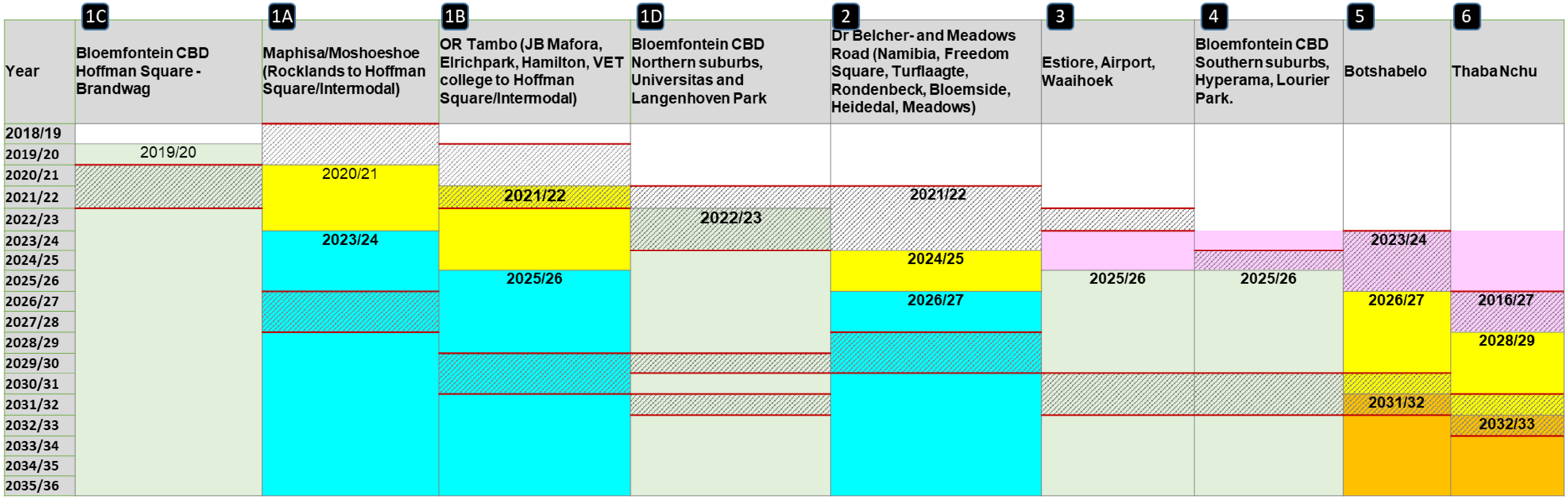
Allowance was made in the budget for localised upgrading as part of maintenance. This entails the upgrading of stations and stops if demand realises at specific main origins destinations like shopping centres, education facilities and other social amenities. The maintenance component was estimated as 3% of the value of infrastructure implemented per year.

Table 18-2 presents the distribution of infrastructure requirement per corridor per financial year and Table 18-3 present the infrastructure implementation in relation to the operationalisation of phases. The infrastructure implementation starts before operationalisation of a particular phase. Refer to detail corridor plans in Section 19 for infrastructure required for operationalisation and increase if capacity in later years.

Table 18-2: Services and Capital Detail

		2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
Infrastructure																				
Maphisa	R279.17M	R89.34M	R106.09M	R83.75M							R20.50M	R9.00M								
OR Tambo	R85.90M		R0.00M	R17.18M	R42.95M	R25.77M	R0.00M							R21.50M	R21.50M					
CBD	R33.76M				R10.13M	R23.63M	R0.00M							R28.50M		R5.00M				
CBD Universitas	R19.58M					R5.87M	R9.79M	R3.92M							R28.50M	R5.00M				
CBD Hyperama	R15.54M							R0.00M	R15.54M						R28.50M	R5.00M				
Dr Belcher	R124.52M					R18.68M	R51.05M	R54.79M					R5.00M	R48.50M						
Botshabelo	R136.04M							R27.21M	R68.02M	R40.81M					R10.00M	R45.50M				
Thaba Nchu	R147.39M										R54.53M	R92.86M	R0.00M	R0.00M	R0.00M	R30.00M	R24.50M			
Maintenance and Upgrading of Facilities	R316.18M				R8.38M	R11.97M	R16.29M	R16.29M	R16.29M	R16.29M	R16.29M	R16.29M	R16.29M	R16.29M	R25.26M	R25.26M	R25.26M	R11.26M	R39.26M	R39.26M
Depot and Upgrade of existing depot facilities subsidised bus services	R260.00M		R6.68M	R31.13M	R31.98M	R45.15M						R41.16M	R41.16M	R25.58M	R25.58M	R12.00M	R24.00M			
ITS CAPEX	R310.72M			R5.00M	R46.34M	R21.34M	R50.11M	R51.79M	R20.13M	R23.62M	R23.62M		R57.90M			R2.15M	R2.43M	R1.71M	R2.46M	R2.12M
ITS OPS	R170.43M				R2.71M	R3.89M	R4.34M	R5.37M	R7.83M	R8.73M	R8.92M	R10.58M	R12.62M	R14.21M	R15.09M	R15.23M	R15.23M	R15.23M	R15.23M	R15.23M
Vehicle Acquisition and Branding of FeederVehicles	R51.13M			R47.00M	R0.36M	R0.27M			R1.19M				R1.90M		R0.42M					
CAPITAL COST		***R89.34M***	***R112.77M***	***R184.07M***	***R140.14M***	***R152.68M***	***R127.23M***	***R153.99M***	***R121.16M***	***R80.72M***	***R114.94M***	***R159.30M***	***R122.25M***	***R140.37M***	***R139.76M***	***R129.91M***	***R76.19M***	***R12.97M***	***R41.72M***	***R41.38M***
Compensation																				
Maphisa	R74.75M				R22.43M	R22.43M	R29.90M		R29.49M	R3.28M										
OR Tambo	R47.86M					R14.36M	R14.36M	R19.14M		R44.61M										
CBD	R113.18M			R6.22M	R27.73M															
CBD Universitas							R16.98M	R16.98M												
CBD Hyperama										R22.64M	R22.64M									
Dr Belcher	R114.63M								R37.83M	R37.83M	R38.97M	R18.97M	R26.56M	R18.97M	R18.97M	R0.00M				
Botshabelo	R28.67M										R9.46M	R9.46M	R9.46M			R57.29M	R24.55M			
Thaba Nchu	R87.73M												R28.95M	R28.95M	R28.95M		R54.60M			
Compensation	R466.82M			***R6.22M***	***R50.15M***	***R36.78M***	***R61.24M***	***R36.12M***	***R67.32M***	***R108.35M***	***R71.07M***	***R28.43M***	***R64.97M***	***R47.92M***	***R47.92M***	***R57.29M***	***R79.15M***			
Capital Cost shortfall/Surplus			***R10.32M***	***-R2.37M***	***-R2.37M***	***-R1.54M***	***-R0.55M***	***-R2.19M***	***-R0.56M***	***-R1.15M***	***R1.91M***	***R0.19M***	***R0.70M***	***-R0.37M***	***R0.24M***	***R0.72M***	***R32.58M***	***R174.95M***	***R146.20M***	***R146.54M***

Table 18-3: Infrastructure Iplementation Timeline



(white)	Minibus and subsidise bus services operate as usual
(pink)	Minibus operate as usual, subsidised bus service contract ending (2022/23) rationalisation start when corridor operationalize
(light green)	Distribution Services
(yellow)	Trunk - Scheduled Services, Feeders - Unscheduled
(orange)	Scheduled Feeder and Trunk Services
(cyan)	Combination of Scheduled Feeder-Trunk and Complementary services
(hatched)	Infrastructure Implementation period and upgrading of roads and facilities

Table 18-4: Patronage

	2019/20	2020/21	2021/22	2023/24	2024/25	2025/26	2026/27	2028/29	2035/36
Maphisa/Moshoeshoe	-	8,732	8,732	13,350	13,350	14,209	14,209	14,209	14,209
OR Tambo	-	-	9,497	14,520	14,520	15,455	15,455	15,455	15,455
Dr Belcher/Meadows	-	-	-	-	47,527	47,527	47,527	47,527	47,527
Botshabelo	-	-	-	-	-	-	23,654	23,654	23,654
Thaba Nchu	-	-	-	-	-	-	-	23,942	23,942
CBD	5,899	5,899	5,899	14,339	14,339	23,252	23,252	23,252	23,252
CBD1	-	-	-	32,397	32,397	52,534	52,534	52,534	52,534
CBD2	-	-	-	-	-	27,671	27,671	27,671	27,671
Excluding CBD	**-**	**8,732**	**18,229**	**27,870**	**75,397**	**77,192**	**100,847**	**124,789**	**124,789**
Total Citywide	**5,899**	**14,631**	**24,128**	**42,209**	**89,736**	**100,444**	**124,098**	**148,041**	**228,246**

Table 18-5: Fleet

2017/18	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
Maphisa																	
120							11	11	11	11	11	11	11	11	11	11	11
80		13	13	13	20	22	9	9	9	9	9	9	9	9	9	9	9
22		6	6	6	22	17	10	10	10	10	10	10	10	10	10	10	10
OR Tambo																	
120							12	12	12	12	12	12	12	12	12	12	12
80			27	27	41	41	25	25	25	25	25	25	25	25	25	25	25
22							13	13	13	13	13	13	13	13	13	13	13
CBD Brandwag																	
120							12	12	12	12	12	12	12	12	12	12	12
80	9	9	9	9	16	16	6	6	6	6	6	6	6	6	6	6	6
22																	
CBD Universitas																	
120							11	11	11	11	11	11	11	11	11	11	11
80				21	46	46	72	72	72	72	72	72	72	72	72	72	72
22				15	37	37	9	9	9	9	9	9	9	9	9	9	9
CBD Hyperama																	
120							29	29	29	29	29	29	29	29	29	29	29
80							6	6	6	6	6	6	6	6	6	6	6
22							14	14	14	14	14	14	14	14	14	14	14
Dr Belcher						Dr Belcher											45
120						54	54	54	45	45	45	45	45	45	45	45	45
80									42	42	42	42	42	42	42	42	42
22									35	35	35	35	35	35	35	35	35
Botshabelo																	
120								41	41	41	36	36	36	36	36	36	36
80											13	13	13	13	13	13	13
22											62	62	62	62	62	62	62
Thaba Nchu																	
120										63	63	63	63	70	70	70	70
80														29	29	29	29
22														39	39	39	39

Table 18-6: Annual Operational km

	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
Maphisa	0	528,665	528,665	528,665	1,127,458	1,127,458	880,539	880,539	880,539	880,539	880,539	880,539	880,539	880,539	880,539	880,539	1,024,209
OR Tambo	0	767,840	767,840	767,840	1,173,966	1,173,966	1,439,462	1,439,462	1,439,462	1,439,462	1,439,462	1,439,462	1,439,462	1,439,462	1,439,462	1,439,462	1,674,327
CBD	196,165	196,165	196,165	196,165	476,789	476,789	514,701	514,701	514,701	514,701	514,701	514,701	514,701	514,701	514,701	514,701	515,864
CBD Universitas	0	0	915,415	915,415	2,410,001	2,410,001	2,677,060	2,677,060	2,677,060	2,677,060	2,677,060	2,677,060	2,677,060	2,677,060	2,677,060	2,677,060	2,683,107
CBD Hyperama	0	0	0	0	1,021,532	1,021,532	1,439,169	1,439,169	1,439,169	1,439,169	1,439,169	1,439,169	1,439,169	1,439,169	1,439,169	1,439,169	1,442,420
Dr Belcher	0	0	0	0	0	3,425,064	3,425,064	3,506,226	3,506,226	3,506,226	3,506,226	3,506,226	3,506,226	3,506,226	3,506,226	3,506,226	3,506,226
Botshabelo	0	0	0	0	0	0	0	0	4,019,690	4,019,690	6,675,482	6,675,482	6,675,482	6,675,482	6,675,482	6,675,482	7,157,351
Thaba Nchu	0	0	0	0	0	0	0	0	0	0	6,393,691	6,393,691	6,393,691	7,311,732	7,311,732	7,311,732	10,081,157
Total	**196,165**	**1,492,670**	**2,408,085**	**2,408,085**	**6,209,746**	**9,634,810**	**10,375,996**	**10,457,159**	**14,476,848**	**14,476,848**	**23,526,332**	**23,526,332**	**23,526,332**	**24,444,373**	**24,444,373**	**24,444,373**	**28,084,662**

18.3 Capital and Operational Cost Implications

The capital requirement in comparison to the available funding is presented in Diagram 18-4. A shortfall is projected for each financial year based on current allocation for capital investment. The capital cost was optimised for all in capital components of the project. Three items are indicated separately that can be optimised or omitted but will have an effect on the quality of the system and the universal accessible compliance of the system, these items are:

- AFC and APTMS and the amount allocated to compensation. The AFC and APTMS cost can only be optimised once a tender was advertised and suppliers provide actual cost or revised cost for specifications provided in the tender. To date no alternative AFC and APTMS systems were procured by a city in South Africa and it is thus possible to reduce the cost. However, if the cost cannot be reduced the conservative approach is presented in the costing.
- Conversion of feeder vehicles to universal accessible compliant vehicles.
  - Allowance was made to convert the existing vehicles to universal accessible vehicles from year 2024/25.
  - The intention is to start operations with existing vehicles that are branded and fitted with AFC and APTMS system. These vehicles are not universally accessible, but two options can be implemented. Refer to the implementation strategy.
  - The capital required for the replacement of these non-compliant vehicles is reflected in the total capital requirement. This can be omitted to minimise capital requirement but will affect the accessibility of the system.
- Compensation for affected operators.
  - The cost reflected take a middle ground to compensation value and can be higher or lower depending on the outcome of the negotiation process.
  - This will remain a high-risk item in the budget and can be managed through the negotiation process and mandate from the city on the compensation value.

The operational cost versus the operational funding and revenue are presented in Diagram 18-5 and the annual CAPEX and OPEX shortfall is presented in Diagram18-6. A significant operational shortfall is foreseen in later years of implementation. The city contribution towards the implementation of a quality public transport system needs to increase to ensure that marginalised users have access to the system. The additional subsidy required to minimise the shortfall is +- R170M per year. This amount is required above the R20M city contribution and the R230M PTOG. Based on the city's rate base an 8% of rate base will contribute R80M. The remainder of the shortfall will need to be sourced from other funding sources that can include:

- Increase in fare. Affordability will become and concern id fare is increased significantly; and
- Increase in PTOG from national treasury.

Diagram 18-4: Capital Requirement versus Capital Funding

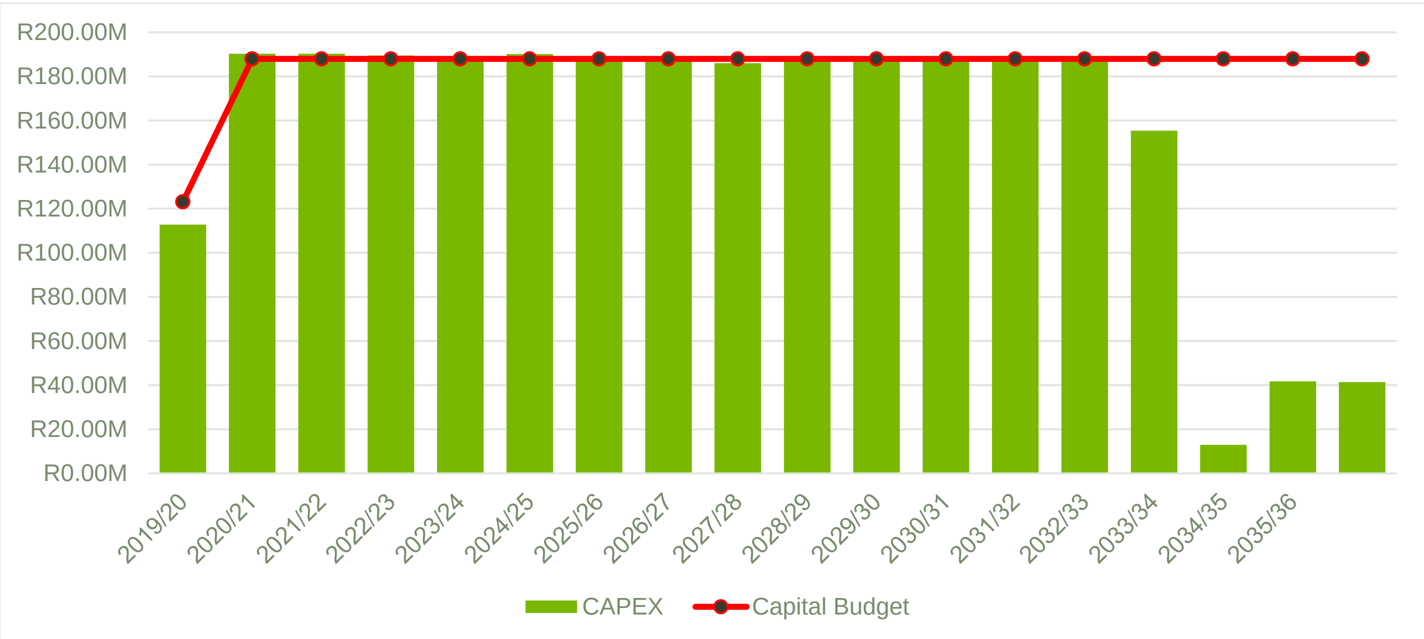


Diagram 18-5: Operational Cost versus Income and Operational Funding

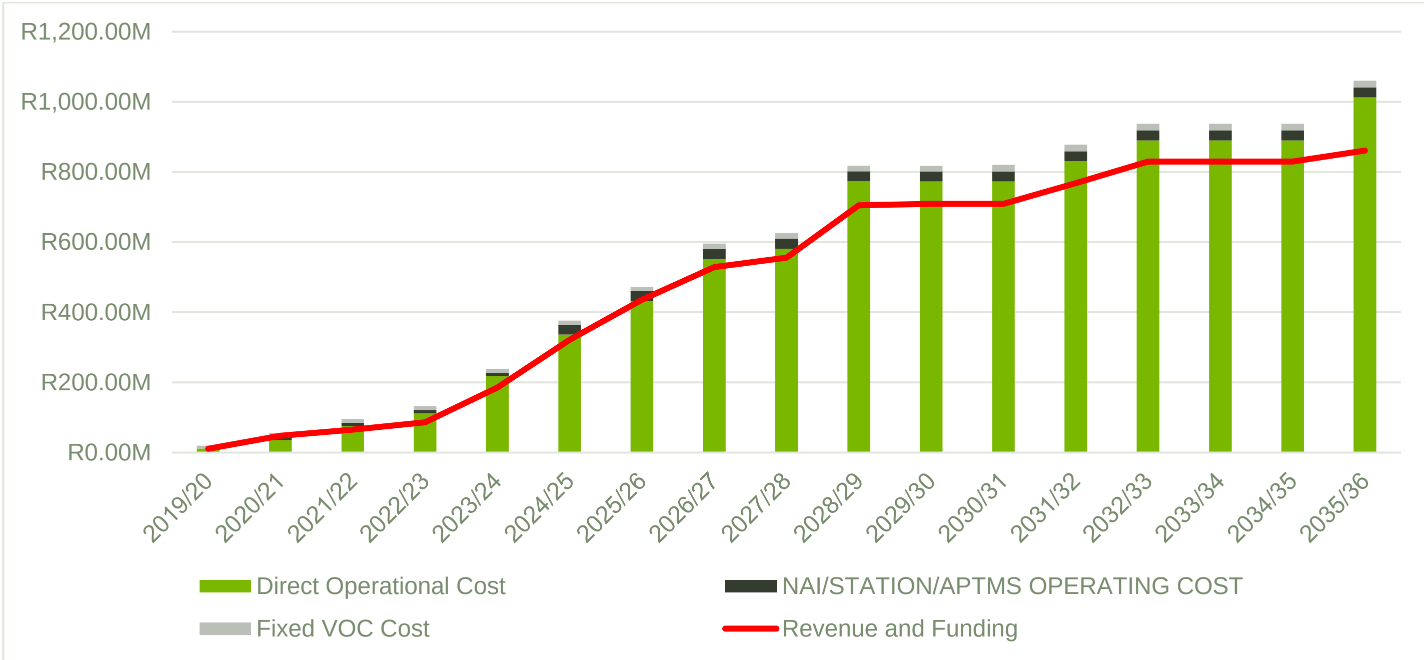
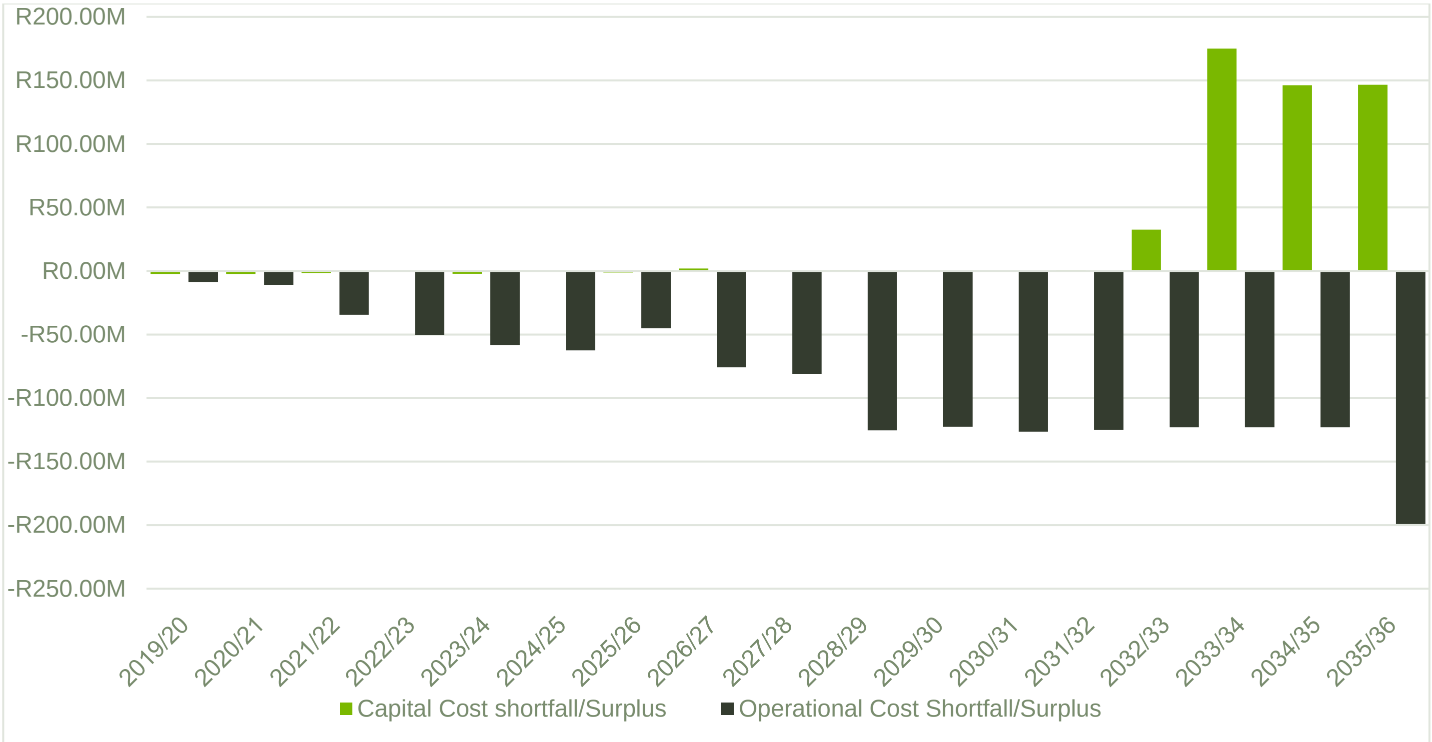


Diagram 18-6: OPEX and CAPEX Shortfall/Surplus



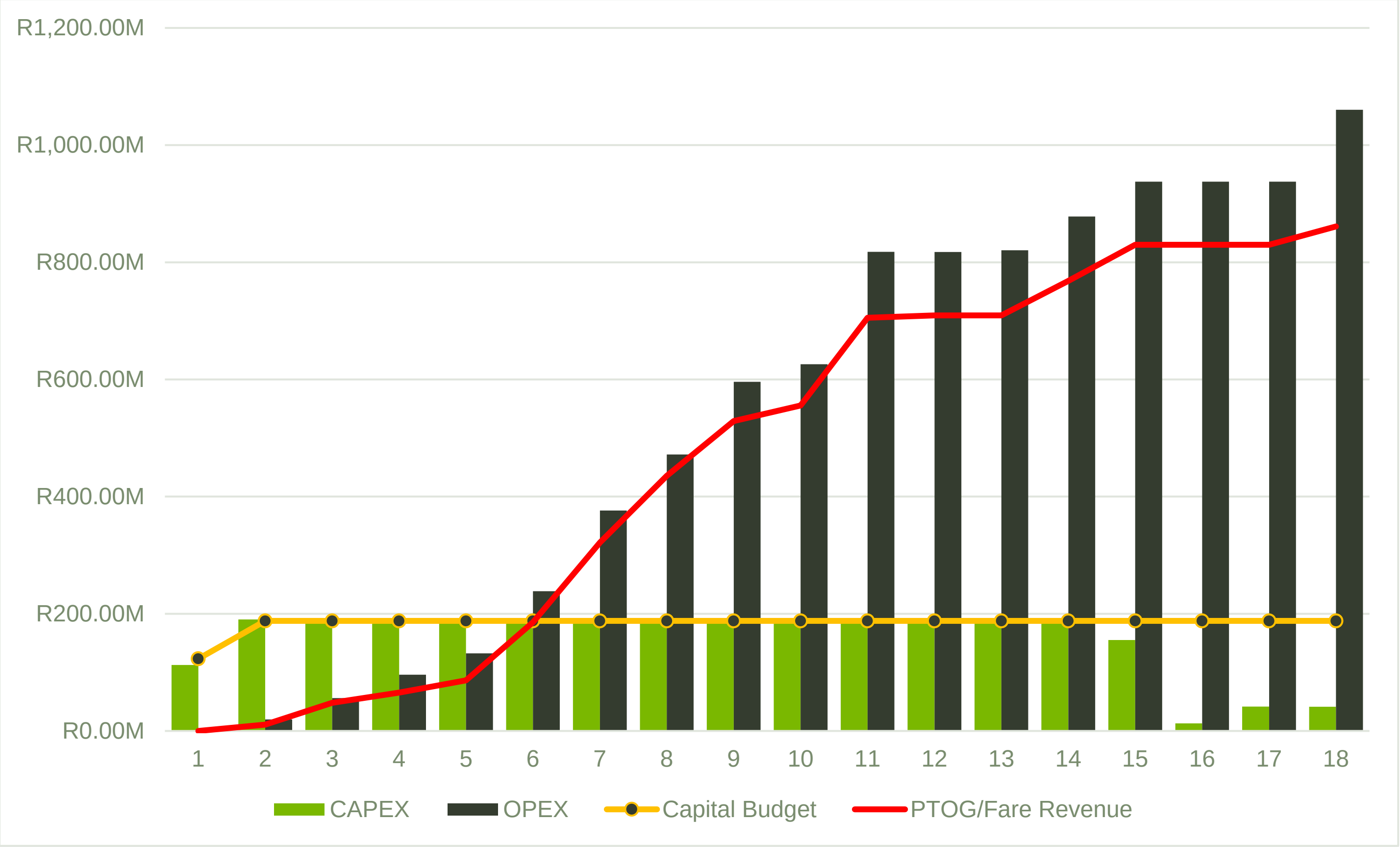
18.4 Financial Implications

This chapter summarises the budgeted cost and financing of the city-wide Mangaung Metropolitan Municipality Integrated Passenger Transport Network (IPTN) system. While costs include both the envisaged costs of planning, designing, building and implementing the system as well as running it, the chapter also addresses the expected indicative ongoing, recurrent costs of running the system through a twenty (20) year financial horizon. The planning, design, build and implementation costs are assumed to be covered almost entirely from national grant funding and to a degree are more predictable and certain. However, the financing of ongoing operations post-implementation will be from a combination of fare and other system revenue, national grants and the MMM's own general revenues. Operating costs and revenues are much more uncertain, entail ongoing commitments, and have substantial risks associated with them largely due to the difficulty in predicting revenue and variable costs over a longer term and the restriction on the extent to which ancillary operating costs may be covered by grant funding. These risks need to be carefully understood and managed by the MMM.

The funding and cost are distributed across financial years to determine the shortfall per year and where necessary to distribute the cost across several years. The envisaged cost and income distribution for the 20-year period are summarised in Diagram 18-7.

Note that the financial model for the IPTN will be developed to quantify the shortfall and the mechanisms and cost to minimise shortfalls.

Diagram 18-7: Citywide IPTN 20-year - Financial Summary



19 Implementation Plan per Corridor

Each of the identified corridors detailed implementation stemming from the alternative analysis and the recommended implementation program is provided. In this section. The detail per corridor is provided in terms of:

- Movement patterns
- Implementation Timeline
- Routes and Services
- Envisaged Patronage
- Fleet deployment
- Infrastructure – Roadways and Facilities
- Industry Transformation
- Capital and Operational Cost

Details pertaining to cross-cutting aspects are addressed in the strategy sections beforehand, business plan and to be detailed per operational plan per corridor or part of the corridor to be implemented.

Strategy to the implementation of Main transfer facilities, Right-of-way, Depot, Control centre, customer care centre and ITS are addressed on city-wide for implementation, refer to preceding sections pertaining to these elements.

19.1.1 Phase 1A (Maphisa/ Moshoeshoe/ Chief Moroka) and Phase 1B (OR Tambo/Taelo Molosioa) Functional Public Transport Corridor

The corridor is host to several low, medium and high-density residential developments, several retail and mixed-use nodes and a large industrial area provide employment to residents of the corridor and rest of the city. The retail and employment areas attract trips and are thus identified as nodes where public transport services will be required.

The SDF of the city governs the development of the area with only one detailed precinct plan developed for the Waaihoek precinct to the north of the corridor. To ensure long-term sustainability the population density needs to increase, and mixed-use development promoted along the corridor. Several high-density social housing projects are under development along OR Tambo and Maphisa Road and thus population density will increase and future ridership most likely increase. The implementation of Hauweng services along these corridors will enhance mobility and accessibility in the corridor and mentioned developments.

To facilitate and govern densification and spatial form of the corridors it is recommended that precinct plans are developed for the main nodes within the public transport corridors. Six nodes were identified where mixed-use development and residential densification could enhance the existing environment or provide facilities in underserviced areas. Three of the precinct plans were already developed, however, three nodes still require precinct plans. The nodes identified for precinct plans are depicted in **Figure 19-1** and existing and required precinct plans are indicated. Precinct plans are required for the area surrounding the main transfer part of the OR Tambo/Taelo Molosioa corridor (c/o Taelo Molosioa Road and Leepile Street) and the area surrounding the Motheo TVET College Hillside View Campus (David Montoedi Street).

19.1.1.1 Movement Patterns

Given the spatial structure of the corridor the conceptual movement in the corridor and to other corridors are presented in **Figure 19-2**. The main points of interest and land uses are presented in **Figure 19-3**. These elements were used to design the route network as well as existing public transport operator services areas and routes.

19.1.1.2 Implementation Timeline

The public transport improvement program through the alternative analysis process recommends that the transformation of existing services to the Hauweng system will be most feasible when the existing services are rationalised to the new system in four increments. The increments were primarily defined based on the “clear the corridor” principle where the operationalisation of the corridor will be a scheduled trunk service with unscheduled feeder services, followed by rationalisation and formalisation of the unscheduled feeder services to scheduled feeders routes or where feasible to complementary routes. The rationalisation and transformation of the feeder services will be spread across three increments and implemented when the rationalisation is proven to be financially feasible i.e. when funding is available and patronage along these feeders are at least 450 pax per hour. The corridor operationalisation year and the rationalisation of feeder services are presented in **Diagram 19-1**.

The corridor will be operationalised during 2020/21 and 2021/22 with full transformation in 2024/2025 given that funding remains at the current level. The route, service, fleet, infrastructure, industry transformation and other system elements are detailed below to realise the implementation and transformation of the existing public transport to a high-quality public transport system for the city.

Diagram 19-1: Maphisa/ Moshoeshoe/ Chief Moroka and OR Tambo/Taelo Molosioa Implementation Timeline

Year	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
(Maphisa/ Moshoeshoe/ Chief Moroka		Trunk - Scheduled Services, Feeders - Unscheduled				Combination of Scheduled Feeder-Trunk and Complementary services											
OR Tambo/ Taelo Molosioa			Trunk - Scheduled Services, Feeders - Unscheduled				Combination of Scheduled Feeder-Trunk and Complementary services										

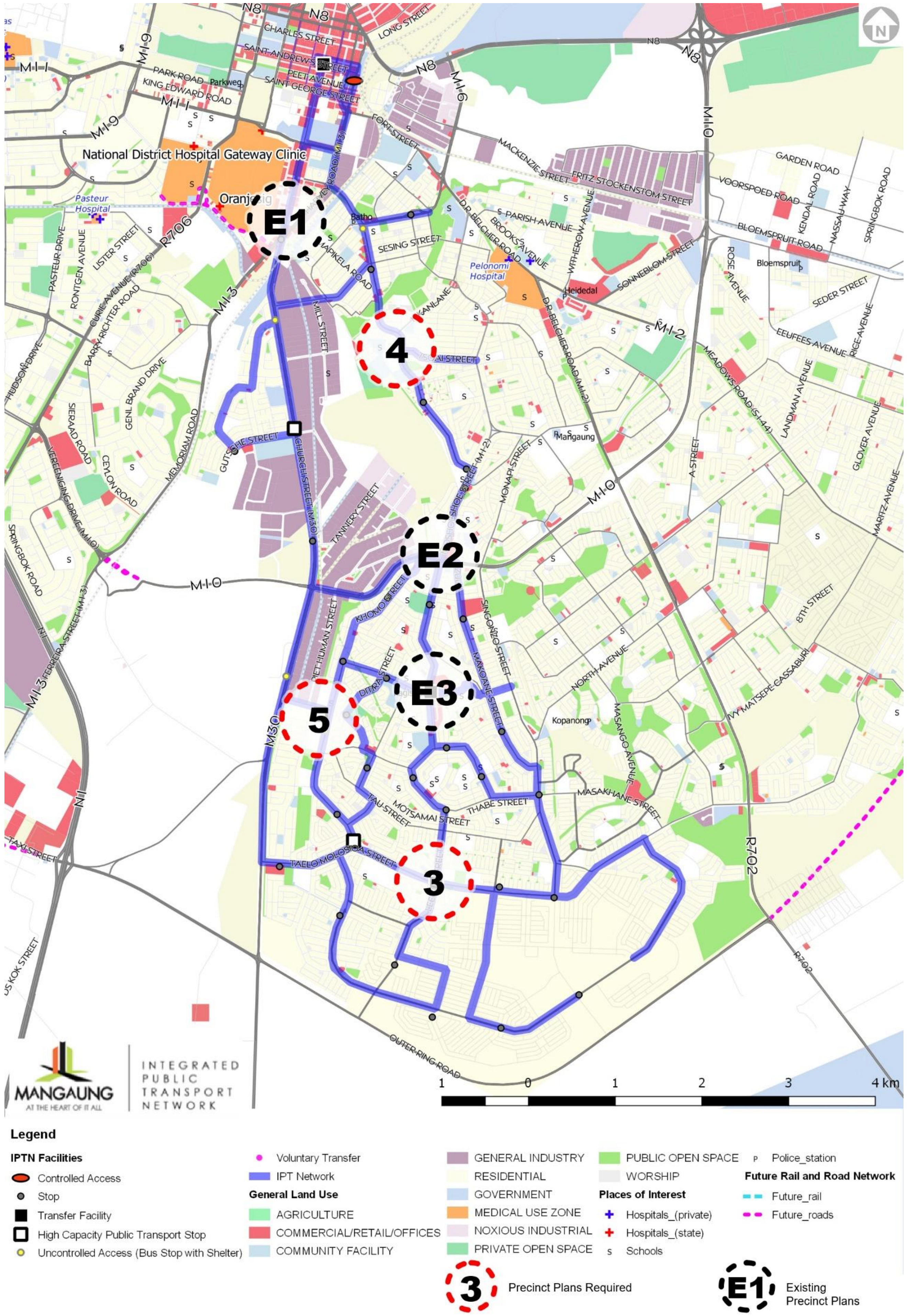


Figure 19-1: Maphisa/Moshoeshoe and OR Tambo Precinct Plans

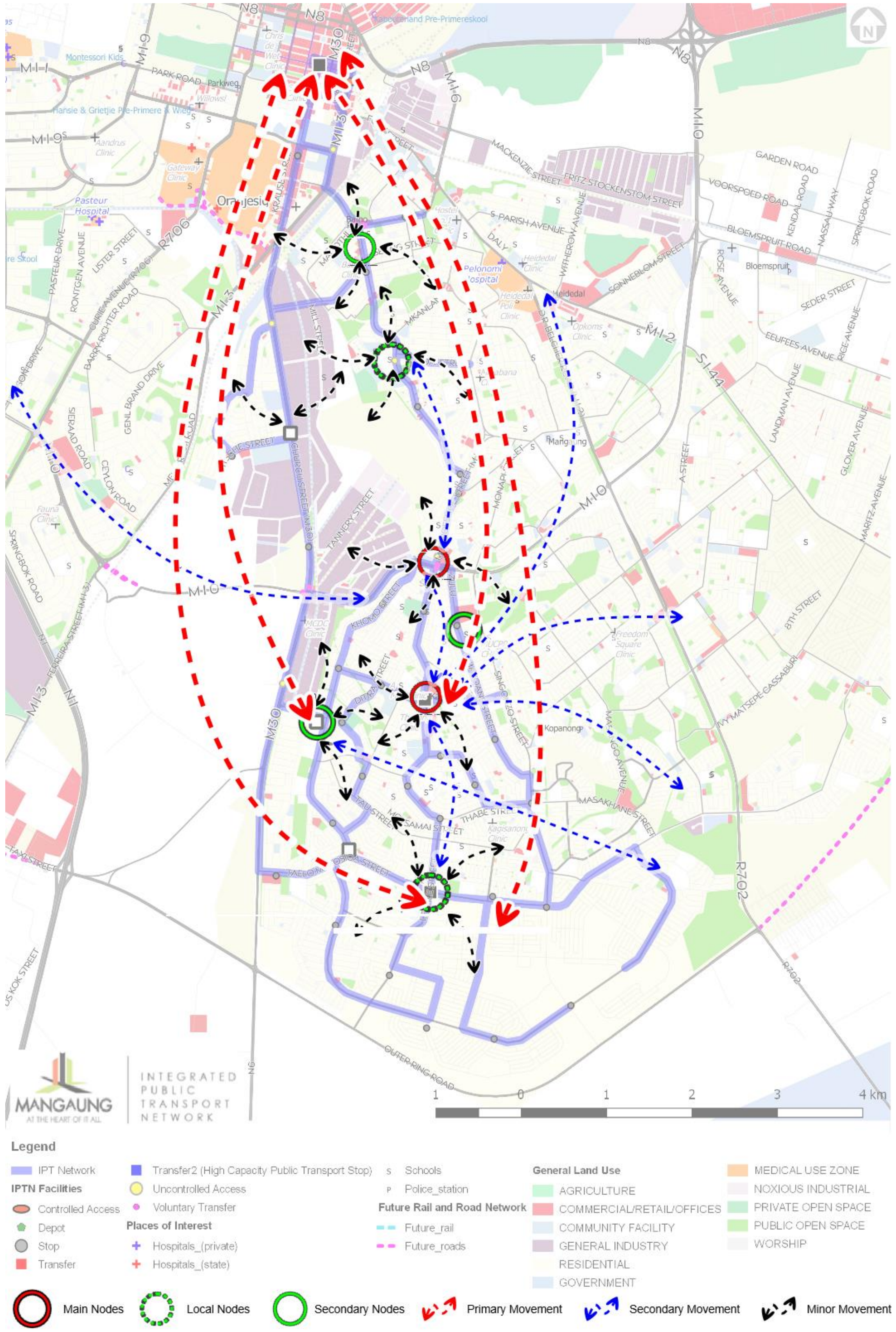


Figure 19-2: Movement Patterns

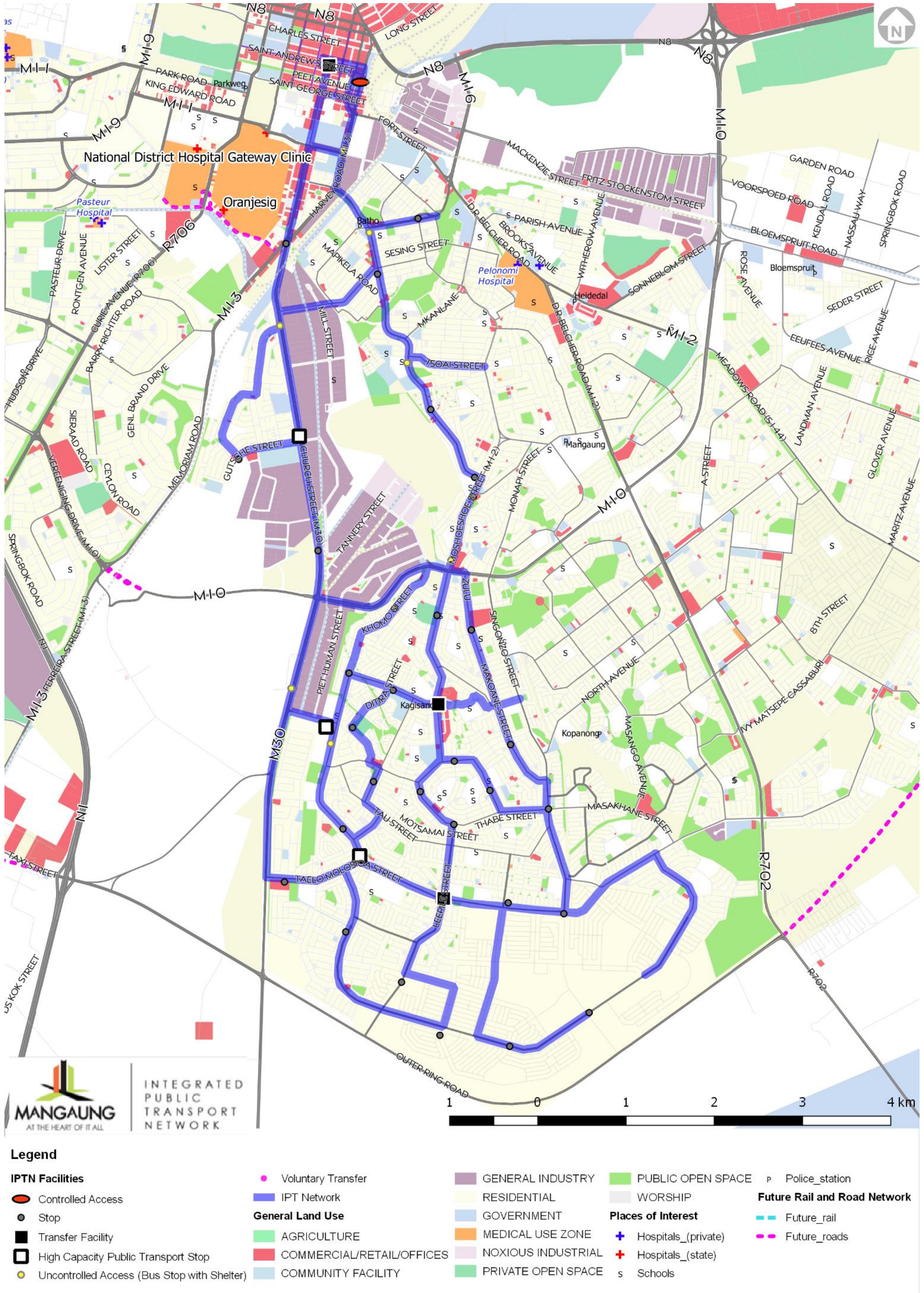


Figure 19-3: Maphisa/Moshoeshoe/Chief Moroka and OR Tambo/ Taelo Molosioa Land Use and Points of Interest

19.1.1.3 Routes

The route design for the operationalisation phase for the corridor is presented in **Figure 19-4** and at full development phase is presented in **Figure 19-5**. Based on the selected implementation plan for the city the route design that needs to be considered when the operational plan is developed for the corridor comprises of two trunk routes:

- Trunk 1 – From Hoffman Square, Intermodal to Rocklands transfer facility near Rocklands Checkers Centre via Maphisa- and Moshoeshoe Roads;
- Trunk 2 - From Hoffman Square, Intermodal to JB Mafora transfer facility via OR Tambo, David Montoedi- and Taelo Molosioa Streets. The area surrounding the proposed transfer is undeveloped and thus the call for the development of a precinct plan to facilitate development in the area. When a transfer is implemented at the recommended location, trading facilities will be required, and it will create the opportunity to provide social amenities in the area since minimal facilities are provided.

During the operationalisation phase, of Maphisa/Moshoes/ Chief Moroka trunk, four (4) unscheduled feeder routes will integrate with the trunk routes at transfer facilities or high capacity bus stops and sic(six) unscheduled feeder routes will integrate with the OR Tambo/ Taelo Molosioa trunk. The trunk-feeder configuration allows for the incremental transformation of the existing public transport operators where operators are contracted to provide an unscheduled feeder service with vehicles complying to minimum standards, vehicle specifications and branded according to the Hauweng brand. These vehicles will be equipped with AFC and limited APTMS to increase commuter experience. The route alignment will be stipulated as part of the amendment of the operating licenses for entities that will provide the feeder services. These will be a contracted service with a service level agreement. The remuneration and principles thereof are addressed in the business plan per phase and developed as part of the Operational Plan per phase.

After the operational phase, six of the ten feeder routes will be rationalised to scheduled complementary routes. The routes to be rationalised are listed in **Table 19-1**. The implementation of the complementary routes will optimise operational cost and the vehicle fleet required for operations and minimise the number of transfers that a commuter has to make. The implementation of complementary routes will furthermore optimise the size of the transfer facility per corridor. Thus to construct large transfer facilities before operationalisation can lead to wasteful expenditure. This rationalisation will only be implemented if demand realises according to estimations.

The initial route design will introduce an additional transfer comparing to existing public transport operations. However, express services are implemented as part of the service offering and will thus enhance the existing stop at all possible pick-up points and optimise passenger journey time.

Table 19-1: Maphisa/Moshoeshoe/Chief Moroka and OR Tambo/ Taelo Molosioa Routes

Route Number	Route Length One direction (km)	2020/21	2021/22	2023/24	Route Length one direction Complementary routes (km)
Maphisa T1	8	Trunk	Trunk	Trunk	8
Rt 21	3	Feeder	Complementary	Complementary	12.3
Rt 22	2.5	Feeder	Complementary	Complementary	12.5
Rt 23	2.2	Feeder	Feeder	Feeder	2.2
Rt 25	2.7	Feeder	Feeder	Feeder	2.7
OR Tambo Trunk	14		Trunk	Trunk	14
Rt26	3		Feeder	Complementary	17
Rt27	3		Feeder	Complementary	17.4
Rt29	3		Feeder	Feeder	3
Rt30	2.4		Feeder	Complementary	16.4
Rt31	2		Feeder	Complementary	10.5
Rt36	3.5		Feeder	Feeder	3.5
Direct Route 1	8	Direct/Diagonal	Direct/Diagonal	Direct/Diagonal	8
Direct Route 2	11.6	Direct/Diagonal	Direct Route Diagonal	Direct Route Diagonal	11.6

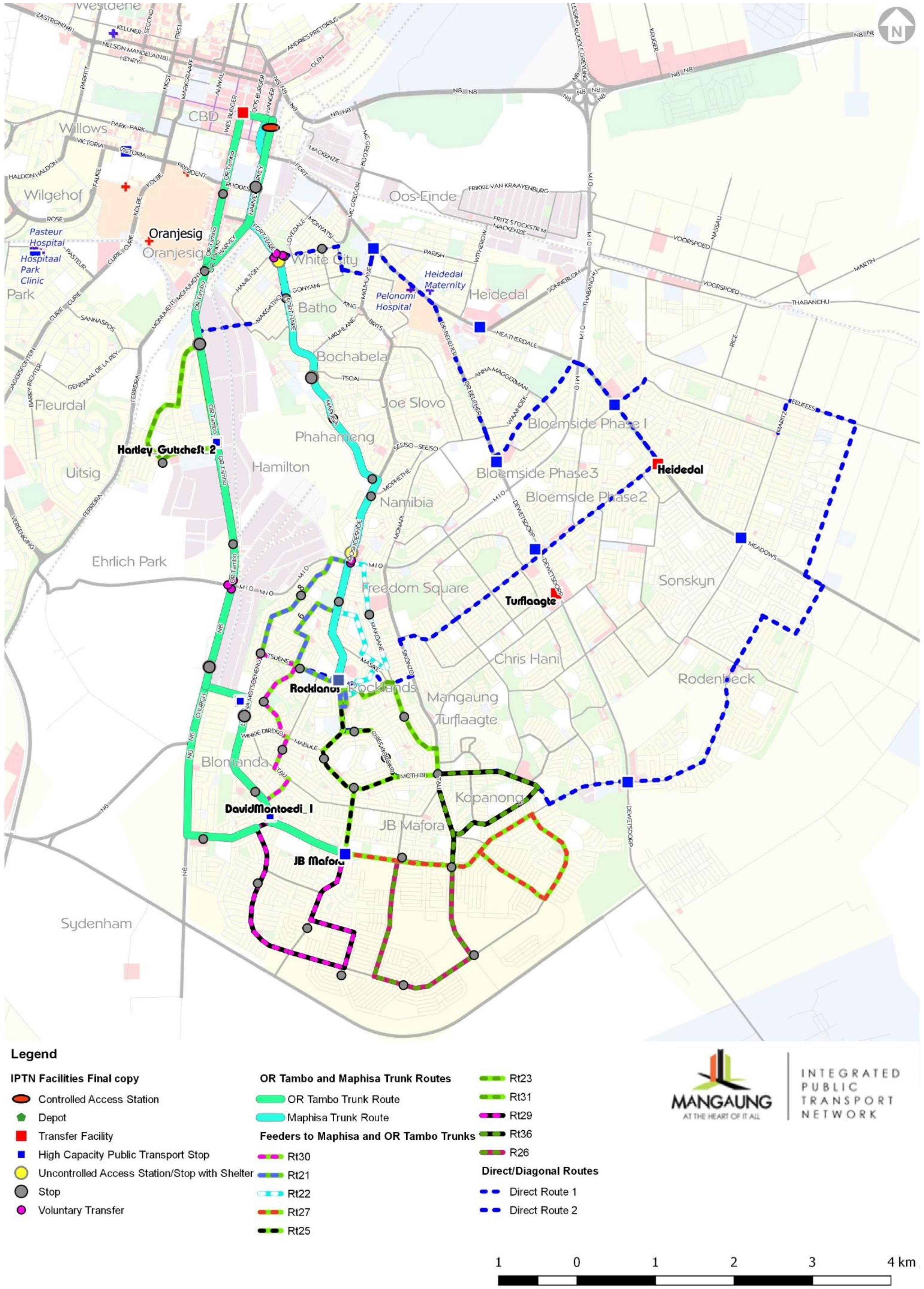


Figure 19-4: Maphisa/Moshoeshoe/Chief Moroka and OR Tambo/ Taelo Molosioa – Operationalisation Phase

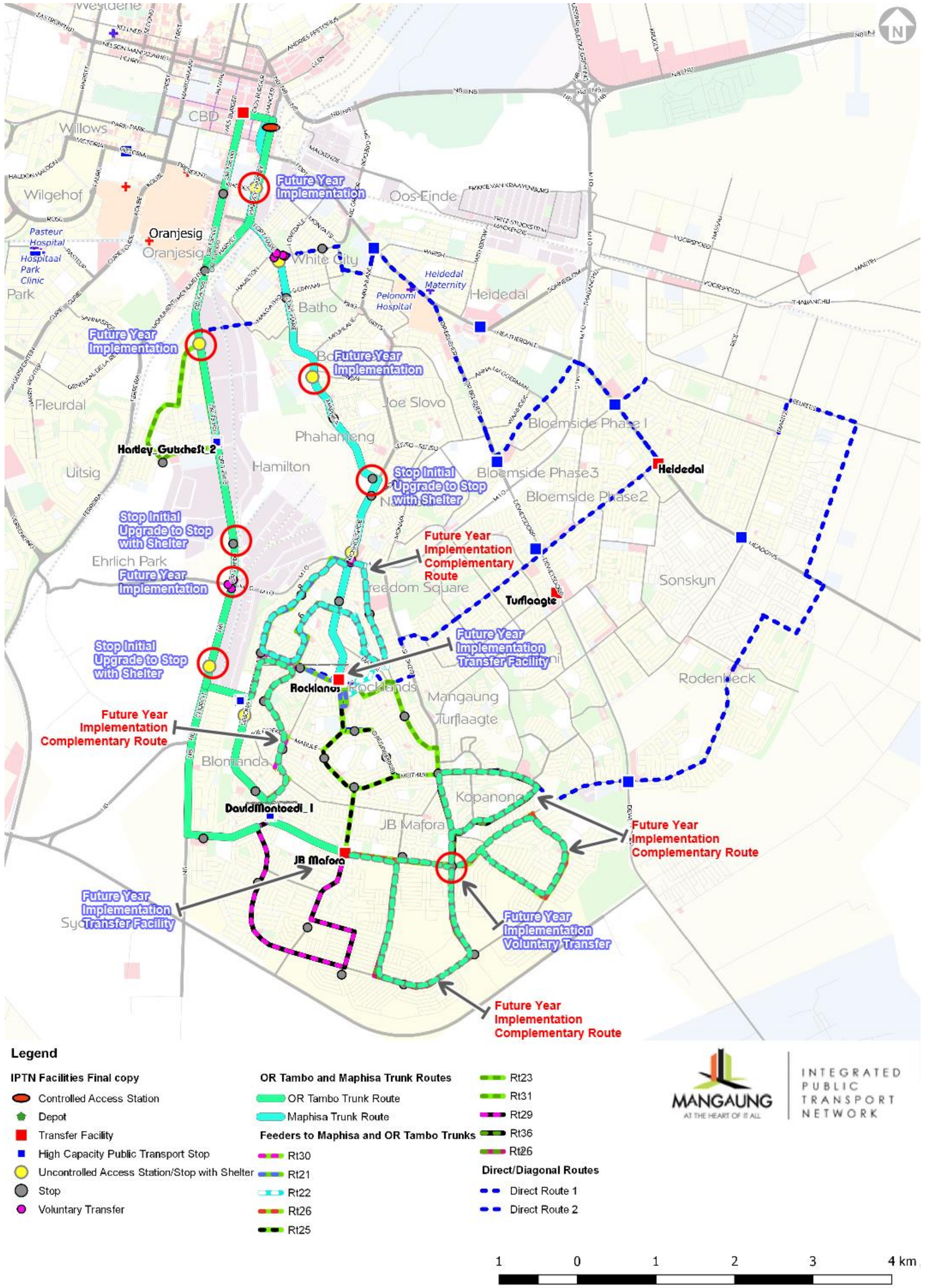


Figure 19-5: Maphisa/Moshoeshoe/Chief Moroka and OR Tambo/ Taelo Molosioa – Full Implementation Phase

19.1.1.4 Services

The service model will vary between the services that will be operated along the feeder and trunk routes.

- Trunk routes:
  - Combination of local services stopping at each stop and stations and express services will be provided.
  - Express services will operate from the transfer facilities to Hoffman Square and Intermodal facility. These services will thus travel directly between the two-point without stopping along the way. Services will be clearly indicated in order for passengers to board the appropriate service.
  - Express services from Rocklands transfer will divert at the M10 towards OR Tambo Drive and travel to Hoffman Square. This will decrease journey time and optimise operational speed.
  - It is envisaged that each second service in the morning will be an express service and can be increased to more express service depending on take-up by commuters. The finalisation of service frequency and schedule can only be confirmed once the detailed on-board surveys are complete, community- and other stakeholder engagement processes are complete.
  - No express services will operate during off-peak periods, only during peak periods of the day. The first increment of implementation will be the activation of express services during the highest hour in the peak period and can then extend to other hours of the peak period triggered by passenger demand.
- Feeder routes:
  - Services will comprise of local services that will stop at each stop along the way and integrate at transfer facilities or high capacity bus stops.
- Complementary routes:
  - Along the section of the route where it enters a suburb or operates along rationalised feeder route a local service will be implemented.
  - Depending on the number of passengers per service, an express service (no stop) can be implemented along sections of the route that coincide with the trunk services.
- Service Direction:
  - Feeders will operate clockwise and counter-clockwise during peak hours to optimise capacity provided at the public transport facilities.
- Service Frequency:
  - The service frequencies required per routes and services are presented in Annexure FF.

19.1.1.5 Patronage

The patronage for the services was estimated taking into consideration the rationalisation of subsidised bus services into the Hauweng service during 2023/24 financial year. The estimated daily passenger demand for the base year and the project horizon years are presented in Table 19-2 and the AM Peak hour volume per corridor is presented in **Table 19-3**.

Table 19-2: Maphisa/Moshoeshoe/Chief Moroka and OR Tambo/ Taelo Molosioa - Daily Estimated Patronage 2017, 2025 and 2036

Year	2019/20	2020/21	2023/24	2025/26	2035/36
Maphisa		8,732	13,350	14,209	16,528
OR Tambo			14,520	15,455	17977

Table 19-3: Maphisa/Moshoeshoe/Chief Moroka and OR Tambo/ Taelo Molosioa - Peak Hour Estimated Patronage 2017, 2025 and 2036

Year	2019/20	2020/21	2023/24	2025/26	2035/36
Maphisa		1,222	1,869	1,989	2,314
OR Tambo			2,033	2,164	2,517

19.1.1.6 Fleet

- Trunk and Complementary Vehicles:
  - The vehicle deployment strategy is to implement new universal accessible compliant vehicles along the trunk routes when the corridor operationalises. The approach is to operationalise the corridor with rigid vehicles only and implement articulated vehicles once demand realises and trigger the utilisation of articulated vehicles. This approach is two-fold given passenger perception of articulated vehicles and the flexibility that rigid vehicles allow if demand does not realise according to estimated demand.
  - The rigid 80 seat vehicles will only load on the left side through one door, but during the outer year 2035/36 articulated vehicles can be considered if demand realises.
- Feeder Vehicles:
  - The feeder vehicle fleet will comprise of existing mini-bus vehicles that will be selected through a validation process. These vehicles will comply with the specifications provided for these vehicles to ensure passenger safety. These feeder vehicles will operate under a contract and will be fitted with the selected AFC system and branded to comply with Hauweng brand. These feeder vehicles will not be UA compliant and will be phased out, approximately 3-years after the corridor was operationalised. Refer to ITS specifications for detail pertaining to AFC and APTMS.
  - The rationalisation and transformation of feeder vehicles to UA compliant vehicles are envisaged to start in year 2024/25 for the Maphisa/Moshoeshoe/Chief Moroka corridor and during 2025/26 for the OR Tambo/Taelo Molosioa corridor.

The vehicle fleet per vehicle capacity category is presented in **Table 19-4.**

Table 19-4: Maphisa/Moshoeshoe/Chief Moroka and OR Tambo/ Taelo Molosioa Corridor – Estimated Fleet per Design Year

Vehicle Capacity	2020/21	2021/22	2023/24	2025/26	2035/36
120				23	27
80	13	40	61	34	40
22	6	6	22	23	27

19.1.1.7 Infrastructure - Roadways

Previously the approach was that all roads where IPTN routes and services will operate need to be rehabilitated and maintained through PTNG funding. However, the purpose of the grant is to implement public transport facilities and roadways where dedicated road-of-way is required. For the purpose of estimating the capital cost associated with the implementation of the IPTN the total cost of maintenance and rehabilitation was determined (refer to **Table 19-5)** and allocated to a specific authority where these roads form part of periodic rehabilitation and maintenance programs. **Table 19-5** indicate the cost for rehabilitation and maintenance of roads per authority and the roads that need to be surfaced in order to operate along these roads. The surfacing of roads is allocated to the PTNG capital cost.

Figure 19-6 indicates the roads required to be surfaced and other elements included in the total road upgrade costing. Table 19-6 indicate the cost of roadway upgrade and surfacing required to operationalise the corridor. The city needs to communicate with other authorities to ensure that the roads identified as part of the IPTN implementation are prioritised on these authorities implementation plans.

Table 19-5: Road Infrastructure Required – Full Implementation Stage

Quantities	Maphisa	OR Tambo	Future Road Links Vista Park
Additional Lane (m^2)	37,193	-	
Resurfacing/rehab road sections (Low Priority) (m^2)	132,905	156,067	
Resurfacing/rehab section(High Priority) (m^2)	195,036	73,306	
Resurfacing/rehab section(Provincial) (m^2)		45,770	
Resurfacing/rehab section (SANRAL) (m^2)			
Future Links (m^2)			30,907

Estimated Cost			
Additional Lane *(R 1 500.00 m²)*	R55.79M		
Resurfacing/rehabilitation of road sections Part of city scheduled maintenance program *(R500.00 m²)*	R66.45M	R78.03M	
Resurfacing/ rehabilitation of section. Prioritise Rehabilitation and Maintenance *(R500.00 m²)*	R97.52M	R36.65M	
Resurfacing/ rehabilitation of sections. Provincial Rehabilitation and Maintenance *(R500.00 m2)*		R22.89M	

Table 19-6: Road Infrastructure Required – Operationalisation Stage

Quantities	Maphisa/ Moshoeshoe/ Chief Moroka	OR Tambo/ Taelo Molosioa	Future Road Links Vista Park
Surfacing of Roads (m²)	37,193	-	
Resurfacing/rehab road sections (Low Priority) (m²)	132,905	109,247	
Resurfacing/rehab section(High Priority) (m²)	195,036		
Resurfacing/rehab section(Provincial) (m²)			
Resurfacing/rehab section (SANRAL) (m²)			
Future Links (m²)			
Estimated Cost			
Surfacing of Roads *(R 1 500.00 m²)*	R55.79M		
Resurfacing/rehabilitation of road sections Part of city scheduled maintenance program *(R500.00 m²)*	R66.45M	R54.03M	
Resurfacing/ rehabilitation of section. Prioritise Rehabilitation and Maintenance *(R500.00 m²)*	R97.52M		
Resurfacing/ rehabilitation of sections. Provincial Rehabilitation and Maintenance *(R500.00 m2)*			
Resurfacing/ rehabilitation of sections. SANRAL Rehabilitation and Maintenance *(R500.00 m2)*			
Future City Road Links - Road Construction *(R 1 500.00 m2)*			

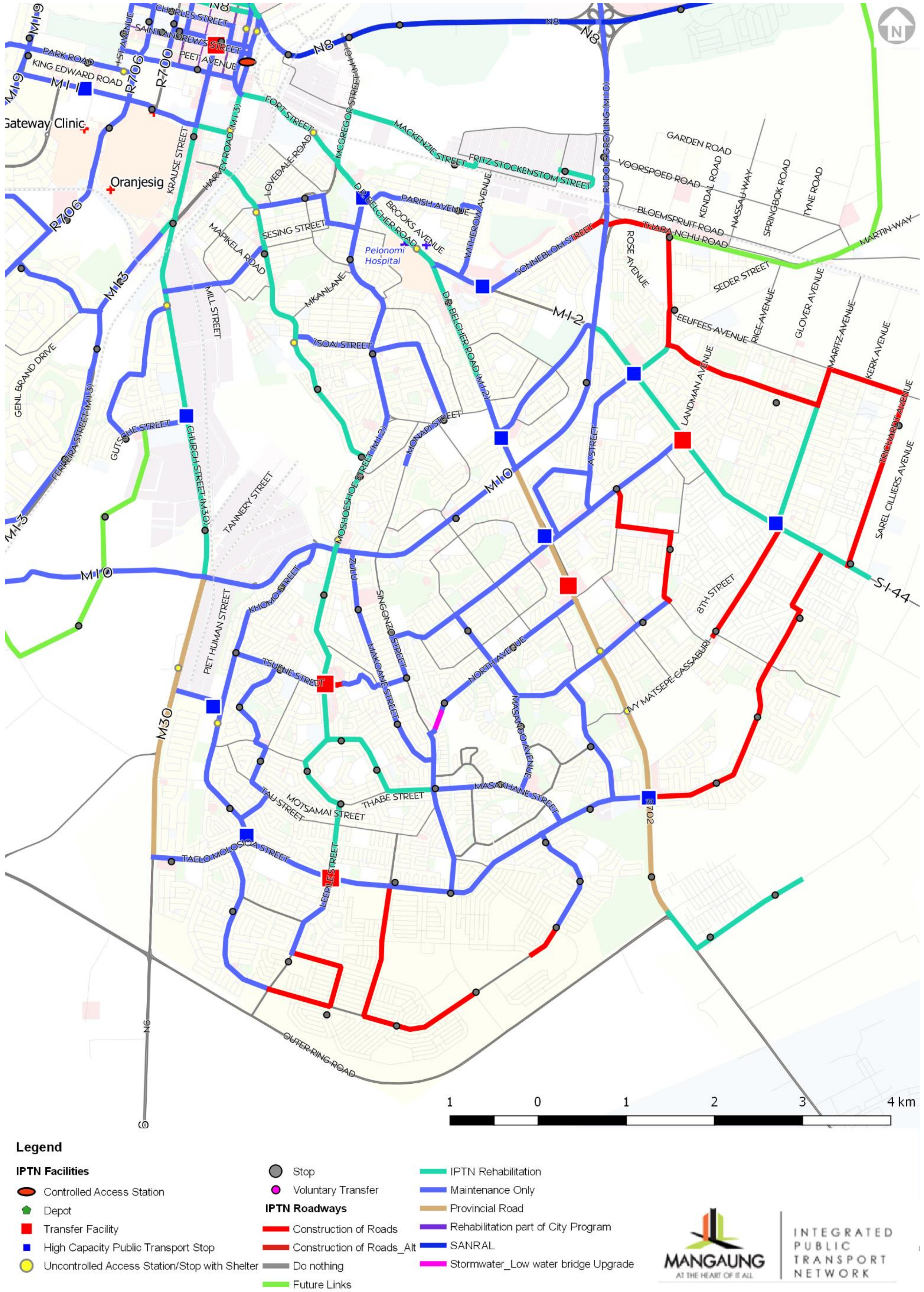


Figure 19-6: Roadway Upgrades and Maintenance Requirement South Eastern Quadrant

19.1.1.8 Infrastructure Public Transport Facilities

The incremental approach to the implementation of facilities is detailed in Section 14.2 and 14.3. For the purpose of operationalisation of the corridor the transfer facilities will be implemented as high capacity public transport stops that will allow for integration between feeder and trunk services. These facilities, trunk-, feeder routes and the envisaged stop or station type is presented in Figure 19-4 and quantities provided in Table 19-7. Figure 19-5 shows the full stage implementation facility types. The detail capacity calculation required per facility for the corridor is attached in **Annexure EE**. The results of the sizing of the facilities yield that the majority of stops and stations will require one module with at least 6 facilities that will require two modules (Refer to Table 19-8). These high demand stops coincide with the high capacity public transport stops proposed (Refer to Figure 19-7).

The capacity required at Hoffman Square and the intermodal facility is presented in Section 14.3.1.1. The depot implementation plan is presented in Section 14.4.

Table 19-7: Maphisa/Moshoeshoe and OR Tambo Corridor Facilities

	Maphisa		OR Tambo	
Facility Type	Operationalise	Upgrade	Operationalise	Upgrade
Depot	0	0	0	0
Sleeping Ground	1	0	0	0
Stops	30	0	28	0
Controlled Access Stations	1	1	1	1
Uncontrolled Access Stations (Stop with Shelters)	4	6	2	8
Transfers (Main)	0	0	0	0
Transfers High Capacity	6	0	6	0
Transfers Low Capacity (Voluntary Transfer)	8	0	4	4
Control Centre	1	0	0	0
Customer Care	0	0	0	0

Table 19-8: Facility Capacity Waiting Areas

2017		Module width 5m				Module width 5m			
Module length (m)		7m	14m	28m	45m	12m	23m	47m	70m
OR Tambo	number of facilities	26	0			26	0		26
Maphisa/Moshoeshoe	number of facilities	24	6			24	6		24
2025		5m				3m			
OR Tambo	number of facilities	26	0			26	0		
Maphisa/Moshoeshoe	number of facilities	30	0			30	0		
2036		5m				3m			
OR Tambo	number of facilities	26	0			26	0		
Maphisa/Moshoeshoe	number of facilities	30	0			30	0		
2036 - x4 passengers per station		5m				3m			
OR Tambo	number of facilities	20	6			20	6		
Maphisa/Moshoeshoe	number of facilities	20	4	6		20	4	6	

Figure 19-7: High Capacity Public Transport Stop – OR Tambo Corridor

19.1.1.9 Intelligent Transport Deployment

The deployment of ITS in the corridor comprises of AFC and limited APTMS. The strategy and details pertaining to the equipment and systems are presented in Section 14.7.

The capital cost associated with the back office is accounted for as part of the implementation of this corridor since the back office will not form part of the starter service operationalisation.

19.1.1.10 Industry Transition

"Clear the corridor" implementation principle will be followed during the roll-out of the Hauweng system. The process of transformation and strategies are detailed in the Industry Transition section and Business Plan. The operators that will be impacted by the operationalisation of the corridor are:

- Mini-Bus Taxi Operators operating along the following routes:
  - Ipopeng;
  - Mafora Central;
  - Mafora East;
  - Mafora West;
  - 4+1 Operators along Maphisa Road.
  - Existing Taxi Fleet is estimated at approximately 351 vehicles. This fleet number needs to be validated during detail design and business planning processes. The 4+1 vehicles are not included in the fleet total mentioned above.
  - The business value of the 4+1 vehicles needs to be determined given the limited market research done to date. The rationalisation of these operators might not be financially feasible, however the regulation of these operators in the corridors is required. The formalisation of these operators is required through the normal OLS process and need to be addressed to minimise competition with the Hauweng system.
- Subsidised Bus Service:

  The routes that will be affected is presented in Figure 19-8.
  - The trips and the number of unique routes are presented in Table 19-9.
  - The rationalisation of the subsidised bus services into the Hauweng system will have a significant impact on patronage. Refer to patronage scenarios, it is envisaged that the rationalisation of these services will commence during 2024/25 and the passenger numbers were included in the demand estimation and the associated PTOG funding included in revenue/funding sources.

  Detailed market research was done for these areas and the compensation value and strategy can be obtained as part of the detailed business case for Phase 1.

Table 19-9: Maphisa/Moshoeshoe and OR Tambo – Subsidised Bus Service Summary (2016)

No Unique Routes	48
Wednesday Vehicle Trips	147
Wednesday Passenger Total	6 439
Passengers - 03:00 AM - 04:59 AM	1 383
Passengers - 05:00 AM - 07:59 PM	4 982
Passengers - 08:00 PM - 12:00 PM	74
Friday Daily Passengers	5 511
Saturday Vehicle Trips	35
Saturday Daily Passenger	1 701
Sunday Daily Vehicle Trips	7
Sunday Daily Passengers	144

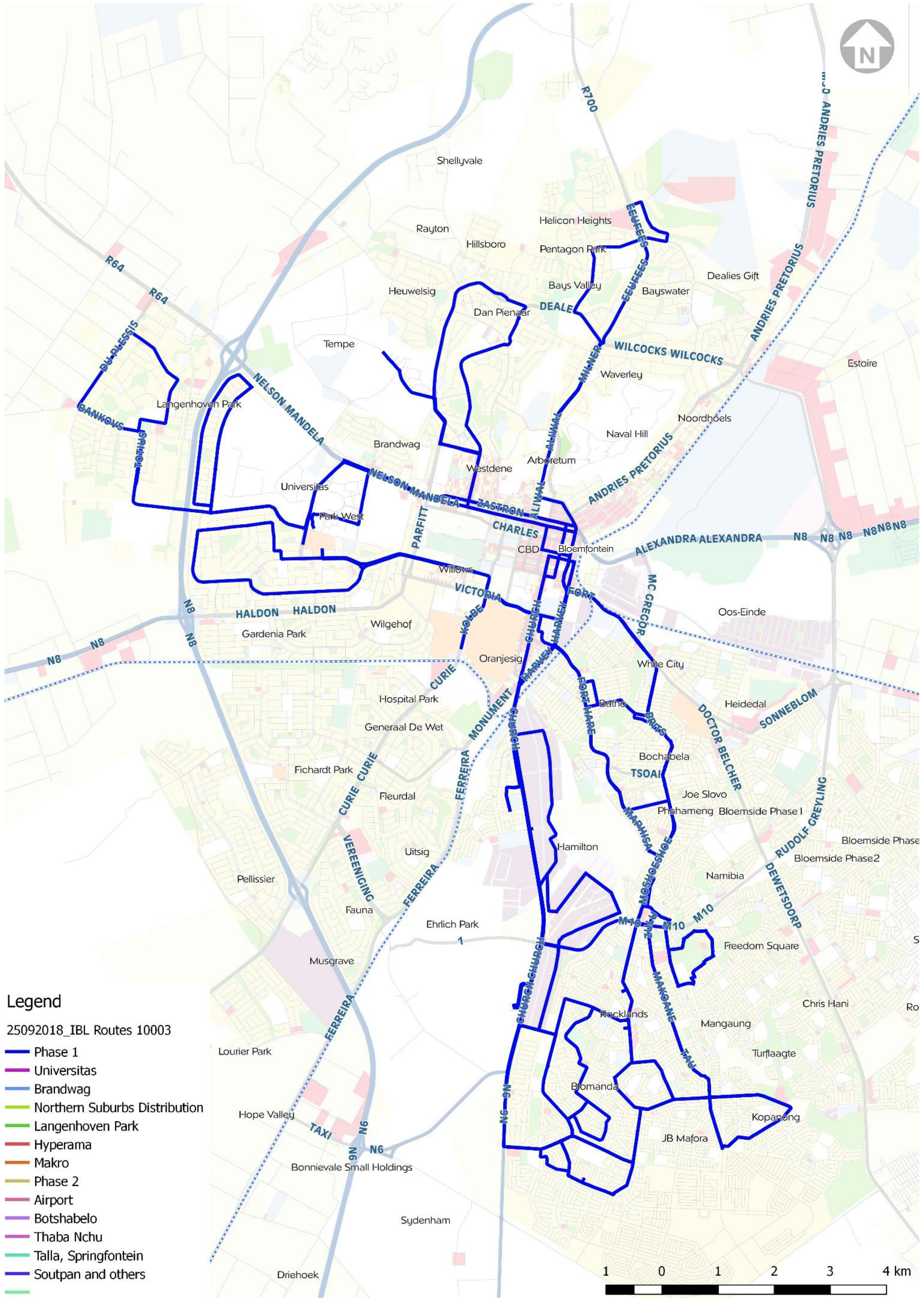


Figure 19-8: Subsidised Bus Service Routes Affected

19.1.1.11 Environmental Screen

Based on the findings of the environmental screening report there were no technical flaws identified and the proposed development is feasible, will have impacts of low significance and should proceed provided no major construction activity is undertaken. In a case where major construction activities such as the construction of the new roads are proposed, the following recommendations can be deduced from the environmental screening process:

- Undertake a Water Use Authorisation application as per the National Water Act; 1998 (Act 36 of 1998);
- Stormwater management plan should be drafted by the Infrastructure Workstream. This plan will be implemented in order to prevent contaminated water from entering the watercourses; and
- Consultation with DESTEA and DWS must be undertaken to confirm the Specialist assessments that must be undertaken for the proposed project.

The detailed screening report is provided in Annexure JJ.

19.1.1.12 Operational and Capital Cost

The direct vehicle operating cost and capital cost associated with the implementation of the corridor is detailed in Annexure GG and summarised in Table 19-10. The indirect operational cost is presented on citywide level in the preceding section. The operational shortfall compared to revenue earned through fare collection the farebox will only cover 54% of the operational cost during operationalisation. From 2025/26 with the increase in demand the farebox will cover 70% of the operational cost. Given the strategic nature of the patronage estimation it needs to acknowledge that this is an optimistic view and that the farebox coverage can be nearer to the base year coverage of 54%. Thus the operational shortfall needs to be verified through detailed financial modelling but optimistic an operational shortfall of R25M -R 50M can be expected from 2025/26 onwards.

Additional funding/subsidy will be required to operate a high-quality service. Refer to the financial chapter for more detail pertaining to other funding sources for the system.

Table 19-10: Capital Cost Maphisa/Moshoeshoe and OR Tambo (millions)

	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
CAPEX – Right-of-way, Roads and Facilities, NMT																		
Maphisa	R106.09M	R83.75M							R20.50M	R9.00M								
OR Tambo		R17.18M	R42.95M	R25.77M								R21.50M	R21.50M					
Maintenance and Upgrading of Facilities		R1.01M	R0.43M	R0.26M					R0.21M	R0.09M	R0.00M	R0.22M	R0.22M					
ITS CAPEX																		
Maphisa			R46.34M															
OR Tambo			R27.98M	R6.76M														
ITS OPEX																		
Maphisa					R35.88M	R0.27M	R0.27M	R0.27M	R0.27M	R0.27M	R0.27M	R0.27M	R0.27M	R0.27M	R0.27M	R0.27M	R0.27M	R0.00M
OR Tambo						R1.09M	R0.76M	R0.76M	R1.05M	R40.98M	R1.05M	R1.05M	R1.05M	R1.05M	R1.05M	R1.05M	R1.05M	R0.00M
Vehicle Acquisition and Branding of Feeder Vehicles																		
Maphisa			R0.36M															
OR Tambo				R0.27M														
Compensation																		
Maphisa			R22.43M	R22.43M	R29.90M		R29.49M	R3.28M										
OR Tambo				R14.36M	R14.36M	R19.14M	R0.00M	R44.61M										
Total CAPEX	**R106.09M**	**R101.94M**	**R140.48M**	**R69.84M**	**R80.14M**	**R20.51M**	**R30.53M**	**R48.92M**	**R22.02M**	**R50.34M**	**R1.32M**	**R23.03M**	**R23.03M**	**R1.32M**	**R1.32M**	**R1.32M**	**R1.32M**	**R0.00M**
OPEX																		
Maphisa			R24.09M	R24.09M	R24.09M	R44.73M	R44.73M	R35.87M	R35.87M	R35.87M	R35.87M	R35.87M	R35.87M	R35.87M	R35.87M	R35.87M	R35.87M	R41.72M
OR Tambo				R39.98M	R39.98M	R61.13M	R61.13M	R61.65M	R61.65M	R61.65M	R61.65M	R61.65M	R61.65M	R61.65M	R61.65M	R61.65M	R61.65M	R71.71M
Total OPEX	**R0.00M**	**R0.00M**	**R24.09M**	**R64.08M**	**R64.08M**	**R105.86M**	**R105.86M**	**R97.52M**	**R97.52M**	**R97.52M**	**R97.52M**	**R97.52M**	**R97.52M**	**R97.52M**	**R97.52M**	**R97.52M**	**R97.52M**	**R113.43M**
Revenue																		
Maphisa			R17.08M	R17.08M	R17.08M	R26.11M	R26.11M	R33.19M	R33.19M	R33.19M	R33.19M	R33.19M	R33.19M	R33.19M	R33.19M	R33.19M	R33.19M	R38.60M
OR Tambo				R17.55M	R17.55M	R32.72M	R32.72M	R34.83M	R34.83M	R34.83M	R34.83M	R34.83M	R34.83M	R34.83M	R34.83M	R34.83M	R34.83M	R40.51M
Total REVENUE			**R17.08M**	**R34.63M**	**R34.63M**	**R58.83M**	**R58.83M**	**R68.02M**	**R68.02M**	**R68.02M**	**R68.02M**	**R68.02M**	**R68.02M**	**R68.02M**	**R68.02M**	**R68.02M**	**R68.02M**	**R79.11M**
Operational Shortfall			**-R7.02M**	**-R29.45M**	**-R29.45M**	**-R47.03M**	**-R47.03M**	**-R29.50M**	**-R29.50M**	**-R29.50M**	**-R29.50M**	**-R29.50M**	**-R29.50M**	**-R29.50M**	**-R29.50M**	**-R29.50M**	**-R29.50M**	**-R34.32M**

19.1.2 Dr Belcher/Meadows Functional Public Transport Corridor

The corridor is situated to the south-east of Bloemfontein CBD and comprises of a mixed-use development with predominately commercial and medical use situated in the northern parts of the corridor. The southern part of the corridor south of the M10 is characterised by residential development and several small retail nodes. These nodes provide one or two shops and thus a main commercial node is required south of the M10 to provide the necessary retail and other functions within the corridor.

The area is developed according to the overall city-wide SDF and detail precinct plans are required to enable the provision of amenities associated with residential development in the area. These precinct plans are proposed to be developed in the vicinity of the proposed main transfer points identified in the corridor. These transfer points are the areas where passengers will transfer from trunk services to feeder services and will attract economic activities. The long-term sustainability of the IPTN implementation requires an increase in population density along the corridor. To facilitate densification, local economic development and ensure integrated planning it is proposed that the precinct plans are developed to assist in the selection of the optimum densification and spatial structure of the areas within a 500m to 1km area surrounding the transfer facilities.

Figure 19-9 indicate the nodes identified for the development of seven precinct plans. These are linked to main transfer points or stops/stations where high passenger activity is foreseen.

19.1.2.1 Movement Patterns

Given the spatial structure of the corridor presented above and taking into consideration social amenities, industrial areas and other main areas of employment the primary, secondary and local nodes were identified. These nodes do not supersede other node structures developed as part of the city-wide SDF. These nodes represent nodes that will attract/generate public transport users and need to be connected through the design of public transport routes. The node hierarchy and conceptual movements patterns for the corridor is presented in Figure 19-10. These primary and secondary movement patterns, nodes, existing public transport operator services areas and routes were used to design the route network for the corridor presented in preceding sections of this report.

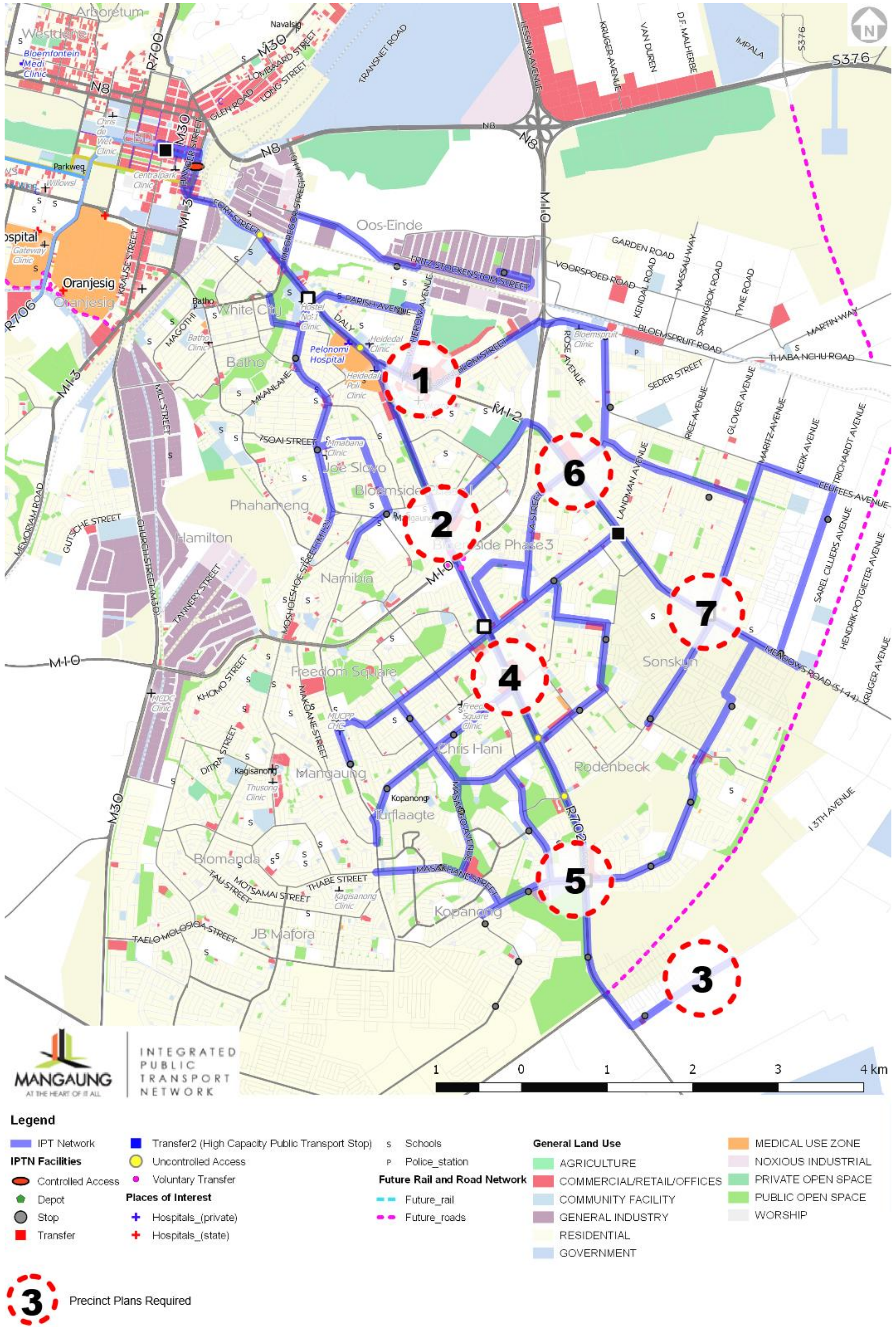


Figure 19-9: Dr Belcher/Meadows Corridor Precinct Plans Proposed

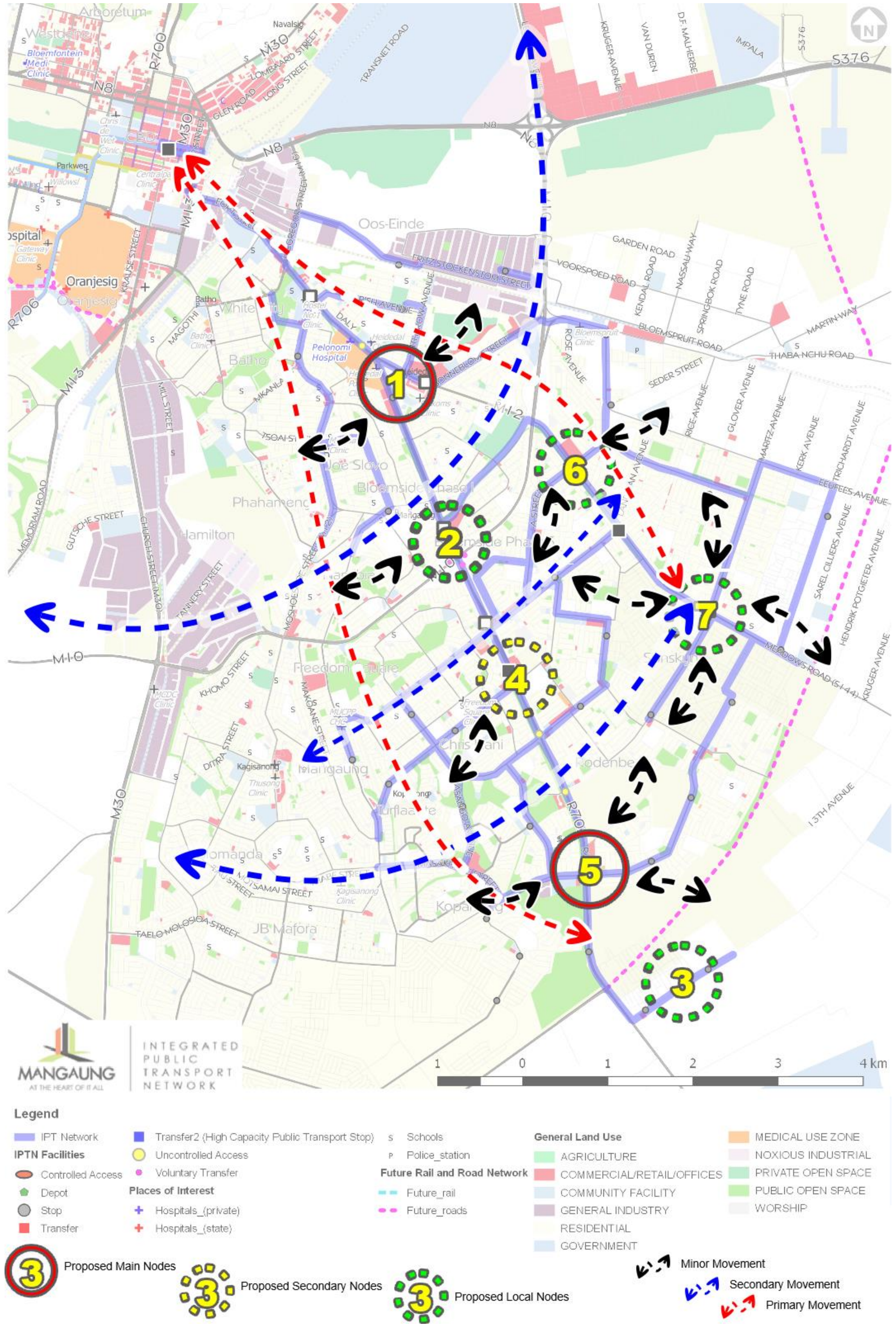


Figure 19-10: Dr Belcher/Meadows Corridor Movement Patterns

19.1.2.2 Implementation Timeline

The public transport improvement program through the alternative analysis process recommends that the transformation of existing services to the Hauweng system will be most feasible when the existing services are rationalised to the new system in three increments. The increments were primarily defined based on the "clear the corridor" principle where the operationalisation of the corridor will be a scheduled trunk service with unscheduled feeder services, followed by rationalisation and formalisation of the unscheduled feeder services to scheduled feeders routes and services or where feasible to complementary routes. The rationalisation and transformation of the feeder services will be spread across three increments and implemented when the rationalisation is proven to be financially feasible i.e. when funding is available and patronage along these feeders are at least 450 passengers per hour.

The geographic extent of the three increments defined to align with existing public transport operator operational areas. These operational areas and the areas that will be transformed per transformation increment are shown in Figure 19-11, and comprise of:

- Namibia,
- Turflaagte, Freedom Square and south of Turflaagte;
- Heidedal.

The operationalisation year and the rationalisation of feeder services per implementation area are presented in Diagram 19-2. The operationalisation of the corridor will include the rationalisation of subsidised bus services demand into the Hauweng system, from year one of operations. Thus, clear the corridor from the operationalisation of the corridor. Figure 19-12 shows the two trunk routes and associated feeder routes. The rationalisation of feeder services will span across three years. Some of the feeder routes will be transformed into trunk-extension services and others will be transformed into scheduled feeder services. Refer to Figure 19-15 to Figure 19-15 for the envisaged routes to be rationalised per year, taking cognisance of financial viability. The contracting arrangements and details pertaining to industry transformation are addressed on a city-wide level and provided in the Business Plan in Section 20.1.1 of this report.

The corridor will be operationalised during 2024/25 with full transformation in 2028/2029 given that funding remains at the current level and feasibility of feeder transformation from unscheduled to scheduled routes and services. The route, service, fleet, infrastructure, industry transformation and other system elements are detailed below to realise the implementation and transformation of the existing public transport system to the quality public transport system for the city.

Diagram 19-2: Dr Belcher/Meadows Implementation Timeline

Year	2019/20	2024/25	2026/27	2027/28	2028/29	2035/36
Dr Belcher		Trunk - Scheduled Services, Feeders - Unscheduled	**Area 1 -** Combination of Scheduled Feeder-Trunk and Complementary services	**Area 2 -** Combination of Scheduled Feeder-Trunk and Complementary services	**Area 3-** Combination of Scheduled Feeder-Trunk and Complementa ry services	

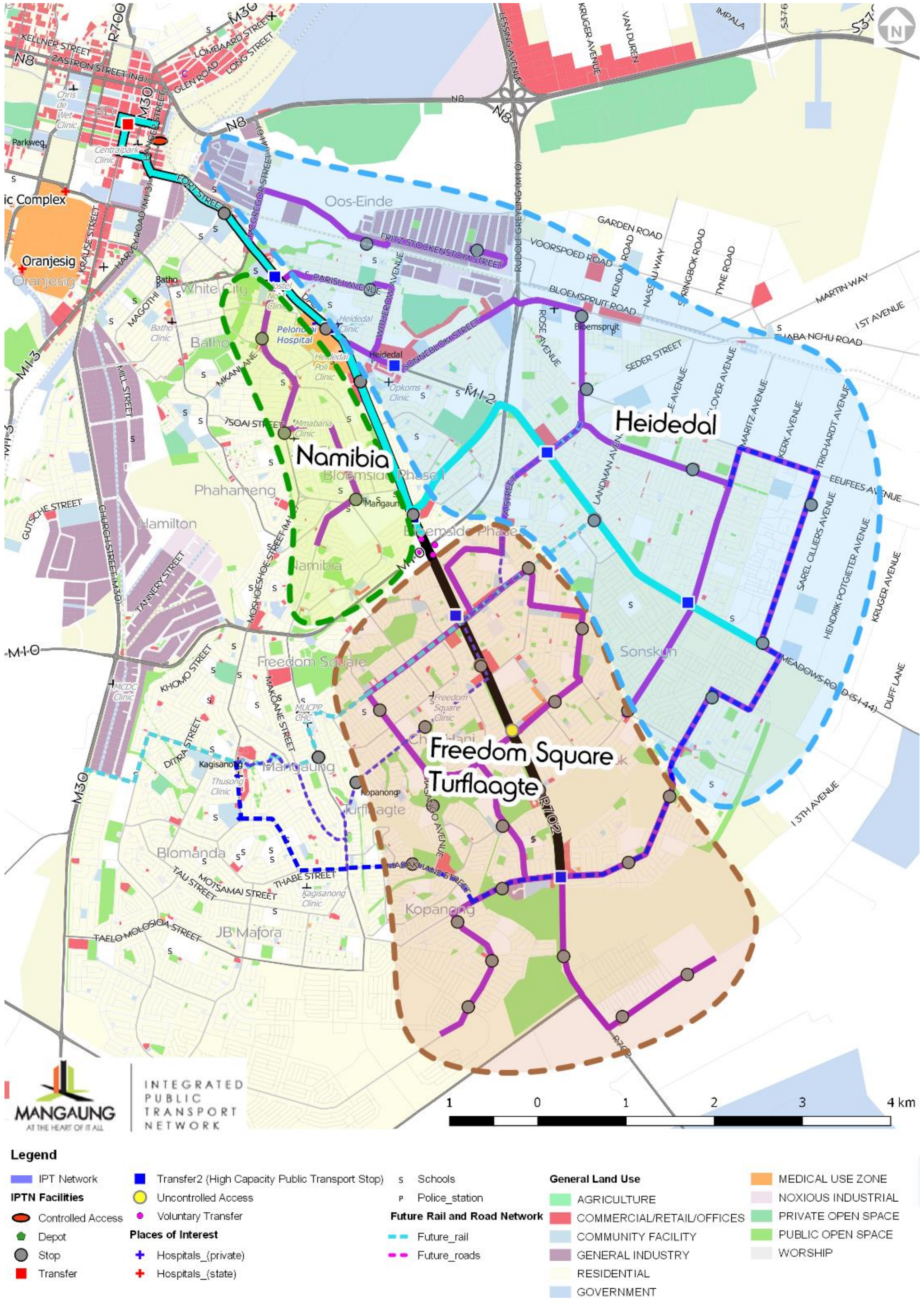


Figure 19-11: Dr Belcher/Meadows Rationalisation Areas

19.1.2.3 Routes

The corridor will be serviced with 2 trunk routs and 14 feeder routes when the corridor operationalised.

- The trunk routes are:
  - Trunk 1 –Along Dr Belcher/Dewetsdorp Road, from 1km south of Ivy Matsepe Cassaburi Street to intersection with Harvey Road, Hanger Road to Intermodal and via Saint George, OR Tambo and Saint Andrews to Hoffman Square. The trunk starts at a high capacity bus stop.
  - Trunk 2 – Along Meadows Road. From Maritz Avenue via Dolfyn Avenue, joining Dr Belcher and then along Dr Belcher same as trunk route 1.
- Feeders Routes:
  - The 14 feeder routes are presented in Figure 19-12 and listed in Table 19-11. The transformation of feeders to complementary routes are presented in Figure 19-13 to Figure 19-15 and listed per envisaged implementation year in Table 19-11.
- Diagonal Routes:
  - Two diagonal routes were included in the design that will link Meadows Road with Dr Belcher and Rocklands Transfer, and a second route that will link up-to Motheo TVET College and University along OR Tambo.

Table 19-11: Dr Belcher/Meadows Routes and Transformation per Year and Increment

	Route Length One Direction (km)	2024/25	2026/27	2027/28	2028/29	Route Length One Direction (km)
P2_T1	**10.9**	**Trunk**			**Trunk**	**10.9**
P2_T2	**14.4**	**Trunk**			**Trunk**	**14.4**
P2_14	5.1	*Feeder*	*Complementary*	*Complementary*	*Complementary*	**9.2**
P2_15	4.3	Feeder			Feeder	**4.3**
P2_16	5.8	Feeder			Feeder	**5.8**
P2_17	6.8	*Feeder*		*Complementary*	*Complementary*	**9.7**
P2_18	3.7	Feeder			Feeder	**3.7**
P2_19	3.5	*Feeder*		*Complementary*	*Complementary*	**11.5**
P2_20	2.2	Feeder			Feeder	**2.2**
P2_21	3.9	*Feeder*		*Complementary*	*Complementary*	**13.6**
P2_22	5.6	Feeder			Feeder	**5.6**
P2_23	5.6	Feeder			Feeder	**5.6**
P2_24	1.4	Feeder			Feeder	**2.3**
P2_25	2.1	*Feeder*			*Complementary*	**2.1**
P2_26	3.7	Direct Route			Direct Route	**13.0**
P2_27	9.9	Direct Route			Direct Route	**9.9**
P2_28	8.8	Direct Route			Direct Route	**8.8**

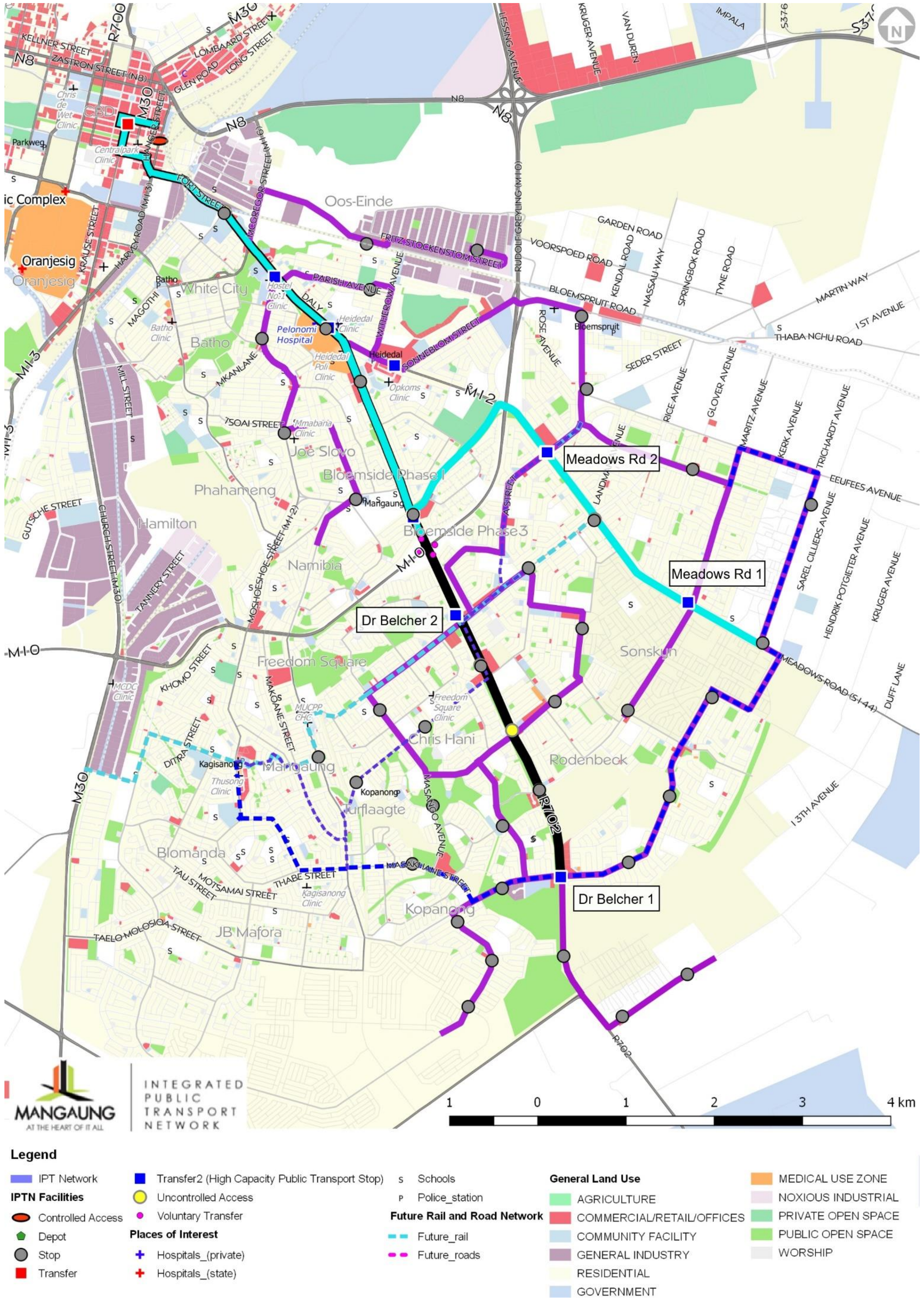


Figure 19-12: Dr Belcher/Meadows Routes and Facilities Operationalisation (2024/25)

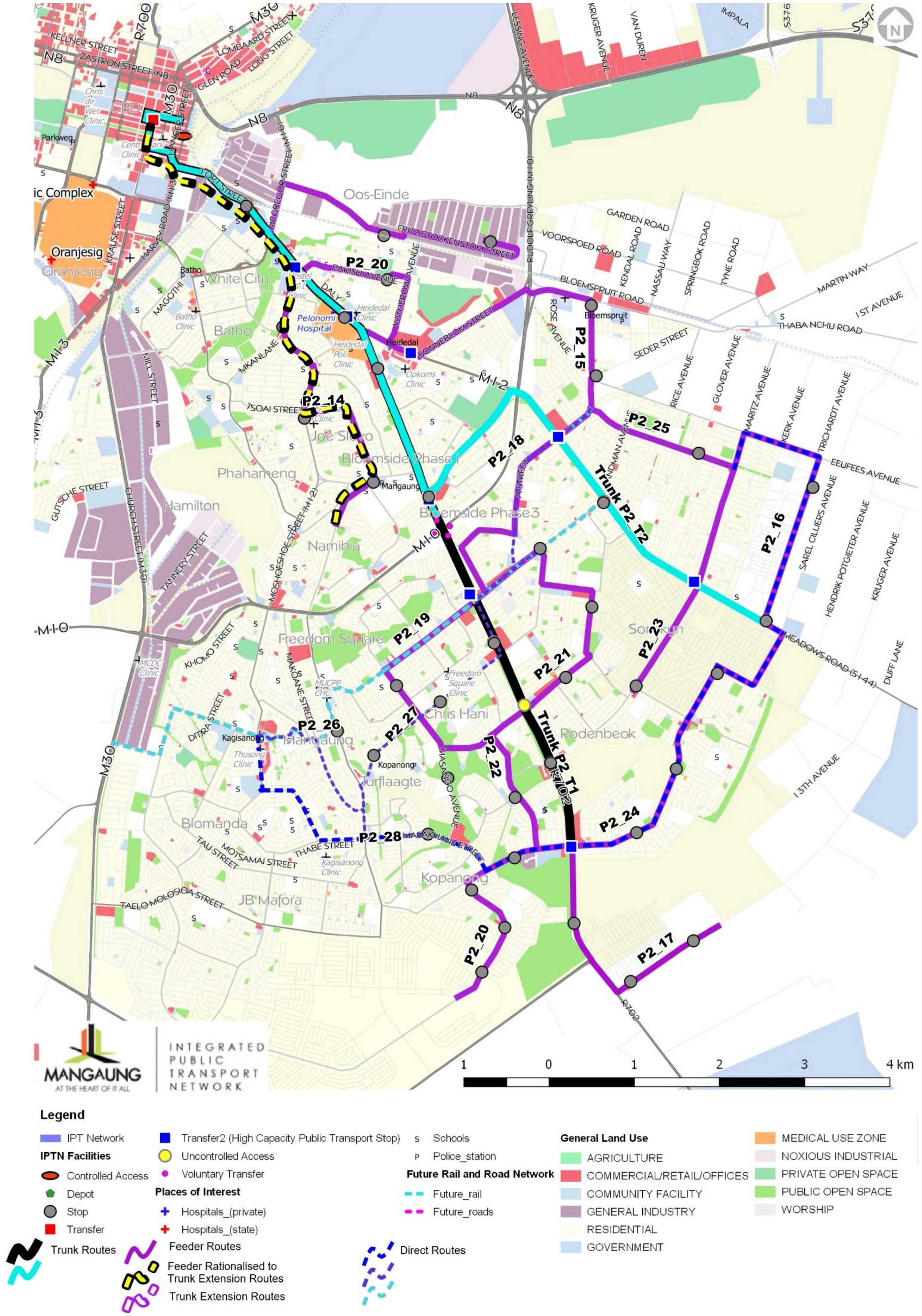


Figure 19-13: Dr Belcher/Meadows Routes and Facilities – Transformation Increment 1 (2026/27)

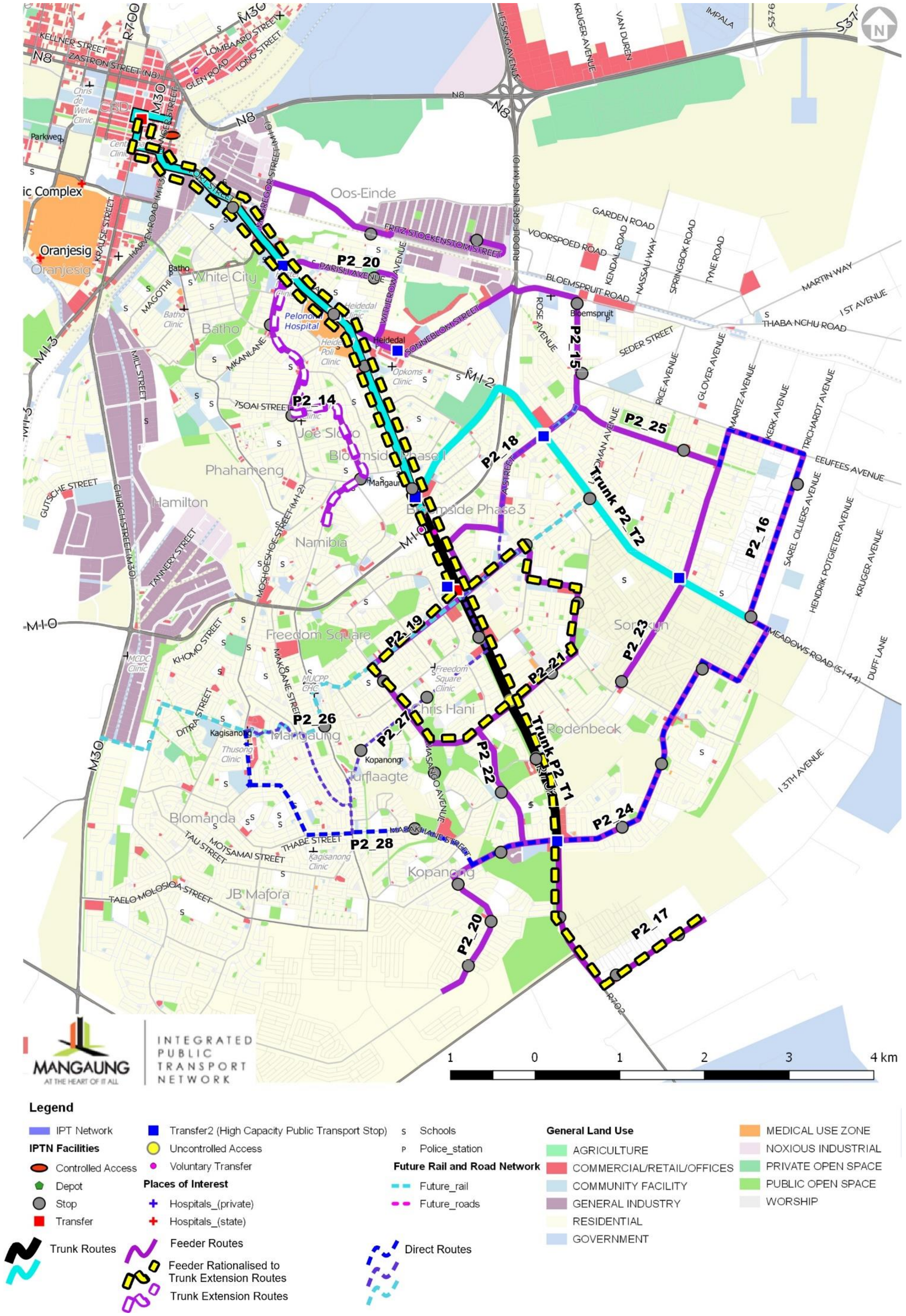


Figure 19-14: Dr Belcher/Meadows Routes and Facilities – Transformation Increment 2 (2027/28)

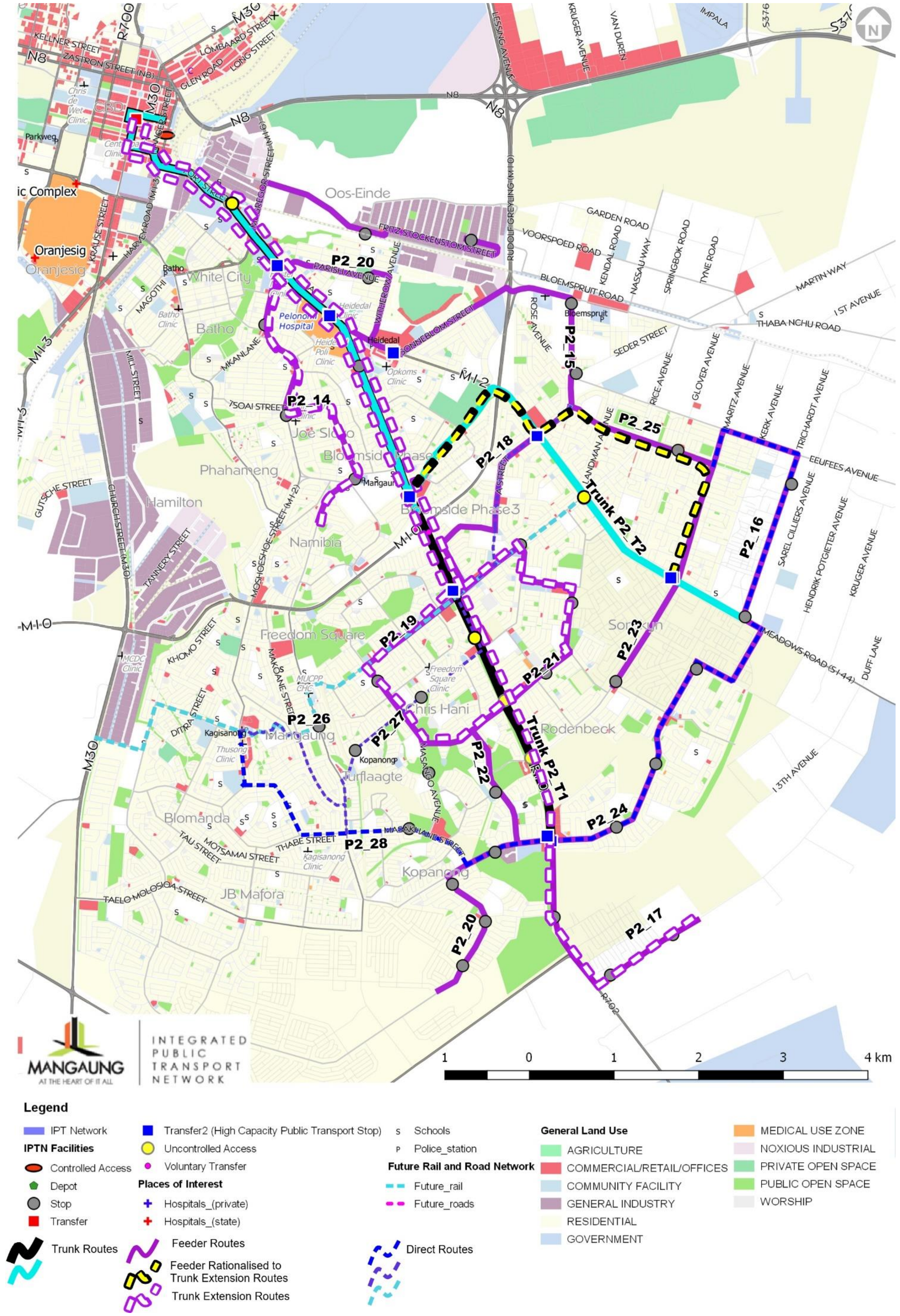


Figure 19-15: Dr Belcher/Meadows Routes and Facilities Full Implementation (2028/29)

19.1.2.4 Services

The service frequency and service type will vary between the services that will be operated along the feeder, trunk and complementary routes. The services per route type are:

- Trunk routes:
  - Combination of local services stopping at each stop and stations and express services will be provided.
  - Express services will operate from the transfer facilities to Hoffman Square and Intermodal facility. These services will thus travel directly between the two points without stopping along the way. Services will be clearly indicated in order for passengers to board the appropriate service.
  - Express services will operate from the following high capacity bus stops along Dr Belcher and Meadows Road (Refer to Figure 19-12):
    - *Dr Belcher 1 and 2*
    - *Meadows Road 1 and 2,*
  - It is envisaged that each second service in the morning will be an express service and can be increased. The finalisation for this operation can only be confirmed once the detailed on-board surveys are completed and the community and other stakeholder engagement processes are complete.
  - No express services will operate during off-peak periods, only during peak periods of the day. The first increment of implementation will be express services during the highest hour in the peak period and can then extend to other hours of the peak period depending on passenger take-up of the service.
- Complementary routes:
  - Along the section of the route where the route enters a suburb or operates along rationalised feeder route a local service will be implemented.
  - Depending on the number of passengers per service, an express service (no stop) can be implemented along sections of the route that coincide with the trunk services.
- Feeder routes:
  - Services will comprise of local services that will stop at each stop along the route.
  - Service Direction: Feeders will operate clockwise and counter-clockwise, to optimise capacity provided at the public transport facilities where transfer between trunk and feeder will occur.
- Service Frequency:
  - The service frequency required per route is presented in Annexure FF and a minimum frequency of 20 minutes was adhered to.
  - The service frequency along unscheduled feeder services will not be prescribed. The intention is that the service will operate according to a minimum service level agreement given that these routes are transformed into scheduled services. The minimum service agreement in combination with AFC and APTMS implementation will assist in higher quality service implementation. Refer to AFC and APTMS implementation approach on a city-wide level, Section 14.7.

19.1.2.5 Patronage

The patronage for the services was estimated taking into consideration the rationalisation of subsidised bus services into the Hauweng service during 2023/24 financial year, thus before the corridor will be operationalised. The estimated daily passenger volume for the operationalisation year 2024/25 and the project horizon years are presented in Table 19-12 and the AM Peak hour volume is presented in Table 19-13.

Table 19-12: Dr Belcher/Meadows Corridor Estimated Daily Patronage 2019, 2025 and 2036

Year	2019/20	2024/25	2025/26	2029/30	2035/36
Dr Belcher		39,303	47,527	47,527	47,527

Table 19-13: Dr Belcher/Meadows Corridor Estimated Hourly Patronage 2019, 2025 and 2036

Year	2019/20	2024/25	2025/26	2029/30	2035/36
Dr Belcher		5,502	6,654	6,654	6,654

19.1.2.6 Fleet

- Trunk and Complementary Vehicles:
  - The vehicle deployment strategy is to implement new universal accessible compliant vehicles along the trunk routes when the corridor operationalises. The approach is to operationalise the corridor with rigid vehicles only and implement articulated vehicles once demand realises and trigger the utilisation of articulated vehicles. This approach is two-fold given passenger perception of articulated vehicles and the flexibility that rigid vehicles allow if demand does not realise according to estimated demand.
  - The rigid 80 seat vehicles will only load on the left side through one door, but during the outer year 2035/36 articulated vehicles can be considered if demand realises and more doors on the left side of the vehicles to enhance loading time.
- Feeder Vehicles:
  - The feeder vehicle fleet will comprise of existing mini-bus vehicles that will be selected through a validation process. These vehicles will comply with the specifications provided for these vehicles to ensure passenger safety. These feeder vehicles will operate under a contract and will be fitted with the selected AFC system and branded to comply with Hauweng brand. These feeder vehicles will not be UA compliant and will be phased out, approximately 3-years after corridor is operationalised depending on funding availability and financial viability. Refer to ITS specifications for detail pertaining to AFC and APTMS Section 14.7.
  - It is envisaged that the rationalisation and transformation of feeder vehicles to UA compliant vehicles will occur in year 2026/27 for the Namibia area, 2027/28 for the Turflaagte, Freedom Square and 2028/29 in the Heidedal area subjected to financial viability once detailed market research of these services are complete.

The vehicle fleet per vehicle capacity category is presented in Table 19-15 per rationalisation and transformation increment and year**.**

Table 19-14: Dr Belcher/Meadows Corridor – Estimated Fleet per design and implementation year

	2019/20	*2024/25*	*2025/26*	**2026/27**	**2027/28**	*2028/29*	*2029/30*	*2035/36*
120		32	32	43	44	44	45	45
80		32	32	43	44	44	45	45
22		33	33	40	41	41	42	42

19.1.2.7 Infrastructure – Roadways and NMT Infrastructure

Previously the approach was that all roads where IPTN routes and services will operate need to be rehabilitated and maintained through PTNG funding. However, the purpose of the grant is to implement public transport facilities and right-of-way where dedicated roadways are required. For the purpose of estimating the capital cost associated with the implementation of the IPTN the total cost of maintenance and rehabilitation was determined (refer to Table 19-15**)** and allocated to a specific authority where these roads form part of periodic rehabilitation and maintenance programs. Table 19-15 indicates the cost for rehabilitation and maintenance of roads per authority and the roads that need to be surfaced in order to operate along these roads. The surfacing of roads is allocated to the PTNG capital cost.

Figure 19-6 indicates the roads required to be surfaced and other elements included in the total road upgrade costing. Table 19-15 furthermore indicate the cost of roadway upgrade and surfacing required to operationalise the corridor and per implementation year thereafter. The city needs to communicate with other authorities to ensure that the roads identified as part of the IPTN implementation are prioritised on these authorities implementation plans.

Table 19-15: Road Infrastructure Required – Full Implementation Stage

Quantities	Total Requirement	2022/23	2023/24	2033/34	2034/35
Additional Lane (m^2)	49,000	24,500	24,500		
Resurfacing/rehab road sections (Low Priority) (m^2)	320,393				
Resurfacing/rehab section(High Priority) (m^2)	157,168				
Resurfacing/rehab section(Provincial) (m^2)	76,590				
Estimated Cost					
Additional Lane *(R 1 500.00 m^2)*	R74.00M	R37.00M	R37.00M		
Resurfacing/rehabilitation of road sections Part of city scheduled maintenance program *(R500.00 m^2)*	R160.20M				
Resurfacing/ rehabilitation of section. Prioritise Rehabilitation and Maintenance *(R500.00 m^2)*	R78.58M			R10.50M	R10.50M
Resurfacing/ rehabilitation of sections. Provincial Rehabilitation and Maintenance *(R500.00 m2)*	R38.29M				

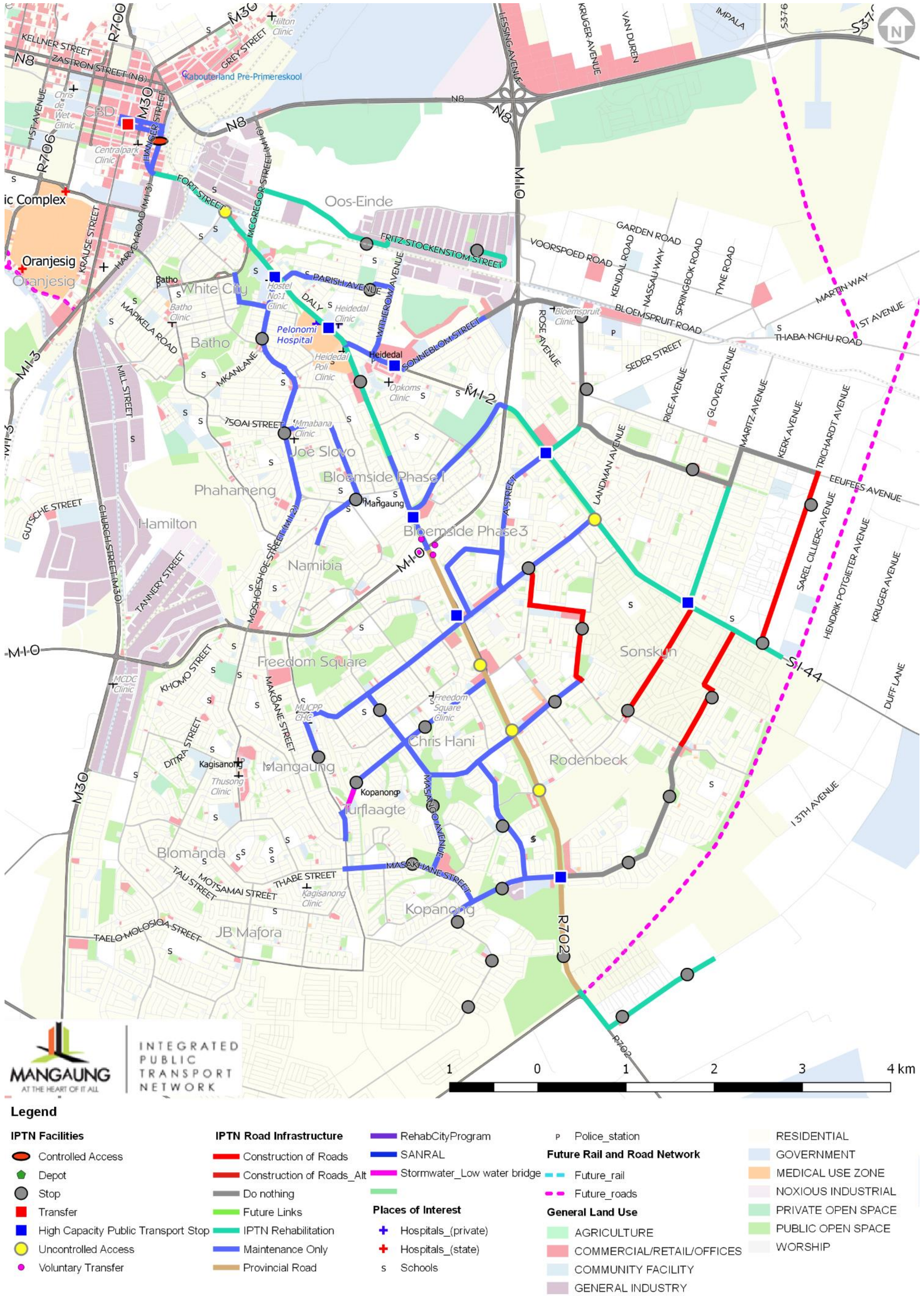


Figure 19-16: Dr Belcher/Meadows Road Upgrades and Maintenance Requirement

19.1.2.8 Facilities

- Facility Type:
  - The incremental approach to the implementation of facilities is detailed in Section 14.2 and 14.3.
  - Table 19-16 lists the facilities required for operationalisation of the corridor and the number of facilities to be upgraded thereafter per implementation year envisaged stemming from available funding and overall implementation plan presented in Section 16.8.
  - The facilities identified to be upgraded in later years will be implemented as a bus stop only for operationalisation and upgraded to the indicated facility type per indicated year.
  - The controlled access stations will only be constructed per implementation year indicated in Table 19-16. Two controlled access stations are required at Hoffman Square for operationalisation of the corridor. Note the incremental approach to the implementation of controlled access stations. These stations will be constructed as open stations initially, once demand realises these stations will be upgraded with mechanisms that allow for pre-validation. Refer to detail in Section 14.3.
  - Voluntary transfers are provided at the intersection of Dr Belcher and M10. This allows for passengers that want to transfer from services along Dr Belcher to services operating along the M10. These facilities allow transfer options to commuters and serve lower demand origin-destination pairs not accommodated in the route design for the corridor.
- Facility Capacity:
  - **Table 19-17** provides a summary of the detail capacity analysis per stop and station per route for the corridor. The detail calculation and results are provided in **Annexure EE.**
  - For the purpose of operationalisation of the corridor the transfer facilities will be implemented as high capacity public transport stops (Refer to **Figure 19-7**) that will allow for integration between feeder and trunk services. If required these can be upgraded when demand triggers upgrading.
  - Figure 19-17 shows the full stage implementation facility types and the number of modules estimated per facility to allow sufficient waiting area and loading bays for operations and associated patronage. The results of the sizing of the facilities yield that the majority of stops and stations will require one module with at least 9 facilities that will require two modules (Refer to **Table 19-17)**. These high demand stops coincide with the high capacity public transport stops proposed and uncontrolled access stations.
  - The high capacity public transport stops are situated at retail developments in the corridor and at main places of employment like Pelonomi Hospital.
  - The capacity required at Hoffman Square and the intermodal facility is presented in Section 14.3.1.1.
  - The depot implementation plan is presented in Section 14.4.

Table 19-16: Dr Belcher/Meadows Corridor Facilities

Facility Type	2022/23 2023/24	2033/34 2034/35
Stops	86	
Controlled Access Stations	2	1
Uncontrolled Access Stations (Stop with Shelters)	8	8
Transfers (Main)	0	
High Capacity Public Transport Stops	6	4
Transfers Low Capacity (Voluntary Transfer)	4	

Table 19-17: Dr Belcher/Meadows Corridor Facility Capacity Waiting Areas

2017	Module width 5m				Module width 3m			
Module length (m)	7	14	28	45	12	23	47	70
Dr Belcher/Meadows	48	9			48	9		
2025	5m				3m			
Dr Belcher/Meadows	48	9			48	9		
2036	5m				3m			
Dr Belcher/Meadows	48	9			48	9		
2036 - x4 passengers per station	5m				3m			
Dr Belcher/Meadows	15	27	12	3	15	27	12	3

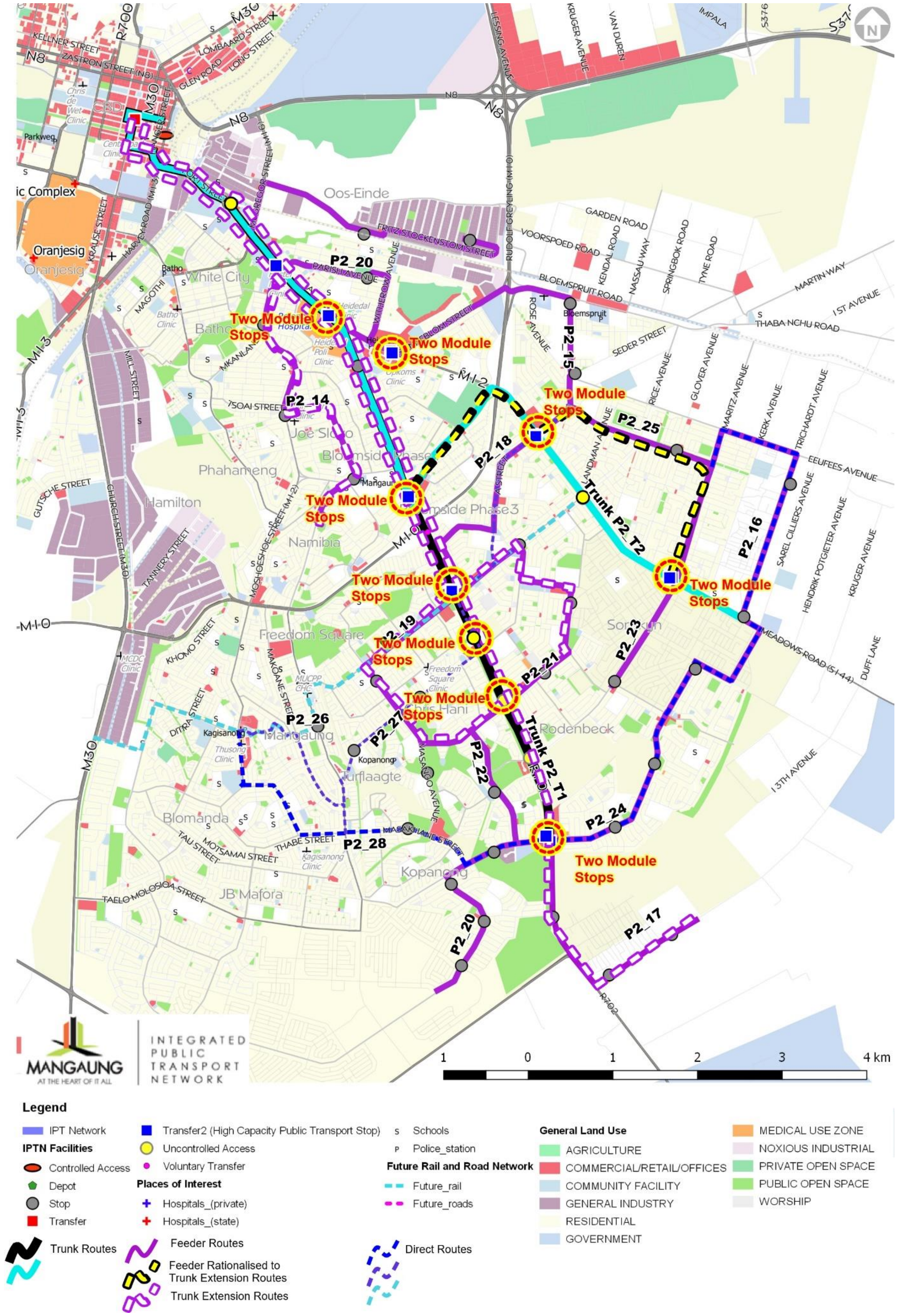


Figure 19-17: Dr Belcher/Meadows Facility Capacity Full Development Stage

19.1.2.9 Industry Transition

"Clear the corridor" implementation principle will be followed during the roll-out of the Hauweng system. The process of transformation and strategies are detailed in the industry transition section and Business Plan refers to Section 20.1.1. The operators that will be impacted by the operationalisation of the corridor are:

- Mini-Bus Taxi Operators operating along the following routes:
  - Namibia;
  - Heidedal;
  - Turflaagte.
  - Freedom Square.
  - Existing Taxi Fleet is estimated at approximately 521 vehicles. This fleet number needs to be validated during detail design and business planning processes and finalisation of market research (on-board surveys).
- Subsidised Bus Service:
  - The routes that will be affected are presented in **Figure 19-18**.
  - The trips and the number of unique routes are presented in **Table 19-18**.
  - The rationalisation of the subsidised bus services into the Hauweng system will have a significant impact on patronage. It is envisaged that the service will be rationalised with the operationalisation of the corridor.

Detailed market research (on-board and related surveys) is required for the corridor to determine the business value and total compensation value for the affected operators. The mentioned surveys and determination of the business value will form part of the business case for the corridor.

Table 19-18: Dr Belcher/Meadows – Subsidised Bus Service Summary

No Unique Routes	39
Wednesday Vehicle Trips	176
Wednesday Passenger Total	8 966
Passengers - 03:00 AM - 04:59 AM	2 715
Passengers - 05:00 AM - 07:59 PM	6 251
Passengers - 08:00 PM - 12:00 PM	0
Friday Daily Passengers	8 008
Saturday Vehicle Trips	4
Saturday Daily Passenger	42
Sunday Daily Vehicle Trips	5
Sunday Daily Passengers	14

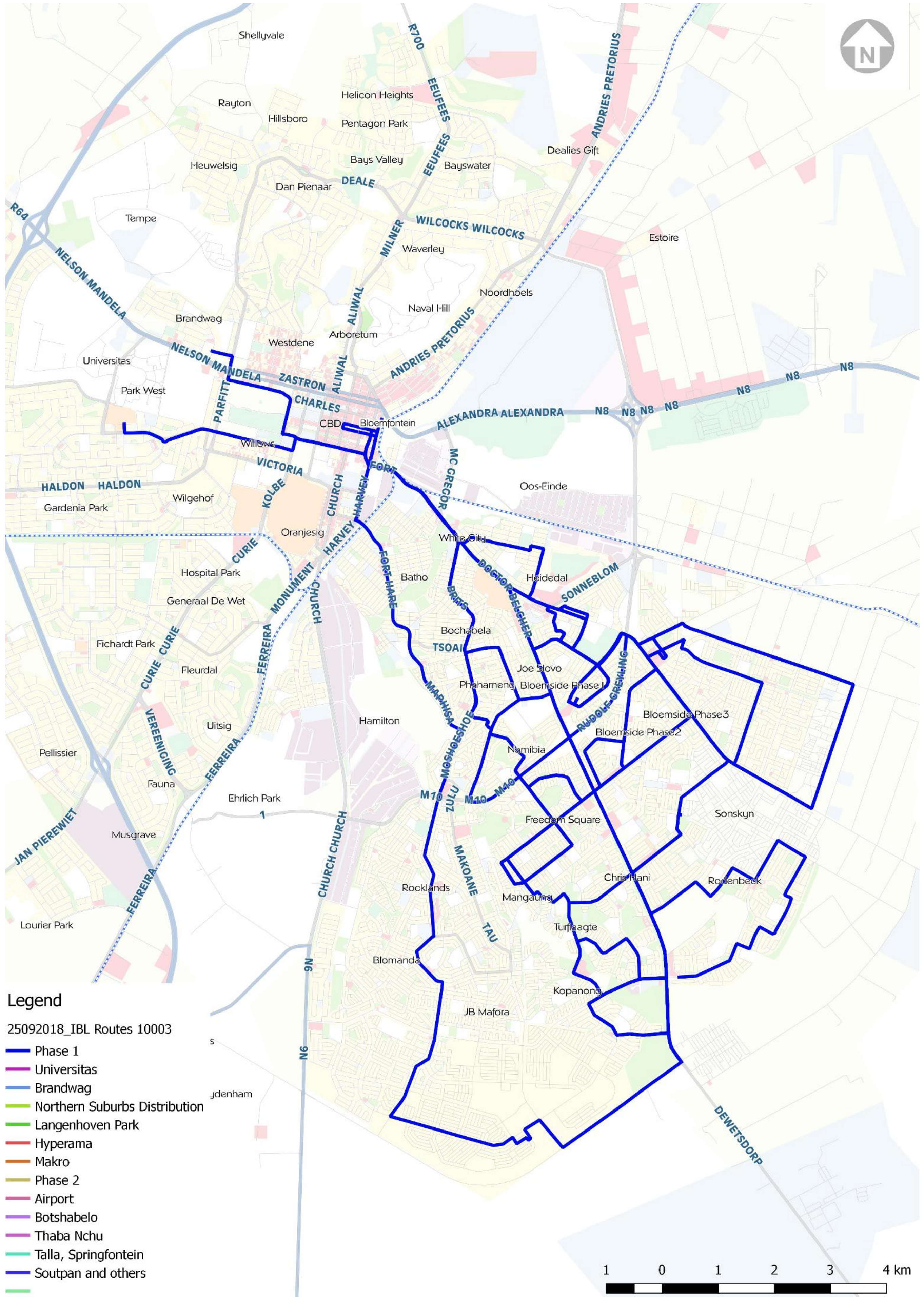


Figure 19-18: Dr Belcher/Meadows Corridor Subsidised Bus Service Routes Affected

19.1.2.10 Environmental Screen

The proposed project will include the construction of stormwater infrastructure on one of the low- lying bridges towards the south-west of the corridor. The screening assessment revealed that a Basic Assessment process would be required for the proposed corridor, a NEMA enquiry will be lodged with the Competent Authority in order to confirm the authorisation requirements. In addition, a Water Use Authorisation will also be required for the proposed Corridor due to the construction and rehabilitation of roads within a DWS regulated area.

Certain Specialist assessments will be required for the undertaking of the proposed development and upgrades in Dr Belcher/Meadows corridor. There is however an allowance of the EAP to motivate for the reasons for not including certain assessments in the assessment report.

The following specialist assessments have been identified as per the DEA screening tool:

- Agricultural Impact Assessment;
- Landscape/Visual Impact Assessment;
- Archaeological and Cultural Heritage Impact Assessment;
- Palaeontology Impact Assessment;
- Terrestrial Biodiversity Impact Assessment;
- Aquatic Biodiversity Impact Assessment;
- Noise Impact Assessment;
- Traffic Impact Assessment;
- Geotechnical Assessment;
- Socio-Economic Assessment;
- Ambient Air Quality Impact Assessment.

The detailed screening report is provided in Annexure JJ.

19.1.2.11 Operational and Capital Cost

The direct vehicle operating cost and capital cost associated with the implementation of the corridor is detailed in Annexure GG and summarised in Table 19-19. The indirect operational cost is presented on citywide level in the preceding section. The operational shortfall compared to revenue earned, through fare collection, the farebox will cover 80% of the operational cost during operationalisation. Given the strategic nature of the patronage estimation it needs to be acknowledged that this is an optimistic view and that the farebox coverage can range between 60 - 80%. Thus the operational shortfall needs to be verified through detailed financial modelling but optimistic an operational shortfall of R25M - R 60M can be expected from 2027/28 onwards.

Additional funding/subsidy will be required to operate a high-quality service. Refer to the financial chapter for more detail pertaining to other funding sources for the system.

Table 19-19: Capital and Operational Cost Dr Belcher/Meadows Corridor

	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
CAPEX																		
Road, Facilities and NMT				R18.68M	R51.05M	R54.79M					R5.00M	R48.50M						
Maintenance and Upgrading of Facilities																		
ITS CAPEX						R51.79M												
ITS OPS							R1.85M	R2.28M	R2.28M	R2.56M	R2.56M	R2.56M	R2.56M	R2.56M	R2.56M	R2.56M	R2.56M	R2.56M
Compensation							R37.83M	R37.83M	R38.97M	R18.97M	R26.56M	R18.97M	R18.97M					
Fleet Transformation																		
Total CAPEX	**R0.00M**	**R0.00M**	**R0.00M**	**R18.68M**	**R51.05M**	**R106.57M**	**R39.68M**	**R40.11M**	**R41.25M**	**R21.53M**	**R34.12M**	**R70.03M**	**R21.53M**	**R2.56M**	**R2.56M**	**R2.56M**	**R2.56M**	**R2.56M**
OPEX																		
Operational Cost	**R0.00M**	**R0.00M**	**R0.00M**	**R0.00M**	**R0.00M**	**R0.00M**	**R118.60M**	**R118.60M**	**R118.60M**	**R148.75M**	**R148.75M**	**R148.75M**	**R148.75M**	**R148.75M**	**R148.75M**	**R148.75M**	**R148.75M**	**R148.75M**
Revenue	**R0.00M**	**R0.00M**	**R0.00M**	**R0.00M**	**R0.00M**	**R0.00M**	**R97.50M**	**R97.50M**	**R97.50M**	**R124.15M**	**R124.15M**	**R124.15M**	**R124.15M**	**R124.15M**	**R124.15M**	**R124.15M**	**R124.15M**	**R124.15M**
Operational Shortfall							**-R21.10M**	**-R21.10M**	**-R21.10M**	**-R24.59M**	**-R24.59M**	**-R24.59M**	**-R24.59M**	**-R24.59M**	**-R24.59M**	**-R24.59M**	**-R24.59M**	**-R24.59M**

19.1.3 CBD Implementation Plan

The CBD corridor was planned and developed around the Central Business District as the primary activity node, and supported by a number of industrial areas Hamilton, Hilton and Ooseinde in close proximity to the rail network and the Transnet rail yard. The economic activity expands to a number of smaller, decentralised nodes along the major traffic routes in the western and north-western suburbs. These smaller nodes are situated along Nelson Mandela Drive, OR Tambo and Curie Avenue.

Brandwag, Willows and Universitas adjacent to the CBD are characterised as mixed land areas with retail and office development along main roads that transverse the areas. Retail development is situated at Mimosa Mall and Loch Logan Waterfront while strategic land uses like the provincial sports stadiums, the University of the Free State and Tempe military base also exist in the area immediately adjacent to the west of the CBD.

In the vicinity of intersections along the N1 freeway which provide access and visual exposure to regional traffic several secondary nodes are in the development stage and expanding rapidly (Makro, Casino Development).

The far western areas of the CBD Corridor(west of route N1) experienced rapid growth during recent years with extensive development in the Langenhovenpark area in the vicinity of the N1-N8 interchange.

To the east and north-east the land is predominantly zoned for industrial use and small scale farming in the Bloemspruit/Shannon and Estoire areas. Three other prominent land uses in this area include the Bram Fischer National Airport, the Schoemanpark sports and recreation facility, and the Grootvlei Prison further to the south.

Numerous new developments are still being planned around Langenhovenpark and towards Spitskop and Bainsvlei. Non-residential uses – especially business – also tend to favour land to the west of the N1 freeway at each of the four access intersections onto the N1.

In line with the municipality's "7 land parcels" initiative, several areas to the west of the N1 freeway have been identified for future inclusionary housing projects, including (refer to Figure 19-19) Brandkop (F1), Brandkop race track (F2), the western extents of Pellissie(F2) and Cecelia (F3).

The areas where precinct plans were developed are presented in Figure 19-19, however, for the Langenhoven Park area and Lourier park areas precinct plans with an emphasis on public transport and the incorporation into the urban area and densification of these areas are still required to ensure the sustainability of the IPTN.

19.1.3.1 Movement Patterns

The spatial structure described above provided the basis for the identification of primary, secondary and minor nodes in the CBD corridor. The classification was furthermore enhanced through analysis of the public transport matrix to determine points or zones where public transport users travel to and from. The primary- and secondary movement patterns are presented in Figure 19-20. These movements provided the basis for the route design and implementation framework for the corridor.

Figure 19-19: CBD Corridor Precinct Plans Proposed

Figure 19-20: CBD Corridor Movement Patterns

19.1.3.2 Implementation Timeline

The public transport improvement program through the alternative analysis process recommends that the transformation of existing services to the Hauweng system need to occur in three stages in the CBD to align with available funding. The stages were primarily defined based on the "clear the corridor" principle where the three stages align with existing public transport operator operational areas. These operational areas provided three distinct sub-corridors. These sub-corridors are shown in Figure 19-21, and comprise of:

- Sub-Corridor 1 (CBD)– Brandwag mini-bus taxi operational area,
- Sub-Corridor 2 (Universitas)– Universitas and Langenhoven Park mini-bus taxi operational area.
- Sub-Corridor 3 (Airport/Hyperama) – Hyperama mini-bus taxi operational area. Areas included in the operational area include Fichardt Park, Lourier Park and Pellissier. Service to Estiore and the Airport is provided by Universitas taxi route operators. To this end, the small sample on-board surveys available indicate that passengers to Estiore and the Airport areas are serviced by Heidedal taxi route and Universitas route. Thus, this demarcation needs to be verified.

Figure 19-21: CBD Sub-corridors

The primary movements, will first be rationalised into the new system through the implementation of scheduled direct routes and services followed by rationalisation of the Universitas sub-corridor and the final rationalisation will be Airport/Hyperama sub-corridor.

The implementation year and the rationalisation of existing routes and services are presented in Diagram 19-3. The operationalisation of the corridor will not include the rationalisation of subsidised bus services demand into the Hauweng system. The subsidised bus service demand will be rationalised into the CBD corridor in the year 2024/25. Thus, "clear the corridor" principle will not be applicable to the operationalisation of the corridor. The rationalisation of routes and services will span across several years, routes per sub-corridor are presented in:

- Sub-Corridor 1 (CBD) - Figure 19-22,
- Sub-Corridor 2 (Universitas) – Figure 19-23;
- Sub-Corridor 3 (Hyperama, Airport) –Figure 19-24 .

The corridor will be operationalised during 2019/20 with full transformation in 2026/27 given that funding remains at the current level. The route, service, fleet, infrastructure, industry transformation and other system elements are detailed below to realise the implementation and transformation of the existing public transport system to the quality public transport system for the city.

Diagram 19-3: CBD Implementation Timeline

Year	2019/20	2024/25	2022/23	2025/26	2035/36
CBD - Brandwag	Start Operations	Include subsidised bus demand			
CBD - Universitas			Start Operations		
CBD - Airport/ Hyperama				Start Operations	

19.1.3.3 Routes

The CBD corridor generates a lower number of public transport trips during the peak hours of the day compared to other corridors in the city. However, the CBD is the main destination of trips in the morning peak and approximately 75% of all trips end within the functional public transport corridor. Thus, the design of a distribution network is the main focus of the route and service design for the corridor. The two main transfers within the city are located at Hoffman Square and the Intermodal facility between Harvey and Hanger Road, next to Bloemfontein rail station.

The routes comprise of direct routes from the mentioned transfer facilities to the destinations identified during the development of the public transport demand matrice and existing public transport operators services and routes. The routes are listed in Table 19-20 with the envisaged year of rationalisation into the Hauweng system. The implementation of the routes per identified implementation increments are presented in Figure 19-22 – Starter Services, Figure 19-23 - Universitas, Figure 19-24 – Airport/Hyperama and all routes at full implementation are presented in Figure 19-25.

Table 19-20: CBD Routes

Route No.	Route Description	Distance One-way	2019/20	2022/23	2025/26
Rt1	Hoffman Square to Uitsig and Hyperama	9			✓
Rt10	Hoffman Square to Universitas Hospital	7		✓	
Rt11	Hoffman Square to Estiore	7			✓
Rt12	Hoffman Square to Airport	7			✓
Rt13	Hoffman Square to Tempe	7	✓		
Rt14	Hoffman Square to Heuwelsig	8		✓	
Rt15	Hoffman Square to Bays Valley	7		✓	
Rt16	Hoffman Square to Northridge Mall	7		✓	
Rt17	Hoffman Square to Bayswater	8		✓	
Rt2	Hoffman Square to Lourier Park	10			
Rt3	Hoffman Square to Langenhoven Park via Mimosa	12		✓	
Rt4	Hoffman Square to Langenhoven Park via Universitas	12		✓	
Rt5	Hoffman Square to Pellissier	12			✓
Rt6	Hoffman Square to UFS	5	✓		
Rt7	Hoffman Square to Makro	11		✓	
Rt9	Hoffman Square to Universitas Area	7		✓	

19.1.3.4 Services

The services will comprise of local services where a vehicle will stop at each stop along the route. The option to implement limited stop services can be investigated given that the detail on-board surveys need to be completed for the existing public transport operators. These surveys will enable the design team to finalise and design the routes and the services to be implemented for the Universitas and Hyperama implementation areas.

For the Starter service the detail on-board surveys were completed, and the design and frequencies will be detailed in the operational plan for this implementation.

- Service Frequency:
  - The service frequency required per route is presented in Annexure FF and a minimum frequency of 20 minutes was adhered to.
- Operational hours for the service are set on a citywide level refer to Section 13.5 for detail.

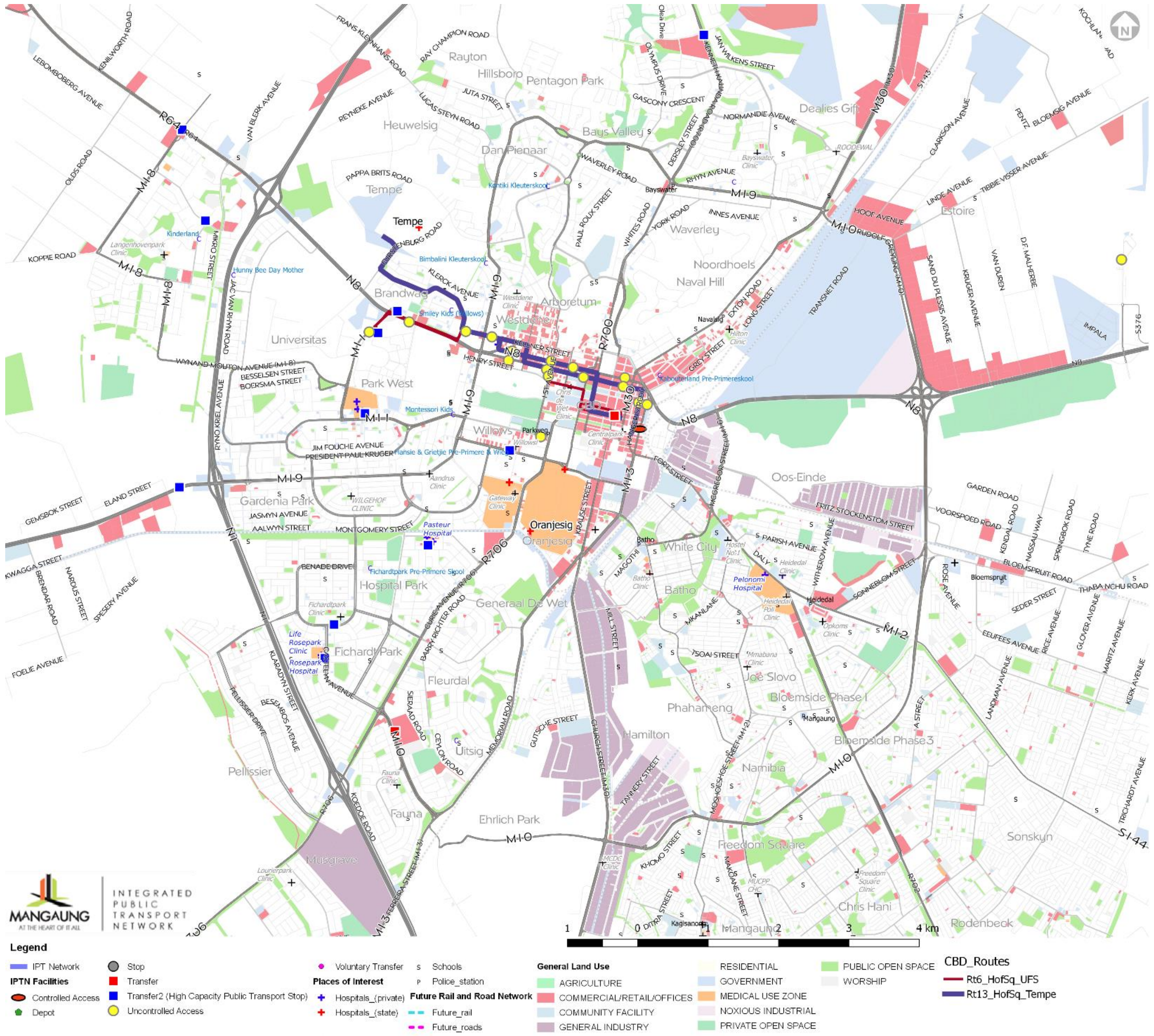


Figure 19-22: CBD – Brandwag Sub-Corridor Routes (2019/20)

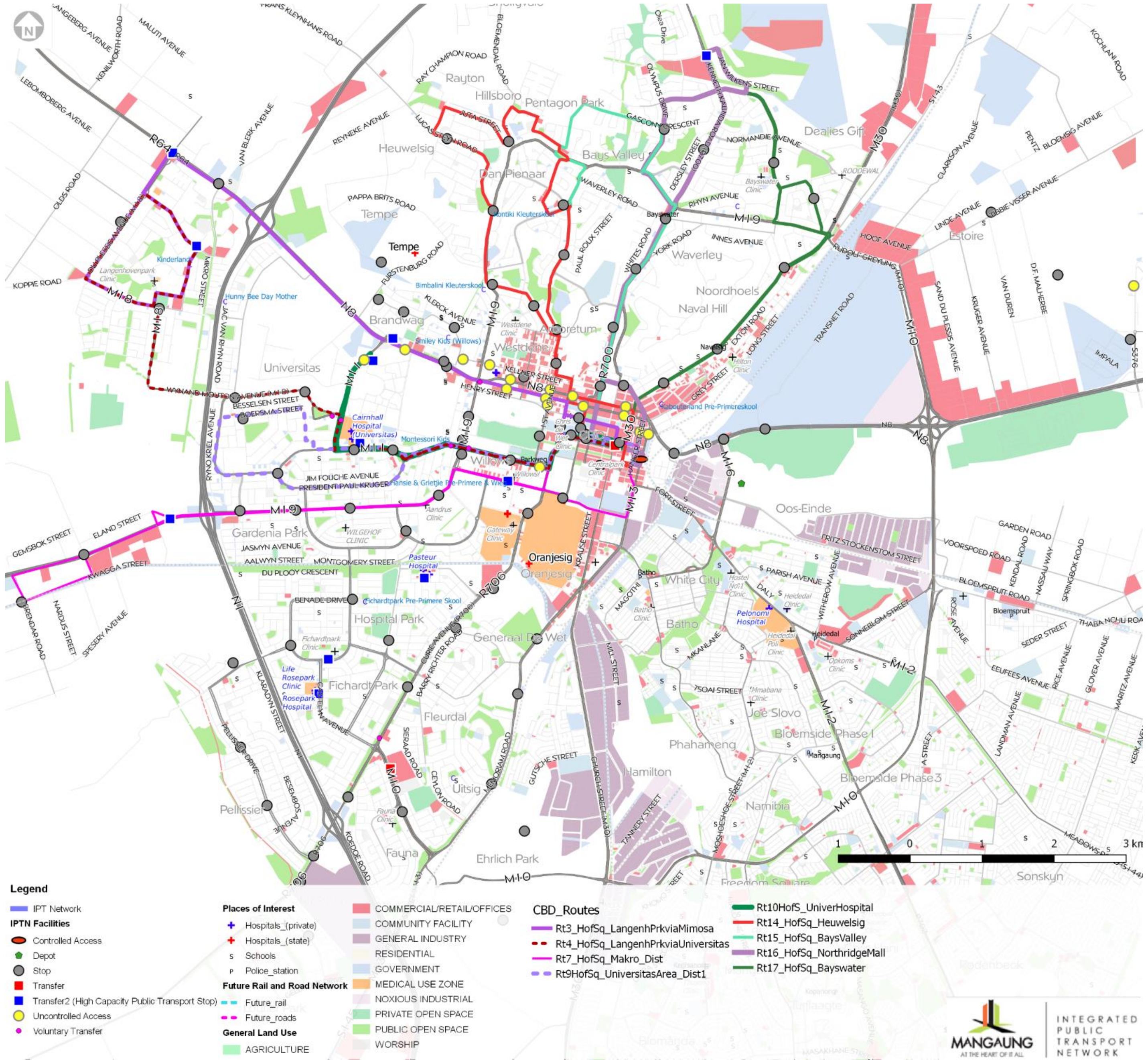


Figure 19-23: CBD – Universitas Sub-Corridor Routes

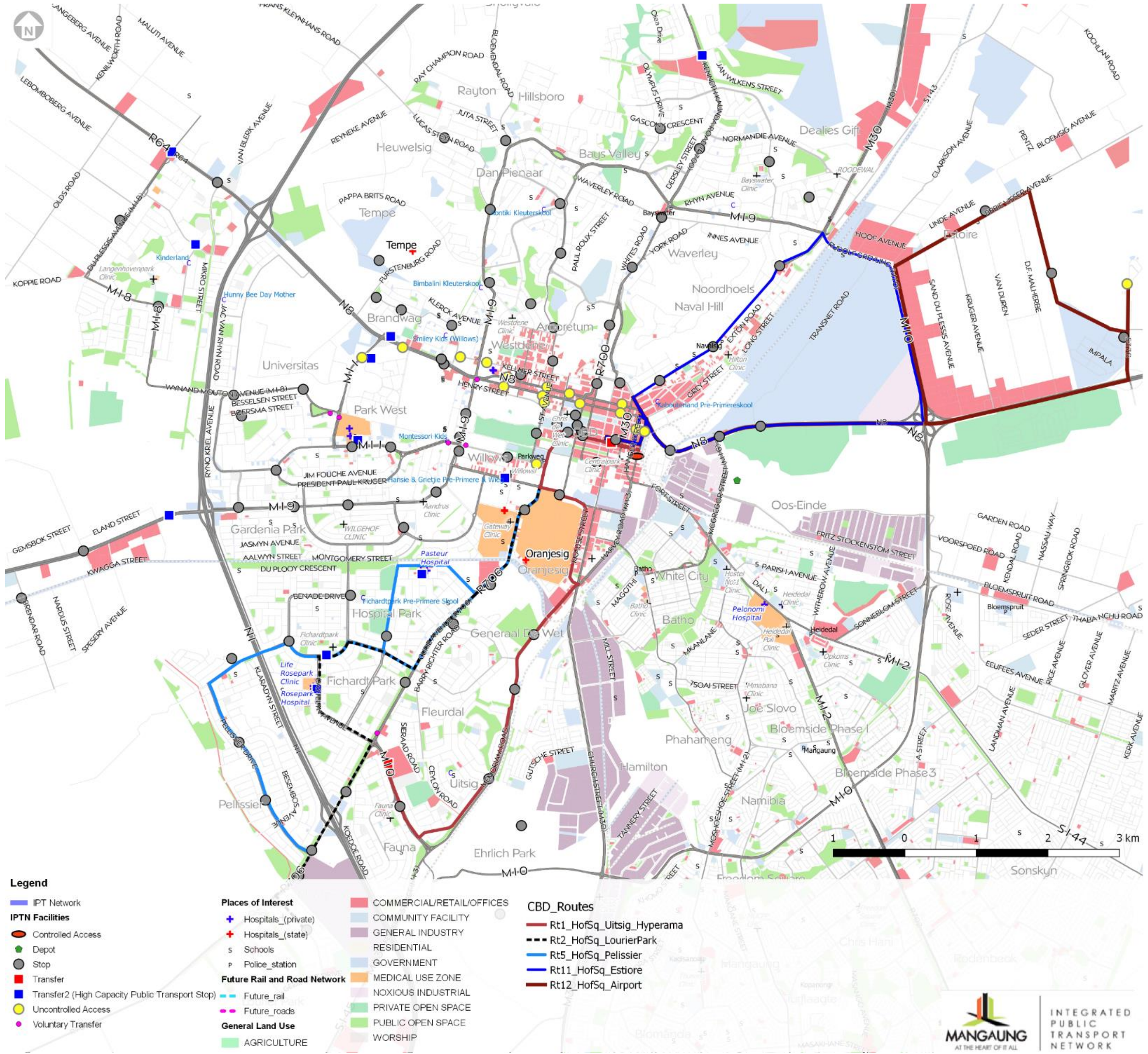


Figure 19-24:CBD – Hyperama Sub-Corridor Routes

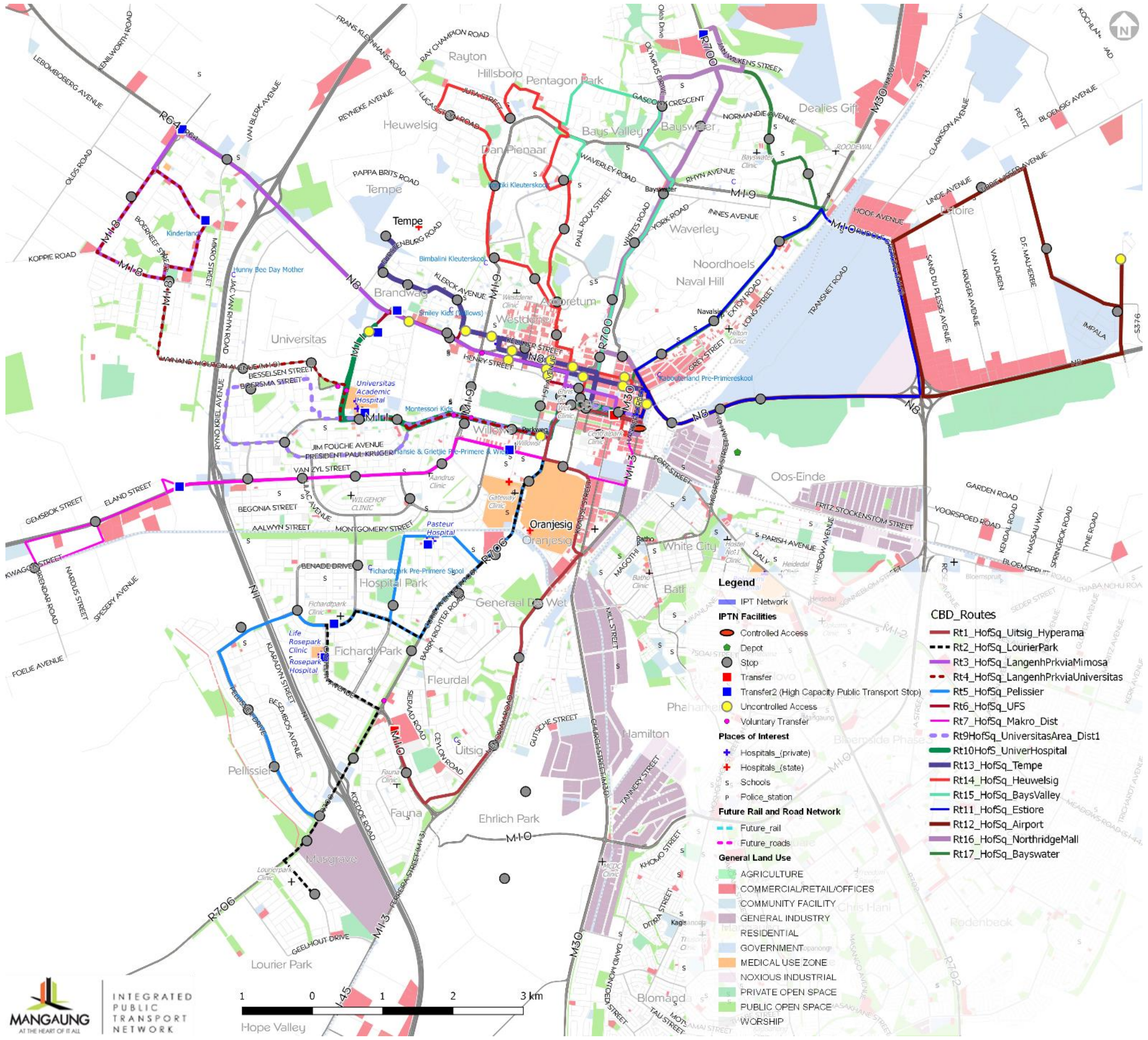


Figure 19-25: CBD Routes Implemented Full Development Stage

19.1.3.5 Patronage

The patronage for the services was estimated taking into consideration the rationalisation of subsidised bus services into the Hauweng service during 2023/24 financial year. The estimated daily passenger volume for the base year and the project horizon years are presented in Table 19-21 and the AM Peak hour volume per corridor is presented in Table 19-22.

Table 19-21: CBD Corridor Estimated Daily Patronage 2019, 2025 and 2036

Year	2019/20	2022/23	2023/24	2025/26	2026/27	2035/36
CBD Brandwag	5,899	5,899	14,339	23,252	23,252	23,252
CBD Universitas		11,315	32,397	52,534	52,534	52,534
CBD Hyperama				27,671	27,671	27,671

Table 19-22: CBD Corridor Estimated Hourly Patronage 2019, 2025 and 2036

Year	2019/20	2022/23	2023/24	2025/26	2026/27	2035/36
CBD Brandwag	826	826	2,007	3,255	3,255	3,255
CBD Universitas		1,500	4500	7,355	7,355	7,355
CBD Hyperama				3,874	3,874	3,874

19.1.3.6 Fleet

The vehicle fleet in the CBD corridor will comprise of the full complement of vehicle capacity envisaged for the Hauweng system. The vehicle capacity per route was determined based on the service frequency required as a minimum and estimated demand per route and design year. It was envisaged that all vehicles would be new fully universal accessible given the universal accessible implementation methodology and the optimisation of AFC and APTMS solutions (Refer to section 14-25). The vehicle fleet per vehicle capacity and rationalisation of services into the Hauweng system, is presented per operationalisation year in Table 19-23.

Table 19-23: CBD Corridor – Estimated Fleet per design and implementation year

Year	Vehicle Capacity	2019/20	2022/23	2023/24	2025/26	2026/27	2035/36
CBD Brandwag	120				12	12	12
	80	9	9	16	6	6	6
CBD Universitas	120				11	11	11
	80		21	46	72	72	72
	22		15	37	9	9	9
CBD Airport/Hyperama	120				29	29	29
	80				6	6	6
	22				14	14	14

19.1.3.7 Infrastructure – Roadways and NMT Infrastructure

Figure 19-26 indicates the road upgrades and maintenance required at full development stage and the authority responsible for the upgrade, maintenance and construction. The minimum requirement to operationalise the corridor is indicated in year 2022/23 and subsequent upgrades presented per financial year. The city needs to communicate with other authorities to ensure that the roadways identified for maintenance and rehabilitation are scheduled and prioritised by these authorities.

A detailed traffic impact study was complete for the Brandwag sub-corridor and is attached in Annexure X with detail pertaining to intersection upgrades required. Allowance was made for 45 intersection upgrades throughout the CBD during the implementation of the IPTN.

Road construction will be required for future phases and in the Estiore and Airport areas. The construction of these roads will form part of the new developments in the area and the implementation of this development will facilitate the construction of the required roads for IPTN.

The detail of the NMT infrastructure required for the implementation of the IPTN in the CBD is attached in the NMT plan for the city. The Focus of the plan is the Brandwag corridor and proposals are attached in Annexure CC. Allowance was made for implementation of NMT during the 2033/34 financial year that coincides with the intersection upgrades in the corridor.

Table 19-24: Road Infrastructure Required – Full Implementation Stage

Quantities	Total Estimated Requirement	2022/23	2023/24	2033/34	2034/35
Additional Lane (m^2)	19,369				
Resurfacing/rehab road sections (Low Priority) (m^2)	320,393				
Resurfacing/rehab section(High Priority) (m^2)	157,168				
Resurfacing/rehab section(Provincial) (m^2)	76,590				
Estimated Cost					
Additional Lane *(R 1 500.00 m^2)*	R29.05M				
Resurfacing/rehabilitation of road sections Part of city scheduled maintenance program *(R500.00 m^2)*	R743.03M				
Resurfacing/ rehabilitation of section. Prioritise Rehabilitation and Maintenance *(R500.00 m^2)*	R20.35M				
Future Links	R60.93M				
Intersection Upgrades	R45.00M			R45.00M	
NMT Infrastructure	R26.00M	R6.00M		R20.00M	

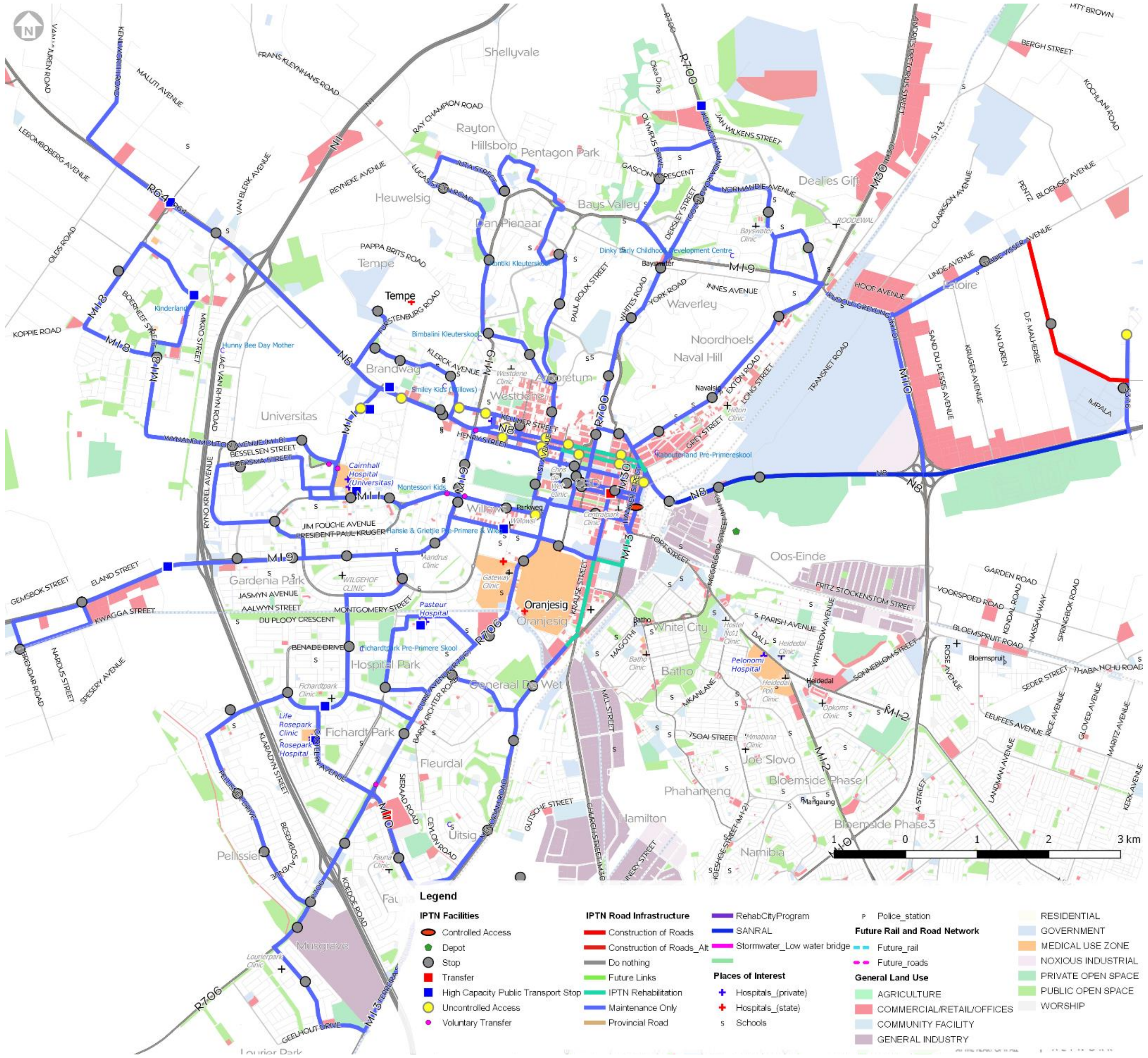


Figure 19-26: Road Maintenance and Upgrades Required

19.1.3.8 Facilities

The incremental approach to the implementation of facilities is detailed in Section 14.2 and 14.3. These facilities, routes and the envisaged stop or station type are presented in Figure 19-27 and quantities provided in Table 19-25. Figure 19-27 shows the full implementation stage facility types. The detail calculation and results are provided in **Annexure EE**

The results of the sizing of the facilities yield that the majority of stops and stations will require one module with at least 5 facilities that will require two modules (Refer to **Table 19-26**). **Figure 19-27** indicate the stops where two modules will be required once all routes are operational.

Several high capacity stops were identified and these are indicated in **Figure 19-27.** These facilities align with existing where holding facilities for midi-buses are provided. These holding areas vary in size and holding area but allow for at least 5 mini-bus taxis to hold at these facilities. Allowance was made in the infrastructure estimation to upgrade the facilities to the Hauweng brand and to allow for new low floor vehicles to load and off-load at the facilities. Detail site visits are required to attain the total cost for the transformation of these facilities.

The capacity required at Hoffman Square and the intermodal facility is presented in Section 14.3.1.1. The depot implementation plan is presented in Section 14.4.

Table 19-25: CBD Corridor Facilities

Facility Type	Operationalise	Upgrade
Stops	85	85
Controlled Access Stations	3	0
Uncontrolled Access Stations (Stop with Shelters)	11	11
Transfers (Main)	1	0
Transfers High Capacity	11	0
Transfers Low Capacity (Voluntary Transfer)	6	0

Table 19-26: CBD Corridor Facility Capacity Waiting Areas

2017	Module width 5m				Module width 3m			
Module length (m)	7	14	28	45	12	23	47	70
2017	96	5			96	5		
2025	96	5			96	5		
2036	92	9			92	9		
2036 - 4 x pax per peak 15-minutes	92	9			92	9		

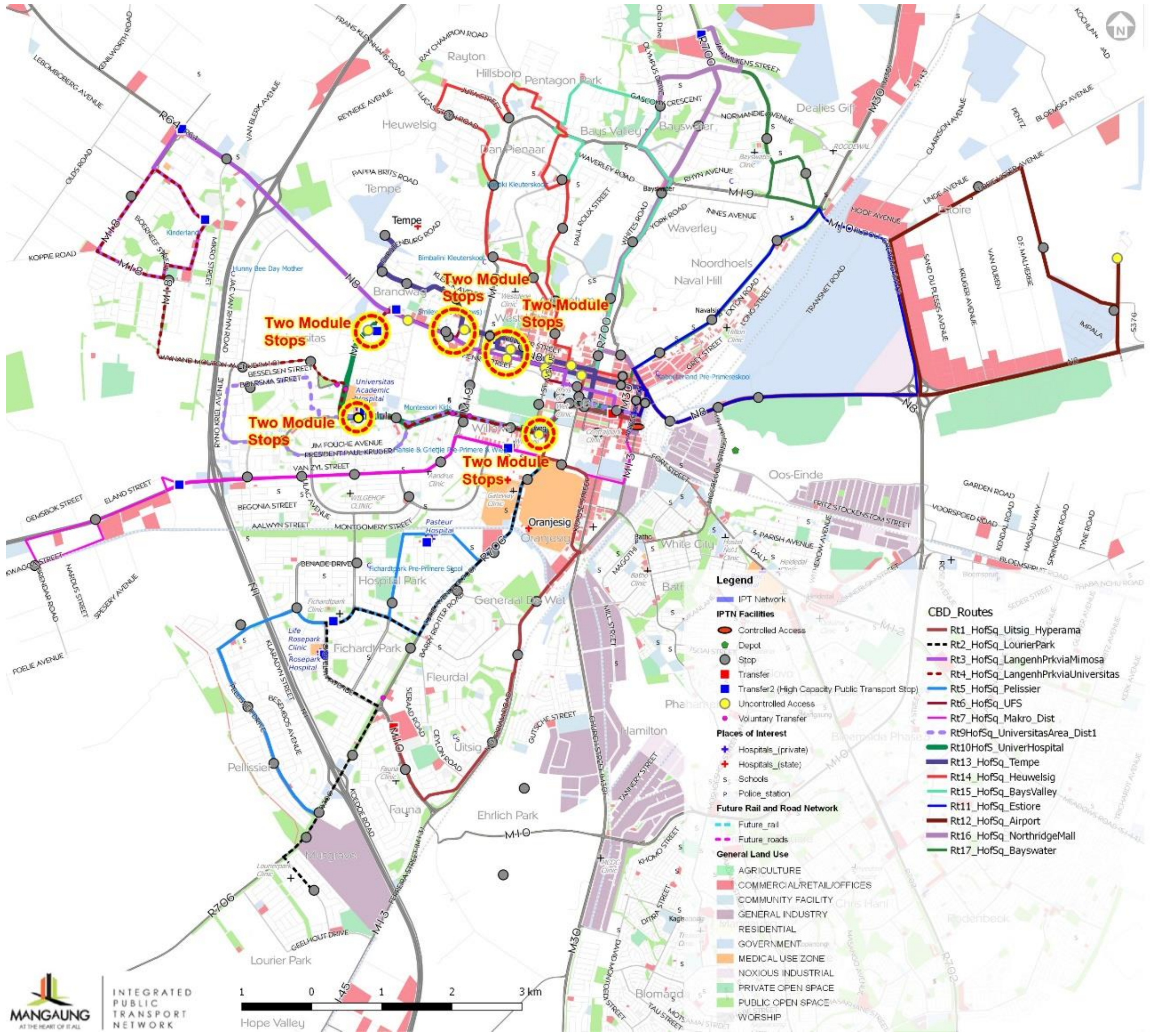


Figure 19-27: Station Sizes All Corridors Implemented

19.1.3.9 Industry Transition

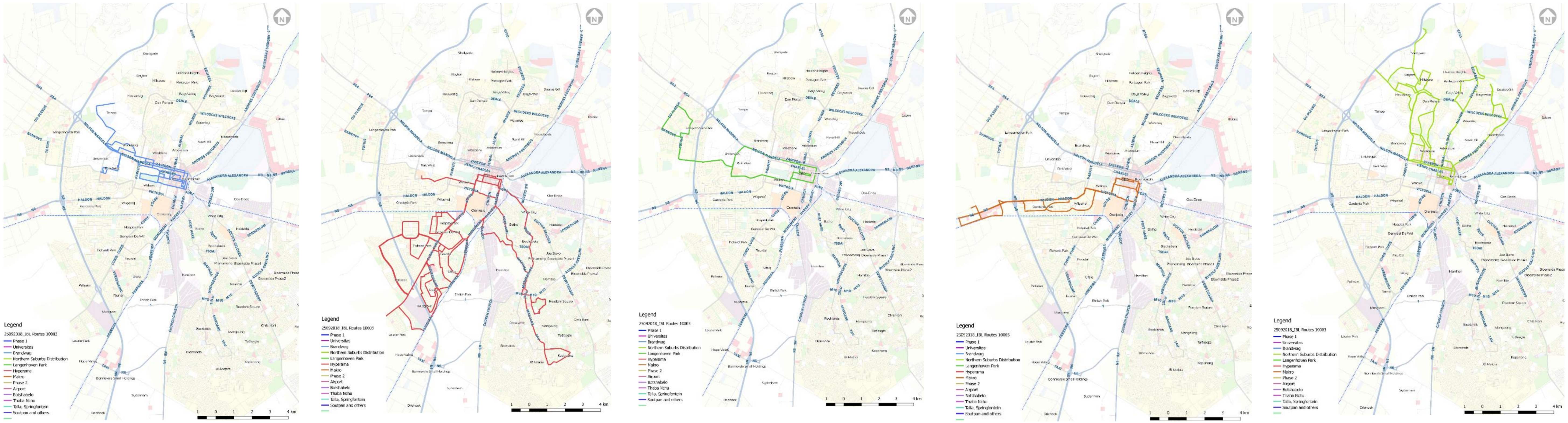
“Clear the corridor” implementation principle will be followed during the roll-out of the Hauweng system. The process of transformation and strategies are detailed in the Industry transition section and Business Plan in Section 20.1.1 of the report. The operators that will be affected by the operationalisation of the corridor are:

- Mini-Bus Taxi Operators operating along the following routes:
  - Brandwag;
  - Universitas;
  - Hyperama;
  - Langenhoven Park.
  - Existing Taxi Fleet is estimated at approximately 263 vehicles. This fleet number needs to be validated during detail design and business planning processes.
  - On-board surveys need to be commissioned to obtain the business value of these operators and the utilisation and operational characteristics of services provided by these operators.
- Subsidised Bus Service:
  - The routes that will be affected are presented in **Figure 19-28**.
  - The trips and the number of unique routes are presented in **Table 19-27**.
  - The rationalisation of the subsidised bus services into the Hauweng system will have a significant impact on patronage.

Detailed market research is required for the corridor to determine the business value and total compensation value for the affected operators. The determination of the business value will form part of the detail business case for the corridor.

Table 19-27: CBD – Subsidised Bus Service Summary

	Brandwag	Hyperama	Langenhoven Park	Makro	Northern Suburbs	Universitas	Airport
No Unique Routes	12	39	7	13	18	12	5
Wednesday Vehicle Trips	39	135	70	51	129	51	8
Wednesday Passenger Total	1,319	4,863	3,442	1,542	4,871	2,127	651
Passengers - 03:00 AM - 04:59 AM		43	88	96		32	-
Passengers - 05:00 AM - 07:59 PM	1,319	4,786	3,354	1,386	4,871	2,095	651
Passengers - 08:00 PM - 12:00 PM		34		60		-	-
Friday Daily Passengers	1,132	5,029	3,645	1,481	4,833	2,037	493
Saturday Vehicle Trips	6	50	18	14	26	15	1
Saturday Daily Passenger	68	865	572	319	449	165	1
Sunday Daily Vehicle Trips		14	4	8		4	-
Sunday Daily Passengers		225	98	81		13	-



Brandwag **Hyperama** **Langenhoven Park** **Makro Universitas** **Universitas/Northern Suburbs**

Figure 19-28: Brandwag and Hyperama Subsidised Routes Affected

19.1.3.10 Operational and Capital Cost

The direct vehicle operating cost and capital cost associated with the implementation of the corridor is detailed in Annexure GG and summarised in Table 19-28 to Table 19-30. The indirect operational cost is presented on citywide level in the preceding section. The operational shortfall compared to revenue earned, through fare collection, the farebox will cover 94% of the operational cost during operationalisation for the Brandwag corridor, 58% for the Universitas and 83% of the Airport/Hyperama operational cost. It needs to be noted that the routes in the Brandwag corridor is short and thus the turn-around time optimised. For the Universitas corridor the farebox coverage of operational cost is projected at 76% in the outer years. This is over-optimistic based on the rule of thumb that the farebox coverage can be in the range 30-70%. The same applies to Airport/Hyperama farebox coverage. Detailed financial modelling is required to determine the extent of the shortfall. This will be determined as part of the detailed operational plan development per corridor.

Additional funding/subsidy will be required to operate a high-quality service. Refer to the financial chapter for more detail pertaining to other funding sources for the system.

19.1.3.11 Environmental Screen

Specialist assessments will be required for the undertaking of the proposed development and upgrades in the CBD Corridor. There is however an allowance of the EAP to motivate for the reasons for not including certain assessments in the assessment report. The following Specialist assessments have been identified as per the DEA Screening tool:

- Agricultural Impact Assessment;
- Landscape/Visual Impact Assessment;
- Archaeological and Cultural Heritage Impact Assessment;
- Palaeontology Impact Assessment;
- Terrestrial Biodiversity Impact Assessment;
- Aquatic Biodiversity Impact Assessment;
- Noise Impact Assessment;
- Traffic Impact Assessment;
- Geotechnical Assessment;
- Socio-Economic Assessment;
- Ambient Air Quality Impact Assessment.

The detailed screen report is provided in Annexure JJ.

Table 19-28: Capital and Operational Cost CBD Brandwag Corridor

	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
CAPEX																	
Road, Facilities and NMT		R10.13M	R23.63M								R28.50M		R5.00M				
Maintenance and Upgrading of Facilities		R0.10M	R0.10M	R0.10M	R0.10M	R0.10M	R0.10M	R0.10M	R0.10M	R0.10M	R0.10M	R0.10M	R0.10M	R0.10M	R0.10M	R0.10M	R0.10M
ITS CAPEX				R12.99M													
ITS OPS		R0.60M	R0.51M	R0.61M	R0.86M	R0.86M	R0.86M	R0.86M	R0.86M	R0.86M	R0.86M	R0.86M	R0.86M	R0.86M	R0.86M	R0.86M	R0.86M
Compensation	R6.22M	R27.73M															
Total CAPEX	**R6.22M**	**R38.56M**	**R24.24M**	**R13.71M**	**R0.96M**	**R0.96M**	**R0.96M**	**R0.96M**	**R0.96M**	**R0.96M**	**R29.46M**	**R0.96M**	**R5.96M**	**R0.96M**	**R0.96M**	**R0.96M**	**R0.96M**
OPEX																	
Operational Cost	**R11.54M**	**R11.54M**	**R11.54M**	**R11.54M**	**R24.15M**	**R24.15M**	**R26.89M**	**R26.83M**	**R26.83M**	**R26.83M**	**R26.83M**	**R26.83M**	**R26.83M**	**R26.83M**	**R26.83M**	**R26.83M**	**R26.89M**
Revenue	**R10.90M**	**R10.90M**	**R10.90M**	**R10.90M**	**R26.50M**	**R26.50M**	**R42.97M**	**R42.97M**	**R42.97M**	**R42.97M**	**R42.97M**	**R42.97M**	**R42.97M**	**R42.97M**	**R42.97M**	**R42.97M**	**R43.07M**
		-R0.64M	**-R0.64M**	**-R0.64M**	**R2.35M**	**R2.35M**	**R16.08M**	**R16.14M**	**R16.14M**	**R16.14M**	**R16.14M**	**R16.14M**	**R16.14M**	**R16.14M**	**R16.14M**	**R16.14M**	**R16.17M**
		94%	94%	94%	110%	110%	160%	160%	160%	160%	160%	160%	160%	160%	160%	160%	160%

Table 19-29: Capital and Operational Cost CBD Universitas Corridor

	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
CAPEX																	
Road, Facilities and NMT			R5.87M	R9.79M	R3.92M							R28.50M	R5.00M				
Maintenance and Upgrading of Facilities																	
ITS CAPEX				R37.11M													
ITS OPS			R0.07M	R0.41M	R0.68M	R0.95M	R1.23M	R1.23M	R1.23M	R1.23M	R1.23M	R1.23M	R1.23M	R1.23M	R1.23M	R1.23M	R1.23M
Compensation				R16.98M	R16.98M												
Total CAPEX	**R0.00M**	**R0.00M**	**R5.94M**	**R64.28M**	**R21.57M**	**R0.95M**	**R1.23M**	**R1.23M**	**R1.23M**	**R1.23M**	**R1.23M**	**R29.73M**	**R6.23M**	**R1.23M**	**R1.23M**	**R1.23M**	**R1.23M**
OPEX																	
Operational Cost				**R36.22M**	**R88.07M**	**R88.07M**	**R127.66M**	**R127.66M**	**R127.66M**	**R127.66M**	**R127.66M**	**R127.66M**	**R127.66M**	**R127.66M**	**R127.66M**	**R127.66M**	**R127.66M**
Revenue				**R20.91M**	**R59.87M**	**R59.87M**	**R97.08M**	**R97.08M**	**R97.08M**	**R97.08M**	**R97.08M**	**R97.08M**	**R97.08M**	**R97.08M**	**R97.08M**	**R97.08M**	**R97.30M**
				-R15.31M	**-R28.20M**	**-R28.20M**	**-R30.58M**	**-R30.58M**	**-R30.58M**	**-R30.58M**	**-R30.58M**	**-R30.58M**	**-R30.58M**	**-R30.58M**	**-R30.58M**	**-R30.58M**	**-R30.36M**
				58%	68%	68%	76%	76%	76%	76%	76%	76%	76%	76%	76%	76%	76%

Table 19-30: Capital and Operational Cost CBD Airport/Hyperama Corridor

	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
CAPEX																	
Road, Facilities and NMT						R15.54M						R28.50M	R5.00M				
Maintenance and Upgrading of Facilities						R0.16M	R0.16M	R0.16M	R0.16M	R0.16M	R0.16M	R0.16M	R0.16M	R0.16M	R0.16M	R0.16M	R0.16M
ITS CAPEX						R20.13M											
ITS OPS					R0.33M	R0.67M	R0.87M	R1.06M	R1.06M	R1.06M	R1.06M	R1.06M	R1.06M	R1.06M	R1.06M	R1.06M	R1.06M
Compensation							R22.64M	R22.64M									
Total CAPEX					**R0.33M**	**R36.49M**	**R23.66M**	**R23.85M**	**R1.22M**	**R1.22M**	**R1.22M**	**R29.72M**	**R6.22M**	**R1.22M**	**R1.22M**	**R1.22M**	**R1.22M**
OPEX																	
Operational Cost							**R61.84M**	**R61.84M**	**R61.84M**	**R61.84M**	**R61.84M**	**R61.84M**	**R61.84M**	**R61.84M**	**R61.84M**	**R61.84M**	**R61.84M**
Revenue							**R51.14M**	**R51.14M**	**R51.14M**	**R51.14M**	**R51.14M**	**R51.14M**	**R51.14M**	**R51.14M**	**R51.14M**	**R51.14M**	**R51.25M**
							-R10.70M	**-R10.70M**	**-R10.70M**	**-R10.70M**	**-R10.70M**	**-R10.70M**	**-R10.70M**	**-R10.70M**	**-R10.70M**	**-R10.70M**	**-R10.59M**
							83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%

19.1.4 Botshabelo Functional Public Transport Corridor

Botshabelo is located about 55 kilometres to the east of Bloemfontein. It was spatially designed along a major access route that runs in a north/south direction through the centre of the area and which links into route N8 to the north. This gave rise to a linear north-south oriented urban form which creates a problem to the most southern communities as they need to travel as far as 10 kilometres to access the economic opportunities and public transport facilities which have developed in the northern parts of the town closer to the N8. The town was originally planned with a CBD in the central section, about 4 kilometres to the south of the N8, and an industrial area at the northern entrance of the town from the N8. Both these areas are only partially developed.

There has been a decline in the manufacturing sector of Botshabelo over the past two decades largely due to subsidy cuts to the industries established in Botshabelo. As a result, Botshabelo offers very limited employment opportunities resulting in commuters having to commute daily between Botshabelo and Bloemfontein.

Several retail, commercial industrial, schools, clinics and other social amenities are provided throughout Botshabelo and are main trip attractors and generators in the area. The local, secondary and primary nodes identified from visual observation are presented in Figure 19-29. This node hierarchy is not a replacement or reflection of a spatial framework thus, only provide premises for the development of movement patterns and assist in the development of a movement network for the area.

19.1.4.1 Movement Patterns

The node hierarchy and the public transport matrix developed for the IPTN and discussed in other sections of the report provided the basis for the conceptual movement patterns presented in Figure 19-30. These movement patterns, existing public transport routes and public transport matrix were used to design the routes for the corridor.

The routes link the nodes and these nodes are or become focal points in the area. To ensure long term sustainability the population density need to be increased along the routes of the IPTN. To this end it is recommended that the primary and secondary nodes are investigated to determine where densification is required and where social amenities can be provided to establish mixed-use nodes in the area.

The precinct plans with priority are Node 1 to 8 presented in Figure 19-29. Within these nodes main public transport facilities, stations, transfers or high capacity bus stops are planned and will enhance the development in the area. Details pertaining to these facilities are provided in subsequent section relating facilities.

19.1.4.2 Implementation Timeline

The public transport improvement program through the alternative analysis process determined that the transformation of existing services to the Hauweng system will occur in two distinct stages. Where the primary movements will be rationalised into the new system through the implementation of scheduled trunk routes and services followed by rationalisation of unscheduled feeder services to scheduled feeder routes and services or complementary route services spread across a number of years depending on the funding available and the financial feasibility of the transformation of the feeder services. The implementation year and the rationalisation of feeder services are presented in **Diagram 19-4**. The operationalisation of the corridor will include the rationalisation of subsidised bus services demand into the Hauweng system, given that a significant portion of the demand in the area is serviced by subsidised bus services. Thus, “clear the corridor” from the operationalisation of the corridor. The rationalisation or transformation of feeder service vehicles will span across four stages, refer to **Figure 19-31** for the areas/zones where routes will be rationalised per stage. These areas align with existing public transport operators routes or operational areas. The rationalisation of feeder services and the implementation is detailed in the routes section below. The rationalisation of feeders from unscheduled feeders services to scheduled services will depend on the financial viability and feasibility of the rationalisation. Refer to the transformation and rationalisation process in the routes section below.

The corridor will be operationalised during 2026/27 with full transformation envisaged in 2035/36 given that funding remains at the current level. The route, service, fleet, infrastructure, industry transformation and other system elements are detailed below to realise the implementation and transformation of the existing public transport system to the quality public transport system for the city.

Diagram 19-4: Botshabelo Implementation Timeline

Year	2019/20	2025/26	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
Botshabelo			Trunk - Scheduled Services, Feeders - Unscheduled			Scheduled Feeder and Trunk Services, with selected Complementary routes				

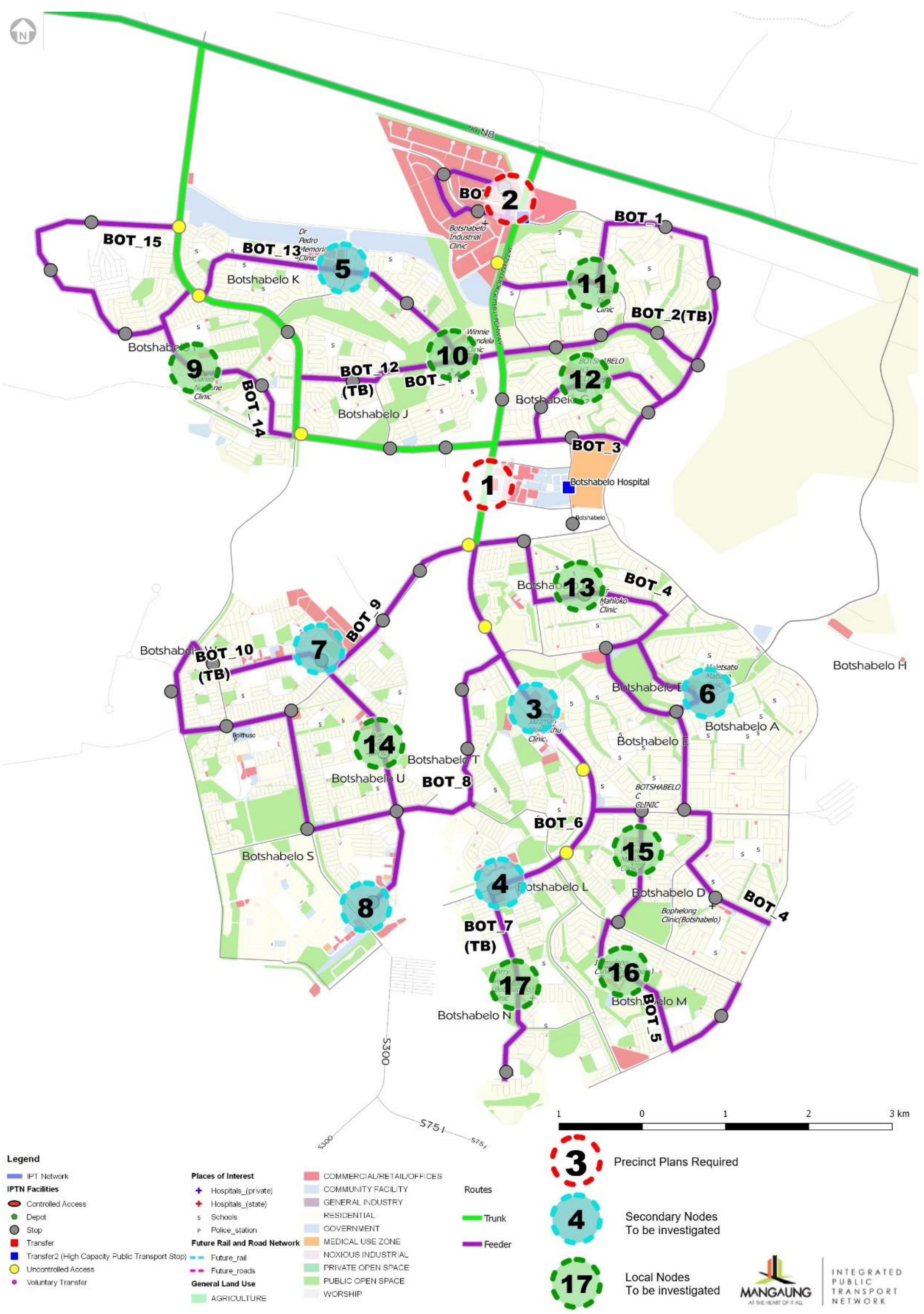


Figure 19-29: Botshabelo Corridor Precinct Plans Proposed

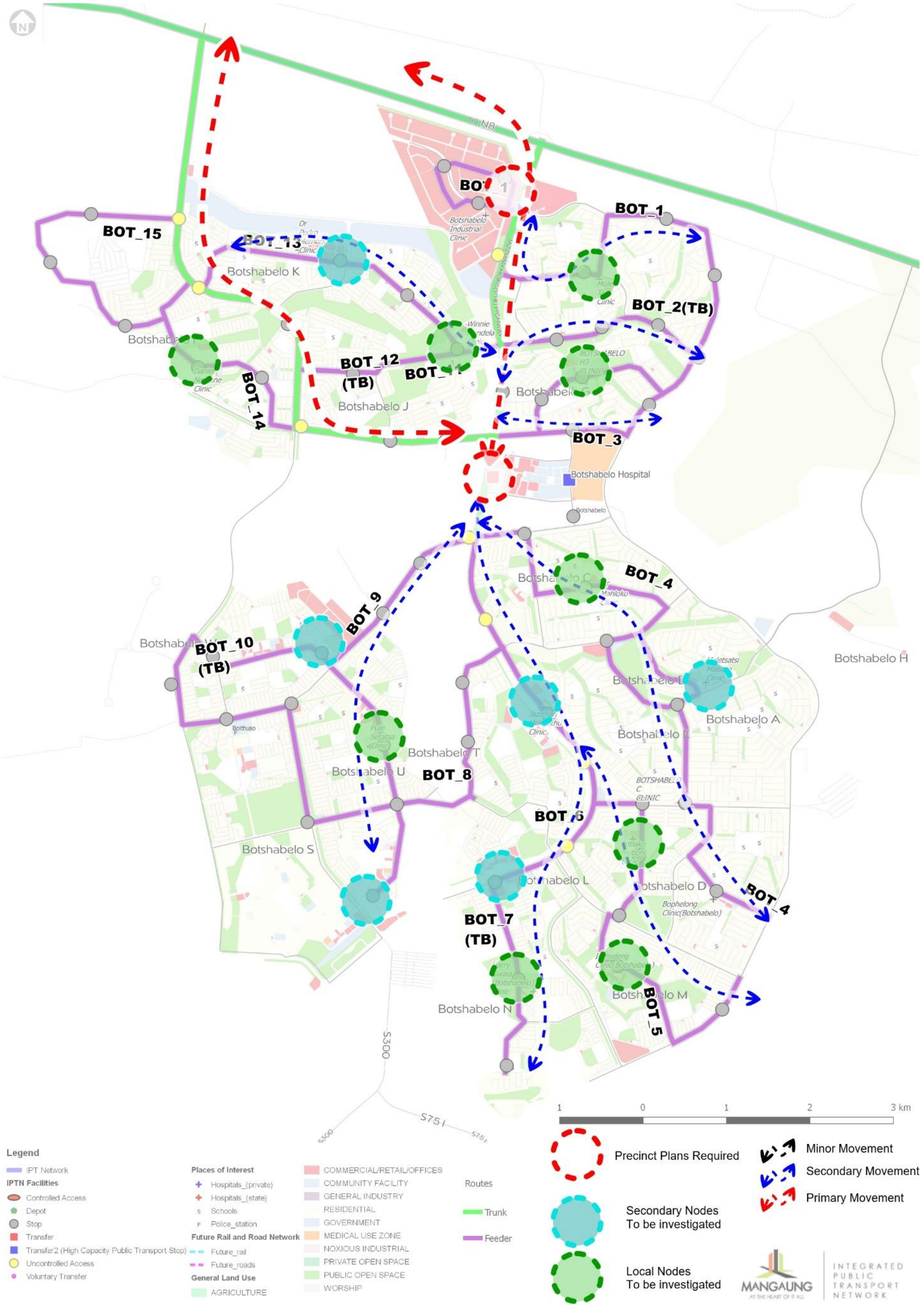


Figure 19-30: Botshabelo Corridor Movement Patterns

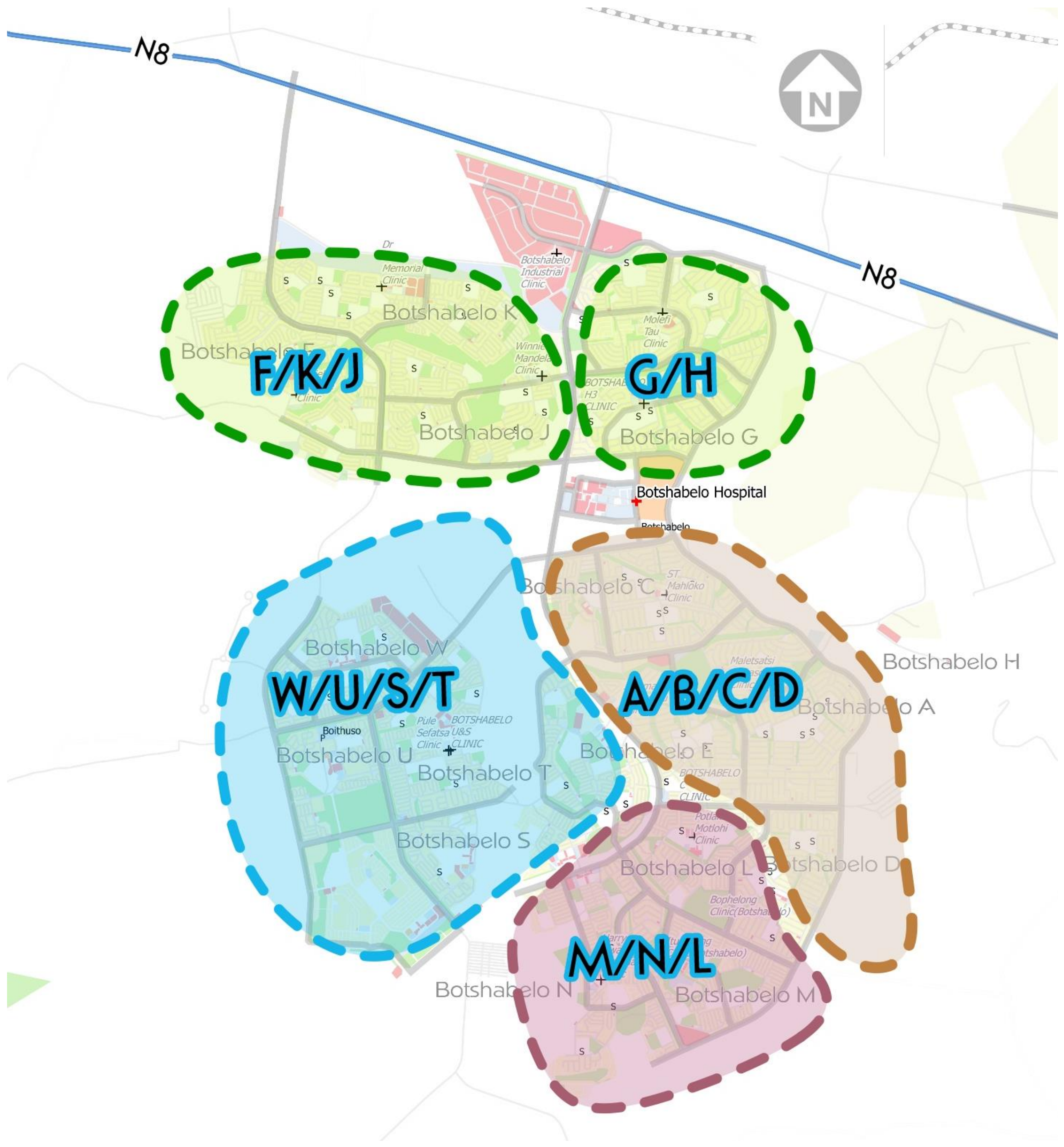


Figure 19-31: Botshabelo Rationalisation Areas

19.1.4.3 Routes

The route design for the operationalisation phase for the corridor is presented in Figure 19-32 and at full development phase is presented in Figure 19-33. Based on the selected implementation plan for the city the route design that needs to be considered when the operational plan is developed for the corridor comprises of two trunk routes:

- Trunk 1 – From Blue rank to Intermodal/Hoffman Square, past shopping centre and industrial are Second Access Road to Botshabelo from Bloemfontein;
- Trunk 2 - From Blue Rank to Hoffman Square, Intermodal via the first access road to Botshabelo from Bloemfontein. This trunk or main route will run via Botshabelo K and Botshabelo J.

During the operationalisation phase, fifteen (15) unscheduled feeder routes will integrate with the trunk routes at transfer facilities. The trunk-feeder configuration allows for the incremental transformation of the existing public transport operators where operators are contracted to provide a service with vehicles complying to minimum standards and branded according to the Hauweng brand. These vehicles will be equipped with AFC and limited APTMS to increase commuter experience. The route alignment will be stipulated as part of the amendment of the operating licenses for entities that will provide the feeder services. This will be a contracted service with a service level agreement. The remuneration and principles thereof are addressed in the business plan **Section 20.1.1**.

After the operational phase, three of the fifteen feeder routes will be rationalised to scheduled complementary routes. The routes to be rationalised are listed in **Table 19-31** and will be rationalised according to the rationalisation zones shown in **Figure 19-31**. The rationalisation and transformation of feeder routes to scheduled feeder routes and services will depend on the feasibility of a scheduled feeder service.

The rationalisation will be based on the minimum requirement of at least 450 pax per feeder route before the service will be transformed into a scheduled service. In the event that the feeder cannot be transformed to a scheduled service the vehicles that provide the service will after approximately three years be transformed/replaced by universal accessible vehicles. The transformation of the vehicles will be according to the rationalisation zones mentioned previously.

The implementation of the complementary routes will optimise operational cost and the vehicle fleet required for operations. The implementation of complementary routes will furthermore optimise the size of a transfer facility. This rationalisation will only be implemented if demand realises according to estimations. Refer to later sections for detail pertaining to contracting, facilities and other elements.

The initial route design will introduce an additional transfer comparing to existing public transport operations. However, express services are implemented as part of the service offering and will thus enhance the existing stop at all possible pick-up points on total journey time.

Table 19-31: Botshabelo Routes

Route Number		2026/27	2029/30	2030/31	2031/32	2031/32	2035/36
BOT_1	5.5	Feeder	Comp			**Comp**	54.9
BOT_2	5.5	Feeder				Feeder	5.5
BOT_3	6.6	Feeder				Feeder	6.6
BOT_4	9.5	Feeder		Comp		**Comp**	58.9
BOT_5	10.1	Feeder				Feeder	10.1
BOT_6	8.9	Feeder				Feeder	8.9
BOT_7	8.9	Feeder				Feeder	8.9
BOT_8	6.8	Feeder				Feeder	6.8
BOT_9	10.5	Feeder			Comp	**Comp**	59.9
BOT_10	10.5	Feeder				Feeder	10.5
BOT_11	6.3	Feeder				Feeder	6.3
BOT_12	6.3	Feeder				Feeder	6.3
BOT_13	5.0	Feeder				Feeder	5.0
BOT_14	4.5	Feeder				Feeder	4.5
BOT_15	4.5	Feeder				Feeder	4.5
BOT_25	49.5	Trunk- Bloemfontein				Trunk	49.5
BOT_24	20.3	Trunk – Thaba Nchu				Trunk	20.3

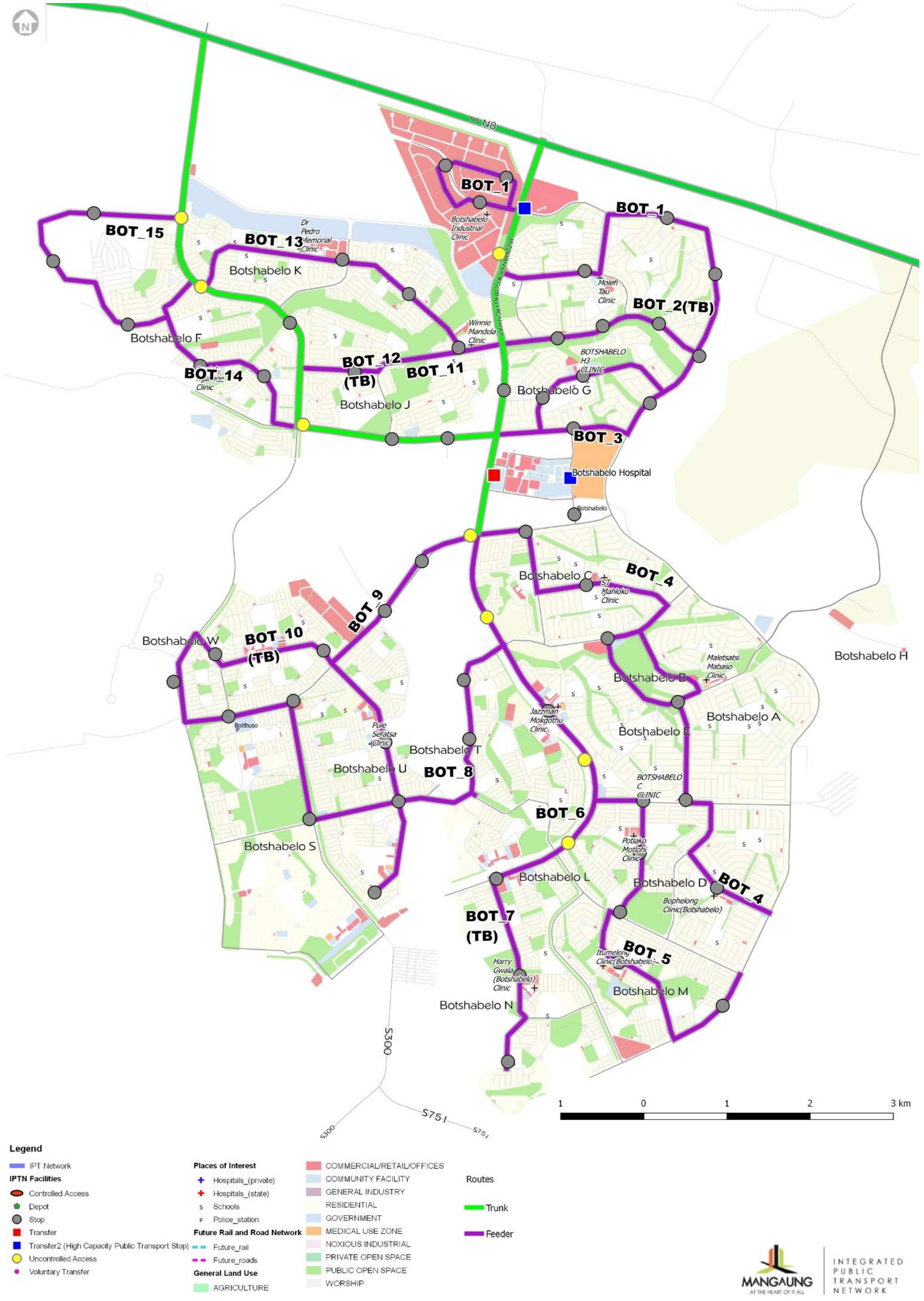


Figure 19-32: Botshabelo Routes Operationalisation (2026/27)

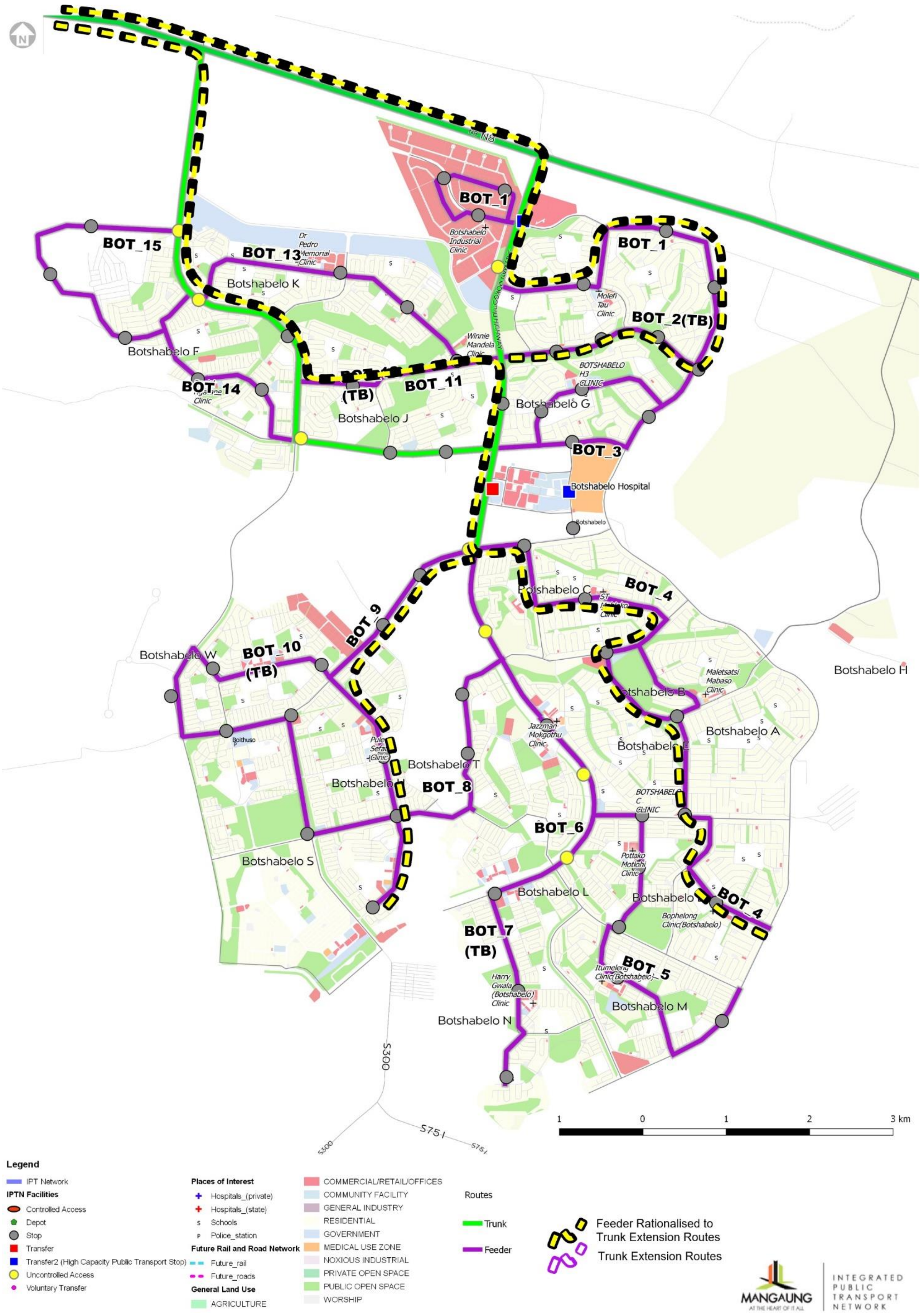


Figure 19-33: Botshabelo Routes Full Implementation (2034/35)

19.1.4.4 Patronage

The patronage for the services was estimated taking into consideration the rationalisation of subsidised bus services into the Hauweng service during 2023/24 financial year. The estimated daily passenger volume for the base year and the project horizon years are presented in and the AM Peak hour volume per corridor is presented in Table 19-33Table 19-32.

Table 19-32: Botshabelo Corridor Estimated Daily Patronage 2019, 2025 and 2036

Year	2019/20	2025/26	2026/27	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
Botshabelo			23,654	23,654	23,654	23,654	23,654	23,654	23,654	25,362

Table 19-33: Botshabelo Corridor Estimated Hourly Patronage 2019, 2025 and 2036

Year	2019/20	2025/26	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
Botshabelo			2,998	2,998	2,998	3,312	3,312	3,312	3,312	3,551

19.1.4.5 Fleet

- Trunk and Complementary Vehicles:
  - The vehicle deployment strategy is to implement new universal compliant vehicles along the trunk routes when the corridor operationalises. The approach was to operationalise the corridor with rigid vehicles only given lessons learned from other cities to rather prepare for demand lower than models estimated, rather than prepare for the exact estimated patronage scenario.
  - The rigid 80 seat vehicles will only load on the left side through one door, but during the outer year 2035/36 articulated vehicles can be considered if demand realises.
- Feeder Vehicles:
  - The feeder vehicle fleet will comprise of existing mini-bus vehicles that will be selected through a validation process. These vehicles will comply with the specifications provided for these vehicles to ensure passenger safety. These feeder vehicles will operate under a contract and will be fitted with the selected AFC system and branded to comply with Hauweng brand. These feeder vehicles will not be UA compliant and will be phased out, approximately 3-years after the corridor was operationalised. Refer to ITS specifications for detail pertaining to AFC and APTMS.
  - The rationalisation and transformation of feeder vehicles to UA compliant vehicles will depend on the financial viability of the transformation of vehicles.

The vehicle fleet per vehicle capacity category and the fleet total required per annum are presented in **Table 19-35.**

Table 19-34: Transformation of Feeder Vehicles to UA compliant vehicles per route and Year

Route Number	2026/27	2029/30	2030/31	2031/32	2032/33
BOT_1	Feeder	✓			
BOT_2	Feeder	✓			
BOT_3	Feeder	✓			
BOT_4	Feeder			✓	
BOT_5	Feeder			✓	
BOT_6	Feeder			✓	
BOT_7	Feeder			✓	

Route Number	2026/27	2029/30	2030/31	2031/32	2032/33
BOT_8	Feeder				✓
BOT_9	Feeder				✓
BOT_10	Feeder				✓
BOT_11	Feeder		✓		
BOT_12	Feeder		✓		
BOT_13	Feeder		✓		
BOT_14	Feeder		✓		
BOT_15	Feeder		✓		
BOT_25	Trunk				
BOT_24	Trunk				

Table 19-35: Botshabelo Corridor – Estimated Fleet per design and implementation year

Vehicle Capacity	2019/20	2025/26	2026/27	2031/32	2032/33	2033/34	2034/35	2035/36
120			41	36	36	36	36	36
80				13	13	13	13	13
22				62	62	62	62	62

19.1.4.6 Infrastructure – Roadways and NMT Infrastructure

Figure 19-34 indicates the road upgrades and maintenance required at full development stage and the authority responsible for the upgrade, maintenance and construction. The minimum requirement to operationalise the corridor is indicated in **Table 19-36** and subsequent upgrades presented per financial year. The city needs to communicate with other authorities to ensure that the roadways identified for maintenance and rehabilitation are scheduled and prioritised by these authorities.

The detail of the NMT infrastructure required for the implementation of the IPTN in the corridor is attached in the NMT plan for the city. The proposals and network are attached in Annexure CC. Allowance was made for implementation of NMT during the 2033/34 financial year that coincides with the intersection upgrades in the corridor. The intersections to be upgraded will be determined by the detail traffic impact study that will be commissioned at least one year before the corridor is operationalised.

Table 19-36: Road Infrastructure Required – Full Implementation Stage

Quantities	Total Requirement	2027/28	2028/29	2033/34	2034/35
Additional Lane (m^2)	83,721	24,500	24,500		
Resurfacing/rehab section(High Priority) (m^2)	564,873				
Resurfacing/rehab section(Provincial) (m^2)					
Estimated Cost					
Additional Lane *(R 1 500.00 m^2)*	R125.58M	R50.23M	R12.56M		
Resurfacing/ rehabilitation of section. Prioritise Rehabilitation and Maintenance *(R500.00 m^2)*	R282.44M				
Resurfacing/ rehabilitation of sections. Provincial Rehabilitation and Maintenance *(R500.00 m^2)*					
Intersection Upgrades	R24.00M			R24.00M	
NMT Infrastructure	R53.75M	R33.75M		R20.00M	

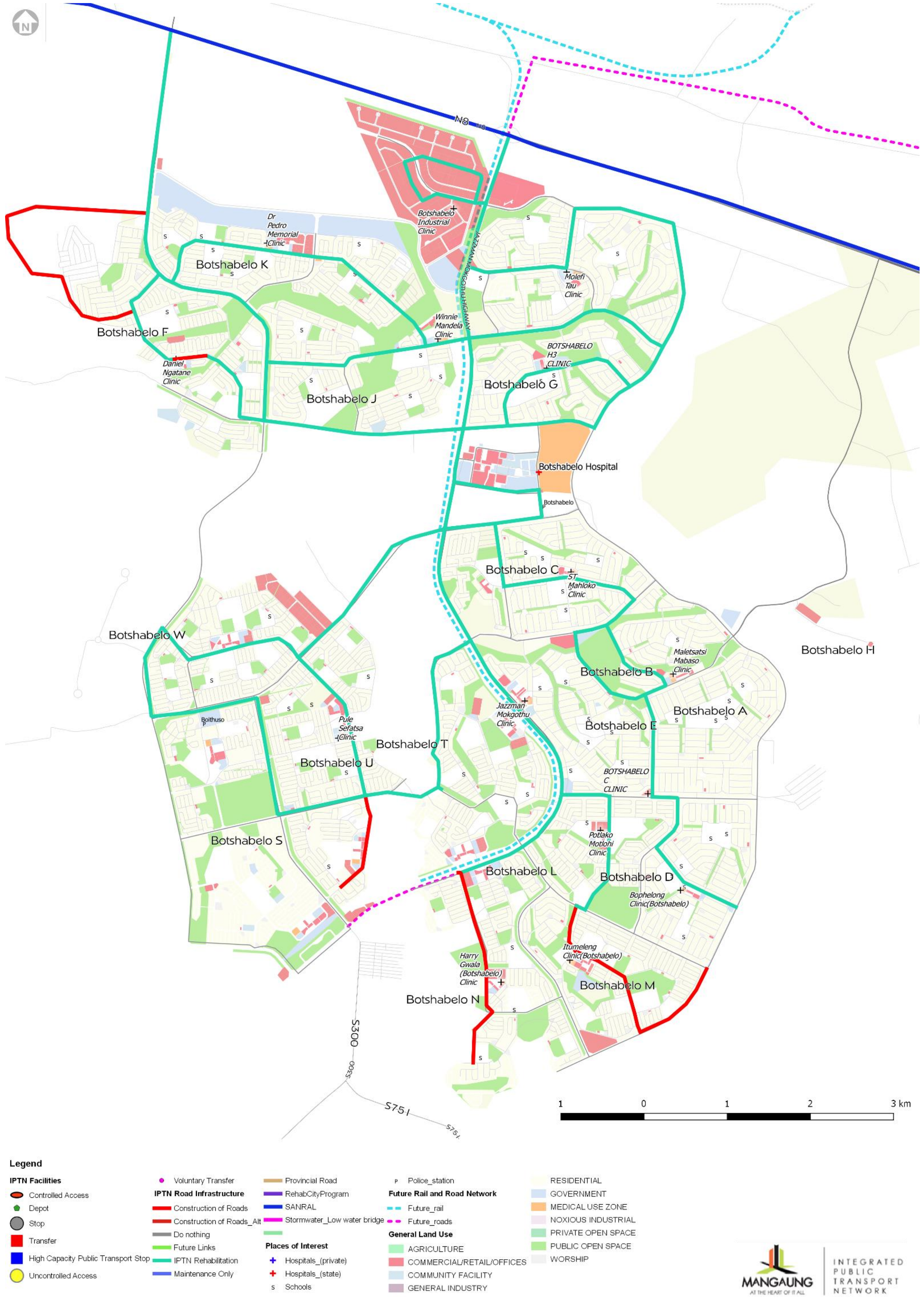


Figure 19-34:Botshabelo Road Rehabilitation, Maintenance and Construction Requirements

19.1.4.7 Facilities

The incremental approach to the implementation of facilities is detailed in Section 14.2 and 14.3. For the purpose of operationalisation of the corridor the transfer facilities will be implemented at the existing taxi and bus ranks in the corridor, Blue Rank and the at the retail centre. Integration between feeder and trunk services will occur at these facilities and at stops identified along the trunk routes. These facilities, trunk and feeder routes and the envisaged stop or station type are presented in Table 19-37 and quantities provided in Table 19-37. Figure 19-35 shows the full stage implementation facility types. The detail capacity calculation required per facility for the corridor is attached in **Annexure EE**. The results of the sizing of the facilities yield that the majority of stops and stations will require one module with at least 6 facilities that will require two modules (Refer to Table 19-38**)**. These high demand stops coincide with the high capacity public transport stops proposed.

The capacity required at Hoffman Square and the intermodal facility is presented in Section 14.3.1.1. The depot implementation plan is presented in Section 14.4.

Table 19-37: Botshabelo Corridor Facilities

Facility Type	Operationalise	Upgrade
Stops	120	0
Controlled Access Stations	1	0
Uncontrolled Access Stations (Stop with Shelters)	8	8
Transfers (Main)	0.5	0.5
High Capacity Public Transport Stop	4	0
Transfers Low Capacity (Voluntary Transfer)	0	0

Table 19-38: Botshabelo Corridor Facility Capacity Waiting Areas

2017	Module width 5m				Module width 3m			
Module length (m)	7	14	28	45	12	23	47	70
Botshabelo	70	0			70	0		
2025	5m				3m			
Botshabelo	70	0			70	0		
2036	5m				3m			
Botshabelo	70	0			70	0		
2036 - x4 passengers per station	5m				3m			
Botshabelo	70				70			

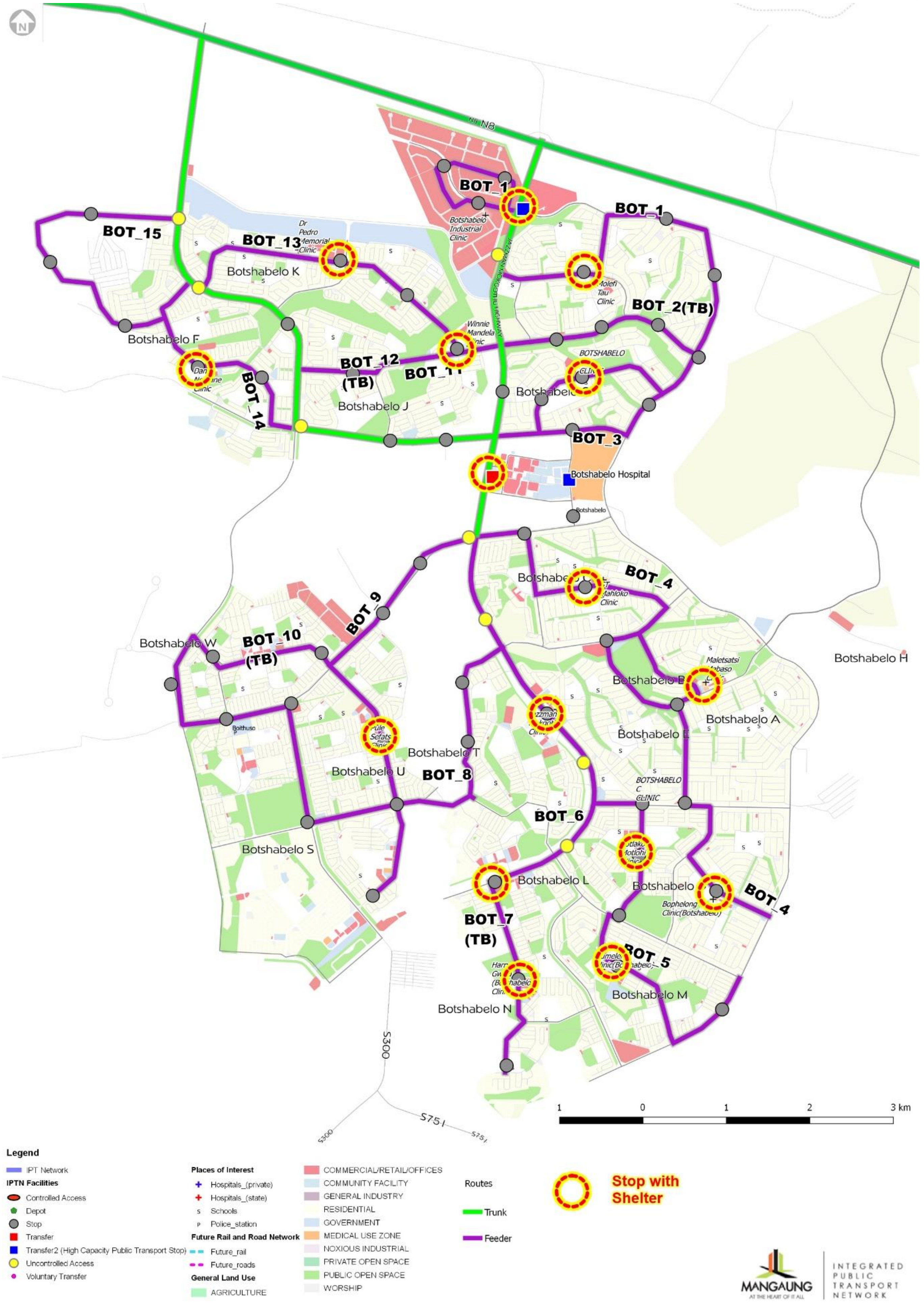


Figure 19-35: Botshabelo Facilities Full Implementation

19.1.4.8 Industry Transition

"Clear the corridor" implementation principle will be followed during the roll-out of the Hauweng system. The process of transformation and strategies are detailed in the Industry transition section and Business Plan. The operators that will be impacted by the operationalisation of the corridor are:

- Mini-Bus Taxi Operators operating along the following routes:
  - Line F/K/J;
  - Line G/H;
  - Line W/U/S/T;
  - Line A/B/C/D;
  - Line M/N/L;
  - Line Thaba Nchu
  - Line Bloemfontein.
  - Existing Taxi Fleet is estimated at approximately 186 vehicles. This fleet number needs to be validated during detail design and business planning processes.
- Subsidised Bus Service:

The routes that will be affected is presented in Figure 19-36.

- The trips and the number of unique routes are presented in Table 19-39.
- The rationalisation of the subsidised bus services into the Hauweng system will have a significant impact on patronage.

Detailed market research is required for the corridor to determine the business value and total compensation value for the affected operators. The determination of the business value will form part of the detail business case for the corridor.

Table 19-39: Botshabelo – Subsidised Bus Service Summary

	Botshabelo
No Unique Routes	117
Wednesday Vehicle Trips	466
Wednesday Passenger Total	29,216
Passengers - 03:00 AM - 04:59 AM	7,300
Passengers - 05:00 AM - 07:59 PM	21,020
Passengers - 08:00 PM - 12:00 PM	896
Friday Daily Passengers	28,658
Saturday Vehicle Trips	239
Saturday Daily Passenger	11,206
Sunday Daily Vehicle Trips	167
Sunday Daily Passengers	6,846

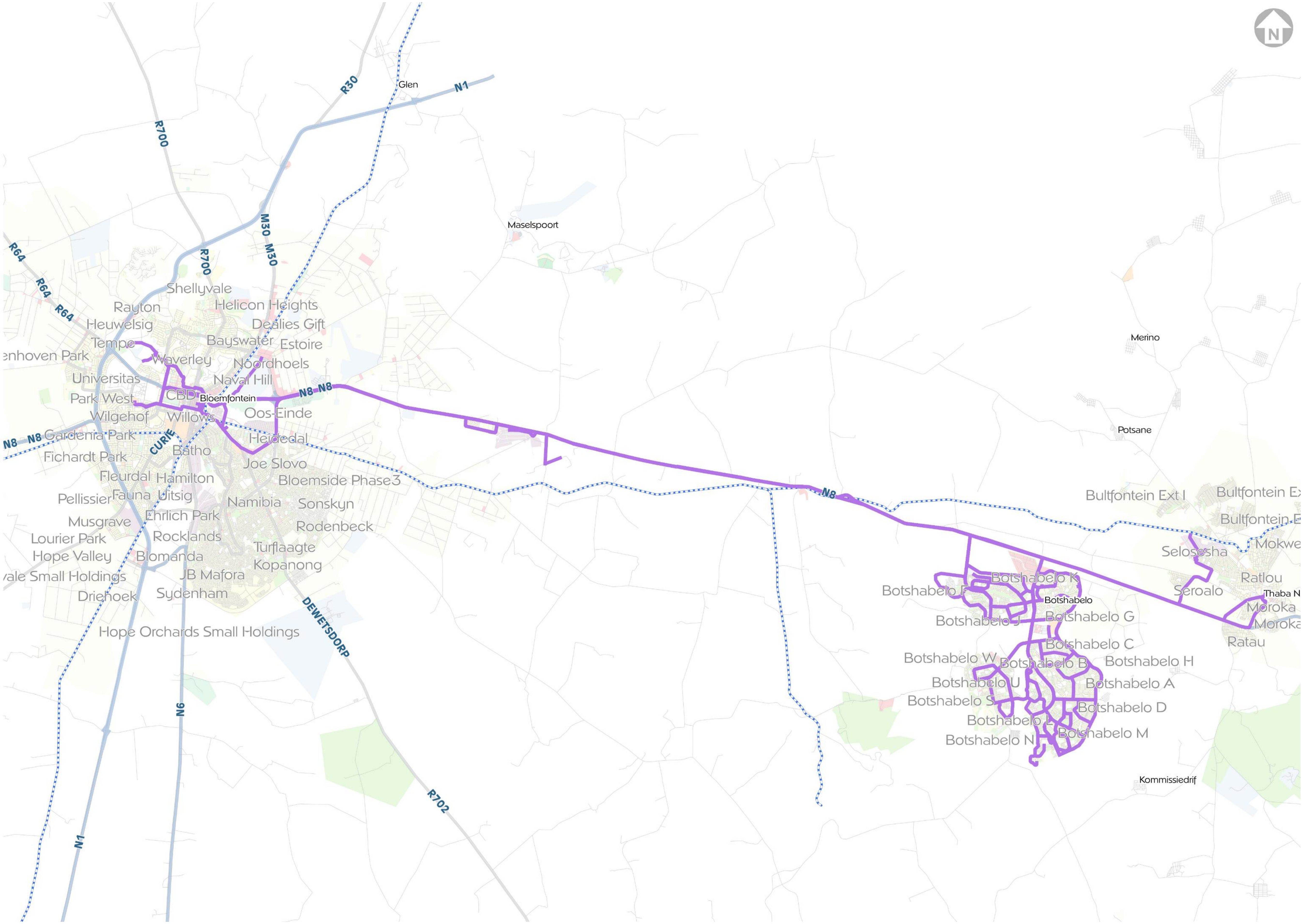


Figure 19-36: Botshabelo Corridor Subsidised Bus Service Routes Affected

19.1.4.9 Operational and Capital Cost

The direct vehicle operating cost and capital cost associated with the implementation of the corridor is detailed in Annexure GG and summarised in Table 19-40. The indirect operational cost is presented on citywide level in the preceding section. The operational shortfall compared to revenue earned, through fare collection, the farebox will cover 79% of the operational cost during operationalisation for the Botshabelo trunk only operations. When feeders are formalised and scheduled the coverage drop to 60%. This is over-optimistic based on the rule of thumb that the farebox coverage can be in the range 30-70%. The shortfall range between R25M – R75M for the design years and present 8% of the current rates base of the city. Detailed financial modelling is required to determine the extent of the shortfall. This will be determined as part of the detailed operational plan development per corridor.

Additional funding/subsidy will be required to operate a high-quality service. Refer to the financial chapter for more detail pertaining to other funding sources for the system.

19.1.4.10 Environmental Screen

Certain Specialist assessments will be required for the undertaking of the proposed development in

Botshabelo. There is however an allowance of the EAP to motivate for the reasons for not including certain assessments in the assessment report. Based on the screening tool and the site visit, which was undertaken as part of the screening process, the following Specialist Assessments will likely be undertaken for the proposed project in Botshabelo Corridor. However, the need for these assessments will be discussed with the competent authority during the pre-application meeting.

- Archaeological and Cultural Heritage Impact Assessment;
- Palaeontology Impact Assessment;
- Aquatic and Wetland Impact Assessment;
- Noise Impact Assessment;
- Traffic Impact Assessment;
- Geotechnical Assessment; and
- Socio-Economic Assessment.

The detail screening report is provided in Annexure JJ.

Table 19-40: Capital and Operational Cost Botshabelo Corridor

	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
CAPEX																
Road, Facilities and NMT				R27.21M	R68.02M	R40.81M					R10.00M	R45.50M				
Maintenance and Upgrading of Facilities					R0.68M	R1.09M	R1.09M	R1.09M	R1.09M	R1.09M	R1.09M	R1.09M	R1.09M	R1.09M	R1.09M	R1.09M
ITS CAPEX						R47.24M										
ITS OPS								R1.37M	R3.41M	R3.41M	R3.41M	R3.55M	R3.55M	R3.55M	R3.55M	R3.55M
Compensation							R9.46M	R9.46M	R9.46M			R57.29M	R24.55M			
Total CAPEX	**R0.00M**	**R0.00M**	**R0.00M**	**R27.21M**	**R68.70M**	**R89.14M**	**R10.55M**	**R11.91M**	**R13.95M**	**R4.49M**	**R14.49M**	**R107.43M**	**R29.19M**	**R4.64M**	**R4.64M**	**R4.64M**
OPEX																
Operational Cost	**R0.00M**	**R0.00M**	**R0.00M**	**R0.00M**	**R0.00M**	**R0.00M**	**R118.97M**	**R118.97M**	**R118.97M**	**R118.60M**	**R118.60M**	**R176.26M**	**R176.26M**	**R176.26M**	**R176.26M**	**R224.02M**
Revenue	**R0.00M**	**R0.00M**	**R0.00M**	**R0.00M**	**R0.00M**	**R0.00M**	**R93.41M**	**R93.41M**	**R93.41M**	**R93.41M**	**R93.41M**	**R103.82M**	**R103.82M**	**R103.82M**	**R103.82M**	**R103.82M**
							-R25.56M	**-R25.56M**	**-R25.56M**	**-R25.19M**	**-R25.19M**	**-R72.44M**	**-R72.44M**	**-R72.44M**	**-R72.44M**	**-R120.20M**
							79%	79%	79%	79%	79%	59%	59%	59%	59%	46%

19.1.5 Thaba Nchu Functional Public Transport Corridor

Thaba Nchu has a more fragmented development pattern with 37 villages surrounding the urban centre, some as far as 35 kilometres from the Thaba Nchu core area. The area is characterised by vast stretches of communal subsistence farming that surround the urban centre.

The majority of new urban developments have developed towards the west along Station Road, while the central business district has developed to the east of these extensions. Some residents centred around the Thaba Nchu urban core reside as far as 8 kilometres from these economic opportunities. The area has two industrial areas, one to the west of the railway station (which is fairly viable) and another located to the east of the CBD. These industrial areas are presently only 65% occupied.

Thaba Nchu has always been a major service centre to the Eastern Free State with many government departments establishing regional offices in this area. However, recently many of these offices and amenities including the sanatorium, the military base, the college and the reformatory school, have closed down, thus leaving the town crippled in terms of economic investment. This leads to fewer visits from outsiders and a decrease in spending in town which, in turn, contributes to the outflow of manufacturing and business activities from the area.

Several retail-, commercial industrial development, schools, clinics and other social amenities are provided throughout Thaba Nchu and are main trip attractors and generators in the area. The local, secondary and primary nodes identified from visual observation are presented in Figure 19-37. This node hierarchy is not a replacement or reflection of a spatial framework thus, only provide premises for the development of movement patterns and assist in the development of a movement network for the area.

19.1.5.1 Movement Patterns

The node hierarchy and the public transport matrix developed for the IPTN and discussed in other sections of the report provided the basis for the conceptual movement patterns presented in Figure 19-38. These movement patterns, existing public transport routes and public transport matrix were used to design the routes for the corridor.

Through the design of public transport routes these nodes are linked and become focal points in the area. To ensure long term sustainability of the public transport system the population density needs to be increased along the public transport routes of the IPTN. To this end it is recommended that the primary and secondary nodes are assessed to determine where residential densification is viable and where social amenities need to be provided to establish mixed-use nodes and support the long-term sustainability of the public transport system.

The Thaba Nhcu CBD rejuvenation plan Twas developed and will govern the development and densification in the CBD (Refer to E1 Figure 19-37). Other nodes identified where precinct plans are required are Node 1-3 presented in Figure 19-37. Within these nodes main public transport facilities, stations, transfers or high capacity bus stops are planned and will enhance the development in the area. Detail pertaining to these facilities are provided in subsequent section relating facilities.

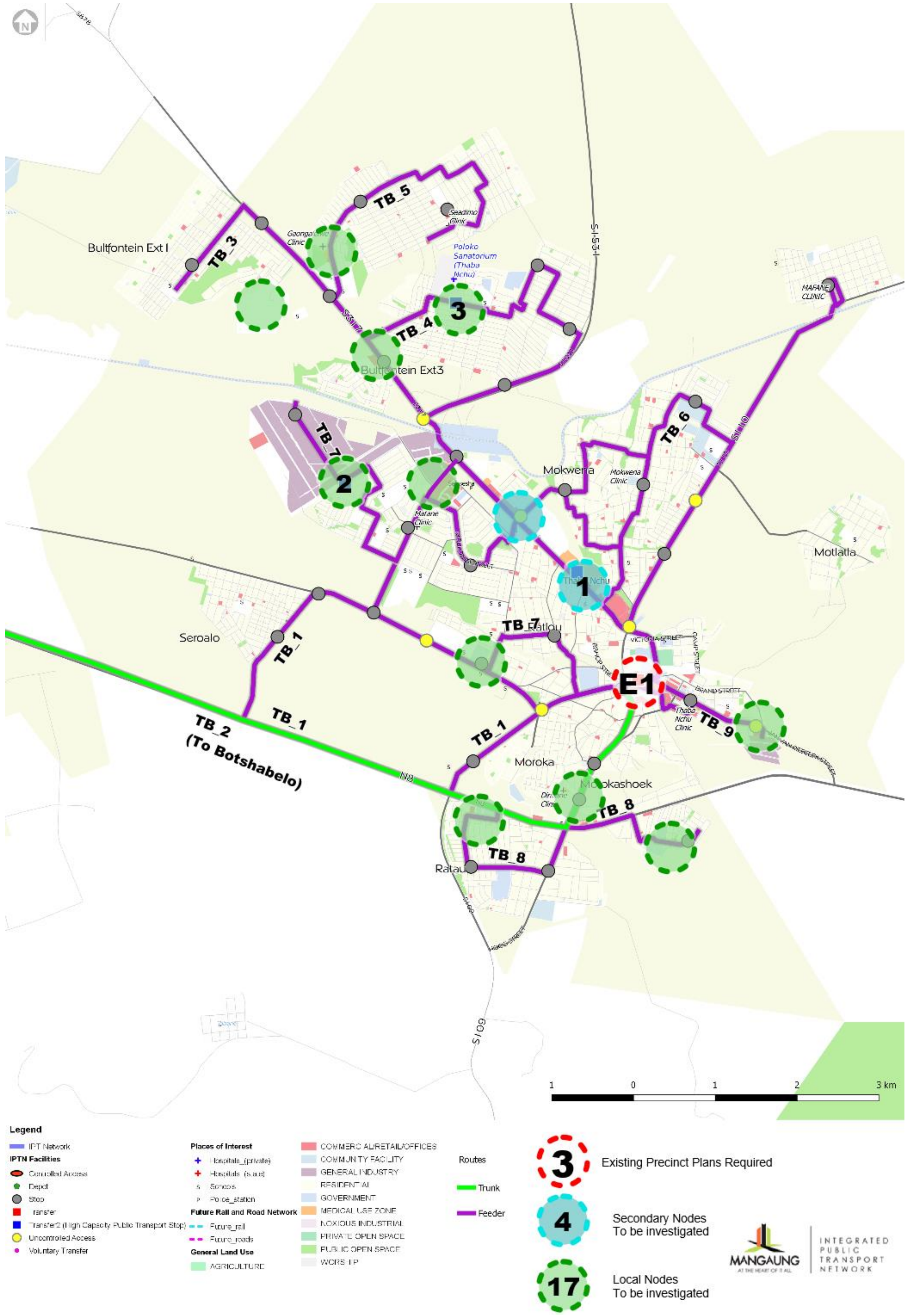


Figure 19-37: Thaba Nchu Corridor - Node Hierarchy

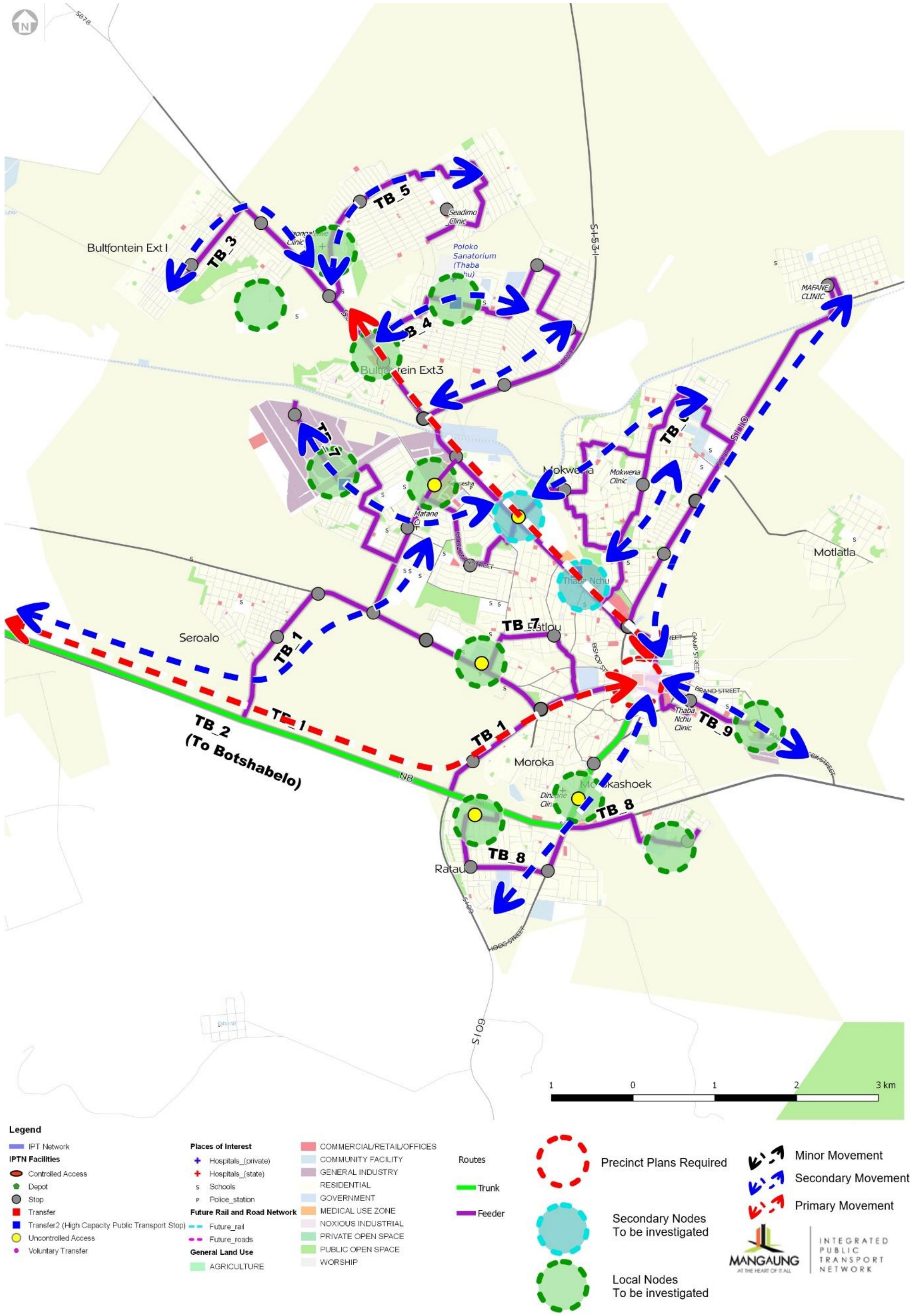


Figure 19-38: Thaba Nchu Corridor Movement Patterns

19.1.5.2 Implementation Timeline

The public transport improvement program through the alternative analysis process determined that the transformation of existing services to the Hauweng system will occur in two distinct stages. Where the primary movements will be rationalised into the new system through the implementation of scheduled trunk routes and services followed by rationalisation of unscheduled feeder services to scheduled feeder routes and services or complementary route services. The implementation year and the year when unscheduled feeder services are investigated for rationalisation and transformation to scheduled services are presented in Diagram 19-5. The operationalisation of the corridor will include the rationalisation of subsidised bus services demand into the Hauweng system. Thus, clear the corridor from the operationalisation of the corridor. The rationalisation/transformation of feeder services will be span across at least two years, where rationalisation will be the transformation of unscheduled feeder services to scheduled feeder services or the replacement of feeder vehicles with universal compliant vehicles. Refer to **Figure 19-39** for the envisaged routes/operational areas were the transformation/rationalisation will occur per year.

The corridor will be operationalised during 2028/29 with full transformation in 2032/33 given that funding remains at the current level. The route, service, fleet, infrastructure, industry transformation and other system elements are detailed below to realise the implementation and transformation of the existing public transport system to the quality public transport system for the city.

Diagram 19-5: Thaba Nchu Implementation Timeline

Year	2019/20	2025/26	2028/29	2031/32	2032/33	2032/33	2034/35	2035/36
Thaba Nchu			Trunk services only	Transform unscheduled feeders to scheduled feeders		Scheduled Feeder-Trunk services		

19.1.5.3 Routes

The route design for the operationalisation phase for the corridor is presented in **Figure 19-40**. Based on the selected implementation plan for the city the route design that needs to be considered when the operational plan is developed for the corridor comprises of trunk route:

- From Thaba Nchu Main Rank (van Riebeeck Street) to Intermodal/Hoffman Square, via Hoog Street or Brand Road.

During the operationalisation phase, six (6) unscheduled feeder routes will integrate with the trunk routes at transfer facilities. The trunk-feeder configuration allows for the incremental transformation of the existing public transport operators where operators are contracted to provide a service with vehicles complying to minimum standards and branded according to the Hauweng brand. These vehicles will be equipped with AFC and limited APTMS to increase commuter experience. The route alignment will be stipulated as part of the amendment of the operating licenses for entities that will provide the feeder services. This will be a contracted service with a service level agreement. The remuneration and principles thereof are addressed in the business plan **Section 20.1.1**.

After the operational phase, three of the seven feeder routes will be rationalised to scheduled feeder routes. The routes to be rationalised are listed in **Table 19-41** and will be rationalised according to the rationalisation zones shown in **Figure 19-39**. The rationalisation and transformation of feeder routes to scheduled feeder routes and services will depend on the feasibility of a scheduled feeder service.

The rationalisation will be based on the minimum requirement of at least 450 pax per feeder route before the service will be transformed into scheduled service. In the event that the feeder cannot be transformed to a scheduled service the vehicles that provide the service will after three years be transformed/replaced by universal accessible vehicles given the outcome of a feasibility study.

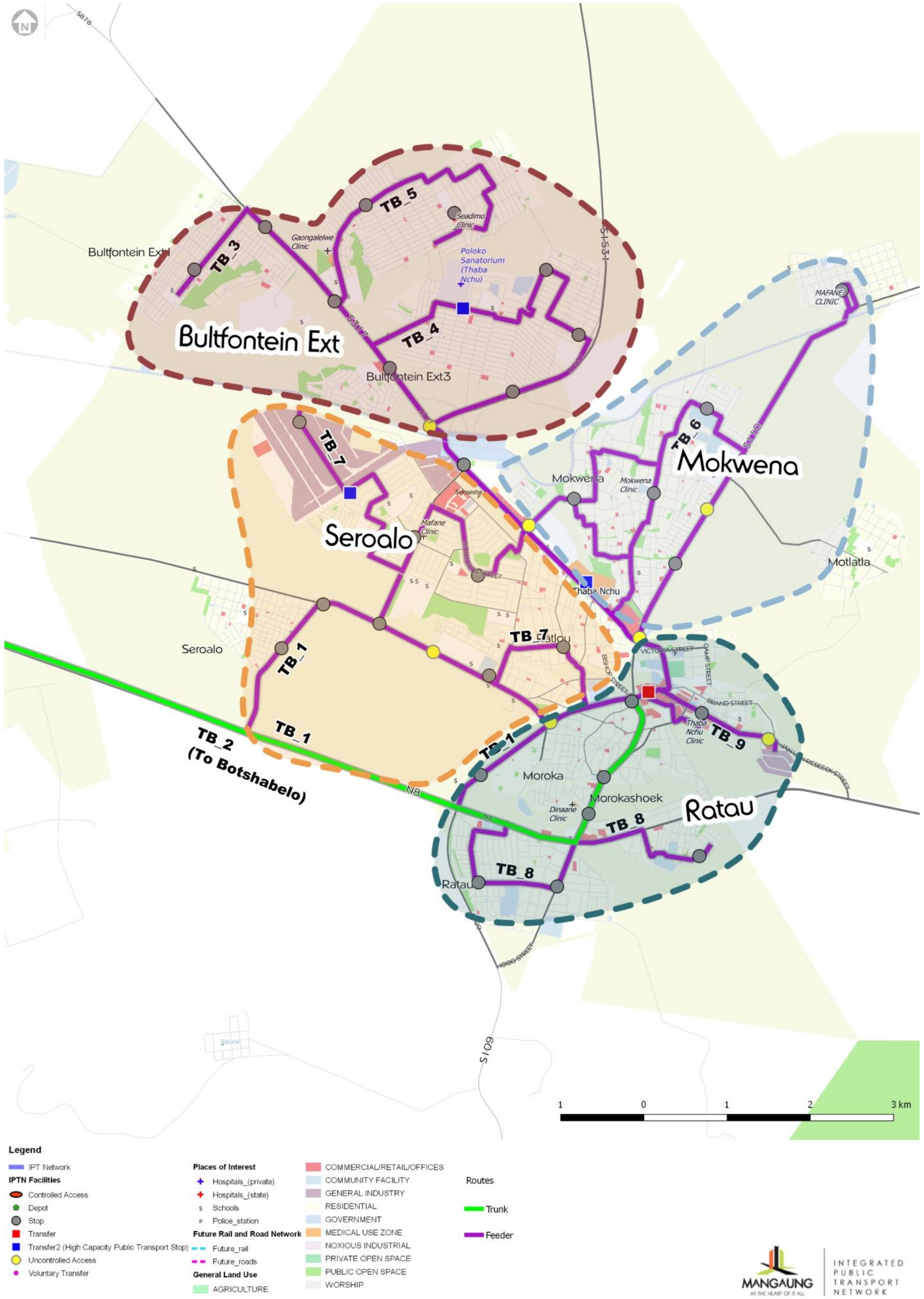


Figure 19-39: Rationalisation/Transformation Areas

Table 19-41: Thaba Nchu Routes

Route Number	One-way Direction	2028/29	2029/30	2030/31	2031/32	2032/33	
TB_1	**68.0**	Trunk					**68.0**
TB_2	**20.0**	Complementary to Botshabelo Blue Rank					**20.0**
TB_3	**9.5**	Unscheduled Feeders				Scheduled Feeders	**9.5**
TB_4	**10.9**	Unscheduled Feeders				Scheduled Feeders	**10.9**
TB_5	**11.3**	Unscheduled Feeders				Scheduled Feeders	**11.3**
TB_6	**7.7**	Unscheduled Feeders	Unscheduled Feeders			Scheduled Feeders	**7.7**
TB_7	**7.0**	Unscheduled Feeders	Unscheduled Feeders	Unscheduled Feeders		Scheduled Feeders	**7.0**
TB_8	**7.0**	Unscheduled Feeders	Unscheduled Feeders	Unscheduled Feeders	Unscheduled Feeders	Scheduled Feeders	**7.0**

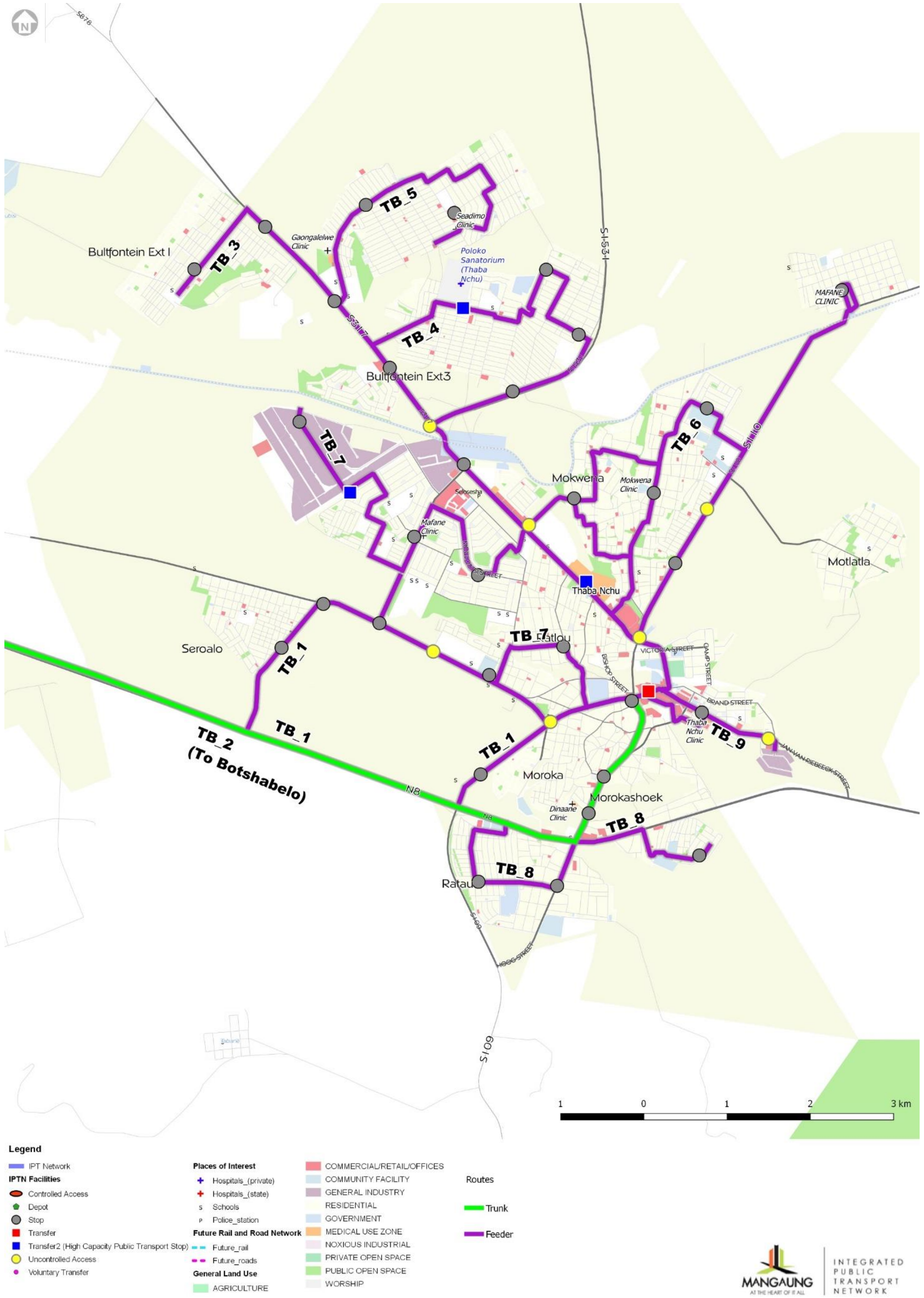


Figure 19-40: Thaba Nchu Routes and Facilities Full Implementation Stage (2028/29)

19.1.5.4 Patronage

The patronage for the services was estimated taking into consideration the rationalisation of subsidised bus services into the Hauweng service during 2023/24 financial year. The estimated daily passenger volume for the base year and the project horizon years are presented in Table 19-42 and the AM Peak hour volume per corridor is presented in Table 19-43.

Table 19-42: Thaba Nchu Corridor Estimated Daily Patronage 2019, 2025 and 2036

Year	2019/20	2025/26	2028/29	2029/30	2030/31	2031/32	2032/33	2035/36
Thaba Nchu			23,942	23,942	23,942	23,942	23,942	24,200

Table 19-43: Thaba Nchu Corridor Estimated Hourly Patronage 2019, 2025 and 2036

Year	2019/20	2025/26	2028/29	2029/30	2030/31	2031/32	2032/33	2035/36
Thaba Nchu			3,352	3,352	3,352	3,352	3,352	3,388

19.1.5.5 Fleet

- Trunk and Complementary Vehicles:
  - The vehicle deployment strategy is to implement new universal compliant vehicles along the trunk routes when the corridor operationalises. The approach was to operationalise the corridor with rigid vehicles only given lessons learned from other cities to rather prepare for demand lower than models estimated, rather than prepare for the exact estimated patronage scenario.
  - Rigid (80 seats) and articulated (109 seats) vehicles with doors on the left-hand side will be utilised for the operationalisation of the corridor. The articulated vehicles are required along the trunk routes to Bloemfontein and Botshabelo. The option to add doors on the left hand to decrease loading and off-loading need to be considered in the 2035/36 years. This will optimise station and stop capacity.
- Feeder Vehicles:
  - The feeder vehicle fleet will comprise of existing mini-bus vehicles that will be selected through a validation process. These vehicles will comply with the specifications provided for these vehicles to ensure passenger safety. These feeder vehicles will operate under a contract and will be fitted with the selected AFC system and branded to comply with Hauweng brand. These feeder vehicles will not be UA compliant and will be phased out, after corridor was operationalised. Refer to ITS specifications for detail pertaining to AFC and APTMS.

The vehicle fleet per vehicle capacity category is presented in Table 19-44**.**

Table 19-44: Thaba Nchu Corridor – Estimated Fleet per design and implementation year

Vehicle Capacity	2018/19	2025/26	2028/29	2029/30	2030/31	2031/32	2032/33	2035/36
120			63	63	63	70	70	94
80						29	29	22
22						39	39	5

19.1.5.6 Infrastructure – Roadways and NMT Infrastructure

Previously the approach was that all roads where IPTN routes and services will operate need to be rehabilitated and maintained through the PTNG funding. However, the purpose of the grant is to implement public transport facilities and right-of-way where dedicated roadways are required. For the purpose of estimating the capital cost associated with the implementation of the IPTN the total cost of maintenance and rehabilitation was determined (refer to **Table 19-45)** and allocated to a specific authority where these roads form part of periodic rehabilitation and maintenance programs. The surfacing of roads is allocated to the PTNG capital cost and indicated as a capital cost to the project and required for the implementation of the corridor.

Figure 19-41 indicates the roads required to be surfaced and other elements. **Table 19-45** presents the total road upgrade cost to provide roads of good riding quality and those roads identified as critical to operationalise of the corridor. It needs to be noted that the other roadways identified need to be allocated to the specific authorities and the city need to communicate with these authorities to ensure that the maintenance and rehabilitation are scheduled into the said authorities budgets.

Table 19-45: Road Infrastructure Required – Full Implementation Stage

Quantities	Total Requirement	2029/30		2034/35	2035/36
The surfacing of roads/Additional Lane (m^2)	55,043	55,043			
Resurfacing/rehab road sections (Low Priority) (m^2)	-				
Resurfacing/rehab section(High Priority) (m^2)	422,226				
Resurfacing/rehab section(Provincial) (m^2)					
Estimated Cost					
The surfacing of roads/Additional Lane *(R 1 500.00 m^2)*	R82.56M	R82.56M			
Resurfacing/rehabilitation of road sections Part of city scheduled maintenance program *(R500.00 m^2)*	R0.00M				
Resurfacing/ rehabilitation of section. Prioritise Rehabilitation and Maintenance *(R500.00 m^2)*	R211.11M				
Resurfacing/ rehabilitation of sections. Provincial Rehabilitation and Maintenance *(R500.00 m2)*					
Intersection Upgrades	R24.00M			R24.00M	
NMT Infrastructure	R53.75M	R33.75M		R20.00M	

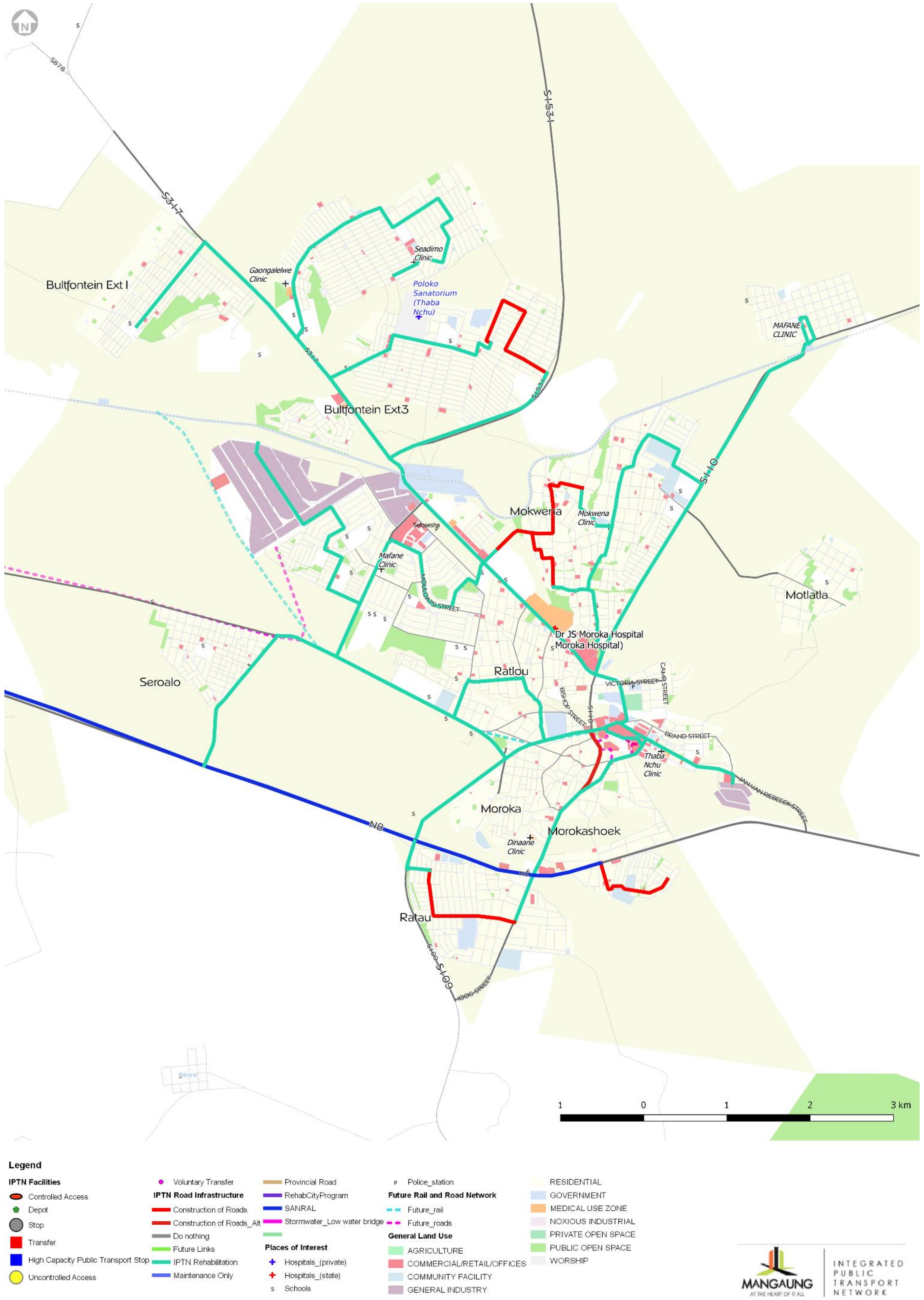


Figure 19-41: Thaba Nchu – Road Maintenance, Construction and Rehabilitation

19.1.5.7 Facilities

The incremental approach to the implementation of facilities is detailed in Section 14.2 and 14.3. For the purpose of operationalisation of the corridor the transfer facility will be implemented at the existing taxi rank. This rank will be upgraded to facilitate the integration between trunk and feeder services. These facilities, trunk and feeder routes and the envisaged stop or station type is presented in **Figure 19-42** and quantities provided in **Table 19-46**. The detail capacity calculation required per facility for the corridor is attached in **Annexure EE**. The results of the sizing of the facilities yield that the majority of stops and stations will require one module with at least 7 facilities that will require two modules (Refer to **Table 19-47**). The two modules refer to the waiting area required at the stop/station. These high demand stops coincide with the high capacity public transport stops proposed and is indicated as stops with shelters in **Figure 19-42**.

The capacity required at Hoffman Square and the intermodal facility is presented in Section 14.3.1.1. The depot implementation plan is presented in Section 14.4.

Table 19-46: Thaba Nchu Corridor Facilities

Facility Type	Operationalise	Upgrade
Stops	62	0
Controlled Access Stations	1	0
Uncontrolled Access Stations (Stop with Shelters)	8	6
Transfers (Main)	0.5	0.5
Transfers High Capacity	6	0
Transfers Low Capacity (Voluntary Transfer)	0	0

Table 19-47: Thaba Nchu Corridor Facility Capacity Waiting Areas

2017	Module width 5m				Module width 3m			
Module length (m)	7	14	28	45	12	23	47	70
Thaba Nchu	39	0			39	0		
2025	5m				3m			
Thaba Nchu	34	7			34	7		
2036	5m				3m			
Thaba Nchu	34	7			34	7		
2036 - x4 passengers per station	5m				3m			
Thaba Nchu	25	9	5		25	9	5	

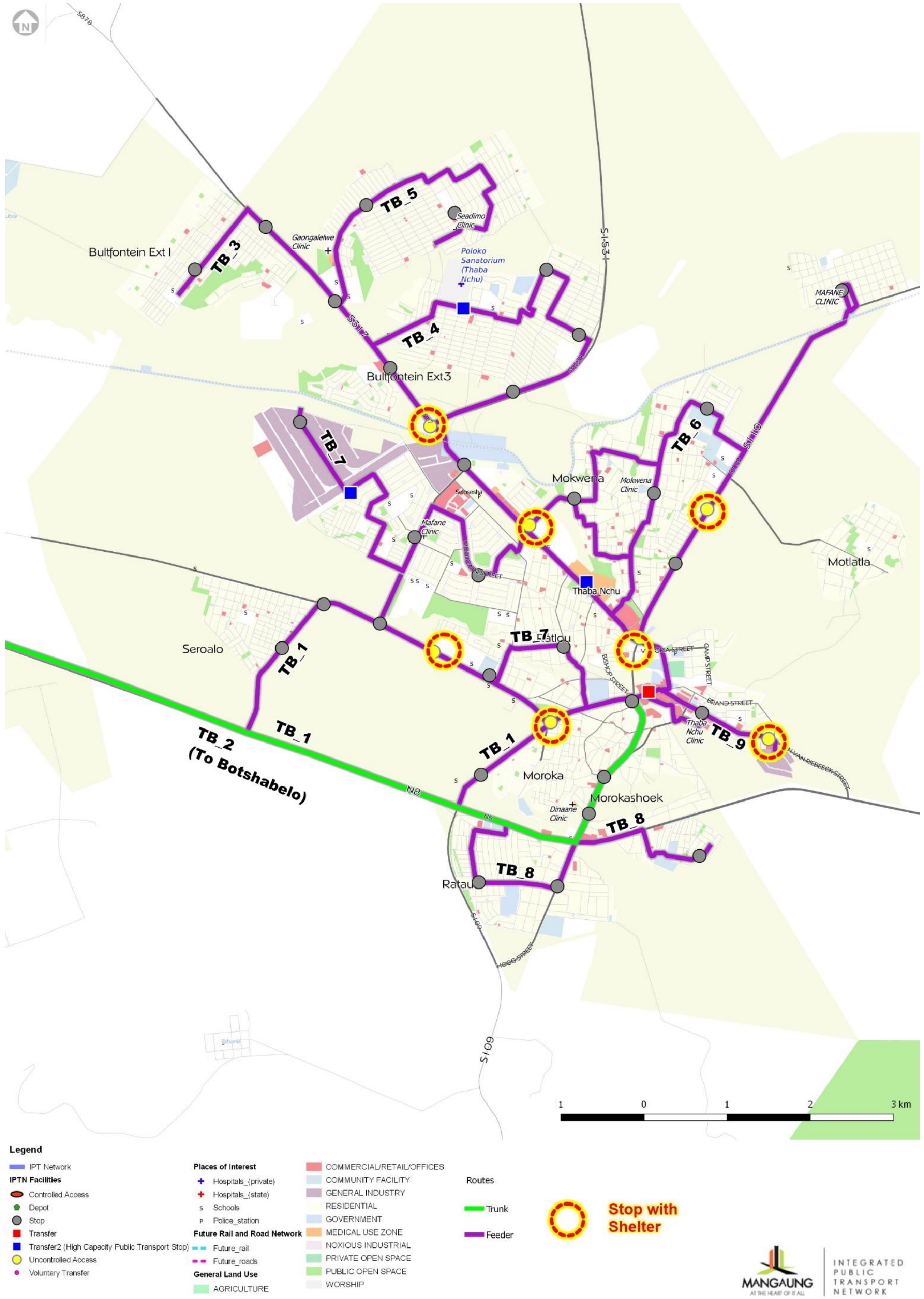


Figure 19-42: Thaba Nchu Facilities Full Implementation

19.1.5.8 Industry Transition

"Clear the corridor" implementation principle will be followed during the roll-out of the Hauweng system. The process of transformation and strategies are detailed in the Industry transition section and Business Plan. The operators that will be impacted by the operationalisation of the corridor are:

- Mini-Bus Taxi Operators operating along the following routes:
  - (FS 003) Trips from Taxi Rank, Van Riebeeck Thaba Nchu to Thaba Nchu Sun Hotel and Casino situated at Groothoekdam, Thaba Nchu via Morolong Village and Ratau Village, Thaba Nchu and return. (Vehicle to be stationed at Thaba Nchu taxi rank, Van Riebeeck Street, Thaba Nchu and must be operated from there).
  - (FS 004) Trips from Taxi Rank, Van Riebeeck Thaba Nchu to Serwalo Village, Thaba Nchu via Paloko Sanatorium, St. Pauls School, Tshipinare School, Child Welfare, Thejane School, Unit Extension, Stadium, Seates Shop, Army Camp, Serwalo Board and return. (Vehicle to be stationed at Thaba Nchu taxi rank, Van Riebeeck Street, Thaba Nchu and must be operated from there).
  - (FS 005) Trips from Taxi Rank, Van Riebeeck Thaba Nchu to Koppie Village, Thaba Nchu via Moroka Hospital, Moroka High School, Station View, Eskom, Fire Station, Lutheran Church, Anglican Church, Civic Centre, Bus Stop 1,2,3, Thaba Nchu and return. (Vehicle to be stationed at Thaba Nchu taxi rank, Van Riebeeck Street, Thaba Nchu and must be operated from there).
  - (FS 008) Trips from Taxi Rank, Van Riebeeck Thaba Nchu to Dikolobeng, Thaba Nchu via Pito's Stop, St. Pauls School, Tshipinare School, Child welfare, Thejane School, Baitemin Unit Ext, Ga Rana Bus Stop, Stadium Stop, Jam Alley, Thaba Nchu return. (Vehicle to be stationed at Thaba Nchu taxi rank, Van Riebeeck Street, Thaba Nchu and must be operated from there).
  - (FS 070) Trips from Taxi Rank, Van Riebeeck Thaba Nchu to Blue Taxi Rank, Reahola Complex, CBD, Botshabelo via Albert Moroka High School situated in road N8, Metro Wholesale, Main Street, Botshabelo and return. (Vehicle to be stationed at Thaba Nchu taxi rank, Van Riebeeck Street, Thaba Nchu and must be operated from there).
  - (FS 071) Trips from Taxi Rank, Van Riebeeck Thaba Nchu to Bastion Square Taxi Rank, c/o St. George Street and Power Road, Bloemfontein via Albert Moroka High School situated in road N8, Thaba Nchu and return. (Vehicle to be stationed at Thaba Nchu taxi rank, Van Riebeeck Street, Thaba Nchu and must be operated from there).
  - Three (3) long-distance routes operate from the main rank in van Riebeeck Street to Excelsior, Rooifontein, Kommisie Drift.
  - Nine (9) cross border routes operate from the rank to Mafikeng, Tweespruit, Hobhouse, Ficksburg, Bethlehem, Phithaditjhaba, Brandfort, Welkom, Kimberly, Rustenburg, Kroonstad
  - Existing Taxi Fleet is estimated at approximately 442 vehicles with 229 active operating licenses. This fleet number needs to be validated during detail design and business planning processes.
- Subsidised Bus Service:

The routes that will be affected is presented in Figure 19-43.

- The trips and the number of unique routes are presented in Table 19-48.
- The rationalisation of the subsidised bus services into the Hauweng system will have a significant impact on patronage.

Detailed market research is required for the corridor to determine the business value and total compensation value for the affected operators. The determination of the business value will form part of the detail business case for the corridor.

Table 19-48: Thaba Nchu – Subsidised Bus Service Summary

	Thaba Nchu
No Unique Routes	61
Wednesday Vehicle Trips	181
Wednesday Passenger Total	11,629
Passengers - 03:00 AM - 04:59 AM	2,378
Passengers - 05:00 AM - 07:59 PM	8,925
Passengers - 08:00 PM - 12:00 PM	326
Friday Daily Passengers	11,699
Saturday Vehicle Trips	72
Saturday Daily Passenger	3,392
Sunday Daily Vehicle Trips	76
Sunday Daily Passengers	2,998

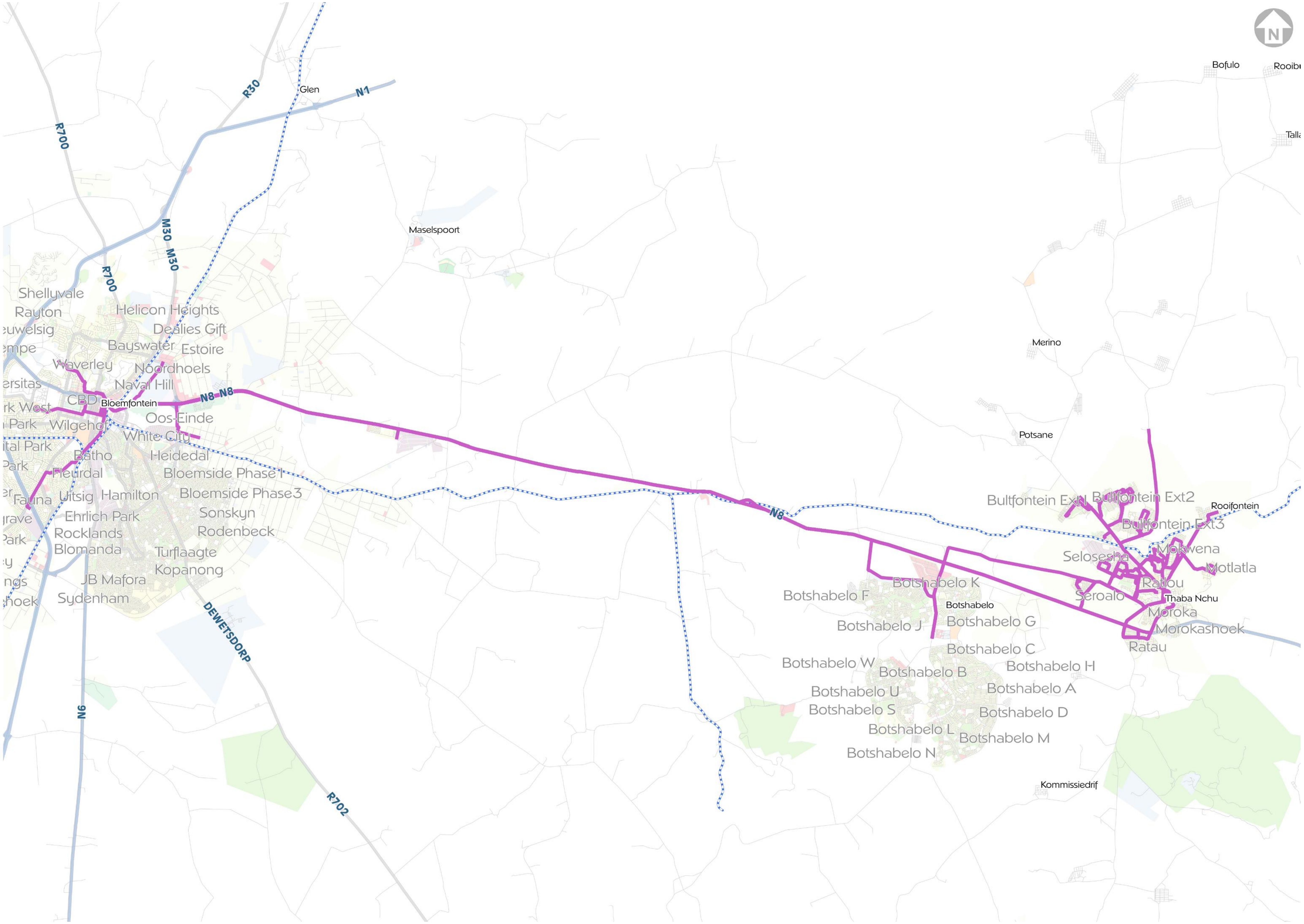


Figure 19-43: Thaba Nchu Corridor Subsidised Bus Service Routes Affected

19.1.5.9 Operational and Capital Cost

The direct vehicle operating cost and capital cost associated with the implementation of the corridor is detailed in Annexure GG and summarised in Table 19-46. The indirect operational cost is presented on citywide level in the preceding section. The operational shortfall compared to revenue earned, through fare collection, the farebox will cover 46% of the operational cost during operationalisation for the Thaba Nchu trunk only operations. When feeders are formalised and scheduled the coverage increase to 48%. The shortfall range between R103M – R125M. It needs to note that this shortfall only pertains to Thaba Nchu, and to determine total shortfall the shortfall of all corridors need to be combined. Detailed financial modelling is required to determine the extent of the shortfall. This will be determined as part of the detailed operational plan development per corridor.

Additional funding/subsidy will be required to operate a high-quality service. Refer to the financial chapter for more detail pertaining to other funding sources for the system.

19.1.5.10 Environmental Screening

The following Specialist assessments have been identified as per the DEA Screening tool:

- Agricultural Impact Assessment;
- Landscape/Visual Impact Assessment;
- Archaeological and Cultural Heritage Impact Assessment;
- Palaeontology Impact Assessment;
- Terrestrial Biodiversity Impact Assessment;
- Aquatic Biodiversity Impact Assessment;
- Noise Impact Assessment;
- Traffic Impact Assessment;
- Geotechnical Assessment;
- Socio-Economic Assessment;

The detailed environmental report is provided in Annexure JJ.

Table 19-49: Capital and Operational Cost Thaba Nchu Corridor

	2019/20	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
CAPEX											
Road, Facilities and NMT		R54.53M	R92.86M				R30.00M	R24.50M			
Maintenance and Upgrading of Facilities								R0.25M	R0.25M	R0.25M	R0.25M
ITS CAPEX				R57.90M							
ITS OPS					R1.59M	R2.47M	R2.47M	R2.47M	R2.47M	R2.47M	R2.47M
Compensation				R28.95M	R28.95M	R28.95M		R54.60M			
Total CAPEX	**R0.00M**	**R54.53M**	**R92.86M**	**R86.85M**	**R30.55M**	**R31.42M**	**R32.47M**	**R81.82M**	**R2.72M**	**R2.72M**	**R2.72M**
OPEX											
Operational Cost	**R0.00M**	**R0.00M**	**R0.00M**	**R191.88M**	**R191.88M**	**R191.88M**	**R191.88M**	**R251.32M**	**R251.32M**	**R251.32M**	**R310.22M**
Revenue	**R0.00M**	**R0.00M**	**R0.00M**	**R88.63M**	**R88.63M**	**R88.63M**	**R88.63M**	**R119.66M**	**R119.66M**	**R119.66M**	**R139.44M**
				-R103.25M	**-R103.25M**	**-R103.25M**	**-R103.25M**	**-R131.66M**	**-R131.66M**	**-R131.66M**	**-R170.78M**
				46%	46%	46%	46%	48%	48%	48%	45%

20 Industry Transition

20.1.1 Purpose of Industry Transformation

The MMM IPTN Services will be introduced on corridors that are already serviced by buses and mini-bus taxis. These road-based public transport operators operating within the jurisdiction of the MMM who will be affected by the introduction of MMM's IPTN Services are referred to as 'Affected Operators'. MMM is therefore seeking to replace these Affected Operators with the new system. This makes it imperative for MMM to have a clear policy, approach and strategy on how these Affected Operators will be consulted, involved and included in the negotiations for the process of introducing the MMM IPTN System. This is referred to as the 'Industry Transition' process.

The Industry Transition Work Stream is one of the key workstreams in the MIPTN as it deals with the dynamic taxi and bus industry. A key element of the Industry Transition is to incorporate existing impacted and affected public transport operators into the proposed system through a negotiated process. The main objective of the workstream is to ensure that there is a successful negotiated 12-year contract entered into both by the affected taxi and bus operator in all the proposed phases of the system. The focus of Industry Transformation is therefore to facilitate a procedure for the bus and mini-bus taxi services on these corridors to be replaced by the MMM IPTN Services.

The Affected Operators, whose legal rights may be affected by the new MMM IPTN Services, will have the option to surrender their operating licenses and operating vehicles in return for compensation and/or participation as shareholders in the vehicle operating company (VOC). The VOC, discussed in further detail in chapters 18 (*Legal and Compliance*) and 19 (*Business Structure and Institutional*), will be entity contracted by the MMM to operate and provide the IPTN Services.

The success of MMM's IPTN Services is largely dependent on sufficient numbers of people using the service. To be effective, including maximising passenger uptake and thereby maximising revenue, the business model requires that as many as possible of the existing bus and mini-bus taxi services on the routes affected by the IPTN services are directly replaced by MMM's IPTN Services. For this to be achieved, some, but preferably all of the existing bus and mini-bus taxi operations on these routes will need to cease operating. The effective

The successful consultations and negotiations with all confirmed stakeholders in the MMM are therefore a critical pillar to the successful achievement of the planning and implementation of MMM's IPTN and its sustainability.

20.1.2 Mandate for Industry Transition

Our approach is based on a robust phased methodology which will ensure delivery of our mandate. We have embarked on a plan that will ensure that the current road based public transport operators are transformed and ultimately sign a negotiated 12-year contract with the City. The following principles inform our plans:

- Short term gains jeopardise long term goals
- Industry should be made to see the bigger picture
- Negotiations are about a great deal more than agreeing to a 12-year contract
- Negotiators should not negotiate for themselves but negotiate for the operators

20.1.3 Legal Basis for Industry Transformation

The rationale for Industry Transformation and the engagement undertaken with the bus and mini-bus taxi industries by the MMM is provided for in national legislation and policy documents, as well as in strategic understandings, specifically:

- The National Land Transport Act No.5 of 2009 (NLTA), which enables contracting authorities to enter into negotiated contracts with operators in their area with a view to, inter alia, integrating services forming part of integrated public transport networks in terms of their integrated transport plans;
- The Public Transport Action Plan (PTAP), which provides policy directives on the required rethink of public transport contracts through negotiations with existing operators and labour (especially the mini-bus taxi sector), with the mini-bus taxi industry becoming part of the integrated public transport arrangements;
- The Integrated Transport Sector Codes in terms of the Broad Based Black Economic Empowerment Act No.53 of 2003, as amended, which promote the transformation of the bus and coach sub-sector through the involvement of SMME operators and role-players (pending the coming into effect of the Amended Transport Sector Codes); and
- Agreements concluded at national level between the Department of Transport and the taxi industry, which issued certain guarantees to the taxi industry on its involvement in IPTN systems, necessitating negotiations and agreement on a number of issues.

20.1.4 Approach to and Phases of Industry Transition

The strategy for industry transition comprises various phases and contracts to be negotiated. Figure 20-1 below illustrates the various phases of the Industry Transition process, including key outcomes:

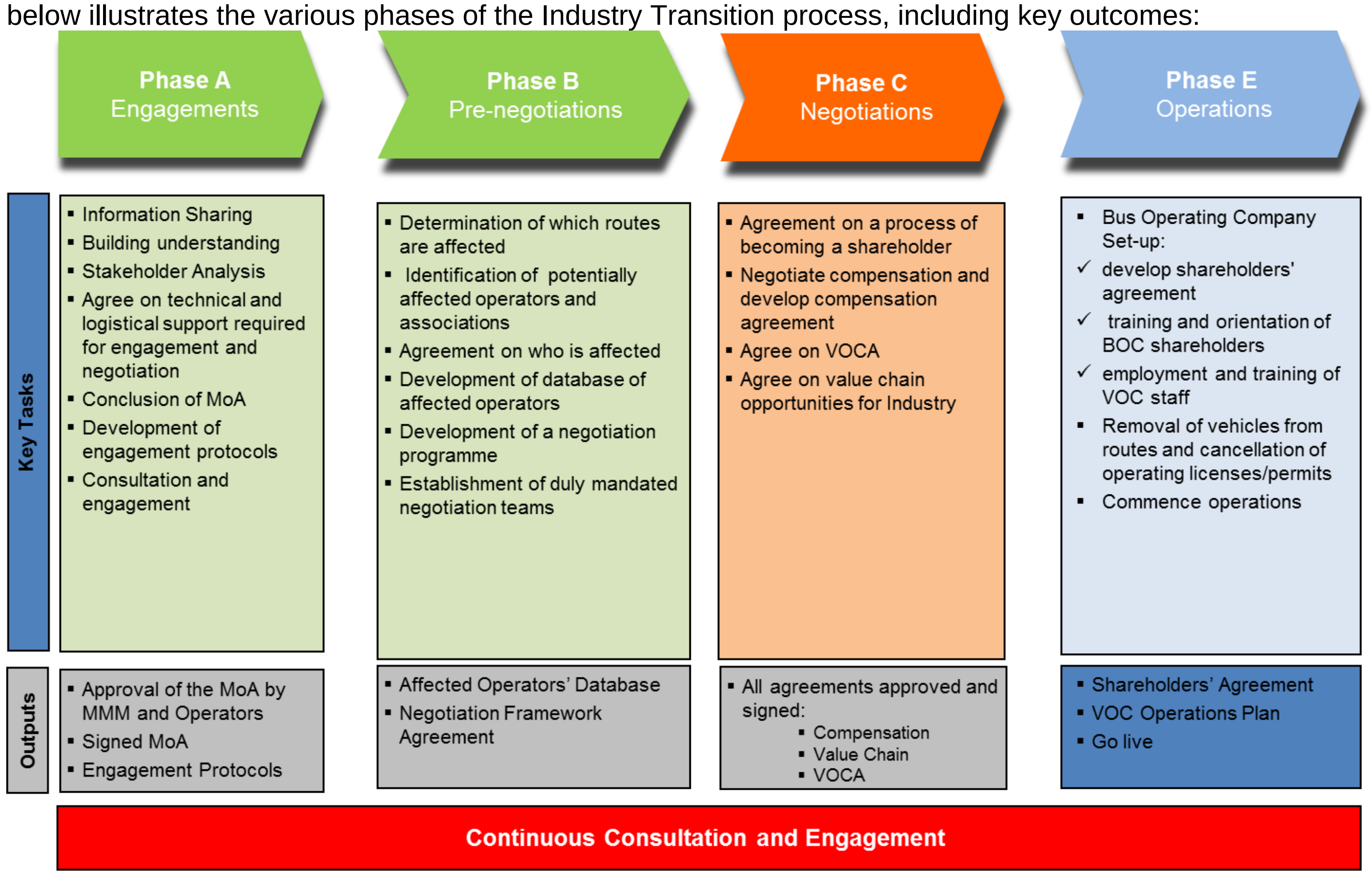


Figure 20-1: Phasing of the Industry Transition Process

The important key outcome of the Pre-negotiation Phase of "Information sharing and engagements with representative structures of the taxi and bus industries" has commenced with the formation of the Joint Steering Committee (JSC) with representatives of both the mini-bus taxi industry leadership and MMM and both parties technical advisory teams. The Joint Technical Committee (JTC), established by the JSC, is designated to manage, administer and implement the mandated agreements, directives and designated outcomes agreed to between MMM and the mini-bus taxi industry. Engagements have taken place with the mini-bus taxi industry with respect to the draft Operational Plan, ensuring that they have some insight into the planning of MMM's IPTN. The Data Committee, as a sub-committee of the JTC and including representatives of both MMM and the mini-bus taxi industry, has been assisting with the planning and implementation of the on-board surveys.

The approach for engagements and participation of the current public transport operators potentially affected by the introduction of city-contracted IPTN services is designed to be inclusive, to educate and inform all stakeholders and to develop, as far as possible, common support for the goals of the IPTN project. The conclusion of a memorandum of agreement (MOA) paves the way for this participatory approach to the process of planning and implementing the MMM IPTN project. MMM has negotiated and recently concluded a MOA with the Mangaung mini-bus taxi industry (MTI), which is the primary public transport stakeholder within MMM. The MOA has been concluded with the MTI which is primarily represented by the regional structure of the MMM mini-bus taxi industry (the Motheo District Taxi Council (MDTC)) and the three local taxi associations, namely the Bloemfontein Amalgamated Taxi Association (BATA), the Greater Bloemfontein Taxi Association (GBTA) and the Thaba Nchu Long and Short Taxi Association (THALSTA). The MTI is represented by the Mangaung District Taxi Council IPTN Steering Committee (MDTC SC), consisting of representatives of the leadership of the MDTC, the GBTA, the BATA and the THALSTA, which MDTC SC will represent the interests of the potentially affected associations and potentially affected operators in their deliberations and negotiations with the MMM in relation to the IPTN.

The conclusion of the MOA marks an important milestone in the transformation of the mini-bus taxi industry and progressing of the planning of MMM's IPTN project, and achievement of the desired outcomes of this initial phase of the engagement with the MTI. A MOA for IBL was drafted but still to be concluded as IBL is affected by the introduction of the MIPTN.
The process of stakeholder analysis has commenced and the further key outcomes of the further phases of the Industry Transition process are outlined in Table 20-1 below:

Table 20-1: Outcomes of the Industry Transition Process

Pre-negotiation Phase
Key outcomes a) Confirmation of affected routes based on MMM's concept of operations. b) Information sharing and engagements with representative structures of the taxi and bus industries. c) Affected operators' database developed for Phase 1. d) Development of a negotiation programme and establishment of a duly mandated negotiation team e) Development and sign off Negotiation Principles that will govern the negotiations to be conducted f) Development of a compensation framework and underlying principles of MMM's compensation model, including reaching a preliminary agreement with the Industry on the compensation model.
Negotiation Phase
Key outcomes a) Negotiations with Affected Operators through their duly appointed representatives. b) Conclusion of agreements on the eligibility criteria for the compensation of Affected Operators, and the process for the determination of a business value. c) Negotiations of the compensation amount and payment mechanism d) Negotiations and conclusion of compensation model and restraint of trade agreements, including agreement on the number of vehicles to be surrendered by affected operators that are specific to certain routes. e) Negotiations and conclusion of agreements on the process for removal of vehicles. f) Development of an employment framework that will lead to the conclusion of an employment framework agreement. g) Negotiations and conclusion of agreement on the process of eligibility to becoming a shareholder in the VOC. h) Negotiations and conclusion of agreement regarding the process for determination of equity contribution required from shareholders and funding required for shareholder investment.
Operations phase
Key outcomes a) Development of financial and administrative support systems to implement and manage the compensation processes. b) Reskilling and training of the industry employees affected by the MMM IPTN Service and who would want to apply for positions in the various opportunities within the MMM IPTN Service. c) Confirmation of shareholding in the VOC by the Affected Operators and conclusion of a shareholders' agreement. d) Appointment of board of directors and key management team of the VOC. e) Development of a VOC operational and management plan. f) Removal of vehicles from routes and cancellation or amendment of operating licenses or permits in terms of the compensation agreements. g) Commencement of operations. h) Monitoring and assessment of the transition process.

20.1.5 Negotiations

The industry transition process and the associated negotiations are structured and based on the MMM's proposed concept of operations and the business model. The overriding consideration is to ensure the inclusion of operators who may be directly affected by the introduction of MMM's IPTN services. This gives effect to the legal requirements in terms of the NLTA.
On the basis of this background, the MMM, by means of a contract with the VOC, will undertake the management of MMM's IPTN Services. Negotiations will be conducted with the Affected Operators for the 12-year vehicle operating company agreement (VOCA) once the process of identifying, validating and registration of such Affected Operators has been concluded.
The entities involved will thus be include:

- The Contracting Authority, i.e. the MMM (through the appropriate mechanism/body as identified through the Section 78 investigation), will perform the service design and monitoring, the management and contracting function for MMM's IPTN service, and will manage contracted functions required for the seamless operation of the MMM IPTN network.
- The VOC, owned and managed by Affected Operators, including mini-bus taxi and bus operators.

To the extent that the station and bus-stop services are contracted out to third parties (which may include the Affected Operators as part of the value chain opportunities), the Station Services Contractor would another entity with whom the MMM would contract, which contractor would be responsible for the following in respect to the stations and bus-stops: management, maintenance, cleaning and security. The precise business model to be followed is still to be developed.

20.1.6 Options Analysis for Negotiations

The negation process could be extended for an unacceptably long period of time or the entire process may become untenable with no viable resolution insight or the operators might decide collectively to halt the process as a negotiation ploy.

Should this happen, Mangaung needs to have Plan B to provide a credible alternative to ensure progress is maintained, even if for an interim period until the current operators come back to the negotiating table. The plan should be continuously revised or checked for validity as negotiations proceed.

21 Legal and Compliance

21.1 Mandate

The main mandate of the Legal and Compliance Workstream in respect of the MMM IPTN is to:-

- provide legal advice and guidance to the other IPTN workstreams on legal issues impacting on and relevant to those workstreams;
- oversee and ensure compliance with the various legislative and policy requirements that underpin the implementation of the MMM IPTN, depicted under clause 19.7.1.1 hereunder; and
- provide guidance and assist with the development, drafting, finalisation, negotiations and implementation of the various IPTN Project related agreements, frameworks and principles referred to under paragraph 21.1.1 below.

21.1.1 The following legislative and policy frameworks underpin the mandate of the Legal and Compliance workstream:

- National Government
  - Constitution of South Africa;
  - National Land Transport Act (NLTA);
  - National Road Traffic Act and Regulations;
  - Local Government: Municipal Systems Act;
  - Local Government: Municipal Finance Management Act;
  - Municipal Supply Chain Management Regulations
  - Division of Revenue Act (DoRA);
  - Public Transport Strategy & Action Plan; and
  - National Land Transport Strategic Framework.
- Free State Provincial Government
  - Provincial Land Transport Framework.
- Mangaung Metropolitan Municipality
  - MMM Policies and By Laws;
  - MMM Integrated Development Plan 2016/2019;
  - MMM Policies relevant to the implementation of its IPTN; and
  - MMM Integrated Transport Plan.

21.1.2 Execution of the Legal and Compliance Mandate

The Legal and Compliance workstream provides guidance and assistance in respect to the development, drafting, negotiations and implementation of the following documents and agreements:

- MMM IPTN Governance Protocols
- Impartiality Declaration (required in terms of section 13(1)(c) of the NLTA) and Confidentiality and Non-Disclosure Agreements required for the IPTN Project
- Appointment of Technical Advisers to the Taxi Industry (draft Terms of Reference and agreement relevant to appointment)
- MOA with the Taxi Industry
- MOA with the bus operator
- Vehicle Operating Company Agreement (VOCA)
- Tri-Partite Agreement (to be entered into between MMM, VOC and Financiers)
- Investigation in terms of section 78 of the Local Government: Municipal Systems Act into the appropriate internal or external mechanism to implement the MMM IPTN
- Affected Operators Principles
- Compensation Framework Agreement
- Participation Framework Agreement
- Negotiations Framework Agreement
- Value Chain Framework Agreement
- Compensation Agreement
- Mayoral, Council and SCM reports to ensure compliance with amongst others:-
  - section 33 of the MFMA in respect of the long term VOCA; and
  - Regulation 36 of the Municipal Supply Chain Management Regulations to enter into a negotiated contract provided for in section 41 of the NLT.
- Other Mayoral, Council and SCM reports to obtain approval of:-
  - the various documents, agreements, frameworks and principles agreed to between MMM and the Taxi Industry/Affected Operators; and
  - all other documents to be drafted on request by MMM that requires Mayoral, Council or SCM approvals.

22 Public Participation, Marketing and Communications

22.1.1 Public Participation

22.1.1.1 Introduction

The implementation of the IPTN will most likely alter the socio-economic landscape of MMM and improve the living conditions of its residents for the better. The introduction of a modern and sophisticated transport service will change the way people commute for both social and economic reasons. The system will increase public transport options and provide a more reliable, efficient and safe mode of transport. It will enhance the way people move from the outskirts of CBD to the CBD and to various locations. The implementation phase, including construction and other earthwork related activities, may result in short term inconveniences to the public. Therefore, regular communication with the public and/or affected stakeholders will be required from inception to completion. It is for this reason the Marketing and Communications Workstream of the IPTN has been established to ensure that there's adequate profiling of the project and that members of the public are kept abreast of developments regarding the implementation of the IPTN system. An Integrated Marketing Communication and Stakeholder Engagement strategy are in place to ensure the phased approach to the task of profiling and communicating issues related to the IPTN project.

22.1.1.2 General Project Consultation

Key stakeholders to the project have been identified and form part of a stakeholder matrix to ensure that relevant parties are consulted and kept abreast of developments and progress around the IPTN project. The stakeholders are segmented according to their role and impact on the project. Leaders of the taxi industry (under Industry Transition) are being engaged through structures that are coordinated by the MMM. Key stakeholders are the Mangaung residents who need to be informed about the impact of the IPTN system on their day-to-day lives, particularly those close to the IPTN routes as they will be affected by the construction process as some may need to be relocated should that be deemed necessary. The Environmental Management and Universal Access teams will undertake focused engagements to ensure adequate compliance with relevant statutes and guidelines in these specialised areas.

22.1.1.3 Objectives of the Public Participation Process

- The primary objectives of the Public Participation process could be summed up as follows:
- To enlist the buy-in of Mangaung residents on the IPTN project
- To instil a sense of ownership and pride in the project/system.
- To ensure that we implement a system that responds to people's needs and.
- To mobilise relevant stakeholders, support the implementation of infrastructure in areas of the project that concern them
- To encourage residents to use the IPTN system.

22.1.1.3.1 Consultation Mechanisms

Mechanisms of carrying out consultations with affected stakeholders are informed by the IPTN project governance protocols as well as the MMM public participation processes. The leadership of various taxi industry associations is informed by a Memorandum of Understanding between the MMM and the Taxi Industry. Engagements are coordination through the technical advisors of the Taxi Industry. In consulting members of the public, the following mechanisms will be explored:

- Public meetings.
- Focus Group Meetings
- Public notices through media.
- Official municipal correspondence
- Media advertising
- Meetings with affected communities through municipal councillors.

22.1.1.3.2 Environmental Impact Assessments

The Environmental Management team works closely with the Marketing and Communication workstream to ensure that all matters related to compliance with environmental statutes are clearly communicated and adhered to.

22.1.1.4 The Communication strategy

The Integrated Marketing Communication strategy outlines a phased approach to implementing IPTN communication. It propagates a process that fosters the communication of milestones achieved in the project. This includes all processes that need to be concluded at initiation stages such as the signing of the Memorandum of Agreement with the taxi industry. The strategy also outlines the need to communicate to the public before construction begins to ensure that members of the public are informed of any impact the project will have on their daily lives, i.e. closure of roads/routes and available detours during this period. The strategy emphasises the need for the creation of an IPTN website through which information would disseminate to commuters and the public in general. The website would also work as an interactive platform to solicit service feedback from commuters.

- As part of the strategy, the following have been achieved thus far:
- Completion of the Integrated Marketing Communication strategy
- Development of the Corporate Identity of the IPTN system
- Conclusion of a partnership with the Central University of Technology regarding the above
- Conclusion of a media partnership with the SABC
- Planning and hosting the signing ceremony of the MoA with the taxi industry
- Relaunch of the IPTN project by the Executive Mayor

22.1.1.5 Communication Mechanisms during Construction

The team will ensure proactive communication during the construction phases to ensure that possible inconveniences are minimised regarding the day-to-day lives of members of the public. This would include possible increased travel times due to possible closure of some roads during construction. Therefore, necessary advice and required adjustments will be communicated. Various methods will be used to achieve this:

- Community meetings.
- Public notices through media.
- Notices using official municipal communication platforms.
- Multi-Media advertising
- Visible notice boards in areas leading to or surrounding construction sites.

22.1.2 Customer Information Services and Integrated Marketing and Communications (CIS & IMC)

22.1.2.1 Introduction

The Customer Information Service (CIS) is an important function of the IPTN system. Through a customised service, our role would be ensuring that queries lodged regarding operations of the system are attended to timeously. The CIS platform will be useful for the proactive communication of technical information regarding operations of the system, i.e. delays experienced in the service, suspension of the service, disruption of service for various reasons, etc.

22.1.2.2 Customer Relationship Management (CRM)

Through the functions performed under Customer Information Services, the operator of the system will be able to source customer feedback regarding the efficiency of the service or challenges experienced by commuters. This feedback mechanism in turn would assist the operator in coming up with immediate interventions to address challenges raised by commuters. Customer Relationship Management will also be implemented through, among others, customer satisfaction surveys conducted physically (field agents) or using the website of the IPTN system.

23 Specialist Studies

23.1 Economic Impact

Refer to Annexure MM.

23.2 Fare Affordability Study

Refer to Annexure MM.

23.3 Social Impact

A project such as the IPTN MMM is designed with the public in mind, since they are the recipients of the project that will create a safe, cost-effective and convenient way to travel in and around the Mangaung Metropolitan area. It is also true that they are the people who will bear the brunt of construction activities such as traffic disruptions, dust, noise, and increased safety concerns amongst others. For this reason, sufficient studies regarding the impact that the project will have on the social environment and effective communication with the public and key stakeholders are crucial. Therefore, the Social Impact Assessment for the IPTN is essential to the success of the IPTN and its acceptance by the public. The Social Impact Assessment forms part of the Environment and Sustainability Work Stream. Also included in this Work Stream is the Public Participation processes that form part of the WULA and BA (enviro-legal processes). Community engagement, public relations and all other communication needs are dealt with by the Marketing and Communications Work Stream.

23.3.1.1 Social Impact Assessment

In 2003, The International Association for Impact Assessment defined Social Impact Assessment (SIA) as the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects), and social change processes invoked by these interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment. In like manner, the Inter-organizational Committee on Principles and Guidelines for Social Impact Assessment (2003) defined Social Impact Assessment in terms of "*efforts to assess, appraise or estimate, in advance, the social consequences that are likely to follow from proposed actions*".

From the above definitions, it is clear why an SIA has been included in the IPTN project. It is due to the fact that the entire project is designed for humans in their environment. For this reason, it is prudent to investigate the positive and negative impacts to ensure sustainable solutions that will aid both the bio-physical and social environments prior to implementation.

The SIA will need to investigate both objective and subjective social impacts. The categories to be investigated should include, but not be limited to:

- Expropriation and displacement;
- Employment impacts (during construction);
- Employment impacts (during operation);
- Affordability of public transport (much information is available already);
- Quality of life impacts;
- Reduction of intra-industry violence;
- Urban environment improvements;
- Adequacy of the routes proposed to date;
- Potential crime reduction benefits; and
- Potential for crime and violence due to the IPTN.

The SIA Practitioner will use both qualitative and quantitative data from primary and secondary sources to compile the SIA. It is recommended that a baseline study be conducted first and then expanded upon with primary data. The SIA Practitioner will use his/her own impact methodology that will be clear and relevant to this particular context. Lastly, the SIA Practitioner will include a chapter within the SIA report that will address more strategic issues of the IPTN that will feed into the Strategic Environmental Assessment.

Refer to Annexure NN for the detailed social impact study for the citywide IPTN. This study is not yet complete due to delay in stakeholder engagement.

23.4 Sustainability Framework and Action Plan

The Sustainability Framework and Action Plan were developed and attached in Annexure JJ.

For the Sustainability Framework key performance indicators were developed to measure the existing situation relating sustainability of public transport in the city versus the impact of the implementation of Hauweng system. These KPI's are presented in a dashboard format that shows the stage or level of sustainability currently and how the implementation is envisaged to enhance sustainability. Given the implementation of the action plan the current status of these KPI's can be improved. The monitoring of these KPI's is key to the sustainability of the IPTN project and the long-term viability.

23.5 Universal Access Strategy and Action Plan

23.5.1 Categories of Special Needs Passengers

User focus design is central to any Universal Design process. In this case categories of passengers with *categories of* special needs are considered. Reality determines that human function changes for every individual over the life cycle span and is not only ordinary but expected. The widest range of human function, ability and lifestyle of targeted passengers and built environment users are considered during the planning, design, managing, redesign and upgrade process of Integrated Public Transport Networks.

Categories of Special Needs Passengers include persons with disabilities, people who struggle with the language, women and pregnant women in particular, older persons, children, those travelling with a number of bags, persons pulling heavy loads *and people traveling with young children*.

Why should the widest range users be in the forefront of the design process?

23.5.2 Legislative Context

Government is the custodian of legislation and the enforcement thereof. The legal framework providing the justification for Universal Accessible Design of the built environment, information and services are mentioned.

National laws, standards, strategies and policies that impact the Public Transport industry include:

- The South African Constitution
- Promotion of Equality and Prevention of Unfair Discrimination Act
- Consumer Protection Act
- Occupational Health and Safety Act
- Basic conditions of Employment Act
- White Paper on the Rights of Persons with Disabilities

Standards and legislation relating to infrastructure and product design, information and communication.

Plus, the South African government was one of the first signatories (as well as ratifying) of the UN Rights for Persons with Disabilities. This treaty places a responsibility on the South African government to make significant changes in order to promote the inclusion of people with disabilities into wider society. The South African government realized that accessible public transport has to underwrite any functional changes in society in this respect. Indeed, it became the focus point and a key requirement in terms of funding from National Government.

- Transport specific legislation and policy: Public Transport Act, White Paper on Transport, NTR1 Part 1 and 2, Public Transportation Strategy, Intermodal facilities, Complete streets policy, Pedestrian crossings.

Provincial and local legislation and plans are also to be considered:

- City or Municipality specific legislation and plans: By-Laws and Local Development Plans

To comply and implement legislation, regulation, standards, policy and plans to address inclusive public transport systems the principles of Universal Design should be applied throughout all the project phases. This approach also adheres to fundamental Human Rights values of equity, dignity and independence. These principles are listed.

23.5.3 Universal Design Principles.

These principles guide the design of Public Transport services, products, environments and communication with the intention of addressing the movement of people.

- **Equitable Use:** When everyone can use the Integrated Public Transport Network easily, safely, independently and in a dignified manner. In a practical way, consideration is given to a wide range of individual preferences and abilities, acknowledging that choice is required, and a single solution is not feasible.

- **Flexibility in Use:** Adaptability in the design *and operation* of an Integrated Public Transport Network to meet different needs at different stages.
- **Simple and Intuitive Use:** The design *and operation* of an Integrated Public Transport Network is easy to understand, regardless of the passenger's experience, language skills, knowledge, or current concentration level.
- **Perceptible Information:** The communication of essential information effectively to transport users, irrespective of the surrounding conditions or the user's sensory capabilities. The IPTN logo, signage and wayfinding are designed to be recognizable and understandable. Websites are also addressed to remove barriers in communication.
- **Tolerance for Error:** The Integrated Public Transport Network design minimises hazards and the adverse consequences of unintended or accidental actions.
- **Low Physical Effort:** The journey of each passenger *(including as pedestrians)* should be comfortable, efficient, and require minimum energy.
- **Size and Space for Approach and use:** The design should allow for appropriate size and space for approach, reach, manipulation, and use, regardless of the user's mobility, use of mobility devices, posture or body size.

For further clarity the whole journey of the pedestrian and passenger is broken down *into the following travel chain*:

- *Planning a trip:* Accessible, real time, accurate information (ICT, ITS)
- *Get to the pick-up point:* Distance, walkway surface and condition, width, barrier free, seating, cover, kerb cuts, lighting. Orientation and direction, moving and finding the bus stop or station, buying a ticket, waiting, facilities at pick-up point.
- *Get into the vehicle:* Independent, safe, easy boarding, clearly marked designated seating.
- *Make the journey:* Safety, visibility, information, training of bus drivers
- *Get out of the vehicle*: Identifying required stop, safe, easy exit
- *Get to the destination:* Orientation and wayfinding, signage, distance to destination, walkway surface and condition, width, barrier free, seating, cover, kerb cuts, lighting.
- *Plan a further trip or return trip:* Accessible real time information available on a range of devices.
- *Give feedback on the trip:* Customer service, reporting problems, complaints, ICT.

In summary the common Principles of Universal Design cover 3 areas across the whole journey:

- Modes of public transportation and communication
  - NMT: Cyclists & pedestrians
  - Public Transportation infrastructure: Bus stations, *buses,* entrances, platforms, stops, pedestrian crossings, ticketing, signage, wayfinding, maps, etc
  - The IPTN provides information of different options of travel. Real time information is provided on all stages of the journey.
- Planning of construction, property and outdoor spaces
  - All areas used for public transportation purposes must be planned to maximise usership. UD must be fundamental in planning and execution of project development. A process for sign-off of designs by the UA consultant complied with. This includes maintenance and upgrading facilities.
- Information and communication technology
  - Information must not only be accessible, but it should also be user-friendly.

Refer to Annexure KK for the detail UDAP. The aim of the development of the Hauweng system is to integrate UA measures throughout the design process of the IPTN and not have a standalone reactive UDAP. Given this approach the standards and requirements relating UA was included in the minimum requirements for infrastructure and facility designs, vehicle specification and other related aspects of the system.

24 Business and Contractual Arrangement

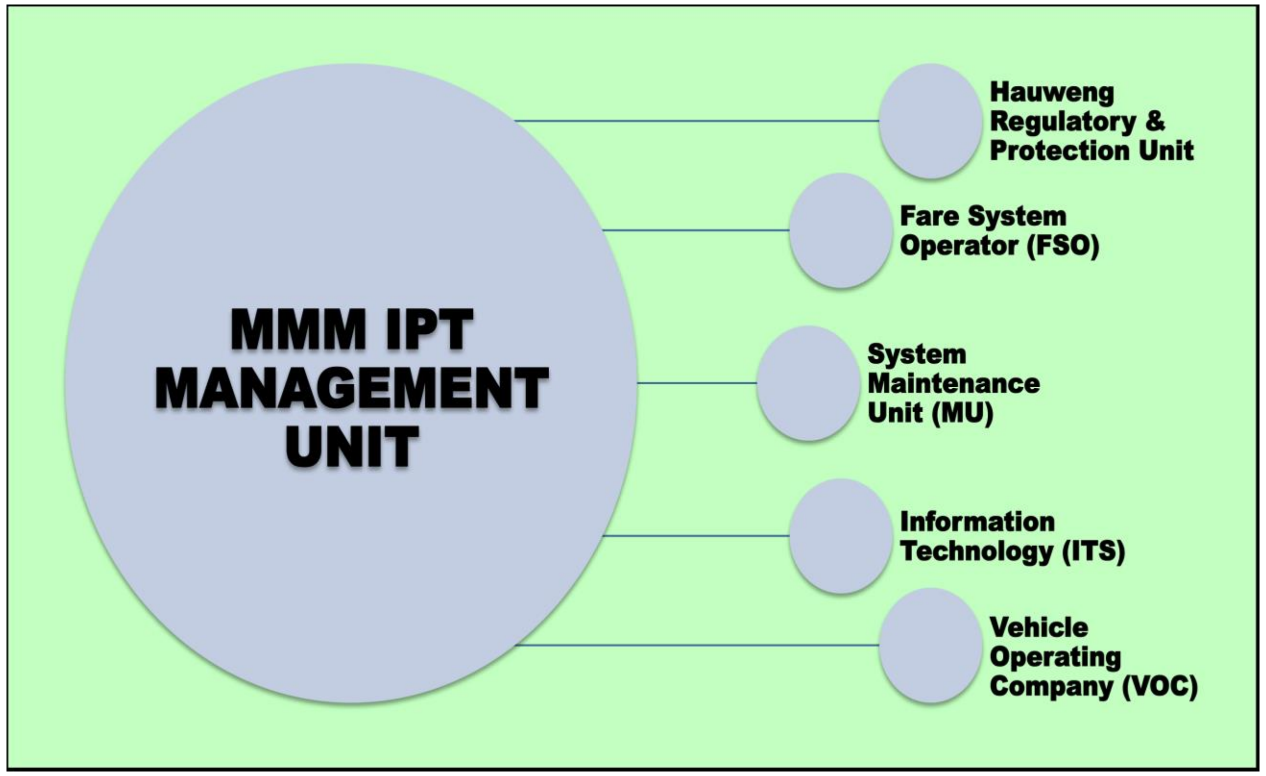
24.1 Business Plan

A business plan was developed for Phase 1 of the IPTN. The outcome and summary of this plan are provided in Annexure II. The strategies proposed was incorporated in the implementation strategies for the citywide IPTN.

24.2 Hauweng Organisational Structure

The Hauweng organisation structure is illustrated in the figure below, with details of each element that follows. Essentially it consists of the MMM IPT management Unit as overarching governance unit, overseeing five individual functional units:

- MMM IPT Management Unit/Division
- Hauweng Regulatory & Protection Unit (Law enforcement)
- Fare System Operator (FSO)
- System Maintenance Unit (MU)
- Information Technology (ITS)
- Vehicle Operating Company (VOC)



24.2.1 The MMM IPT Management Unit

The MMM IPT Management Unit is primarily the institution that will govern the Integrated Public Transport (IPT) system as a whole on mandated authority of the MMM Council. It may be an internal MMM division or an external, independent institution but still operating under mandate and authority and funding from the City.

Its main purpose is to govern exclusively the implementation and future sustainable existence of the IPTN, of which the Hauweng Bus system is one but important component.

The main responsibility would be the following:

- To conduct all strategic and detailed **planning** of the IPTN system
- To oversee and monitor the **implementation** of the IPT
- To **regulate** all aspects of the system both in terms of the economic regulatory requirements including the operating permits and infrastructure access and control. This function may be structured in a separate functional unit.

- To **fund** the IPT system based on allocations from the City and Treasury/NDOT, including the management of the fare revenues
- To **manage contracts** issued to external service providers under the IPT umbrella. The main contracts to manage would amongst others be the infrastructure implementation contracts (construction), the fare system contract, the Vehicle Operating Company contract(s), and any other such contracts that may be deemed necessary to be issued to external service providers that cannot be executed internally within the City or the IPT Division, such as marketing and advertising campaigns.
- To manage all other associated **corporate affairs** of the IPT unit, including financial management, legal, human resource development and other administrative responsibilities associated with municipal institutions. Note that some of these functions may be performed on a share basis with the City, for example the legal and human resource departments.
- The **management of the stations and stops** of the Hauweng system may be a separate private sector contract or it may be part of a current division of the City.
- The **ITS system** for the Hauweng system is intended to be an integral part of the IPT Management Division but may be supported by external contracts performing specialized ITS services.

i. The Hauweng Regulatory and Protection Unit

The IPT Protection Unit is the "policing" department for the IPT but would perform some-what different and specialized functions that are usually performed by a typical City Police or Traffic Department. It may be a separate unit within the IPT Management Unit, or it may be a unit that is managed as part of the MMM City Police or Traffic departments. However, it has to be a unit that is exclusively dedicated to govern the regulatory affairs of the IPT.

The main responsibilities will include:

- Protecting the assets of the IPT system, i.e. security services
- Protecting the right-of-way that is provided exclusively for the use of the IPT (Hauweng) system. It includes in particular the patrolling of the bus routes to ensure that taxis and other buses do not occupy the roadways and bus stop areas that exclusively reserved for the use by the IPT buses.
- It also has to ensure that taxis and other buses do not serve parallel corridors that have been acquired for the Hauweng system. This task focus on protecting the business of the Hauweng system as these routes have been purchased through the compensation agreements to be negotiated and concluded with the Taxi Industry and IBL.
- Finally, this unit will also be responsible for the administration arm for the issuing, control and monitoring of the public transport Operating License system, once it has been taken over from the provincial authority. Essentially, it will pertain to the governance of the public transport operating licenses, and in particular those that have been issued for the routes that are to be served through the IPT Hauweng system.

24.2.2 The Integrated Fare System Operator

The mechanism to govern the fare system is based on an automated fare collection system (AFC) contracted out by the City to a private sector company. For details, refer to the sections on Funding and the Fare Mechanism.

24.2.3 The Facilities Maintenance Unit

The Right of Way (bus routes), the stations and stops and all roadside furniture that is associated with the Hauweng system requires regular cleaning, maintenance and upgrading from time to time. This unit will be responsible for this function. A similar unit within the City that is responsible for Works and Roads may well perform the function. However, it is advisable that a dedicated unit be established for this purpose.

The traditional Stations Operating Company that is the norm at all other cities must not be confused with this unit. Station management is not a function performed by the Hauweng system as an "open" station concept is developed, where no fare evasion policing is required, nor is other associated functions performed at the stations such as automated information displays.

24.2.4 The Vehicle Operating Company (VOC)

The private sector Vehicle Operating Company (VOC) is the bus operator that will be contracted by the City via the IPT Business Division to deliver the prescribed bus services in accordance with specifications contained in the Operational Plan.

The VOC may consist of a single company that will operate one or more contracts, or it may be more than one VOC company each performing its separate individual contract(s). The first of these two approaches are preferred but its format and structure are subject to negotiations with the industry. It is anticipated that at least two main contracts, potentially more, will be developed over time:

- Firstly, the contract to deliver the short distance Hauweng bus services in and around Mangaung;
- Secondly the long distance services mainly to Thaba Nchu and Botshabelo.

These services are in nature much different and will be provided by different types of buses. Currently the taxi Industry and IBL respectively dominate one of these services each. The internal competitiveness and politics amongst the two industries are complex and may require separate institutional arrangements.

The proposed policy is however, that all public transport services in the MMM area must be provided under the same umbrella and that no competing operators should exist and allowed to operate where and when these services are funded or subsidised by any government source of funding. This is also a long-standing policy principle on national level. Hence a separate strategy has been formulated to transfer the IBL services currently under contract with and funded by Treasury at the provincial level, to be transferred on municipal level to MMM.

In essence however, current legislation allows a once-off 12-year (maximum) service contract to be negotiated with the affected operators who will be compensated for their business rights on the corridors that will be taken over by the City. It means a contract or multiple contracts will be negotiated once with these affected operators that will have the choice to become shareholders of the new VOC to operate under contract with the City. Following this period, a normal tendered contract will continue for the services within the usual procurement rules.

The formation of the VOC(s) may be subject to special arrangements - a "Special Purpose Vehicle" to allow the purchase and ownership of the new bus fleet. This issue is dealt with in a separate arrangement.

24.3 Institutional Structure

24.3.1 Introduction

The institutional structure is the mandated mechanism to execute the Hauweng system. The determination of the objects and characteristics of the institutional structure is based on a global recognized business principle namely ***"forms follows functions".***

It implies that the first step is to determine all mandated **functions to be performed** to execute the system, as identified by the business plan; and then with these functions as basis the second step is to develop an **organizational structure**, i.e. an integrated set of **"forms" or individual executive departments.**

The organizational structure links and integrates the departments to execute the identified functions. These identified functions flow directly from the operational concept, the operational plan and the associated business plan.

This section deals therefore with the identification of the individual Hauweng functions, followed by the organizational structure to fit the functions to be performed. Combined, these two elements are considered the Institutional Structure.

24.3.2 Hauweng Functions

The following Hauweng functions are to be performed:

24.3.2.1 Hauweng Design and Implementation

Hauweng can be classified in two functional parts:
a) Hauweng Design which entails the following:

- Research and market surveys
- Planning and system design, consisting of a number of system elements, including the items listed underneath.
- Negotiations and principle agreement
- Approval by both parties' principles, the City Council and the Industry's respective governance bodies;

a) Contracting **which would entail a number of individual sub-contracts, each for specific sub-functions to be executed, namely**

- Infrastructure and facility contracts (roadways, transfer stations and associated facilities such as bus stops, lay-byes, depots and workshops, signage and road side furniture;

- Vehicle Operating Contract, which includes the procurement of the bus fleet and the fleet maintenance (workshops) which may be a separate sub-contract, as well as the day to day operations of the bus fleet in accordance with a pre-determined schedule of services and a route network;
- Station Management Contract, of which three separate sub-functions may be identified
  - The daily housekeeping functions to ensure the stations and stops are in a suitable clean and acceptable condition, accessible and "available" for the purpose.
  - Security tasks to ensure a safe environment for the public and that the amenities are safeguarded
  - To manage or oversee commercial activities that may be allowed in and around the stations and stops
- Infrastructure and Facilities Maintenance contract, to ensure that all infrastructure and facility items are kept in proper working order
- EMV Fare System, which entails a number of sub-functions that would ensure that passengers are supplied by a specific fare media, associated with financial transactions and management of the fare revenues
- ITS system, which entails all technical systems and facilities that will generate and display series of information for use by both the system management, the passengers using the system and, in some respects, also the general public that may require information of the public transport system
- Information and Public Relations, using some of the outputs of the ITS system and other techniques to display and advertise the IPTN system

a) Implementation of each of the above contracts once approved and funded. The implementation process involves a relatively short period during which the design team would oversee the solution or facility being established to an object that would enable permanent functioning. The implementation team may be the same - but is often not the same as the team that will be deployed for permanent functioning.

b) IPTN Periodic Review, which requires a cyclic repeat of the above, as part of the management of the system as listed below.

24.3.2.2 Standard Operating Procedures (SOP's)

Once each function has been identified, and the individual executive departments and its elements (staff positions or vacancies) and staff numbers have been identified, a set of SOP's has to be developed for each individual position.

SOP's are essentially a job description that sets out the exact step-by-step tasks to be executed by each staff position. It allows the "order" (sometimes defined as the "functional algorithm") for each position to be administered and managed.

24.3.2.3 Management of the Hauweng System (following implementation)

a. Monitoring **of each individual contract**

- Information management, i.e. information obtained via ITS, EMV and other manual and electronic information systems, and the safekeeping of the data base
- Operational control
- Performance control: record keeping, analysis, daily/weekly performance reporting
- Monthly management reporting

b. Functional administration and control **(day-to-day) internally and for each individual contract, which in turn requires a series of sub-functions:**

- Financial management, executed in three categories namely fare structure and revenue management; funding and budgeting; debtors and creditors
- Operational management which deals with the control over each individual contract, leading to daily/weekly performance reports and interaction with individual contractors (VOC, SOCA, EMV, ITS),
- Infrastructure and facilities management and maintenance, the associated control tasks and interaction with individual contractors to ensure effective functioning of each facility
- Law enforcement and IPTN regulatory control, including the protection of the IPTN corridors from illegal competition, IPTN traffic regulatory control, operating licenses and any other public transport regulatory matter.
- Human resources, with three focus areas, namely internal HR requirements; training and capacity building;
- Legal requirements including compliance control, legal reviews of each contract, the associated control activities and HR dispute resolution
- Marketing, Public Relations and Communications, including the information centre, displays

c. Executive management, focusing on:

- IPTN executive management (IPTN Exco-activities)
- Reporting and interaction with MMM Council and executive management
- Interaction with industry executive management
- Monthly and annual management reporting

24.3.3 Hauweng Organizational Structure

The organizational structure is designed with the defined functions (see Section 24.3.2) as basis. However, it is important to take into account the nature of the operational system, the associated operational concepts and business principles that are being introduced, as elaborated in Annexure II.

For example, if the policy is **not** to allow any commercial activities in and around the major transfer stations and stops, then the "commercial" function as identified, is reduced to a simplified basic function that is not as elaborate as when intensified commercial activities are allowed. Similarly, if the EMV system requires tap-on and tap-off on the bus, as against tapping at the stations, then the security functions at the stations will be much more intense.

Essentially, given the impact of each individual "operational concept", as defined by the functional details of each system component, the organizational structure is designed accordingly; the same for the SOP's to be developed. Accordingly, a number of operational policies are defined underneath.

24.3.3.1 Business Policies Underlying the Organisational Structure

i. **Project governance and privatisation**

It is standard policy for all IPTN systems in all metropolitan areas to make a clear distinction between the governance of the IPTN system and the executive performance of system components (individual contracts):

a. The governance **of the IPTN system is executed by the MMM as the mandated local government institution. MMM will perform the governance function internally by means of a new department established by the City specifically for this purpose, or as a section of an existing department. For the purpose of this document, this internal department is referred to as the MMM** *IPTN Management Unit***. The IPTN MU to be established by the City will be headed by an Executive Director at an appropriate management seniority level.**

b. The executive performance **of each individual component of the IPTN is executed as outsourced contracted functions under the supervision of the IPTN MU. The outsourced contracts structured such that specific parties are identified for specific tasks:**

- **The operational function related to the provision of bus services is contracted to the** affected parties**, namely the taxi and the bus industries from which the passenger demand is withdrawn and transferred to the IPTN system, which is contracted as a once-off 12-year maximum period negotiated contract as provided by special legislation. Once the maximum of 12-year contract has terminated, a competitive bidding process will be followed as the normal procurement process.**
- **All other functions (i.e. with the exception of the bus operations) will be contracted to private companies in accordance to the standard procurement regulations of the City.**
- **The City may perform some functions internally and not outsource it should it be within its mandated powers.**

ii. Statutory provisions: Affected operators and negotiated contract

From a statutory point of view, the legal provisions that will enable the establishment of an entity that will provide the IPTN services is contained in the National Land Transport Act, section 41 (NLTA). It provides for the current business interests of current public transport operators to be obtained by means of negotiated financial compensation and then transferred to a new entity to provide the services based on an approved Operational Plan for the IPTN, the latter of which is for a once-off negotiated contract for a maximum period of 12 years as provided by the NLTA.

This process requires inter alia the identification of the affected operators, the determination of its affectedness and then a further process that will allow eventually for compensation to these operators and the withdrawal of the current services and the implementation of the new IPTN services. Notably, the definition of affectedness is important, as it relates to:

a. **IDENTITY:** namely WHO are affected, i.e. the parties involved
b. **TIME:** the point in time WHEN a specific operator becomes affected, i.e. when the IPTN system is introduced, which will then affect the business of the affected operators.
c. **VALUE:** the EXTENT to which the number of passengers and other operational parameters will change in terms of service delivery (fleet numbers, operational kilometres etc.), and also the associated monetary values associated with fare revenues, cost of service delivery and value of fixed investments such as the fleet capacity, immovable properties such as transfer stations etc.
d. **SPATIAL:** the affected market area WHERE the changes take place, particularly he origins and destinations of the passengers and the associated service routes.
e. **STATUTORY:** the AUTHORITY under which the affected services are rendered, referring to the operating licenses (which are linked to the spatial element) and the jurisdiction area under control of a specific mandated authority that is responsible for the regulatory responsibilities.

The above elements of affectedness provide the basis within which the affected operators are defined and re-established within the new IPTN structures.

iii. Competitive Environment

An important part of the Business Plan, which will affect the institutional structure, is the approach towards the competitive environment. In particular the principle of **no competition** along the IPTN routes. It also refers to the **"clear-the-corridor"** strategy described earlier.

iv. Shareholding Identity

The shareholding identity is determined by the affected operator identities (refer to Industry Transition chapter). Two main groups of affected operators have been identified, namely the taxi industry (GBTA) and the bus industry, specifically IBL (Interstate Bus Lines). IBL's operations include the short distance or the long distance routes. Long distance routes include those to Botshabelo and Thaba Nchu and other less volume corridors. These LD routes are scheduled to become part of the IPTN in the long term only, whilst the short distance routes include the southern township areas, the CBD and the northern suburbs.
All short distance routes of IBL mirror the taxi industry routes in the same areas, and hence the majority of these routes are targeted for Hauweng implementation in Phase 1 and 2. Clearly both industries are candidates for shareholding from the inception date of Phase 1, and the extent of shareholding by each will change as more phases are introduced. A flexible shareholding profile is therefore essential.

v. Separation of operational responsibility for trunk and feeder services respectively

As it is presented and quantified in an earlier section of this chapter, the Hauweng business concept separates the responsibility of trunk services and feeder services. In both cases the executing party will be the affected operators, but the executing authority will be under a different contractual dispensation. The SPV as the forerunner of the VOC will undertake the trunk services and the remaining taxi industry (i.e. those taxis that were not withdrawn) will be responsible for the feeder services for at least the interim contract period prior to the 12-year negotiated contract takes effect.
This dispensation will apply at least until the 12-year contract takes effect, after which the feeder responsibility may be re-considered. It may be transferred to the successor of the SPV, or it may remain with the taxi industry. The intention is however, that the feeder services may in time be part of the VOC, but still provided through a separate contract. It may be part of the same 12-year contract but the conditions for the feeders and those for the trunk services may be different.
The adopted policy for the feeder services remuneration is on a **performance – or production basis**, i.e. the feeder operator will be paid for each passenger delivered to the trunk service. This principle will apply for the interim contract period as well as the permanent 12-year contract period. Prior to the latter permanent contract period, each taxi operator will continue with its usual way of operations with the exception that the OLS will be redefined to indicate the feeder area, and the fare collection process will be part of the EMV system. One the 12-year contract starts the remuneration basis will remain the same, but it may then be executed under different contract conditions as the vehicles may be owned by VOC, and even the service characteristics such as the routes and schedules may become more formalized.

The basic principle is however, that the less formalized the feeder contract is, the less operational cost pressure will be as the operator would have more freedom to exploit market opportunities and will be motivated to deliver more passenger volumes in accordance with the production based remuneration principle.
This approach is subject to negotiations with the industry. Should the outcome of the negotiations not be acceptable to any of the two parties, then the alternative fallback position would be to provide the feeder service as a normal VOC contract service, with potential additional financial implications as a VOC feeder service will be provided in a more formalized basis with additional cost implications. A further implication may then also be that the go-live date may have to be postponed subject to budget position. However, preliminary interaction with the Taxi Industry on the issue indicates a positive but not necessarily a conclusive reaction.
Assuming the above policy is agreed upon, the dispensation would require an organizational structure and systems that would enable the following:

- **Contract management for different contracts that may be identified, one for the trunk and one for the feeder services. Other potential contracts may also be identified such as the IBL contracts that may be taken over as is and phased out systematically as an alternative replacing IPTN routes are implemented.**
- **Comprehensive control and recording of passengers numbers delivered by the taxi industry, with sufficient detail that would allow an acceptable and transparent fare revenue and remuneration dispensation.**

vi. Fare revenue and the EMV system

The fare revenue and all associated functions that relate to fare collection and setting of the fare structure, is the responsibility of the City. Accordingly, the City carries the risks associated with the fare revenues. It is also standard policy for all metropolitan authorities to deploy an electronic ticketing system (the EMV system) as prescribed by the Department of Transport. The executive task associated with the EMV system may be outsourced to a private company, but under supervision of the IPTN MU.
Another policy principle related to the MMM EMV system is that the EMV system activities are exclusively performed **on the bus**, i.e. the tapping of EMV card is performed at a device **equipped on the bus** and not at the stations or bus stops. It does not mean that tapping would never be allowed at the station turnstiles (with exception at high volume stations), but the main access system is on-bus bus tapping. Tapping on the bus has the advantage that it may offer major cost saving associated with supervisory and security personnel at the stations and also costs associated with equipment at the stations.
The implication is however that the bus driver becomes a responsible party to ensure that each passenger would tap when boarding. Alternatively, CCTV equipment may be installed on the buses to monitor tapping. This policy is however a risk as the bus driver is an employee of the VOC, which in turn is not responsible for the fare revenue and is not necessarily motivated by any mechanism to prevent fare evasion (tapping activities).

vii. Fleet size, ownership and procurement

The ownership and procurement of the bus fleet is vested in the contracted bus company (VOC). The advantage of this approach is less pressure on the CAPEX and consequently also the required grant for operational shortfalls infrastructure. The cost of the bus fleet will then be diverted to the OPEX, with higher grant pressure. It may well be argued with reason that the VOC would take better care of the bus fleet should it be owned by the VOC. The alternative approach (not preferred) would be that the City would be the owner, in which case the bus fleet would be leased to the VOC. The grant funding is then used to fund the bus procurement.
The fleet size (seat capacity) is determined through the planned scheduling module of the business model, which also determines the number of taxi and IBL buses to be withdrawn, based on the seat-for-a-seat principle. It means that for every IPTN bus seat capacity provided, an equivalent number of taxi and IBL bus seats will be withdrawn and compensated. This policy approach is motivated by preventing that the IPTN system to become the "solution" to resolve the over-capacity situation of the taxi industry. The seat-for-a-seat principle is the only mechanism to determine a fair number of taxis to be withdrawn.

viii. Shared functional responsibilities

A number of Hauweng functions to be performed by the IPTN MU may be executed by current departments within the City itself, which are available with the necessary qualified personnel. Typical examples include the legal function, information and public relations, roadway and other facility maintenance functions. Decisions on shared functional responsibility would rely on the following:

- The extent to which additional human resources would be required as dictated by the additional IPTN requirements. In essence, it is always preferred to have in-house capacity available to ensure dedicated attention, unless the extent of the function is limited and can be provided a through a shared approach.
- The available capacity within the City to accept additional workload generated by the IPTN on a particular function
- The extent to which a particular function is unique and can be performed within the available current capacities

ix. Station management

An "open" design is adopted for access to - and control over passengers to board and transfer at the bus stops and transfer facilities. "Open" refers to **no** access gates (turnstiles) on the station or bus stop where passengers need to tap the EMV card on a device to obtain access to the buses.

An open approach means tapping would happen on the bus. It means that the personnel required to serve at the stations/bus stops would be limited to those required for maintenance and security only to safeguard and upkeep the facilities. However, this HR requirement may be influenced by secondary activities that may happen in and around the transfer facilities, as elaborated below.

x. Integrated commercial activities

Given the open approach for access control at stations, the capacities and qualification of personnel at the stations may be influenced by the policy that is adopted for commercial activities in and around the stations and bus stops. The approach by most metropolitan cities is not to allow any commercial activities on the roadways, sidewalks and anywhere along the precinct of the stations.

The main reason is to ensure safe, quick and proper access for passenger movements at the stations, especially in view of the station design concept where the facilities are situated in the centre of the road reserve and not on the sides of the road reserve as is the case for the Mangaung station facilities.

Given the concept for the positioning of Mangaung stations, as well as the standard practice in the taxi industry where informal commercial activities take place adjacent to - and sometimes within taxi ranks, a more flexible approach may be justified in terms of the Mangaung network. Such flexible accommodating approach should however still comply with some minimum standards to ensure safe and sufficient access to the stations and that the normal traffic flow is not inhibited. The main criteria would be the extent to which commercial activities may influence the effective flow of pedestrian and bus traffic in and around stations, as well as the potential impact on passenger and system safety and security.

The above approach requires a new concept in terms of commercial activities at the stations, which in turn would determine what controls and supervision would be required. It includes the identification of areas where commercial activities may take place and a fit-for-purpose regulatory system should be formulated for the use of such facilities and under what financial and other technical conditions the commercial practice may function.

xi. Shareholding and Institutional Efficiency

From the above business principles and legal basis, it can be concluded that affected operators would have the right to exercise a choice namely to accept the negotiated compensation amount and exit the market (complete restraint of trade agreement), or to re-invest and become the new shareholders (re-invest the calculated compensation amount in full or partly or more) and become a shareholder of the new bus operating company and/or the other associated institutions that may be contracted to operate any of the outsourced tasks.

It also follows the need to identify a new institutional structure that would be efficient and easy to administer. For this reason, the nature of the services to be contracted may affect the way in which the contracts are structured. The envisaged contractual dispensation is proposed to be as follows:

- VOC - Vehicle operational contract(s) for trunk and complementary services
- A separate service contract for feeder services with specific taxi operators and/or IBL short distance services
- IBL long distance services (not part of Phase 1 and 2)
- Station Management Services (which may be integrated as part of the VOC)
- AFC/EMV services for the automated fare collection system by means of EMV cards and access control
- APTMS services for the integrated public transport management system, i.e. the information technology component of the system.

In terms of the VOC contract two alternative approaches may be followed:

a. Firstly, one single bus operating company (VOC) may be established with different shareholders consisting of all affected operators in two main groups, namely the taxi industry (one association) and the bus industry comprising of IBL only. The value of shareholding will be relative to the size of the affected business that is transferred to the VOC. In this alternative a single operating company is established with one corporative structure that will oversee three different contracts as identified above. Each contract will be different as the remuneration basis will be different.

b. The second alternative approach is to establish two or three subsidiary companies under the umbrella of the main holding company (VOC Holdings). This structure will still present one corporate structure but each of the three service types are ring fenced comprehensively in terms of its business values and cost structures.

c. The third alternative approach would be to establish three different VOCs entirely independent from each other with different shareholders entirely.

The preferred approach would be the first alternative listed above, namely (a). The reason being that it would offer the least possible institutional cost and that it may be least complex to manage from a contract management point of view. The main problem associated with this alternative is the complexities associated with joint shareholding amongst groups of affected operators that are not easily reconcilable. This option is however the last resort to be taken and limitations in terms of associated corporate costs would be major issue.

xii. SPV Establishment and Conditions

Given the circumstances that the comprehensive IPTN is developed in phases and that the preliminary first phase will cover only a relatively small portion of the eventual full system, as well as the NLTA provisions for a maximum of 12-year contract that may be negotiated only once, it is inevitable that the industry's affected operators would prefer that the inception date of the negotiated contract be postponed until such time that a meaningful part of the entire system is developed. Hence it is also inevitable that:

- A forerunner implementation period (or interim period) be introduced to test the system on a smaller scale that is sufficient to allow an optimum start for the permanent contract
- The interim period services need to operate on a fully completed part of the system, such that all functional components of the system can be subjected to testing.
- It is preferred that all categories of affected parties are part of the preliminary system.
- The remuneration of the interim system should be based on a cost-plus principle. The FMA procurement regulations of the City would allow an interim contract period of maximum three years only.

Within the above framework it means that infrastructure implementation should have proceeded well before the interim period would commence. During this period an interim institutional arrangement is required and for this purpose an SPV needs to be established, i.e. a Special Purpose Vehicle company, i.e. a preliminary operating company that would be responsible for the execution of all operational functions during the interim period. It will include the procurement of the buses. Refer to the Legal chapter that will deal in more detail about the SPV.

However, from a business and institutional point of view, a number of important conditions are identified in terms of the financial and regulatory affairs of this SPV. These are:

a. The interim contract would be based on a **cost-plus principle**, which means that the operational cost budget needs to be negotiated between the two parties and a reasonable profit may be included should the MFA allows such profit margin.

b. In view of the above, the SPV would be allowed to conduct only those functions as allocated specifically for this purpose. The reason being that the potential cost of any other unrelated function may obscure the intended cost structure of the main objective, i.e. the public transport services as planned for the IPTN.

c. The objective of the SPV should be totally focussed and not distracted by other objectives to allow optimum testing and functioning of the interim system.

d. Contributing factors include the following:

- The risk of the fare box lies with the City and not at the operator as the case is with current tendered contracts for bus services.
- The cost-plus principle is also essential, as the City would prefer a flexible operational environment should it become necessary as part of the testing process. That is the purpose of testing, namely, to adapt when the outcomes indicate changes are required, and which may then require a chance in the costing structure
- With the fare box risk vested in the City and the cost-plus principle as the basis for the interim contract, it means that the SPV shareholders are relatively risk-free. Also, for the SPV it is not a tendered contract environment and as a result potential competitive influences are absent in the negotiated contract. The SPV can negotiate in a much more relaxed environment.

To conclude:

- With all major business risks vested mainly in the City, a ring-fenced environment is required when the negotiated contract is negotiated.
- Should the SPV/VOC require a wider business scope to conduct other businesses as well, the SPV/VOC should still be ring-fenced by through a subsidiary company. The holding company would then be free to conduct other business without interference into cost structure of the ring-fenced VOC.
- The main criteria would relate to ensuring that NO additional cost of any other business that may impede on the SPV and also the future VOC.
- Within the ring-fenced VOC structure, any “additional” function that may be allowed would be functions that are directly related to the IPTN system, such as security services, station management etc.

24.4 Facilities Management and Operations

The operations plan describes how the various components of the service plan will be provided. Functions such as, but not limited to operation of revenue services, driver scheduling and dispatching, revenue service monitoring and supervision, maintenance of infrastructure, facilities and equipment for fare collection and revenue management are addressed in the plan. The level of detail required will vary depending where the project lies along the Project development stage process as discussed above. The closer the project is towards the Project Implementation stage, the more detailed should be the information provided, with higher levels of accuracy and confidence.

24.4.1 Controlled Access Stations

24.4.1.1 Functions

The following apply:

- Controlled Access Stations handle higher volumes of passengers than other stations and are staffed and equipped to support this requirement
- Correct staffing and the provision of specialised equipment enhance passenger boarding and travel times, in support of passenger service quality and efficiency
- The enclosed nature of the station design with automated bus boarding doors and controlled access from outside, supplies shelter against inclement weather and creates a safe passenger boarding environment
- Static up-to-date passenger information at all stations assists passengers with journey planning. Station staff deals with passenger queries
- Station staff report events and issues that impact on service quality, passenger comfort and safety to the Control Centre for further action and dissemination into the integrated system
- Station staff Attend to minor first aid urgent requirements in case of injury and arrange professional services when required
- Access to stations is integrated with NMT to enhance accessibility and safety
- Station staff communicate service deviations and demand fluctuations to Control Centre for further action.

24.4.1.2 Management and Operation

The following design principles apply:

- Station operation and management services are functions that will in all probability be contracted
- Controlled Access Stations are staffed by 1 Security Guard per shift on 24/7 basis, 1 Marshall at the fare gate and 1 Marshall at loading doors per shift during operations, roving supervision and cleaning complete the station staffing component. Provision is made for a streamlined overarching management team to manage all station operations
- All stations, including the staffed Access Controlled Stations are, in addition to on-station staff, further supported by roving security and repair and maintenance staff
- No fare sales or card top-ups will be executed at stations
- A Station Marshall will be used to assist with fare control and passenger support at fare gates allowing access to the paid area at Controlled Access Stations
- The quality of services rendered by any contractor, including station and bus services, contracted to render a service to the MMM IPTN, will be monitored for compliance by the Quality Management function under Operations in the MMM IPTN Business Unit.

24.4.2 Uncontrolled Access Trunk Route Stations

24.4.2.1 Functions

The following apply:

- Uncontrolled Access Stations handle normal volumes of passengers efficiently
- Passenger boarding and travel time is enhanced by the use of a 1.1 metre wide front bus door and easy to use fare verification equipment monitored by the bus driver
- Uncontrolled Access Stations are enclosed against the elements
- Passenger information at Uncontrolled Access Stations supply passenger information via up-to-date-static service information
- There is no fare payment verification required when entering an Uncontrolled Access Station as all fare verification id done when a passenger boards a bus
- Uncontrolled Access Stations create a much safer boarding environment than normal stops due to lighting and roving security
- Station design is integrated with NMT designs giving access to these stations, enhancing general accessibility.

24.4.2.2 Management and Operation

The following design principles apply:

- Although not staffed, the supervisory, maintenance, cleaning and roving security services are included in the station management contract as part of the IPTN value chain opportunities and mitigation of job losses
- The quality of services rendered by any contractor, contracted to render a service to the MMM IPTN, will be monitored for compliance by the Quality Management function under Operations in the MMM IPTN Business Unit.

24.4.3 Complementary and Feeder Route Stops

24.4.3.1 Functions

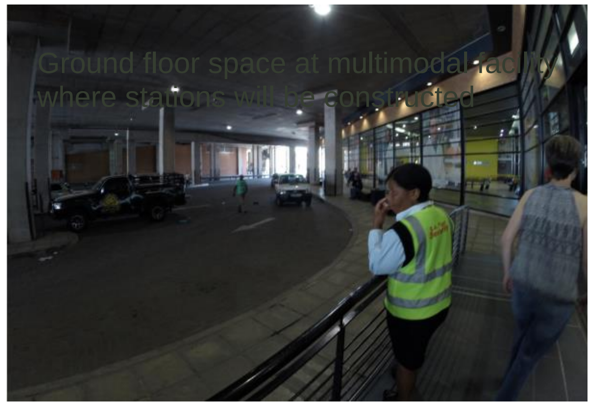
- Serve as designated boarding and alighting points not on the designated trunk routes where IPTN service vehicles will stop to allow passengers to board and alight
- Fare control will be situated on-bus at left front boarding door

24.4.3.2 Management and Operation

- Stop maintenance, cleaning and repairs will be contracted as part of the IPTN value chain opportunities to mitigate against job losses in the taxi industry when IPTN services are implemented. This service would include the updating of static passenger information at stops.

24.4.4 Multimodal Facility


Concourse of multimodal facility


Ground floor space at multimodal facility where stations will be constructed

24.4.4.1 Functions

The functions which will be performed by the Multi-modal facility will consist of the following, namely:

- Serves as distribution and collection hub for incoming and distribution services, both taxi and bus
- Allows easy access to other integrated modes of public transport such as rail, subsidised bus services, Long Distance taxi services, and taxi services not yet integrated into the IPTN
- Allows easy access to Customer Care Centre for the purchase of fare smartcards, top-ups and the resolution of fare collection, concession procurement, and service problems
- The Controlled Access stations will be constructed on the ground floor and will perform all other functions and services available at other Access Controlled Stations.

24.4.4.2 Management and Operation

The management and operations of the Multi-modal facility will incorporate and facilitate the following approach, namely:

- The taxi industry may be contracted to manage and operate sections of the Multimodal Facility as part of the IPTN value chain opportunities, the City will remain responsible for the staffing, operations and management of the Customer Care Centre situated in the Multimodal Facility adjacent to the IPTN stations
- The quality of services rendered by any contractor, contracted to render a service to the MMM IPTN, will be monitored for compliance by the Quality Management function under Operations in the MMM IPTN Business Unit
- Should accommodation for the IPTN Control Centre not be available at the venue where the MMM IPTN Business Unit will be housed, will it be necessary to identify a suitable alternative which will be able to house the backup servers and alternative emergency Control Units. The control centre and backup facility can however not be housed at the same location.

24.4.5 Customer Care Centre

24.4.5.1 Management and Operation

The management and operations of the Customer Care Centre will incorporate and facilitate the following approach, namely:

- The management of the Customer Care Centre will fall directly under the Customer Service function in the MMM IPTN Business Unit from where the quality and functionality of all customer service issues will be managed.

24.4.6 Control Centre

24.4.6.1 Management and Operation

- The following management and operation actions of the Control Centre will apply:
  - Contractors are not involved in the management or operation of the Control Centre, save for the presence of an ITS maintenance supplier to ensure maximum uptime of the ITS systems
  - The Control Centre is an integral part of the Operations function of the MMM IPTN Business Unit and ensures effective City monitoring of service delivery on its contracted-out functions
  - The Control Centre staff and functions are overseen by a Control Centre Supervisor reporting to the Operations Director in the MMM IPTN Business Unit.

24.4.7 Depots and Holding Areas

24.4.7.1 Ownership, Management and Operation

- The depot land and buildings will be owned by the MMM
- The depot will be leased to the Vehicle Operating Company (VOC) for them to be able to operate the MMM contracted IPTN services
- Depot maintenance and all in depot functions will be the responsibility of the VOC
- The MMM will supply and own some of the basic equipment such as fuel tanks, oil dispensing and brake testing equipment
- MMM will insure all MMM-owned assets while the VOC will insure all VOC-owned assets.

24.5 Intelligent Transport Systems

This section of the OPS Plan provides details on the components of the Intelligent Transport Systems (ITS) that will facilitate the operations of the MMM IPTN. The two key areas are the Control centre operations and the fare system operations. The purpose of each component is explained below. A breakdown of costs is provided, and the proposed programme is outlined.
The MMM IPTN network will be implemented in specific phases as per Chapters 2 and 3 of the Operations Plan. To ensure continuity, it is critical that all hardware and software solutions be modular and scalable similar to the stations and stops. The systems shall be compatible with other similar products so as not to limit future expansion of any part of the ITS system due to proprietary hardware, software or protocols.
Training in the use of all ITS systems will form part of the scope of works. The procurement will also involve extensive training for the operations personnel so that they fully understand the system requirements and boundaries they will be working with.

24.5.1 APTMS

24.5.1.1 Control Centre

The Control Centre, as a functional component of the MMM Business Unit, is at the heart of the IPTN real-time service quality monitoring and is one of the main drivers to monitor the successful operations of the IPTN system. The Control Centre provides space for the personnel and equipment that allows the Contracting Authority to monitor the transport operations and communicate with other stakeholders involved in the IPTN operations (VOC, Station Management, Business Unit Operations, Supervisors and customer care functionaries, Security and the AFCA), so that a high level of service provision can be maintained through active real-time service management.
The MMM IPTN Control Centre is scaled to fulfil the critical functions required to ensure real-time service continuity and quality during operations and to take action or escalate incidents in accordance with a communications matrix containing current data and contact detail of all stakeholders, including emergency services, law enforcement agencies, the VOC and Business Unit Management.
The Concept of Operations approved for the MMM IPTN services does not require a large, bespoke Control Centre. The Control Centre will be housed in an office environment with two screens allocated to each workstation. Bus and Station controlling will be shared by two Controllers per shift, equally skilled in the operation of both functions. These Controllers will also monitor the low level of CCTV coverage and handle security issues when applicable. Provision is made for the
contracted ITS maintenance contractor to man a workstation during operating hours (05H00 – 19H00) and act as an ITS helpdesk and be available to respond to emergencies in the server environment to ensure maximum uptime of the system.
The initial Control Centre staffing configuration will be extended as may be dictated by future growth in the service environment. Five workstations will be provided for.

The broad functions that will be carried out by Control Room staff are as follows:

- Real-time management and monitoring of the contracted services provided by the two main service contractors, i.e. the VOC and station management contractors during operations.
- Managing and monitoring system safety and security;
- Recording and managing of incidents, including communication with relevant stakeholders to resolve issues that may impact on service delivery and quality;

- Communicating with MMM IPTN supervisors and other relevant stakeholders to ensure that all buses are on the road and that AFC and other critical APTMS components are functional;

The more detailed requirement in terms of personnel that will occupy the control room area, is outlined in Table 24-1 below:

Table 24-1: Control Room Staffing Requirement

No	Description	Workstations Required	Note
2 Per shift	Bus and Station Controllers	2	Tasks: Bus tracking and communication with the bus drivers, VOC and IPTN Supervisors, plus security monitoring View CCTV footage of stations, handle all stations related queries
Contractor	Maintenance Contractor Help Desk	1	IT, APTMS to provide space for maintenance contractors and any testing that may need to be conducted
	Spare workstation in CC	1	Spare workstation for increased demand
	Scheduling workstation in BU Operations Offices	1	Scheduling function undertaken in BU Operations Office
Total Workstations		5	

There will be no video wall provided in the Control Centre. Operators will view operations on their workstation screens to obtain the information they need to carry out their tasks.

24.5.1.2 CCTV

CCTV provides the operator with a window on critical locations in the IPTN service network and supports control and service delivery without having to resort to costly manpower solutions. It allows the MMM to monitor incidents and facilitates quick action in support of continuous high quality service delivery to the citizens of the MMM.

The pressure of limited funding and the relatively less-congested Mangaung operating environment make it possible to limit initial CCTV coverage to one camera per station, inside of the station building for Access Controlled Stations, and outside of Uncontrolled Access Stations, monitoring both station and station precinct activity.

Bus body design will make provision for on-bus CCTV cabling to facilitate future fitment of CCTV cameras and other equipment without the need to retrofit cabling that is difficult and costly to retrofit. CCTV will not be extended to cover intersections initially.

24.5.1.3 Communications

An Integrated Intelligent Transport System consists of numerous items of equipment in a multitude of locations. The communications network is the glue that ties all these items together. Recent years have seen great advances in the communication technologies available and significant reductions in the costs of procuring these technologies. The designers and users of ITS can take advantage of these new technologies. There is however a need to understand the difference between the technologies and their suitability for application in a specific situation.

The communication links must be able to provide sufficient bandwidth to pass the required data accurately within the time limits required by the equipment. Modern telecommunications systems are based on IP standards. This allows the network designer to combine different technologies depending on application requirements and the location of equipment.

At this stage of the project development the communications network outline design consists of the following principles:

Back office and control room equipment will be linked to a specific MMM IPTN Gigabit Ethernet Local Area Network. This will allow the rapid exchange of data between the applications and the immediate user interfaces. This LAN will have redundancy built into it so that a single point of failure will not result in failure of the entire system.

The back office system communication paths to the roadside equipment will be via two principle routes:

Optic fibre will be installed when required by future growth along the trunk route and stations in sleeves built into the roadways during construction. During the initial stage the system will employ wireless technologies appropriate to the location and type of equipment. The use of this technology will provide the greatest cost efficiency and flexibility for future growth.

Communication links between the Control Centre and MMM IPTN contracted vehicles will also be included as part of the communications network design. Current thinking is that the vehicles will form part of the wireless network. As the vehicles will only travel on fixed routes that are already equipped with wireless communications the addition of data and voice connections for on-bus systems should be possible.

24.5.1.4 Scheduling System

This application will allow the Contracting Authority to fully adapt and manage the MMM IPTN operations dynamically. The system will allow for the preparation of standard and non-standard vehicle schedules (for instance, for use on public holidays or days with special events where a different pattern of passenger numbers and journey times are expected).

These schedules will form the basis for the services. The data collected will also include real time passenger numbers so that the services can be fine-tuned to match supply and demand. All the data contained within this scheduling application will be stored and extracted for planning purposes.

The VOC will have access to the driver and bus allocation component of the system to be able to fully integrate the scheduling and timetables contracted by the MMM from the VOC and to ensure maximum efficiency in the use of labour and expensive assets such as buses.

24.5.1.5 Scheduling Adherence

The SAC system deals with real-time scheduling, schedule adherence and dispatch changes. Bus Controllers in the Control Centre will monitor the movement and time variations to the scheduled timetables to ensure that the network operates at maximum efficiency and that trip arrivals at specific points are predictable to assist passengers with trip planning.

24.5.1.6 Fleet Management System

The Fleet Management Application allows the Vehicle Operating Company (VOC) to monitor the performance of bus drivers in terms of fuel usage, breakdowns, security incidents, acceleration and deceleration, engine revolutions and idle times. The application will therefore allow the VOC to manage incidents and unplanned events to a high level of efficiency. By monitoring these events over time, the VOC can improve the costly impact of bad driver behaviour to improve its own profitability with substantial spin-offs accruing to the MMM in terms of incidents, passenger complaints and service disruptions.

24.5.2 Fare Collection System

24.5.2.1 Fare system framework

The MMM IPTN Fare System will be compliant with the Government AFC Regulations to the NLTA of June 2011. The system will be a fully EMV-compliant, card only system. There will be no cash taken on the buses. Every passenger will be required to have procured a bank-issued EMV-compliant card with MMM IPTN branding before boarding the vehicles or entering controlled access stations. Monetary value will have to be loaded onto the card to make payment to the IPTN system at commencement of a journey.

Legislation requires that all new public transport ticketing systems comply with the NLTA AFC Regulations published in June 2011. The regulations provide for an interoperable public transport ticket, which means that a passenger with a MyCiti or A Re Yeng card (in fact any issued South African public transport card or bank issued EMV compatible card) will be able to use it on the MMM IPTN system and vice versa once the system is fully operational and all banks participate.

In accordance with the Regulations, and in order to achieve an integrated AFC System for public transport that is interoperable nationally, it must contain the following elements:

- AFC must be implemented through any Bank Issued Fare Media;
- AFC must be interoperable through all Participating Banks;
- Clearing and settlement of payment transactions must take place through the National Payment System in accordance with the National Payment System Act, 1998 (Act No. 78 of 1998);
- Banked Passengers must be able to use Bank Issued Fare Media obtained as a result of their relationship with any Participating Bank;
- Unbanked Passengers and those Passengers who do not bank with a Participation Bank, must be able to obtain prepaid stored value Bank Issued Fare Media from a Participating Bank or a third party card issuer operating in conjunction with a Participating Bank;
- The payment system must adhere to the banking and payment regulatory framework; and
- The DoT's AFC Data Structure must be loaded onto all Bank Issued Low Value Payment enabled Fare Media.

Passengers will access the fare system by firstly having a compliant card. Passengers with bank accounts will have a chip in their bank debit card that is compliant. Passengers without compliant cards will have to purchase a card through an outlet (at designated vendors, participating retailers, MMM pay points, or at the Customer Care Centre). EMV cards hold an electronic purse that can be 'topped up' with cash. These cards can then be used to access the MMM services by tagging the card readers at stations or readers on complementary or feeder buses. Fares are set for the initial phased rollout tranches at a flat rate that includes travel from points within the service design network in the south-eastern suburbs to the multimodal facility and further to destinations within the CBD and beyond the multimodal facility.

As the service network is extended to points further away from the point of origin, the base for the calculations of the fares will have to be adapted to take distance into consideration. The system design can accommodate multiple flat fares and can be adapted to calculate total fares based on the points of boarding and alighting.

No fare media top-ups or card sales will be made available at stations. Card sales and top-ups will be available form selected Vendors, registered Low Value Vendors, MMM pay points and the Customer Care Centre.

It is anticipated that the first fare card procured by any potential passenger will be made available to the passengers free of charge to promote card acquisition to support and promote the legislated fare collection system.

The EMV fare collection system to be introduced in the MMM IPTN system could be integrated with any other mode of public transport that makes use of a similarly compliant EMV system.

The system provides for a secure cashless process which enhances fare evasion management and cash leakage through staff intervention.

24.5.2.2 Vendor Policy, Strategy and Functions

As part of the fare media/ card distribution strategy a network of Low Value Payment (LVP) merchants will provide top up facilities and smart card sales along the MMM IPTN routes. The location of fare media sales and loading points will be strategically situated to support the MMM IPTN system. This requirement translates to the sales points being situated in close proximity to the MMM IPTN stations and stops, along with key strategic points of congregation within the service area.
The exact number of sales points as well as the location criteria still needs to be finalised. In order to keep costs low, existing City sales points that are in close proximity to the routes will be preferred. LVP merchants are an important factor in the card distribution strategy. The merchants will ensure that there is sufficient market penetration and that fare media and top-up facilities are easily accessible to commuters. These vendors will receive compensation based on their top-ups and card sales, as the current commissions allowed by the EMV participating banks are inadequate to motivate vendors to participate which places the entire risk and cost of the fare collection process on the cities.
It is also anticipated that selected vendors will be established in the areas made available by land acquisition on trunk routes where stations are placed as there will be sufficient room to construct a small retail facility that would also sell fare media and do card top-ups.

24.5.2.3 Trunk station access gates and card validators

Once a card has been purchased and value has been loaded onto the card, passengers can undertake journeys on the system. The MMM IPTN system will comprise of Access Controlled and Uncontrolled Access stations. Controlled Access Stations will be established at both ends of a trunk route where passenger demand warrants their construction and operation. To enter the MMM IPTN system from a Access Controlled Station, passengers 'tap-in' at the fare gates giving access to a paid-up area from where they will board the desired bus without having to undergo any further fare control monitoring. Fare collection inspectors may confirm that passengers have indeed made payment for a journey during any journey as a secondary fare verification mechanism.
On a feeder route or at Uncontrolled Access Stations, the fare system will be "open" with no physical access controls (gates or turnstiles) in place. To enter the system from such a station or at feeder and complementary stops, passengers will 'tap-in' on a validator situated just inside the left front bus door where the passenger boards. The bus driver is tasked to ensure that passengers 'tap-in when boarding.
When the system grows from a flat fare system to a distance-based fare system, passengers will be required to 'tap-in' when boarding and tap-out when alighting to ensure that a fare is correctly calculated and subtracted from the card.
The MMM IPTN buses will have two access doors on the left side of the bus. One at the left front with another further to the rear of the bus. Only the left hand front door will provide access to a bus from feeder and complementary route stops and Uncontrolled Access Stations on trunk routes. Both doors on the left hand side of a bus will be used to allow passengers to board through the two automated station doors at Controlled Access Stations where validation occurs when entering the station paid up area.

24.5.2.4 Fare structures

A compliant fare structure for the MMM IPTN will be focused on:

- The minimization of the operational subsidy requirement;
- Redressing of historical imbalances; and
- Sustainability of quality service and affordability issues.

The final fare structure that will be implemented is still under consideration, but it is proposed to be a flat fare for the initial phases due to all routes being too short to enforce passenger transfers from one vehicle to another. The phases to be implemented at a later stage will be based on a distance-based fare calculated according to the distance travelled through various fare zones. The proposed fare zones will be outlined during the detail design stage.

Concessionary or discounted fares are also part of the proposed fare regime, with discounts to be offered to the aged, children, scholars and people buying multi-journey ticket products. Concessionary fares are geared to attain specific strategies in terms of specific identified market segments, such as people with special needs, pensioners and students. Concessionary fares will be considered for their social contribution to making the system accessible to more users, as well as the impact on the revenue required to ensure the sustainability of the system. All Concessions will be submitted for Council approval during the normal budgeting process.

24.5.2.5 Cash management

A substantial volume of cash will flow through the cash collection system. This flow is reduced substantially with the use of an extensive vendor network and no cash sales being done at stations. The concept of operations endeavours to reduce the risk of collecting cash for the MMM as far as possible. The flow of cash and transactions made by the AFC system and the banking partner still needs to be tracked, audited and managed in accordance with national banking and financial requirements. The fare collection system will therefore require sound management systems and procedures with a need to provide reports that meet the requirements of MMM policies, systems and procedures, as well as compliance with all relevant legislation, i.e. the MFMA.

When the contactless card is tapped on a validator, a record of the transaction is stored on the validator. All transactions stored on the validator will be sent to the back office through a secure network from where they will be sent to the bank for reconciliation and deposit into the MMM's bank account.

Secure cash collection services to recover cash generated by the MMM pay points and the Customer Care Centre need to be put in place if such collections cannot be combined with normal existing MMM cash collection arrangements.

24.5.2.6 AFCA operational costs

Revenue control is vested in the financial function of the MMM IPTN Business Unit and makes provision for all reconciliations, reporting, budgets and resolution of inconsistencies and monitoring of transactions executed and recorded by the banking partner.

The staff structure of the MMM IPTN Business Unit makes provision for sufficient capacity to execute these functions and to monitor the performance of the vendor network and sales commissions.

The maintenance cost provided for the operation of the fare collection system includes maintenance of the equipment and the rental of server capacity to an outsourced supplier.

24.5.3 Fare Policy and Regime

24.5.3.1 Integrating the EMV AFC system and fare structures

An integrated fare approach with other public transport modes that will form part of the IPTN needs to be followed. Such an approach will be outlined in an integrated fare structure design document that will be developed during the detailed design stage. The main elements to be considered for integration include:

- Fare Structure (includes fare type, concessionary fares and fare levels)
- Fare Media (EMV card)
- Fare Rules (transfers, penalties, park and ride and policy guidance)

The proposed EMV-based AFC system has the capability to operate in a multi-operator environment and enable integration of fares across various modes of transport in future. Whilst an integrated fare structure is motivated, such integrated approach presents a number of challenges to be overcome. Challenges include the differences in the fare structures of different operators and the accommodation of concession fares. The fare structure, fare policy, and business rules to be developed for the MMM IPTN will address the planned level of:

- The future role of other bus services within the longer term IPTN network
- Policy Principle: Parallel, competition between other bus services are not allowed
- Policy Principle: Commuters should not pay more because transfers take place between operators.

24.6 Safety and Security

24.6.1.1 Introduction

The lack of co-ordinated integrated quality public transport services in the Mangaung Metropolitan Municipal environment and the progress made at other cities in this regard undoubtedly have a negative impact on economic competitiveness, environmental well-being and levels of social equity in the City. The need to develop an IPTN, and more specifically an Integrated IPTN operational service network, was identified by the MMM with the development of an initial high-level Operational Plan.

The MMM IPTN system is intended to transform the public transport sector in the MMM through the provision of a high-quality, affordable public transport system in line with national policy. The IPTN system will also be aimed at reducing overall journey times for public transport users. A key benefit of the IPTN system will be an improvement in the ease of accessibility between residential areas and major economic nodes. In order for the system to offer the intended service quality, it needs to also improve the general safety and security of public transport users making use of the IPTN service network. Research worldwide has shown that the capacity of a transit system has to be consistently dependable in terms of safety and security and has to be able to deal with emergencies, which remains critical for gaining user trust and attracting patronage.

A Terms of Reference (ToR) will be developed to guide the preparation of a Safety and Security Plan for the MMM IPTN service network for both the construction and operational phases.

24.6.1.2 Minimum Requirements for an MMM IPTN Emergency, Safety and Security Plan

The scope of the proposed plan is as follows:

- The plan should include a comprehensive evaluation of threats and vulnerabilities using realistic scenarios and categorise these according to magnitude of risk and suitable response measures.
- It must prioritise threats and plan for the creation of sufficient preparedness in order to ensure that required resources are mobilised and distributed appropriately and timeously. The evaluation must reflect the variation in threat levels and protection requirements at different locations along the network.

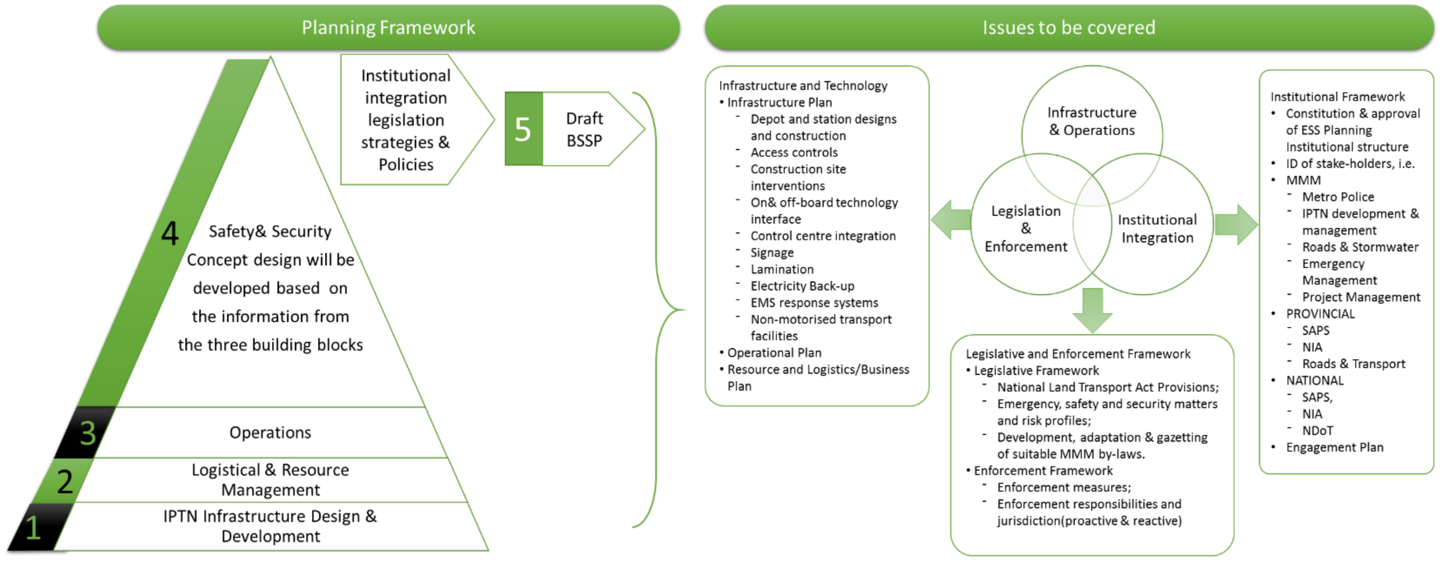


Figure 24-1: IPTN Planning Framework

- It must also set goals and performance indicators, which will be used in continuous assessment of risk against the state of readiness and the associated funding and training priorities.
- The plan should include a security and emergency preparedness program (SEPP) which will bring together many of the system's existing activities, integrating them into an overall security and preparedness effort, rather than a disparate set of technologies and procedures.
- The plan will recommend an institutional arrangement that promotes integration between different departments to enhance the smooth implementation of preparedness and response programmes, in a way that is commensurate with the MMM IPTN system's resources and capabilities.

All critical departments involved has to be familiarised with the plan, in order to expedite disaster response by avoiding confusion, delays or redundant response efforts. The programme must therefore be easy to integrate and coordinate with existing city, provincial and national emergency planning efforts and operations plans.

- The plan must set out procedures to gather, package, and disseminate accurate and timely information to the passengers or public throughout a crisis.
- The MMM IPTN Project Management Team, together with the designated members of the MMM Task Team, as well as other relevant Departments and functions such as the Metropolitan Police Department, Emergency Management Services (EMS), Roads, Legal will supply the necessary expertise to compile the Plan.
- Due to the nature of the relevant safety and security issues, the Metro Police will, in all probability take the lead in this activity. The Project Management Team will provide technical, logistical and management support.

The critical components of a safety and security plan are shown in Figure 24-1.

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Annexure EE: Facility Sizing per Design Year

Annexure FF: Route Details per Design Year Trunk, Feeder and Complementary Routes (31_Excel File)

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Annexure HH: Subsidised Bus Service Volumes and routes per functional public transport corridor

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Annexure KK: Universal Access Strategy and Action Plan

Annexure LL: Marketing Communications

Annexure MM: Economic Impact

Annexure NN: Social Impact

Annexure OO: Household Travel Survey Technical Report and Results