Trans Kalahari Rail & Port Project

Development Plan

Botswana Government

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1 Glossary

1.1 Glossary and technical concepts

Term	Definition
Above Rail	Rail transport services provided by passenger and freight transport operators. Does not include ownership of rail tracks (see Below Rail).
Access arrangement	An arrangement for third party access to a railway provided by the Project Company
Accident	A non-deliberate, undesired, unplanned and / or uncontrolled event that results in a loss with definable consequences, i.e. harm to people, damage to property, loss to process and/or adverse impact to the environment.
Accredited Rail Manager	A party who is Approved to maintain effective management and control of rail infrastructure or proposed rail infrastructure – a) whether or not the person owns or will own the rail infrastructure; who a) carries a primary liability to maintain the infrastructure in good and safe order and condition, and b) agrees to provide to Accredited Rail Operators.
Accredited Rail Operator	A party who is Approved to operate rail services on the infrastructure under an Approved Access Agreement with an Accredited Rail Manager, and who carries a primary liability to operate such services safely and to the provisions of their Approved SMS.
AMIS	Asset Management Information System (see also CMMS)
Anchor mine	A large mine upon which the entire infrastructure project (rail and port) can be underwritten (i.e. to secure project finance).
Approved	Denotes Approved by the TKR Rail Regulator
Archive	A record or series of records that is not used on a daily basis and is stored remote to the work site.
Asset Management	Asset management is the long term management of physical assets with the primary objective of achieving its optimum functionality for the end user through efficient and effective assurance of its reliability, availability, maintainability and safety
Asset Management Framework	The AM Framework provides a guide and overview of the various key components to be considered and incorporated in the development of a healthy Asset Management regime in the organisation.
Asset Management Policy	A high level management document that provides vision for the business and a framework setting out principles and general requirements for the Asset Management function as mandated by the Business Plan.
Asset Management Strategy	It describes how the AM Policy will be implemented and will turn the general requirements of the AM Policy into more specific objectives.
Assumed Risk	A specific, analysed residual risk accepted at an appropriate level of management. Normally, the risk has undergone alternative analysis for increasing control and evaluation of the

Term	Definition
	significance of consequences.
Audit	A verification activity performed so as to evaluate conformance and performance. ▪ Internal audit – conducted by an Inspector. ▪ External audit – conducted by independent external party.
Back Up	A process of copying critical data and retaining off-site so that business can continue in the event of a disaster.
Ballast	The granular material placed around and between the sleeper and the formation to hold the track to top and line, to provide lateral stability and to assist in drainage of the track and load spreading from the rail and sleepers to the formation, so that the formation is not overstressed.
Bank guarantee	A form of on demand guarantee issued by a bank.
Below Rail (Services)	Provision of rail infrastructure services to freight and passenger rail transport operators, including rail tracks and associated infrastructure such as signalling. Associated with the provision and management of Rail Infrastructure, including the construction, maintenance and renewal of Rail Infrastructure assets, and the network management services required for the safe operation of Train Services on the Rail Infrastructure, including Train Control Services and the implementation of Safeworking Procedures.
Brownfield	Project involving refurbishment of an existing facility, or building on a site where there have previously been major structures.
BSI PAS 55:2008	It is the international reference standard for the optimum management of physical assets and is applicable to any organisation where physical assets are key or a critical factor in achieving business goals.
BS ISO 55000	This is a family of standards for Asset Management and comprises of three documents ie: Overview, Management System Requirements and Guidelines.
Business Plan	A high order document providing strategic guidance and direction to the business.
Calculated Risk	Specific, analysed, and where possible, quantified probabilities measuring risk in a project and/or activity.
Capex	Capital costs. Usually, the initial costs of construction the project.
CHF	Coal Handling Facility
CMMS	Computerised Maintenance Management System (see also AMIS)
Coal Supply Chain	The coal supply chain encompasses all activities associated with the flow and transformation of coal from the extraction stage, through to the end user, as well as the associated information flows
Competent Authority	A competent authority is an individual or organization that has the delegated authority of the Rail Regulator to perform a designated function.
Competent Person	Denotes a person who by reason of qualifications and experience has the skills necessary to perform the duties under the Regulations, and consequently has been delegated in respect to which by the Accredited Rail Manager or the Accredited Rail Operator to perform those duties.
Concession agreement	A PPP contract relating to a Concession to operate a project.
Concessionaire	A PPP contract relating to a Concession to operate a project.
Contractor	An individual or company working under agreement or contract to the Accredited Rail Manager or the Accredited Rail Operator to perform those duties.
Controlled Document	A document that is subject to amendment and reissue.
Corrective Action	Measures taken to rectify conditions adverse to safety.
CR	Control Room
Cross border risks	Risks which arise when a loan or investment is made from one country to a project in another

Term	Definition
Debt	Finance provided by the lenders.
Debt service	Payment of interest and debt principal instalments.
Discount rate	The percentage rate used to reduce a future cash flow to a current value.
Due diligence	Review and evaluation of the proposed contracts between parties and their related risks. Carried out by lenders and the Government.
EMP	Emergency Management Plan - the Approved plan for the management of Incidents.
Employee	Denotes an individual who works under a contract of employment or apprenticeship whether paid or unpaid.
Employer	Denotes a corporation which, or an individual who, employs persons under contracts of employment or apprenticeship.
ERP	Emergency Response Plan – the Approved plan for the management of emergencies.
Equity	The proportion of the project's capex contributed by the investors to the Project Company, either as capital or subordinated debt.
FMECA	Failure Mode Effect & Critical Analysis is a method that examines product or process failures, evaluates risk priorities and helps to determine remedial actions to avoid identified problems.
Form	A document in the Approved TKR SMS which supports various procedures and work instructions.
Free on board (FOB)	Where the title of the goods is transferred at the shipping point and the buyer is responsible for all risk and cost once the goods pass the ships rail
GDP	Gross Domestic Product, i.e. an aggregate measure of production equal to the sum of the gross values added of all resident institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs.
Greenfield	Project involving construction a completed new facility, or building on a site where there have previous been no major structures.
GoB	Government of Botswana
Group Risk	Rates and projections for a class of exposure.
Hand back	Return of the project (facility) to the Government at the end of the PPP contract.
Haul Distance	The distance from origin to destination for a relevant train service
Hazard	The potential in an activity, process, condition and/or situation for sequences of errors, omissions, oversights, changes, and stresses to result in a loss with definable consequences (a source of risk).
Hazard Analysis	The process consisting of functions and steps for the detection, identification and analysis of hazard exposures.
Hurdle rate	The discount rate or minimum IRR used to determine if an investment produces the minimum required return.
IFC	International Finance Corporation
IMP	TKR Interface Management Plan – the Approved plan for the management of interface where the TKR impacts or contacts other infrastructure either directly or indirectly.
Implementation Plan	This is a sub-document to the management Plans and will focus on the critical and other assets
Incident	An unplanned event that has or might cause, or could have caused injury or damage to personnel or property and involves: ▪ An employee of the Regulator or the Accredited Rail Manager or the Accredited Rail Operator, or ▪ An employee of a Contractor, and which ▪ Occurs within the control of TKR, or

Term	Definition
	▪ Involves operation of the TKR.
Incident Recovery Co-Coordinator	The Person(s) nominated by the Accredited Rail Manager and/or Accredited Rail Operator to co-ordinate Accident/Incident Recovery operations.
Inherent Risk	The risk that exists in an uncontrolled activity, i.e. before control measures in place.
Inspector	Denotes a Competent Authority appointed for the purposes of inspecting or investigating an Incident.
Investment bank	A bank which organises PPP investment funds but does not provide debt.
Investors	Sponsors and other parties investing equity into the Project Company.
IRR	Internal rate of return. The rate of return on an investment calculated from its future cash flows.
KPI	Key performance indicators. Used to measure service standards under the PPP contract.
Lenders	Banks or bond investors.
Life Cycle Management	This is a philosophy adopted in Asset Management to consider all the elements in the total value chain of an asset from design to commissioning to demolition.
Limited recourse loan	Finance with limited guarantees from the Sponsors.
Load time	The time from commencement of loading when the first coal is loaded in the first wagon or into the shipping vessel to completion of loading when the last coal is loaded in the last wagon or into the shipping vessel.
Loss	Any defined undesired consequence, financial or otherwise.
Lost Time Injury Or Disease	Those occurrences that resulted in a fatality, permanent disability, or time lost from work of one day / shift or more.
Management Plan	This will define the philosophy of the various elements that are required to build a strong AM foundation in support of and integration with the AM Strategy.
Major Incident	An incident that: ▪ Causes death or disabling injury to a person; or ▪ Results in lost time injury / alternative duties / medical treatment; or ▪ Is likely to give rise to public comment; or ▪ Is likely to result in legal proceedings against TKR or a Contractor, or the Accredited Rail Manager, or the Accredited Rail Operator; ▪ Causes significant property damage; or ▪ Is a near hit with the potential to cause any of the above (serious near hit).
Major Non-Conformance	A non-conformance with the TKR service, process or system that cannot be resolved with the skills of the personnel involved. Major non-conformances include non-conformances found during audits and customer complaints.
Major Purchases	Fixed infrastructure or anything that exceeds the value of US$1,000.
Management Review	Review of the effectiveness of the Approved SMS by responsible management.
May	Denotes there is an option.
Middlings	Low energy coaly material, usually as a by-product of the coal washing process.
Minor Incident	An incident that results in: ▪ First Aid injuries; or ▪ Minor property damage; or ▪ A near hit with limited consequences.
Minor Non-Conformance	A non-conformance with the TKR service, process or system that can be resolved in accordance with the skills of the personnel involved.

Term	Definition
Minor Purchases	Consumables or anything less than the value of US$1,000.
Mobile Plant	Denotes any earthmoving, road making, or other mobile machine. This term does not include items of plant, which are mobile for transport between projects, but operate in a fixed mode on the project.
Near Miss	Any unplanned incidents that occurred at the workplace, which although not resulting in any injury or disease, had the potential to do so.
Non-Conformance	A deficiency in characteristics, documentation or process, which renders safety outside that required by the relevant specification, contract, process or system as appropriate.
Non-Employee	Denotes a person reasonably at a workplace on the project who is not an employee of TKR or any other contractor or person in control of the workplace, e.g. Local Government engineers, delivery truck drivers, members of the general public.
Opex	Operating costs.
Person In Control Of A Workplace	Denotes either the Contractor or a representative of TKR in control of a workplace used by employees and non-employees.
Personal Protective Equipment	Denotes clothing or equipment which, when worn or used correctly, protects part or all of the body from identified risks of injury or disease in the workplace. The term includes multiple items and may include: ▪ Eye protection; ▪ Protective footwear; ▪ Protective headwear; ▪ Gloves; ▪ Hearing protection; ▪ High visibility safety garments, and ▪ Respiratory protective equipment. *NOTE: Personal protective equipment will be referred to in this safety management system as PPE.*
Plan	A document in the Approved SMS which provides the basis by which the Accredited Rail Manager and/or Accredited Rail Operator shall ensure safe management and operation. of the railway.
Policy	A statement in the Approved SMS which defines the Accredited Rail Manager and/or Accredited Rail Operator's policy in various safety related areas.
Position Description	A description of the roles and responsibilities for a particular position.
PPP	Public-private partnership. A contract under which the private sector party invests in a facility to provide a service on behalf of the Government.
PPP contract	The contract between the Government and the Project Company does the design, construction, finance and operation of the project.
Preventive maintenance	This is a pro-active approach to maintaining assets and is defined as the systematic care, servicing and inspection of assets with the purpose of maintaining it in a serviceable condition and detecting and eliminating failure modes.
Procedure	A document in the Approved SMS which details the broad steps required to achieve a certain outcome.
Project Company – Project Co	The SPV which is the Government's counterparty under the PPP contract.
Project finance	A method of raising long term debt financing for major projects based on lending against the cash flow generated by the project alone. It depends on a detailed evaluation of a project's construction, operating and revenue risks and their allocation between investors, lenders and other parties through contractual and other arrangements.

Term	Definition
Rail grinding	A maintenance process of mechanically grinding the rail to maintain its profile
Ramp up	The early years after construction of a project, when the usage is still building up.
RCA	Rail Connection Agreement with an adjoining railway
RCMP	Risk Control and Management Plan
Record	Information stored on hardcopy and/or electronically, required to enable monitoring and auditing of the Approved SMS.
Regulator	Denotes the office responsible for the proper oversight of the TKRP. Refer to chapter 10 for detail on the economic regulator and chapter 12 for the safety regulator for the TKRP.
Relevant External Agencies	Denotes appropriate bodies, including but not limited to Botswana and Namibian Government Departments, etc.
Residual Risk	The risk that exists after the application of risk control strategies.
Response Agency	The agency with the statutory or delegated power to respond to a particular functional response. These agencies include Botswana and Namibian Government Departments, and the Rail Regulator.
Richard's Bay benchmark	Richard's Bay thermal coal spot price is the benchmark price for most South African thermal coal sold on shorter-term contracts.
Risk	The probability of a hazard resulting in a loss with definable consequences.
Risk Analysis	The systemic process for the detailed understanding of the risk exposure and its causes following risk detection and identification.
Risk Assessment	The process applied to determine risk exposure magnitude in terms of duration; occurrence; consequence; detection and control.
Risk Control	That part of risk management where the hierarchy of controls (elimination, engineering, barriers, devices, separation, competency, procedures, rules and protective equipment) to eliminate, avoid and/or minimise adverse risks facing Accredited Rail Manager and/or Accredited Rail Operator.
Risk Management	The systematic application of management policies, processes and practices to the activities associated with risk mitigation strategy development, implementation, management, monitoring, review and evaluation. *NOTE: These components are interdependent requiring that the risk management function be integrated with the normal business management system, programs and activities.*
Rolling Stock	means locomotives, carriages, wagons, rail cars, rail motors, light rail vehicles, light inspection vehicles, rail/road vehicles, trolleys and any other vehicle that operates on or uses the track
Safe	A condition, activity or state where the residual risks are deemed as low as reasonably practicable.
Safety	The prevention of accidental loss.
Security	The prevention of deliberate loss.
Shall	Denotes a mandatory requirement.
Should	Denotes an option.
Site	Shall be taken to mean all areas encompassed by the TKR, including the alignment, the corridor, and all associated offices, amenities and facilities.
Site Commander	Person responsible for the overall co-ordination of the Incident response.
SMS	The Safety Management System – the system of Policy, Standards, and Plans which defines and describes the manner by which the Accredited Rail Manager and/or Accredited Rail Operator will meet the direction of the Regulator.
SPV	Special purpose vehicle. A legal entity with no activity other than those connected to its

Term	Definition
	borrowing to develop the project.
Sponsors	The investors who bid for, develop and lead the project through their investment in the Project Company.
Staff	Paid personnel.

Term	Definition
Standard	An approved model for system process operation and performance. An approved model is ▪ anything taken by general consent as a basis of comparison, and/or ▪ A level of performance, which is regarded and sanctioned as normal, adequate, or acceptable.
Subcontractor	Denotes any party engaged by Accredited Rail Manager and/or Accredited Rail Operator or a Contractor.
Subordinated debt	Debt provided by investors whose debt service is paid after amount due to the lenders but before payments of dividends.
System	An arrangement of components, which are interrelated, and which act and interact to perform a related series of functions in a particular environment.
Tariff	Payments under a contract (i.e. access arrangement).
Thermal coal	Thermal coal - is mainly used in power generation. Coking coal - also known as metallurgical coal - is mainly used in steel production.
TKRP	Trans Kalahari Rail & Port. In a number of instances, TKR is used to emphasise the rail component of the project.
Uncontrolled Document	A document that is not subject to updating with the latest issue and is therefore only current at the time of issue.
Volunteer	A non-paid employee.
WACC	Weighted Average Cost of Capital. The weighted average of the costs of a company's equity and debt funding.
WHS And R	Denotes Workplace, Health, Safety and Rehabilitation
Will	Denotes that an action is mandatory and must be effected
Work Instruction	A document in the Approved SMS which details the specific steps required to safely perform a task.
Works	Any major new construction, or change to existing infrastructure

2 Background

2.1 The need for action

2.1.1 Botswana's continuing development

Prior to its Independence from the United Kingdom in 1966, Botswana was one of the poorest countries in Africa with a GDP per capita of about US$70. Since then Botswana has transformed itself, becoming one of the fastest-growing economies in the world with a GDP (purchasing power parity) per capita of about $14,000. Botswana has enjoyed the fruits of its vast resources in diamonds over the last four decades.

The country also possesses substantial largely untapped mineral resources, particularly coal. In light of the increasing coal demand, especially in the Asian market, coal has been identified as a strategic resource which carries the potential to generate sizeable revenues for the country as revenues from diamonds begin to wane.

Diversification of the economy is a key strategic thrust of the Botswana's current National Development Plan[1]. The need to achieve this objective has become more critical in view of the global financial and economic crisis and the envisaged decline in diamond and SACU revenues. This will entail among others providing infrastructure needs for the private sector as an engine for economic growth.

2.1.2 The development of Botswana's coal resources

The Government of Botswana has thus commenced a national strategy on coal development, the Coal Roadmap, for the orderly, timely and beneficial exploitation of these very valuable coal resources.

Coal exports, power exports, and domestic power are considered the most attractive routes to monetising Botswana's coal resources, with clear synergies existing between the three. The quality of Botswana's coal is very much suitable for the export market.

The Karoo Supergroup in Southern Africa

[1] 10th National Development Plan (NDP10) covering the period 2009 to 2016.

Three distinct export channels for coal from Botswana have been previously contemplated:

- **Westbound rail corridor** to a new port on the west coast of Namibia (Trans-Kalahari Rail)
- **Eastbound rail corridor** via Zimbabwe and Mozambique to an expanded port at Maputo (or new port in Mozambique, e.g. Ponta Techobanine)
- **South-eastbound rail** to connect to South Africa's Transnet rail network to an expanded port at Richards Bay (or new port in Kwazulu-Natal)

On 19 March 2014, a Bi-lateral Agreement between Botswana and Namibia was signed to progress the development of the westbound rail corridor (Trans-Kalahari Rail).

As a land-locked country, Botswana's physical infrastructure is an integral part of its regional and international competitiveness. The development of an export route for Botswana's coal industry will have profound impact on other parts of its economy. Access to and efficiency of infrastructures is of paramount importance to Botswana's competitiveness.

2.1.3 Development Plan

One of the key actions required to facilitate the progression of the Trans-Kalahari Rail Project as part of the Coal Roadmap is a **Development Plan**. Defining and developing the Development Plan is crucial to provide a clear and transparent path for Government to develop Policy and contemplate development of the Country's coal industry. This report is the Development Plan linking the previous studies with the more detailed design and implementation.

This Development Plan will serve to inform investors and provide more confidence around the long term strategy and implementation plans such that investors are better able to engage with Government more constructively with regard to on-going development of the industry and the Trans-Kalahari Rail in particular.

This Development Plan will provide a clear linkage between coal development in Botswana and the infrastructure required to facilitate the export of coal. It will facilitate the development of the Botswana Export Coal Industry through the Trans-Kalahari Rail corridor.

2.2 The Namibian connection

The development of the Trans Kalahari Rail Project is consistent with or working towards the Namibian Government's desired outcomes 6 (DO6), as stated in its NDP4 National Development Plan:

DO6

By 2017, the volume in cargo handling and rail-transported cargo is double that of 2012, and the Port of Walvis Bay has become the preferred African West coast port and logistics corridor for southern and central African logistics operations.

Namibia is strategically positioned within the SADC region, meaning it can offer a gateway for trade to and from the region. Namibia's transport and communication infrastructure, although lagging behind by international standards, remains competitive in relation to what is available in the region. For instance, the Port of Walvis Bay saves shipping companies up to five days for goods transported within the SADC region, Europe and the Americas.

There are a number of great opportunities for Namibia to be positioned as a logistics hub. It is a fact that economic development in a number of SADC countries is expected to take off rapidly. In addition to the facilitation of flows of imports, exports and trans-shipments via Namibia, the availability of a good international logistics network will also attract other industries to Namibia.

Logistics also has the ability to create sustainable employment opportunities, which are in such great demand in Namibia.

In order to achieve the desired outcome of becoming a regional logistics hub, a number of high-level strategies and actions will be pursued over the next five-year planning cycle. These include the expansion of the Port of Walvis Bay: it needs to be able to accommodate the ocean-liner class of container ships, and make their turnaround time as short as 24 hours. The rail connections to Angola, Botswana and Zambia also need to be completed, with particular focus on the Trans-Kalahari Railway.

3 Multi-criteria assessment

3.1 Background

The export channel options assessed in the "Pre-Feasibility Study of the TKR Report" prepared by CPCS in 2011 present specific and very different advantages and disadvantages. The report contains a Comparative Assessment of Impacts of Proposed Route Options (section 8.4.7). Building upon this assessment, an overall relative assessment of the options was undertaken to better understand the relative merits of the western alignment options. As a result, these options were subjected to a further structured process commonly referred to as a Multi-Criteria Analysis (MCA).

The Multi-Criteria Assessment (MCA) is a standard decision making tool in which criteria are identified, weighted and then each option is rated against the others for relative performance.

By using this method, consideration was able to be given to a full range of social, environmental, technical, economic and financial criteria in a single table, allowing for a better understanding of the alternatives under evaluation.

The aim of the MCA is to assist in the evaluation process by enabling a range of quantitative and qualitative criteria that may affect each option to be compared. Scores are allocated to each criterion and weights are given in order to compare the relative importance of each criterion against the other. The overall weighted scores will determine the ranking of each option.

For this particular project, the MCA was used as a tool to qualify, quantify and understand the different alignment options contemplated for the Trans Kalahari Rail Project. More specifically, the options considered included a Northern Option (via Gobabis and Windhoek) and a Southern Option (via Mariental). Both alignment options were considered in terms of Standard Gauge (1435mm) and Cape Gauge (1067mm).

3.2 Scope definition

The MCA assessment is part of Aurecon's Development Plan Deliverable 2.3.1 (refer to Aurecon's Proposal, 30 May 2014). This process provides the Botswana and Namibian Government with additional information to assess the relative merits of the options, even if decisions on route have already been made[2].

[2] We understand that the Southern route via Mariental will encounter significant environmental barriers as it proposes to traverse the protected Namib-Naukluft Park, and as such is unlikely to be a viable alternative. Hence the Bi-Lateral Agreement signed by the Namibian and Botswana Governments focussed on the northern alignment, via Gobabis and Windhoek.

3.3 Multi criteria analysis presentation

On Wednesday 24 September 2014 the MCA approach was presented to the Coal Development Unit as part of the capacity building program. Preliminary results of this MCA were provided as part of that session.

3.4 MCA Process

The MCA involves several defined steps to ensure effectiveness of the process. The steps in the MCA are typically:

1. Defining the Scope (What are we trying to compare?)
2. Defining the Categories (Grouping of Criteria)
3. Weighting of Categories
4. Defining of Criteria within each Category
5. Weighting of Criteria
6. Measuring the Criteria
7. Scoring the Criteria
8. Evaluating the Results (Weighted Scores of Criteria and Ranking)
9. Conduct Sensitivity Analysis

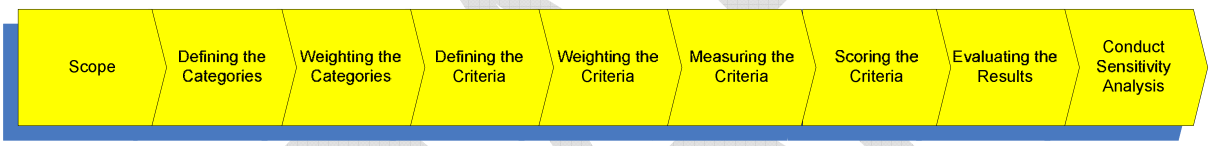


Figure 1 Defined Steps of the MCA Process

3.4.1 Defining the scope

Before embarking on a detailed MCA, the options being investigated will need to be articulated. This is to ensure all stakeholders in the process understand the options being assessed.

Table 1 Options Assessed as Part of This MCA

Alignment	Gauge	Description
Northern	Standard	Std Gauge, Follows Trans Kalahari Highway, then via Mamuno, Gobabis, Windhoek and Okahanja, to Walvis Bay
Northern	Cape	Cape Gauge, Follows Trans Kalahari Highway, then via Mamuno, Gobabis, Windhoek and Okahanja, to Walvis Bay
Southern	Standard	Std Gauge, Via Aranos, Mariental and Nomtas, to Walvis Bay
Southern	Cape	Cape Gauge, Via Aranos, Mariental and Nomtas, to Walvis Bay

The options are illustrated in Figure 2 and Figure 3 below.

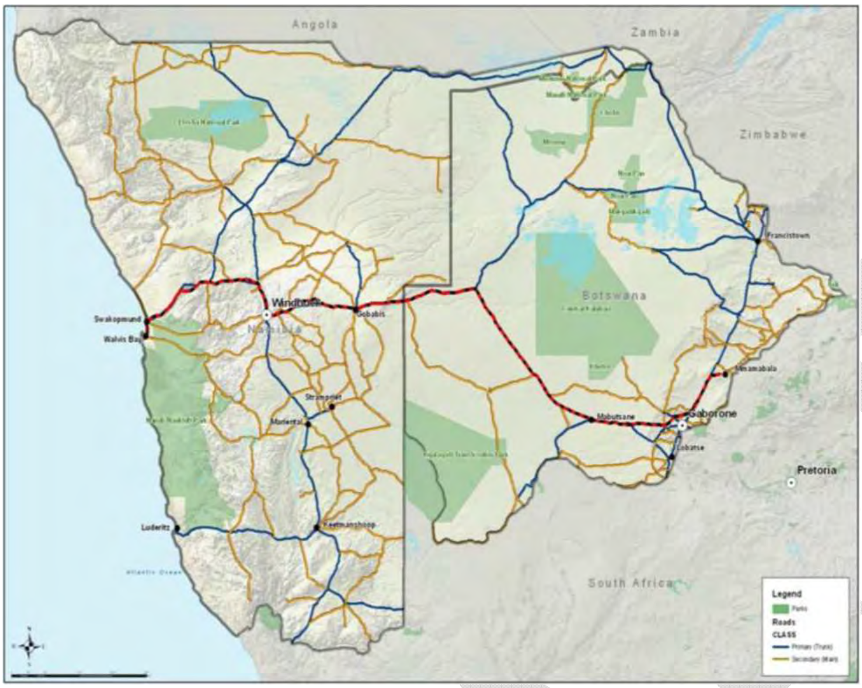


Figure 2 Northern Alignment

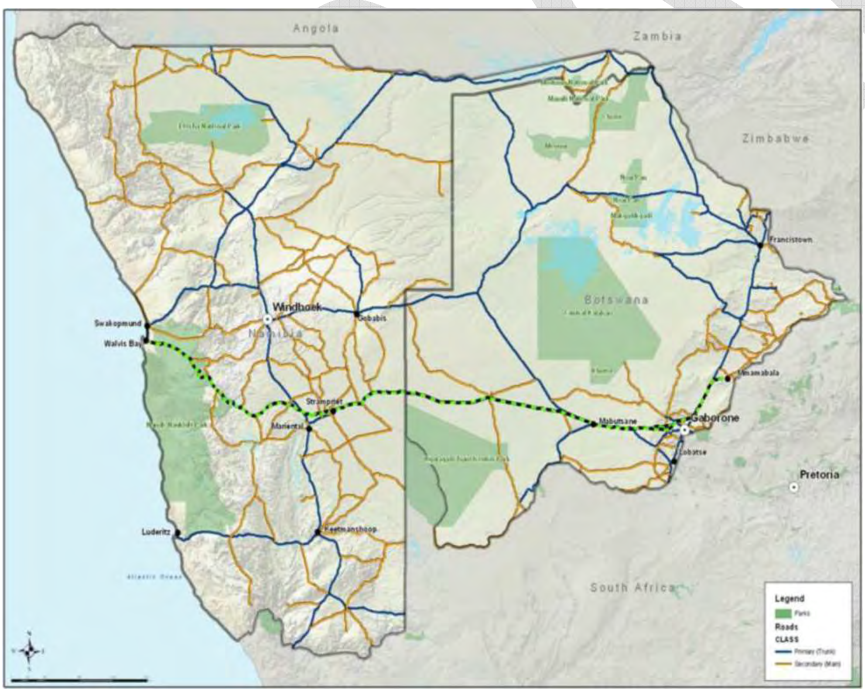


Figure 3 Southern Alignment

3.4.2 Step 2: Definition of categories

A set of evaluation criteria was defined for this MCA. Evaluation criteria should be grouped in like categories to facilitate understanding. Such categorisation also assists in allocating responsibilities for measuring, scoring and weighting the criteria. Five categories of criteria were established to capture important elements for this project. These included the following:

Table 2 Category Criteria

Category	Description
Engineering	Engineering, technical issues relating to the rail alignment options.
Operations	Rail operational issues relating to the rail alignment options. This includes maintenance of the rail infrastructure and train operations.
Environmental, Heritage & Social	Impact on society/community/environment
Cost	Capital Cost/Operating Cost
Safety	Safety risk during construction and once in operation

3.4.3 Step 3: Weighting of categories

Whilst each category can have a different number of criteria, it is necessary to agree on the relative importance of each category. The following weightings were assumed:

Table 3 Category Weightings

Category	Weighting
Engineering	20%
Operations	15%
Environmental, Heritage & Social	30%
Safety	20%
Capital/operating cost	15%

Environmental, Heritage & Social criteria was deemed to be more important, hence the higher weighting for this category. Capital and operating costs as a category on its own were weighted below average since there is a strong correlation with the Engineering category.

3.4.4 Step 4: Defining of criteria within each category

Evaluation criteria should cover as broader spectrum of issues as possible, and cover areas that may have a significant influence on the project's development or ongoing viability. A set of evaluation criteria was defined for this study. These are detailed below:

Table 4 Alignment Criteria

Cat	ID	Criteria
Eng	1	Constructability
Eng	2	Timeframe to implement (Engineering)
Eng	3	Earthworks Volumes
Eng	4	Earthworks Balance
Eng	5	Geotechnical (Formation / sub-base strength issues eg soft soils)
Eng	6	Construction Resources
Ops	7	Linkages to Intermodal traffic in/out Windhoek
Ops	8	Infrastructure Maintenance
Ops	9	Above Rail Maintenance
Ops	10	Train Operations
Ops	11	Total Climb
EHS	12	Impact on Fauna
EHS	13	Loss of vegetation and habitat destruction
EHS	14	Impact on Archaeology along route
EHS	15	Impact on Landholders
EHS	16	Timeframe for environmental approvals
Cos	17	Below Rail Operating Cost
Cos	18	Above Rail Operating Cost
Cos	19	Operations Staff Requirements
Cos	20	Below Rail Capital cost
Cos	21	Above Rail Capital cost
Saf	22	Risk during construction
Saf	23	Remaining risk during operations

3.4.5 Step 5: Weighting of criteria

This MCA used Descriptive Weightings Scores of assigning weighting to each criterion. Three descriptions/levels have been used as follows:

1. For Low Importance Criteria
2. For Medium Importance Criteria
3. For High Importance Criteria

These weightings provide an indication of the criteria's relative importance assessed for the study's objectives, i.e. relative to some other criteria within that same category. The assignment of these weightings is an important step in undertaking a MCA. The following weightings were recommended:

Table 5 Weightings Criteria

ID	Criteria	Importance Weighting (1 – 3)
Eng1	Constructability	2
Eng2	Timeframe to implement (Engineering)	1
Eng3	Earthworks Volumes	2
Eng4	Earthworks Balance	3
Eng5	Geotechnical (Formation / sub-base strength issues eg soft soils)	1
Eng6	Construction Resources	2
Ops7	Linkages to Intermodal traffic in/out Windhoek	2
Ops8	Infrastructure Maintenance	2
Ops9	Above Rail Maintenance	2
Ops10	Train Operations	3
Ops11	Total Climb	3
EHS12	Impact on Fauna	3
EHS13	Loss of vegetation and habitat destruction	3
EHS14	Impact on Archaeology along route	1
EHS15	Impact on Landholders	2
EHS16	Timeframe for environmental approvals	3
Cos17	Below Rail Operating Cost	1
Cos18	Above Rail Operating Cost	3
Cos19	Operations Staff Requirements	2
Cos20	Below Rail Capital cost	3
Cos21	Above Rail Capital cost	3
Saf22	Risk during construction	2
Saf23	Remaining risk during operations	3

3.4.6 Step 6: Measuring the criteria

The measurement of the criteria identified depends on the nature of the criteria being measured. This is best defined by the technical experts in each field. Considering this is a FEL-2 stage combined with time constraints, no detailed measurements were undertaken. Often, no detailed data is available in any case. As such, expert opinion overlaid by peer review underpinned most measurements and scorings of the criteria for this project.

Appendix A provides some background information used by workshop participants to provide a basis for scoring the options against the criteria.

3.4.7 Step 7: Scoring of Criteria

Each criteria was scored based on the relative performance in that category. The best performing option attracts the highest score 10, and the worst performing option scores the lowest score 1. All other options are scored in proportion to its performance versus the best and worst option. Scoring is best undertaken by the technical experts in each field. Where performances between the options do not vary much at all, scoring can be within a tighter range.

Scoring of each criteria is summarised below.

Table 6 Criteria Scoring

ID	Criteria	Options Investigated			
		1	2	3	4
		Northern Option - Standard Gauge	Northern Option - Cape Gauge	Southern Option - Standard Gauge	Southern Option - Cape Gauge
Eng1	Constructability	5.1	5.1	5.4	5.4
Eng2	Timeframe to implement (Engineering)	5.0	5.0	6.0	6.0
Eng3	Earthworks Volumes	2.1	1.0	9.5	10.0
Eng4	Earthworks Balance	3.2	1.0	10.0	9.4
Eng5	Geotechnical (Formation / sub-base strength issues eg soft soils)	5.7	5.7	4.7	4.7
Eng6	Construction Resources	5.4	5.4	4.6	4.6
Ops7	Linkages to Intermodal traffic in/out Windhoek	7.0	7.0	3.0	3.0
Ops8	Infrastructure Maintenance	4.2	4.0	4.4	4.2
Ops9	Above Rail Maintenance	7.0	4.0	8.0	5.0
Ops10	Train Operations	6.3	4.3	7.8	5.5
Ops11	Total Climb	4.5	4.5	6.5	6.5
EHS12	Impact on Fauna	9.0	9.0	3.0	3.0
EHS13	Loss of vegetation and habitat destruction	9.0	9.0	3.0	3.0
EHS14	Impact on Archaeology along route	5.0	5.0	4.0	4.0
EHS15	Impact on Landholders	8.0	8.0	3.0	3.0
EHS16	Timeframe for environmental approvals	6.0	6.0	4.0	4.0
Cos17	Below Rail Operating Cost	2.6	1.0	10.0	7.9
Cos18	Above Rail Operating Cost	6.7	1.0	10.0	4.7
Cos19	Operations Staff Requirements	8.0	5.0	9.0	6.0
Cos20	Below Rail Capital cost	5.0	6.0	6.0	7.0
Cos21	Above Rail Capital cost	5.6	1.0	10.0	7.6
Saf22	Risk during construction	5.5	5.5	6.0	6.0
Saf23	Remaining risk during operations	6.0	6.0	4.0	4.0

3.4.8 Step 8: Evaluating the results

Total weighted scores of each option were determined by multiplying the score for each criteria with the weightings applied to each criteria, as well as the weighting of each category.

For example, for the "Northern Option Standard Gauge" the scoring in the Engineering Category was determined as follows:

Criteria 1 (Constructability): Score = 5.1, Weight = 2, Weighted Criteria score = 5.1 x 2	10.2
Criteria 2 (Time to implement (Engineering)): Score = 5.0, Weight = 1, Weighted Criteria score = 5.0 x 1	5.0
Criteria 3 (Earthworks Volume): Score = 2.1, Weight = 2, Weighted Criteria score = 2.1 x 2	4.2
Criteria 4 (Earthworks Balance): Score = 3.2, Weight = 3, Weighted Criteria score = 3.2 x 3	9.6
Criteria 5 (Geotechnical (Formation / sub-base strength issues eg soft soils)): Score = 5.7, Weight = 1, Weighted Criteria score = 5.7 x 1	5.7
Criteria 6 (Construction Resources): Score = 5.4, Weight = 2, Weighted Criteria score = 5.4 x 2	10.8
Total Engineering category "Northern Option Standard Gauge": **(Sum of the above)**	**45.5**
Category (Engineering) weighting:	20%
Total Engineering Weighted Score (Northern Option Standard Gauge): **(20% x 45.5)**	**9.1**

The resultant weighted scores for each criteria applied to each option is summarised in Table 7 below. This shows that Option 1 (Northern Standard Gauge Option) scored the overall best result, with Option 3 (Southern Standard Gauge Option) close behind.

Table 7 Weighted Scores

ID	Category	Options Investigated			
		1	2	3	4
		Northern Option - Standard Gauge	Northern Option - Cape Gauge	Southern Option - Standard Gauge	Southern Option - Cape Gauge
Eng	Engineering	9.1	7.3	15.9	15.8
Ops	Operations	10.3	8.4	11.0	9.1
EHS	Environmental, Heritage & Social	27.9	27.9	12.0	12.0
Cos	Capital/operating cost	5.8	5.8	4.8	4.8
Saf	Safety	10.6	5.3	15.9	11.7
ALL	**Total Weighted Score**	**63.7**	**54.7**	**59.7**	**53.3**
	Ranking	**1**	**3**	**2**	**4**

3.4.8.1 Breakdown of Scoring

A breakdown in the scoring is provided below in Figure 4.

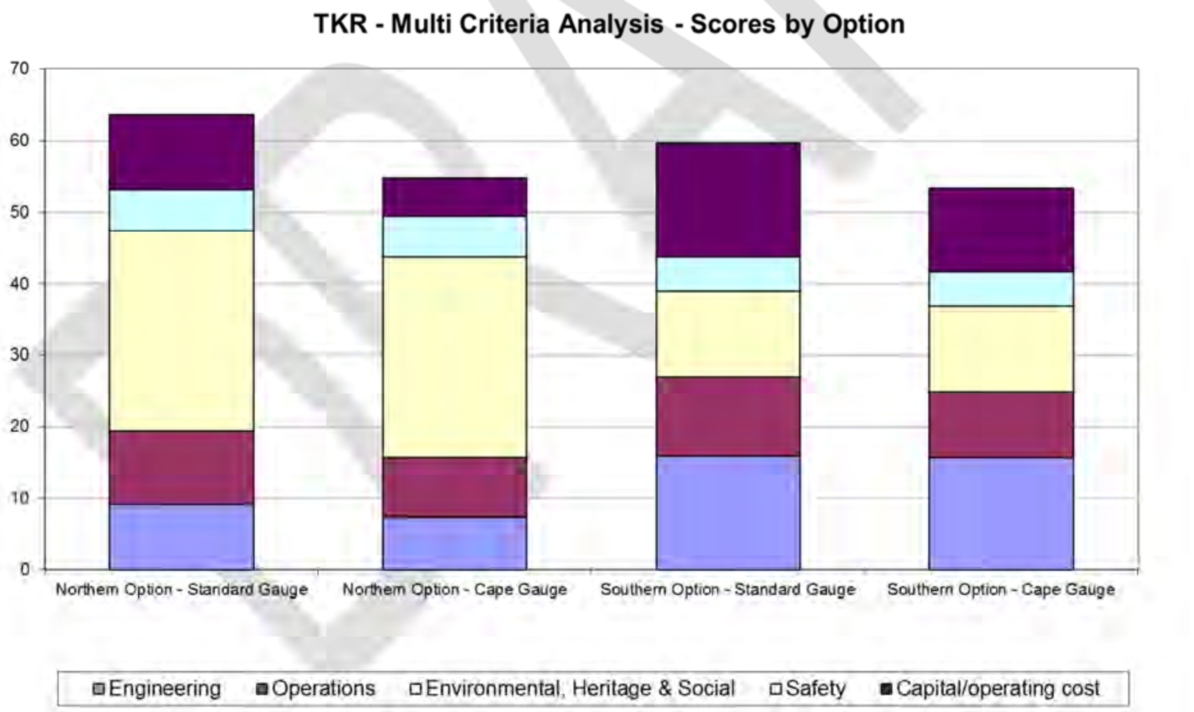


Figure 4 Breakdown Summary

It appears that the largest contributor to Options 1 and 2 (Northern Options) is the “Environmental Heritage and Social” category. Options 3 and 4 (Southern Options) are the best in terms of “Engineering” and Capital/ Operating Costs”. Refer to Figure 5 to Figure 9 below for the scores of each location option within each category.

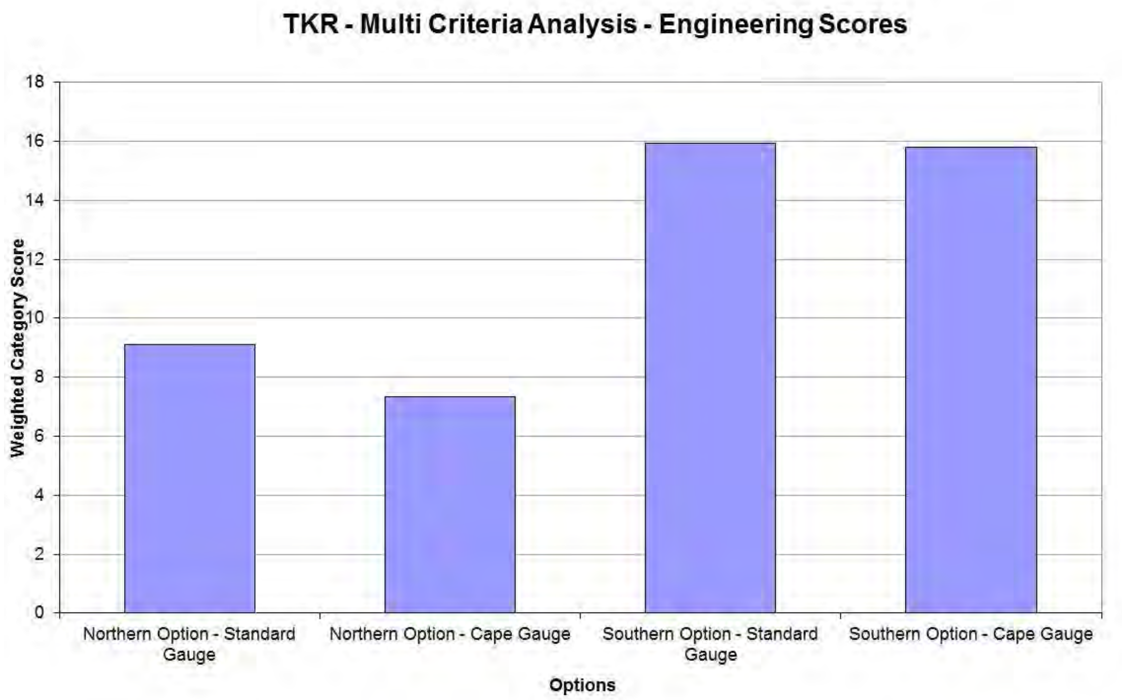


Figure 5 Engineering Scores

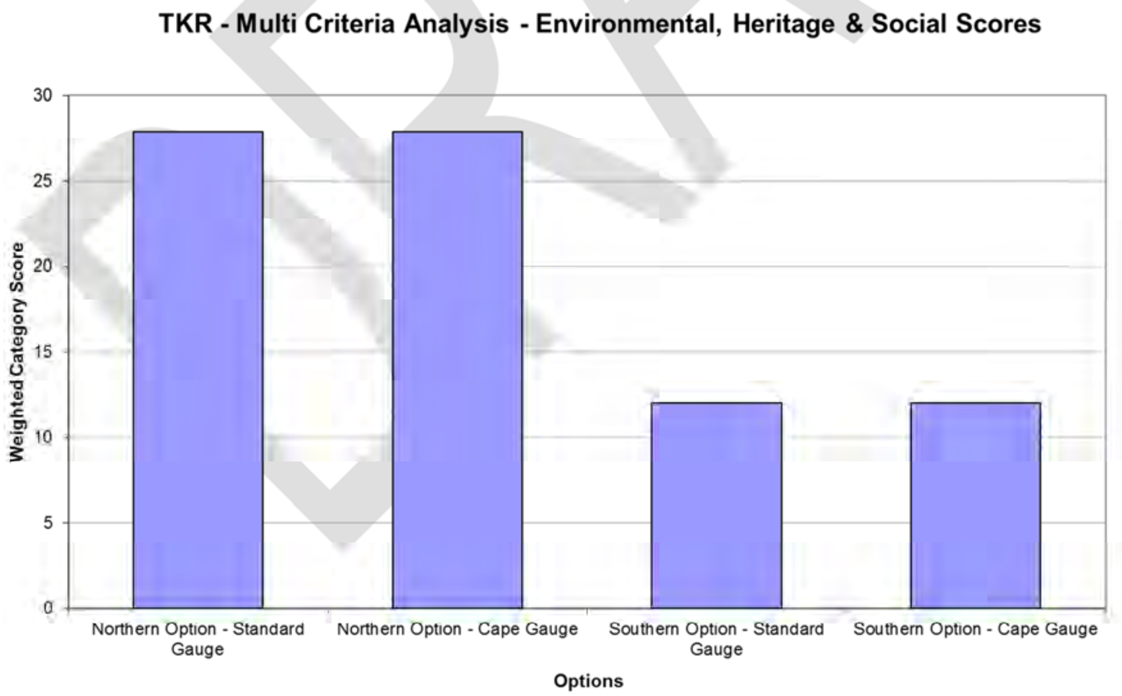


Figure 6 Environmental, Heritage & Social Scores

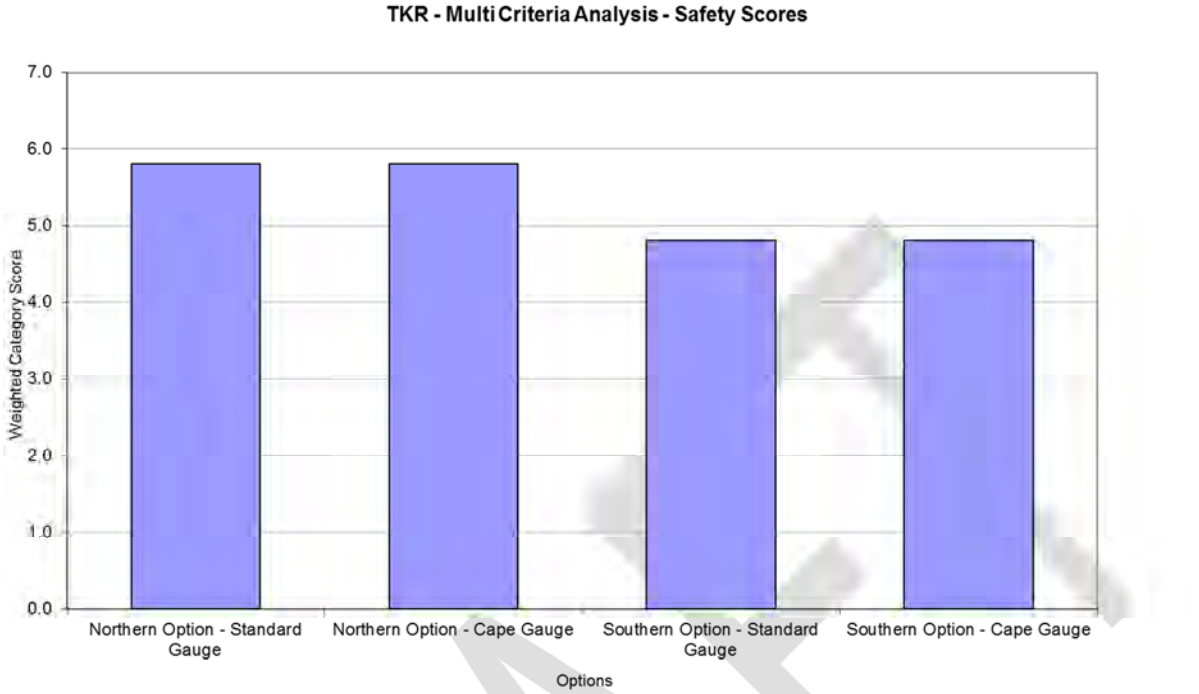


Figure 7 Safety Scores

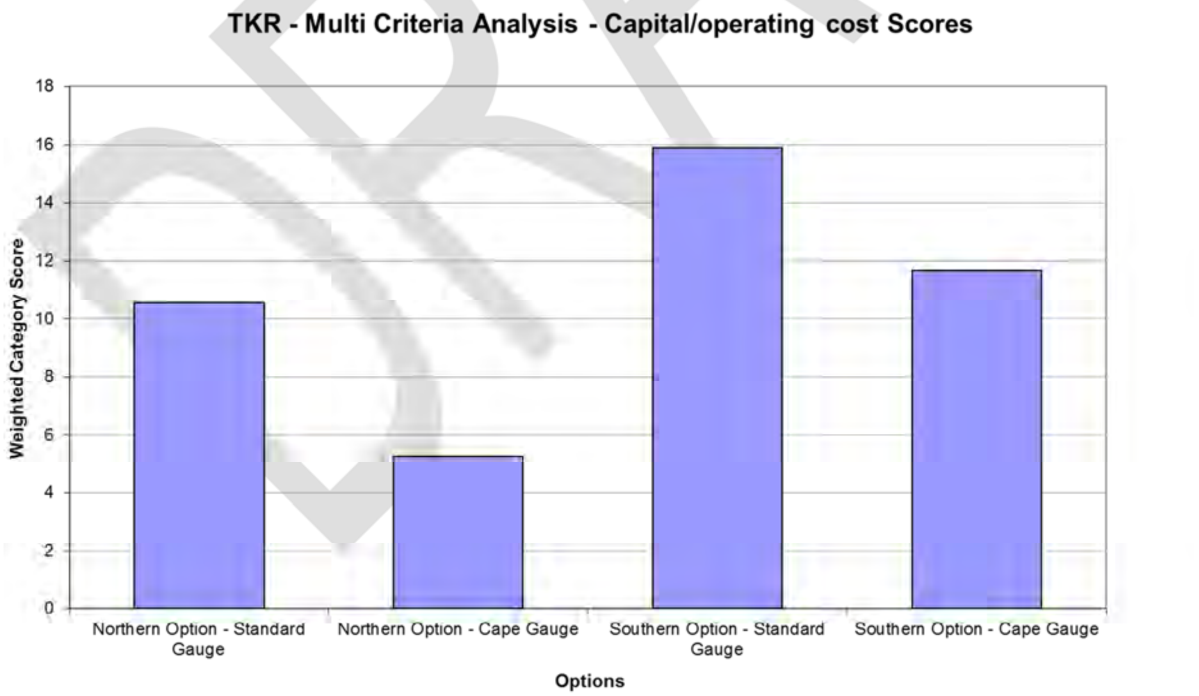


Figure 8 Capital/Operating Cost Scores

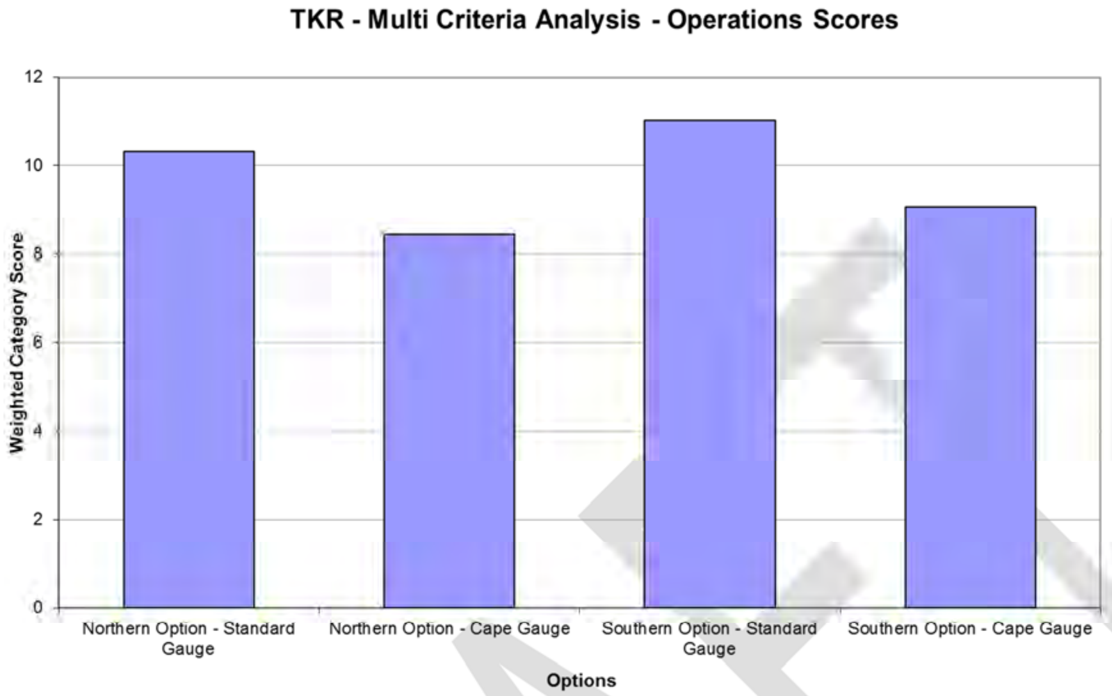


Figure 9 Operations Scores

3.4.9 Sensitivity analysis

Sensitivity analysis has been applied to the MCA to understand the robustness of the outcome of this assessment. The outcome from this sensitivity analysis is shown in Table 8 below. The highest scoring option (and therefore preferred) is shown by the highlighted cell in the table. Some of these sensitivities are merely provided to understand the impacts, and may not reflect a reasonable position to adopt.

Table 8 Weighted Scores with Sensitivities Applied

ID	Sensitivity Applied	Northern Option - Standard Gauge	Northern Option - Cape Gauge	Southern Option - Standard Gauge	Southern Option - Cape Gauge
	BASE MCA Assessment	**63.7**	**54.7**	**59.7**	**53.3**
1	Each category to have an equal 20% weighting	61.4	50.0	64.6	56.2
2	All criteria to have equal weighting of 3	81.7	71.1	79.0	71.2
3	1 & 2 (Each category to have an equal 20% weighting AND All criteria to have equal weighting of 3)	79.1	65.7	85.1	74.7
4	Capital/Operating Cost category has a zero weighting, all other categories have an equal (25% weighting). In other words, ignore any costs.	59.1	53.7	54.3	50.8
5	Environmental, Heritage & Social category has a zero weighting, all other categories have an equal (25% weighting). In other words, ignore any impact on Environmental, Heritage & Social.	53.4	39.2	70.8	60.3

3.5 Conclusion

The MCA undertaken determined that Option 1 (Northern Standard Gauge) is the recommended "go-forward" alignment for the Trans Kalahari Rail. Option 1 is shown in Figure 10 below.

Sensitivities applied to weightings did suggest the Southern Standard Gauge alignment option be an alternative however, the sensitivity of a heavy haul rail line through the Namib-Naukluft Park cannot be underestimated. The recommendation is therefore the progress with the Northern option. Economic modelling undertaken as part of this Development Plan will indicate the criticality with regard to gauge, in terms of viability for miners to use the proposed Trans Kalahari Rail as a viable export supply chain.

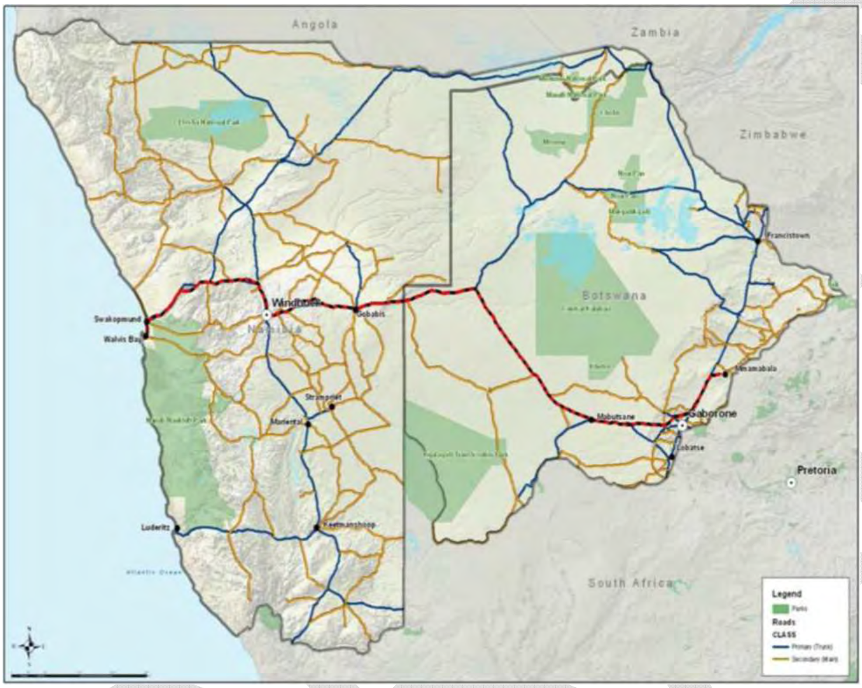


Figure 10 Option 1 determined as the "go-forward" alignment option for the Trans Kalahari Rail Project.

4 Master planning

4.1 Rationale for master planning

It is generally recognised that the viability of a major export supply chain of this length and complexity necessitates a substantial export tonnage throughput for it to be commercially viable. This is particularly the case due to the significant economies of scale a railway provides. From a commercial perspective this means that a substantial throughput has to be achieved very early and perhaps from diverse sources within eastern Botswana and potentially other sources adjacent to the corridor.

As such, this chapter of the Development Plan has been dedicated to the identification of potential coal users of the Trans Kalahari Rail line. More specifically:

- Where the coal resources are geographically located in Botswana.
- Where, in relation to the proposed rail corridor, the likely mine sites are expected to be.
- How these mine sites can reasonably be connected to the main rail corridor.
- How, through collaboration, several mine sites are likely to benefit by sharing some infrastructure assets such as train loading stations and spur lines.
- What the minimum commitment requirement would need to be for all coal miners to use the main rail corridor so as to maximise the efficiency of the entire supply chain from mine to port.
- The base traffic requirements from the various entry points to the main corridor.
- Potential staging of the coal developments and how this would impact on the overall corridor development.

In addition to coal resources, other bulk materials, in particular those of relatively high value such as copper, iron or manganese ores can contribute to the viability of the Trans Kalahari Rail line. Accordingly, this chapter will briefly cover the potential linkage of the western Botswana copper fields with the Trans Kalahari Rail line, as well as potential linkage to the manganese ore resources in southern Botswana.

4.2 Volume requirements

As mentioned above, the viability of a major export supply chain of this length and complexity necessitates a substantial export tonnage throughput for it to be commercially viable. Figure 11 and Figure 12 below illustrate the expected total rail costs per tonne at increasing volumes for different options[3] for the Trans Kalahari Rail.

[3] Standard Gauge and Cape Gauge diesel options

Impact of Volume on Total Above and Below Rail Cost for Coal Services

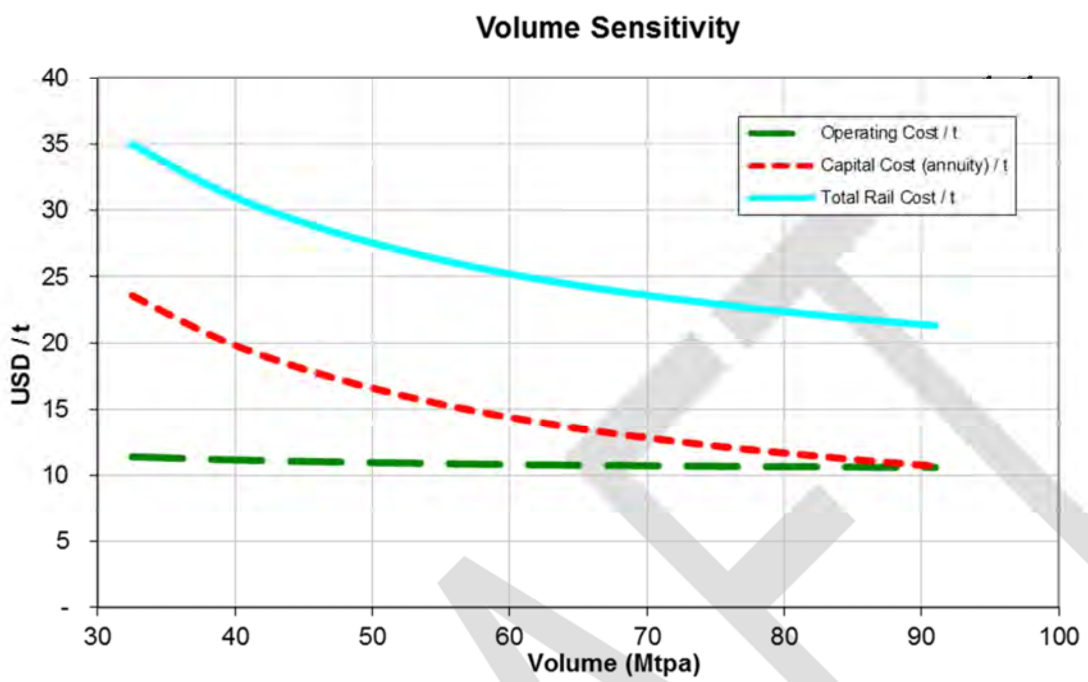


Figure 11 Diesel Standard Gauge, Northern Option

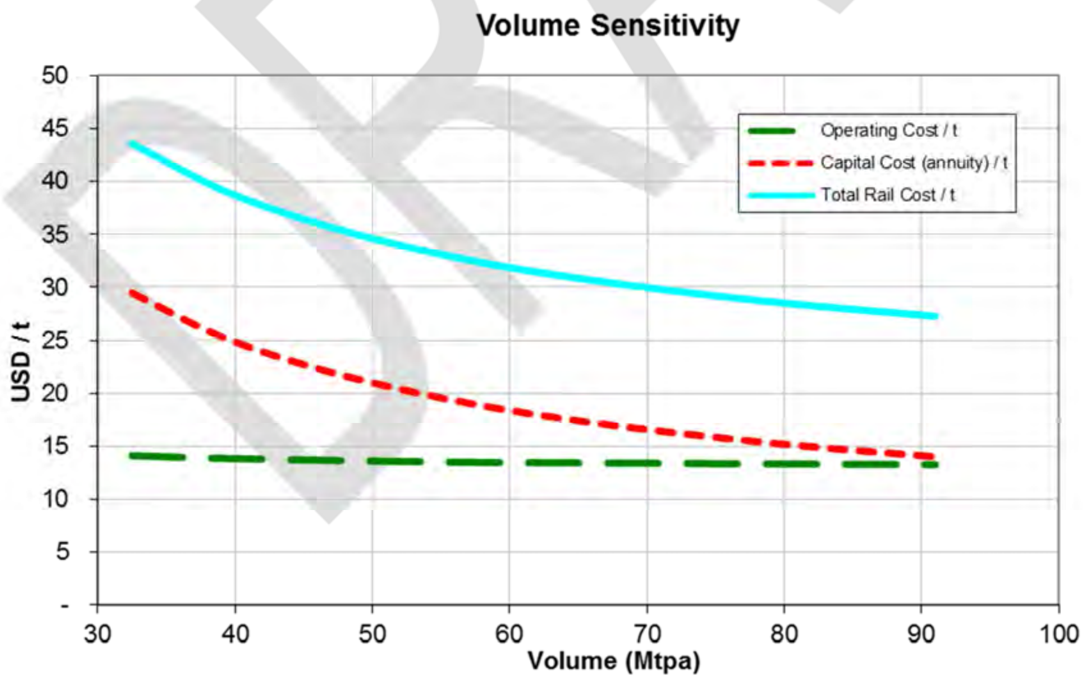


Figure 12 Diesel Cape Gauge, Northern Option

It is clear from these charts that increasing volumes are required to reduce the overall unit rate per tonne of product due to the significant economies of scale that rail provides.

4.3 Botswana coal resources

The coal resources likely to benefit from the development of an export supply chain was based on information such as exploration leases, interpretation of geological resource data as well as consultation with the various stakeholders such as Botswana's Ministry of Minerals, Energy and Water Resources, Botswana's Department of Geological Survey, and members of the Botswana Chamber of Mines.

4.3.1 Spur Lines to new mines

A number of rail spurs have been identified that could service the potential coal mines in Botswana. These are notionally illustrated in Figure 13 and Figure 14 below for the enhanced (optimised) alignment. Appendix B contains a more detailed topographic map showing these notional rail spurs.

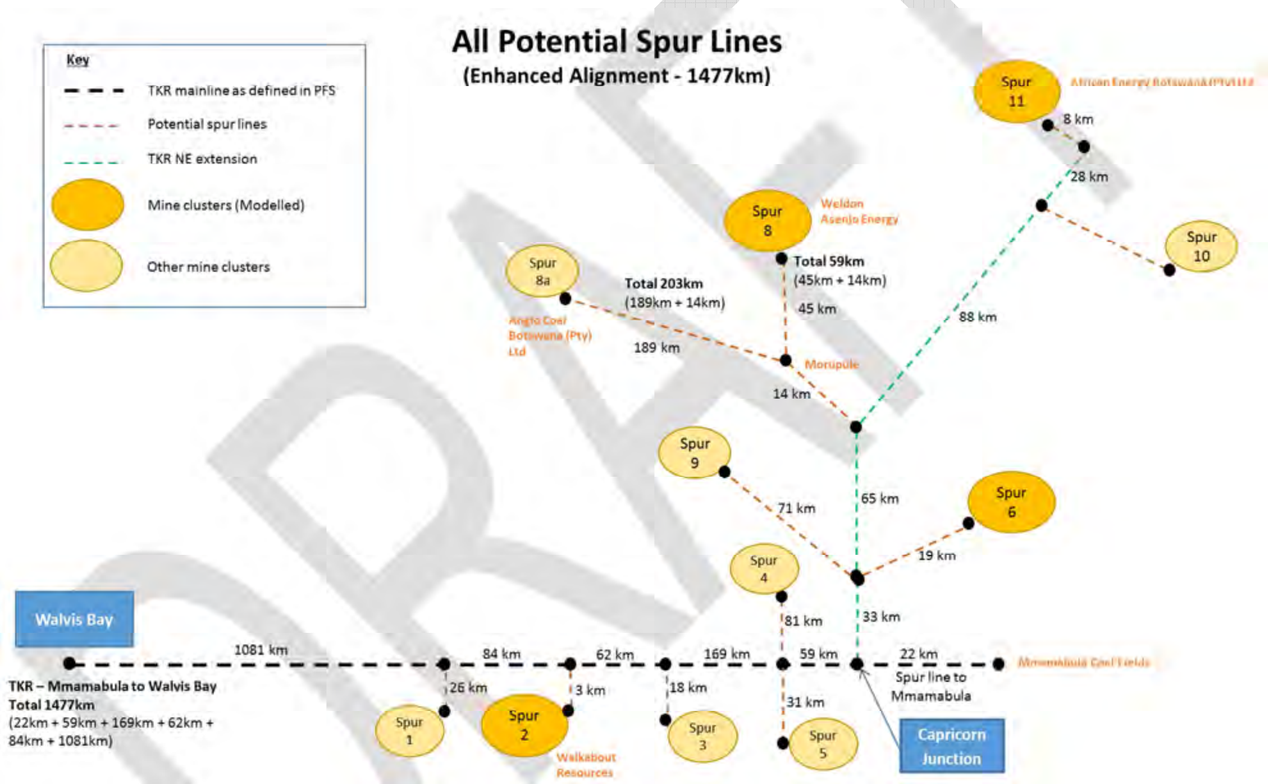


Figure 13 Potential Mine Spur Connections to TKR

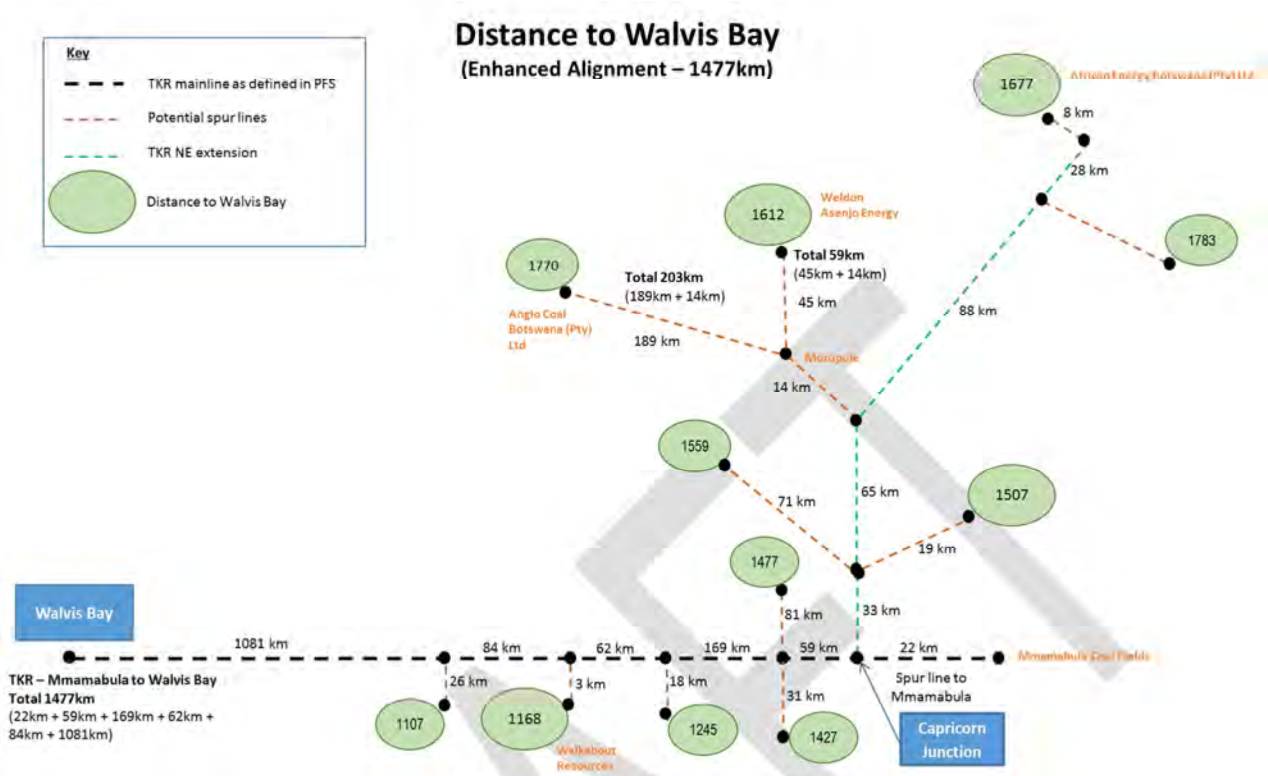


Figure 14 Potential Mine Spur Connections to TKR and resultant distance to Walvis Bay

The availability of geological data, and potential mine information, combined with the fact that modelling all potential mines will be extremely time consuming with limited additional benefit, only a select few spur lines were modelled. The information derived for these modelled spurs can be used to extrapolate the potential for those spurs not modelled. For example, the overall cost to transport coal from spurs 3, 4 and 5 is likely to be between that modelled for spurs 2 and 6.

The average cost per km for these spur lines have been derived from the unit rate per km for the TKR mainline, as summarised in Table 9 below. Since the traffic level on these spur lines will be less than on the TKR mainline, this assumption is therefore deemed reasonable if not conservative.

Table 9 Spur line Capital Cost Assumptions (per route km)

	Cape Gauge	Standard Gauge
Diesel track	3,060,000	3,110,000
Electrified track	4,260,000	4,300,000

Based on these assumptions, and the assumed length of each spur line, the capital cost estimated for each spur line was estimated to be as follows:

Table 10 Estimated Spur Line Capital Cost (USD m)

Spur	Diesel		Electric	
	Cape Gauge	Standard Gauge	Cape Gauge	Standard Gauge
1	79.6	80.9	110.8	111.8
2	9.2	9.3	12.8	12.9
3	55.1	56.0	76.7	77.4
4	247.9	251.9	345.1	348.3
5	94.9	96.4	132.1	133.3
Mmamabula (a)	67.3	68.4	93.7	94.6
6	58.1	59.1	80.9	81.7
8	180.5	183.5	251.3	253.7
8a	621.2	631.3	864.8	872.9
9	217.3	220.8	302.5	305.3
10	434.5	441.6	604.9	610.6
11	24.5	24.9	34.1	34.4

(a) Included in mainline TKR

To illustrate, the spur to service mines in cluster 6 is estimated to cost in the order of $58m to $82m depending on the gauge and whether it is electrified or not.

4.3.2 Extension of TKR

The TKR, as defined in the PFS, refers to the rail line from Mmamabula to Walvis Bay. As can be seen in Figure 13 above, a number of clusters are located north-east of Capricorn Junction (the junction to Mmamabula mine), and therefore require the TKR to be extended further north-east along the corridor comprising the existing rail line between Gaborone and Francistown. For the purposes of master planning these extensions, unit rate per km consistent with the TKR mainline has been adopted

Table 11 Estimated TKR Mainline Extension Capital Cost (USD m)

To Service Spur	Diesel		Electric	
	Cape Gauge	Standard Gauge	Cape Gauge	Standard Gauge
1				
2				
3				
4				
5				
Mmamabula				
6	101.0	102.6	140.6	141.9
8	299.9	304.8	417.5	421.4
8a	299.9	304.8	417.5	421.4
9	101.0	102.6	140.6	141.9
10	569.2	578.5	792.4	799.8
11	654.8	665.5	911.6	920.2

(a) Estimates shown are from the Mmamabula spur junction to the junction of the particular mine spur.

To illustrate, the extension of the TKR mainline to service mines in cluster 6 is estimated to cost in the order of $102m to $142m, depending on the gauge and whether it is electrified or not. This is in addition to the estimated spur capital cost shown in Table 10 above.

4.4 Minimum service requirements

Considerable investments in rail infrastructure to facilitate the loading of trains at mines will need to be undertaken. Ideally, these investments should allow for full length trains, i.e. 220 standard gauge wagon trains[4], to be brought to the mine directly for loading. The volumes expected to come from a number of these mines however will make this requirement unrealistic.

The recommendation would be to provide facilities at the mines to break the larger 220 wagon trains into smaller portions. Considering the likely train configuration (which should be verified through detailed modelling in the next stage), is a combination of five locomotives plus 220 wagons, arranged such as to minimise in-train forces whilst retaining optimal operational efficiency.

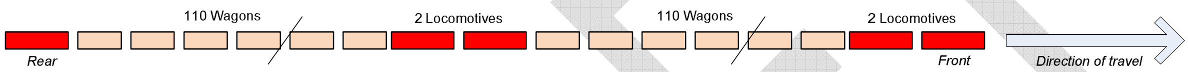


Figure 15 below illustrates such configuration, where the train comprises two rakes of 110 wagons, with the five locomotives distributed as two leading, two mid, and one rear.

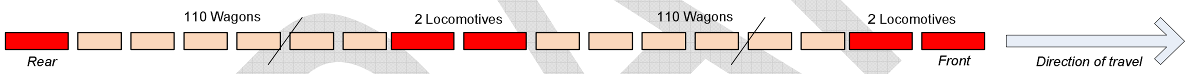


Figure 15 Likely Train Configuration (5 Locomotives + 2 x 110 Wagons)

This method of operation, i.e. sending 110 wagon rake trains directly to mines where the coal output volume is less than a certain threshold should be an integral part of the future strategy of the Trans Kalahari Rail export supply chain.

We anticipate that the new coal miners will not have the initial volume of throughput to support the development of extensive rail facilities at each mine. In the interest of the overall coal supply chain efficiency, a minimum level of service will need to be specified. Aurecon recommends the following minimum service levels to be adhered to by all new entrants to the Trans Kalahari Rail line to ensure that the integrity of the supply chain as a high volume supply chain is not compromised:

Table 12 Minimum Service Levels

Issue	Standard Gauge Specification	Cape Gauge Specification	Rationale

[4] For the Cape Gauge option, trains are likely to comprise five locomotives and 160 wagons due to the reduced haulage power of the Cape Gauge locomotives. Alternatively, six locomotives with 192 wagons may be used. More detailed modelling in the detailed design phase should fine tune this important element.

Issue	Standard Gauge Specification	Cape Gauge Specification	Rationale
Minimum number of wagons to be loaded at any one time (Hence minimum consignment size)	110	80	Size of rake within the full train length governed by the position of the remote locomotives, to facilitate putting an entire train together in minimal time
Minimum payload per wagon	103 tonnes	82 tonnes	To maximise the tonnage throughput capacity of the main line.
Maximum payload per wagon	108 tonnes	86 tonnes	To not exceed allowable axle load limits, assuming wagon tares of 22 and 20 for Standard Gauge and Cape Gauge wagons respectively.
Number of products (grades) per wagon rake train	1		To minimise stacker movements and thus delays at the port unloading
Maximum time to load a rake of wagons (subject to modelling outcomes)	3 hours for loading	2 hours for loading	To minimise impact on wagon fleet requirements
Minimum stockpile requirements at mine	12,000 t of the one product to be loaded	7,000 t of the one product to be loaded	Equivalent to one rake of wagons. To minimise delay to the loading of the train
Days and hours of operation	24 hours per day, 7 days per week		To increase flexibility of loading trains and thus maximise coal supply chain throughput capacity
Maintenance of Load Out Station (LOS) and rail facilities between LOS and mainline	Coordinated with TKR Supply Chain Coordinator		To reduce impact of maintenance and thus maximise Ore Line throughput capacity
Minimum availability of Load Out Station (LOS)	90%		To maximise efficiency of scheduling trains to LOS

4.5 Consolidation yards

Where coal miners do not have the required volumes to load a full length (220 wagons) train without breaking into parts, it is recommended that a Consolidation Yard be constructed to service several mines in the same geographic region. A Consolidation Yard allows miners to jointly fund rail facilities to break a full length train into 2 x 110 wagon rakes, before proceeding to the mine site and loading with product. This same facility allows these 2 x 110 wagon rakes to be put back together again. For clarity, the operation of rakes still requires a minimum of only one product per 110 wagon rake, however allows two products per each 220 wagon train.

Depending on the location of the facility, and proximity to mines, each Consolidation Yard may be further expanded to include loading of 110 wagon rakes of product through a multi-user rapid loading facility. The product can be transported to this facility by a variety of means[5] also jointly funded by the miners requiring this service. Common user stockyard space is recommended to facilitate smooth loading of trains, i.e. not being tied to the timing of the inflow of product from the mine.

The main operational strategy for the Trans Kalahari Rail line is recommended to involve 2 x 110 wagon rake trains on the main line to achieve the targeted throughput capacity of 65 Mtpa or more on an annual, sustainable basis. Consolidation Yards play an important role in achieving this throughput

[5] Via conveyor belts, road trucks, etc.

target by marshalling 110 wagon rakes prior to dispatching to the stockyard at the port of Walvis Bay, to be located behind Dune 7 east of Walvis Bay.

4.6 Maintenance yards

The rolling stock required to transport the coal will need to be serviced and maintained. In addition, the locomotives will need to be provisioned, cleaned, refuelled (if diesel powered). All these activities are ideally co-located in a maintenance yard. These yards will also allow consolidation of rakes into whole trains.

Due to the length of the Trans Kalahari Rail line, it is recommended that two such maintenance yards be constructed, i.e. one in eastern Botswana (e.g. near Gaborone) and one near Walvis Bay. Locating these maintenance yards near urban developments allow easy access for staff, spares and other supplies.

4.7 Botswana copper resources

Substantial copper resources can be found in Botswana. The Ghanzi and Boseto stratabound, sediment hosted copper-silver deposits of the Lake N'Gami district define the continuation of the Kalahari Copper Belt in Botswana, which stretches discontinuously for approximately 800 km along the south-eastern margins of the Damaran/Katangan rift basin, from central Namibia, extending into northern Botswana, to the vicinity of the Shinamba Hills. The Ghanzi and Boseto deposits are approximately 90 km SW of the town of Maun in northwestern Botswana. They remain relatively undeveloped with the exception of the recently developed Boseto Copper Project by Discovery Metals Limited. Refer Figure 16, Figure 17 and Figure 18.

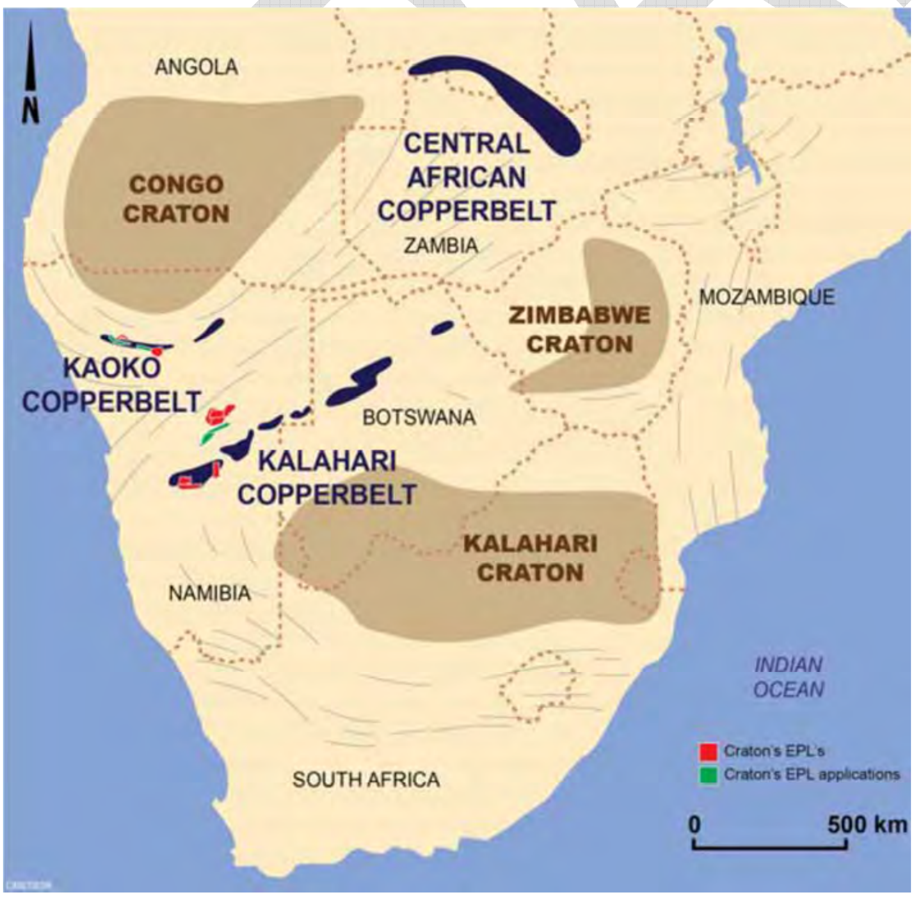


Figure 16 Kalahari Copper Belt (Source: International Base Metals Limited Presentation, February 2012)

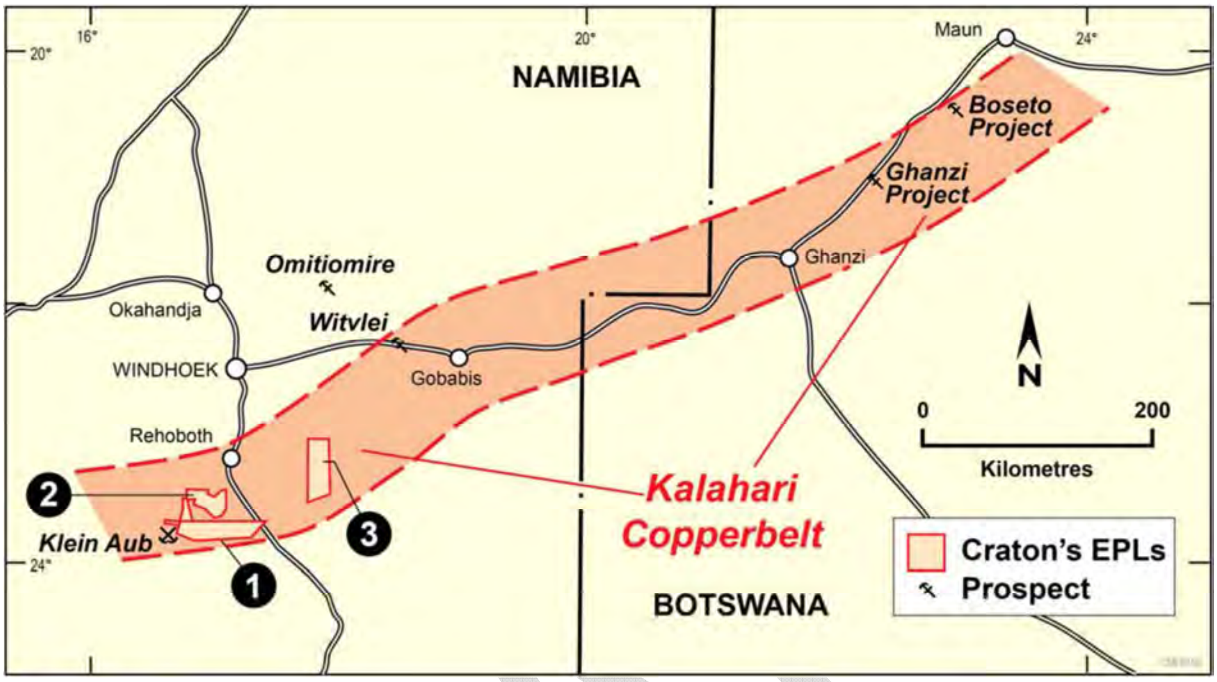


Figure 17 Kalahari Copper Belt (2) (Source: International Base Metals Limited Presentation, February 2012)

Figure 18 Botswana Copper Belt Detail (Source: Discover Metals Presentation, June 2014)

Linking the Kalahari Copper Belt to the Trans Kalahari Rail line will provide a significantly improved export supply chain for these copper deposits. As a comparison, current transportation costs for Zambian copper to the Gauteng area for procession is in the order of $75 per tonne. Transportation cost from the Kalahari Copper Belt is likely to in the same order of magnitude. Providing a significantly more efficient rail transport option (compared with road), will provide the Kalahari Copper Belt miners with a competitive advantage, and at the same time contribute to the fixed cost of developing and continuing to provide the Trans Kalahari Rail Line.

An alignment connection with the Kalahari Copper Belt deposits in Botswana has the potential to contribute up to $6m towards the fixed cost of the Trans Kalahari Rail line, assuming an annual copper ore production of say 200,000 tonnes.

It is recommended that, as part of the BFS, a more detailed assessment of the Kalahari Copper Belt resources not just in Botswana but also in Namibia be undertaken. These additional commodities have the potential to significantly contribute to the viability of the Trans Kalahari Rail line as well as provide for further diversifications of the economies of Botswana and Namibia.

4.8 Botswana manganese resources

Manganese is essential to iron and steel production by virtue of its sulphur-fixing, deoxidizing, and alloying properties. Steelmaking, including its iron-making component, has accounted for most manganese demand, presently in the range of 85% to 90% of the total demand. Among a variety of other uses, manganese is a key component of low-cost stainless steel formulations. Manganese has no satisfactory substitute in its major applications, which are related to metallurgical alloy use.

About 80% of the known world manganese resources are found in South Africa. The northern Karoo in South Africa contains a significant amount of South Africa's manganese resources. The northern extension of this world-class mineral district, the Kalahari Manganese Field, reaches into southern Botswana.

The Kalahari Manganese Field is exposed in a 90-km-long north-south belt over an area of about 400 km2 (refer Figure 19). It contains three distinct manganese units, which are interlayered with iron-rich units over a thickness of approximately 150 m. The manganese- and iron-rich units are flat lying and particularly fine grained. Production comes from secondarily enriched high-grade deposits and from lower-grade primary sedimentary manganese layers such as those in the large open-pit Mamatwan mine.

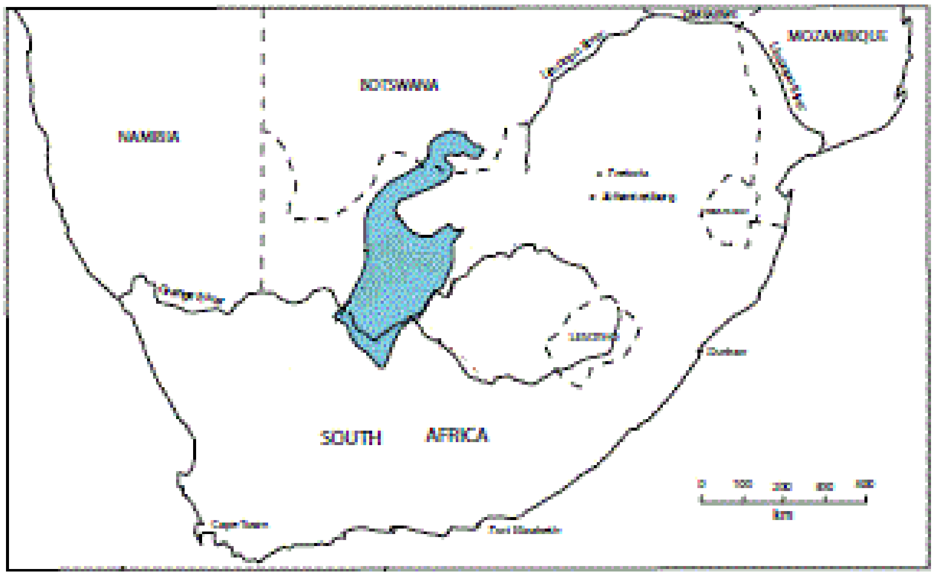


Figure 19 Kalahari Manganese Field

Exploration for manganese in Botswana to date has been limited, however the potential is there. The development of the TKR will provide a path to market for this commodity in Botswana. Once developed, the TKR will be able to be reached through a spur line connection to this future manganese ore producing district in Botswana. As such, the potential link to these future manganese resources should be investigated during the BFS.

4.9 Namibian mineral resources

Namibia ranks among the top five countries in Africa in terms of its zinc, copper and lead reserves and production. Figure 20 below shows the mineralisation of base metals. The TKR will benefit the further development of these resources.

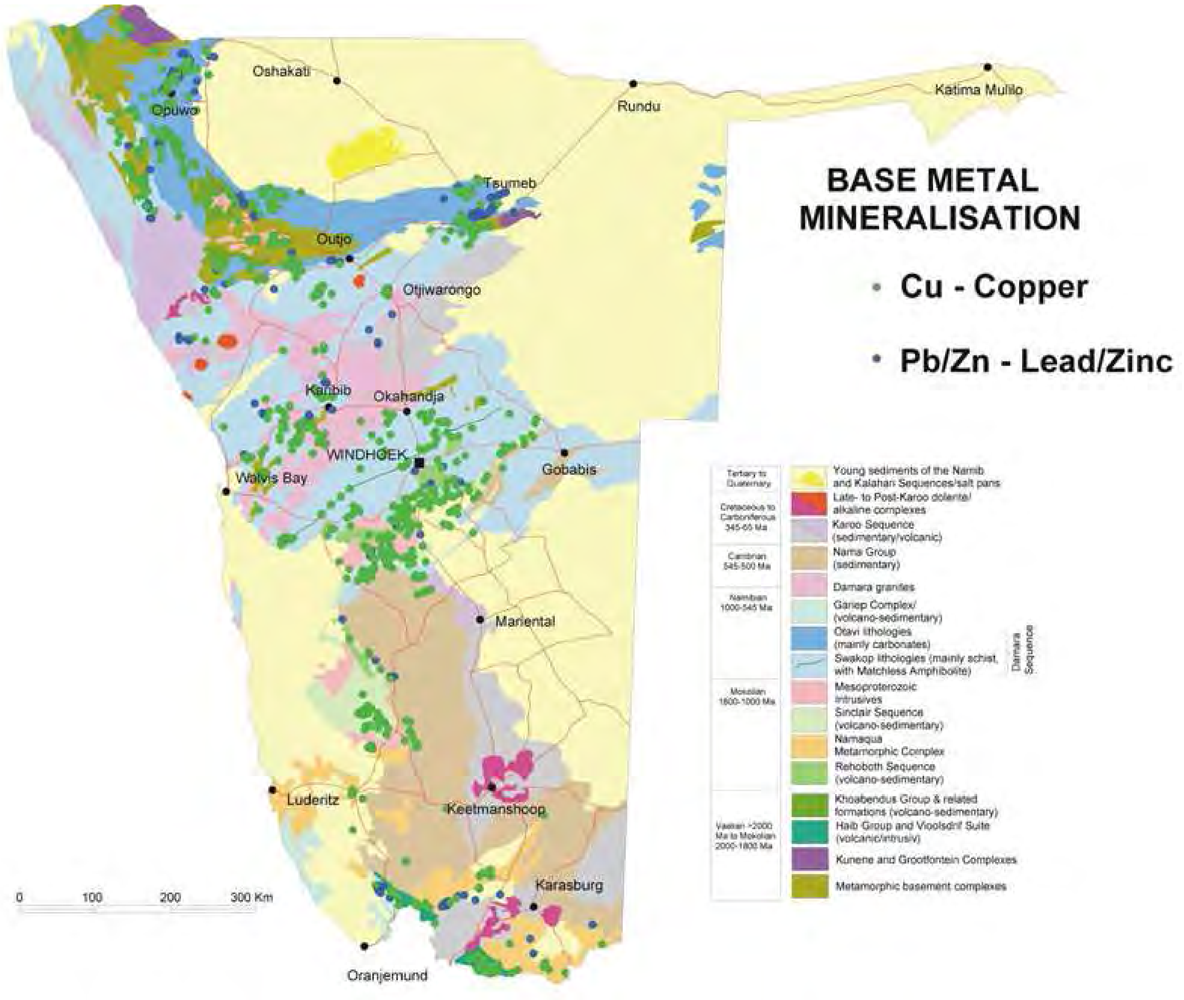


Figure 20 Namibia Base Metals Mineralisation

The BFS should investigate the potential of these commodities to contribute to the development and ongoing viability of the TKR.

5 Supply chain infrastructure

5.1 Background

The export of coal from Botswana will require the development of rail, bulk material handling, and port infrastructure to be cost efficient, to enable the users of the corridor to compete on the world coal market. This chapter of the Development Plan will articulate the infrastructure recommended and required for such an efficient export supply chain.

5.2 Rail Infrastructure

Aurecon has compiled this chapter using the extensive information already provided in previous studies such as the "Pre-Feasibility Study of the TKR Report" prepared by CPCS in 2011, and updated for any adjustments made to the alignment. A description of the rail design parameters for a world class heavy haul operation is summarised in Table 13 below.

Table 13 Design Parameters

No.	Description	Cape Gauge Diesel	Cape Gauge Electric	Standard Gauge Diesel	Standard Gauge Electric	Comments / Variation from PFS
1	**Locomotives**					
	Locomotive Type	GE Dash 9-40CW Diesel or equivalent	Class 15E or equivalent	SD70ACe Diesel or equivalent	HXD1 or equivalent	
	Horse Power	4000 hp	6000 hp	4300 hp	2 x 6300 hp	
	Minimum Continuous Speed	25.3km/h	TBA	14.0 km/h	TBA	
	Mass	160 t	180t (will need to be reduced to 160t)	195 t	184 + 200 t	
	Length	22.25m	21.38m	22.63m	35.22m (twin)	
2	**Wagons**					
	Wagon Type	Cape Gauge Tippler		Standard Gauge Tippler		
	% Under load	2%		2%		Not specified
	Wagon Payload	82.3 t		103.9 t		PFS overstated payloads marginally for the Std Gauge wagons
	Wagon Tare	20 t		22 t		
3	**Operations**					
	Maximum Line Speed	80 km/h				
	Speed Limits on down grades in loaded direction	44 km/h for 1:100, 35 km/h for 1:80, and 25 km/h for 1:60 on long downgrades where there is a risk of trains running away				
	Brake System Enhancements	electronically controlled pneumatic (ECP) braking				Not specified
	Train Size	5 Locomotives + 160 Wagons (6 Locomotives + 192	5 Locomotives + 160 Wagons (6 Locomotives + 192	5 Locomotives + 220 Wagons	5 Locomotives + 220 Wagons	Detailed simulation during the BFS on the final alignment may

No.	Description	Cape Gauge Diesel	Cape Gauge Electric	Standard Gauge Diesel	Standard Gauge Electric	Comments / Variation from PFS
		Wagons possible alternative)	Wagons possible alternative)			alter the train size marginally
4	**Track Geometry – Horizontal Alignment**					
	Mainline curve radius ▪ Desirable ▪ Preferred Minimum ▪ Minimum ▪ Absolute Minimum	> 1000m 800m 600m 300m		> 1200m 1000m 800m 400m		PFS based on curves too tight. The lower PFS standards were also not strictly adhered to.
	Yard Tracks ▪ Minimum	100m				
	Speed of Operations	see Cape Gauge sub-table below		see Standard Gauge sub-table below		

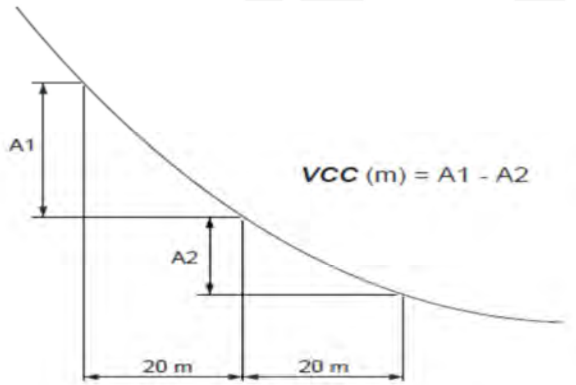
Speed of Operations – Cape Gauge:

Radius of Curve (m)	Maximum Speed (km/h)
≥80 and <100	25
≥100 and <136	30
≥136 and <212	40
≥212 and <300	50
≥300 and <415	60
≥415 and <542	70
≥542 and <687	80
≥687 and <848	90
≥848 and <1026	100
≥1026 and < 1221	110
≥1221 and <1432	120
≥1432 and <1662	130
≥1662 and < 1910	140
≥1910 and <2170	150

Speed of Operations – Standard Gauge:

Radius of Curve (m)	Maximum Speed (km/h)
Heavy Freight Lines	
≥160 and <168	40
≥168 and < 243	50
≥243 and <330	60
≥330 and <432	70
≥432 and <547	80
≥547 and <675	90
≥675 and <817	100
≥817 and <893	110
≥893	115
Other Lines	
≥160 and <212	50
≥212 and <289	60
≥289 and <378	70

No.	Description	Cape Gauge Diesel	Cape Gauge Electric	Standard Gauge Diesel	Standard Gauge Electric	Comments / Variation from PFS
		≥2170	160	≥378 and <478	80	
				≥478 and <591	90	
				≥591 and <715	100	
				≥715 and <851	110	
				≥851 and <998	120	
				≥998 and <1158	130	
				≥1158 and <1329	140	
				≥1329 and <1512	150	
				≥1512	160	
	Track Centres	The minimum track centres for new tracks should be: ▪ Coal mainlines and balloon loops 4.2m ▪ Mainline to yard track 6.5 m ▪ Quad track, between the inner tracks of track pairs 6.5 m ▪ Mainlines where mast located between 6.5 m ▪ Other mainlines 4.0 m ▪ Yard tracks TBD		▪ For curved tracks of radius less than 1000 m, track centres must be 3916 mm + 2M + (if positive only) 2.5 x (So –Si) ▪ 5200 mm for straight and curved tracks.		
	Crossing Loop Lengths	Sufficient to allow 2700m long trains, with safety margins, i.e. up to 3500m		Sufficient to allow 3700m long trains, with safety margins, i.e. up to 4800m		PFS showed “To be determined”

No.	Description	Cape Gauge Diesel	Cape Gauge Electric	Standard Gauge Diesel	Standard Gauge Electric	Comments / Variation from PFS
5	**Track Geometry – Vertical Alignment**					
	Vertical Alignment	The parameters for the design of vertical alignment of tracks must be adopted taking into account the train details and operating characteristics of the relevant rolling stock. The ruling grade must be defined by the owner as a system parameter in considering the overall design of the railway. A change in grade must not impose a vertical acceleration on traffic greater than 0.4 m/s^2, where the acceleration is calculated from the following formula: Acceleration = VCC x $(V/3.6)^2 / C^2$, where VCC = Vertical Curve Constant, V = speed in km/h, and C = VCC chord length (20 m). 				
		For Cape Gauge rail infrastructure: Steepest mainline grade incorporating curve compensation except as specified next. — 1 in 100 (1%) Steepest grade on spur line in the unloaded direction. — 1 in 50 (2%) Steepest grade in station — 1 in 200 (0.5%)		**For Standard Gauge rail infrastructure:** The steepest desirable grade is 1 in 100 (1%). Grades over short distances may be steeper than this if it can be shown that there will be no effect on train operations, including grade compensation. A vertical curve should be designed when the grade difference is:		

No.	Description	Cape Gauge Diesel	Cape Gauge Electric	Standard Gauge Diesel	Standard Gauge Electric	Comments / Variation from PFS
		yards and other yard tracks.		ΔG ≥ 2600 / V2 or ΔG ≥ 1%. where ΔG = difference between two adjacent grades in %. The vertical curve radius should be determined from: Rv = V2 / 12.96 x av where Rv = vertical curve radius in m, V = speed in km/h, and av = vertical acceleration in m/s2. The minimum vertical curve radius should be 1,300 m. The maximum vertical acceleration should be 0.4 m/s2.		
		Steepest grade through station platforms.	1 in 200 (0.5%)			
		Balloon loops	On approach side of loadout, such that the train is in continuous tension. Level from loadout to weighbridge and 20m either side. On departure side of weighbridge, compensated grade level to max rising grade of 1 in 300 (0.33%).			
		Minimum vertical curve radius in mainlines with speed ≤ 120 km/h at summit (vertical curve constant)	6670 m (VCC = 0.060 m)			
		Minimum vertical curve radius in mainlines with speed ≤ 120 km/h at sag. (vertical curve constant)	13300 m (VCC = 0.030 m)			
		Minimum radius of vertical curve in yard tracks at summit and sag (vertical curve constant)	5350 m (VCC = 0.075 m)			
		Minimum radius of vertical curve in mainlines with speed >120km/h at summit (vertical curve constant)	13300 m (VCC = 0.030 m)			
		Minimum radius of vertical curve in mainlines with speed >120km/h at sag. (vertical curve constant)	26600 m (VCC = 0.015 m)			

A description of the rail infrastructure is provided below.

Table 14 Rail Infrastructure (Northern Enhanced Alignment)

ID	Description	Type/Detail	Units	Quantity
1	**General**			
a	Route Length (Mainline)	From junction to Mmamabula mine (i.e. Capricorn Junction) to Walvis Bay	km	1455
b	Number of Passing Loops	On Mainline	no.	24
c	Mainline TKR extension	beyond junction to Mmamabula mine	km	33 + 65 + 88 + 28
d	Mine Spur 0	Mmamabula	km	22
e	Mine Spur 1		km	26
f	Mine Spur 2	Walkabout Resources	km	3
g	Mine Spur 3		km	18
h	Mine Spur 4		km	81
i	Mine Spur 5		km	31
j	Mine Spur 6		km	19
k	Mine Spur 7		km	
l	Mine Spur 8	Weldon Asenjo Energy	km	59
m	Mine Spur 8a	Anglo Coal Botswana	km	203
n	Mine Spur 9		km	71
o	Mine Spur 10		km	142
p	Mine Spur 11	African Energy Resources	km	8
2	**Superstructure**			
a	Rail – Mainline & Loops	60kg / metre rail	km	3,140km
b	Rail – Other (Yards)	50kg – 60kg / metre rail	km	300km
c	Rail - Spurs	60kg / metre	km	1,366km
d	Rail - TKR extension	60kg / metre	km	428km
e	Sleepers – Mainline & Loops	Concrete Pandrol PY	no.	2.6million
f	Sleepers – Other (yards)	Concrete Pandrol PY	no.	0.5million
g	Sleepers - Spurs	Concrete Pandrol PY	no.	1.1million
h	Sleepers - TKR extension	Concrete Pandrol PY	no.	0.4million
i	Ballast (Mainline & Loops)		m^3	3.4million
j	Turnouts – Mainline Crossing Loops	1 in 16 or equivalent	No.	48
3	**Sub-structure**			
a	Capping Layer		m^3	5,700
b	Fill Material		m^3	41.21
c	Cut Material		m^3	16.55
d	Cross Drainage Culverts			

ID	Description	Type/Detail	Units	Quantity
4	**Structures**			
a	Road over rail bridge	Gravel	Total length (m)	300
b	Road over rail bridge	Surfaced	Total length (m)	2,040
c	Rail over river bridge	Small (<20m)	Total length (m)	3,382
d	Rail over river bridge	Medium (20 - 500m)	Total length (m)	13,200
e	Rail over river bridge	Large (>500m)	Total length (m)	3,110
f	Tunnels		no.	3
g	Tunnel 1 length		Length (m)	3,885
h	Tunnel 2 length		Length (m)	11,408
i	Tunnel 3 length		Length (m)	402
j	Viaduct (across Schwelle)		Total length (m)	45,000

5.3 Port & Stockyard Infrastructure

The Prefeasibility Study completed in 2011 describes a concept for a coal export facility at the Walvis Bay site. The PFS concept broadly includes:

- Staged development for 16.8 Mtpa and 65 Mtpa throughput steps
- Relatively low capacity unit train size (both wagon payload and total consist payload)
- Rotary tippler unloading method with up to 5 unloading stations for 65 Mtpa
- Large volume, dedicated stockpile storage regime
- Multiple Stacker/reclaimer stockyard machines servicing a relatively short and wide stockpile footprint
- 3 shiploaders and 3 berths to service 65 Mtpa

The concept as presented in the PFS appears workable however is possibly not fully optimised for the likely operational parameters of the complete export supply chain, particularly at the higher throughput. Further, a number of the key parameters that inform the early stages of definition of a coal export facility are known to have evolved following publication of the PFS to the extent that development of a revised concept, to be further developed and ratified during the BFS, is appropriate to guide the early stages of the BFS data collection and concept development phases.

It is noted the PFS concept allows for a low capacity early stage development and relatively low wagon payload. These two factors dictate relatively low capacity rail unloading facilities at the port which require multiple facilities for higher throughput. The need to receive and stack out from multiple rail unloading stations then has an effect on the number of stockyard machines and affects the complexity of the stockyard layout. On the ship-loading side, the low throughput initial development also drives a relatively small ship-loading string capacity which subsequently requires multiple systems for the higher throughput levels.

The BFS will consider a high throughput initial development with the opportunity to utilise high payload wagons and large unit train sizes. This allows an improvement in rail unloading capacity from an individual unloading station and therefore fewer stations to service a given capacity. This, combined with fewer but higher capacity ship-loading systems enables a less complex facility configuration.

This section of the Development Plan report identifies the key issues and information requirements to guide the development of the configuration of the export facility concept during the BFS, and presents a revised concept based on the currently understood requirements and parameters including those discussed above.

5.3.1 BFS data requirements

The following table summarises the key parameters and their influence on the facility configuration and operation that are important to define before or early in the BFS stage. It is envisaged that the list of issues in the table below will be developed through consultation with stakeholders early in the BFS.

To provide some indication of a likely terminal configuration, a summary of assumptions based on currently known or assumed values for each of the parameters in the following table is provided in Section 5.3.2 together with a description of a possible suitable configuration.

Table 15 Key Parameters Influencing the Coal Export Terminal

Item	Parameter	Influence on facility configuration and operation
1	Throughput targets and growth increments	Both the initial start-up capacity and expected growth increments are critical factors for the selection of equipment capacities and facility configuration. Large throughput increments typically require cost-effective addition or extension of major capital infrastructure and favour a lower number of high capacity systems. Conversely, smaller incremental steps require either the ability to stretch the capacity of existing infrastructure and/or add low capacity infrastructure so as not to over-invest in latent capacity. Therefore this approach favours lower capacity systems however for a given ultimate capacity, more infrastructure is typically required for a high overall Capex. The ultimate throughput requirement is important to guide the overall facility layout to be efficiently expanded according to the expected growth profile.
2	Stockyard site land availability and configuration	The size and shape of the available land for the stockyard affects the total storage volume as well as the length and number of individual stockpiles. The latter subsequently affects the machinery requirements to service the stockpiles. In addition to the physical configuration of the facility, land availability can also affect the facility operating methodology. For a constrained site, a “cargo-assembly” operating mode may be preferred to reduce stockpile storage requirements compared to a “dedicated storage” mode where larger stockpile storage is typically required. Note however that land availability is only one factor affecting operating mode selection. Refer further below.
3	Technology selection	Consideration should be given to the services and skills currently available, or to be developed in the local area that will be required to support the ongoing operation and maintenance of the facility. Specialist skills and equipment (eg instrumentation and control technicians, rail and stockpile logistics planners, structural integrity and condition monitoring technicians, high capacity mobile cranes etc) are required for the ongoing support of some equipment that may be relatively uncommon in the region. This may lead to a preference for a lower technology (eg dozer reclaim) or higher technology (eg high capacity bucketwheel stacker-reclaimer machines) solution for the facility which will have a significant effect on the facility layout, Capex and Opex profile.

Item	Parameter	Influence on facility configuration and operation
4	Coal mix and proportions	To guide the selection of the Dedicated or Cargo Assembly operating mode, in addition to land availability requested in item 2 above, the following are the key parameters: - Number of users/mines involved - Number of different coal types to be handled and throughput proportions of each type. E.g. is the throughput dominated by a particular subset of product types? - Number of coal types that must be kept completely separate and cannot be combined with other remnants in stockpile Dedicated storage at the export facility allows for a regular mine production and railing schedule, with the export facility stockyard forming the main buffer between the mining operations and shipping. This method tends to simplify mining and railing operations however requires relatively large buffer storage at the export facility to accommodate the irregular shipping pattern. Stockyard area restrictions (limited by land availability and investment) may limit the number of product types that can be stored since volume/product type is set by shipping variability. Cargo assembly generally requires the mine stockyard/s forming the main buffer between mine production and shipping and is particularly useful where land area at the Port may be limited. Stockyard area requirements are determined by the cargo assembly time from mine to port and this time is reduced by campaign railing of the required cargo's from mine to the export facility to meet the predetermined shipping queue. Cargo assembly mode tends to become more favoured when the facility is required to handle a large number of discrete products with low throughputs and variable shipping patterns. Mixed-mode operation (ie part dedicated, part cargo assembly) may also be appropriate if there are a few higher throughput coal types and a number of smaller throughput types.
5	Shipment size and variability for each coal type	This has significance for a dedicated storage/regular railing facility where this directly drives stockpile volume requirements. In a cargo assembly facility, only the variability in shipping frequency across all ships is of interest (rather than per products type) as this drives the average retention time. Hence, for a multi-user facility if there are large variations in shipping frequency for individual shippers, a cargo assembly approach will provide significant benefits in reducing stockpile volume requirements.
6	Rolling-stock details: - Unit train size presenting to the export facility unloading station - Individual wagon capacity and length - Bottom Dump or Tippler style	Significant factor in determining the train unloading infrastructure requirements including number and capacity of rail unloading stations and associated inloading systems. Further affects the stockyard configuration to ensure multiple unloading stations can be serviced concurrently so as not to delay train cycle times. This not only affects the required number of stacking paths (which may also affect reclaiming/ship-loading operations for dual function stacker-reclaimer machines) but also affects the need for multiple stockpile locations for each coal type.

Item	Parameter	Influence on facility configuration and operation
7	Train operations at the export facility that determine train arrival pattern at the unloading station	Impacts the availability of trains at the unloading station and the required inloading rate to achieve a given annual throughput. If locomotive decoupling for servicing and/or consist division is required, the ideal situation is to have a rail arrival yard with buffer capacity and sufficient number of service locomotives so that delays associated with decoupling and mounting of service locomotives, brake wagons etc. and re-formation of consists occur as parallel activities that do not influence the dumping sequence.
8	Are there any extraordinary delays in railing or shipping that are desired to be buffered by stockyard capacity at the terminal that are outside of 'normal' operation?	May add to stockyard volume requirements at the terminal by driving a particular min % of throughput criteria for dedicated storage or minimum retention time for cargo assembly.
9	Is there a requirement for blending at the export facility – either upon stacking to the stockpiles or upon reclaim to ship-loading? If blending is required: ▪ What proportion of throughput would be blended? ▪ How many products would be blended in a single blend (2-way, 3-way)? ▪ In what potential proportions (50/50, 80/20 etc)?	Requirements for blending upon loading to the vessel have a very significant impact upon the determination of the type of stacking and reclaiming equipment required. For stacker/reclaimer type stockyards this impacts the required number and capacities of reclaimer machines. For cases where significant three-way blending is required stacker/reclaimer type stockyards may become impractical and the use of dozer reclaim to underground reclaim tunnels may become the only viable option.
10	Stockyard storage method and allocation	For dedicated storage mode of operation, areas would typically be allocated to User companies and within those, to specific brands that are repeated in two or more locations across the stockyard. This allows simultaneous access to the same product for loading concurrent vessels. If there are a large number of products, multiple outloading systems and cross-user multi parcel vessels allowed, the pursuit of a dedicated storage concept with bucketwheel reclaimers may become unfeasible because of the high level of repetition of stockpile types or yard machines that would be required. The situation may force a cargo assembly approach to be adopted. Alternatively, dozer reclaim to multiple outlets under dedicated storage areas may be a preferred option. For cargo assembly mode of operation, residence and cargo assembly times are the important factors to determine stockpile size requirements and allocation methods.

Item	Parameter	Influence on facility configuration and operation
		The target residence time is the buffer that is managed to absorb railing or other upstream delays. The average time to assemble is a function of the rail network and particularly the extent of campaign railing that is possible from each source mine loadout facility. Short assembly times can be problematic to maintain for rail systems with widely varying distances between mine and port, or for systems with poor mine loading characteristics (which could be due to poor rail infrastructure, or mine stockpiling and loading infrastructure which will limit the dispatch rate of trains from that load point).
11	Typical ship size mix. i.e. the proportion of Handi's, Panamax and Cape size vessels.	Contributes to berthing delays and hatch change delays (frequency and duration) and is therefore a major factor in berth/shiploader productivity and utilisation. Significant factor in determining the offshore infrastructure requirements including number and capacity of berths and shiploaders, and associated outloading systems.
12	Coal properties – lump size, bulk density, dustiness, cohesive flow properties.	Impacts stockyard cross-section design, materials handling plant sizing and provisions for dust control.
13	Product sampling/testing requirements at the export facility.	Informs requirements for accommodating sample stations which may be located on the inloading, outloading or both sides of the stockyard
14	Other requirements	There are many other issues that will need to be addressed and resolved during the BFS stage that may affect the export facility configuration and operation that will have a bearing on Capex and Opex. An example of some of the issues (not exhaustive) are listed below: ▪ Environmental/community requirements ▪ Stockyard dust suppression requirements – water availability ▪ Wagon washing/cleaning facilities ▪ Ship provisioning requirements ▪ Tugging facilities and requirements ▪ Level of automation ▪ Security provisions

5.3.2 Facility configuration

5.3.2.1 Assumed input data

The following table lists the current understanding of the confirmed, likely or assumed input data for the export facility configuration and operation assessment. Each of the assumptions below require further assessment and confirmation during the BFS however are suitable and appropriate for a high capacity, long haul rail transport system.

These parameters are used in the following section to propose a facility configuration.

5.3.2.1.1 Throughput targets and growth increments

- Start-up capacity 65 Mtpa CONFIRMED
- Options for further expansion to be investigated (Large increments in the order of 15 Mtpa ASSUMED)

5.3.2.1.2 Stockyard site availability

- Walvis Bay site CONFIRMED
- Rail approach from the north CONFIRMED
- No land availability issues for either size or configuration CONFIRMED

5.3.2.1.3 Technology selection

- It is ASSUMED that higher technology, automated type equipment is acceptable, however this requires further discussion and assessment during the BFS. The assessment should consider the facility operational model (i.e. owner operated or contracted) and the ability of the operator to meet the resource needs for a large-scale facility with skills and resources matched to the technology of the plant. This may be a particular challenge if the operator does not have previous experience with facilities of this type

5.3.2.1.4 Coal mix and proportions

- ASSUME 4 mining operations each with 3 different products that need to be separately stockpiled
- ASSUME total throughput shared roughly equally between each of the miners
- ASSUME each miner has 2 major products and one minor product (e.g. 40/40/20% proportions)

5.3.2.1.5 Shipment size and variability

- ASSUME ship arrivals for each coal type in proportion to throughput for that type with normal level of ship arrival variability.
- ASSUME ship sizing in item 12 below applies generally to all coal types exported

5.3.2.1.6 Rolling Stock Details

- ASSUME 240 rake for main haul, split in two x 120 rakes for unloading at the export facility
- ASSUME 100t individual wagon payload
- ASSUME tippler style wagons although this requires further assessment and trade-off studies during the BFS between tippler and bottom dump wagon styles.

Both bottom dump and tippler styles are suitable for this scale of operation although the bottom dump style will maximise the efficiency of the export facility as higher unloading rates are achievable compared to tippler style.

It is feasible to achieve the start-up capacity of 65 Mtpa with 2 high capacity, continuous movement, bottom dump style rail unloading stations provided there is adequate queueing and train servicing facilities upstream of the export facility to allow reliable and ordered dispatch of trains to the export facility unloading stations. This should be possible for a new and dedicated heavy haul rail system that is not constrained by other network operations.

However, it is possible that tippler style wagons are more suitable for this application given the very long haul rail system for the following reasons:

- Higher payload per wagon for a given gross mass improves rail efficiency
- Shorter overall length for a given payload reduces passing bay lengths etc.
- Lower complexity wagons (no door mechanisms) reduce unit wagon cost and improve wagon reliability
- Reduced risk of coal hang-up in wagons at discharge point due to consolidation over very long transport route and time
- Higher likelihood of back-load capability
- Lower unload rate for tippler wagons compared to bottom dump does not significantly affect total train cycle time

For the reasons above, it is expected that tippler style wagons are preferred however the lower unloading rates require that a minimum of 3 unloading station will be required for the 65 Mtpa start-up capacity.

5.3.2.1.7 Train arrival pattern at the unloading station

- It is ASSUMED that a train marshalling and handling facility upstream of the export facility will allow a reliable and timely dispatch of trains independently to each of the unloading stations.

Given the length of the haul route, it is anticipated that very long trains (e.g. 240 wagon rakes) would arrive at the upstream marshalling facility. For tippler unloading style wagons, these would need to be split into half rakes (e.g. 120 wagon rakes) to enable handling by the tippler indexer/positioner. The longer rakes are too heavy to be handled efficiently by the indexer/positioner and unloading rates would suffer.

It is assumed that the train marshalling facility has buffer capacity and sufficient number of service locomotives so that delays associated with decoupling and mounting of service locomotives, brake wagons etc. and re-formation of consists occur as parallel activities that do not influence the arrival sequence and in particular, the inter-arrival time between consecutive trains at each of the unloading stations.

5.3.2.1.8 Extraordinary delays in railing or shipping

Given it is important that to maximise the efficiency of the rail system, the export facility should be able to receive and unload trains as a priority. Therefore it is proposed to include an additional stockpile storage buffer for each product type to accommodate delays in ship arrival of up to 3 days from the planned arrival. This has the effect of requiring an additional 3 days' of rail deliveries to be stored in each product stockpile area.

5.3.2.1.9 Blending requirements

- ASSUME 50% of throughput could be blended.
- ASSUME blending on reclaim from stockpile
- ASSUME maximum 2-way blends
- ASSUME blending proportions from 50%/50% to 65%/35% proportions

5.3.2.1.10 Stockyard storage method and allocation

The advice and reasoning documented in the PFS supporting a preference for a dedicated storage mode of operation for this facility is reasonable, given the assumptions of regular rail scheduling, typical ship arrival patterns and the key assumption of relatively few coal types, each with a regular production and shipping profile.

Each of these assumptions will need to be validated during the BFS and significant variance to any of these assumptions may affect the preferred mode of operation and/or stockpile allocation methodology.

Based on the above assumptions and Dedicated Storage operational mode, further detail of the stockpile allocation methodology is provided in Section 5.3.2.2.1.

5.3.2.1.11 Ship size mix

While it is acknowledged that the PFS report indicates an average design vessel as 170 dwt Capesize vessel, our experience is that for the seaborne thermal coal market, some mix of other vessel classes and sizes is likely. The following vessel mix is ASSUMED based on ship history data from other facilities:

Class	Nominal dwt	Proportion of Vessels	Average dwt
Cape	>125,000	30	170,000
Panamax	60,000 – 125,000	60	80,000
Handy	< 60,000	10	50,000

It is assumed that the number of geared vessels will be negligible. Geared vessels negatively impact facility performance by increasing hatch change delay time and therefore reducing shiploading gross rate.

5.3.2.1.12 Coal properties

- ASSUME typical properties with no particular exceptions.

The handleability characteristics of the coal would ideally be assessed by laboratory testing during the BFS to confirm cohesiveness parameters which are important for transfer chute, bin and hopper design. These factors affect the facility layout and should be determined early in the project lifecycle.

5.3.2.1.13 Product sampling/testing requirements

- ASSUME sampling on reclaim side of stockpile only

5.3.2.1.14 Other requirements

The parameters referred to above are sufficient to define a basic definition of the export facility functional requirements and enable a high level arrangement and operation to be proposed. Other requirements will need to be discussed and developed in detail during the BFS however are not addressed further in this report.

5.3.2.2 Proposed arrangement

5.3.2.2.1 Stockpile storage requirements

At this early development phase, the empirical methods described in the PFS for determining stockpile storage volume requirements are appropriate. These are as follows:

- Criteria A – 3 x average parcel size
- Criteria B – 2 x max parcel size
- Criteria C – percentage of throughput with indicative range of 6 – 10%.
- Additional criteria – 3 days of rail deliveries for each product type

The maximum of each of criteria A, B and C could be used and added to the additional criteria however in reality, there are overlaps in some of the allowances and so judgement should be used to determine and appropriate storage requirement.

The following table provides a summary of the parameters that are applicable to the selection of an appropriate storage requirement for each of the assumed “low” and “high” throughput coal types. From section 5.3.2.1.4, there are assumed to be 8 high and 4 low throughput coal types. The total stockpile volume requirement is the sum of the individual storage requirements for each of the 12 coal types according to the individual storage requirements proposed below.

Parameter	High throughput coal types	Low throughput coal types
Typical annual throughput	6.5 Mtpa	3.25 Mtpa
Average single-type parcel size (simplified):		
▪ Average unblended Cape (approx. 25% throughput)	170,000 t	
▪ Average blended Cape (approx. 25% by t/put)	85,000 t	
▪ Average unblended Panamax (approx. 25% by t/put)	80,000 t	
▪ Average blended Panamax (approx. 25% by t/put)	40,000 t	
▪ Weighted average parcel size	93,750 t	
Max parcel size (200k dwt Cape)	200,000 t	
Criteria A – 3 x Average parcel size (93,750 t)	280,000 t	280,000 t
Criteria B – 2 x Max parcel size	400,000 t	400,000 t
Criteria C – 6-10% of throughput	390-650,000 t	195-325,000 t
Additional storage – 3 days a rail deliveries	53,000 t	26,000 t
Proposed storage capacity per product type	**450,000 t**	**325,000 t**
Total storage requirement	**4,900,000 t**	

5.3.2.2.2 Train Unloading system

Modern, high capacity tippler/indexers systems can achieve tipping cycle times in the order of 90 seconds. Using dual-cell tipplers and nominal 100t payload wagons, unloading rates of up to 8,000tph are achievable.

Using equipment of this specification, combined with an upstream train handling/marshalling facility that allows for a utilisation level of 80% for the unloading stations, annual throughput of approximately 30 Mtpa is achievable from a single unloading station provided stacking has priority over reclaiming.

The following indicates the key performance parameters based on the assumed conditions for each unloading facility:

Parameter	Unit	Value
Train configuration	No. wagons x payload	120 x 100t
Cycle time per wagon pair	sec	90
Capacity during unloading	tph	8000
Gross unload rate (from start to end of train unloading)	tph	6800
Annual Capacity per unloading station	Mtpa	30

While 3 unloading facilities each capable of 30Mtpa is in excess of the initial facility requirements, operation of the unloading facilities at low utilisation is likely preferred so as not to constrain rail operations which are seen as the critical element of the project.

Based on the above assessment, the following configuration is proposed:

Unloading System - Start-up configuration for 65 Mtpa

- 3 x dual cell tippler and indexer/positioner systems, 90 second cycle time, 16,000t approx. total consist mass (12,000t payload in 120 x 100t wagons)
- 2 x 200t unloading hoppers per unloading station, each with 2000mm wide feeder belt, 4000tph
- 3 x inloading conveyors, 2200mm belt, 8000tph, partly underground under unloading stations

Unloading System – Potential future expansion

- The requirement for 3 unloading stations to achieve the start-up capacity of 65 Mtpa results in significant unused, “latent” capacity in the unloading system. Should other parts of the export facility be upgraded, the total capacity of the unloading system of 90 Mtpa is possible. With further optimisation of various aspects of the unloading equipment and the train dispatch process, and assuming improvements in system availability as operational experience is gained, it may be possible to achieve up to 100 Mtpa with 3 unloading stations.

5.3.2.2.3 Shiploading system

High capacity shiploading systems with peak delivery rates in the order of 8000 – 8500 tph are typically able to achieve throughputs in the order of 30 Mtpa where a single shiploader services a single berth, increasing to around 35 Mtpa where a single shiploader services 2 berths. The higher capacity of the latter configuration results from reduction or elimination of ship berthing/deberthing operational delays.

Throughputs of this order are contingent on efficient stockpile reclaiming systems where there are relatively few delays due to reclaimer non-availability or inability of a reclaimer to access the required coal type. Delays of this type become more frequent and lengthy as:

- The number of coal types increase and reclaimer access to coal types reduces, further exacerbated with blending operations where unavailability of any one coal type suspends the entire ship loading process
- Interruptions to dual-purpose stacker-reclaimer machines to service train arrivals as a priority
- Longer stockyards due to machine relocation delays and particularly so where vessels are loaded with multiple coal types requiring frequent change in reclaimer position from one pile to another
- Stockpile configurations that require complex reclaim patterns that reduce reclaimer machine efficiency

The shiploader/berth capacities nominated above are contingent on delays due to the above effects being reasonably well controlled. Configuration of the stockyard including pile geometry and yard machine type, number and size are important parameters that have a significant bearing on the delays imposed by the stockyard on the outloading/shiploading system. Further detail of the proposed stockyard configuration is provided in Section 5.3.2.2.4

In order to optimise net shiploading rates, it is proposed to utilise a surge bin in each of the outloading systems. This surge bin is sized to allow stockyard reclaimers to continue reclaiming during typical hatch change periods so that hatch change delays do not impact upon stockyard reclaim rates and vice-versa.

Based on the inclusion of an outloading system surge bin, and stockyard delays to shiploading kept at a reasonably low level, preliminary calculations have confirmed the following capacity could be achieved based on the vessel mix described in Section 5.3.2.1.11:

Parameter	Unit	Single shiploader, single berth	Single shiploader, two berths
Average reclaim rate	tph	7500	7500
Surge bin capacity	t	2000	2000
Shiploading rate	tph	8000	8000
Gross loading rate (from start of one vessel to start of next)	tph	3900	4500
Annual Capacity per outloading string	Mtpa	30	37
Combined capacity for 3 berths, 2 shiploaders	Mtpa	70 - 72	

Therefore, the proposed shiploading system configuration is as follows:

Shiploading System - Start-up configuration for 65 Mtpa

- 2 x 8000 – 8500 tph capacity shiploaders
- 3 Cape-size vessel berths, in-line such that both shiploaders can service 3 berths
- 2 x jetty and shiploader feed conveyor systems, 2000mm wide belts, 8000tph

Shiploading System – Potential future expansion

The following provides basic expansion steps for the shiploading system up to the latent capacity of the 3 train unloading stations. Note that each expansion step assumes additional capacity is available or added in the stockyard to keep yard system delays approximately the same.

- Start-up: 3 x Berths, 2 x 8000tph shiploaders – max capacity approx. 70-72 Mtpa
- Step 1 additional berth: 4 x Berths, 2 x 8000tph shiploaders – max capacity approx. 74-75 Mtpa

- Step 2 additional shiploader and outloading system: 4 x berths, 3 x 8000tph shiploaders – max capacity approx. 90 – 95 Mtpa

It is noted that a third outloading and shiploading system represents a step change to the terminal complexity particularly in regard to stockpiling strategy and reclaim efficiency. This is due to the need for coal types to be replicated a number of times in the stockyard to provide sufficient reclaimer access to most coal types to ensure reclaim delays remain acceptable. This becomes particularly difficult if combined with an increase in the number of coal types (which often occurs in-line with total throughput increases). Therefore, projections for throughput capacity with 3 outloading strings becomes even more dependent on the coal product mix.

5.3.2.2.4 Stockpile layout and machine configuration

A number of options exist for the stockpile layout including the type and size of stockyard stacker and reclaimer machines, number of stockpile rows and capacity and placement of individual coal type stockpiles throughout the stockyard.

The stockyard arrangement must suit the inloading and outloading configuration and allow suitably efficient operation of each system without causing excessive delay to each other.

For a dedicated storage mode of operation, the start-up configuration of the inloading and outloading systems for 65Mtpa described above, the stockpiling system is preferably able to:

- Accommodate simultaneous operation of 3 rail unloading stations (albeit at relatively low utilisation for 65 Mtpa) and 2 shiploading systems.
- Is preferably able to accommodate simultaneous reclaim operations for 4 different coal types to satisfy the requirement for a high proportion of blended cargoes
- Allow access by all stacking and reclaiming machines to all coal types and for dual machine reclaiming operations, allow pairs of machines to access the same coal type simultaneously

The preferences above represent an ideal situation for a fully flexible operation with minimal restrictions to stacking and reclaiming operations due to yard “conflicts” (where machines are unable to access a particular coal type stockpile). However providing this level of flexibility typically requires a high level of infrastructure, and this becomes more extensive as the number of different products increases.

This is because full flexibility to avoid machine conflicts requires replication of coal types throughout the stockyard to enable access by all stacking and reclaiming machines. The level of replication of different coal types is in turn affected by the machine and pile configuration.

Full replication is preferred for high throughout coal types however it may be possible to accept a lower level for lower throughput coals. The ship cargo patterns may also allow a reduction in the level of replication should certain coal types never be shipped together.

Therefore, determination of the ideal level of flexibility and distribution of coal types in the stockyard is a relatively complex task (increasing in complexity as the number of coal types increase) and requires a detailed assessment of the product throughput mix (coal types and quantities) as well as the likely shipping patterns including the likelihood, frequency and make-up of multi-cargo shipments.

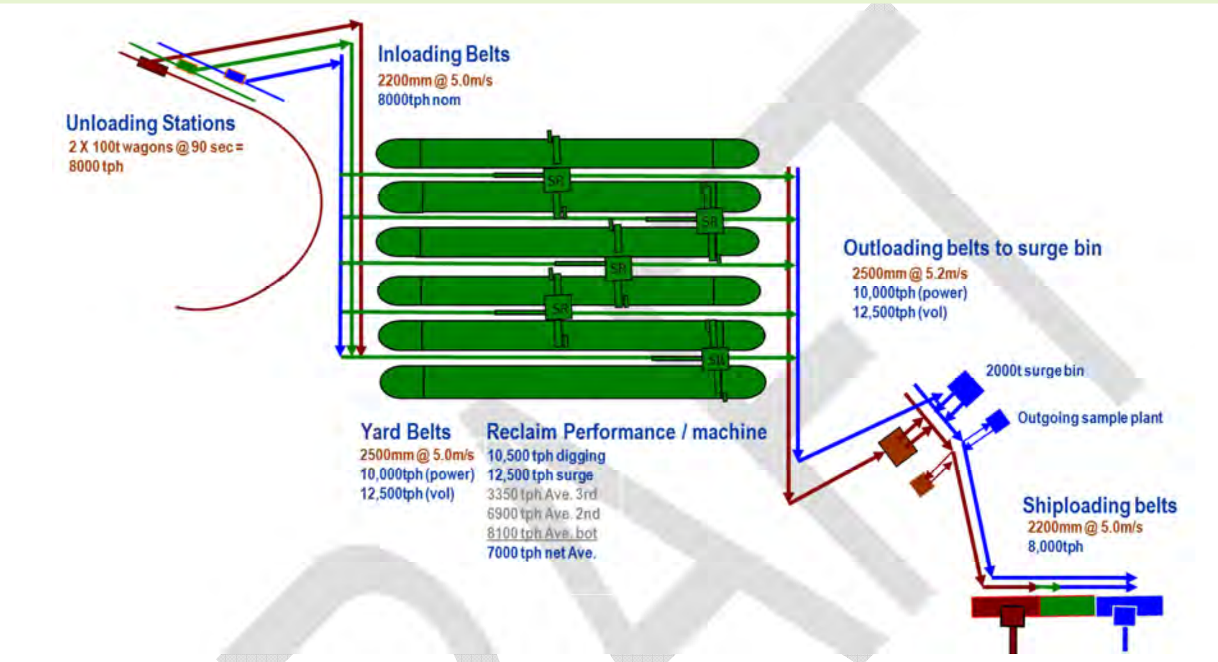
The following section describes the various stockyard configuration options that are possible and associated advantages and disadvantages of each.

5.3.2.2.5 Stockyard configuration options

OPTION 1

Dual-purpose stacker/reclaimer machines each individually capable of achieving the inloading and shiploading rate

Minimalist solution for the start-up case would include 5 x high capacity SR’s (8,000tph stack, 10,500tph peak reclaim) each on a separate runway servicing 6 pile rows in total

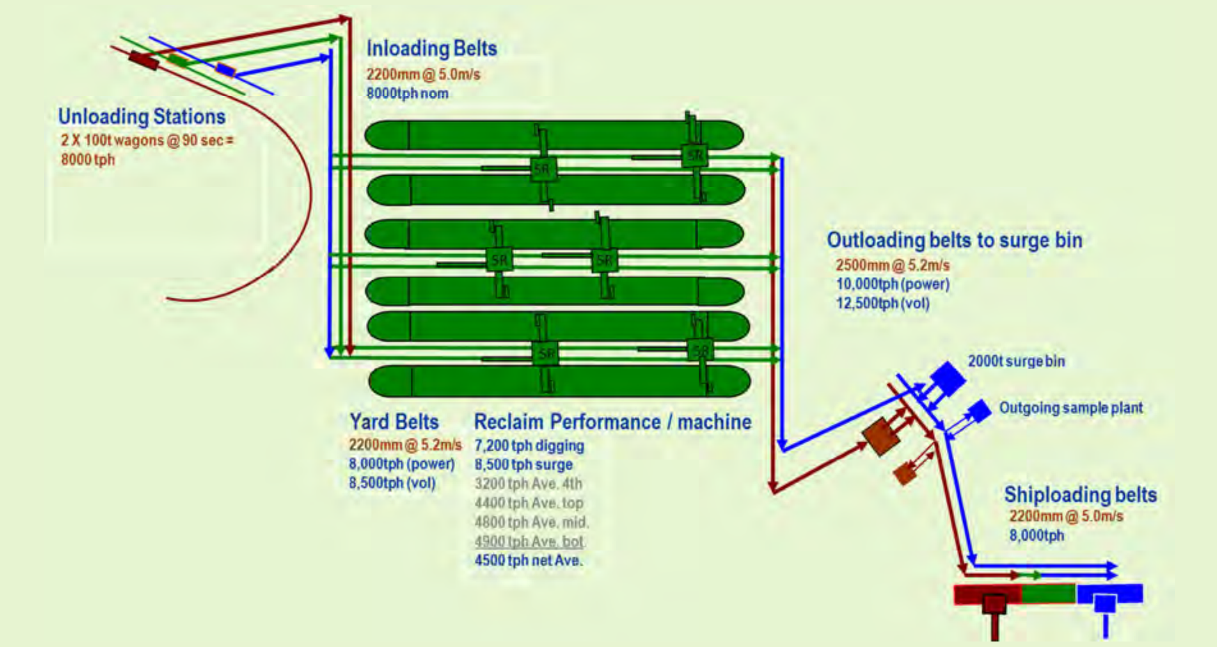


Advantages	Disadvantages
▪ Provides for the most “minimalist” option in terms of number of yard machines however suitable only for specific operations as follows ▪ Suited to high throughputs of small number of single-product, unblended cargos	▪ Not well suited to blending operations as two machines operating at reduced capacity will affect other operations and/or will incur lengthy delays ▪ Requires very large capacity machines in order to meet the shiploading rate - machines are relatively expensive and are supplied by a limited range of OEM’s ▪ Inloading and outloading operations are “linked” with each affecting the other to some degree. Preference to service rail unloading will tend to increase delays to shiploading for stacking operations ▪ A level of delinking of inloading and outloading can be provided with additional machines replication of coal types to be accessible by a number of machines becomes problematic as the number of coal types increase ▪ For the minimum number of machines, little or no redundancy is provided against machine breakdown which will have a large impact on facility throughput due to the large capacity affected by a single machine ▪ To limit relocation delays between stacking and reclaiming operations, machine runway and stockpile length tends to be shorter which necessitates a larger number of stockpiles for a given capacity compared to facilities where stacking and reclaiming operations are delinked

OPTION 2

Lower capacity dual stacker/reclaimer machines requiring 2 machines reclaiming together to achieve the shiploading rate (single machine capable of meeting the inloading rate for stacking)

Minimalist solution would include 6 stacker-reclaimer machines (8000tph stacking, 7200tph reclaiming) with 2 on each of 3 runways, servicing a total of 6 stockpile rows

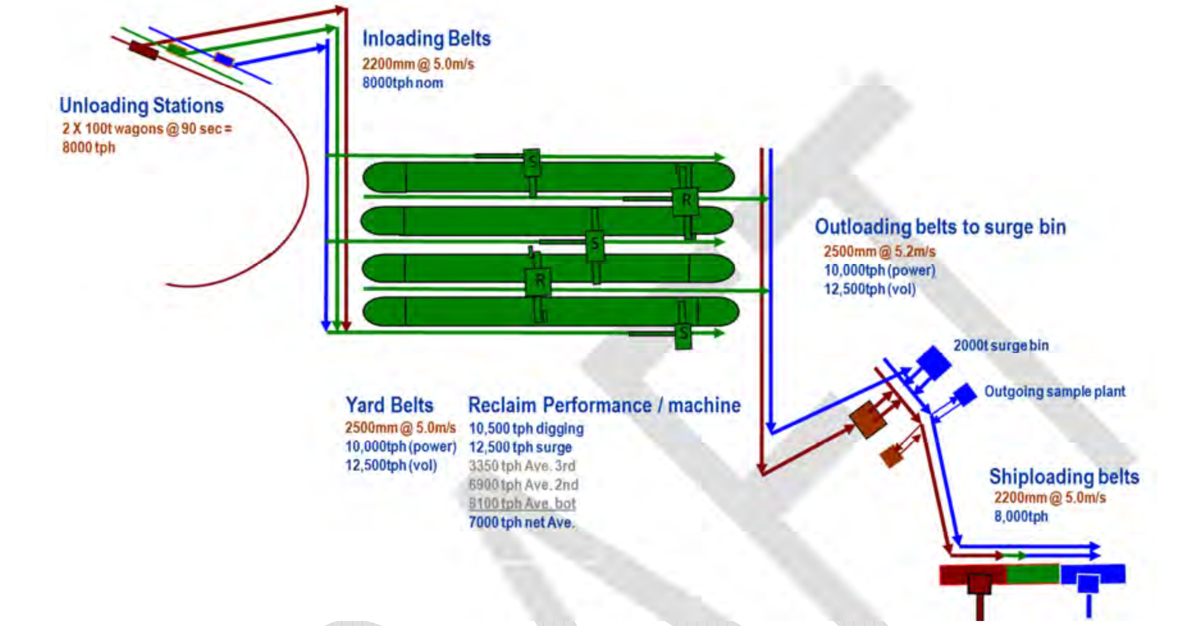


Advantages	Disadvantages
▪ Lower capacity machines are more readily available from a range of OEM's ▪ Readily accommodates blending operations ▪ Increased resilience to machine breakdown as shiploading can continue (for a non-blended shipment) at a reduced rate ▪ Two machines can operate on a single rail system, reducing infrastructure costs	▪ Inloading and outloading operations are linked however stacking operations will lead to a reduction in shiploading rates rather than a complete suspension as for the high-capacity SR option ▪ Additional conveying infrastructure compared with high capacity SR option ▪ Similar issues to Option 1 above in respect to need to replicate coal types to be accessible by all machines to provide a level of delinking of inloading and outloading

OPTION 3

Separate stacker and reclaimer machines with large reclaimers each capable of achieving the shiploading rate

Minimalist solution is 2 high capacity reclaimers (10,500tph peak reclaim) and 3 stackers (8,000tph) each on separate runways servicing 4 stockpile rows

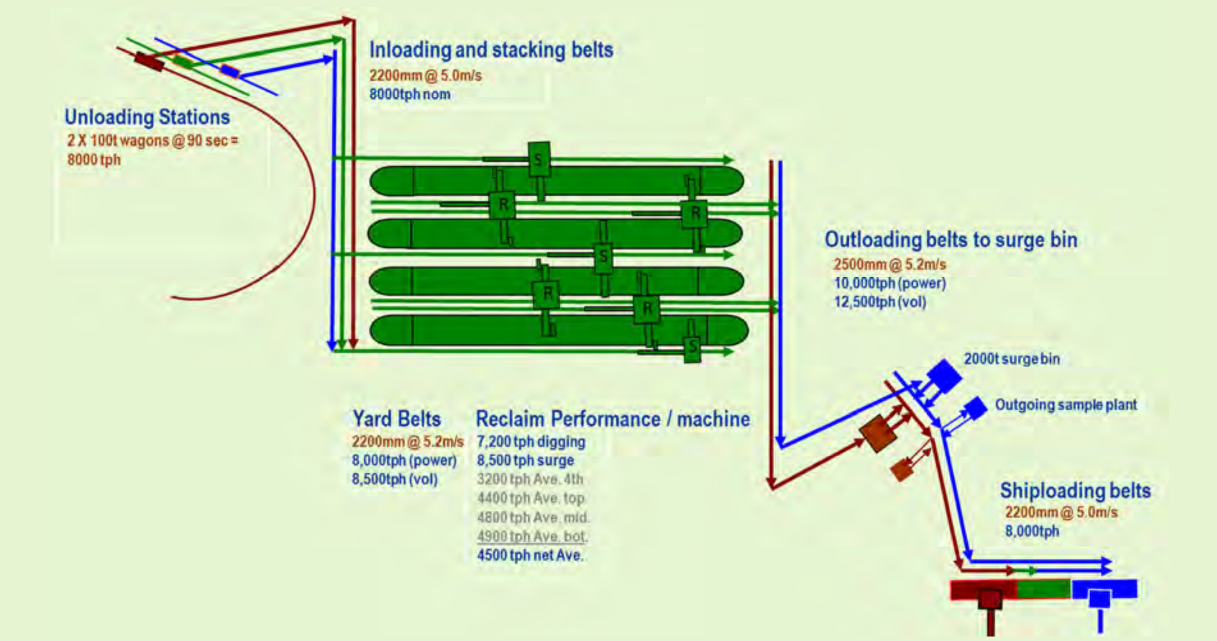


Advantages	Disadvantages
■ Similar issues to Option 1 however with the advantage of delinking of inloading and outloading operations	■ Not suitable for blending ex-stockpile and so is not suitable for the assumed conditions ■ For the minimalist solution there is a very high risk of machine breakdown impacting facility throughput

OPTION 4

Separate stacker and reclaimer machines with smaller reclaimers requiring 2 machines to achieve the shiploading rate

Minimalist solution includes 4 lower capacity reclaimers (2 each on 2 runways) and 3 stackers servicing 4 stockpile rows



Advantages	Disadvantages
▪ Highly flexible option that is suited to blending ▪ Provides a high degree of redundancy against machine breakdown	▪ Largest amount of infrastructure ▪ For the minimalist solution there is a very high risk of machine breakdown impacting facility throughput

OPTION 5

Combination of individual stackers and dual-purpose stacker reclaimers either as an initial step or as a later development/expansion step

Under some circumstances it may be advantageous to combine stackers and SR's. Such an arrangement may develop as a later stage development following an initial start-up as a combined, stacker-reclaimer facility per Option 1 or 2 above. If the number of products increases (either as part of or separate to a capacity increase), addition of stacker machines to service existing stockpile rows facilitates delinking of inloading and outloading operations to improve the reclaim performance of the existing machines.

5.3.2.2.6 Preferred stockyard configuration option

Should blending be confirmed to be a requirement as has been assumed, the options that do not favour blending should be discounted. These include the options with high capacity Stacker-reclaimers (Option 1) and high capacity reclaimers (Option 3).

The remaining options 2 and 4 are suitable for blending operations and the minimalist options described above would seem to suit the start-up configuration of 65 Mtpa. Option 4 is the only option that satisfies the ideal parameters listed above including the ability to service 3 simultaneous inloading operations and 2 blended outloading operations and provide a high degree of delinking of inloading and outloading. Option 4 is therefore the basis basis for the cost review in the following section.

However, given the relatively low utilisation of the rail dumpstations, and given that not all shiploading operations are blended cargoes (and possibly less than the 50% assumed), it is possible that Option 2 may be viable for the start-up capacity. Option 2 is noteworthy in its expandability by addition of centre-row stackers to provide improved delinking and reclaimer performance as terminal throughput and/or cargo complexity increases.

Details for the preferred stockyard system are as below:

Stockyard System - Start-up configuration for 65 Mtpa

- Approx 5,000,000 t stockpile capacity in 4 rows, each 2800m long. 24 individual stockpiles 48m wide x 17.6m high
- 3 x 8000 tph slewing stackers, 40m boom length, 12m rail centres each on an earthen bund and runway system
- 4 x 7200 tph slewing reclaimers, 62.5m boom length, 14m rail centres each on an earthen bund and runway system
- 7 stockyard belts, 2000mm wide approx. 5.0m/sec, 8000 – 8500 tph

Stockyard System – Potential future expansion

The capacity of the stockyard system for the selected configuration is largely based on the ability of the reclaimers to access the required coal types for shiploading and the utilisation levels of the reclaimers themselves. For the 65 Mtpa start-up case, accessibility to coal types is largely managed by duplication of coal types in the stockyard which is achievable given the relatively low number of assumed coal types. Under these conditions, a throughput capacity per reclaimer machine in the order of 20 Mtpa is acheviable. Therefore the configuration for the start-up case should be sufficient to service both the maximum 3 berth, 2 shiploader throughput (approx. 70-72 Mtpa) and the maximum 4 berth, 2 shiploader throughput (approx. 75 Mtpa).

Throughput beyond approximately 75 Mtpa requires an additional outloading string and shiploader and this will necessitate the addition of an additional pair of reclaimers servicing two new pile rows. As described in Section 5.3.2.2.3, a third outloading string will increase the complexity of the stockyard by requiring further replication of coal types throughout the yard to sustain 3 simultaneous shiploading operations. If the higher throughput occurs as a result of additional coal types being added, the ability to adequately replicate all coal types may be difficult, even with the additional stockpile rows.

If the number of coal types does not increase substantially, the additional machines and stockpile rows should be sufficient to match the capacity of the three inloading and outloading systems of approximately 90 - 95 Mtpa as described in the preceding sections.

5.3.2.2.7 Summary of development steps

The following figure summaries the major equipment configurations for the initial development and two expansion steps to approximately 90 – 95 Mtpa.

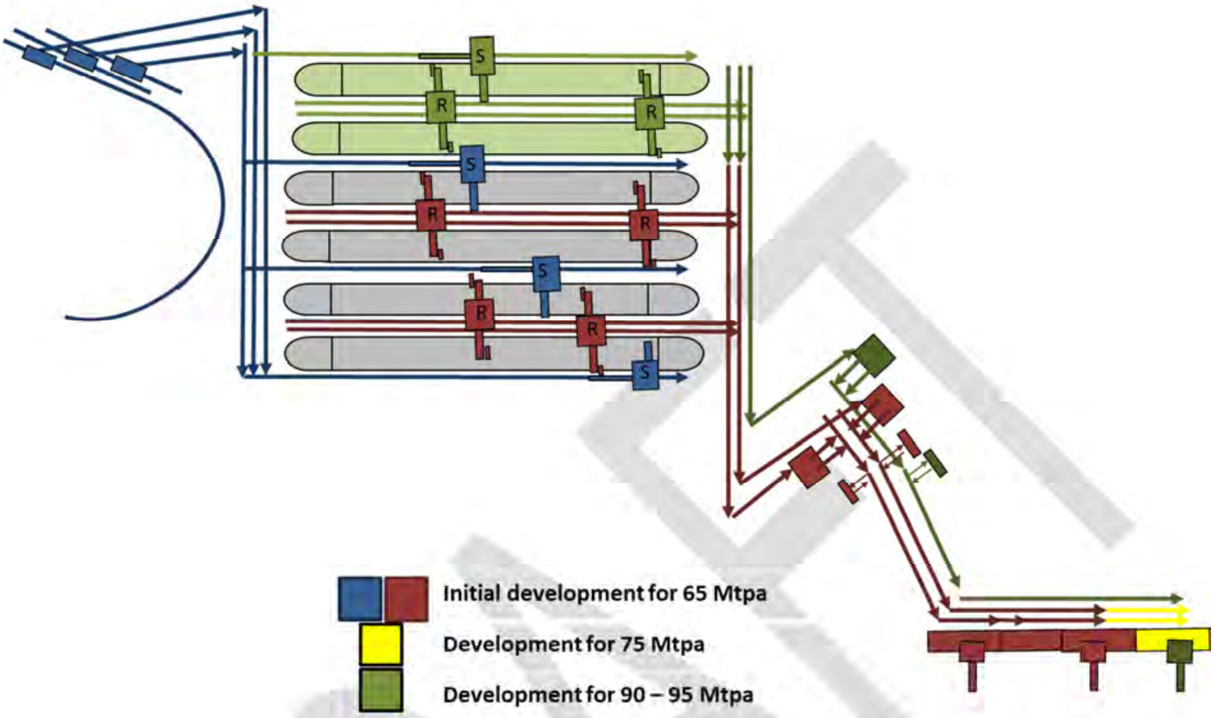


Figure 21 Terminal Development Stages

5.3.3 Physical configuration

The physical layout at Walvis Bay assumes the following:

- The rail line approaches from the north and to the east of the dune system
- The stockpile location will be due east of the township on the eastern side of the dune system
- There are no physical constraints to the size and shape of the stockpile facility and as such, a relatively long and narrow stockpile area configuration has been adopted as this represents and efficient solution
- The berth location is a separate, offshore facility to the north of the township

An indicative layout is shown in drawing 243411-0000-SKT-MI-0001 in Appendix C. A review of current land use and availability has not been undertaken during preparation of this layout.

A number of options have been shown for the conveyor link from the stockyard site to the wharf site as follows:

Straight conveyor option

A string of conventional straight conveyors and intermediate transfer towers following a route identified in previous study work is shown. There is potential to optimise the number of separate conveyors and transfers based on land availability. The plant listing and cost review discussed in the following sections are based on this option.

Curved conveyor option

The existing land use constraints between the stockpile and wharf sites possibly suit the use of horizontally curved conveyors to minimise the total conveyor route length but more importantly the number of transfer stations along the route.

High capacity, horizontally curved conveyors are well-proven technology such as this example at the new Wiggins Island Coal Terminal in Queensland which is quite similar in terms of capacity, overall length and curve radius to those proposed in the layout sketch.

Figure 22 Typical Curved Conveyor System

Rope suspended conveyor

This is a relatively new, proprietary technology system that is suited to situations with difficult topography or constraints associated with land availability, environmental or security concerns associated with conventional ground-level or elevated conveyor systems requiring frequent support.

Single spans of 1000 – 1500m are possible and this would allow spanning of the dunes and adjacent road/rail with a relatively small number of high level towers.

Feasibility of the arrangement for the spans, overall length and capacity would need to be investigated by the vendor.

Figure 23 Typical Rope Conveyor System

5.3.3.1 Plant listing

Based on the functional and physical configuration of the proposed plant described in the preceding sections, a list of the physical plant is included in the following table. Note this is based on the conventional straight conveyor option between stockpile and port (WBS items 1530 and 1540).

Table 16 Coal Export Terminal Plant Listing

Area Code	Item	Sub Item	Description	QTY	Unit
1000	**ONSHORE WORKS**				
	1100	**Site Wide**			
	1120	Bulk Earthworks			
		Stockyard formation	Stockyard area 3150m x 420m	1	unit
		Stacker bunds	16m Wide at top x 4.3m high.	9000	m
		Reclaimer bunds	20m Wide at top x 3.7m high.	6000	m
		Bund access ramps		10	unit
		Rail unloading and inloading area	approx area 25,000m2, large excavations required	1	unit
		Onshore outloading area	approx area 50,000m2	1	unit
		Admin & Operations Area	approx area 100,000m2	1	unit
	1130	Drainage			
		Stockyard Area	5 x 3000m concrete toe drain @ $1500/m + cross drains + subsoil drains	1	unit
		Rail unloading and inloading area	Coal collection pits	1	unit
		Onshore outloading area	Coal collection pits	1	unit
		Admin & Operations Area	Storm water pits and piping	1	unit
	1140	Roadworks			
		Road Formation and Pavement		20	km
		Hardstand		120000	m2
		Manufacture & Stockpile Material	Type B road base	50000	m3
		Road Furniture (for 5001 Items above)	Guide Posts, Bollards, Barriers & Guard Rails, line marking, signage	1	unit
		Terminal Access Road		1	km
		RR Access Road		1	km
	1150	Basins, Ponds & Dams			
		Industrial Dams	approx 226,000m2	1	unit
		RR Dams	approx 37,000m2	1	unit
		Storage Dams & Runoff Water Management		1	unit
	1160	Fire, Water and Sewerage network			

Area Code	Item	Sub Item	Description	QTY	Unit
1000	**ONSHORE WORKS**				
		Industrial Water Reticulation, Loop Main & Interior Connections		15000	m
		Fire Service System Reticulation		15000	m
		Pump stations and mains connection	RR, OL, Industrial dam, storage dam	1	unit
		OL water supply		10000	m
1170	Electrical and communications network				
		Electrical Site Power Supply & 3.3kV Switchgear		1	Lot
1180	Buildings and Facilities				
		Offices and Workshops		1	Lot
1200	**Rail Unloading**				
1210	Unloading station DS1				
		Concrete structure	Below ground concrete pit structure	1	unit
		Steel structure	Roof structure over unloading station	1	unit
		Positioner and tippler equipment	3 x dual cell tippler and indexer/positioner systems, 90 second cycle time, 16,000t approx. total consist mass	1	unit
		Unloading hopper	200t unloading hoppers	2	unit
		Belt feeder DS1BF01	4000tph, 2500mm wide, 0.5m/s	30	m
		Belt feeder DS2BF02	4000tph, 2500mm wide, 0.5m/s	30	m
		Mechanical services (ventilation, lifting)	Pit ventilation, hopper dust extraction and maintenance cranes	1	unit
		Water services		1	unit
		E&I services		1	unit
1220	Unloading station DS2				
		Concrete structure	Below ground concrete pit structure	1	unit
		Steel structure	Roof structure over unloading station	1	unit
		Positioner and tippler equipment	3 x dual cell tippler and indexer/positioner systems, 90 second cycle time, 16,000t approx. total consist mass	1	unit
		Unloading hopper	200t unloading hoppers	2	unit
		Belt feeder 01	4000tph, 2500mm wide, 0.5m/s	30	m
		Belt feeder 02	4000tph, 2500mm wide, 0.5m/s	30	m
		Mechanical services (ventilation, lifting)	Pit ventilation, hopper dust extraction and maintenance cranes	1	unit
		Water services		1	unit
		E&I services		1	unit

Area Code		Item	Sub Item	Description	QTY	Unit
1000		**ONSHORE WORKS**				
	1230	Unloading station DS2				
			Concrete structure	Below ground concrete pit structure	1	unit
			Steel structure	Roof structure over unloading station	1	unit
			Positioner and tippler equipment	3 x dual cell tippler and indexer/positioner systems, 90 second cycle time, 16,000t approx. total consist mass	1	unit
			Unloading hopper	200t unloading hoppers	2	unit
			Belt feeder 01	4000tph, 2500mm wide, 0.5m/s	30	m
			Belt feeder 02	4000tph, 2500mm wide, 0.5m/s	30	m
			Mechanical services (ventilation, lifting)	Pit ventilation, hopper dust extraction and maintenance cranes	1	unit
			Water services		1	unit
			E&I services		1	unit
	1300	**Inloading**				
	1310	Inloading system IL1				
			Dumpstation extraction conveyor IL1CV01	8000tph, 2200mm wide belt, 5.0 m/s	500	m
			Inloading transfer tower IL1TF01	Single transfer	1	unit
			Inloading conveyor IL1CV02	8000tph, 2200mm wide belt, 5.0 m/s	400	m
			Yard transfer tower IL1TF02	Pop-up tripper	1	unit
			Yard transfer tower IL1TF03	Pop-up tripper	1	unit
			Yard transfer tower IL1TF04	Single transfer	1	unit
			Water services		1	lot
			E&I services		1	lot
	1320	Inloading system IL2				
			Dumpstation extraction conveyor IL2CV01	8000tph, 2200mm wide belt, 5.0 m/s	500	m
			Inloading transfer tower IL2TF01	Single transfer	1	unit
			Inloading conveyor IL2CV02	8000tph, 2200mm wide belt, 5.0 m/s	400	m
			Yard transfer tower IL2TF02	Pop-up tripper	1	unit
			Yard transfer tower IL2TF03	Pop-up tripper	1	unit
			Yard transfer tower IL2TF04	Single transfer	1	unit
			Water services		1	lot

Area Code	Item	Sub Item		Description	QTY	Unit
1000	**ONSHORE WORKS**					
			E&I services		1	lot
	1330	Inloading system IL3				
			Dumpstation extraction conveyor IL3CV01	8000tph, 2200mm wide belt, 5.0 m/s	500	m
			Inloading transfer tower IL3TF01	Single transfer	1	unit
			Inloading conveyor IL3CV02	8000tph, 2200mm wide belt, 5.0 m/s	400	m
			Yard transfer tower IL3TF02	Pop-up tripper	1	unit
			Yard transfer tower IL3TF03	Pop-up tripper	1	unit
			Yard transfer tower IL3TF04	Single transfer	1	unit
			Water services		1	lot
			E&I services		1	lot
	1400	**Stockyard**				
	1410	Stockpile machines				
			Stacker SK01	8,000tph slewing luffing stacker, 40m boom, 12m rail centres	1	unit
			Stacker SK02	8,000tph slewing luffing stacker, 40m boom, 12m rail centres	1	unit
			Stacker SK03	8,000tph slewing luffing stacker, 40m boom, 12m rail centres	1	unit
			Reclaimer RL01	7,200tph slewing luffing reclaimer, 62.5m boom, 14m rail ctrs	1	unit
			Reclaimer RL02	7,200tph slewing luffing reclaimer, 62.5m boom, 14m rail ctrs	1	unit
			Reclaimer RL03	7,200tph slewing luffing reclaimer, 62.5m boom, 14m rail ctrs	1	unit
			Reclaimer RL04	7,200tph slewing luffing reclaimer, 62.5m boom, 14m rail ctrs	1	unit
	1420	Stacking system ST1				
			Stacking conveyor ST1CV01	8000tph, 2200mm wide belt, 5.0 m/s	3000	m
			Drive tower ST1DT01	Head end drive and take-up tower	1	unit
			Water services		1	lot
			E&I services		1	lot
	1430	Stacking system ST2				
			Stacking conveyor ST2CV01	8000tph, 2200mm wide belt, 5.0 m/s	3000	m
			Drive tower ST2DT01	Head end drive and take-up tower	1	unit
			Water services		1	lot

Area Code	Item	Sub Item		Description	QTY	Unit
1000		**ONSHORE WORKS**				
			E&I services		1	lot
	1440	Stacking system ST3				
			Stacking conveyor ST3CV01	8000tph, 2200mm wide belt, 5.0 m/s	3000	m
			Drive tower ST3DT01	Head end drive and take-up tower	1	unit
			Water services		1	lot
			E&I services		1	lot
	1450	Reclaim system RL1				
			Reclaim conveyor RL1CV01	8000tph, 2200mm wide belt, 5.2 m/s	3000	m
			Reclaim conveyor RL1CV02	8000tph, 2200mm wide belt, 5.2 m/s	3000	m
			Diverter transfer tower RL1TF01	2-way transfer	1	unit
			Water services		1	lot
			E&I services		1	lot
	1460	Reclaim system RL2				
			Reclaim conveyor RL2CV01	8000tph, 2200mm wide belt, 5.2 m/s	3000	m
			Reclaim conveyor RL2CV02	8000tph, 2200mm wide belt, 5.2 m/s	3000	m
			Diverter transfer tower RL2TF01	2-way transfer	1	unit
			Water services		1	lot
			E&I services		1	lot
	1500	**Onshore Outloading**				
	1510	Outloading system OL1 (to surge bin)				
			Outloading Conveyor OL1CV01	10,000tph, 2500mm wide, 5.2m/s	400	m
			Single transfer tower OL1TF01	Single transfer	1	unit
			Outloading Conveyor OL1CV02	10,000tph, 2500mm wide, 5.2m/s	500	m
			Drive tower OL1DT01	Head end drive and take-up tower	1	unit
			Surge Bin SBN1	2,000t material capacity	1	unit
			Surge bin belt feeder OL1BF01	4000tph, 2500mm wide, 0.5m/s	30	m
			Surge bin belt feeder OL1BF02	4000tph, 2500mm wide, 0.5m/s	30	m
			Sample plant OL1SP1	4-stage plant	1	unit
			Water services		1	lot

Area Code	Item	Sub Item		Description	QTY	Unit
1000	**ONSHORE WORKS**					
			E&I services		1	lot
	1520	Outloading system OL2 (to surge bin)				
			Outloading Conveyor OL2CV01	10,000tph, 2500mm wide, 5.2m/s	400	m
			Single transfer tower OL2TF01	Single transfer	1	unit
			Outloading Conveyor OL2CV02	10,000tph, 2500mm wide, 5.2m/s	500	m
			Drive tower OL2DT01	Head end drive and take-up tower	1	unit
			Surge Bin SBN2	2,000t material capacity	1	unit
			Surge bin belt feeder OL2BF01	4000tph, 2500mm wide, 0.5m/s	30	m
			Surge bin belt feeder OL2BF02	4000tph, 2500mm wide, 0.5m/s	30	m
			Sample plant OL2SP1	4-stage plant	1	unit
			Water services		1	lot
			E&I services		1	lot
	1530	Outloading system OL1 (surge bin to jetty)				
			Outloading Conveyor OL1CV03	8,000tph, 2200mm wide, 5.0m/s	4000	m
			Single transfer tower OL1TF02	Single transfer	1	unit
			Outloading Conveyor OL1CV04	8,000tph, 2200mm wide, 5.0m/s	2950	m
			Single transfer tower OL1TF03	Single transfer	1	unit
			Outloading Conveyor OL1CV05	8,000tph, 2200mm wide, 5.0m/s	5200	m
			Single transfer tower OL1TF04	Single transfer	1	unit
			Outloading Conveyor OL1CV06	8,000tph, 2200mm wide, 5.0m/s	950	m
			Single transfer tower OL1TF05	Single transfer	1	unit
			Outloading Conveyor OL1CV07	8,000tph, 2200mm wide, 5.0m/s	3800	m
			Single transfer tower OL1TF06	Single transfer	1	unit
			Water services		1	lot
			E&I services		1	lot
	1540	Outloading system OL2 (surge bin to jetty)				

Area Code		Item	Sub Item	Description	QTY	Unit
1000		**ONSHORE WORKS**				
			Outloading Conveyor OL2CV03	8,000tph, 2200mm wide, 5.0m/s	4000	m
			Single transfer tower OL2TF02	Single transfer	1	unit
			Outloading Conveyor OL2CV04	8,000tph, 2200mm wide, 5.0m/s	2950	m
			Single transfer tower OL2TF03	Single transfer	1	unit
			Outloading Conveyor OL2CV05	8,000tph, 2200mm wide, 5.0m/s	5200	m
			Single transfer tower OL2TF04	Single transfer	1	unit
			Outloading Conveyor OL2CV06	8,000tph, 2200mm wide, 5.0m/s	950	m
			Single transfer tower OLTF05	Single transfer	1	unit
			Outloading Conveyor OL2CV07	8,000tph, 2200mm wide, 5.0m/s	3800	m
			Single transfer tower OLTF06	Single transfer	1	unit
			Water services		1	lot
			E&I services		1	lot
2000		**OFFSHORE WORKS**				
	2100	**Site Wide**				
	2120	Dredging				
			Berth pockets		3	lot
	2130	Fire, Water and Sewerage network				
			Offshore water reticulation		1	unit
	2140	Electrical and communications network				
			Electrical Site Power Supply & 3.3kV Switchgear		3.69	%
	2150	Buildings and Facilities				
			Amenities		1	unit
	2200	**Marine Structures (below deck)**				
	2210	Jetty Structure				
			Jetty	2-pile bent suitable for 3 x OL conveyors, plus concrete deck roadway	3800	m
			Jetty pile anchoring		1	unit
			Head end transfer platform		1	unit
	2220	Berth 1				

Area Code		Item	Sub Item	Description	QTY	Unit
1000		**ONSHORE WORKS**				
				Cape-size berth and fendering structure	1	unit
				Conveyor structures	1	unit
	2230	Berth 2				
				Cape-size berth and fendering structure + berth 1 extension	1	unit
				Conveyor structures	1	unit
	2240	Berth 3				
				Cape-size berth and fendering structure + berth 1 & 2 extensions	1	unit
				Conveyor structures	1	unit
	2300	**Offshore outloading**				
	2310	Outloading system OL1				
			Outloading Conveyor OL1CV11	8,000tph, 2200mm wide, 5.0m/s	4000	m
			Single transfer tower OL1TF11	Off shore single transfer	1	unit
			Water services		1	lot
			E&I services		1	lot
	2320	Outloading system OL2				
			Outloading Conveyor OL2CV11	8,000tph, 2200mm wide, 5.0m/s	4000	m
			Single transfer tower OL2TF11	Off shore single transfer	1	unit
			Water services		1	lot
			E&I services		1	lot
	2310	Shiploading system SC01				
			Shiploading Conveyor SC1CV01	8,000tph, 2200mm wide, 5.0m/s	1000	m
			Drive tower SC1DT01	Head end drive and take-up tower	1	unit
			Water services		1	lot
			E&I services		1	lot
	2320	Shiploading system SC02				
			Shiploading Conveyor SC1CV01	8,000tph, 2200mm wide, 5.0m/s	1000	m
			Drive tower SC1DT01	Head end drive and take-up tower	1	unit
			Water services		1	lot
			E&I services		1	lot
	2350	Shiploader machines				
			Shiploader SL01	8,000tph, long travelling, luffing shiploader	1	unit
			Shiploader SL02	8,000tph, long travelling, luffing shiploader	1	unit

6 Opportunity 1 - Electrification

6.1 Introduction

The objective is to develop a heavy haul railway for transportation of coal from the eastern Botswana coal fields for export through a new coal export terminal at Walvis Bay in Namibia.

The purpose of this chapter is to conduct a high level review of the merits of electrifying the Trans Kalahari Railway, in comparison to using diesel powered locomotives for the proposed operations. It is noted that the PFS document made only passing reference to the potential and this chapter aims to increase the understanding whether electrification ought to be more seriously considered in the subsequent more detailed Bankable Feasibility Phase.

Choice of traction is a fundamental consideration in planning and designing for a railway. Current practical options are either diesel or electric, and technology development in support of each has been driven by North American diesel locomotive manufacturers and their technology and equipment suppliers, and their counterpart European/Japanese suppliers for electric traction. Alternative energy sources (for example, natural gas) have yet to be proven for heavy-duty locomotive use.

6.2 Relative merits

6.2.1 Advantages of electric traction

There are a number of advantages electric traction provides to a heavy haul railway. These include:

- Higher available usable power and higher balanced train speeds
- Reduced locomotive maintenance costs (and higher availability/reliability)
- Quicker train cycle times (higher average speeds and no requirement for re-fuelling) resulting in less congestion, higher system capacity
- Generally more certainty in the short - medium term on fuel prices, and longer-term surety in energy availability in a peak-oil constrained world
- Better likelihood in the medium - long term of managing greenhouse gas emissions (carbon capture and sequestration for fossil fuel power stations), and/or use of less GHG emissions electrical energy production (renewables, gas, nuclear)

6.2.2 Disadvantages of electric traction

There are also a number of disadvantages electric traction provides to a heavy haul railway. These include:

- Higher initial capital cost and long-life assets compared to typical haulage contract durations.
- A more restrictive operating environment (fixed structures, workplace and public safety issues associated particularly with the high voltage equipment)
- Limited flexibility (operations more strictly constrained within the original power system design criteria). Individual trains do not operate in isolation, with each impacting on the traction system (and potentially on each other) and back into the power supply network, and on non-traction related systems from electromagnetic induction and stray return currents. Impacts on the external supply grid also arise from the single-phase power drawdown, and resultant excessive phase imbalances and harmonic impacts this causes.
- Local power supply failures have far more widespread consequences, and generally slower response times (remoteness of sites to find fault and fix)
- Accidents (derailments) involving damage to the overhead structure have greater cost/disruption impact due to more rectification to undertake, the sequential nature of how repairs need to be undertaken, and safety issues imposed by the high voltage traction system
- Very limited flexibility to deploy locomotives elsewhere, and fixed infrastructure has limited alternate use (essentially scrap value only) – stranding risks

6.2.3 Drivers of financial viability

The main drivers that would impact on the financial viability of electrification include:

- Capital cost of the fixed traction infrastructure.
- Capital cost of locomotives and supporting infrastructure.
- Accessibility to power supply.
- Relative prices of electricity and diesel fuel distillate.
- Volume of traffic (to determine unit prices) and expected life of asset and traffic volumes.
- Lead times involved in planning and construction.
- Difference in maintenance costs of fixed infrastructure and locomotives.
- Differences in availability and reliability of both systems.
- Risk allocation between the various parties and how these are covered.

The risk allocation includes stranding risks for both the fixed asset owner and the rail operators, and the considerable mismatch between useful asset lives and the normal rail haulage and track access contracts.

6.3 Relative cost for this coal supply chain

The table below summaries implications of an electrified option compared to the base diesel option, for the Trans Kalahari Rail Project:

Table 17 Areas Impacted

Item of Impact	Cost implication
Rolling Stock Fleet - Electric locomotives	Generally costing approximately $ 1.6m per unit more than diesel locomotives, however generally more powerful (and thus can pull more wagons) and lower cost to maintain
Energy – Diesel vs Electricity	A 65 Mtpa diesel operation is expected to require approximately 450 million litres of diesel fuel every year (Northern Standard Gauge Alignment Option), at an assumed cost after rebates of taxes of $0.92 per litre. As shown in Figure 24 overleaf, diesel fuel represents a significant portion of the ongoing Above Rail operating cost. A 65 Mtpa electrified service is expected to require 1.6 million MWh per year, at an assumed wholesale rate of $0.15 per kWh
Yard Facilities – Provisioning Facilities & fuel storage tanks	Some Provisioning Facilities and fuel storage tanks will not be required for a total electric operation. Electric hauled services are also able to spend marginally less time in the yard.
Rail Infrastructure – Overhead Masts	Overhead masts required approximately every 65 meters, which for this corridor would total approx. 27,000 units. Additional masts will be required when passing loops are added. Formation width will have to allow for these masts.
Rail Infrastructure – Catenary Wire	Required along the entire track, including at passing loops
Rail Infrastructure – Feeder Stations	High level assessment suggests 28 feeder stations will be required for 65 Mtpa, assuming a 25kV system, at an average spacing of 57km; Further studies need to determine the throughput level these 28 could possibly sustain; Incremental feeder stations are likely required at different throughput levels and the spacing of these will need to be planned for ultimate design capacity .
Rail Infrastructure – Auto Transformers	Estimated to be required every 10 km; total of 161 assumed required. More detailed modeling will have to be undertaken to determine the actual requirements.
Rail Infrastructure – Track Section Cabins	High level assessment suggests 33 track section cabins will be required for 65 Mtpa; Further studies need to determine the throughput these 33 could possibly sustain; Incremental track section cabins likely required at different throughput levels and the spacing of these will need to be planned for ultimate design capacity.
Rail Infrastructure – Connection to Electricity Grid	High Voltage electricity lines to connect to the Feeder stations and Track Section Cabins. This could be quite significant as it depends on the proximity and capacity of the existing grid in Botswana. An allowance has been assumed.

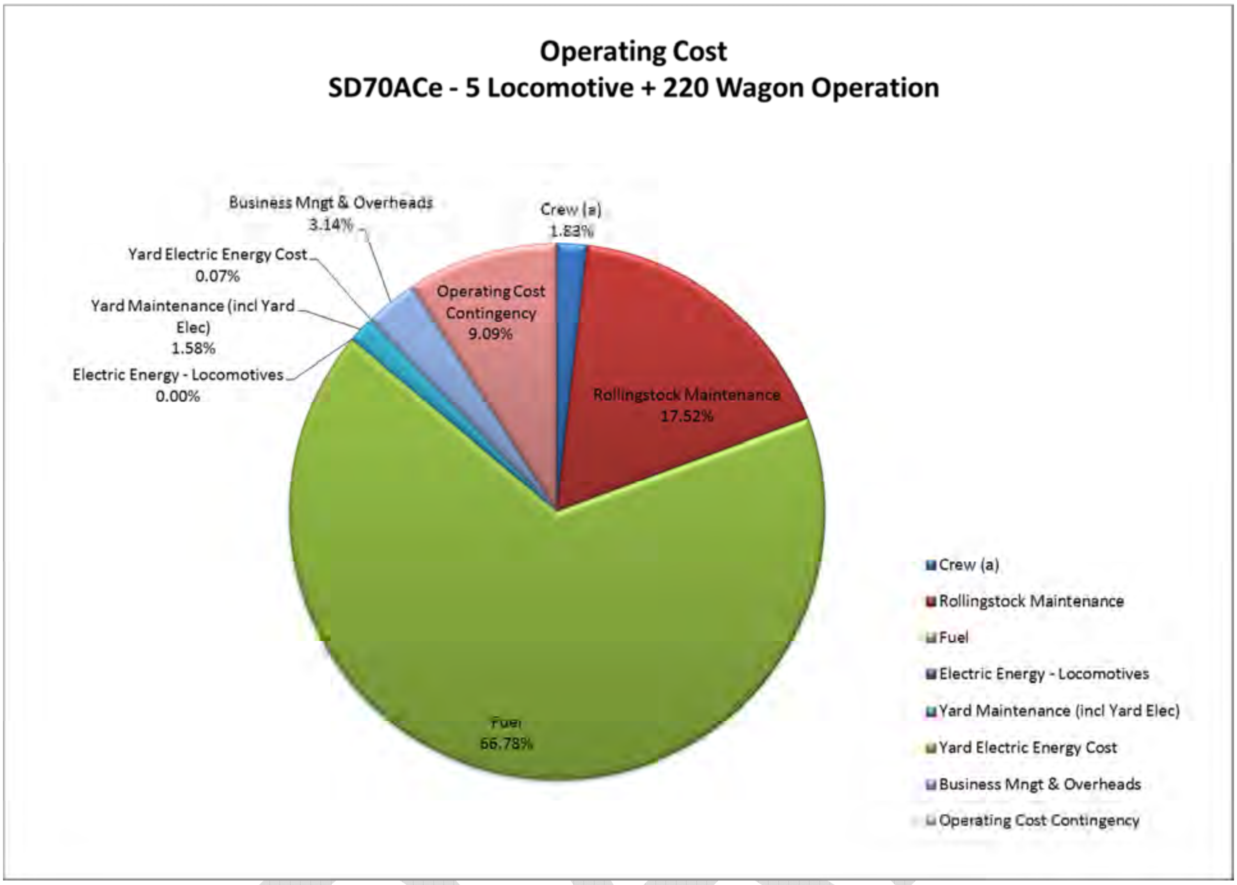


Figure 24 Approximate Annual Above Rail Operating Cost Split

6.3.1 Capital costs

The incremental impact on the capital cost for the Trans Kalahari Rail Project has been estimated as follows:

Table 18 Capital Cost Incremental Impacts (USD)

Item of Impact	45 Mtpa	65 Mtpa	85 Mtpa
Rolling Stock Fleet - Electric locomotives	+$165m	+$209m	+$309m
Rolling Stock Fleet – Change in Wagon Numbers (possible due to marginally faster cycle times)	*N.A.*	*-$23m*	*N.A.*
Yard Facilities – Provisioning Facilities & fuel storage tanks	*-$17m*	*-$34m*	*-$33m*
Rail Infrastructure – Overhead Masts	+$261m	+$267m	+$273m
Rail Infrastructure – Catenary Wire	+$203m	+$208m	+$213m
Rail Infrastructure – Feeder Stations	+$450m	+$504m	+$558m
Rail Infrastructure – Auto Transformers	+$64m	+$64m	+$64m
Rail Infrastructure – Track Section Cabins	+$120m	+$132m	+$144m

Item of Impact	45 Mtpa	65 Mtpa	85 Mtpa
Rail Infrastructure – Connection to Electricity Grid	+$87m	+$126m	+$165m
TOTAL Initial Capital Investment Difference	**+$1333m**	**+$1453m**	**+$1693m**

6.3.2 Operating costs

The additional capital investment required for an electric hauled option will be offset by expected reduced operating costs as follows:

Table 19 Operating Cost Incremental Impacts (USD)

Item of Impact	45 Mtpa	65 Mtpa	85 Mtpa
Maintenance of Rolling Stock Fleet - Electric locomotives	-$2.1m	-$3.4m	-$4.0m
Energy – Diesel vs Electricity consumption	-$288m for diesel +$188m for electricity	-$407m for diesel +$271m for electricity	-$533m for diesel +$355m for electricity
Maintenance of electric overhead infrastructure assets	+$4.1m	+$4.1m	+$4.3m
TOTAL Annual Operating Cost Difference	**-$98.0m**	**-$135.3m**	**-$177.0m**
Years of Opex savings to cover increased Capex	**13.6**	**10.7**	**9.5**

Inherent in the above operating costs estimates are two key assumptions relating to the costs of diesel fuel and electric energy. The assumption for diesel fuel is based on a wholesale price of $0.92 per litre after rebate of taxes available to rail operators. Prices for diesel fuel may be different inland, for example at Gaborone, due to transport costs, than at Walvis Bay, depending on fuel import supply chains. The bulk fuel purchase for the operation of trains will most likely drive a different commercial outcome. Since this heavy haul railway is expected to use approximately 450 million litres of diesel fuel every year (for the 65 Mtpa Standard Gauge Gobabis scenario), or approx. 8.7 million litres per week, a different supply arrangement and commercial outcome will need to be developed. The recommendation would be to have 50% of the diesel fuel shipped in to Walvis Bay, and a pipeline be provided to pump the fuel to the fuel storage facility at the marshalling yard in that area.

With regard the assumed price for electricity, a wholesale price of $0.15 per kWh was assumed. It is understood that the Botswana and Namibian electricity market is insufficiently developed to absorb the additional electric energy requirements an electrified railway would impose. As such, current retail and potentially even wholesale prices may not reflect the potential opportunities and cost this development may trigger. The size and nature of the electric energy requirements an electrified railway from Mmamabula to Walvis Bay is likely to encourage the development of a dedicated power station, or enhancement of a planned/existing power station to feed the expected 2,400 million kWh (for a 65 Mtpa scenario). There is likely to be no shortage of investors willing to invest and construct a power station if they are guaranteed to sell this significant amount of electricity 365 days per year for $0.15 per kWh.

A comparison was also made with the wholesale prices being charged to heavy industry and mining in neighbouring South Africa. These were found to be $0.051 per kWh (in 2012). It is therefore not unreasonable to assume a $0.15 per kWh for this project, which would equate to an electricity price three times the 2012 wholesale price in South Africa for mining industry. In Australia, for example, a major rail operator paid less than 40% of the retail price; it is able to do that due to bulk purchase, and with a reasonable level of predictability in demand.

6.3.3 Sensitivity analysis

The significant investments required to facilitate the operation of electric trains will deliver significant on-going savings in operating costs. The high level assessment appears to indicate that 65 Mtpa or more will provide sufficient pay-back to make the electrified option viable. The chart below illustrates the Present Value of the Electric vs Diesel option, using a 6%, 8% and 10% discount rate, over a 30 year investment period.

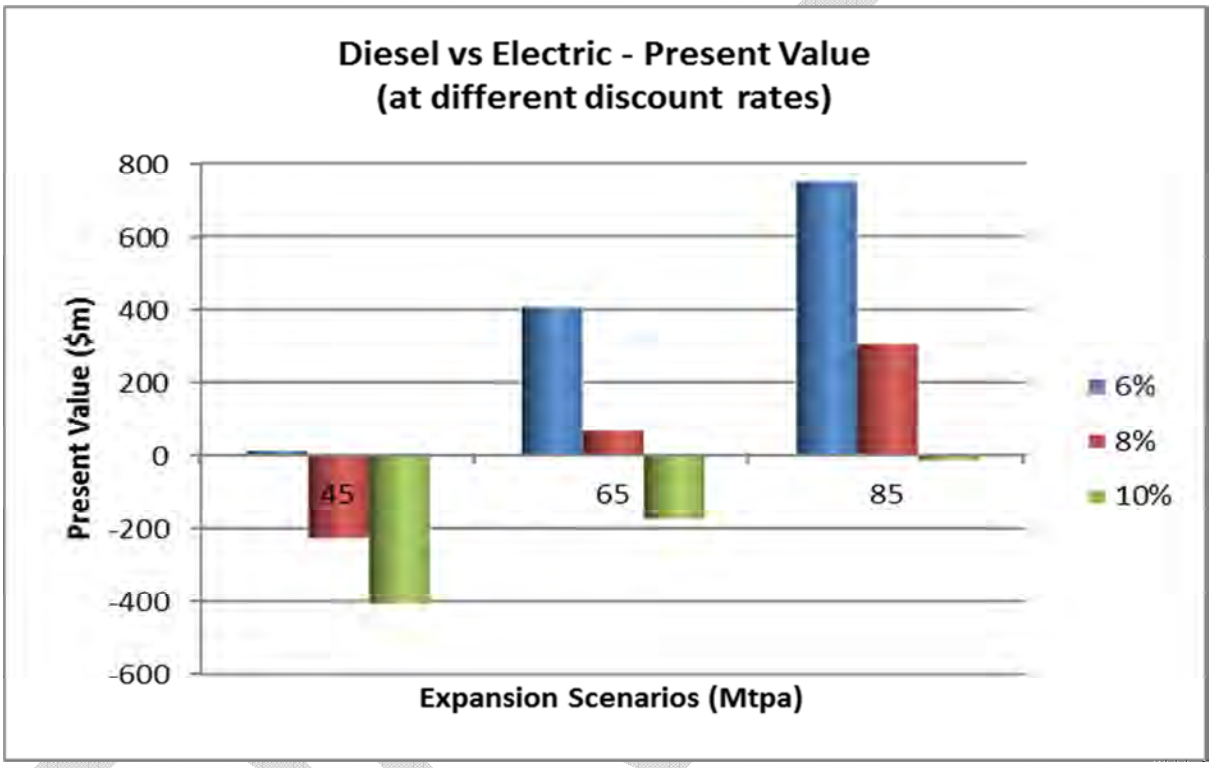


Figure 25 Present Value of Options

The electricity price has a significant impact on the viability of the electrified option. The chart below illustrates the impact of lower and higher prices of electricity for the 65Mtpa scenario

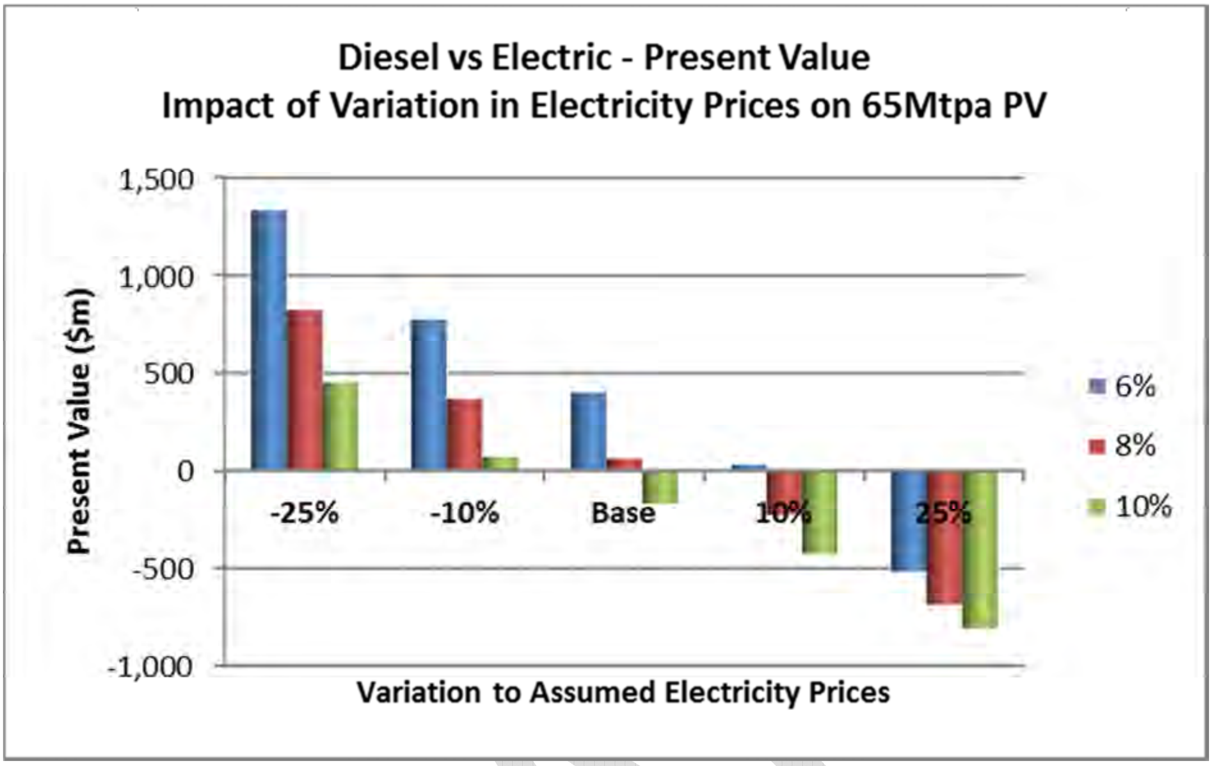


Figure 26 Present Value of Options – Impact of Variation in Electricity Prices

The assumed price of diesel fuel can significantly impact on the viability to electrify or not. The chart below illustrates the impact of lower and higher diesel fuel prices.

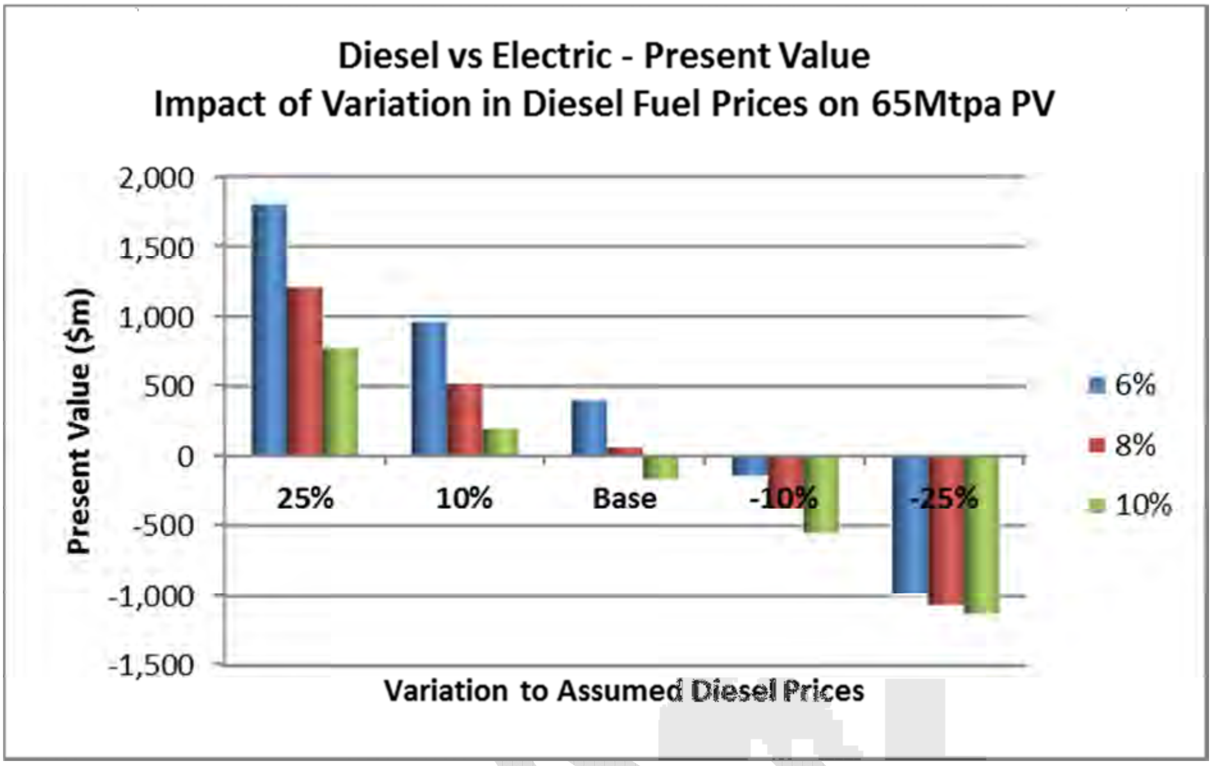


Figure 27 Present Value of Options – Impact of Variation in Diesel Fuel Prices

6.4 Why electrify?

Electrification of rail in countries was generally influenced by whether that country had abundant domestic energy reserves such as coal, centralised ownership of the rail and/or supply chain or as a strategy to mitigate any perceived risk based on uncertain supply of oil from overseas sources. After the shocks of the 1973 oil crisis countries such as China and India, abundant in such domestic energy reserves, reviewed their dependence on imported sources of oil and reshaped their energy policy to electrify their rail networks. It also provided them an opportunity to boost their local economy, decrease dependence on imported oil and increase production of domestic energy resources.

China, with its key central planning, was able to develop the lowest whole-of-life supply chain and was also able to take into account wider issues such as emissions and supply risks, and was able to do so looking at the long term impact of these on the supply chain.

Botswana, with an abundant domestic energy reserves of coal, and heavy reliant on imported diesel fuel, would significantly decrease external influence and thus increase is independence in the area of energy. Electrification of the Trans Kalahari in this context therefore makes sense.

6.5 Staging the investment

If the investment in electric overhead system requires a significant upfront capital investment, and is reliant on significant volumes of traffic to make it viable, why not consider diesel operation first, and later convert to an electrified system? There are several issues that make this decision process much more complex:

- Once a rail operator has invested a significant amount in diesel locomotives, there is a significant cost involved in replacing these often quite reliable locomotives with electric version before their life expiry. This is particularly made more complex by the fact that the acquisition of diesel locomotives would most likely have occurred over a ramp up period during the earlier years of the project.

- The conversion from diesel to electric will make a small number of infrastructure assets potentially redundant, such as diesel fuel provisioning facilities and associated fuel storage tanks. The diesel locomotive maintenance shed will also require to be refurbished/converted, or replaced altogether.
- During the conversion phase from diesel to electric, the price incentive does not support the electric trains since the maintenance and return on electric infrastructure assets are generally borne by the electric services only. The benefit of the volume does not present itself until most or all the diesel services are converted to electric.
- The operation of diesel trains and electric trains on the same network has the potential to reduce the overall capacity due to the different operating characteristics of these services in terms of acceleration, deceleration and speed.

6.6 Summary

The long term projection of inputs such as the costs of diesel fuel and electricity, as well as the ultimate volume of traffic on the corridor that would use the electric overhead system are critical elements to determine the viability of an electrified rail network. These issues become even more important since the investment decision often has to be made upfront due to the significant complexities associated with converting a diesel corridor to an electrified one at a later stage.

The decision to electrify is therefore an **important strategic decision**, requiring careful assessment of the long term projections of key inputs. Considering the above, the recommendation would be to undertake a more detailed electrification study in the Bankable Feasibility Phase to determine definitively whether the TKR should be electrified or not.

7 Opportunity 2 - Alignment

7.1 Length of TKR

The length of the Trans Kalahari Rail is by comparison with many other coal rail supply chains quite long. Combined with the fact that most if not all of the rail will need to be constructed from day one of operations, this imposes a significant upfront capital cost penalty on this supply chain. It is therefore critical to reduce the length and the upfront capital cost of the TKR where practical to enable it to better compete with other export coal supply chains in the world.

7.2 Review undertaken by GoB

It is understood that the GoB has modified the PFS alignment, in particular the portion between Pilane and Kang to better align with existing infrastructure and to minimise impact on communities. This enhancement appears to reduce the overall length of the TKR by approximately 24km.

Figure 28 GoB Enhancement (light blue) vs PFS

In addition, spurs 2 to 5 are as a result shorter for this enhancement, which should further benefit the coal mines to be serviced by these spurs, should they be developed.

7.3 Enhancements in Namibia

A review was undertaken of the northern alignment through Namibia. This review identified three potential locations where the alignment can be shortened with significant reductions in capital and operating cost for the project. These are detailed below.

7.3.1 Omitara Bypass

East of Windhoek, the PFS shows the TKR alignment following the existing railway through the town of Omitara. The B6 highway, on the other hand, bypasses the town some 9km south. The proposal is to construct the TKR alignment for approximately 68km adjacent to the B6 highway, and as a result reduce the overall length by some 11km. This is illustrated in Figure 29 below.

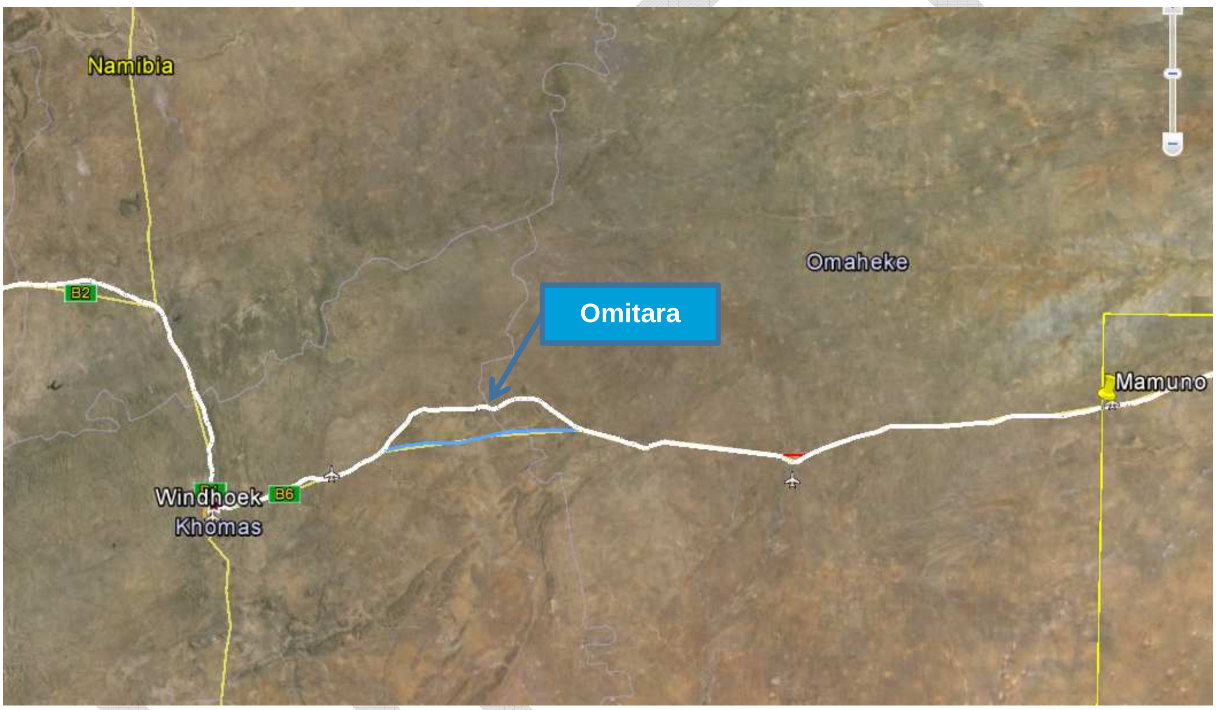


Figure 29 Omitara Bypass (shown in blue)

7.3.2 Erongo Straight

Between Usakos and Arandis the PFS shows the TKR alignment continuing to follow the existing rail alignment, which was constructed many years ago. Modern technology and earthwork construction methodology allows for rail lines to be constructed using a much straighter trajectory. A high level desk top assessment appears to show a potential deviation that would cut 7km of the TKR length.

Figure 30 Eronga Straight (shown in blue)

7.3.3 Walvis Bay approach

Closer to the coast, the PFS shows the alignment following the existing rail line into Swakopmund, then proceed eastwards, only to be turning westwards again to follow the coast line down to Walvis Bay. Considering the location of the proposed stockyard is behind Dune 7 approximately 10km east of Walvis Bay, staying behind the dunes and following the existing rail corridor to Walvis Bay would make more sense. This enhancement would reduce the overall length of the TKR by 14km. The rail line behind the dunes would also be less exposed to the elements, i.e. salt air, wind and sand, impacting on the rail systems and infrastructure.

Figure 31: Approach to Swakopmund

7.4 Schwelle Crossing

Between Kang and Gobabis the PFS shows the TKR alignment continuing to follow the existing Trans Kalahari Highway. Whilst this may facilitate easy access from a construction and maintenance point of view, this adds significant length to the TKR alignment. In addition, due to the presence of developments near the Trans Kalahari Highway, the TKR has the potential to impact more on these developments, with consequential increase in the number of road overpasses, deviations to avoid properties, and potential trespassing.

There is merit in finding a straighter alignment between Kang and Gobabis, such as the one proposed in Figure 32 below.

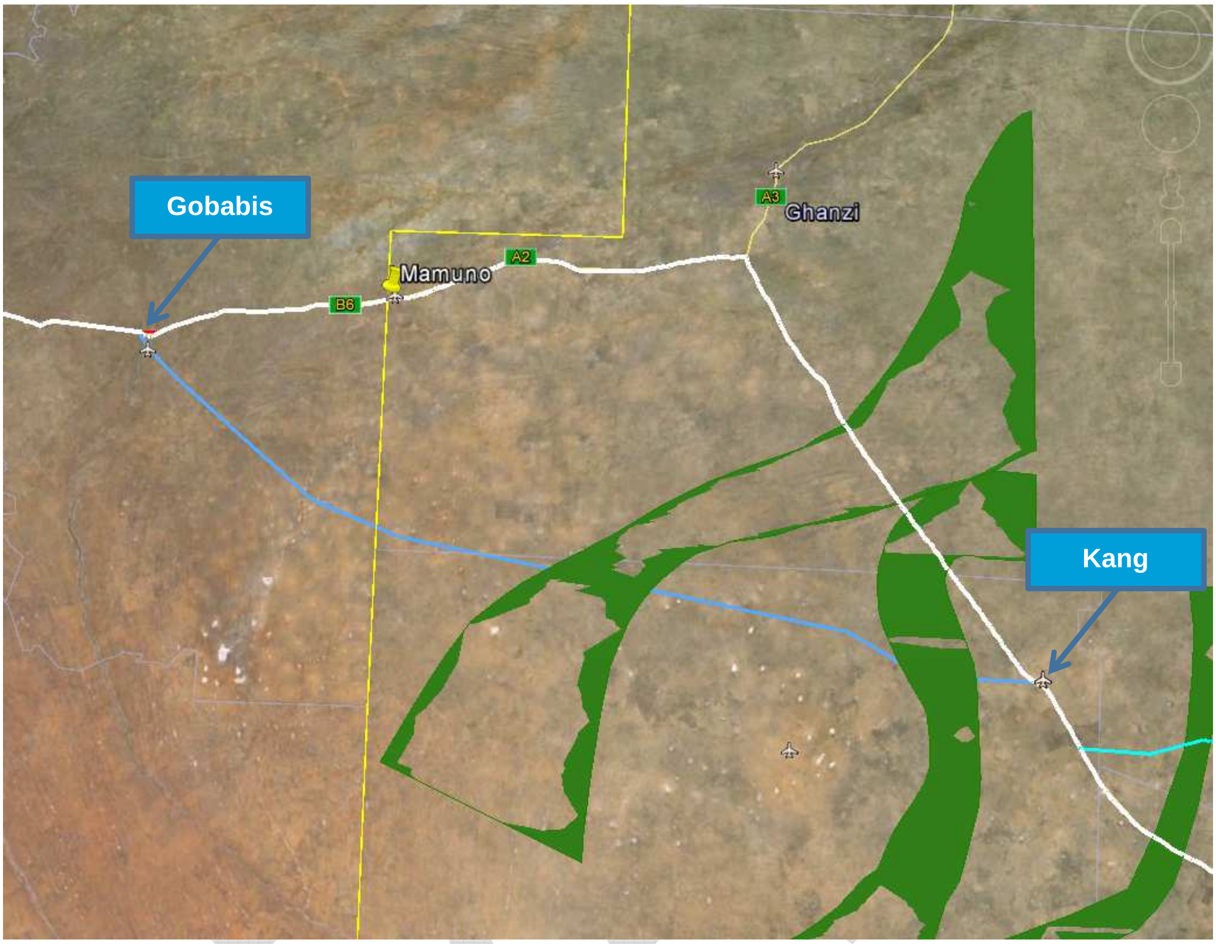


Figure 32 Schwelle Crossing (shown in blue; migratory animal corridors shown in green)

This enhancement is approximately 68km shorter resulting in significant capital cost reduction of approximately $200m to $300m in additional to ongoing operating savings. More detailed maps of this enhancement can be found in Appendix D.

Whether the TKR is constructed adjacent to the Trans Kalahari Highway or as proposed in Figure 32 requires mitigation measures to be put in place to manage the migratory animals. This is dealt with in more detail in Chapter 9.7 below.

8 Capital and operating costs

8.1 Background

The "Pre-Feasibility Study of the TKR Report" prepared by CPCS in 2011 contained capital and operating costs estimates for the rail and port. A high level review of these costs has been undertaken as a result of a number of issues:

- Changes to the construction market since 2011[6],
- Changes in operating philosophy of the rail[7], and
- Proposed enhancements to the project as detailed in section 6 and 7 above.

This chapter details the outcome from this review in terms of expected capital and operating costs for a number of alignment options:

- Alignment broadly in line with the PFS,
- PFS alignment with enhancement to the alignment between Pilane and Kang as developed by the Botswana Government,
- Enhanced alignment taking into account further reductions in length as detailed in section 7 above, and
- Standard gauge, Cape gauge and Dual gauge versions of the above

Note, only the northern alignment via Gobabis and Windhoek is considered here.

This chapter also contains details in relation to the review of the capital and operating cost undertaken for the coal stockyard and export terminal at Walvis Bay.

[6] The current global construction market is much more subdued due to slowing growth in China, deflationary pressures in Europe and slowing commodity markets.
[7] The basis of this Development Plan assessment is that rail services carrying coal (or other major bulk commodities) have priority running in both the loaded and empty directions. Other traffics are expected to pay for the incremental cost they impose on the TKR.

8.2 Capital cost

8.2.1 Below rail capital cost

8.2.1.1 PFS Alignment

An enhanced operating philosophy involving providing priority running for both the loaded and empty coal trains has the potential to reduce the capital cost for the TKR. Non-coal services as a result are likely to incur marginally higher operating costs. Combined with a less heated construction market, the overall capital cost was able to be reduced by $589m and $362m for the Standard Gauge and Cape Gauge alignments respectively. Further capital cost reductions are shown in Table 21 and Table 22 below. The 2011 PFS did not cost electrified versions of these alignments, nor dual gauge.

Table 20 Below Rail Capital Costs (USD 000's) – PFS Alignment

	Standard Gauge, Electric	Standard Gauge, Diesel	Cape Gauge, Electric	Cape Gauge. Diesel	Dual Gauge, Electric	Dual Gauge, Diesel
Identification	SG_EL_N	SG_D_N	CG_EL_N	CG_D_N	DG_EL_N	DG_D_N
Clearing & Grubbing	16,493	16,493	16,493	16,493	16,493	16,493
Earthworks	859,306	861,673	768,024	769,556	859,306	861,673
Bridge Structures and Culverts	771,613	771,613	771,613	771,613	771,613	771,613
Grade-separated Crossings	18,081	18,081	18,081	18,081	18,081	18,081
At Grade Crossings	3,169	3,169	3,169	3,169	3,169	3,169
Tunnel Costs	552,464	552,464	552,464	552,464	552,464	552,464
Capping Layer	129,784	129,784	129,784	129,784	129,784	129,784
Ballast	115,183	115,501	101,168	101,370	115,183	115,501
Rail	593,145	594,779	602,335	603,537	889,717	892,168
Mainline turnouts	8,995	9,341	14,876	15,222	13,492	14,011
Sleepers	337,014	337,943	342,236	342,919	337,014	337,943
Electrification	1,301,422	-	1,321,021	-	1,301,422	-
Drainages and Environmental Controls	264,505	264,505	264,505	264,505	264,505	264,505
Fencing, Road Signage & Furniture	27,255	27,255	27,255	27,255	27,255	27,255
Signall, Comms, Power and Others	189,409	191,299	211,981	213,661	189,409	191,299
Construction Sub-Total	**5,187,839**	**3,893,900**	**5,145,006**	**3,829,630**	**5,488,909**	**4,195,960**
Access Track	17,901	17,901	17,901	17,901	17,901	17,901
Property	23,176	23,176	23,176	23,176	23,176	23,176
Construction Camps	91,960	91,960	91,960	91,960	91,960	91,960
Sub-Total	**5,320,875**	**4,026,937**	**5,278,042**	**3,962,667**	**5,621,945**	**4,328,997**
Contractor Indirect Costs	1,489,845	1,127,542	1,477,852	1,109,547	1,574,145	1,212,119
Sub-Total	**6,810,720**	**5,154,479**	**6,755,894**	**5,072,213**	**7,196,090**	**5,541,116**
Contingency	1,021,608	773,172	1,013,384	760,832	1,079,413	831,167
Total Below Rail Capital Costs	**7,832,329**	**5,927,651**	**7,769,278**	**5,833,045**	**8,275,503**	**6,372,283**
Capitalised Interest	679,480	514,243	674,010	506,036	717,927	552,816
Total Below Rail Capital Cost (incl. capitalised interest)	**8,511,809**	**6,441,894**	**8,443,289**	**6,339,081**	**8,993,430**	**6,925,100**
Variation from 2011 PFS	**N.A.**	**-589,006**	**N.A.**	**-362,019**	**N.A.**	**N.A.**

Note, Table 20 above excludes migratory animal mitigation cost as detailed in 9.7 which is likely to add $600m to the cost shown above.

8.2.1.2 GoB Alignment

The Botswana Government introduced an enhancement to the alignment between Pilane and Kang reducing the overall length of the rail line by approximately 24km compared with the original PFS alignment. This has resulted in a further capital cost reduction between $70m and $114m as detailed in Table 21 below.

Table 21 Below Rail Capital Costs (USD 000's) – GoB Enhanced Alignment

	Standard Gauge, Electric	Standard Gauge, Diesel	Cape Gauge, Electric	Cape Gauge. Diesel	Dual Gauge, Electric	Dual Gauge, Diesel
Identification	Gob_SG_EL_N	Gob_SG_D_N	Gob_CG_EL_N	Gob_CG_D_N	Gob_DG_EL_N	Gob_DG_D_N
Clearing & Grubbing	16,247	16,247	16,247	16,247	16,247	16,247
Earthworks	847,409	847,409	756,021	757,554	847,409	847,409
Bridge Structures and Culverts	767,242	767,242	767,242	767,242	767,242	767,242
Grade-separated Crossings	18,081	18,081	18,081	18,081	18,081	18,081
At Grade Crossings	3,169	3,169	3,169	3,169	3,169	3,169
Tunnel Costs	552,464	552,464	552,464	552,464	552,464	552,464
Capping Layer	127,849	127,849	127,849	127,849	127,849	127,849
Ballast	113,589	113,589	99,587	99,789	113,589	113,589
Rail	584,933	584,933	592,922	594,123	877,400	877,400
Mainline turnouts	8,995	8,995	14,530	14,876	13,492	13,492
Sleepers	332,348	332,348	336,887	337,570	332,348	332,348
Electrification	1,274,167	-	1,306,681	-	1,274,167	-
Drainages and Environmental Controls	260,561	260,561	260,561	260,561	260,561	260,561
Fencing, Road Signage & Furniture	26,848	26,848	26,848	26,848	26,848	26,848
Signall, Comms, Power and Others	187,396	187,396	208,287	209,968	187,396	187,396
Construction Sub-Total	**5,121,300**	**3,847,133**	**5,087,378**	**3,786,342**	**5,418,264**	**4,144,097**
Access Track	17,634	17,634	17,634	17,634	17,634	17,634
Property	22,830	22,830	22,830	22,830	22,830	22,830
Construction Camps	91,960	91,960	91,960	91,960	91,960	91,960
Sub-Total	**5,253,724**	**3,979,557**	**5,219,802**	**3,918,766**	**5,550,688**	**4,276,521**
Contractor Indirect Costs	1,471,043	1,114,276	1,461,544	1,097,255	1,554,193	1,197,426
Sub-Total	**6,724,766**	**5,093,833**	**6,681,346**	**5,016,021**	**7,104,880**	**5,473,947**
Contingency	1,008,715	764,075	1,002,202	752,403	1,065,732	821,092
Total Below Rail Capital Costs	**7,733,481**	**5,857,908**	**7,683,548**	**5,768,424**	**8,170,613**	**6,295,039**
Capitalised Interest	670,905	508,193	666,573	500,430	708,827	546,115
Total Below Rail Capital Cost (incl. capitalised interest)	**8,404,386**	**6,366,100**	**8,350,121**	**6,268,854**	**8,879,440**	**6,841,154**
Variation from PFS alignment	-107,422	-75,794	-93,167	-70,227	-113,990	-83,946

(a) Excludes migratory animal mitigation cost as detailed in 9.7 which is likely to add $600m to the cost shown above.

8.2.1.3 Enhanced Alignment

Further enhancements to the alignment are possible, as detailed in section 7 above. These result in further reductions ranging from $309m to $464m as detailed below.

Table 22 Below Rail Capital Costs (USD 000's) – Section 7 Enhanced Alignment

	Standard Gauge, Electric	Standard Gauge, Diesel	Cape Gauge, Electric	Cape Gauge. Diesel	Dual Gauge, Electric	Dual Gauge, Diesel
Identification	OSG_EL_N	OSG_D_N	OCG_EL_N	OCG_D_N	ODG_EL_N	ODG_D_N
Clearing & Grubbing	15,141	15,141	15,141	15,141	15,141	15,141
Earthworks	789,142	789,142	705,840	705,840	789,142	789,142
Bridge Structures and Culverts	748,555	748,555	748,555	748,555	748,555	748,555
Grade-separated Crossings	18,081	18,081	18,081	18,081	18,081	18,081
At Grade Crossings	3,169	3,169	3,169	3,169	3,169	3,169
Tunnel Costs	552,464	552,464	552,464	552,464	552,464	552,464
Capping Layer	119,140	119,140	119,140	119,140	119,140	119,140
Ballast	105,779	105,779	92,977	92,977	105,779	105,779
Rail	544,713	544,713	553,566	553,566	817,070	817,070
Mainline turnouts	8,303	8,303	13,838	13,838	12,455	12,455
Sleepers	309,496	309,496	314,526	314,526	309,496	309,496
Electrification	1,203,102	-	1,217,755	-	1,203,102	-
Drainages and Environmental Controls	242,811	242,811	242,811	242,811	242,811	242,811
Fencing, Road Signage & Furniture	25,019	25,019	25,019	25,019	25,019	25,019
Signall, Comms, Power and Others	174,556	174,556	195,868	195,868	174,556	174,556
Construction Sub-Total	**4,859,472**	**3,656,370**	**4,818,752**	**3,600,997**	**5,135,980**	**3,932,878**
Access Track	16,433	16,433	16,433	16,433	16,433	16,433
Property	21,275	21,275	21,275	21,275	21,275	21,275
Construction Camps	87,120	87,120	87,120	87,120	87,120	87,120
Sub-Total	**4,984,299**	**3,781,197**	**4,943,579**	**3,725,824**	**5,260,807**	**4,057,706**
Contractor Indirect Costs	1,395,604	1,058,735	1,384,202	1,043,231	1,473,026	1,136,158
Sub-Total	**6,379,903**	**4,839,933**	**6,327,781**	**4,769,055**	**6,733,833**	**5,193,863**
Contingency	956,985	725,990	949,167	715,358	1,010,075	779,079
Total Below Rail Capital Costs	**7,336,888**	**5,565,922**	**7,276,948**	**5,484,414**	**7,743,908**	**5,972,943**
Capitalised Interest	636,499	482,862	631,299	475,791	671,809	518,172
Total Below Rail Capital Cost (incl. capitalised interest)	**7,973,387**	**6,048,785**	**7,908,248**	**5,960,205**	**8,415,718**	**6,491,115**
Variation from GoB Alignment	-430,999	-317,316	-441,874	-308,649	-463,722	-350,039
Variation from PFS alignment	-538,421	**-982,116**	-535,041	**-740,895**	-577,712	433,985

(a) Excludes migratory animal mitigation cost as detailed in 9.7 which is likely to add $600m to the cost shown above.

(b) The inclusion of the proposed enhancements to the alignment results in the overall capital costs to be reduced by $982m and $741m for Standard gauge (Diesel) and Cape gauge (Diesel) respectively.

8.2.2 Above capital cost

8.2.2.1 Enhanced alignment

An enhanced operating philosophy involving providing priority running for both the loaded and empty coal trains coupled with a reduced haul length has the potential to reduce the number of coal locomotives and wagons required to operate the coal services on the TKR substantially. The overall Above Rail Capital cost has been able to be reduced significantly. The 2011 PFS also did not provide Above Rail Capital costs for the electrified version of the TKR.

Table 23 Above Rail Capital (USD 000's) – Section 7 Enhanced Alignment

	Standard Gauge, Electric	Standard Gauge, Diesel	Cape Gauge, Electric	Cape Gauge. Diesel	Dual Gauge, Electric	Dual Gauge, Diesel
Identification	OSG_EL_N	OSG_D_N	OCG_EL_N	OCG_D_N	ODG_EL_N	ODG_D_N
Train sets required	27	27	42	42	27	27
Total Mainline Locomotives required	138	138	213	213	138	138
Number of New Mainline Locomotives	138	138	213	213	138	138
Operational wagons required (excluding spares)	5,940	5,940	6,720	6,720	5,940	5,940
New Mainline Locomotive capital investment	772,800	552,000	1,022,400	681,600	772,800	552,000
Wagon capital investment	636,376	636,376	719,888	719,888	636,376	636,376
Shunt Locomotive	19,200	19,200	22,400	22,400	19,200	19,200
Total Yard	245,553	268,593	295,663	322,543	245,553	268,593
Capital Cost Contingency (on Yard only)	24,555	26,859	29,566	32,254	24,555	26,859
Total Above Rail Capital Cost	1,698,485	1,503,029	2,089,917	1,778,685	1,698,485	1,503,029
Capitalised Interest	202,498	178,920	249,201	211,708	202,498	178,920
Total Above Rail Capital Cost (incl. capitalised interest)	**1,900,983**	**1,681,948**	**2,339,117**	**1,990,393**	**1,900,983**	**1,681,948**

8.2.3 Port capital cost

A high level capital cost assessment for the Option 4 facility configuration is provided below (conventional straight conveyors between stockpile and port). This is considered an "order of magnitude" estimate developed by extrapolating cost data from previous studies and projects in Australia. An approximate adjustment has been made for a reduced labour input cost in Namibia.

Some large components including land acquisition, road and other infrastructure diversions and/or relocations and shipping channel dredging are not included are these items are highly dependent on local conditions and these have not been assessed during this review.

The estimate below is considered Class 4/5 according to AACE guidelines (accuracy in the range of +/- 30-50%). No contingency has been included.

The estimate compares reasonably well with the high level PFS estimate and within the accuracy range. The indicated cost for the onshore works is less than in the PFS and this is likely due to the reduced quantity of equipment required that is possible when high capacity unloading and shiploading systems are used.

Table 24 Coal Terminal Capital ($million)

Area Code		Item	Cost USD Millions
1000		**ONSHORE WORKS**	**1955**
	1100	**Site Wide**	**556**
	1110	Preliminaries (Civil works)	**7**
	1120	Bulk Earthworks	**364**
	1130	Drainage	**41**
	1140	Roadworks	**24**
	1150	Basins, Ponds & Dams	**18**
	1160	Fire, Water and Sewerage network	**62**
	1170	Electrical and communications network	**34**
	1180	Buildings and Facilities	**7**
	1200	**Rail Unloading**	**145**
	1210	Unloading station DS1	**48**
	1220	Unloading station DS2	**48**
	1230	Unloading station DS3	**48**
	1300	**Inloading**	**125**
	1310	Inloading system IL1	**42**
	1320	Inloading system IL2	**42**
	1330	Inloading system IL3	**42**
	1400	**Stockyard**	**359**
	1410	Stockpile machines	**186**
	1420	Stacking system ST1	**24**
	1430	Stacking system ST2	**24**
	1440	Stacking system ST3	**24**
	1450	Reclaim system RL1	**50**
	1460	Reclaim system RL2	**50**
	1500	**Onshore Outloading**	**577**
	1510	Outloading system OL1 (to surge bin)	**70**
	1520	Outloading system OL2 (to surge bin)	**70**
	1530	Outloading system OL1 (surge bin to jetty)	**219**
	1540	Outloading system OL2 (surge bin to jetty)	**219**
	1900	**Indirects**	**193**
2000		**OFFSHORE WORKS**	**1251**
	2100	**Site Wide**	**159**
	2110	Preliminaries	**109**

Area Code	Item	Cost USD Millions
2120	Dredging (berth pocket)	**18**
2130	Fire, Water and Sewerage network	**3**
2140	Electrical and communications network	**26**
2150	Buildings and Facilities	**3**
2200	**Marine Structures (below deck)**	**606**
2210	Jetty Structure	**265**
2220	Berth 1	**95**
2230	Berth 2	**114**
2240	Berth 3	**132**
2300	**Offshore outloading**	**335**
2310	Outloading system OL1	**88**
2320	Outloading system OL2	**88**
2310	Shiploading system SC01	**39**
2320	Shiploading system SC02	**39**
2350	Shiploader machines	**80**
2900	**Indirects**	**151**
	TOTAL - onshore + offshore USD millions	**3205**
		excludes contingency

8.3 Operating cost

8.3.1 Below rail operating cost

8.3.1.1 Enhanced alignment

The shorter distance involved (compared with the PFS alignment) will result in a reduction in Below Rail operating costs.

Table 25 Below Rail Operating Cost (USD 000's) – Section 7 Enhanced Alignment

	Standard Gauge, Electric	Standard Gauge, Diesel	Cape Gauge, Electric	Cape Gauge. Diesel	Dual Gauge, Electric	Dual Gauge, Diesel
Identification	OSG_EL_N	OSG_D_N	OCG_EL_N	OCG_D_N	ODG_EL_N	ODG_D_N
Structures & Track Maintenance	51,736	51,736	52,856	52,856	54,323	54,323
Facilities Maintenance	134	134	136	136	134	134
Electric Maintenance	4,190	-	4,258	-	4,190	-
Comms & Trackside Systems Maintenance	4,458	4,458	4,530	4,530	4,458	4,458
Business Overheads	6,373	5,901	6,476	5,997	6,822	6,369
Train Control	3,362	3,362	5,833	5,833	3,362	3,362
Contingency	9,957	9,258	10,481	9,771	10,619	9,947
Total Below Rail Operating Costs	**80,209**	**74,848**	**84,570**	**79,122**	**83,907**	**78,591**

8.3.2 Above rail operating cost

8.3.2.1 Enhanced alignment

An enhanced operating philosophy involving providing priority running for both the loaded and empty coal trains coupled with a reduce haul length has the potential to reduce the operating cost for the coal services on the TKR substantially. In addition to a review of the unit rates for major cost items such as locomotive and wagon maintenance in particular, has further reduced the operating costs. The overall operating cost has been able to be reduced significantly. The 2011 PFS also did not provide operating costs for the electrified version of the TKR.

Table 26 Above Rail Operating Cost (USD 000's) – Section 7 Enhanced Alignment

	Standard Gauge, Electric	Standard Gauge, Diesel	Cape Gauge, Electric	Cape Gauge. Diesel	Dual Gauge, Electric	Dual Gauge, Diesel
Identification	OSG_EL_N	OSG_D_N	OCG_EL_N	OCG_D_N	ODG_EL_N	ODG_D_N
Locomotive Maintenance	53,640,277	56,425,115	91,953,124	96,573,577	53,640,277	56,425,115
Wagon Maintenance	41,730,417	41,730,417	52,039,241	52,039,241	41,730,417	41,730,417
Yard & Facilities Maintenance	8,857,805	8,857,805	10,856,678	10,856,678	8,857,805	8,857,805
Yard Electric Energy Use	402,823	402,823	460,836	460,836	402,823	402,823
Fuel Cost	-	374,276,296	-	439,645,346	-	374,276,296
Electric Energy Cost	248,919,219	-	265,167,677	-	248,919,219	-
Crew Cost	11,111,883	11,111,883	16,535,540	16,535,540	11,111,883	11,111,883
Driver Simulator	13,333	13,333	13,333	13,333	13,333	13,333
Business Overheads	17,314,391	17,732,116	25,721,021	26,414,089	17,314,391	17,732,116
Operating Cost Contingency	38,199,015	51,054,979	46,274,745	64,253,864	38,199,015	51,054,979
Total Above Rail Operating Costs	**420,189,164**	**561,604,768**	**509,022,195**	**706,792,504**	**420,189,164**	**561,604,768**

8.3.3 Port operating cost

A detailed breakdown of operating cost components has not been carried out however for modern facilities such as these, an ongoing operating cost in the order of $2 - $3 per tonne of throughput is expected. For a 65Mt per annum throughput the port operating cost would be in the order of USD 130m to US195m per annum.

9 Risks

9.1 Preliminary risk assessment

This Preliminary Risk Control and Management Plan (RCMP) contained in this Development Plan seeks to identify and highlight risks currently apparent to the Trans-Kalahari Rail Project (TKR) and consider control and management of such risk exposures so as to expedite the project in the most efficient and economical way possible.

This RCMP is developed on the foundation that the developers of the TKR are committed to establishing, operating and maintaining timely train operations that are effective, secure, safe and without undue business and operational risk to personnel, contractors, customers, industry, community and environment. Hence, Aurecon has adopted the provisions of ISO 31000 (International Standard for Risk Management) to –

- Detect, identify, analyse and assess risk exposures consequential to, arising from, and which have a detrimental impact on the successful development of the project or its ultimate conduct of business activities;
- Develop, implement, manage, monitor and review risk mitigation strategies that are effective, beneficial and relevant to the appropriate risk control and management of the project;
- Leverage technological innovation in pursuit of effective, efficient, economical, secure, and safe project development strategies;
- Determine TKR risk exposure tolerability levels;
- Develop and implement strategic, operational and tactical risk control and management goals and plans so as to inform development of the TKR, and thus reduce risk exposures to within the accepted tolerability levels; and
- Allocate appropriate financial, personnel and physical resources (internal and external) to meet the intended objectives of the project throughout its development.

9.2 Risk control and management principles

The development of the TKR might expose its developers, directors, managers, personnel and other stakeholders to risk and loss. Quite apart from the wisdom and ethical obligations of good corporate governance, the developers of the TKR are bound by legislation to manage and control risks associated with its development so as to guard the interests of their governments and limit liability.

Hence, preliminary risk analysis has been conducted at this early stage of project development so as to identify potential hazards, and propose mitigation strategies and the individuals responsible for their oversight and implementation.

9.3 Scope

The TKRP Project entails the development of a rail infrastructure to facilitate the transport across Botswana and Namibia by rail of coal, minerals, and other paying traffic. Such infrastructure development requires significant investment and hence very high standards of risk and loss prevention.

At this Feasibility Stage, other risks to the project are also present or may become evident as the project develops and matures.

Hence, this Preliminary Risk Assessment should be seen as a foundation document – with risks added, and others removed which have been extinguished or otherwise mitigated. The principal components of this Preliminary Risk Assessment are:

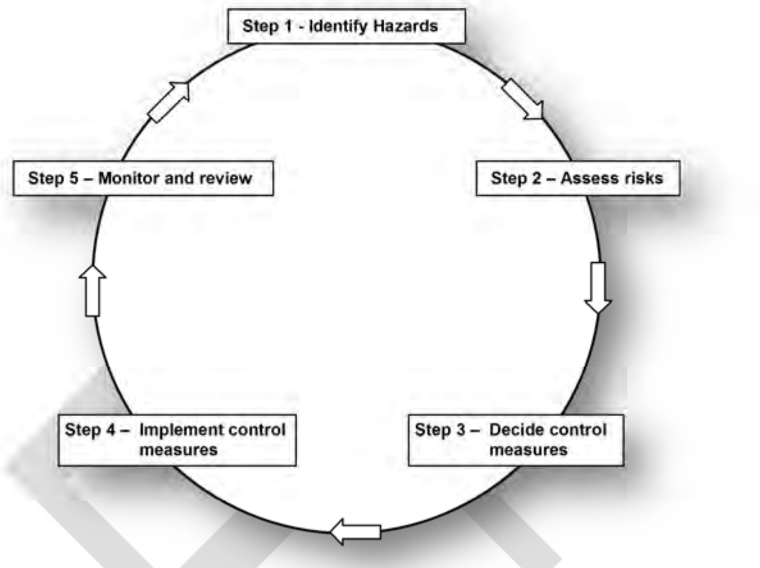
- Risk Identification
- Risk Analysis
- Risk Evaluation
- Risk Mitigation Strategy Development
  - Risk and Loss Control; Risk and Loss Reduction; Risk and Loss Prevention;
  - Risk and Loss Financing (Insurance); and
  - Risk and Loss Transference (Contract).
- Risk Mitigation Strategy Implementation
- Risk Mitigation Strategy Management
- Risk Mitigation Strategy Monitoring
- Risk Mitigation Strategy Evaluation
- Risk Mitigation Strategy Improvement

The developers propose to maintain and share this Preliminary Risk Assessment with proponents as they provide input to the development of the project and in so doing better inform them of the issues to be solved, and the mitigations proposed.

9.4 Risk Management - Risk Ranking Method

Consistent with ISO 31000 the developers of the TKR recognise and acknowledge that –

1. Risk exposures can never be completely eliminated;
2. Care and effort can reduce risk exposures; and
3. Any effort expended to reduce risk exposures should return maximum possible benefits.



A largely qualitative risk ranking process has been adopted for primary detection, identification, analysis and assessment of risk exposures. More thorough and exhaustive risk control and management processes will be developed as the project matures.

9.4.1 Risk Identification

Risk identification is the functional process step of determining what can happen, why and how. All risk identification results in a comprehensive list of potential risks (Risk Inventory) relating to a set of specific activities. Risks will be identified by any or all of the following methods:

1. Analysis of historical and experiential data – derived from experience gained in the development of similar projects,
2. Staff interviews, workshops or brain-storming with a multi-disciplinary team;
3. Systems and processes analysis where it includes such techniques as Flowcharts, HAZAN, HAZOP, Fault Tree Analysis etc.; and
4. Surveys or questionnaires, record and documentation analysis, physical inspection of facilities, operations and plant by independent auditors (internal and external).

9.4.2 Risk Analysis

Identified Risks will be subjected to a systematic examination of available, modelled and hypothesised information to determine how often the specified events may occur and the magnitude of their likely consequences.

9.4.3 Risk Assessment

Risk assessment involves determination of risk management priorities by evaluating and comparing the level of risk against predetermined standards, target risk levels and other criteria.

9.4.4 Risk Ranking and Score

Risk is expressed in terms of –

- The likelihood or probability of some hazardous event (exposure) occuring; and
- The consequences which arise from that event.

Likelihood and Probability

The **Likelihood** of occurrence of a hazardous exposure is related to the probability that it might actually occur. At the present maturity of the project (Feasibility stage) a 6-level likelihood scale ranging from 'Possible but Unlikely' to 'Very High Likelihood' as defined in the table below has been adopted.

Level	Descriptor	Description
6	Very High Likelihood	Very high probability that the event will occur in this phase of the project
5	High Likelihood	High probability that the event will probably occur in some circumstances.
4	Probably Occur	The event is anticipated to occur at some time.
3	Has Occurred	The event has occurred at some time.
2	Low Probability	The event may occur only in exceptional circumstances.
1	Possible But Unlikely	The event may occur but only in the most extreme circumstances..

The **Consequence** of an event having occurred are described in the table overleaf and given a score from 6 (catastrophic) to 1 (insignificant).

Category		Description and Examples				
		(NOTE: Cost of property damage or operational loss does not correlate to cost of personal injury.)				
Score	**Rating**	**Cost/loss to Organization ($)**	**Personal Injury**	**Environment**	**Legal Liability**	**Public Perception**
6	Catastrophic	>$10 Million	Multiple public/ visitor/ employee fatality	Large-scale irreversible environmental harm.	Officer jailed. Corporate fine > $5M. Multiple third party claims total >$10M.	Forced shut down or curtailment of operations.
5	Disaster	$1 to 10 Million	Single public/ visitor/ employee fatality	Major release of pollutants. Significant, long-term environmental harm. Release of pollutants to extremely sensitive area.	Corporate fine $1-5M. Personnel fine. Multiple third party claims total $5M-10M.	Extended national/ International adverse media campaign. Parliamentary inquiry.
4	Major	$500K - 1 Million	Multiple serious injuries to members of the public/ visitors/employee	Release of pollutants to sensitive areas. Immediate off site contamination, this is beyond the normal combatant resources available at site.	Corporate fine $100K-1M. Third party claim(s) $500K-5M.	Adverse national media coverage.
3	Moderate	$100K to 500K	Serious injury (hospitalisation) to members of the public/ visitor/ employee	Contamination of the organization's property that may cause environmental harm, minor off site contamination.	Corporate fine <$100K. Third party claim(s) $100K - 500K.	Adverse capital city media coverage.
2	Minor	$10K to $100K	Medical (doctor treatment) to members of the public/employee	Contamination of the organization's property that does not constitute a threat to the environment.	Third party claim <$100K.	Local media coverage. Public (telephone) complaints.
1	Insignificant	<$10K	Illness or injury treatment only or no treatment	Contamination in protected areas and can be managed through normal operations.	Third party claim <$10K	Public normally unaware.

9.4.5 Risk Ranking

Consequence and likelihood are combined in the table below to provide the risk-rating matrix.

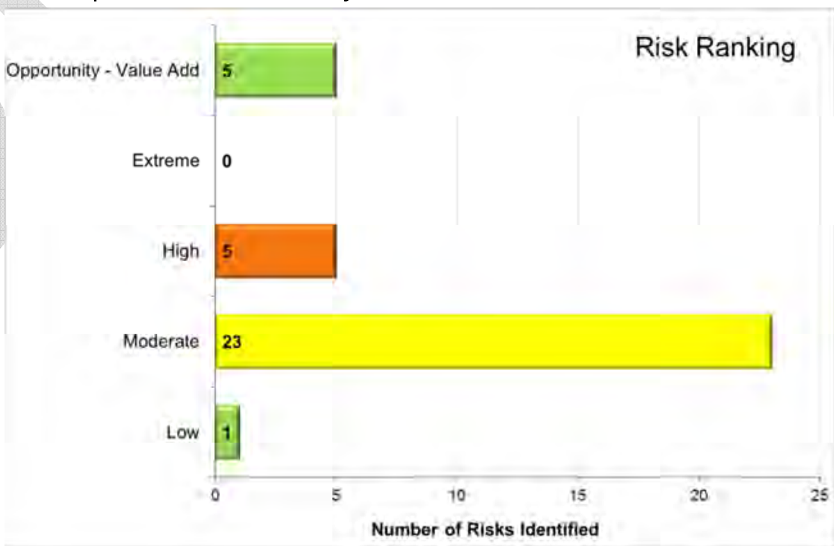
	CONSEQUENCE					
LIKELIHOOD	**Insignificant** (1)	**Minor** (2)	**Moderate** (3)	**Major** (4)	**Disaster** (5)	**Catastrophic** (6)
Very High Likelihood (6)	7	8	9	10	11	12
High Likelihood (5)	6	7	8	9	10	11
Probably Occur (4)	5	6	7	8	9	10
Has Occurred (3)	4	5	6	7	8	9
Low Probability (2)	3	4	5	6	7	8
Possible But Unlikely (1)	2	3	4	5	6	7

Given that it is not practical to completely eliminate all risk exposures, the Risk Matrix identifies those risk exposures greater than 11 which are defined as "Extreme" and which cannot be tolerated and hence must be immediately managed out of the project and those greater than 8 which are defined as "High" which should be managed during this phase of project development.

Key	
	11 - 12 = ***Extreme Risk***
	8 - 10 = ***High Risk***
	5 - 7 = ***Moderate Risk***
	2 - 4 = ***Low Risk***

9.5 Preliminary risk assessment

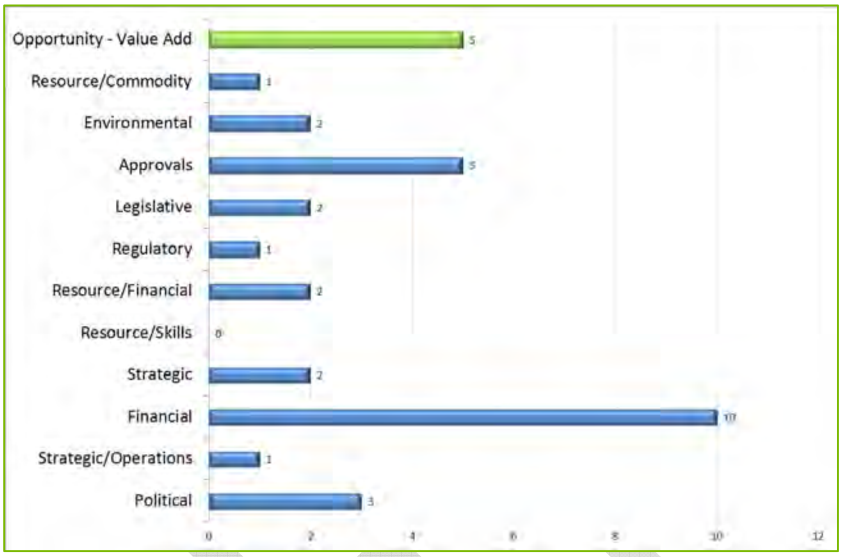
On 6-7 May 2014 representatives of the Botswana Coal Development Unit (Ministry of Minerals, Energy, and Water Resources), visited Aurecon Australia to investigate the Development Plan for the Trans-Kalahari Rail project. As part of this process, a Preliminary Risk Assessment was undertaken. Subsequently, on 25 September 2014 a second Risk Assessment was undertaken with the Coal Development Unit and other representatives of the Government of Botswana.



The outcomes of these 2 Risk Assessments are provided overleaf.

At this stage, no Extreme Risks were identified, and only 5 of the 34 identified risks were ranked as High.

The majority of the risks were ranked as Moderate (for consideration in forthcoming stages of project development) or Low (unlikely to arise, and of little consequence).



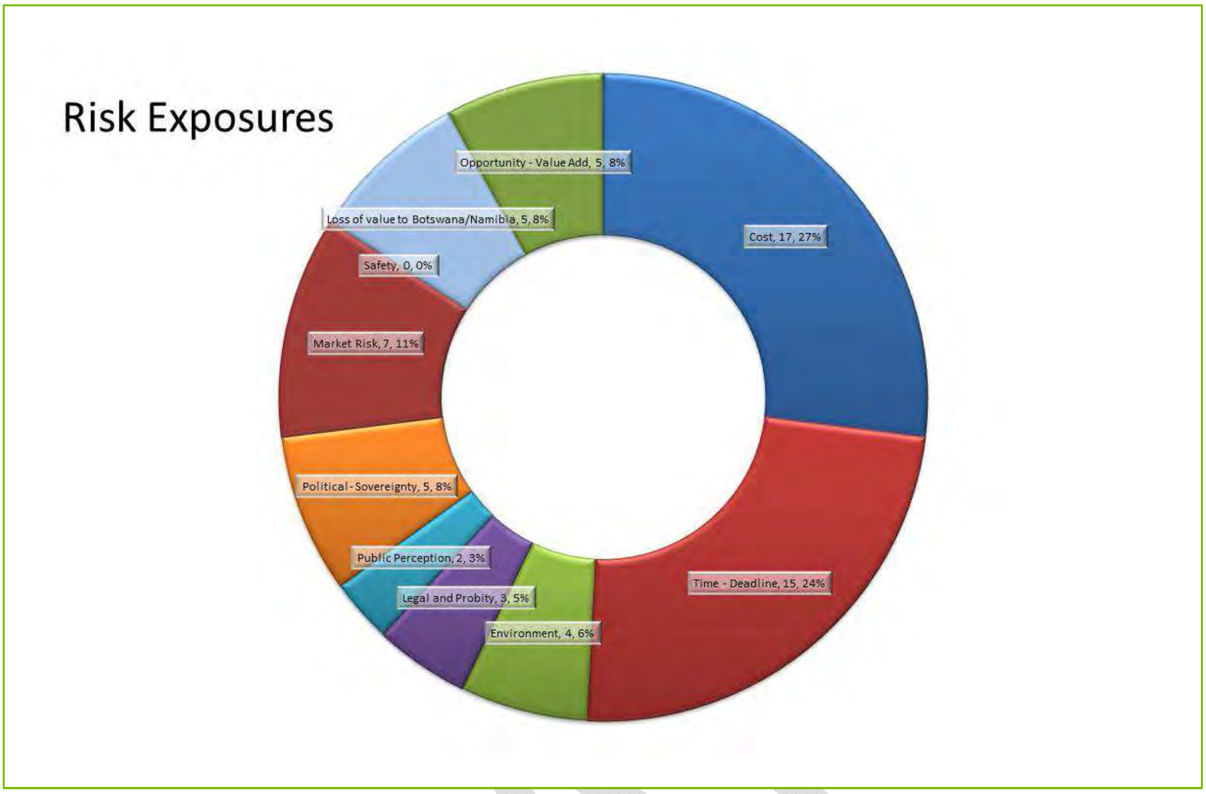
Consistent with the philosophy of Risk and Opportunity Analysis, 5 Opportunities were identified for investigation in the succeeding stage of project development.

Of most relevant concern at this stage of the project development were issues relating to Financial (10), and Approvals (5).

Remarkably, when seen in context, Cost (27%) and Time-Deadline (24%) were identified as the most pressing risks facing the project – collectively these represent the greatest risks facing the project followed by –

- Market Risk (11%),
- Political-Sovereignty (8%), and
- Loss of value to Botswana/Namibia (8%)

Of the 8 risk exposure categories ranked at this stage of the project, those nominated above represent 78% of the total.



The complete Risk Assessment including Mitigation Strategies, and Responsible Party delegated to manage the risk is included overleaf.

In subsequent stages of the project development, identified risks will be reassessed, mitigation strategies evaluated for their effectiveness, and new risks identified and ranked.

Risk Assessment							Uncontrolled ("Do Nothing") Risk Ranking					Risk Owner	Risk Mitigation Strategy	
ID	Risk Scenario *(Source/Event)*	Risk Category	Causes *(Drivers)*	Impacts *(Where will the Risk be felt)*			Likelihood		Consequence		Risk Ranking	Who	Mitigation/Control Strategy	Deadline - Timing
1	Risk of failure of inter-government cooperation	Political	Change of Govt - misalignment of approach/direction	Time - Deadline	Market Risk	Political - Sovereignty	Low Probability	2	Moderate	3	Moderate	MMEWR (Mr Ezekiel Moumakwa, CDU)	Keep Govts informed	Ongoing - Continuous
2	Cross-border project	Political	Different objectives between the governments - different understanding	Time - Deadline	Cost	Political - Sovereignty	Low Probability	2	Moderate	3	Moderate	MMEWR (Mr Ezekiel Moumakwa, CDU)	Discuss with and transfer risk to Minister Mokaila	Ongoing - Continuous
3	Loss of alignment/land for rail corridor + port stockpiles	Strategic/Operations	Critical land not available or lost to the project	Time - Deadline	Cost		Has Occurred	3	Moderate	3	Moderate	MMEWR (Mr Ezekiel Moumakwa, CDU)	Ensure that the project continues to be defined as a high priority and expedited	Ongoing - Continuous
4	Delay in sourcing funding for the BFS	Financial	Availability of funds between the Govts and finding other sources of funds	Time - Deadline	Cost	Public Perception	Low Probability	2	Moderate	3	Moderate	MMEWR (Mr Ezekiel Moumakwa, CDU)	Seek funding for BFS - derived from completion of the Development Plan	By completion of the Development Plan
5	Loss of the project to a major resource player	Strategic	A major coal miner/developer seeking to take control of the project to the detriment of the Govt of Botswana	Loss of value to Botswana/Namibia			Probably Occur	4	Major	4	High	MMEWR (Mr Ezekiel Moumakwa, CDU)	Discuss and confirm with Botswana/Namibia Governments	Ongoing - Continuous
6	No major resource player takes interest in the project - lack of anchor client	Financial	Development Plan fails to entice/attract major resource player	Time - Deadline	Market Risk		Low Probability	2	Moderate	3	Moderate	The Project Team	Confirm and work with Botswana CDU	By completion of the Development Plan
7	Loss of key resources	Resource/Financial	Loss of key project staff	Time - Deadline	Market Risk		Has Occurred	3	Moderate	3	Moderate	The Project Team	Ensure Project Team remain committed to the project	Ongoing - Continuous
8	Low coal price - non-viable project	Resource/Financial	Coal price remains low - project viable	Market Risk			Probably Occur	4	Major	4	High	The Project Team	Collective responsibility to get the timing right	By completion of the Development Plan
9	Competing "path to market" - other projects (South or East)	Financial	"TKO of the TKR" - a path to market through another country is developed over the TKR - loss of value to Botswana and Namibia - restriction on the growth potential of Botswana export minerals industry	Loss of value to Botswana/Namibia	Market Risk		Possible but Unlikely	1	Moderate	3	Low	MMEWR (Mr Ezekiel Moumakwa, CDU)	Keep engaging with other proponents, diplomatic	Ongoing - Continuous
10	Lack of available international capital - competing projects throughout the world	Financial	Another "Global Financial Crisis" - other projects competing for funds	Time - Deadline	Cost	Loss of value to Botswana/Namibia	Has Occurred	3	Major	4	Moderate	Deloitte Access Econ	Advise on what's happening world-wide, track where funds are being invested in infrastructure, define and track competing investments	By completion of the Development Plan
11	Suboptimal supply chain solution	Political	Driven by political directives for competing traffic (agricultural, etc)	Cost	Market Risk		Has Occurred	3	Moderate	3	Moderate	MMEWR (Mr Ezekiel Moumakwa, CDU)	Keep politicians well informed	Ongoing - Continuous
12	Regulatory Regime is not well defined or not defined to the benefit of Botswana + Namibia Governments	Regulatory	Unable to agree on an effective Regulatory Regime	Cost	Loss of value to Botswana/Namibia		Low Probability	2	Moderate	3	Moderate	Synergies Economics	Well defined Regulatory Regime + ongoing consultation with CDU + Botswana/Namibia Governments	By completion of the Development Plan
13	Legislation not in place to support the project development + operation	Legislative	Legislation to underpin the project and the Regulatory Regime is not well defined or enacted	Legal and Probity	Time - Deadline		Low Probability	2	Moderate	3	Moderate	MMEWR (Mr Ezekiel Moumakwa, CDU)	Keep politicians well informed, maintain project momentum	Running parallel with BFS - by the completion of the BFS to have them onside
14	The Development Plan fails to excite the market and initiate the project	Strategic	The Project doesn't stack-up, the Development Plan cannot adequately sell the value of the project	Market Risk			Low Probability	2	Major	4	Moderate	The Project Team	Shared responsibility between Aurecon + Deloitte - define the most economical solution and sell it best to the market	By completion of the Development Plan
15	The prospecting programs for some of the mines are not expedited	Resource/Commodity	Some of the mines, critical to ramp-up, lag in their development - fail to be in a position to utilise the TKR	Cost	Time - Deadline	Public Perception	Has Occurred	3	Major	4	Moderate	The Project Team	The Project Team (CDU + Aurecon + Deloitte + Synergies) to keep the miners and potential investors motivated	Running parallel with BFS - by the completion of the BFS to have them onside
16	Botswana + Namibia unable to guarantee/underwrite the project if called upon	Financial	Project financiers attempt to have Botswana + Namibia guarantee the project	Cost			Possible but Unlikely	1	Major	4	Moderate	Deloitte Access Econ	Risk has to be borne by the investor/developer - cannot be carried by Botswana + Namibia Governments - not to be reflected in agreements + legal contracts	Ongoing - Continuous
17	Land acquisition - negotiation - approvals	Approvals	Planning Approvals - Greenfield alignment - timeframe of the project might be delayed due to land acquisition taking longer than expected	Cost	Time - Deadline		High Likelihood	5	Disaster	5	High	MMEWR (Mr Isaac Moepeng, CDU)	Maintain close liaison between the MMEWR and the Land Boards	Ongoing - Continuous
18	Planning Approvals	Approvals	Planning Approvals - EIS (Stage 1) might take longer than anticipated due to the scope of the project and availability of Botswana Govt resources	Cost	Time - Deadline	Environment	Low Probability	2	Moderate	3	Moderate	MMEWR (Mr Isaac Moepeng, CDU)	Maintain close liaison between the MMEWR and the Environment Dept	Ongoing - Continuous
19	Change of Government - change of policy	Approvals	Change of Government - change of policy away from export coal	Political - Sovereignty	Loss of value to Botswana/Namibia		Low Probability	2	Major	4	Moderate	MMEWR (Mr Isaac Moepeng, CDU)	Maintain close liaison between the MMEWR and other Botswana Govt Departments	Ongoing - Continuous
20	Project timing - resource projects gearing up for the next wave	Approvals	Construction - heated market - lack of availability of contractors - who's first to market (mines - rail - port)	Cost			Has Occurred	3	Disaster	5	High	Aurecon	Aurecon to maintain a "watching brief" over the momentum and development of the project and keep MMEWR well advised of any impending issues	Ongoing - Continuous
21	Legal/political/community action against the export of coal - "Climate change" activism	Approvals	Legal/political action against the project	Political - Sovereignty	Legal and Probity		Has Occurred	3	Moderate	3	Moderate	MMEWR (Mr Isaac Moepeng, CDU)	See also Risk 19 - Maintain close liaison between the MMEWR and other Botswana Govt Departments	Ongoing - Continuous
22	Project timing - resource projects gearing up for the next wave - tying up finite construction resources	Financial	Availability of finite construction resources	Cost	Time - Deadline		Has Occurred	3	Moderate	3	Moderate	Aurecon	Aurecon to maintain a "watching brief" over the momentum and development of the project and keep MMEWR well advised of any impending issues	Ongoing - Continuous
23	The Walvis Bay Export Terminal is not developed concurrently with the TKR - failure/delay of that project has a detrimental impact on the TKR	Financial	Whole-of-supply-chain planning - not aligning port and rail development (mine to rail seen to be the most significant exposure)	Cost	Time - Deadline		Has Occurred	3	Moderate	3	Moderate	MMEWR (Mr Ezekiel Moumakwa, CDU)	Maintain close liaison between the MMEWR and the Govt of Namibia + WILP Proponents	Ongoing - Continuous
24	The Walvis Bay Export Terminal development runs slow or capability of Walvis Bay developers to meet the timeline of the TKR	Financial	Timing of Port development may impact adversely upon rail project	Cost	Time - Deadline		Has Occurred	3	Disaster	5	High	MMEWR (Mr Ezekiel Moumakwa, CDU)	Maintain close liaison between the MMEWR and the Govt of Namibia + WILP Proponents	Ongoing - Continuous
25	Noted that the alignment is yet to be finalised, hence survey has not been completed - latent risks	Environmental	Survey of the alignment has not yet been completed - latent risk	Time - Deadline	Environment		Has Occurred	3	Moderate	3	Moderate	The Project Team	Be aware of the risk - build sufficient Contingency into the project to consider this issue	Ongoing - Continuous
26	Noted that the alignment is yet to be finalised, hence survey has not been completed - flood modelling not completed	Environmental	Flood immunity of the rail alignment may present a risk	Environment			Has Occurred	3	Moderate	3	Moderate	The Project Team	See also Risk 25 - Be aware of the risk - build sufficient Contingency into the project to consider this issue	Ongoing - Continuous
27	Discussion and agreement with the Botswana miners is yet to be completed to determine the best location for the load-out loop at the mines - noted that the best solution for rail or alignment of the rail line might impact upon some coal reserves	Financial	The placement of the rail loop at the mine might sterilise commercial coal reserves.	Cost			Has Occurred	3	Moderate	3	Moderate	MMEWR (Mr Ezekiel Moumakwa, CDU)	Maintain close liaison between the MMEWR and the miners (prospective Users)	Ongoing - Continuous
28	Fibre-optic and comms required for the train could be expanded to provide services along the corridor	Opportunity - Value Add	Potential to provide additional communications capacity along the route for telephone and data/internet services	Opportunity - Value Add							Opportunity - Value Add	MMEWR (Mr Isaac Moepeng, CDU)	Maintain close liaison between the MMEWR and BOCRA (Botswana Communications and Regulatory Authority)	Ongoing - Continuous
29	If the train is electrically powered (as opposed to diesel powered), the alignment can be used as a power transmission corridor to provide power along the corridor	Opportunity - Value Add	Provision of power along the route for development	Opportunity - Value Add							Opportunity - Value Add	MMEWR (Mr Isaac Moepeng, CDU)	Maintain close liaison between the MMEWR and miners (prospective mine-mouth power generators)	Ongoing - Continuous
30	If the train is electrically powered (as opposed to diesel powered), the alignment can be used as a power transmission corridor to provide power to Walvis Bay Export Terminal	Opportunity - Value Add	Provision of power to Walvis Bay (Port)	Opportunity - Value Add							Opportunity - Value Add	Aurecon MMEWR (Mr Ezekiel Moumakwa, CDU)	Investigate and document the viability of Electric Traction versus Diesel trains Maintain close liaison between the MMEWR and miners (prospective mine-mouth power generators) and the Govt of Namibia + WILP Proponents	By completion of the Development Plan By completion of the Development Plan
31	Immature developers/contractors bid for and underestimate the compliance requirements of the project	Financial	Developers underestimate the cost and extent of Environmental Assessment and Compliance	Cost	Environment		Low Probability	2	Major	4	Moderate	The Project Team	Be aware of the risk - develop procurement strategy to ensure scrutiny of developers/contractors	By completion of the BFS
32	Noted that the SPV (Special Purpose Vehicle) contemplated in the Government Bi-Lateral Agreement requires compliance with 2 sovereign legislative regimes - compatability between the 2 regimes might give rise to issues	Legislative	Compatability of the 2 respective legal frameworks between Namibia and Botswana	Cost	Legal and Probity		Has Occurred	3	Moderate	3	Moderate	MMEWR (Mr Ezekiel Moumakwa, CDU)	See also Risk 1 - Maintain close liaison between the MMEWR and the Govts of both Botswana and Namibia	Ongoing - Continuous
33	The TKR wil provide an export supply chain for resources other than just Botswana coal - possibility of copper, iron ore, manganese, etc for export through Walvis Bay and import/export of containers into/through Namibia/Botswana	Opportunity - Value Add	Other traffic on the TKR - Copper, iron ore, etc	Opportunity - Value Add							Opportunity - Value Add	MMEWR (Mr Ezekiel Moumakwa, CDU)	Aproach and investigate interest from other miners (prospective Users)	By completion of the Development Plan
34	Noted that the Government Bi-Lateral Agreement *(ARTICLE 4 - RAILWAY GAUGE)* contemplates the TKR be constructed to 1067mm (Cape Gauge) - technical/commercial feasibility to investigate 1435mm Standard Gauge - cost savings on capex and opex might provide a significant opportunity for cost saving	Opportunity - Value Add	Standard Gauge rail as opposed to Cape/Narrow gauge	Opportunity - Value Add	Political - Sovereignty						Opportunity - Value Add	Aurecon	Investigate and document the viability of Standard Gauge versus Narrow Gauge rail solution	By completion of the Development Plan

9.6 “High” Risks Identified in the Preliminary Risk Assessment

The Preliminary Risk Control and Management Plan (RCMP) identified 5 “High” risks which should be addressed and/or mitigated during the Development Plan stage of the project.

It should be noted that notwithstanding the Preliminary Risk Ranking has identified these Risks as High, subsequent assessment might reduce their Likelihood and hence their risk ranking.

9.6.1 (Risk 5) Loss of the project to a major resource player

ID	Risk Scenario *(Source/Event)*	Risk Category	Causes *(Drivers)*	Impacts *(Where will the Risk be felt)*	Likelihood		Consequence		Risk Ranking	Who	Mitigation/Control Strategy	Deadline - Timing
5	Loss of the project to a major resource player	Strategic	A major coal miner/developer seeking to take control of the project to the detriment of the Govt of Botswana	Loss of value to Botswana/Namibia	Probably Occur	4	Major	4	High	MMEWR (Mr Ezekiel Moumakwa, CDU)	Discuss and confirm with Botswana / Namibia Governments	Ongoing - Continuous

It was identified that a major coal developer may seek to take control of the project once the Botswana Government has invested significantly to initiate the project. Such a scenario has arisen in the past where the major User on a coal railway has sought to dictate terms favourable to them – from the position that their base tonnage is critical for the project’s viability.

The project should be aware of this possibility and seek to maintain control by the Botswana and Namibian Governments.

9.6.2 (Risk 8) Low coal price - non-viable project

ID	Risk Scenario *(Source/Event)*	Risk Category	Causes *(Drivers)*	Impacts *(Where will the Risk be felt)*	Likelihood		Consequence		Risk Rankin g	Who	Mitigation/Control Strategy	Deadline - Timing
8	Low coal price - non-viable project	Resource / Financial	Coal price remains low - project viable	Market Risk	Probabl y Occur	4	Major	4	High	The Project Team	Collective responsibility to get the timing right	By completion of the Developme nt Plan

It was identified that the principal driver for the project is the economic and commercial viability of the export coal. In the absence of a viable Free On Board coal price, the project is unlikely to proceed. Timing is thus seen to be a critical issue – to see the project delivered at a time when the market can/will sustainably support the capital and operating investment over the term of the project. The issue is very much upon market timing, the delivery of the project to market when the market is in the right position to support. Proposed to include long+medium term commodity forecasting into the BFS so as to assure and inform investors. Noted that the TKR is a long-term infrastructure investment and commodity peaks and troughs are to be anticipated.

9.6.3 (Risk 17) Land acquisition - negotiation – approvals

ID	Risk Scenario *(Source/Event)*	Risk Category	Causes *(Drivers)*	Impacts *(Where will the Risk be felt)*		Likelihood		Consequence		Risk Ranking	Who	Mitigation/Control Strategy	Deadline - Timing
17	Land acquisition - negotiation - approvals	Approvals	Planning Approvals - Greenfield alignment - timeframe of the project might be delayed due to land acquisition taking longer than expected	Cost	Time - Deadline	High Likelihood	5	Disaster	5	High	MMEWR (Mr Isaac Moepeng, CDU)	Maintain close liaison between the MMEWR and the Land Boards	Ongoing - Continuous

It was noted that land acquisition for the majority of the alignment of the TKR may not be a concern – in that the line traverses open and remote country. Notwithstanding this, it was identified that the alignment has a significant material impact upon the viability of the project insofar as it drives the capital cost of the project. Consequently every effort must be made to reduce capital costs (hence, length of line) which might bring the alignment into populated or developed areas (as opposed from the existing alignment).

9.6.4 (Risk 20) Project timing - resource projects gearing up for the next wave

ID	Risk Scenario *(Source/Event)*	Risk Category	Causes *(Drivers)*	Impacts *(Where will the Risk be felt)*	Likelihood		Consequence		Risk Ranking	Who	Mitigation/Control Strategy	Deadline - Timing
20	Project timing - resource projects gearing up for the next wave	Approvals	Construction - heated market - lack of availability of contractors - who's first to market (mines - rail - port)	Cost	Has Occurred	3	Disaster	5	High	Aurecon	Aurecon to maintain a "watching brief" over the momentum and development of the project and keep MMEWR well advised of any impending issues	Ongoing - Continuous

It was identified that Botswana and Namibia do not have the domestic resources and workforce to develop this project. Consequently, it was seen that the project developers would need to draw from the larger (perhaps SADC) resource pool. Noted that a project of this scale will consume and require access to finite resources which are likely to be in short supply as economic development in the region grows.

9.6.5 (Risk 20) The Walvis Bay Export Terminal development runs slow or capability of Walvis Bay developers to meet the timeline of the TKR

ID	Risk Scenario *(Source/Event)*	Risk Category	Causes *(Drivers)*	Impacts *(Where will the Risk be felt)*		Likelihood		Consequence		Risk Ranking	Who	Mitigation/Control Strategy	Deadline - Timing
24	The Walvis Bay Export Terminal development runs slow or capability of Walvis Bay developers to meet the timeline of the TKR	Financial	Timing of Port development may impact adversely upon rail project	Cost	Time - Deadline	Has Occurred	3	Disaster	5	High	MMEWR (Mr Ezekiel Moumakwa, CDU)	Maintain close liaison between the MMEWR and the Govt of Namibia + WILP Proponents	Ongoing - Continuous

It was noted that the TKR must be considered within and as part of the total export supply chain. In that the Walvis Bay Export Terminal is being developed by a private entity separate from the TKR, it is imperative that both projects align. Noted that the railway is of no value unless it has a port to feed into, and that the port must be delivered concurrently with the TKR. It was identified that the TKR developers must maintain close liaison with the Walvis Bay developers. If the port fails to develop, the rail is unlikely to proceed.

9.7 Migratory animals

The movement of wildlife across the Schwelle imposes a significant environment risk to the animals and a safety risk for trains crossing the plains in that area. The PFS states that wildlife migration corridors should be considered, however only provides solutions at a high level, without costing these required measures.

As part of this Development Plan, the movement of wildlife across the Schwelle was assessed in more detail, with the particular objective to establish the potential cost associated with the mitigation measures. As mentioned in 7.4 above, whether the TKR is constructed adjacent to the Trans Kalahari Highway or more stand-alone as proposed in Figure 32 (refer the 'Enhanced Alignment' option) requires mitigation measures to be put in place to manage the migratory animals.

The Conservation International report[8] was one of the key documents used as a basis for understanding the risks involved in this particular area, including the mitigation measures to address these risks. This report identified three main wildlife corridors linking the Kgalagadi Transfrontier Park and the Central Kalahari Game Reserve. Refer Figure 33 for the location of these corridors.

The width of these three corridors as it crosses the proposed Trans Kalahari Rail line (as defined in the PFS) has been estimated to be approximately 40, 30 and 20km wide for corridors 1, 2 and 3 respectively. For the enhanced, i.e. shorter alignment (refer 7.4 above), the corridors are approximately 45, 33 and 12km. Considering the width of the wildlife corridors, and the number of animals involved, wild life land bridging may not be practical, cost effective, or able to be constructed whilst the wildlife migration is underway.

The recommendation is to provide access for the migratory animals by elevating the rail line. This is proposed to be achieved by constructing the rail line on a low bridge or viaduct type structure on defined sections across the Schwelle. This method alleviates the need for significant earthworks, allows cross drainage and can be constructed without adverse impact on the continuing movement of wildlife through these corridors. These viaducts can also be used by farmers and their livestock wishing to move from one side of the rail line to the other side. For the purposes of developing a high level cost estimate for this Development Plan, it has been assumed that 50% of the wildlife corridor width be constructed as viaducts.

[8] Conservation International, 2010, Consultancy to identify important Habitats for Key Wildlife in the Western Kgalagadi Conservation Corridor (WKCC)

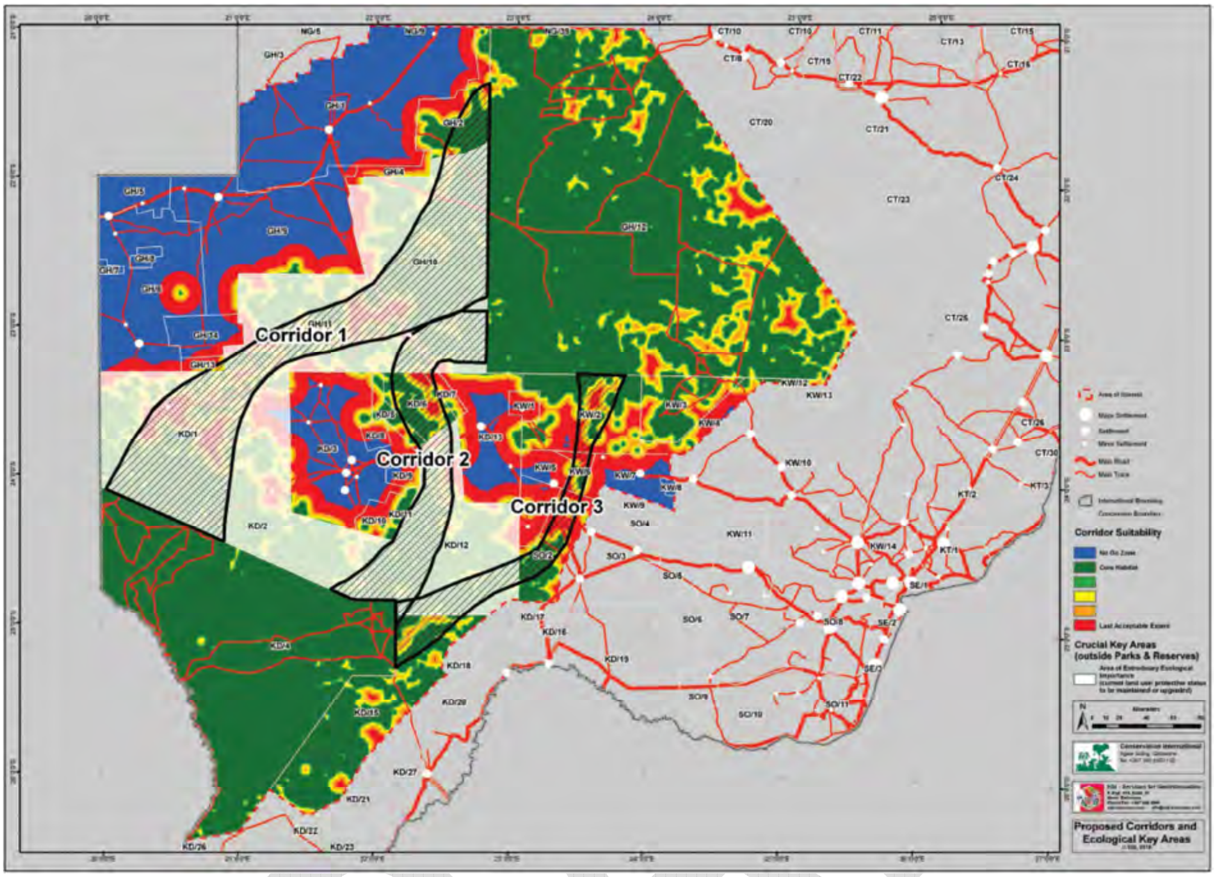


Figure 33 Identified Wildlife Corridors

Figure 34 Typical Viaduct Using Prefabricated Components

Based on these assumptions, it is estimated that the additional capital cost to manage this particular risk is in the order of $600m.

Table 27 Providing for Migratory Animals – Estimated Incremental Capital Cost

Corridor	1	2	3	TOTAL	Unit	Comment
Width of corridor	45	33	12	90	km	
Average height formation	1	1	1		m	
Fill per linear metre	7.9	7.9	7.9		m3	
Percentage viaduct	50%	50%	50%			
Earthworks saved	177,750	130,350	47,400	355,500	m3	where viaducts are
Earthworks cost / m3	165	165	165		USD	all-in cost
Number of viaducts	4	3	2		no.	Average length 3 - 6km
Extra earthworks for ramps	39,240	29,430	19,620	88,290	m3	
Total Length of viaduct	22.5	16.5	6	45	km	
Height of viaduct	4	4	4		m	To allow free movement underneath
Equivalent bridge length (m)	22,500	16,500	6,000	45,000	m	
Average cost per m	15,000	15,000	15,000		USD	Similar to cost of small bridge in PFS due to economies of scale

Corridor	1	2	3	TOTAL	Unit	Comment
Cost of viaduct (USDm)	338	248	90	675	USDm	
Less e/w saved	29	21	8	59	USDm	
Plus e/w for ramps	6	5	3	15	USDm	
Less redundant bridges	17	13	5	34	USDm	Bridges already in PFS (assumed USD380K per route km)
Net Cost	**298**	**218**	**81**	**597**	**USDm**	

10 Regulatory framework

10.1 Introduction

This chapter sets out the range of issues that will need to be addressed in developing an economic regulatory framework to apply to the proposed Rail and Port Coal Export Project, i.e. the Trans Kalahari Rail and Port Project (TKRP). This includes the development of a greenfields coal export supply chain for coal sourced from the coal fields in eastern Botswana, to be transported by a purpose built railway to a port in a neighbouring country.

This chapter addresses the steps that need to be taken and the issues that need to be addressed in developing a regulatory framework to apply to the TKRP. The chapter is structured as follows:

- Objectives for the regulatory framework
- Structure to which the regulatory framework applies
- Design of the access regime – institutions and architecture
- Content of regulatory arrangements

The TKRP comprises the development of both rail and port infrastructure as part of a coal export supply chain to enable the development of Botswana's coal resources. This supply chain will include a greenfields railway linking the coal fields in eastern Botswana to Walvis Bay in Namibia. A new coal terminal facility is also proposed to be developed at Walvis Bay as part of this project. This report addresses the issues to be considered in the development of an economic regulatory framework to apply to the TKRP.

The railway is expected to be developed to have 65 mtpa export capacity of thermal coal, with the scope for potential capacity expansions in the future.

There are a range of mining lease holders in Botswana, who may be potential users of this transport infrastructure. To facilitate the development of these coal resources, the supply chain infrastructure will be subject to some form of third party access, allowing mines to transport coal to the point of export. In terms of the rail infrastructure, it is anticipated that this will not be a dedicated coal railway, with the expectation that general and containerised freight will also utilise the rail infrastructure.

The term 'regulator' in this chapter, unless otherwise indicated, refers to economic regulator.

10.2 Infrastructure reform and regulation

Services provided by infrastructure can be separated into monopoly and contestable elements, reflecting principally their different underlying cost characteristics. The monopoly elements of infrastructure services are normally characterised as being inefficient to duplicate, meaning that demand can be met most efficiently by a single service provider. However, for other elements of the service that can be efficiently provided by several market participants in competition with one another (being contestable elements), it is feasible for more than one service provider to provide the service.

Historically, these monopoly and contestable elements of infrastructure services have been provided as a 'bundled' service by a single entity. However, infrastructure across a range of sectors has been reformed over the last thirty years to introduce competition where possible (i.e. for the contestable elements) as a means of driving efficiency gains. This has also been accompanied by economic regulation of the monopoly elements of the infrastructure.

Electricity was the first sector to undergo 'vertical separation' of the monopoly and contestable elements of the service. This recognised that the monopoly elements of the infrastructure are the poles and wires of the distribution and transmission sector, which could be effectively separated from the potentially contestable generation and retail sector. The United Kingdom pioneered this type of structural reform in the energy sector, and since then it has occurred in a range of other infrastructure sectors – the United States lead with the separation of gas supply from pipeline delivery infrastructure; and Australia has pioneered the separation of water from water delivery infrastructure, allowing a market to develop in tradeable water entitlements.

Similar reforms have happened to the rail infrastructure sector in many countries, including the United Kingdom and Australia. The below rail (track) element of the service has monopoly characteristics, whereas the above rail (haulage) element can feasibly be provided by more than one train operator. The structural model adopted will have implications for the extent of any competition concerns and, hence, need for economic regulation.

Different industry models are:

- Vertical integration - retain below and above rail elements within a single vertically integrated entity:
  - Mandate third party access to the below rail infrastructure to introduce competitive pressures into the above rail market
  - As the access provider will be a competitor of third party train operators in the above rail market, it will have an incentive to frustrate access, indicating that a more extensive degree of regulatory oversight will be required
- Vertical separation - structural separation of below rail from above rail infrastructure into two separate entities:
  - Mandate third party access to the below rail infrastructure to introduce competitive pressures into the above rail market
  - Economic regulation of the below rail provider will be required to address monopoly pricing concerns. However, there is less competition concern as the below rail access provider will not have an incentive to frustrate access.

A key consideration in the rail sector in terms of different structural options is the technical interdependency of the above and below rail infrastructure. The wheel-rail interface is quite complex, with significant interdependencies and trade-offs between the two elements. The performance of one element will have an impact on the performance of the other – for example, investment to improve track quality has the ability to improve above rail transit times; the standard of the rolling stock, in particular the wheel specifications and maintenance regime, can cause damage to the track. Given the interdependency in the performance of the above and below rail infrastructure, compared to other infrastructure sectors, there are considerable advantages to having a rail industry structure that manages these two elements together in order to optimise overall rail performance. Whichever model is adopted, the market situation will evolve over time in response to regulatory and commercial factors, particularly the above rail market (if it is competitive). The key consideration is to establish the best structural and regulatory framework at the beginning as, once established, it can be very difficult to address emerging issues due to the rigidities that are in place once contracts are struck.

10.3 Objectives

10.3.1 Clarifying objectives

10.3.1.1 Stakeholder objectives

There is a range of stakeholders, each of whom has objectives that may differ from each other. These objectives were discussed in the regulation workshop held on 23 September 2014, and are summarised in Table 28 below.

Table 28 Stakeholder Objectives

Botswana Government ▪ Develop railway to unlock resources and provide transport links ▪ efficient infrastructure solution ▪ economic benefits – employment, growth, diversity, royalties etc ▪ prevent misuse of market power ▪ no holdups on expansions	**Mining companies** ▪ export pathway – minimal haulage cost with enough flexibility to maximise mine efficiency – ie. low prices, service quality, expandability, delivery certainty, market responsiveness ▪ some regulatory flexibility required but confidence in integrity of arrangements ▪ no holdups on expansions ▪ prevent misuse of market power
Potential investors and owners ▪ Commercial return – bankability ▪ Appropriate regulation and minimal risk of regulatory change ▪ Prefer autonomy in managing supply chain arrangements ▪ Vertical integration may be preferred	**Future competing haulage operators** ▪ certainty of access – confidence in integrity of haulage market (level playing field) ▪ prefer vertical separation ▪ prevent misuse of market power, especially preferential self dealing ▪ some regulatory flexibility may be required ▪ efficient solution for their operations ▪ no holdups on expansions ▪ profitable mines

There is a significant degree of alignment of objectives between these stakeholders. This alignment of objectives particularly applies in the project development phase up until the point where the project is developed and operational. Up until this point, the key goal of all parties is to develop the project and, in the current fiercely competitive global environment, this is likely to require all parties to co-operatively work together in order to ensure that the project does not embed inefficient costs or risks (including regulatory risks) as these will undermine the viability of the overall project development.

However, once the project is operational, there is much greater opportunity for divergence of stakeholder interests. The Botswana and Namibian Governments, mining companies and, if competitive rail haulage is pursued, future operators will be seeking a regime that provides access on fair and reasonable terms, which prevents misuse of market power, and which incentivises efficiency improvements within the supply chain, as this will support the competitiveness of mines and haulage operators in their respective markets, which in turn will support the development of the resources sector in Botswana.

Operators in a competitive haulage market will prefer a vertically separated structure to achieve this outcome given the risk of preferential self dealing by the access provider. Preferential self dealing occurs when the infrastructure owner operates in such a way as to favour its related entity in providing access – for example, by providing access to its related entity in the above rail market on more favourable terms and conditions than it does to third party operators. Mining companies will be concerned about an outcome that delivers an efficient and responsive supply chain and gives them some control over haulage services.

However, for prospective investors in the infrastructure, the critical objective will be to earn a commercial return and to minimise risk. Once the project is operational, there may be opportunity for the infrastructure owner to try to increase its profit margins, for example by restricting supply of capacity or delaying expansions. As there is little opportunity to export coal without using this infrastructure, the infrastructure owner will have substantial power in capacity negotiations.

There will need to be appropriate regulation that constrains the infrastructure from acting in this way, once the project is operational.

10.3.1.2 Objectives of the regulatory regime

It is important to clarify the overall objectives of the regime upfront. Given the discussion on stakeholder objectives, and the identified opportunity for stakeholder objectives to diverge, It is considered that the objectives of the regulatory regime will be to achieve:

- Efficiency of individual elements of the transport supply chain, including rail and port;
- Supply chain efficiency, that is, efficiency in the way that the transport supply elements work together to provide an end to end transport of coal; and
- Reasonableness in the charges for infrastructure – based on ensuring the owner earns a commercial return on its investment.

If these objectives are realised, then the regime should contribute to increasing mining output and gross domestic product.

An access regime that meets these objectives will deliver the efficient provision of infrastructure services in a non-discriminatory way. Another attribute of an efficient regime is providing customers with greater control over haulage services.

The more efficient and responsive the transport sector, the better the opportunities for Botswana's mining developments in a very competitive global market.

10.3.2 Challenges and opportunities

The development of the rail and port infrastructure provides a number of challenges and opportunities. These challenges and opportunities, and the associated implications, are:

- Opportunity to develop Botswana's mineral resources:
  - The market for developing resources is very competitive;
  - Commodity markets are very competitive;
  - Rail and port infrastructure is a substantial component of the overall cost of supplying mineral resources into the export market; and
  - Efficient rail and port infrastructure is central to capitalising on the opportunity to develop Botswana's mineral resources.

- Nature of haul:
  - TKR is a long, trans-national haul, suggesting inter-government agreement will be crucial;
  - Vertical separation may present the best environment for miners by increasing competitive pressure in the haulage market. However, mines will primarily be concerned about the efficiency of whole-of-supply-chain costs and their control over supply chain capacity (however this may be achieved).
- Greenfields infrastructure development:
  - It is necessary to establish alignments and secure corridors, through both Botswana and Namibia;
  - It provides opportunity for a greenfields structure - the benefit of this is that there are no 'legacy' issues and infrastructure can be developed and operated in the most optimal way possible;
  - However, there will be challenges in making the infrastructure work efficiently and effectively, particularly in the context of managing the objectives for integration into existing rail transport systems.
- Complexity:
  - There is limited experience in heavy haul supply chains outside of South Africa;
  - The Botswana and Namibian Governments have limited experience with economic regulation of infrastructure; and
  - Complex solutions increase risk and scope for delay.

10.3.3 Costs and benefits of access regimes

Third party access regimes have the potential to deliver a range of benefits, including a more efficient and responsive supply chain, incentives for investment, a more competitive mining sector and growth in GDP. However, access regimes are not costless. These costs are both direct and indirect. The direct costs of access include the cost of establishing an economic regulator, costs associated with compliance and managing the on-going relationship with the regulator. Indirect costs include costs associated with uncertainty about regulatory outcomes, strategic behaviour and regulatory error (see Figure 1).

For the regulatory arrangements to enhance economic welfare, it is essential that the benefits of regulation outweigh the costs. This is generally the case with access regimes, provided that the right choices are made in regulatory design. Good regulatory design will maximise the gains from establishing a rail access regime whilst minimising the costs.

Regulatory accountability is a very important aspect of regulatory design which will help ensure that access results in net benefits. Regulatory accountability requires: a clear objective for the regime; specifying the roles and functions of the regulator; guiding principles in the establishing legislation for the regulator to reasonably constrain its discretion (i.e. pricing principles, matters to be taken into account in decision making); a commitment to transparent decision making processes; and appeal rights for regulatory decisions. Accountability of the regulator is an important issue in regulatory design as, if it is not properly achieved, the regulator can become an end in itself rather than a means to an end.

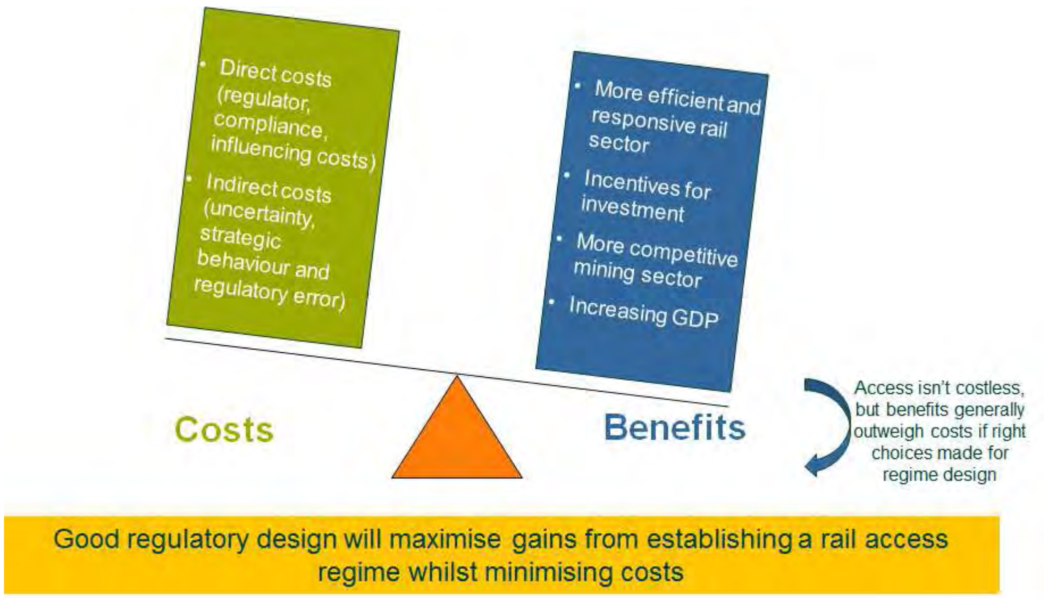


Figure 35 Costs and benefits of access regimes

10.4 Competitive environment and project structure

10.4.1 Competitive environment

A fundamental question in establishing an economic regulatory regime is to consider what aspects of the supply chain should be subject to competition in the market. The extent of competition in a market will determine whether economic regulation is justified and, if so, what form it should take.

The natural monopoly nature of below rail (track) and (probably) coal export terminal infrastructure at the port (and the use of the port, specifically the channel, itself) means that these elements of the coal supply chain will not be subject to competition.

There is a high fixed initial cost involved in the development of this infrastructure, and a single railway and port development will provide sufficient capacity to meet the likely expected demand. As a result, it is these monopoly elements of infrastructure that would typically be subject to economic regulation given the potential for the owner to use its market power in the below rail market or terminal and port services markets to prevent or hinder the competitive supply of infrastructure services or otherwise to earn excessive profit.

The above rail (haulage) market has different cost characteristics in that it is economically feasible to develop capacity in much smaller increments, meaning that it is potentially contestable. A key issue is therefore whether a third party access regime for the rail infrastructure should apply to the below rail services to allow for open access to the track by competing train operators. This would promote competition in the above rail market, which in turn could be expected to promote improved price and service offerings to customers (mines).

However, when compared to an unregulated environment, third party access will result in higher administrative and associated costs for the infrastructure owner and can be expected to reduce the returns available from haulage operations and the riskiness of future returns available to it, making the initial investment less attractive for a proponent.

Where the track owner is vertically integrated into the above rail market (but with the expectation that it will allow other rail operators to compete in that market), it can use its position and market power in the below rail market to frustrate or prevent third party train operators from gaining access to the track and competing with the track owner's haulage operations. A third party access regulation framework would seek to prevent such discriminatory conduct. This invariably results in an invasive regime with ongoing regulatory involvement.

Conversely, where third party access applies in the context of separated ownership of the above and below rail elements, it also introduces the prospect of foregone efficiency improvements being achieved due to the separation of the wheel/rail relationship.

There are different forms of economic regulation that could apply, with the extent of regulatory control tailored to match the extent of market power held by the infrastructure owner. For example, the form of regulation may range from a price monitoring regimes to more intrusive price control and/or third party access regulation. In determining the right form of regulatory control (if any), it is important to ensure that the costs of regulation do not exceed the expected benefits.

The greenfields nature of the project is also a relevant consideration. Greenfields supply chain infrastructure has a relatively high risk profile as its financial viability will depend on the viability of the (yet to be developed) mines, which in turn compete in highly competitive global commodity markets. To the extent that economic regulation reduces the returns of an investor in the export infrastructure and/or increases the perceived riskiness of the investment (as is virtually inevitably the case), then it may have a material financial impact on the project.

The best way to manage this issue for greenfields infrastructure development is to define the regulatory framework upfront in the context of the foundation contracts that underpin the financing of the project so as to reduce the risk and uncertainty for investors as much as possible. This framework should be based on an upfront assessment of the costs and benefits of different forms of economic regulation.

An alternative to providing access to below rail infrastructure to third party train operators is to have a 'haulage' access regime. Under a haulage access regime, the vertically integrated owner would have an obligation to negotiate for access to its haulage service, rather than its track network. In this way, a mine's coal would be hauled on the railway owners rolling stock, rather than that mine operating its own rolling stock on the owner's tracks, or engaging an independent haulage operator.

10.4.2 TKRP structure

There are a number of structural options for the proposed rail and port infrastructure, encompassing varying degrees of vertical integration. Importantly, different structural approaches will have both commercial and competition implications – and hence different implications for the nature of the required economic regulatory regime. The different models are depicted in Figure 2 and their implications are discussed below.

'Infrastructure' refers to both below rail and port infrastructure in this diagram. For the purpose of this discussion, it is assumed that below rail (at least) and port infrastructure are horizontally integrated – that is, owned by the same entity. This need not be the case but integration in this way has the benefit of improved co-ordination which gives all parties of greater certainty over the export pathway from mine to port.

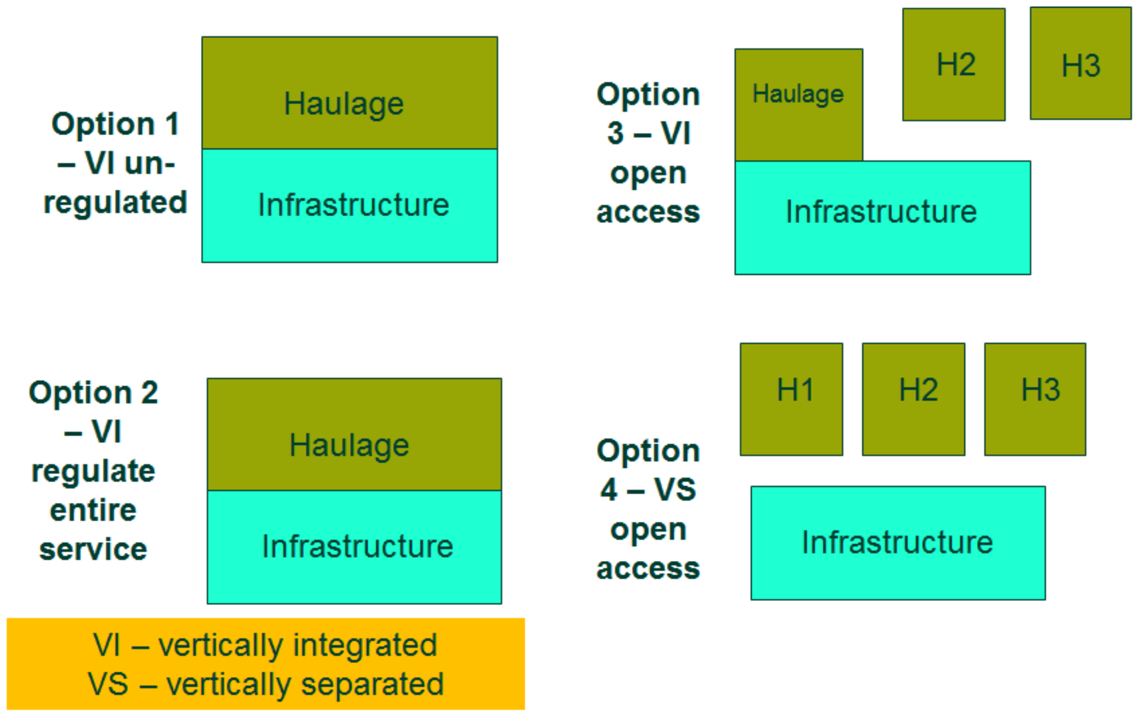
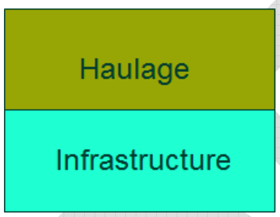


Figure 36 Which structural/regulatory reform option for rail and port infrastructure?

10.4.3 Option 1 – vertical integration, unregulated

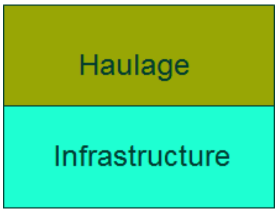


Option 1 reflects vertical integration of above rail (haulage) services with below rail (track) infrastructure. As with all of the options shown in the diagram, ‘infrastructure’ refers to both below rail and port infrastructure (i.e. horizontal integration).

Under this option, bundled below and above rail services will be provided by the incumbent. If the infrastructure provider is not a mining company, it will have an incentive to haul coal from all mines in the region. However, if the infrastructure provider is vertically integrated into the mining sector, it will have a disincentive to haul competing mines’ product, and would be in a position to use its market power to prevent these mines developing.

As the infrastructure provider is unregulated under this model, it would have incentive and opportunity to be able to extract all of the economic rents available in the market through restricting the supply of capacity, and would potentially be in a position to discriminate against competing mines. This would be unsustainable and does not achieve the objectives of any other stakeholder.

10.4.4 Option 2 – vertical integration, regulate entire service



Option 2 involves vertical integration of above and below rail infrastructure, with third party access to a bundled haulage service mandated under a regulatory regime. A haulage regime means that the infrastructure owner must negotiate in good faith for access to a bundled (above and below rail) service. The rail haulage regime would be combined with a port access regime.

A key benefit of regulating rail haulage (as opposed to below rail access only) is that it preserves the operational benefits of vertical integration. This has operational efficiency benefits given the interdependencies between above and below rail infrastructure. For example, greater investment in track infrastructure may result in improved above rail cycle times. These complementarities are particularly strong where the railway is electrified, as this involves a large below rail investment for the purpose of achieving reduced above rail costs. By managing above and below rail infrastructure within a single entity, operational efficiency can be optimised, taking into account the close inter-relationship between the two elements.

A haulage access regime is also much simpler and with lower transaction costs as these operational interfaces are managed within a single entity, rather than being subject to negotiation and contracting arrangements between below and above rail operators (as would be the case in a below rail only access regime with contestable haulage (see Option 3).

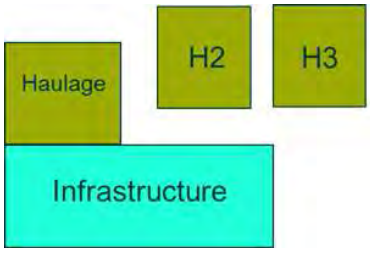
Another benefit of this approach is that it is likely to be more commercially attractive to at least some investors (noting that different investors will have different perspectives on this issue). Having a single entity controlling key supply chain infrastructure will promote operational and economic efficiencies, which in turn will be attractive to potential investors. We anticipate that investors who are currently owners of integrated railways will be most attracted to this model – other classes of investor may well be less concerned about the structure so long as there is confidence around the earnings that will flow from the investment.

A disadvantage of this option is that it results in a wider regulatory net than is necessary. It is only the below rail and port infrastructure that has monopoly characteristics, with the above rail infrastructure potentially contestable. By regulating a haulage regime, access regulation extends beyond the infrastructure where such regulation is economically justified.

It would also mean losing the benefits of competition in the haulage market. Regulation is a poor substitute for competition and, as such, without contestable rail haulage, the dynamism of a competitive rail haulage market, and with it, the responsiveness to customer requirements as they evolve over time will be lost or at very best imperilled. This will mean a haulage service that is less responsive to customer wants and subject to less pressure for efficiency. A haulage regime would instead rely on regulation to ensure that the infrastructure owner does not abuse its market power in setting haulage charges and that it is also encouraged to strive for efficiency gains.

However, this model would allow for a regulatory regime that focuses largely on pricing rather than on other aspects (discussed below) that become more important where there is above rail competition.

10.4.5 Option 3 - vertical integration, open access



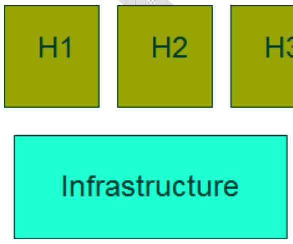
Option 3 reflects a vertically integrated above and below rail service provider with regulated below rail access. This means that the haulage market is contestable. The rail access regime would be combined with a port access regime, to provide for access to both elements of infrastructure.

This option facilitates competition in the rail haulage market, allowing the benefits of competition to be gained by stakeholders (consistent with the objectives of mines, haulage operators and the Botswana Government). It also provides greater scope for retaining the benefits of vertical integration. By retaining vertically integrated operations, this option may be less operationally risky than a vertically separated approach (although a greenfields railway is more conducive to vertical separation up front).

However, as the infrastructure owner will be competing in the haulage market with other haulage operators, it will have an incentive to use its position and market power in the below rail market to prevent or hinder access to third party operators. This means that, under this model, a detailed regulatory response will be required to address this risk. In particular, the access framework may extend to requiring separation of functions (to avoid conflicts of interest between the below and above rail parts of the business) as well as regulation of conduct (such as ringfencing arrangements to protect access seeker confidential information). A robust and extensive third party access regime will be necessary to ensure haulage providers are sufficiently confident in the integrity of the regime to be willing to enter the market.

The need for a comprehensive (and more intrusive) regulatory regime creates additional regulatory risk for an investor and an ongoing invasive regulatory requirement that the Botswana and Namibian Governments will need to manage. However, importantly, the regime is unlikely to create any greater risk around the quantum of returns that are available to the infrastructure owner in the provision of below rail services – rather the risk is that it will be become subject to regulation of the way in which it manages the provision of access to those services.

10.4.6 Option 4 – vertical separation, open access



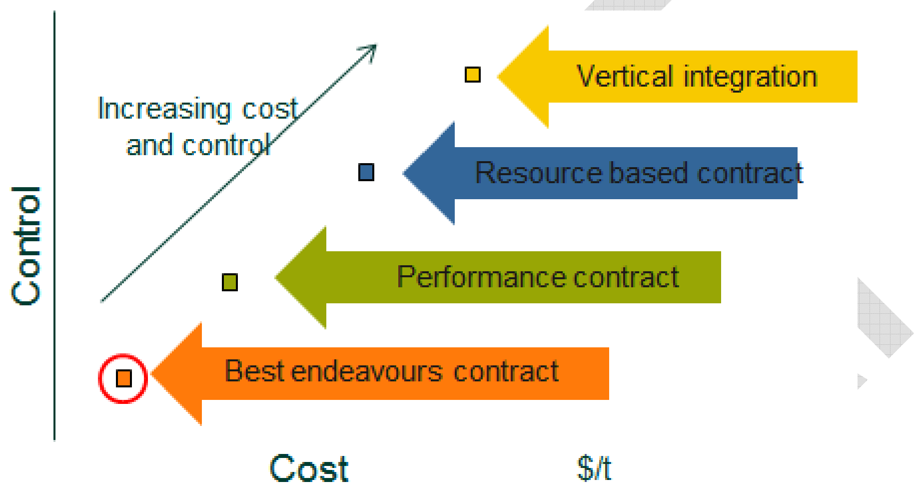
Option 4 is a vertically separated infrastructure provider subject to an open access regime. Under this model, the incumbent owns below rail (and port) infrastructure, with a contestable haulage market.

This option provides the best environment for competition to flourish, thereby promoting efficient operations through competition which, in turn, will benefit haulage operators and mines. Further, the track owner will have an incentive to promote access to maximise the use of its infrastructure by carrying more coal.

As the below rail infrastructure owner is not competing in the above rail market (and there is therefore no risk of discriminatory conduct in providing access), this option allows for a simpler, more targeted regulatory approach (focused on pricing) which can be determined up front for a lengthy period.

This option, however, results in a more fragmented supply chain, which in turn requires a more extensive effort from all supply chain participants to continue to operate the supply chain in the most efficient manner as it evolves. This approach also risks forgoing some (but by no means all) of the operational efficiencies associated with vertical integration.

Importantly, this approach is likely to be the most responsive to customer desires. Experience elsewhere suggests that customers seek differing levels of service commitment from haulage providers at different times. Some mining companies, for example, may seek to vertically integrate into the haulage of coal from their mines to the port. Others may be content with a defined capacity entitlement from a haulage service provider. An important benefit of the vertically separated model (as well as Option 3 to a more limited extent) is that it allows customer to choose the nature of the haulage service that best suits it. An overview of different contracting models is given in Figure 37 below.



There are different contracting models for haulage with varying degrees of cost and control for the end customer.

Best endeavours contract – under this model, haulage provider maximises its profit from a portfolio of customers given that it has a limited performance obligation. While this is the lowest cost haulage option, customers have relatively little control, making it a challenge to ensure that the haulage provider performs adequately.

Performance contract – this model has stronger performance obligations, but increases haulage costs. The haulage provider maximises profit from a portfolio of customers given constraints imposed by performance obligation (eg. timeliness, surge capacity).

Resource based contract – this model provides the customer with dedicated resources to give it greater control at higher cost. The haulage provider dedicates resources to the customer, who decides how services are to be provided given resource constraints. The mine can contract directly for paths for the operator to utilise to meet the mine's needs (may be any mine to any port connectivity).

Vertical integration – under this model, the mine owns rolling stock and runs the haulage service itself. This will be at a higher cost, but gives the mine maximum control. The mine can contract directly for paths to meet the mine's needs (may be any mine to any port connectivity).

Figure 37 Contracting models for haulage

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Vertical integration – under this model, the mine owns rolling stock and runs the haulage service itself. This will be at a higher cost, but gives the mine maximum control. The mine can contract directly for paths to meet the mine's needs (may be any mine to any port connectivity).

This option may also be less commercially attractive to an investor who wishes to invest specifically as a vertically integrated rail haulage. However, there are examples of vertically separated privately owned below rail providers encountering no constraints to raise capital (e.g. Brookfield Rail in Australia). Also, proponents may be concerned about the separation of above and below rail creating inefficiencies or causing difficulties in coordination, potentially limiting or delaying productivity enhancing investments or future expansions. These are issues which can be largely addressed through measures to improve co-ordination across the supply chain.

10.5 Design of access regime – institutions and architecture

10.5.1 Best practice regulatory design

The development of an economic regulation framework for TKRP should be guided by the following best practice regulatory design principles:

- Governance
  - There is a need to establish an independent regulatory body and to confer powers on that body;
  - The challenges of a trans-national railway will pose particular governance issues, both in the development/construction phase and during ongoing operations. Trans-national issues that will need to be addressed include:
  - Approvals and access for construction of railway and port infrastructure;
  - Certainty around ongoing access for rail operations;
  - Recognition of a single economic regulator;
  - Preferably, recognition of a single rail safety framework; and
  - Preferably, arrangements for dealing with emergency response to incidents.

These are threshold issues for the project and will be best addressed by inter-governmental agreement, rather than the onus being on the private investor to negotiate the necessary arrangements.

- regulation only applied where justified:
  - There should be a cost/benefit assessment of the proposed regulatory approach to ensure that it is expected to create net benefits
  - Where the regulatory framework provides the potential for increased regulatory intervention, the triggers for such increased intervention should be clearly established to ensure economic regulation is not misapplied
- ability of regulator to undertake task:
  - The regulator needs to have developed expertise in rail regulation – especially under Option 3
  - The regulator needs access to information and powers necessary to carry out its functions
  - It needs a strong understanding of the industry that it is regulating
  - It should be outcomes rather than process focus
- Clearly defining regulator's discretion:
  - Obligations on regulator about how they regulate (objectives, guidelines etc)
  - The regulator should be responsible for ensuring compliance with the 'rules' for providing access
  - Some regulatory discretion allows flexibility to address evolving circumstances
  - However in in order to protect the infrastructure provider from unacceptable regulatory risk, there should be provisions to ensure accountability, such as defining the limits of regulatory discretion and allowing for review of regulatory decisions in defined cases
- the form of regulation should be appropriate:
  - Linked to market power – the degree of regulatory control should be commensurate with the extent of market power and concerns about its misuse
  - Consider light handed approaches wherever possible, potentially with triggers for stronger intervention in the event that the light handed approach does not provide sufficient constraint on the infrastructure provider
- transparency of 'rules' for providing access:
  - Obligations on access provider about how they provide access
  - Communicate expectations and requirements
  - Provide confidence and certainty to all parties

The above factors should be taken into account in developing the regulatory framework for the TKRP.

10.5.2 Access regime development

The development of the access regime to apply to the TKRP can be thought of in terms of a number of building blocks. Each of these building blocks reflect elements of the institutional and governance framework that ideally would be in place to achieve an effective framework that is consistent with best practice regulatory design. These building block layers of an access regime are shown in Figure 38.

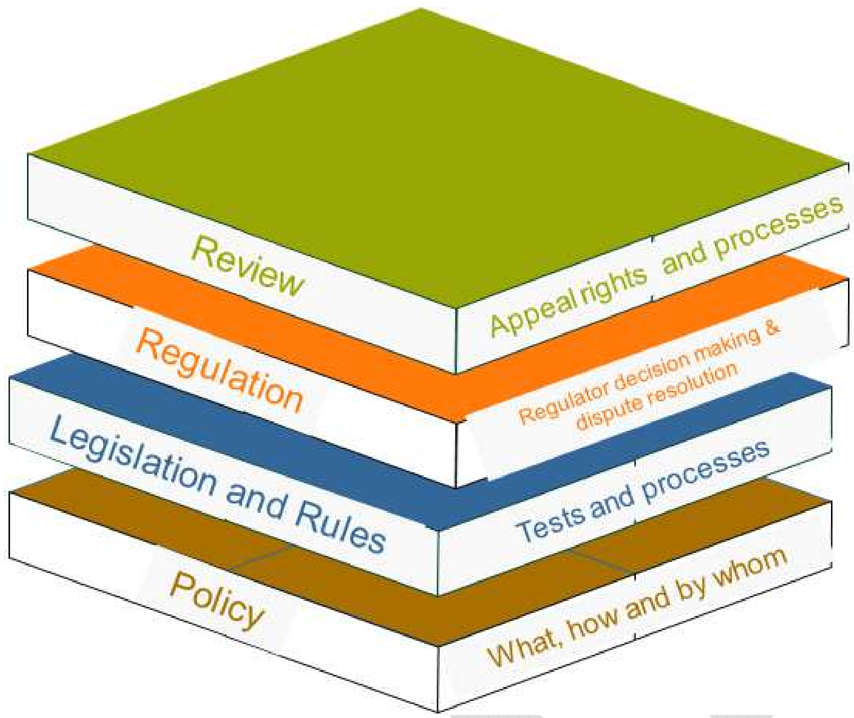


Figure 38 Governance – layers of an access regime

Policy direction

The Botswana and Namibian Governments will need to develop a clear policy on the role, purpose and intent of the access regime, as a first step to underpin the development of the access regime. The recommended regulatory framework will form the cornerstone of this policy; however the policy framework will require further development as the project progresses.

This policy capability will need to encompass the complex commercial and regulatory issues associated with a project of this nature. This complexity is compounded by the cross border issues as an integral part of the project development phase will involve negotiations and establishing protocols between neighbouring countries.

The Botswana and Namibian Governments should therefore consider the mechanics of how this policy making capability will operate, in particular, which persons/institutions within the Governments should be responsible for this task and the steps and processes to be followed. This capacity is a very critical part of project success as it will shape the regulatory and commercial environment for the entire project.

Legislation and rules

Once the policy direction is set it will be necessary to develop the legislation and rules that will form the architecture of the regulatory framework. These are very important in terms of providing regulatory accountability and constraining regulatory discretion – factors which will be essential to giving investors comfort in the credibility of the regime and minimising regulatory risk. This legislative framework may include:

- Legislation to establish the regulatory body. This will need to specify a wide range of matters pertaining to the operation of economic regulation, including:
  - Specifying the roles, functions, powers, decision-making processes, information gathering powers of the regulator

- The regulatory instruments at the regulator's disposal, such as approving and/or monitoring access prices, approving access arrangements up front for a regulated entity and undertaking arbitrations of access disputes
- Tests for applying economic regulation
- Processes that will apply in undertaking regulatory functions
- This legislation may also have subordinate legislative instruments underneath it, such as a set of rules or guidelines that are to apply in particular cases. For example, the legislative framework could include guidelines for setting/approving access prices and specifying matters that must be addressed in an access agreement.

Application of regulation

Once the legislative framework is established, the regulator will need to perform its functions as required. This will depend on the form of regulation that is adopted for the infrastructure (in accordance with the regulatory framework), which in turn will be determined by the structural model adopted and its associated competition concerns.

For example, a vertically separated railway will raise less competition concerns than a vertically integrated railway competing with third party operators in the haulage market. In the latter case, a more prescriptive access regime will be required (such as the approval of a detailed access arrangement, and possibly reference prices, upfront by the regulator). In the former case, it may be sufficient to have the service 'declared' for access, meaning that the owner must negotiate in good faith with access seekers, with recourse to binding dispute resolution where negotiations fail.

Review

The ability to review a regulator's decision is another element that may be included as part of the regulatory framework. The rationale for including this step is that the regulator's decisions can have a significant commercial impact on the infrastructure owner and access seekers and, with the best of intentions, regulatory error can occur. Regulatory decisions can also have a major impact on economic welfare more generally if errors are made which lead to either under or over-investment in the regulated infrastructure (for example, through regulatory decisions on the prices that may be charged for access).

The ability to have a regulatory decision reviewed provides an opportunity to correct any such errors in decision making. This may be an important element for investors as it provides a means of addressing regulatory risk by minimising the potential investor impact of the exercise of regulatory discretion.

10.6 Content of access regime

The content of the economic regulation framework to apply to the rail and port infrastructure will be determined in part by the structural model adopted. In general, a vertically integrated railway will raise greater concerns about competition and the risk of the owner preventing or hindering third party access than will a stand-alone below rail network/port owner because of the latter's indifference to who operates on the network (subject to the operator being operationally efficacious). The content of the economic regulation framework will therefore need to be tailored to the extent of competition concerns.

As noted above, there is the option of having either a below rail third party access regime or a bundled haulage access regime. This will have significant implications for the content of the access regime and the nature of the requirements on Government to manage and operate the regime. For example, a haulage regime will not need to address operational and interface issues, whereas this is an important aspect of access negotiations in a below rail access regime.

10.6.1 Third party access

Third party access is based on a 'negotiate-arbitrate' model, in which there is an obligation on the owner of the rail and port infrastructure to negotiate in good faith with third parties for access to the infrastructure. Typically, the access provider will have an obligation to provide certain information to access seekers in order to enable them to develop an access proposal and engage in meaningful negotiations (for example, information about available capacity, technical specifications of the railway and, potentially, the indicative cost/price of access – the latter may be in the form of a 'reference tariff' reflecting a defined 'reference service'). While the onus is on the parties to negotiate an access agreement, should negotiations fail, then the access regime provides recourse to a binding independent dispute resolution. The clearer the outcomes of that dispute resolution process and the more readily it is able to be achieved, the less likely it is that disputes will arise.

An access regime may be relatively 'light handed', being limited to a simple 'negotiate-arbitrate' framework. This approach provides little guidance in access negotiations for the parties, leaving all matters up to commercial negotiation. Alternatively, the regime could be specified in more detail, with certain processes and matters to be addressed identified up front to guide access negotiations. This can help facilitate commercial negotiations and minimise the risk of access disputes as access negotiations occur within certain guidelines. The greater the competition concerns, the more detailed the access regime will be to address the risk of the access provider using its market power in the below rail market to prevent or hinder access, or provide access to third party access seekers on less favourable terms than it provides to its own related business. The focus of economic regulation will vary depending on the structural model adopted as each model will have different competition implications. For example, given that the infrastructure owner (under any model) will have monopoly power, pricing issues will be important (although noting that a stand-alone infrastructure provider will have an incentive to promote supply chain throughput).

However, the extent of market power that this infrastructure owner will be able to exert will vary over the life of the project – in the early stages, where gaining sufficient volume is critical in order to ensure the financial viability of the project, the infrastructure owner may have only limited market power in practice. However, once the project is established, the market power of the infrastructure provider is likely to increase, as the additional costs associated with providing additional capacity may only be low, and the value of this additional capacity to a new user may be high. To some extent, this upside might be important for attracting infrastructure investors in the first place – it is therefore important that the regime clearly define the circumstances in which regulatory intervention is authorised.

However, the terms and conditions of access will be less of an issue if there is an alignment of interest arising from the ownership structure – i.e. a vertically integrated railway providing third party access, or a vertically integrated mine-port supply chain providing access to other mines will clearly create greater scope for conflict than a vertically separated rail access provider with no ownership links with mines.

10.6.2 Matters to be addressed in an access framework

The key elements of the access framework that will need to be addressed are discussed below. These are divided into two categories:

- Matters that should be covered in an access regime. These are those matters that are essential to make a relatively light handed regime operate effectively; and
- Additional matters that may be considered for inclusion in an access regime. Inclusion of these matters may give the regime greater credibility with stakeholders, however, they will also have commercial implications for the access provider which will need to be carefully considered.

10.6.2.1 Matters that should be covered in access regime

Objective

Specifying an objective of the regime is an important means of guiding both access negotiations and arbitrations. An appropriate objective for a rail access regime is to promote efficient investment in and use of the infrastructure covered by the regime.

There may also be other objectives that the Governments may wish the access regime to achieve, for example, in relation to the operation of non-coal freight, or interconnection with the existing rail network. If additional objectives are incorporated into the access regime, care will need to be taken that these do not undermine the viability of the core coal services, and that they do not undermine the incentive of the infrastructure owner to invest in expanding capacity of the network.

Coverage

The regime should specify the scope of services subject to third party access. For example, this would specify:

- Whether it was a below rail service, or a bundled haulage service;
- A coal carrying service only, or open to access for other goods;
- A cyclic service or a timetable service;
- The interaction, with the existing Botswana or Namibian railways (ie. the nature of the service for an access seeker traversing both networks); and
- Whether expansions to the network are covered.

Negotiation process

Essentially an access regime is a structured negotiation process for the provision of a regulated service. A fundamental element therefore is the structured process through which the infrastructure owner's obligation to negotiate in good faith with an access seeker to reach an access agreement can be defined. Matters to be included in a structured negotiation process include:

- The format of access applications, including information required;
- Exchange of preliminary information relating to the proposed service;
- Provision of an initial or indicative access proposal by the access provider;
- A negotiation phase. This would specify the matters to be addressed during access negotiations and time limits that apply. Matters include:
  - Price and other terms and conditions of access;
  - Rights to be conferred under the access agreement (eg capacity entitlements etc)
  - Environment issues – this will be in accordance with established environmental regulatory frameworks in Botswana and Namibia respectively;
  - Rail safety and operator accreditation – this will need to be in accordance with the rail safety regime adopted by the Botswana and Namibia Governments collectively;
- Conditions for access negotiations – these are triggers that would allow for cessation of access negotiations, such as lack of creditworthiness of the access seeker.

Dispute resolution

The process for resolving disputes that arise during an access negotiation is another essential element of the access framework. This should include:

- Steps in the dispute resolution process – notification of a dispute by either party and steps to be taken to resolve to resolve dispute (eg. Chief Executive resolution, mediation, expert resolution, arbitration)
- Identity and appointment of expert/arbitrator – this may be an identified party, such as a regulator or other official, or it may specify that the expert/arbitrator is chosen from a certain body (e.g. Institute of Engineers)
- How the costs of dispute resolution will be met

Another important element is the guidance to be given in how a dispute must be resolved. While the expert/arbitrator will inevitably have a reasonable degree of discretion, the inclusion of dispute resolution guidelines in the access framework can provide greater certainty for both parties and mitigate the risks association with the outcomes, noting the smaller the scope for disagreement, the less likely it is that disputes will arise.

Confidentiality

The access framework will need to include obligations relating to the handling of confidential information exchanged during the access application and negotiation process. At a minimum, the access framework will need to ensure that confidential information is not improperly disclosed or used for a purpose other than that for which it was provided.

Vertical integration

If the access provider is vertically integrated into a competing market, it will be necessary to include ringfencing obligations to ensure there is confidence in the integrity of the access regime in that the vertically integrated rail provider cannot provide an inappropriate commercial advantage to its affiliated entity. Matters that would typically be addressed in ringfencing arrangements for a vertically integrated rail access provider are:

- Protection of access seeker confidential information;
- Avoidance of conflicts of interest – this may be through varying degrees of functional separation: that is, separating access from non-access related functions within the business;
- Decision making by the below rail component of the entity – to avoid discrimination in pricing or operational decisions; and
- An obligation to maintain and report separate regulatory accounts (separating access and non-access related functions).

Interface and operational issues

A below rail access regime will have to address how interface issues are managed, specifically around operational matters as well as safety and environmental requirements.

10.6.2.2 Additional matters that may be covered in access regime

There are a range of additional matters that the respective governments and other stakeholders may wish to be included as part of the access framework to provide greater certainty for access seekers and give the regime greater credibility.

Capacity allocation and management

Further information about how network capacity will be allocated and managed may be important for access seekers. Potential issues to be addressed include:

- Capacity allocation – how capacity will be allocated between competing access seekers, particularly where additional capacity is sought by foundation customers
- Capacity management – this includes arrangements allowing for the resumption, relinquish and transfer of capacity entitlements in certain circumstances as well
- Capacity accountability – mechanisms to promote accountability for capacity consumption by access holders may be beneficial for the efficient operation of the rail infrastructure and help send efficient price signals about the need for future investment. Accountability measures would create incentives for users to ensure that actual capacity consumption did not diverge from contracted capacity consumption. This can have significant flow-on effects as delays by one train operator can cause further delays elsewhere on the network.

Terms and conditions of access

Developing a set of standard terms and conditions of access will provide guidance for access negotiations. Standard terms can provide a basis for negotiations, although parties should be able to negotiate variations from those terms. However, they also provide guidance to the arbitrator in an access dispute, as they effectively provide a 'fall back' position in an access determination.

Another option is for the access framework to provide a list of the matters that are to be included in an access agreement, rather than specifying in detail the standard terms and conditions that will apply.

Supply chain

As a greenfields railway, the opportunity exists for the TKRP proponent to establish arrangements as part of the access framework that promote the efficient operation of the supply chain. Optimising supply chain efficiency will benefit the infrastructure owner (both rail and port), train operators and customers as it will make best use of available capacity and potentially delay the need for costly investments in new capacity.

The more vertically integrated the supply chain, the fewer parties there are that need to coordinate activities in the coal supply chain. Where the supply chain is fragmented, coordinating the activities of multiple parties on the network (i.e. train operators, end customers) becomes more complex, with greater risk of coordination failures.

Mechanisms to promote supply chain efficiency may include:

- Commitments to consult with supply chain participants about future plans and emerging capacity constraints and issues
- The development and publication of a master plan setting out the expected future expansion path of the infrastructure
- Undertaking system master planning, encompassing all elements of the supply chain (where there are multiple parties)
- Capacity accountability mechanisms – involving monitoring of actual capacity consumption compared to contracted capacity consumption, with the potential for consequences where these diverge significantly

Some of these mechanisms will be more onerous than others to implement, so that the TKR proponent will need to consider whether the likely benefits of greater supply chain coordination will outweigh the costs. The benefits will be greater where the infrastructure is capacity constrained and, therefore, this may not be a significant issue initially. However, as a greenfields railway, there is an opportunity to 'get it right' from the start by establishing incentives for behaviours that promote overall supply chain efficiency. Experience in other bulk supply chains where there are multiple participants is that it is extremely difficult to resolve coordination problems once they become established.

11 Financial and commercial assessment

11.1 Introduction

The preliminary financial and commercial assessment undertaken by Deloitte forms a key input to this Development Plan. The purpose of the financial and commercial assessment is to inform future Government decision-making about the project by:

- Assessing the financial viability of potential mines using the project based on a mine to port financial modelling
- Assessing the key commercial factors of the project

This chapter contains the outcome from this assessment. The detailed Deloitte report can be found in Appendix E.

11.2 Approach

The financial viability of the TKR is dependent on its final development specification (including associated assumptions) and the impact of this on key stakeholders.

For the purpose of this study the TKR development specification was narrowed down to include the following three alignment options that link Botswana to Walvis Bay:

The northern route via Windhoek to Walvis Bay (PFS alignment)

- The prefeasibility study identified a Northern route via Windhoek to Walvis Bay.

The Government of Botswana route (GoB alignment)

- On March 2014 a Bilateral Agreement was signed between Botswana and Namibia approving a rail corridor for the TKR via Windhoek to Walvis Bay. This has been termed the GoB route alignment for the purpose of this report.

The enhanced northern route (Enhanced alignment)

- Given the investment required for each additional kilometre of railway, Aurecon considered whether the GoB alignment could be optimised to reduce the total required km of track. Aurecon identified a number of potential efficiencies that have been modelled as the enhanced northern route.

Each alignment option was given the potential to be developed as a standard gauge, dual gauge or narrow gauge railway with either an electrified or non-electrified (i.e. diesel) track. This resulted in a total of 18 options being assessed within the preliminary financial analysis (see Figure 39). Option 10 is designated as the project defined in the Bilateral Agreement.

Figure 39 Modelled options

Option:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Route:	North via Windhoek (PFS)						North via Windhoek (GoB)						Northern optimised route					
Gauge:	Standard		Narrow		Dual		Standard		Narrow		Dual		Standard		Narrow		Dual	
Fuel type:	ELEC	DSL	ELEC	DSL	ELEC	DSL	ELEC	DSL	ELEC	DSL	ELEC	DSL	ELEC	DSL	ELEC	DSL	ELEC	DSL

Note: DSL = Diesel, ELEC = Electricity

Each option was considered from the perspective of key stakeholders including:

- Potential miners;
- The Governments of Botswana and Namibia; and
- Potential below rail and port investors.

This was considered critical as the incentives for each stakeholder vary and are in some cases negatively correlated, for example a lower mining royalty may benefit the miners but decrease the amount of tax collected by the Government. In order for the TKR to be viable, appropriate incentives need to exist for all key stakeholders. However, given that the commercial viability of all stakeholders will be dependent on the ability of the mines to make a profit from their operations this was the focus of the analysis.

11.3 Model methodology

The model focussed on assessing the revenues and expenses attributable to each set of stakeholders across each element of the overall supply chain for the identified options. This included an assessment of the magnitude and quality of Botswana's current coal reserves and the potential global demand for this coal as well as the costs associated with key supply chain elements including:

- Potential mines
- Below rail infrastructure
- Above rail infrastructure and services
- Coal handling facility
- Port at Walvis Bay
- Shipping costs to potential customers

Each of these elements is discussed in turn below. Figure 40 provides an illustrative example of the different elements assessed as part of this project.

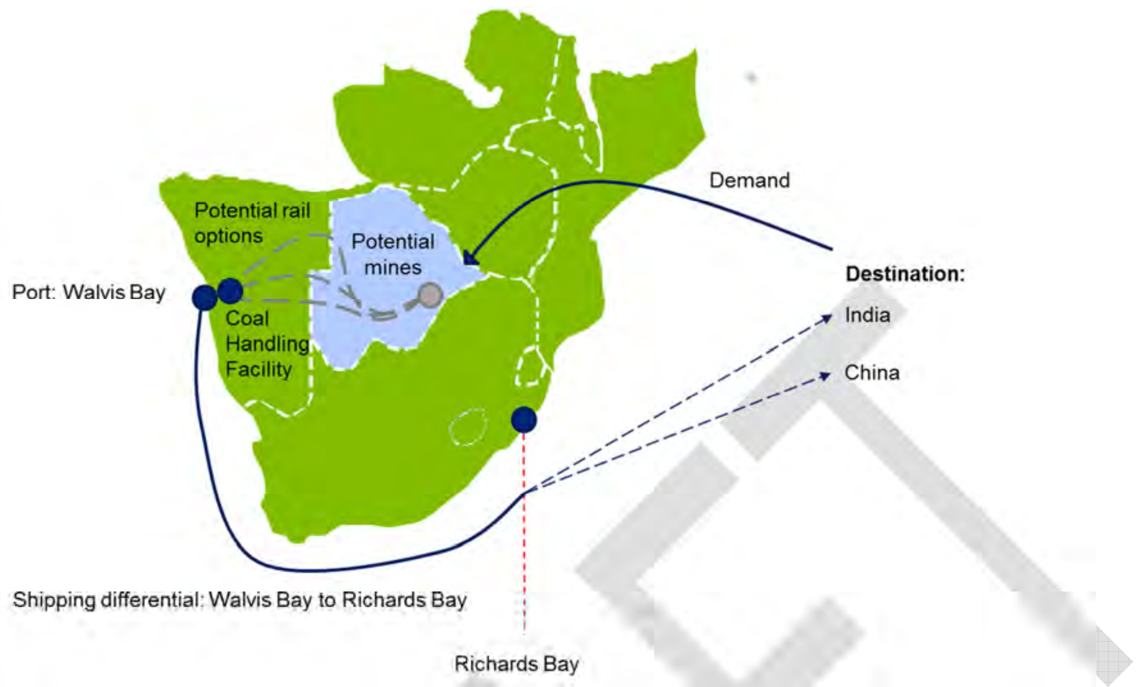


Figure 40 Botswana coal supply chain

11.4 Potential mine developments and coal quality

Coal has been known to exist in Botswana since end of the nineteenth century but systematic exploration did not begin until the late 1940's. Botswana's first (and only) coal mine began production in 1973.

Since 1970, interest in the coal resource of Botswana has attracted the attention of several companies and a significant area of the country has been explored for coal deposits of possible economic potential. This exploration has confirmed the presence of large resources of low-medium quality bituminous coal, which in certain areas responds to beneficiation (i.e. washing) to produce coal suitable for export markets.

11.4.1 Development regions

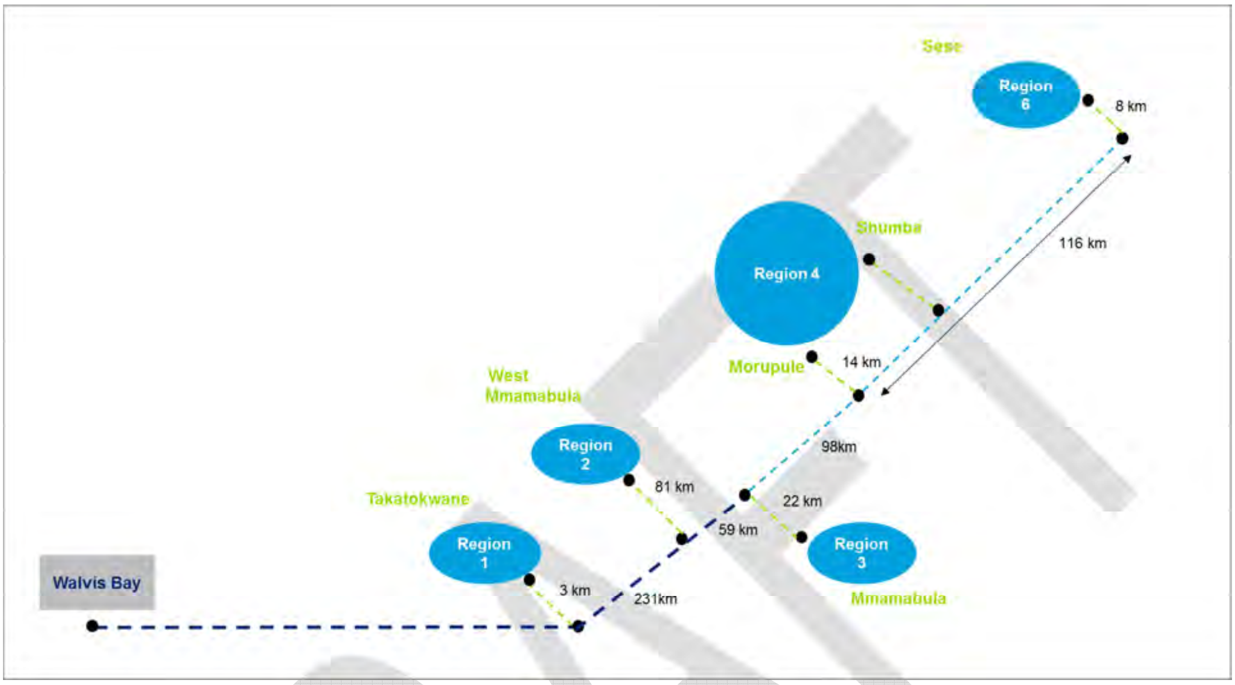
The potential resource is currently controlled by a number of different mining companies that have bought exploration rights throughout the coal basin. These potential miners have published information on the quality of their deposits and it is this data that has been used as the basis for determining the size and quality of coal deposits that could be developed if they had access to the railway. Using this data we have developed estimates of potential production from five potential mining regions. The regions were selected to be representative of the different coal seams and the likely geographic range of potential mines along the TKR. Each mining region was analysed to estimate its potential scale, marketability and risk profile as well as likely extraction and investment costs.

Data from a wide range of sources including the following potential mines was used in this analysis:

- Takatokwane Project (Walkabout)
- Mmamabula West (Africa Energy)
- Mmamabula (Jindal)

- Moropule (Debswana diamond company i.e. Anglo American and the Government of Botswana)
- Sese (African Energy)

Figure 41 Stylised map of regions modelled



It is noted that there are other mining potential mining regions but the data available on these regions is not as extensive as those listed above it is not likely that the coal from these regions will be significantly better than those listed above in terms of coal quality and mining cost.

11.4.2 Coal quality

Botswana coal is thermal coal which is typically assessed based on three key characteristics:

1. Energy level
2. Ash content
3. Presence of trace elements (e.g. Sulphur)

Raw coal resources in Botswana can be described as having high ash levels, low to moderate energy and high sulphur, through processing the coal can be improved (i.e. the ash and sulphur content can be reduced) but as illustrated in Figure 42 this has a cost in terms of both production costs and waste output. The higher the quality of the coal produced the higher the cost of production and production of waste product (middlings) and the lower the quantity of coal produced per tonne of raw coal mined.

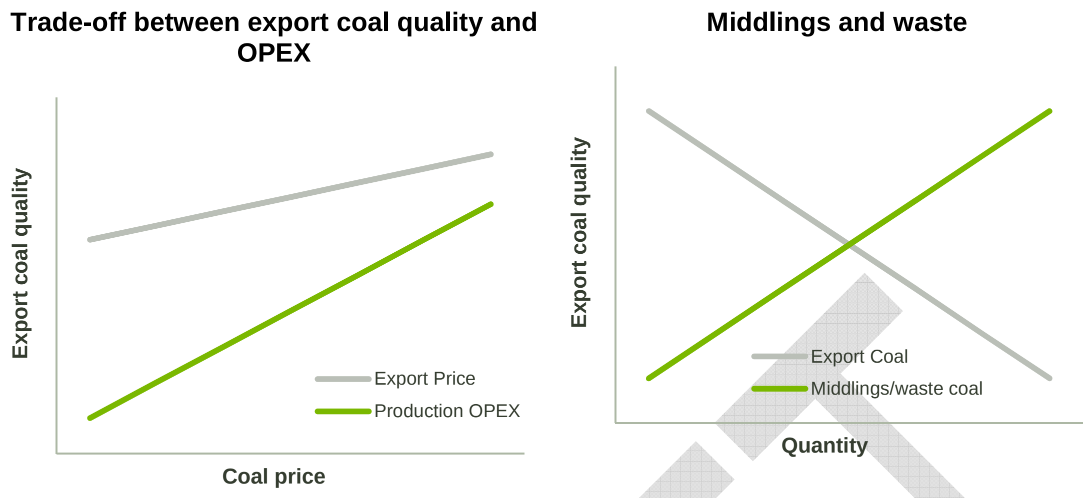


Figure 42 Trade-off between export coal quality / price and production costs

The miners' actual choice of production technique will depend on the market for coal at the time the railway is built but broadly miners will have two options:

- **Option 1:** Produce a relatively high quality product (higher energy, lower ash and sulphur) export product. This will secure a higher price but a lower yield and relatively large volumes of low energy coaly material as either a by-product of the coal washing process (middlings) or waste from open cut mining of seams with high ash and uneconomic yields. This material is important for several reasons. First, if it is not utilised it may become an environmental hazard as it may spontaneously combust and it is likely to be acid generating due to the high sulphur content and therefore add to operating capital and rehabilitation costs. Second, to cover the cost of producing this product miners need to be able to sell it. Many of the undeveloped projects in Botswana include the sale of this material in the forecasted project economics. Typically this material has been assumed to be sold to domestic power stations and other local end-users. It could also be utilised for coal to liquids processes if the economics are attractive. The size of the market for this material however appears limited and the returns low. Optimistic assumptions in this regard are a risk to the project economics and viability.
- **Option 2:** Produce a higher ash, lower energy export thermal product for the Indian and Chinese markets and a smaller volume of middlings / domestic thermal coal. This will secure lower FOB prices but increased volumes and reduce the cost and issues associated with unutilised middlings.

If all miners chose Option 1 it is estimated that approximately 20mtpa of middlings would be produced if coal exports were to reach 60 mtpa. Given the regional and domestic market for middlings coal appears small (current Botswana domestic demand can be satisfied with 2mtpa) it would seem that Botswana miners will generally favour Option 2. As a result it is anticipated that the majority of producers will blend to produce a higher volume mid-range product with a calorific value of around 5,500 c/kg, an ash content of 16% and sulphur of <1%.

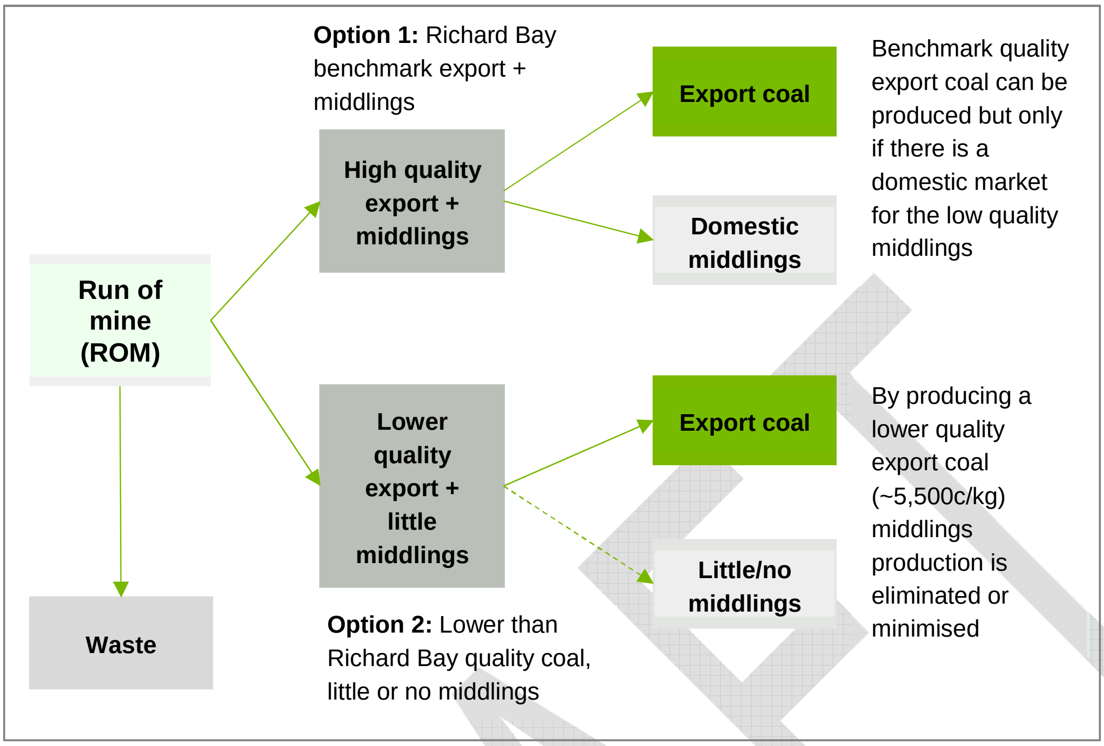


Figure 43 Coal production options

11.4.3 Coal Volume

Botswana has *in situ* reserves of over 2 billion tonnes of coal and individual miners such as Jindal, Walkabout, Africa Energy and Debswana have plans that show that each of their mines could be expanded to produce over 20mtpa of export coal. As a result while there is no one individual mine or miner that could produce 65mtpa of export coal there is a large number of possible combinations of different miners that could potentially develop their mines to produce 65mtpa (or more) of export coal for a period of over 40 years. However, it is noted that these mine developments will require significant investment in detailing drilling around the deposits before they can be developed.

11.4.4 Coal Price

Individual seaborne coals are priced by reference to benchmark coal that has specific coal qualities.

There are a number of benchmarks which are specific to particular regions but the two most widely published benchmarks of thermal coal are the Richards Bay and Newcastle benchmarks. The McCloskey Richards Bay FOB benchmark coal is rated 6000 c/kg net air dried with an ash content of 16% and a maximum sulphur content of 1%. In December 2014 this coal was trading for approximately 65USD per tonne (FOB). Variations in price from this benchmark are generally related three key factors

- **Calorific value:** all other things being equal there is a close to linear relationship between calorific value and price, a 10% reduction in the calorific value of the coal will result in a 10% reduction in the price.
- **Sulphur content:** high sulphur content (>1%) will preclude the sale of the coal to some major markets and typically results in a lower sale price.
- **Ash levels:** higher ash levels result in higher waste disposal costs at power stations can result in a price discount and /or preclude the sale of the coal to some markets where disposal costs are very high (e.g. Japan).

Table 29 presents an estimate of the probable FOB price per tonne that could be achieved for the range of coal products that are likely to be produced from Botswana mines served by the TKR. It is expected the majority of Botswana coal will sell at a discount of around 8% to the Richards Bay benchmark (not accounting for the impact of higher shipping costs).

Table 29 Estimated price variations from Richards Bay benchmark for Botswana coal

Price estimation	kcal	Ash discount	Price - $USD/t
Export @ 15% ash and 6,209kcal/kg	6,209	0%	$67
Export @ 13% ash and 6,200kcal/kg	6,200	0%	$67
Richards Bay Benchmark 15% ash and 6,000 kcal/kg	**6,000**	**0%**	**$65**
Export @ 18% ash and 6,000kcal/kg	6,000	0%	$65
Export @ 20% ash and 5,731kcal/kg	5,731	0%	$62
Export @ 20% ash and 5,500kcal/kg	5,500	0%	$60
Export @ 17% ash and 5,250kcal/kg	5,250	0%	$57
Export @ 27% ash and 4,500kcal/kg	4,500	0%	$49
Export @ 22% ash and 4,500kcal/kg	4,500	0%	$49
Domestic middlings @37% ash and 4,175kcal/kg	4,175	20%	$36

11.4.5 Coal production costs

Enable was engaged to estimate mining costs for the potential mines in Botswana. Enable sourced publically available information on undeveloped Botswanan coal resources and mine planning studies as well as operating cost data for existing South African operations. This information has been utilised to estimate (by benchmarking) the likely mine operating costs for Botswanan coal projects thought to typify the potential mining districts. Capital costs have been similarly estimated using high level benchmarking data from published statements on Botswana projects. Indicative capital costs per annual tonne of production for a low ratio open cut mine and a standard configuration bord and pillar operation have been compiled.

The operating and capital costs generally utilised in the financial assessment are shown in Table 30.

Table 30 Estimated Operating and Capital Costs per ROM tonne produced

Mine type	Rate per ROM tonne
▪ Underground (bord and pillar)	▪ Operating costs USD25.0 ▪ Capital cost USD50
▪ Open cut (Truck shovel)	▪ Operating costs USD13.4 ▪ Capital cost USD30

Source: Enable

This cost data is high level and assumes that power and water supply issues are resolved such that the impacts on operating and capital costs are minor. This may be an optimistic assumption. The cumulative impact on power and water sources and infrastructure may be considerable and significantly impact operating and capital costs. In Queensland Australia water studies have indicated that 200ML of fresh (raw untreated) water are required per 1Mt of coal production. This volume is achieved with very high levels of water recycling in the mine and processing plants.

11.4.6 Mine development

Enable has developed an indicative coal mine development schedule (see Figure 44) based on Enable's understanding of the Botswanan regulatory requirements, and typical exploration, feasibility, environmental and stakeholder engagement processes.

A well-resourced and successful project could achieve first coal production within six years from discovery assuming all the relevant approvals (both internal and external) are progressed as quickly as possible.

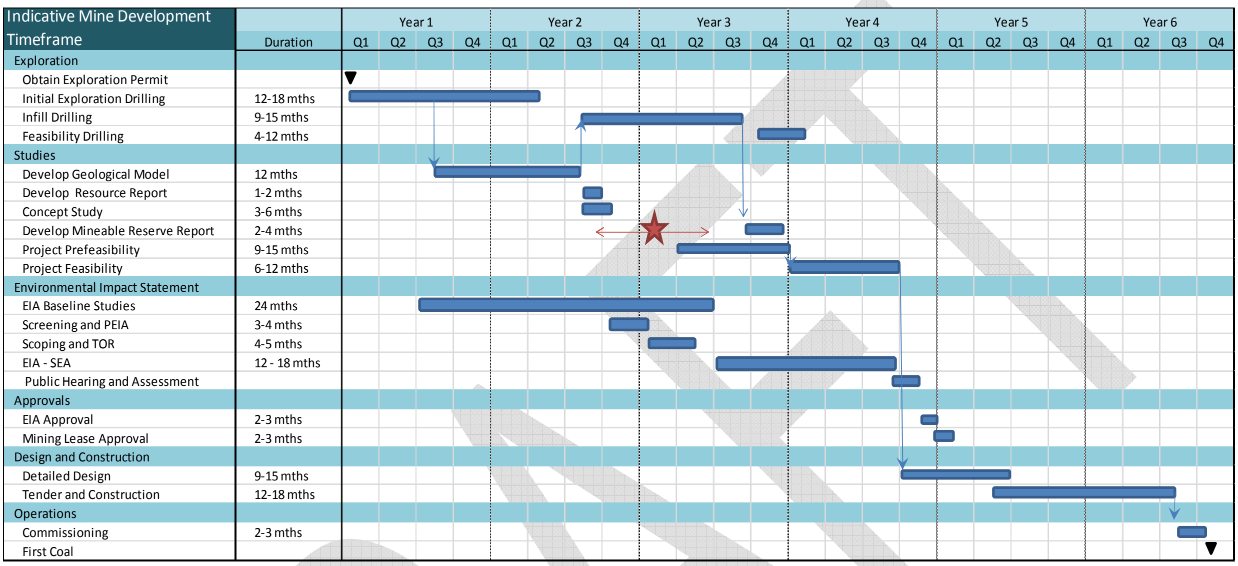
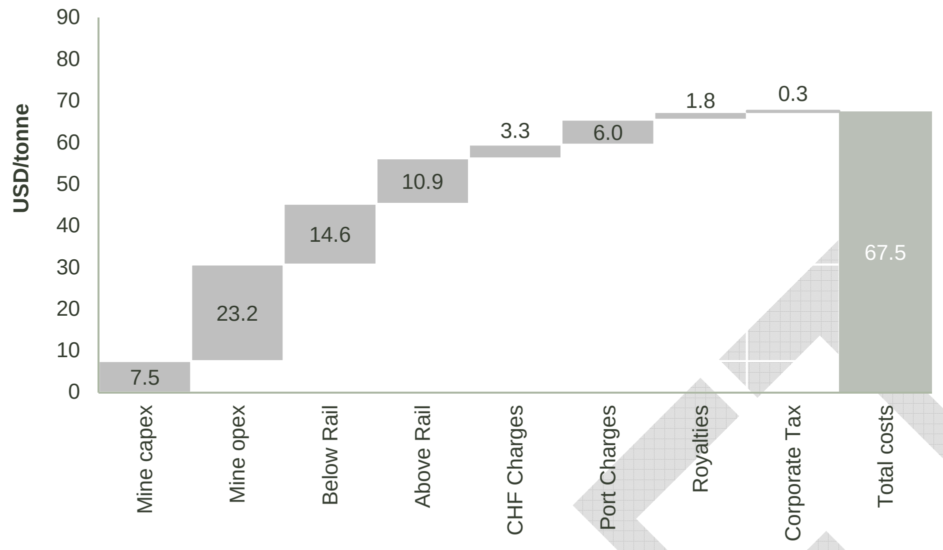


Figure 44 Indicative mine development time table

Note: Development timeframes will vary and may be affected by the nature and scale of deposit, mode of operation, options assessed, environmental impacts, corporate approach, government time frames and community objections.

11.5 Estimated total cost of mining and transport costs

Error! Reference source not found. illustrates the total cost of mining and transporting the coal to Walvis Bay for each component of the supply chain for the lowest cost option (the Base Case). Average costs have been standardised by taking the NPV of potential costs over the NPV of potential tonnes over a 40 year period. The most significant costs are seen to relate to mining opex and rail costs.



Source: Deloitte

Figure 45 Combined miners average cost under the Base Case over a 40 year horizon

Table 31 ranks the 18 options in terms of the total cost, from lowest cost to highest cost. It provides an indication of the cost to miners of variations from the base case (being "Option 14: standard gauge, enhanced/optimised northern alignment, diesel"), key findings are:

- Dual gauge adds $0.80 per tonne
- Dual gauge and the GOB alignment costs $2.10 per tonne
- Dual gauge, the GOB alignment and electric traction costs $4.80 per tonne

The implications of these cost variations are discussed in more detail in the Government Section below.

Table 31 NPV of costs to all miners over NPV of total tonnes over a 40 year time horizon (USD / tonne)

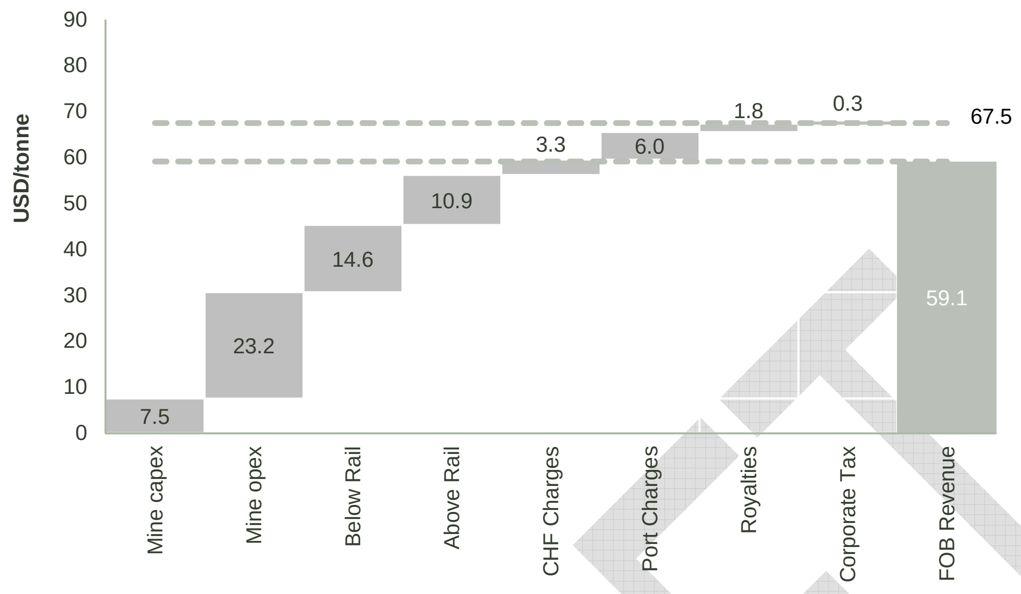
Option reference	Upfront mine capex	Mining opex	Below rail charges	Above rail charges	CHF charges	Port charges	Royalties and corp. tax	Total charges
Option 14: ONR, SG, DSL	**7.49**	**23.19**	**14.59**	**10.88**	**3.26**	**5.98**	**2.10**	**67.48**
Option 18: ONR, DG, DSL	7.49	23.19	15.44	10.88	3.26	5.98	2.06	68.29
Option 8: GoB, SG, DSL	7.49	23.19	15.24	11.58	3.26	5.98	2.02	68.75
Option 2: PFS, SG, DSL	7.49	23.19	15.40	11.69	3.26	5.98	2.01	69.02
Option 12: GoB, DG, DSL	7.49	23.19	16.15	11.58	3.26	5.98	1.99	69.63
Option 6: PFS, DG, DSL	7.49	23.19	16.33	11.69	3.26	5.98	1.98	69.92
Option 13: ONR,	7.49	23.19	19.17	9.08	3.26	5.98	2.00	70.17

Option reference	Upfront mine capex	Mining opex	Below rail charges	Above rail charges	CHF charges	Port charges	Royalties and corp. tax	Total charges
SG, ELEC								
Option 16: ONR, NG, DSL	7.49	23.19	14.55	14.27	3.26	5.98	1.92	70.66
Option 17: ONR, DG, ELEC	7.49	23.19	20.02	9.08	3.26	5.98	1.98	70.99
Option 7: GoB, SG, ELEC	7.49	23.19	20.04	9.54	3.26	5.98	1.96	71.45
Option 1: PFS, SG, ELEC	7.49	23.19	20.23	9.76	3.26	5.98	1.94	71.85
Option 10: GoB, NG, DSL	7.49	23.19	15.19	15.16	3.26	5.98	1.87	72.14
Option 11: GoB, DG, ELEC	7.49	23.19	20.95	9.54	3.26	5.98	1.93	72.34
Option 15: ONR, NG, ELEC	7.49	23.19	19.21	11.58	3.26	5.98	1.90	72.60
Option 4: PFS, NG, DSL	7.49	23.19	15.35	15.50	3.26	5.98	1.86	72.62
Option 5: PFS, DG, ELEC	7.49	23.19	21.15	9.76	3.26	5.98	1.92	72.75
Option 9: GoB, NG, ELEC	7.49	23.19	20.12	12.36	3.26	5.98	1.86	74.26
Option 3: PFS, NG, ELEC	7.49	23.19	20.29	12.47	3.26	5.98	1.86	74.53

Source: Deloitte
** Option 10 is the project as defined in the Bilateral Agreement*
Note: ONR = Northern optimised route, GoB = North via Windhoek (GoB), PFS = North via Windhoek (PFS), SG = standard gauge, DG = dual gauge, NG = narrow gauge, DSL = diesel, ELEC = electric

11.6 Estimated returns to miners

Figure 46 compares the estimated FOB cost of mining and transporting the coal to Walvis Bay to the expected revenue per tonne that the miners will receive for their produce (given the current Richards Bay Benchmark price of $65 per tonne) for the most viable option (the Base Case, being “Option 14: standard gauge, enhanced/optimised northern alignment, diesel”). Average costs have been standardised by taking the NPV of potential costs over the NPV of potential tonnes over a 40 year period.



Source: Deloitte

Figure 46 Combined miners average cost under the Base Case over a 40 year horizon

The results in Figure 46 show that at current prices[9] even under the Base Case, total costs for the whole supply chain are expected to exceed total revenue. This analysis assumes that the coal production is spread across the three most prospective coal producing regions and as revenues and costs are discounted at a WACC equivalent to a 15% pre-tax real return. This WACC is an estimate of the minimum return that miners would be willing to accept to develop their mines.

As detailed in Figure 47 at current prices the highest expected returns to a miner is approximately 8%, this is well below the minimum benchmark of 15% (pre-tax real WACC).

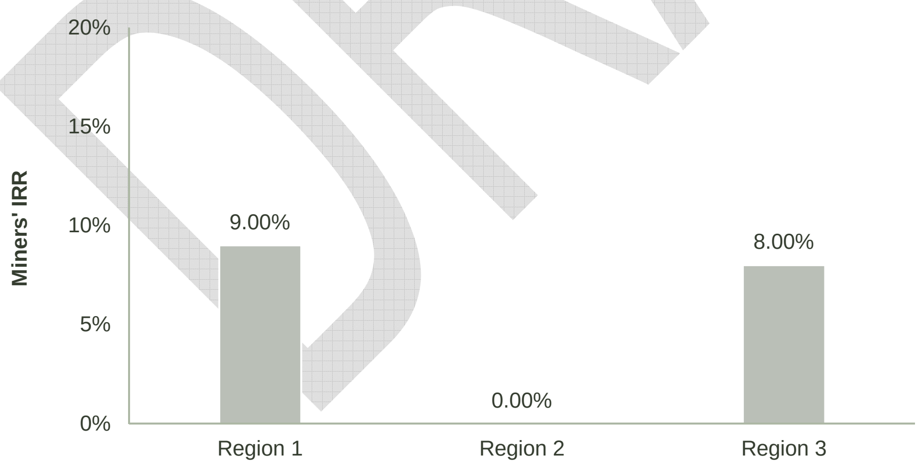


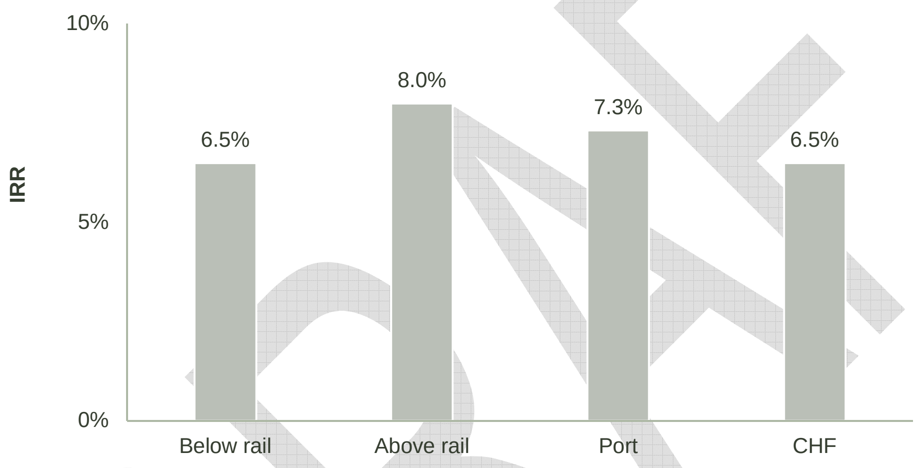
Figure 47 IRR of different mining regions over a 40 year horizon and assuming a Richards Bay FOB price of USD 65/tonne

[9] At the time of this report these were taken to be approximately USD 65/tonne for coal which approximated the Richards Bay benchmark.

For the railway to get funding it miners in all regions would need to be able to show their investors that there project was viable. To achieve this it is estimated, based on detailed financial modelling, that the Richards Bay benchmark price of coal would have to be at least USD81 per tonne and forecast to remain above that level for the life of the mines. At USD81 per tonne, all stakeholders can expect a reasonable return on their investments. This is approximately USD16 higher than it was in December 2014.

11.7 Returns to infrastructure investors

The Model assumes that infrastructure investors always receive a return equal to their estimated WACC. These returns are summarised in Figure 48. As a result, returns to infrastructure investors do not change across options. However, it is important to note that these returns are all based on the assumptions that the miners sign up long terms take or pay arrangements with the infrastructure owners.



Source: Deloitte

Figure 48 Investors estimated WACCs

11.8 Returns to Government

The Government's perspective may change significantly depending on whether or not they choose to invest in the project. For the purpose of the analysis it was assumed that the project would need to be viable on a standalone basis with Government involvement limited to facility the project rather than investing in it.

Assuming there is no Government investment in the TKR, private investors are likely to select the most efficient option for development of the TKR – as in, the Base Case. Therefore if the Government continues to prefer the alignment and gauge set out in the Bilateral Agreement, it may be required to subsidise the incremental investment required (from the Base Case) in order to ensure miners profitability is not impacted as a result. Alternatively investors will need to wait until the price of coal is proportionally higher for the miners to be willing to invest in the project.

The likely incremental impact on miners' tariffs (from the Base Case) is shown in Table 32. As shown the likely impact of selecting the Bilateral Agreement scenario is an increase of approximately USD4.4/tonne of coal railed.

Table 32 Incremental cost to miners of different options (USD / tonne)

	Windhoek (GoB)	Optimised northern route	Windhoek (PFS)
Diesel, SG			2.6
Diesel, DG	0.8	2.3	3.9
Diesel, NG	1.7	4.4	5.6
Electric, SG	2.6	4.8	5.6
Electric, DG	3.4	5.3	6.1
Electric, NG	4.0	7.4	7.7

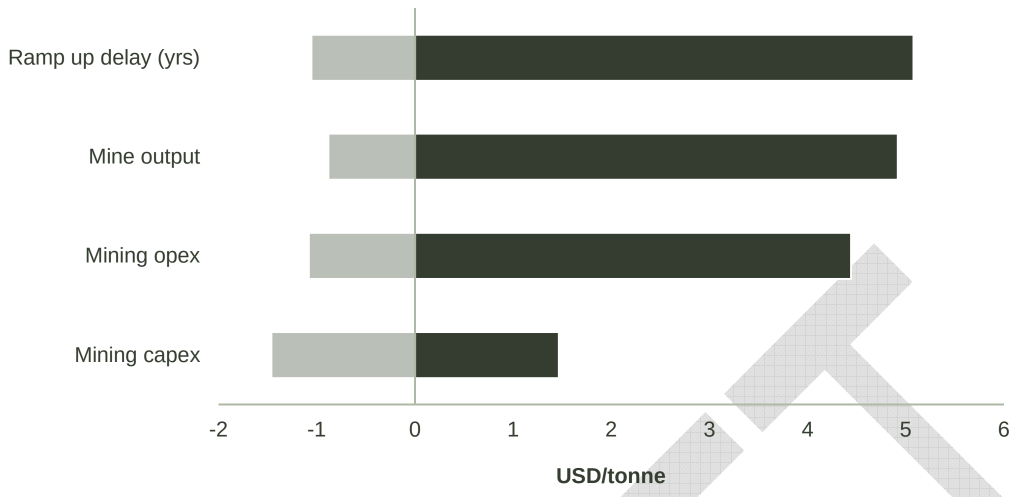
Table 33 shows that the total incremental investment support required by Government (taking both capital spending and construction finance interest into account) is approximately USD 1.055bn.

Table 33 Incremental Investment required to achieve different options (USD millions)

	Windhoek (GoB)	Optimised northern route	Windhoek (PFS)
Diesel, SG	-	342.7	630.7
Diesel, DG	196.2	555.3	941.8
Diesel, NG	413.8	1,055.0	1,339.9
Electric, SG	619.6	1,164.1	1,347.3
Electric, DG	817.7	1,272.1	1,465.8
Electric, NG	950.1	1,773.9	1,847.6

11.9 Sensitivity analysis

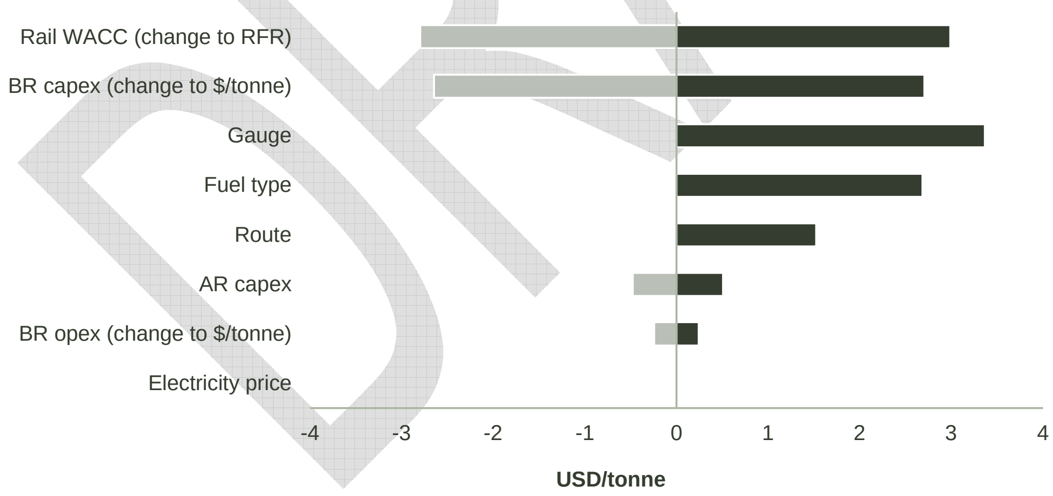
Sensitivity analysis was performed on all key variables. Sensitivities have a high variation of 20% and a low variation of minus 20% unless otherwise stated. Results have been grouped according to key supply chain elements. Figure 49 shows mine returns are almost equally sensitive to a longer than expected ramp up period, lower than expected mine output and higher than expected mine operating costs. To minimise these risks it would be expected that miners invest heavily in studying their resource and planning its development prior to signing any agreements with infrastructure owners. For example, it is understood that Xstrata spent over $200m and two years on pre-planning the development of a major mine in Queensland, Australia.



Source: Deloitte
Ramp up:-1 year and +5 years
Mine output: -5% and +20%
Mining capex: -5% and +20%

Figure 49 Mine related sensitivity variables

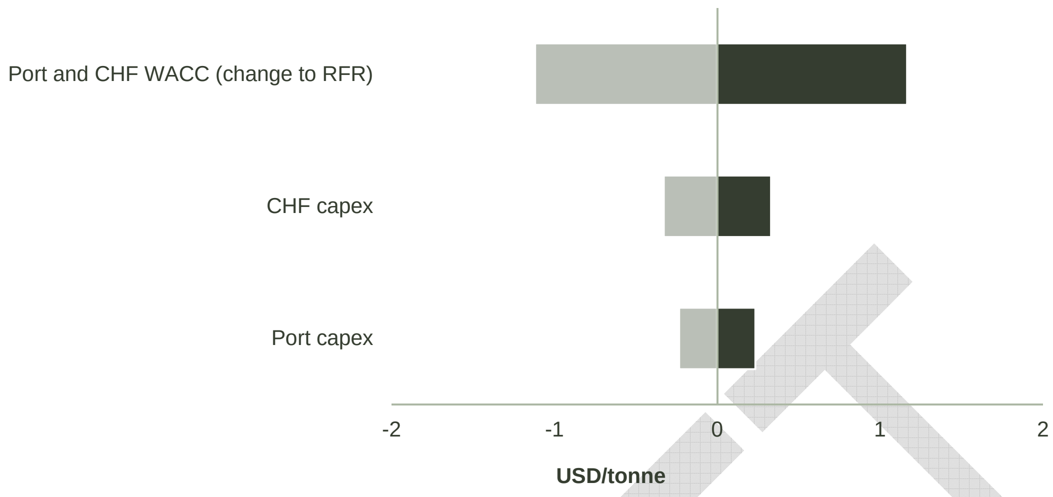
Figure 50 details the impact of a range of variables on total rail costs. It indicates that no one variable has the impact of the mining related variables but in aggregate the potential variation in costs caused by factors such as that below rail capex, WACC, gauge and fuel type of capital is significant. The graph shows that switching from standard gauge or dual gauge to narrow gauge or from diesel to electric traction could negatively impact the combined NPV of miners by approximately USD 3 per tonne.



Source: Deloitte
Rail WACC: -2 percentage points and +2 percentage points

Figure 50 Rail sensitivities

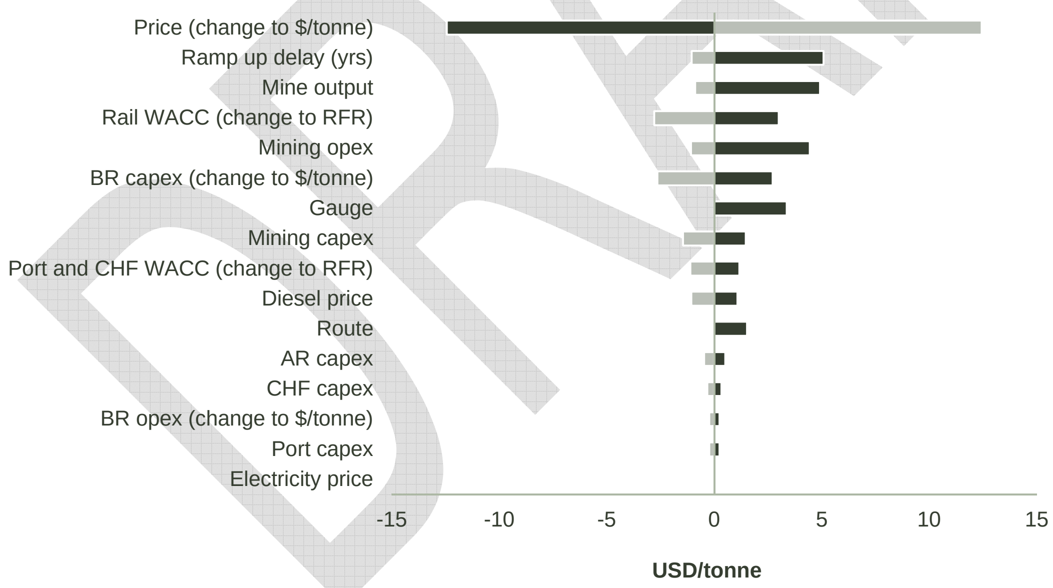
Figure 51 shows that variables related to the CHF and port (including the estimated WACC) have a much lower impact on costs to miners than those impacting on the rail and mining factors.



Source: Deloitte
Port and CHF WACC: -2 percentage points and +2 percentage points

Figure 51 Port and CHF sensitivities

Figure 52 includes all variables included in the above sensitivities analysis and price. It shows that despite the significance of key variables noted above price is by far the most significant impacting combined miner returns. However, of those variables which are at least partially under the influence of government policy gauge and fuel type are the most material.



Source: Deloitte

Figure 52 Summary Sensitivity Tests

11.10 Commercial assessment

11.10.1 Introduction

According to Article 5 of the Bilateral Agreement, the investment model for the project is through a Public Private Partnership (PPP). A special purpose vehicle (a joint owned company, JOC) will be formed by government agencies from Botswana and Namibia who will issue the concession to develop the project[10]. It is proposed that the joint owned company will be formed by Botswana Railways and TransNamib Holdings Limited. At the end of the concession period the project transfers back to the JOC.

As part of the preliminary commercial assessment, the potential delivery strategy, financing and funding structure for the project are investigated. This chapter outlines the issues surrounding the use of a potential PPP funding structure for the project.

The main features of the project that may lend it to be delivered through a PPP are:

- Substantial capital costs which are estimated to be up to USD12b (below and above rail and port capital costs)
- The long life of asset
- Integral component to the coal supply chain and potentially other mineral resources, bulk goods and containers
- Significant scope for innovation in the design, construction and operation of the asset (or components of it)
- May appeal to overseas investors with a different risk appetite and funding profile
- Scope for innovation by the private sector requiring careful consideration of the risk transfer issues

The discussion in the following pages outlines the high level issues associated with the delivery of the project. However to make an informed decision, a more detailed analysis in line with the international infrastructure procurement guidelines will need to be made to determine the optimal approach to deliver the project.

11.10.2 What is a PPP?

A PPP is a service contract between the public and private sectors where the government contracts the private sector to deliver infrastructure and related services over the long term. The private provider would build the asset and operate or maintain it to specified standards over the term of the concession. The private provider usually finances the project.

PPPs typically make the private sector parties who build the infrastructure financially responsible for its condition and performance throughout the asset's lifetime. Under a PPP a licence is granted to the private sector to use the asset for the PPP term (usually between 20 to 35 years).

In a PPP arrangement for the Trans-Kalahari rail and port project, the government would:

- Prepare an output-based specification rather than a prescriptive specification which would require the asset to be available for rail freight services, in this case coal haulage
- Engage a provider to deliver the construction and operation of the line over the long term, e.g. 20 to 35 years or more

[10] Note: the joint owned company is a special purpose vehicle set up to manage the PPP contract and concession. It may not be the vehicle the respective governments use to invest in the project.

- Require the provider to design, finance, construct, operate and maintain the project.
- Transfer revenue / demand risk to the private sector.
- Eventually take back ownership of the asset at a specified handover quality/standard.

Given the fixed asset nature of the project, a PPP contract is likely to focus on the infrastructure assets only (e.g. the below rail). However, the Bilateral Agreement has provisions for the PPP to provide operations (e.g. port and above rail).

The table below shows a high level assessment of the pros and cons of PPP structures for project delivery.

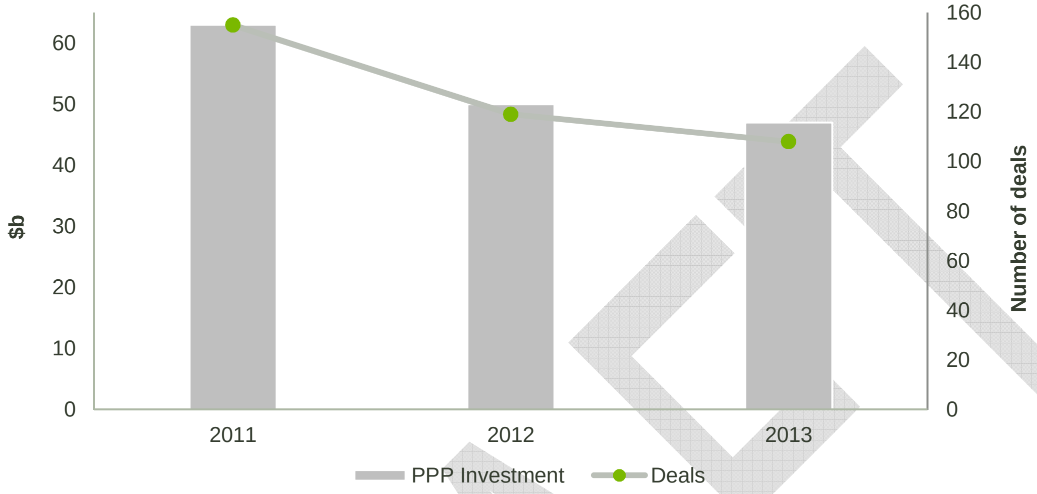
Table 34 Pros and cons of PPP structures

Advantages	Disadvantages/issues
Full integration of design, construction, financing and maintenance responsibilities with a proponent that has significant experience in the rail and port sector.	Success relies on well-defined functional and service specifications, including capacity and other operational requirements.
Greater transfer of risk to the private sector, for example risks surrounding construction, operational and environmental issues. These may be better managed by the private sector.	Where there are multiple concept designs being developed simultaneously during the bid phase, this can require significant stakeholder resources.
Potential for greater innovation in design and construction, as the private sector would take account of whole of life cost of project including earthworks, operation and maintenance.	Changes to design may require additional contract negotiations.
Transfer of lifecycle cost risk encourages efficient design and quality construction and finishes. For example, bridges would be designed to facilitate efficient maintenance practices.	The ability to make a variation needs to be addressed in the contract, for example where fire safety regulations and climate change and related environmental / safety regulations change over time.
Overall design and fit-for-purpose risk lies with the private sector party, including suitability for use by coal trains.	Potential for higher government agency tendering costs.
Potential for lower cost of asset development and service provision through private sector efficiencies and better planning of maintenance activities to fit within allowed maintenance windows on an operational railway.	Requires departmental skills (or consultants) for financial and technical assessment, tendering and management.
Involvement of private funders (banks / equity investors) adds additional level of scrutiny to project, increasing confidence that outcomes will be achieved. For example, forecast coal demand and individual mine viability will be examined by an additional set of experts.	Need to educate stakeholders who are likely to be unfamiliar with this procurement method to ensure that other project success factors are not compromised.
Performance standards for rail operations are in place, such as operating speeds, waiting times etc.	Cost of funds may be higher, especially if a demand risk transfer PPP is utilised.
Will provide an additional source of funds as government balance sheet is stretched.	Less control over project and less flexibility as delivery is based on the contract, for example maintenance scheduling may interfere with rail operations.
	Procurement process is generally longer and more expensive.

Source: Deloitte

11.10.3 Global PPP markets

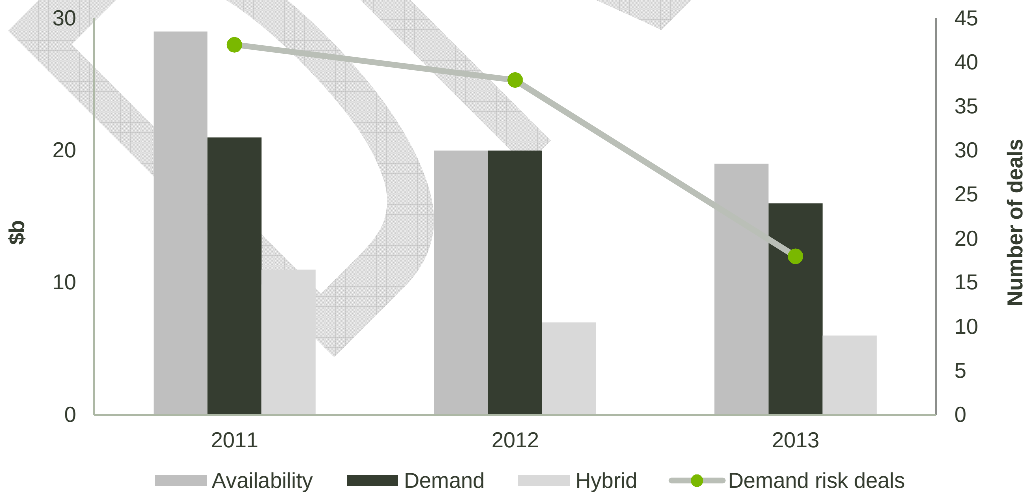
Global economic conditions have improved since the global finance crisis, and global infrastructure investment rose in 2013. However, according to data from IJGlobal (2014), PPP investment declined, particularly for new-build projects with high construction costs. As a result, the global PPP market is now in its third year of decline (see Figure 53).



Source: IJGlobal (2014)

Figure 53 Global PPP Investments (all infrastructure types)

In terms of deal activity, a total of 108 transactions reached financial close in 2013, of which 92 projects carried a construction risk, a lower proportion than the previous year. Of the 92 construction projects that closed in 2013, projects that benefited from availability payments accounted for 78%, demand risk projects 18% and hybrid structures accounted for the rest. As shown in Figure 54, the risk appetite of investors for demand risk PPPs has fallen significantly. According to information from IJGlobal, the number of demand risk PPPs was over 40 in 2011 but has fallen to less than 20 in 2013.



Source: IJGlobal (2014)

Figure 54 Global PPP infrastructure by risk profile 2011 to 2013

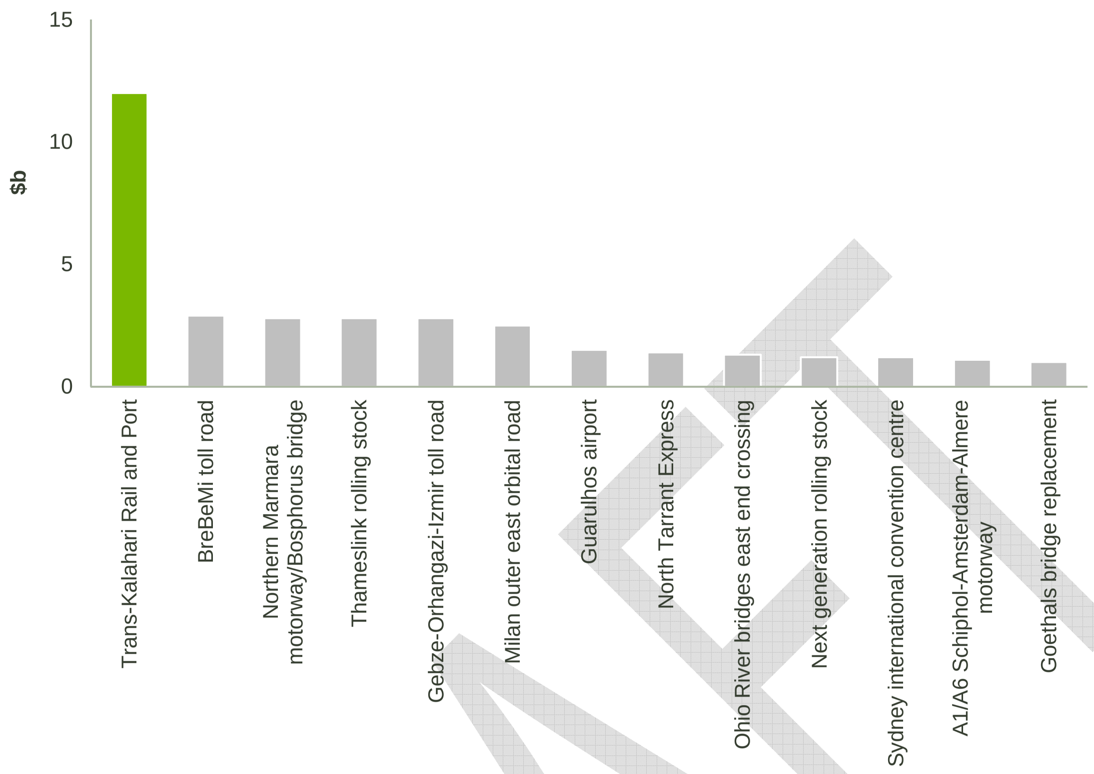
It is also important to consider the size and scale of the Trans-Kalahari rail and port project and its impact on the attractiveness to investors. For example, the majority of deals in the last three years required capital investment of between $100 million and $500 million. In 2013, only 12 PPP deals were larger than $1 billion each, and their combined value makes up more than half of the total market volume that year. These large scale projects are provided in Table 35.

Table 35 Largest global PPP deals in 2013

Country	Type	Project	Capital cost ($b)
Italy	Road	BreBeMi toll road	$2.9b
Turkey	Road	Northern Marmara motorway/Bosphorus bridge	$2.8b
UK	Rolling Stock	Thameslink rolling stock	$2.8b
Turkey	Road	Gebze-Orhangazi-Izmir toll road	$2.8b
Italy	Road	Milan outer east orbital road	$2.5b
Brazil	Airport	Guarulhos airport	$1.5b
US	Road	North Tarrant Express	$1.4b
US	Road	Ohio River bridges east end crossing	$1.3b
Australia	Rolling Stock	Next generation rolling stock	$1.2b
Australia	Entertainment	Sydney international convention centre	$1.2b
Netherlands	Road	A1/A6 Schiphol-Amsterdam-Almere motorway	$1.1b
US	Road	Goethals bridge replacement	$1.0b

Source: IJGlobal (2014)

Figure 55 shows that the Trans-Kalahari rail and port project would be one of the largest PPP deals in recent history.



Source: IJGlobal (2014)

Figure 55 Comparison of the project to other PPP deals in 2013

11.10.4 Bilateral agreement

The Bilateral Agreement states that the project includes “the evaluation, development, design, construction, financing, ownership, operation, repair, replacement, refurbishment, maintenance and expansion of the Trans-Kalahari railway line, coal terminal and associated loading facilities in Walvis Bay”. According to Article 5 of the Bilateral Agreement, the project shall be development through a PPP model based on a Design, Build, Own, Operate, Transfer (DBOOT) contractual arrangement whereby the developer:

- Undertakes the financing, design, construction, operation and maintenance of the project
- Owns the project during the concession period
- Operates the project over the concession period to revoke its investment, operating and maintenance expenses for the project under such a tariff structure as may be agreed upon in the concession agreement or the specific project regulatory framework.
- At the end of the concession period transfer the project to the JOC

The structure of the PPP model described in the Bilateral Agreement is shown in Figure 56. Under the proposed PPP model in the Bilateral Agreement, the project is horizontally integrated (i.e. the Project Company “Project Co” would own both the railway line and the dedicated port).

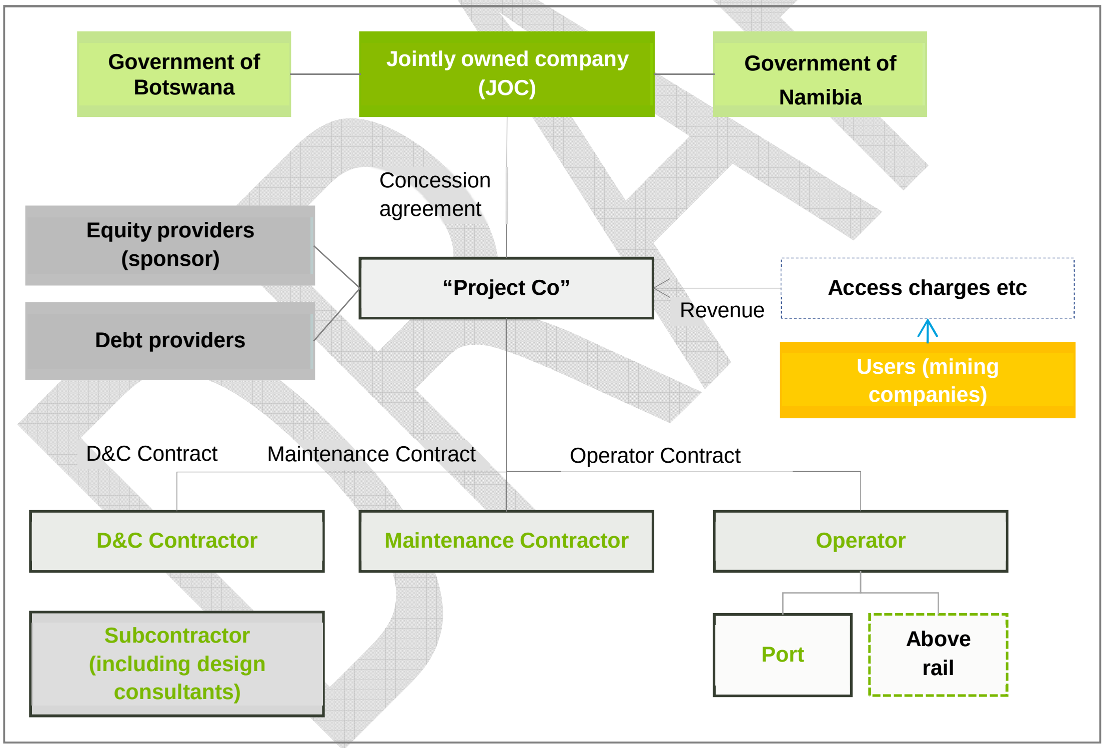


Figure 56 Proposed PPP model from the Bilateral Agreement

While the Bilateral Agreement outlines that the rail and port are to be operated by the developer, it is not clear if “operations” explicitly means above rail, as opposed to “operating” the below rail. For this reason the Bilateral Agreement needs to better define the inclusion of above rail operations.

Regardless, it is envisaged that an open access railway regime would be adopted that allows both above rail operations for the Project Co, third party rail operator and/or mining companies (e.g. using their own locomotives).

Ultimately, the final PPP structure and regulatory regime adopted by the government will determine whether the Project Co is able to be vertically integrated i.e. own both the below rail and the above rail operations or if any of the other options would be more appropriate.

11.10.5 Delivering the project

The use of PPPs for mining related infrastructure can lead to disagreements between government and the private sector about how the infrastructure is to be used. For example, governments typically view the project as a catalyst for broader economic growth. When governments contribute to the project, e.g. through gifting of land, they assume rights to influence the design and operation (usage) of the project. The government might also wish to use the project to foster other parts of the economy (i.e. the project has multiple uses). For example, the project is expected to be a dedicated coal railway. However, the government may want to ensure that general container freight or passenger services can use the project. This can however significantly impact on the efficiency of the coal supply chain.

On the other hand, the private sector has a more narrow view of the project scope and is driven by generating a return on the project relative to its risks.

Getting the balance right is crucial.

There are very few examples of successful mining infrastructure PPPs in the world, and no examples in Africa. This does not mean that it is impossible, rather it demonstrates the magnitude of the challenges that stakeholders face to structure and finance the project.

The lack of examples suggests that there are limited options with respect to commercial structures that will results in successful project financing. Historically, it also reflects the reluctance of mining companies to share infrastructure. Typically two structures can be used – PPP (third party) or integrated mine and rail (miner owned railway). Around the world governments have invested in rail infrastructure to stimulate their mining industries (e.g. the Queensland Government in Australia led the investment in rail infrastructure). Other rail projects have been fully integrated with the mine (i.e. miner develops own railway) as is the case currently in the Western Australia Pilbara region. Case studies have been provided in the following pages.

Table 36 below summarises the potential ownership models for the project. For completeness we have included a government ownership option.

Table 36 Comparison of delivery models

	Public sector	Mining company	PPP (Third party)
Decision maker	Government	Mining company(ies)	Investors
Country financial exposure	Maximum	Limited	Limited

	Public sector	Mining company	PPP (Third party)
Key attributes	▪ Maximum government flexibility in deciding usage ▪ Operations and maintenance performed by government contractor	▪ Infrastructure evaluated as a consolidated project with the mine ▪ Limited government ability to influence usage ▪ Operations and maintenance performed by mining company or contracted out ▪ Lower risk of product transport = lower risk premium for mining company	▪ Suitable for servicing multiple small mines ▪ Evaluated on a standalone basis ▪ Limited government ability to influence usage ▪ Operations and maintenance performed by concessionaire or contracted out ▪ Small mine company comfort with mine deposit delivery outlook
Risks	▪ Operational inefficiency ▪ Mismanagement ▪ Potentially higher costs ▪ Funding risk	▪ Political risk ▪ Regulatory risk	▪ Political risk ▪ Potentially higher operating costs ▪ Potentially higher tariffs ▪ Regulatory risk ▪ Operating risk
Likelihood of project financing	Low	High	High (but lower than mining company ownership model)

Source: IFC (2013)

Under the public ownership model, the project is majority owned by the government. Operations and maintenance are either undertaken by state owned enterprises (e.g. Botswana Rail) or contracted out. The biggest benefit of this model is that the government has the greatest degree of freedom to implement and develop the project as it wishes. This allows the government to maximise the use of the infrastructure to benefit the greatest number of potential users across multiple sectors to help grow the economy (i.e. multi-user and multi-purpose).

However given the lack of public sector capital and the mismanagement of many developing countries running stated owned infrastructure, historically many mining companies have decided to develop their own infrastructure. From a miners perspective, the ideal model involves the full ownership and integration of the mine, rail and port projects. Under this ownership model, the project has the highest likelihood of proceeding as a proportion of the repayment of the limited recourse loan would be underwritten by the coal volumes of the mining company itself. The drawback of this option is that government would loss some control over the development of the project. However, the government could improve its control by including specific conditions in the agreement. For example, allowing multi-user access (i.e. other miners). However the government must be careful not to place unduly conditions that might impact the project economics.

Some undeveloped mining deposits may fail to become commercial viable if they are required to absorb the entire costs of the related transport infrastructure. Some mining projects are simply located too far away from import markets to generate the profits required to pay for the infrastructure on a standalone basis. For these reasons, a PPP model may be attractive. The critical difference between the mining ownership model is that under the PPP model the project will be evaluated on a standalone basis. Therefore the project must be able to demonstrate that it can generate profits in its own right. That is, it must pay for its operating and maintenance costs, taxes and debt service and generate the required rate of return for its equity investors rather than being accounted for as one of the costs of the overall mining operation. Under a PPP model, it is crucial to understand the credit profile of each of the different miners using the railway. In some cases, users will not be credit worthy. The commercial viability of the project will be heavily dependent on the credit quality of the different users. The viability of the project becomes more complicated when not all users are identified at the time of the financing of the project (i.e. different mine commissioning timetables).

11.10.6 Funding options

Funding refers to the sources of cash available to pay for the project. This is opposed to financing, which are the mechanisms available to convert the requirement for lump sum cashflows during the construction period to a requirement for payments over time (for example borrowing money and repaying the loan over time).

Table 37 sets out some potential forms of funding that may be used for the project. Due to the nature of the project, there is likely to be one main source of funding. The main source is from access payments from mining companies.

Due to the size of the project, any additional funding would be welcomed. For example, under a hybrid PPP approach governments may support a proportion of the funding requirement.

Table 37 Potential funding sources for the TKR

Funding source	Discussion	Potential value
Access arrangements – over time	Mining companies may be willing to enter into long term access contracts with access payments made over time. This will provide a guaranteed level of revenue to the project that can be used to obtain finance to pay for the construction costs. A large established mining company, would provide significantly more certainty (and hence more attractive financing) then the junior miners, at least until the mines were operational and had an operating history. In the case of the project, the access contract will be directly with the asset owner, the PPP. The access contract could be intermediated or supported by the government in order to increase the 'bankability' of the contract and hence achieve more favourable financing terms. For a large company, the benefit from government support is likely to be lower than if the counterparty was a junior miner due to the lower credit quality of the junior miners.	Unknown – likely significant with a major miner or a number of smaller miners
Access arrangements – up front	Mining companies may be willing to enter into long term access contracts with an up-front access payment that guarantees access for the period of the contract. This will provide cash during the development of the project that can be used to pay for construction costs. As a large established mining company would have the capacity to fund an up-front payment of this type. However, the junior miners are less likely to have the balance sheet strength or capacity to raise funds to make a significant up-front payment. There are also considerable coordination problems and potential competition issues in trying to coordinate investment between a large group of small miners.	Unknown – likely significant with a major miner or a number of smaller miners
Government of Botswana	The Government of Botswana may be willing to provide some funding for the project in order to facilitate the development of the export coal industry.	Potentially 15% of rail capital costs
Government of Namibia	The Government of Namibia may be willing to provide some funding for the project in order to facilitate the development of its economy.	Unknown – likely insignificant
Other users	There is the potential for other users on the project at a later point in time. For example from intermodal traffic or other bulk commodities. However, these users have not been identified at this stage and their contribution to the project is likely to be insignificant.	Unknown – likely insignificant

Source: Deloitte

For completeness we have identified three different funding options for the PPP. The following PPP options are potentially available:

- Demand risk PPP
- Availability PPP
- Hybrid PPP

11.10.6.1 Demand risk PPP

Under this option, a private consortium is appointed to design, build, own, operate and then transfer (DBOOT) back the infrastructure after a specified period. In return for these services the private consortium is allowed to keep the revenue collected from the service. This is the model proposed in the Bilateral Agreement.

This option has the benefits that a single entity is responsible for the delivery of the services, increasing the level of risk transfer and incentive to design and operate the facilities based on the lowest whole of life cost. Also, the transfer of demand risk to the private sector may provide value for money benefits to government where the private sector is able to confidently forecast the level of future demand.

However, the contractual arrangements for a PPP are often complex and time consuming to procure, lowering the number of tenderers and adding cost to the project. In addition, funding costs are likely to be higher where demand risk lies with the private sector. This is especially the case in this project, where the level of future usage is uncertain, given that the forecast for future commodity demand levels is not well understood. On a demand risk based PPP project, debt gearing can be expected to be approximately 60-70%. However on this project, given its nature and risks, it is likely that debt gearing would be less than 50%. This is significantly lower than for availability based PPPs (80-90%), resulting in a higher cost of capital.

In recent years the private sector's appetite to assume revenue risk on 'greenfield' infrastructure development has reduced, as a result of a number of high profile failures on several projects[11]. In addition, the GFC and tightening debt markets have changed views on the level of risk involved. While there are still some projects where the private sector will take demand risk (where there is a well demonstrated demand for the infrastructure that can be quantified accurately), the majority of projects have required the government to take some or all of the risk, for example through the use of payments based on the availability of the infrastructure, or provision of a floor level of demand/revenue.

A demand risk PPP may possibly appeal to an overseas investor with a different risk profile and long-term perspective of an integrated supply chain including teaming up with a rail company to partly finance the project.

For example, the Galilee rail corridor in North Queensland, Australia, has seen a joint venture (JV) between Aurizon (Aurizon is a rail infrastructure owner and above rail operator) and Hancock-GVK (Hancock is a leading mining company and GVK is a major Indian infrastructure / mining / power provider). Under the terms of this arrangement, the parties have combined to offer a consolidated mine, rail and port solution. Following the completion of the transaction, Aurizon would gain the rights to operate and jointly manage with GVK the rail infrastructure to exclusively provide rail haulage from

[11] For example in Australian toll roads such as the Cross City and Lane Cove Tunnels in Sydney, RiverCity Motorway and Airport Link Motorway in Brisbane, and passenger rail projects such as the Airport Rail Link in Sydney.

GV Hancock's Alpha and Kevin's Corner mines for up to 60mtpa of coal[12]. The proposed structure for that project is shown in Figure 57.

More generally on the Queensland freight network, Aurizon has responsibility through different business entities for both below rail and above rail activities, although in the case of the latter, they compete with other rail operators to secure cargo. In the above rail operations, contracts are usually sold on a take-or-pay basis with the miners effectively taking the demand risk.

The project will largely involve the movement of coal (potentially as well an assumption of new products). Rail access charges will be levied by the Project Co (however, there may be complex approval/legislative/policy approvals required depending on the regulatory regime adopted).

It is expected that the PPP proponent of the project would be required to take on 100% of the demand risk. Based on our experience and given the level of uncertainty surrounding the level of rail traffic demand it is unlikely that reasonably priced funding for the project would be available where more than 20% of the revenue is subject to demand risk.

As noted in the financial modelling, until prices return to greater than \$81/t a demand risk PPP will not be bankable. Options for government are to fund up-front, over time or provide a state backed guarantee to the Project Co.

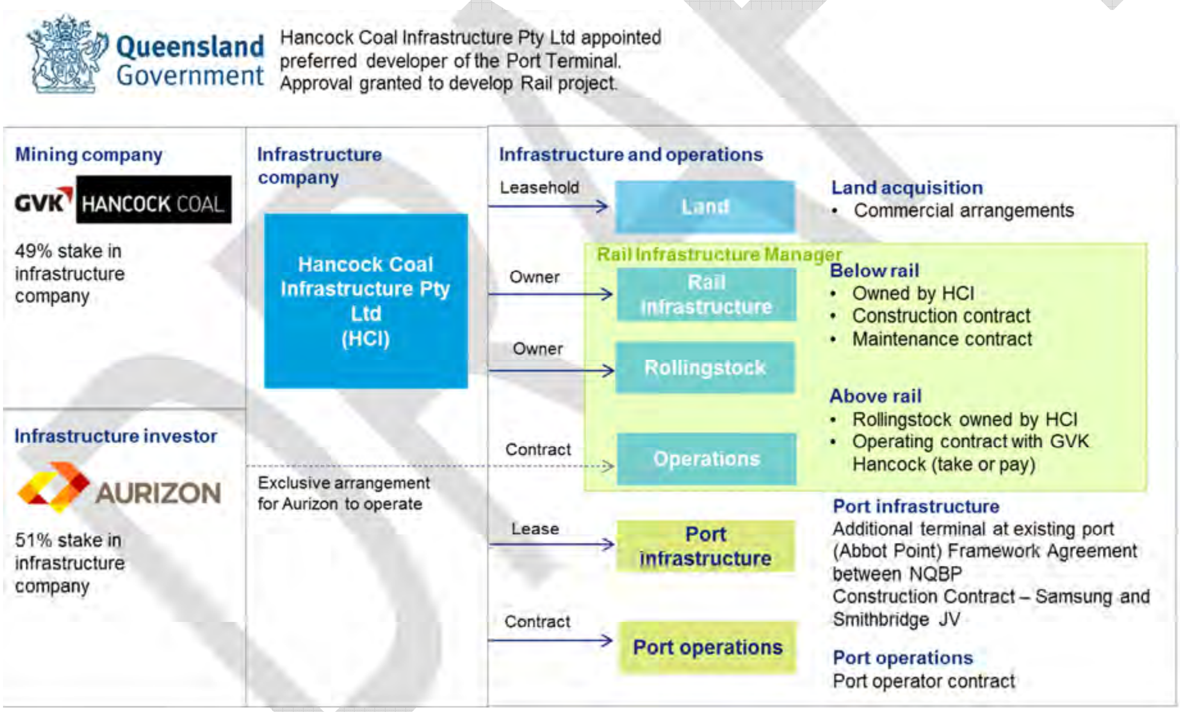


Figure 57 Proposed structure of the GVK-Hancock rail and port project in the Galilee Basin, Queensland, Australia

11.10.6.2 Availability PPP

Under this option, a private consortium is appointed to deliver and operate the project and in return for these services a monthly payment is made by the government to reflect the cost of funding and operating the infrastructure. This payment is conditional on the private sector meeting the service requirements set out in the contract, including availability of the infrastructure, condition of the assets

[12] As of December 2014, GVK has been unable to finance the project.

(maintenance program undertaken), and providing the desired frequency of service. If these conditions are not met, each performance failure incurs a deduction against the monthly charge.

For example, a Service Level Agreement (SLA) may include requirements that the project be able to handle a certain number of trains per day, of a specified length and weight. Also that the track is available for use 95% of the time and that maintenance periods are limited to weekends or nights. At the end of the contract, the project would have to be handed back to the government in a specified condition. Where the SLA's are not achieved, there would be deductions from the monthly availability payment based on the severity of the non-compliance. Over the years prior to the end of the contract, the condition of the assets would be monitored, and deductions made if it was not being maintained at the required level.

This option has the benefit that a single entity is responsible for the delivery of the services, increasing the level of risk transfer and incentive to design and operate the facilities based on the lowest whole of life cost. Also, the availability based payment stream is generally considered low risk by financiers, leading to lower funding costs.

In a transport context, a number of UK trunk roads, the below rail infrastructure for the Docklands Light Rail and the Peninsular Freeway in Victoria were all developed by the private sector with payments by governments providing that the infrastructure is operational. They were constructed under PPP contracts where the private sector designed, constructed and maintained the facility for a set period. At the end of the concession the assets are returned to the ownership of the State. In return for provision of a working asset, the private sector contractor is paid a monthly availability payment.

11.10.6.3 Hybrid PPP

Under this option a combination of government finance, demand risk and availability payments could be used. To date, there have been few projects that have used both demand risk and availability payments, as there are generally different investors and return expectations for demand risk versus availability projects[13]. Where they are combined, investors would default to the higher returns, removing the cost benefits associated with the low risk availability payments.

On this project, funding could be structured as a combination of government grants and an availability payment PPP. The level of government grant would depend on the availability of government funding and whether there was a preference for paying for the project up front or over time.

Alternatively, the project could be funded as a combination of government grant and a demand risk PPP. However, we would expect that the proportion of the project that could be funded by a demand risk PPP would be low – funders are unlikely to accept significant risk on freight volumes, resulting in low expected revenues being used to forecast debt and equity returns. In order to understand the level of funding that may be possible, a more detailed analysis of forecast coal rail traffic and the prices charged for access to the TKR will be required as coal prices improve.

[13] The F3-M2 highway link project in New South Wales is currently being considered using a combination of Federal and State government grants and a demand risk PPP with the private sector. This has been done because the Federal / State governments do not have sufficient funding available to pay for the whole project themselves, and the forecast traffic on the road is not sufficient to ensure returns for investors without support from the government.

11.10.7 Financing

A large project such as this project is typically financed through project financing (through a limited recourse loan). PPPs are generally financed on a limited recourse basis meaning that loan is payable by the Project Co and not the sponsors[14].

Under a public sector ownership model, the responsibility for financing the project rests entirely with the government. The construction of such a large project presents economic opportunities and challenges for both Botswana and Namibia which may justify an investment from government. Botswana is considered investment grade and credit worthy countries can raise finance from capital markets[15]. Both governments have access to international and domestic credit markets which could be used to finance the project.

Raising the money domestically through debt will pull savings away from other sectors of the economy, increasing the cost of capital which will reduce private sector investment. The increased government debt could alternatively be financed via the central bank directly increasing the supply of money. This would have similar effects on private sector activity due to higher inflation and the resulting lower returns on investment. The exchange rate regimes in each country are different. However, raising the debt internationally will have similar effects as the increased inward capital flows will result in higher domestic inflation.

Botswana's debt ceiling is legislated at 40% of GDP, that is, 20% local and 20% external debt. At current reports, Botswana has around 16-17% of external debt. Therefore the ability to raise external debt to support the project is limited. Given the project costs, capital contributions from the Botswana or Namibian governments are not likely to be significant (see Table 38).

Alternatively, concessional financing, from the World Bank, for some proportion of the project has been identified as an option. However, International Finance Corporation, IFC (2013) notes that "World Bank commitments in Sub-Saharan Africa and across all sectors totalled USD 37.7 billion as of January 2012. However, for iron-ore rich countries, World Bank net commitments for transport projects were USD 1.3 billion as of January 2012 versus an estimated need of more than USD 50 billion for iron ore projects alone". This seriously puts into question the ability for concession funding from the World Bank to contribute a significant proportion of financing to the project.

Therefore, involving the private sector, through project finance seems the only viable option to source the necessary funds for the project.

Table 38 Mismatch between Botswana budget resources and size of capital required

Factor	Measure
S&P sovereign credit rating	A-
Gross domestic product (GDP)	$14b (2013)
Debt ceiling	Limit 40% of GDP (current debt 15-17% external and 5-7% internal)
Project capital costs	Total $11b to $15b (~$6b-$8.5b for Below Rail) (~$2b for Above Rail) (~$3.2b for Port)

Source: various

As noted earlier, for PPPs, the private sector usually finances projects via project finance on a limited recourse basis. A limited recourse loan limits the exposure of corporate balance sheets from the risks of a particular project. In project finance, lenders (debt providers) look at the cash flows of the project

[14] Although in some cases there is some recourse to sponsors. For example, the no recourse threshold is generally only reached when the project is operational.
[15] Note: Namibia is only rated BBB- according to Fitch sovereign credit rating (2014).

itself as those using the railway and port are the only source of repayment for the limited recourse loan – that is, the miners. Investors typically establish a special purpose vehicle ("SPV") or project company to develop, finance, construct, and operate a project. It is the SPV or project company that raises the financing, with the investors exposure limited to the amount of equity being contributed to the project.

A number of key factors considered by lenders before offering project finance is shown in Table 39.

Table 39 Lenders considerations for project finance

Lenders key factors	Description
Project sponsor	Quality of the project sponsor is generally the first aspect lenders assess. Lenders focus their review and analysis on the experience, reliability and creditworthiness of the company or consortium of companies responsible for developing, building, owning and (potentially) operating the project. In particular, lenders will likely require completion guarantees. They will therefore assess the financial ability of the company or individual shareholders in a consortium to stand behind their guarantees.
Financial viability and economics	The project will be assessed on a stand-alone basis. Project finance lenders focus their analysis on the project's cash flow, as they are lending against this single cash flow stream from the project. In this case, usage of the rail and port is made solely by miners. Lenders will therefore need to have confidence that economics of the project stack up. In this case, this means that mines need to be profitable and the outlook for coal needs to be positive.
Compliance	Compliance with various performance standards on social and environmental sustainability. For example, the Equator Principles.
Risks	Lenders will only lend to a project if, and only if, both commercial and non-commercial risks are adequately mitigated.
Stakeholders	Project finance lenders focus their attention on understanding and analysing project participants, to ensure that they are technically and financially capable of honouring their contractual obligations. The main contractual arrangements made between the stakeholders are the "take or pay" arrangements. In particular, the lenders will need to get comfortable with each counterparty's experience, credibility and creditworthiness. Lenders will especially scrutinise the counterparty's track record in similar projects. The key stakeholders in this project are the miners. For large miners this is not expected to be a major concern. However this may prove a problem for some junior miners. In this instance, junior miners will need to have their own bank guarantees so that the project finance lenders can be confident that any arrangement made with a junior miner will be honoured.

Source: IFC (2013)

A key factor that may limit the financing of the project concerns the coordination of all the stakeholders involved in the project. The sharing of infrastructure between the miners is likely to raise issues around timing. For the project to be successfully developed, the concurrent development and financing of the mines is a prerequisite. According to the IFC (2013), "even if this is the case, the level of complexity necessary in a debt financing of such a structure might deter certain lenders from participating. The banks would have to underwrite multiple mines since they will need to evaluate the probability of each mine continuing production. Furthermore, solid contractual relationships would have to be established between all of the mines, the project company that would own the infrastructure, and the lenders themselves. And, cross-default provisions would likely have to be established between the mines and the infrastructure. The combination of these factors will make the debt financing so complex that it would be difficult to execute them even in developed markets, let alone in developing regions".

11.10.7.1 Example structuring and financing

A common cited problem with greenfield mining related infrastructure is the "chicken and egg" situation, i.e. does the railway and port need to be developed before the mines? Or do the mines need to be developed before the railway and port?

In practice, the rail, port and mine projects are mutually dependent. That is, the viability of each project depends on the viability of the other.

To describe the interrelationship between the rail and port project, and the mines, we have developed three simple examples to show the interaction between each of the stakeholders.

The following simple examples have been developed:

1. Relationship between the Project Co and a mining company ("Mining Co") where the Mining Co intends to use its own locomotives. It is assumed that the Mining Co's use of the railway and port will cover the debt repayments of the Project Co.
2. Relationship between the Project Co and a Mining Co where the Mining Co intends to use the locomotives of a third party rail operator ("Rail Co"). It is assumed that the Mining Co's use of the railway and port will cover the debt repayments of the Project Co.
3. Relationship between the Project Co and Mining Co "A" where the Mining Co "A" intends to use its own locomotives, and Mining Co "B' where the Mining Co "B" intends to use the locomotives of a third party, Rail Co. It is assumed that both the demand from Mining Co "A" and Mining Co "B" for the rail and port is required to cover the Project Co's debt repayments.

Example 1 – Relationship between Project Co and Mining Co

Figure 58 shows the interactions between the Project Co, Mining Co "A" and the various banks and debt providers. In this example we assume that Mining Co "A" will use its own locomotives and that the use of the railway and port by Mining Co "A" is sufficient to cover the debt repayment for the project.

The diagram shows the following features:

1. The Project Co will not be able to secure project finance from lenders without some form of guarantee that there is a steady cash flow to repay the debt. Therefore, the Project Co requires "take or pay" (ToP) agreements with Mining Co "A" to demonstrate to lenders that there is likely to be demand for the project, and therefore revenue, which can be used to repay the debt.
2. The debt providers to the Project Co will undertake due diligence on Mining Co "A" to ensure that the ToP agreement is credit worthy. This can be an issue for junior miners unless the ToP is supported by a bank guarantee[16].
3. Before both the bank guarantee is given and the debt providers to Project Co are satisfied that the ToP is bankable, Mining Co "A" would have to demonstrate that the economics of its mining operation are commercially viable if the rail and port are developed. In particular, lenders will want to ensure that the mining operation of Mining Co "A" is competitive and sits in the lower quartiles of the global production cost curve for coal. This will ensure continuing operations even at times of depressed commodity prices. In this case, achieving the lower end production cost curve will mean not only delivering the lowest possible mining cost, but also the lowest possible transportation cost[17].
4. The debt providers to Mining Co "A" will not provide financing to develop the mine until they are certain that Mining Co "A" will be able to repay its debt. This means that Mining Co "A" must demonstrate that with a path to market, via the rail and port project, their mine generates sufficient profits to repay the debt. Therefore the debt providers to Mining Co "A" will review the economics of the mine but will also be concerned with the ability of the Project Co to deliver the rail and port project on time and on budget, and for the agreed access charges.

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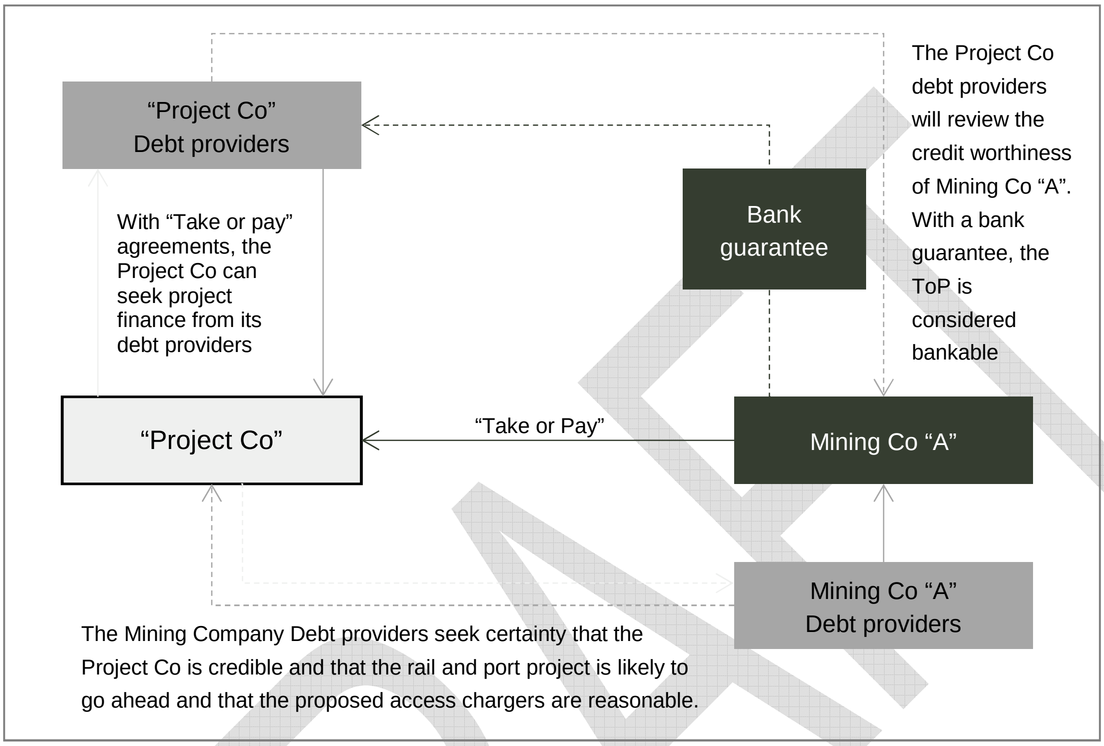
[16] In this instance, a bank guarantee is a written commitment issued on the mining company's behalf in favour of the Project Co to undertake to pay on demand the amount specified in the guarantee to meet the obligations of Mining Co "A" under the ToP.
[17] IFC (2013)

For this scenario to be considered bankable, it would require a large miner that would have coal export volumes sufficiently large to cover the capital and operating costs of the rail and port project. Therefore the rail and port project would be fully funded and underwritten by a large “anchor” mining client.



Source: Deloitte

Figure 58 Example relationship between Project Co and Mining Co “A”

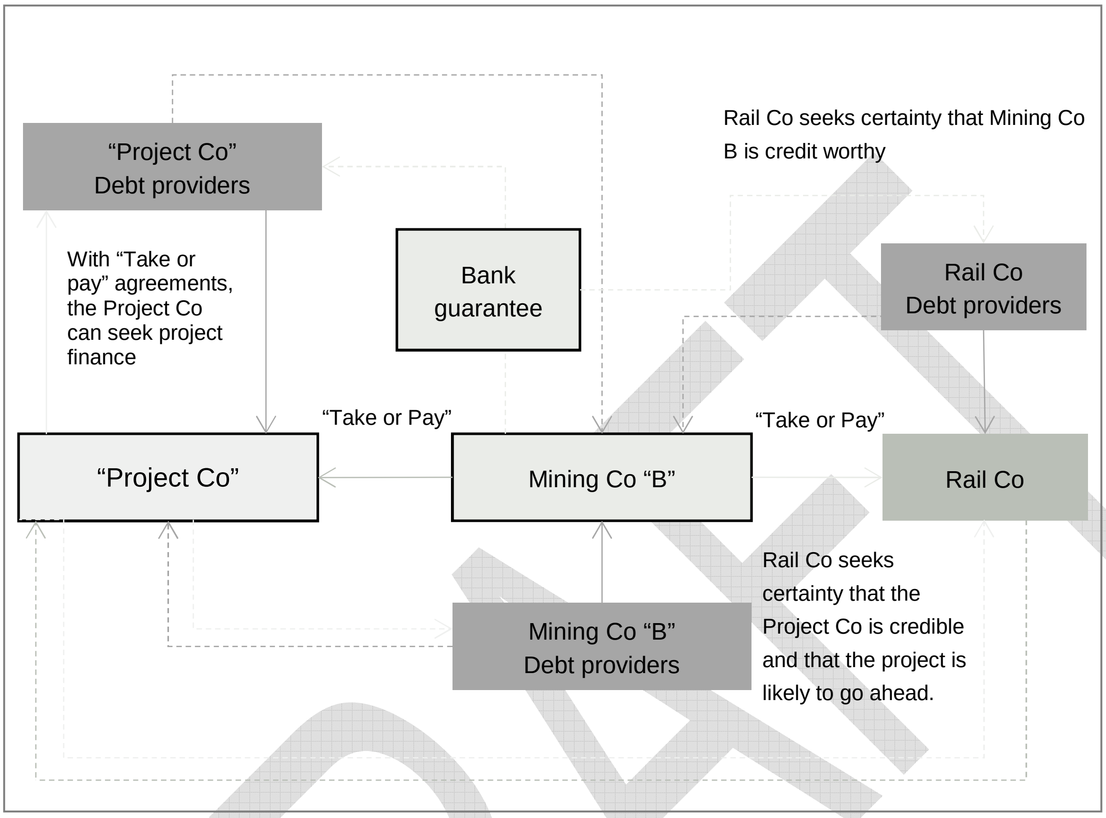
Example 2 - Relationship between Project Co, Mining Co and Rail Co

This example is a variation from Example 1, where the mining company does not have its own locomotives and requires a third party for the transport of its product. Figure 59 shows the added complication to the arrangements between the parties.

The additional features of this example include:

1. Mining Co “B” needs to sign a ToP agreement with both the Project Co and the Rail Co. The ToP with the Rail Co guarantees that it will use the services of Rail Co to transport its product. Essentially the ToP with the Project Co is for capacity on the below rail and the ToP will the Rail Co is for above rail services.
2. Rail Co requires the ToP from Mining Co “B” in order to receive finance from its debt providers to purchase new rolling stock etc. As shown in the previous chapter the upfront above rail capital costs are expected to be around $2b (depending on the gauge and traction).
3. The debt providers to Rail Co will review the credit worthiness of the ToP provided by Mining Co “B” and in the case of junior miners will require a bank guarantee.
4. Rail Co and its debt providers will also want assurances that the Project Co will be able to deliver the rail and port project on time and budget.

This example shows the extra layer of project finance that is required for Rail Co to provide its services to Mining Co "B". Like Example 1, this example assumes that Mining Co "B" is a large miner and has volumes using the rail and port sufficient for the Project Co to repay its debts.



Source: Deloitte

Figure 59 Example relationship between Project Co, Mining Co "B" and Rail Co

Example 3 - Relationship between Project Co, Mining Co "A" & "B" and Rail Co

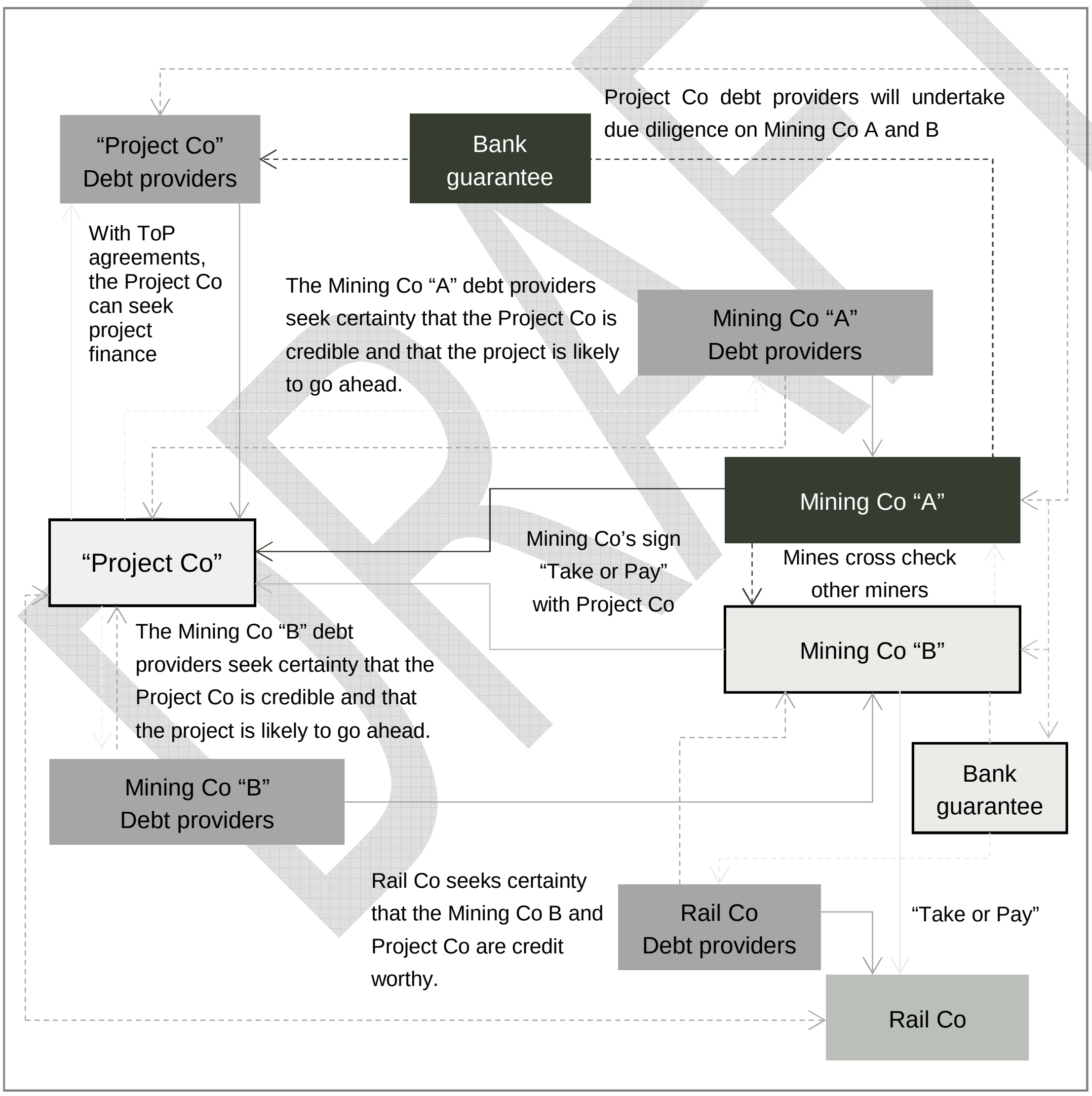
The final example is shown in Figure 60. Example 3 shows the interactions between the Project Co, the two mining companies (Mining Co "A" and "B") and the third party above rail operator, Rail Co. This example shows the complex interactions that are involved when two mining companies are involved in the transaction. In this example it is assumed that the Project Co needs the volumes from both Mining Co "A" and Mining Co "B" (50-50 split) to repay its debt.

The additional features of this example include the following:

1. The Project Co will not be able to secure debt financing from lenders without ToPs from both Mining Co "A" and Mining Co "B".
2. The debt providers to the Project Co will have to undertake due diligence on Mining Co "A" and Mining Co "B". Both miners must be able to demonstrate the viability and sustainability of their operations. The debt providers to the Project Co will be concerned with the likelihood of both mines being able to deliver on their commitments as the project financing depends on the volumes from both miners. Timing will be an important factor in their analysis. For example, will both mines develop according to the agreed timeframe and ramp up accordingly?

3. Mining Co “A” and Mining Co “B” will not seek financing for their projects unless they have confidence that the other party will agree to its commitments on the rail and port project. It is highly unlikely that the mining companies will agree formally in writing to each other.
4. The Rail Co is now also interested in Mining Co “A” as its ToP with Mining Co “B” is dependent on the viability of Mining Co “A” and the flow on viability to the Project Co.

This example shows the complexities involved when two miners are involved. It shows that each of the stakeholder’s operation impacts the commercial viability of the others. The Project Co would need to be underwritten by both mines and lenders need confidence of the continued production of each mine. A number of cross-defaults would need to be in place to protect each lender. The combination of these factors will make the debt financing difficult to execute in practice. As of the beginning of 2015, the Botswana coal mining industry is dominated by small and medium players. In the current state it is likely that the project would need to be underwritten by more than two miners.



Source: Deloitte

Figure 60 Example relationship between Project Co, Mining Co “A” & “B” and Rail Co

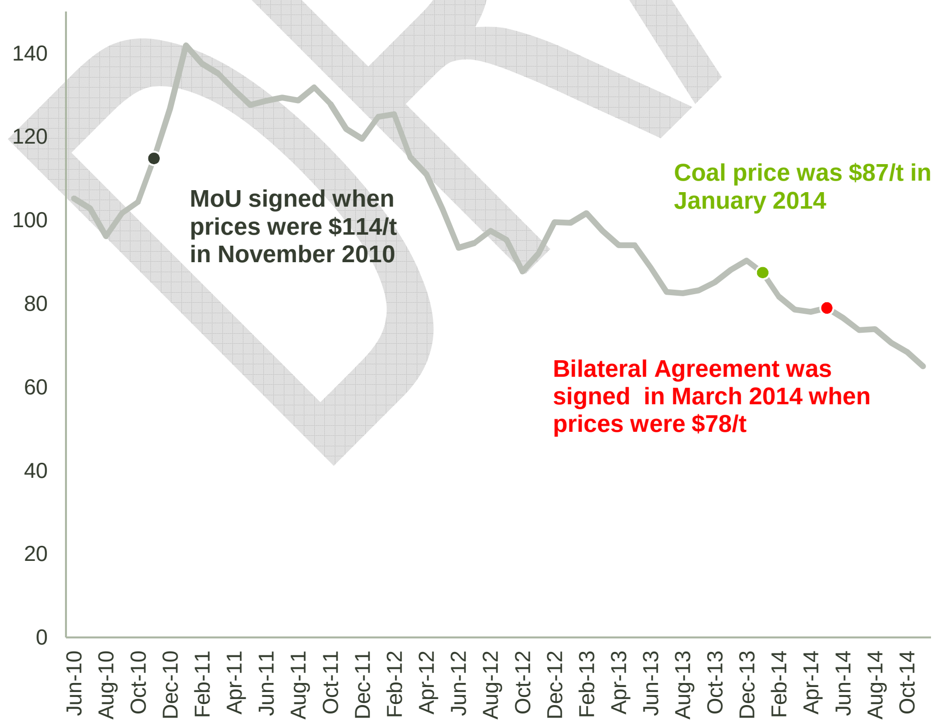
11.10.8 Implications for the project

Botswana has substantial coal reserves that can produce at least 65mtpa of medium quality export coal that would be expected to sell at a discount of around 8% to the Richards Bay benchmark. This coal is of equivalent quality to that which is already bought by both China and India.

Mine development and capital costs are expected to be at the lower end of world mine cost curves but significant investment is required by miners before they can develop their resources. To gain funding for this investment the miners will need to be able to show their investors that they have a viable path to market for their coal. Our analysis suggest that the **TKR could provide investors with this confidence if the Richards Bay price of coal rises and is sustained at prices above USD81 and the most efficient infrastructure options are developed.** At the current Richards Bay benchmark price of USD65 the analysis shows that it will not be economic to develop the mines and utilise the TKR and Walvis Bay port option.

Clearly, the coal market has changed significantly since the various commitments were made by government (see Figure 61). This has changed the landscape in which the project is viewed by potential investors. Since the signing of the Memorandum of Understanding (MoU) and the Bilateral Agreement coal prices have fallen significantly The MoU was signed between the two governments when the coal price was $114 per tonne in November 2010 while the Bilateral Agreement was signed in March 2014 when the coal price was $78 per tonne. Since the signing of the Bilateral Agreement in March the coal price has fallen by 20% in 9 months to around $65 per tonne (December 2014).

However, the price of coal was above USD87 in January 2014, meaning that such a price rise is possible to make the project viable, but to facilitate the development it will be critical for Botswana to select the most efficient scenario for development of the TKR.



Source: various

Figure 61 Coal price and announcements ($USD/t)

Sensitivities suggest there are three critical areas in which the government can impact on the potential viability of the railway:

- Alignment
- Gauge
- Locomotive fuel type

If potential investors are not provided the flexibility to choose the most efficient development options the price of coal required to provide investors with a viable return on their mine developments would be expected to rise to well above USD90.

The bankability of the project will also depend on its intended purpose and usage. This is yet to be defined and it will be important for the BFS to consider all of the options. For example, is the project dedicated to mining operations or will it be used by other users such as general freight or passengers?

Public financing is most likely unavailable, meaning private financing is the only viable source of capital. From a lenders perspective there is an inverse relationship between complexity and bankability. Lenders favour simple and less complex projects; see Figure 62.

The bankability of project will be heavily dependent on the credit quality of the different users. The bankability of the project becomes more complicated when not all users are identified at the time of the financing of the project (different mine commissioning timetables).

Source: IFC (2013)

Figure 62 Complexity and bankability

The miners are the sole source of revenue for the project and therefore the source of debt repayment for the limited recourse loan. Lenders will spend a significant amount of time studying the credit quality of the users and their 'ability to pay'. Lenders will assess the individual viability of the mines using the project. In particular, lenders will want to ensure that the mining operation is competitive and sits in the lower quartiles of global production curves to ensure operations will continue during depressed commodity prices[18].

This means that not only do the mines have to be cost effective, the project must provide the lowest transportation cost possible.

[18] IFC (2013).

The quality of the “anchor” mine is, and always will be, a *sine qua non* of a successful, feasible and bankable mining infrastructure project. The structure most likely to receive non-recourse financing in support of the development of the project is one in which the mining company is partially or substantially owner of the infrastructure. This allows the project to be underwritten based on volume from the anchor mine itself as shown in Figure 63[19]. While this type of structure would be preferred by lenders, it will also require strong regulation to ensure the provision of third party access.

Small mines lack the scale to develop the project on their own. A large volume is necessary to justify the development of the project. Our analysis suggests that 65mtpa of coal traffic is required (at a coal price of $81/t). There is currently not a large anchor mining client with these volumes in Botswana. Without a large anchor mining client the rail and port will need to be shared by multiple miners, which will increase the complexity of the financing and structuring of the project.

Timing is crucial. For the project to be underwritten by a syndicate of small miners, the concurrent development and financing of each one of the small mines is a prerequisite. The banks would have to underwrite multiple mines since they will need to evaluate the probability of each mine continuing production[20].

The scale of the project will present a challenge to most infrastructure funds and financial investors. As shown earlier, the appetite for demand risk PPPs is on the decline.

This is not to say that non-traditional financial investors such as Chinese state-owned development funds or commercial banks might not be willing to finance greenfield transport mining infrastructure. However, it would be expected that in this case, the financing would be tied to the award to a Chinese mining company of the mineral rights supporting the project.

[19] Approaches to structuring infrastructure projects around the world typically involve a mix of miners, infrastructure (constructors) and above rail operators developing the project, for example the GVK-Hancock and Aurizon project in Queensland, Australia. In some cases the infrastructure investors also have stakes in the mining project as well, for example POSCO, a South Korean infrastructure provider, has a stake in the Adani “Carmichael” mine project in the Galilee basin, Australia.
[20] IFC (2013)

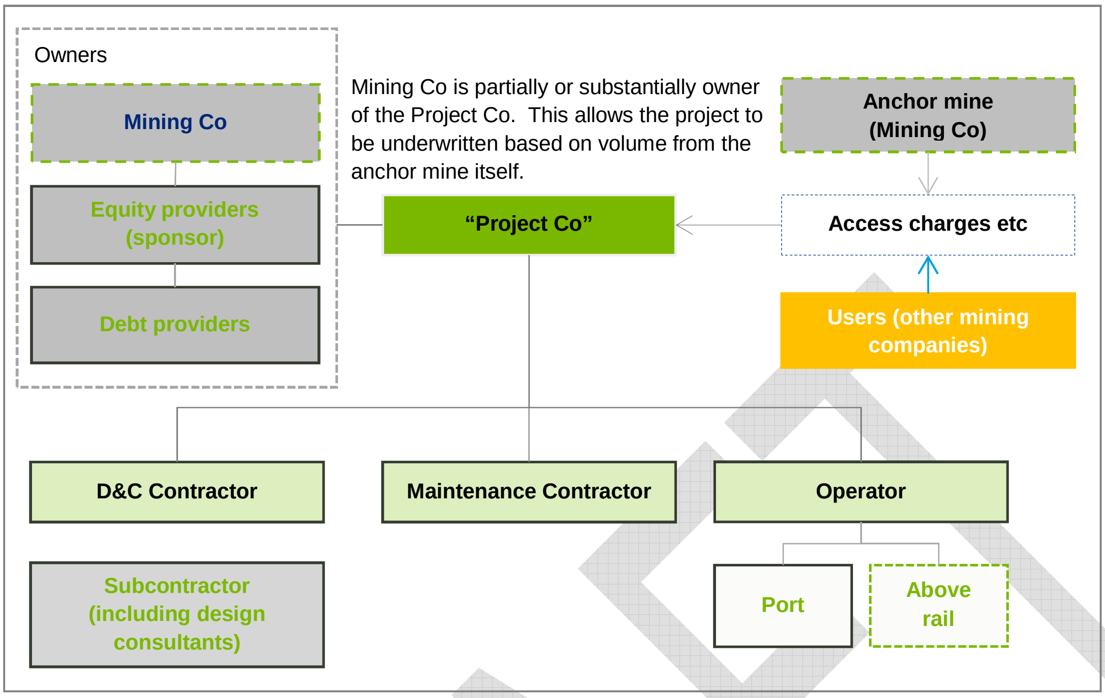


Figure 63 PPP structure with investment by mining company

In summary, the key requirements for the PPP include:

- The project will require an anchor mining customer to enable the Project Co to obtain project finance
- Project financing by a PPP for the project is only feasible if its cash flows are assured under a robust take-or-pay (TOP) agreement from an investment-grade anchor client. In most cases, this will involve parent or bank guarantees.
- The major mining companies are best-placed to support the PPP approach
- Some junior mining companies do not have sufficient credit standing to support this structure. The downturn in commodity prices has meant that even the largest mining groups are managing their balance sheet exposures very carefully.
- The critical "underwriting" contribution made by investment grade anchor mining customer must be adequately compensated/rewarded in the context of any infrastructure sharing arrangements
- A package of "foundation rights" will generally be needed, which could include priority access rights, a pre-agreed upside-sharing mechanism, etc
- Lastly, public authorities might have to accept that multi-usage demands made to transport mining infrastructure operators might have to be initially or permanently restricted to secure, first and foremost, the delivery of an efficient mining transport system at the lowest possible cost to its anchor user/client.

12 Rail accreditation

12.1 Background and context

Accreditation is a defined, encompassing term which describes and specifies the management regime within which rail infrastructure is owned, designed, constructed, maintained, managed, and operated.

It is a given fact that Railways impose a significant impact upon the sovereign and economic viability of the country they serve. Put simply, railways are both the path to market for exports and the import conduit for essential imports and are thus intrinsic to the economic viability of the country. In the event that a railway (a significant supply chain) fails, whether through commercial or physical failure substantial downstream effects will be felt as the country is no longer able to generate export revenues, nor provide essential import goods to residents, nor even provide public transport to citizens.

It is for this reason that the Regulation of Railways – both by way of the economic regime (through the Economic Regulator) and the safety/management regime (through the Rail Safety Regulator) – can be seen to be essential to the viability of the railway and the economic vitality of the country.

This is notable as the reason why railways and other heavy-haul transport assets are often the first targeted by enemies of the State. The impact of such loss can have a crippling effect on the country.

To this end, Rail Accreditation is the Regime within which the Rail Safety Regulator ensures the on-going provision of rail services. Hence, a definition of Accreditation might be,

A defined Regime directed at ensuring the provision of on-going rail services through the Regulation of Rail Managers, Rail Maintainers, Rail Transport Operators, and Government Statutory Bodies who have specific responsibility or impact upon the Rail Network. The Regulator of the Regime is principally responsible for ensuring that parties apply and invest sufficient resources, and have the competence and capacity to ensure the provision of on-going rail services.

Figure 64 Rail Accreditation Regime

Practically, this entails the Regulator Accrediting a party who can demonstrate –

- Economical and efficient design of rail infrastructure
- Safe and effective construction and on-going maintenance of rail infrastructure
- Effective and economical management and control of rail infrastructure
- Safe, effective, and economical management and operation of rolling stock
- Competence, capacity, and resources to manage risks that may arise on the rail infrastructure so as to recover from foreseen and unforeseen events
- Safe, effective, and economical management of railway operations
- Competent management of both Rail Infrastructure Managers (RIM) and Rail Operators (RO) who are empowered and delegated with sufficient resources so as to ensure that the rail infrastructure is not compromised nor its value to the State or others is diminished.

The Accreditation candidate demonstrates the validity of their candidacy to the Regulator through their **Safety Management System** (SMS). Consequently, the overarching obligation of the Accredited party is to comply with the provisions of their Approved SMS – to abide by the conditions of their Accreditation and effectively implement the SMS which was the basis of their grant of Accreditation. Typically this includes –

- Compliance with rail legislation - complying with the direction of the RSR, meeting regulations, mandatory guidelines and other applicable legislation
- For Rail Operators (RO), compliance with network rules reasonably imposed by the RIM and terms of access agreements
- Identification, assessment and elimination or control of safety risks
- Review of risk assessments at defined intervals or in response to occurrences and investigations
- Compliance with the requirements of internal systems implemented to control risks, through training, supervision and audit
- Reporting of “Notifiable Occurrences” to the RSR
- Maintaining effective Emergency Management Systems and resources,

- Ensuring the security of cargo, passengers, freight, and the rail assets (infrastructure and rolling stock)
- Internal investigation and management of occurrences
- Application of learning from occurrences, through the adoption of recommendations arising from investigation reports and safety actions in response to occurrences
- Annual review of the Accredited party's SMS
- Annual and regular reporting to the RSR
- Applying principles of continuous improvement to the SMS, safety culture and outcomes
- Implementing appropriate occurrence notification, investigation, analysis, development of safety actions, and reporting in a just culture environment
- Effective "Management of Change" practices including application for variation to the Accreditation, or notification to the RSR where necessary
- Consulting with and ensuring the involvement of rail safety workers, their representatives and other stakeholders in respect to decisions that affect the safety of the railway organisation's operations, within the risk management process and during system review and improvement,
- Payment of annual Accreditation fees to the office of the RSR

The term 'regulator' in this chapter, unless otherwise indicated, refers to safety regulator.

12.2 The Safety Management System

As noted earlier, the Safety Management System (SMS) is the foundation upon which the Regime is effected. RIMs and ROs develop and submit their SMS so as to achieve Accreditation and it is upon this suite of documents that their performance is audited and evaluated.

In the event of an action/derailment/accident/incident the SMS forms the basis of the investigation so as to ensure that approved practices have been followed.

At the heart of the SMS is the Risk Management and Control Plan. Rail is by definition a "Risk based regime" and hence Standards and Guidelines are derived and/or developed so as to address and mitigate an identified risk.

It's worth noting that in this regard the Standards can have a significant impact upon the commercial viability of the rail network. An unscrupulous Accreditation candidate might seek to adopt Standards which are lowest cost but not necessarily Fit for Purpose. The SMS should thus demonstrate to the reasonable satisfaction of the RSR a clear link between the Standards and the management of risk (and more particularly those risks identified in the Risk Assessment). In short, the SMS is the practical application of Standards appropriate for the rail network and safe rail operations. At a high-level, a typical SMS might contemplate –

1. ***Safety Management*** *- Safety policy, Governance and internal control arrangements, Responsibilities, accountabilities, authorities and interrelationships, Regulatory compliance*
2. ***Risk Control and Management*** *- Risk management, Exposure Prevention, Human factors*
3. ***Engineering Management and Standards*** *- General engineering and operational systems safety requirements, Process control, Asset management, Safety interface coordination, Engineering Design Standards*

4. ***Operations and Maintenance***
5. ***Change Management*** *- Management of change, Consultation, Internal communication*
6. ***Asset Management***
7. ***Resource Management***
8. ***Human Resource Management*** *- Rail safety worker competence, Health and fitness management plan, Alcohol and drug management plan, Fatigue management plan*
9. ***Audit Management*** *– Review, Safety performance measures, Safety audit arrangements, Corrective action*
10. ***Procurement*** *- Procurement and contract management*
11. ***Incident Management*** *- Management of Notifiable occurrences, Security management, Emergency management*
12. ***Emergency Response*** *- Emergency Response Procedure, Accident Treatment and Major Incidents and Near Misses, Incident Reporting, Accident, Incident Investigation and External Reporting,*
13. ***Document Control*** *– Procedure, Document Master Lists, Backups and Retention, Archiving, Storage and Maintenance, Disposal, Document Transmittal, Document Change Request, Record Index Register, External Documents Master Register, Document Inspection Regime*

12.3 Principal responsibility of the Rail Safety Regulator

The Rail Safety Regulator (the "RSR") is principally bound under the provisions of Legislation which dictates, mandates, and prescribes the delegated authority within which the RSR provides for the safe and on-going operation of the rail network.

This should not be interpreted as the RSR carrying direct liability for the economic or commercial viability of the Railway - such which is borne by the investors of the rail assets (Above and Below Rail) and administered/monitored by the Economic Regulator.

The performance of the RSR is rather appraised on the basis of the availability of the rail network to service the needs of Rail Operators – provided those Rail Operators are able to meet the commercial and economic conditions imposed upon them through the RIM's Access Agreement. Hence, it can be seen that the RSR must work in concert with the Economic Regulator within a light-handed regulatory approach to ensure that safe operations continue –

- That where possible actions/derailments/accidents/incidents are avoided and do not close the infrastructure and deny rail services for extended periods of time
- That reinstatement of the rail infrastructure occurs in the most efficient and economical way possible
- That investigations when such actions/derailments/accidents/incidents invariably occur, do not deny rail services for extended periods of time

12.4 The office of the Rail Safety Regulator

The RSR -

- Defines and advises candidates of the minimum requirements for the scope and content of SMS documents in accordance with the legislative framework
- makes recommendations for Policy, Regulation, and Legislation pertinent to the rail network for consideration by Government

- evaluates and assesses the “Fitness for Purpose” of Standards proposed for the design, construction, maintenance, and operation of the rail network
- Evaluates and assesses candidate SMSs and provides an opinion on whether the Standards proposed demonstrate the viability of the rail network/operation, and whether the candidate has the skills and capacity to operate as specified
- Evaluates, assesses, and provides an opinion on whether all risks have been effectively mitigated by the SMS and the nominated Standards
- Evaluates, assesses, and provides an opinion on whether the SMS complies with and meets the minimum requirements as specified by the RSR
- Evaluates, assesses, and provides an opinion on whether the candidate SMS is a system based on risk management and continuous improvement, and that there is a clear linkage between risks/hazards identified, and the mitigation
- Monitors compliance with the Accredited party’s SMS through compliance auditing, inspection, and investigation
- Leads industry safety and operational efficiency promotion and education to facilitate compliance and promote improved safety and operational outcomes
- Undertakes enforcement action where necessary and within the provisions of the Legislation so as to ensure public safety and the on-going provision of the rail assets
- Monitors and reports to Government on rail network safety and operational performance through occurrence reports, trend analysis and regular Safety Reports submitted by Accredited parties
- Represents and reports to Government on matters pertaining to the rail network and rail infrastructure assets and operations.

Figure 65 Rail Safety Regulator

12.5 The Relationship between the Rail Safety Regulator and the Rail Infrastructure Manager

A Rail Infrastructure Manager (RIM) is defined as –

A party Accredited to maintain effective management and control of rail infrastructure or proposed rail infrastructure –

b) whether or not that party owns or will own the rail infrastructure; and who

c) carries a primary liability to maintain the infrastructure in good and safe order and condition, and

d) agrees to provide Access to Accredited Rail Operators.

The RIM is primarily responsible for the development, application, and maintenance of:

- **Rail Design Standards** specific to the Rail Network and specific to the identified rail traffic
- **Rail Construction Standards** (for yards and other infrastructure intrinsic to the operation of rail transport services)
- **Rail Maintenance Standards** (so as to ensure the safe operation of rail transport services)
- **Rail Operations Standards** (the specific requirements which ROs must meet and adhere to in operating on the rail infrastructure, and the manner by which the RIM operates the rail infrastructure under normal conditions and under actions/derailments/accidents/incidents),

These Standards form the Development of the Safety Management System (the "SMS") which the RIM submits to the RSR and upon which their performance is audited. Once Accredited, the Approved SMS is the fundamental basis upon which the rail network is constructed, maintained, and operated.

Hence, in the development of the TKR it is envisaged that the RIM will consult with the RSR during the design and delivery phases of the project with the SMS being developed as the project is designed/delivered.

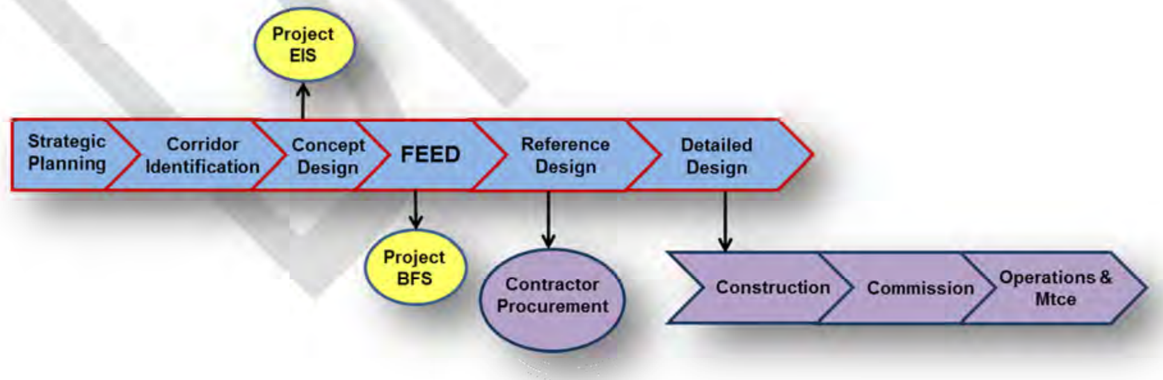


Figure 66 Project Phases

Within this consultation, the RSR is principally concerned with:

- **Fitness for Purpose** – that the overall functionality of the rail network (the proposed design, construction, and operation) is sufficient to provide safe performance criteria. This is typically demonstrated though the modification of established and mature Standards and independent verification to the satisfaction of the RSR that they meet the "*Fitness for Purpose*" test. Evidence would include design calculations, typical and reference drawings, and proof that such Design Standard are applicable and the most effective for the given location and proposed operation).

- **Compatibility with local and available construction methodologies and requirements** – that the design proposed can be effectively constructed by proposed contractors appointed for the respective elements. This includes the availability of competent contractors and workers, and the availability of physical resources to design and deliver the rail network.

- **Compliance with technical requirements** – design compliance with relevant local codes and prevailing standards, and relevant industry practices. To this end, the RSR may look to the RIM to demonstrate acceptability of the design by a suitable qualified contractor.

- **Compliance with interface infrastructure authority requirements** – agreement from and compliance with the minimum reasonable requirements of adjacent infrastructure owners/managers (for example Regional and National Governments, power transmission, water pipelines, gas pipelines, existing railway authorities, and road authorities. The RIM is to ensure that the Design, Construction, Maintenance, and Operation of the rail network will not compromise the integrity, safety, or effectiveness of adjacent infrastructure.

- **Compliance with requirements of approval Competent Authorities** – prior to the application of the Design (hence, prior to construction, maintenance, operation) proof that the Design has been ratified by and approvals provided by Competent Authorities (such as the Environmental Protection Authority).

- **Consistency with "*Safety in Design*" practices** – consistent with the safe operation of rail, proof should be provided to the RSR that Safety has been implicitly designed into the construction, maintenance, and operation of the rail network. This is typically effected through Independent Design Verification and advice to the RSR.

Hence, it can be seen that the development of the RIM SMS progressively evolves throughout the rail project's development. Railway Accreditation within each of the development stages is discussed in more detail below.

- **Design** – the design process is not specifically accredited by the RSR with the principle obligation upon the RIM to satisfy the RSR that design is consistent with the proposed rail network operations. Typically this is demonstrated by the Independent Verifier who provides advice to the RIM (who then in turn submits this advice to the RSR) that the Design is Fit for Purpose and incorporates Safety in Design principles.

- **Construction** – with the approval of the RSR, the RIM awards the construction contract to a suitably qualified contractor consistent with the provisions of the SMS. The RSR provides ongoing certification that the approved design is being effectively delivered. The contractor must work under the direction and within the liability imposed upon the RIM – thus the RIM maintains principal liability for the delivery of the works to the approved design. In short, the RIM cannot contract out of their liabilities and must satisfy the RSR at all stages of the construction process that the approved design is being delivered. Typically, the RSR provides step-function approval to the RIM to commence works and indicate their satisfaction when each of these stages have been satisfactorily delivered and commissioned.

- **Commissioning** – as the works are delivered it is typical that they are incrementally commissioned and then subsequently the rail infrastructure commissioned as an integrated whole. Prior to the provision of the infrastructure for Rail Operations, the RIM must satisfy the RSR that commissioning has been successful. This is typically demonstrated by way of progressive and final commissioning certificates provided by the contractor, acknowledged and accepted by the Independent Verifier, and subsequently submitted to the RSR as evidence. It may be that Rail Operations can commence on discrete sections of the rail infrastructure whilst construction continues provided that protections are defined, approved, and effected to ensure safety on the incomplete sections. Whilst it is typical practice for the RSR to allow fleet testing, driver training, train control commissioning, and the testing of operational procedures during the Commissioning process, revenue earning services cannot commence until Accreditation Approval is granted by the RSR.

- **Operations** – With Commissioning and subsequent Accreditation Approval, rail operations can commence. Prior to the commencement of revenue earning services there might exist a transitionary phase where the RSR grants Rail Operators a period of supervised access for the purposes of driver training, and fleet testing. The provisions of RIM Accreditation are such that only Accredited Rail Operators are permitted to provide revenue earning services within the provisions of their respective Approved SMS's.
- **Maintenance** – An Operating and Maintenance Plan is an intrinsic part of the RIM's SMS and specifies the standards and practices by which the infrastructure will be maintained and recovered following actions/derailments/accidents/incidents. Operations and Maintenance should contemplate commencement of revenue earning services by a new Accredited Rail Operator or where a section of the infrastructure is being employed for the first time (following initial construction, or after major works) or after a period on inactivity (where the infrastructure may have been "moth-balled"). The Operations and Maintenance Plan, as part of the RIM's Approved SMS should specify the inspection regime, and the minimum deterioration of the infrastructure which will be tolerated before rehabilitation, or maintenance is effected.

As can be seen, there must be a strong and open relationship between the RIM and the RSR. The RSR should be seen by the RIM as having a keen interest in ensuring the ongoing safe rail operations.

12.6 The Relationship between the Rail Safety Regulator and the Rail Operator

A Rail Operator (RO) is defined as –

A party Accredited to operate revenue-earning rail services on the infrastructure under an Approved Access Agreement with an Accredited Rail Infrastructure Manager (RIM), and who carries a primary liability to operate such services safely and to the provisions of their Approved SMS.

The RO is primarily responsible for the development, application, and maintenance of:

- **Rail Operating Standards** specific to the Rail Network and specific to the identified rail traffic,
- **Rail Construction Standards** and **Rail Maintenance Standards** for yards and maintenance depots which are operated by the RO, and
- **Rolling stock Operating and Maintenance Standards** which demonstrate the safety and effectiveness of the nominated rolling stock on the defined rail infrastructure, and
- **Rail Access Standards** which demonstrate how the reasonable requirements imposed by the RIM will be met – this includes interface with other Rail Operators on the infrastructure under normal conditions and under actions/derailments/accidents/incidents.

These Standards form the Development of the Safety Management System (the "SMS") which the RO submits to the RSR and upon which their performance is audited. Once Accredited, the Approved SMS is the fundamental basis upon which rail operations are conducted.

Hence, in the development of the TKR it is envisaged that a number of potential RO's might take interest in the design and delivery phases of the project with their SMS being developed as the project is designed/delivered.

Within this consultation, the RSR is principally concerned with –

- **Fitness for Purpose** – in that the RO is able to effectively and safely operate within the imposed functionality of the rail network (the design, construction, and maintenance). As with the RIM, the RO must demonstrate Operating Standards and independent verification to the satisfaction of the RSR that their proposed operations meet the "*Fitness for Purpose*" test. Evidence might include simulations, training/competence standards, and rolling stock specifications which demonstrate the safe and effective employment of the infrastructure.
- **Compliance with interface infrastructure authority requirements** – agreement from and compliance with the minimum reasonable requirements of adjacent infrastructure owners/managers (for example Regional and National Governments, power transmission, water pipelines, gas pipelines, existing railway authorities, and road authorities. The RO is to ensure that Operations on the rail network will not compromise the integrity, safety, or effectiveness of adjacent infrastructure.
- **Compliance with requirements of approval Competent Authorities** – prior to and ongoing throughout operations, proof that the proposed operations have been ratified by and approvals provided by Competent Authorities (such as the Environmental Protection Authority).

Hence, it can be seen that the development of the RO's SMS may progressively evolve throughout the rail project's development or RO Accreditation might be sought later by an RO from another regime or even country.

Consistent with the RIM Accreditation, the RO should effectively demonstrate the follow to the RSR.

- **Operational Design** – so as to satisfy the RSR that the proposed Operations are consistent with the limitations of the rail infrastructure. This might be demonstrated by submission to an Independent Verifier who provides advice to the RO (who then in turn submits this advice to the RIM granting Access) that the Operations are Fit for Purpose and incorporate Safety principles.
- **Construction of Yards and Depots** – consistent with the provisions of the approval granted by the RSR to the RIM, the RO should demonstrate to the satisfaction of the RSR that design and construction of the Yards and Depots is being contracted by a suitably qualified contractor consistent with the provisions of the SMS. The RSR provides ongoing certification that the **approved** design is being effectively delivered. The contractor must work under the direction and within the liability imposed upon the RO – thus the RO maintains principal liability for the delivery of the works to the approved design. As with the RIM, the RO cannot contract out of their liabilities and must satisfy the RSR at all stages of the construction process that the approved design is being delivered. Typically, the RSR provides step-function approval to the RO to commence works and indicate their satisfaction when each of these stages have been satisfactorily delivered and commissioned.
- **Commissioning** – this might contemplate commissioning of Yards and Depots as well as commissioning of operations prior to the commencement of revenue-earning services. In short, the RO must satisfy the RSR that commissioning has been successful and operations can safely commence. This is effected through demonstrated and progressive commissioning of fleet testing, driver training, and testing of operational procedures. Revenue earning services cannot commence until Accreditation Approval is granted by the RSR.
- **Operations** – An Operating Plan is an intrinsic part of the RO's SMS and specifies the standards and practices by which revenue-earning services are provided, along with the proposed Daily and Monthly Train Plan.

As can be seen, there must be a strong and open relationship between the RO and the RIM and the RSR. The RO should be proactive in demonstrating to the RSR a keen interest in ensuring the ongoing safe rail operations.

12.7 Scope of Accreditation

Accreditation may be granted on a temporary (for example the construction or delivery of a defined project, the provision of services over a defined period) or ongoing basis. Typically, Accreditation once granted remains in force until it is suspended or cancelled.

Accreditation does not imply that the systems submitted to the RSR are static, will remain adequate over time, or that development and improvement of systems is at an end. Rather, it is a given that experience, changes within the organisation, advances in the discipline of safety science and improvements in the safety culture will give rise to innovation in the Approved SMS.

In keeping with the philosophy of Continuous Improvement, a system which fails to innovate and develop may lead to complacency and indicate latent failure. Accredited parties thus have an obligation to ensure ongoing review and improvement of the SMS as a basis for their Accreditation.

A separate but related element of Accreditation is the issue of appropriate interface coordination plans between ROs operating on the same infrastructure and where one RIM adjoins another RIM's rail network.

These interfaces impose their own specific risk and must be actively managed. Consequently, the addition of a new RO onto an existing RIM's rail network may give rise to other ROs re-evaluating the comprehensive effectiveness of their respective SMSs.

Once again, the liability and responsibility is upon each Accredited party to ensure the integrity of their own systems and not rely upon their interfacing parties to protect their interests nor provide cover.

12.8 International issues which impact upon the role of the RSR

We have taken the view that the Accreditation regime for the Trans-Kalahari Rail (TKR) will be consistent across the entire length of the supply chain – that is that a single unified regime will be comprehensively and unilaterally effected for the RIM and the respective ROs and Rail Maintainers.

The operational efficiency of the supply chain would be greatly diminished if every train was required to stop at the border and effect Customs, Quarantine, and Security inspection. That being said, we acknowledge that this will impose certain complexities such as border protection from illegal immigrants, customs and duty on goods transported across the respective borders, and ensuring that quarantines between countries (biological and environmental) are maintained. At this stage of the project development, we are confident that strategies and guidelines which have proven successful in other jurisdictions (such as the case in Europe) can be implemented for the TKR. We suggest that the Accreditation and Safety Management Regime must thus contemplate –

- The Government Railways of Botswana and Namibia operate within their respective national borders – notwithstanding we acknowledge that international rail operations have been effected between Botswana and its neighbours.
- The TKR necessitates a significant paradigm and operational shift which away from domestic operations and thus supports the establishment of the TKR RSR with jurisdiction across the entire supply chain. Enabling mirror legislation consistent with the intent of the Bi-Lateral Agreement will be required for Botswana and Namibia so as to ensure this.
- Consistency across the TKR, for example train inspections, infrastructure maintenance practices, and other elements nominated in the SMSs of RIMs, ROs, and Rail Maintainers must be maintained and enforced. For example, a train service authorized to proceed in Botswana must be accepted as

consistent and compliant in Namibia and vice versa. Likewise, track maintenance should not stop at the border, fibre-optic cables and data/communications will traverse the entire length of the TKR, and must be treated within the TKR as a whole.

- Locomotive and driver changes will not necessarily occur at the border. Locomotive drivers may require special visa treatment as they cross the border at speed on board a train service. Other jurisdictions (such as Europe) have effected simple processes to address this issue.

We propose that the TKR be contemplated as a “seamless international rail freight corridor”, consistent with the Bi-Lateral Agreement. Hence, the TKR is likely to precipitate a suite of inter-governmental agreements and legislation essential to provide a streamlined international rail system.

We hold that the viability of the TKR could be severely diminished, if not lost completely, if such agreements are not effected and maintained. Notwithstanding this concern, we remain confident that if the European rail network – which constitutes a patchwork of national systems with often conflicting technical standards, track gauges, signalling systems, loading gauges, pantograph headroom, maximum axle-loads, and safety systems – can effect reasonably efficient international rail operations, then this issue can be effectively addressed by Botswana and Namibia.

Ongoing Government engagement will be essential to provide the enabling international legislation which is critical to effect and maintain the TKR Accreditation Regime.

13 Asset management

13.1 Introduction

Asset Management for large rail infrastructure assets such as the TKR project would be essential to establish a long term reliable, available and safe system. The objective would be to ensure a continued operation of coal haulage over the many years to come. The cost and performance of the railway network, including all related infrastructure facilities, would be a significant issue to the Botswana and Namibia Governments and to the various participating coal miners, funders and other key stakeholders.

Asset Management is a science on its own and has developed over the years into a value add activity for every organisation. Asset management provides a systematic approach for operating, maintaining, upgrading and disposing of assets in the most efficient and cost-effective manner over the entire economic life span. Those that endorse the Full Life Cycle management concept will experience the efficiency and longevity of the assets over the life of the assets.

The Full Life Cycle Asset Management can be considered to be the implementation of the overall strategy which is to deliver a sustained performance at an efficient cost to the satisfaction of the end user. From the date of commissioning it follows a distinct activity cycle as described in 13.2 below. AM has an integration function to link all related assets to the operational functions ensuring the smooth running of the train sets on schedule.

It is further critical to ensure the smooth operations of a large capital investment project from the date of completion. In order to achieve this it is important to provide assurance to both Governments that all processes, systems, people etc. are all ready to operate effectively from the first day of commissioning of the operations. In providing this assurance an Operational Readiness approach would be required to be conducted during the construction phase of the project. The Operational Readiness approach is closely integrated with the Asset Management processes explained in this document.

BSI PAS 55:2008 is the international reference standard for the optimum management of physical assets and is applicable to any organisation where physical assets are key or a critical factor in achieving business goals. The latest international standard for Asset Management ISO 55000 defines the standards for good Asset Management. The principles of this standard are applied in the development of this document and are intended to help the TKR managers to specify the main building blocks of an asset management system.

The Asset Management regime adopted will also form part of the Safety Management System (SMS) which requires approval from the Rail Safety Regulator. Refer chapter 12.

13.2 What is Asset Management

Asset Management (AM) can be defined in different ways. It is defined in PAS 55 as:

"The systematic and coordinated activities and practices through which an organisation optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their life cycle for the purpose of achieving the organisational strategic plan"

Another definition of Asset Management, complementary to the above, is:

"The applied philosophy which structures the approach to the long term management of physical assets with the primary objective of achieving its optimum functionality for the end user through efficient and effective assurance of its reliability, availability, maintainability and safety."

The introduction of the PAS 55 guideline in 2008 played an immense role in narrowing this definition by giving a 28-point requirements checklist for good asset management practices. Over the past few years, this definition has been further refined and in January 2014, this converged with the issue of ISO 55000.

According to the ISO 55000 definition, Asset Management is: "**the coordinated activities of an organization to realise value from assets".**

This definition implies that Asset Management is NOT about "**doing things to assets**", but more about "**using assets to derive value and achieve an organisation's business objectives**".

The BS ISO 55000 family of standards comprises three documents:

- BS ISO 55000, Asset management — Overview, principles and terminology
- BS ISO 55001, Asset management — Management systems — Requirements
- BS ISO 55002, Asset management — Management systems — *Guidelines for the application of ISO 55001*

The principles and elements of ISO55000 have been adopted in this AM Framework. Figure 67 below provides the ISO 55001 elements of an AM System:

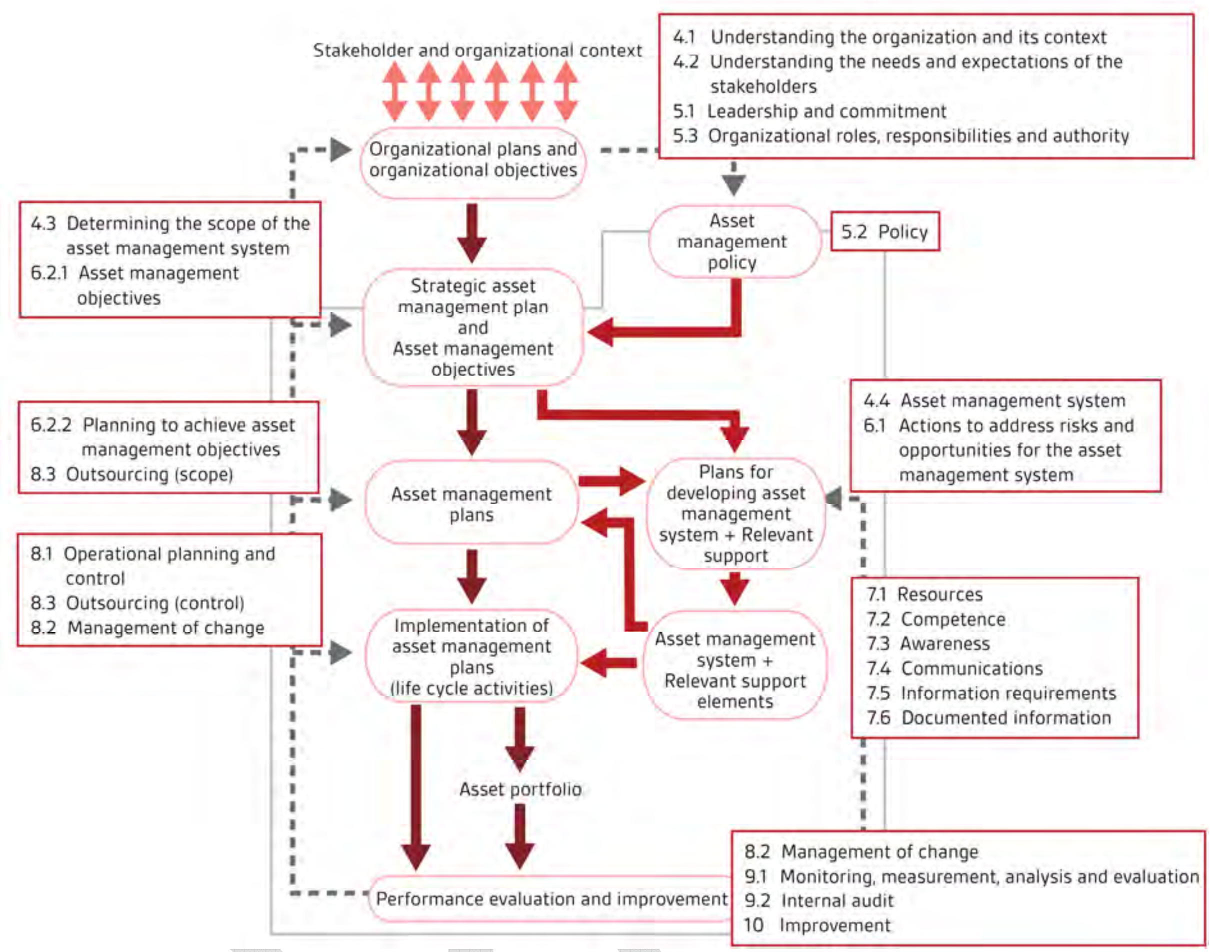


Figure 67 The new international standard for asset management – Transition Guide (Source: Moving from PAS 55 to BS ISO 55001)

Asset Management includes the Full Life Cycle Management of assets which encompasses the various elements in the total value chain. These elements are acquisition, commissioning, operations, maintenance, upgrades/refurbishment and disposal. It requires good engineering principles with sound business/economic practices to make informed decisions. It further requires integration of external factors and all decisions and activities relating to Asset Management with regards to the operation of the network, including train path capacity planning and timetabling. Figure 68 shows a typical Full Life Cycle Asset Management Model.

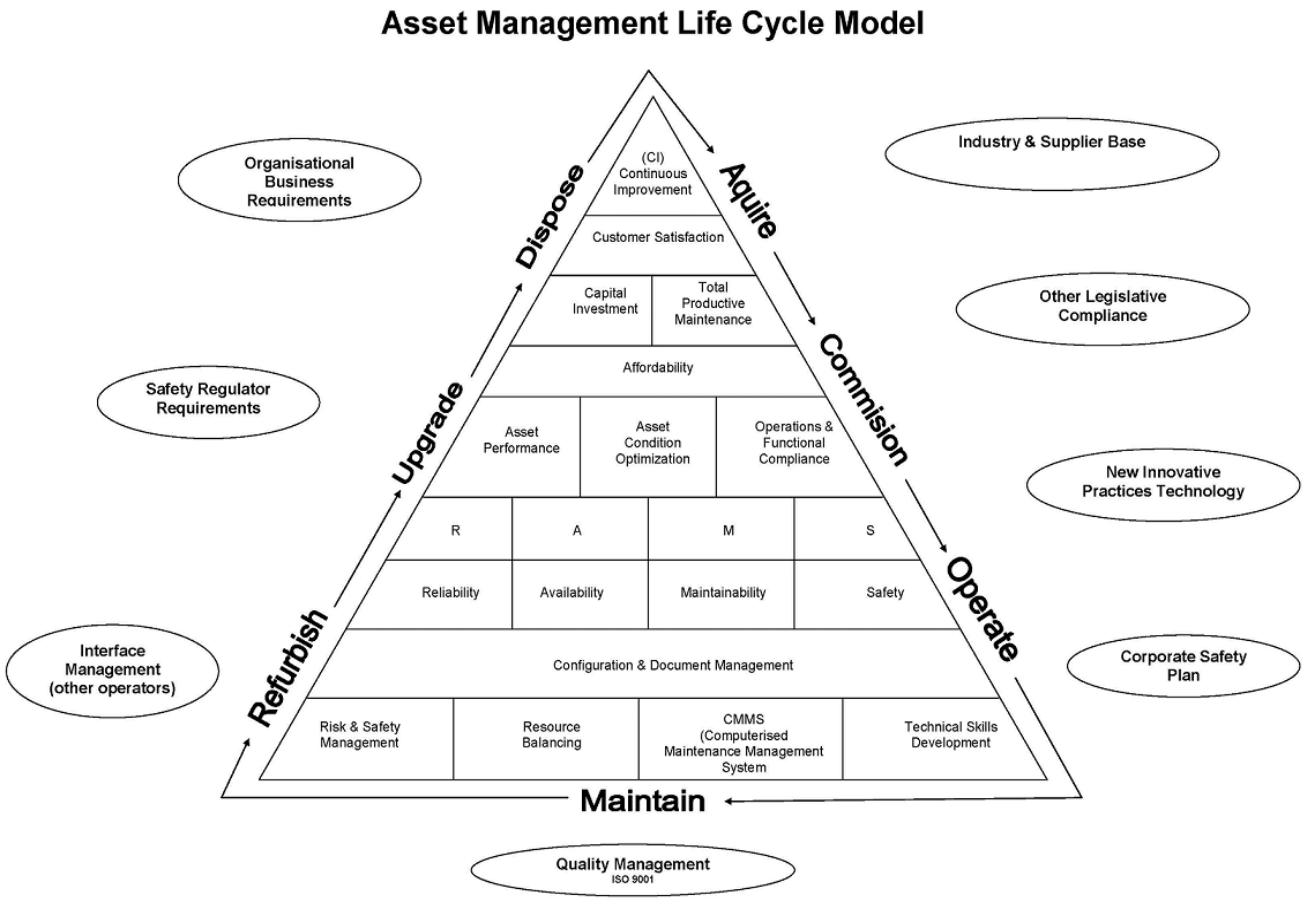
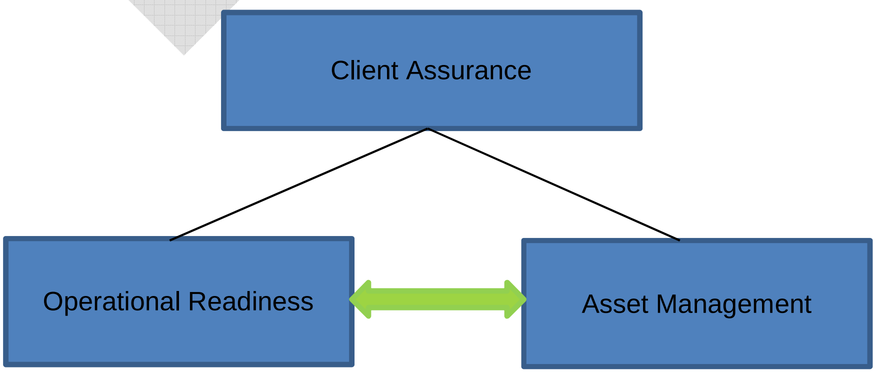


Figure 68 Typical Full Life Cycle Asset Management Model

The essence of asset management is:

- Determine the need for infrastructure and other assets, considering the client/customer and industry demands
- Provision of the asset, plus the management of maintenance and refurbishment to satisfy ongoing and changing needs
- Ongoing effective operation of the asset
- Disposal of life expired assets when the functionality of the asset is no longer required

13.3 What is operational readiness



Transition from project execution into operations has been highlighted as an area where the risk of high value leakage occurring is high. This is generally due to the lack of “operationalising” the project resulting in some aspects of the operation not being in place at this critical transition period.

Operational preparedness typically does not receive the same amount of attention as the other phases of the project lifecycle. The lack of operational readiness is likely to result in costly delays in ramping up the operation to the planned capacity and thus not achieving the planned project NPV. Figure 69 below shows the consequential impact on the planned NPV of a project when delays and operational shortages are experienced due to a failure of not being ready for the critical phases of a project.

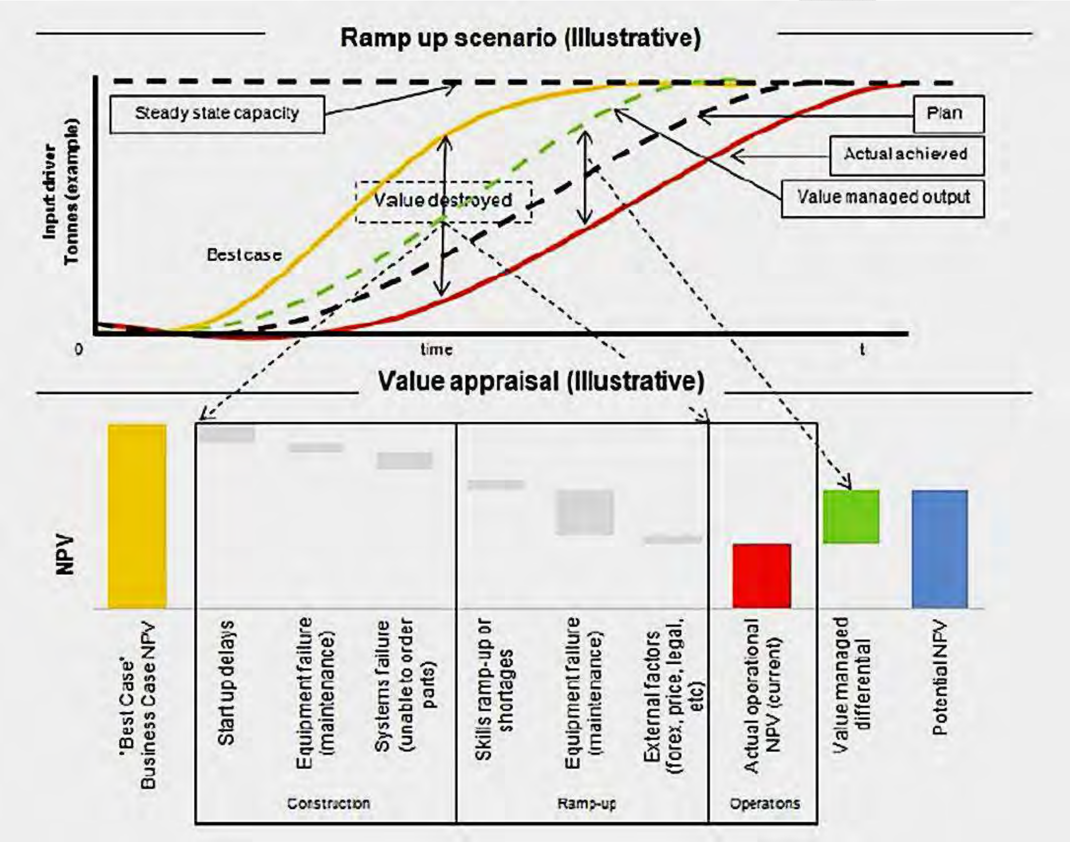


Figure 69 Illustrative Impact on NPV due to lack of Readiness

Operation readiness is the structured approach and process, integrated into the project plant, to ensure that all aspects of the operations are in place and truly ready for safe, reliable operation at the planned ramp up rate.

The operational readiness process typically covers the following aspects of the operation:

- Asset Management & maintenance readiness
- Operational readiness
- Systems readiness
- Organisational readiness
- Supply chain readiness

This process is to prevent that on handover to the operations team, to discover that something has been omitted or overlooked which would subsequently prevent operation of the asset in an efficient manner.

The word 'assurance' refers to the act of reassuring both the Botswana and Namibian governments that their asset and organisation is in a state of operations readiness, or providing a measure of assurance that it will be by the time commissioning and handover takes place.

See section 13.7 below.

13.4 Asset Management strategy

The TKR must develop an Asset Management Strategy document which indicates the organisation's overall approach to managing the physical assets. The strategy document is not a standalone document but is derived from the organisations Business Plan and Asset Management Policy document.

The Business Plan is the high order document providing strategic guidance and direction to the business. TKR will set out various business and operational requirements and high level achievements to satisfy the various government entities, regulators, stakeholders, private partners and clients.

The Asset Management Policy is a high level management document that provides a vision for the Rail business and a framework setting out principles and general requirements for the AM function as mandated by the Business Plan. Its purpose would be to connect TKR's strategic goals and mission to the rationale of the AM strategic framework and the actions being taken to manage its rail assets.

The Policy would include items such as;

- High level client requirements for the railway
- Compliance with relevant mandatory legislation
- Demand growth & impact on coal haulage and freight operations
- Funding levels and long term business sustainability
- Rail capacity and access regime
- Operational and control requirements and performance
- High level budgets and timelines
- Rail infrastructure requirements
- High level targets to be achieved
- Rail network condition & performance

The link between the AM Policy and the methods and requirements of “operating” the AM system is provided by the AM Strategy which describes how the AM Policy will be implemented. The **AM Strategy** will turn the general requirements of the AM Policy into more specific objectives and will contain statements or direction on:

- Stakeholders in the Asset Management function
- Direction on what is specifically required and the procedures that will be supported by the organisation
- Life Cycle Management requirement for assets
- Risk management and assessment
- Asset Management performance criteria (costs & sustainability)
- Methodologies and approaches to key Asset Management processes (etc. inspection & maintenance regime,)
- Responsibilities and medium to long range schedules
- Defined Asset Management Objectives
- Criteria for Asset Management Plans
- Timeframes for implementation of the strategy

This AM Strategy document must receive full support from the TKR management. It is a document that will apply over a long range time scale relative to any other asset plans. It must, therefore, be formally reviewed at regular intervals to ensure its effectiveness and its currency with respect to associated management policies, strategies and plans.

As a planning document the Strategy should contain details of **Implementation Plans** for various elements of the AM system. The following section provides a brief description of the elements to be covered in the AM Strategy.

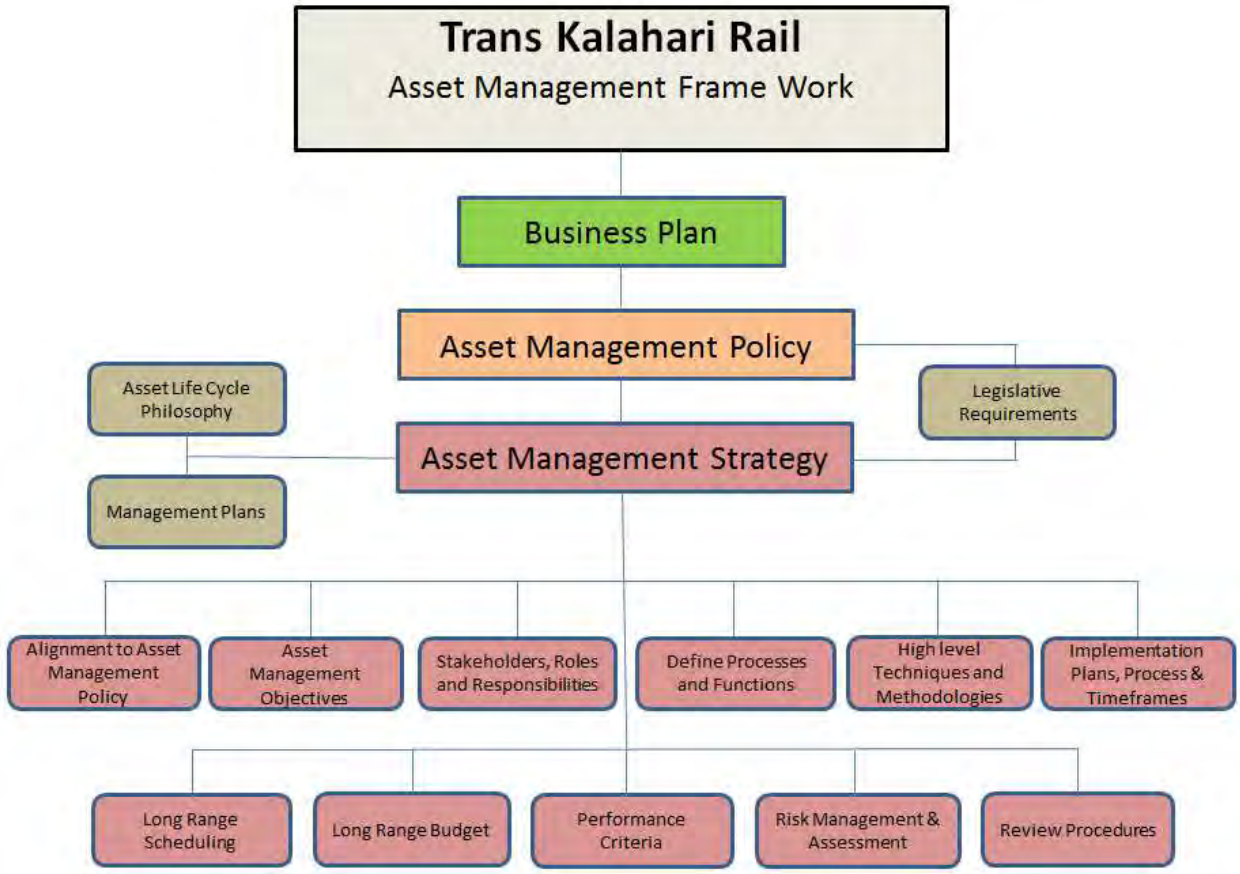


Figure 70 Elements of the Asset Management Framework

13.4.1 Alignment of Asset Management to other policies

The AM Strategy must be aligned with the critical points set out in the AM Policy document. An outcome of this process should be a documented framework for the Strategy which is to be followed throughout its development. The AM Policy must be representative of other corporate rail entities' policies and plans. The same alignment process must be undertaken with other organisational policies and plans to ensure that there are no impacts upon the AM Strategy.

These may include, but not be restricted to:

- Safety, Health and Environmental policies and procedures
- Legal and statutory obligations
- Financial/cost management systems
- Human resources procedures and systems
- IT systems
- Capital management programs
- Risk management systems
- Quality Assurance systems
- Operational procedures and systems

The aim of this exercise is to identify areas of alignment and interface and to expand or modify the intended AM Strategy framework. This is to ensure that alignment is achieved as effectively and efficiently as possible.

13.4.2 Asset Management objectives

The core drive for the AM Strategy must be the development of the AM Objectives. These objectives will be derived from the AM Policy and will be a clear point of focus for the Strategy. They will serve as indicators of the success of the Strategy.

AM Objectives should be kept to a manageable number as it is important that they be monitored, reported on and corrective action taken if they are not met. They will be formulated to be:

- Specific
- Measurable
- Achievable
- Relevant
- Time-based

In this respect is it also necessary to ensure that the data required to measure progress or performance against the AM Objectives can be readily sourced.

13.4.3 Stakeholders, roles and responsibilities

A number of stakeholders of the AM System will exist within the TKR organisation. The stakeholders may be individuals or groups and will be either in a position of being affected by asset management or be one of executing various aspects of asset management.

In determining who these stakeholders are, it is imperative that their expectations, commitments, roles and responsibilities are fully understood and recorded so that their engagement with the system can be adequately managed.

13.4.4 Processes and functions

The processes and functions within the AM System must be focused on the Whole of Life Asset & Infrastructure Management (WOL AIM) System. The WOL AIM model must be aligned with TKR's specific requirements. Since the TKR will be a new system it may be necessary to pre-define the processes and functions.

13.4.5 High level techniques and methodologies

The AM Strategy will contain broad descriptions of the techniques and methodologies required to implement the various elements of the AM System.

Depending on the rail system element concerned the technique/methodology would need to be a fully customised solution, or it could be a proven process used widely in the asset management throughout the rail industry. Example of this would be using Reliable Centred Maintenance (RCM) or Preventative Maintenance (PM) to undertake maintenance strategy development.

The detailed description of these methodologies will be left to develop standard procedures, which are not part of the AM Strategy document but will be developed in the Management Plans in section 0 below.

13.4.6 Implementation, processes and timeframes

Implementation Plans will establish processes to be followed to bring the defined AM elements into effective operation. These plans will set out:

- The steps to be carried out
- Personnel responsible for each step
- Documents that will be required (e.g. standard procedures, work instruction, forms, etc)
- Tools (software or hardware) that may be required
- Implementation schedule (timeframes and milestones)
- Ongoing operational requirements

The TKR railway will be a large system with a diverse portfolio of assets and specific element **Implementation Plans** will be developed separately from the AM Strategy within the organisation. The AM Strategy document will make reference to these Implementations Plans prepared for each asset element. Specific skilled personnel will take responsibility for the implementation of these various plans and achieve the required end results. These Implementation Plans will be guided by the **Organisation Management Plans** as shown in section 0 below.

13.4.7 Long range schedule

It would be required to prepare a schedule, preferably in Gantt Chart format, to give a time reference to all aspects of the AM development over a defined period of time. The timeframe will be determined in consultation with all the role players, e.g. asset owner, operator, maintainer etc. This timeframe will extend for a minimum period of one year and with a 5 year plan for strategic planning purposes.

It must be understood that the development of long range schedules such as this may require assumptions to be made about certain aspects of the AM Strategy. These assumptions are best to be made by experienced rail asset personnel and must be recorded so that the Strategy can be validated from time to time.

The tasks included in the schedule will be the higher level activities required to bring about the achievement of the AM Objectives. In many cases it will be necessary to prepare more detailed schedules for specific activities.

It will be important to regularly review the AM Strategy long-range schedule as it will initially be developed based on a number of forecasts and assumptions that can change over extended time periods.

13.4.8 Long range budget

Prepare a budget to identify the costs of implementing the AM Strategy. As with the schedule this budget will be high level. It will cover the same time period, will also be based on a range of assumptions that must be recorded, and will be subject to periodic review and amendment. It is expected that the TKR asset management budget will initially be at a low level, due to the new infrastructure, and increase as the years progress.

13.4.9 Performance criteria

The TKR would need to determine a set of performance criteria for the AM Strategy. These criteria will enable an assessment to be made of the ongoing validity of the AM Strategy, as distinct from the AM Objectives which are more of an indicator of the performance of the AM System. These performance criteria can typically be deployed as "key performance areas" (KPA's).

These KPA's must relate to the output of the rail infrastructure that has an impact directly on customers, funders and other key stakeholders. It further has a consequential service impact on the train frequency and performance, the safety of passengers, workers and members of the public (e.g. level crossings), and the environmental impact.

In general the selected KPA's for measuring and evaluating the performance of the Strategy could include:

- Accuracy of the schedule (target levels and timescales to match performance requirements)
- Accuracy of the budget (maintaining the ultimate capability of the rail system)
- Accuracy of assumptions (continuous analysis and benchmarking to improve accuracy)
- Demonstration of overall AM improvement, progress and continued development
- Measure the overall level of user satisfaction i.e. availability, quality etc.

The TKR's measurement of performance (KPA's) will be a key tool within the overall AM process. When used in conjunction with the "key performance indicators" (KPI's) as developed in the execution plans, it will provide an indispensable aid for ensuring effective and efficient delivery of AM services.

13.4.10 Risk management and assessment

The fundamental aspect of doing business is that all activities involve taking risk. Decisions and plans for renewing, maintaining and operating the railway infrastructure should be robust against uncertainties in assumptions and hazards or other events that may occur. The risk management process should address both strategic and operational risks within a single framework. Operational risk is very important in how it interacts and often drives the AM processes.

Risk management should provide an effective mechanism for identifying threats to asset management objectives, for assessing their impact and for identifying appropriate mitigating measures. The organisation's business risk exposure plays a big role in the development of suitable strategies and procedure to maximise the upside and minimise the downside. It would be beneficial to assess the risks in the initial planning stages of the business operations.

Techniques developed for managing safety risk e.g. the ALARP framework, should be extended and applied to provide an integrated approach covering, for example, train performance, financial risks, environmental impact, critical assets etc.

The application of risk analysis must be done in the context of the impact of the risk management strategies on the AM processes and ultimate profits.

13.4.11 Review procedures

A regular review of the AM Strategy will be required to ensure its ongoing validity. This review will be undertaken at senior management level. It needs to be formally structured so as to monitor and improve the effectiveness of the asset management regime in delivering sustainable infrastructure outputs commensurate to the level of committed funds.

The review will take place at times partway through the nominated strategic timeframe. For the 5 year AM Strategy an annual review would be suitable. For the annual Implementation Plans the reviews must be conducted on a 6 monthly or quarterly basis. The review methodology will set out:

- Review frequency
- Responsibilities
- Describe general processes of review
- Identify potential response strategies

The reviews should look at a number of aspects, including, but not limited to:

- Performance of the AM System against the AM Objectives.
- Performance of the AM Strategy against its defined performance criteria (KPA's) and KPI's.
- Review asset audit results
- Validity of assumptions made
- Benchmark against previous reviews
- Changes to external factors affecting asset management

13.4.12 Legislative requirements

The TKR would need to adopt a legal framework which incorporates legislation from both Botswana and Namibia Governments. Any inconsistencies in the legislation between the two countries must be resolved and agreed at an early stage.

The TKR organisation must be fully aware of these duties imposed under the legal instruments for all of their activities and must ensure its systems and procedures for the physical assets fully comply with the requirements.

Employees of the TKR and participating entities must be fully aware of their responsibilities under the various statutory laws and fulfil these duties so as not to expose the business to any undue risk.

13.4.13 Management plans

Management Plans are required to define the Philosophy of the various elements that are required to build a strong AM foundation in support of and integration with the AM Strategy. It may have high level processes and procedures but the detail is covered in the Implementation Plans. The following Chart indicates the typical Management Plans that TKR would expect to develop and that the AM Strategy will integrate with. It would be up to TKR management to decide if these management plans are merged into one AM Management Plan.

Figure 71 indicates the proposed Management Plans to be developed for the TKRP Project.

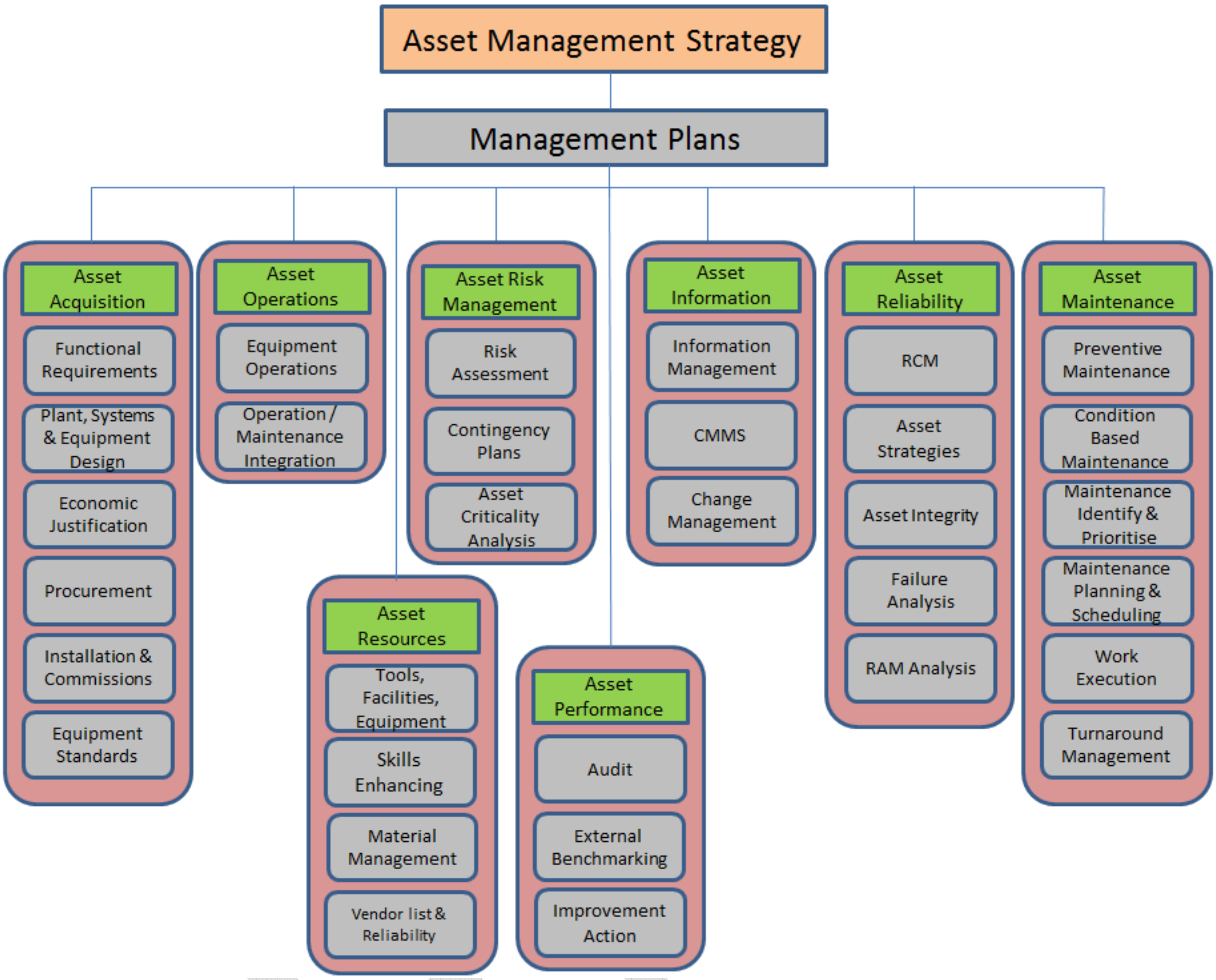


Figure 71: Asset Management Plans

13.4.14 Asset life cycle philosophy

The TKR Rail Asset Management will involve the management of the rail network consisting of diverse assets as indicated below to maintain operational performance and satisfy the end user at the "lowest possible cost" over a long period of time. In order to achieve this, the Full Life Cycle management philosophy must be adopted.

13.4.14.1 Railway asset infrastructure

Based on the planned TKR project the following list of assets are expected to form part of the full asset base:

- Ground area
- Track formation, embankments and capping layer
- Engineering structures: bridges, culverts, viaducts, fauna and other overpasses, tunnels
- At grade Level Crossings and road safety signage etc
- Superstructure, in particular: rails, sleepers, fittings, ballast, points, turnouts and crossings
- Access roads for maintenance staff

- Signalling and telecommunications installations on the open track, in stations and in marshalling yards etc
- Above rail facilities e.g. maintenance and provisioning yards and equipment, office and station buildings, crew & maintenance facilities and related building components
- Rolling Stock – (It must be noted that TKR may select to outsource the maintenance of this asset and other related assets and only manage a performance regime)
- And other

13.4.14.2 Life cycle areas of focus

Some focus areas would be:

- Introduce Maintenance Management Information Systems to enhance decision making in the short and long term.
- Developing a data base by collecting, recording and ongoing analysis of permanent way inventory and condition data
- Use the Information Management tool to confidently over time determine critical deteriorating areas and predict the remaining service life of the major components of the assets
- Establish methodologies for the asset condition, monitoring and reporting
- Develop an understanding of the asset deterioration and trend analysis together with anticipated end of life
- Enhance the decision making process based on cost effectiveness and acceptable risks
- Develop Maintenance Programs and their optimisation
- Develop a priority system for upgrades and capital renewals

These focus areas would be captured in the Management Plans referred to above.

13.5 Business model for rail infrastructure maintenance and investment

Figure 72 provides an overview of a typical Business Model of a Rail Entity depicting some of the Asset Management principles:

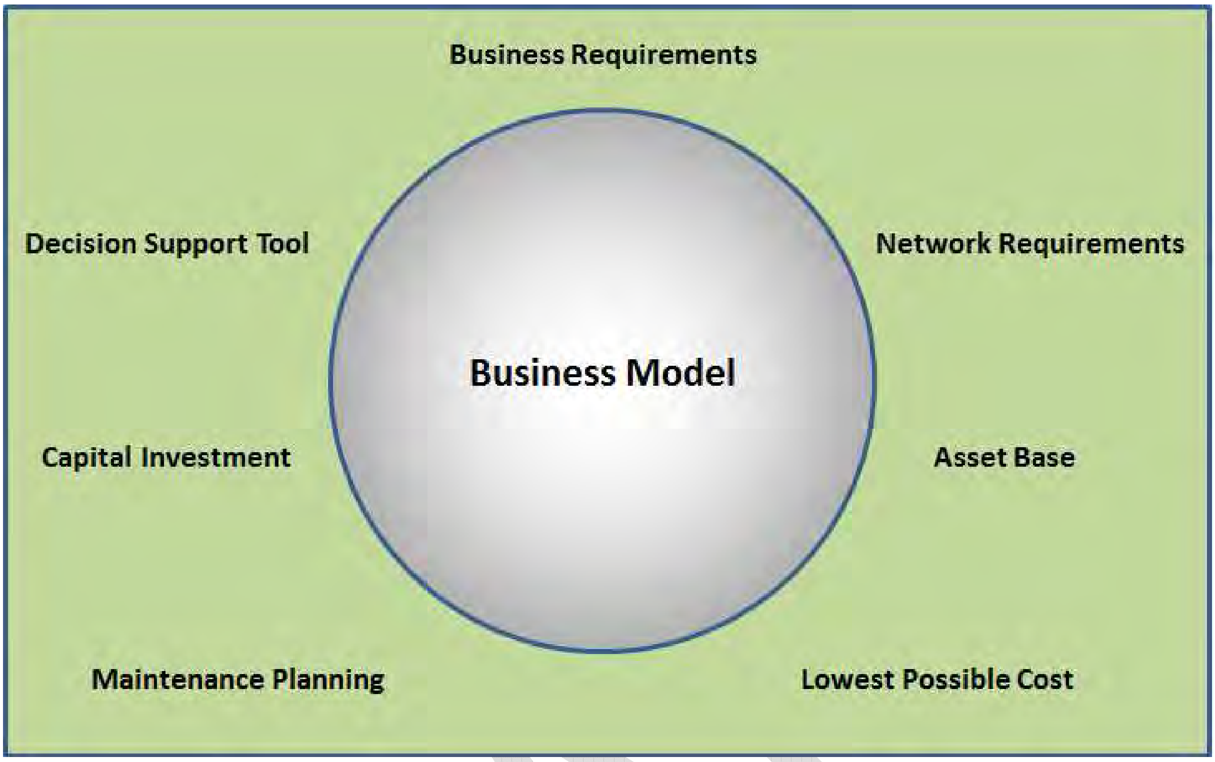


Figure 72 Business Model

13.5.1 Business requirements

The TKR will be providing access to the tracks for the haulage of coal and consideration must be given to:

- Customer/Clients needs and demands
- Efficiency of the service provided i.e.: predictability, frequency and on time service etc.
- Profitability of the service

13.5.2 Network requirements

Network requirements are driven by operational requirements.

- Corridor Characteristics
- Capacity Needs
  - Slots
  - Axle Loads
  - Tonnage
  - Service frequency
  - Headways
  - Line Speed

13.5.3 Asset base (Inventory)

The asset base typically consists of rail Infrastructure as indicated in section 13.4.14.1 above. It would be advisable to capture all rail assets with a spatial reference into the adopted Asset Management Information System / Computerised Maintenance Management System (CMMS) form the start. This asset inventory will be the register used for all future asset condition assessment inspections, asset maintenance, repairs & renewals etc.

13.5.4 Lowest possible cost

The Asset Life Cycle Philosophy is ultimately to ensure an AM system at the "lowest possible cost". This can be achieved by having an optimum balance of various business related factors and could result in a trade-off between the various elements such as:

- Cost vs Risk vs Safety
- Network Capacity vs Operational Efficiency vs Customer Demand Satisfaction
- Asset Replacement vs Recurring Maintenance
- Standards vs Asset Condition vs Functionality

The above balancing factors will be a focus area for the TKR business partners. There must be recognition that TKR may introduce innovative opportunities and best practices of rail asset management during operations while being cognitive of its client's business environment and build a support function around this understanding.

Some of the main steps towards best practice are:

- To pursue the full extent of Rail Asset Management in the long run but with initial focus on specific rail assets and related components in the short run.
- To commence the Asset Management function on the new Track related assets.
- To optimise its Asset Management regime and to minimising asset related costs over its life.

13.5.5 Maintenance planning

The TKR may adopt a different philosophy/strategy with respect to their maintenance regime however; Preventative Maintenance is a proven process in the rail industry and is one of the strategies which are discussed below:

13.5.5.1 Corrective Preventative Maintenance Activities

Methods of addressing this approach on the "permanent way" are by applying the following:

- Machine Repairs:
  - Ballast Tampers
  - Stabilizers
  - Ballast Screening
  - Rail Grinding
  - Sleeper Changing
  - Set Replacements

- Manual Repairs:
  - Minor Breakdown repairs
  - Day to Day Repairs
  - Traditional Work Teams
  - Hi-Rail Working
- Track maintenance
- Welding
- Signalling
- And other

The functional capability of the asset will be improved by applying the above approach.

13.5.5.2 Routine Preventative Maintenance Activities

Methods of addressing this approach on the "permanent way" are by applying the following:

- Physical Inspections by rail staff on the tracks:
  - Fault detection
- Measuring Cars which provide a wide range of data on:
  - Track Parameters
  - Rail profile
  - Track geometry
- Ultrasonic measuring Cars eg: rail flow detection
- Ground penetrating Radar measurement for ballast condition, water penetration in the formation etc.
- Strain gauges
- Stress measurements
- Cyclic/Routine maintenance:
  - Scheduling
  - Works orders
  - Productivity
  - Unit Costs

The information provides:

- Detail and location of faults
- Verification of the assets
- Benchmarking data for comparing similar asset groups in different areas along the corridor.

13.5.6 Capital investment

Investment is required to improve the Structural and Functional capability of the Assets. Due to the newly installed TKR assets the capital investment in the initial years will be very low.

The TKR as the asset owner will have a daunting task in the later years to determine when the asset has come to the end of its life and based on available information on the condition, performance and the cost of maintaining the asset a decision would need to be made to execute one of the following:

- Refurbishment
- Upgrade
- Replacement

The process to achieve this would be to follow the normal Project Management process as following:

- Prioritisation
- Motivation and feasibility
- Fund allocation
- Specification
- Procurement
- Contracting
- Monitoring
- Commissioning

The above would be continuously checked against the Business and Network Requirements as indicated above.

The TKR must be diligent in providing adequate levels of funding for maintenance and capital investment as well as ensure the optimisation and prioritisation of the above. It will be daunting challenge to ensure that best value for money is achieved.

Some of the main steps towards achieving this are:

- Developing deterioration models for critical asset i.e. rail, ballast, formation, capping etc. for different scenarios such as changes in train volumes (million gross ton), frequencies, line speeds, increases in axle loads, etc.
- The ability to demonstrate future maintenance actions and capital budgets required to maintain the rail network to a satisfactory level of performance and customer satisfaction
- Conducting performance measurement and benchmarking

13.5.7 Decision support tool

All Rail entities worldwide have developed or acquired Asset Management Information Systems (AMIS) or also known as the Computerised Maintenance Management System (CMMS) for their infrastructure maintenance management activities. TKR would need to acquire such a CMMS which would serve as a Decision Support Tool that will provide condition data in a user friendly format to allow enhanced asset decision making.

13.5.7.1 The system

The System must consist of a linear viewer of rail-based infrastructure asset information which can be integrated with TKR's current system such as the SAP PM R/3 system. The CMMS will enhance the availability of work-related information and integrate with on track measuring cars. The main objectives of the Decision Support Tool are to provide information that is complete, updated, and valid and in the required format in order to:

- Ensure that assets are at an appropriate service level within a required level of reliability
- Ensure economic and productive maintenance input
- Minimise disruptions of train operations as a result of less and more effective maintenance work
- Ensure increased availability of assets to increase transport capacity
- Ensure that maintenance service is rendered in a safe and responsible manner

The main component of the system must be the database. The database must be a powerful relational database that will integrate assets, work history, and condition data based on location referencing information. The features built into the system must be as follows:

- Importing of infrastructure asset inventory data, condition information and work history data from existing databases or manually through a manual asset-capturing tool. This data is imported into the main database
- Import information from Geometry Condition Measurement & Ultrasonic Condition Measurement vehicles and Ground Penetrating Radar Surveys.
- Asset matching tool to integrate asset information from the various sources into a relational database referenced by asset location
- Displaying of infrastructure data in a graphical view with condition, maintenance and operational information relating to the infrastructure asset
- Efficient and user-definable reporting on asset information
- Exporting of asset information in a user-definable format for analysis purposes

13.5.7.2 Input components

13.5.7.2.1 Asset inventory data import

The function of this import is to populate the database which will serve as the reference for all other imported data. An example of this type of asset inventory database would be created during a Fast Laser Imaging Mobile Airborne Platform (i.e. FLIMAP) aerial survey.

13.5.7.2.2 Work data import

Previous and ongoing maintenance activity as it relates to each asset is critical information to consider when planning and budgeting. The work data import facilitates the incorporation of maintenance activities into the database. The system allows for customising the imports from various existing systems such as SAP.

13.5.7.2.3 Condition information import

Condition data consists of automated measurements and visual evaluation inspections as well as in-service failures. Automated measurements consist of continuous and spot measurements generally using sophisticated measuring devices mounted on vehicles. Examples of this type of data are track geometry measurements, rail profile and wear measurements and ultrasonic defect measurements.

These condition measurement vehicles are equipped with high-tech measuring devices like GPS and laser, and record the geometry condition of the track and rail profile and wear at a speed of 90 km/hr. The Ultrasonic Measuring Vehicle detects rail flaws using ultrasound.

13.5.7.2.4 Manual asset capturing tool

Manual editing or adding of assets to the main database is provided for in the manual asset-capturing tool. This tool can be used for infrastructure that is not captured with automated surveying tools or for new assets added to the railway system.

13.5.7.3 Output components

13.5.7.3.1 Viewer

The viewer function must be the main interface of the system with menus and submenus as well as various sub-interfaces. It is to provide the ability to select and view inventory, condition and maintenance data related to the relevant railway infrastructure asset in an integrated, graphical manner.

13.5.7.3.2 Reporting tool

The system is to provide an extremely powerful reporting system characterized by the ability to allow users to create and store any number of reports and display these in tabular form, as a number of different graph types, or using GIS location coordinates. The system is to be implemented initially with a number of predefined reports created as required by the asset owner. However these can be edited and new reports created by the user, either directly using Structured Query Language (SQL) commands or through an included report creation wizard.

13.5.7.4 Export of information for analysis

The asset information export tool must allow users to select predefined export data formats to export. The user must be able to select fields to export in general recognised formats to be used in other software programs (e.g. spreadsheets). The export tool must also allow users to customize the set of predefined export formats.

13.6 Maintenance considerations during operations

It must be recognised by the TKR that the Asset Management Policy as described in this chapter is an intrinsic element of any rail system, with potential impact on system availability, capacity, capital and operating costs. In addition to this the below rail maintenance plan must be well defined to support the ultimate achievement of the Asset Management Strategy. It is further assumed that the above rail maintenance would most likely be outsourced to a supplier/operator on a Build Own Operate and Maintain (BOOM) basis.

The following criteria would be applicable for the TKR operational phase:

- The primary objective of the maintenance strategy is safety with secondary objectives of cost effectiveness, high reliability and high availability of the rail infrastructure.
- Co-ordination and integration of both SMS's for Above and Below Rail Operators.

- Maintenance Depots should ideally be located close to existing towns with easy access and generally not further apart than 150km to 200km.
- Maximum train speeds are ±80kph (loaded and empty)
- Maximum axle loads are 26.5t for Cape gauge and 32.5t for Standard gauge
- Maximum planned capacity will be ±65Mtpa; future expansion to be allowed for
- Gross tonne kilometres (gtk) to be established to guide maintenance effort and frequencies

It is anticipated that corrective maintenance requirements in the early years of the TKR project (e.g. first five years) will be minimal; however the asset performance characteristics will need to be recorded through an effective maintenance inspection regime to enable trends to be established and projected and thereby justify any changes to the routine maintenance inspection standards adopted. To this extent, it is recommended that a suitable maintenance standard be initially implemented and be amended or "tailored" to safely and reliably accommodate the asset performance requirements for the ongoing operation.

Despite expecting corrective maintenance works to be minimal in the initial years, it is likely that bedding in/teething issues will need attention in the early stages and minor corrective works such as tamping or rail stress adjustment works will be likely around the mine loading and port unloading areas as well as the turnouts in these areas and passing loops.

It is anticipated that this initial period will also identify any areas where inspection or remedial works may be required as a result of climatic conditions such as heavy rains, strong winds (in the case of sand blowing onto the track) or high variances in rail temperature.

Availability requirements for the infrastructure should be targeted and calculated based on a Reliability, Availability, Maintenance & Safety (RAMS) assessment founded on the specified assets, the maintenance regime and the operational and safety parameters within which the operation needs to operate. It is expected that shutdowns for the mine, port and rail system will be able to be co-ordinated to provide a high level of utilisation from each system.

From a maintenance strategy perspective, recording the track geometry on a frequent basis is essential. This information needs to be supported by track side detection equipment and maintenance inspections to generate trends and project the maintenance intervention requirements to produce the required operational outcomes.

13.6.1 Planned maintenance activities

The key maintenance activities would require frequency and a planned delivery method. Inspections must be conducted from the start of operations to prevent any build-up of potential repair work.

Corrective maintenance activities would, in the case of a new rail line such as the TKR, generally not be required in the early years of the project. Some activities such as re-railing may only be required in year 20 or longer being subject to the gross ton per annum run over the rails.

The activities are not limited to those listed in Table 40 below:

Table 40 Planned Maintenance Activities

Activity Type	Activity Description
TRACK AND CORRIDOR INSPECTIONS	
Track Inspections (Track Patrol)	Inspection to detect potential problems and defects, includes looking for damaged, cracked or broken rails, missing fastenings, track obstructions, drainage issues or potential slips or washaways

Activity Type	Activity Description
Culvert Inspections	Reinforced Concrete Pipe: inspection of RCP's is mainly looking for blockages and obvious damage. Corrugated Metal Pipe Inspection: inspection CMP's and where possible the use of a pressure cleaner to clean out and fully inspect the pipes. This would mean ensuring that the sites are accessible to a 4WD vehicle with water tank and pressure cleaning gear.
Front Of Train Examination	Front of train with train driver. Inspection to note any track issues impacting train operations and interface with train driver on any infrastructure issues
Track Geometry Recording	Track geometry recording via equipment fitted to in service mainline locomotives as a base operation, supported by localised examination via a trolley system towed by or equipment fitted to a hi-rail vehicle. Recordings to be reviewed and assessed by track inspections staff to ensure track is maintained within geometry tolerances for top, line, twist, gauge.
Extreme Weather Patrol (Extreme Hot Weather; Sand storms, Heavy Rain)	Inspection as a result of inclement weather with the potential to cause unsafe conditions for the track.
Detailed Walking Examination	This inspection is general an industry standard requirement. Walking inspection of high risk areas only. It is specified to inspect and note any infrastructure or corridor issues that require attention.
Track Clearances	Inspection to monitor track clearance issues.
WTSA (Welded Track Stability Analysis)	The process is detailed with measuring and recording of alignment and rail 'creep' at 500 metre intervals, assessment for ballast deficiencies, any rail gap and temperature recordings, recent 'disturbance' scrutiny, pumping track and erratic geometry.
Track Centres (for passing loop areas)	Monitor track centres in dual or multiple track areas.
Ultrasonic Rail Examination	Inspection to check for any defects in the rail, welds and turnouts. Defects generated by rail steel metallurgical properties and fatigue. Generally a stop/start activity and operated within a track possession.
Ultrasonic Rail & weld Testing (e.g. Krautkramer)	Test all rails for internal rail defects and for acceptance testing of rail welds and weld repairs.
Rail Wear Examination	Included as a minor entry as this applies to known wear locations, mainly heavier tonnage sharp curve track terrain.
Insulated Joint Examination	Examination of GIJ (Glued Insulated Joints)
Rail Lubricators	Inspect operation of any rail lubricators.
Detailed Turnout Examination	Visual inspection and measurement of turnouts.
Drainage Inspection – Surface Drainage, Pipe & Sump	Inspection of drainage systems noting any issues for remedial work.
Earthworks Inspection (Cutting and Embankment visual)	Visual inspection with spot walking (eg for "top" drain access) using hi-rail at low speeds.
Geotechnical Risk Sites	Inspection of any known sensitive locations and topography.
Level Crossing Examination (track and roadway)	Inspection of each level crossing. Utilise hi-rail vehicle with stops at site and close visual for track geometry, level crossing structure and overall condition, flange-ways and any fastenings, road surface and approaches, drainage, sighting distances and signage

Activity Type	Activity Description
Structures Inspections (Concrete and Steel)	Inspection of the integrity and performance of Civil Structures. Noting any defects and remedial maintenance activities
Right Of Way	A low speed visual inspection
Speed Boards	Hi Rail annual inspection which supplements front of train observations which are done at say monthly intervals.
CORRECTIVE & CYCLIC MAINTENANCE ACTIVITIES	
Corrective Track Maintenance	Repair to minor track geometry defects, lopping fowling trees, washaways etc
Resurfacing(tamping and regulating)	To repair out of tolerance track geometry
Rail Grinding	To maintain correct rail profile and prevent corrugation, gauge cracking etc
Re-railing	To replace life expired rail
Ballast Replacement	Ballast replacement would be used in lieu of ballast cleaning as it is potentially a quicker operation and likely to lead to less down time. Washaways are generally only a problem in flat areas where overland flows are unpredictable, in hilly areas the watercourses are well defined and any problem would be likely to take out the embankment as well as the ballast.
Reconditioning formation	Repair failed formation due to excessive mud spots poor drainage etc
Spot Sleeper Replacement	Replace life expired sleepers due to age, derailments etc Major face replacement of concrete sleepers is unlikely to be required. Small patches may need to be replaced at mud spots or large ones at derailments, but in general start to look at spot replacements after about 15-20 years to avoid the need for mass replacements and lengthy shutdowns.
Emergency response	Callouts due to broken rails, points failure, signal failure, washaways etc
Remote weed control	Annual spraying of weeds to prevent overgrowth and fouling of ballast

13.6.2 Major rail maintenance equipment and vehicles

Assuming an owner / operator maintenance regime is the preferred maintenance delivery strategy to be adopted, a significant investment in rail maintenance equipment will be required as some specialised equipment will need to be acquired. The acquisition process associated with this equipment is typically characterised by long lead times, hence the need to proceed with the acquisition process during the construction phase.

It is not recommended that the TKR acquire highly specialised equipment which may have low levels of utilisation. By way of example large rail grinding machines (e.g. 36 or 48 stone rail profile grinders) are expensive machines and require high levels of skill and experience to operate effectively and deliver quality outcomes. It is anticipated that these machines may only be required for 30 to 40 shifts per year which would be insufficient for operators to maintain their skill levels for this operation. As a result, this particular operation is generally better suited to be outsourced. Similarly, it is suggested that ultrasonic testing is conducted by a specialised contractor.

It is further advised that the resurfacing should be undertaken at optimum intervals and not deferred unnecessary. This will ensure that minor track alignment defects are not allowed to develop and cause major geometry issues or damage to the underlying substructure. Therefore, it is suggested that TKR consider acquiring a tamper and regulator and have an in-house mechanical team. The tamper must be capable of handling both mainline and turnout tamping, thus a Plasser 4S (or similar) could be considered.

Should road access constraints for the greenfield corridor be a problem, then TKR may consider that a rake of flat top wagons and a rake of ballast wagons be acquired to allow rail access for the movement of maintenance materials and equipment. The haulage of these wagons could be contracted on an as needed basis to the TKR Above Rail operator.

Consideration to be given to acquiring the following equipment for each of the track gangs:

- Hi-rail excavator (fitted with tamping head and 360 degree sleeper grab)
- Hi-rail gang truck (9 tonne)
- Hi-rail flatbed truck (fitted with a hi-ab crane) and road trailer
- Hi-rail inspection vehicle fitted with track geometry recording equipment

In addition, say two flash butt welders (FBW) will be kept at the maintenance depots, one in Namibia and one in Botswana and made available to each crew as required. Should only one FBW be adequate then a central depot location should be selected where it can be stored. All rail bound maintenance equipment and hi-rails will need to be fitted out according to the signalling system adopted. It has been assumed that this will be an in-cab system.

Track Geometry Recording Equipment (for the measurement of twist, top, line, gauge and others as specified) should be fitted to both the specialised hi-rail inspection vehicles and a mainline locomotive. A locomotive will do the measurements during every completed cycle thus allowing for measurements on at least a 48 hour basis. To ensure constant coverage a second locomotive could also be equipped. On-vehicle measurement provides a steady stream of information for planning and reduces the demand on the maintenance team, thus ensuring maintenance is planned rather than reactive.

In addition to the crew vehicles, a pool of four wheel drive (4WD) road based vehicles need to be provided for the superintendents and the asset management staff.

13.6.3 Infrastructure Asset Protection Equipment

To aid in the protection of the track infrastructure and rolling stock TKR would need to ensure that a variety of track side detection/measurement equipment is designed into the infrastructure and installed during the construction phase. This would be subject to discussions and agreement with the successful above rail BOOM contractor.

A brief list of the type of equipment to be contemplated includes as a minimum the following:

- Impact detectors – these detect any flat wheels on rolling stock allowing management of rolling stock wheel condition and minimising damage to both track infrastructure and rolling stock
- Hot box / hot wheel detectors – detect issues with wheels and axle bearings and assist in the management of wheel / axle condition and the management of rolling stock conditions that could cause a failure of the wheel / axle assembly which could result in a derailment of the rolling stock. Derailment of trains caused by wheel bearing faults is a significant issue in the rail transport industry. A considerable number of derailments and train stoppages annually around the world are due to actual and potential overheated bearings. Trains consist of multiple wagons containing a large number of bearings. The failure of just one bearing poses a significant safety risk.
- In addition to hot box detectors, acoustic monitoring systems should be used which have been proven as better at predicting bearing failures.
- In motion weigh bridges - to detect abnormal load distribution or over loading conditions existing within the rolling stock

- Broken Rail Detectors: these detect broken rails in the system by sending electrical or acoustic signals from transmitters to receivers at regular intervals. If the receiver fails to detect the signal it sends an alarm. Broken rails are the most common source of track failure and derailment.
- Early warning systems – these systems may be utilised to detect ground movements within sensitive geotechnical areas, or alternatively may provide early warnings for a flood event which may impact the rail infrastructure. There may be the opportunity to detect the movement of sand dunes especially in the Namibia where the movement of dunes are a common occurrence. (available technology to be explored)

13.6.4 Infrastructure maintenance structure

The structure below in Figure 73 would be a typical Infrastructure Maintenance structure that TKR may consider to adopt and implement. The resource requirements for each asset need to be established and the number of crew teams and team sizing are critical to cover the designated track kilometres to be maintained. Consideration should be given to the outsourcing of some maintenance activities as mentioned above, which are more infrequent and require a large capital investment i.e. rail grinding.

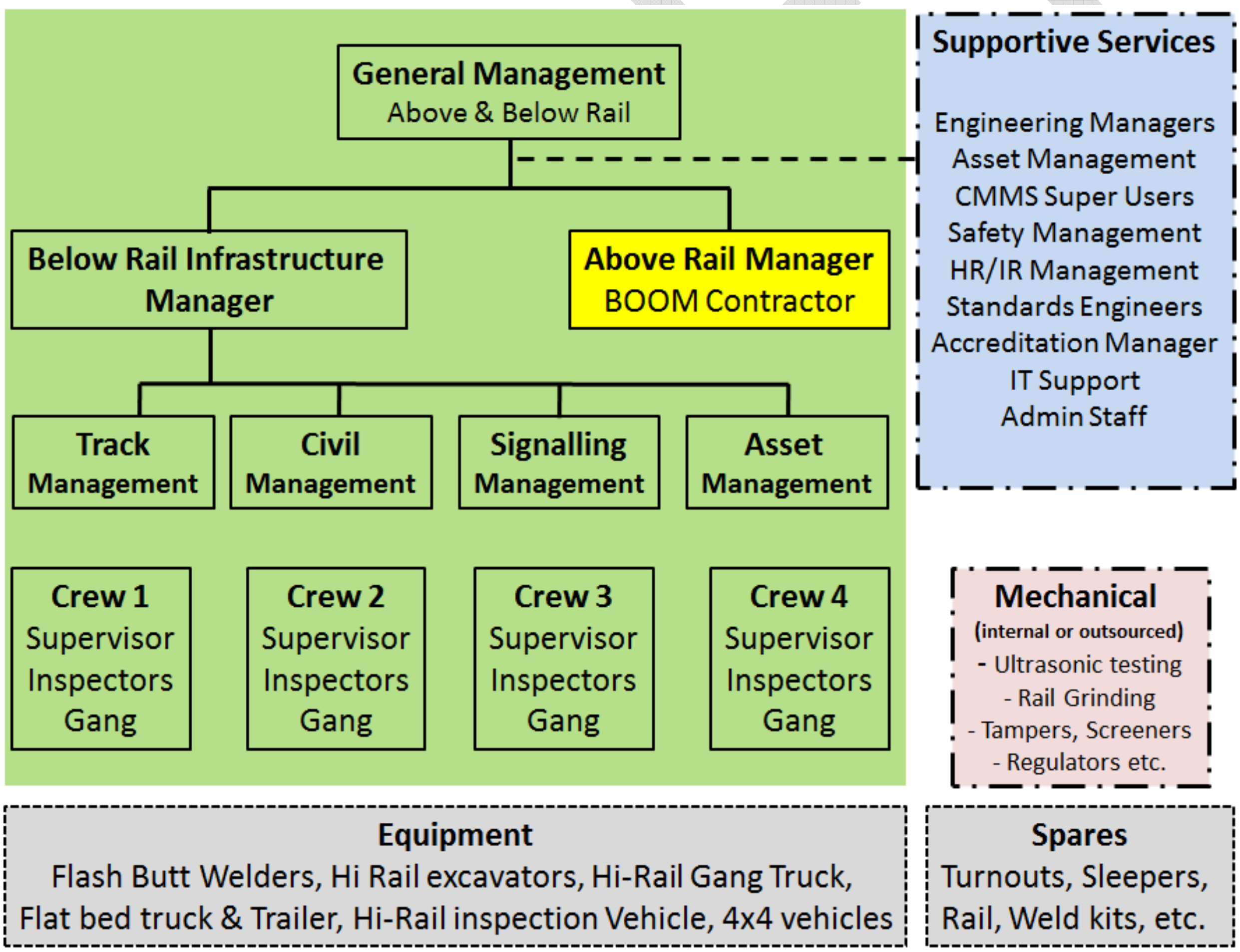


Figure 73 Typical Infrastructure Maintenance Structure

13.7 Operational readiness

The Operational Readiness element as stated above includes activities to support TKR's Operating and Maintenance teams to prepare, in advance, for the time when the TKR project will be completed and commissioned. This would require activities such as, training, maintenance planning, early acquiring of equipment etc. Typical operational readiness activities would be:

- Creation of Asset Management Strategies and Plans to optimise maintenance activity and asset utilisation
- Creation of Maintenance Execution Plans prior to commissioning enabling clear resource profiles to be understood
- Identification and definition of critical assets and implementation of a Failure mode, effects and criticality analysis (FMECA) and creation of related maintenance actions to address these from day 1.
- Accurate creation of the Asset Register in the selected Computerised Maintenance Management System (CMMS) with asset specification information.
- Creation of asset performance monitoring and measurement processes to facilitate benchmarking and performance trending
- Establishment of condition monitoring activities for implementation on day 1
- Inclusion of appropriate condition monitoring equipment into the design to reduce less effective retrofits
- Incorporating operational and maintenance knowledge into the design phase to maximise asset availability and maintainability.
- Creation of asset component selection and design configurations to optimise life cycle costing
- Establish outsourcing of services and develop the work scope specifications and the management thereof.

Operational Readiness and Asset Management is and integrated process which needs to commence during the construction phase. An Operational Readiness plan that is integrated with the Asset Management Plan and the overarching project would be required. This encompasses an operators perspective in defining needs, risk identification, and strategic planning through to the tactical work involved in developing and deploying the procedures, systems and workplace tools required to successfully operate and maintain a new or upgraded assets. It is vital that the operating staff, data, processes and systems are put in place to assist to make this happen.

Operational readiness for the TKR rail project should commence early in the project life cycle as a planning function and will continue until the project is commissioned and handed over for service and becomes operational. For a typical rail project to be accepted as operationally ready it must be ready to operate with:

- All rail infrastructure, buildings, equipment and systems completed and commissioned
- All required documentation completed and approved
- All necessary operational plans and approvals in place
- All operational staff fully trained and certified
- All external works and related projects completed

- All users ready to accept the responsibility for handover and the ongoing operation and maintenance of the new integrated asset

Commissioning and Operational Readiness covers the completion of all activities necessary to enable hand over of the new infrastructure, buildings, equipment and systems to the owner/operator. Commissioning and Operational Readiness are two separate but closely related processes, which will become more intensive towards the completion of the TKR project (or a particular stage/ phase of the project), to ensure the project meets the user requirements and is ready to become operational at handover.

Operational Readiness begins as a planning function early in the project life cycle, as stated above, and continues until the project becomes operational. Completion of operational activities will likely be progressive and may be staged along with project delivery.

The elements of operational readiness can be defined as infrastructure ready, personnel ready and documentation ready.

Some specific areas that would require attention in preparation for Operational Readiness may include:

- Preparing initial Maintenance & Reliability Philosophy Statement
- Provision of General Operability Requirements
- Review Organisational Issues
- Establish Organisation Operations Structure and people requirement
- Development of Maintenance & Reliability Programmes
- Reliability & Maintainability (RAM) Modelling
- Project stage Audits Planning and Execution
- Preliminary Commissioning & Start-up Planning
- Critical Equipment & Systems Identification
- Conduct Strategy Development
- Spare Parts Assessments
- Operations Training & Competency Program Development
- Establishing Contracts and Supply Agreements
- Logistics Planning
- Equipment Specific Training
- Integrated Operations Plans
- Operations & Maintenance Procedure Development
- Safety Management and Pre-start Safety procedures
- Commissioning plan development
- Project Continuous Improvement Lessons Workshops

14 Moving forward

14.1 Staged approach

Development of the project will be effected in stages, with Toll-Gate decision points nominated.

In this way, the project can be staged to deliver at the time when the market is there to support it. As noted previously in the Plan, it has been determined that a critical element in the success of the project is the ability of the rail cargo to pay for the rail and export terminal infrastructure. The present depressed coal prices do not support the investment and hence, as this constitutes the base traffic, it is proposed to “soft-start” the project by undertaking low-cost elements as the market improves to support the project viability.

14.2 Immediate next steps for the TKR (2015)

The following section defines the Immediate Next Steps, those stages which should be effected in the next 12 months of the development of the TKR.

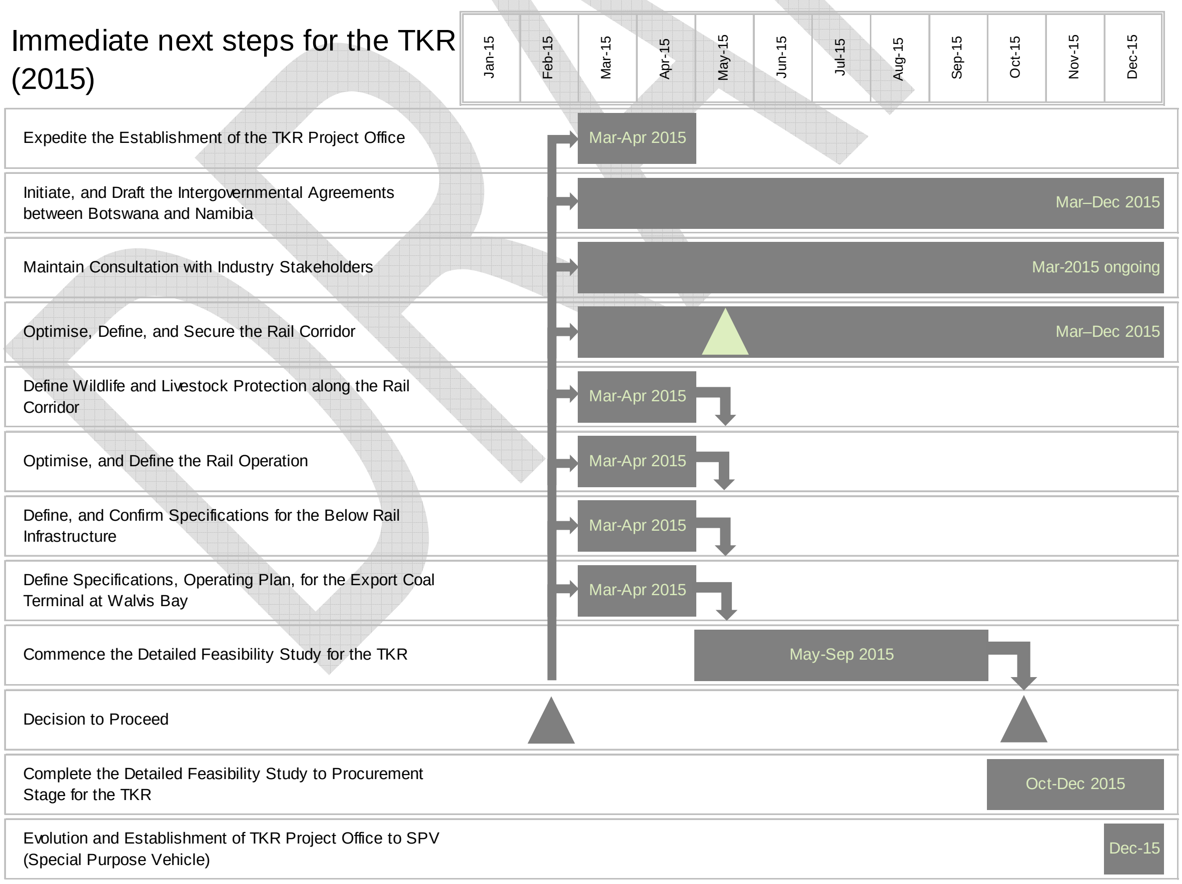
Table 41 Immediate Next Steps

Task	Description	Period
Expedite the Establishment of the TKR Project Office	▪ The TKR Intergovernmental Agreement contemplates the establishment of the TKR Project Office in Namibia. ▪ It is proposed to effect this office as soon as possible with a specific task of tracking and projecting export coal viability (FOB for export Botswana coal utilising the TKR), evaluating and approaching other traffic (manganese, copper, other Namibian minerals, and other rail traffic) so as to improve and build the viability of the TKR.	Mar-Apr 2015
Maintain Consultation with Industry Stakeholders	▪ Consultation with industry stakeholders will be essential to maintain momentum on the project. It is acknowledged that mine developers must have confidence in the ongoing development of the TKR for them to undertake their own Development Plans. ▪ It is proposed to fully brief the Botswana coal industry and other stakeholders in the period commencing March 2015. ▪ A key strategy considered is to host The TKR Industry Conference in March 2015 where the Development Plan can be shared with stakeholders and specific briefings initiated with interested parties and potential investors/users. We propose that regular consultation should be maintained with these stakeholders as the project proceeds.	Mar-2015 ongoing

Task	Description	Period
Optimise, Define, and Secure the Rail Corridor	▪ A key success factor for the project is to define the most economical rail alignment. ▪ It is proposed to undertake a specific alignment study in the period (Mar-Apr 2015) to specify the optimised rail alignment. ▪ In the succeeding months to December 2015, it is proposed to secure the alignment corridor which may/will entail consultation with affected property holders, and purchasing (or taking an option) on freehold properties.	Mar–Dec 2015
Define Wildlife and Livestock Protection along the Rail Corridor	▪ It is proposed to undertake a more detailed assessment of the wildlife and livestock protection along the nominated alignment. ▪ This contemplates a separate study to determine where, and how such protection will be effected. The deliverable from this will be a design specification to be employed in the detailed design.	Mar-Apr 2015
Optimise, and Define the Rail Operation	▪ The Development Plan has revealed that electric traction locomotives might have significant long-term benefits to the Botswana economy arising from reduced reliance on imported diesel fuel. It is proposed to undertake a detailed economic and operational assessment of "electric versus diesel traction option" so as to determine the go-forward design specification. It is acknowledged that an electric traction solution might be attractive to coal miners contemplating development of a mine-mouth power station. ▪ The rail operation will also be defined in terms of a number of other elements including train crewing (whether and where to have crew change facilities, or to consider on-boarding – where the crew stay on the train for the entire journey in on-board crew quarters).	Mar-Apr 2015
Define, and Confirm Specifications for the Below Rail Infrastructure	▪ The Below Rail infrastructure will be defined with respect to Cape (1067mm) versus Standard (1435mm) gauge, TAL (train axle load), ruling grade, maximum speed, Passing Roads versus Passing Loops, etc. ▪ This contemplates a separate study to determine the infrastructure design specifications. The deliverable from this will be a design specification to be employed in the detailed design.	Mar-Apr 2015
Define Specifications, Operating Plan, for the Export Coal Terminal at Walvis Bay	▪ This contemplates a separate study to determine the infrastructure design specifications for the export coal terminal. The deliverable from this will be a concept layout and conceptual operating plan for the Export Coal Terminal. ▪ A significant element of this task will be to effect and maintain consultation with the Walvis Bay developers, WILP.	Mar-Apr 2015
Initiate, and Draft the Intergovernmental Agreements between Botswana and Namibia	▪ The Development Plan has revealed that a suite of intergovernmental agreements must be drafted and executed between the two governments for the TKR to operate as an international integrated export supply chain. ▪ This contemplates a separate study to identify and commence drafting those agreements. We acknowledge that this task could take a considerable time – and we propose that the subsequent agreements might be legislated executed in the succeeding year (2016).	Mar–Dec 2015

Task	Description	Period
Commence the Detailed Feasibility Study for the TKR	▪ With the previous work completed and design specifications agreed, it is proposed to commence Detailed Feasibility Study such that a more detailed costing can be determined, and greater surety on the project. ▪ The outcome of this stage will be a more detailed design and costing sufficient for the Botswana Government to make the decision to proceed or hold.	May-Sep 2015
Decision to Proceed	▪ Proceed or Hold	Oct-2015
Complete the Detailed Feasibility Study for the TKR	▪ Contingent upon the decision to proceed, the design will be further developed to provide a package to put to the market for Expressions of Interest from constructors, suppliers, operators, and users.	Oct-2015 – Jun-2016
Evolution and Establishment of TKR Project Office to SPV (Special Purpose Vehicle)	▪ With the decision to Proceed, the role of the TKR Project Office contemplated in the Intergovernmental Agreement will evolve. ▪ At this stage, it is proposed to vest the Intellectual Property of TKR design into the SPV, and initiate and define shareholding. ▪ Project financing will also be initiated at this stage.	Dec–2015

The above steps are illustrated in Gantt chart below:



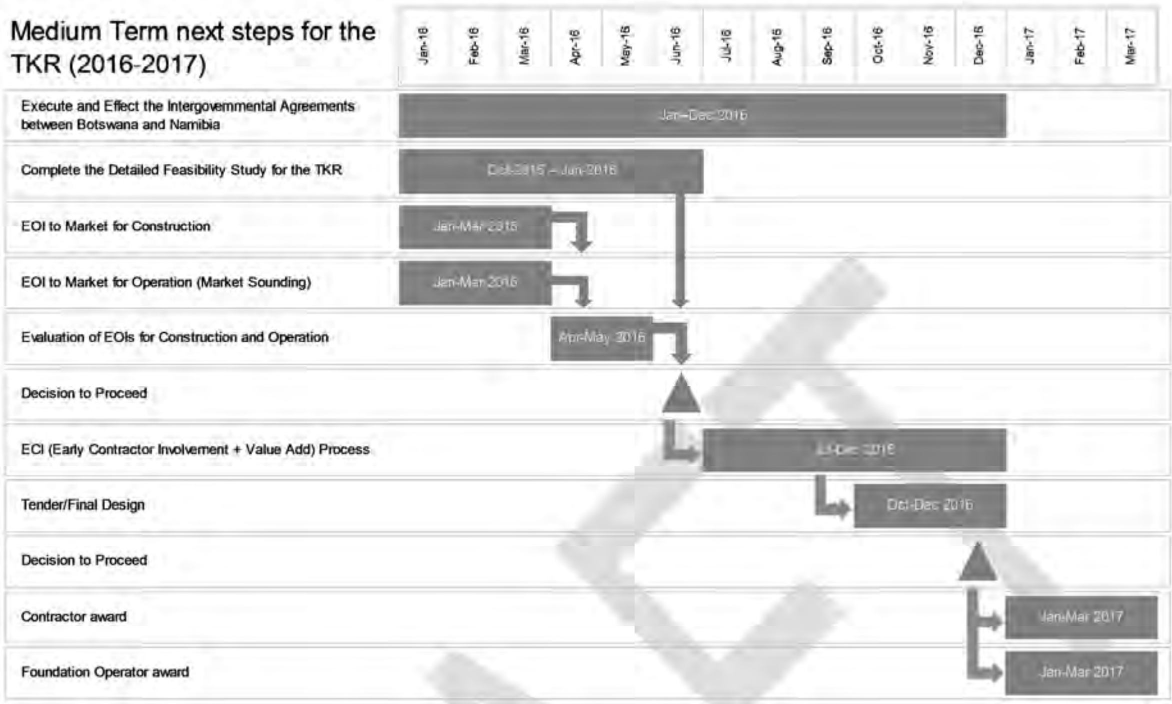
14.3 Medium term next steps for the TKR (2016-2017)

The following section defines the Medium Term Next Steps, those stages which should be effected prior to construction and subsequent operations commencement.

Table 42 Medium Term Next Steps

Task	Description	Period
Execute and Effect the Intergovernmental Agreements between Botswana and Namibia	▪ Execute and Effect the Intergovernmental Agreements between Botswana and Namibia	Jan-Dec 2016
EOI to Market for Construction	▪ Expressions of Interest will be sought from constructors, and suppliers.	Jan-Mar 2016
EOI to Market for Operation	▪ Expressions of Interest will be sought from potential operators, and users.	Jan-Mar 2016
Evaluation of EOIs for Construction and Operation	▪ Expressions of Interest will be evaluated and a short-list of tenderers determined.	Apr-May 2016
Decision to Proceed	▪ Based upon the outcomes of the EOI process, advice will be sought as to whether to Proceed or Hold	Jun-2016
ECI (Early Contractor Involvement) Process	▪ Based upon the outcomes of the EOI process, the short-listed contractors will be invited to enter into an ECI (Early Contractor Involvement) process to hone the design solution and compete for project.	Jul-Dec 2016
Tender/Final Design	▪ During this stage, and in consultation with the ECI competitors, the design will be further developed such that it can be packaged for tender costing.	Oct-Dec 2016
Decision to Proceed	▪ Based upon the outcomes of the Tender Design and Tender Costing, advice will be sought as to whether to Proceed or Hold	Dec-2016
Contractor award	▪ The successful Contractor will be awarded the project. ▪ Negotiations to effect the contract.	Jan-Mar 2017
Foundation Operator award	▪ Notwithstanding the TKR will be Open Access, it is acknowledged that a Foundation Operator (who will in turn be awarded the contract to develop yards and rolling stock service facilities) will be required. ▪ Based on the outcome of the EOI to Market for Operation, the successful Foundation Operator will be awarded the project ▪ Negotiations to effect the contract	Jan-Mar 2017

The above steps are illustrated in Gantt chart below:


Medium Term next steps for the TKR (2016-2017)
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Execute and Effect the Intergovernmental Agreements between Botswana and Namibia
Jan–Dec 2016
Complete the Detailed Feasibility Study for the TKR
EOI to Market for Construction
EOI to Market for Operation (Market Sounding)
Jan-Mar 2016
Evaluation of EOIs for Construction and Operation
Apr-May 2016
Decision to Proceed
ECI (Early Contractor Involvement + Value Add) Process
Tender/Final Design
Oct-Dec 2016
Decision to Proceed
Contractor award
Foundation Operator award
Jan-Mar 2017

Appendices