CHAPTER 3

RAIL DEVELOPMENT PLAN

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Please note this Long-Term Planning Framework is not a business or operational plan, and is unconstrained to capital planning and independent to other more detailed Transnet business and operating division (OD) plans. The LTPF is only a planning tool, to guide Transnet and all external and public stakeholders. The LTPF is published annually at www.transnet.net.

ACRONYMS AND ABBREVIATINS

AC	Alternative Current
CBA	Communication Based Authorisation
CTC	Central Train Control
DBT	Dry-bulk Terminal
DC	Direct Current
DDOP	Durban Dig-out Port
DP	Distributed Power
ECP	Electronically Controlled Pneumatic
FER	Front End Research
GFB	General Freight Business
GIS	Geographical Information System
IDP	Integrated Development Plan
IDZ	Industrial Development Zone
ITCMS	Integrated Train Conditioning Monitoring System
LTPF	Long Term Planning Framework
OHTE	Overhead Traction Equipment
PICC	Presidential Infrastructure Coordinating Committee
PRASA	Passenger Rail Agency South Africa
RDP	Radio Distributed Power
SAR&H	South African Railways and Harbours
SEZ	Special Economic Zone
SRL	Swazi Rail Link
TEUs	Twenty Foot Equivalent Units
TFR	Transnet Freight Rail
TWS	Track Warrant System
WDP	Wire Distributed Power
WILMA	Wayside Intelligent Longstress Management System

1. INTRODUCTION

The rail section of the Long-Term Planning Framework (LTPF) provides the development plans for the rail network, terminals and rolling stock. It is based on providing the required capacity to meet both the unconstrained demand and development of a strategic network to enhance economic development within South Africa and its neighbouring states.

Transnet owns and operates the largest rail network on the continent. Of the 55 000km of track in sub-Saharan Africa, 40% of the operating network and 70% of the traffic are operated by Transnet. Overall Southern Africa handles about 74% of sub-Saharan freight traffic and more than 80% of total net ton-kilometres.

As the freight rail operator in South Africa, it is Transnet's responsibility to lower the cost of doing business by providing an efficient transport service. However, the rail network faces strong competition from road and has lost large tonnages to road. In the last few years, tonnages have begun to migrate back to rail due to a consistent focus to provide capacity, and a more efficient and cost-effective service.

The LTPF must be seen in this context, where the rail network must be developed to handle the predicted tonnages, but it is also vital to accomplish this in a competitive manner.

1.1 INFRASTRUCTURE OVERVIEW

The LTPF has evolved over the last few years to a far more comprehensive and aligned long term view and the rail development plans have also been adapted accordingly. Rail developments must support and facilitate business imperatives such as operational efficiencies and safety.

Insufficient standardisation creates increased operational complexity and maintenance costs due to increased stock levels and training requirements.

The LTPF seeks to develop rail corridors with a substantially increased level of standardised operating principles and applied infrastructure technologies, such as:

- Development of consistent train operating principles throughout the whole corridor as far as possible for dominant traffic flows;
- Replace 3kV DC traction infrastructure and rolling stock with 25kV AC;
- Developing infrastructure for longer trains with heavier axle loads where justified. This is achieved by allowing for increased axle load rail infrastructure and increasing train crossing loop lengths and easing critical curves and gradients;
- Focus on "pit-to-port" unit train loads with minimal shunting along the route. This minimises yard requirements and results in associated reduced consignment throughput times and increased rolling stock efficiencies; and
- Standardised CTC (Central Train Control) and track warrant train control systems.

The following development areas are included in the LTPF 2016:

INFRASTRUCTURE

- Infrastructure condition assessment allows for the effect of increased maintenance on corridors where condition is not to the required standards;
- Installed and desired future technologies are considered in developing future infrastructure with a view to standardisation of technologies wherever it makes business sense and will improve operational efficiencies and safety; and
- An improved capacity determination model gives more accurate views of future capacity constraints and what interventions are required to increase capacity.

CAPACITY

- A newly developed costing model allows for more accurate estimates of interventions required than in previous years; and
- Branch lines require different commercial and operational strategies to that of main lines and have been included.

ROLLING STOCK

- Rolling stock deployment and acquisition strategies have been independently developed to show an ideal scenario; and
- Investments required for more standardisation and the use of more appropriate rolling stock technologies have been accommodated.

HUBS AND TERMINALS

- Updated hubs and terminal views indicate the continued growth in the container, automotive and palletised goods markets.

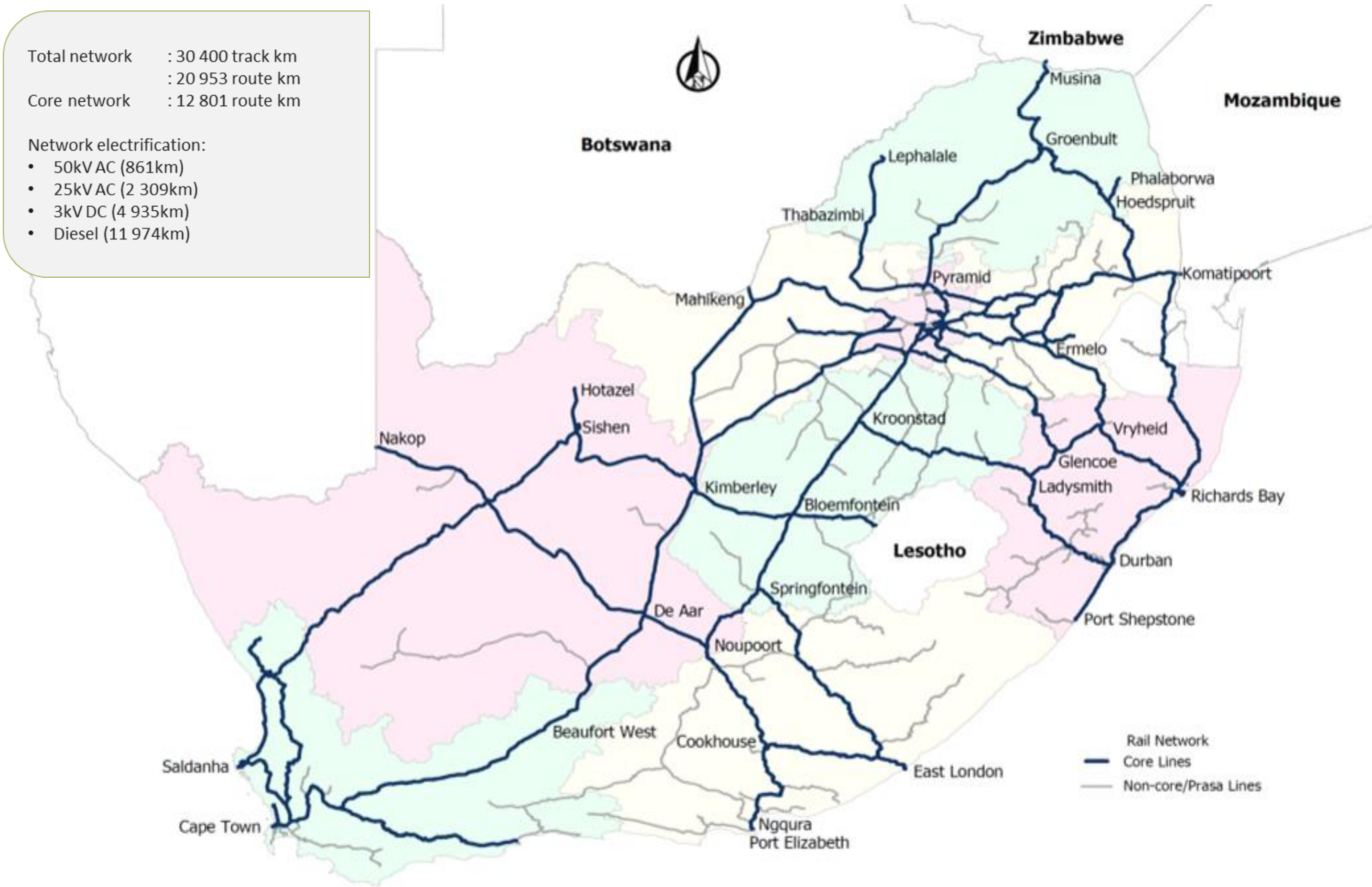


Figure 1: Infrastructure Overview Map

The rail network consists of more than 30 000km of track. The actual route distance is about 20 900 km. The network provides excellent coverage of most of South Africa from a freight demand point of view and links all of the major mining and primary production areas with the port system. The network also covers all of the major commercial and consumer areas.

Roughly 60% of the network can be classified as the "Core Network" with about 9 000km of lines classified as "branch lines," with the potential to service communities and activities not directly on the main corridors.

With the formation of a unified rail system in 1910, the SAR&H was mandated to be a stimulus for growth, and by 1930 much of the network that we see today was already built. Since the end of the 1970s hardly any new lines were built and freight concentration considerations influenced the focus on main corridors maintenance and capacity enhancements.

Network electrification:	50kV AC (861km)
	25kV AC (2 309km)
	3kV DC (4 935km)
Axle loading:	Main lines at 20t/axle
	Coal and ore lines 30t/axle (coal line operates at 26t/axle)

1.2 DEVELOPMENT PLANNING PRINCIPLES

In order to guide and direct the development of the rail plan, certain planning principles were adopted. Although all the principles are applicable, the most fundamental principle used in the plan is that of matching capacity to demand.

1. **Match capacity to demand**

   Provide adequate corridor and terminal capacity at the right place ahead of demand. Rail demand is derived from the surface demand forecast and applied to the rail network in terms of the number of slots required.

2. **Align infrastructure to freight type**

   Heavy haul or light industrial standards depending on the freight type, considering when to change lines to heavy-haul standards or even to upgrade to higher speeds due to the type of freight that needs to be moved.

3. **Improve operational characteristics**

   Reconfigure line infrastructure and layouts to remove bottlenecks, considering the changes to the network to improve operability, even if capacity is not a constraint. This may include the elimination of crossovers, repositioning of signals and new links or reconfigurations to improve reliability, maintainability and operational costs. The South African rail system provides connectivity of the hinterland with the ports and also supports connectivity to the Southern African railway system.

4. **Ensure network connectivity**

   Link complementary ports with inland connections. Support connectivity to SADC/regional railways. Emphasises the need to retain the current connectivity to support further developments in future. This principle also considers interconnectivity between ports.

5. **Standardise infrastructure**

   Use similar technologies across the network to improve safety, maintainability and operational performance. Supports the need to standardise the infrastructure in order to improve safety of operations, enhance maintainability and increase operational performance. This principle is also used with the development of rail terminals to provide a standardised design that will be cost-effective to replicate and predictable from an end-user/operator point of view.

6. **Align with PRASA/non-Transnet operator requirements**

   Separate, re-route and enhance services where needed. Consider inter-operability with branch-line services. Highlights the need for integrated planning with other agencies such as PRASA and branch line operators. Alignment with PRASA will be applicable on the rail networks that are currently shared or planned to be shared in future.

Figure 2: Development Planning Principles

1.3 OPTIONS FOR CAPACITY CREATION (PRINCIPLE 1)

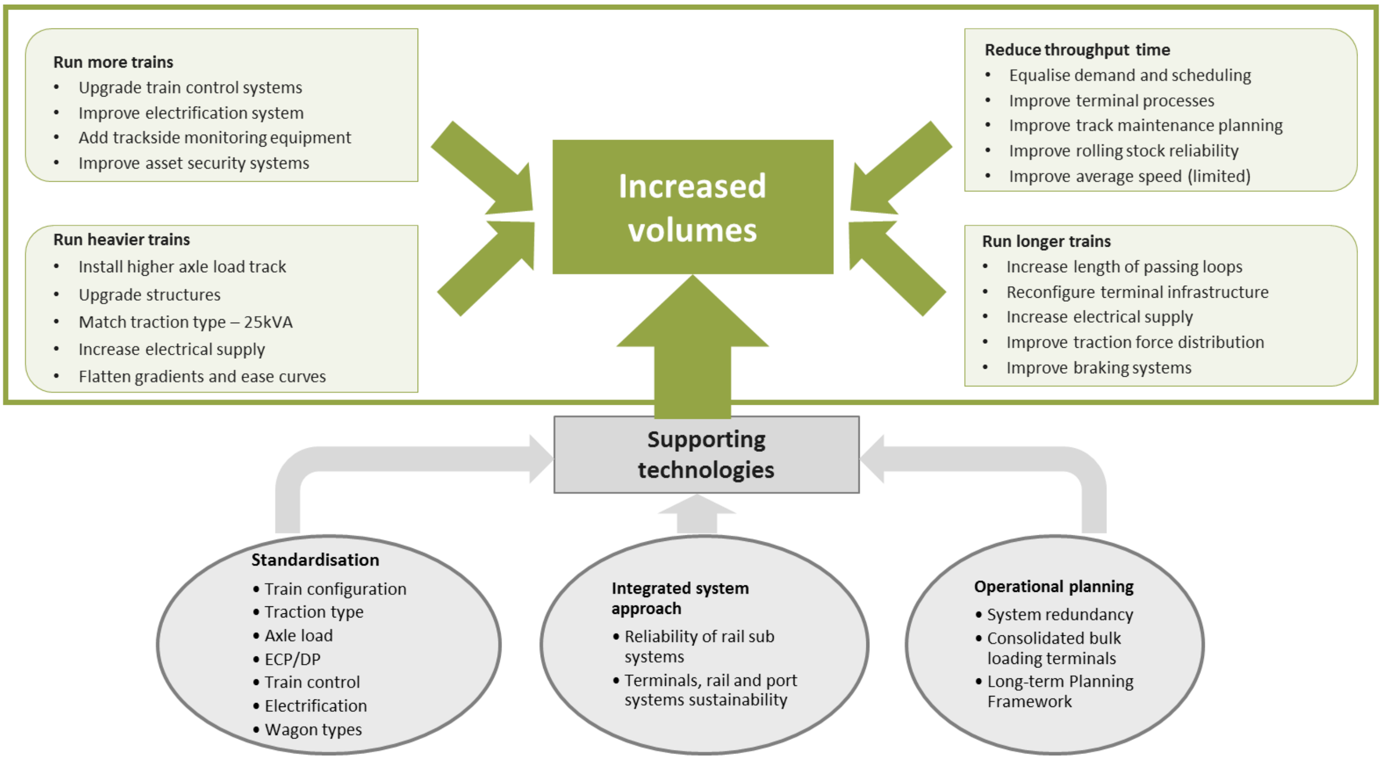


Figure 3: Options for capacity creation

There are four steps to increase volume throughput on a rail network (not in order of priority):

- Reduce throughput time
- Run more trains
- Run longer trains
- Run heavier trains

Therefore, the supporting operating levers need to be explored during the early system design stage. For example, to run more trains on the system, the operating levers should include upgrading of both train control systems and electrification systems, improving asset security systems and enhancing trackside monitoring systems.

This should be done in conjunction with the following supporting technologies:

1.3.1 STANDARDISATION

In order to improve train operation efficiency, optimise maintenance slots and maximise operational revenues, the following train operational requirements underpin the train operating models and standardisation of the rail system:

- Run longer trains where possible
- Convert the 3kV DC sections to 25kV AC
- Axle loading across feeder system and main lines to be standardised
- The utilisation of diesel DP/ECP to overcome gradient challenges

The utilisation of distributed power technology allows for the operation of longer trains, but has a major impact on the siding and yard layouts. It is preferred if locomotives are positioned at the front or the back of the train.

Heavier axle loading on existing infrastructure can be achieved by merely replacing the loose components (ballast, sleepers and rail). The formation, however, needs to be suited for the bearing capacity of trains. It is often possible to increase from 20t/axle to 26t/axle loading, but not from 20t/axle to higher than 26t/axle.

Communication-based authorisation (CBA; in-cab signalling) has a major impact on line capacity as this technology reduces headway between trains and increases the number of slots on a line. The CBA technology is not ready to be deployed yet.

1.3.2 AN INTEGRATED SYSTEM APPROACH

- Integration of the various rail subsystems to develop an integrated rail operation and capacity expansion plan;
- Terminals, rail and port systems need to be integrated to ensure that supply chain elements are aligned with required throughput volumes; and
- Reliability and sustainability of both fixed infrastructure and rolling stock.

1.4 CAPACITY CREATION LOGIC

The illustration (Figure 4) demonstrates the application of the principles of finding practical solutions for infrastructure ahead of demand. It considers the operational improvements prior to implementation of major and costly new infrastructure solutions. The impact of the bottom-up capacity solution pyramid is that quick changes derived from operational discipline and redesign are in most cases affordable, whereas quantum infrastructure is only required for a high demand forecast.

Cognisance should be taken that the implementation of quantum infrastructure development is associated with massive investment and extensive disruption of operations.

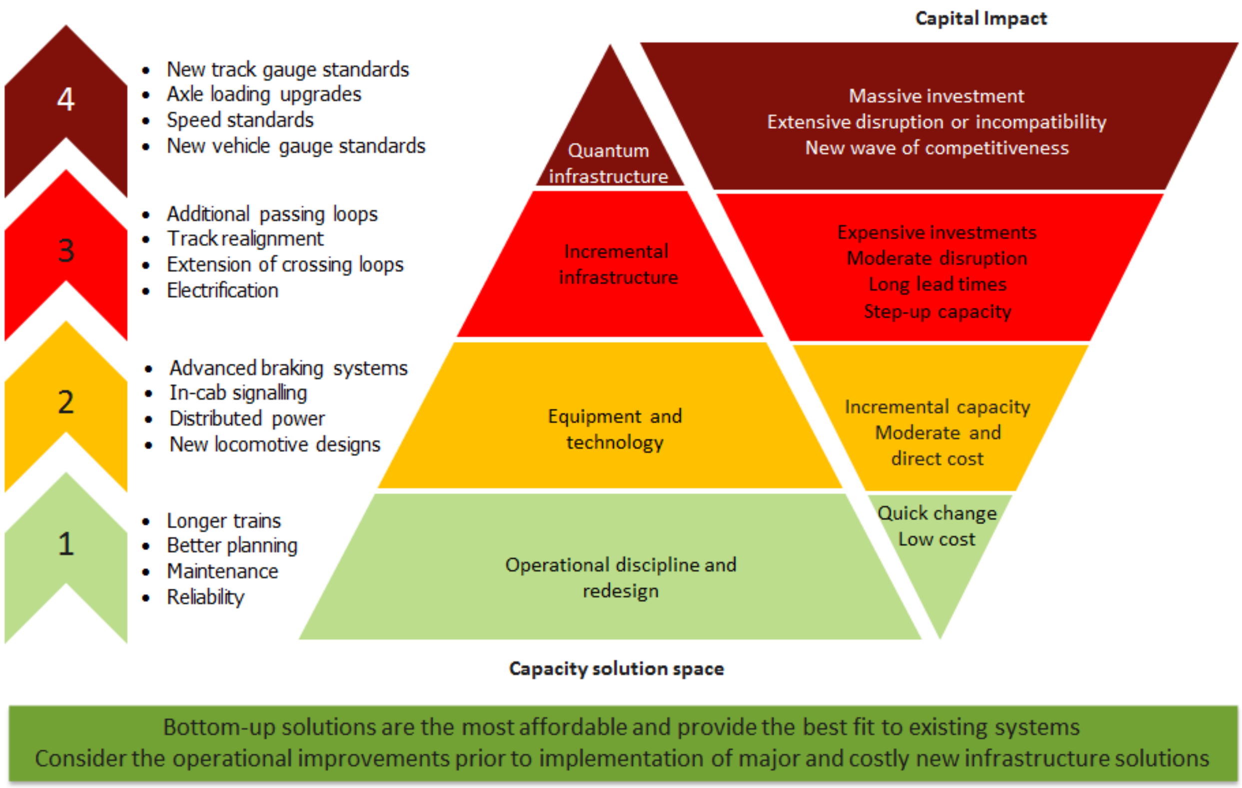


Figure 4: Capacity creation logic diagram

It may be appropriate to jump straight to the top of the pyramid, but in most cases an incremental approach offers the best cost to benefit ratio.

2. Network demand

2.1 PLANNED DEMAND

These maps show rail network tonnage demand per section as per the road-to-rail migration strategy and market share targets planned for the next 30 years. The line colours reflect traffic density flowing over the section for 2015, 2025, 2035 and 2044 respectively.

The demand per section ranges from less than 1mtpa to more than 60mtpa for the export coal system to Richards Bay and the export iron ore from Sishen to Saldanha. Large differences are evident and a substantial part of the total volumes are concentrated on only a few of the corridors. The Cape, Natcor and Lephalale corridors show significant growth due to increased containers, domestic coal to Tutuka power station and Waterberg coal respectively. The volume growth along the central port corridor from Hotazel to Ngqura is largely due to high forecast of the export manganese and container businesses.

RAIL DEVELOPMENT PLAN

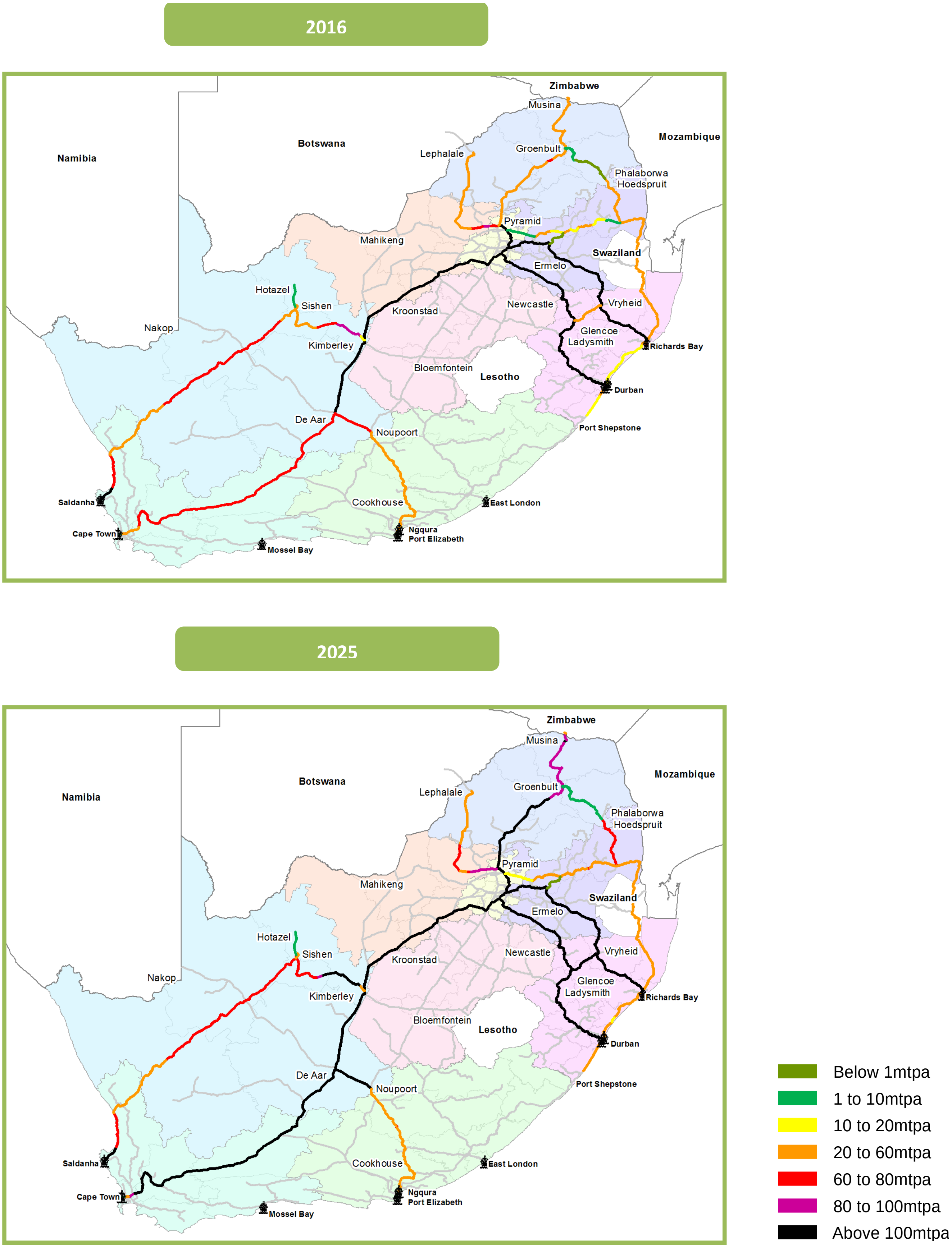
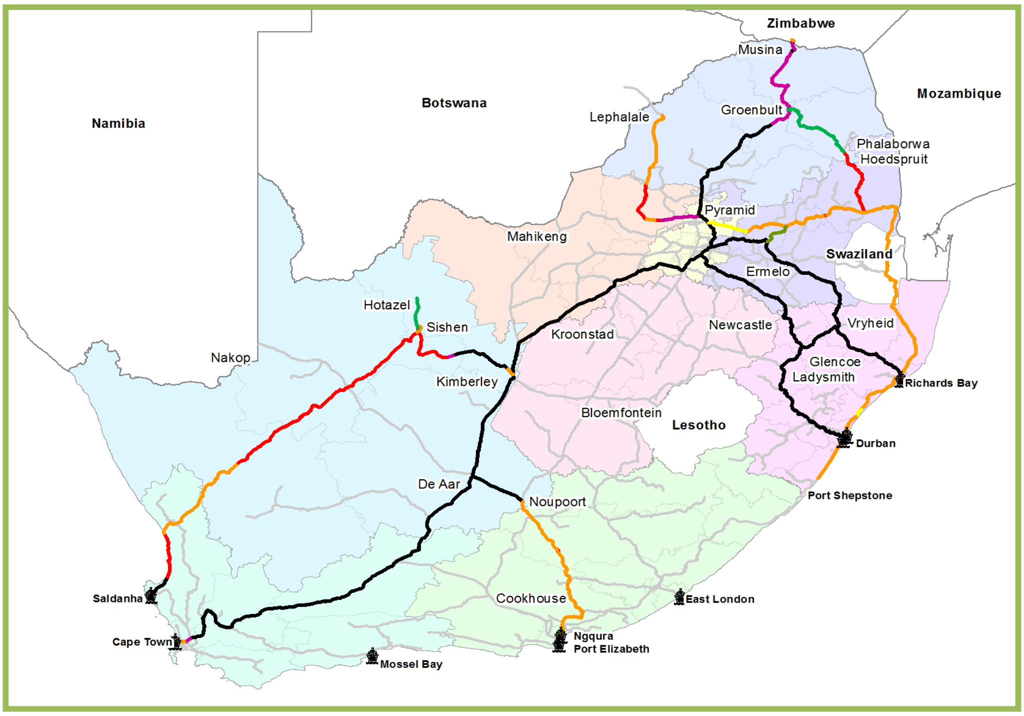


Figure 5 - 6: 2016 – 2025 Flows density maps

RAIL DEVELOPMENT PLAN

2035



2046

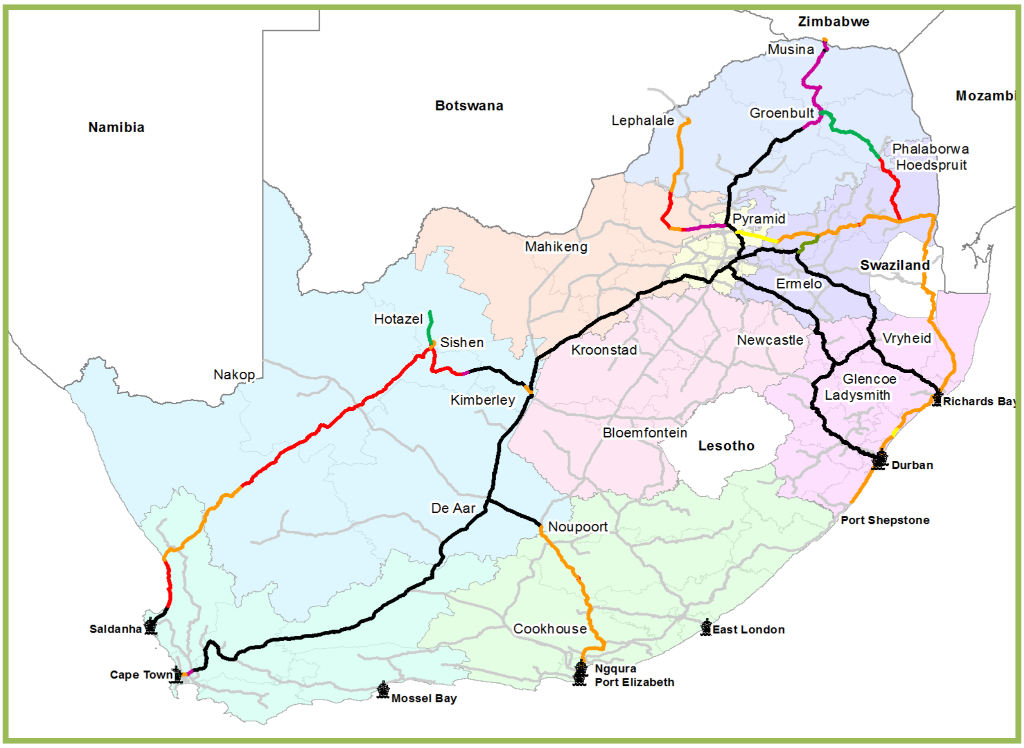


Figure 7 - 8: 2035 – 2046 Flows density maps

2.2 TRANSLATING TONNAGE TO CAPACITY UTILISATION

Network utilisation is an indicator of how hard each section is working.
This is used to determine when and where capacity improvements will be required.

Utilisation

Light utilisation:	< 60%	No action required
Moderate utilisation:	60 – 80%	Consider operational reengineering
Heavy utilisation:	80 – 95%	Operational redesign. Limited infrastructure upgrades
Utilisation limit:	95 – 105%	Operational redesign limit. Infrastructure upgrades
Over-utilisation:	105 – 130%	New infrastructure needed. New operational plan
System failure:	>130%	Significant infrastructure upgrades. Doubling or new lines

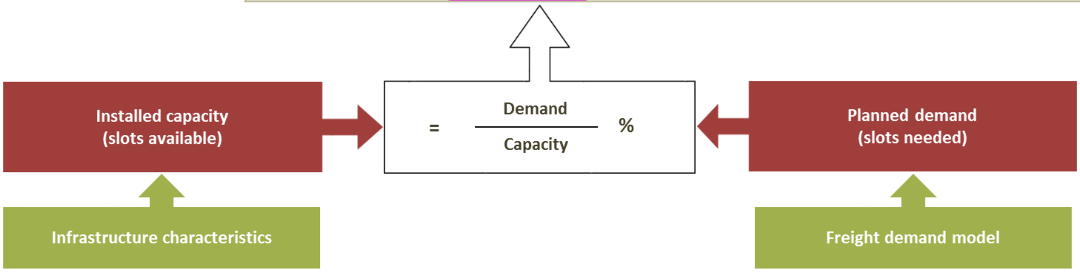


Figure 9: Translating tonnage to capacity utilisation

As indicated earlier, network analysis requires matching capacity with demand. The diagram indicates how these functions relate to each other and are used to determine network capacity utilisation.

Capacity: following the conversion of traffic demand to train requirements per day, the installed network capacity per line segment is determined.

Double-lines: the capacity of a double track railway line is determined by the headway between two trains and therefore is typically a function of signal spacing and running speeds.

Single-lines: on single-track lines, capacity is governed by the available opportunities to pass trains at crossing loops that are long enough to accommodate them.

Mixed traffic capacity calculation on single-lines: where more than one train length is operated on single-line sections, capacity is calculated as a combination of short and long train capacity, each with its own limits.

Metro and Mainline Passenger Services: the capacity calculations for freight sharing sections with Metro or long- distance passenger services makes allowance for the number of slots used by them. These passenger trains run at relatively higher speeds than freight trains, resulting in such trains using more capacity than freight trains. It was assumed that a passenger train uses 1,3 freight train operational slots when sharing the network.

Utilisation: the formula for calculating capacity utilisation is quite simple: demand/installed capacity. This results in a percentile figure, which is then classified in terms of use, ranging from light traffic to system failure. The utilisation figure is the key driver in determining when a section of line should be reviewed or upgraded.

The calculated capacity utilisation per segment is displayed for the whole network, showing the effect of increased train traffic on the system if the required investments were not made.

2.3 LINE CAPACITY

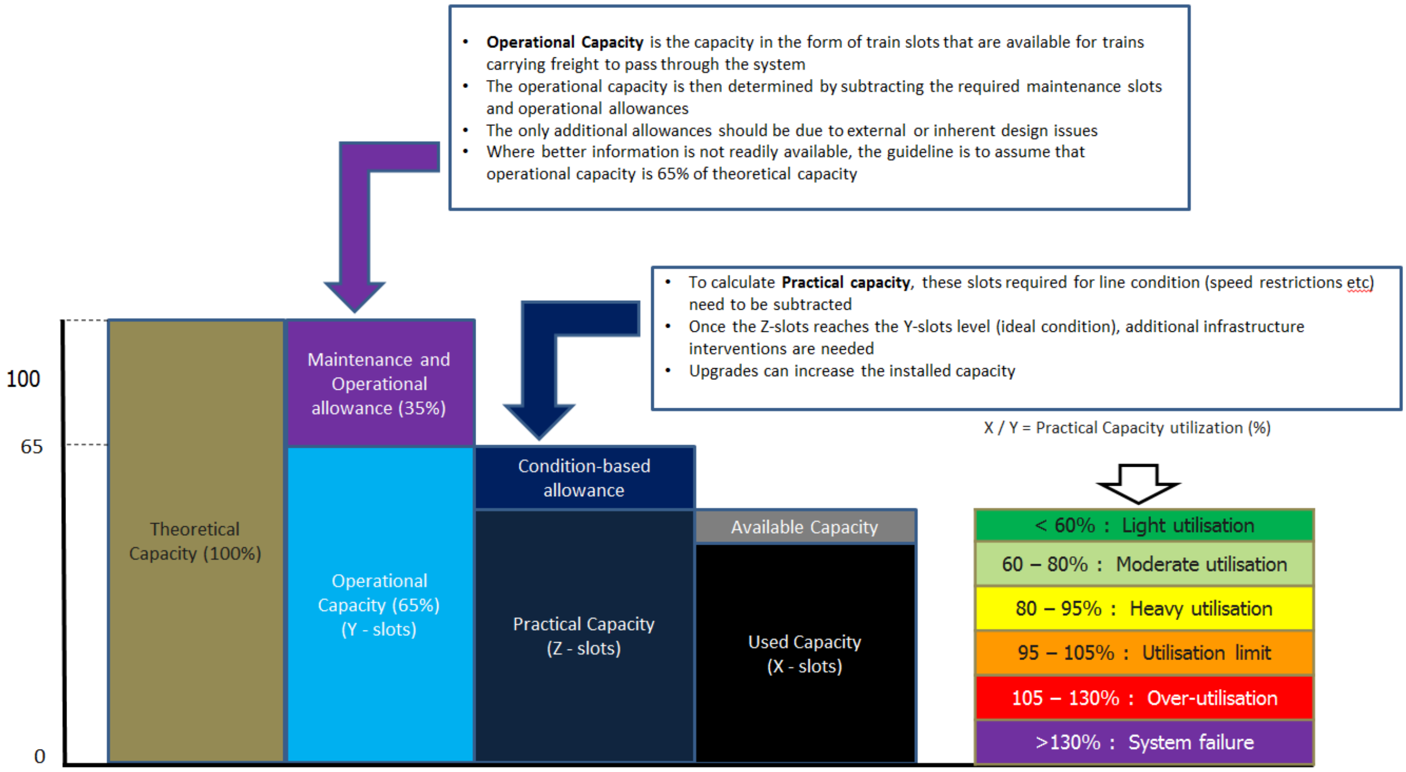


Figure 10: Line capacity diagram

- Operational capacity is the capacity in the form of train slots that are usable for trains to pass through the system;
- The operational capacity is then determined by subtracting maintenance slots and operational allowances assuming that the infrastructure is in optimal condition;
- When calculating operational capacity, it may be tempting to allow for additional maintenance slots or operational failures due to poor condition. This should be avoided;
- The only additional allowance should be due to external or inherent design issues e.g. installed alignment, clay conditions or difficult operational regimes;
- Where better information is not readily available, the guideline is to assume that operational capacity is 65% of theoretical capacity. This assumption has been tried and tested and is safe to use under most conditions;
- The current condition may be below the threshold, where it negatively impacts on the installed capacity due to speed restrictions, increased failure rates and corrective maintenance;
- To calculate the condition-based or practical capacity, these "lost" slots need to be subtracted;
- By comparing the capacity needed (demand driven) with the practical capacity; it is possible to determine the minimum condition level that a line would need to be maintained at in order not to impact on volumes. (Don't let the Z-slots drop below the X-slots below);
- Once the Z-slots reach the Y-slots level (ideal condition), additional infrastructure interventions are needed;
- It is indeed more complex since assets have an age-to-condition relationship (lifecycle) and refurbishments and replacements need to be considered as well; and
- End-of-life replacements and refurbishments can increase the installed capacity if these are upgraded.

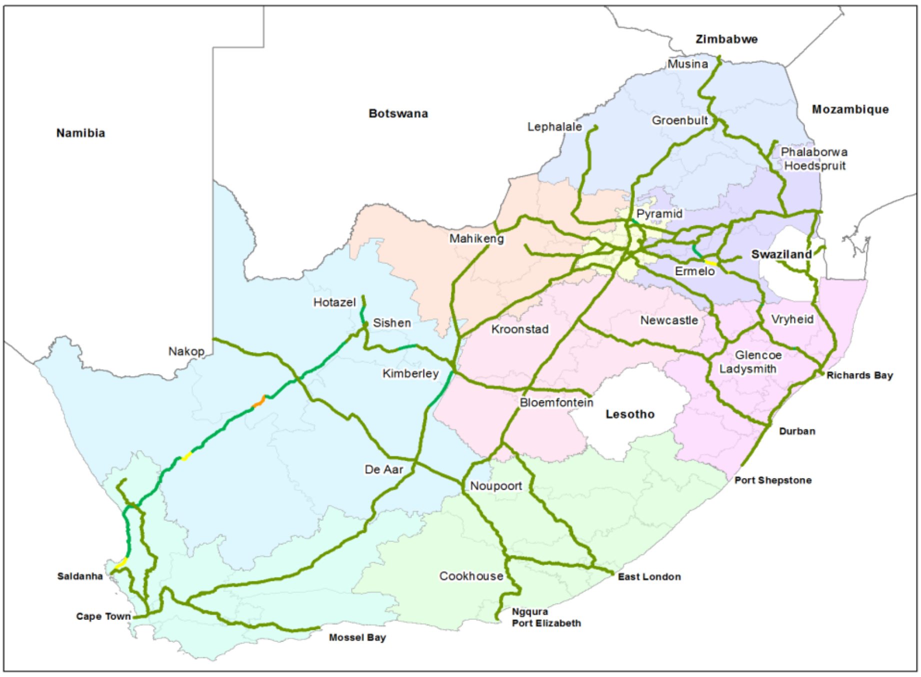
2.4 NETWORK UTILISATION: IF NO INVESTMENTS ARE MADE

The calculated capacity utilisation per segment is displayed for the whole network, showing the effect of increased train traffic on the system if the required investments are not made.

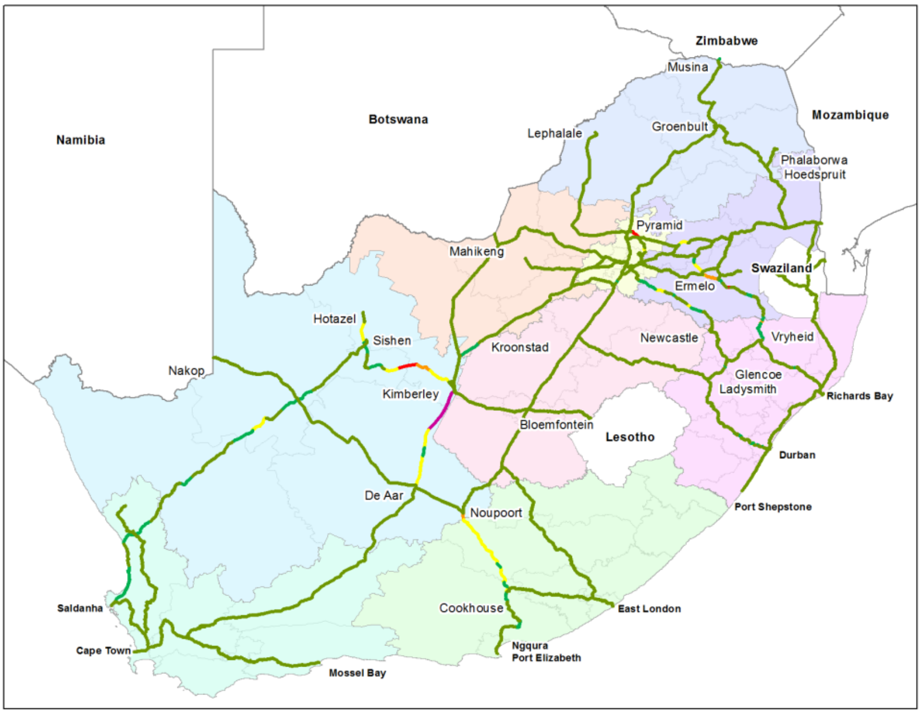
RAIL DEVELOPMENT PLAN

The majority of sections have adequate capacity (Figure 12-15). Major constraints are apparent on the line from Kimberley to Port Elizabeth. This is due to it being a single-line with few passing opportunities, as well as handling a mixture of heavy freight (manganese ore) and passenger services running at different speeds, thereby consuming a greater number of slots.

2016



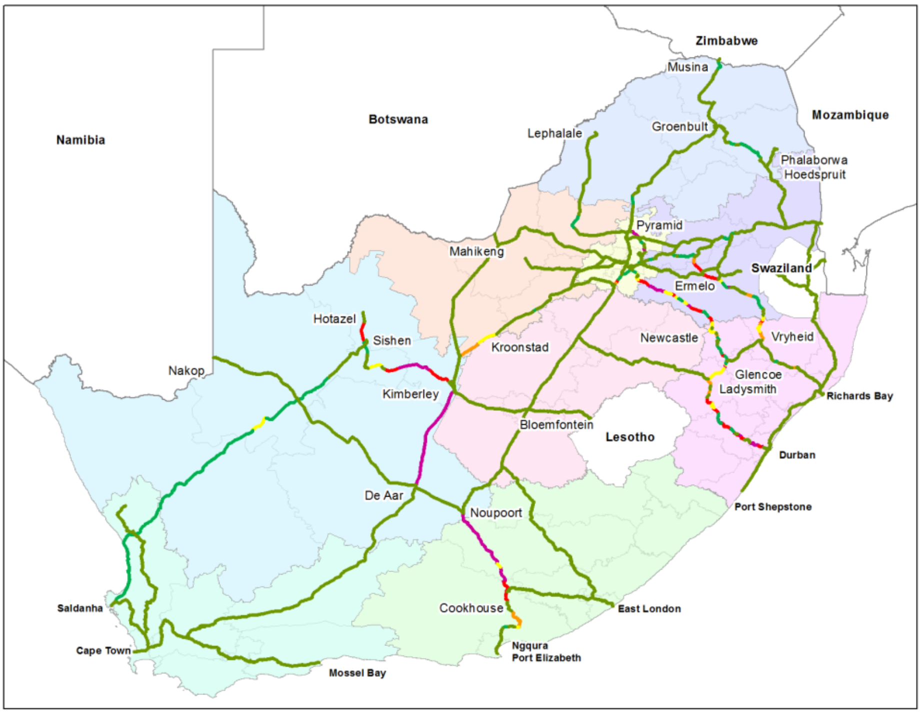
2025



- Light traffic – < 60%
- Moderate traffic – 60-80%
- Heavy traffic – 80-95%
- Traffic limit – 95-105%
- Heavy congestion – 105-130%
- Network collapse – >130%

Figure 11: Network Utilisation in 2016 to 2025

2035



2046

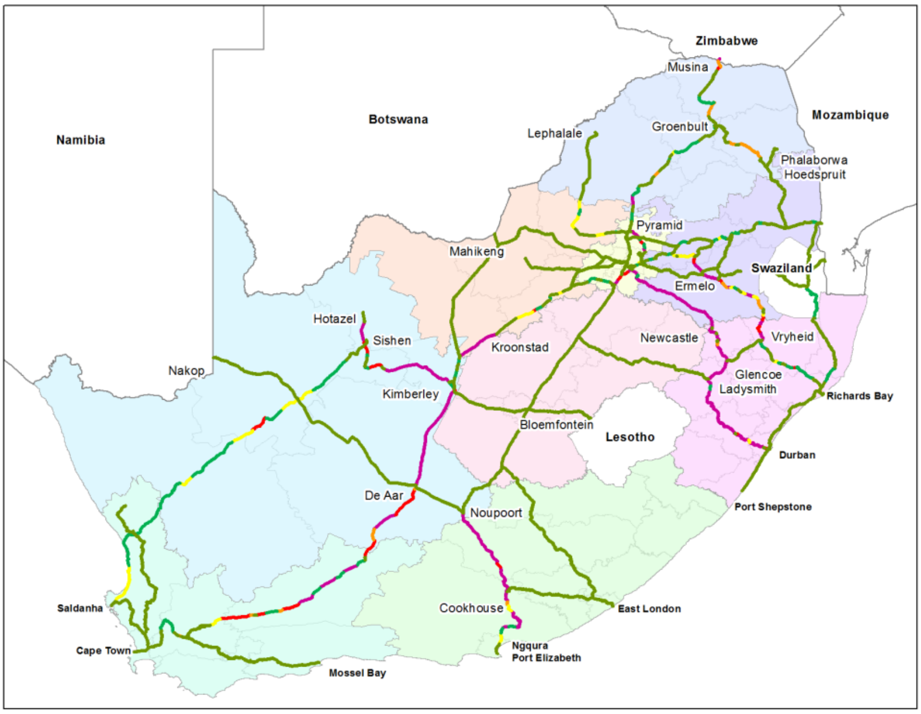


Figure 12: Network Utilisation in 2035 to 2046

The line running through Swaziland also shows heavy utilisation. Although demand is not as significant as on the Port Elizabeth line, the installed capacity is low due to very few passing opportunities. Similarly, the section from Lephalale to Thabazimbi is also heavily congested due to insufficient passing opportunities and the lengthening of the loop at Matlabas will resolve this issue. There are constraints over some smaller sections in the metropolitan areas of Gauteng and Durban, which are due to Metro Rail services sharing the line with freight traffic.

By 2035, most corridors in the core network show constraints. The forecasted aggressive growth in the railed container market will create constraints on all the routes between Gauteng and South Africa's major ports (except East London), as well as some over border traffic into the rest of Africa. Increased domestic iron ore from the Sishen area and magnetite from Phalaborwa to Richards Bay will also require substantial capacity upgrades.

3. Development Plans: Core Network Systems

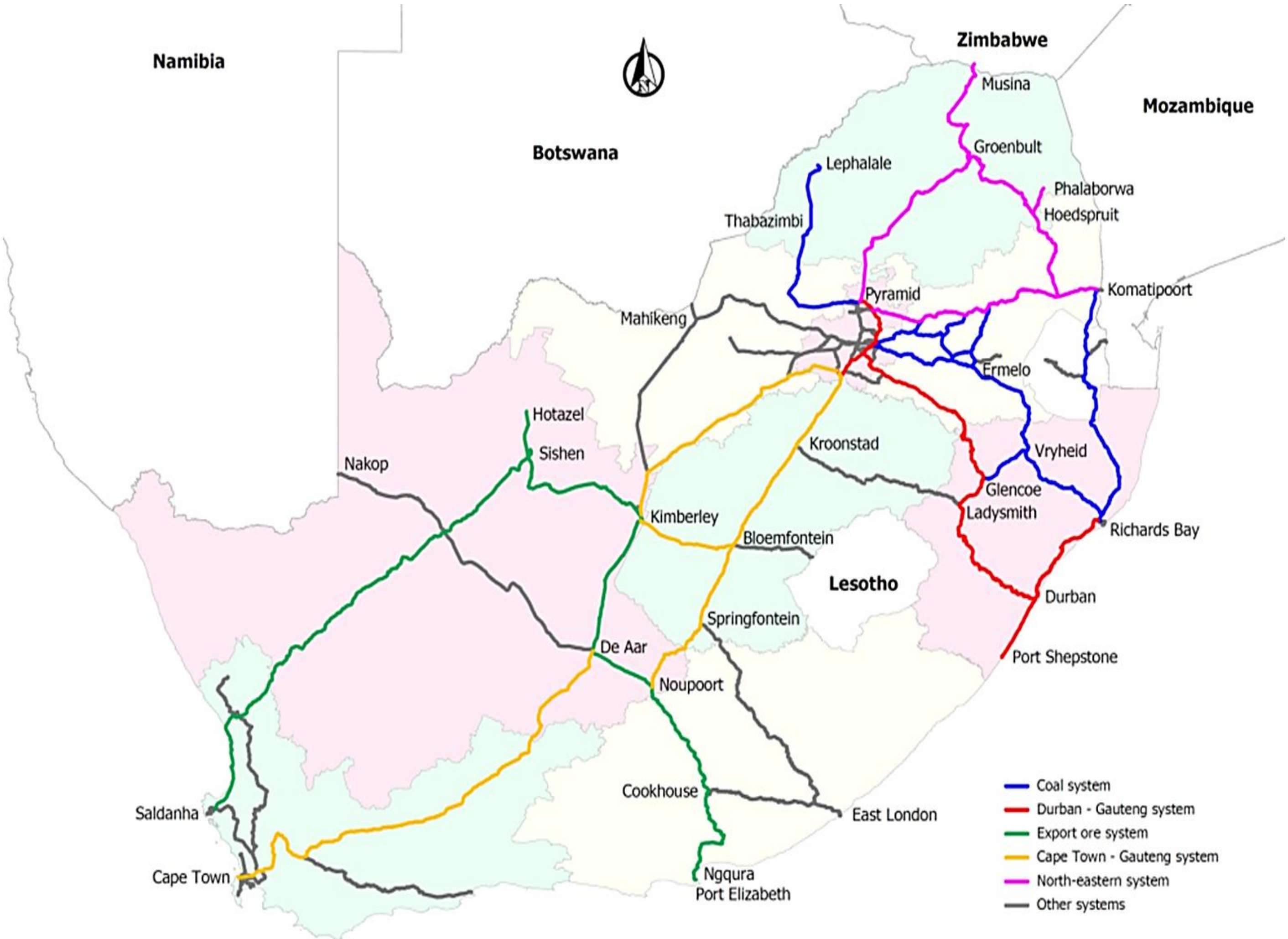


Figure 13: Core Network Systems

The core network is made up of 18 individual sections that can be rolled up to four systems:

a) Iron Ore and Manganese Systems

- Heavy haul lines linking the Northern Cape with Saldanha and Port Elizabeth/Ngqura;
- Predominantly export iron ore to Saldanha and domestic iron ore to steel plants as well as export manganese ore to Port Elizabeth/Ngqura; and
- Train size is predominantly heavy.

b) Coal System

- Feeder lines from the Mpumalanga and Lephalale areas to domestic destinations, Richards Bay and Maputo, including the proposed Swaziland link;
- Predominantly export and domestic coal, as well as domestic iron ore to steel plants. Substantial component of existing trains convey bulk traffic and the proposed Swaziland link will be aligned to this; and
- Train size is medium to heavy.

c) North-eastern system

- General freight traffic with predominantly agricultural products and fuel. Limpopo coal and other minerals are expected to increase in tonnage on this system; and
- Train size is light to medium.

d) Intermodal and general freight system

Gauteng to Durban System

- Predominantly a general freight route with containers, domestic coal, fuel and other general freight traffic; and
- Train size is light to medium.

Gauteng to Cape Town System

- Links between the Gauteng, Western Cape and Free State provinces;
- Traffic is predominantly containers, domestic coal to Saldanha and other general freight. Some container and automotive traffic to Port Elizabeth also flows on part of the route; and
- Trains are mostly light to medium.

3.1 IRON ORE AND MANGANESE SYSTEMS

3.1.1 SYSTEM OVERVIEW

3.1.1.1 Summary

The Northern Cape has substantial mineral resources. Iron ore and manganese ore are the most prominent of these. Large mining developments for domestic and export purposes are being investigated and transport requirements are anticipated to grow substantially. The Transnet network serving these commodities follows two distinct routes; Sishen to Saldanha (iron ore) and Hotazel to Port Elizabeth (manganese). The second of these consists of three line sections: Hotazel to Kimberley, Kimberley to De Aar, and De Aar to Port Elizabeth.

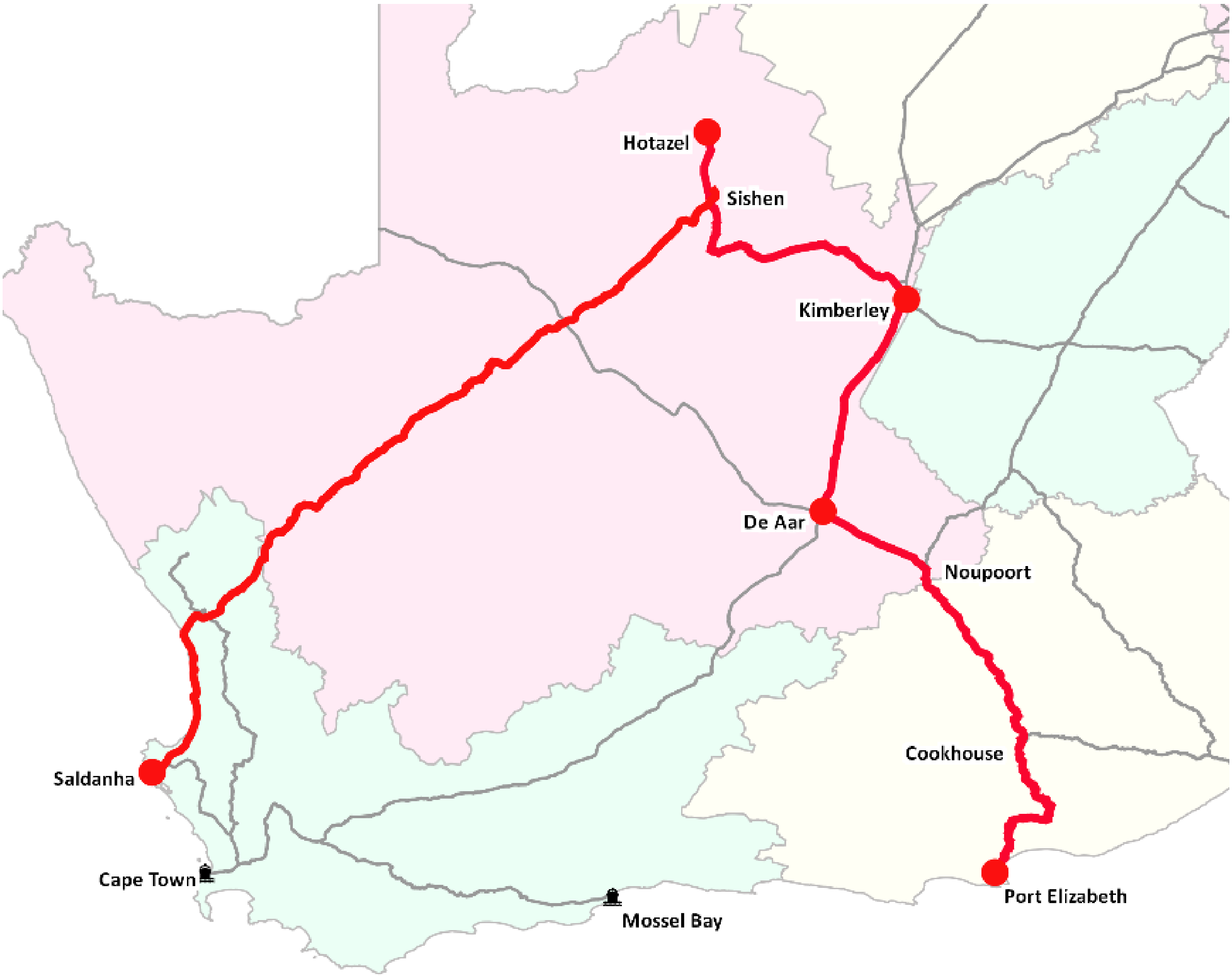


Figure 14: Iron Ore and Manganese Systems

3.1.1.2 System Description

Sishen – Saldanha

The Sishen to Saldanha railway line is an 861km long, heavy haul, single railway line, which connects iron ore mines near Sishen in the Northern Cape with the port at Saldanha Bay in the Western Cape. The line is energised at 50kV AC, carrying axle loads of up to 30t/axle. It has crossing loops designed for 342-wagon trains. Overall condition of the line infrastructure is good, taking into consideration that it carries the heaviest/axle tonnage (30t/axle). It represents a high standard of maintenance; all infrastructure components are performing well.

Hotazel - Kimberley

The Hotazel to Kimberley line is a heavy-haul link, consisting of double and single-line sections. It is electrified to 3kV and carries axle tonnages of up to 20t/axle. Crossing loops on the single-line section are designed to allow for the crossing of 104-wagon manganese ore trains.

Kimberley – De Aar

Kimberley to De Aar is a general freight section that also caters for passenger services. It consists of a single-line electrified at 25kV AC with an axle load capacity of 20t/axle. Crossing loops are designed to allow for the passing of 104-wagon manganese ore trains.

De Aar – Port Elizabeth

The De Aar to Port Elizabeth section operates as a general freight line, but also accommodates some passenger services. It is the main link between Gauteng and the Eastern Cape and is a single-line section. It is electrified to 25kV AC with a 20t/axle capacity. Crossing loops allow for 104-wagon manganese ore trains.

Notes

- The Sishen – Saldanha line is the only section of the railway network energised at 50kV AC, carrying axle loads of up to 30 tonnes. The overall condition of the line infrastructure is good and its performance is well above the network average.
- The manganese corridor's capacity is constrained by the 3kV DC system from Hotazel to Kimberley, single line from Kimberly to De Aar and both steep gradients and sharp curves on the De Aar to Port Elizabeth section.

Line properties

Section	Line type	Axle load	Traction	Train control	Sharpest curve	Steepest gradient
Sishen – Saldanha	Single	30t	50kV AC	CTC	800m	1:250
Hotazel – Kimberley	Single/Double	20t	3kV DC	CTC/RTO	302m	1:100
Kimberley - De Aar	Single	20t	25kV AC	CTC	805m	1:80
De Aar - Port Elizabeth	Single	20t	25kV AC	CTC	300m	1:100

General condition

Section	Formation	Structures	Perway	Electrical	OHTE	Signals	Telecoms	Overall
Sishen – Saldanha	🟢	🟢	🟡	🟢	🟢	🟢	🟡	🟢
Hotazel – Kimberley	🟡	🟡	🟡	🟡	🟡	🟡	🟢	🟡
Kimberley - De Aar	🟢	🟢	🟡	🟢	🟢	🟢	🟢	🟢
De Aar - Port Elizabeth	🟡	🟡	🟡	🟢	🟢	🟡	🟢	🟡

Figure 15: Export Ore system: Status quo

SECTION PERFORMANCE

Sishen – Saldanha

The Iron Ore line functions as a ring-fenced system with tight controls on rolling stock technology and condition as well as infrastructure maintenance. As a result it is the national performance benchmark. Track over bridge structures is an area of concern, however, due to the extreme temperature fluctuations in the Northern Cape and high gross tonnes traversing the lines.

Hotazel – Kimberley

Efforts are directed toward addressing critical network bottlenecks (primarily perway related) that degrade the present service and inhibit the ability to effectively absorb future traffic increases.

Kimberley – De Aar

The line infrastructure is generally in a good condition, although high levels of congestion negatively impact its performance. Performance statistics indicate that recurring telecoms issues must be addressed.

De Aar – Port Elizabeth

Perway and electrical failures are the predominant causes of capacity losses on the line. Current expansion work also contributes to delays experienced on the line.

GENERAL ISSUES

Sishen – Saldanha

The operational capacity on the ore line is constrained due to sub-optimal yard processes, power supply limitations and operational resource shortages. Once these issues have been resolved, the slot capacity on the line may be expanded by extending crossing loops.

<u>Slot capacity:</u> Current operations are near to the capacity limitations of the line. The line capacity is further constrained by the presence of manganese volumes being routed to Saldanha in the short term.

<u>Power distribution:</u> Power distribution capacity is inadequate, resulting in the continued use of diesel-electric locomotives to supplement electric locomotives in multiple unit trains. It is necessary to increase the supply capacity ahead of further increases in the number of trains on the network.

<u>Yard operations:</u> Infrastructure and operating procedures of Salkor yard do not permit sufficiently quick turnaround of trains. The recently completed Transnet FEL-2 study has identified opportunities for reconfiguration and improved working, and is further described.

Hotazel – Kimberley

The low slot capacity for long trains is the cause of congestion resulting in reduced operational capacity. Power supply capacity and locomotive reliability also strain operations.

<u>Slot capacity:</u> Near to its limits, especially between Hotazel and Sishen. In the short term, manganese is being road-hauled to Bloemfontein where it is transloaded into containers destined for Port Elizabeth harbour.

<u>Train control:</u> Systematic component replacements have already been undertaken between Kamfersdam and Postmasburg -section requires interlocking replacement.

<u>Formation:</u> Signs of subsidence are evident due to mining at Lime Acres.

<u>Telecoms:</u> Optical fibre replacements are required along the route as equipment is at the end of its service life.

3.1.2 IRON ORE SYSTEM OPERATING PHILOSOPHY

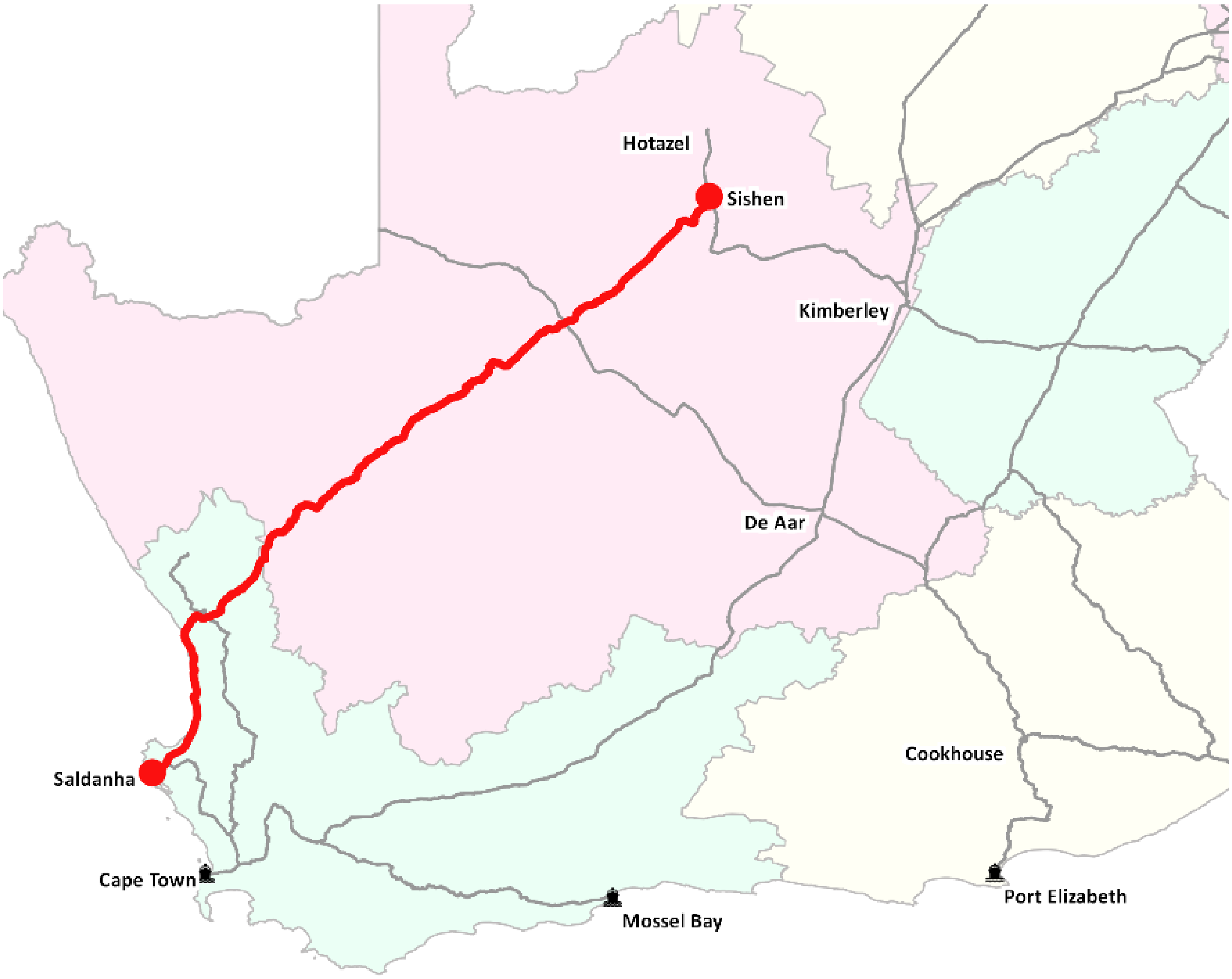


Figure 16: Export Ore System: Status Quo Map

TRAIN CONFIGURATION

- 30t/axle (maximum achieved on 1 065mm gauge)
- The 342-wagon train comprises
- 3 x114-wagon rakes, separated by three locomotive consists. Ideally 5 x Class 15E locomotives are distributed in a 2+2+1 configuration
- Variations using Class 43D and Class 9E locomotives are also prevalent
- Large portions of the route are flat and straight, suited to higher-speed operation (70 – 80km/h)
- All GFB traffic will in future be operated using Class 43D locomotives

OPERATIONS

- Operating philosophy aims to maximise the single-line configuration using heavy-haul principles
- Slot capacity will be optimised by achieving equal running times between crossings
- The line functions as a ring-fenced system and is often used as the proving ground for new technologies such as Radio Distributed Power (RDP)
- Aim is to reduce GFB slot utilisation by consolidating loads into longer trains at heavier axle loads
- Potential common user facility for the consolidation of loading operations for junior miners will enable compilation of mainline train consists
- Rolling stock maintenance and provisioning take place at the offloading terminal (Salkor)

SUPPORTING TECHNOLOGIES

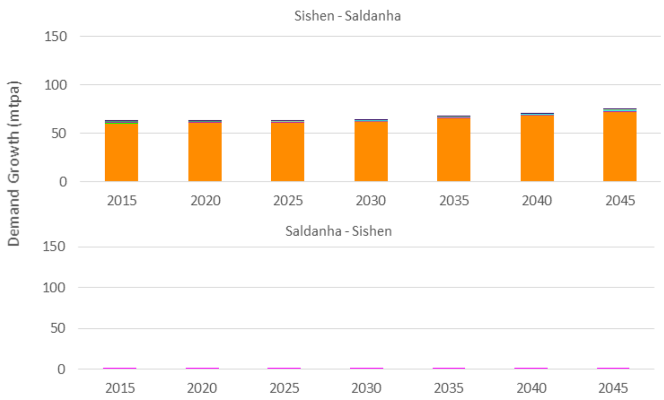
- Radio Distributed Power is used to manage the coupler forces of the 342-wagon trains
- Specially designed Class 15E Electric locomotives, 50kV AC traction and 28t/axle provide high traction effort and power capabilities. The current fleet of 76 locomotives must be increased to 90 for 71mtpa.
- CR10 bulk wagons with 100ton payload
- HS V type self-steering bogies with custom wheel profiles suited to heavy axle load 70-80km/h operation

SUPPORTING INFRASTRUCTURE

- Compilation yards
- Extension of crossing loops to beyond 4000m to reduce mainline section running times
- Additional tippler in Salkor
- Re-modelling of Salkor Yard.

3.1.3 IRON ORE SYSTEM ANALYSIS

3.1.3.1 Capacity utilisation



Commodity	2015 (mtpa)	2030 (mtpa)	2046 (mtpa)
Iron Ore Exports	59.71	62.23	72.24
Gypsum	0.17	0.25	0.47
Zircon	0.22	0.26	0.42
Titanium slag	0.43	0.18	0.23
Iron & Steel	0.14	0.18	0.23
Other Non-Ferrous Metal	0.06	0.1	0.15
Limestone	0.04	0.12	0.12
Other Manu. Industries	0	0.01	0.12
Non-Ferrous Metal Prod.	0.05	0.07	0.08
Manganese Exports	1.2	0	0

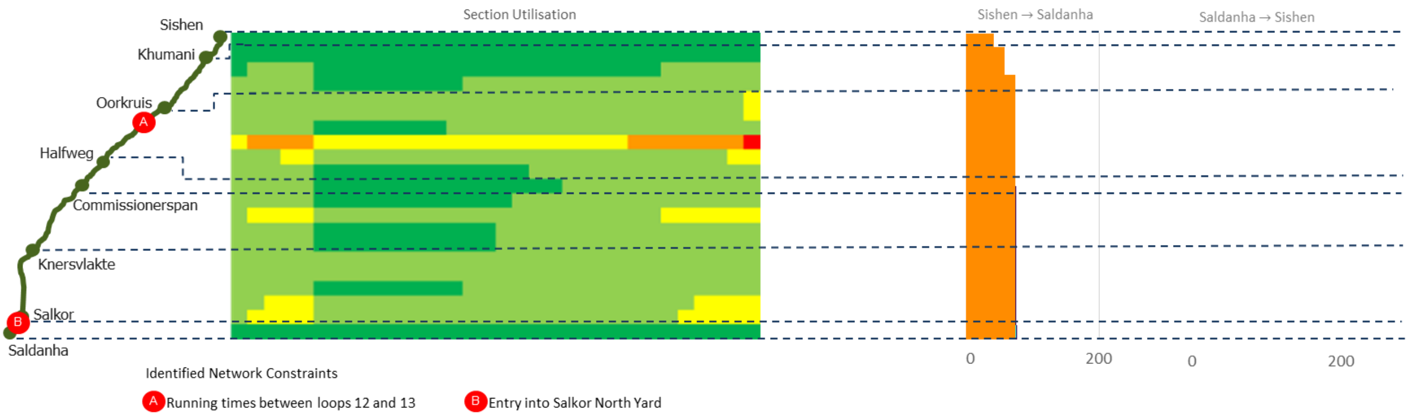


Figure 17: Iron Ore Capacity Utilisation

DEMAND

The dominant direction sees export iron ore being transported to the Port of Saldanha from the mines in the Sishen area. Volumes for iron ore rise from 55 up to 95mtpa in 2044, albeit with subdued growth for the first 10 years for a period of five years, up to 2019, manganese is present on the line, after which it is diverted to Coega port via Kimberley. The segmented view shows that nearly all the traffic is loaded near Sishen and travels the length of the line. Some coal and iron ore for domestic use leave the line at Salkor.

The opposite direction shows relatively low volumes, made up of stone, cement and industrial chemicals, most of which are used in the mines at Sishen. Some domestic iron ore also travels up the line from Khumani, which is destined for domestic plants.

3.1.3.2 Capacity Interventions

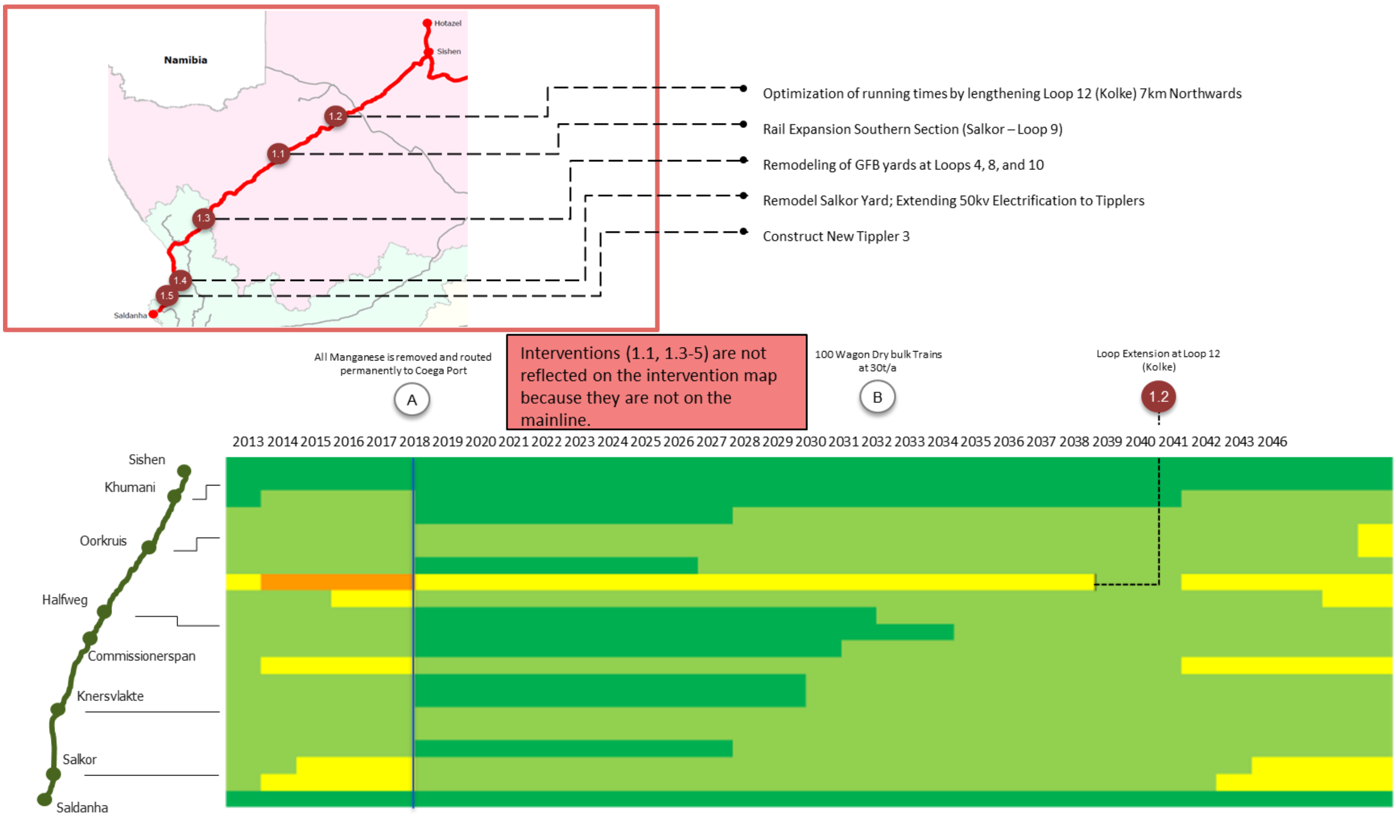


Figure 18: Iron Ore Capacity Interventions

DISCUSSION

CAPACITY DEVELOPMENT

Export Iron Ore Capacity		
Development Phase	**Trains/Week**	**Mtpa**
Current	38	60
Phase 1	45	71
Phase 2	52	82

Table 1: Iron Ore Capacity Development

- Deployment of additional resources: Additional rolling stock and train crews are required to prevent delays associated with lack of these resources and maximise infrastructure potential.
- Support infrastructure – yards, OHTE: The power supply must be expanded to support increased number of 342-wagon trains. Salkor yard will be reconfigured to streamline train processing.
- Optimise mainline infrastructure: Ore train capacity can be increased from 38 per week to 45 and later 52 by reducing section running times and creating short double-line sections.
- Large-scale intervention: Beyond 82mtpa it is anticipated that large scale infrastructure interventions will be required, potentially doubling the entire Sishen Saldanha route.

MAINLINE

- Loop 12 – Loop 13 is the constraining section on the line. By extending loop 12 to the North, the section running time will be reduced and increase the slot capacity of the line from 38 to 45 ore trains per week.
- Similar extensions to select crossing loops may further increase slot capacity to 52 trains per week in future.
- For further expansion interim crossing loops for GFB trains will be considered to allow GFB trains to run in-between ore train slots and thus increase iron ore export capacity.
- Trolley wire electrification on additional loop lines to be decommissioned as all GFB traffic to use diesel traction.

YARDS

- A common user facility will support entrance of junior miners. It will also function as a consolidation facility to prepare trains for dispatch on the mainline, therefore streamlining rail operations.
- Salkor yard facilitates 342-wagon train compilation and break-ups, air-brake tests and train inspections. Facilities within the yard provide for heavy maintenance for locomotives and wagons, locomotive provisioning and driver-exchange. As mainline capacity is expanded it will be necessary to expand Salkor yard concurrently.
- Link lines to the tipplers will be electrified to allow the electric locomotives to haul ore-wagon rakes to the tipplers.
- Salkor North arrival yard will be extended northwards towards Loop 1 to reduce the section running time.
- The GFB yard will be remodeled to improve access to the Multi-Purpose Terminal and streamline processing for ore wagon rakes.

3.1.3.3 Costing Summary

Iron Ore System — **Expansion and Investment**

Project	Intervention No.	Intervention Name	Total Value	Construction Period
Ore Line 71Mtpa	SS.1.1	Salkor - Loop 9	136	3
Ore Line 71Mtpa	SS.1.2	Loop 12 - Sishen	244	3
Ore Line 71Mtpa	SS.1.3	Additional Rail Expansion (OHTE, Signalling)	2 873	3
Ore Line 71Mtpa	SS.1.4	Salkor Yard expansion	627	3
Ore Line 71Mtpa	SS.1.5	Tippler 3		3

Development Plan

Intervention No.	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
SS.1.1			1	2	7	64	62																									
SS.1.2																				1	3	13	116	111								
SS.1.3			11	36	149	1 365	1 312																									
SS.1.4			3	8	33	298	286																									
SS.1.5																																

Table 2: Iron Ore System: Expansion and Development

3.1.4 MANGANESE SYSTEM OPERATING PHILOSOPHY

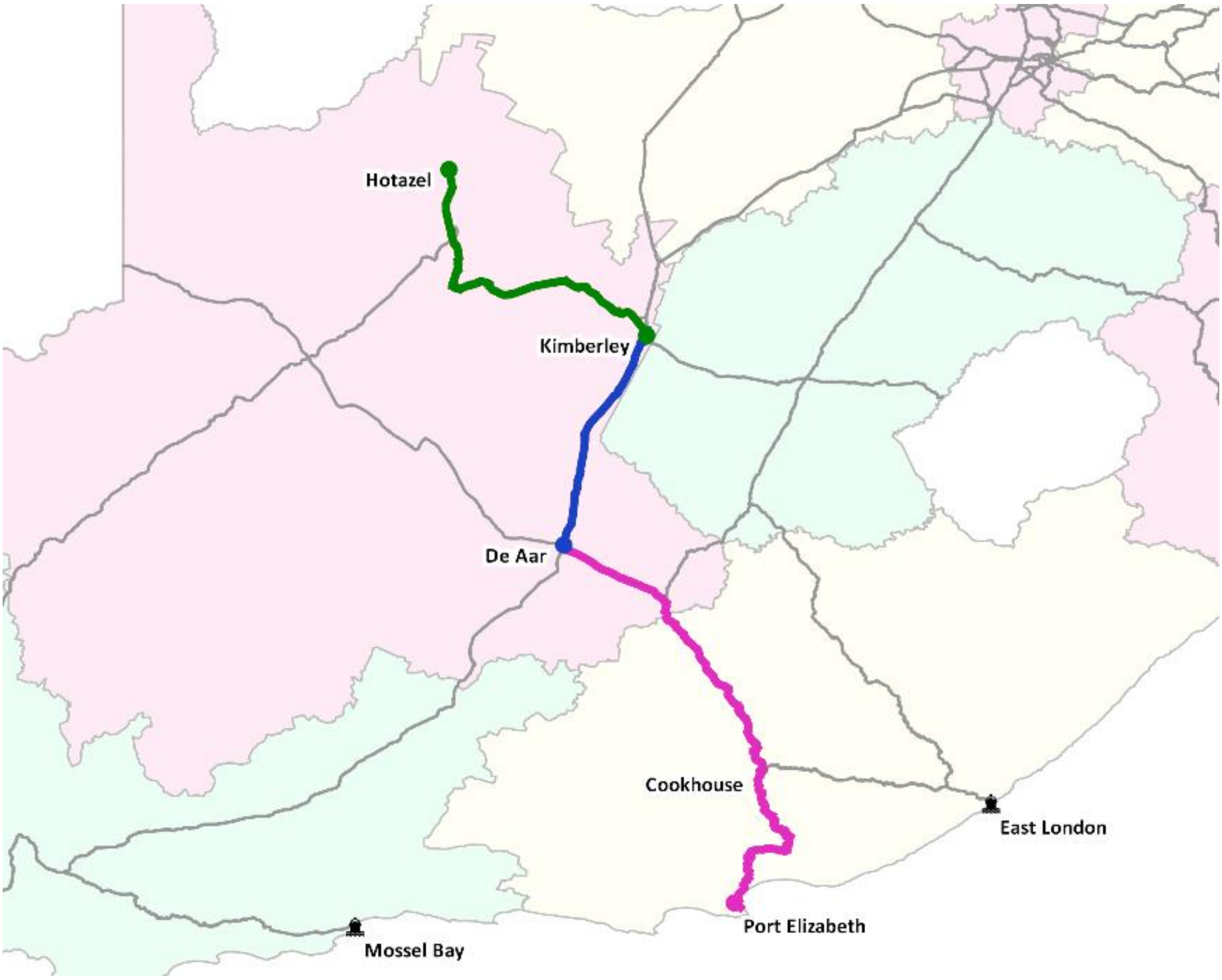


Figure 19: Manganese System

OPERATIONS

- The medium term demand forecast for manganese of less than 25mtpa over a route of 1 000km lies well within the capability of a single-line heavy-haul operation (as proven by the iron ore line between Sishen and Saldanha).
- The nature of the operation will be heavy haul, classified according to gross train mass.
- Maintain single train and traction configuration from source to destination, thereby reducing TAT and rolling stock capital requirements.
- Optimise existing operation ahead of expansion. Run more 104-wagon bulk trains, later migrating to longer trains (200-wagons).
- A common user facility to consolidate loading operations for junior miners, enabling compilation of mainline train configurations. Rakes of 100-wagons loaded by mines, compiled into 200-wagons for the mainline.
- The market for manganese exceeds the current supply capacity of the line and therefore stop-gap measures have been implemented, including road-haul to Bloemfontein where the ore is loaded into containers and railed to Port Elizabeth, and routing small parcels via the Sishen – Saldanha line.

TRAIN CONFIGURATION

- Traditionally heavy-haul lines operate at axle loads of 26t and higher, however, the cost of upgrading a route of 1 000km is prohibitive. Thus the carrying capacity of the line should be exploited by increasing train length at the current 20t/axle load limit. Beyond 16mtpa the potential for 26t/axle operation increases significantly.
- In contrast to the ore line where large portions of the route alignment are regarded as flat and straight and therefore suited to higher-speed operation (70–80km/h), the topography of the route to Coega is more challenging and is not suited to such speeds.
- Train length of 200-wagons in a 100-wagon + 100-wagon DP configuration has been identified as optimal based on optimal locomotive utilisation and length of customer facilities (104-wagons).
- Dual voltage locomotives capable of traversing AC and DC electrical sections will eliminate the need for traction changeovers and the associated delays en-route. 23E locomotives have been selected.
- To accommodate growth in container and automotive traffic, intermodal trains will be lengthened to 75 and later 150-wagon consists (or equivalent length).

SUPPORTING TECHNOLOGIES

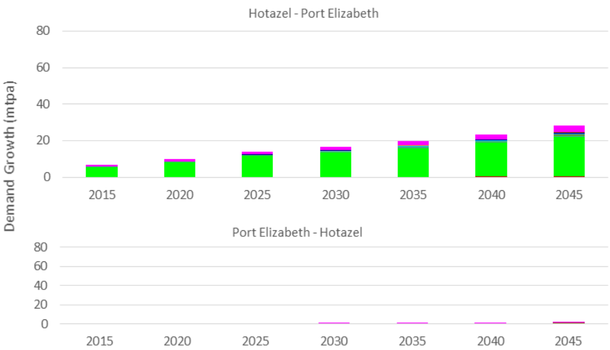
- Radio distributed power will be used to manage the coupler forces of the 200-wagon trains.
- Dual-voltage 20E and 23E locomotives will provide the high levels of tractive effort required to haul the 200-wagon consists and provide on-the-fly changeover capabilities.

SUPPORTING INFRASTRUCTURE

- Common user loading facility and compilation yards.
- Extension of crossing loops to accommodate 200-wagon bulk trains.
- Semi-doubling of Kimberley – De Aar section to provide capacity for bulk and intermodal traffic.
- On-the-fly voltage changeover at Beaconsfield.

3.1.5 MANGANESE SYSTEM ANALYSIS

3.1.5.1 Capacity Utilisation



Commodity	2015 (mtpa)	2030 (mtpa)	2045 (mtpa)
Manganese Exports	5.26	13.36	21.64
Containers	0.77	1.72	3.60
Limestone	0.45	0.55	0.89
Coal Mining Domestic	0.00	0.00	0.36
Petrol	0.05	0.27	0.35
Cement	0.06	0.16	0.31
Processed Foods	0.05	0.14	0.28
Motor vehicles and trucks	0.03	0.06	0.18
Chemicals	0.00	0.02	0.12
Other Manu. Industries	0.00	0.07	0.12

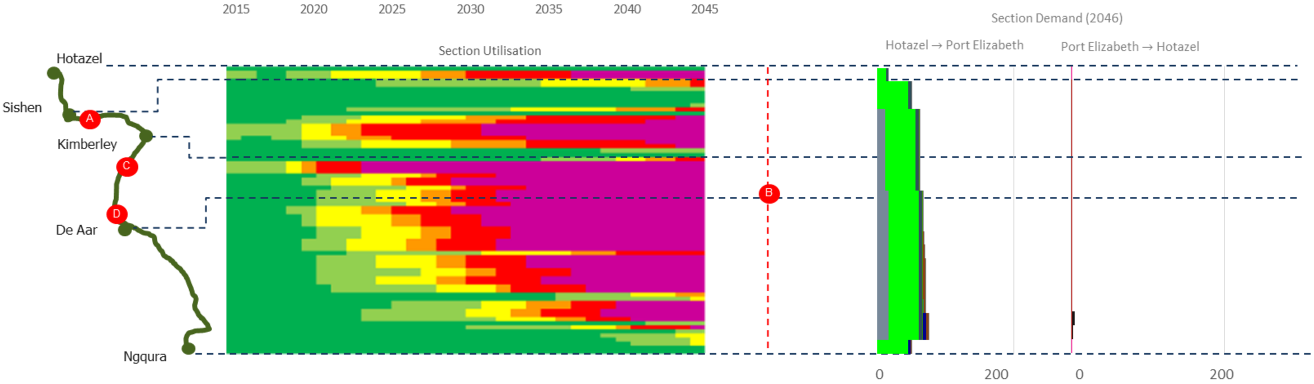


Figure 20: Manganese Capacity Utilisation

Demand

Hotazel – Kimberley

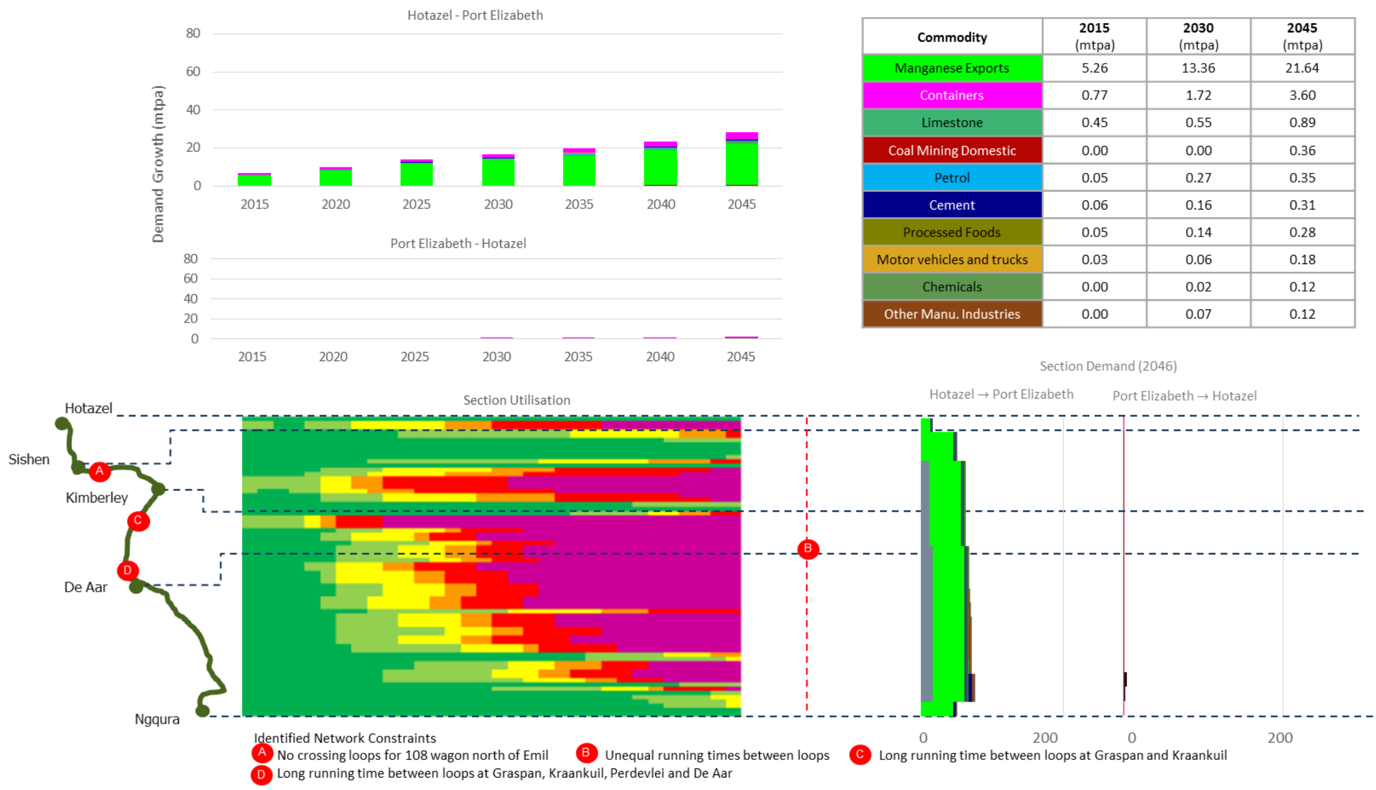
Export manganese ore and domestic ore are the major commodities on this line in the Fieldsview direction. Manganese ore ramps up quickly when Ngqura becomes fully operational. Iron ore is destined for Bijlkor and Newcastle and shows high growth over the forecast period. In the opposite direction, coal for use at the mine is the main commodity to be transported. The demand forecast for this is fairly steady and is related to the productivity of the iron ore and manganese ore mines

De Aar – Port Elizabeth

The dominant direction on this section is from De Aar to Port Elizabeth, with an aggressive ramp-up in manganese ore, reaching more than 20mtpa. After 2019 the corridor shows a growth in container traffic ramping up from 0,22 to 4,4mtpa. The remainder of the tonnage in this direction includes lime, fuel, chemicals and agricultural products.

In the opposite direction, containers also show a high growth, making up more than half of the total traffic in 2044. Motor vehicles are a commodity to note on this section with relatively large growth as well as non-iron mining and mining products.

3.1.5.2 Capacity Interventions



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Processed Foods	0.05	0.14	0.28
Motor vehicles and trucks	0.03	0.06	0.18
Chemicals	0.00	0.02	0.12
Other Manu. Industries	0.00	0.07	0.12

Figure 21: Manganese Capacity Interventions

3.1.5.3 Strategic Discussion and Implementation Discussion

DISCUSSION

CAPACITY DEVELOPMENT

Manganese Export Capacity		
Development Phase	**Trains/D**	**Mtpa**
Current	3 x 100	6
Phase 1	4 x 100	8
Phase 2	4 x 200	16

Table 3: Manganese capacity development

- Implement interim solutions: While Phase 1 work-packages are being executed manganese volumes exceeding 6mtpa are routed to Saldana and a portion road-hauled to Bloemfontein to be loaded onto rail in containers.
- Deploy additional resources: New-generation dual-voltage locomotives deployed to increase reliability and reduce TAT. To reach the current programme target of 16mtpa, approximately 1 500 CR wagons will be upgraded and another 1600 newly manufactured to accommodate the volume growth.
- Phase 1: More 104-wagon trains: Capacity for 104-wagon trains will be increased from three slots to four and later to six slots by means of additional crossing loops and semi-doubling of Kimberley – De Aar.
- Phase 2: Introduce 200-wagon trains: 4x200-wagon manganese export trains increase export capacity to 16mtpa after lengthening of crossing loops.

Hotazel – Kimberley

- The construction of a new crossing loop at Mamathwane and lengthening four other loops will increase slot capacity for long bulk trains.
- 3kV DC upgrade is necessary to supply sufficient power to operate 200-wagon trains.
- A common user facility will support entrance of junior miners. It will also function as a consolidation facility to prepare trains for dispatch on the mainline, therefore streamlining rail operations.

Kimberley – De Aar

- Long loops will provide a less capital-intensive alternative to complete doubling of the line.
- All new construction work to be done to 26t/axle standards.
- Make use of the earthworks and formation from the previously uplifted double-track where possible.

De Aar – Port Elizabeth

- OHTE and substation upgrade is necessary to support heavier 200-wagon trains.
- Difficult terrain prohibits optimal placement of 200-wagon crossing loops; as a result the Cookhouse – Golden Valley section will be doubled.
- The Klipplaat line is to be reinstated for use by automotive and passenger trains.

Yards

- Ronaldsvlei is an AC/DC exchange yard that facilitates locomotive exchange from 25kV AC to 3kV DC or vice versa. New-generation AC/DC locomotives, together with an on-the-fly changeover facility will eliminate the need for lengthy locomotive exchange procedures and reduce the fleet turnaround time.
- Coega currently services the automotive and container industries and in the future it will facilitate manganese via the bulk terminal. Current manganese offloading and shipping operations take place from Port Elizabeth harbour; however, this facility is limited to 6mtpa of bulk Manganese. Once the Coega port facility becomes fully operational, all manganese activities will move away from Port Elizabeth harbour.
- The rail facilities at Coega will be expanded to include an arrival and departures yard capable of processing 200-wagon trains, two bulk-tipplers for offloading, as well as heavy maintenance facilities for rolling stock.

3.1.5.4 Costing Summary

MANGANESE ORE SYSTEM

Manganese Ore System — **Expansion and Investment**

Project	Intervention No.	Intervention Name	Total Value	Construction Period
Manganese Line Ph 1 Expansion	MN.1.1	Loop Extension at Rosmead	2 335	3
Manganese Line Ph 1 Expansion	MN.1.2	Double 97km		3
Manganese Line Ph 2 Expansion	MN.2.1	10 Loop Extensions and 2 New Loops	10 066	4
Manganese Line Ph 2 Expansion	MN.2.2	Coega compilation yard		4
Manganese Line Expansion	MN.3.1	Double remainder of the single line sections	2 491	4
Manganese Line Expansion	MN.3.2	8 Loop Extensions and 1 New Loop	357	2

Development Plan

Intervention No.	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
MN.1.1		9	29	121	1 109	1 066																										
MN.1.2																																
MN.2.1	40	126	272	1 703	5 242	2 684																										
MN.2.2																																
MN.3.1							10	31	67	421	1 297	664																				
MN.3.2											1	4	70	281																		

Table 4: Manganese Ore System: Expansion and Development

3.2 Coal Systems

3.2.1 SYSTEM OVERVIEW

3.2.1.1 Summary

The coal system comprises a diverse mix of line types and capacities which together feed both the domestic and export markets. The most prominent line section is the heavy-haul export line between Ermelo and Richards Bay. It serves the Mpumalanga coal fields via a feeder network known as the coal backbone. The system also serves the Waterberg coal fields by means of the Rustenburg line and the Gauteng freight ring.

3.2.1.2 System Description

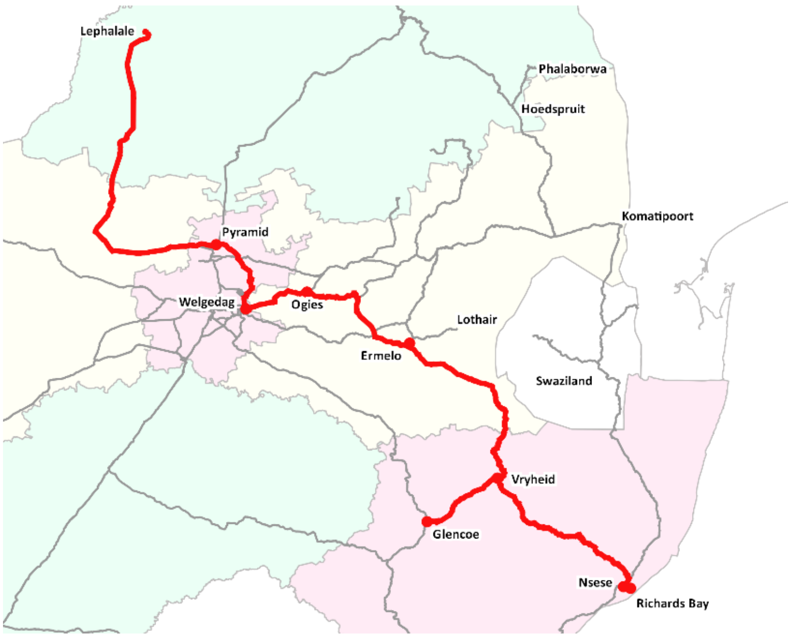


Figure 22: Coal System

Lephalale – Pyramid

The Lephalale to Pyramid link is a single- track general freight line. The section from Lephalale to Thabazimbi is non-electrified, while that from Thabazimbi to Pyramid is energised at 25kV AC. Both sections are designed to carry axle tonnage of up to 20t/axle.

Pyramid – Ogies

This section is primarily double-tracked with isolated sections of single-track totalling 40km. The line has a maximum loading of 20t/axle and is electrified at 3kV DC. The line carries mixed traffic; including coal, CAB, GFB and passenger trains.

Ogies – Ermelo

The Welgedag to Ermelo section is a mixed double and triple track, energised at 3kV DC. Between Ogies and Broodsnsyersplaas, two lines have an axle load capacity of 20t/axle with a third at 26t/axle. The double-track between Broodsnsyersplaas and Ermelo operates at 26t/axle.

Ermelo – Richards Bay

The Ermelo to Richards Bay section forms the southern part of the coal line, carrying mainly heavy-haul traffic with some general freight. The line section is double, with the exception of the Overvaal tunnel, which is currently single. The line is electrified to 25kV AC and supports 26t/axle loading.

Notes

- The system consists of both heavy haul and light axle load capacity sections
- Section 3 is a heavy-haul coal export line from Ermelo to Richards Bay
- Clay soil formation on parts of Section 1 inhibits axle load capacity increase on that section
- Planned maintenance activities on the Welgedag – Richards Bay section will address the Perway condition through the replacement of rail, sleepers, ballast and turnouts
- The outdated telecoms infrastructure needs to be replaced in the next seven years

Line properties

Section	Line type	Axle load	Traction	Train control	Sharpest curve	Steepest gradient
Lephalale – Pyramid	Single	20t	Diesel/25kV AC	TWS	200m	1:75
Pyramid - Ogies	Double	20/26t	3kV DC	CTC	153m	1:100
Ogies - Ermelo	Double	20/26t	3kV DC	CTC	153m	1:100
Ermelo – Richards Bay	Double	26t	25kV AC	CTC	550m	1:160
Glencoe – Vryheid	Single	20t	3kV DC	RTO	200m	1:66

General condition

Section	Formation	Structures	Perway	Electrical	OHTE	Signals	Telecoms	Overall
Lephalale – Pyramid	●	●	●	●	●	●	●	●
Pyramid - Ogies	●	●	●	●	●	●	●	●
Ogies - Ermelo	●	●	●	●	●	●	●	●
Ermelo – Richards Bay	●	●	●	●	●	●	●	●
Glencoe - Vryheid	●	●	●	●	●	●		●

Figure 23: Coal System: Status Quo

SECTION PERFORMANCE

Lephalale – Pyramid

The section performance of the line is slightly below the network average. The clay soil conditions prevalent on this section limit its ability to sustainably support future traffic growth or increases in axle load. A single train control system is not present for the entire route, portions utilising colour-light-signalling and others Track-Warrant. As traffic ramps-up in the short term a unified system with higher capacity will be considered.

Ogies – Ermelo

The performance of this section is below the network average. Power supply issues need immediate attention in order to sustain current traffic levels and accommodate future traffic. Signalling and telecoms failures contribute to poor performance levels, which further adds to congestion and delays on the route.

Ermelo – Richards Bay

The line is plagued by power supply constraints and frequent outages, resulting in operational delays. The colour-light signaling system is at the end of its service life and is due for replacement in the near future.

GENERAL ISSUES

Lephalale – Pyramid

Slot capacity: constrained due to electrification and short passing loops.

Complex shunting operations to and from chrome and ferrochrome loading sites consumes a significant portion of the available slot capacity on the line. Speed restrictions across public level crossings increase the section running times and result in both capacity loss and longer rolling stock turn-around time.

Formation: accelerated sleeper replacement required. Extensive clay formation issue prevents increase to 26t/axle design.

Pyramid – Ogies

Slot capacity: constrained due to electrification and mixed double- single-track operation.

Interoperability: Diverse mix of bulk, GFB and CAB traffic, as well as passenger trains limit the opportunities for standardisation and optimisation

Ogies – Ermelo

Electrical: Inadequate power supply on the 3kV DC network constrains the capacity for 100-wagon coal trains as they must be spaced sufficiently far apart to prevent faults such as breaker trips.

Slot capacity: The short running times between signals result in a high theoretical slot capacity, but this cannot be fully leveraged due to power supply constraints, and the complexities associated with accessing loading sites, having only one out of the three lines at 26t/axle.

Ermelo – Richards Bay

Electrical: Power supply constraints impose restrictions on train scheduling and contribute to train delays.

Signalling: The colour-light signalling system is nearing the end of its service life and is due for replacement/ refurbishment. This should be done in conjunction with the plans for increased slot capacity and reduced travel time as afforded by the new-generation dual-voltage locomotives.

Slot Capacity: The maximum capacity for 200-wagon export trains (16 per day) is limited by the single-track section through the Overvaal tunnel and power supply limitations.

Resources: Locomotive and train crew shortages frequently delay train departures. The delivery of 21E locomotives during 2015/16 will aid in this regard.

The delays resulting from power supply constraints, as well as resources shortages (locomotives, and train drivers) have caused a 2-on-1-off scheduling philosophy to be adopted for 200-wagon trains. Therefore, every third 200-wagon slot is reserved for catch-up purposes rather than normal running.

MAINTENANCE INTERVENTIONS

During the course of 2015 the replacement of various turnouts, sleepers, rails, track switch structures, section insulators, and signal components is planned. The obsolete WILMA system will also be replaced. Formation and drainage rehabilitation are planned for 2015 in addition to the upgrade of transformer cubicles in relay rooms.

3.2.2 OPERATING PHILOSOPHY

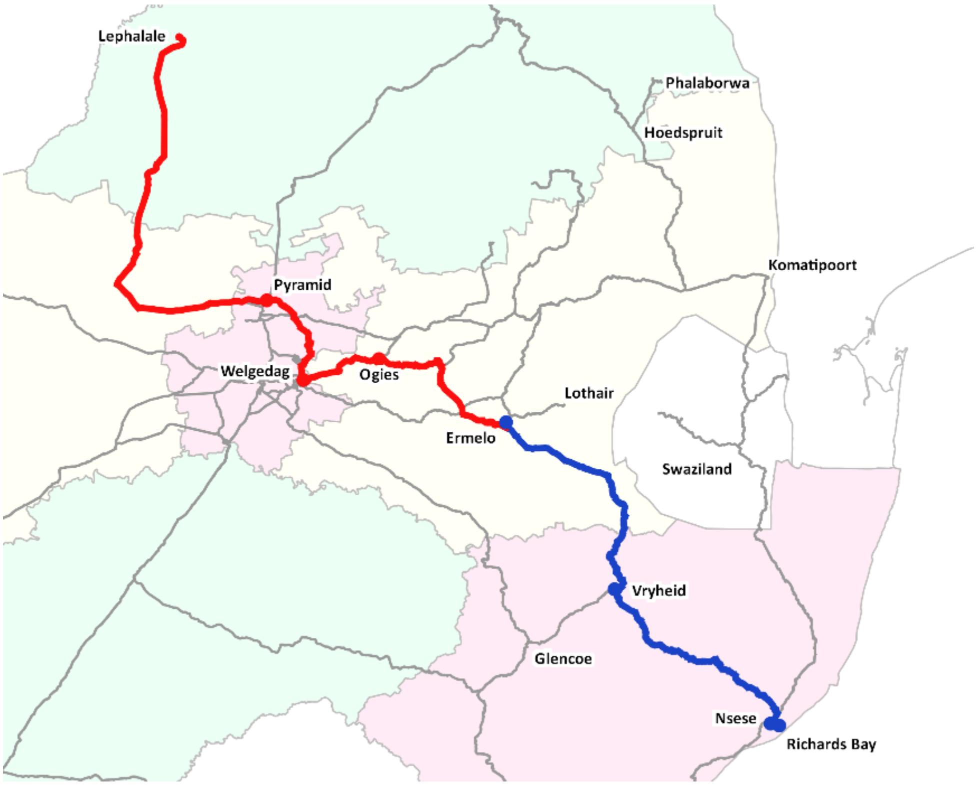


Figure 24: Coal System

Operations

- The coal system comprises a diverse array of line sections with diverse design criteria, resulting in complex operations.
- The unlocking of the Waterberg and Botswana coal reserves require improvements in efficiency because of the increased haulage distance. Two major programmes are the upgrade of the current Lephalale line and the construction of a Greenfields Heavy Haul line.
- The mix of 20t/axle and 26t/axle loading will remain in the short-medium term; however, the potential heavy line at 26t/axle will increase efficiencies to Waterberg.
- Aspirations are to standardise train lengths to 200-wagons for export and 100-wagons for domestic traffic, enabled through various railway technologies such as WDP and ECP.
- To improve capacity utilisation corridors will be dedicated for specific commodity types: Coal: Ermelo – Richards
- Bay GFB: Swaziland Rail.
- Maintaining scheduled railway operations are key.
- For double-lines, normal operation should be as independent down and up lines, crossing trains only during emergencies/maintenance downtime or to access sidings.
- Crew change locations will be selected to optimise shift lengths and minimise total TAT.
- Common-user facilities will enable trains to be consolidated near to source and ahead of mainline operation.

TRAIN CONFIGURATION

- Standardise train length and gross train mass.
- 200-wagon 12 000nt and 16 800nt for export coal.
- Avoid train configuration change en-route except near-source consolidation such as a common-use facility (bypass Ermelo yard, electrify Lephalale – Thabazimbi).
- Locomotives remain coupled to trains throughout, including load-out and RDP consolidation site.
- Rolling stock maintenance and provisioning facilities will be situated at ports/offloading terminals.

SUPPORTING TECHNOLOGIES

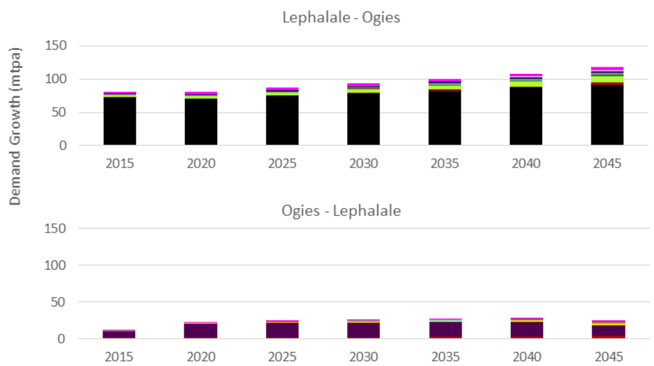
- CCL jumbo wagons purpose designed to optimise carrying capacity for coal.
- Dual-voltage locomotives (19E, 21E, 22E, 23E) with on-the-fly changeover capability.
- Wire-distributed- power (WDP) allows drivers to effectively manage high coupler forces for heavy trains on steep grades.
- Electronically-controlled- pneumatic (ECP) braking systems improve train control.
- Mixed-traction diesel and electrically powered trains will assist to overcome short term power limitations.
- Line-side ITCMS.

SUPPORTING INFRASTRUCTURE

- On-the-fly-changeover at Ermelo, Pyramid South, and Vryheid.
- Increased loop length for 200-wagon trains on the Lephalale line.
- Electrification of Lephalale – Thabazimbi.
- New double-track tunnel at Overvaal. Grade separations at Ilangakazi and Sikame.
- Increased OHTE and power supply capacity on all routes.
- Potential conversion of 3kV DC network between Ogies and Ermelo to 25kV AC.

3.2.3 LEPHALALE – OGIES ANALYSIS

3.2.3.1 Capacity Utilisation



Commodity	2015 (mtpa)	2030 (mtpa)	2046 (mtpa)
Coal Mining Exports	71.95	78.43	91.05
Coal Mining Powerstation	8.34	19.51	14.00
Chrome	2.84	4.89	9.09
Containers	3.18	4.09	5.29
Ferrochrome	1.48	2.11	3.48
Coal Mining Domestic	0.66	1.24	3.44
Magnetite	0.32	1.16	2.62
Chemicals	0.74	1.33	2.28
Stone	0.05	0.34	1.32
Pulp of wood and paper	0.05	0.52	0.87

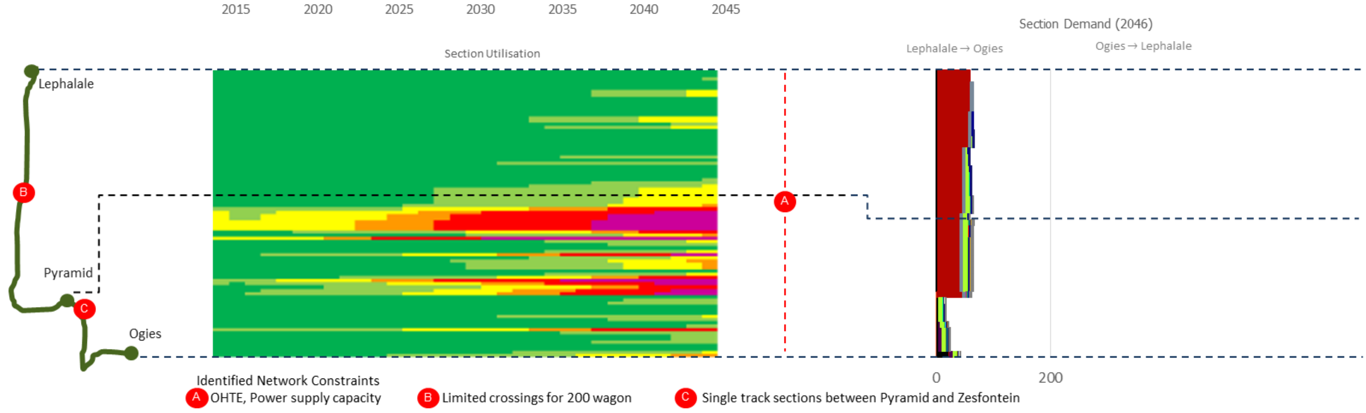


Figure 25: Lephalale – Ogies Capacity Utilisation

]

DEMAND

The section displays the ramp-up in Waterberg coal exports, which provides the majority of the tonnage over the section. Volumes of export coal reach 104mtpa, as they gradually replace Mpumalanga coal. Domestic coal and iron ore are also volume contributors and travel the length of the section.

3.2.3.2 Capacity Interventions

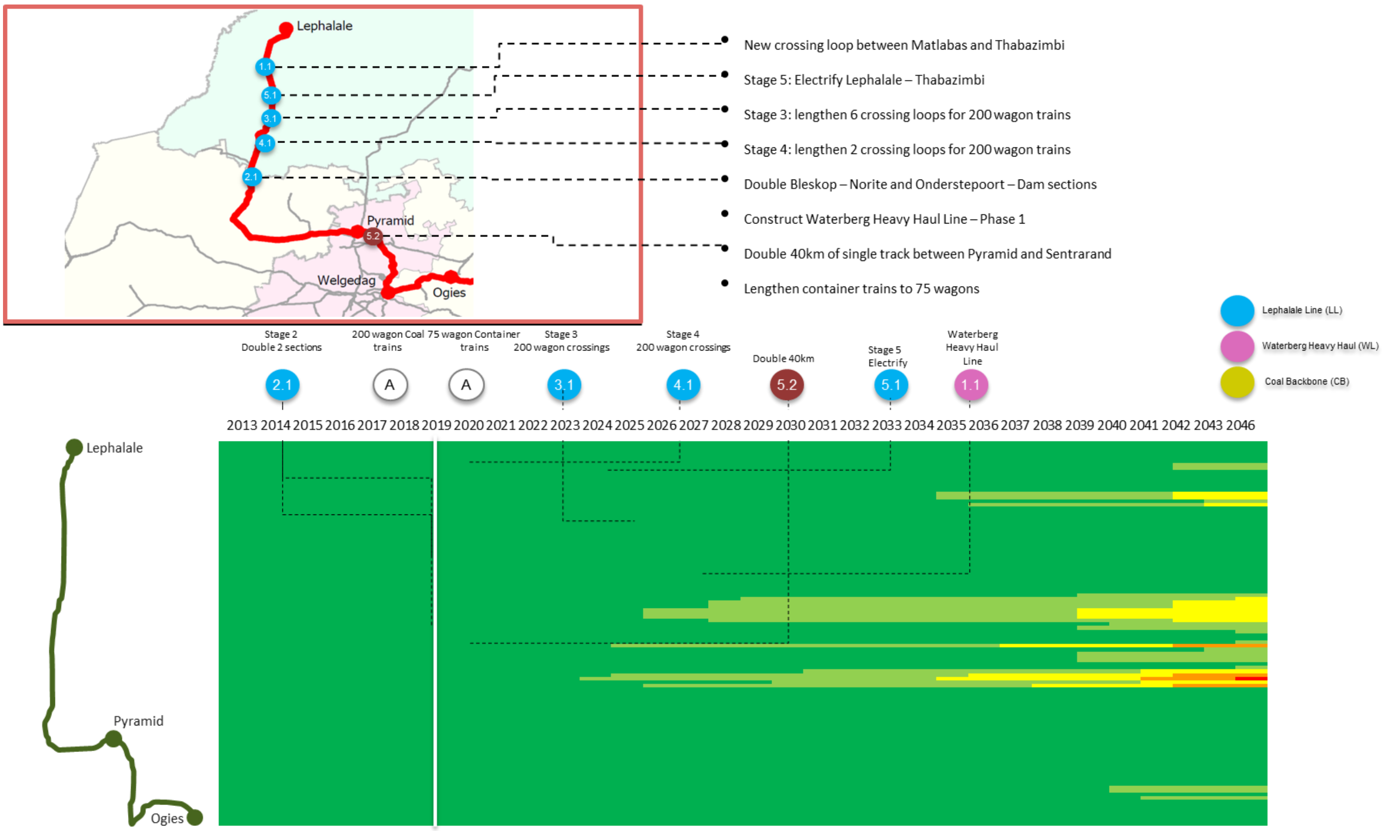


Figure 26: Lephalale – Ogies Capacity Interventions

3.2.3.3 Strategic Discussion and Implementation Discussion

DISCUSSION

CAPACITY DEVELOPMENT

Export Coal Capacity		
Development Phase	Trains/day	mtpa
Stage 1	1x100	2
Stage 2	3x100	6
Stage 3	3x200	12
Stage 4	6x200	24

Table 5: Lephalale – Ogies Export Coal Capacity

- Stage 1: 1 x 100-wagons: Lengthen Matlabas crossing loop to accommodate 100-wagon export coal train
- Stage 2: 3 x 100-wagons: Increase the number of 100-wagon trains to three.
- Stage 3: 3 x 200-wagons: Lengthen trains to 200-wagons using DP. Requires longer crossing loops and the double-tracking of freight ring.
- Stage 4: 6 x 200-wagons: Maximum carrying capacity of the existing line.
- Heavy-haul line: Migrate operations to newly-constructed heavy-haul line (26t/axle), offering greater capacity and higher levels of efficiency.

Lephalale – Pyramid

- The line may be upgraded to 24mtpa of coal through upgrades to run 200-wagon, 20t/axle trains using DP.
- Line capacity will be expanded from 1 x 100-wagon train to 6 x 200-wagons in stages.
- The electrification of Lephalale – Thabazimbi (stage 5) will eliminate the need for time-consuming traction change at Thabazimbi. Power supply constraints prevent all-electric traction, requiring 200-wagon trains to have mixed diesel-electric traction.
- The design criteria of the line does not support high-efficiency, high volume bulk exports, therefore an alternative single-track heavy-haul line is planned with 26t/axle and flatter gradients. The capacity of the line at Phase 1 is estimated to be 35-40mtpa.
- Strategic short-sections are to be doubled to accommodate movements of chrome and ferrochrome trains.

Pyramid – Ogies

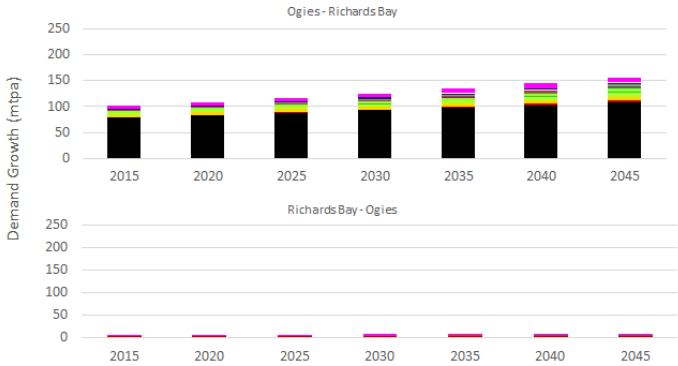
- Section is dominated by GFB, CAB traffic, and significant growth in these is anticipated. 40km of single-track requires doubling to increase line capacity and smooth scheduling operations.
- Intermodal train lengths are to be increased to 75 and later 150-wagon on the freight ring section to create additional capacity ahead of doubling.

Yards

- Sites in the Rustenburg area have been identified for multi-user facilities to facilitate in the collation of traffic from various chrome and ferrochrome clients. This will assist with reducing the number of loose locomotives that collect traffic from various locations and occupying slots on the mainline.
- Installation of an on-the-fly changeover facility at Pyramid South, together with new-generation dual-voltage locomotives will eliminate the need for traction changeover

3.2.4 OGIES – RICHARDS BAY ANALYSIS

3.2.4.1 Capacity Utilisation



Commodity	2015 (mtpa)	2030 (mtpa)	2045 (mtpa)
Coal Mining Exports	78.43	82.63	107.41
Containers	5.57	5.92	9.46
Chrome	2.84	3.56	9.13
Magnetite	4.57	5.22	6.20
Rock Phosphate	2.68	2.94	5.78
Coal Mining Domestic	1.07	1.29	4.64
Ferrochrome	1.48	1.59	3.48
Pulp of wood and paper	2.45	2.45	3.45
Chemicals	0.78	0.97	2.37
Titanium slag	0.65	0.73	1.39

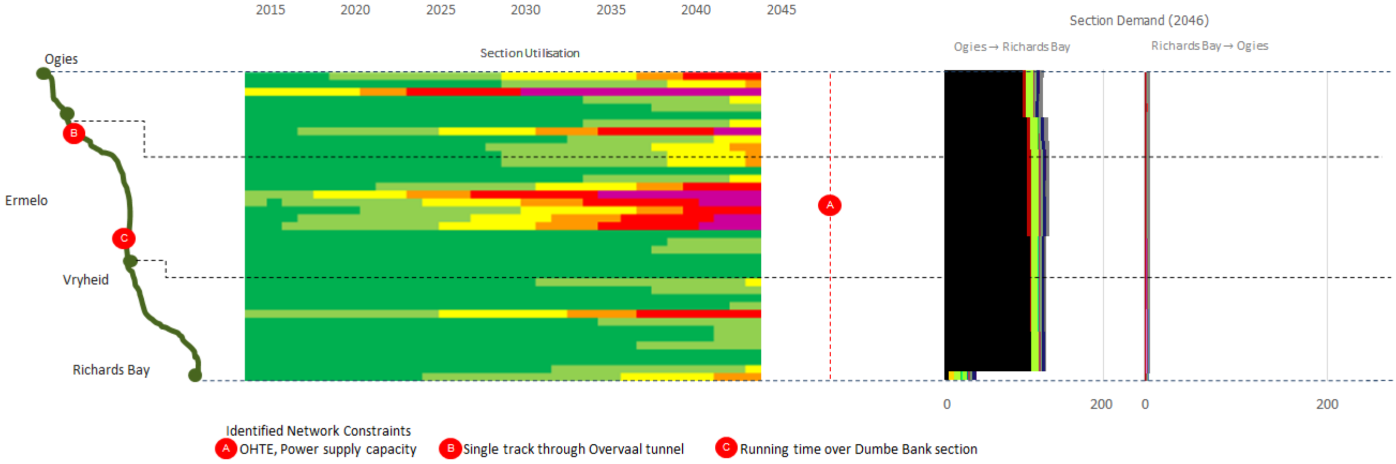


Figure 27: Ogies – Richards Bay Capacity Utilisation

DEMAND

The volumes are dominated by export coal towards Richards Bay and domestic destined for various power stations. General freight and containers show some growth, but this is constrained by the large volumes of coal. Export coal ramps up from 60mtpa to 104mtpa on this section over the next 30 years.

South of Ermelo traffic is further dominated by export coal. Traffic towards hinterland destinations show much lower projections than north of Ermelo, as the power station coal is not present on this section. Containers and other non-iron based mining show rapid growth, although ultimate tonnages are low.

3.2.4.2 Capacity Interventions

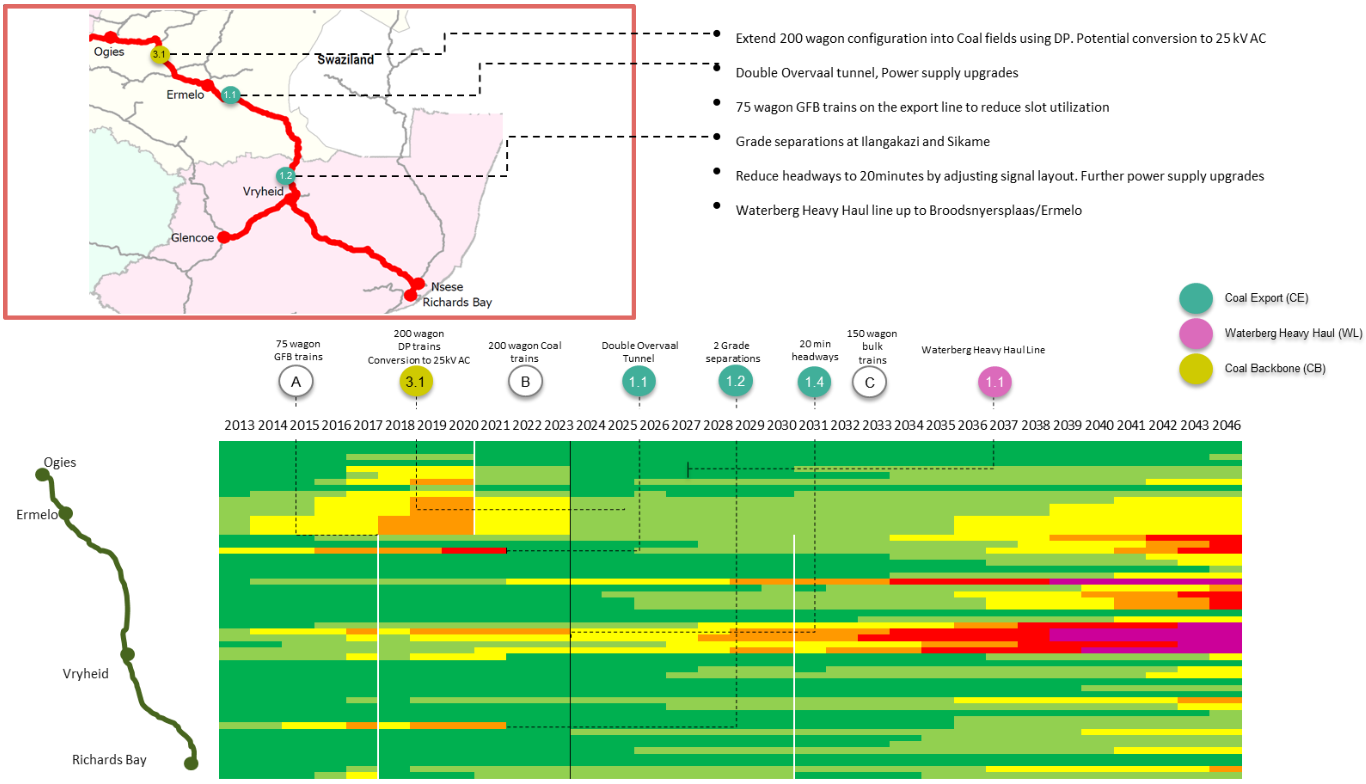


Figure 28: Ogies – Richards Bay Capacity Intervention

3.2.4.3 Strategic Discussion and Implementation Discussion

DISCUSSION

CAPACITY DEVELOPMENT

Coal Export Capacity		
Development Phase	**Trains/Day**	**Mtpa**
Improve Operations	14x200	76
Sustainability Improvements	16x200	87
Double Track	20x200	108
GFB Rerouted	24x200	130

Table 6: Ogies – Richards Bay Coal Export Capacity

- Improve operations, deploy additional resources: Lengthen GFB trains to 50 and 75-wagons. Deploy new-generation locomotives in DP configuration (14 x 200W).
- Sustainability improvements: Increase traction power supply, refurbish signalling system (16 x 200W).
- Extend 200-wagon operation: 200-wagons operated from source, potential conversion to 25kV AC.
- Revised double-track operation: Overvaal tunnel, Grade Separations, increase power supply, reduce headways (20 x 200W).
- Expand feeder network: Second and third 26t/axle lines from Ogies, Broodsnyersplaas.
- Divert GFB: GFB diverted to the dedicated corridor through Swaziland (24 x 200w).

Ogies – Ermelo

- This section is saturated by coal trains up to 100-wagons in length (domestic and export) as well as GFB traffic. WDP has the potential to enable operation of 200-wagon trains on this section, which has steeper grades than the section south of Ermelo.
- The operation of 200-wagon trains to and from the loading sites as a pit-to-port strategy aims to reduce en-route delays and fleet turnaround time.
- Power supply limitations constrain current operations and require upgrades. To accommodate 200-wagon DP trains here a conversion to 25kV AC electrification is under investigation.
- Complex scheduling and routing to the numerous loading sites reduces capacity available for mainline operations. This, in combination with the planned volumes to Majuba and Tutuka powerstations, necessitates the upgrade of one of the 20t/axle to Broodnsyersplaas to 26t/axle and a new line to Ermelo. It is planned to upgrade one of the existing 20t/axle lines to 26t/axle by constructing short deviations while formation upgrades take place.

Ermelo – Richards Bay

- The ongoing Coal 81 programme will upgrade all system components to reliably sustain 81mtpa export coal traffic. It is imperative that this be achieved before large-scale investment into infrastructure expansion is undertaken.
- Project Shongololo has implemented the first phase of DP working, reducing the train processing time required in Ermelo. Further gains in this area are necessary to reduce the delays associated with train compilation and increase locomotive productivity.
- Power supply capacity in conjunction with the single-track Overvaal tunnel restricts capacity to 16 export trains per day. Increasing power supply and doubling the Overvaal tunnel are required to exceed 81mtpa capacity.
- Signal spacing of 20-25 minutes must be reduced to 20 minutes in future. This, together with the doubling of the Overvaal tunnel and power-supply upgrades will raise the potential number of long-coal-train slots from 16 to 24.
- The separation of coal and GFB operations enabled by the planned GFB corridor via Swaziland will optimise coal operations and release a portion of line capacity for coal trains.

Yards

- Ermelo yard currently serves as a preparation facility for compiling and breaking-up 200-wagon head-end power coal trains. It also serves as an exchange yard for switching from 3kV DC to 25kV AC traction and provides light to medium locomotive and wagon maintenance.
- To reduce the turnaround time an on-the-fly voltage changeover facility has been installed, allowing new-generation locomotives to transition directly from DC to AC traction systems. The facility layout will be reconfigured to suit the compilation of distributed power trains.
- Richards Bay harbour yard (Skoonkaai) is the main staging yard of commodities destined for various dedicated port facilities. As mainline capacity is expanded it will be necessary to remodel the yard to provide rapid transitioning of trains by means of the following:
  a) Construction of a balloon;
  b) Replacing current tipplers with twin cell rotary tipplers;
  c) Develop a new break bulk stock yard; and
  d) Reconfiguration of Bizholo yard for 100-wagon trains.

3.2.4.4 Costing Summary

COAL ORE SYSTEM

Project	Intervention No.	Intervention Name	Total Value	Construction Period
Stage 1	LL.1.1	Lengthen Matlabas Loop	21	2
Stage 3	LL.3.1	Lengthen 6 loops for 200W	1 414	2
Stage 4	LL.4.1	Lengthen 3 crossing loops for 200W	803	3
Stage 5	LL.5.1	Electrify Lephalale - Thabazimbi	1 125	2
Bulk Minerals Expansion	LL.6.1	Multi-User facility	1 125	2
Waterberg Heavy Haul Line Ph 1	WL.1.1	Phase 1: Greenfields Construction	27 463	7
Botswana Link	WL.3.1	Greenfields construction	4 520	4
3rd Lines Ogies - Ermelo	CB.1.1	3rd Line		
Upgrade 2nd line to 26t/a	CB.2.1	2nd 26t/a line	4 144	7
Convert to 25kV AC	CB.3.1	Convert DC to AC		
Overvaal Tunnel	CE.1.1	Double the Overvaal tunnel	4 023	5
Overvaal Tunnel	CE.1.2	Grade separations at Ilangakazi and Sikame	550	3
Overvaal Tunnel	CE.1.3	Upgrade the power supply near Ermelo		3
Overvaal Tunnel	CE.1.4	Resignal to 20 min headways		3
Port Link Expansion	CE.2.1	Expand link between Nses and RCB Port	725	4

Development Plan

Intervention No.	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
LL.1.1			4	17																												
LL.3.1		6	18	277	1113																											
LL.4.1		3	10	42	382	367																										
LL.5.1							4	14	221	885																						
LL.6.1							4	14	221	885																						
WL.1.1					110	343	417	431	1739	5 599	9 431	8280	1111																			
WL.3.1						18	56	122	765	2354	1205																					
CB.1.1																																
CB.2.1		17	52	63	65	262	845	1 423	1 249	168																						
CB.3.1																																
CE.1.1		16	50	86	242	1147	1833	648																								
CE.1.2		2	7	29	262	251																										
CE.1.3																																
CE.1.4																																
CE.2.1	9	20	123	378	193																											

Table 7: Coal System: Expansion and Development

3.3 NORTH-EASTERN SYSTEM

3.3.1 SYSTEM OVERVIEW

3.3.1.1 Summary

The Bulk Minerals system is a developing system focused on connecting hinterland mineral mining areas with the eastern seaboard ports of Richards Bay and Maputo. The system is consists of the Groenbult/Phalaborwa line to Kaapmuiden, a portion of the eastern mainline toward Komatipoort and the line from Komatipoort to Richards Bay via Swaziland. In future, the system will also include the planned Swaziland Rail Corridor, and serve the chrome and ferrochrome systems in the North West province.

The lines from Gauteng to Musina and Komatipoort also form part of the North-eastern system and are the main routes to Zimbabwe and Mozambique respectively. These routes carry primarily intermodal and general freight traffic.

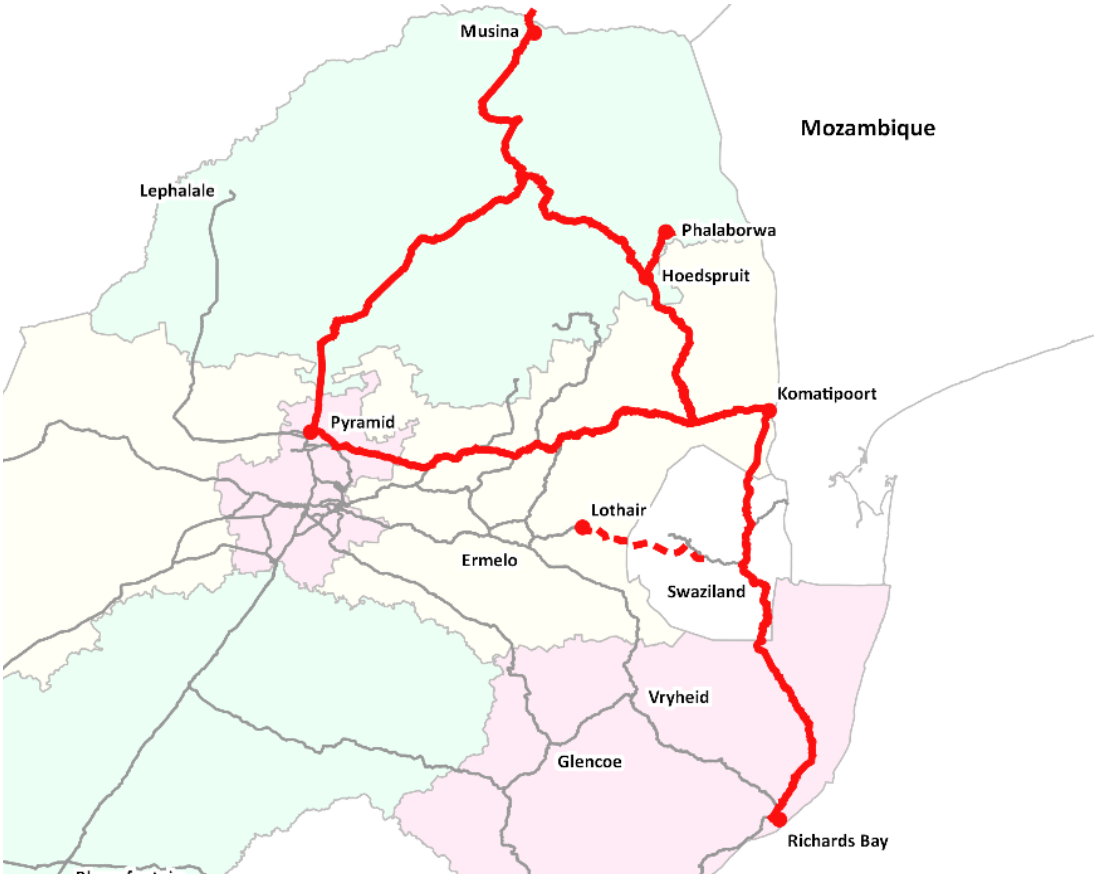


Figure 29: North-eastern System

Musina – Pyramid

Musina to Pyramid is a general freight line, consisting of single and double-line sections. The double-line section is energised at 25kV AC and is from Polokwane to Pyramid. The single-line section is non-electrified and is from Musina to Polokwane. Both sections carry 20t/axle loads.

The overall condition of the existing railway line infrastructure is acceptable and all infrastructure disciplines are performing adequately, with the exception of formation and perway, which are poor relative to network averages.

Groenbult – Kaapmuiden

Groenbult to Kaapmuiden carries general freight and is a single-line section with passing loops. The section operates in two main sections; non-electrified section from Groenbult to Hoedspruit, recently upgraded to carrying 20t/axle loads, and a 3kV DC electrified section from Phalaborwa to Kaapmuiden.

Bulk exports of Magnetite and Phosphates dominate this line section. The route was previously electrified at 3kV DC but the OHTE and power supply systems have subsequently been decommissioned and only diesel traction is used.

Greenview – Komatipoort

Greenview to Komatipoort is a general freight single-line section, electrified at 3kV DC and carrying 20t/axle. This section links Gauteng with Mozambique and Richards Bay via Swaziland.

Komatipoort – Richards Bay

The Komatipoort to Richards Bay section is a general freight, single-line, which connects Komatipoort to the port at Richards Bay through Swaziland. It has an axle load capacity of 20 tonnes; crossing loops for 75 CR-type wagon trains.

Notes

- The system includes the Musina to Pyramid, Groenbult to Kaapmuiden and Greenview to Komatipoort as major sections
- The Greenview to Komatipoort section's capacity is limited to 50 wagon trains due to the very sharp curves and steep gradients of the horseshoe at Waterval Boven
- The section north of Polokwane is constrained by the few opportunities for crossing trains
- Poor infrastructure condition on the Groenbult to Hoedspruit section relating to sharp curves, steep gradients, poor telecoms coverage and obsolete perway materials impacts severely on train operations

Line properties

Section	Line type	Axle load	Traction	Train control	Sharpest curve	Steepest gradient
Musina – Pyramid	Single/Double	20t	Diesel/25kV AC	TWS/CTC	200m	1:50
Groenbult – Kaapmuiden	Single/Double	18.5t/20t	Diesel/3kV DC	TWS/CTC	160m	1:66
Greenview - Komatipoort	Single	20t	3kV DC	CTC	250m	1:66
Komatipoort – Richards Bay	Single	20t	Diesel/25kV AC	TWS	250m	1:120
Davel – Phuzumoya (Future)	Single	26t	Diesel	TWS	350m	1:80

General condition

Section	Formation	Structures	Perway	Electrical	OHTE	Signals	Telecoms	Overall
Musina - Pyramid	🟡	🟡	🟡	🟢	🟢	🔴	🔴	🟡
Groenbult - Kaapmuiden	🟡	🟡	🔴	🟡	🔴	🟡	🟡	🟡
Greenview - Komatipoort	🟡	🟡	🔴	🟡	🟡	🟡		🟡
Komatipoort – Richards Bay	🟡	🟡	🟡					🟡

Figure 30: North-eastern System: Status Quo

SECTION PERFORMANCE

Musina – Pyramid

The telecoms and signalling equipment condition is not up to the required standard, leading to faults and train delays. Typically low volumes have led to underinvestment over time.

This section needs to be closely monitored because of anticipated increase in passenger rail traffic (suburban to Hammanskraal and long-distance between Musina and Pretoria) as well as freight traffic resulting from future mining developments planned in the Limpopo province.

Groenbult – Kaapmuiden

The performance of the line is good compared to the network average. In anticipation of aggressive growth in magnetite and over border traffic from Zimbabwe and beyond, upgrades have recently been undertaken to address perway condition, lengthen crossing loops for 65-wagon trains and upgrade the axle load from 18,5t/axle to 20t/axle.

Greenview – Komatipoort

Overall condition of the existing railway line infrastructure is "acceptable". Telecoms are in particularly good condition, having been recently replaced.

Komatipoort – Richards Bay

The performance is adequate for the current traffic, however, in anticipation of growth in magnetite and other bulk commodities upgrades to the infrastructure and support technologies are required.

GENERAL ISSUES

Musina – Pyramid

Line use: section north of Polokwane has a low train frequency resulting in increased incidents of theft and vandalism of perway materials and informal line crossings.

Commuters: PRASA plans to expand service on the Hammanskraal section which will reduce the available capacity for freight.

Groenbult – Kaapmuiden

Slot capacity: While portions of the line experience congestion, the slot capacity is underutilised due to operational inefficiencies. Performance and practical capacity may be increased through improved planning, train scheduling and resource allocation.

Axle loading: Groenbult to Hoedspruit section has recently been upgraded been upgraded to 20t/axle from the previous 18,5t/axle.

Gauteng – Mozambique

Perway: upgrading of the line required between Uitkyk and Witbank to increase axle load capacity to 26t/axle as a feeder line for the coal line.

Commuters: PRASA is increasing services on the Mamelodi to Pienaarspoort section, which will affect the access for freight traffic to and from Gauteng.

Shosholoza Meyl: A link from the southern portion of the freight ring onto the Maputo corridor at Greenview is necessary to streamline routing as trains currently pass on to Pyramid before turning around.

Komatipoort – Richards Bay

Train control: Nsezi yard has challenges in terms of radio communications due to size of the yard and availability of frequencies.

Formation: Formation problems have resulted in the introduction of speed restrictions in certain sections which reduce the practical line capacity.

Track geometry: maintenance of key areas is a challenge to capacity utilisation.

3.3.2 BULK MINERAL EXPORTS SYSTEM OPERATING PHILOSOPHY

Figure 31: Bulk Mineral Export System

Groenbult – Kaapmuiden

OPERATIONS

- The Bulk Minerals Export system connects hinterland locations including Gauteng, Phalaborwa and Rustenburg to the eastern seaboard ports of Maputo and Richards Bay.
- The variations in design criteria of the lines which form the north-eastern system pose a significant challenge to creating a unified operating philosophy. However, Transnet has identified the need for a dedicated GFB export corridor to increase export capacity (to Richards Bay and/or Maputo) and streamline GFB operations.
- A route to Richards Bay via Swaziland has been selected with a view to furthering regional integration, the key project of which is the Greenfields Swaziland Rail link between Lothair and Sidvokodvo.
- The planned GFB corridor will streamline operations by the migration towards an optimal train configuration in multiples of 75-wagons.

TRAIN CONFIGURATION

- Trains of 75-wagons, or multiples thereof, have been identified as the preferred length for the GFB export corridor.
- A 150-wagon train test has been performed between Phalaborwa and Richards Bay in anticipation of the planned change in operating philosophy.
- Train compilation will be done at source where possible.

SUPPORTING TECHNOLOGIES

- Radio distributed power will be used with the introduction of the Swaziland Rail Link (SRL) as well as the Phalaborwa and Rustenburg routes.
- Modified Track Warrant system (TWS) is under development to allow for simultaneous entry into crossing loops on the SRL. Colour-light signalling at TWS is used at various other locations on the Class 43D/44D locomotives which will provide high tractive effort and high power capabilities to traverse the varying topography.

SUPPORTING INFRASTRUCTURE

Phalaborwa – Komatipoort

- Increased loop lengths.
- Easing of steep grades.

Komatipoort – Richards Bay

OPERATIONS

- Single track with crossing loops, non-electrified.
- Diesel-only traction.
- Route operated by drivers from both TFR and SR.
- Locomotive provisioning is to be done at Komatipoort, Davel, Phuzumoya and Richards Bay, while all primary maintenance activities will be carried out at Richards Bay.

TRAIN CONFIGURATION

- Trains of 75-wagons, or multiples thereof, have been identified as the preferred length for the GFB export corridor.
- A 150-wagon train test has been performed between Phalaborwa and Richards Bay in anticipation of the planned change in operating philosophy.
- Train compilation will be done at source where possible.

SUPPORTING TECHNOLOGIES

- Radio-distributed power (RDP) will be used with the introduction of the Swaziland Rail Link (SRL) as well as the Phalaborwa and Rustenburg routes.
- Modified Track Warrant system (TWS) is under development to allow for simultaneous entry into crossing loops on the SRL. Colour-light signalling at TWS is used at various other locations on the Class 43D/44D locomotives which will provide high tractive effort and high power capabilities to traverse the varying topography.

SUPPORTING INFRASTRUCTURE

1. Komatipoort – Phuzumoya

- Increased loop lengths.
- Easing of steep grades.

2. Phuzumoya – Richards Bay

- Incraesed loop lengths for 150-wagon trains.
- New crossing loops for 150-wagon trains.
- Partial realignment to flatten steep grades, ease sharp curves.
- Arrivals / departure yard to facilitate train break-up and compilation in Richard's Bay.

Davel – Phuzumoya (Swaziland Rail Link)

SUPPORTING TECHNOLOGIES

- Radio distributed power will be used with the introduction of the SRL as well as the Phalaborwa and Rustenburg routes.
- Modified Track Warrant system (TWS) is under development to allow for simultaneous entry into crossing loops on the SRL. Colour light signalling at TWS is used at various other locations on the Class 43D/44D locomotives which will provide high tractive effort and high power capabilities to traverse the varying topography.

SUPPORTING INFRASTRUCTURE

- Davel yard complex.
- 146km new track at 26t/axle.
- 142km upgrades at 20t/axle.
- 14 x 3000m crossing loops.
- Stabilisation yard at Phuzumoya.

3.3.3 OVER BORDER INTERMODAL SYSTEM OPERATING PHILOSOPHY

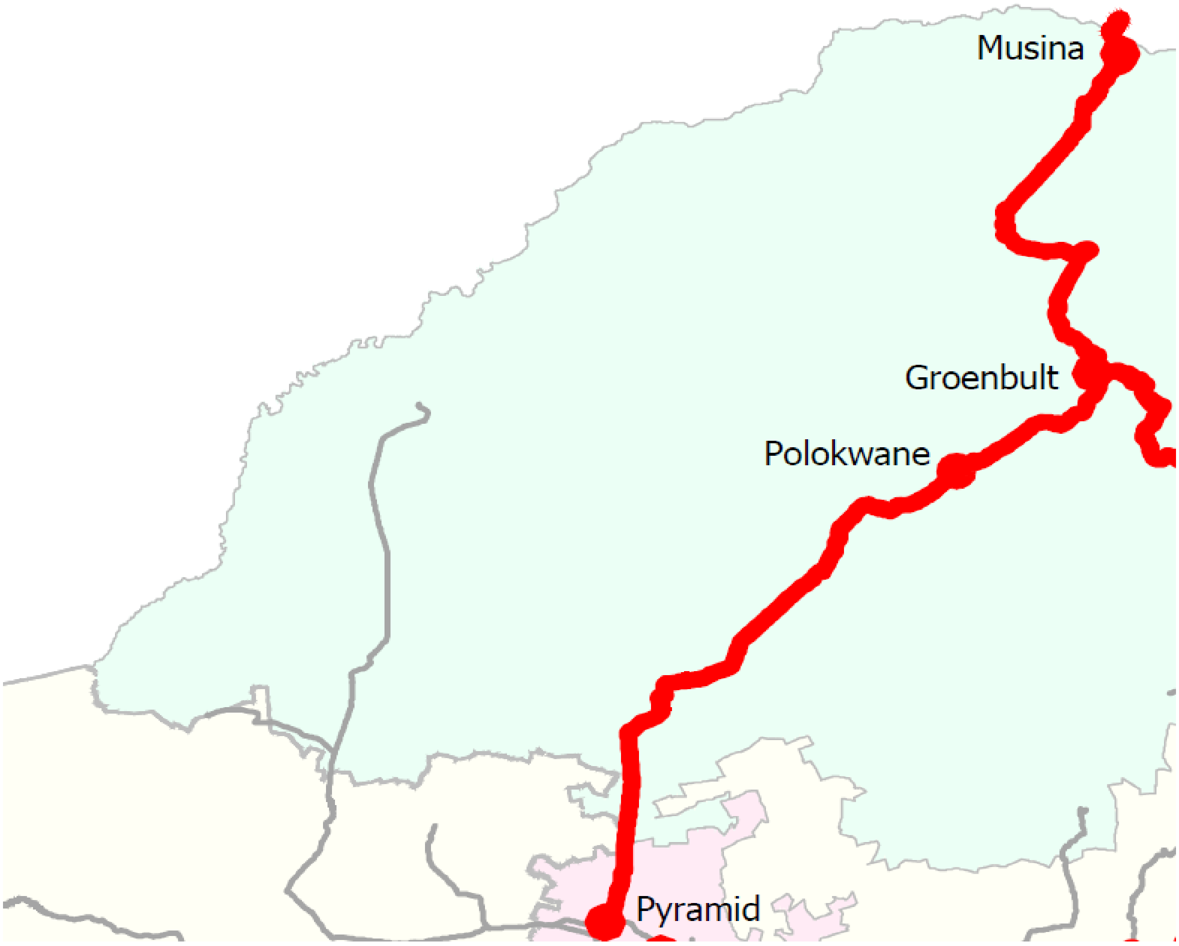


Figure 32: Over Border Intermodal System

Musina - Pyramid

OPERATIONS

This route is operated with greater independence than other routes in the system. Single track with crossing loops which can accommodate a maximum train length of 40-wagons.

TRAIN CONFIGURATION

40-wagon trains; later to be increased to 75/80-wagons in conjunction with lengthening of crossing loop. 25kV AC traction up to Polokwane; diesel traction to the north.

SUPPORTING INFRASTRUCTURE

- Intermodal terminal at Musina SEZ.
- Lengthen crossing loops to 1 200m.
- Easing of steep grades.

Greenview – Komatipoort

OPERATIONS

The route comprises single-track sections with crossing loops as well as double track sections. Between Waterval Boven and Waterval Onder a tight-curved double-track section dubbed the 'horseshoe' restricts train lengths to a maximum of 50-wagons.

Primarily 3kV DC traction is used west of Kaapmuiden; thereafter a traction mix of 3kv DC and diesel becomes prevalent.

Passenger services such as the Shosholoza Meyl, Premiere Class and Blue Train operate on the section and as such the operation is pressurised to maintain and improve efficiency and minimize delays; this will be aided by the addition of dual-voltage locomotives to the current fleet.

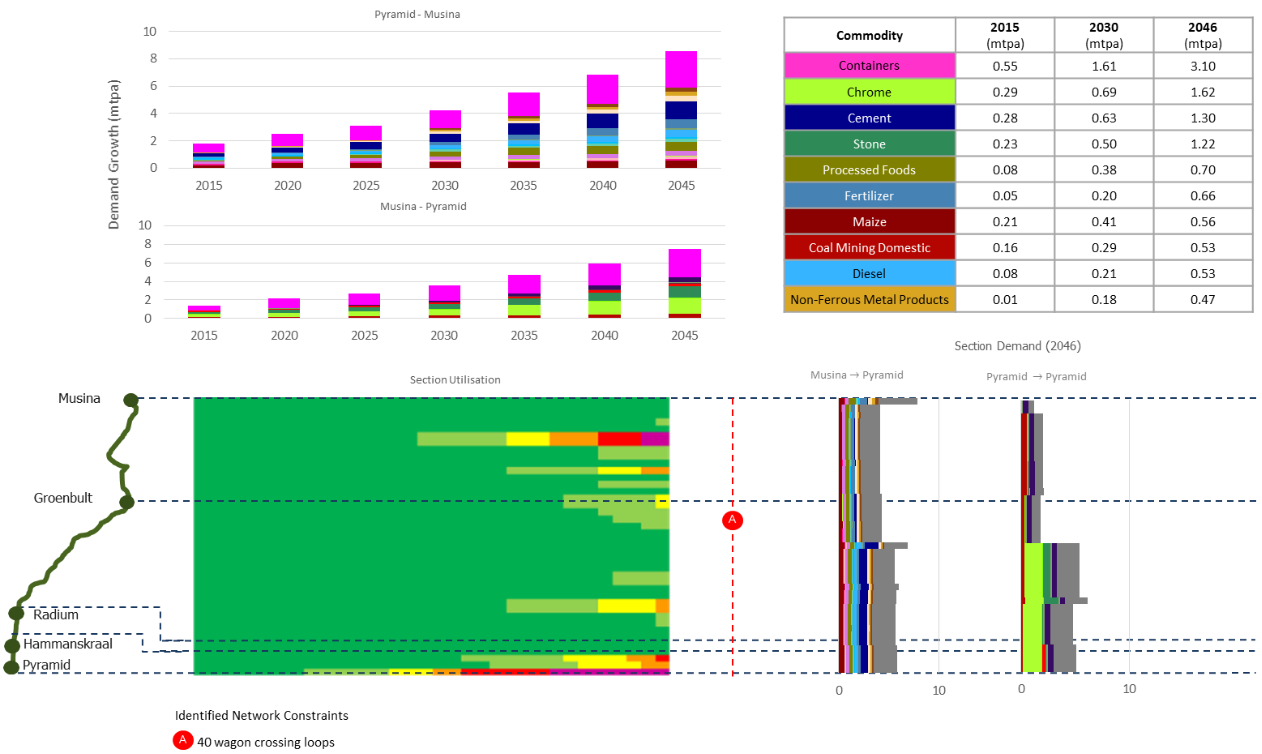
TRAIN CONFIGURATION

Trains passing between Waterval Boven and Waterval Onder via the so-called Horseshoe bend are restricted to lengths of 50-wagons due to the tight curvature. Primarily electric traction is to be used.

Traffic from Steelpoort to be consolidated into 75-wagon trains at Belfast and routed via Davel and the SRL.

3.3.4 MUSINA – PYRAMID SYSTEM ANALYSIS

3.3.4.1 Capacity Utilisation



Commodity	2015 (mtpa)	2030 (mtpa)	2046 (mtpa)
Containers	0.55	1.61	3.10
Chrome	0.29	0.69	1.62
Cement	0.28	0.63	1.30
Stone	0.23	0.50	1.22
Processed Foods	0.08	0.38	0.70
Fertilizer	0.05	0.20	0.66
Maize	0.21	0.41	0.56
Coal Mining Domestic	0.16	0.29	0.53
Diesel	0.08	0.21	0.53
Non-Ferrous Metal Products	0.01	0.18	0.47

Figure 33: Musina – Pyramid Capacity Utilisation

DEMAND

The section from Pyramid to Musina links South Africa and the rest of southern Africa. Coming into Gauteng is mainly coal and containers. These commodities all show a keen market share up take, with total volumes rising from 1mtpa to 8mtpa by 2044. Most commodities coming into the country are destined for Gauteng or further inland and therefore travel the length of the section.

In the opposite direction, fuel, containers and agricultural goods travel north from Gauteng. There is little over border traffic, however, with only 1mtpa (mainly fuel) going into Zimbabwe in 2044. Again, market share ambitions are high for these commodities on this section.

3.3.4.2 Capacity Interventions

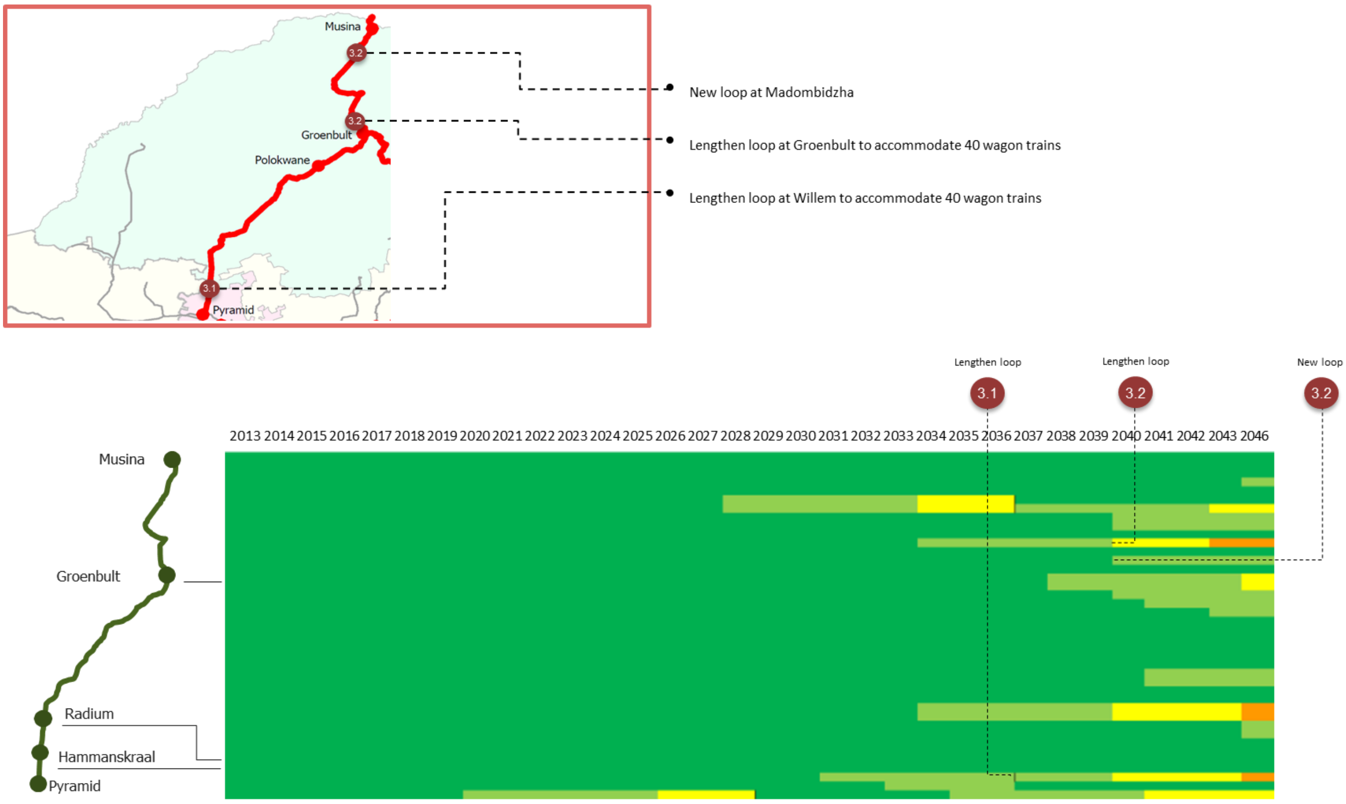


Figure 34: Musina – Pyramid Capacity Intervention

3.3.4.3 Strategic Discussion and Implementation

DISCUSSION

CAPACITY DEVELOPMENT

- It is anticipated that traffic on this corridor will grow significantly over the next 30 years. However, capacity is expected to be adequate, with only minor interventions required such as the lengthening of a small number of crossing loops to accommodate 40-wagon trains

MAINLINE

- This line serves as the primary connector between Zimbabwe and Gauteng and therefore a significant portion of its traffic is over border in short-train consists, often 40-wagons or less. The line also services Polokwane with general freight and containerized goods.

- As the route is not characterised by high demand forecasts there is little impetus for expansion. However, the development of a Special Economic Zone (SEZ) at Musina could catalyse further growth, as would the development of a container terminal at Polokwane.

3.3.4.4 Costing Summary

Zimbabwe Link

Expansion and Investment

Project	Intervention No.	Intervention Name	Total Value	Construction Period
Zimbabwe Link Expansion	LM.3.1	Lengthen loop for 40 wagon trains	96	1
Zimbabwe Link Expansion	LM.3.2	Lengthen loops & new loops for 40 wagon trains	47	2

Development Plan

Intervention No.	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046		
LM.3.1		0	1	94										
LM.3.2				0	1	9	37							

Table 8: Zimbabwe Link Expansion and Development

3.3.5 GROENBULT –KAAPMUIDEN SYSTEM ANALYSIS

3.3.5.1 Capacity Utilisation

Commodity	2015 (mtpa)	2030 (mtpa)	2046 (mtpa)
Magnetite	8.15	10.51	13.70
Rock Phosphate	1.94	2.60	3.85
Containers	0.00	0.81	1.35
Other Mining	0.08	0.27	0.83
Cement	0.00	0.12	0.31
Coal Mining Domestic	0.09	0.14	0.28
Other Non-Ferrous Metal Min	0.00	0.05	0.20
Fertilizer	0.00	0.04	0.15
Chemicals	0.04	0.06	0.09
Salt	0.00	0.03	0.08

Figure 35: Groenbult – Kaapmuiden Capacity Utilisation

DEMAND

- Volumes on the Groenbult to Kaapmuiden section are low between Groenbult and Hoedspruit, however, the opportunity for further growth exists for over border traffic to/from the SADC region destined for Durban and/or Richards Bay ports.

- Phalaborwa is the primary source of traffic, including magnetite and rock phosphate destined for Richards Bay.
- Magnetite volumes are dependent on the global iron ore market developments and Port of Richards Bay DBT expansion programmes.

3.3.5.2 Capacity Interventions

- Exports of Magnetite will in future be handled in 150 wagon train consists and travel on the upgraded Komatipoort – Richards Bay line.
- Sections of re-grading and re-alignment may be necessary to better suit the train handling characteristics of the distributed power trains
- Crossing loops at Palmloop and Brakspruit, between Phalaborwa and Hoedspruit, must be lengthened to accommodate 150 wagon trains

Figure 36: Groenbult – Kaapmuiden Capacity Interventions

3.3.5.3 Strategic Discussion and Implementation Discussion

CAPACITY DEVELOPMENT

Bulk Minerals Capacity		
Development Phase	**Trains/Day**	**Mtpa**
Current	8	13
Phase 1	8	27

Table 9: Groenbult-Kaapmuiden Bulk Minerals Capacity

- The planned system capacity for Magnetite will increase from 13mtpa (75 CR wagons) to 27mtpa (150 CR wagons with 150-wagon crossing loops) while maintaining a train frequency of eight daily slots.

MAINLINE

- Phalaborwa is the primary source of traffic for the Groenbult line, with commodities such as magnetite destined for Maputo and Richards Bay ports.
- Capacity expansion for the route is dependent on the upgrade of the Swaziland line to correspond with the introduction of the Swaziland Rail Link (SRL), as such, the line will in future operate 150-wagon distributed power (DP) trains.
- Re-grading of curves and the relaxing of curves is anticipated in certain areas to improve the handling characteristics of the 150-wagon DP trains.
- In anticipation of growth in commodities originating in Zimbabwe or further inland, the section between Groenbult and Hoedpsruit has been upgraded to 20t/axle from 18t/axle.
- Crossing loops between Hoedspruit and Phalaborwa, namely Palmloop and Brakspruit, have been extended to accommodate 75-wagon trains. These will later be extended to 1 700m for 150-wagon trains.

YARDS

- The Komatipoort and Phalaborwa yards require lines to be extended to accommodate 75-wagon trains initially, and later 150-wagon trains.

3.3.5.4 Costing Summary

Groenbult –Kaapmuiden Link

Groenbult – Kaapmuiden Link **Expansion and Investment**

Project	Intervention No.	Intervention Name	Total Value	Construction Period
Groenbult/Kaapmuiden Expansion	LM.2.1	Construct two consolidation loops at Phalaborwa for 150 Wagon trains	116	1
Groenbult/Kaapmuiden Expansion	LM.2.2	Construct two consolidation loops at Droogland for 150 Wagon trains	181	1
Groenbult/Kaapmuiden Expansion	LM.2.3	Lengthen 2 crossing loops for 150 wagon trains	42	1

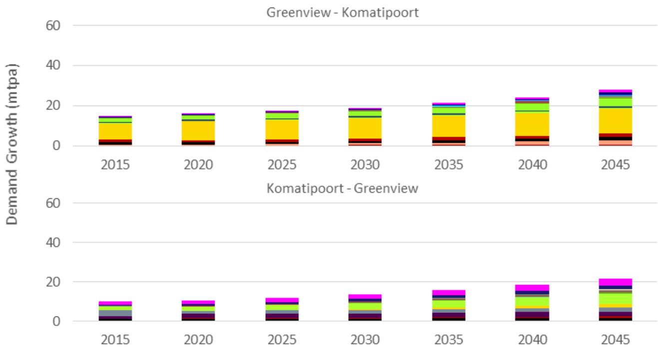
Development Plan

Intervention No.	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
LM.2.1	0	1	114																													
LM.2.2	1	2	178																													
LM.2.3					0	1	41																									

Table 10: Groenbult – Kaapmuiden Link Expansion and Development

3.3.6 GREENVIEW – KOMATIPOORT SYSTEM ANALYSIS

3.3.6.1 Capacity Utilisation Including Swazi Rail Link



Commodity	2015 (mtpa)	2030 (mtpa)	2046 (mtpa)
Magnetite	7.99	10.02	12.14
Chrome	1.53	2.86	5.03
Rock Phosphate	1.88	2.51	3.72
Containers	1.74	2.49	3.46
Coal Mining Powerstation	1.30	2.30	2.30
Sugar cane	0.48	0.87	2.19
Iron Ore Domestic	2.91	1.68	1.96
Ferrochrome	0.75	1.12	1.92
Coal Mining Domestic	1.08	1.39	1.89
Coal Mining Exports	1.05	1.33	1.54

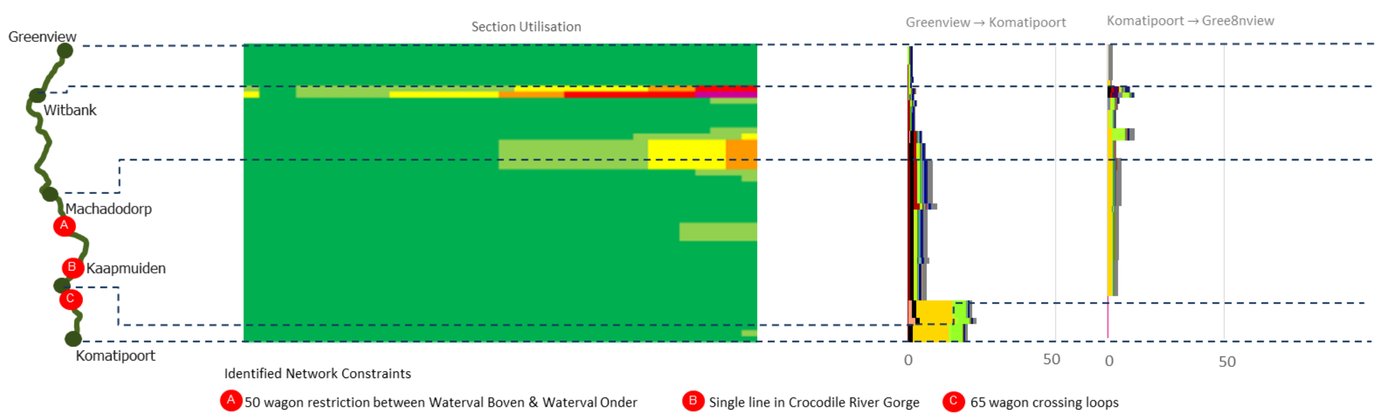


Figure 37: Greenview - Komatipoort Capacity Utilisation

DEMAND

Demand and capacity utilisation for the Greenview to Komatipoort section is higher than for the Pyramid to Musina and Groenbult to Hoedspruit sections. Demand on this corridor is constituted of a variety of commodities, most of which only travel on certain sections of the whole corridor. Magnetite in particular shows aggressive growth in the first seven years of the forecast period, but this slows thereafter. Magnetite is a special commodity, requiring a specific buyer, as it is relatively abundant and therefore does not have much margin for profit, especially when transported over long-distances. These commodities come from Phalaborwa and are destined for Richards Bay, meaning that they only travel on the short section of Kaapmuiden to Komatipoort. Export coal destined for Matola (Maputo) makes up a considerable portion of the traffic.

The opposite direction shows a similar pattern and with similar total tonnages beginning with 7mtpa and reaching up to 35mtpa. Containers, although not a major contributor to total tonnages, are targeted as a key commodity for market share growth.

3.3.6.2 Capacity Interventions Including Swazi Rail Link

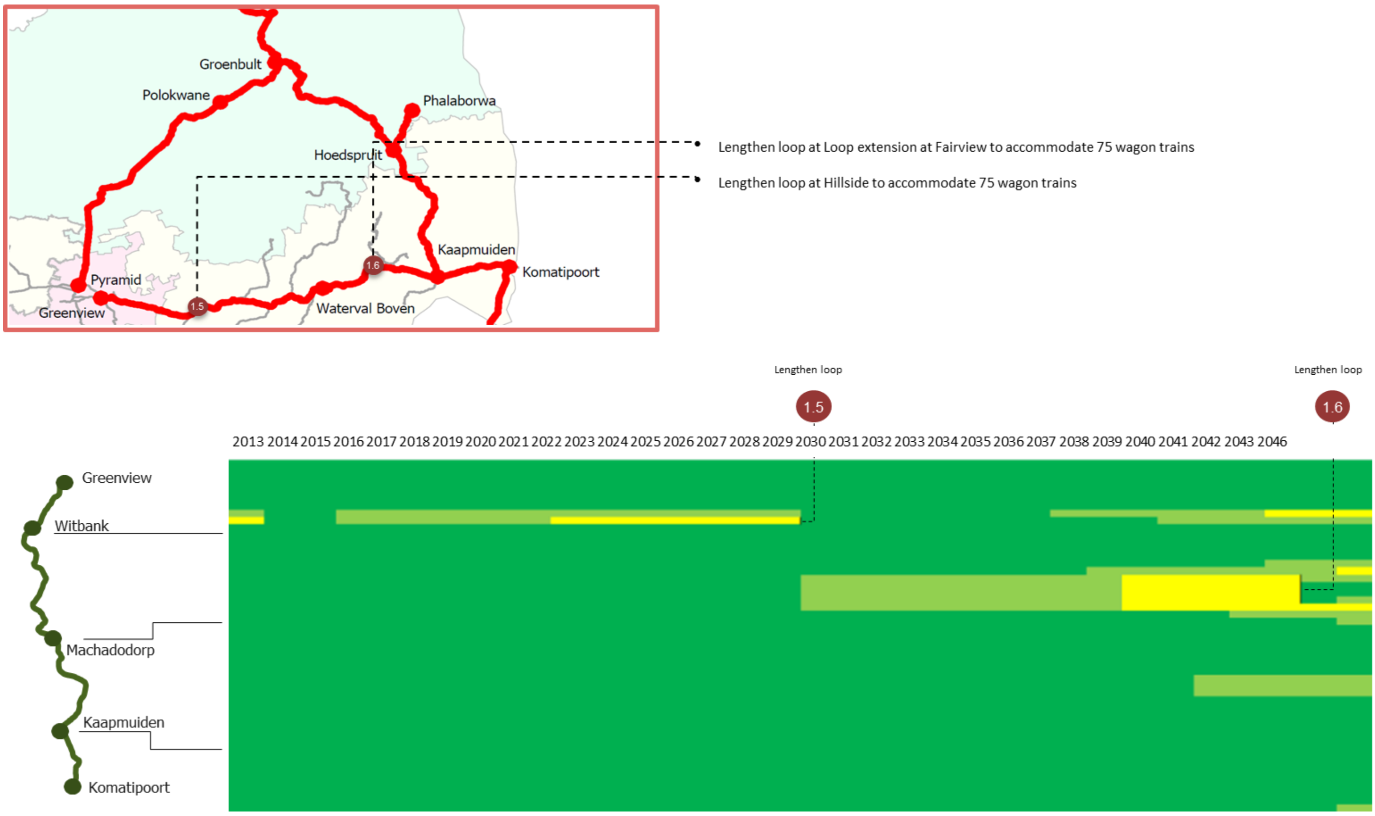


Figure 38: Greenview - Komatipoort Capacity Interventions

3.3.6.3 Strategic Discussion and Implementation Discussion

CAPACITY DEVELOPMENT

- Capacity expansion will be achieved primarily by means of completing double-tracking between the existing long loops.
- Adjustments to the alignment (gradients and curves) may be required to accommodate 150-wagon trains originating in Phalaborwa, destined for Richards Bay via Swaziland.

MAINLINE

- This line is the primary route between Gauteng and Mozambique, while also handling bulk commodities such as coal and magnetite destined for export via Richards Bay.
- Portions of the route are not suited to the movement of long, heavy trains as per the Transnet strategy for bulk traffic, the primary constraints are the steep gradients, the tight horseshoe bend, and the single-track through the Gorge section.
- While parts of the route carry bulk-type trains it is more suited to intermodal and general freight traffic and long-distance passenger services. Future expansion efforts will be directed as such where possible.
- Due to the near-spacing of the existing crossing locations capacity creation will be undertaken by means of doubling. However, due the challenging topography of certain portions of the route this may not be practical and re-routing may be considered instead, such as via the planned Swaziland Rail Link.

YARDS

- Komatipoort yard provides train provisioning and preparation and serves as a multi-functional yard for domestic and over border traffic. The functionality of the yards is to remain unchanged but it is necessary to expand the yard to facilitate compilation and break-up of 150-wagon distributed power trains.
- It is planned to use Belfast as a consolidation facility for 150-wagon trains, origination in shorter rakes from the Steelpoort area.

3.3.6.4 Costing Summary

Expansion and Investment

Project	Intervention No.	Intervention Name	Total Value	Construction Period
Mozambique Link Expansion	LM.1.5	Loop extension at Hillside	9	1
Mozambique Link Expansion	LM.1.6	Loop extension at Fairview	9	1

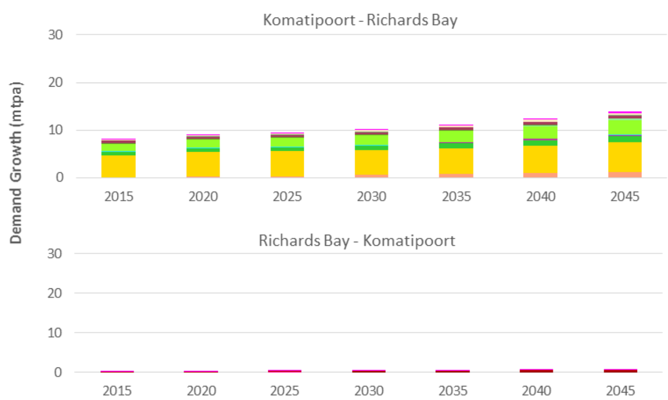
Development Plan

Intervention No.	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
LM.1.5		0.0	0.1	9.0															
LM.1.6																0.0	0.1	9.0	

Table 11: Mozambique Link Expansion and Development

3.3.7 KOMATIPOORT – RICHARDS BAY SYSTEM ANALYSIS

3.3.7.1 Capacity Utilisation including Swazi Rail Link



Commodity	2015 (mtpa)	2030 (mtpa)	2045 (mtpa)
Magnetite	4.57	5.24	6.20
Rock Phosphate	1.54	1.98	2.99
Titanium slag	0.65	0.86	1.27
Sugar cane	0.09	0.51	1.21
Pulp of wood and paper	0.55	0.51	0.54
Iron & Steel	0.33	0.40	0.50
Coal Mining Domestic	0.13	0.31	0.46
Containers	0.01	0.13	0.40
Other Non-Ferrous Metal Min.	0.00	0.06	0.22
Zircon	0.15	0.13	0.19
Other Mining	0.08	0.12	0.17

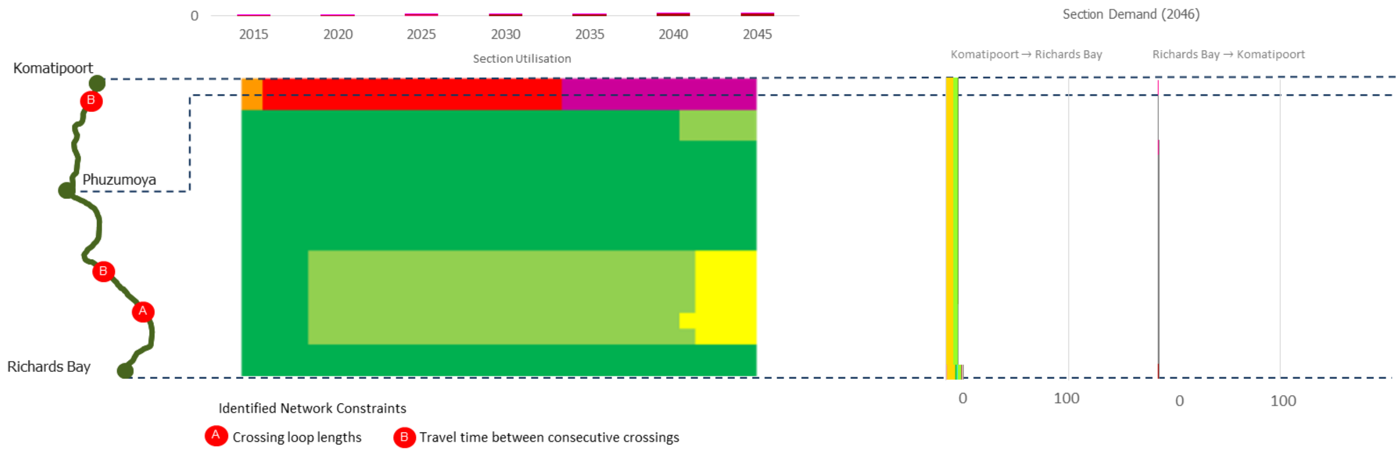


Figure 39: Komatipoort – Richards Bay Capacity Utilisation

DEMAND

The commodities present on the Swaziland land consist of magnetite and rock phosphate from the Phalaborwa region, destined for export through Richards Bay, and other bulk commodities including chrome and coal, which will be diverted from the coal line via the Swaziland Rail Link. Heavy bulk commodities will run predominantly towards the coast, while low volumes of general freight items will return into Swaziland and/or towards Komatipoort.

The combined growth in bulk commodities from the Phalaborwa line and the Swaziland Rail Link call for significant capacity upgrades to the line, such that the operating philosophy of the line has had to be redeveloped.

3.3.7.2 Capacity Interventions

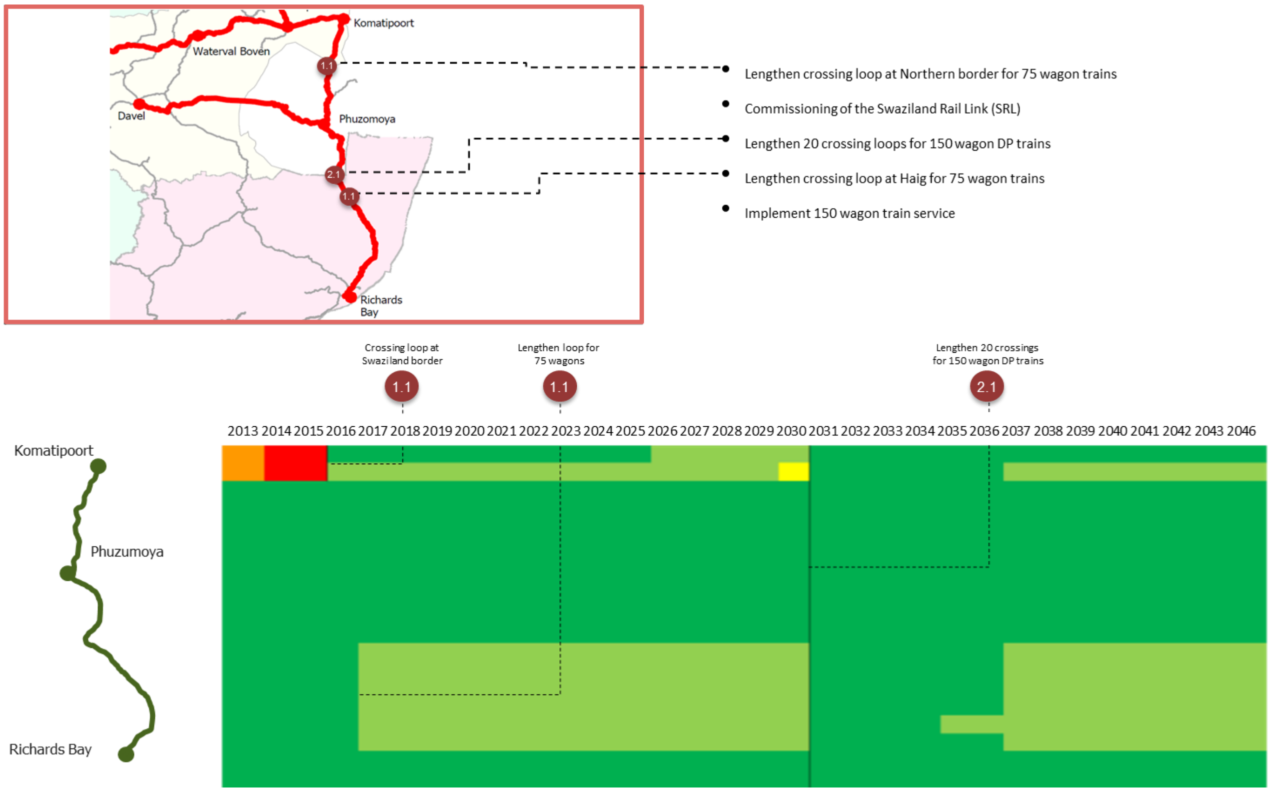


Figure 40: Komatipoort – Richards Bay Capacity Interventions

3.3.7.3 Strategic Discussion and Implementation Discussion

CAPACITY DEVELOPMENT

Bulk Minerals Capacity		
Development Phase	**Trains/Day**	**Mtpa**
Current	8	14
75-wagon trains	11	16
150-wagon trains	11	38
26t/axle load	11	53

Table 12: Mozambique Link Bulk Minerals Capacity

- **75-wagon Trains:** Crossing loops at the northern Swaziland border and Haig must be lengthened for 75-wagon trains.
- **75-wagon Trains:** 20 crossing loops must be lengthened to 3000m to accommodate 150-wagon trains originating in Phalaborwa and from the SRL. In addition, to portions of the route require regrading/realignment.
- **26 Tonne axle load:** In the long term the line may be upgraded to heavy-haul standards thereby accommodating greater bulk tonnages.

MAINLINE

- The two primary routes were considered for creating a GFB corridor; the Eastern mainline towards Maputo Port and the Komatipoort line to Richards Bay via Swaziland.
- Due to the challenges associated with the topography of the Eastern mainline, namely the Horseshoe bend and the single-track section in the Crocodile River gorge between Karino and Boulders stations, this route is not suited to heavy bulk traffic.
- A Greenfields route from Lothair to Sidvokodvo was selected with a view to supporting Regional Integration with Swaziland; thereby creating a GFB corridor from Davel to Richards Bay via Phuzumoya.
- The train length selection process considered 50, 75, 100, 150 and 200-wagon trains and assessed them on
- The basis of the infrastructure capital investment needed to reach the required tonnage forecasts as well as the impact on customer facilities. The preferred train configuration was found to be 150-wagon trains; comprising 2 x 75-wagon rakes in DP mode.
- All Greenfields construction work will be completed to the 26t/axle standard.
- Close co-ordination is necessary between the greenfields and brownfields programmes to ensure system capacity is made available timeously.

YARDS

- The compilation of 75 and 150-wagon trains will be enabled through the use of multi-user facilities near loading sites and the expansion of existing rail yards such as Komatipoort and Belfast.
- Work is underway to expand Bizholo yard to receive and dispatch 100-wagon trains for non-RBCT coal exports.
- It is necessary to allocate a portion of Nsese yard to be expanded to accommodate the planned 150-wagon distributed power trains.

3.3.7.4 Costing Summary

SWAZILAND LINK

Swaziland Link — **Expansion and Investment**

Project	Intervention No.	Intervention Name	Total Value	Construction Period
75W Expansion	KN.1.1	75 Wagon Crossing Loops	114	1
75W Expansion	KN.1.2	2 new loops between Komatipoort and Swaziland	155	1

Development Plan

Intervention No.	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
KN.1.1																0	1	112														
KN.1.2		1	2	152																												

Table 13: Swaziland Link Expansion and Development

3.3.8 DAVEL – PHUZUMOYA SYSTEM ANALYSIS

3.3.8.1 Capacity Utilisation

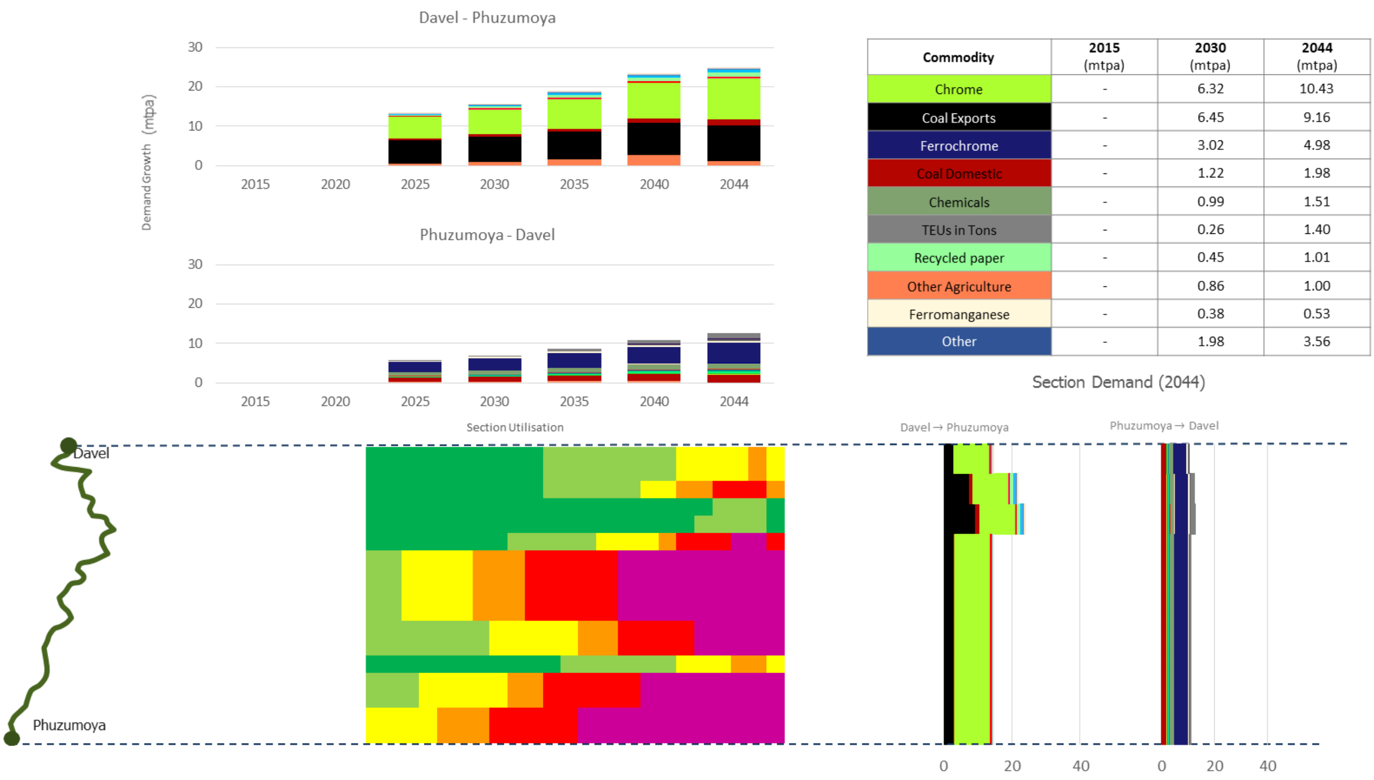


Figure 41: Davel – Phuzumoya Capacity Utilisation

DEMAND

As this link is a planned Greenfields programme the utilisation chart is shown only from its planned inception in 2021/22. However, the volumes which are planned for the link line would otherwise run on the Mozambique mainline and the coal export line to Maputo and Richards Bay, respectively. The demand consists predominantly of bulk minerals destined for export through the previously-mentioned ports. Chrome, ferrochrome and coal form the largest component of the demand. Traffic from Phuzumoya towards Davel is significantly less and is made up of intermodal and general freight traffic such as timber.

3.3.8.2 Capacity Interventions

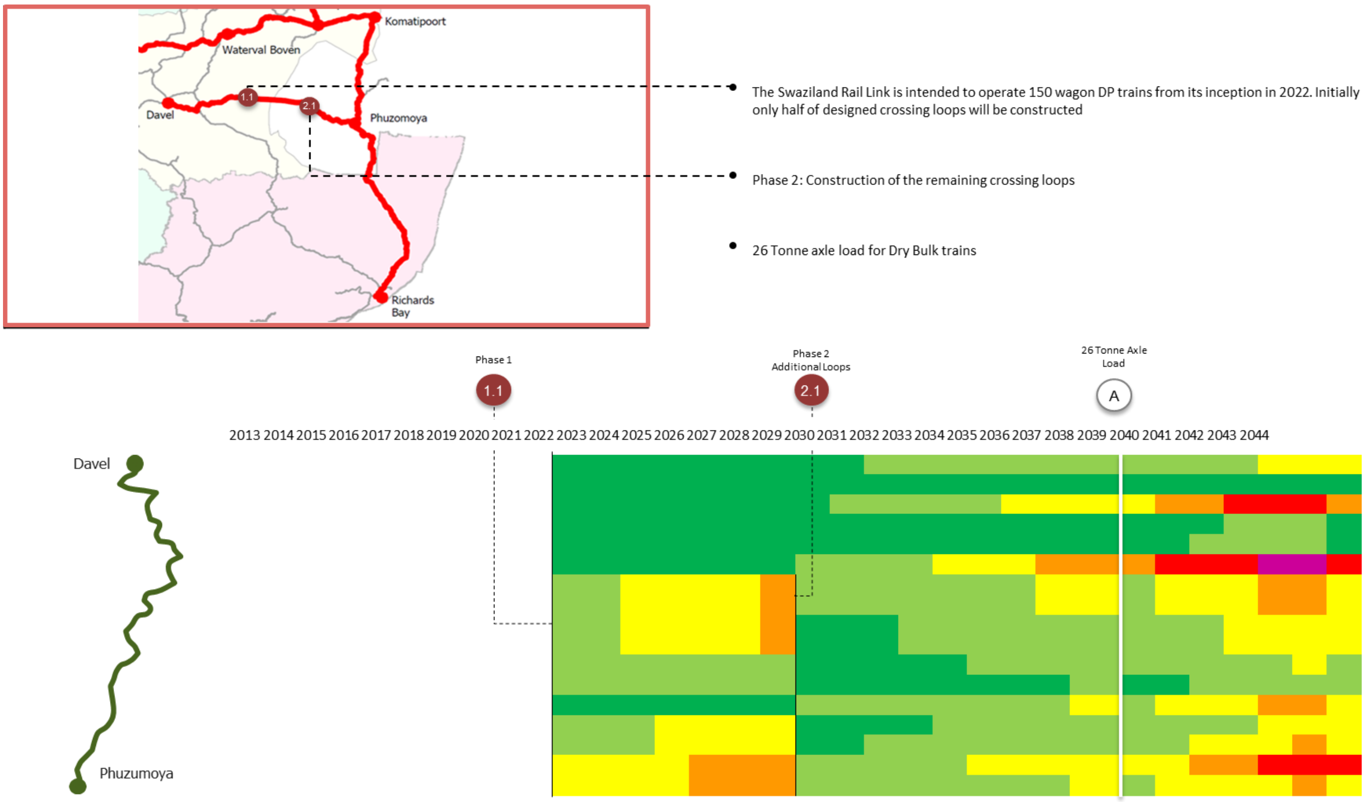


Figure 42: Davel – Phuzumoya Capacity Interventions

3.3.8.3 Strategic Discussion and Implementation Discussion

CAPACITY DEVELOPMENT

Bulk Minerals Capacity		
Development Phase	**Trains/Day**	**Mtpa**
Development Phase	6	14
Phase 1	6	18
Phase 2	8	24

Table 14: Davel – Phuzumoya Bulk Minerals Capacity

- **Phase 1:** Construction of eight of the 14 planned crossing loops, creating the potential for up to six bulk trains per direction per day.
- **Phase 2:** The remaining crossing loops to be constructed unlocking a total of 8–10 bulk train slots.
- 150-wagon trains will be operated during both phases, eliminating the need to construct an interim consolidation facility at Phuzumoya, as consolidation into 150-wagons take place at Davel or at source during Phase 2.
- Additional crossing places for coal trains traversing the Carolina line are required between Breyten and Buhrmanskop.

MAINLINE

- The route from Davel to Phuzumoya, connecting to the Komatipoort line to Richards Bay, provides an opportunity for a new corridor to the eastern seaboard while vastly improving over border logistics between South African and Swaziland.
- By taking off at Davel the corridor will avoid the congested coal export line which is continually being optimised for coal export trains.
- 150-wagon distributed power trains provide the best-comprise-solution for the required line capacity and minimal infrastructure cost on the Komatipoort-Nsese line; this is the primary driver for the operating philosophy of the link line.
- The link line will be constructed with 26t/axle standard formation to provide for a potential conversion to heavy- haul corridor. Until such time the line will make use of 20t/axle superstructure and operate at 20t/axle loads.
- An adapted version of the track warrant train authorisation system will be employed which will allow trains to enter the crossing loops simultaneously, reducing the need for undesirable stoppages on the steep mainline sections.

YARDS

- A new facility at Davel will facilitate compilation of 150-wagon trains from incoming 75-wagon rakes.
- The facility will also provide for locomotive changeover from electric to diesel powered as required alongside provisioning facilities.
- Davel yard may also be used as a stabilisation yard for trains destined for the new Majuba line.
- A yard at Phuzumoya West will control arrival and departures onto the line to Richards Bay.

3.3.8.4 Costing Summary

SWAZILAND RAIL LINK

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Swaziland Rail Link — **Expansion and Investment**

Project	Intervention No.	Intervention Name	Total Value	Construction Period
SRL Greenfields	SRL.1.1	Greenfields: Lothair - Nerston: 52.5km	3 569	4
SRL Greenfields	SRL.1.2	Greenfields: Nerston - Sidvokodvo: 93.7km	6 368	4
SRL Brownfields	SRL.2.1	Brownfields: Davel - Lothair	4 820	4
SRL Brownfields	SRL.2.2	Brownfields: Sidvokodvo - Phuzumoya	-	4

Development Plan

Intervention No.	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
SRL.1.1	14	45	96	604	1 858	951																										
SRL.1.2	25	80	172	1 077	3 316	1 698																										
SRL.2.1	19	60	130	815	2 510	1 285																										
SRL.2.2																																

Table 15: Swaziland Rail Link Expansion and Development

3.4 INTERMODAL AND GENERAL FREIGHT SYSTEM

3.4.1 SYSTEM OVERVIEW

3.4. 1. 1 Summary

The intermodal system provides important logistics services for domestic, over border, and international trade. The system is broken up into the Pyramid – Musina and Greenview – Komatipoort lines which provide logistics connections to Zimbabwe and Mozambique, and the Gauteng – Durban and Gauteng-Cape corridors connecting to various ports. Gauteng is crucial hub connecting these lines by means of the Gauteng Freight Ring on the eastern border of the province. The Natcor line, as part of the Gauteng – Durban corridor is the largest by volume and presents the largest opportunity for growth.

3.4. 1. 2 System Description Development Plans: Core Network Systems

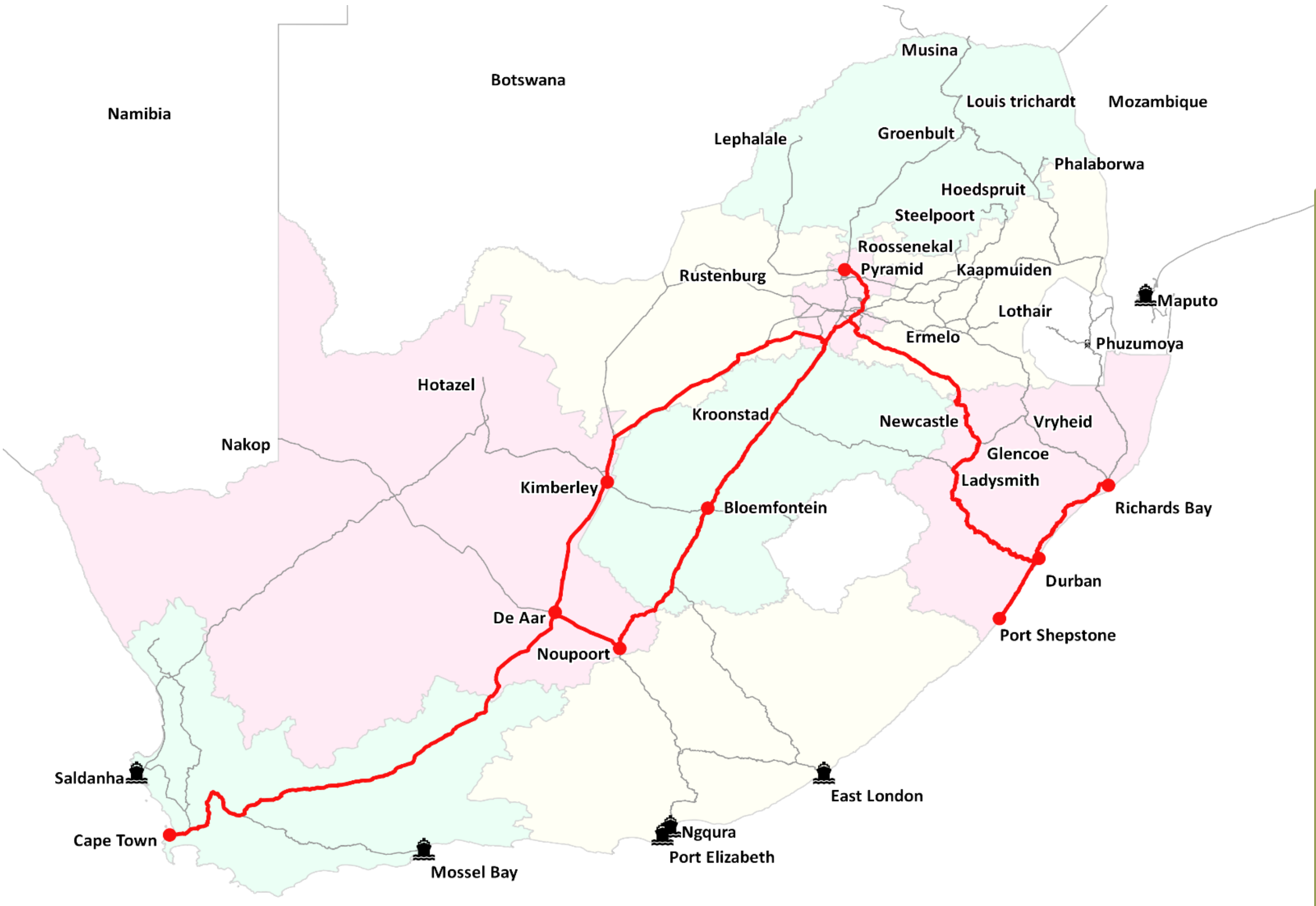


Figure 43: Intermodal and General Freight Systems Gauteng Freight Ring

Gauteng Freight Ring carries general freight and has single and double-line sections. It supports axle loads up to 20t. The primary nodes connecting to the respective corridors are Pyramid South, Greenview, Sentrarand, Rietvallei, Vereeniging and Houtheuwel. Overall condition of the line infrastructure is acceptable, but electrical and signalling infrastructure are in poor condition.

Gauteng – Durban

The Gauteng to Durban corridor is classified as a general freight line and is double track electrified at 3kV DC and traverses difficult terrain including steep gradients and sharp curves.

The current/axle loads supported are up to 20t/axle. Train movement control is colour-light signalling. Overall condition of the existing network infrastructure is not acceptable with formation, bridges and tunnels requiring more attention.

Gauteng – Cape Town

Cape Town to De Aar is a general freight and long-distance passenger single railway line, which connects Gauteng to the Western Cape. The line from Cape Town to Beaufort West is electrified at 3kV DC. Beaufort West to De Aar is electrified at 25kV AC, carrying axle tonnages of up to 20t/axle.

The Kimberley to Vereeniging line is used for both heavy-haul and passenger services, it consists of both double and single-line sections. Crossing loops on the single-line sections allow for the crossing of 104-wagon trains.

The Vereeniging to Noupoort line carries general freight traffic and consists of double and single-line sections. The line is electrified to 3kV DC between Bloemfontein and Gauteng, with diesel operations south of Bloemfontein.

Notes

- The system consists of the Gauteng Freight Ring (Pyramid to Houtheuwel), Natcor (Gauteng to Durban) and the KZN North and South coast lines (Nsese to Port Shepstone)
- Natcor infrastructure is heavily utilised but constrained by challenging alignment design. Poor formation and tunnel design infringe capacity development opportunities
- Gauteng freight ring capacity is constrained by single line sections. OHTE theft and obsolete train control technology impacts severely on its train operations
- KZN North and South coast signalling equipment is obsolete and must be replaced

Line properties

Section	Line type	Axle load	Traction	Train control	Sharpest curve	Steepest gradient
Pyramid – Houtheuwel	Single/Double	20t	3kV DC	CTC	305m	1:100
Rietvallei – Glencoe	Double	20t	3kV DC	CTC	285m	1:60
Glencoe – Booth	Double	20t	3kV DC	CTC	220m	1:45
Nsese – Durban	Single/Double	18.5t/20t	3kV DC/25kV AC	CTC/TWS	250m	1:66
Durban – Port Shepstone	Single/Double	18.5t	3kV DC	CTC/RTO	250m	1:66
Cape Town - De Aar	Single	20t	3kV DC/25kV AC	CTC	250m	1:66
Kimberley – Houtheuwel	Double/Single	20t	3kV DC	CTC	402m	1:72
Noupoort - Vereeniging	Single/Double	20t	Diesel/3kV DC	TWS/CTC	200m	1:100

General condition

Section	Formation	Structures	Perway	Electrical	OHTE	Signals	Telecoms	Overall
Pyramid – Houtheuwel	🟡	🟡	🟡	🟡	🔴	🟡	🟡	🟡
Rietvallei – Glencoe	🟡	🟡	🟡	🟡	🔴	🟡	🟡	🟡
Glencoe – Booth	🟡	🟡	🔴	🟡	🟡	🟡	🟡	🟡
Nsese – Port Shepstone	🟡	🔴	🟡	🔴	🔴	🔴		🔴
Cape Town - De Aar	🟢	🟢	🟡	🟡	🟡	🟡	🟢	🟡
Kimberley – Houtheuwel	🟡	🟡	🟡	🟢	🟡	🟢		🟡
Noupoort - Vereeniging	🟡	🟡	🟡	🟢	🟢	🟡		🟢

Figure 44: Intermodal and General Freight: Status Quo

SECTION PERFORMANCE

Gauteng Freight Ring

The section performance is significantly below the network average with over twice as much delay due to faults recorded on the section compared to the network average.

Cape Town – De Aar

The performance of the line is not acceptable as delays caused by failures on the section are above the network average. Implementation of state-of-the-art traffic control and safety systems can greatly improve operational performance that degrade present service and inhibit the ability to effectively absorb future traffic. This would also enhance the ability of the section to carry mixed (passenger and freight) traffic.

De Aar – Kimberley

- The performance of this section is substantially below the performance of the network average despite generally being in a fair condition.
- Signal equipment theft and vandalism are the main contributors to section failures and require special attention; and
- The capacity of this entire section is severely limited by mixed use by heavy-haul and passenger services and electrical-related network failures. Train control planning effort should be directed towards minimising conflict between passenger and freight requirements. This would improve logistical efficiency and secure railway network capacity and reliability gains for the benefit of all users.

Kimberley – Houtheuwel

- The performance of this section is substantially below the network average. Theft is a major issue on the line and can be held accountable for much of the electrical and signalling failures;
- The capacity of this entire section is severely limited mainly by an old interlocking and aging track circuits technology overdue for replacement. Effort should be directed towards rerouting passenger traffic to Cape Town and Port Elizabeth along alternative routes where possible in order to increase capacity until train control systems are replaced; and
- Railway network capacity and reliability, and implementing state- of-the-art train control and safety systems.

City Deep – Booth

- Section performance is worse than the network average. Most failure delays are caused by electrical faults.
- Effort on this section should be directed towards removing bottlenecks, handling the conflict between passenger and freight train capacity requirements, securing railway network capacity and reliability, as well as implementing state-of-the-art train control and safety systems.

GENERAL ISSUES

Gauteng Freight Ring

- Track configuration: Mixed single and double-line sections;
- Condition: Overall condition of the line infrastructure is acceptable, but electrical and signalling infrastructures are in poor condition;
- Slot capacity: Single track sections between Pyramid and LUD are the primary constraints; and
- Commuter: The Skansdam – Houtheuwel section is utilised by both freight and commuter services; capacity and efficiency are therefore severely constrained in this region.

Cape Town – De Aar

- Train control: Obsolete train control systems are still in use on the section between Worcester and Kraaifontein requiring replacement with CTC;
- Substations and electrical supply: This is a constraining factor on capacity. 25kV AC system has more capacity than the 3kV system that suffers from low voltage problems;
- Interoperability: Shared infrastructure with long-distance passenger such as the Shosholoza Meyl trains leads to operational challenges; and
- Telecoms: signalling to be connected with optic fibre along the whole route.

De Aar – Kimberley

- Line use: Mixed use heavy-haul and passenger services, which incur incompatibility problems operationally. Maintenance requirements on single-line sections cause a reduction in capacity;
- Electrical: Theft of OHTE and cables is rife on single-line sections; and
- Shosholoza Meyl: Poor punctuality, which makes for difficult operational planning.

Kimberley – Houtheuwel

- Slot capacity: Viljoensdrift possible slipway to get faster access to private siding; and
- Train control: Old technology overdue for replacement.

City Deep – Booth

- Train operation: Heavy coal trains to Majuba problematic with very limited redundancy;
- Electrical: OHTE cable theft, steelwork in the process of being replaced, high corrosion on rails in tunnels due to stray currents. Signal and electrical cables often get stolen only days after replacement;
- Line use: Single-line section from Rooikop to Rietvallei and the line configuration to Jupiter are causing bottlenecks. High cube containers cannot be accommodated safely due to structure gauge restrictions. Speed restrictions applied on certain sections due to infrastructure conditions;
- Slot capacity: Installed capacity is sufficiently high but requires OHTE, power supply and changes in operating methodology to be unlocked;
- Train control: Theft of signal cables result in major service disruptions. Signalling system is at least 30 years old. Migration from copper is a priority. Obsolete interlocking and track circuit components need to be replaced;
- Formation: Rietvallei to Booth is problematic due to poor drainage in tunnels and weak formation; and
- Commuter trains: High frequency of commuter trains on the Cato Ridge to Booth section impacting on capacity utilisation. On the route from Union to Durban, the passenger trains require 2 freight slots, however in the denser in Gauteng, a metro peak applies, seven hours per day where freight trains are not allowed to run.

MAINTENANCE INTERVENTIONS

The following interventions are considered:

- Replace obsolete track circuits with new at 15 stations (Clavis-Hattingspruit);
- Signal gantry refurbishments;
- Air conditioners in relay rooms;
- Power equipment replacements;
- Replace obsolete hot bearing detectors with new generation;
- Signal gantry replacements;
- Anti-vandal covers;
- Upgrade relay rooms battery backup for eight hour standby time;
- Replace obsolete hot bearing detectors with new generation;
- Change from obsolete colour light signals to Track Warrant System of train control (matching the TWS from Bethlehem-Harrismith); and
- Install fibre-optic cable Ladysmith-Harrismith.

3.4.2 OPERATING PHILOSOPHY

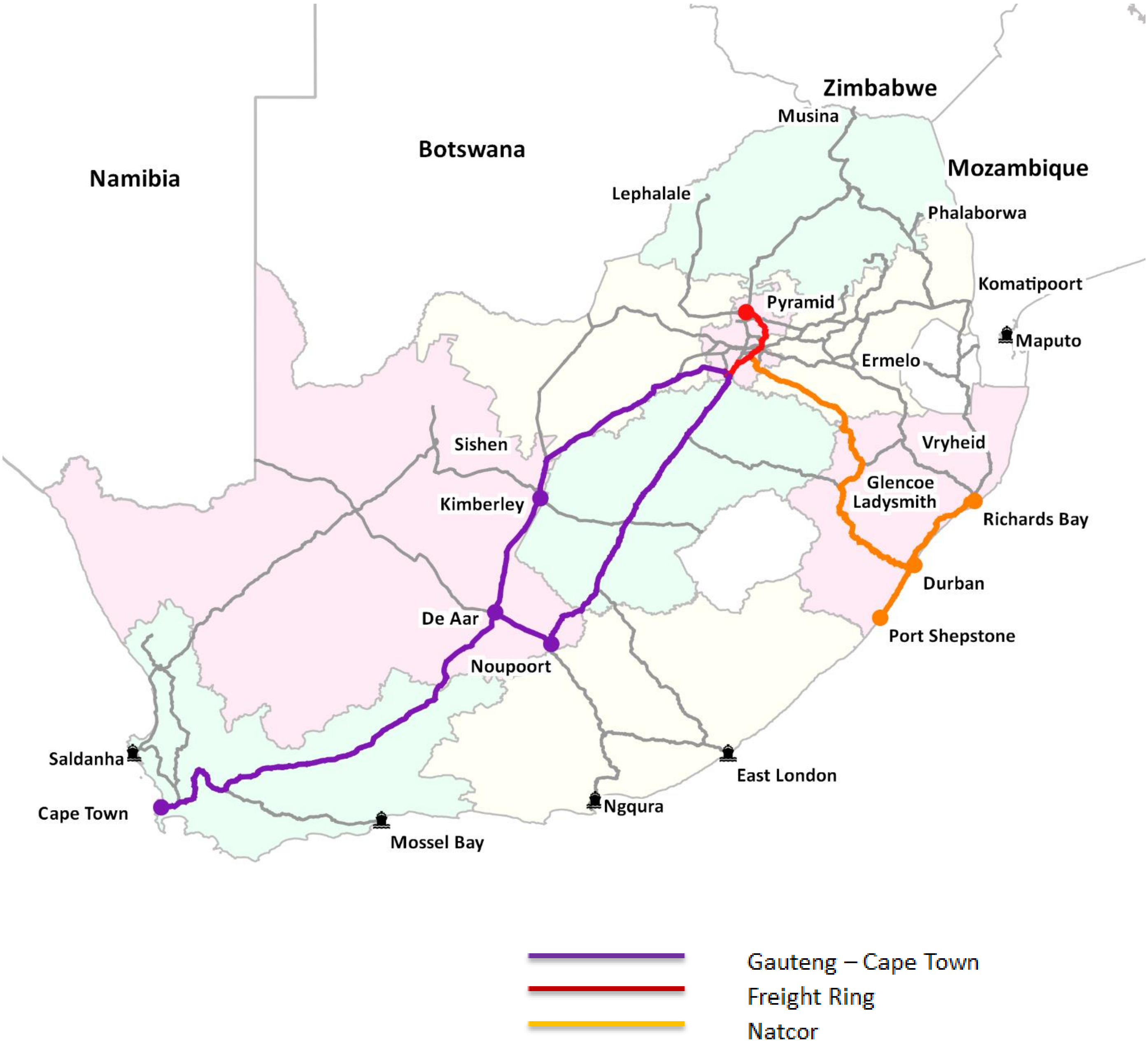


Figure 45: Intermodal and General Freight Operating Philosophy

Gauteng – Cape Town

OPERATIONS

- The Cape – Gauteng corridor carries predominantly intermodal freight and general freight commodities, however, the Kimberley – De Aar section has shared operations with the manganese heavy-haul corridor.
- Kamfersdam and Beaufort West form are important nodes which serve as the DC-AC-DC interfaces and where locomotives are shunted off and replaced with the appropriate traction technology.
- In future, the exchange yards at Kamfersdam and Beaufort West will be replaced by on-the-fly locomotive changeover facilities thereby eliminating the need for lengthy yard dwell times.
- The corridor also has supports significant long-distance passenger services such as the Shosholoza Meyl, Premiere Class and Blue Train and as such is pressurised to maintain and improve efficiency and minimise delays.

TRAIN CONFIGURATION

- Aside from the manganese bulk traffic train configurations are predominantly 40-wagons or less.
- Train lengths will in future be migrated towards the unit train length of 50-wagons; and later to 75-wagons or equivalent for strategic commodities such as containers and automotives.
- The corridor operates a mix of diesel, 3kV DC and 25kV AC locomotives; as new generation dual-voltage locomotives become more prevalent in the fleet – such as the Bo-Bo configuration 20E – these will replaced the single traction type locomotives.
- The axle loading restriction of 20t/axle is well suited to the intermodal traffic which dominates the Cape corridor.

SUPPORTING INFRASTRUCTURE

- An on-the-fly voltage changeover facility will be installed at Beaufort West.

Gauteng – Durban

OPERATIONS

- The current demand (2014) shows a theoretical 33 trains per day and eventual end state requirement of 184 trains by 2044, which is not possible.
- Due to the increased demand of container, break-bulk and agriculture trains, various operation philosophies can be adopted including removing the increasing the train running speeds from 50km/hr to 80km/hr; however, there are too many areas where the curve and gradient maximums make this impossible.
- A possible upgrade to 26t/axle; however, this is not recommended on account of low volumes of heavy bulk commodities.
- The only feasible long term operational plan for the Natcor lines is running longer trains.

TRAIN CONFIGURATION

- 50-wagon container trains to be reconfigured to 75-wagon and 150-wagon trains in the long term (DP) (150-wagon trains are still to be tested).
- 45-wagon automotive trains block will be reconfigured to 90-wagons.
- Coal trains 75-wagons – Majuba, 50 – Durban; import coke 75/80-wagons.
- Iron ore trains – 105-wagons to Newcastle.
- Other GFB will consist 40 vacuum and 50 air brake.

SUPPORTING TECHNOLOGIES

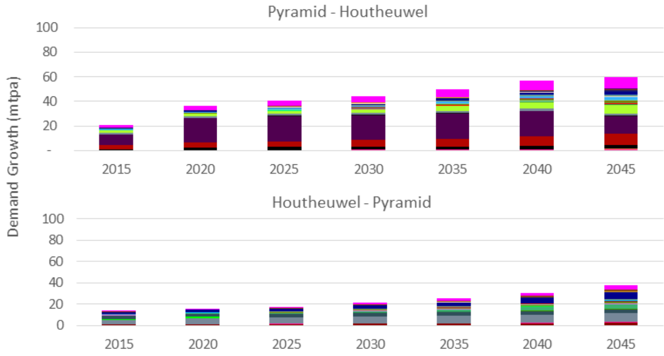
- Container trains have been identified as SMLJ/SHLJ wagons.
- Automotive will consist of newly designed prototyped SCL wagons.
- Upgrade 3kV AC to 25Kv DC.
- 20E dual voltage equivalent to be used on the basis of 20t/axle as well as the new class 43D locomotives (18E current use and phase out plan).

SUPPORTING INFRASTRUCTURE

- Doubling of line at Kwandengezi to Thornwood.
- Construction of new/reinstating block splits.
- Doubling of line from Rooikop to Rietvallei.
- Potential conversion of 3kV DC network to 25kV AC.

3.4.3 GAUTENG FREIGHT RING ANALYSIS

3.4.3.1 Capacity Utilisation



Commodity	2015 (mtpa)	2030 (mtpa)	2045 (mtpa)
Coal Mining Powerstation	8.34	20.32	14.00
Coal Mining Domestic	3.65	5.37	9.60
Containers	2.36	5.05	9.49
Iron Ore Domestic	4.23	6.87	7.97
Chrome	1.78	3.14	6.80
Cement	1.73	3.03	6.08
Limestone	0.31	1.42	4.44
Manganese Domestic	3.02	2.93	3.40
Coal Mining Exports	0.64	2.37	2.75
Maize	0.50	1.37	2.56

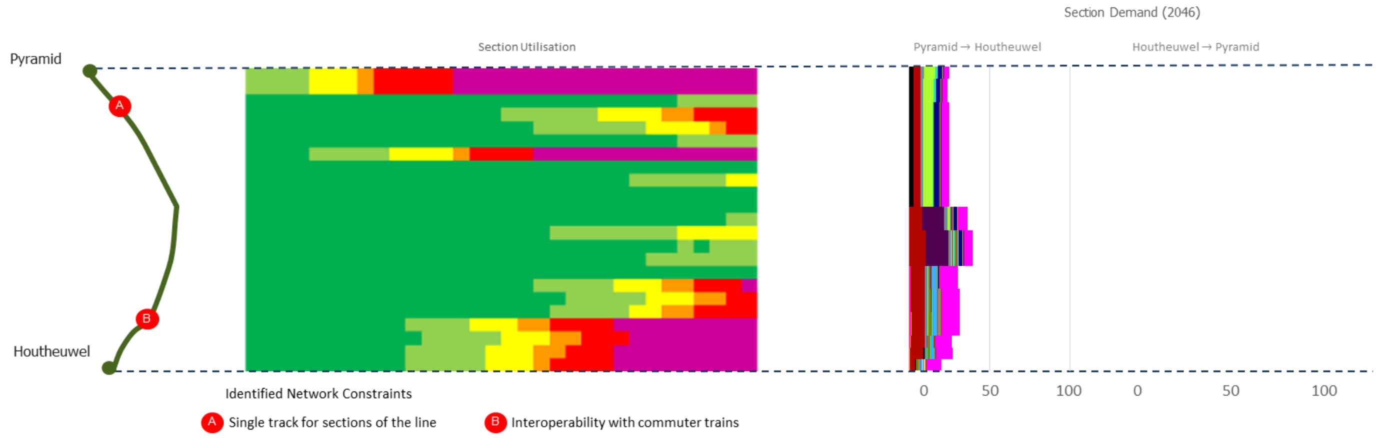


Figure 46: Gauteng Freight Ring Capacity Utilisation

DEMAND

The freight ring is a mixed-commodity line, carrying coal, general freight and intermodal traffic bi-directionally around Gauteng. As the Lephalale line is upgraded to accommodate higher coal volumes this traffic will also traverse the freight ring. However, the anticipated growth in Intermodal traffic to and from the planned super terminals in Gauteng will become the primary driver of expansion due to the corresponding increase in the number of container and automotive trains on the line.

On the southern portion of the line, where commuter trains are also in operation, capacity will become constrained more rapidly as PRASA services experience growth alongside freight volumes.

3.4.3.2 Capacity Interventions

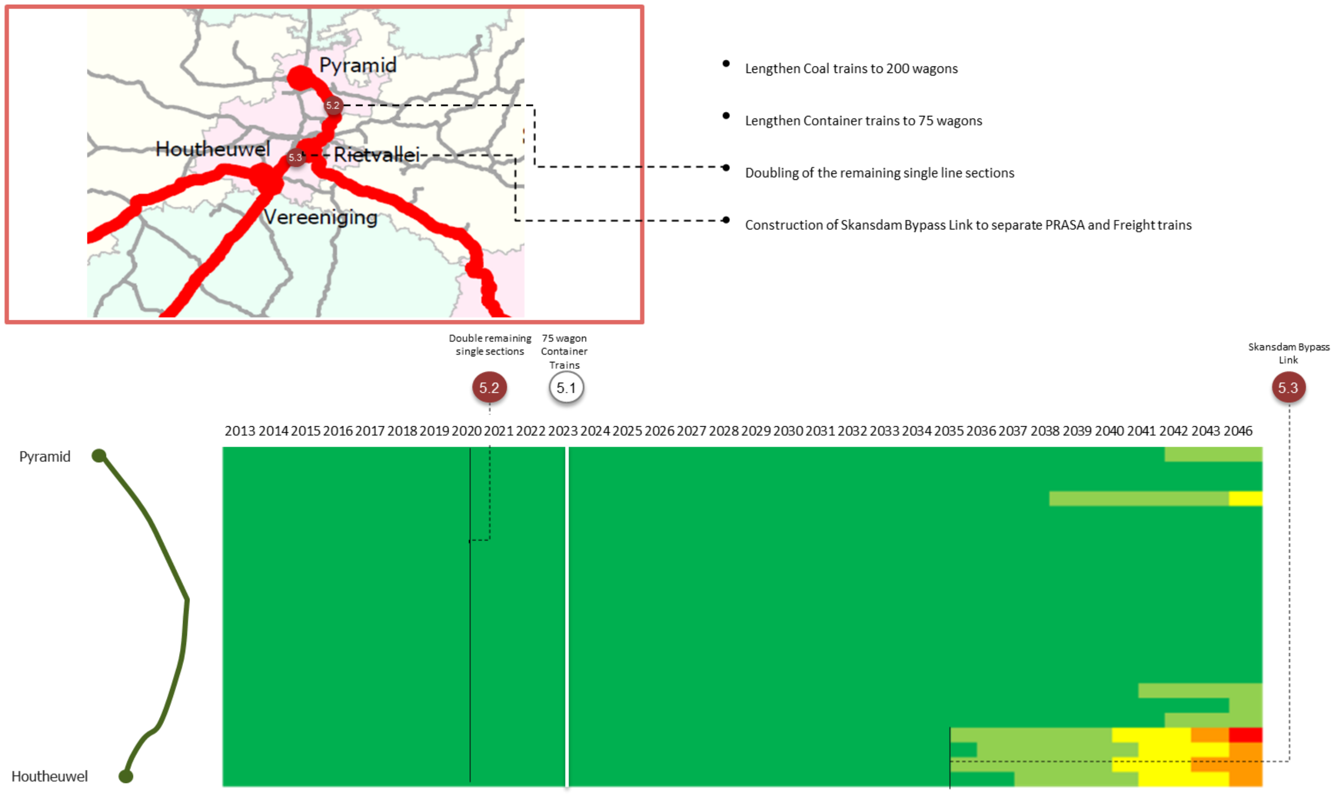


Figure 47: Gauteng Freight Ring Capacity Interventions

3.4.3.3 Strategic Discussion and Implementation Discussion

CAPACITY DEVELOPMENT

Bulk Minerals Capacity		
Development Phase	**Trains/Day**	**Mtpa**
Current	16	16
Increase train lengths to 75W	16	27
Double remaining sections	36	45
Increase train lengths to 150W	36	49
Skansdam Bypass Link	36+1	65

Table 16: Gauteng Freight Ring Total Capacity

- **75-wagon trains:** Intermodal trains which currently operate at 50-wagons or less will be lengthened to 75-wagons in line with expansion of the Natal corridor.
- **Double remaining single-line sections:** Doubling of the single-line sections will unlock 36 slots on the network, resulting in an increase from 27 to 45mtpa. This will assist with regards to the slots currently lost due to loose locomotives occupying mainline slots for shunting operations.
- **75-wagon trains:** Container and intermodal trains to be lengthened to 150-wagons in line with Natcor expansion and Intermodal super terminals.

MAINLINE

- The line section is a crucial link between the various intermodal corridors, as well as the Waterberg line and Mpumalanga coal fields. The line is semi-doubled with the single-track sections posing significant capacity and operating constraints. It is necessary that these sections are double-tracked.
- The line shares operations with commuter services in the Greenview and Skansdam areas, limiting freight capacity. A freight-only bypass link between Skansdam and Houtheuwel is planned, along with track chords at Greenview and Rietvallei to improve flexibility.
- Major bridges on the single-line sections are already double or have support columns for double-tracking.
- It is important that double-tracking be completed before the line capacity reaches its limitation to ensure that the necessary track occupations for the tie-ins may be accommodated with minimal service disruptions.

YARDS

- The planned intermodal super terminals at Tambo Springs, Sentrarand, Vereeniging and Pyramid South will be supported through the development of yards for arrivals, departures and train compilation.
- The City Deep rail facility processes import and export intermodal trains up to 50-wagons. This will be extended to accommodate 75-wagon trains.

3.4.3.4 Costing Summary

Gauteng Freight Ring

Gauteng Freight Ring — **Expansion and Investment**

Project	Intervention No.	Intervention Name	Total Value	Construction Period
Gauteng Freight Ring	NC.5.1	75 Wagon Container trains	-	3
Gauteng Freight Ring	NC.5.2	Double 40km of single track	981	3
Gauteng Freight Ring	NC.5.3	Skansdam Bypass Link	1 530	4
Gauteng Freight Ring	NC.5.4	OHTE & Power supply upgrades	171	5
Gauteng Freight Ring	NC.5.5	Conversion to 25kV AC	245	3
Gauteng Freight Ring	NC.5.6	Rietvallei chord	114	1
Gauteng Freight Ring	NC.5.7	Greenview chord	88	1
Gauteng Freight Ring	NC.5.8	Rosslyn Link	25	1

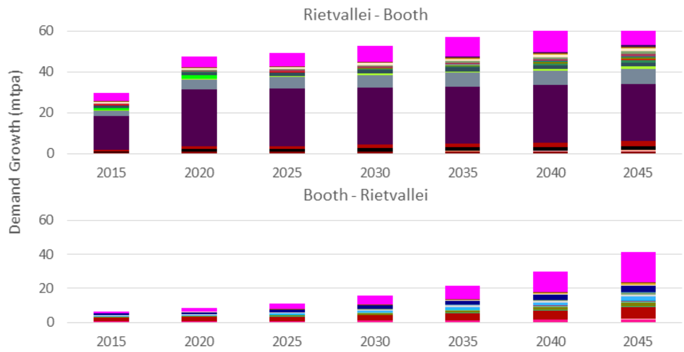
Development Plan

Intervention No.	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
NC.5.1																																
NC.5.2		4	12	51	466	448																										
NC.5.3															6	19	41	259	797	408												
NC.5.4	2	4	10	49	78	28																										
NC.5.5						1	3	13	117	112																						
NC.5.6										1	112																					
NC.5.7										1	86																					
NC.5.8				25																												

Table 17: Gauteng Freight Ring Expansion and Development

3.4.4 GAUTENG – DURBAN ANALYSIS

3.4.4.1 Capacity Utilisation



Commodity	2015 (mtpa)	2030 (mtpa)	2045 (mtpa)
Coal Mining Powerstation	16.47	28.00	28.00
Containers	1.11	5.25	18.11
Iron Ore Domestic	2.47	6.30	7.32
Coal Mining Domestic	2.08	3.09	6.43
Cement	1.04	1.87	3.91
Diesel	0.24	0.82	2.19
Manganese Domestic	1.43	1.76	2.04
Coal Mining Exports	0.42	1.58	1.83
Processed Foods	0.49	0.99	1.82
Wheat	0.53	0.83	1.79

Figure 48: Gauteng – Durban Capacity Utilisation

DEMAND

Commodity growth is expected to increase from approximately 30mtpa to over 100mtpa (2014-2042). The significant increase can be attributed to containers, break bulk and agricultural traffic.

The coal requirement to Eskom for the Majuba Power Station increases annually until 2018. Thereafter the dedicated line from Ermelo to Majuba, which is currently under construction, will be operational and that traffic will be rerouted releasing additional slot capacity for other commodities. Based on the demand data, it is envisaged that Natcor will run out of capacity near 2020.

3.4.4.2 Capacity Interventions

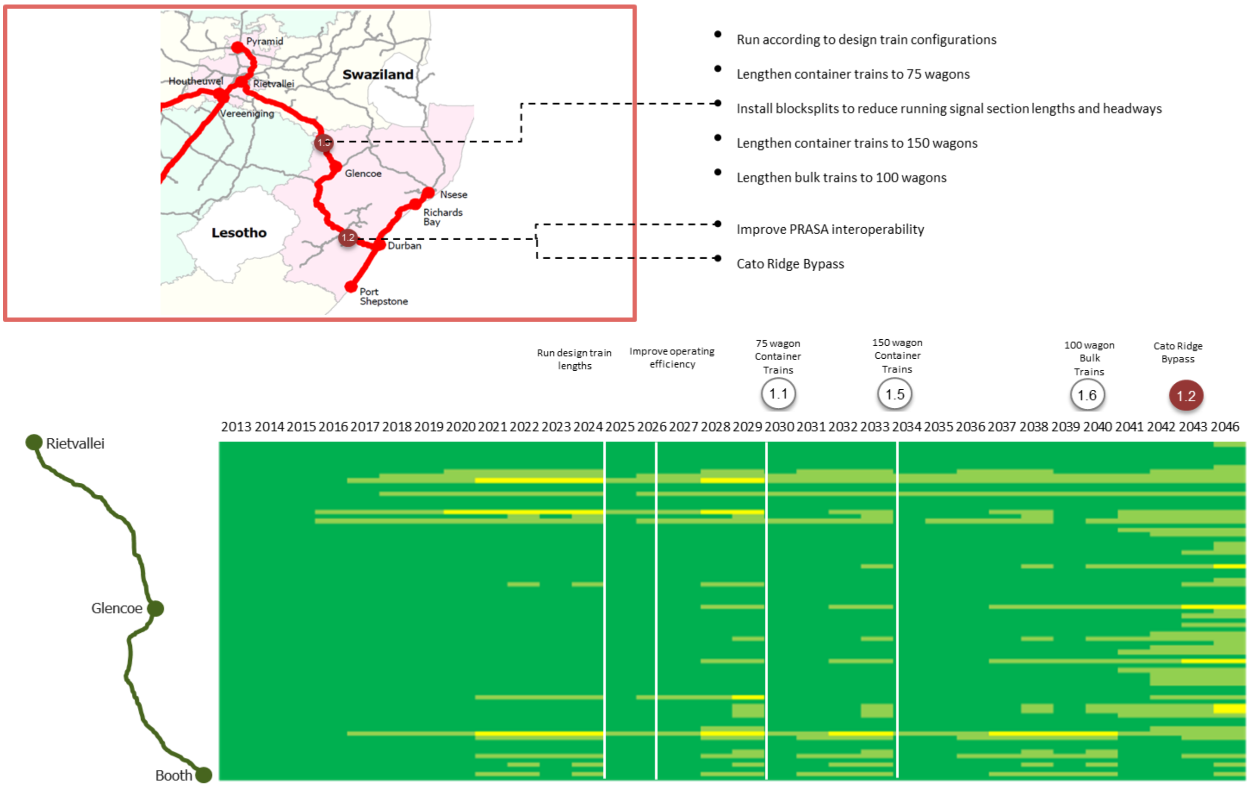


Figure 49: Gauteng – Durban Capacity Interventions

3.4.4.3 Strategic Discussion and Implementation Discussion

CAPACITY DEVELOPMENT

Bulk Minerals Capacity		
Development Phase	**Trains/Day**	**Mtpa**
Current	45	37
Refurbishment, operational improvements	49	43
75-wagon expansion	49	53
100-wagon expansion	64	76
150-wagon expansion	64	101

Table 18: Gauteng – Durban Intermodal Capacity

- **Refurbishment, operational improvements:** Operational constraints, infrastructure condition issues and availability of resources limit current operational capacity. Network refurbishment and operational improvements will release four additional slots.
- **75-wagon expansion:** Container and other intermodal trains to be lengthened to 75-wagons to increase per-train capacity.
- **Cato Ridge bypass:** Due the high number of metro trains between Cato Ridge and Booth capacity for freight trains is inadequate on this section. A new freight-only route is required to separate PRASA and TFR trains operations.
- **100-wagon expansion and supporting infrastructure:** Adjustments to the signal spacing will unlock 64 slots. Upgrades to the current 3kV electrical system will maximise the capacity and enable 100-wagon trains.
- **75-wagon expansion:** Capacity will be further expanded by lengthening container trains to 150-wagons.
- This requires conversion of the 3kV DC electrical system to 25kV AC. This will also allow bulk trains to operate as 100-wagons.

MAINLINE

- The line is double-tracked and most signals are spaced for 15-minute headways; thus opportunities for further infrastructure capacity expansion are limited.
- Operational solutions for capacity expansion have been sought, resulting in the plan to lengthen intermodal trains to 75-wagons or length-equivalent and later to 150-wagons using distributed power.
- Plans are to deploy a single locomotive type across the corridor to streamline maintenance activities, planning.
- The conversion from 3kV DC to 25kV AC poses a significant constructability challenge for which a solution is still under investigation.
- The line capacity between Durban and Cato Ridge is shared with PRASA commuter trains, this is one of the primary constrains on the route; the proposed Cato-Ridge bypass line would create an alternative route dedicated to freight traffic.
- Capacity requirements beyond that provided for by 150-wagon intermodal trains will require a large-scale intervention such as the construction of a third line or a change of track gauge to permit double-stacking of containers.

YARDS AND TERMINALS

- The location for a 150-wagon train compilation/de-compilation yard in the Durban complex must still be identified
- Bayhead is utilised for mainline departure and arrivals and facilitates compilation and separation of trains up to 50-wagons. In future, the yard is to become the primary arrivals and departure yard for the Durban ports complex, including the Durban Dig-out Port. Lines across the Umgeni river channel will be joined in order to facilitate
- 100-wagon container trains.
- The following upgrades are planned to accommodate the increasing container demand within the existing Durban Port Complex: i) Remodelling of the marshalling yard to facilitate the handling of container trains outside of the port terminal perimeter. ii) Yards within the terminal to be converted into stacking areas iii) Development of a rail terminal to handle 75-wagon trains in King's Rest.

3.4.4.4 Costing Summary

Gauteng – Durban Link

Expansion and Investment

Project	Intervention No.	Intervention Name	Total Value	Construction Period
Natcor Expansion	NC.1.1	Accommodate 75W trains	1 341	3
Natcor Expansion	NC.1.2	Cato Ridge Bypass	46 318	6
Natcor Expansion	NC.1.3	Block splits	706	2
Natcor Expansion	NC.1.4	OHTE & Power supply upgrades	6 648	4
Natcor Expansion	NC.1.5	Accommodate 150W trains	13 294	3
Natcor Expansion	NC.1.6	Accommodate 100W bulk trains	352	2
Natcor Expansion	NC.1.7	25kV AC Conversion	6 374	4

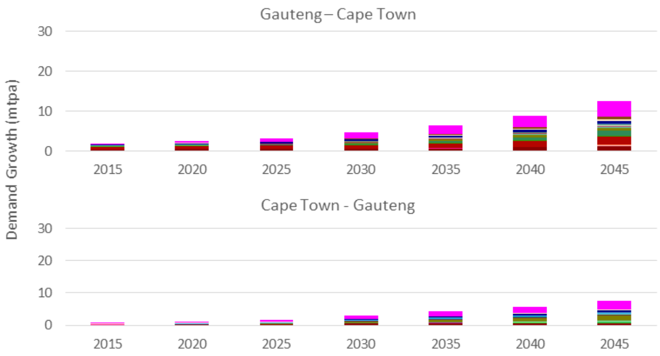
Development Plan

Intervention No.	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
NC.1.1		5	17	70	637	612													
NC.1.2											185	579	825	1 584	6 677	15 326	16 940	4 202	
NC.1.3				3	9	138	556												
NC.1.4						27	83	179	1 125	3 462	1 772								
NC.1.5							53	166	691	6 315	6 068								
NC.1.6								1	4	69	277								
NC.1.7						25	80	172	1 078	3 319	1 699								

Table 19: Gauteng – Durban Expansion and Development

3.4.5 GAUTENG – CAPE TOWN ANALYSIS

3.4.5.1 Capacity Utilisation



Commodity	2015 (mtpa)	2030 (mtpa)	2046 (mtpa)
Containers	0.25	1.47	3.96
Coal Mining Domestic	0.64	0.94	1.91
Processed Foods	0.00	0.40	1.43
Maize	0.47	0.53	1.27
Stone	0.05	0.23	1.23
Cement	0.16	0.38	0.80
Other Man. Industries	0.07	0.18	0.62
Other Mining	0.00	0.07	0.35
Iron & Steel	0.06	0.08	0.29
Chemicals	0.04	0.12	0.27

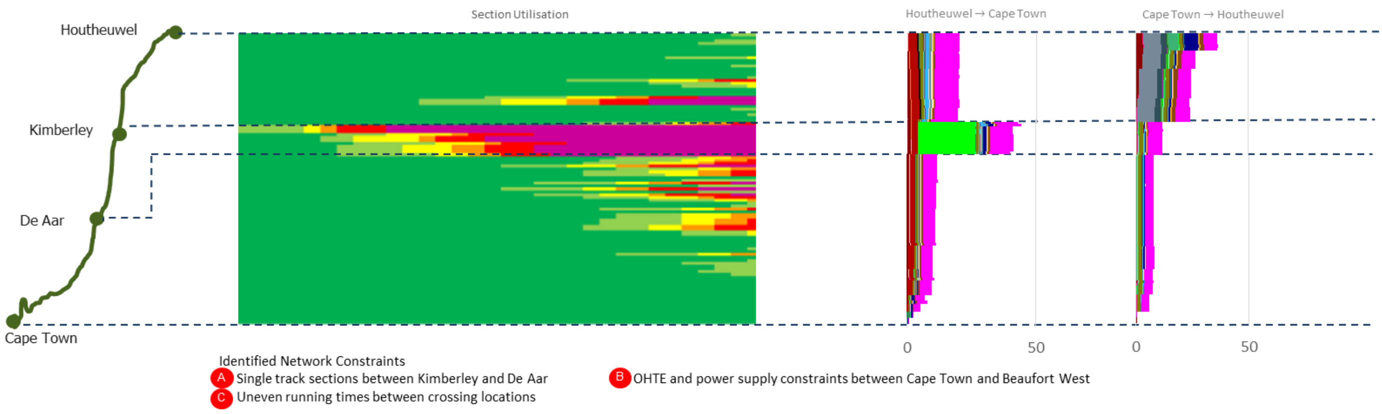


Figure 50: Gauteng – Cape Town Capacity Utilisation

DEMAND

Cape Town – De Aar

Intermodal traffic as well as general freight are forecast to grow significantly in the long term. Rail volumes in both directions and are mainly made up of containers, coal and agricultural products.

De Aar – Kimberley

As part of the manganese corridor this line section carries volumes of bulk traffic in addition to the intermodal traffic (containers and automotives) destined for both Port Elizabeth/Coega and Cape Town. Long-distance passenger trains are also present on the network and pose a challenge in terms of interoperability and the effective use of line capacity.

Kimberley – Houtheuwel

This route sees a diverse mix of traffic including domestic coal, bulk iron ore and manganese for domestic consumption and export in low volumes through Durban port. Intermodal traffic to and from Cape Town and Port Elizabeth/Coega is one of the largest drivers of growth.

Vereeniging – Noupoort

Volumes show variation across the section where feeder lines and junctions meet, but most volumes move the length of the corridor. However, volumes are considerably higher in both directions between Gauteng and Sasolburg, as fuel, refined productions and coal are transported to and from the plant.

3.4.5.2 Capacity Interventions

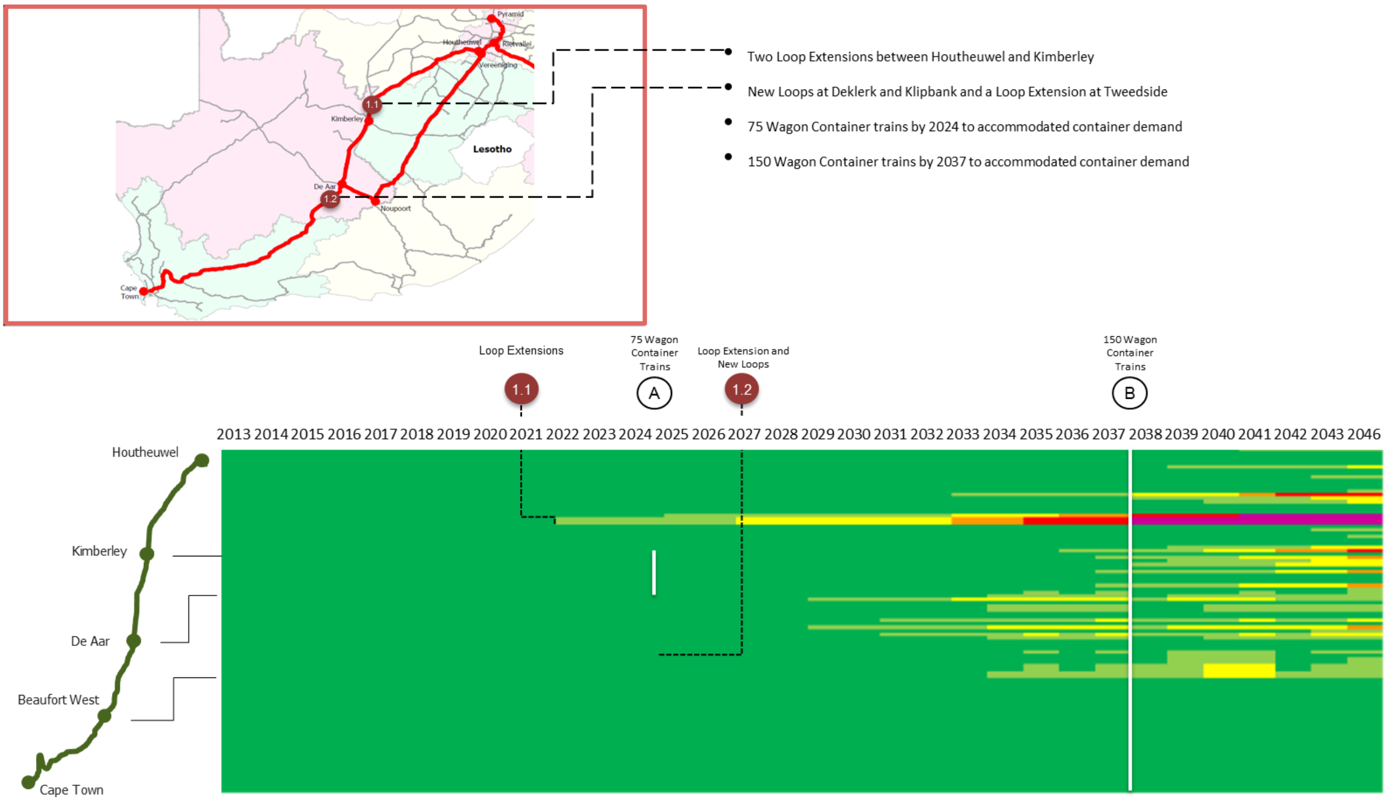


Figure 51: Gauteng – Cape Town Capacity Interventions

3.4.5.3 Strategic Discussion and Implementation Discussion

CAPACITY DEVELOPMENT

Gauteng – Cape Town Container Capacity		
Development Phase	**Trains/Day**	**Mtpa**
Current	9	13
75-Wagon expansion	8	19

Table 20: Gauteng – Cape Town Capacity Development

- **75-wagon expansion:** An additional 3mtpa can be gained with the extension of container trains to 75-wagons. Several loop extensions will be required between Houtheuwel to Beaconsfield and De Aar to Cape Town to facilitate the longer trains on the network.

MAINLINE

- Primary constraint is the Kimberley – De Aar section which will be partially doubled (97km) as part of the Manganese expansion programme.
- Intermodal trains may be lengthened to 75-wagons in future to maximise the infrastructure capacity.

YARDS AND TERMINALS

- To reduce turnaround time and improve operating efficiency on-the-fly voltage changeover facilities will be installed at Beaufort West and Kamfersdam.
- Bellville Marshalling yard facilities container traffic destined to and from Belcon container terminal. The yard is able to handle 50-wagon trains and provides maintenance services for locomotives and wagons. As 75 and later 150-wagon consists become the standard for intermodal trains, an additional facility must be developed to accommodate the longer trains.

3.4.5.4 Costing Summary

Gauteng – Cape Town System

Gauteng – Cape Town System — **Expansion and Investment**

Project	Intervention No.	Intervention Name	Total Value	Construction Period
CapeCor Expansion	CC.1.2	Loop Extensions at Tweedside and Quarry	25	2
CapeCor Expansion	CC.1.7	Double Single line sections between Kimberley and Houtheuwel	3 617	3
CapeCor Expansion	CC.1.8	DC - AC Conversion	575	5
CapeCor Expansion	CC.1.9	DC - AC Conversion	1 420	5

Development Plan

Intervention No.	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
CC.1.2																								0	0	5	20					
CC.1.7																14	45	188	1 718	1 651												
CC.1.8																			8	29	117	1121	1434									
CC.1.9																	7	25	43	120	569	909	321									

Table 21: Gauteng – Cape Town Expansion and Development

4. Hubs and terminals

4.1 INTRODUCTION

The rail network is a system that consists of the main rail lines that regularly move trains from origin to destination, rail yards, and rail terminals for freight consolidation and transfer from one mode of transport to another. Throughout South Africa there are a number of existing intermodal terminals, typically small or intermediate in capacity, these terminals have been located such as to optimise the rail lines, rail yards and roads linked to the terminal. Most of these rail terminals by design are linked to port terminals for export and import purposes supported by both rail and road transport. Historically hubs and terminals developed around industrial activities or attracted those activities due to the rail transport service in close proximity.

Intermodal terminals are significant in ensuring cost efficient supply chains and ensure sufficient capacity for future growth is adequately supplied through the optimisation of rail and road infrastructure. Commodities handled at intermodal and rail terminals include containers, automotive (vehicles, vehicle equipment and parts), bulk mineral and break bulk. Commodities are consolidated at a specific source and distributed (either by road or rail) for local consumption or exported to international markets (though ports and shipping). Freight terminals (container, automotive, bulk and break bulk) operate differently, serve different markets and therefore require different handling equipment. To this end each rail terminal type is designed to serve a specific purpose and service a specific commodity.

The existing terminals at their current form will not be able to offer enough capacity for the next thirty years, either as a result of rail, yard or terminal capacity constraints or terminals not strategically located to serve the current and future rail and yard capacity requirements. Transnet is planning to capture 80% market share of long haul (rail friendly) transportation of intermodal traffic and as well as a significant domestic traffic market share. To achieve this objective Transnet requires a number of intermodal terminals at critical locations within South Africa so as to ease the transfer of commodities between the road and rail modes. To this end the following development approach has been advanced.

TERMINAL DEVELOPMENT APPROACH

- Ensure sufficient terminal capacity is available to incrementally increase capacity to optimise rail, yard and road infrastructure when required.
- Maximise the footprint of the existing terminals before developing mega-terminals.
- Build new standard terminals to potentially bring potential operational benefits and economies of scale, and as well as necessitate the provision of cost-effective, reliable, available and competitive transportation mechanisms.
- Effective and efficient integration and linkages with the rail network and ports, as well as incorporating corridor strategies.
- Support the optimisation of the logistic chain and minimisation of the cost of logistics.

4.2 STATUS QUO

The hubs and terminals status quo map shows the positions of the intermodal (container) terminals, automotive terminals and general freight terminals across South Africa. Rail terminals are therefore a significant provider of modal transfer capacity; however, their market share is declining, with terminals such as Eastcon being dormant and others such as Vaalcon declining in operations. A number of these terminals will be crucial in the strategic growth of container traffic and the domestic transport market in the medium to long-term future.

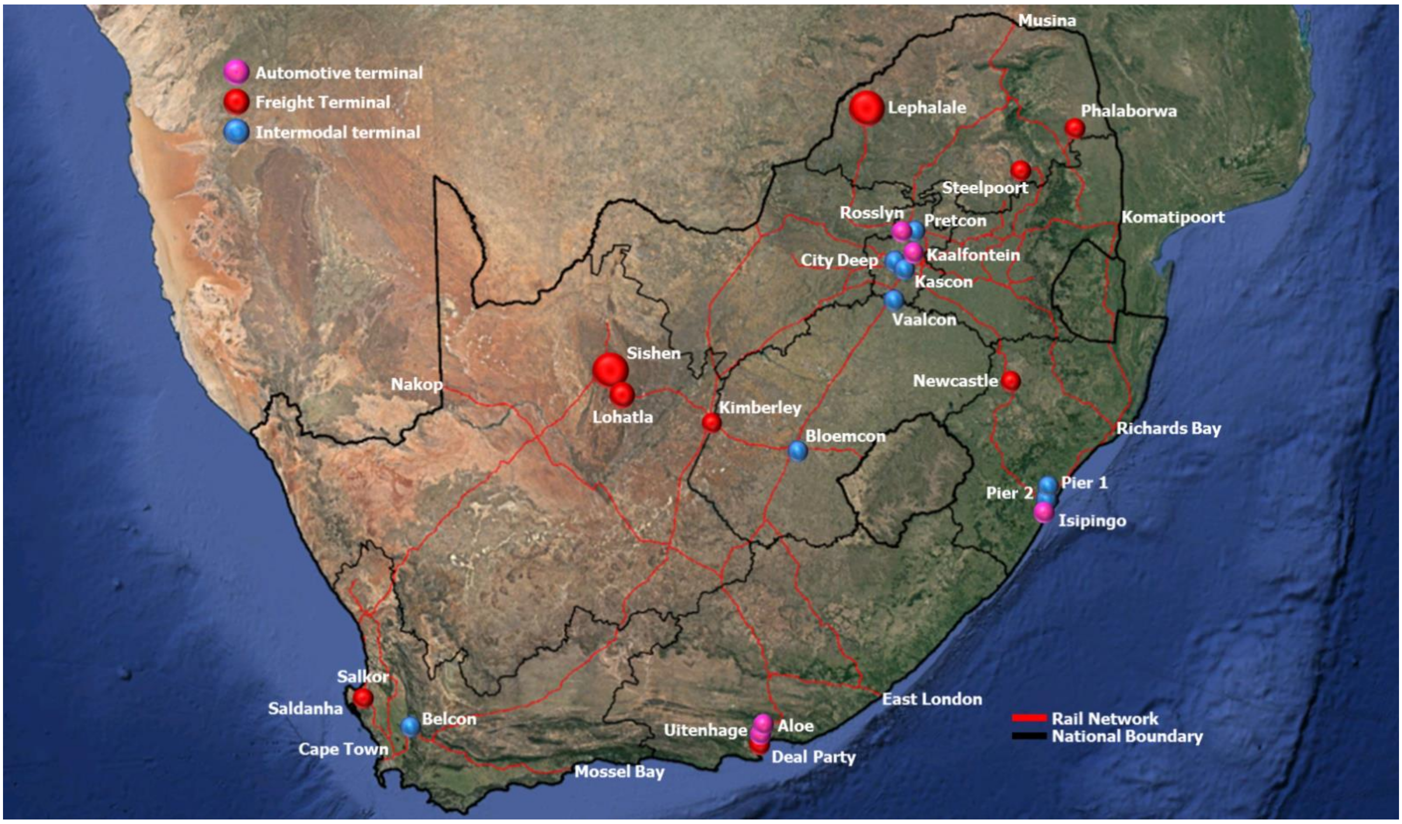


Figure 52: Hubs and Terminal Status Quo

4.3 CONTAINER TERMINALS

4.3.1 STATUS QUO

Containerised freight traffic is increasing globally and in developing countries, such as South Africa, the growth in port container handling is expected to be even greater over the next three decades. The increased national economic growth and global container trends have resulted in an increase in the requirement for container handling capacity throughout South African ports, main rail lines and yards, as well as roads.

The hubs and terminals status quo map above shows the positions of container (inland) terminals. The intermodal terminals consist of inland and port container terminals serving the container business through the three major General Freight corridors namely the Capecor, Natcor and Southcor. Majority of South Africa's freight moves on the Natcor between Gauteng and the Durban ports, it handles more than 70% of all container movements in the country.

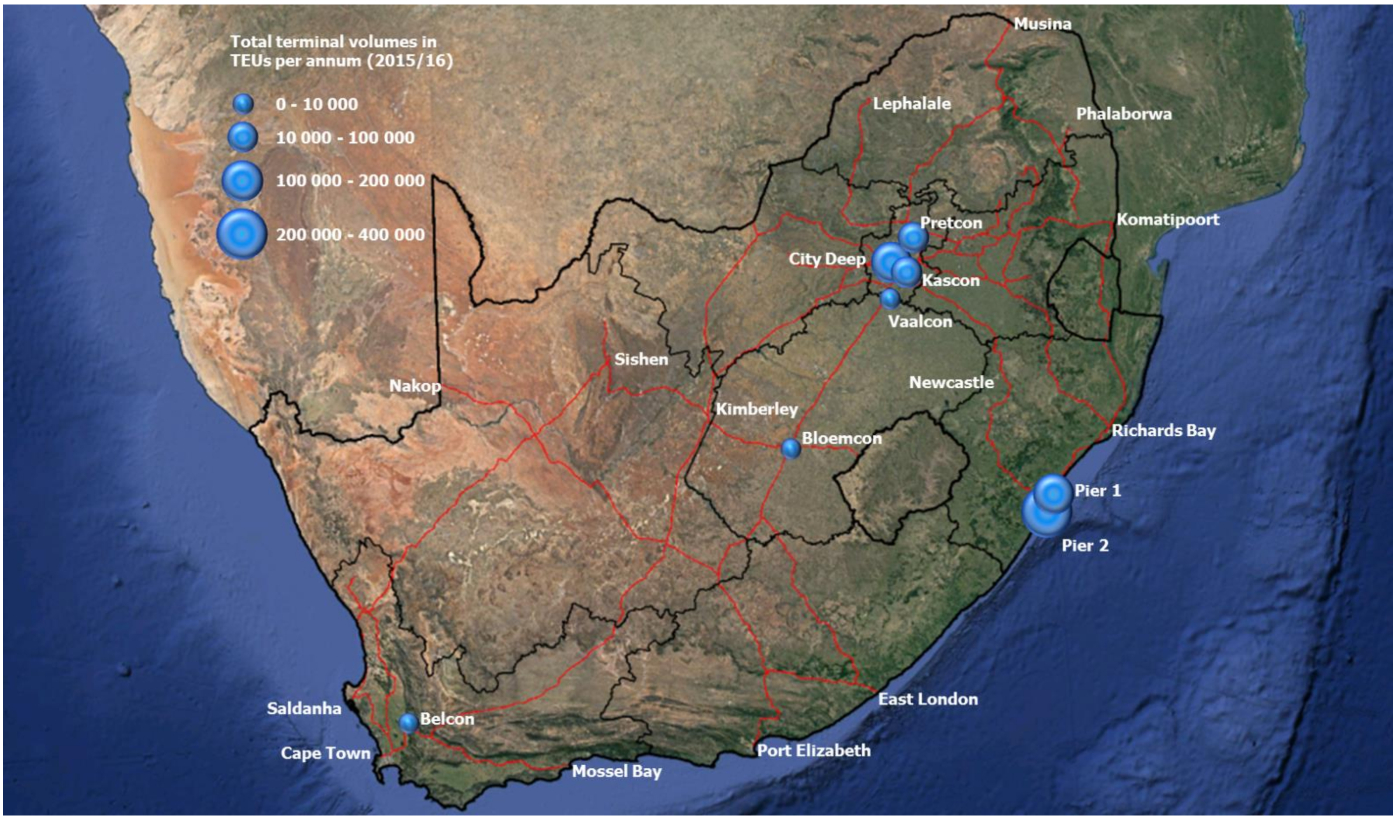


Figure 53: Status Quo (Current Container Terminals)

Container volumes have been declining in most of the container terminals with the exception of City Deep, Kascon, Pretcon and Durban rail terminals, which have seen an increase in container volumes, hence their dominance in freight movements and continued sustainability. These five (5) terminals form an important part the future growth of container volumes in the country. Smaller terminals, notwithstanding their declining volumes, have a potential growth factor and can play an important role container movement and support the domestic growth strategy.

4.3.1.1 Durban Intermodal Terminals

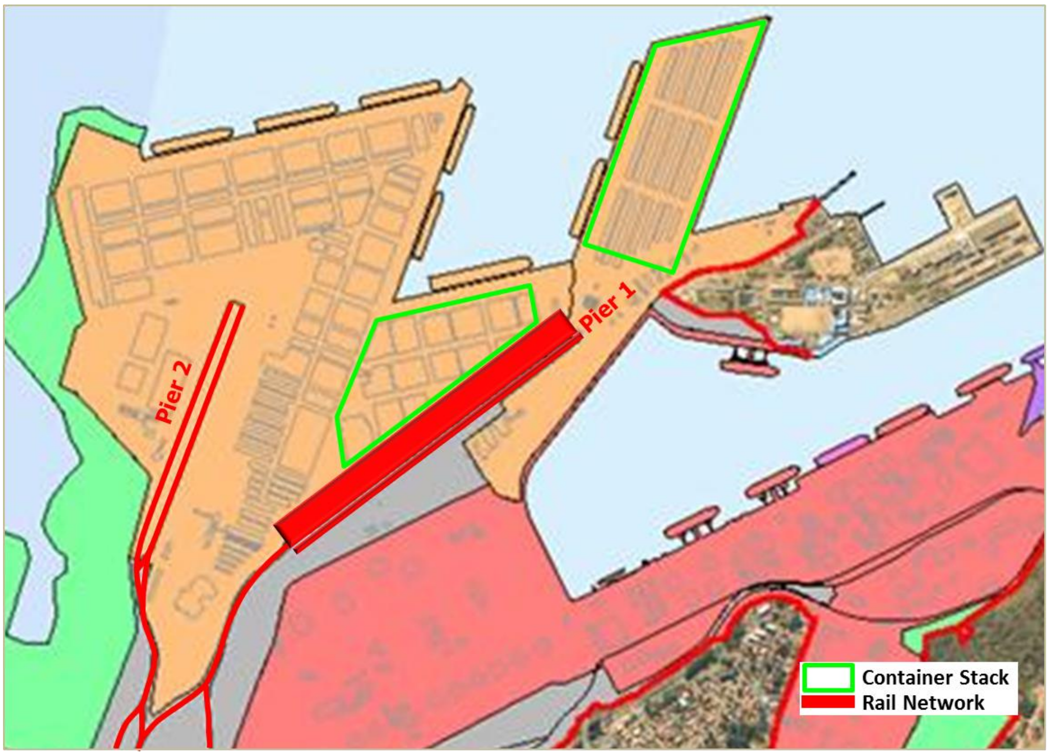
Durban is considered South Africa's most significant port in terms of container and automotive imports and exports, and is also known as the biggest and busiest container terminal in Africa. Future port developments are being assessed in order to increase South Africa's economic competitiveness. A concept study has envisaged that in order for rail to meet its desired market share of rail friendly containerised traffic Durban will need to significantly increase its intermodal terminal capacity by 2046.

Currently the port of Durban has two rail container terminals (Pier 1 and Pier 2) and a buffer stack which provides a combined capacity of 550 000 TEUs, the two terminals handle over 70% of South Africa's container volumes.

The existing yards and terminals can only handle 50-wagon container trains, this negatively impact the handling capacity into the container terminals.

Kings Rest which is to temporarily buffer containers unable to enter the port terminals upon arrival. This enables trains to be fully offloaded and turned around rapidly. The buffer does not provide additional container handling capacity.

A. PIER 1



Pier 1 is located west of Salisbury Island, the terminal is located within the Durban Port. The terminal is located at the Durban port container terminal which is known as Africa's biggest and busiest container terminal.

Infrastructure Characteristics:

- 3 handling tracks (800m for a 50 wagon terminal) served by 2 Rail Mounted Gantries (RMGs).
- 250 000 TEUs terminal capacity (per annum)

General Issues:

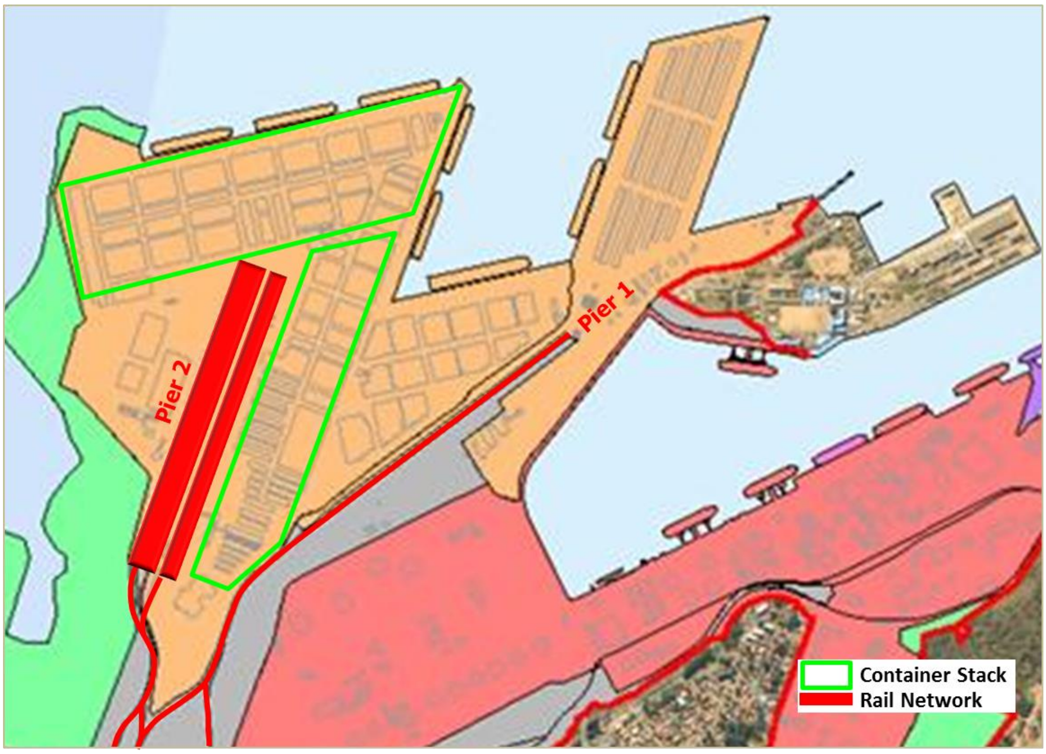
- Pier 1 terminal is operating at its design capacity
- Terminal limited to short trains only and not enough rail stack capacity
- Multiple Yards. inefficient terminal layouts, redundant capacity, complicated access and limited road / rail access

Container trains to or from Pier 1 are prepared at the Kings Rest yard and dispatched to the main line when slots open. The Kings Rest yard is also used to temporarily buffer containers unable to enter the port terminals upon arrival. This enables trains to be fully offloaded and turned around rapidly. The buffer does not provide additional container handling capacity.

Figure 54: Current Pier 1 Container Terminal

Pier 1 is located west of Salisbury Island, the terminal is located within the Durban Port, and the terminal is accessed through the Kings Rest yard. Longer trains have to be broken up into two (at Kings Rest yard) before being shunted and placed for loading and off-loading. Pier 1 is designed to accommodate 50-wagon container trains with six lines and three rail-mounted gantry cranes (the other three lines have no gantry cranes) and has a design capacity of 250 000 TEUs per annum.

B. PIER 2



Pier 1 is located west of Salisbury Island, the terminal is located within the Durban Port. The terminal is located at the Durban port container terminal which is known as Africa's biggest and busiest container terminal.

Infrastructure Characteristics:

- 3 handling tracks (750m for a 50 wagon terminal) operated by 3 Rail Mounted Gantries (RMGs)
- 300 000 TEUs terminal capacity (per annum)

General Issues:

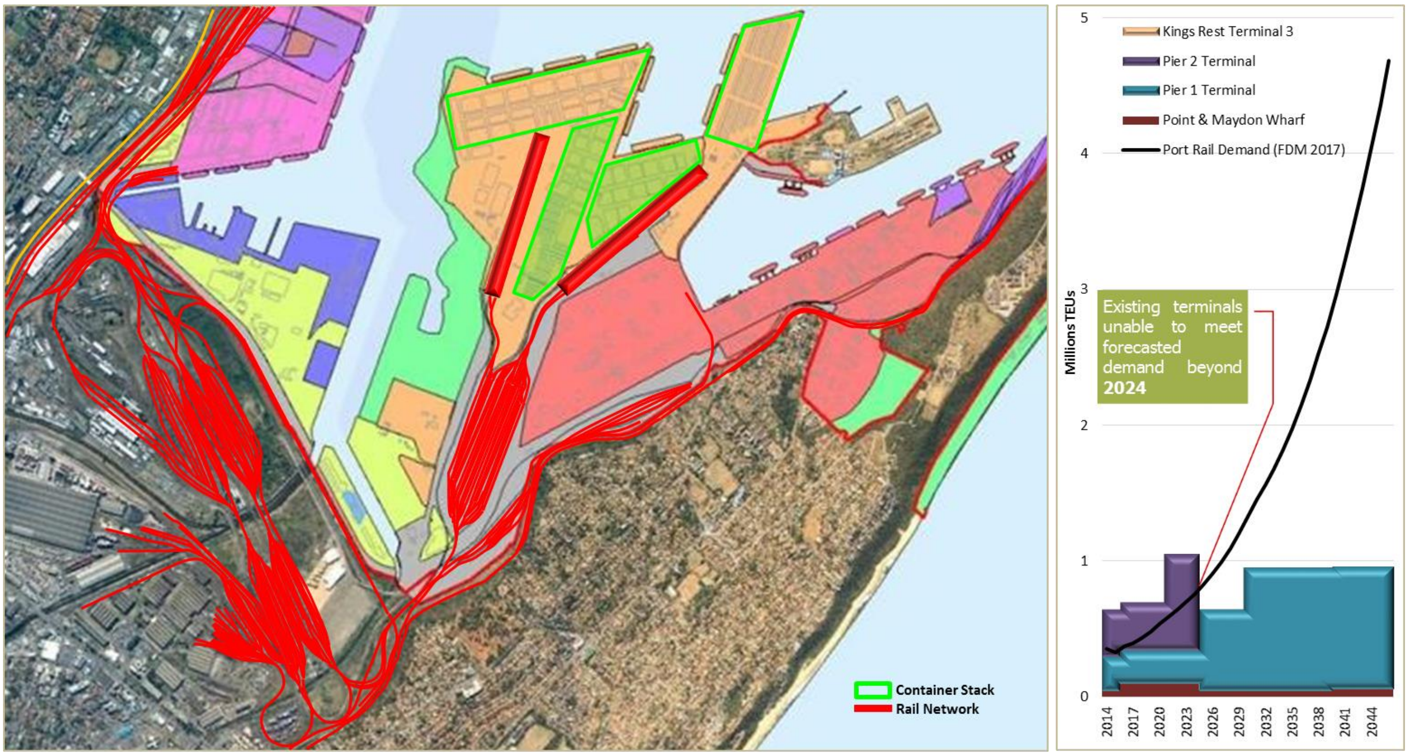
- Pier 2 terminal is operating at its design capacity
- Terminal limited to short trains only and not enough rail stack capacity
- Multiple Yards. inefficient terminal layouts, redundant capacity, complicated access and limited road / rail access

Container trains to or from Pier 2 are prepared at the Kings Rest yard and dispatched to the main line when slots open. The Kings Rest yard is also used to temporarily buffer containers unable to enter the port terminals upon arrival. This enables trains to be fully offloaded and turned around rapidly. The buffer does not provide additional container handling capacity.

Figure 55: Current Pier 2 Container Terminal

Pier 2 is located at the west side of Salisbury Island. Container trains at the Pier 2 rail terminal either arrive at or depart from the King's Rest yard. The current capacity of the terminal is 300 000 TEUs per annum. Pier 2 container terminal has three loading and offloading lines operated by three rail-mounted gantry cranes.

C. DEMAND VS. CAPACITY – PIER 1 AND 2 (DCT)



- The port of Durban has two rail container terminals at Pier 1 and DCT/Pier 2 with 250 000 and 300 000 TEUs per annum capacity respectively Both Bayhead and Kings Rest yards are configured to handle 50 wagon container trains which presented a challenge for the recent 75 wagon Anaconda trains along the corridor.
- The current rail intermodal (Pier 1 and DCT/Pier 2) capacity will not be able to accommodate the increase in container traffic forecasted over the next 30 years

Figure 56: Demand vs. Current Terminal Capacity

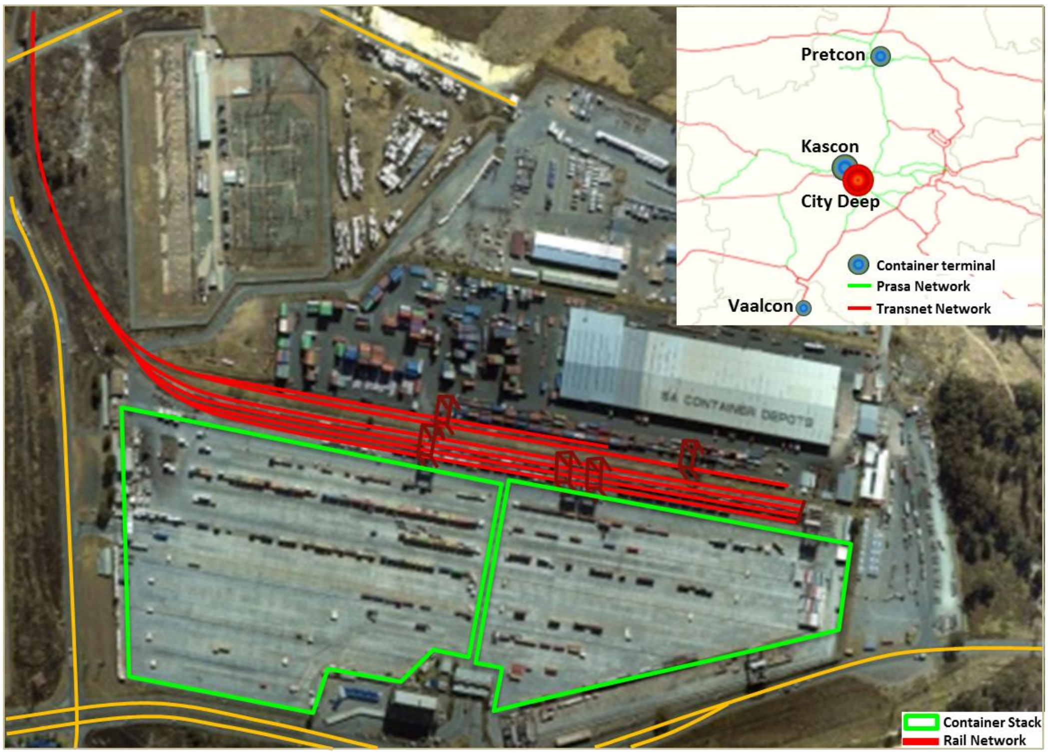
The demand versus capacity graph indicates the forecasted growth in rail container growth for the next 30 years against the capacity of the current Durban rail terminals. The graph indicates that demand will exceed the current capacity by 2017 if there are no capacity expansion plans implemented in the next two years. With the increase in container traffic forecast over the next 30 years it is vital to increase the port's current rail intermodal capacity to match the corridor and inland capacities, including longer train configurations.

4.3.1.2 Gauteng intermodal terminals

Currently, Gauteng has limited rail and terminal capacity to accommodate the potential growth in this industry. The existing facilities are located in or close to the Central Business Districts with limited or inadequate road accessibility, as well as expansion potential. Gauteng provides freight rail links to all areas of the country, and main rail flows are for import and export through the Ports. However in the central areas of Gauteng these rail links are often shared with PRASA (passenger services) leading to inefficiencies.

Container traffic on rail between Durban and Gauteng typically arrives at the centre of industry (City Deep and Kaserne). The other terminals are located close to the main industrial centres of Gauteng, in the north (Pretoria), south (Viljoensdrif) and east (Dunnottar). Transnet currently has four (4) intermodal terminals in operation in and around Gauteng, namely City Deep, Kascon, Pretcon, and Vaalcon terminals. Together they have a maximum handling capacity of 800 000 TEUs per annum.

A. CITY DEEP



City Deep container terminal is Transnet's primary intermodal terminal, located south of central Johannesburg

Infrastructure Characteristics:

- 4 handling tracks (50 wagon terminal) served by Rail Mounted Gantries (RMGs)
- 5 976 TEU container stacking capacity
- 400 000 TEUs terminal capacity (per annum) with 193 447 TEU's handled during 2015/16 Financial Year

General Issues:

- Limited slot capacity on the mainline (access line shared with Prasa)
- Road traffic congestion (accessing the terminal) and truck staging area

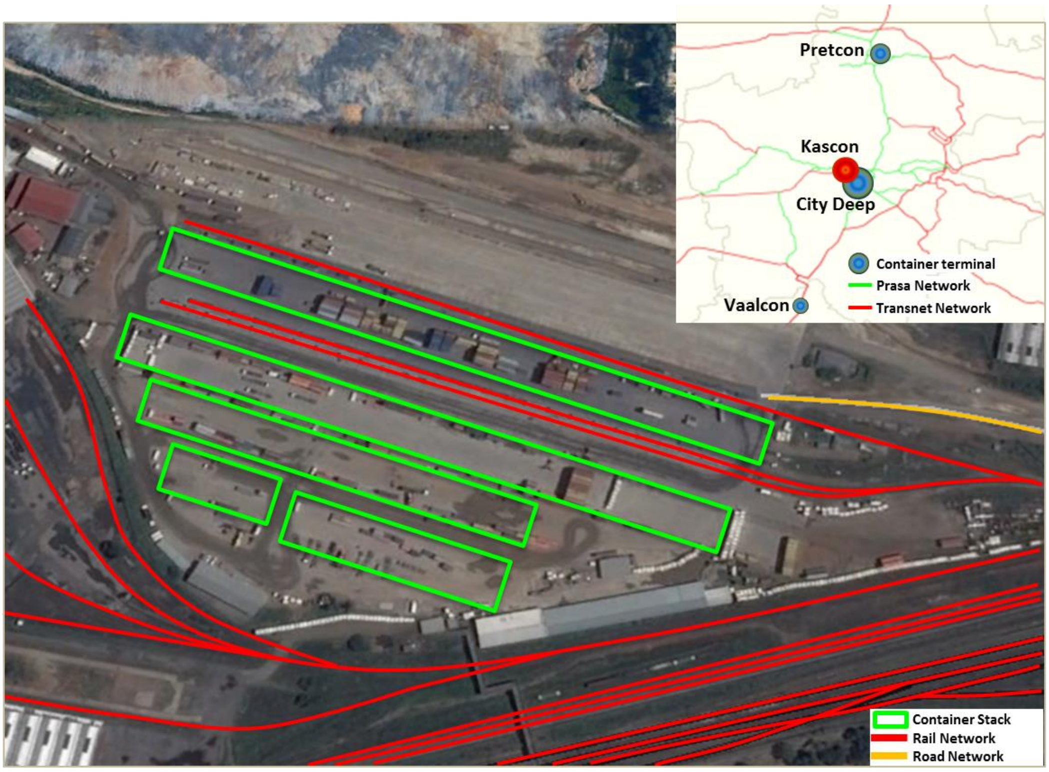
70% of all TEU handled at the terminal were predominantly imports, originating from deep sea with 82% being full TEU. 20% of all TEU handled was Empties for Financial Year 2016/16.

Figure 57: City Deep Container Terminal

City Deep is approximately 4 km south east of the Johannesburg CBD. The terminal is accessed from the Natcor mainline via shared commuter lines restricting line capacity during morning and afternoon peak periods. Road access to the terminal is an issue due to the presence of other road-road and road-rail intermodal facilities and private sidings in the City Deep area. City Deep has four (4) lines that accommodate 50-wagon trains and is served by rail from the Kaserne marshalling yard.

The City Deep terminal is the largest inland container terminal in South Africa with a capacity of 400 000 TEUs per annum. City Deep terminal has undergone an upgrade to increase its capacity in the last three years, hence the decrease in volumes between 2012 and 2014 indicated in figure 60 above. City Deep handles most of the containers in Gauteng, it handles both import and export volumes.

B. KASCON



Kascon is located in the Kaserne area (3 km from City Deep), adjacent to Kaserne West station in Johannesburg.

Infrastructure Characteristics:

- 4 handling tracks (25 wagon terminal) operated by reachstackers
- 1 400 TEU container stacking capacity
- 110 000 TEUs terminal capacity (per annum) with 87 163 TEU's handled during 2015/16 Financial Year

General Issues:

- Current operational capacity on rail is limited to 25 wagon train lengths
- The location of the terminal is within a passenger rail services that restricts access during morning and afternoon peak periods

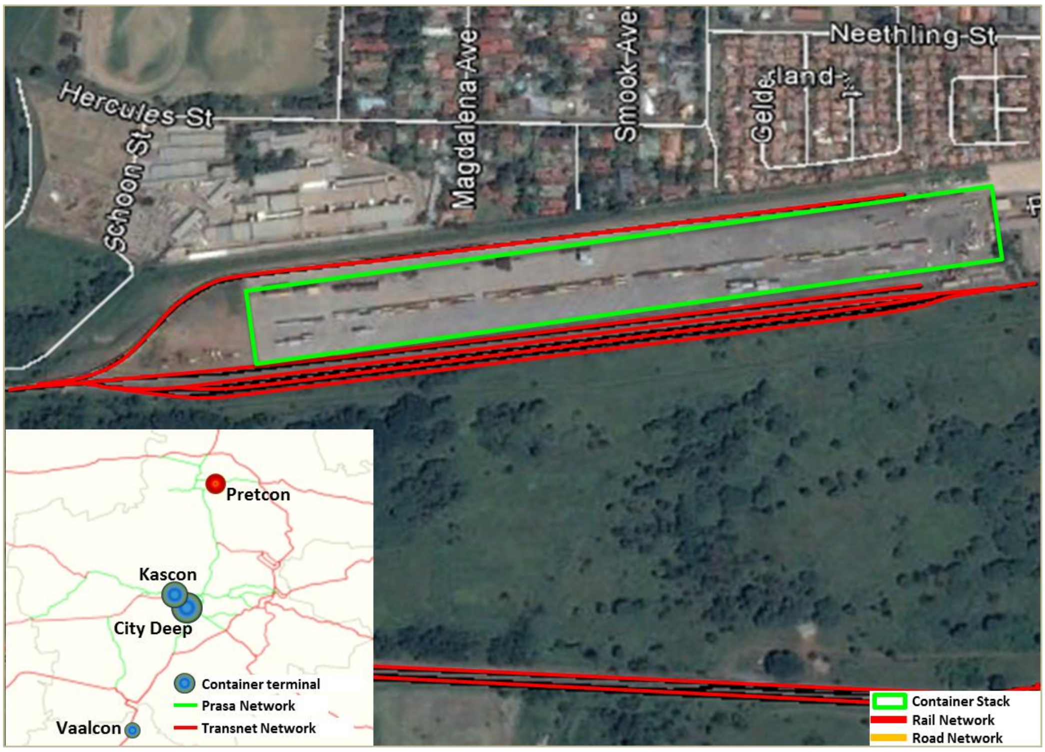
Kascon has experienced growth in the number of empty container throughput for the last five financial years. On average, 74% of the throughput consists of empty containers.

Figure 58: Kascon Container Terminal

The site is located in the Kaserne area of Johannesburg, with road access from the M2 freeway. The terminal is situated adjacent to Kaserne West station, with rail access from a single service line on the western side of Kaserne goods middle shunting yard. Access to the site is by a roadway shared with other adjacent container sites. The terminal consists of three (3) 25-wagon lines operated by reach stackers and currently has a capacity of 110 000 TEUs per annum.

Similar to the situation at City Deep, road access to Kascon is a challenge due to activities of other road-road and rail-road intermodal facilities and private sidings in the area. The terminal mostly handles empty containers and export traffic.

C. PRETCON



Pretcon is located in Capital Park and road access is via Mansfield Avenue (R101).

Infrastructure Characteristics:

- 5 handling tracks (52 wagon terminal) operated by reachstackers
- 3 168 TEU container stacking capacity
- 210 000 TEUs terminal capacity (per annum) with 52 129 TEU's handled during 2015/16 Financial Year

General Issues:

- Delays in sidings as trains access the terminal via a single track from Capital Park and commuter services curtail freight train movement during peak commuter hours.
- The road access is restricted to major arterials to the east and the south.

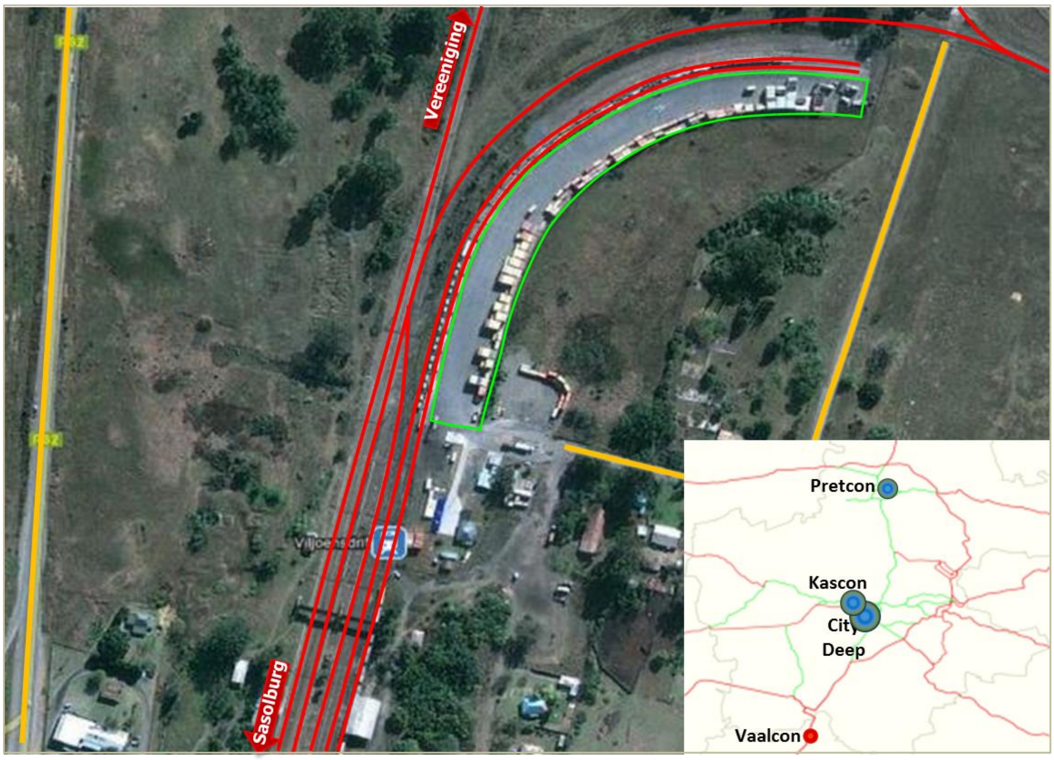
Pretcon has operated at 47% of throughput capacity on average over the past five financial years. 74% of all TEUs on average is full containers.

Figure 59: Pretcon Container Terminal

Pretcon container terminal is located in Capital Park in Pretoria, between Hercules and Koedoespoort. The terminal served by rail from Capital Park shunting yard and is accessed by road via R101 (Mansfield Avenue), west of Capital Park station. Passenger and freight services share the rail lines in this section, thus limits access into the terminals during peak commuting hours. This site is also surrounded by a residential area which impacts the possibility of expansion and being in a residential area, terminal operating hours are limited.

Pretcon has operated on average at 47% of throughput capacity over the last five (5) years. The terminal is operated by reach stackers and it has a design capacity of 210 000 TEUs per annum

D. VAALCON



The terminal is located at Viljoensdrif station, with Vereeniging and Leeuhof towards the north in the up direction of rail travel and Sasolburg to the south in the down direction.

Infrastructure Characteristics:

- 4 handling tracks (25 wagon terminal) operated reachstackers
- 540 TEU container stacking capacity
- 50 000 TEUs terminal capacity (per annum) with 9 326 TEU's handled during 2015/16 Financial Year

General Issues:

The curved shape of the terminal constrains operations and reduces the stacking area significantly.

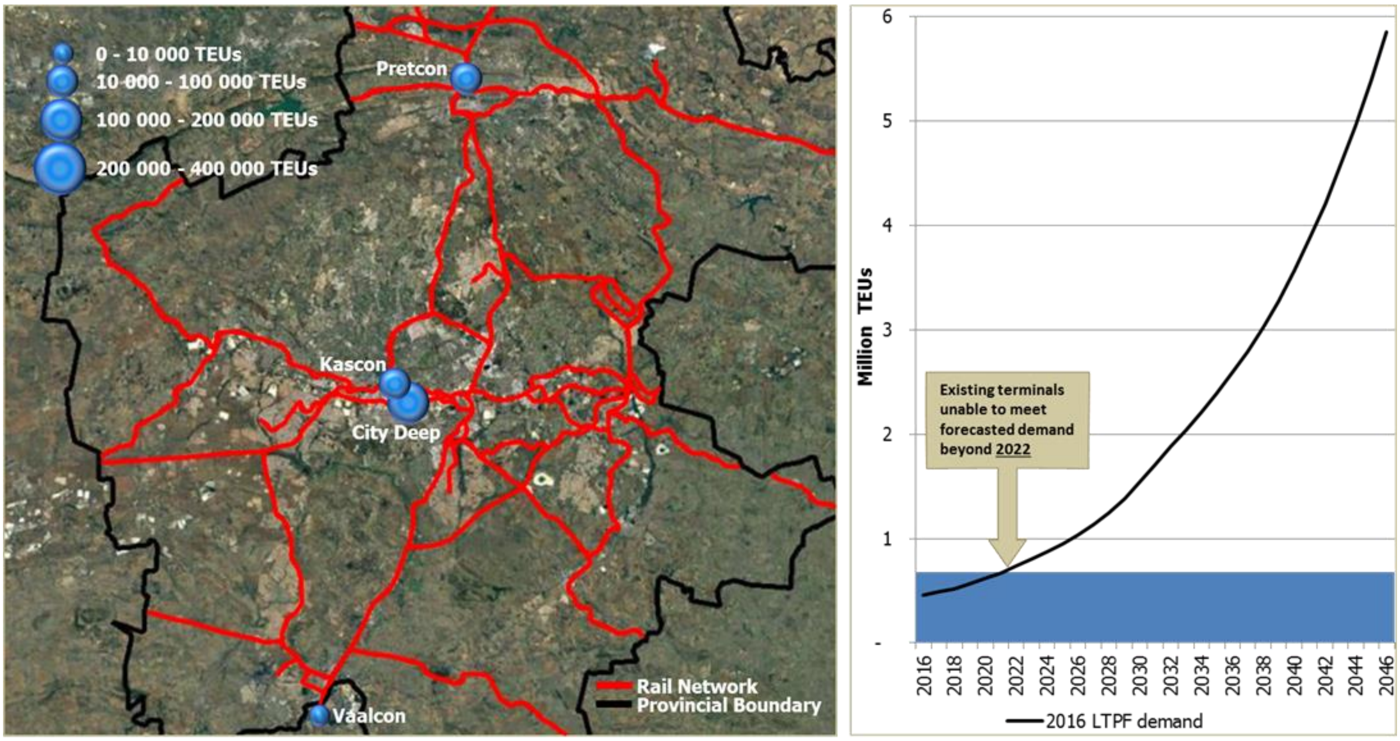
The throughput of TEUs at Vaalcon has reduced by 35% over the past five years. On average, 80% of the throughput is full containers. The terminal utilised 18% of planned capacity during 2015/16 Financial Year.

Figure 60: Vaalcon Container Terminal

The terminal is in a rural location with narrow access roads, along a paved road through a rural residential area. Vaalcon is situated close to the R59 freeway with industrial centres of Sasolburg and Vereeniging in close proximity. The branch line to the power station runs along the north of the terminal, hence the curvature of the terminal and sidings that creates difficulty for expansion. The curved shape of the terminal constrains operations and reduces the stacking area.

Vaalcon container throughput of has declined by 35% over the past five (5) years and the terminal only utilised 18% of the available capacity. The terminal is operated by reach stackers and it has a design capacity of 50 000 TEUs per annum.

E. DEMAND VERSUS CAPACITY – GAUTENG TERMINALS



- The demand for container transportation will increase rapidly over the next 30 years and Transnet aims to significantly increase its market share.
- The graph shows rail's planned increase in container TEU volumes over the next 30 years

Figure 61: Gauteng Terminals - Demand Capacity

The figure above shows the combined terminal capacity of all the four (4) operational terminals in Gauteng against the forecasted container volume increase over the next 30 years. Even with the recent capacity upgrades at City Deep as well as the ongoing capacity upgrades at Kascon, the forecasted container volumes will exceed the current Gauteng terminal capacity by 2022, including the rail sections and yards linked to the terminals. Thus additional rail, yard and terminal capacity will be required in order to meet the rail's desired market share.

4.3.1.3 Other Container Terminals

a. Bayhead Container Terminal

Bayhead container handling facility located in Bayhead close to the Durban Port. The facility consists of three (3) rail lines to accommodate 40-50 wagon trains, operated by an RMG, 20 945 TEUs handled during 2015/16 Financial Year. Shunting occurs at the Bayhead yard. There is severe traffic congestion in the area and as a result road and rail access into the area is a problem.

b. Belcon Container Terminal

Belcon container terminal is located south of Bellville at a major railway junction, conveniently outside the Cape Town City centre and approximately 20 km from the port. The terminal consists of two (2) 25 wagon lines operated by an RMG, 13 827 TEUs handled during 2015/16 Financial Year. The terminal uses the Bellville marshalling yard for shunting and the entrance to the yard is controlled by PRASA signalling and this results delays.

c. Belcon Container Terminal

Belcon container terminal is located south of Bellville at a major railway junction, conveniently outside the Cape Town City centre and approximately 20 km from the port. The terminal consists of two (2) 25 wagon lines operated by an RMG, 13 827 TEUs handled during 2015/16 Financial Year. The terminal uses the Bellville marshalling yard for shunting and the entrance to the yard is controlled by PRASA signalling and this results delays. A building in the middle of the terminal lines negatively impacts on the stacking capacity within the terminal.

d. Bloemcon Container Terminal

This container terminal is located in Bloemfontein and it is used as a low volume container terminal, 525 TEUs handled during 2015/16 Financial Year. The site is located in a convenient area to service the traffic from the south to the north of the country. The current terminal is undergoing refurbishment, and a new Bloemcon terminal is under construction in a new site. The existing Bloemcon terminal consists of short tracks and limited storage space 10 wagons.

e. Kimberley Container Handling Facility

Kimberley This container handling facility is located in the center of Kimberley with short tracks and minimal stacking space. The containers are handled at the old goods shed opposite the Kimberley passenger station. There is currently no ability to expand this terminal due to the adjacent property and existing railway station.

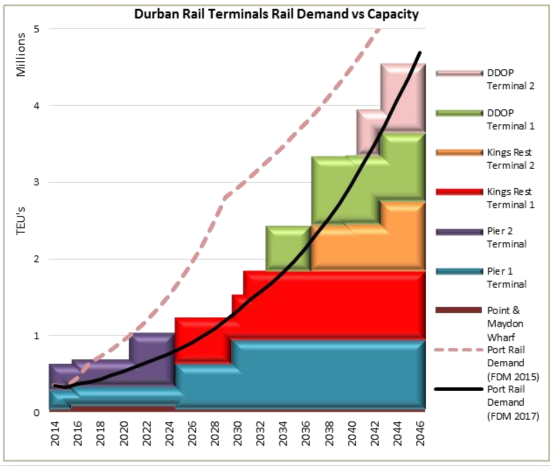
f. Cambridge, Deal Party, Dalcon, Salkor, Eastcon and Pietermaritzburg

Cambridge (East London), Deal Party (Port Elizabeth), Dalcon, Salkor (Northern Cape), Eastcon and Roscon (Gauteng), Pietermaritzburg (Kwa-Zulu Natal) are either running very low volumes or are currently not operational.

4.3.2 DEVELOPMENT STRATEGY

The significant increase in intermodal, bulk minerals and automotive traffic is expected on the Gauteng-Free State-Durban, Gauteng-Cape Town, Gauteng-Port Elizabeth-Ngqura and Gauteng to Southern African Development Community (SADC) countries. Transnet is improving and expanding current terminal infrastructure and planning to significantly increase capacity on rail, yards and terminals to provide cost effective, reliable, available and competitive rail supply chains. This will result in an optimised supply chain for Transnet which will enable it to capture a significant desired market share of rail friendly containerised traffic.

4.3.2.1 Durban Development Strategy



Work Package Description	Package Total	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Pier 1 Decommissioning																													
DCT / Pier 2 Decommissioning																													
DCT / Old Pier 2 Re- Implementation - Rail/Port Terminals	178			71	107																								
Kings Rest 1 *	800			10	30	145	206	180	29	200																			
Kings Rest 2	927						46	93	139	278	371																		
Kings Rest 3	927																46	93	139	278	371								
Intermodal (Road-Rail)																													
Island View Upgrade	281														14	28	42	84	112										
DDOP 1																													
Isipingo Automotive	422																								21	42	63	126	169
Short Term Upgrades																													
Bayhead 1st Stage	582						5	43	24	68	106	144	192																
Bayhead 2nd Stage	361															18	36	54	108	145									
DDOP Yard																													
Cato Creek																													
Isipingo	243																									12	37	73	122
Bayhead to Kings Rest																													
Mainline to DDOP	128																		6	19	39	64							
Contingencies & Owner Costs	**2424**			**41**	**69**	**73**	**129**	**158**	**96**	**273**	**239**	**72**	**96**		**7**	**23**	**62**	**116**	**183**	**221**	**205**	**32**			**11**	**27**	**50**	**100**	**146**
Total Costs (unescalated)	**7273**			**122**	**206**	**218**	**386**	**474**	**288**	**819**	**716**	**216**	**288**		**21**	**69**	**186**	**347**	**548**	**663**	**615**	**96**			**32**	**81**	**150**	**299**	**437**

* **Note:** One terminal at Kings Rest may be replaced by a longer Pier 1 terminal – study underway

Figure 62: Durban Terminals - Development Strategy

The current Pier 1 and Pier 2 terminal capacity will not have sufficient rail and terminal capacity to be able to handle containers beyond the current capacity, therefore it will be vital to increase the port's current rail intermodal capacity to match the corridor and inland capacities, including longer train configurations.

Durban's back of port rail development plans are as follows:

- Construct Kings Rest terminal 1a for 50 wagon lines by 2018 and 1b for 75 wagon lines by 20122
- Decommission Pier 1 & 2 rail terminals by 2022
- Construct Bayhead arrivals yard 1st Stage for 75 wagon lines by 2022 and the 2nd Stage by 2025
- Construct Mainline to DDOP - Link Lines (Single) by 2022 and add the second by 2033
- Construct Kings Rest terminal 2 and 3 by 2025 and 2029 respectively
- Construct Island View Upgrade - Rail/Port Terminals by 2029

Additional actions:

- Separate freight and passenger/Metro traffic as far as feasible to streamline operations and capacity;
- Develop the airport link;
- Consider new high capacity bypass line (such as Cato Ridge Bypass) to complement Natcor line
- Consider longer trains, such as 150 wagons on Natcor

i. Initial Kings Rest Terminals

Sequencing:

- 2016/17 – Improve Pier 1 efficiency and utilisation
- 2020/21 – Re-instate old DCT terminal
- 2024/25 – Commission Kingsrest Terminal 1
- 2025/26 – Decommission Pier 2 Terminal
- 2029/30 – Lengthen Kingsrest & Pier 1 terminals to 75-wagon
  – Bayhead 75 wagon yard
  – Durban Goods domestic terminal 75-wagon
- 2039/40 – Commission Kings Rest Terminal 2

NOTES:

1. Existing Bayhead domestic terminal to be lengthened to 75-wagons
2. Strong possibility to lengthen the existing 50-wagon terminal at Pier 2 to 75 wagons as part of the TNPA infill project. It postpones the need to build the first terminal at Kingsrest as proposed by the FEL-1 study.

Figure 63: Initial Kings Rest Terminals

In the short to medium term, prior to development of the DDOP, the 50 wagon Pier 1 and DCT/Pier 2 terminals inside the port of Durban will be retracted to make way for two new 75 wagon terminals on the area currently occupied by the Kings Rest arrival departure yard. The Kings Rest terminal will start off as a 50 wagon terminal and thereafter will be extended to a 75 wagon terminal by 2024. These terminals will be supported by new yard developments in Bayhead, as well as a domestic terminal at the previous PX terminal.

ii DDOP and Durban Port Expansion

Sequencing:

- 2028/29 – Island View TAT upgrade
- 2029/30 – Bayhead 75 wagon yard expansion
- 2035/36 – DDOP Link upgrade
  – Cato Creek lengthening
- 2024/25 – DDOP Terminal 1 – moved to 2033
  – DDOP rail link - moved to 2033
- 2038/39 – Isipingo yard
- 2039/40 – Isipingo Automotive terminal
- 2040+ – Future DDOP expansion

Figure 64: DDOP and Durban Port Expansion plans

Capacity of the Durban rail system will be expanded to meet capacity developments in both ports, i.e. the newly developed DDOP as well as future expansions of the Port of Durban. Bayhead yard will be enlarged and a dedicated DDOP yard will be established to receive and dispatch trains to and from the Natcor.

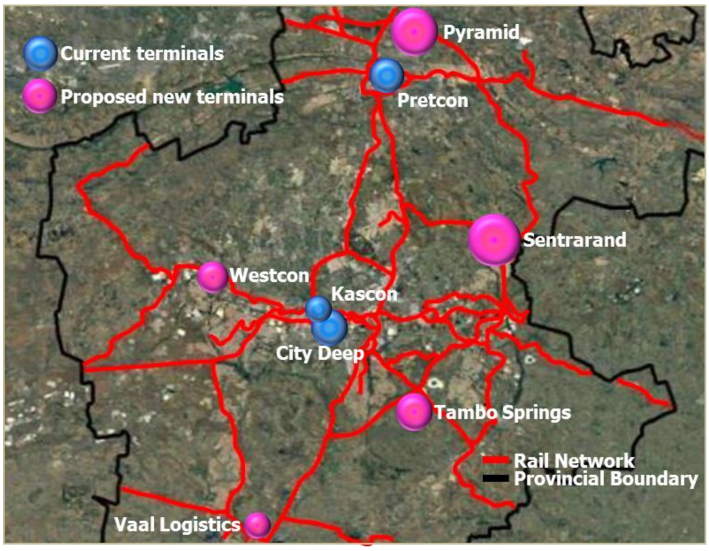
Other capacity interventions include lengthening of the Cato Creek automotive terminal and/or development of a new automotive terminal at Isipingo supported by the DDOP, and improved turnaround times at Island View liquid bulk terminal.

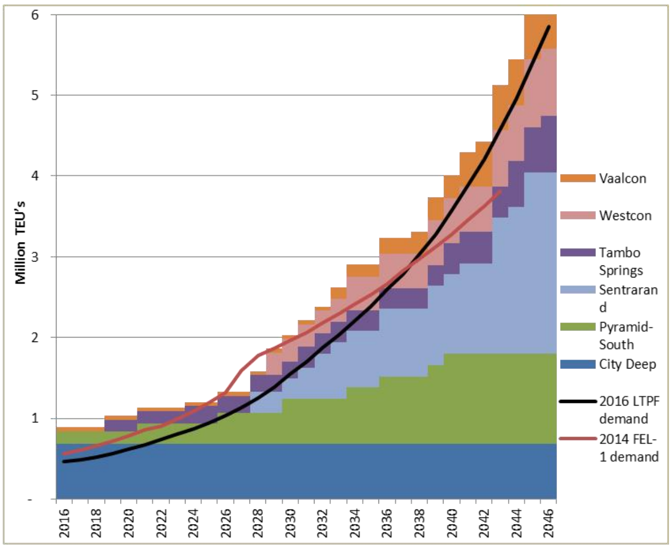
4.3.2.2 Gauteng Development Strategy

The significant increase in traffic on the major rail corridors in South Africa will necessitate the need for significant capacity increase and handling ability in the country. Majority of intermodal traffic is handled in Gauteng, to this end the Gauteng terminals concept study estimated that in order for rail to achieve its desired market share, an additional 2 million TEU handling capacity at terminals will be required to complement the growth on the ports, rail corridors (especially on the Natcor corridor) and yards.

The study estimated that Gauteng will require new 'standard' container terminals, the standardised methodology (layouts, designs and operations) will maximise the efficiency, flexibility and utilisation of the new intermodal terminals. Three locations (Pyramid, Sentrarand and Tambo Springs) were identified for the development of new intermodal terminals and two smaller terminals that will serve the South and West regions of Gauteng. These new developments are planned in conjunction with the phasing over of Vaalcon and Pretcon excess volumes to large terminal operations.

RAIL DEVELOPMENT PLAN





Development plan

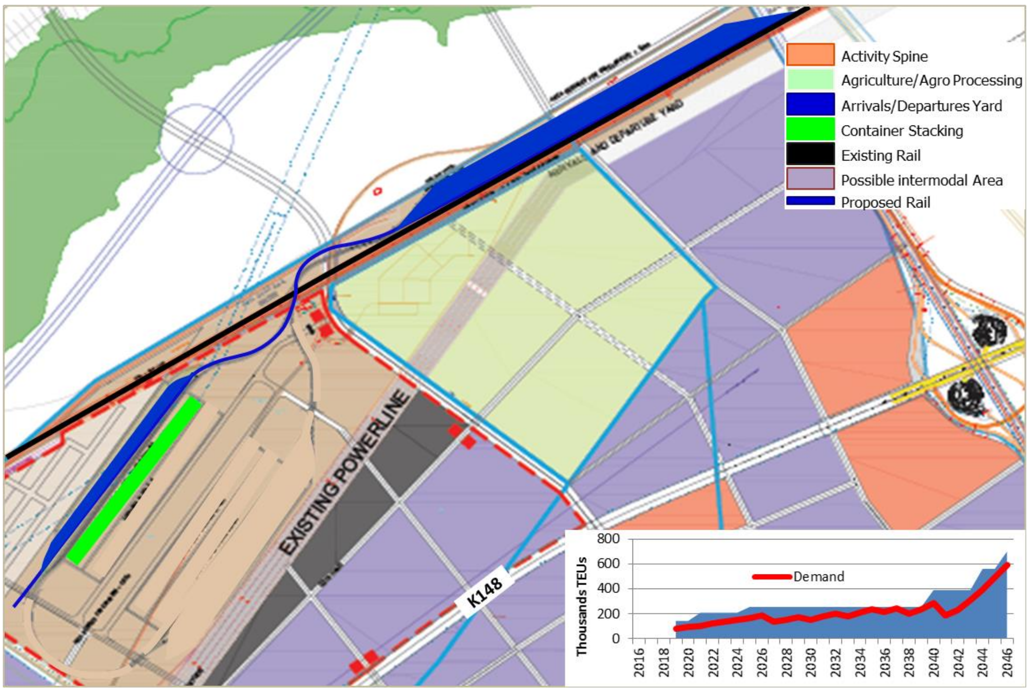
Location	Terminal type	Capacity created	ETC (Rm)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Tambo Springs(Yard)	Container	560 000	493	14	29	100	350																										
Pyramid (Rosslyn)	Automotive	558 000	417			4	44	111	155	89	14																						
Pyramid	Container	560 000	1 791				15	25	350	350	350	24				142			393		142												
Pyramid	Container	560 000	1 855																	20	100	350	400	280		393	312						
Sentrarand	Container	1 020 000	1 997							20	80	180	315	360	200	137				393							312						
Sentrarand	Container	1 020 000	1 855																						20	100	350	400	280			393	312
Total cash flow (Rm)			**8 408**	**14**	**29**	**104**	**409**	**136**	**505**	**459**	**444**	**204**	**315**	**360**	**200**	**279**	**0**	**0**	**393**	**413**	**242**	**350**	**400**	**280**	**20**	**493**	**974**	**400**	**280**	**0**	**0**	**393**	**312**

FEL-2: Pre-Feasibility
FEL-3: Feasibility
Construction

Figure 65: Gauteng Terminal development sequence

RAIL DEVELOPMENT PLAN

i. Tambo Springs Intermodal Concept



Development plan									
Location	Terminal type	Capacity created	ETC (Rm)	2016	2017	2018	2019	2020	2021
Tambo Springs(Yard)	Container	144 000	493	14	29	100	350		
Total cash flow (Rm)			493	14	29	100	350		

Tambo Springs is located in the south east of the Province at the junction of the N3 and the Gauteng Freight Ring. Tambo Springs area was chosen for its suitability and ideal location, the site is on the urban edge, with sufficient land available and well located to connect to major road and rail network. The terminal is earmarked to accommodate the forecasted container demand in the South East of Gauteng. Tambo Springs is ideally located to service the freight needs of the south east area (Nigel), the Centre (Johannesburg) and the South (Vaal), as well as the Western region of Gauteng (Carletonville). It is ideally suited to handle the transhipment rail freight as it all passes through this area.

Potential demand for the site are estimated as follows:

- Container terminal - 140 000 TEUs/pa (4 Trains/day) by 2022
- A ramp up to 250 000 TEUs/pa (8 trains/day) by 2027
- The development of an intermodal terminal in Tambo Springs will add an additional 8 trains per day (both directions) by 2028 onto the Natcor and the section between Rietvallei and City Deep

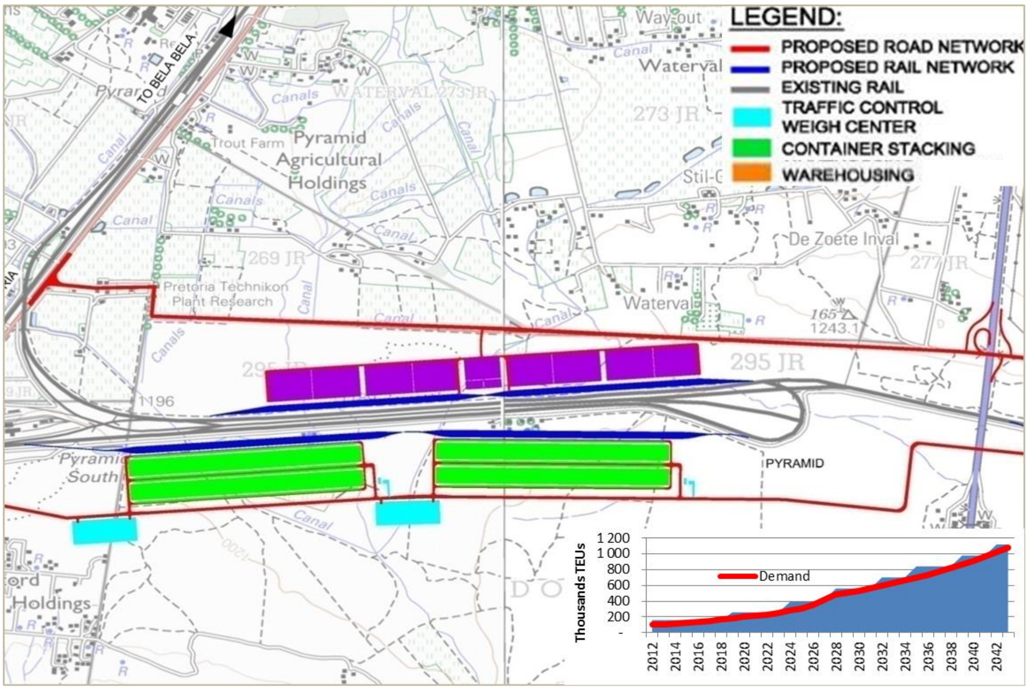
The terminal development will include additional yard facilities for arrivals and departures.

Figure 66: Tambo Springs intermodal concept

Tambo Springs, located in the south east of the province, is ideally located for the development of an intermodal terminal in the South East of Gauteng and well suited to connect with major national rail and road networks (N3, Natcor and the Gauteng Freight Ring). Tambo Springs could be developed to accommodate a standard container terminal (500 000 TEUs per annum design).

As the rail section between Rietvallei and City Deep, the rail yards and container terminals at City Deep and Kaserne gradually reach their design capacities; the Tambo Springs terminal will be initiated to address the capacity constraints. The first container terminal (phase 1) with its own rail yard facility could be developed to handle 1400 000 TEUs per annum from 2019 and possibly ramped up to 250 000 TEUs per annum to increase the handling capacity in this section by 2025 (phase 2).

ii Pyramid Intermodal Concept



Pyramid (South) is located in the northern region of Pretoria, adjacent to the Gauteng Freight Ring and Pyramid South exchange yard, within 4 km from the N4. The development of Pyramid as an intermodal terminal will address the current capacity constraints at the existing terminal (Pretcon). The terminal will increase container and automotive handling capacity in the Pretoria region over the next 30 years.

The site is ideally situated to capture freight for the North West, Limpopo (Musina/Polokwane), North and North East of Gauteng, as well as capturing and consolidating freight to Botswana, Namibia and Zimbabwe. It can potentially pick up freight from the Maputo corridor.

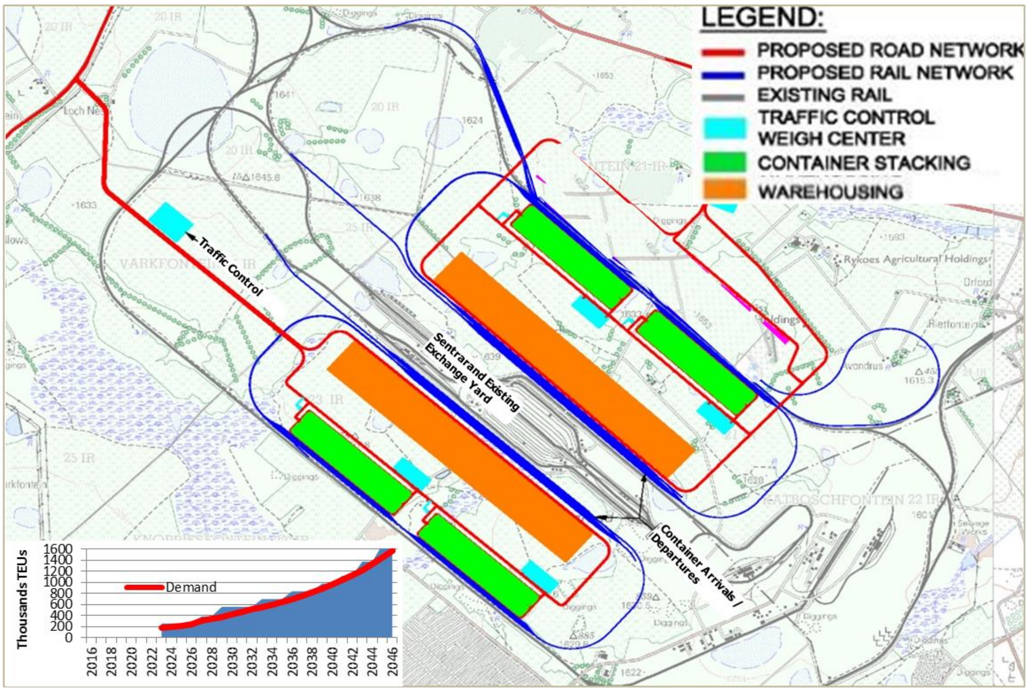
Potential demand for the site are estimated as follows:

- Container (Phase 1) - 500 000 TEUs/pa (16 trains/day) by 2025, starting with 250 000 TEUs/pa from 2023 to 2025
- Automotive terminal (P2 – possibly at Rosslyn): 558 000 Units/pa (12 trains/day) by 2024
- Container (Phase3): 500 000 TEUs/pa (16 trains/day) by 2027

Development plan																											
Terminal type	Capacity created	ETC (Rm)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Automotive	558 000	417			4	44	111	155	89	14																	
Container	560 000	1 791				15	25	350	350	350	24				142			393		142							
Container	560 000	1 855																	20	100	350	400	280		393	312	
Total cash flow (Rm)		4 063			4	59	136	505	439	364	24				142			393	20	242	350	400	280	0	393	312	

Figure 67: Pyramid intermodal concept

iii. Sentrarand Intermodal Concept



Sentrarand is located east of Johannesburg, just north of Springs. Sentrarand is ideally located to service the freight needs of Gauteng being less than 60 km from the main industrial areas around the Province. Sentrarand is an ideal position to directly access the Gauteng Freight Ring linking it with the Natcor to Durban and the Coal line to Ermelo and Richards Bay, as well as linking it with Rustenburg Polokwane/Musina, Cape Town, East London and Port Elizabeth. Sentrarand, largely in Transnet's ownership, has sufficient land available for the development mega intermodal terminal.

The Sentrarand area has a significant demand from freight in its own right and is also well suited to accept freight from the industry in the city centre and the south as well as the key corridors to the north, Durban and Cape Town

Potential demand for the site are estimated as follows:

- Container terminal (P1): 500 000 TEUs/pa (16 trains/day) by 2024, starting with 250 000 TEUs/pa
- Container terminal (P2): 500 000 TEUs/pa (16 trains/day) by 2033

Development plan

Terminal type	Capacity created	ETC (Rm)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Container	1 020 000	1 997							20	80	180	315	360	200	137				393							312						
Container	1 020 000	1 855																						20	100	350	400	280			393	312
Total cash flow (Rm)		3 852							20	80	180	315	360	200	137				393					20	100	662	400	280			393	312

Figure 68: Sentrarand intermodal concept

4.4 AUTOMOTIVE TERMINALS

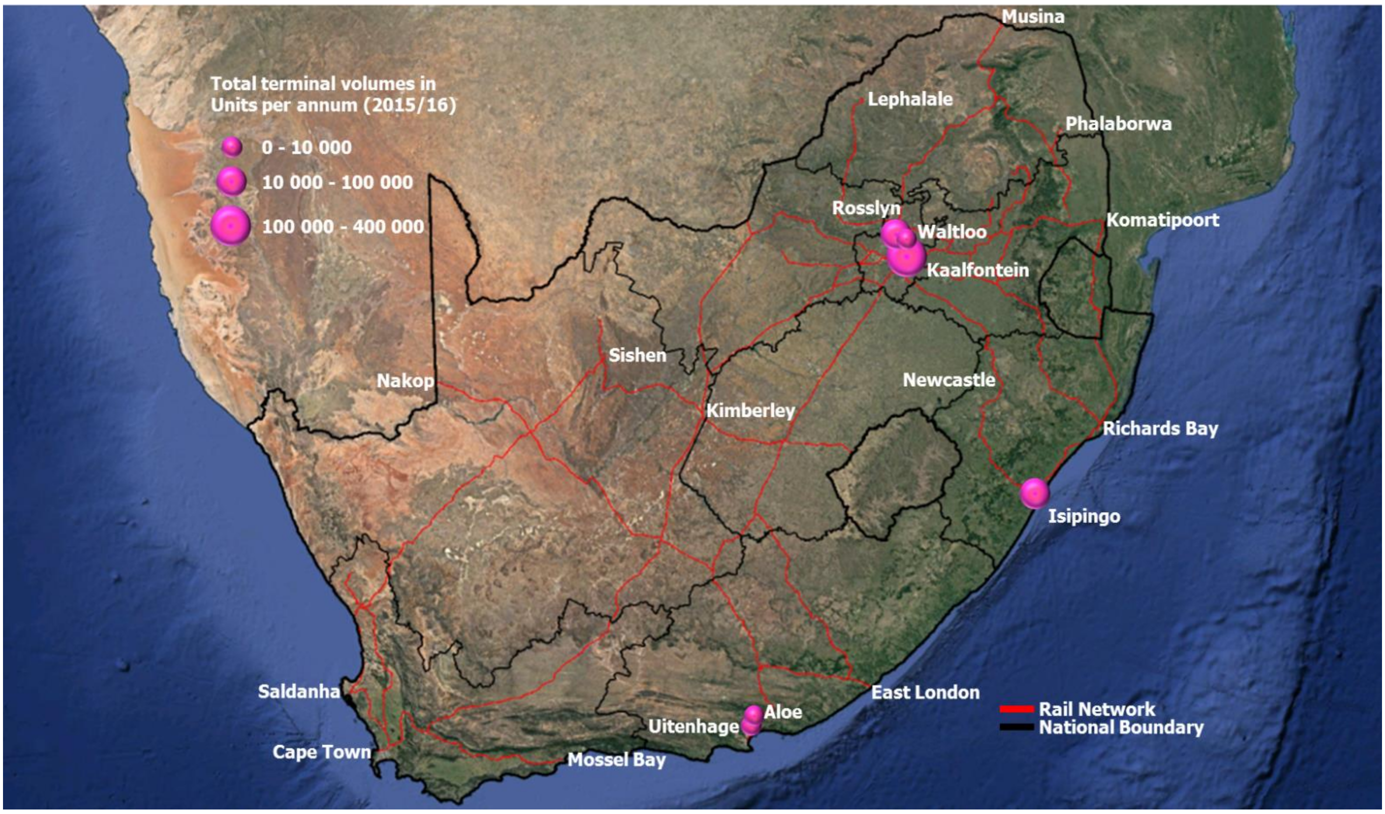


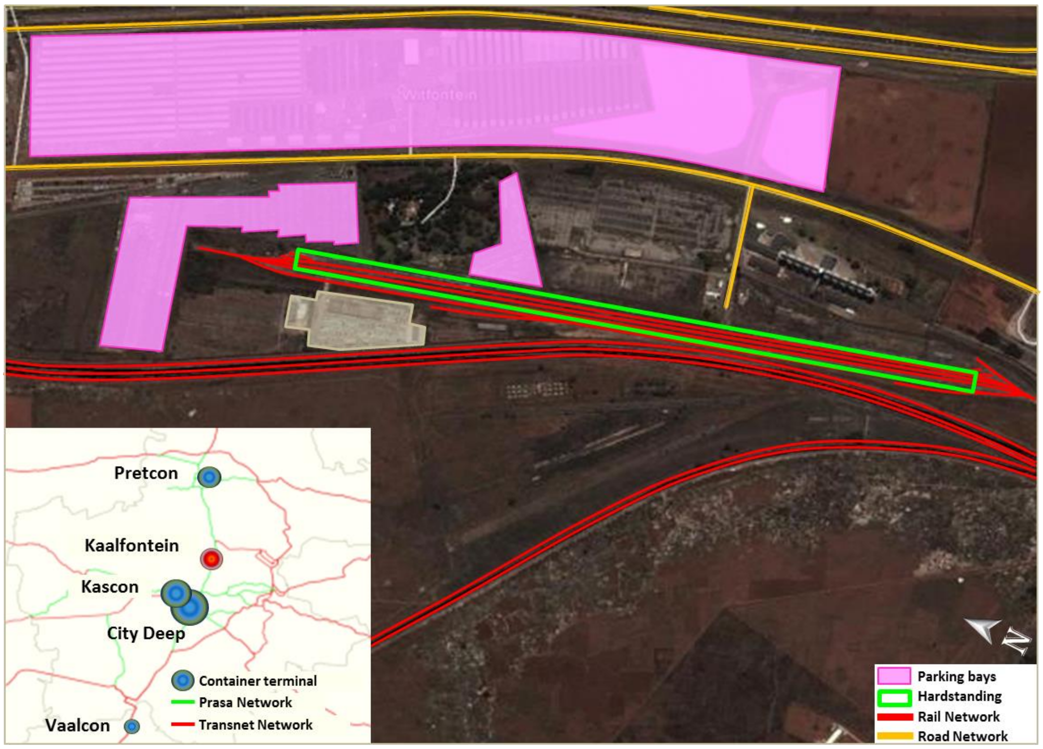
Figure 69: Automotive Terminals

The automotive terminal map adjacent (figure 72) shows the positions of current automotive terminals. The terminals serviced by the four corridors, namely the Capecor, Natcor, Southcor and South East corridor. The Natcor handles majority of the automotive volumes, which moves between the Kaalfontein terminal and Isipingo terminal.

Completely Built Up (CBU) units get moved in specialised car wagons to be loaded (Isipingo, Aloe, etc.) and offloaded (Kaalfontein) at Transnet operated facilities. Completely-Knocked-Down (CKD) parts are moved in containers and transported to areas such as Rosslyn where there are many private sidings that serve the automotive industry in Gauteng and other neighbouring provinces.

The site is located at Kaalfontein station just north-east of the central part of Gauteng, 25km from Johannesburg. Kaalfontein automotive terminal handles automotive units originating from Durban (Point and Isipingo terminals), East London, Port Elizabeth and Rosslyn. The terminal provides facilities for the loading and unloading car trains. The terminal is accessed from the south section via shared metro lines, restricting line capacity during morning and afternoon peak passenger periods. The terminal is located close to a private vehicle distribution centre precinct and surrounded by a number of automotive industry stakeholders.

a. Kaalfontein Automotive Terminal



Kaalfontein is a automotive terminal with automotive units originating from deep sea Durban, East London, Port Elizabeth and Rosslyn.

Infrastructure Characteristics:

- 3 operational tracks (50 wagon terminal) and a hardstanding area
- Private Vehicle Distribution Centre (VDC) with 20 000 parking bays available (on a 50 ha property)
- The terminal has a design capacity of 558 000 units per annum with 203 830 units handled during 2014

General Issues:

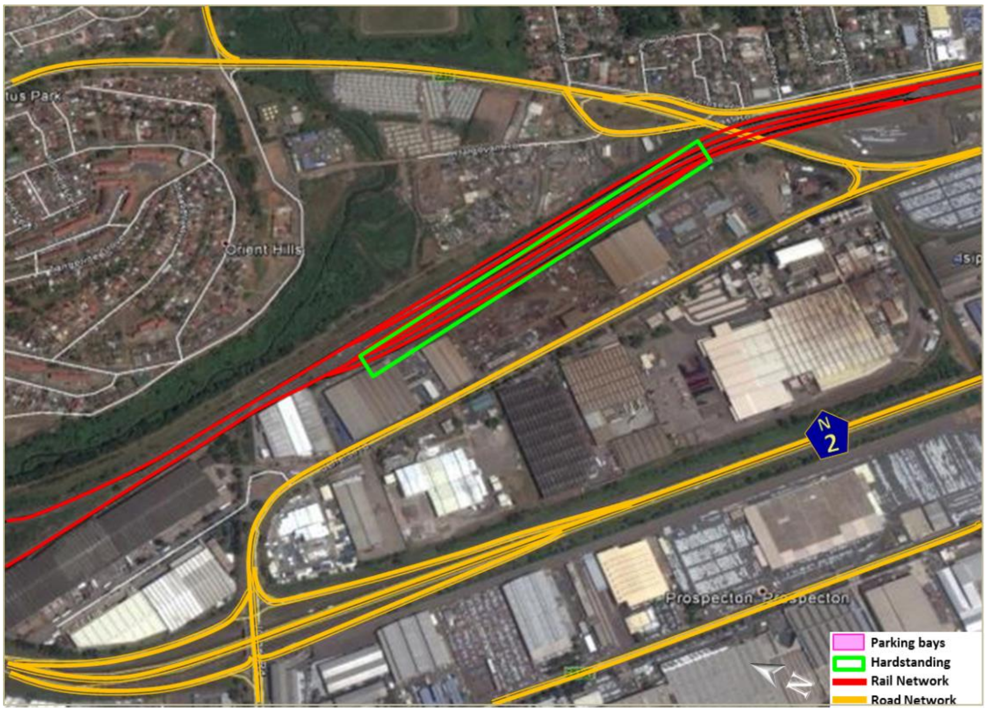
- Limited slot capacity on the mainline (access line shared with PRASA)
- Delays in sidings as trains access the terminal via a double track with restricted access from major roads to the west and northern parts of the terminal

- Kaalfontein current capacity is sufficient to handle projected automotive volumes for the inland region.
- The site is well located relative to automotive demand as well as from a last mile transport cost perspective.

Figure 70: Kaalfontein Automotive Terminal

b Isipingo Automotive Terminal

Transnet transports both major CBU units and CKD parts services through the General Freight corridors. The CBU units are transported through the Natcor (BMW, Ford Group and Toyota SA) and the Southcor (GMSA and VWSA). The CKD parts are commonly transported through the Capecor (BMW), Natcor (Nissan) and through the Southcor (Ford Group and Nissan).



The Isipingo terminal is located approximately 12 km south of Durban, adjacent to the Toyota assembly plant.

Infrastructure Characteristics:

- 3 operational tracks (25 wagon terminal)
- This car terminal serves the adjacent Toyota automotive assembly plant which assembles motor cars at this location for distribution and export.

General Issues:

- Train length is limited to 25 wagons
- The site is bounded by Factory Road to the north, railway tracks to the west, and Jeffels/Old Main Roads to the south and east.

- The benefit of the automotive development is its close proximity and connectivity to the new proposed Airport dig-out port.

Figure 71: Isipingo Automotive Terminal

The Isipingo terminal is located approximately 12 km south of Durban, adjacent to the Toyota assembly plant. The site is sandwiched in an area to the west of the N2 between the freeway and the railway line. It is bound by Factory Road on the north, rail tracks on the west and Jeffels Road/Old Main Road on the east and south. This facility consists of three rail lines (each approximately 550 m in length).

This car terminal serves the adjacent Toyota automotive assembly plant which assembles motor cars at this location for distribution and export. At the vehicle handling facility, Motorvia operate a receive, hold, and despatch facility for new motor vehicles.

c. Other Automotive Terminals

Aloes Terminal

Aloes is located approximately 16km north of Port Elizabeth, just south of Aloes station. Four tracks of circa 1km in length. Three can be used for automotive loading with hardstanding alongside. There is land available for hard standing and parking for expansion but currently there are no plans to expand the terminal. Assembled Volkswagen cars (from Uitenhage) are loaded onto trains for transport to Kaalfontein, Belville and Durban.

Rosslyn Siding(s)

These sidings are located in the industrial area of Rosslyn, west of Pretoria. The Rosslyn sidings mainly service the BMW and Nissan plants located in the area, the plants are used to load cars for distribution and export. Trains are broken up in the Rosslyn station yard and sent through in different consists to different siding. The site is constrained by industry around it, therefore it has limited expansion potential.

Uitenhage

The Volkswagen assembly plant is located in Uitenhage (24km North West of Port Elizabeth and 18km west of Aloes). Assembled cars for distribution and export are driven from here to Aloes. Cars destined for export through Port Elizabeth are driven directly to Algoa Bay.

4.5 GENERAL FREIGHT TERMINALS

General freight terminals are small terminals used for repackaging of commodities and some of these terminals represent the loading and offloading facilities either inland or at the port for the export of bulk minerals. The most noticeable loading terminals are those located close to critical and strategic minerals in South Africa, namely the Mpumalanga coalfields, manganese and iron ore area and chrome-rich area of Phalaborwa.

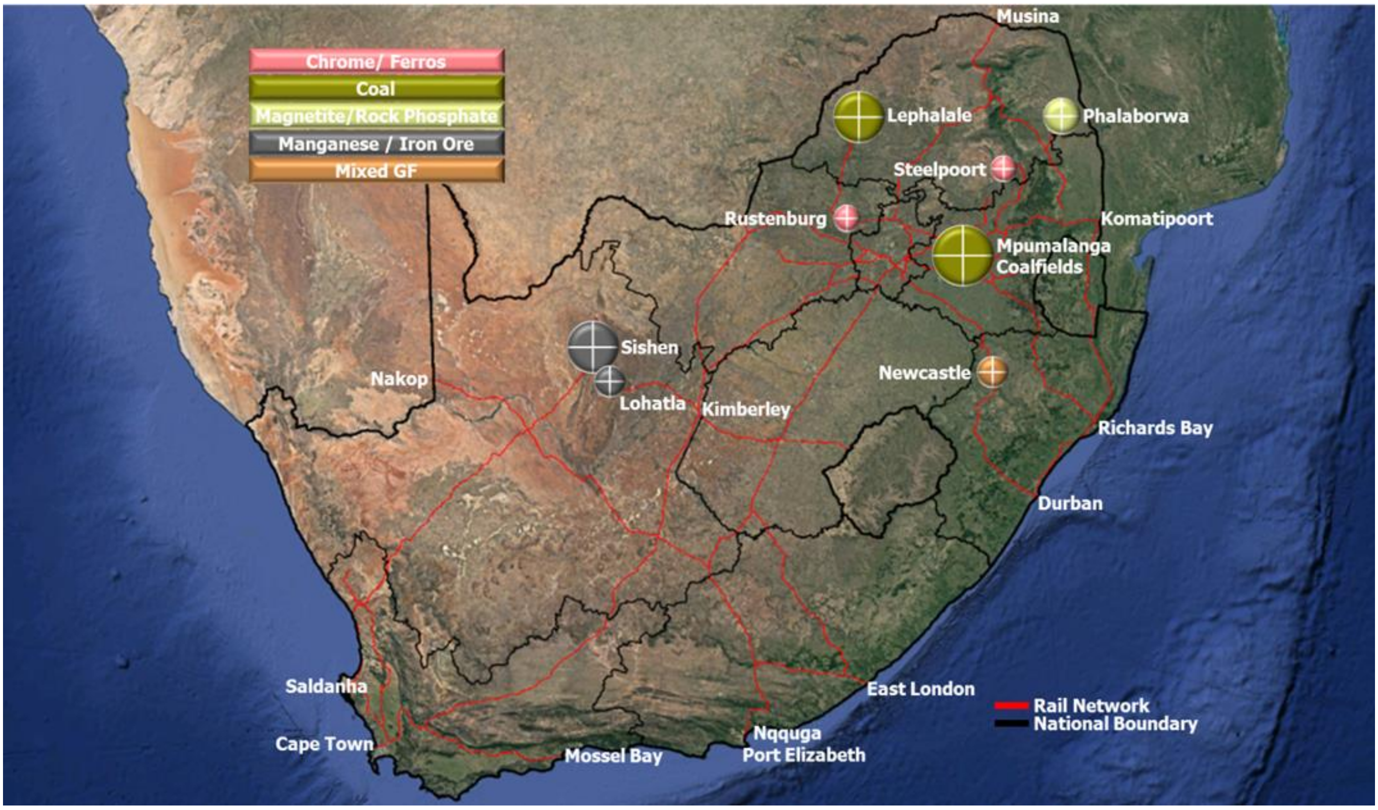


Figure 72: General Freight Terminals

a. Lohatla/Mamathwane

Iron ore is transported from mines in the Northern Cape to the Port of Saldanha. Manganese ore is transported to various destinations for domestic and export markets. Export manganese is transported from mines in the Northern Cape to Port Elizabeth and Durban Ports. Manganese for domestic usage is transported to, among others, Meyerton, Fairview, Clewer, Nelspruit and Cato Ridge.

A Common User Facility (CUF) comprising internal roads, stockpile area, haulage vehicles, bulk fuel storage and mechanical equipment for loading, offloading, stacking and reclaiming is used to consolidate the manganese and iron ore for transfer. Manganese and iron ore are road hauled to the CUF from various smaller outlying mines without rail loading infrastructure and loaded into designated bins in the stockpile area. Front-end loaders are predominantly used for the movement of ore within the facility, including the building of stockpiles although ore may also be reclaimed by other means such as gravity feed conveyors.

b. Mpumalanga Coalfields

The main coal mining areas are presently in the Witbank-Middelburg, Ermelo and Standerton-Secunda areas of Mpumalanga, around Sasolburg-Vereeniging in the Free State/Gauteng and in north-western KwaZulu-Natal where smaller operations are found.

c. Phalaborwa and Rustenburg Chrome

Magnetite flows from Phalaborwa to Richards Bay, Maputo and Broodsnyersplaas. Rock phosphate flows from Phalaborwa to Richards Bay and Maputo. Chrome/ferrochrome from Rustenburg to Witbank and from Witbank and Steelpoort to Richards Bay. Granite from Rustenburg to Richards Bay.

In support of long term planning and future business sustainability, property planning becomes important in ensuring the development of a property strategy to support the rail capacity. Noting that property is a relatively inflexible asset that requires long lead times to build, sell or buy, property planning becomes key. Rail property requirements are addressed through a breakdown of requirements as specified by the development plans around new rail lines, expansion of existing lines and hubs as well as terminals. Environmental challenges associated with the newline or expansion projects are discussed and the projects were aligned through spatial analysis to the respective municipal Spatial Developmental Frameworks they transverse.

5. Rail property planning

5.1 NEW RAIL LINES/RAIL STRATEGIC PROJECTS

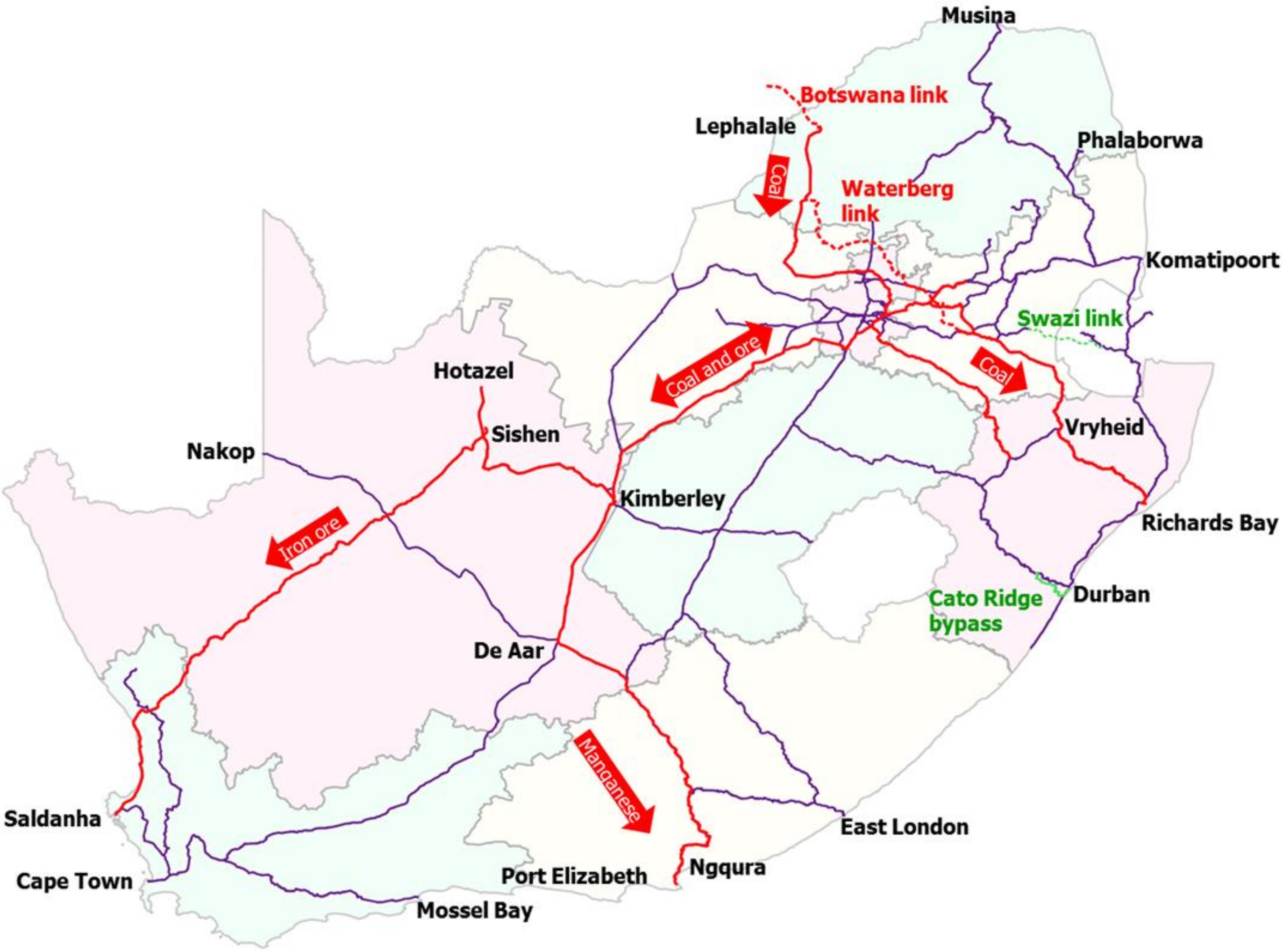
The rail property strategy is defined essentially by categorising and identifying land that will be required for new lines and by consolidating existing property where necessary. New lines will be developed to provide rail access that sustains the mineral areas on the key bulk corridors; namely, for coal on the Waterberg link and for manganese from Northern Cape to the Port of Ngqura.

- Transnet's Long-term Planning Framework property section outlines the strategic planning and provides a framework that governs the spatial planning, property disposals and acquisitions, land use management, and zoning of key properties identified for future use.
- Distinction in property planning is made between diverse yet important Transnet's core and non-core property portfolio, and LTPF's focus on strategic property which is required for future expansion and growth of Transnet business.
- Strategic property planning supports delivery and fulfilment of Transnet mandate by ensuring that strategic property assets are timeously identified and secured in order to meet the aspirations of the market demand as well as uphold Transnet's long-term business sustainability.

RAIL DEVELOPMENT PLAN

PLANNED NETWORK (30 YEARS)

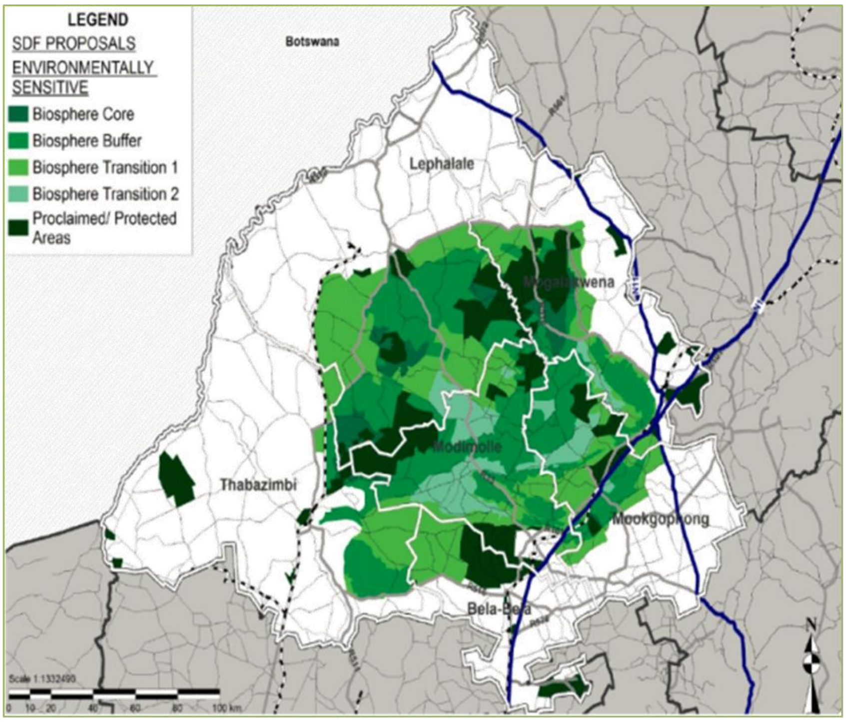
TYPICAL PROFILE				
	Axle load	Speed	Train length	Use
General freight line	20t per axle	60-100km/h	30-100 wagons	General freight
Heavy haul line	26-30t per axle	40-80km/h	100-342 wagons	Heavy bulk



Property	Area (ha)	Notes
Lephalale – Ermelo	1 953ha	Develop a new heavy haul line from Lephalale (Waterberg coalfields) to Ermelo to connect with the existing export line (558km).
Lephalale – Mahalapye **Botswana link**	147ha	Develop new rail line from Lephalale to link Botswana railway line (42 km). This excludes the property required within Botswana to link up to their network
Waterberg Property requirements	400ha	Develop complementary yards and workshop facilities for the Waterberg heavy haul line (Botswana link and Lephalale-Ermelo line)
Lothair – Sidvokodvo - Nsese (Swaziland) **Swazi link**	1217ha	New link from Lothair to Sidvokodvo in Swaziland. This will include land required for existing lines upgrade. The land parcels will include properties in South Africa (Davel, Lothair and Nsese) and Swaziland (Sidvokodvo Phuzumoya and Golela)
Glencoe – Cato Ridge **Natcor South**	875ha	Requirement for additional land for the deviations to accommodate flatter grades and curves. This includes Glencoe – Vryheid chord.
Cato Ridge – Durban **Cato Ridge bypass**	227ha	New rail line to by-pass challenging topography from Cato Ridge to Durban.
Sishen – Erts **Ore system**	100ha	Consolidation of yards to handle iron ore from the new mine developments (Northern region)
De Aar – Springfontein **Ore system**	389ha	New link to connect the proposed high speed passenger and light industrial traffic and thereby separate operations from the heavy haul line.
Coal link (Mpumalanga) **Coal system**	200ha	Consolidated coal loading terminals required for small miners in the Mpumalanga area.
Ore line expansion projects	± 70ha	• Sishen West Expansion Project deviation • Postmasburg-Sishen South link line

Figure 73: Property Planning for Planned Network for New Rail Lines

5.2 WATERBERG NEW HEAVY-HAUL LINE AND BOTSWANA RAIL LINK



Land Requirements;

- Total land required for the development of an Arrival/ Departure Yard as well as a rail link into Botswana will be 2500 hectares
- 1953ha required for New Heavy-haul line
- 400ha for development of the complimentary yards and workshop facilities
- Botswana link will need 147ha

Strategic Environmental and social impact;

- The existing rail that require upgrade will have minimal impact and little or no transformation of natural or semi-natural land since the rail bed already exists.
- There are exclusion zones in the Waterberg biosphere and national parks which are expected to limit the options for the new line.
- It is anticipated that the environmental approval process will be lengthy, due to the proposed line traversing agricultural, rural, mining and game farming areas, and possibly areas earmarked for metropolitan development.
- The project will have a huge environmental and social benefit and will strengthen the Mpumalanga economic Development

Project alignment to Spatial development Framework;

- Municipalities' plans is according to their spatial development frameworks and communities have organised their lives to accommodate the existing rail and the impact of an upgrade or new railway line should therefore be minimal.

Figure 74: Waterberg Environmental Sensitive Areas

To move coal from Botswana to South Africa, a link to Botswana that connects the South African network with the Botswana rail network will be required and the total land required for the development of an arrival/ departure yard as well as a rail link into Botswana will be 2500 hectares. Development of the Waterberg New Heavy–haul Line requires 1 953 hectares to connect to existing export line, 400 hectares for development of complementary yards and workshops facilities and the Botswana Link will need 147 hectares.

This project is aligned to the aspiration of building regional railway networks that will link regional economies in southern Africa and it conforms to the Gert Sibande District Municipality Spatial Development Framework and Integrated Development Plan (IDP), highlighting several policies, guidelines and strategies which are of particular importance in the development of the District municipality. The main areas surrounding the proposed rail line display both high levels of economic potential as well as relatively high levels of poverty.

The proposed route traverses 37 farms from Lothair to the South African/Swaziland border. Approximately 75% of the required land is located within a forested areas which comprise predominantly eucalyptus, pine and wattle trees. In Swaziland the route stretches over 14 farms and in turn traverses 13 chieftaincies which account for approximately 88% of the project land. Seven per cent of the land is held in private ownership. The location of the line is therefore predominantly in rural Swaziland which has a direct impact on the livelihood of communities living across 13 chieftaincies. The construction phase of the project will have a positive impact on the local labour market.

The construction of the Swaziland Rail link is expected to result in the migration of farm employees (agricultural sector) to lucrative opportunities in construction. Construction may be delayed owing to lengthy approval processes for borrow pits and water use licences.

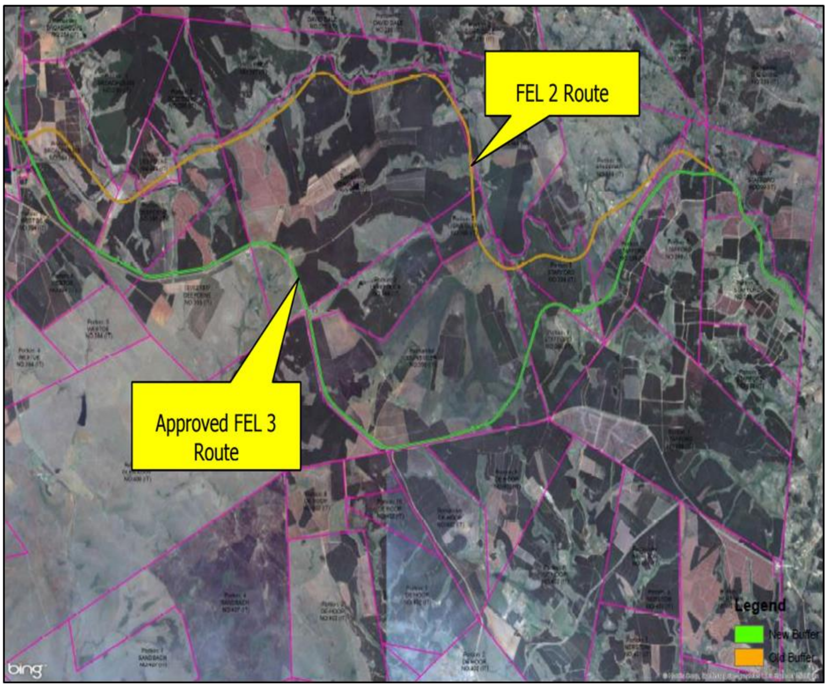
5.4 SISHEN-SALDANA IRON ORE CORRIDOR CAPACITY EXPANSION

The land required for ore line expansion (Sishen West Expansion Project deviation Postmasburg-Sishen South link line) and consolidation of yards to handle iron ore from the new mine developments (northern region) will be 170 hectares, ±70 hectares for expansion projects and 100 hectares for Sishen – Iron Ore System.

Much of the province's primary agricultural and mineral production is produced in localities distant from markets and from points of export. The existing rail that requires upgrade will have minimal impact and little or no transformation of natural or semi-natural land since the rail-bed already exists. There are exclusion zones in the Waterberg biosphere and national parks which are expected to limit the options for the new line. It is anticipated that the environmental approval process will be lengthy, due to the proposed line traversing agricultural, rural, mining and game farming areas, and possibly areas earmarked for metropolitan development. Municipalities' plans are according to their spatial development frameworks and communities have organised their lives to accommodate the existing rail and the impact of an upgrade or new railway line should therefore be minimal. The additional rail, capacity will shift coal from road-to-rail in Mpumalanga with positive environmental and social benefits. Supportive logistics corridors will help to strengthen Mpumalanga's economic development.

5.3 SWAZILAND RAIL LINK

The construction of this bilateral project between Transnet and Swaziland Railway link route will initially necessitate the acquisition of approximately 742 hectares of land over a 146 kilometre route, impacting a total of 23 landowners in both South Africa and Swaziland. In view of adverse soil condition in both countries the total land take for the project has subsequently increased to 1 217 hectares of which 505,8 hectares are located in South Africa and 712,51 hectares in Swaziland. In South Africa, the majority of land to be acquired is located within commercial afforested areas. This translates to approximately 318 hectares of land from points of export. The current Integrated Development Plan and Supplied Development Framework promote industrial development and are very specific about supply of power in their clearly stated support of National and Provincial Government's key projects. The Port of Saldanha and the "back of port" area have been identified as the economic engine room of the Municipal area. The "back of port" is seen as a major economic growth point in the Western Cape Province and the importance is further acknowledged and planned in the IDP and SDF, respectively. It is anticipated that the "back of port" industrial expansion will be a turnkey project driving the growth of a major industrial corridor which, in the longer term, is envisaged to link the eastern part of Saldanha with the port and the port with the south-western section of Vredenburg. It is further anticipated that the industrial corridor will grow towards the other towns and benefit the entire district.



Land Requirements;

- Total land required for this project is 1217ha
- 505.8ha is required in South African side and
  712.51 hectares required in Swaziland
  Botswana link will need 147ha
- In South Africa, the majority of land to be acquired is located within commercial afforested areas. This translates to approximately 318 hectares of land out of a total of 508 hectares.

Strategic Environmental and social impact;

- The route traverses 37 farms from Lothair to the border. Approximately 75% of the required land is located within afforested areas which comprises predominantly of eucalyptus, pine and wattle trees.
- In Swaziland the route stretches over 14 farms and in turn traverses over 13 Chieftaincies which accounts for approximately 88% of the project land. 7 % privately owned.
- The location of the line is therefore predominantly in rural Swaziland which has a direct impact on the livelihood of communities.
- Construction – Positive impact on local Labour
  Farm employees might migrate due to opportunities in construction

Project alignment to Spatial development Framework;

- This project is aligned to the aspiration of building regional railway networks that will link regional economies in Southern Africa and it conforms to the Gert Sibande District Municipality Spatial Development Framework. Municipal Integrated Development Plan highlight several policies, guidelines and strategies which are of particular importance in the development of the District Municipality and this project is one of the projects that is highlighted.

Figure 75: Illustrates the initial FEL 2 route (Total land area of 742 hectares)

Vegetation along the ore line varies from seashore vegetation to arid vegetation. Two of the affected vegetation types have been included in the National List of Ecosystems that are threatened and in need of protection. The environmental screening of bio-physical issues pointed out no fatal flaws. As the development of the ore line is closely linked to the inhabitants of Saldanha Bay and an even wider sphere of influence due to the national and regional importance of the port, it is imperative that attention should be directed to the potential social impacts of the development. The expansion of the iron ore line also entails a number of economic benefits. These are in the form of employment opportunities and growth in the regional economy since capital projects create demands for several inputs (labour, materials etc.) and increase production.

MANGANESE EXPANSION PROJECT: HOTAZEL – NGQURA

The rail infrastructure comprises the new compilation yards in Mamathwane and Coega (near the Port of Ngqura), new crossing loops and lengthening of existing crossing loops and lengthening of existing crossing loops en-route, maintenance and operational facilities, and monitoring equipment. The total land required for this project will be 416 hectares; most of this land will be for rail infrastructure.

The existing manganese ore railway line is provided for in the infrastructure planning of the municipalities and the proposed upgrade will feed into the relevant plans of the various municipalities. It should also be noted that the project is in line with the Provincial Growth Strategy in terms of its contribution to the provincial economy. The bulk of the Northern Cape's primary agricultural and mineral produce is generated in localities distant from markets and points of export. This and other dedicated lines are also essential for developing good linkages between Ngqura and the main mineral producing areas of South Africa in the Northern Cape and the Free State. The improvement of rail links will reinforce the important role the region's harbours play as a transit point for mineral exports.

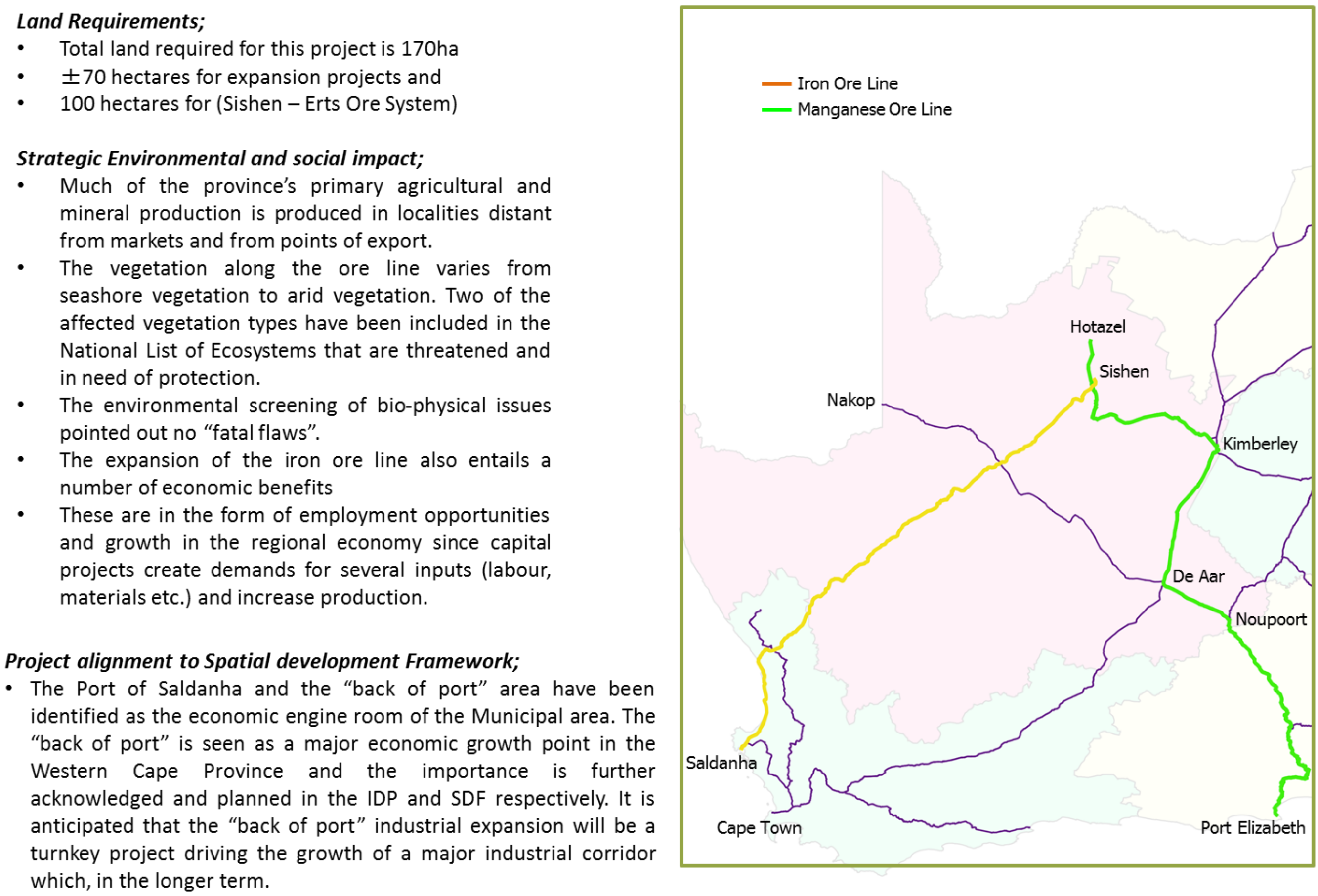


Figure 76: Iron and Manganese Ore Lines

The proposed project will occur in several local municipalities within the Eastern and Northern Cape. This project is expected to contribute to the local economy in the following ways: increased Government revenue, increased exportation of manganese ore (operation only), creation of employment which will lead to increased spending, procurement of local goods and services. The impact during the construction phase will be negative and direct as increased road traffic may lead to the deterioration of major roads, injuries and potential death (human and livestock) on secondary roads. Operational activities of the project are expected to decrease the heavy vehicle traffic on the roads, as the manganese will be transported by rail as opposed to by road on heavy vehicles.

Agricultural land will be lost in certain sections of the railway line due to the shortage of land within the existing railway reserve. The combined size of the project affected farms is approximately 50 000 hectares. There are potential impacts to vegetation and protected trees and impacts to faunal and avi-faunal habitats; however, this is expected to reduce to an acceptable level upon implementation of the recommended mitigation measures.

5.5 DURBAN GAUTENG RAIL CORRIDOR (NATCOR)

The Natcor line passes through three provinces of South Africa originating in KwaZulu-Natal moving through the south-western regions of Mpumalanga, ending in Gauteng. Natcor requires a total land area of 1 102 hectares,

227 hectares will be for new rail line to by-pass challenging topography from Cato Ridge –Durban and 875 hectares will be required for additional land for the deviations to accommodate flatter grades and curves. (This is inclusive of Glencoe - Vryheid chord).

The Natcor project connects the major economic centres of Gauteng and Durban/Pinetown, and at the same time, connects these centres with improved export capacity through our sea ports. A significant amount of work has been undertaken by different municipalities within Gauteng, Mpumalanga and KZN in an attempt to align spatial planning priorities with national priorities. Natcor is the cross boundary project that is aligned in the IDP, SDF, GIS based (Geographical Information System) spatial plans and development applications of all the municipalities that are affected. Some of the route options pass through cultivated land, densely populated areas, sparsely populated farm areas and industrial areas. The route options also cross several major roads and highways. Approximately

4 500 dwellings will be affected by the proposed route and yard options. Displacement or resettlement will impact people living within or in close proximity to the current or proposed rail reserves. The line expansion will have a positive impact on the local economy through the creation of job opportunities and skills development.

Most of the proposed upgrades will take place along the line within KwaZulu-Natal. Several yard options have also been highlighted in the DDOP region. The affected biomes are mainly the Savanna and Grassland biomes with ecosystem statuses varying between critically endangered near the coast to endangered, vulnerable and the least threatened where the expansions move more inland. The affected biome in Mpumalanga area is the only Grassland biome which has an ecosystem status of Least Threatened, and in Gauteng the proposed line will take place along the existing route near Mpumalanga-Gauteng border. The proposed route will potentially interact with or pass few channelled valley-bottom wetlands and floodplain wetlands.

Land Requirements;

- NATCOR requires a total land area of 1102 hectares, the 227 hectares will be for new rail line to by-pass challenging topography from Cato Ridge – Durban and the 875 hectares will be required for additional land for the deviations to accommodate flatter grades and curves (This is inclusive of Glencoe- Vryheid chord).

Strategic Environmental and social impact;

- Some route options pass through cultivated land, densely populated areas, sparsely populated farm areas and industrial areas.
- The route options also cross several major roads and highways.
- Approximately 4500 dwellings will be affected by the proposed route and yard options.
- Displacement or resettlement will impact particularly pertaining to people living within or in close proximity to the current or proposed rail reserves and the change in land use particularly where new railway lines will be placed, new yards will be constructed
- The line expansion will have a positive impact on the local economy through the creation of job opportunities and skills development.
- The affected Biomes are mainly the Savanna and Grassland biomes with ecosystem statuses varying between critically endangered near the coast to endangered, vulnerable and the least threatened where the expansions move more inland. The affected biome in Mpumalanga area is only the Grassland biome which has an ecosystem status of Least Threatened

Project alignment to Spatial development Framework;

- Natcor is the cross boundary project that is aligned in the IDP, SDF, GIS based (Geographical Information systems) spatial plans and Development Applications of all the municipalities that are affected both in Gauteng and KwaZulu/Natal

Figure 77: Rail Property Planning: Hubs and Terminals

5.6 HUBS AND TERMINALS

PLANNED HUBS AND TERMINALS

Transnet aims to effect a substantial modal shift of cargo haulage from road onto rail and increase its market share of the long-distance transportation of mineral exports, containerised traffic and general freight business. International trends indicate that one of the main drivers to achieve and capture such market share is through the development of mega-terminals and super-terminals in strategically located corridors.

6. Freight and Passenger Alignment

6.1 INTEROPERABILITY – OPERATIONAL CONCEPTS

There have been various investigations into new high-speed routes for intercity passenger services, particularly on the Johannesburg – Durban Corridor. These investigations have, however, shown that it may be exorbitantly expensive to implement such a system and that it would be difficult to recover the costs from relatively low passenger volumes.

The solution appears to be to migrate long-distance rail passenger transport to road, but before this is done Transnet and PRASA have agreed that an alternative be considered. The alternative should consider utilising some of the low density freight routes and upgrade these to a medium-speed standard. This alternative may allow passenger services to compete effectively with road-based transport, and at the same time may also allow Transnet to introduce rapid freight services for time-sensitive freight traffic.

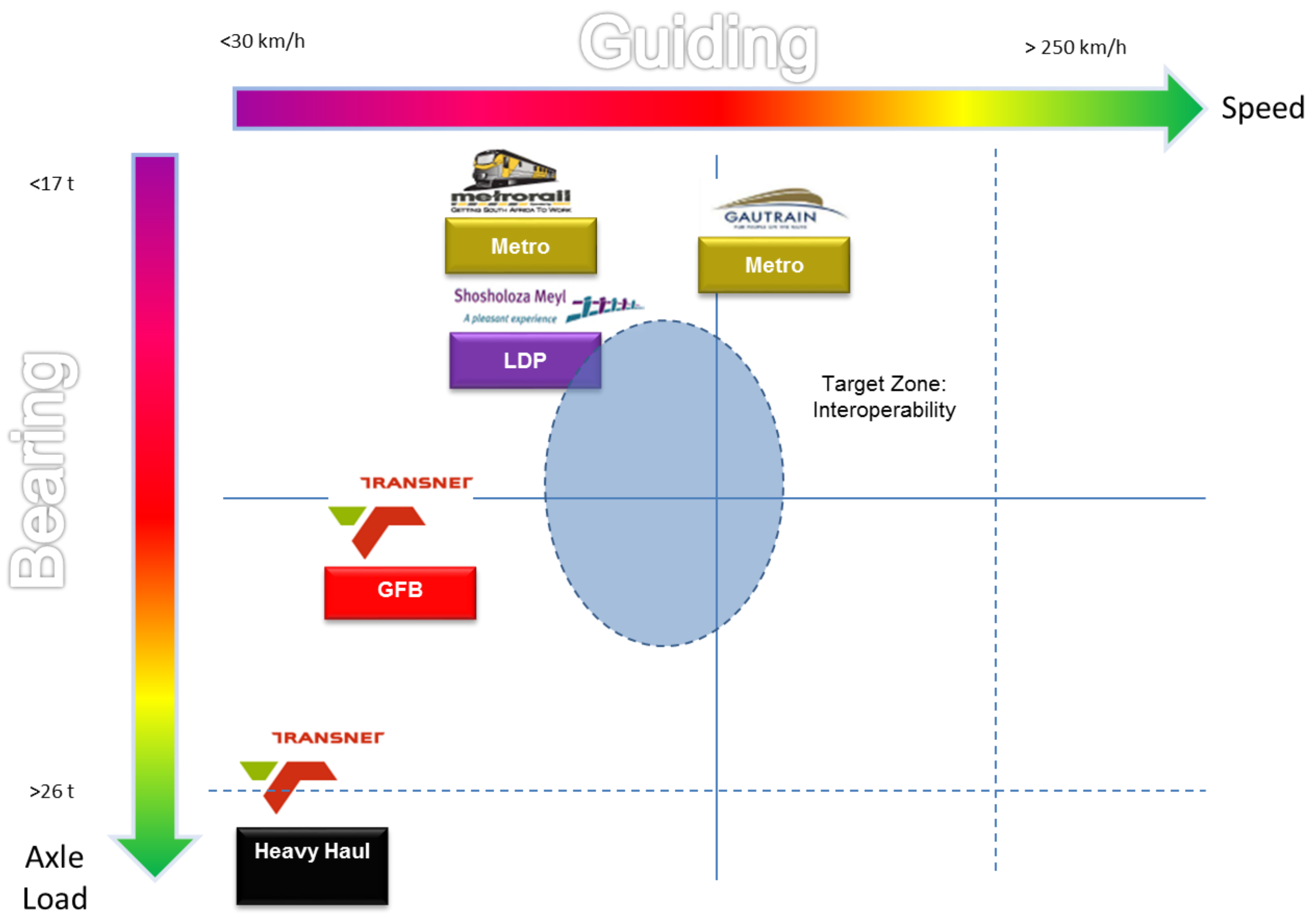


Figure 78: Operational Concepts

6.1.1 TEST ROUTES

Two routes have been selected during an FER level study for evaluation of freight/passenger interoperability.

The Cape Route

Following from the line assessments a number of interventions have been proposed to upgrade the Cape Corridor mainline to support higher speeds. Two categories of interventions have been used:

i) Curve easing and

ii) Construction of bypasses.

Table 22 below shows the estimated cost for the Cape Route interventions.

Section	Curve easements	Curve easements and bypasses	New construction
Cape Town to De Aar	R7 74	R30 12	R43 21
De Aar to Colesberg	R3 62	R3 62	R3 62
Colesberg to Vereeniging	R4 35	R5 81	R13 44
Total	**R15 71**	**R39 56**	**R60 28**

Table 22: Capital Cost Estimate (Billions of Rands)

The Eastern Mainline

South African passenger and freight trains typically operate in different speed, axle load, curve and gradient zones. For light freight such as containers, a zone of co-existence with passenger trains is being investigated on the non-heavy-haul network lines (120-160km/h zone). Co-existence of freight and passengers in the true high-speed zone (+200km/h) is not feasible.

Across the globe, transport systems and infrastructure have been recognised as critical strategic assets and vitally important in allowing countries to develop and advance. Technological and operational advances have also changed the way that transport infrastructure is planned, managed and integrated with greater requirements for volume, efficiency and speed. Within this, one of the major challenges becomes how to efficiently use existing infrastructure (that was planned and developed based on previous generation transport philosophy) within the framework of the current transport management models and technological possibilities. This is particularly relevant within the rail sector where technological improvements have led to rapidly diverging requirements in the freight and passenger traffic areas.

Transnet Freight Rail (TFR) and Shosholoza Meyl passenger trains (PRASA) share the same rail network on the long-distance routes between major cities. The different natures of passenger and freight traffic, specifically their speed, has a significant impact on slot availability, with passenger trains requiring between 1,5 and 3 equivalent freight slots. As the demand for the transportation of bulk freight commodities such as coal and ore increases, the negative impact introduced by the passenger trains becomes more severe. The current strategy is therefore to separate the passenger and freight traffic in the long term.

As with the Cape Route, two categories of interventions have been used:

i) Curve easing and

ii) Construction of bypasses.

The table below shows the estimated costs for the Eastern mainline interventions.

Section	Curve easements	Curve easements and bypasses	New construction
Greenview to Komatipoort	R5 205	R87 606	R91 091
Total	**R5 205**	**R87 606**	**R91 091**

Table 23: Capital Cost Estimate (Billions of Rands)

Further studies are necessary and a decision must be taken whether to implement freight/passenger interoperability on a selected route.

6.2 CURRENT NETWORK

TYPICAL PROFILE				
	Axle load	Speed	Train length	Use
General freight line	20t per axle	60-100km/h	30-100 wagons	General freight
Heavy haul line	26-30t per axle	40-80km/h	100-342 wagons	Heavy bulk

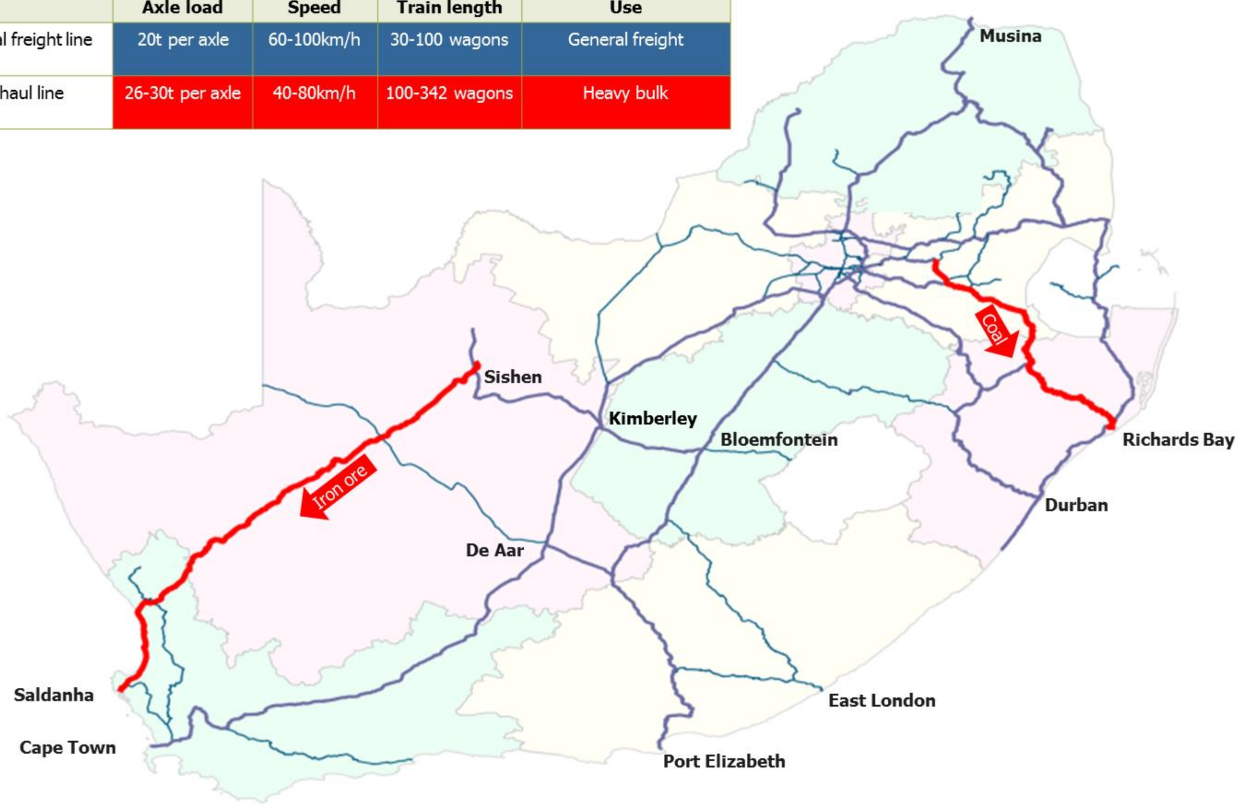


Figure 79: Current Network: Status Quo

The current rail network profile is dominated by the general freight network with only two heavy-haul lines, namely:

- Iron ore export line from Sishen to Saldanha; and
- Coal export line from Ogies to Richards Bay.

6.3 PLANNED NETWORK (30 YEARS)

TYPICAL PROFILE				
	Axle load	Speed	Train length	Use
General freight line	20t per axle	60-100km/h	30-100 wagons	General freight
Heavy haul line	26-30t per axle	40-80km/h	100-342 wagons	Heavy bulk

NEW LINES	
Export coal planned	
Other planned	

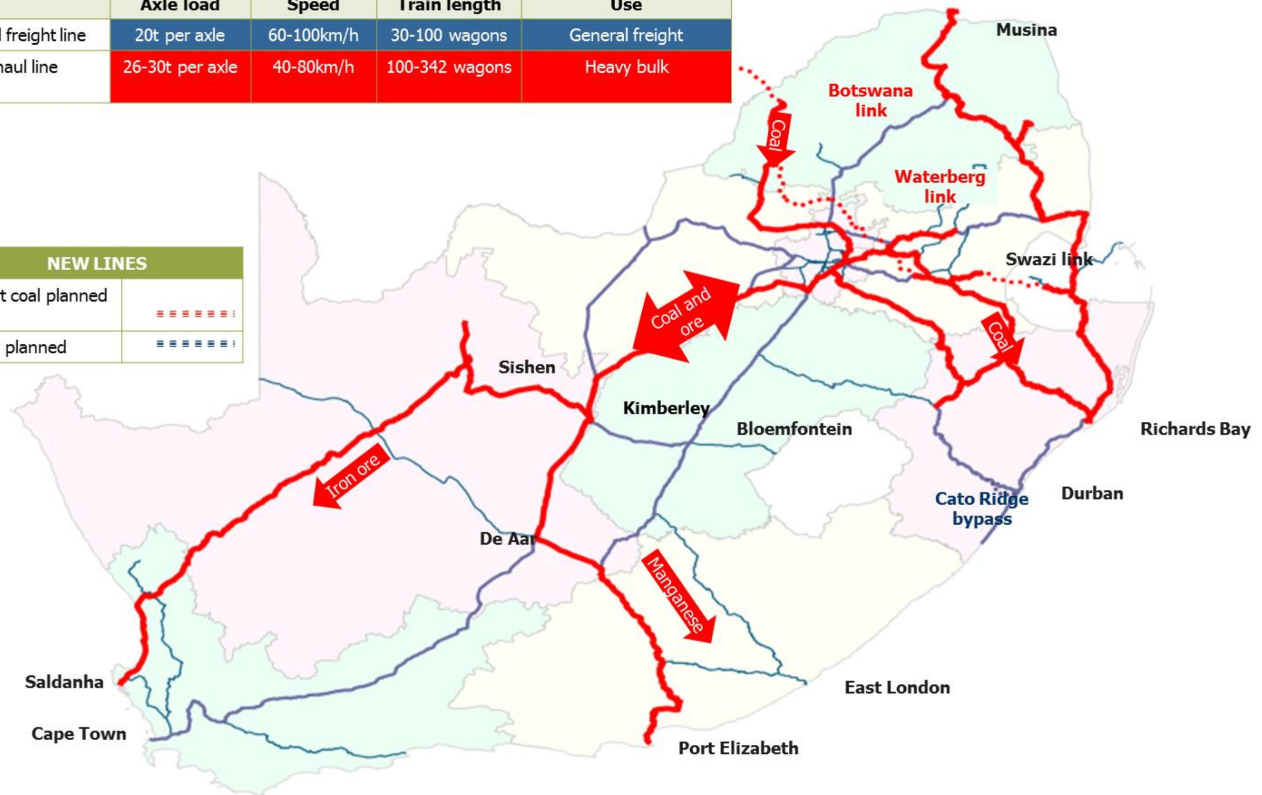
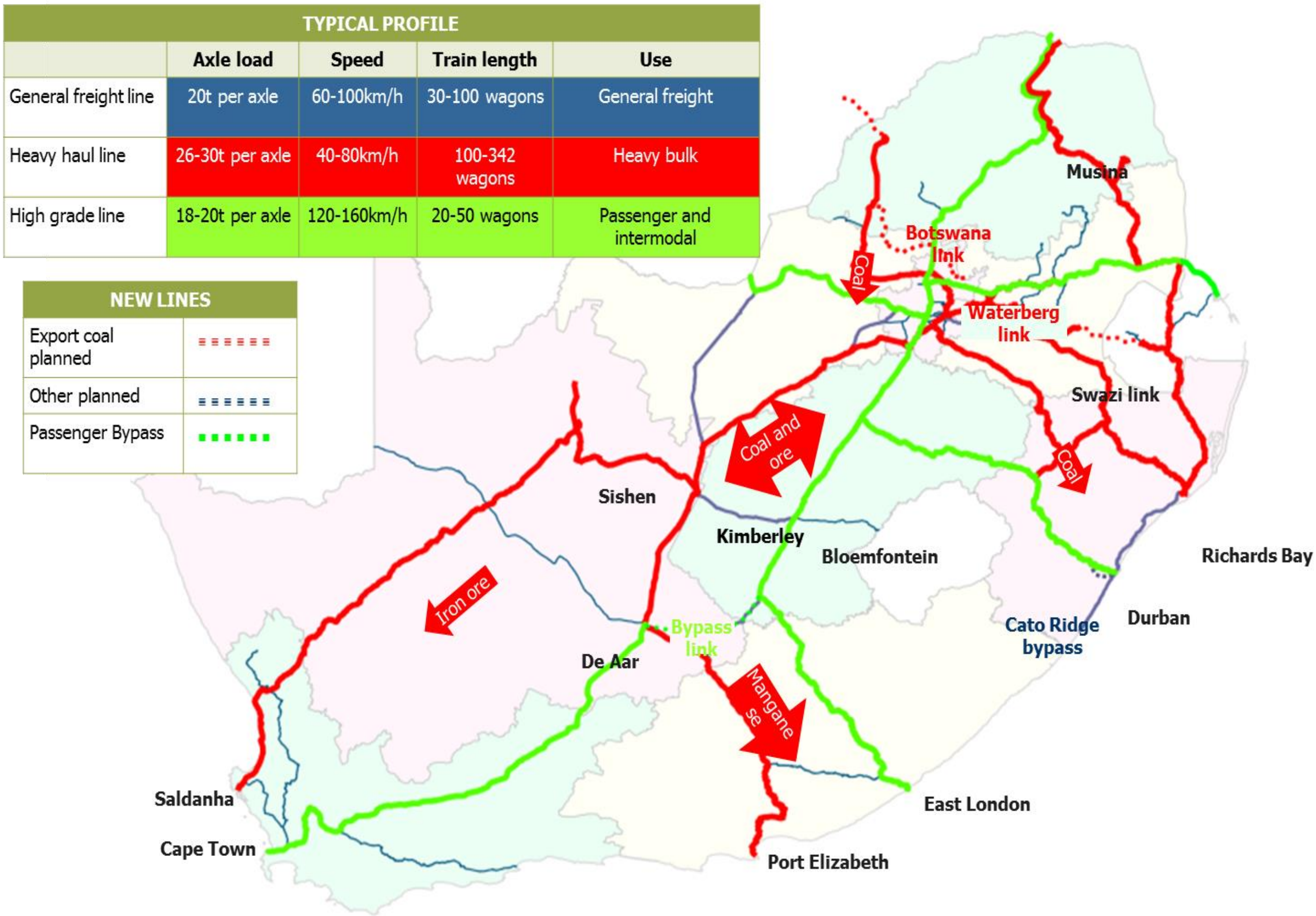


Figure 80: 30-year Planned Network (Heavy Haul)

In the next 30 years the identified sections will be converted to heavy-haul status, with axle load increased to 26t/axle and electrification system upgraded to 25kV AC. These sections comprise of the following rail segments:

- Lephalale to Ermelo – extension of the export coal line to the Waterberg coalfields. Based on the demand forecast exceeding 30mtpa, a new line may need to be constructed to be able to run 200-wagon trains from Richards Bay to the Waterberg coalfields. A link to Botswana will be necessary to connect the South African network with the Botswana rail network, thereby allowing the railage of coal from the Botswana coalfield to South Africa for consumption or export purposes;
- Hotazel to the Port of Ngqura – manganese export corridor from the Northern Cape to the deep sea Port of Ngqura in the Eastern Cape;
- Hotazel to Glencoe – iron ore, manganese and coal corridor. The iron ore and manganese is mainly transported to the steel plants in Vanderbijlpark and Newcastle. The coal from either Waterberg or Mpumalanga is also transported along the Natcor to the Eskom power stations;
- Ogies to Ermelo – the coal back bone handling most of the domestic coal to the Eskom power stations in the Mpumalanga area. The joint Eskom and Transnet strategy to migrate coal from road-to-rail will be a major contributor to the system expansion requirements; and
- Pyramid to Houtheuwel – this section forms part of the freight ring, which will receive traffic from Waterberg, Northern Cape, Limpopo and Mpumalanga coalfields. The general freight traffic is also high in this area.

RAIL DEVELOPMENT PLAN



TYPICAL PROFILE				
	Axle load	Speed	Train length	Use
General freight line	20t per axle	60-100km/h	30-100 wagons	General freight
Heavy haul line	26-30t per axle	40-80km/h	100-342 wagons	Heavy bulk
High grade line	18-20t per axle	120-160km/h	20-50 wagons	Passenger and intermodal

NEW LINES	
Export coal planned	
Other planned	
Passenger Bypass	

Figure 81: Long Term Shared Network – PRASA/Transnet (interOperations)

Due to different train operating speeds, required track standards and the impact on capacity, passenger and freight traffic are not compatible on a shared network. Transnet and PRASA have initiated joint planning sessions to resolve the incompatibility of both passenger and freight traffic on specific networks. Considering traffic density by 2042 as well as the freight type on specific routes, Transnet has developed a series of capacity creation interventions, including the upgrade of some lines to heavy-haul standards. By 2042 the heavy-haul lines will cover the routes shown here in red. On these routes, compatibility with passenger services will become problematic.

There are other routes, which are not as highly utilised as the heavy-haul lines, which can serve as alternate routes for light industrial traffic, containers and passenger trains.

These lines are indicated on the map as upgraded passenger and light industrial routes. Due to the nature of the traffic it is believed that these traffic types are interoperable at a medium speed of approximately 160km/h.

The track standard will have to be improved on these specific routes to support the light industrial medium speed traffic types. By developing another corridor for light industrial traffic, additional capacity is released or created for heavy haul, light industrial and passenger traffic.

6.4 LONG TERM NETWORK POTENTIAL

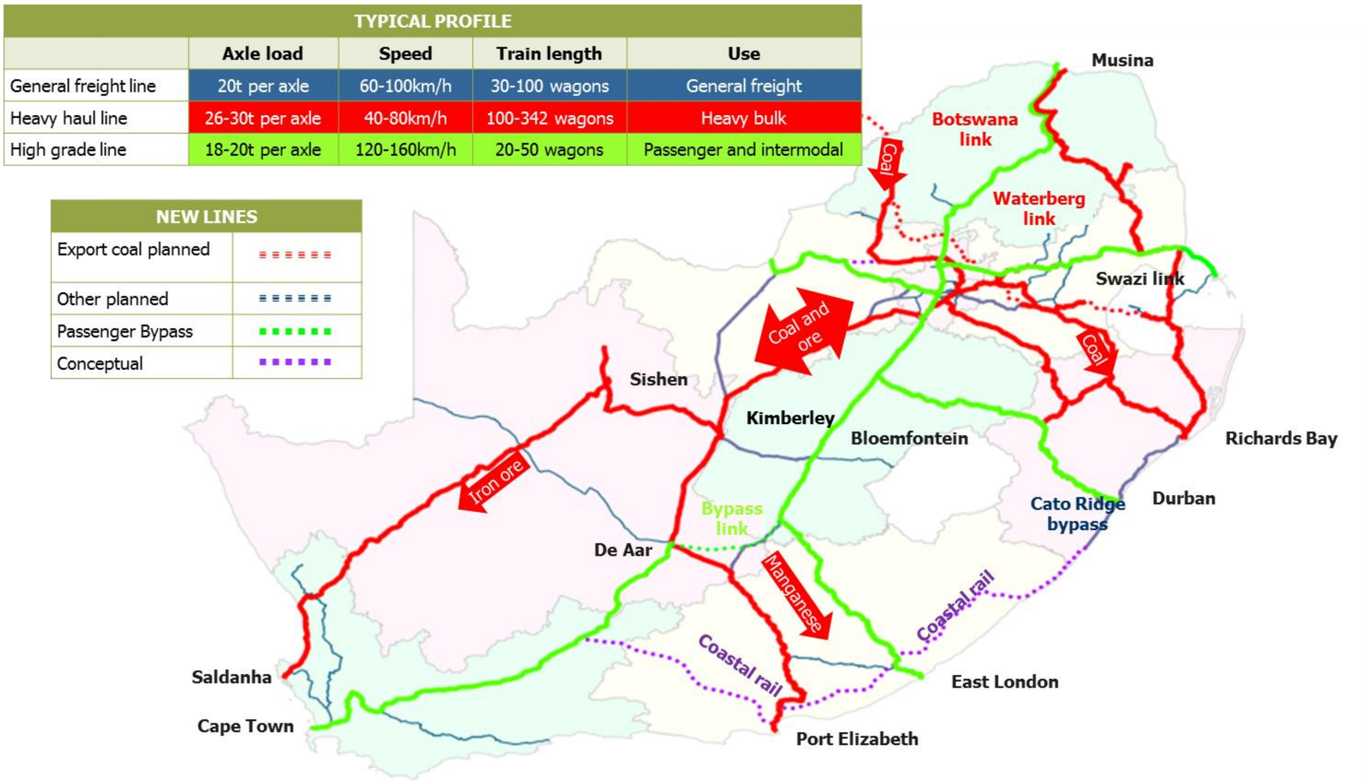


Figure 82: Beyond 30 Years

In the long term, it is likely that a high-speed passenger service will be implemented between Gauteng and Durban.

Other regional and strategic connections are also considered, such as:

- Coastal Rail – rail connection from the Western Cape to KwaZulu-Natal via the Eastern Cape province;
- Sishen Link – rail link connecting the iron ore network to Gauteng, Botswana and the Waterberg coalfields using the existing West Rand to Mahikeng section; and
- Trans Kalahari – regional rail link from Walvis Bay in Namibia to link with the South African network via Botswana.

The network future state is defined by the long term strategy, resource planning and the principle of standardisation. As shown, the bulk mineral export and feeder lines will be upgraded to heavy-haul status; preferably with axle loading of 26t/axle, incab signalling and electrification at 25kV AC. The low capacity lines will retain 20t/axle, 3kV DC or de-electrified and track warrant train control system.

7. Network future state: 2044

7.1 AXLE LOAD

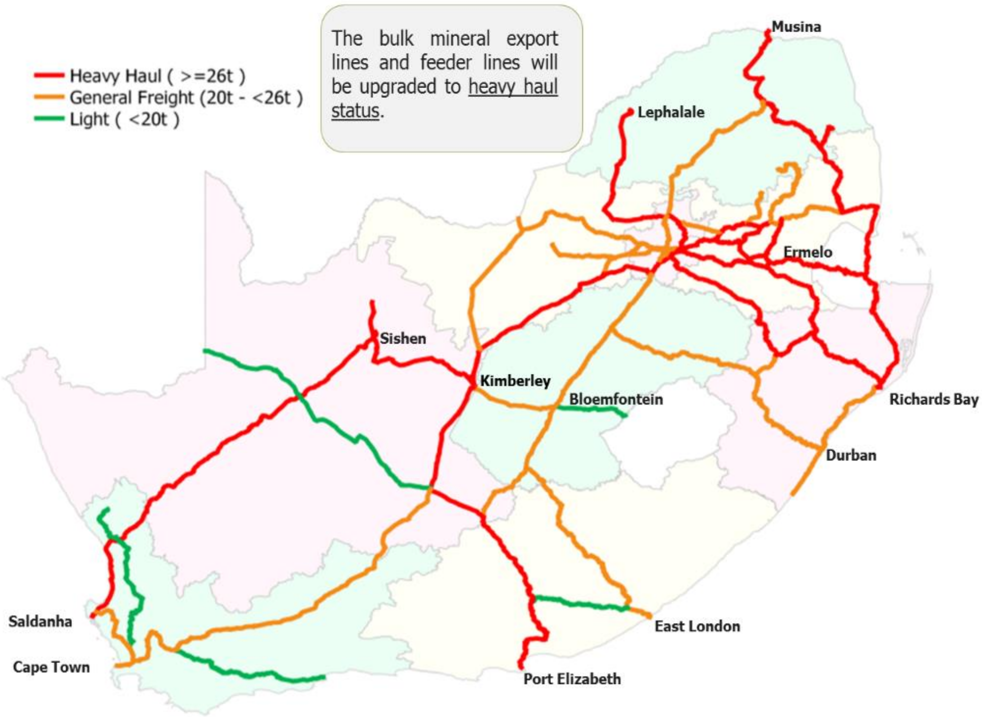


Figure 83: Future Axle Load (standardised)

7.2 ELECTRIFICATION

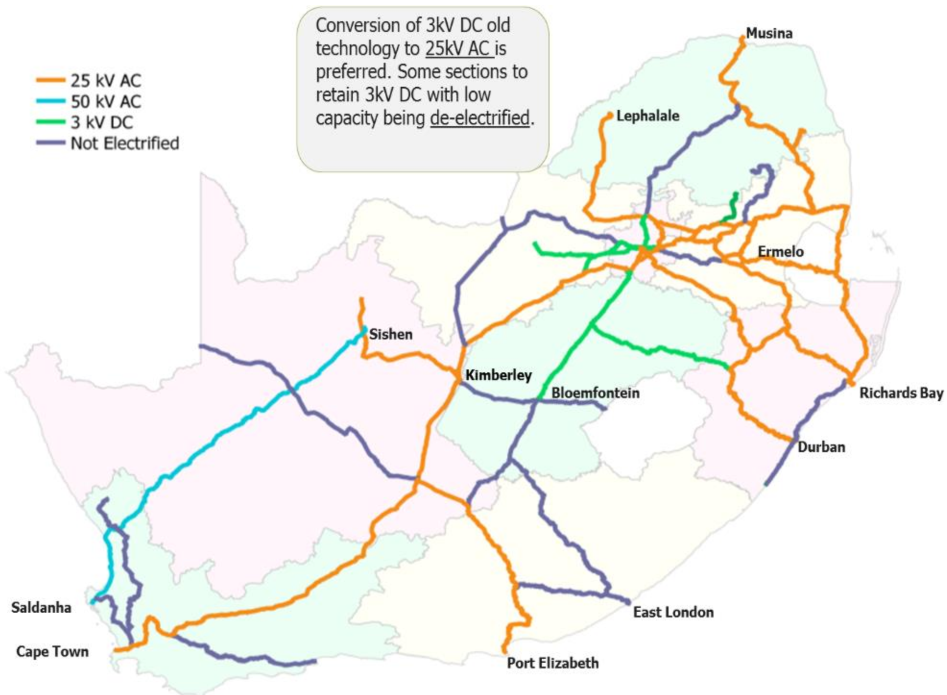


Figure 84: Future Electrification

The sections for upgrading axle loading are heavily dependent on commodity flows, even more so than the two disciplines of electrification and train control. The ore line remains at 30t/axle. The new Waterberg alignment and Swazi link will be built at 26t/axle and the route from Sishen to Gauteng via Kimberley will also be upgraded to 26t/axle.

Gauteng to Glencoe line will also be upgraded to 26t/axle due to the nature of the heavy-haul bulk commodities that utilise the route. The Hotazel to Port Elizabeth via Kimberly and De Aar line will also be upgraded to 26t/axle to accommodate increased manganese volumes on the route.

The network future state map for electrification shows the impact of specific corridor upgrades and a general shift towards 25kV AC electrification of the core network. The ore line remains at 50kV AC. The new alignment from Waterberg to Ermelo and Swazi link will be installed with 25kV AC traction, as well as the northern coal line, and Maputo corridor. The route from Hotazel to Gauteng via Kimberley is converted to support the commodity flows that utilise the sections, in particular iron ore.

The Beaufort West to Cape Town and Gauteng to Durban via Glencoe lines will also be upgraded to 25kV AC. The standardised view shows the remainder of the core network will be 3kV DC and non- electrified. Some of the existing electrified lines that have low volumes will be de-electrified, with the view that the future volumes do not support the electrical maintenance or upgrade.

7.3 FUTURE TRACTION ENERGY STRATEGIES

Rolling stock is an essential and integral part of a rail system with interdependence on the infrastructure. It also contributes significantly to the required expansion capital, with infrastructure and rolling stock being the largest portions thereof.

The rolling stock plan considers traffic demand projections for rail transported origins and destinations. The Freight Rail 10-year MDS is used as a yardstick for assessing and adjusting the plan derived from traffic projections over the next 10 years. A 30-year long term view is then derived from the corrected base to determine approximate requirements for rolling stock. Certain assumptions are made about reliability, availability and performance improvements to allow for continuous improvement, re-engineering and technological developments that would inevitably be required to remain competitive.

Future freight traction energy evaluation	3kV DC	25kV AC	Diesel
Efficiency	Acceptable	Good	Acceptable
Heavy haul suitable	Acceptable	Good	Good
Flexibility of use	Acceptable	Acceptable	Good
Latest technology	Acceptable	Good	Good
Best practice	Acceptable	Good	Good
Regen into grid	Not acceptable	Good	Not acceptable

Legend: Good | Acceptable | Not acceptable

Table 24: Evaluation of Different Traction Energy Types

Based on this high-level evaluation, it is clear that the 25kV traction type should be the choice for the Transnet future network where volumes are significant.

The strategy adopted:

- High-volume lines to be converted to 25kV (ore line will remain at 50kV);
- Standardisation to 25kV to avoid traction changes; and
- Low-volume lines to be de-electrified and operated with diesel locomotives.
- Refine to detail train and route level;
- Optimise train length and mass with locomotive allocation;
- Allocate locomotives to the required train service;
- Apply optimal locomotive allocation rather than historic use;
- Apply design cycle times rather than historic cycle times with improvement target; and

- As the operational plan is deemed to have the most significant impact on the required locomotive fleet, the optimum fleet should be determined by applying various operational strategies. It is believed that a large proportion (up to 80%) of the train plan should tend towards ring-fenced locomotives for dedicated services and eventually for unitised trains where the volumes are supportive. This should give the benefit of reduced locomotive requirements due to the increased utilisation, and is also the basis of the current proposed "revised operating philosophy".

7.4 TRAIN CONTROL

Figure 85: Future Train Control

The core network and lines with substantial volumes are upgraded to CTC signalling train control. The necessity for upgrading train control is primarily a factor for the volumes running over a section, with high-volume forecast being the most eligible candidates. The standardised view eliminates all of the old train control systems such as wooden train staff and telegraph order and replaces them with two types: CTC and Track Warrant.

This is done with the view of simplifying operations on the network and improves turnaround times. CTC signalling to be rolled out firstly on heavy-haul lines to maximise throughput and improve system safety, secondary lines to Track Warrant and minor lines to radio train order.

8. Rolling stock

Rolling stock is an essential and integral part of a rail system with interdependence on the infrastructure. It also contributes significantly to the required expansion capital, with infrastructure and rolling stock being the largest portions thereof.

The rolling stock plan considers traffic demand projections for all transported origins and destinations.

The Freight Rail 10-year MDS is used as a yardstick for assessing and adjusting the plan derived from traffic projections over the next 10 years. A 30-year long term view is then derived from the corrected base to determine approximate requirements for rolling stock. Certain assumptions are made about reliability, availability and performance improvements to allow for continuous improvement, re-engineering and technological developments that would inevitably be required to remain competitive.

a) Key Planning Principles for Locomotives

IMPACT AREA: CAPACITY PLANNING

It is clear that the current network configuration has a number of required traction change-over points, where locomotives must be changed in order to accommodate the different traction supply system. Operations are negatively affected by the number of traction changes. Evaluation of the different traction energy types is given in Table 24 above.

IMPACT AREA: INFRASTRUCTURE IMPACT

- Match and optimise locomotive characteristics with infra capacity i.e. number of locomotives in consist, tangential force sustainable by the rail crown, power available for traction, axle load and train lengths; and
- Investigate the medium and long term optimum for the electrification configuration of the network in relation to locomotive type. (E.g. 25kV future network with interim dual voltage 3kV DC/25kV AC locomotives, with a medium term conversion programme to 25kV AC.)

IMPACT AREA: MAINTENANCE

- Review and update maintenance strategy to optimise asset availability for operations, and reliability in service;
- Align maintenance strategy to asset lifecycle and operations strategy to maximise utilisation of assets made available for service;
- Pursue the benefits of newer technologies to minimise maintenance interventions and maximise operational efficiency, e.g. remote monitoring of locomotives; and
- To the extent that the age of the technology permits, the result of maintenance review should increase availability and reliability, as well as increase energy- and cost-efficiency;

IMPACT AREA: TECHNOLOGY

It is essential to raise the competitiveness bar regularly, to work old equipment that is no longer competitive out of the fleet, thereby to make space for new technologies and the refreshed competitiveness that they bring. Apply the latest proven technology where relevant and as far as economically justifiable, as follows;

- Design train loads and services to exploit fully the increased adhesion of which the AC traction motors in TFR’s new locomotives are capable;
- Specify dual-voltage AC-DC capability when electric locomotives are acquired;
- Evolve to 25kV AC where electrification is justified;
- Standardise equipment attributes as far as possible for flexibility of deployment and operational efficiency, but with due regard for specific service design requirements;
- Endeavour to standardise locomotive characteristics to minimise the number of classes;
- Ensure interoperability among locomotive classes as last resort by means of distributed power where native protocols cannot support interoperability; and
- Implement ECP braking and distributed power, mainly on heavy-haul operations in the short term, as well as on other ring-fenced operations to which rolling stock is dedicated.

IMPACT AREA: TRACTION PLAN

- As the locomotives (and wagons) are the means of production of a railway, it is crucial to ensure their future availability, reliability and cost-effectiveness;
- A consolidated medium-to long term plan should therefore avoid knee-jerk reactions that result in ineffective locomotive procurement when viewed within the complete system. The lack of a committed investment plan can also lead to severe under investment, as was experienced in the past 12 to 15 years and which was relieved through the recently announced tender awards for 1 064 diesel and electric locomotives; and
- Because of the relatively long lead times for new locomotives, it is imperative that a continuous annual investment plan be followed. Financial provision must be made to support this programme under various financial conditions. Financial constraints on an annual basis can be accommodated by adjusting annual order volumes, but the replacement or renewal programme must continue without interruption.

b) Key Planning Principles for Wagons

IMPACT AREA: CAPACITY PLANNING

- Refine to detail commodity and route level;
- Apply optimal commodity and wagon matching rather than historic use;
- Apply design cycle times rather than historic cycle times with improvement target;
- Endeavour to smooth demand as far as possible;
- Employ ring-fenced unit trains to increase efficiency;
- Optimise required fleet size with frequency of volumes to be transported; and
- Perform final system cost review and optimisation.

IMPACT AREA: INFRASTRUCTURE

- Ensure that wagon designs are maximised within moving structure gauge, with due regard for the density of the commodity or lading for which they are intended, and for physical constraints such as clearance marks;
- Maximise train lengths within infra capacity (optimise longer trains), while also prioritising uniform train lengths, which impact on yard and crossing loop lengths, so that a short yard road or crossing loop somewhere on the route does not constrain train length over its entire line haul journey; and
- Wagon design and commodity allocation must achieve maximum payload and capacity utilisation in terms of allowable axle load.

IMPACT AREA: MAINTENANCE

- Review and update maintenance strategy to optimise asset availability for operations, and reliability in service;
- Align maintenance strategy to asset lifecycle and operations strategy to maximise utilisation of assets made available for service; and
- Pursue the benefits of newer technologies to minimise maintenance interventions and maximise operational efficiency.

IMPACT AREA: TECHNOLOGY

- Apply the latest technology as far as possible and where relevant (i.e. white metal bearings and vacuum brakes to be converted at increased rate);
- Use new improved materials to increase body component life;
- Improve load to tare ratio;
- ECP braking;
- Bogie mounted brakes; and
- Ensure optimal wagon design per commodity or commodity group.

c) New Rolling Stock

A set of key planning principles were used for compiling the long term plans. The intent is that whenever the plans are compiled or revised, these plans be tested against the key planning principles in order to ensure alignment within the business as a whole, and also that all the important aspects are addressed. Listed below are the key planning principles for wagons and locomotives.

8.1 LOCOMOTIVES CURRENT FLEET

a) Locomotive Fleet Size

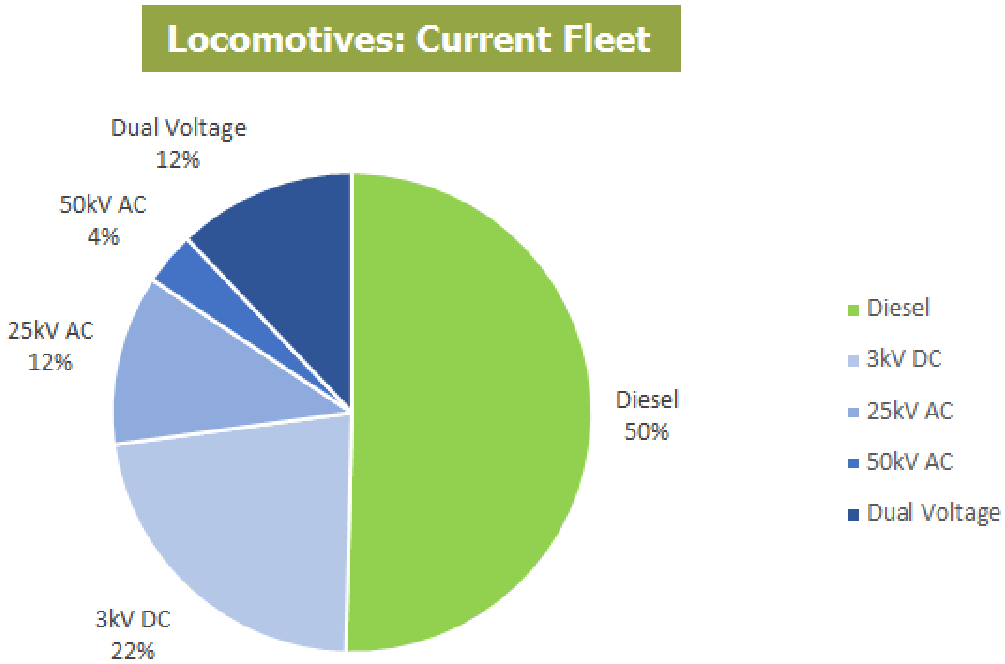


Figure 86: Locomotive Fleet Size

The locomotive fleet primarily consists of three main traction types, namely 3kV DC (22%), 25kV AC (12%) and Diesel Electric (50%). The remainder of the fleet includes 3kV/diesel electric dual traction locos, 3kV/25kV dual voltage locos and 50kV AC locos, the latter operating only on the iron ore export line from Sishen to Saldanha harbour.

The future state image clearly shows Freight Rail's strategy to migrate towards greater use of electrical traction as the network infrastructure is upgrade and expanded.

b) Locomotive Availability and Reliability

Availability and reliability data includes an adjusted target, which is derived from an international benchmark but adjusted for local conditions and the current fleet. Availability is defined as the percentage of the total active rolling stock fleet, which is available for operational deployment. The non-available locomotives are typically receiving scheduled or unscheduled maintenance. The active fleet is defined as the total fleet less the rolling stock damaged in accidents and derailments or staged.

For general freight the optimal flexibility of wagon types must be applied.

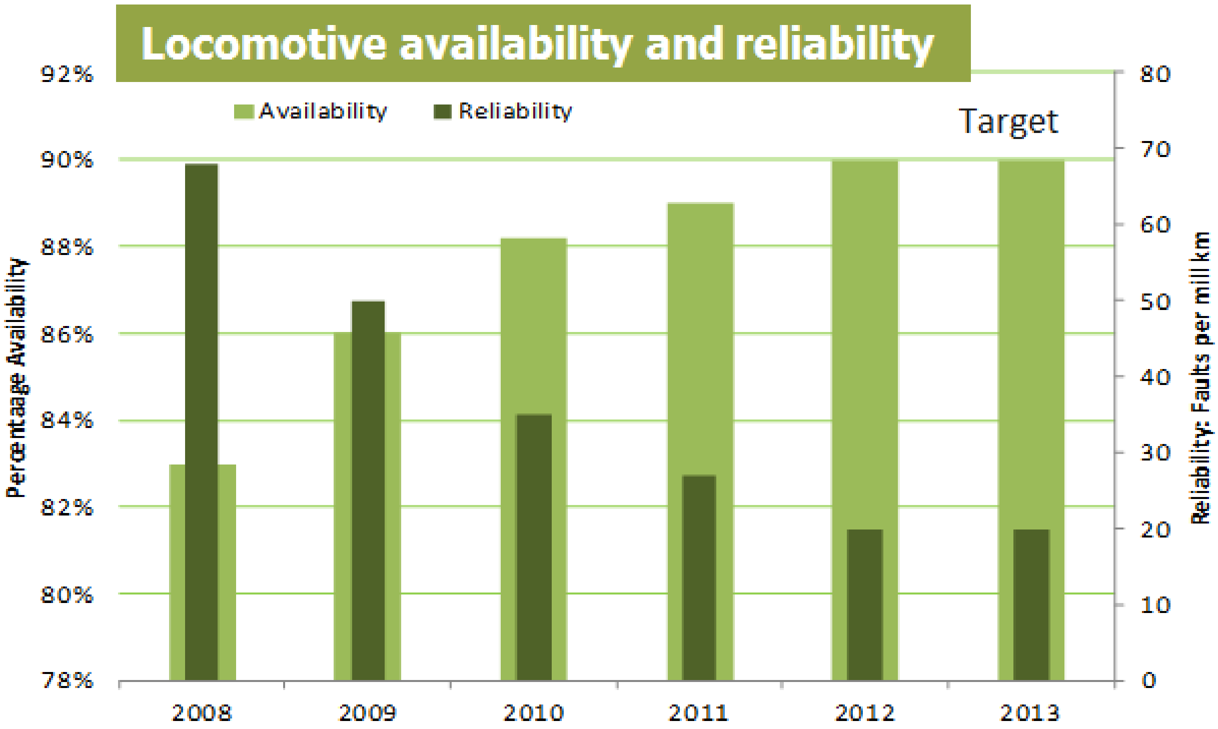


Figure 87: Locomotive Availability and Reliability

Reliability is measured as a failure rate in units of faults per million vehicle kilometres. The lower the failure rate, the higher the reliability.

From the figures for availability and reliability it is clear that the current performance of the fleet is below that of international benchmarks and the future targets that are set (90% availability and less than 20 faults per million kilometres). The reason for this poor performance is twofold:

- The protracted lack of investment in new rolling stock, which led to old technologies remaining in service beyond its design life; and
- The postponement of major repair programmes due to cash flow constraints, which ruled out opportunities for technology upgrades.

Most of the old technologies have inherently lower reliability (design reliability) and availability when compared to newer technologies. It is therefore important to note that the reliability cannot necessarily be improved by increasing maintenance interventions but more readily by upgrading components to newer technologies or by acquiring new rolling stock. While the reinstatement of the postponed major repair programmes will improve the fleet, it cannot bridge the gap completely to meet best practice targets without technology upgrades or new rolling stock.

c) Locomotive Age Distribution

There are two prominent peaks in the locomotive age distribution. The first peak represents reasonably new or upgraded locos up to 10 years old, and comprises mainly 18Es, a locomotive upgraded from old 6E1s. The programme started in 2004 with the locomotives retaining their 3kV- only capability. The sub-group up to five years is showing the inflow of the new Classes 19E, 15E and 20E electric locomotives, upgraded Class 39 and new Class 43 diesel locomotives.

The second peak represents locomotives of 20-40 years of age. They are mainly diesel locomotives plus a large proportion of the remaining AC-only and DC-only electric locomotives. The figure displays a serious lack of investment during the 11-25 years age group, with only some 50 locomotives being procured during that period.

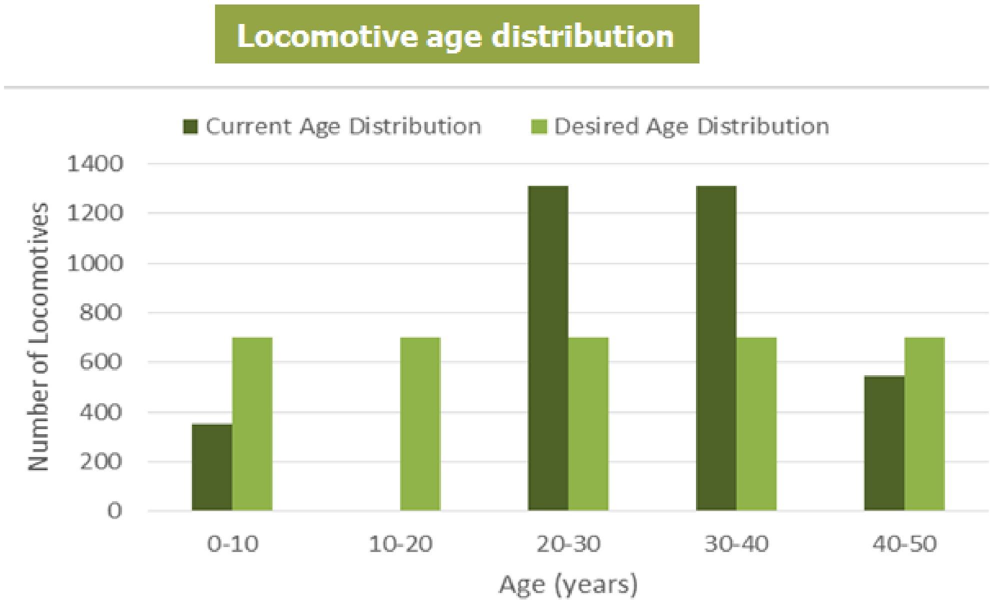


Figure 88: Locomotive Age and Distribution

8.2 LOCOMOTIVES FUTURE CLASSIFICATION STRATEGY

Locomotive type	Locomotive application		Sample
Electric heavy haul – 50 kV	Specifically used on the iron ore line	15E	
Electric heavy haul – 3 kV/25 kV **Dual voltage 26 ton per axle**	Operations on the coal line or GFB corridor where this axle load is permitted	19E	
Electric general purpose – 3 kV/25 kV **Dual voltage 21 ton per axle**	To be used on GFB corridors	20E	
Electric general purpose – 3 kV/25 kV **Dual voltage 26 ton per axle**	To be used on the coal line	21E	
Electric general purpose – 3 kV/25 kV **Dual voltage 21 ton per axle**	To be used on GFB corridors	22E / 23E	
General purpose diesel – kN/ kN **21 ton per axle with AC traction motors**	To be used across all corridors including the coal and ore export line	43D	
General purpose diesel – kN/ kN **21 ton per axle with AC traction motors**	To be used across all corridors including the coal and ore export line	44D /45D	
Trip and shunting loco – dual voltage 25 kV/3 kV, diesel 750 kW, double cab	Light hauler and shunt locomotive on branch lines and in yards: 18 t/axle		Still to be procured

Figure 89: Locomotive Future Classification Strategy

The following new locomotives are currently in the procurement process:

15E Electric locomotive (50kV AC)

New high-powered, high-technology locomotives procured for replacing the 9E and diesel locomotives on the ore line. Continuous tractive effort of the 15E is rated at 454 kN compared with the 388 kN of the existing 9E. The first prototype locomotives were delivered by mid-2010, with final delivery of the complete fleet of 76 locomotives by 2013.

19E/21E Dual Voltage Electric Locomotive (3kV DC and 25kV AC)

These new high-technology dual-voltage locomotives were procured to displace the 7E AC-only and 10E DC-only locomotives on the coal line and its electrified feeders. The first prototype locomotives were delivered during 2009, with the complete fleet in service by the end of 2013. By virtue of their dual-voltage capability,

19E locomotives support through running from the Mpumalanga coalfields to the Port of Richards Bay.

In conjunction with wire-distributed power, it is now workable to compile 200-wagon trains in the coalfields and run them direct to Richards Bay, bypassing Ermelo Yard and the loss of productivity that the latter incurs. In this way the 200-Jumbo-wagon Shongololo train powered by eight 19E locomotives saves two hours on the loaded trip.

To supplement the 19E fleet, 100 new locomotives for the same design specification have been sourced and are currently in production. These locomotives will be classified as 21Es and improve on the capabilities of the 19E by having on-the-fly AC-DC traction changeover capabilities.

20E Dual Voltage General Freight Locomotives (3kV DC and 25kV AC)

An order was placed during 2012 for 95 of these new general freight locomotives, during the early part of 2015 the entire fleet was commissioned and has been deployed across various parts of the country. Four locomotives have been dedicated to the operation of the Blue Train.

22E/23E Dual Voltage General Freight Locomotives (3kV DC and 25kV AC)

An order for 599 new electric locomotives was placed in March 2014, for delivery within three and a half years, with manufacturers from China and Europe. These will be of the Co-Co configuration and will take duty on the general freight lines eventually replacing both the 7E and 10E fleets.

39D Diesel-Electric Locomotive

These as-new locomotives were upgraded from 34D diesel-electric locomotives by providing new control systems to extend life and increase efficiency. The tractive effort was improved from the former 218kN to 273kN, while retaining their original power rating of 2470kW. The first prototype locomotives were delivered during 2009, with the full fleet of 50 in service in 2011.

43D Diesel-Electric Locomotive

The class 43D locomotive is the latest generation diesel-electric locomotive in the TFR fleet. It has been deployed on the Sishen-Saldanha line as a supplement to the 15E fleet, on various general freight lines as well as portions of the non-electrified coal network. The locomotive has 21t/axle load and is fitted with high-adhesion AC traction motors.

44D/45D Diesel Electric Locomotive

Orders for 465 new diesel-electric locomotives were recently placed. These locomotives are similar to the abovementioned 43D locomotives, but with increased power output (3 300kW).

The foregoing descriptions attest to Freight Rail acquiring locomotives with which to compete vigorously in the heavy-haul market, as well as at the heavy end of the general freight market. As a whole, the acquisition programme indicates a positioning shift to significantly higher power and tractive effort compared to its previous locomotives.

8.3 LOCOMOTIVES FUTURE REQUIRED FLEET

a) Methodology

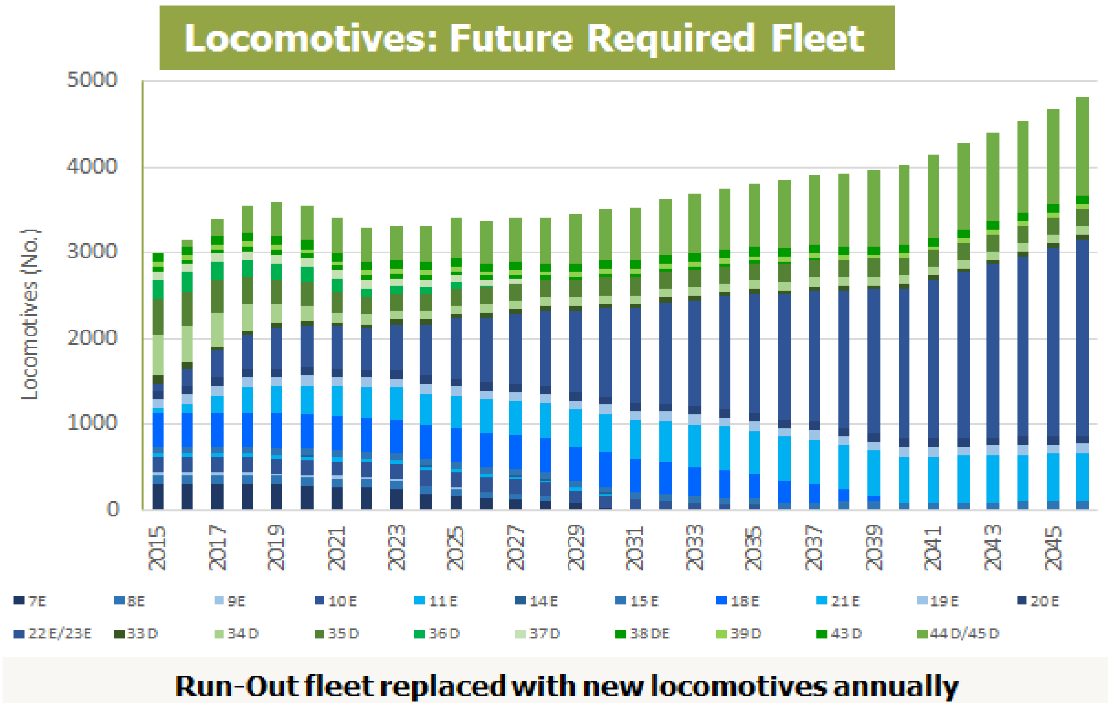


Figure 90: Locomotive Future Required Fleet Methodology

The future requirement for rolling stock is determined from traffic projections. This task is complicated by the multitude of origin destination pairs as well as the variety in the current locomotive and wagon fleets. The 10-year MDS plan is used as a base and is integrated with the 30-year LTPF in order to determine the fleet sizes.

The methodology employed in determining rolling stock demand includes consideration of:

- The infrastructure constraints impacting on locomotive distribution and wagon deployment;
- The position of maintenance facilities;
- The operating philosophy of siding to siding block loads and/or consolidation traffic in a hub and spoke system;
- The traffic volume demand per origin-destination pair;
- The payload and train capability of the wagons;
- The total vehicle turnaround times;
- The crewing requirements and crew change over points;
- The existing rolling stock fleets, run-outs and upgrades and new build's in process; and
- Improved utilisation targets for locomotives and wagons.

The outcome of the rolling stock demand process indicates the total fleets required including the fleet shortages and new rolling stock to be procured.

In addition to the pure commodity demand for rolling stock, the technical fleet plans address the requirement in terms of sustaining the fleet and ensuring technology benefits are achieved. This could imply that new rolling stock needs to be procured without a growth in volume demand.

b) Locomotives Required

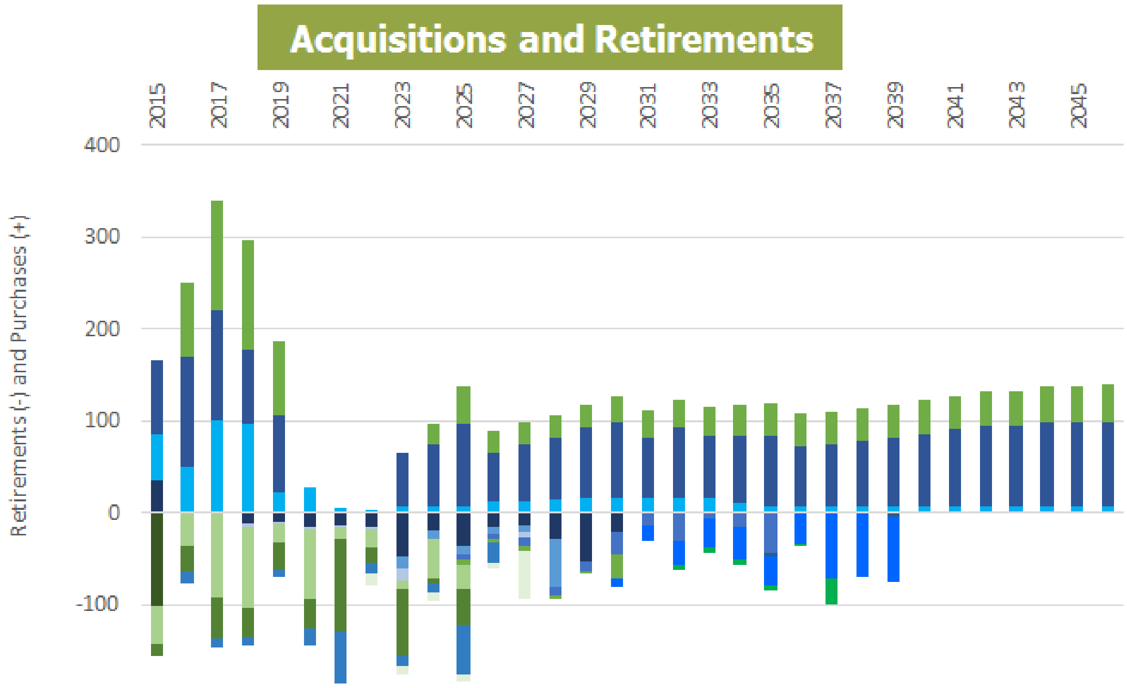


Figure 91: Locomotives Required

The locomotive requirement is shown per locomotive type and category. General freight (including non-heavy- haul bulk minerals) fleet sees a significant growth, as evidenced by the newly ordered 22E and 44D (or equivalent) locomotives, which is related to the expected demand growth of these commodities into the 30-year forecasting horizon.

c) Locomotives Investment

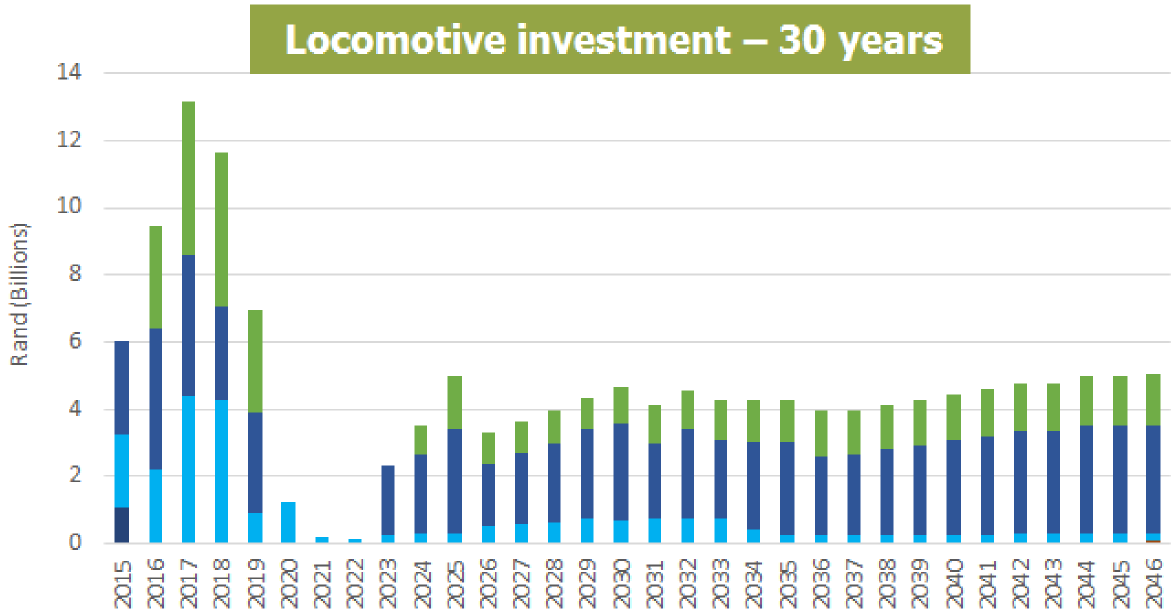


Figure 92: Locomotive Investment

The required locomotive fleet size per year as calculated from traffic demand projections. The future required fleet is calculated from traffic demand for the full 30-year period. As the locomotive fleet plan is currently being refined, it is expected that better alignment of these figures will flow from this exercise. What is important to note from the long term values, is that provision is to be made for a continuous investment in sustaining the fleet and providing for annual volume growth.

8.4 WAGONS CURRENT FLEET

a) Wagon Fleet Size

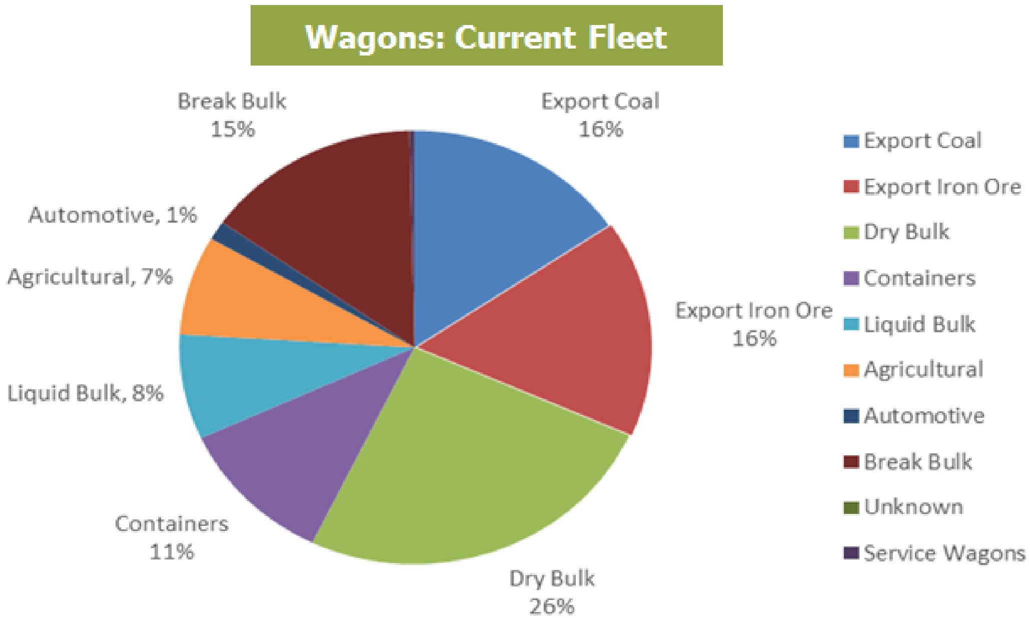


Figure 93: Wagon Fleet Size

Wagon fleet size status quo shows that although coal and iron ore are moved in substantial tonnages, the majority of the fleet is used for transporting general freight.

C- type (34%) (including CCL/CCR) and CR-type (17%) make up over 40% of the current fleet. These wagons are typically used for coal and ore respectively, but are also used for a wide variety of general freight commodities such as coke, magnetite and rock phosphate.

D- type wagons make up 3% of the fleet and carry break-bulk goods. They are preferred to other break-bulk types due to their drop-side door system allowing for easier loading/unloading.

FG-type wagons are used for grain and make up 3% of the current fleet and SH-type wagons are flat-beds used for carrying containers, making up 11% of the fleet. The remainder (32%) of wagons are a mixture of timber, fuel, and other break-bulk carrying wagons.

The heavy-haul lines have mainly one or two types of wagons while the general freight business has approximately 66-wagon groupings with even more detail types within each group. This is largely due to the variety of commodities that are transported in the general freight business.

b) Wagon Availability and Reliability

Figure 94: Wagon Availability and Reliability

Regarding utilisation, the most severe infrastructure limitation for wagons is allowable axle loading, especially for dry-bulk commodities such as coal, iron ore, and manganese. Although it is possible to reduce wagon payload to accommodate sections with lighter axle load, the practice leads to sub-optimal use of rolling stock, and of line capacity on sections that are constrained. Typically, the network accommodates these requirements with the coal and ore lines as heavy-haul lines at a higher axle loading of respectively 26- and 30t/axle in order to achieve high train capacity for high throughput demand. The core of the general freight network is currently at 20t/axle with some of the branch and feeder lines as low as 16t/axle.

Other important infrastructure factors to consider for wagons include:

- Vehicle gauge: This is the maximum allowable profile for wagons and their lading not to interfere with fixed structures such as platforms, tunnels, bridges as well as other trackside and overhead equipment. This is especially important to consider for longer wagons such as motorcar wagons. On electrified portions of the network, overhead traction equipment will limit the vertical height of moving loads and constrain double stacking of containers unless it is raised as has been done in other parts of the world. The narrow track gauge also limits centre-of-gravity height, thereby rendering the double stacking of containers unsafe; and
- Train length: This is typically determined by the number of wagons and the individual wagon lengths and may be influenced by train braking system limitations (such as inherent in vacuum and air brakes) and by train dynamics considerations (such as coupler and drawgear characteristics, optimum load per locomotive, availability of distributed power, etc.). Train lengths influence the provision of passing loops on single-line sections as well as yard configurations and setup facilities.

c) Wagon Age Distribution

The rolling stock fleets are relatively old when compared with international benchmarks. From the graph it is clear that little or no investment occurred for approximately 15 years.

The effect of relatively old rolling stock fleets manifests in lower availability and reliability when compared to younger fleets, mainly because the benefits of newer technology were not introduced in the Transnet fleet during the last 15 to 20 years. For the wagon fleet, the shifts in commodity volumes created a mismatch between the wagon designs in terms of the specific commodity to be transported. Thus there is currently a relative large volume of commodities that are transported in less than ideal wagons.

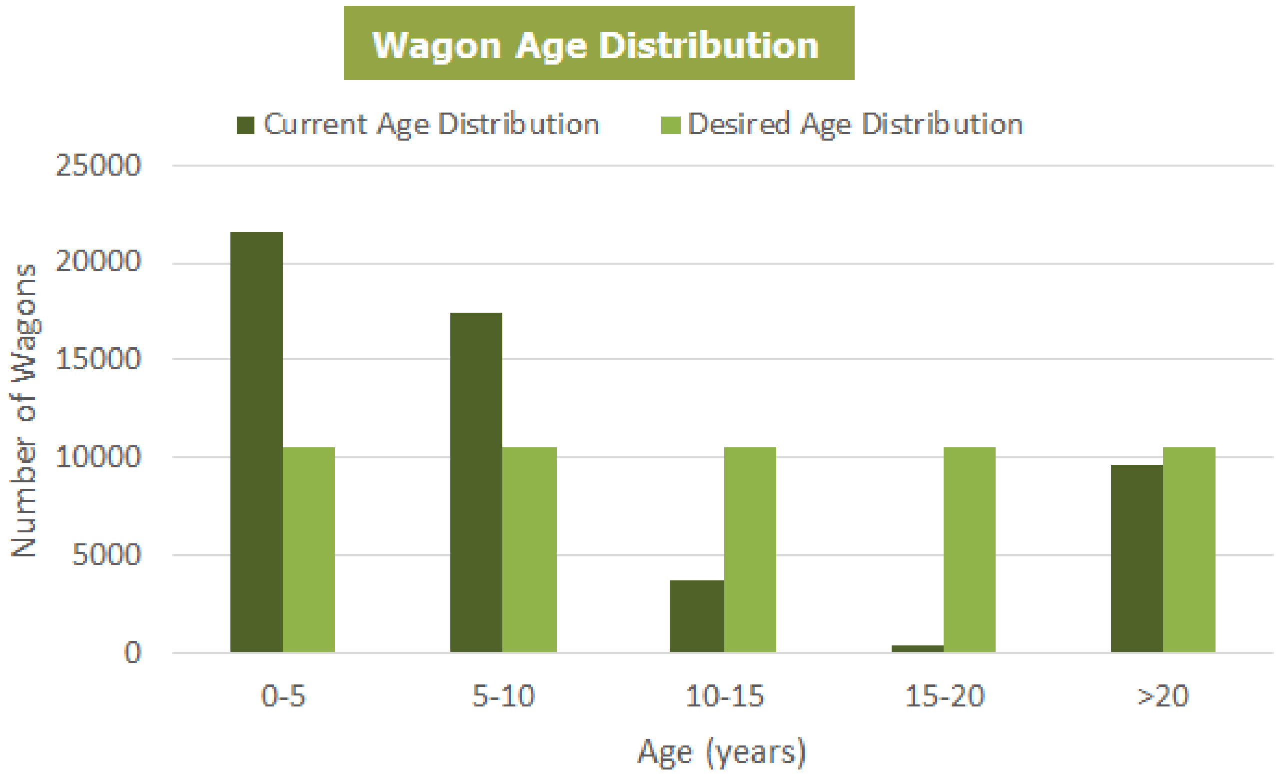


Figure 95: Wagon Age Distribution

8.5 WAGON FUTURE REQUIRED FLEET

a) Wagon Acquisitions and Retirements

During the ongoing refurbishment programme for wagons, container wagons are being upgraded to 60 ton payload and C and D type wagons are upgraded to 60 ton payload with volumetric capacity for coal transport at 60 ton per wagon.

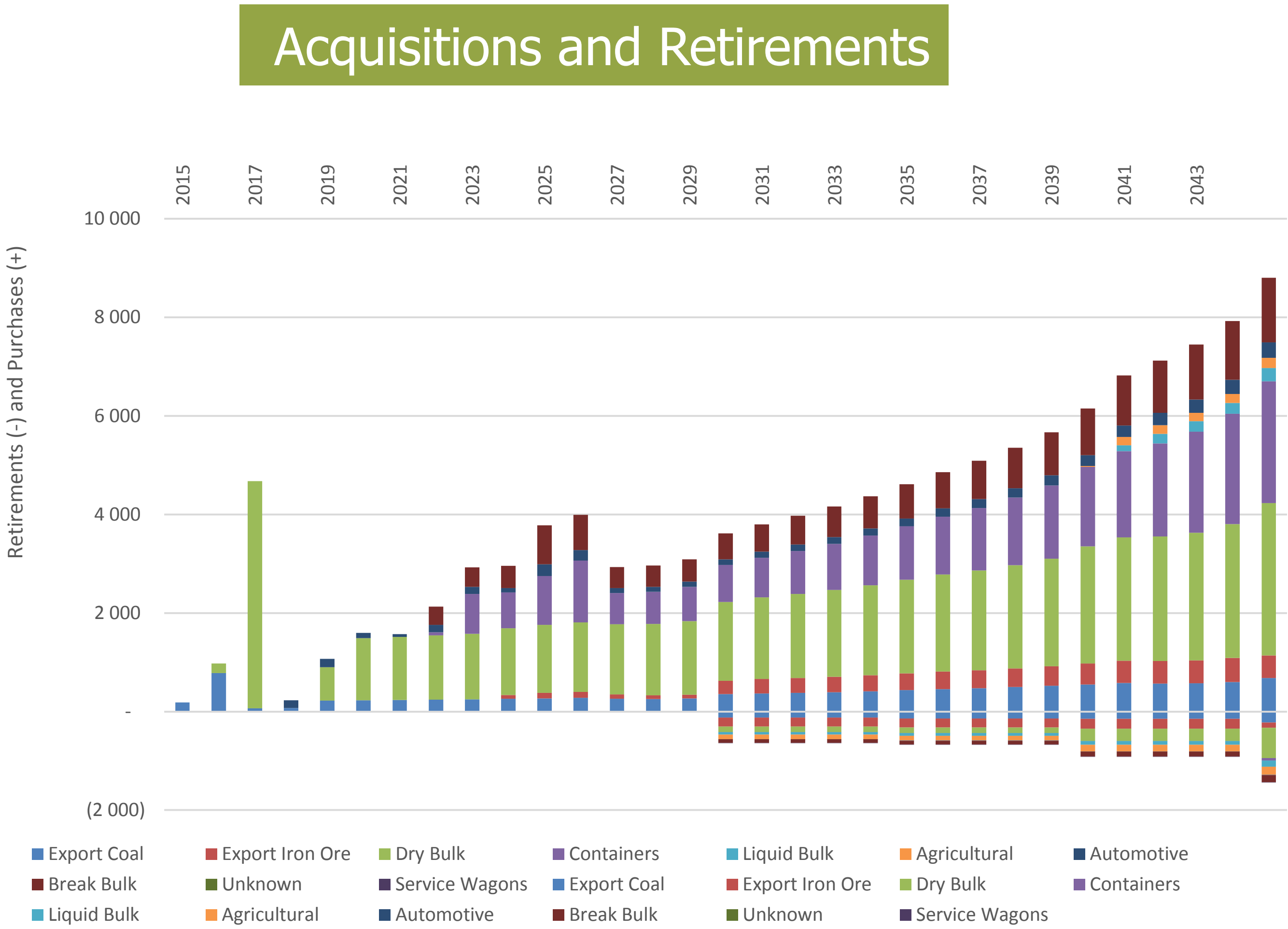


Figure 96: Wagon Future Required Fleet

The figure indicates the total wagon fleet demand for the 30-year forecast as from the Freight Demand Model. The efficiency parameters of Freight Rail were applied for the 10-year period and the improvement in efficiencies cause wagon requirement to increase at a lower rate than traffic demand.

The new container wagons requirements need to be addressed. The conversion of BA wagons to C-type wagons will be alleviated by the influx of Smalls (CCR1/3) wagons from the coal line cascading programme. There is an urgent need for additional CR-type bulk wagons to accommodate the anticipated growth in bulk minerals such as chrome, ferrochrome, magnetite and manganese ore.

b) **Wagon Investment**

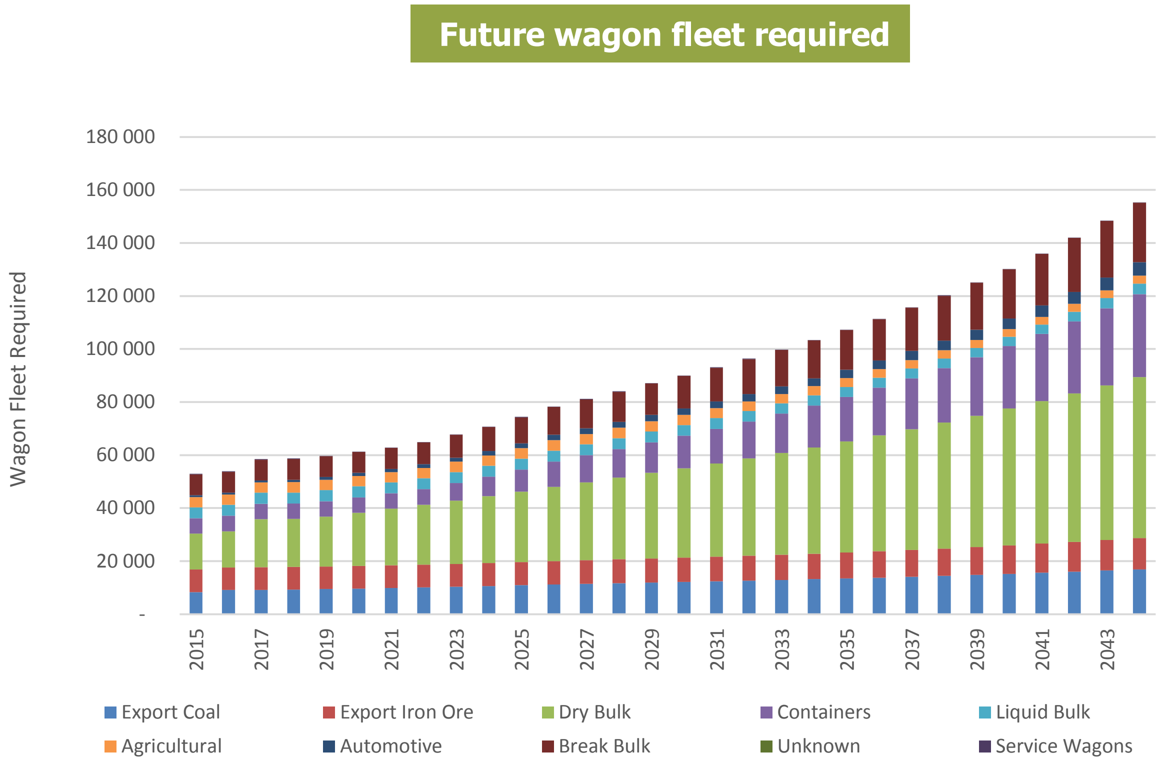


Figure 97: Wagon Future Required Fleet

The wagon investment plan is indicated by the "Wagon Investment" figure to the left. The need for investment in additional Jumbo wagons for the growth in coal traffic is evident, as is the need for new CR wagons for use in transporting dry-bulk commodities.

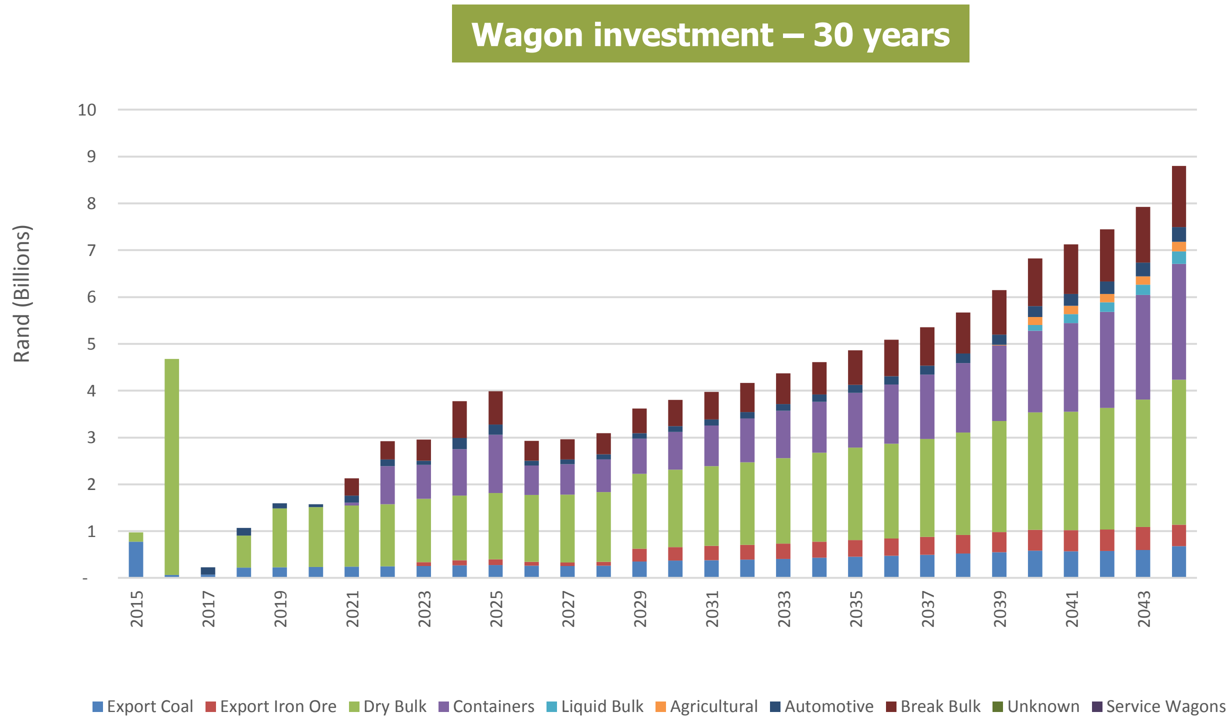


Figure 98: Wagon Future Required Fleet

8.6 ROLLING STOCK TECHNOLOGIES

Technologies currently available, including Distributed Power (DP) and Electronically Controlled Pneumatic (ECP) braking, enable longer and heavier trains on the existing network. The ore export line is already employing most of the latest technologies. The coal export line can still benefit from distributed power and dual-voltage locomotives, which are now being implemented and delivered.

General freight operations can benefit significantly from the latest technological advances to achieve:

- Longer trains – 100-wagon trains or more as standard is possible by employing DP and ECP braking;
- Heavier trains – by increasing maximum axle load to 26 and 30 tons;
- Higher energy-efficiency trains through highly improved traction control technologies, AC traction motors, regenerative braking, improved diesel engine technology, and lower rolling resistance due to higher axle loads;
- Safer trains due to improved train handling technology through ECP braking systems as a first priority; then the addition of DP where train length, mass and the terrain warrant it;
- Environmentally friendlier trains through reduced energy consumption and lower diesel engine emissions.
- Increased line capacity with benefits available from CBA (Communications Based Authorisation);
- Reduced theft, vandalism and service disruptions due to less track side equipment; and
- Improved train trip reliability with improved on-board and wayside train condition monitoring.

9. Branch Lines

9.1 BRANCH LINES CONTEXT AND STATUS QUO

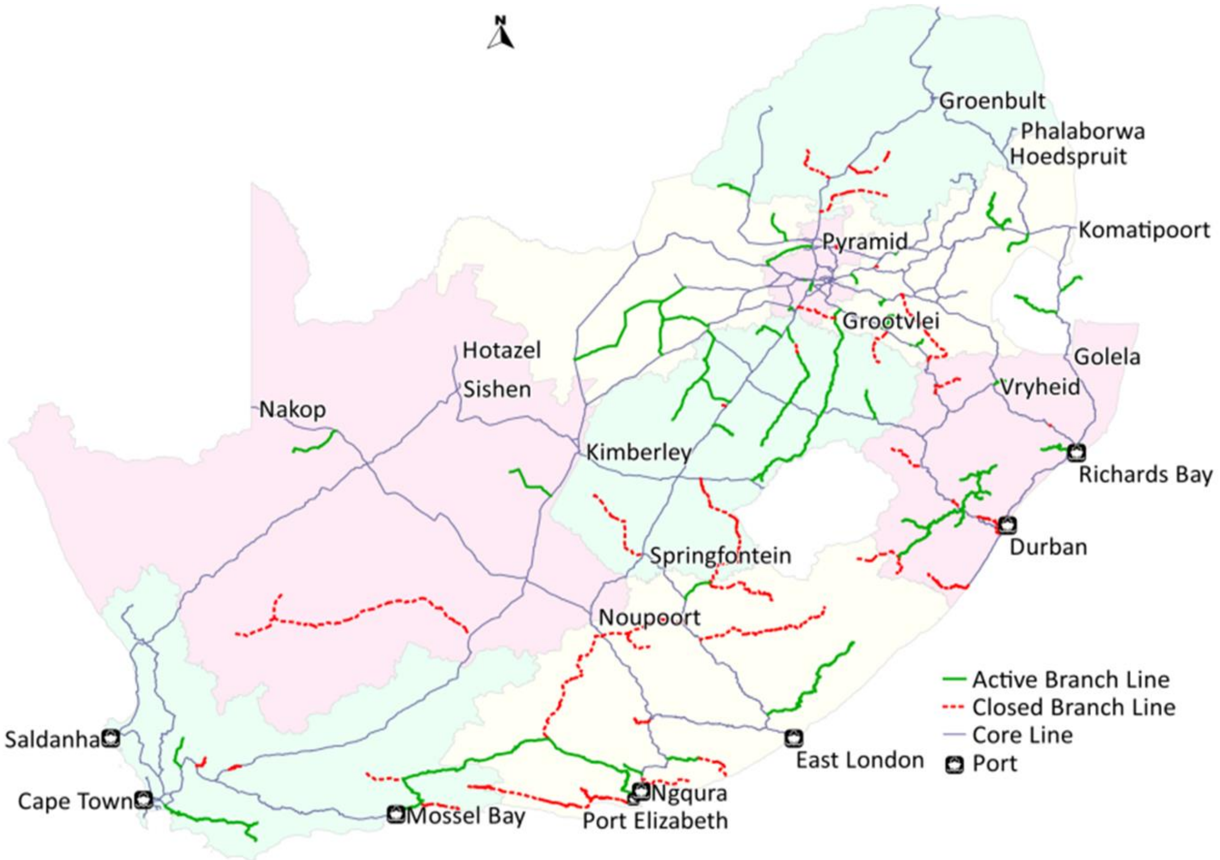


Figure 99: Branch Lines Status Quo

- Many of the current branch lines have been in existence for nearly 100 years and nearly all have not been operating profitably.
- By 1935 most branch lines were already constructed and are now a substantial part of the total network. They are found in all provinces.
- About 7 500km of the South African network are classified as "branch lines" with the potential to service communities and activities not directly on the main corridors. Branch lines are important links to rural areas of the country and when active contribute to main line tonnages. This network is a combination of lifted and stolen lines, closed lines and active lines.

9.2 BRANCH LINE STRATEGY

- Efficiently operating branch lines are crucial for economic development of particularly rural areas of the country, and to reopen and operate them sustainably requires different strategic, funding and operating models to those of main lines.
- Transnet's strategy supports development of economic activity within rural areas and to recapture traffic back from road-to-rail requires renewed focus on revitalising many of these branch lines.
- Transnet and Government have initiated a branch line revitalisation programme to provide opportunities for refurbishment and, where desirable, for external operators on these lines. Transnet Freight Rail will, however, continue to operate through an independent unit called Branch Line Operations and Management Unit (BLOM).

This has resulted in the:

- Commencement of refurbishment of some branch lines and allocation of funds to refurbish others in the next few years;
- Confirmation of market interest to operate branch lines; and
- Commencement of a process to select operators and to conclude the necessary agreements.

Since branch lines serve as feeder routes to the core rail network, strategic clusters have been identified to serve specific commodities:

- Grain is the predominant commodity on most of the central branch lines;
- Other commodities are mainly timber, fuel, fertiliser, cement, coal, gold ore and containers; and
- Many branch lines have the potential to attract additional traffic not handled in the past.

9.3 CURRENT BRANCH LINE OPERATIONS MODEL

The branch lines currently adhere to the same planning and operations principles as the rest of Transnet Freight Rail. This implies the following:

- Trains are designed to run as so-called full trains of either 40 or 50-wagons, depending on whether it will be vacuum or air braked;
- Locomotive resources are often allocated based on maximum train designs and not in accordance with actual traffic requirements on the line;
- Operational deployment is not focused on maximising time utilisation of assets for branch line operations;
- Operations management responsible for the branch lines are focused on main line operations to the detriment of branch lines;
- There is a perception that branch lines have a shortage of assets, especially locomotives;
- Branch line costs and revenue are often not available or transparent; and
- No special cost management processes exist to actively reduce costs on branch lines.

9.4 COST DRIVERS AND ESSENTIALS FOR BRANCH LINE PROFITABILITY

The main cost drivers for the branch line operations include train operating costs as well as the network maintenance costs. Train operating costs include:

- Diesel fuel or electrical energy;
- Locomotive and wagon capital depreciation or leasing;
- Locomotive and wagon maintenance;
- Train crews;
- Shunting teams;
- Terminal operations; and
- Commercial (includes support costs, vehicle rentals, communication etc.).

Network maintenance costs include:

- Material costs (rails, sleepers, ballast, fasteners etc.);
- Maintenance crews;
- Contracted services (weed control, fire breaks etc.); and
- Commercial.

Essential (basic) issues for branch line profitability are:

- Focus on and design services for maximum asset utilisation;
- Know costs and design services that will allow reduction of operational costs; and
- Identify opportunities to reduce fixed costs.

9.5 LTPF BRANCH LINE APPROACH

- Revitalisation of branch lines;
- Align services of feeders into and from the core network;
- Different operations models aimed at:
  - Focus on and design services for maximum asset utilisation;
  - Know costs and design services that will allow reduction of operational costs;
  - Identify opportunities to reduce fixed costs;
  - Initially limited opportunity for heavy investment to upgrade to core network or heavy-haul standards; and
  - Focus will be to rebuild and sustain current design capacity.

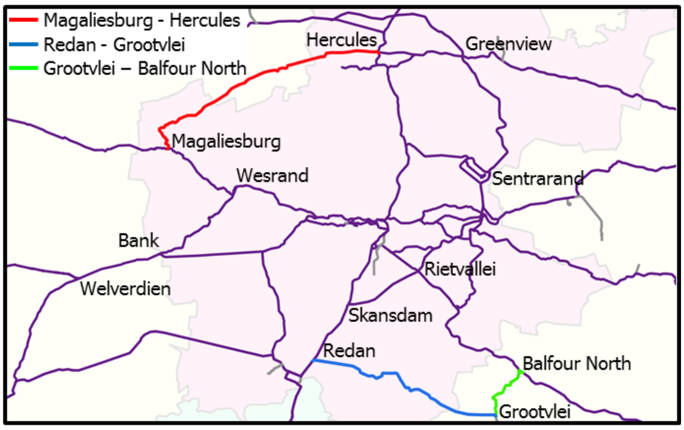
9.6 TRANSNET BRANCH LINE INITIATIVES

9.6.1 REINSTATEMENT OF THE MAGALIESBURG-HERCULES, REDAN-GROOTVLEI AND GROOTVLEI-BALFOUR NORTH LINES

Project description
- Magaliesburg and Hercules

Costs
- R450m – R700m (Copex)

Timelines
- 18 – 24 months from commencement to completion.
- Study and report finalised: Nov / Dec 2013.



Project description
- Redan and Grootvlei (to be sequenced with Grootvlei – Balfour North line and terminal and needs assessment)

Costs
- R250m – R300m to reinstate the line at heavy haul standards with recovered rails from the iron ore line.

Timelines
- Target commencement : 2014 - 2015.
- Target completion : 2016.

Project description
- Re-instatement of 21km rail line between Grootvlei and Balfour North.

Costs
- Budget of R125m – fully funded from capital investment budget.

Timelines
- Commencement : 7 Jan 2013 (rail re-instatement).
- Target completion : March – June 2014.
- First limited train service: April - June 2014.

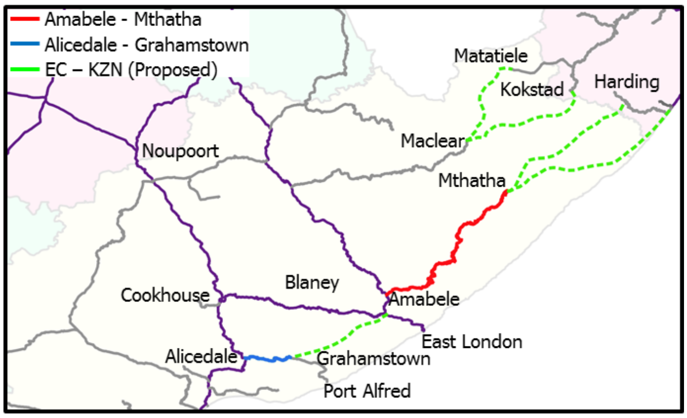
Figure 100: Magaliesburg-Hercules and Grootvlei Power Station

9.6.2 REINSTATEMENT OF THE AMABELE-MTHATHA AND ALICEDALE-GRAHAMSTOWN LINES AND THE PROPOSED KWAZULU-NATAL RAIL LINK

Project description
- Mthatha and Amabele commenced in 2012 after a commitment by Transnet to the Premier of the Eastern Cape to assist in getting the line operationally safe. (The Eastern Cape province cancelled the lease of the line towards the end of 2012 and before its expiry).

Costs
- Estimated total costs are R100m.

Timelines
- The major interventions and investment catch-up was June 2013.



Project description
- Alicedale and Grahamstown

Costs
- R3,5m Copex.

Timelines
- Completed during latter part of 2013 (line). (Grahamstown station investment to be made by PRASA)

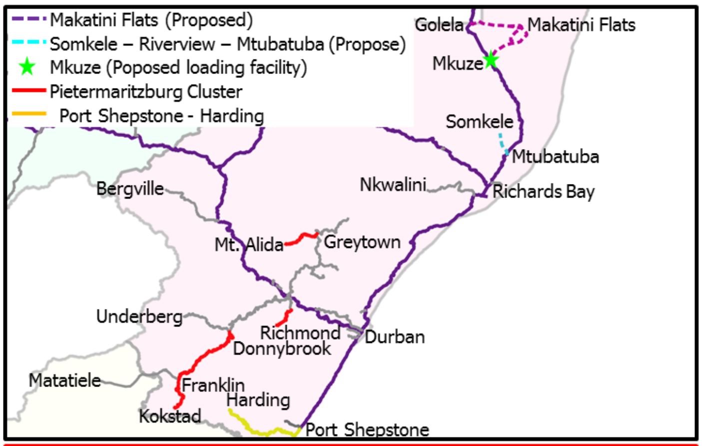
Project description
- The scope of this proposal is to link the existing rail network in the Eastern Cape province to that of KZN.

Project detail & issues
- Various potential routes have to be evaluated.
- Will be a strategic option only at this stage, as volume justification has not been verified.
- Exceptionally high infrastructure costs due to topography.
- Volume expectations may be too low to support investment.
- Will compete with road and coastal shipping.

Figure 101: Eastern Cape (North) Cluster and Proposed KwaZulu-Natal Rail Link

9.6.3 REINSTATEMENT OF THE KWAZULU-NATAL BRANCH LINES

Project description
- The development of a new line to link the Makatini flats with the Golela – Richards Bay line in support of the National Planning Commission and New Growth Path.



Project description
- Possible re-instatement of the line between Somkele and Mtubatuba closed in 1928.
- Re-instatement of the line between Mtubatuba and Riverview (Umfolozi sugar mill).

Project description
- Upgrade and re-instatement of the line from Mt. Alida to Greytown, Donnybrook to Kokstad and potentially Pietermaritzburg to Richmont.

Project description
- Development of loading facilities at Mkhuze (on the Golela – Richards Bay coal line) for 0,8mtpa of sugar cane destined for the Felixston sugar mill.

Project description
- Potential reinstatement of the line and safeguard the right of way.

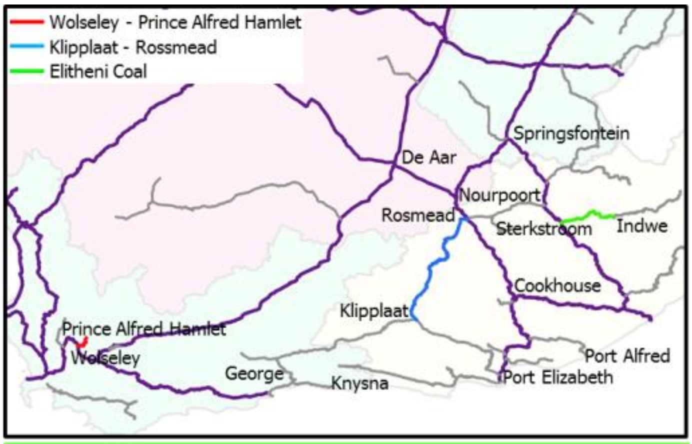
Figure 102: KwaZulu-Natal Branch Line Cluster

9.6.4 REINSTATEMENT OF THE WOLSELEY-PRINCE ALFRED HAMLET, KLIPPLAAT-ROSSMEAD AND STERKSTROOM-MACLEAR LINES

Project description
- Re-instatement of the Wolseley - Prince Alfred Hamlet rail line, which is in a relatively good condition and will require minimum backlog investment, to 16t/axle.

Costs
- Target R15m Copex.
- More or less R5m – R8m for the line and R10m for a container terminal in the station precinct of Ceres – to be funded as a PSP and to leverage third party involvement in the terminal.

Timelines
- Target commencement for line and terminal re-instatement and operations during 2014/15



Project description
- Reinstatement of the rail line between Klipplaat and Rossmead.

Costs
- R52m Copex.

Timelines
- Target completion: 2014/15.

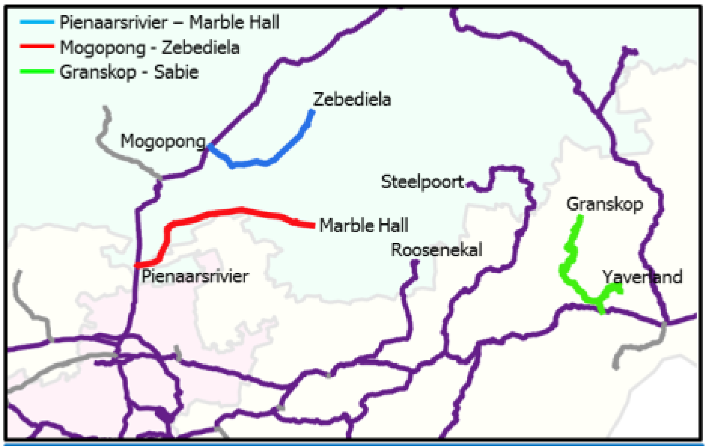
Project description
- Rail logistics solutions to transport 2mtpa of export coal from the Indwe mine to the Port of East London.

Figure 103: Western Cape and Eastern Cape Clusters

9.6.5 REINSTATEMENT OF THE GRASKOP-SABIE, MOGOPONG-ZEBEDIELA AND PIENAARSRIVIER-MARBLE HALL LINES

Project description

- Potential re-instatement of line between Sabie and Graskop and Nelspruit and Plaston for the forestry industry.



Project description

- Potential re-instatement of this branch line for the development of the limestone, agricultural and other citrus industries.

Project description

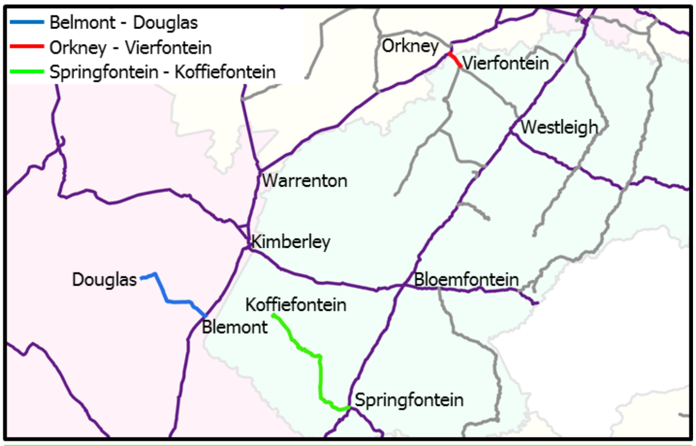
- Potential re-instatement of this branch line for the development of the limestone, cement, agricultural and fluorspar industries.

Figure 104: Limpopo and Mpumalanga Clusters

9.6.6 REINSTATEMENT OF THE BELMONT-DOUGLAS, ORKNEY-VIERFONTEIN AND SPRINGFONTEIN-KOFFIEFONTEIN LINES

Project background & description
- The line was built to 11t/axle. This created severe cost and service implications for clients at Douglas. Grain wagons could only be filled to half of their capacities and topped-up at Modderrivier.
- In 2007/08 the Northern Cape Government funded the upgrade of only the section between Douglas and Salt Lake to 20tons per axle.

Timelines
- Upgrading of the remaining 41km commenced in 2012/13.
- Completion targeted for March - April 2014.



Project description
- Reinstatement of the rail line between Orkney and Vierfontein to 20t/axle and rehabilitation of the Milner Bridge over the Vaal River.

Costs
- R42m Copex.

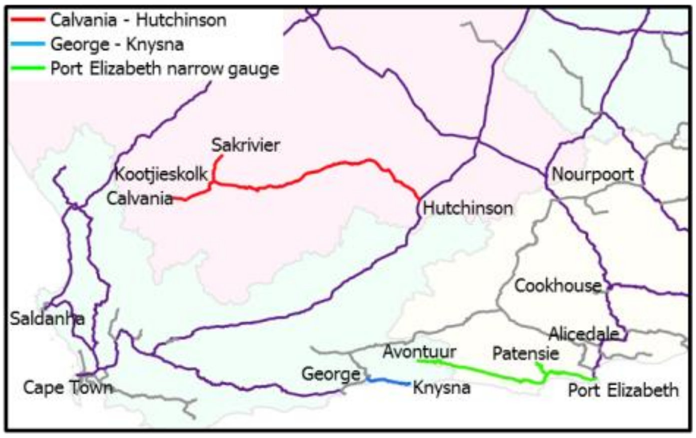
Timelines
- Completed : April 2013.

Project description
- Potential re-instatement and rehabilitation of this branch line in support of agricultural business with the potential extension of this line to either Belmont or Modderrivier (both will require about 60km of new track).

Figure 105: Free State and Northern Cape clusters

9.6.7 REINSTATEMENT OF THE CALVINIA-HUTCHINSON, GEORGE-KNYSNA, AND PORT ELIZABETH-AVONTUUR LINES

Project description
- Potential re-instatement of the line from Calvinia to Hutchison in support of the SKA (Square kilometre array radio telescope).



Project description
- Potential re-instatement and rehabilitation of the line between George and Knysna.

Project description
- Potential re-instatement the Port Elizabeth narrow gauge line.
- Investigate the potential for dual gauge.

Figure 106: Western Cape, Eastern Cape and Northern Cape Clusters

10. INDUSTRIALISATION scenarios

10.1 INTRODUCTION

The industrialisation scenarios considered a range of alternate scenarios for beneficiation of raw materials that is not included in the Freight Demand Model (FDM). These are not included, because it is believed that the necessary capacity in the economy around especially the availability of finance, skills and entrepreneurship does not exist to execute these over the short term. Beneficiation over the long term, especially by around 2025 to 2030, is included in the FDM, to the extent that it is believed that it could be achieved.

But in the light of the importance of the issue and the attention that it receives, the work was necessary. It can, however, only be seen as an extremely optimistic scenario.

Therefore this, section considers the effect of the probable industrialisation scenarios on the network capacity.

10.2 APPROACH

Scenarios for six large industrialisation facilities were considered. These were:

- Another steel mill at Saldanha;
- Another chrome smelter at Rustenburg;
- Another aluminium smelter at Richards Bay;
- Another ferromanganese smelter at Cato Ridge;
- Sasol 4 at Koppies; and
- A definite go for the oil refinery at Coega.

In most of the cases the volumes due to industrialisation were negligible compared to the existing volumes on those sections and they were deemed not to breach the existing capacity tranches as planned. However, the volumes on the Sishen-Saldanha section and the Lephalale-Pyramid section were selected for further analysis as they may have an impact on capacity and interventions.

10.3 AFFECTED SECTIONS

10.3.1 ANOTHER STEEL MILL AT SALDANHA (SISHEN-SALDANHA SECTION)

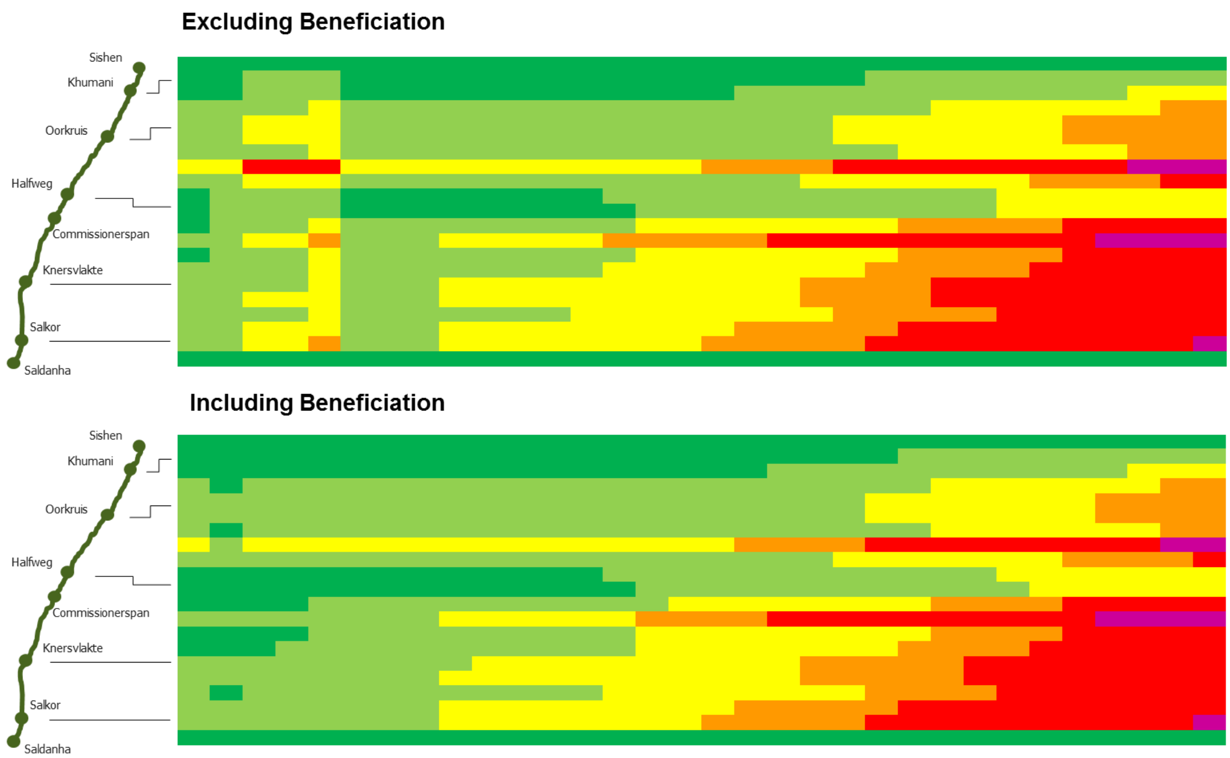


Figure 107: Saldanha (Sishen–Saldanha Section) Beneficiation

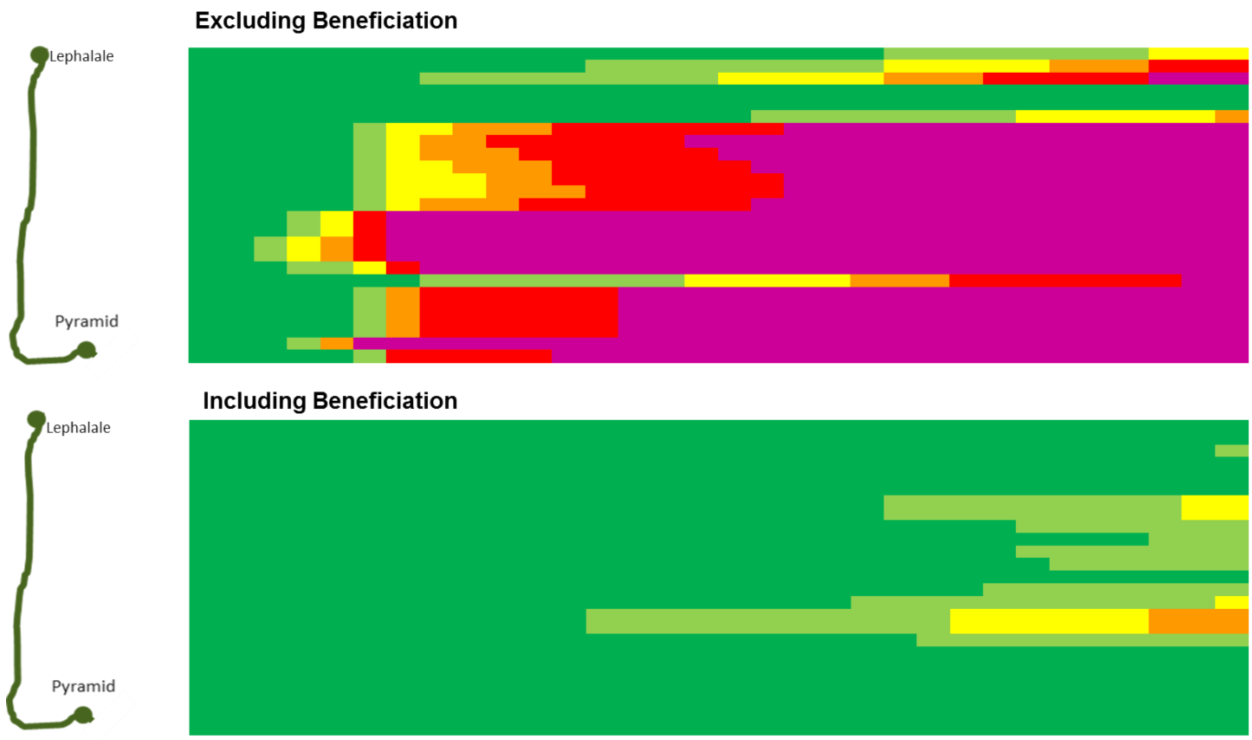


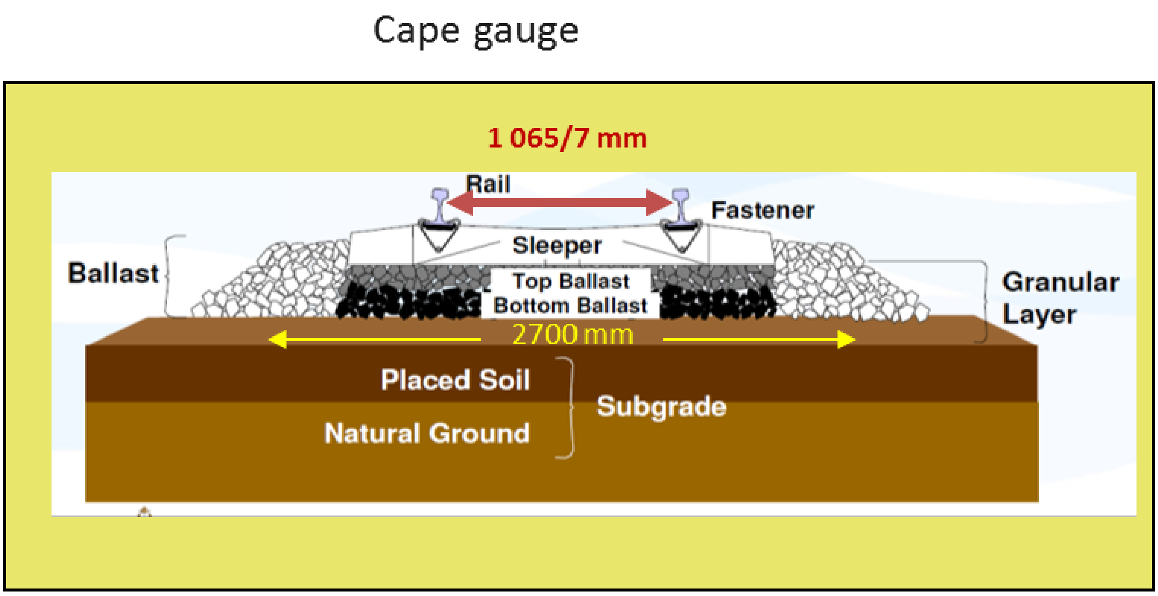
Figure 108: Coal System Beneficiation

The volume changes due to beneficiation on the Lephalale-Pyramid section are significant due to no domestic coal on the section. As seen from the figures above, there will be no requirement for interventions for the beneficiation scenario.

11. Technological Advances/ Emerging Technologies

The effect of the beneficiation alleviates the constraint at loop 12 (Kolke). Depending on the eventual timing of this beneficiation scenario, Transnet can consider the option of executing the intervention at a later stage.

11.1 RAIL GAUGE CONTEXT: WHAT IS IT AND WHY IS IT IMPORTANT?



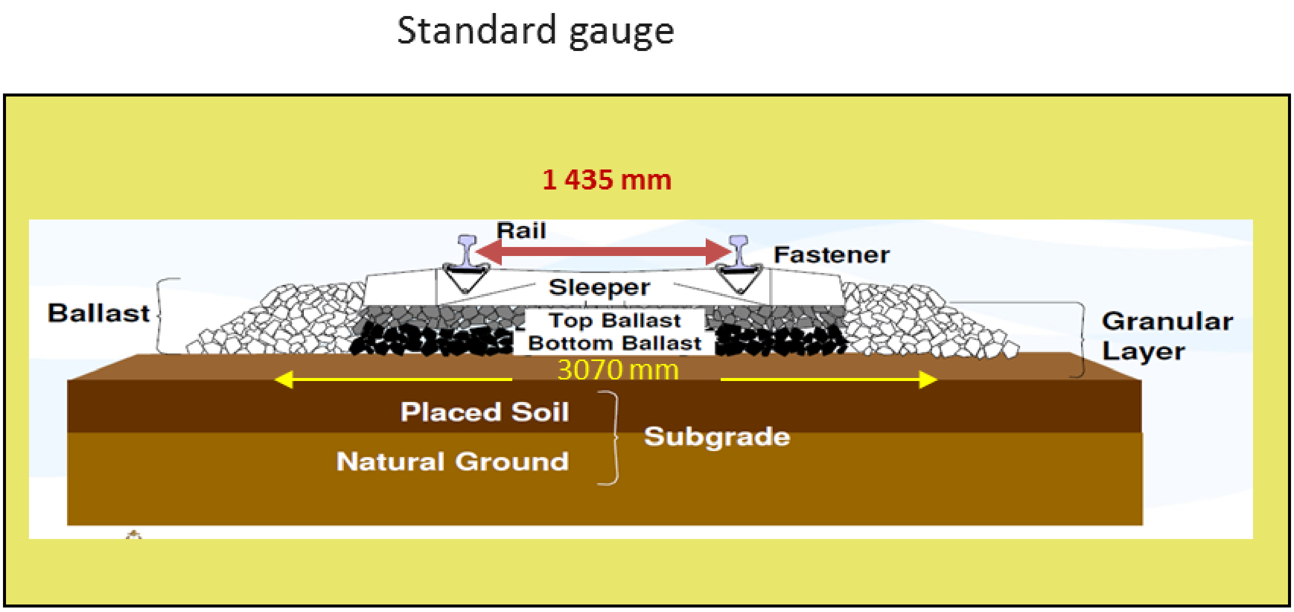
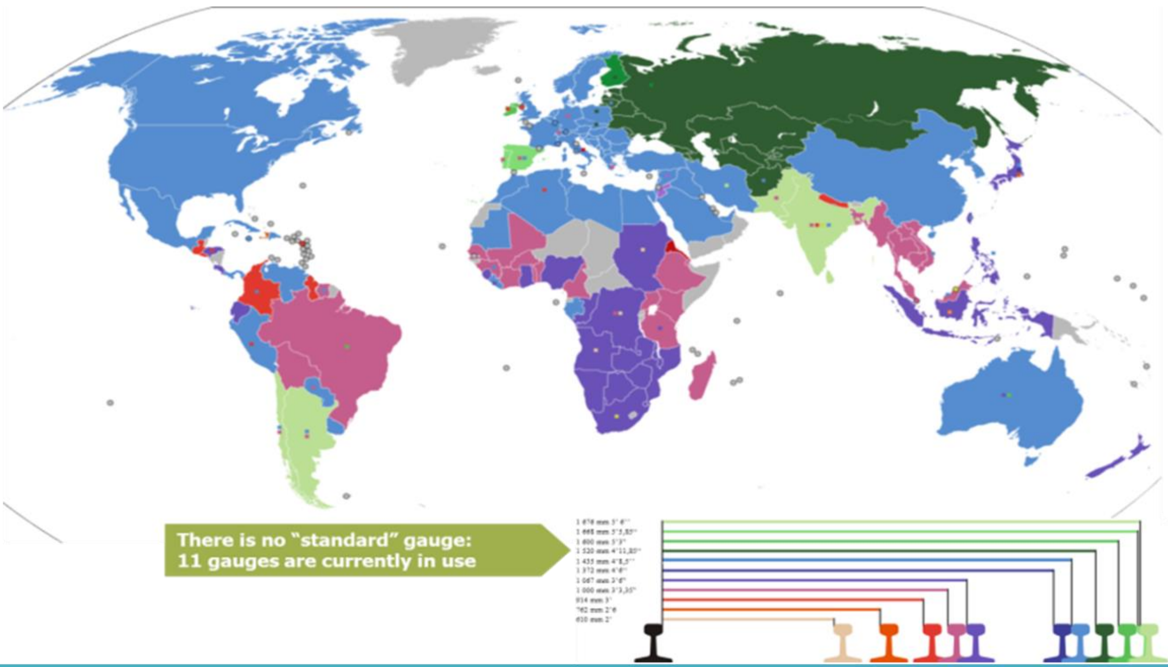


Figure 109: Rail Gauge Context

- Rail gauge is the distance between the inner sides of the two parallel rails;
- It affects train axle load, maximum speeds and stability;
- Wider gauges are more expensive to construct but are more suited to heavier axle loads and faster train services as:
  - Forces are spread over a larger surface area;
  - Train stability is enhanced due to the greater distance between wheels; and
  - Larger rolling stock with higher carrying capacity can be deployed and
- Two of the more commonly found gauges are:
  - Cape gauge: 1 065/7mm; and
  - Standard gauge: 1 435mm.

11.2 GLOBAL RAIL GAUGES



- Although the term "standard gauge" has become a popular term to refer to the gauge used in parts of Europe and the USA, it is by no means the common gauge of choice in the world. There are many different gauges, ranging from about 610 mm to 1 676 mm, each with its own characteristics and origins.

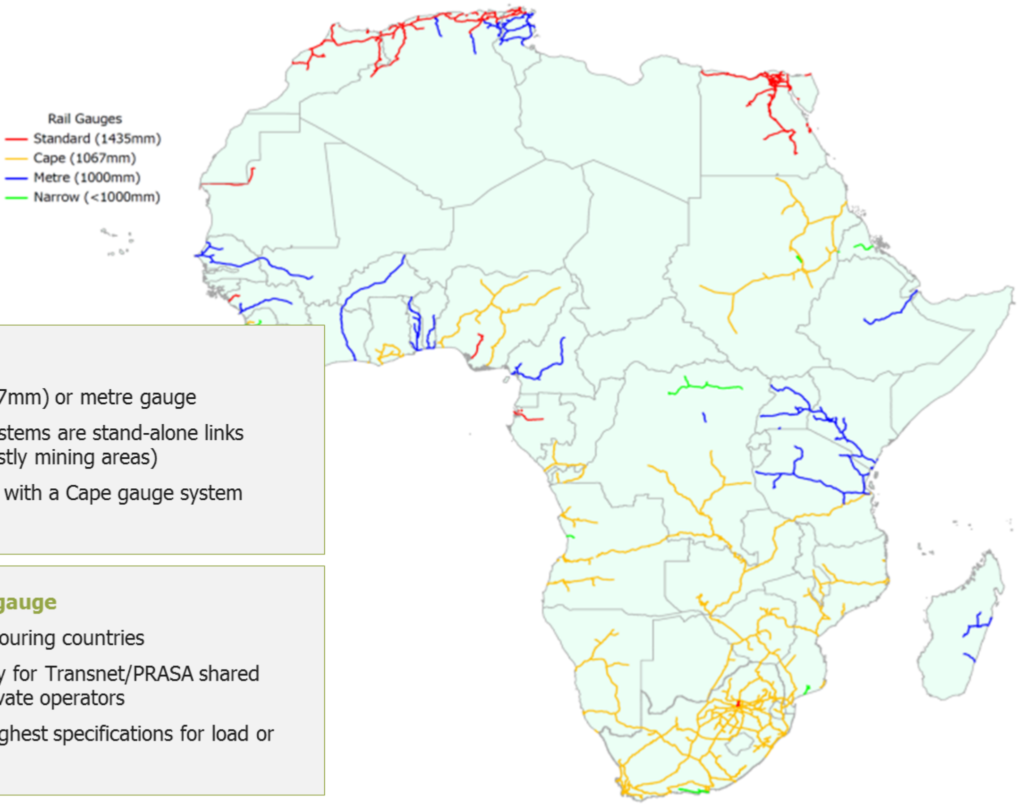
Figure 110: Global Rail Gauges

Rail gauge is defined as the distance between the inner sides of the two parallel rails. This distance then determines the wheel spacing on the rolling stock that can be safely operated on the line and has a major impact on vehicle dynamics, permissible axle load and vehicle size. In South Africa there are basically three gauges, namely:

- Standard gauge at 1 435mm – only the Gautrain passenger network;
- Cape gauge at 1 067mm – the core network plus the majority of the branch line network; and
- Narrow gauge at 610mm – some isolated lines on the branch line network.

Although the term "standard gauge" has become a popular term to refer to the gauge used in parts of Europe and the USA, it is by no means the common gauge of choice in the world. As can be seen from the map, there are many different gauges, ranging from 610mm to 1 676mm, each with its own characteristics and origins.

11.3 RAIL CONNECTIVITY AND GAUGES IN AFRICA



Rail gauge and connectivity

- Predominantly Cape gauge (1 067mm) or metre gauge
- North and Western African rail systems are stand-alone links from coastal towns to inland (mostly mining areas)
- Southern Africa is well connected with a Cape gauge system

Key factors for selection of rail gauge

- Network connectivity with neighbouring countries
- Network interoperability especially for Transnet/PRASA shared infrastructure and branch line private operators
- Stand-alone lines – choose the highest specifications for load or speed

Figure 111: Rail Connectivity and Gauges in Africa Map

11.4 SIGNALLING INITIATIVES

The international trend for signalling has been to migrate part or all of the system onto the locomotive. In Europe, which is largely passenger-based railway, ERTMS level 2 has been largely adopted as the standard for the core passenger network. In the USA, PTC is being utilised as an overlay to the existing signalling system to obtain this additional safety. The additional safety is inherent to both systems. Improved safety combined with a system that could potentially provide minimum infrastructure, which decreases the opportunity for theft and vandalism, as well as ensure better headway management, are attractive features which makes a locomotive based signalling system as a technology that will become the future standard.

One of the significant challenges that exist within the railway environment with regard to the deployment of signalling on low density lines is the prohibitive cost of a traditional lineside signalling system. This usually results in the deployment of technologies such as the Track Warrant system which are more cost-effective and result in sections which are commonly referred to as dark territories. The use of these systems on their own results in additional challenges which include the inability to provide real-time tracking of movements of trains as well as resulting in additional authorisation methodologies which have to be maintained within Freight Rail. As a result of these challenges, the traditional authorisation methodology has been adapted to allow for more cost-effective solutions to be implemented for low density lines. This new technology combined with the existing OBC technology is perceived to improve safety and efficiency in the dark territories. The new technology has been developed and the first deployment of the technology is planned for 2014/2015, which will test the effectiveness of the new solution.

11.5 HISTORIC DEVELOPMENT

South Africa's railway system started with two pioneer railways in Cape Town and Durban, connected to the ports. Between 1872 and 1877, these lines became Government property. The discovery of diamonds and later gold and coal in Kimberley and the Transvaal Republic respectively, triggered the building of the lines between Cape Town and Johannesburg via Kimberley as well as Durban and Johannesburg.

The South African rail system is gauge-wise well connected to the southern African region and any gauge change will certainly disconnect the network from its neighbours. On the other hand, selective consideration of wider gauge for high axle load (in the case of freight) or high speed (in the case of passengers) applications should be considered where new lines and services are to be introduced, since the benefits could be significant.

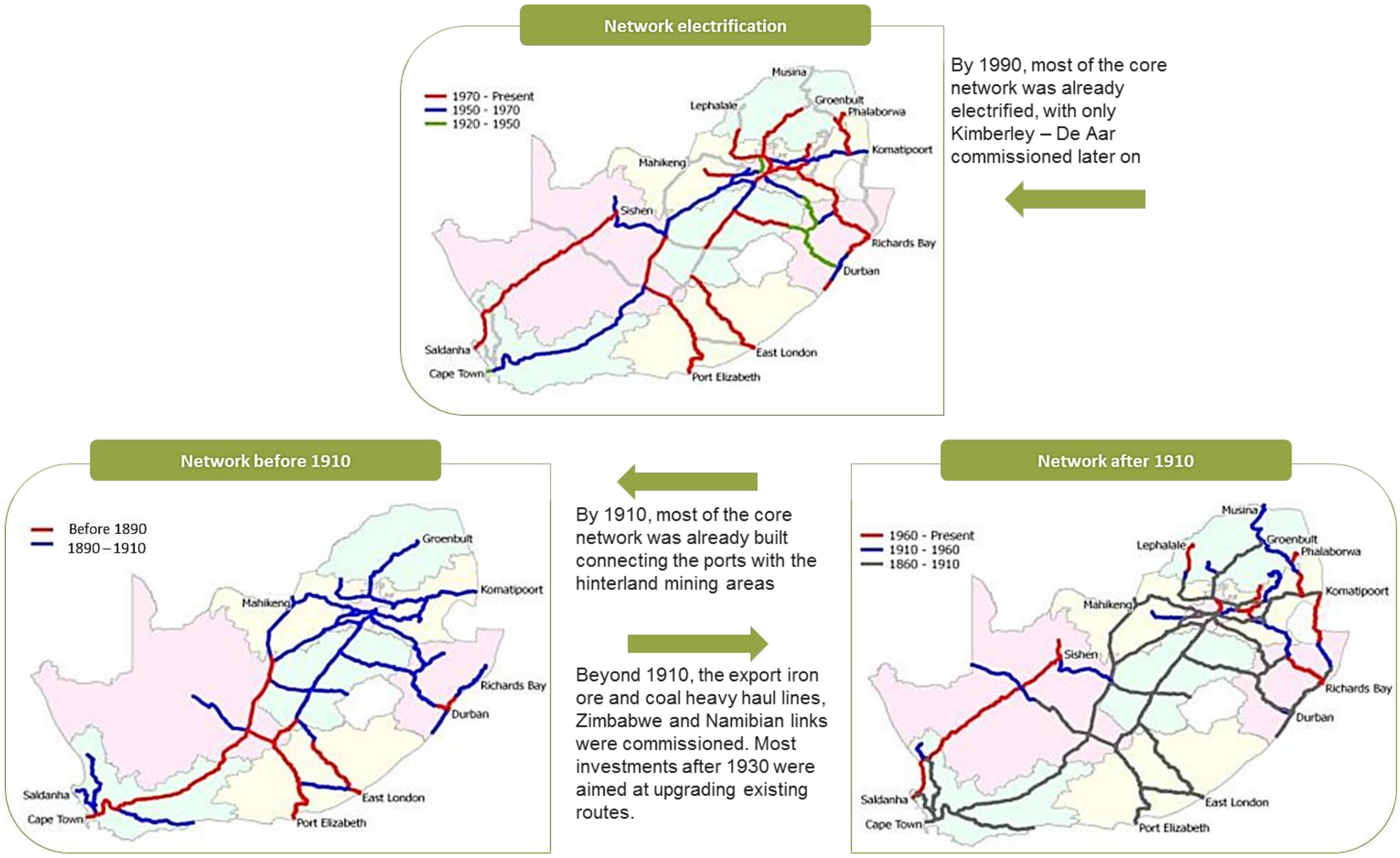


Figure 112: Railway Network Development Before and After 1910

At that stage, the narrower rail gauge of 1 067mm (now referred to as "Cape Gauge") was chosen for its advantages in construction costs and also its suitability to the mountainous topography in the areas of South Africa in which it was to be installed.

The selection of gauge needs to be considered against the backdrop of:

- Regional and over border connectivity – an important consideration for regional interoperability and economic development;
- Application – certain applications such as high-speed passenger services benefit from wider gauges;
- Ease of procurement – it is sometimes easier and cheaper to procure systems and rolling stock from providers with an established gauge specification – Gautrain is a good example; and
- Installed legacy systems – to change the gauge for a whole network may be impractical and not economically viable.

From a freight perspective alone, the opportunities for developments on a different gauge are considered to be limited. However, consideration should be given to future high-speed intercity passenger services, where a broader gauge may be viable and also be used for freight services. Such plans are under development and may very well reveal the need for major conversions or upgrades.

As the map shows, the majority of what is now termed the "Core Network" was developed by 1910, with links between Gauteng and Cape Town, Durban, Port Elizabeth, East London and Maputo having been established.

In 1910, the Union of South Africa was established and with it a decision to use railways to unify the country's widespread towns and cities.

The South African Railways and Harbours (SAR&H) administration was also established. By the 1930s, a network of rail lines covered most of South Africa, and the big cities were serviced by metropolitan commuter rail.

The SAR&H was restructured in the 1970s and network expansion now turned to capacity enhancement with many projects aimed at realigning and upgrading lines to modern standards. During this time, considerable portions of the lines were electrified to the much more advanced 25kV AC standard, and new train control standards were also introduced.

11.6 INSTALLED TECHNOLOGY

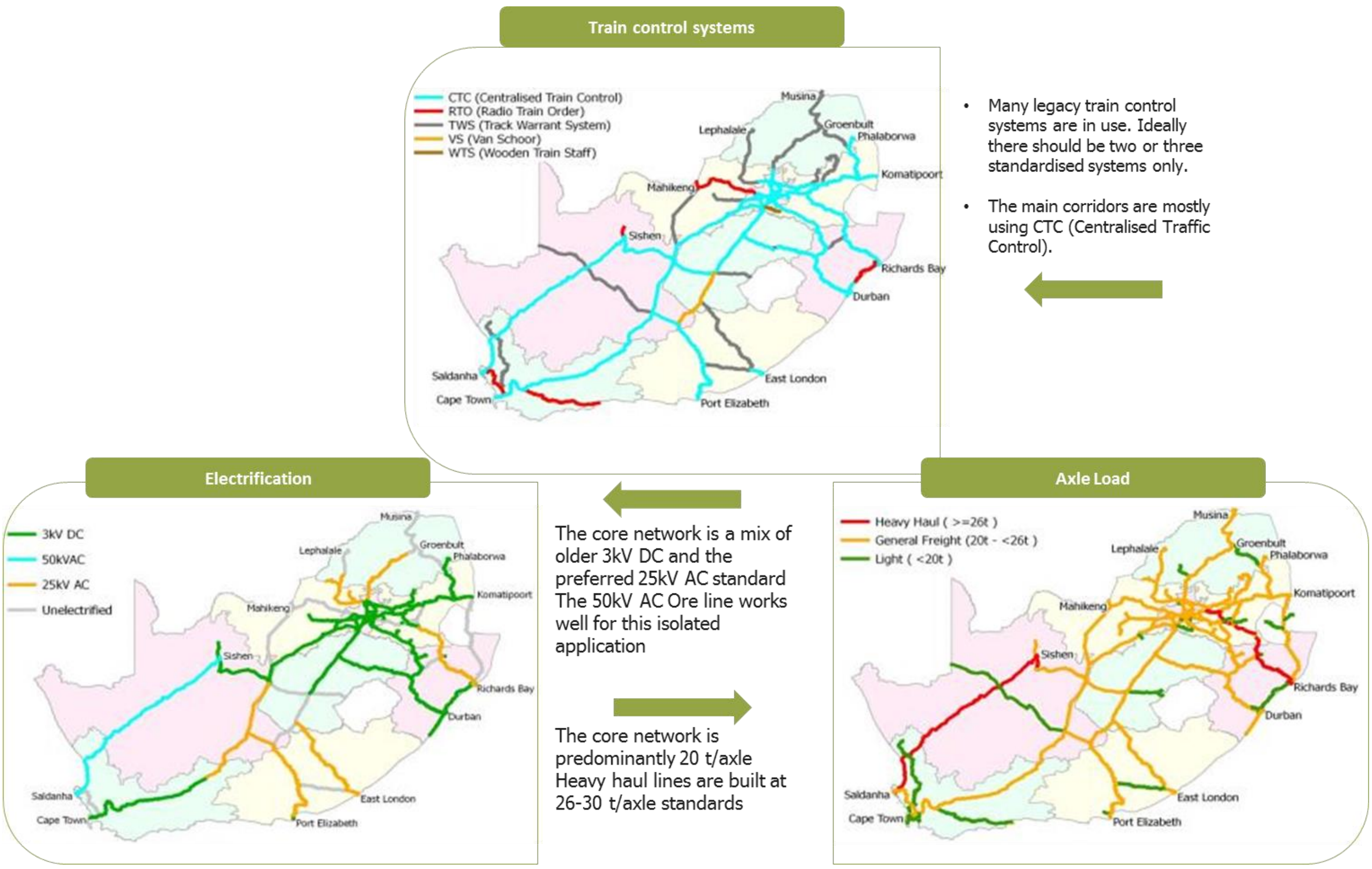


Figure 113: Electrification, Systems and Axle Load Installed Technology Map

Traction on the rail network is either diesel (non-electrified), 3kV DC, 25kV AC or 50kV AC. The 3kV DC is the older system with the substations at relatively shorter intervals. The network comprises approximately 20 800 route kilometres of "Cape" gauge lines (1 067mm), of which 4 900km (24%) are electrified at 3kV DC, 2 300km (11%) at 25kV AC, and 861km (4%) at 50kV AC. The latter is the Sishen to Saldanha ore line, which is the only route electrified by this system. In addition there are 15 switchable route kilometres electrified at either 3kV DC or 25kV AC.

Since the early 1980s, investment in infrastructure has been declining steadily and with it, Transnet has seen a huge loss of market share. Since 2000, both Transnet and its Shareholder (Government) realised that a major investment programme would be required to get rail back on track, and in 2006 this negative trend was reversed for the first time.

Electric traction exists in three forms in South Africa: 3kV DC, 25kV AC and 50kV AC. Electrification of the network in South Africa was initialised in 1925, when a portion of the section between Ladysmith and Pietermaritzburg on the Natal Mainline was upgraded to 3kV DC traction. Shortly thereafter in the Cape, the inner city line was electrified from Monument to Sea Point.

Over the following decade, these sections and areas of electrification were extended and the inner Johannesburg network was electrified. The 1950s and 1960s saw major 3kV DC electrification of the core

These are changeover locations, where the voltage can be switched from one system to the other to permit through working by dual voltage locomotives, or a locomotive change without the need to use diesel traction to haul the train through an intermediate non-electrified section.

The carrying capacity of any line section is related to the maximum allowable axle load. Transnet strategy allows for key sections of the network to be upgraded to 26t/axle to cater for increased future rail demand. As a result, a 26t/axle load has been specified as the minimum for all new rail constructions projects.

Bridge loading characteristics are closely aligned to the axle loading characteristics of the line.

The enhancements required to accommodate increased axle loads are generally limited to a decrease in the spacing between sleepers, use of heavier rail sections and an increase in live loading on bridges.

The latter can be offset to only a small degree by a reduction in permissible speed.

This system is especially suitable for light traffic and urban applications, with short distances between stations.

Electrification of the Sishen-Saldanha line, as well as the Richards Bay Corridor, was completed in the late 1970s and the majority of the remaining core network was upgraded into the 1980s. During this stage of development, the more advanced 25kV AC system was introduced. It is currently the international standard for freight railways and can cover much longer distances without significant line losses.

A significant issue with increasing axle loads is the disproportionate increase in track damage, which results in increased maintenance and asset renewal programmes. These costs can outweigh the benefits of the heavier haul loads, in extreme cases.

11.7 STANDARDISATION

Quite a few different types of train control are still used. Track Warrant is mainly used on single-lines and is a radio-based system usually controlled from a central location that is often remote from the section itself.

- Traction types: Many main corridors are a mixture of 3kV DC, 25kV AC and diesel. This detrimentally affects consignment throughput times and locomotive utilisation as substantial time is lost during locomotive changeovers. Consideration has been given to standardising electrification along key routes as this improves journey times and reliability by removing the need to change over locomotives during a journey. Over time standardising electrification adds significant benefits such as standardised parts, spares and maintenance. Switching to AC electrification is also becoming an operational and practical consideration, since the

- DC electrification (the older system) is nearing the end of its lifecycle and traction requirements are exceeding DC's ability. This migration needs to be carefully coordinated with PRASA on the sections shared with
- metro services;
- Gradients and curves: Many corridor design characteristics are not standardised, resulting in underutilisation of locomotives as traction power on trains are provided to cope with the steepest gradients along the route and are not required for most of the time. Non-standardised curves result in different speed profiles between trains that further limit line capacity;
- Train control: Old or obsolete train control systems are to be replaced with Centralised Traffic Control (CTC) or Track Warrant systems as part of a standardisation initiative, especially corridors or sections with growing traffic densities;
- Locomotives: The large number of different locomotive types in use increase maintenance training and spares requirements;
- Wagons: Different wagon types are required deal to with the large number of commodities transported. Dedicated wagons are most suited for bulk flows such as iron ore and coal, but multipurpose wagons are more suitable where flow variations are greater;
- Operating philosophy: Freight Rail traffic is categorised in megaRAIL (large, regular consignments), accessRAIL

This section identifies the key issues and constraints based on the current network installed technology configuration, which must be standardised in the network development plans.

- A high level standardisation status assessment was taken to establish and to understand the extent of the rail standardisation activities required and to determine the approach of the LTPF: (regular wagon loads handled on a hub-and-spoke principle) and flexi RAIL (irregular ad-hoc consignments). These allow tailor made designs for all customer and traffic types; and
- Customer and commodity base: Consolidation will result in lost revenues, but may increase profitability. Many smaller consignments are not rail friendly and transported at a loss. Reduction will significantly reduce operational complexities, but result in further loads on and deterioration of the road network. This will be contrary to our mandate as an enabler to economic development.

LTPF standardisation approach:

- Network and rolling stock standardisation along logical corridors to be pursued as far as is practical and justified;
- Focus on regional standardisation;
- Current gauge to be retained, except for unconnected and standalone heavy-haul or passenger lines where standard gauge will be considered;
- As indicated earlier, separating the network for heavy-haul and light industrial (containers, automotive) and passenger trains is being pursued; and
- Develop consolidated loading sites to obtain economies of scale and increase unit load traffic, (e.g. junior miners).

Standardisation

Status quo assessment heat map		
Topic	**Comments**	**Status**
Gauge	Single gauge on main lines	Green
Axle load	Main corridors 20t/axle.	Orange
Traction types	Corridors not standardised	Red
Gradients & curves	Corridors not standardised	Red
Train control	Corridors not standardised	Red
Locomotives	± 20 main classes	Red
Wagons	> 80 groups	Red
Operating philosophy	Unit loads, wagon loads	Orange
Customer base	> 800 Consolidate.	Orange
Commodity base	Substantial	Orange

- **Gauge:** Virtually the whole Southern African network is on Cape gauge and connectivity is excellent.
- **Axle load:** Axle load on virtually all the main corridors is at 20t/axle or more. Most branch lines at less than 20t/axle but have sufficient capacity if maintained in good condition.
- **Traction types:** Many main corridors are a mixture of 3kV DC, 25kV AC and Diesel. This detrimentally affects consignment throughput times and locomotive utilisation as substantial time is lost during locomotive changeovers.
- **Gradients & curves:** Many corridor design characteristics are not standardised, resulting in underutilisation of locomotives as traction power on trains are provided to cope with the steepest gradients along the route and are not required for most or the time. Non-standardised curves result in different speed profiles between trains that further limit line capacity.
- **Locomotives:** The large number of different locomotive types in use increase maintenance training and spares requirements.
- **Wagons:** Different wagon types are required deal with the large number of commodities transported. Dedicated wagons are most suited for bulk flows such as iron ore and coal, but multi purpose wagons are more suitable where flow variations are more greater.
- **Operating philosophy:** TFR traffic is categorised in megaRail (large, regular consignments), accessRail (regular wagon loads handled on a hub-and-spoke principle) and flexiRail (irregular ad-hoc consignments). These allow tailor made designs for all Customer and traffic types.
- **Customer and commodity base:** Consolidation will result in lost revenues but may increase profitability. Many smaller consignments are not rail friendly and transported at a loss. Consolidation will significantly reduce operational complexities but result in further loads on and deterioration of the road network. This will be contrary to our mandate as an enabler to economic development.

Table 25: Status Quo Assessment Heat Map

11.8 NETWORK CONDITION

Network condition is classified in terms of its remaining life and ability to permit the safe and efficient running of trains.

Poor sections are often older designs with steep gradients, sharp curves and long tunnels, and in most cases, have low remaining infrastructure life with high wear and tear resulting in excessive maintenance. Some may have reduced remaining lives resulting from traffic levels exceeding the original design parameters.

- Axle load: Axle load on virtually all the main corridors is at 20t/axle or more. Most branch lines are at less than 20t/axle, but have sufficient capacity if maintained in good condition.
- A longer-term goal would be to operate more "heavy haul" trains on corridors with heavy traffic densities and large parcel sizes, where construction of new lines with a 26t/axle (and renewals of existing lines to the same value) would make economic sense.

Good sections were usually designed to much higher standards with flatter gradients, longer curves and better train control systems, supported by proactive and well executed maintenance programmes.

Condition assessment colour coding (legend) for all the discipline (train control, perway and electrification) is as follows:

- Green – good: full operational capacity achievable;
- Orange – acceptable: required operational capacity achievable; and
- Red – not acceptable: less than 20% remaining life.

TRAIN CONTROL CONDITION

The main problematic train control sections are mainly in the Richards Bay to Port Shepstone due to an obsolete signalling system.

PERWAY CONDITION

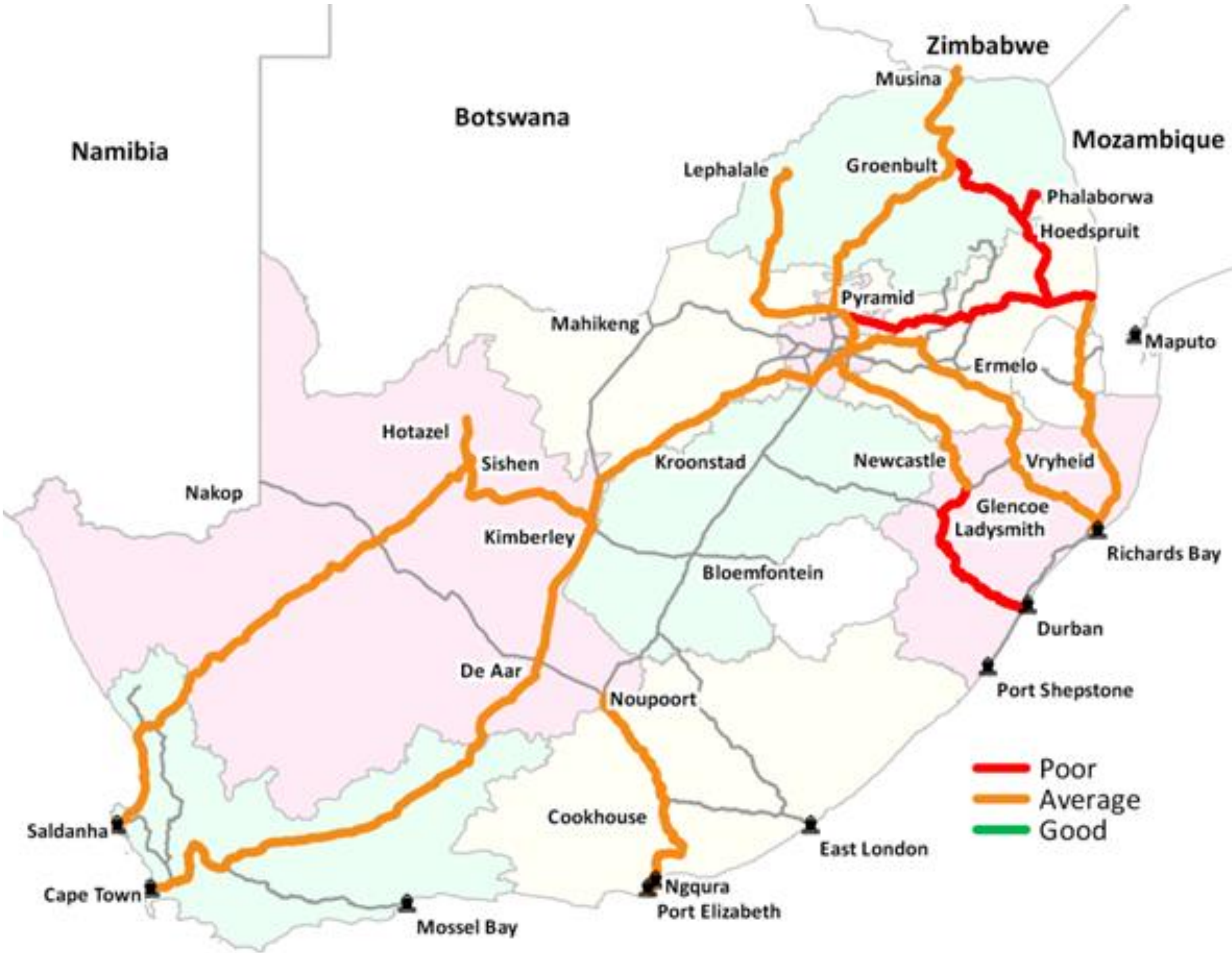


Figure 114: Condition – Perway

OHTE CONDITION

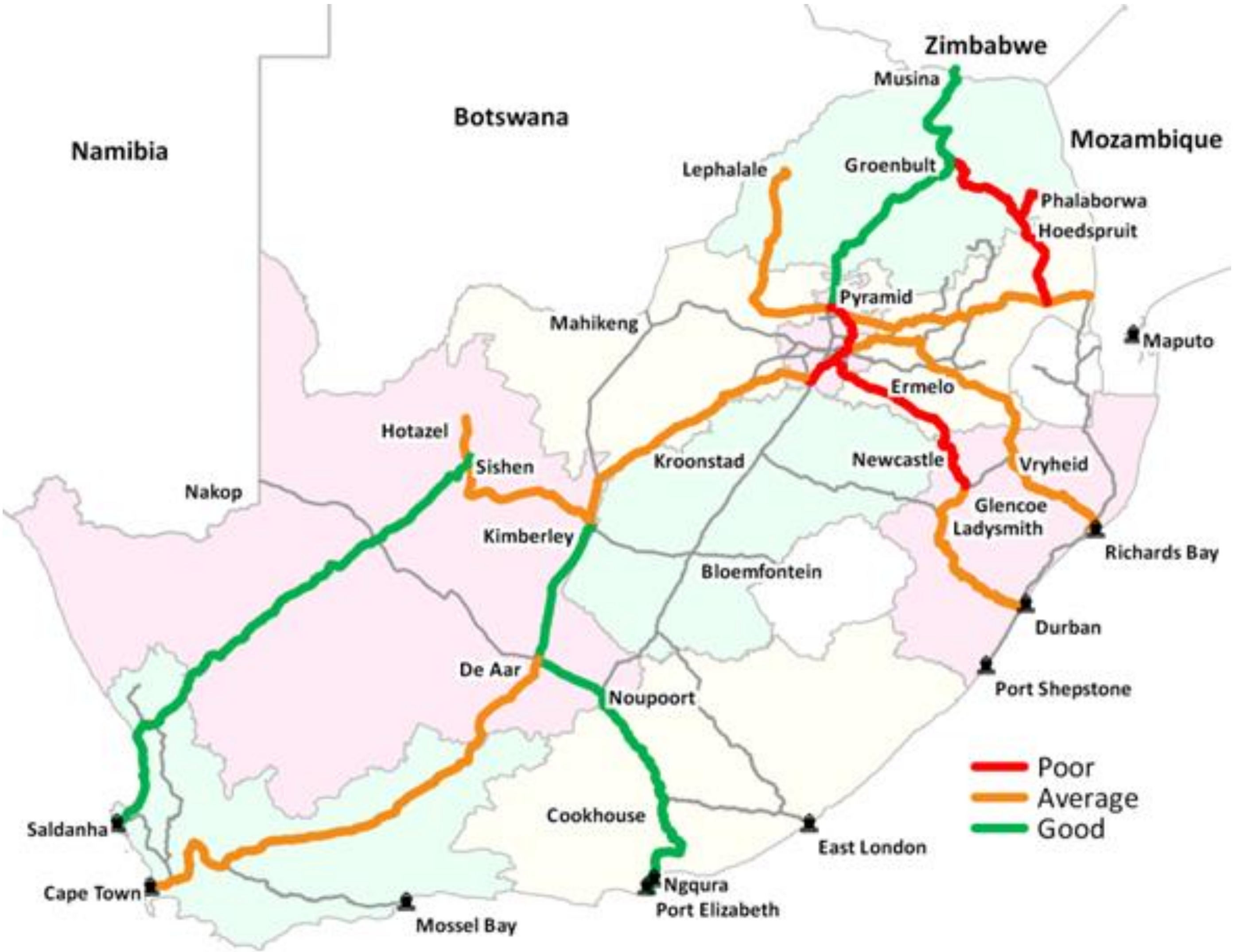


Figure 115: Condition – OHTE (Electrical)

The main problematic perway sections are as follows:

- Groenbult – Hoedspruit: old line standards – difficult terrain (low volumes);
  - Gauteng – Maputo: track geometry difficult terrain;
  - Durban – Gauteng: old line standards difficult terrain (high volumes); and
- Komati – Richards Bay: poor alignment, maintenance and geology.

The main problematic OHTE sections are as follows:

- Richards Bay – Port Shepstone: corroded overhead equipment due to humidity;
- Natcor: insufficient power supply for long heavy trains; and
- Eastcor: insufficient power supply at Greenview.

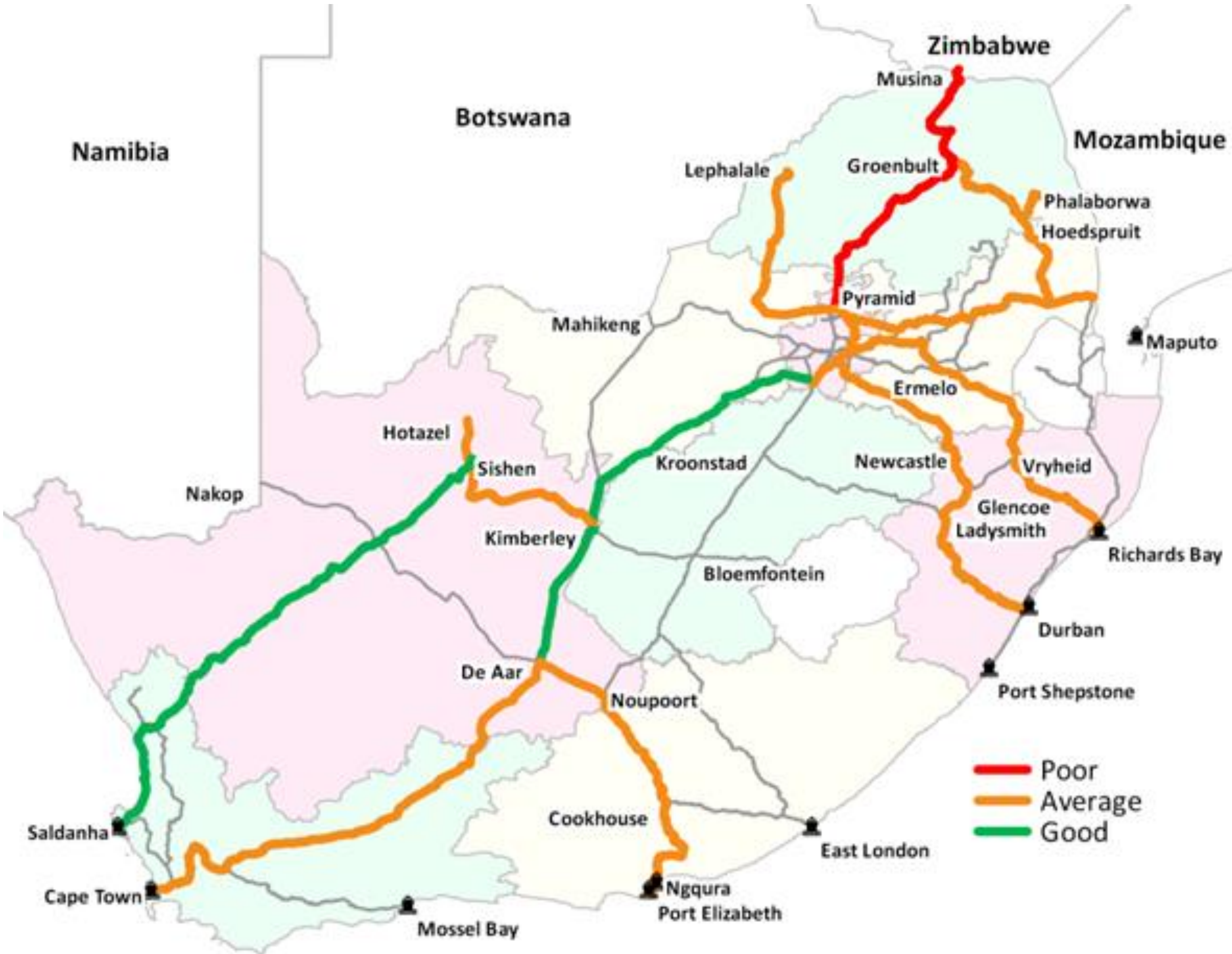


Figure 116: Condition – Train Control

11.9 NETWORK COMPARATIVE PERFORMANCE

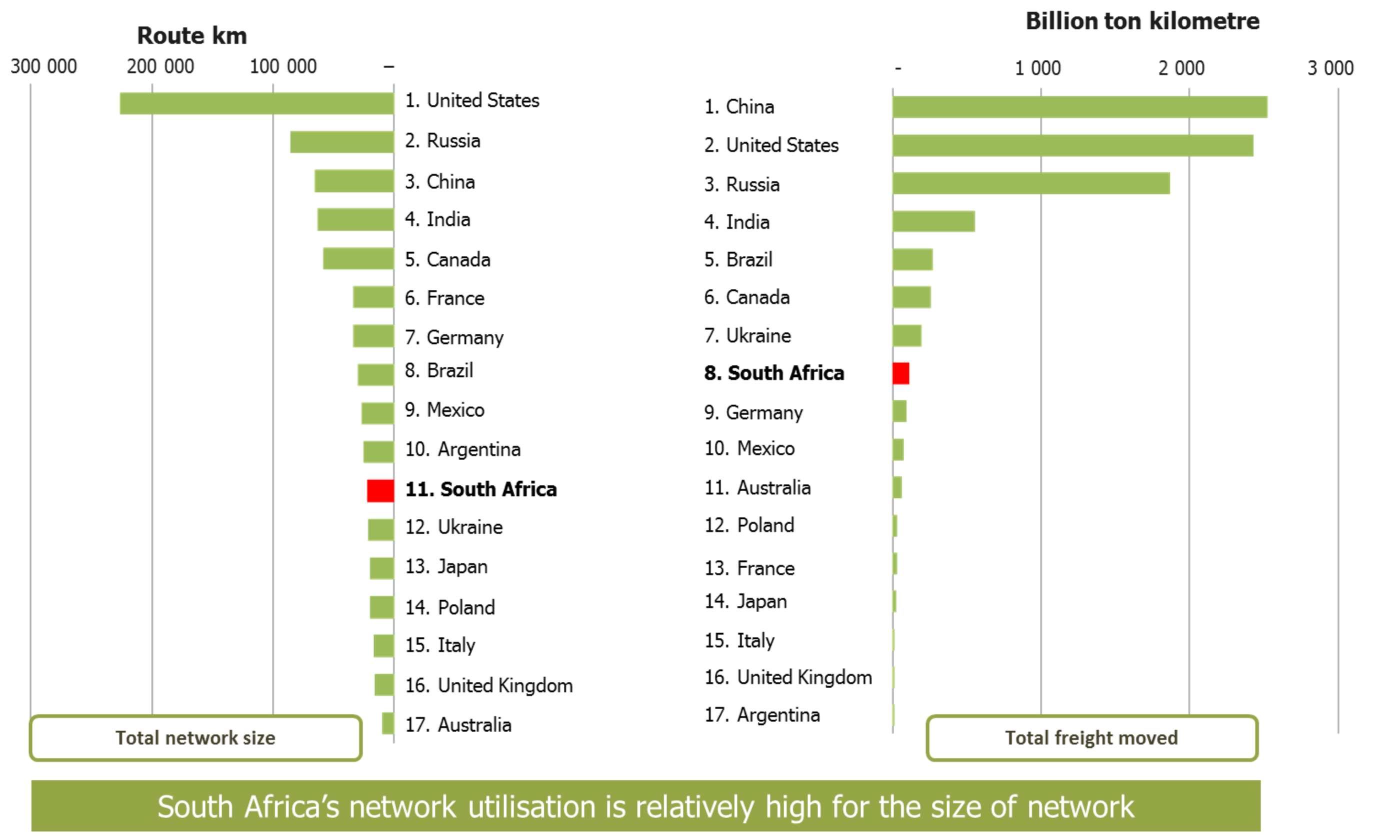


Figure 117: Network Comparative Performance

In the global context, the South African rail system is ranked number 11 in terms of route km. However, the route distance does not directly translate to the measure of freight volumes railed in ton kilometre (t/km). For example, the above illustration shows that China transported the most traffic, even though its rail network is less than a third of that of the United States of America.