AURIZON

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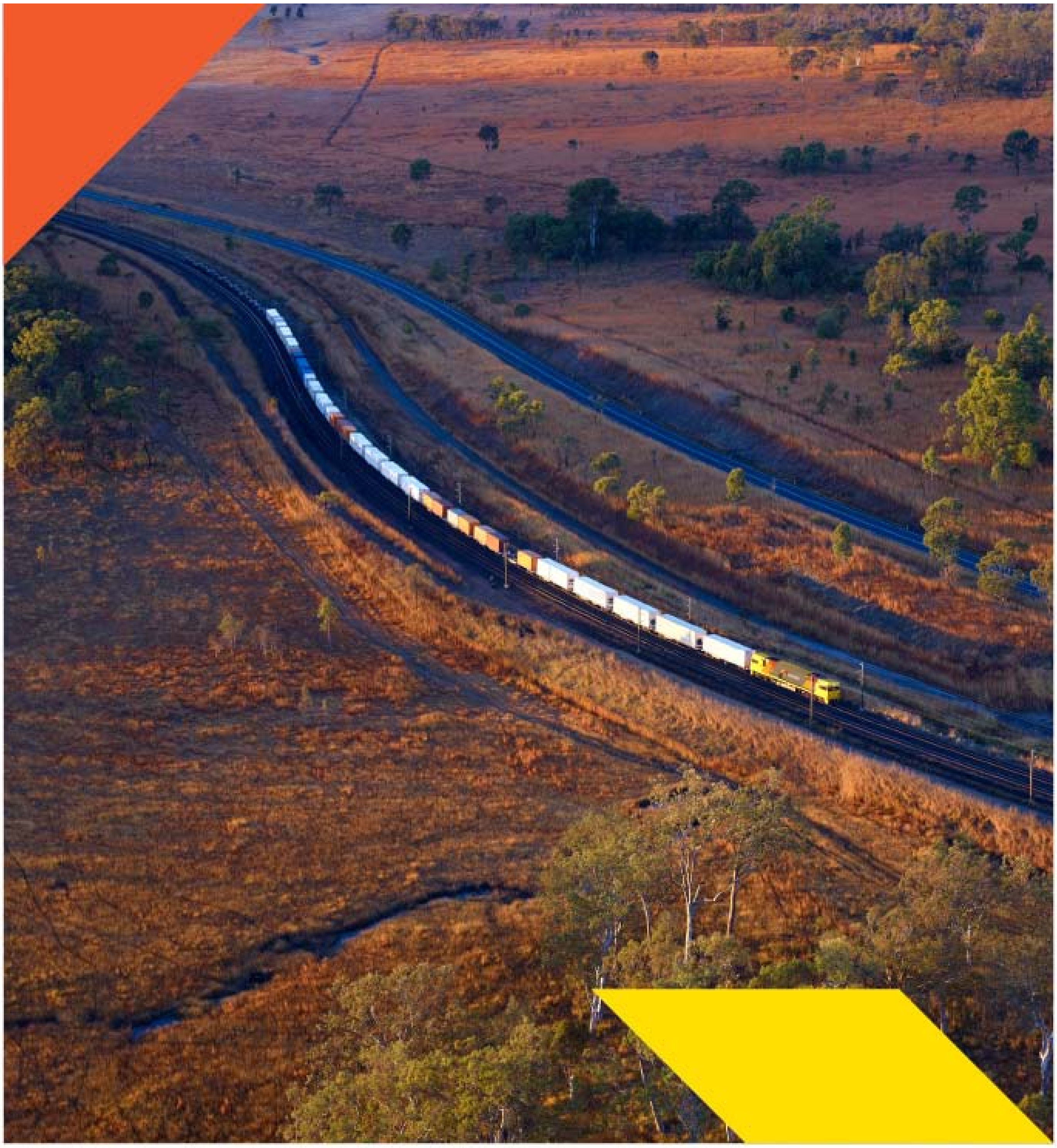
UT4 Maintenance Submission



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DEFINITIONS AND ABBREVIATIONS

Term	Meaning
AMS	Asset Management System
ARTC	Australian Rail Track Corporation
ATP	Automated Train Protection
ATSI	Aboriginal & Torres Strait Islander
Aurizon	The new brand for QR National. All references to Aurizon encompass the QR National and its history.
Aurizon Network	The new brand for QR Network. All references to Aurizon Network encompass the QR National and its history.
AWS	Automatic Warning System
BRTT	Below Rail Transport Time
BUG	Blackwater User Group
CETS	Civil Engineering Track Standards
CLMP	Coal Loss Management Plan
CQCN	Central Queensland Coal Network
CQCR	Central Queensland Coal Region
DAU	Draft Access Undertaking
DBCT	Dalrymple Bay Coal Terminal
DCI	Data Correlation Index
DED	Dragging Equipment Detector
DoO	Day of Operations
DTC	Direct Traffic Control
DTMR	Department of Transport and Main Roads
EPA	Environmental Protection Agency
ERAWA	Economic Regulation Authority of Western Australia
GAPE	Goonyella and Abbot Point Expansion
GCI	Grinding Profile Compliance Index
GTK	Gross Tonne Kilometre
GPR	Ground Penetrating Radar
HBD	Hot Bearing Detector
HWD	Hot Wheel Detector
ILC	Integrated Logistics Company Pty Ltd

Term	Meaning
IPT	Integrated Planning Team
KPI	Key Performance Indicators
LTFR	Lost Time Frequency Rate
LTI	Lost Time Injury
LTIFR	Lost Time Injury Frequency Rate
MFS	Mineral conveyor and storage unit - (German)
MGT	Million Gross Tonnes
MNT	Million Net Tonnes
MSR	Maintenance Supervisory Radio System
MTIFR	Medically Treated Injury Frequency Rate
MTPA	Million Tonnes Per Annum
MUG	Moura User Group
Narrow Gauge	Rail tracks which are 1067mm apart
NDT	Non-Destructive Testing
NGER	National Greenhouse Energy Reporting
NMRP	Network Maintenance and Renewal Plan
NRSR	National Rail Safety Regulator
NSAP	Network Strategic Asset Plan
NSCA	National Safety Council of Australia
NTK	Net Tonne Kilometre
OTCI	Overall Track Condition Index
PVC	Percentage Void Contamination
QCA	Queensland Competition Authority
QMS	Quality Management Systems
RCS	Remote Controlled Signalling
RIMS	Rail Infrastructure Maintenance System
RISSB	Rail Safety Standard Board
ROA	Return on Assets
RTU	Remote Terminal Unit
SCADA	Systems Control and Data Acquisition
SMS	Safety Management System
STS	Specialised Trade Services

Term	Meaning
Tal	Total Axle Load
TLC	Transport and Logistics Council
TMS	Track Maintenance Supervisor
TOC	Track Operations Coordinator
TP	Track Planner
TRC	Track Recording Car
TTD	Transit Time Delay
UGMS	Universal Geometric Measurement Systems
UTC	Universal Traffic Control
WICET	Wiggins Island Coal Export Terminal
WIRP1	Wiggins Island Rail Project Stage 1
WIRP2	Wiggins Island Rail Project Stage 2

EXECUTIVE SUMMARY

Aurizon Network is pleased to present the Maintenance Submission that provides details on the efficient delivery of a maintenance regime required to deliver a highly reliable world class rail network. The submission describes the required activity necessary to sustain the Central Queensland Coal Network and provides for the forecast increases in coal railings across the network.

The Maintenance Regime ensures the Central Queensland Coal Network is capable of meeting customer commitments in an efficient manner. This submission is built upon the approved UT3 maintenance regime and ensures the Rail Infrastructure Manager legislative responsibilities are not compromised. This submission enhances customer outcomes with a focus on:

- continued improvements in safety
- cost efficiency improvements for both labour and plant production performance as compared to UT3
- working in partnership with all supply chain entities to encourage clarity and transparency of accountabilities to the benefit of the supply chain
- balancing inherent trade offs between short and long term objectives of customers across the supply chain
- ensuring highest possible performance from a large unique and complex rail network
- ensuring focus remains on high reliability and availability of the network
- a maintenance scope which is underpinned by Aurizon Network Safety Management System and is fundamental to Aurizon Network discharging legal obligations
- all activity being conducted in a manner consistent with Aurizon Network remaining a good corporate citizen supporting the community in Central Queensland.

Railings across the Central Queensland Coal Network are projected to increase to over 246 Million Net tonnes by 2017. This is a significant increase across the Network from the 2012 tonnages and coupled with an increase in asset quantities – up to and including WIRP1 infrastructure – it requires a proportional increase in maintenance activity. Aurizon Network will continue to work with industry through the various planning forums, using increasingly sophisticated planning tools to optimise the maintenance activity. Aurizon Network is proud to offer industry a proposal that demonstrates improving maintenance cost per Net Tonne Kilometre which is further evidenced by separate reports commissioned with Evans and Peck and Worley Parsons.

This submission considers the following key factors:

> The challenges of managing and operating a unique rail infrastructure network
> Responsively meeting industry needs through active engagement and consequent actions
> Delivery of a scope appropriate to industry requirements and forecasts
> Provision of efficient pricing and service delivery model
> Ensuring a reliable, available, sustainable safe rail network.

Responding to Industry Needs

Industry engagement confirms a safe, reliable and available network is a priority. Prioritisation of maintenance activities are developed in partnership with all supply chain entities. Regular operational forums include the Southern and Northern Planning meetings, Executive level engagement, regular stakeholder meetings and industry forums. These considerations result in a solution tailored to meeting our customer commitments.

Aurizon Network also periodically surveys mine owners and other stakeholders on Aurizon Network's performance and their preferences for future investment across the key dimensions of reliability, availability and safety. Results show a preference for future investment to be directed towards improving below rail reliability and availability in preference to other factors in the coal supply chain.

Aurizon Network is conscious the coal supply chain is a complex, competitive and commercial environment featuring a range of often contrasting commercial objectives. This is exemplified in the wide range of short and long term strategies among mine operators. Examples include:

> At times, the supply chain is focussed on servicing short-term spot market prices and unpredictable delivery schedules leading them to favour continuous operation and availability which may require changes to scheduled maintenance tasks
> Alternatively, long term coal supply contracts tend to favour predictable schedules and sustainable reliability, focussed on long-term predictable tonnages, maximising annual delivery, making it easier to both schedule maintenance and justify ongoing investment in the rail network's asset quality.

The challenge for Aurizon Network is to balance these differing needs while ensuring safety and long term viability of the infrastructure as a key component of the coal supply chain over multiple economic cycles. With this submission covering a four year period, it is accepted flexibility; adaptability and sustainability need to be built into the service delivery model. This necessitates on-going engagement with industry and QCA.

Scope appropriate to industry requirements and forecasts

The scope of the maintenance activities adopted for this submission is based upon forecast tonnage profiles, derived from a conservative projection relative to contracted tonnes. Furthermore the scope requirements are predicated on the engineering standards contained within Aurizon Network's Safety Management System. We note however, while there is currently considerable uncertainty in world markets, the tonnage forecasts indicated to Aurizon Network and subsequent requirements for new infrastructure, remain positive.

Asset quantity is a major factor in determining the scope of work for the purpose of this Maintenance Submission. Aurizon Network has considered the total quantity of assets currently deployed up to and including the Wiggins Island Rail Project Stage 1 currently under construction. The scope specifically excludes other potential projects such as: Wiggins Island Rail Project Stage 2 (WIRP 2) and Goonyella Abbot Point 140, none of which have, as yet, secured funding for construction at the time this Maintenance Submission was developed.

Aurizon Network has sought to improve on previous undertakings by assessing each of the building blocks used for determining both the scope and the costing models. Ultimately this will deliver a cost-efficient program of maintenance activities required for a reliable world class rail network.

Efficient cost and delivery model

Aurizon Network is presenting an efficient maintenance cost to support the coal supply chain and comply with legislative obligations and community expectations. This efficient cost has been determined to balance three crucial dimensions of asset performance: cost vs. reliability; optimised availability vs. availability certainty; and short-term throughput vs. long term throughput.

Aurizon Network’s operational structure is designed to focus capability and resources on core maintenance, repair, response and recovery services with the best outcome being achieved through better maintaining the network and reducing unplanned disruptions. With greater flexibility in Aurizon Network’s operating models, Aurizon Network is now better positioned to support the coal supply chain to deliver greater reliability and availability as tonnes increase.

This maintenance submission builds on the foundation elements of the approved UT3 maintenance effort, and is further confirmed by the report prepared by Worley Parsons included in that submission. It allows for increased tonnages, a larger rail network, the impacts of legislative changes and the requirements of the Safety Management System. The Evans & Peck report also confirmed:

> Aurizon Network's maintenance cost efficiency is comparable with ARTC's Hunter Valley Coal Network
> The characteristics of the CQCN are a key contributor to the maintenance task
> Maintenance of the below rail infrastructure may need to allow for over capacity or surge capacity for the supply chain to operate optimally
> Maintenance costs are very sensitive to access for maintenance and possession regimes and there are access scenario/access regimes which can minimise cost.

Aurizon Network has engaged the most experienced personnel to develop this submission based on their long-standing expertise and intimate knowledge of the CQCN. This includes internal experts and external consultants in the form of:

> Evans & Peck - to benchmark of Aurizon Network's costs against the comparable coal network operations
> Deloitte Touché Tohmatsu – to provide technical support in the development of the maintenance cost submission and validation of the maintenance cost models
> GHD - to assist in the development of the maintenance scope
> BIS Shrapnel - to develop and project the Maintenance Cost Index (MCI)
> Aurizon Network expertise in Rail Infrastructure Management, Operations and Planning, Registered Professional Engineers in Queensland.

The development of this submission also considers the following matters:

> a more focussed approach to operational safety, including a more onerous national approach to the safe access to the rail corridor
> increased traffic volumes driving higher maintenance effort
> cost increase and logistics pressure associated with increased reliance on external service providers up to 50% of the base cost
> general increase in the age of the asset over previous undertakings

In spite of otherwise softness in global demand, Aurizon Network recognises the strong upward pressures on the labour market, accommodation and fuel costs in one of Australia's leading economically-productive regions.

The cost for each of the maintenance products across the regulatory period is detailed in Table 1 below:

Table 1: Cost of each maintenance products per year (in FY12 $)

Maintenance Discipline	FY14 ($m)	FY15 ($m)	FY16 ($m)	FY17 ($m)
Forecast Net Tonnes	**196.6**	**218.3**	**231.5**	**246.5**
Mechanised Maintenance				
Ballast undercutting	$55.271	$64.859	$65.883	$66.361
Resurfacing	$18.979	$19.015	$20.867	$20.927
Rail Grinding	$12.513	$13.516	$13.958	$14.435
General Track Maintenance	$47.319	$50.472	$52.004	$53.581
Re-railing	$15.267	$15.061	$15.722	$16.144
Structures	$2.650	$2.769	$2.841	$2.935
Signalling	$22.591	$23.457	$23.944	$24.417
Traction Power	$9.556	$9.598	$9.598	$9.597
Telecommunications	$5.365	$5.514	$5.516	$5.518
Direct Costs	**$189.510**	**$204.260**	**$210.332**	**$213.915**
Return on Inventory, Working Capital & Fixed Assets Employed	$10.774	$12.765	$12.430	$12.324
Corporate Costs	$12.090	$12.090	$12.090	$12.090
Total (Real FY12)	**$212.374**	**$229.115**	**$234.853**	**$238.329**
Benchmark Cost per NTK[1]	2.42	2.25	2.18	2.09

The above costs are based on the forecast tonnage profile detailed in the table below:

Table 2: Estimated tonnage profile per system (in Millions)

System	FY14	FY15	FY16	FY17
Blackwater	54.366	60.896	67.408	73.389
Goonyella	97.332	106.428	112.028	116.928
Moura	12.535	13.608	12.963	14.080
Newlands	32.411	37.410	39.053	42.121
Total	**196.643**	**218.342**	**231.452**	**246.518**

Managing a Unique Coal Rail Network

The Central Queensland Coal Network is unlike any other in the world due to its combination of extreme climatic and geographical challenges. This is combined with the historical legacy of a narrow gauge infrastructure now extending over four complex inter-related coal systems

[1] Benchmark cost per NTK excludes Mechanised Ballast Undercutting, Traction Power and Telecommunications

for a total of more than 2,667 km of track servicing 42 mines, 3 power stations, 5 port terminals and multiple rail operators.

Overall, given the unique conditions characterising the network, it is difficult to make direct comparisons with other coal networks operating here in Australia or elsewhere. Nevertheless, a study commissioned from Evans & Peck[2] indicates that the costs of maintaining the CQCN are reasonably in line with those of other networks, such as the Australian Rail Track Corporation's (ARTC) Hunter Valley Coal Network.

We deliver reliably and safely

As the Accredited Rail Infrastructure Manager for the Central Queensland Coal Network, Aurizon Network is bound by the Queensland Transport (Rail Safety) Act 2010. At all times, Aurizon Network must ensure it is maintaining and operating the network in a safe manner. These obligations extend to the management and supervision of external contractors.

Aurizon Network's accreditation and its ability to own and operate the Central Queensland Coal Network is based on the efficacy of its Safety Management System and is the subject of regulation enforced by the Rail Safety Regulator. Aurizon Network's Safety Management System details the prevention/intervention levels and the associated activities required to maintain the network. It also provides direction and guidance on how the maintenance tasks should be managed safely. These requirements constitute an inviolable baseline for determination of the maintenance scope. Maintaining the accreditation is subject to a rigid regime of external and internal audits and reviews.

It is acknowledged through empirical studies that investment in improved safety practices and behaviours delivers cost savings and improved production to the supply chain. Aurizon Network also understands our commitment to safety represents the most cost-effective approach to the long-term sustainability of the network.

This submission represents a balance between the need to drive an economical benefit for industry, with Aurizon Network's desire to deliver a World Class Rail Network. We look forward to working in partnership with the Queensland Competition Authority and the supply chain entities in their consideration of this submission.

[2] Evans & Peck (June 2012) Aurizon Network Services Operating and Maintenance Costs Investigation and Benchmarking

1. BACKGROUND

Background - Key points

> This Maintenance Submission has been heavily influenced by the UT3 Maintenance Submission

> The scope of the maintenance effort is underpinned by the requirements of Aurizon Network's Safety Management System

> The Central Queensland Coal Network is unique because:

- Asset age and original design capabilities of the infrastructure
- Narrow Gauge railway with associated impacts on infrastructure and operating requirements
- Impacts of Central Queensland environmental factors particularly soil types, temperature, mountain ranges and rain events
- Contractual relationships add complexity to a supply chain optimised output

> The tonnage profile for the UT4 period has been based on reduced contract volumes but exceeds all previous haulage profiles.

> The quantity of infrastructure required to be maintained has increased over previous Undertakings.

> Aurizon Network is committed to World Class Safety Performance, Legislative Compliance and being a responsible corporate citizen.

1.1 Submission Document Structure

The document is structured as follows:

1. Background	Provides the context of the network and the drivers and challenges considered for the next Regulatory Period. It provides the reader with grounding in the unique characteristics of the CQCN that must be considered in the development and evaluation of this Maintenance submission.
2. Network Maintenance Philosophy	The principles and practices governing our approach and the competing prioritises in the delivery of the CQCN performance.
3. Network Maintenance Regime	Approach to industry engagement, network access planning in the short and long term, maintenance delivery and optimisation for the supply chain.
4. Asset Management Products	Categories and classes of products and their descriptions.
5.NetworkMaintenance Costs	The methodology and description of how the maintenance costs have been developed.
6. Blackwater System Plan and Costs	The specific plan and maintenance cost for maintaining the Blackwater system.
7-Goonyella System Plan and Costs	The specific plan and maintenance cost for maintaining the Goonyella system

8. Moura System Plan and Costs	The specific plan and maintenance cost for maintaining the Moura system
9. Newlands System Plan and Costs	The specific plan and maintenance cost for maintaining the Newlands system
10. Assumptions	The assumptions underpinning the maintenance cost as presented.
11. Risks	A summary of risks that could impact aspects of this maintenance price submission.

1.2 Submission Development Process

Aurizon Network has engaged leading industry experts to ensure this DAU provides for an efficient cost of maintenance services to the Central Queensland Coal Network that is transparent in its application and repeatable in a volatile economic environment. Aspects of our submission have been benchmarked against International and Australian railways, including several Class 1 Railways in the USA and the ARTC's network in the Hunter Valley NSW.

Importantly this Maintenance Submission is based on the fundamental maintenance practices described in the UT3 Maintenance Submission. As a result the maintenance effort remains substantially unchanged between the two Regulatory Periods, allowing for increased tonnages and a larger rail network. The maintenance effort described and costed in this Maintenance Submission remains consistent with the approach taken in UT3 and includes the requirements for the design, construction, operation and maintenance of the network as provided for in Aurizon Network's Safety Management System. The Safety Management System is approved and continually reviewed by the Department of Transport Main Roads as part of their obligations under the *Transport (Rail Safety) Act* 2010, which enable Aurizon Network to operate the Central Queensland Coal Network.

The key difference from the approach used in the UT3 Submission is better management information systems and data quality has enabled Aurizon Network to more accurately determine the actual costs entailed in delivering each of the maintenance products that are used in the build-up of the maintenance cost. Further detail on how Aurizon Network has used this enhanced business intelligence is described in Section 5: Maintenance Cost.

In additional to the previously mentioned Evans & Peck benchmarking report (Appendix N), our approach is further confirmed by a series of independent consultancy reports prepared by Worley Parsons and the Transportation Technology Centre (TTC) USA. A copy of the suite of reports, known as the UT3 Parallel Active Comparison Exercise, is attached in Appendices P to W and includes:

- Appendix P – [CONFIDENTIAL] Worley Parsons and Transport Technology Centre: Parallel Active Comparison Exercise
- Appendix Q - [CONFIDENTIAL] Life Asset Register Benchmark
- Appendix R- [CONFIDENTIAL] Marginal Costs: Fixed and Dynamic Variables- Contemporary and Accepted Theorems
- Appendix S - [CONFIDENTIAL] Queensland railways Maintenance Variability
- Appendix T - [CONFIDENTIAL] Optimising Locations of Maintenance Depots
- Appendix U - [CONFIDENTIAL] Comments on Service Level Specification for Rail Infrastructure Maintenance

> Appendix V - [CONFIDENTIAL] Benchmark Heavy Haul Lines- International and National Comparison
> Appendix W - [CONFIDENTIAL] Northern Queensland Coal Network Systems.

Aurizon Network's objectives in developing the DAU include:

> Assisting the Queensland Competition Authority and participants in the CQCN supply chain to understand and the nature of the asset and performance expectations
> The effort required to maintain a highly reliable world class rail network
> Ensure sufficient flexibility in the delivery of the maintenance services to adapt to a range of changes in the market
> Identifying and establishing a process to manage potential risks occurring during the undertaking period
> Analysing current and future activities to ensure best practice has been developed, without compromising safety, efficiency or reliability of service.

Aurizon Network's Safety Management System details the prevention/intervention levels and the associated activities required to maintain the network. It also provides direction and guidance on how the maintenance tasks should be managed safely. These requirements have been formulated in the context of the legislative and regulatory frameworks affecting Aurizon Network's operations and constitute an inviolable baseline for determination of the maintenance scope. Aurizon Network's accreditation as a Rail Infrastructure Manager/ Operator and therefore its ability to own and operate the Central Queensland Coal Network are based on the efficacy of its Safety Management System and is the subject regulation set down by the Queensland Rail Safety Regulator. Maintaining the accreditation is subject to a regime of external and internal audits and reviews. This included audits from three (3) separate government departments; Electrical Safety Office, Department of Main Roads and Transport (Rail Safety) and the Division of Workplace Health and Safety.

In considering the approach to scope, three primary maintenance modes need to be considered: time-based, usage-based and repair-on-failure. This approach is consistent with the methodology described in Aurizon Network's Maintenance costs for UT3. The scope for time-based activities is based on the requirements of the Safety Management System, while the intervention levels for usage-based activities have been set on the forecast tonnages derived from the train paths provided within the Access Agreements. Repair-on-failure maintenance is treated as a purely reactive activity.

This Maintenance price was developed by:

> Identifying all cost inputs in the scope of works completed in FY12, ensuring capital and external works are excluded
> Extrapolating these inputs to reflect the resources required to complete the maintenance activities considering:
  - The volume increase in maintenance scope, due to increase in assets and tonnage forecasts
  - The acquisition of new plant and their associated productivity improvements
  - The engagement of additional external resources, both labour and plant
> Identifying the asset base used in the maintenance function, which was then used for calculating
  - Return on Assets (ROA)
  - Return on Inventory
  - Working Capital and Fixed Assets Employed

- Identification of applicable corporate overhead allowance
- Applying escalation across the four-year period, based on the Maintenance Cost Index.

1.2.1 Key Assumptions

The following assumptions underpin the maintenance scope and maintenance price:

- The scope in part is based on forecast tonnes provided for within the Access Agreements
- The time-based and usage-based maintenance activities are as specified in the Safety Management System
- The mechanised maintenance involves a mix of leased and owned equipment
- The price provides for the procurement of additional external resources to meet the scope
- International and National benchmarking has confirmed the prudency of the cost build up within this Maintenance Submission
- An escalation factor (Maintenance Cost Index) similar to UT3 will be applied retrospectively at the end of each financial year covered in the regulatory period
- Corporate overheads have been based on a combination of industry benchmarking and a bottom up cost build up based on a hypothetical maintenance business. More detail on this matter is contained in Section 5.9: Corporate Costs.

The manner in which Aurizon Network plans and delivers its maintenance activities was benchmarked against several national and international railways by the consulting firm Evans and Peck. The report concludes the closest comparative railway operation was the ARTC's Hunter Valley Coal Network operations. The report goes on to say:

> " extensive analysis has been carried out comparing QR Network's four systems with the ARTC HVCN and this analysis clearly indicated QR Network's CQCN cost efficiency to be reasonable and prudent when compared with the ARTC HVCN on a unit cost basis of dollars' per track kilometre versus net system tonnage. The Figure[3] below shows the unit maintenance cost expressed in dollars per track kilometre plotted against net system tonnage…. To draw out efficiency comparisons, upper and lower bands of ± 10% and ± 25% have been applied to the figure, with a simple linear regression analysis used to compare the maintenance expenditures."

[3] Traditionally one would expect the curve to increase exponentially and then begin to flatten as tonnages increased over a certain level. However the correlation of R_2 = 0.08732 was the best fit non-linear graphical representation. It is considered that a higher number of data points and some available points that sit beyond the 100-120Mtpa would show the trend line beginning to flatten and plateau as opposed to continuing in the exponential increase shown, however this was not possible to determine with the data available.

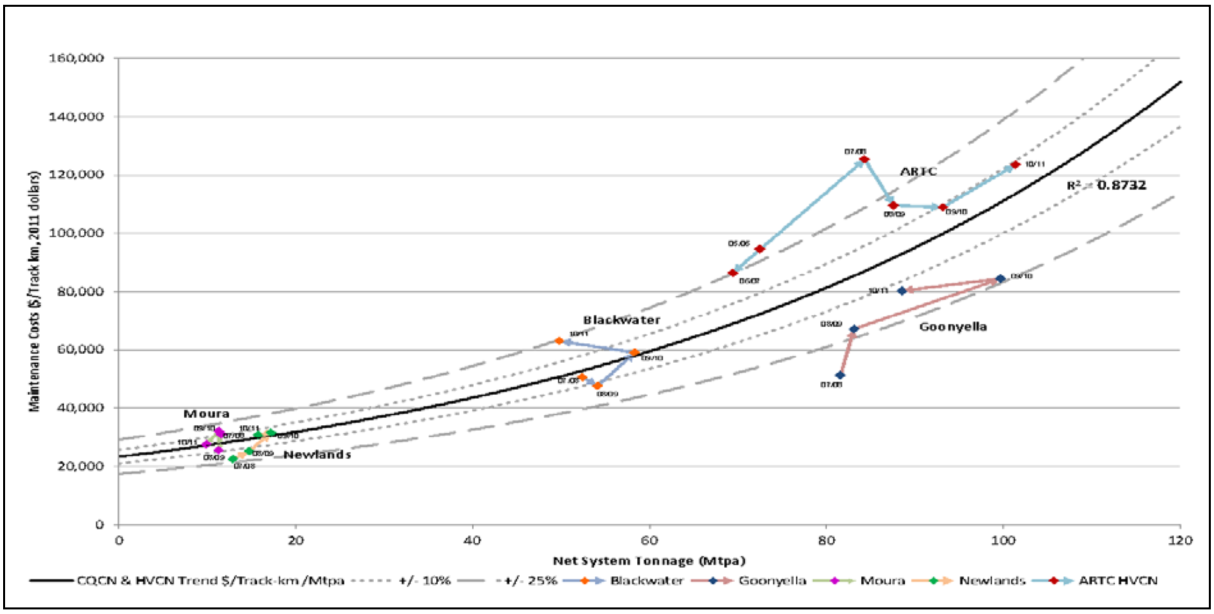


Figure 1: Benchmark &/Track km Maintenance Costs Against Net System Tonnage

1.2.2 Efficiency Gains

Aurizon Network will undertake a number of improvement initiatives across the asset management, infrastructure technology and maintenance planning and delivery functions. These improvements are designed to:

> Improve the performance and reliability of assets

> Enable more effective and timely planning for maintenance tasks

> Enable more efficient use of maintenance resources within a constrained maintenance environment.

The efficiency gains expected from these initiatives have been built into the UT4 price as detailed in this Maintenance Submission. Restructuring activities across the Aurizon group during the FY13 are expected to deliver cost efficiencies across a range of corporate overhead and services and have also been considered in the development of this submission.

1.2.3 Use of External Expertise

In the development of the Maintenance Submission, Aurizon Network has used a number of expert external resources. The services provided by these experts were as follows:

> Deloitte Touché Tohmatsu for financial modelling, corporate overhead benchmarking and general advice on associated regulatory matters

> Evans & Peck for customer surveys on maintenance activities and cost, benchmarking on maintenance services and price

> BIS Shrapnel for the Maintenance Cost Index

> GHD assisted with the scope development

> Aurora Marketing for the development and analysis of the 2012 Stakeholder Survey.

1.2.4 Maintenance Cost Index

A consideration in the build-up of the price for the UT4 Maintenance Submission has been the downstream cost impacts caused by the increase in mining activities in the Central Queensland Coal Region. With this in mind, Aurizon Network has reviewed the applicability and effectiveness of the components and weightings of the Maintenance Cost Index used in the current UT3 agreement and has determined the components were not appropriate for the Central Queensland Coal Region. Accordingly, a modified suite of indices and weightings for this maintenance submission has been developed in conjunction with BIS Shrapnel.

1.2.5 Internal Experts

As well as drawing on external consultants for specific skills and knowledge, Aurizon Network has a strong pool of experienced managers, engineers and subject matter experts with many years of experience for managing the rail assets. A range of these professionals has been involved in the development of this submission, including the following people listed in Table 3. Curriculum Vitae for the personnel above are attached as Appendix X – Aurizon Key Personnel.

Table 3: Aurizon Network managers and subject matter experts involved in developing the submission

Name	Job Title	Experience	Role and area of expertise
Steven Jaksic	Signalling & Corridor Systems Asset Manager	25 years rail signalling design, delivery and management.	Steven is responsible for the Signalling Asset Plan, including planning for: interfaces, strategy, system performance improvements, signalling assets, and the 5 year capital investment plan. He also coordinates the Wayside Systems Asset Plan covering: interfaces, system performance improvements strategies, weighbridges, asset protection systems, dragging equipment detectors, hot box detectors, wheel impact load detectors, remote monitoring systems for level crossings and weather stations, condition Monitoring and the 5 year capital investment plan.
Clayton McDonald	Vice President Network Operations	15 years in transport and logistics sector in QLD and NSW	As Vice President Network Operations, Clay is responsible for safely and sustainably delivering maximum system throughput at the lowest cost of operation, while ensuring the integrity of the Central Queensland Coal Network for the Coal industry.
Max McFadzen	Manager Maintenance - North	34 years in deliver and management of infrastructure maintenance	Max is responsible for managing the civil infrastructure resources of the section and to co-ordinate the local delivery of civil infrastructure services from other parts of QR Services Group. He has responsibility for life cycle management of track, structures, yard and rail corridor assets

Name	Job Title	Experience	Role and area of expertise
Scott Riedel	General Manager Network Assets	25 years experience in the rail and petrochemical industries in Australia, Asia and the United Kingdom	Managing all phases of rail projects from concept to renewal, including project execution and operational requirements
Michael Ladd	Manager, Network Operations	25 years experience leading and managing commercial and operational functions	Developing and delivering possession planning and facilitating access to the Network
Scott Thomas	Asset Business Manager	18 years experience in managing infrastructure through Asset life	Rail project and investment programme management, commercial contract design and management
Simon Shelley	Technical Director Asset Strategy	30 years rail infrastructure management	Simon is responsible for infrastructure asset management, management of railway systems for assets and operations
Jason Livingston	Corridor Assets Manager	16 years rail infrastructure maintenance and management	Asset management of corridor infrastructure
Jane Livingston	Strategic Planning Manager	16 years rail infrastructure maintenance and management	System planning and infrastructure engineering
Eric Rudorfer	Electrical Assets Manager	27 years experience in designing and managing electrical infrastructure	Asset management of electrical infrastructure
Brian Rowan	Asset Assurance Manager	33 years experience maintaining and monitoring	Brian is responsible for development and implementation of legislation compliance and implementation programs incorporating change management processes, and development and implementation of assurance & verification business process to confirm compliance with Rail Safety Legislation to maintain accreditation as a Rail Manager Operator.
Kevin Nagle	Commercial Manager UT4	Broadly experienced finance professional	Financial analysis and modelling of the costs for the UT4 submission.
Ross Pocock	Asset undertaking Manger	25 years experience in safety construction and management	I have over 25 years experience in the energy and construction industry. A major focus has been the delivery of key projects on time, on budget and without any injuries.

Name	Job Title	Experience	Role and area of expertise
Wayne Prosser	Manager Maintenance South	26 years in vary leadership roles	Maintenance management leading field staff in delivery maintenance obligation
Mick Keefe	Manager Mechanised Production	25 years infrastructure development and maintenance	Delivery of the Ballast Cleaning and Track Resurfacing program in the Central Queensland Coal Network
Scott Andrews	Telecommunications Systems Asset Manager	34 years experience in maintenance and management telecommunication and signalling equipment	Asset management of Telecommunications infrastructure

1.3 Aurizon Network's Business Structure

QR Network Pty Ltd (QR Network) is a fully-owned subsidiary of QR National Ltd (QR National) and was formed in 2008. Both businesses have recently been rebranded as Aurizon Network (Previously QR Network), and Aurizon (previously QR National). Aurizon comprises the principal commercial rail freight operations, including the operation and management of the CQCN infrastructure, the above rail coal haulage operations, the above rail freight activities and selected services businesses.

1.3.1 Business Structure History

On 21 September 2010 QR National became a non-operating holding company for the group comprising itself, QR Limited and QR Limited's controlled entities, by issuing shares to the State of Queensland in exchange for the State's existing shares in QR Limited. Up until 30 June 2010, QR Limited was the ultimate parent entity of a group which owned the QR National business and the Queensland Rail business. The Queensland Rail business was separated from QR Limited on 30 June 2010 through:

- A restructure, whereby certain assets and liabilities attributable to the Queensland Rail business were transferred to QR Limited's wholly-owned subsidiary Queensland Rail Limited
- The subsequent transfer by QR Limited of its shares in Queensland Rail Limited to the State.

Immediately following the restructure, QR Limited and its remaining subsidiaries conducted only the QR National business. QR National subsequently became QR Limited's non-operating holding company and the group comprising QR National, QR Limited and QR Limited's controlled entities was formed.

In 2012, the QR National business underwent re-branding, to become Aurizon.

1.3.2 Aurizon Network's Operational Structure

Aurizon Network owns the assets and uses internal highly skilled teams and numerous external parties to carry out maintenance activities under contract. The Coallink Alliance team is responsible for the management and performance of the maintenance activities undertaken by Aurizon Network. The provision of all maintenance tasks regardless of the method of delivery or how the task is resourced is managed by this Alliance.

The Aurizon Network operational structure is designed to focus capability and resources on core maintenance, repair, response and recovery services that deliver better maintenance of the network and reduce unplanned disruptions. Accountability for the Maintenance and Specialised Track Services teams sits within the Aurizon Network business group. To ensure the focus on improving system reliability through maintenance, the Network Assets (Engineering) team has aligned with regional based maintenance staff to provide key Asset Management strategies and support functions to ensure optimal asset value. (Please see Figure 2: Aurizon Network organisational structure).

We recognise field leadership roles are key to delivering continuous improvement as Aurizon Network seeks to achieve world-class standards in safety performance. As such, Aurizon and Aurizon Network employees all commit to Personal Action Safety Plans which encompass the workers pledge to, and measurement of, their individual safety performance and goals. These plans are reviewed monthly by the workers and their supervisor to track and support the workers' endeavour to achieve their stated safety objectives.

To better support the coal supply chain through higher levels of reliability and availability we have also continued to develop Aurizon Network's internal capability. The Aurizon group of companies has been running an active program to recruit employees who represent "world's best practice" in logistics and rail expertise. This exercise has seen several Executive and Senior personnel recruited from Interstate, the USA and Canada.

The management structure for Aurizon Network is summarised in the figure below:

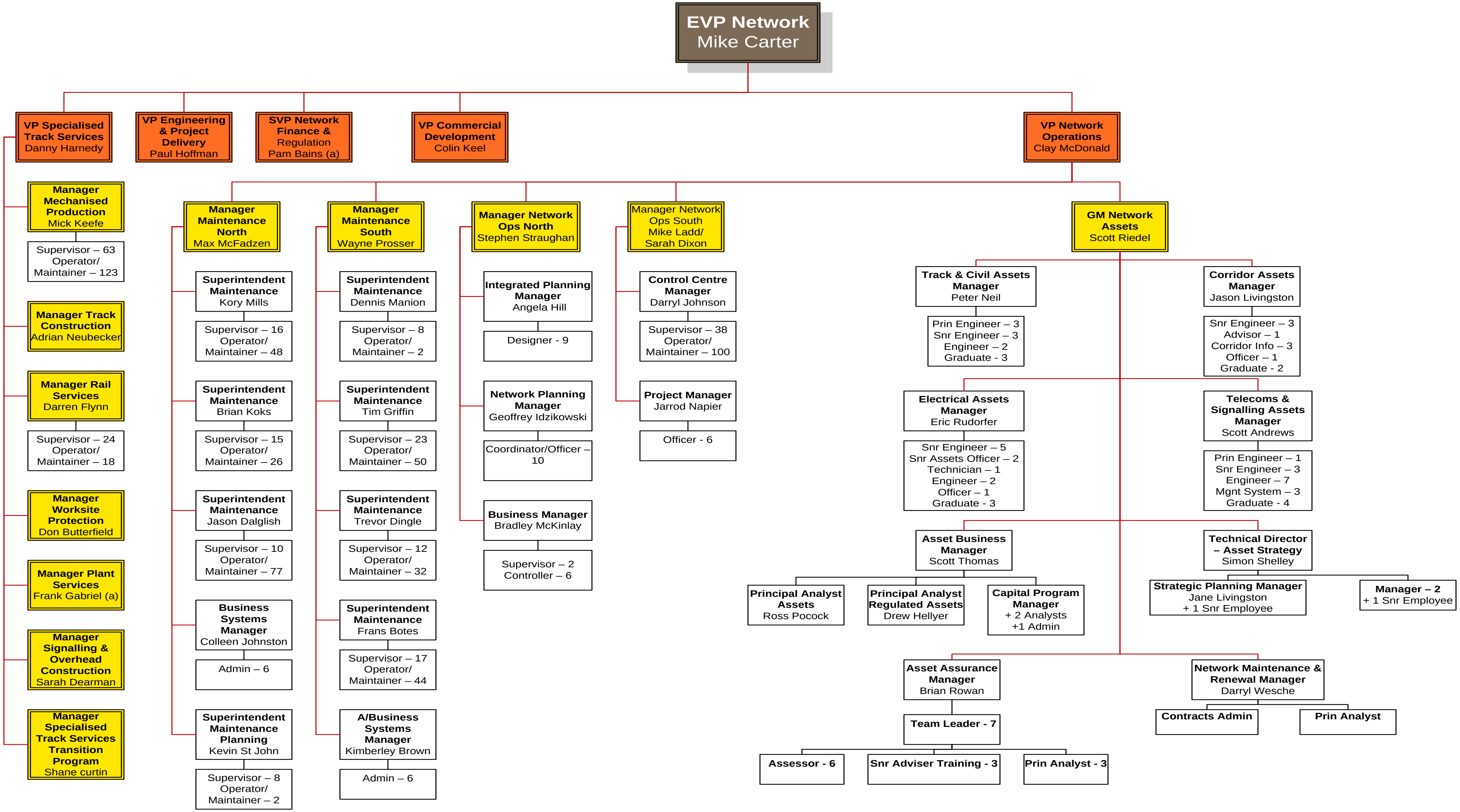


Figure 2: Aurizon Network organisational structure

1.4 Nature of the Asset

The CQCN rail infrastructure consists of a major heavy-haul coal network spanning more than 2,667 kilometres serving coal ports at Gladstone, Mackay and Abbot Point, and includes the:

- Blackwater System (includes lines from Rolleston, Minerva, and Gregory, through Blackwater to Port of Gladstone) – Refer Section 6 for the Blackwater system plan and costs
- Goonyella System (includes lines from Gregory, Blair Athol, Goonyella and Hail Creek to Port of Hay Point and Dalrymple Bay at Mackay) – Refer Section 7 for the Goonyella system plan and costs
- Moura System (Moura to Port of Gladstone) - Refer Section 8 for the Moura system plan and costs
- Newlands System (Goonyella North to Port of Abbot Point) - Refer Section 9 for the Newlands System plan and costs.

The Blackwater system is the oldest of all the systems, having been operational since 1867. This line existed before the mines it now services were contemplated, and was originally built to transport wool on 12 tonne axle loads. Similarly the Goonyella and Newlands systems have a long history dating back the 19th century and early 20th century respectively, with design capacity for lower volumes and axle loads. Collectively all four systems were operational in the 1960s for Coal transportation, with refurbishments and additions to all, including electrification on Blackwater and Goonyella systems, completed in the 1980s.

Approximately 1,731 km of this CQCN network is electrified, and various types of Safe Working Systems, such as Universal Train Control, Direct Train Control and Remote Control Systems are in operation throughout the CQCN. A core challenge for Aurizon Network is the four systems were designed and built for much lower axle loads and freight volumes. The alignment of the track, the gradients of the terrain, the weather and the soil issues in the region add to these challenges, creating unique operational and maintenance requirements. These matters are discussed in detail in Section 1.4.1 below.

The map below shows the Central Queensland Coal Network four systems and key locations. Refer Appendix Y for a larger version of this map and detailed maps for each of the four Systems.

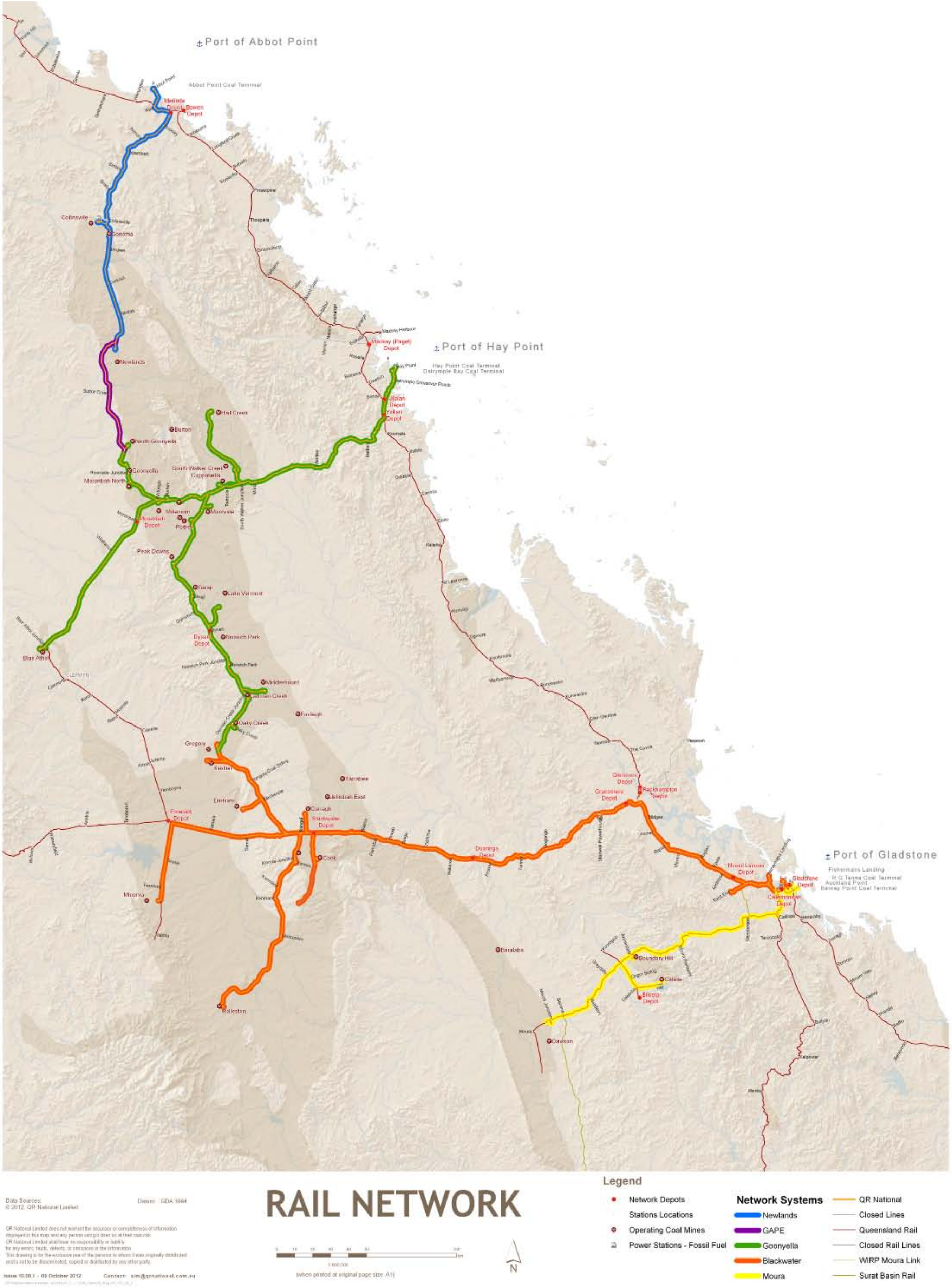


Figure 3: Map of the Central Queensland Coal Network

1.4.1 Narrow Gauge History and Implications

The choice of the non-standard 3 ft 6 in (1,067 mm) gauge is founded in the history of Queensland. Using narrow gauge was approved by a very small majority in the State parliament in 1863. At that time the narrow gauge configuration was selected for cost savings and suitability for the terrain along Queensland's Coast. This configuration was subsequently copied by three other Australian states as well as a number of other countries.

Queensland's range of geographical features, such as mountain ranges, waterways and expansive flood plains, and the original design requirements have significantly influenced the current day configuration of the railway infrastructure. As result, the CQCN features a narrow gauge railway with proportionally higher than normal density of railway asset features such as tight curves, steep gradients, bridges, culverts, level crossings and signal constrained locations.

The original Queensland Railways was designed for operation at 15 mph to 20 mph and relatively small axle loading by today's standards. The network developed from this early system over the last 149 years reflects a history of incremental growth of the haulage task. As a result, Aurizon Network now operates one of the few narrow gauge (1067 mm) heavy haul railways in the world. It is only in recent years there has been a significant growth in commodity prices which has driven major capacity infrastructure investment.

The implications of the narrow gauge configuration are:

> Capital cost - Lower levels of capital investment are required for initial construction of narrow gauge railways due to the shorter sleeper, narrower formation and lower ballast requirements. The savings compared to standard gauge are generally estimated to be around 5 to 7% for a new railway line.

> Speed - A narrower wheel base than standard gauge railways means narrow gauge trains have less stability and lower safe speeds on both straights and curves than their standard gauge counterparts. However, while passenger services can typically run at speeds of 100 – 120 km/h, world class heavy haul trains (including those on the CQCN) run at speeds of up to 80 km/h, which is similar to standard gauge heavy haul and therefore of minimal significance.

> Frequency of service – Narrow gauge wagons have lower volumetric capacities, which is a significant disadvantage for light commodities such as coal. The wagon fleet size required for a large narrow gauge coal rail operation tends to be greater, which results in more frequent and longer train services (more wagons), and correspondingly greater traffic density. Higher traffic volumes increase the difficulty of accessing the infrastructure to undertake maintenance tasks and also impacts usage-based maintenance tasks.

> Formation stresses –The narrower base increases the impact of differential settlement on cross levels, which affects ride quality and increases track maintenance intervention requirements.

> Track maintenance (and tolerances) – Similarly, the narrow gauge track structure provides less resistance to lateral displacement compared to the standard gauge track structure. In terms of riding quality, the narrow gauge track is also less tolerant to errors of twist in the running top (a 5mm error in twist on standard gauge will have the same effect as a 3.7mm error on narrow gauge). Again, this results in stricter tolerances and increased safe maintenance intervention requirements[4].

To provide an independent view of the impacts a narrow gauge network and other unique operating matters have on maintenance tasks, Aurizon Network commissioned Evans & Peck to undertake a robust benchmarking investigation of rail operations in Australia and overseas. Evans & Peck concluded:

"…identified that the unique characteristics of the CQCN, such as relatively high annual tonnages, significant temperature ranges, periods of extreme weather, high operating speeds, spillage of coal, poor formation support and narrow gauge track configuration all result in distinctive management and maintenance challenges for Aurizon Network, and consequently contribute significantly to the magnitude of Aurizon Networks maintenance task. A "one size fits all" maintenance strategy will not

[4] Source: RSA Department of Transport (2009) Rail Gauge Study Report
http://www.kzntransport.gov.za/reading_room/reports/natmap/NATMAP%20Rail%20Gauge%20Report%20-%20Final.pdf

always provide the most efficient solution as maintenance strategies need to appropriately account for unique network characteristics and the operating regime."

A full copy of the Evans & Peck report is included in Appendix N.

1.4.2 Network statistics

Table 4: Key attributes of the Central Queensland Coal Network

	Blackwater	Goonyella	Moura	Newlands
Track configuration	Bi-directional duplicated track with crossovers between Callemondah/Rocklands, Wycarbah/Grantleigh, Tunnel/Dingo and Bluff/Rangal). Single line with passing loops for the remainder of the system	Bi-directional duplicated track with crossovers between Dalrymple Junction/Broadlea). Single line with passing loops for the remainder of the system	Single line with passing loops	Single line with passing loops
Track gauge	1067 mm	1067 mm	1067 mm	1067 mm
Rail section for the main line	60/53 kg/m	60/53 kg/m	60 kg/m	60/53 kg/m
Rail section for sidings and passing loops	Mix of 60/53/47 kg/m 41kg/m (various locations)	Mix of 60/53/47 kg/m 41 kg/m (various locations)	60 kg/m (mostly) 53/47//41/31 kg/m (various locations)	53 kg/m (mostly) 50/47 kg/m (various locations)
Sleeper type	Sleeper Concrete timber and steel in some locations. Spacing typically 685 mm			
Formation Support	Crushed Rock Ballast			

Figure 4 below provides a ready reference of some of the terms used throughout this document. The key design and asset features have been labelled.

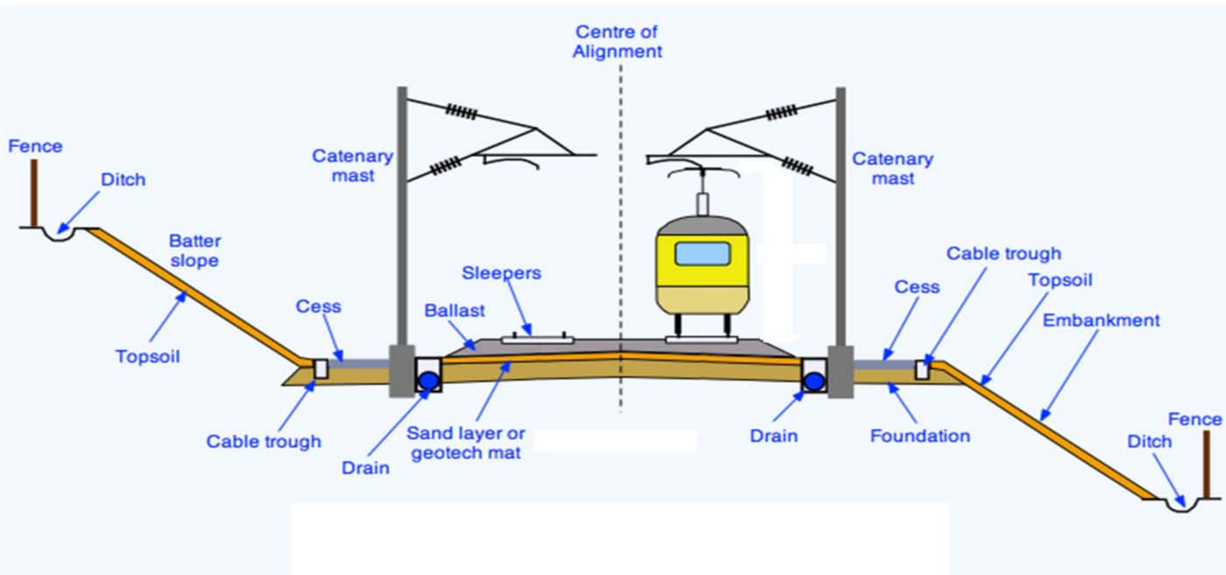


Figure 4: Railway cross sectional view with key terminology

Table 5 provides statistical data in relation to the quantity of physical assets that are currently deployed in the CQCN.

Table 5: System Statistics

	Blackwater	Goonyella	Moura	Newlands
Track length	1107 km	978 km	260 km	320 km
Electrified track	807 km	978 km	0	0
Turnouts	283	560	137	95
Number of culverts	1501	1224	528	777
Duplicated track length	263.71 km	203.43 km	0 km	19.80 km
Crossing loop length	75.98 km	66.76 km	22.03 km	31.47 km
Cross overs	6.5 km	4.2 km	0 km	0 km
Sidings	23.12 km	14.20 km	3.15 km	4.98 km
Fencing	1269 km	349 km	107 km	371 km
Signals	537	1226	119	214
Level crossings	220	300	145	93
Bridges (timber, concrete, and steel)	121	67	27	33
Footbridges (concrete and steel)	5	7	1	1
Weigh bridges and over load detectors	10	18	3	3
Dragging equipment detectors	83	91	19	24
HBD/HWD	7	12	2	5
Track circuits	2022	1594	224	242
Axle counters	69	105	20	116
Fixed radio monitors (locations)	56	74	16	50
Traction feeder stations	10	10	0	0

1.4.3 Additional Infrastructure

The high international demand for coal over recent years has seen considerable activity in the Central Queensland Coal Region and the network. Currently Aurizon Network has twenty seven (27) separate requests for additions to the existing network.

While some of these works are for additional balloon and passing loops, several major projects are being considered. These projects are at various stages in both feasibility and design, and are pending determination of their economic viability. Of these projects, Wiggins Island Rail Project (WIRP) Stage 1 has reached a level of maturity sufficient to justify inclusion in this submission. Construction works have commenced and the first train is expected to operate in mid-2014.

WIRP Stage 1 is a major infrastructure enhancement project designed to facilitate transport of approximately 27 MTPA of coal to the new Wiggins Island Coal Export Terminal (WICET). The works include new and upgraded infrastructure on Blackwater & Moura systems of approximately $900 million. This represents an increase in the capital value of the regulated asset base of approximately 20% and, therefore, a significant maintenance task increase. The project involves:

> Constructing a 13.2km single rail balloon loop adjacent to the existing North Coast Line to enable train unloading near WICET port facility
> Constructing a 10km triplication between Aldoga and the WICET balloon loop
> Formation strengthening on the Moura line
> Duplicating remaining seven single line segments on the Blackwater Line
> New passing loop and improved rail access on the branch line to Rolleston
> Constructing overheads, and electrifying the Wiggins Island Balloon Loop

As other projects reach execution stage, and where quantities of new infrastructure become known, Aurizon Network will seek to reach agreement with QCA on the impacts on the maintenance task.

The matters of ownership and management of the remaining projects are unsettled at this stage. Aurizon Network will consider the impact of these matters on this submission as and when the results are agreed to by the relevant parties.

Figure 5 illustrates the overall growth in the network as compared to maintenance costs for 6 years up to FY13. This graph highlights that during UT4 a significant increase in infrastructure that is required to be maintained in comparison to the UT3 period.

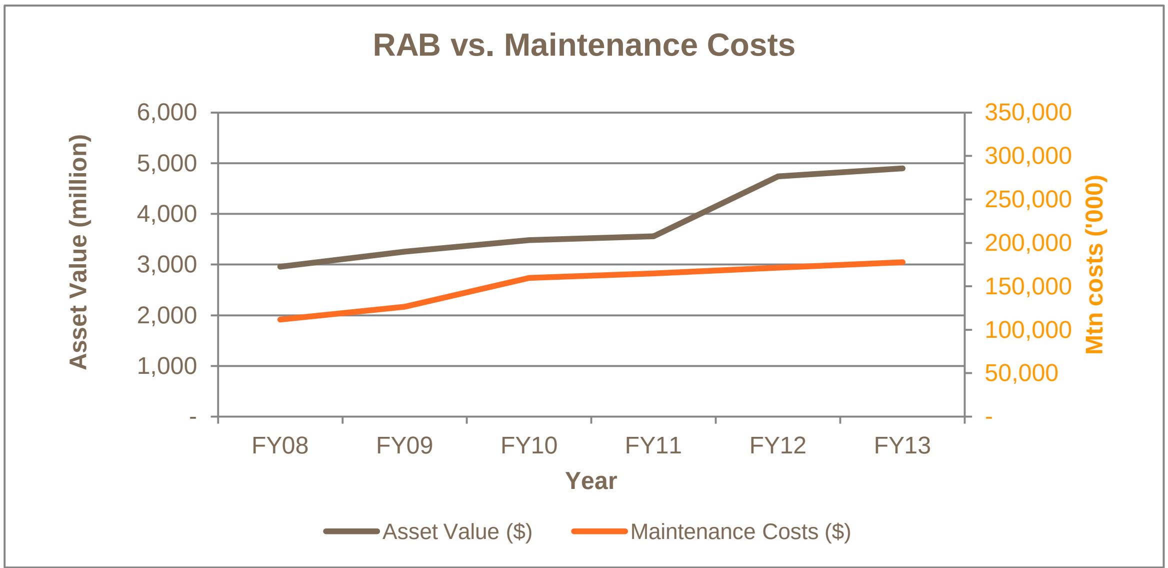


Figure 5: Growth in the network as compared to maintenance costs

1.4.4 Tonnage volumes

Over the last 25 year period, tonnage volumes have increased nearly threefold across the four systems as detailed in Table 6 and Figure 6 below.

Table 6: The coal tonnage figures for the CQCN over the last 25 years in Million Net Tonnes

System	FY88	FY93	FY98	FY02	FY07	FY12
Blackwater	19,960	22,113	31,658	38,567	49,150	55,067
Goonyella	34,507	39,544	50,751	71,188	87,769	84,031
Moura	5,516	6,439	9,121	9,756	11,865	12,986
Newlands	6,682	7,425	8,581	12,255	11,156	14,645
Total	66,665	75,522	100,111	131,767	159,939	166,738

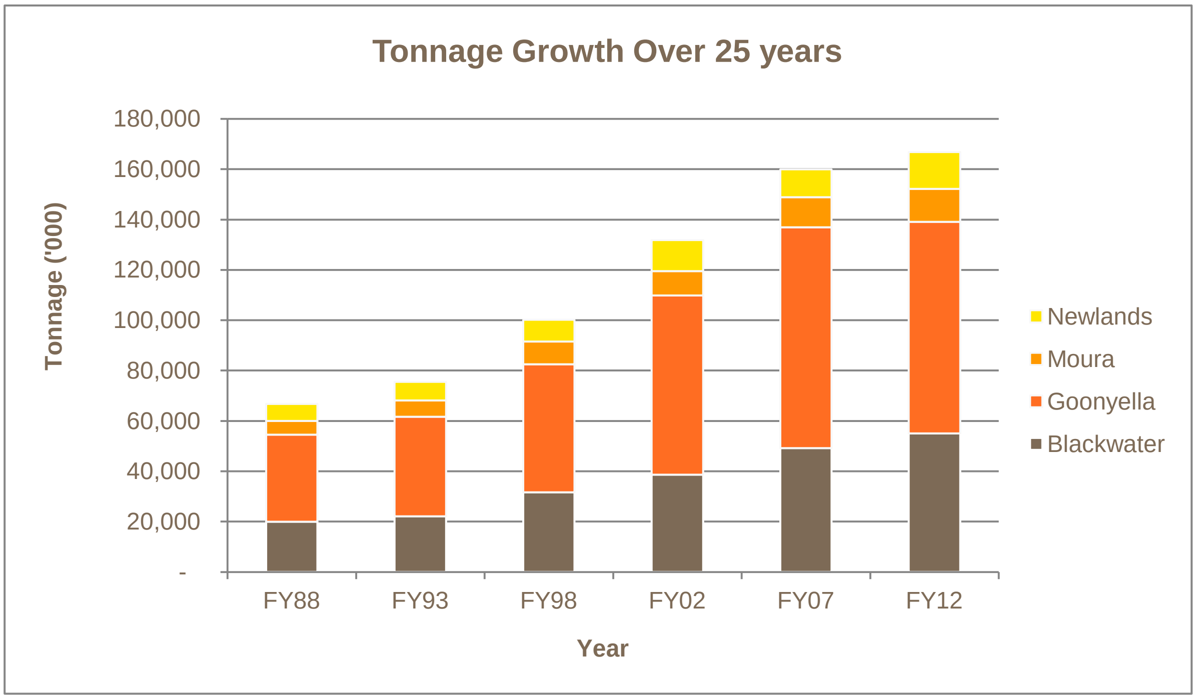


Figure 6: CQCN tonnage growth over the last 25 years

The table and graph below depict the actual volumes transported over the UT1 to UT3 period, and the forecast tonnages for the UT4 period. Although the Goonyella system will continue to carry around 50% of the total network capacity, the Blackwater, Moura and Newlands tonnage profile will increase as a result of the development activity in these catchments (e.g. WIRP 1, Goonyella Abbot Point Expansion).

Table 7: UT1 to UT3 Actual and UT4 forecast tonnages

	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09
System	UT1 Period - Actual				UT2 Period - Actual			
Blackwater	38,567	37,833	39,115	42,470	45,122	49,150	52,404	54,135
Goonyella	71,188	74,489	78,179	86,739	82,438	87,769	81,567	83,109
Moura	9,756	9,453	10,275	10,291	10,047	11,865	11,600	11,234
Newlands	12,255	12,899	12,272	12,984	11,624	11,156	12,914	14,721
Total	131,767	134,674	139,841	152,484	149,232	159,939	158,486	163,199

	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17
System	UT3 Period - Actual/Forecast				UT4 Period - Forecast			
Blackwater	58,290	49,810	55,076	54,795	54,366	60,896	67,408	73,389
Goonyella	99,660	88,521	84,031	96,861	97,332	106,428	112,028	116,928
Moura	11,296	9,896	12,986	11,772	12,535	13,608	12,963	14,080
Newlands	17,210	15,752	14,645	18,420	32,411	37,410	39,053	42,121
Total	186,456	163,978	166,738	181,848	196,643	218,342	231,452	246,518

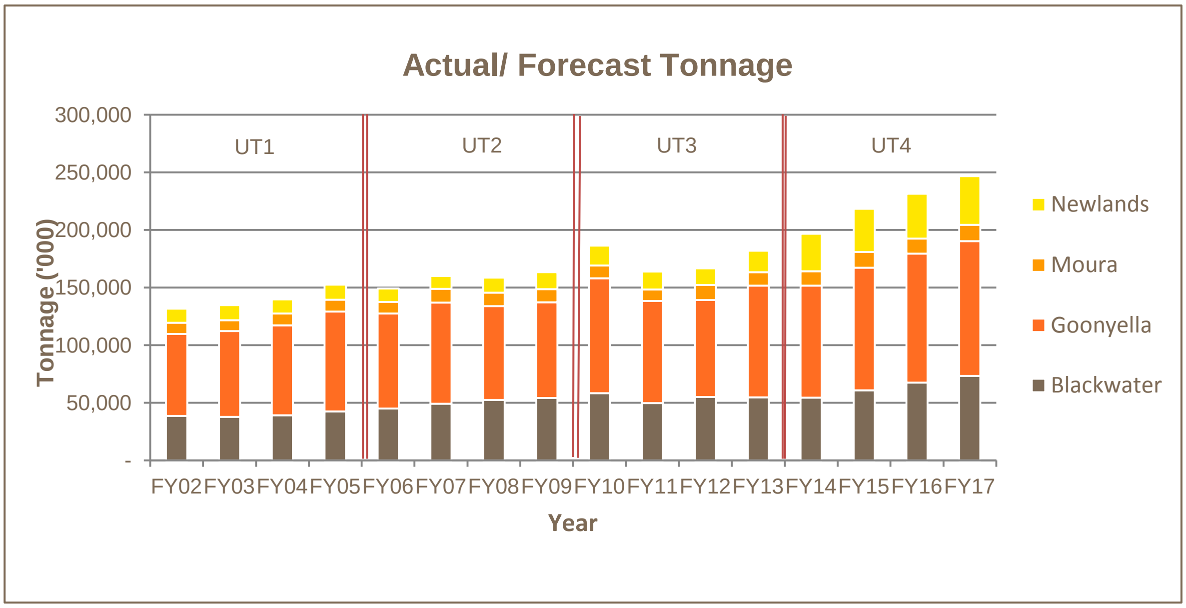


Figure 7: CQCN actual and forecast tonnages for UT1 to UT4

Because substantial quantities of track maintenance are based on wear rates, and as depicted in the tables above the Network is being used more by the supply chain participants, Aurizon Network's maintenance effort has also increased. Additionally, it must be noted due to the differing levels of individual mine activity and the inherently linear nature of railways, the distribution of the tonnage load varies widely across the network.

Closer to the ports the cumulative tonnage carried are inevitably higher than further out on the network and consequently require higher levels of maintenance. The demand on the lines also means the time available to carry out maintenance work is constrained. Figure 8 illustrates the impact of the cumulative tonnes on the infrastructure as it moves closer to the ports.

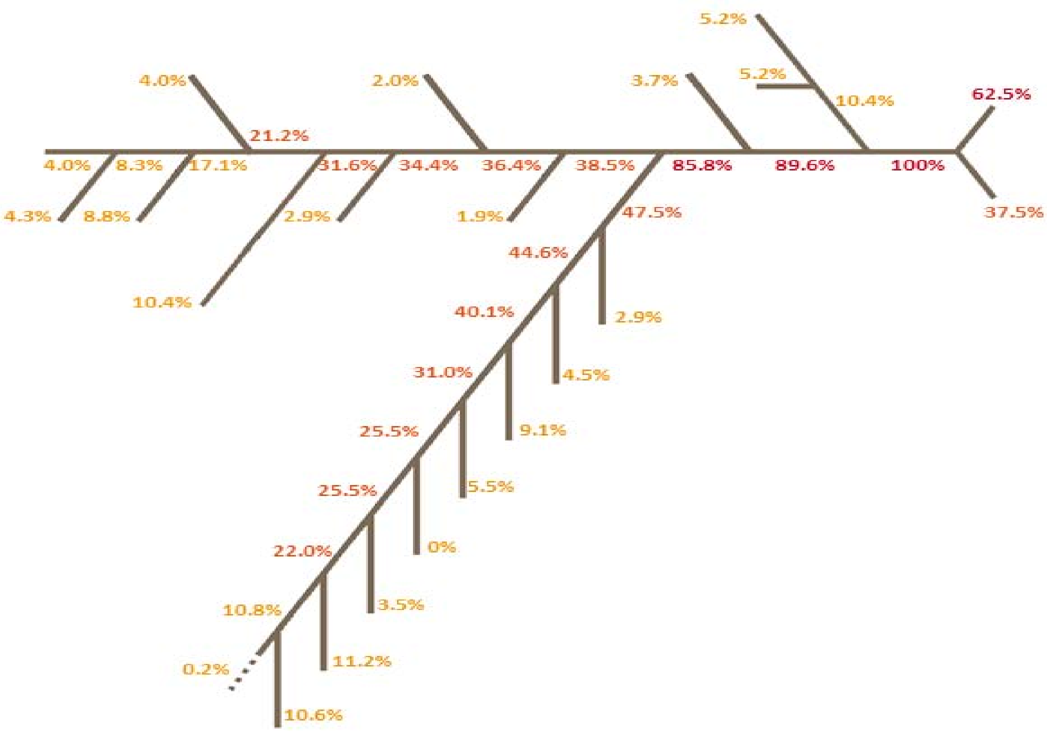


Figure 8: Cumulative tonnages across a system rise dramatically closer to the ports

1.5 Coal Supply Chain

The CQCN services a significant number of customers, stakeholders and facilities involved in the coal supply system, including:

> 42 mines plus loading facilities

> 4 above rail operators Queensland Rail, Aurizon (previously QR National), Pacific National and BMA in the future

> 3 power stations (Gladstone, Stanwell, Collinsville)

> 2 Port Authorities with 5 Terminal Operators servicing 5 coal terminals:

- North Queensland Bulk Port Authority.
  - Hay Point with the Hay Point Services Coal Terminal (BHP)
  - Dalrymple Bay with the Dalrymple Bay Coal Terminal (Brookfield)
  - Abbot Point with the T1 Terminal (Adani Mundra Ports)
- Gladstone Port Authority
  - Gladstone Port with the RG Tanna Coal Terminal (Yancoal)
  - Barney Point with the Barney Point Coal Terminal

> 4 major industrial plants (Yarwun Refinery, Queensland Alumina Plant, Cement Australia, Bowen Coke Works)

> Numerous industry groups (refer to Section 3.3.2 for further detail).

In addition to the above, numerous other stakeholders are affected by the coal network operations, including: property owners, local communities, local councils, government agencies, other rail infrastructure managers and major business partners. All of which have a range of competing interests and expectations of the coal network.

Aurizon Network actively engages with all members of the supply chain in the planning and delivery of maintenance services to endeavour to fulfil the access and product delivery needs and expectations of the various stakeholders. Where contradictory requirements are found, Aurizon Network seeks to resolve the differences and deliver an effective outcome for the industry as a whole.

Further information on how the Coal Supply Chain influences Aurizon Network's maintenance philosophy can be found in Section 3.3.2.

1.5.1 Contractual arrangements

The commercial arrangements involved in the coal supply chain consist of a number of related contractual arrangements. These commercial arrangements define terms and conditions under which services will be requested, supplied and paid for.

Overall, the complexity of the stakeholder and contractual relationships inherent in the coal supply chain has increased markedly as new mines, port facilities and other operators have gained entry to the environment and the systems have become more interconnected with more reverse direction mine/port combinations.

Aurizon Network is one of four entity types involved in the logistics of the coal supply chain. Aurizon Network has two commercial relationships for the transport of coal with either the above rail operator or, more directly, the mine itself. The remaining contractual relationships Aurizon Network has in the chain are in place for the safe management of interfaces.

With the mines managing numerous interfaces into the supply chain the performance requirements become extremely complex. Requirements for different parts of the supply chain vary according to the widely different commercial drivers affecting each component and their relative cost in the chain. Recent market research undertaken indicates that the below rail access costs represent a small component of the total cost of moving coal from mine-head to end customer. More details on this discussion are contained in Section 5.2.

In addition to the above, this complexity is multiplied many times given the number of mine operations across Central Queensland. As such, from the supply chain perspective efficient cost must be couched in terms of the availability, reliability and certainty demands and trade-offs of industry. Figure 9 illustrates the complexity of the contractual flows within the coal supply chain.

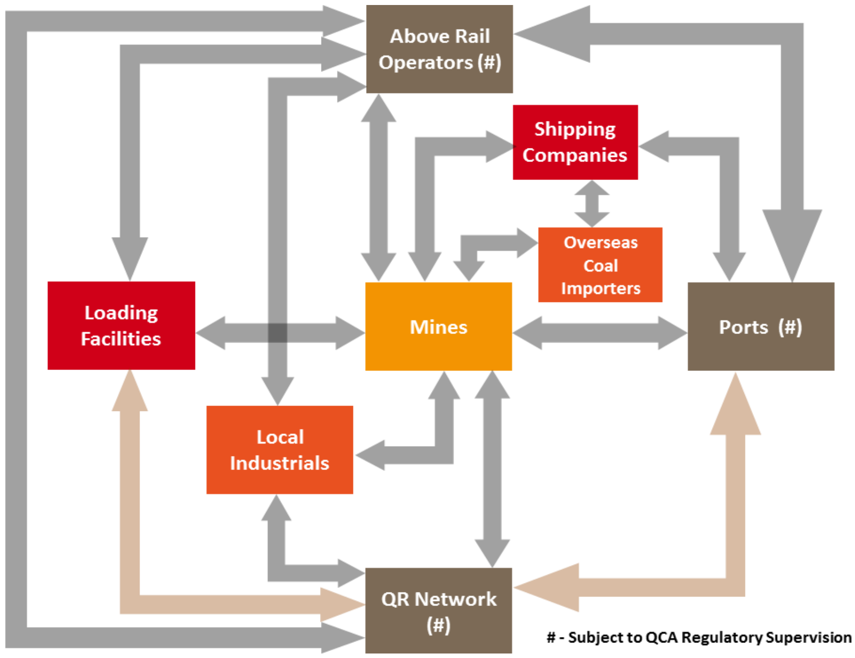


Figure 9: Contractual flows of the CQCN

1.6 Environmental and Geological Considerations

Because of the location and geography of the CQCN system, it experiences extreme weather conditions which can affect the delivery of services and have a high impact on the maintenance budget due to the direct and indirect damage caused to track and associated rail infrastructure.

1.6.1 Rainfall and Flooding

Over recent years, the La Niña weather phase has been prevalent. This phase is often associated with above average winter, spring and summer rainfall over most of eastern Australia. Tropical cyclones are often more frequent during La Niña events. These cyclones can cross the Queensland coast at any point with the latest being Cyclone Yasi in 2011, which was considered one of Queensland's most serious disasters. Cyclone Yasi was not an isolated event but came amidst a very strong La Nina weather event. There was heavy rain in Queensland beginning in August 2010, producing the wettest spring since 1900, nearly triple the average rainfall. Thirty per cent of Queensland (south-west, central interior, central and tropical coasts, and adjacent inland) had the highest rainfall on record, with the rest of Queensland having 'very much above average' rainfall.

It should be noted while the weather event may reduce maintenance activities while it is occurring, it also requires an escalation in maintenance tasks after the event. Traditionally the nature of the remedial work is defined in time and effort; time taken to complete the maintenance task so as to enable trains to operate under speed restrictions or impaired operational conditions. It is also possible additional time required completing the remediation works is required to reinstate the track to its previous condition. The maintenance planning cycle's consideration of the design capability of the infrastructure assists in the forecast maintenance planning for the network. During this maintenance planning stage, provision is also made for preventative maintenance requirements of the asset as well as specialised maintenance tasks to reinstate a flood-affected asset.

Queensland has a wet-summer, dry-winter rain pattern. Generally, the wet season in Queensland is from January to April where monthly rain falls of 400 mm or more can occur, with localised high-intensity rainfall. The highest rainfall occurs on the seaward side of the Great Dividing Range. At times in summer the inland extension of low-level moist airflow, in combination with intense surface heating, produces significant thunderstorm activity.

The Coastal Dividing Range causes further variability. This coastal strip experiences average annual rain of 1000-1600 mm in the south to over 3000 mm around Innisfail, while west of the dividing range rainfall averages 700 mm (Dalby) to 215 mm (Birdsville).

Flooding of low lying areas is likely to occur during these periods of extreme rainfall. Due to flooding, the Goonyella, Blackwater, Newlands and Moura Systems can be closed on average for 2-3 days every 3-4 years. This is an average figure and closure periods of greater duration are possible in any one year.

In comparison to other states, the average yearly Queensland rainfall is generally a lot higher. This is evidenced in Figure 10 below, which shows the long-term annual rainfall for Queensland compared with NSW/ACT.

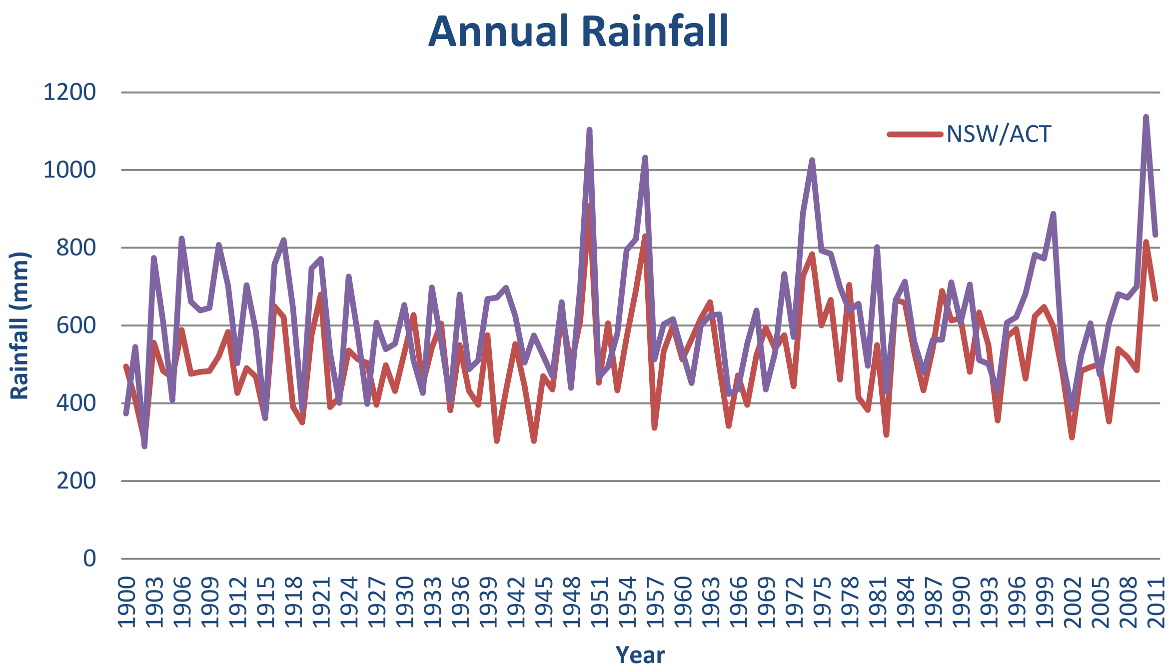


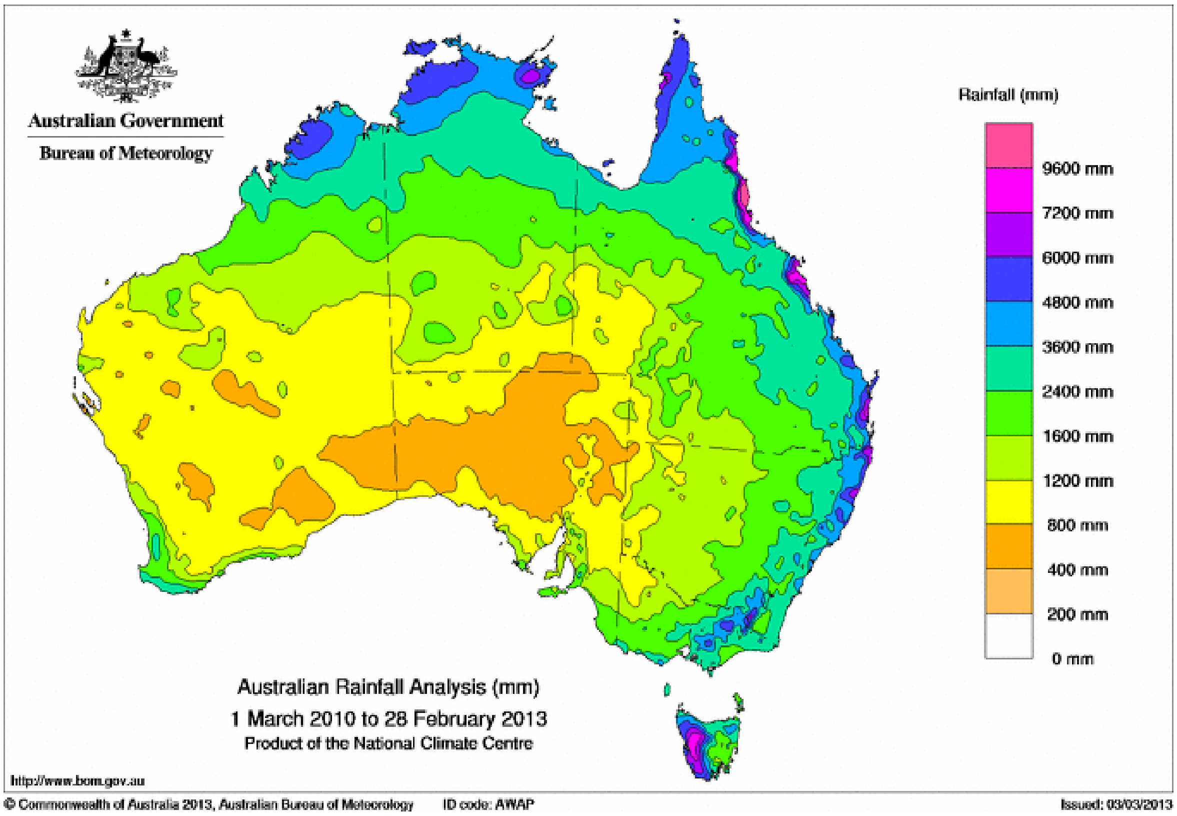
Figure 10: Total Rainfall comparison QLD vs. NSW/ACT

Large volume and high intensity rainfall has a significant detrimental effect on railway infrastructure. This can be manifested in increased occurrence of formation failures, contaminant to ballast layers, track inundation, track structure erosion and washout, culvert blockages, electrical equipment failure, corrosion especially in coastal areas, difficult access to the corridor to effect repairs and accelerated growth of vegetation in the corridor.

These impacts can be felt immediately where direct damages caused by localised flooding and water ingress, but equally apply to longer term impairment of the asset. It is not uncommon to experience high levels of mud-holes and formation failure 12-18 months after a significant rain event. In addition to these rain events, direct and indirect lightning damage due to thunderstorms can affect communications, signalling and electrical infrastructure.

Flood vulnerable facilities, such as the rail yard at Aroona, are often fitted with alarms and automated cut-off switches to limit electrical damage. Where extreme wet weather events are imminent, Aurizon Network takes preventative actions to protect trackside equipment in anticipation of flooding. This means closing the network in advance of the weather event to allow maintenance crews to remove track circuit equipment, points machines and transformers. This is the type of maintenance planning described on the previous page.

Figure 11 shows higher levels of rainfall in Queensland occur over wider areas and with many more areas of extremely high rainfall near the coast than is the case in either NSW or Western Australia.



http://www.bom.gov.au/jsp/awap/rain/index.jsp?colour=colour&time=latest&step=0&map=totals&period=36month&area=nat

Figure 11: Total Rainfall comparisons across Australia

The effects of extreme wet conditions include impairment to the ability of telecommunication maintenance personnel to service hard to get to locations, such as:

> The last few kilometres of dirt track to a hill top antenna facility which may be washed away
> Road surface gutters
> Track washouts and the danger of sharp drop-offs.

Telecommunications equipment and signalling facilities can also be adversely impacted by lightning and power supply issues. For example, an induced electrical current caused by a lightning strike can affect points and other trackside equipment when the electrical current is conducted through the rails or other power and control cables.

1.6.2 Extreme temperatures

Periods of extreme temperature either hot or cold have the potential to cause damage to track structures, including track buckling and breakage.

Most of Queensland is subjected to mean maximum temperatures above 24°C, with 50% of Queensland subjected to mean maximum temperatures above 30°C. However, almost all parts of Queensland can experience peak maximum temperatures above 30°C, with 70% of Queensland experiencing peak maximum temperatures above 33°C

To mitigate the risk of an incident and to help protect the network, Aurizon Network implements a range of hot weather precautions which uses speed restrictions to manage the speed of trains. The key elements of the controls are:

> Air Temperature 38°C and above:
  - On timber sleepered track, restrict all trains to 60 km/h ([5])

[5] Note: Steel sleepered track and timber sleepered track with interspersed steel sleepers are regarded as equivalent to timber sleepered track for track stability.

> Air Temperature 40°C and above:

- On timber sleepered track, restrict all trains to 40 km/h
- On concrete sleepered track, restrict all trains to 60 km/h

Temperature extremes have a mechanical effect on the track; whereby very high temperatures can cause tracks to buckle, while extremely low temperatures can result in the tracks contracting, which can lead to “pull-aparts”. In either case, these conditions can lead to the need for additional maintenance effort and remedial work. Temperature issues are exacerbated during transitions from cold to hot periods when higher than normal temperature differentials along the tracks create additional rail stress.

During extreme cold weather periods the rail is often affected by thermal contraction leading to intermittent faults with the train detection systems. This affects train services as there is a need to check and correct the indicated faults before the network can return to normal operations.

The CQCN network straddles three main climatic types - Equatorial, Tropical, and Sub-Tropical - each of which produces extreme temperatures and high rainfall. Other similar coal networks, such as the ARTC in the HVCN, tend to be located in temperate climate areas where the rainfall and temperature changes are mild and do exhibit the extremes experienced in CQCR.

The figures below illustrate how coal networks in NSW are subject to maximum temperatures of approximately 27°C, where the QRN Network reaches average maximum temperatures of 33°C. These variations in temperature have a considerable impact on the design and maintenance of each CQCN.

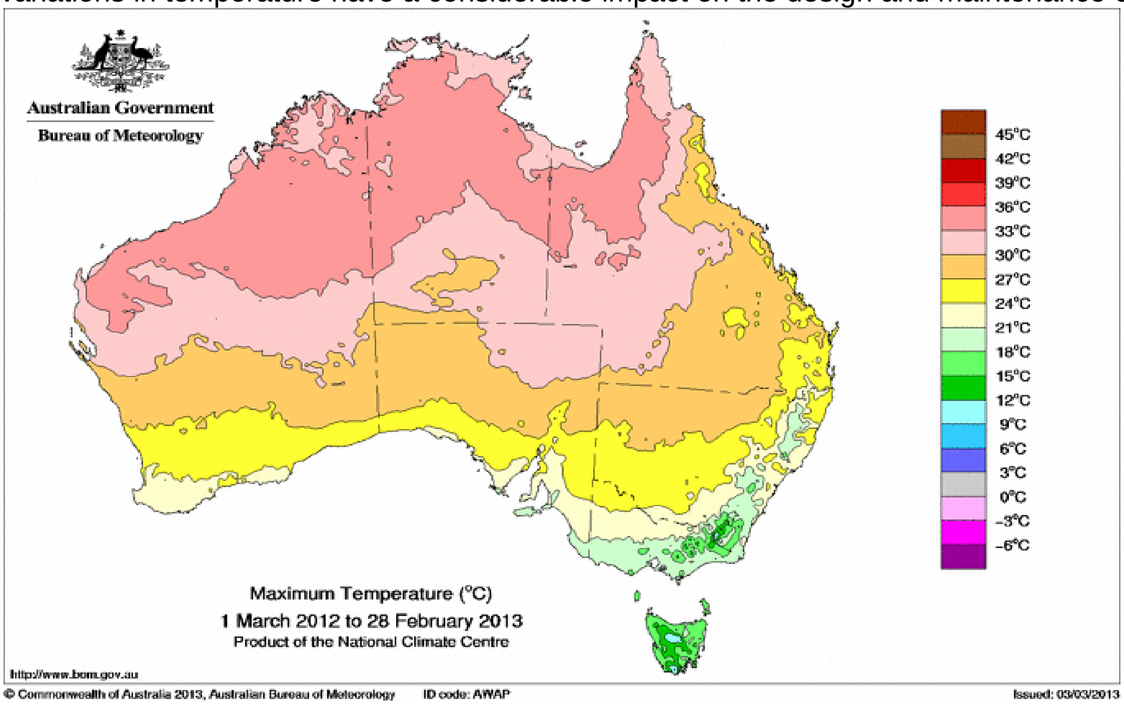


Figure 12: Mean maximum temperature comparisons across Australia

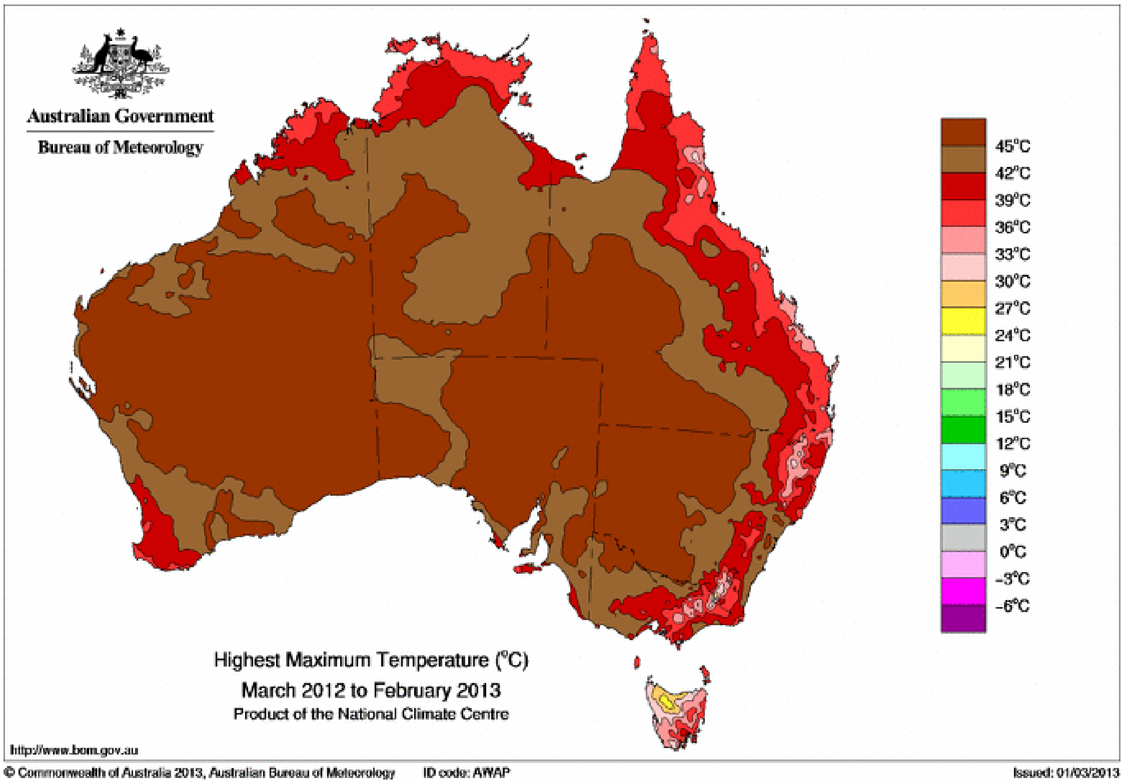


Figure 13: Highest maximum temperature comparisons across Australia

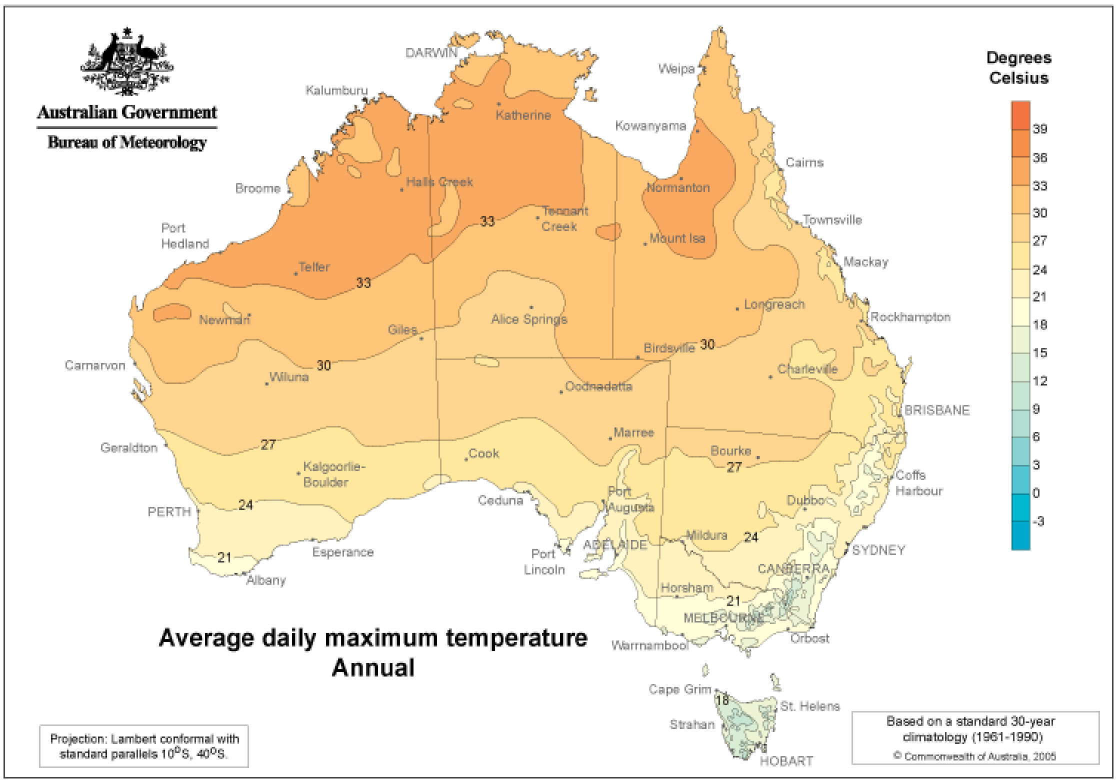


Figure 14: Average daily maximum temperature comparisons across Australia

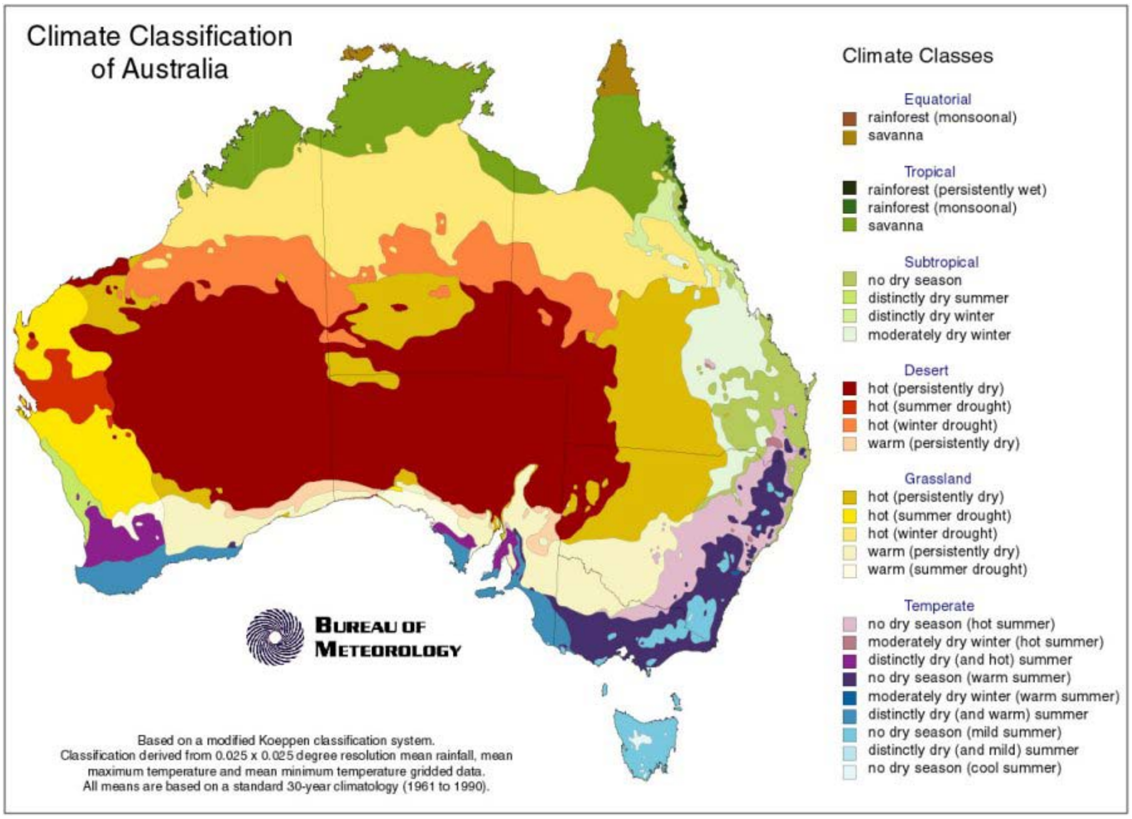


Figure 15: Climate classification of Australia

1.6.3 Soil conditions

Vertosols, or black soils, are the most common soil in Queensland; covering 29% of the State (see Figure 17 below, depicting the soil types and coverage in Australia). They are typically clay soils exhibiting strong cracking when dry. Shrinking and swelling causes strong physical pressures within cracking clays that may impact on the long-term structural integrity of the soil. These effects are manifested during periods of extreme weather conditions – wet and/or high temperatures.

Sodosols, or sodic soils, are very high in the element Sodium. Sodicity in soils has a strong influence on the soil structure. A high proportion of sodium within the soil can result in dispersion, which occurs when the clay particles swell strongly and separate from each other on wetting. On drying, the soil becomes dense, cloddy and without structure. This dense layer is often impermeable to water and plant roots. Within central Queensland, sodicity occurs on older alluvial and scrub soils. Most of the grazing soils in central Queensland are sodic at depth. Sodic soils are particularly prone to erosion which can result in damage to access roads and cuttings, and the need to remove deposits clogging culverts and cess drainage.

Figure 16: A cutting through sodic soil at Riverside on the Goonyella Line

Acid sulphate soils containing iron sulphides which, when exposed to air after being disturbed, produce sulphuric acid and often release toxic quantities of iron, aluminium and heavy metals. They are commonly found in mangroves, salt marshes, floodplains, swamps, wetlands, estuaries, and brackish or tidal lakes, particularly in low-lying coastal areas. Acid sulphate soils can have major environmental, economic, engineering, and health impacts, and can constrain development, construction and other activities in affected areas. Their corrosive impact on the rail infrastructure limits the use of corrugated iron culverts and increases maintenance costs in respect of metallic assets frequently exposed to ground water.

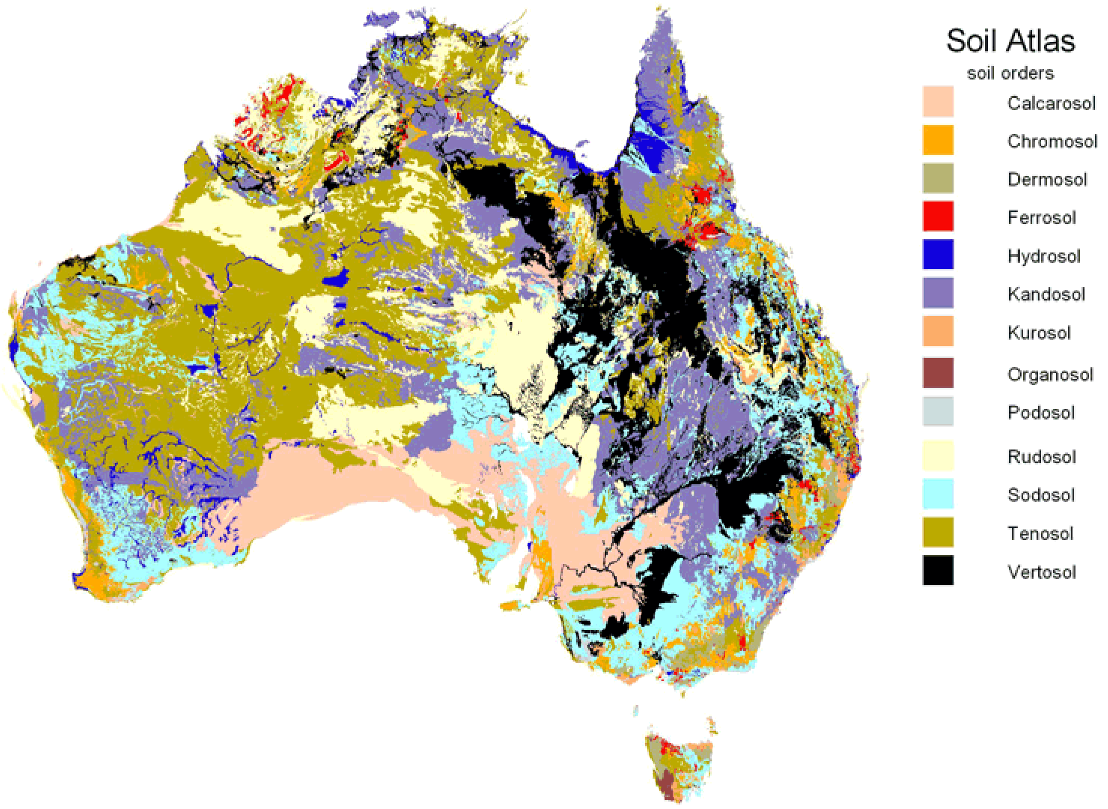


Figure 17: Australian Soil Classification

When combined with the high incidence of tropical cyclones and high intensity rainfall events frequently occurring during the summer months, these problematic soil types have created additional maintenance workloads due to the need to repair damage to formations and embankments and clear clogged drainage channels.

The fine silts these soil types produce are especially problematic as they are hard to clear through normal runoff water flows and are particularly prone to catch in the track ballast, which results in a need for more regular ballast cleaning efforts. Sinkhole or piping failure increases the maintenance and reduces the immunity to severe rainfall events. This also increases maintenance costs and may result in train delays and speed restrictions.

Where the CQCN passes through the Great Dividing Range escarpment (e.g. at Black Mountain), high rainfall is implicated in rock falls and slips affecting both man-made formations and natural slopes needing to be anticipated through surveys, periodic checks and remedial works.

Apart from the erosive impacts upon cuttings, embankments and track formations, expansive soils can also place stress on optical fibre cables, particularly where there are older cables. This can result in degradation of signal quality and higher levels of corrective maintenance activity.

1.7 Safety as a Core Value

The Commonwealth and every state/territory have legislation to cover rail safety, electrical safety and workplace health and safety. Together these laws provide every entity and person in every workplace in Australia with specific legal responsibilities to ensure the health and safety of themselves and others. Where the requirements of these laws are not met, financial penalties and jail terms apply. Although each jurisdiction has its own laws, the main features are the same:

> Employers carry the main responsibility for health and safety in the workplace - they are required by a 'duty of care' principle to show due diligence in protecting the health, safety and welfare of employees, visitors, contractors, general public and others in the workplace

- Employers must take all reasonable care to reduce and control the risk of injury or illness to workers and members of the public arising as a result of work activities being undertaken in their workplace.
- Employees have a responsibility to take reasonable care of themselves, others and to cooperate with employers in matters of health and safety
- Manufacturers and suppliers of plant and substances have a responsibility to ensure their products are safe when properly used, and to provide information on the correct use and potential hazards associated with the use of the products in the workplace.

Aurizon Network embraces its responsibility for ensuring that every worker is able to return home uninjured. Safety is a core value for the entire Aurizon group. Together the group strives for a “ZEROHarm” culture through which Aurizon Network aims to ensure its employees, contractors and all other people affected by Aurizon Network’s operations can expect to remain free from injury.

Results for the latest reporting period show Aurizon Network’s Lost Time Injury Frequency Rate (LTIFR) was reduced by 22% and Medically Treated Injury Frequency Rate (MTIFR) reduced by 44%. More detail on Aurizon Networks performance is contained in the following section.

Taking into account the stringent safety requirements of rail operations, mining sites and port facilities, being able to provide the level of safety standards consistent with Aurizon Network’s values is challenging and comes at a financial cost.

1.7.1 Achieving “ZEROHarm”

To achieve its “ZEROHarm” goal, Aurizon Network uses an integrated Safety Management System (SMS) providing a set of proven processes and systems driving safety outcomes at both an organisational level and while working on the network. The SMS contains engineering and technical information and specifications for asset design, construction and maintenance as well as rail, workplace health and safety and electrical safety requirements described in law. The SMS conforms to the requirements of the Transport (Rail Safety) Act 2010 and as an accredited Rail Operator and Rail Manager; Aurizon Network is legally compelled to adhere to stringent safe working practices. A key element in Aurizon Network’s safety commitment has been its partnering with DuPont. DuPont is regarded as a world leader in safety practice and innovation. As the science in workplace safety continues to involve, an ever increasing focus on worker/contractor behaviour has been critical in the improved safety performance of Aurizon.

These processes are extensively monitored and audited to ensure ongoing compliance with the Rail Safety, Workplace Health and Safety, Electrical Safety and Workers Compensation Acts and relevant Australian standards.

Aurizon Network’s “ZEROHarm” philosophy is evidenced in every point within the maintenance planning and delivery process. This is based on five principles:

- All injuries and diseases are preventable
- No task is so important it cannot be done in a safe manner
- We seek to identify all foreseeable hazards and manage the risks associated with them
- Everyone has a personal responsibility for the health and safety of themselves and others
- Health and safety performance can always improve.

Aurizon Network applies a range of best practice safety initiatives in its day-to-day operations across all facets of the business, including but not limited to:

- Safety shares
- Safety interactions
- Hazard identification
- Safety Leadership Coaching
- Situational Safety Awareness training (for all operational safety)
- Risk Awareness training (for all operational supervisors and managers)
- Toolbox talks and pre-start meetings

- Workplace inspections
- Risk assessments
- Safety Improvement Committees
- Worker competency framework
- Continuous improvement and application of the Safety Management System.

The safety system Aurizon Network applies to the work carried out under this Access Undertaking aims to:

- Ensure Aurizon Network's activities are undertaken in accordance with all relevant legislation
- Ensure processes and practices comply with:
  - AS 4292 Series for Rail Safety
  - AS/NZS 4801 and 4804 Occupational Health and Safety Management
  - AS/NZS ISO 9001 Quality Management Systems
  - AS/NZS ISO 14001 Environmental Management
  - AS/NZS 4360 Risk Management.
- Identify, analyse and mitigate potential hazards resulting from operational activities
- Institute a proactive risk management system
- Provide information, instruction, training and supervision to staff, contractors and all parties entering or interfacing with the rail corridor to ensure strong safety management
- Put in place safety processes and programs recognising, protecting and benefiting all stakeholders
- Drive clear open communication and support for the safety systems at all levels
- Promote a safety-conscious culture
- Provide transparent and consistent reporting to all stakeholders, the Rail Regulator and other interested parties.

1.7.2 Examples of Specific Safety Risks

Each of the systems has unique safety risks dependant to their location, which are discussed further in Sections 6-9. However, some examples of the network-wide risks to be mitigated through operational procedure and at a maintenance cost are detailed in the table below.

Table 8: Examples of network-wide safety risks

Safety Risk	Safety Practice
Fatigue issues	Safe working procedures mean total shift length and travel time is considered a part of the working day. In some cases, accommodation may be required close to the maintenance site to avoid travelling in a fatigued state.
Working in extreme temperatures	Work practices are appropriately modified during extreme conditions.
Working track-side safely	To ensure that workers can perform maintenance tasks without the risk of collision with rolling stock and track machines, a comprehensive program of "safe working" is deployed.
Blackwater and Goonyella Track Electrification	Electrical isolation of the worksite must occur prior to commencing any maintenance work.
Operating rollingstock in extreme temperatures and gradients, causing possible derailment or damage to the track	Aurizon Network enforces speed restrictions when temperatures reach 38°C and above.

Safety Risk	Safety Practice
Risk of bush fire, due to sparks generated during grinding activities	Mitigated by scrub elimination of flora close to the track lines, fire breaks created, maintained, and at times, grinding at night in cooler temperatures.
Rock falls and slips	Monitoring equipment and rock fall sensors are in place on those systems that are badly affected.
Subsidence in access roads or under rail structures caused by black soils swell-shrink properties	All maintenance vehicles must proceed with caution on access roads. Awareness of the high risk areas is essential. Monitoring methods are utilised to ensure structures are secure, or if additional ballast is required for stability.

Maintenance training time statistics for June 2012 show mandatory safety, compliance and competency training now represents over 8% of operational time.

1.7.3 Managing contractor safety and quality

Aurizon Network has specific obligations for managing subcontractors. In particular, it is required to comply with the requirements of the Transport (Rail Safety) Act 2010 and the Queensland Workplace Health and Safety Act 2010.

While any work is being undertaken in the Rail Corridor and the network, Aurizon Network is responsible to ensure all people including subcontractors and their employees comply with the requirements of the Safety Management System (SMS). Mature safety management processes form a part of Aurizon Network's selection criteria for subcontractors and, as a minimum, they are required to comply with Aurizon Network's SMS and specific safety management plans.

All workers who work within the Rail Corridor are required to:

> Have the appropriate training and accreditation

> Undertake safety training

> Attend and participate in all pre-start briefings

> Adhere to Aurizon Network's SMS as it applies to their operations onsite

> Follow all procedures within the Safety Management Plan and cooperate fully with site emergency incident procedures and consultative arrangements

> Observe subcontract and statutory requirements and legislation, and follow instructions issued by Aurizon Network management and supervisory personnel

> Manage or comply with all directions issued by the Principal Contractor associated with the activity

> Nominate site representatives to liaise with Aurizon Network on the safety requirements for site activities and take responsibility for those activities.

Contractors may also be required to comply with Aurizon Network's Quality Management System (QMS) and have in place systems and processes approved and operated in accordance with the requirements of ISO 9001 Quality Management Systems.

To help develop an integrated and assured quality approach, contractors are:

> Treated as an extension of the Aurizon Network team and inducted and receive all the necessary training for them to perform their roles safely and efficiently while delivering the expected quality outcomes

> Closely monitored to ensure their activities and deliverables comply with the QMS

> Required to produce reports detailing their compliance, and any quality concerns.

Aurizon Network regularly monitors the work of contractors to assess the effectiveness of their safety management measures and determine compliance with the requirements of the Safety Management Plan and Aurizon Network's quality standard

1.7.4 Safety Performance

Aurizon Network's investment in safety through the period mid-2008 to mid-2011 shows a 50% reduction in LTIFR.

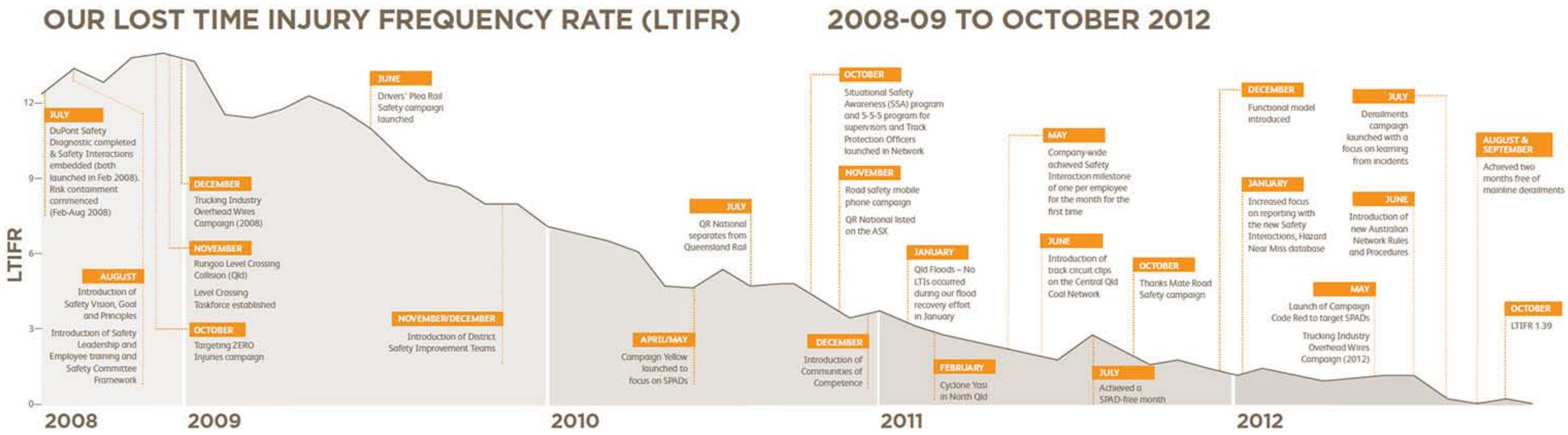


Figure 18: Lost time injury frequency rates (LTIFR) and Medically Treated Injury Frequency rates (MTIFR) 2009 to 2012

A key aspect of rail safety is Trackside Safety Rules, also known as the "rule book". Over the past 7 years Aurizon Network has lead Australia in the development and deployment of a new suit of "Trackside Safety Rules". These rules have been collaboratively developed through the Rail Safety Standards Board (RISSB) and all rail operators in Australia. In this regard, Aurizon Network is an Australian and world leader. We have successfully deployed the new rules to Aurizon Network's staff, contractors, above rail operators and all parties interfacing with the network

As a result of Aurizon Network's commitment and achievements to safety, the business has been recognised at a national level for its safety performance. In 2011 Aurizon Network (as Aurizon Network) was recognised by the National Safety Council of Australia (NSCA) and the Transport and Logistics Council (TLC) for training and innovation in the delivery of safety training.

1.7.5 Safety trends

Aurizon Network expects to see continued moves to improve worker safety across all industries in Australia over the next few years. This will potentially result in greater legislative obligations and oversight. For example, in July 2009 the Council of Australian Government (COAG) agreed to establish a National Rail Safety Regulator (NRSR) by 2013.

The NRSR will have responsibility for regulatory oversight across all of Australia. This will include national law, operational policies and processes, planning and reporting, education, research and safety promotion together with overall leadership and coordination of regulatory functions.

The impacts of this change on Aurizon Network's maintenance activities will need to be assessed as the changes are implemented.

1.8 Access Undertaking Performance

The Access Undertaking framework has been operating since 2001 and has passed through three cycles so far; UT1, UT2 and UT3. Over those years, Aurizon Network has endeavoured to ensure the maintenance scope is appropriate to industry standards and has matured the management of the program for maximum efficiency in both pricing and delivery models.

The maintenance scope and cost contained within this Maintenance Submission builds on that contained in the UT3 Maintenance Submission. The foundation elements of the maintenance effort remain unchanged between the two Regulatory Periods, allowing for increased tonnages and a larger rail network. The maintenance effort described and costed in this submission remains consistent with the approach taken in UT3 and is based on the requirements of the Safety Management System.

1.8.1 UT1

UT1 maintenance costs included in the tariff calculations were agreed after the QCA undertook a detailed review process which is summarised in the paper, *The Cost Effectiveness of Queensland Rail's Infrastructure Maintenance, Central Queensland Coal Systems* (November 2000).

The review took over twelve months and "utilised extensive Queensland Rail staff interview information and data supplied by Queensland Rail, maintenance contractors and other railway administrations."[6] As a result of the review, the QCA applied a 15% efficiency factor to QR's forecasts.

1.8.2 UT2

Forecasts for the UT2 period were developed using average target cost levels which reflected expected efficiencies for specific maintenance activities, such as ballast undercutting and rail grinding.

QCA reviewed these forecasts and concluded while the costs were reasonable in their own right, they included costs attributable to non-coal traffic and were not consistent with the higher volume forecasts they proposed.

[6] Rail Management Services Pty Ltd (2000), Queensland Rail's Infrastructure Maintenance Central Queensland Coal Systems, November.

Adjusting for these two factors, the QCA approved maintenance costs that were on average 1% higher in real terms than those proposed by Queensland Rail. Based on the proposed efficiency gains built into Queensland Rail's forecasts an X factor (efficiency improvement) of zero was applied to the approved total.

In late 2006 it became evident Queensland Rail's actual maintenance costs were significantly higher than the forecasts approved for UT2.

A full review of the UT2 maintenance allowance conducted by Queensland Rail in 2006-07 revealed the original UT2 maintenance forecasts Queensland Rail submitted to the QCA in early 2004, and which underlined the UT2 allowance, were fundamentally flawed because they:

> Did not anticipate the significant impact the construction and mining boom in the Central Queensland Coal Region had on input costs
> Took insufficient account of the impact of increased network activity on the unit rates for key activities (including locomotive test trains, and rail material supply trains)
> Did not anticipate changes in maintenance practices required to respond to the increased demand for access to the network, increased capacity expansion program and a need to minimise the number of track possessions to maximise throughput
> Were produced using data which underestimated the true cost of delivering maintenance activities
> Were based on target efficiency gains on key activities that did not eventuate and were no longer expected to eventuate in the prevailing central Queensland economic climate.

As a result, QR proposed the approved UT2 maintenance forecasts not be used as a basis for preparing a revised maintenance cost allowance for UT2 and put forward an alternative methodology which based the maintenance forecasts for the final two years of the undertaking on the maintenance forecasts approved in the UT1 decision.

These latter forecasts based on the UT1 numbers were accepted by the QCA and resulted in an increase in the maintenance allowance in the final two years of the undertaking.

1.8.3 UT3

The UT3 Maintenance Costs submission of 2009 was based upon a full review of the maintenance activities leading to a detailed maintenance plan used to develop a robust UT3 maintenance cost forecast, including:

> A detailed quantification of assets to be maintained
> The specification of the objectives of the maintenance standards and any required maintenance standards
> An explanation of the activities to be undertaken to achieve these goals and how these activities were to be managed
> A discussion of why the proposed approach to maintenance activities was chosen
> An analysis of the forecasting approach both in terms of the scope of work and the unit rates used to derive the cost estimates
> The quantification of key risk factors and specification of how these risk factors were accounted for in the forecasting process.

A number of discussion papers were released to industry prior to the development of the maintenance cost forecasts. This consultation process received only limited industry feedback.

Unlike UT1 and UT2, which benefited from long periods of low rainfall during the El Nino cycle, UT3 performance was impacted by the extreme La Nina weather events of 2010 through to early 2012 and, generally, a return to above average rainfalls. The increased costs and production difficulties associated with the wet conditions were not contemplated during the UT3 development process.

Other impacts on maintenance delivery during UT3 include:

> High demand for accommodation in the CQCR, due to the mining demand, limited the availability of accommodation for workers to perform maintenance across the network. As a result, many crews

had to travel long distances to complete maintenance tasks, adding to cost and introducing greater fatigue management issues.

> Resource retention of maintenance teams was affected by coal industry skills shortages. This was most acutely felt in plant operators of the mechanised maintenance products, who typically require 12 months training on the job, yet had a 30% turn-over. The attraction and retention of technicians and electricians required to maintain the signalling and traction equipment was also an issue. Aurizon Network has moved these staff to higher paying contracts in an effort to compete for resource.

> Major derailments totalling $5.3m had an impact on maintenance scope and costs during 2010/11. In line with the long term average, there were five major derailments in 2010/11 causing major track and infrastructure damage to the Network. There was a slight improvement on the 2011/12 year, with a derailment spend of $2.8m.

> A high production turn-out tamper was severely damaged and written off by a road vehicle at a level crossing in September 2010. Major plant, typically, takes in excess of 2 years to procure.

> Several new safety processes and improvements were implemented throughout the year contributing to an improved LTIFR, however some elements have impacted on production rates and costs allowed under the UT3 funding.

Many of these factors are systemic and long term and will inevitably have a bearing on the maintenance activity for UT4.

As part of Aurizon Network's commitment to continual improvement it has taken learning's from each of the three previous periods in the development of this Draft Access Undertaking. Of particular importance is the improved cost build up model developed for the pricing in this DAU (see Section 5. Maintenance Cost).

1.9 Legislation

Aurizon Network is subject to a number of regulatory bodies in its capacity as Rail Infrastructure Manager. As such, Aurizon Network accepts regulation by federal, state, and local authorities covering factors such as health, safety, labour, environmental, rail operations and economic matters (amongst others) are part of its normal operational parameters. We need to ensure the appropriate costs of managing personnel, subcontractors, planning and reporting are included in budgetary preparations.

While at a federal level there have been substantial gains in the rationalisation of many key statutes, Queensland still retains a more onerous legislative regime that other states. An example of this is in Queensland, Aurizon Network has three separate and complex statutes dealing with Workplace Safety, Electrical Safety and Workers Compensation, whereas other Australian jurisdictions have only two or in some cases only one streamlined statute covering the same legislative issues.

The significant regulatory bodies and legislation complied with in the scoping and pricing of the delivery of the services include:

Regulatory Bodies

> Rail Safety Regulator – Department of Transport and Roads

> Rail Economic Regulator – Queensland Competition Authority (QCA)

> Electrical Safety Regulator – Electrical Safety Office (ESO)

> Workplace Safety Regulator – Department of Work Place Health and Safety (WH&S)

> Environmental Regulator – Department Environment and Resource Management (DERM)

> Securities Regulator - Australian Stock Exchange (ASX).

Legislation

- > Transport (Rail Safety Act) 2010 Queensland
- > Transport Infrastructure Act 1994 Queensland
- > Corporations Act 2011
- > Queensland Competition Authority Act 1997
- > Workplace Health and Safety 1995
- > Work Health and Safety Act 2011
- > Environmental Protection Act 1994
- > Environmental Protection and Biodiversity Conservation Act 1999
- > Energy Efficiency Opportunities Act 2006
- > National Greenhouse and Energy Reporting Act 2007
- > Aboriginal Cultural Heritage Act 2003
- > Electrical Safety Act 2002
- > Land Act 1994
- > Native Title Act 1993
- > Nature Conservation Act 1992
- > Mining & Quarry Safety Health Act 1999
- > Queensland Heritage Act 1992
- > Sustainable Planning Act 1999
- > Vegetation Management Act 1999
- > Water Act 2000.

In addition to the above, a significant number of laws and regulations apply to Aurizon Network's operation of the CQCN. Appendix Z – Legislation listing for Aurizon - provides a more comprehensive list of the statutes and regulations with which we must monitor and comply.

Aurizon Network has established systems and procedures to satisfy its legislative requirements and also deliver a network meeting the current requirements while also planning to meet the future expectations of its customers and stakeholders. These processes include ensuring correct licences, permits and authorisations are obtained as required. Aurizon Network's training program for its Track Workers is aligned to the National Training and Competency Framework. Inspections, audits and incident reporting regimes are included in the processes, as is the training and competency management for the maintenance of all internal staff and contractor competencies to ensure effective compliance. As discussed in Section 1.7, Aurizon Network has invested heavily to ensure worker safety and we apply good Corporate Governance to all other applicable laws in the same manner.

This submission has allowance for meeting current compliance requirements. However, any change of law with a material effect on the maintenance regime will need to be assessed at the time of enactment.

In addition, Aurizon Network continues to seek representation and actively participate in committees and forums in the development of new legislation and evolving of existing legislation to ensure the company stays abreast of, and influences any changes on behalf of, the supply chain.

1.10 Corporate Responsibility

In order to discharge its corporate responsibilities, Aurizon Network has developed a comprehensive corporate responsibility framework extending across the areas of safety, community, people, performance, personal integrity, and the environment.

These responsibilities have been acknowledged and endorsed by the Aurizon Board and are encapsulated in Aurizon Network's Corporate Responsibility Statement, as follows:

Aurizon recognises that acting responsibly, operating in a sustainable manner and providing a positive contribution to society is vital to Aurizon Network's ongoing business success. We adhere to the following principles:

Safety

- > Safety of ourselves and others is our number one priority
- > We work with our people, customers and suppliers to create and maintain a safe workplace
- > We have comprehensive safety policies and are committed to our target of "ZEROHarm".

Community

- We support the communities in which we work through community investment and engagement programs
- We are part of the community and we are here for the long term.

People

- We are committed to promoting a non-discriminatory, diverse, inclusive, respectful and collaborative business
- We promote equal employment opportunity in our recruitment, selection and employment practices
- We are committed to the ongoing education and training of our people.

Performance

- We strive to deliver world class performance and superior value for our customers
- We deliver results with energy and conviction
- We commit to delivering outstanding corporate performance and returns to our shareholders.

Integrity

- We adhere to our Code of Conduct
- We are honest and fair and conduct business with the highest ethical standards
- We adhere to high standards of corporate governance and report annually on our corporate governance.

Environment

- We responsibly consider the community and the environment in our actions and decisions
- We are committed to the efficient use of resources and waste minimisation
- We are committed to promoting rail as an energy efficient mode of transport.

1.10.1 Aurizon Network's Environmental Commitment

Aurizon Network recognises acting responsibly, operating in a sustainable manner and providing a positive contribution to the community is vital to Aurizon Network's ongoing business success and stakeholder engagement.

Aurizon Network is committed to managing its operational activities and services in an environmentally responsible manner to meet legal, social and moral obligations. In order to deliver on this commitment, Aurizon Network seeks to comply with all applicable environmental laws and regulations.

As one of Australia's largest rail transport providers, Aurizon Network acknowledges the important role Aurizon Network can play in leading environmental sustainability for the industry. As an example, Aurizon Network facilitated the Coal Loss Management Plan (CLMP) for the Central Queensland Coal Network. This plan was developed by supply chain participants and resulted in a series of actions for the participants to undertake to reduce the environmental impact of coal loss emanating from the transportation, loading and unloading of coal. In adopting a proactive approach to mitigating the Company's environmental footprint, a new company-wide Environmental Policy was recently introduced to guide the continual improvement in environmental performance around the operational activities and services Aurizon Network provides. The Policy takes the precautionary approach of assessing environmental risk before undertaking activities. All Aurizon Network employees are accountable for ensuring all business activities, facilities and equipment within their area of responsibility are managed in accordance with this policy.

Additionally, Aurizon Network continues to meet its obligations under the Energy Efficiency Opportunities Act 2006, which requires assessment and public reporting of energy usage and identification, investigation and evaluation of energy saving opportunities. The National Greenhouse and Energy Reporting Act 2007 (Cwth) ("NGER Act") also requires reporting of annual greenhouse gas emissions and energy use. Aurizon Network has implemented systems and processes for the collection and calculation of the data required and is now registered under the NGER Act. The cost for environmental compliance is captured in this Maintenance Submission.

1.10.2 Community Engagement

As a good corporate citizen, Aurizon Network has a major role to play in the welfare of the general Queensland population who living and working in the Central Queensland coal fields. In this regard, Aurizon Network has engaged the community on several key initiatives outside of its commitment to the participants in the CQCN supply chain.

- Rail grinding - Aurizon Network has openly engaged the community on operational matters impacting their everyday lives, such as modifying the operating parameters for Aurizon Network's rail grinding activities so Aurizon Network's operations will not affect the quality of life for nearby residents. As a direct result of this decision the business has had to increase maintenance spend in fire detection and fire prevention while operating the Rail Grinder in daylight hours.
- Level Crossings – Given level crossings are an area of great concern to the community, Aurizon Network has engaged with the community through a targeted safety media campaign and a program of works including removal and replacement of roadway and trackside signage to enhance safety in these vicinities. Aurizon Network has commenced developing "Level Crossing Agreements" with each and every level crossing co-owner. Co-owners of the crossing include private land owners, Regional Councils, the Department of Main Roads and Mine Operators. The purpose of this agreement is to assess the risks associated with the operation of the crossing, develop and agree controls to manage those risks and then undertake the delivery of those controls. There are 676 level crossings on the network. Not all costs associated with this program of works are maintenance tasks.

Apart from broader community expectations, Aurizon Network also takes a proactive role in dealing with communities on local issues. An example is the community stakeholder and engagement activities currently underway with the Collinsville Township over noise and dust concerns. A solution to resolve this matter has been agreed and will be implemented in the near future.

In summary, Aurizon Network recognises close community engagement is important to the business to ensure the quality of life for people in Queensland.

1.10.3 Indigenous Employment

Aurizon is a signatory to the Australian Employment Covenant, an initiative to address the employment disadvantages faced by Indigenous Australians. To support this important indigenous strategy, Steve Renouf (of Brisbane Broncos, State of Origin and Australian Rugby League fame) was appointed to establish and guide the Major Skills Unit and the Aurizon business in the engagement with community and educators to bolster and enhance this key business strategy.

Key objectives of the program include:

- To have a workforce with indigenous participation representative of the local communities in which Aurizon operates and meet our AEC obligations
- Increase awareness with workforce – targeted cultural awareness training
- Address unconscious bias in order to better inform recruitment, succession, development decision making decisions
- Empower Aboriginal and Torres Strait Islander people to be proactive about their Aurizon careers
- Improve Aurizon's profile to the external market as a company of choice for ATSI people
- Implement a mentoring program to build internal mentors across the organisation for indigenous staff
- Create links between Aurizon depots and local indigenous organisations
- Create genuine sustainable indigenous employment opportunities.

Aurizon has also established a Diversity Council to promote and action best practice recruitment, promotion and development opportunities for women and indigenous employees.

Figure 19: Indigenous employment leaflet

In support of Aurizon Network's aim to increase indigenous participation in Aurizon Network's workforce, cultural awareness training has been provided to recruitment teams to better inform recruitment, succession and development decision making. Steps have also been taken to negotiate indigenous recruitment strategies such as the use of interviews and testing. The Central Queensland Coal Network operates in an area where indigenous people have lived for over 50,000 years. By actively engaging with the Traditional owners, Aurizon Network has been able to better manage its cultural obligations and also tap into a ready supply of local workers in high demand in the Queensland Coal Fields (see targeted advertising material such as the leaflet in Figure 19). These measures have been supported by indigenous specific sponsorships, such as the NAIDOC and Murri Carnival.

1.10.4 Training and Youth Development

Aurizon announced in August 2010 it would treble its apprentice, trainee and graduate numbers. Managing Director & CEO, Lance Hockridge, said at the time Aurizon was keen to harness the talent of young Australians to help grow the business. Unlike other publicly listed companies, Aurizon is continuing to play an active part of the community in regional towns and cities as has been the case for many years.

In particular, Aurizon is continuing to support employment in these communities. Mr Hockridge also announced at the time Aurizon would boost its apprentice, trainee and graduate numbers from the current approximately 75 per year in 2010 to 300 per year within three years. In 2011 One Hundred and

Sixty Seven were recruited; in 2012 Two Hundred and Fourteen were recruited; in 2013 the target is Three Hundred.

In December 2010, the Major Skills Unit was established to manage and promote this initiative. The Major Skills Unit's operational brief is to:

> Increase the volume and quality of apprentices, trainees and graduates across the enterprise to enable the business to have a high quality pipeline of potential leaders as the organisation enters a new period of growth and commercial focus

> Increase recruitment of apprentices, trainees and graduates from 75 per year to 300 per year within the next three years

> Enhance the quality of current and newly recruited apprentice and trainee training

> Implement the right learning practices to support our people to be productive sooner and established strategic alliances with universities, TAFEs and other education providers to support the development of recruits.

2. NETWORK MAINTENANCE PHILOSOPHY

Chapter 2 - Key points

> The network philosophy for maintenance is consistent across the UT3 and UT4 Regulatory Periods

> The network philosophy balances supply chain trades-offs to deliver greatest value from the network to the coal supply chain;

- This involves managing trade-offs of cost, reliability, availability, certainty, short and long term supply chain throughput

> At all times, the Aurizon Network must not compromise obligations associated with its Rail Infrastructure Manager and Operations accreditation

> Total Below Rail costs have been maintained at an average of 3% of the value chain of the CQCN over the last eight years

> 45% of the total maintenance budget is procured through the open market

> Network availability and throughput is carefully balanced through the possession planning process and consultation with industry.

Aurizon Network's maintenance philosophy is centred on ensuring the long-term integrity and safety of the networking, and the network is maintained to a standard maximising supply chain efficiency, catering for volume growth and new mine development, and consistently with the level of service quality desired by users.

In order to achieve these goals, Aurizon Network's maintenance philosophy involves:

> Effecting a preventative maintenance-based schedule, which will limit the rate of corrective and emergency maintenance required and lessening the impact to the supply chain and specialised resources at short notice

> Engagement with the supply chain to ensure their needs are addressed

> Building on Aurizon Network's mature asset management and procurement methodology

> Ensuring the safety of Aurizon Network's team, while also focussing on a high level of network availability

> Meeting all legislative and regulatory requirements associated with these maintenance activities

> Ensuring flexibility and retaining the ability to reflect and respond to current and future market conditions.

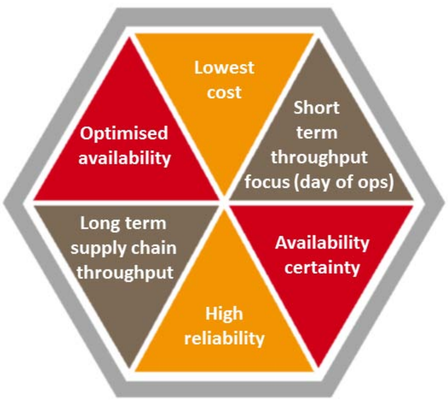


Figure 20: Performance characteristics of the logistical chain

Figure 20 demonstrate the trade-offs involved in balancing the three crucial dimensions of asset maintenance: cost vs. reliability; optimised availability vs availability certainty; and short-term throughput vs long term throughput.

Aurizon Network has sought to continue to further develop and improve its approach, which has evolved through three previous regulatory periods, by assessing each of the building blocks used for determining both the scope and the costing models. Ultimately this will deliver a cost efficient program of maintenance activities on the regulated rail assets in the CQCN.

The Network Philosophy recognises Infrastructure Performance is underpinned by the inherent capability and configuration of the asset, which is largely defined during the design and construction phases of the asset's life. This is particularly relevant with long-life infrastructure lasting decades and expected to perform across numerous economic cycles.

2.1 Network Cost vs. Reliability

"Reliability" refers to all of the functional performance characteristics specified as necessary to achieve the agreed business services.

Aurizon Network is committed to manage the capability, capacity, cost and performance across the entire life of the asset in line with the expectations of the business and the intended purpose of the asset.

Aurizon Network's Network Maintenance program has two primary objectives:

> To retain inherent levels of safety and reliability built into the infrastructure

> To return that infrastructure to a serviceable condition when deterioration has occurred.

The effectiveness of this process in assuring the integrity of the infrastructure is dependent on the quality of the design and delivery of the maintenance program.

The design of the Network Maintenance Plan (NMP) uses Aurizon Network's engineering capability to define the various maintenance requirements necessary to keep the network functioning at an optimum level. Many assets have been in service for an extended period and represent older technology, which adds to the complexity of the task and presents a significant challenge to us as asset managers.

Aurizon Network's approach is represented in the figure below. It highlights the interdependent relationship and demonstrates how all three connected performance outcomes of Safety, then Reliability, then Cost impact the determination of supply chain outcomes. This Reliability and Maintainability Analysis provides a structured method for assessing the likely causes of failure for an asset and the consequences for safety, asset performance and cost.

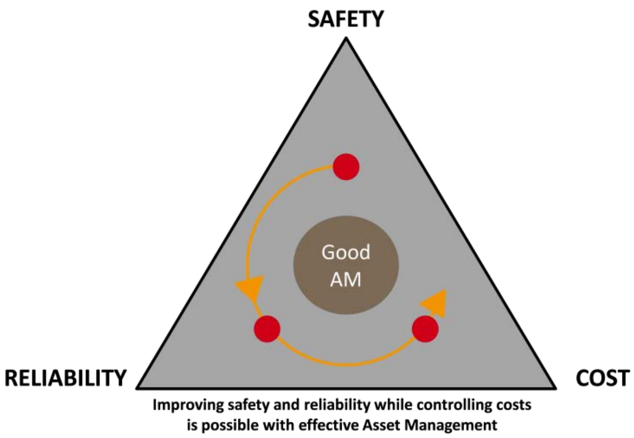


Figure 21: Improving Safety and Reliability while controlling costs

Aurizon Network strives to deliver value for money to the supply chain and recent research confirms this has been achieved. The research shows the Below Rail cost only accounted for an average of 3% of the value chain of the CQCN mines and 5% of the C1 Cash Costs (Wood and Mackenzie Supply Service: Cost and Margin Tool, November 2012). A graphical representation of these results and how the components of Coal Miner's FOB Cash Costs are developed are included in Figure 22 and 23.

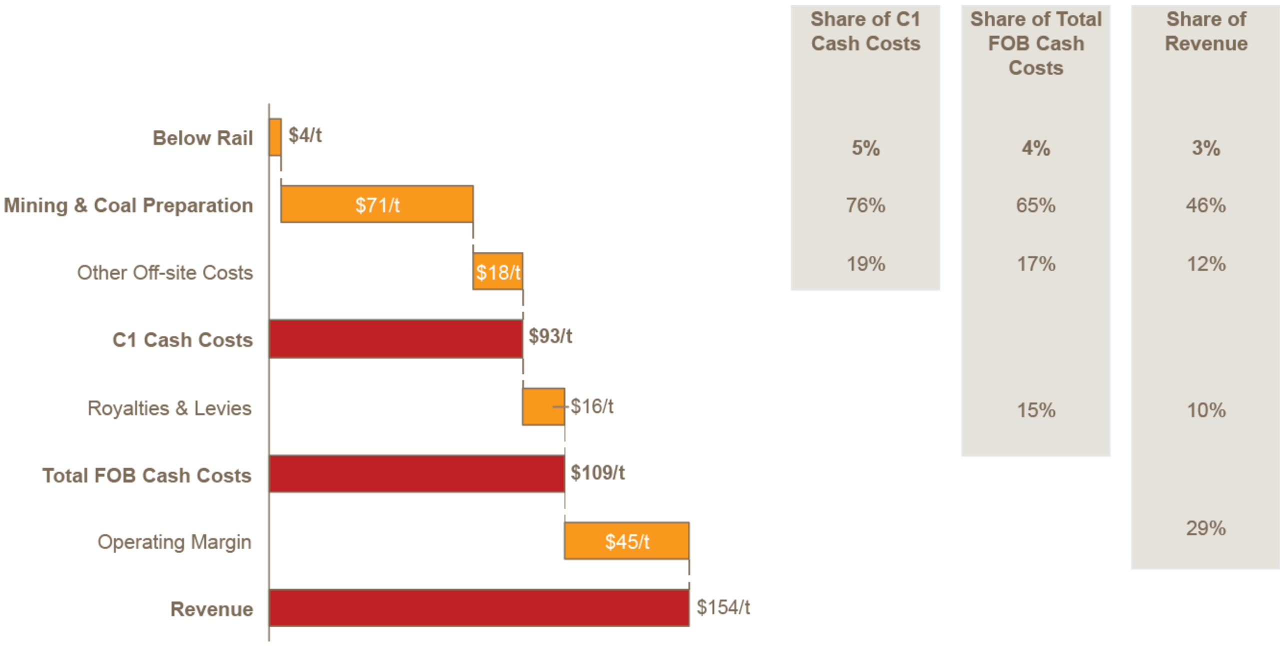


Figure 22: Weighted average FOB Cash Costs for CCCN mines. (AU$/t, Nominal)

Source: Wood Mackenzie Cost & Margin Tool, February 2013, Aurizon Network Financial reports, Aurizon analysis

Figure 23: Components of Coal Miners FOB Cash costs

Source: Wood Mackenzie Supply Service: Cost and Margin Tool, February 2013 and unpublished 2004 data provided by Wood Mackenzie [7]

2.1.1 Network Safety vs. Cost

The continued operation by Aurizon Network of the CQCN is reliant upon the business maintaining its Rail Infrastructure Manager and Operations Accreditation and compliance with the Rail Safety Act. The accreditation forms a foundation or minimal level of requirements for asset management and technical standards, work procedures and operation in and around the infrastructure and governance requirements to ensure the safe operation of the railway. This accreditation is regularly audited to confirm compliance and also requires continuous monitoring and adoption of safety improvement initiatives as to enhance safety on the rail. Any breaches or incidents are subject to investigations and may lead to loss of accreditation, restriction operations and punitive damages. The elements of the Rail Safety Act to be complied with include:

> Safety policy
> Safety culture
> Governance and internal control arrangements
> Management responsibilities, accountabilities and authorities
> Regulatory compliance
> Document control arrangements and information management
> Review of the safety management system
> Safety performance measures
> Safety audit arrangements
> Corrective action

[7] Cash Costs exclude capital costs components, expansion or sustaining, depreciation and amortization charges.

> Management of change
> Consultation
> Internal communication
> Risk management
> Human factors
> Procurement and contract management
> General engineering and operational systems safety requirements
> Process control
> Asset management
> Safety interface coordination
> Management of notifiable occurrences
> Security management
> Emergency management
> Rail safety worker competence
> Fatigue
> Drugs and alcohol
> Health and fitness
> Resource availability.

In addition to the Rail Safety legislation, other relevant safety and standards are also applicable to the rail manager with material consequence for breach including financial penalties and incarceration for Directors, Officers and workers. The Electrical Safety Act and Work Place Health and Safety Acts place minimum obligations on the Aurizon Network however applicable legislation for a Rail Manager is numerous and complex. A complete list of legislation monitored and managed by our experienced asset engineering and safety professionals is included in Appendix Z– Legislation listing for Aurizon Network.

It is Network Philosophy at no time can the drive for cost efficiency result in compromising these legislative obligations. This is supported within the Zero Harm Safety Principles:

> Safety is the core Aurizon Value
> All injuries can be prevented
> Management is accountable for creating and maintaining a safe workplace
> We are all responsible for preventing injuries
> Working safely is a condition of employment.

2.1.2 Commercial arrangements and procurement

Aurizon Network engages with a large number of service providers in order to conduct its maintenance task. Prudent procurement practices are used to ensure the services are delivered in not only a cost effective manner but also to the necessary safety and quality standards required by the coal industry.

To complement the range of internal expert resources and operation of specialised plant, more competitively available services are used. In total, 45% of the total maintenance budget is procured through normal commercial means on the open market. The types of services this covers include:

> Wet and dry hire of earthmoving plant, such as backhoes
> Rotable inventory items
> Generic consumables such as fuel, accommodation, travel
> Competitively tendered plant
> Land and associated infrastructure required for depots

> Rail infrastructure specific consumables.

Aurizon Network takes advantage of its large size to leverage economies of scale through bulk purchasing agreements under the best possible commercial terms. Aurizon Network's centralised Procurement team guides the policies and process to ensure best value is extracted in the relationships Aurizon Network has with Aurizon Network's suppliers.

These advantages are to some degree moderated by the price competition in the Central Queensland area, which is largely driven by the mining operations in the CQCN.

Further details of Aurizon Network's procurement processes are provided in Section 3.3.7.

2.2 Network Availability

Increasingly stakeholders are intent on achieving an assured and sustainable level of network availability. Aurizon Network's success in delivering this service will be determined by Aurizon Network's ability to manage the integrated CQCN assets to ensure a continuing capability to meet those requirements, in respect of the service provision, safely and reliably.

Network Operations Planning determines the long-term planning requirements for corridor access. Proposed maintenance and construction activities and their impact in the long-term planning horizon are communicated to all supply chain stakeholders. Critical Asset activities are then aligned to maximise system capacity.

Network Operations Planning assess all network access requests, based on the impact to network train paths, which is a factor of time taken and total geography affected including any required protection, (track protection or electrical isolation). Operational constraints and infrastructure configuration will also be considered in determining how long the asset can be restrained.

Access availability in terms of train paths and an unrestricted network is paramount to Aurizon Network's stakeholders. Aurizon Network's ability to optimise the availability of the network underpins the efficiency of the supply chain and therefore the processes for possession planning (including actual day of operations train paths) are critical.

Networks Maintenance Philosophy also recognises the importance of availability of the network to support the supply chain during and immediately after extreme weather conditions or safety incidents on the network. A focus of the network business is to minimise outages following from incidents and Force Majeure events compromising the asset integrity and affecting operations. Consideration is given to ensuring the availability of the capability and resources required to respond to events including flood, cyclones, derailments and dewirements.

2.3 Network Throughput

Aurizon Network has developed a network maintenance plan based on the increased tonnages forecast by the mines and above rail operators for the UT4 period.

Aurizon Network recognises its network will deteriorate from its original as built condition due to the impacts of its operational environment. The major factors influencing the rate of deterioration are traffic related, i.e. tonnage hauled, axle load and speed, the environment, and the original construction standards of the time.

Aurizon Network has demonstrated the network can be managed safely by attending to non-conformances and variations from the as-constructed condition on a priority basis, with professional judgement being exercised by its team of experienced engineers.

Aurizon Network's ability to deliver contracted throughput is dependent on the possession planning process, which is constrained by the following key planning factors:

> Coal chain consultation for best-fit alignment with maintenance strategy
  - Determine the criticality of maintenance requirements
  - Commercial focus on network availability
  - Understanding the maintenance requirements of connecting assets i.e. unloading facilities at the Ports

- Forecasts for tonnages and long term requirement for train paths

> Possession Modelling scenarios to achieve Contract delivery
  - Determine what can be further aligned to reduce throughput loss
  - Optimisation of shorter term train paths (including day of operations).
  - Feedback on delivery options

> Above rail fleet application to modelled paths
  - Use of paths and template design
  - Operator consultation (including day of operations).

3. NETWORK MAINTENANCE REGIME

Section 3 - Key points

> Scope for the asset maintenance is derived from fundamental asset management building blocks including the concept of Reliability Centred Asset Maintenance with consideration of asset quantities, individual infrastructure failure profiles and consequences of failure in terms of safety and supply chain outcomes

> Aurizon Network stakeholder engagement program allows the partnership all entities in the supply chain to meet our common needs and requirements

> The planning, scheduling and delivery of the maintenance tasks has significantly improved over recent years which has seen a more responsive and flexible approach to meeting our customer commitments

> Network promotes and delivers an approach of continuous improvement to drive performance improvements for its customers

> Customer engagement through a broad range of forums promotes alignment of customer requirements and in particular supports the process of maintenance scheduling and allocation of system outages to enable on-track maintenance to occur.

> Effective governance processes are in place to with skilled experts to manage the maintenance delivery.

3.1 Overview

One of the primary ways Aurizon Network can contribute towards the development and ongoing enhancement of an efficient coal supply chain is via its network maintenance practices. For the purposes of this submission, these are based upon the maintenance practices described in the UT3 Maintenance submission and other contemporary asset management principles.

As such, the maintenance regime must at all times ensure the minimum safety level is achieved, as agreed with the Queensland Department of Transport and Main Roads (DTMR) in accordance with the relevant safety legislation. The maintenance regime must also ensure the network is maintained to a standard delivering an appropriate level of service quality to users and aligning with the access provisions agreed with the coal supply chain dictating the opportunity to perform maintenance works.

The maintenance programme for all system assets is determined through reliability-centred maintenance assessments. This process is designed to deliver the optimal level of asset availability at the least cost of ownership through the entire asset life cycle.

This section describes the considerations undertaken when planning for maintenance activities and the delivery plan required to ensure all aspects of the CQCN are covered over the scheduled period.

3.2 Objectives of the maintenance regime

The core objectives of Aurizon Network's maintenance regime are to:

> Ensure the asset is in safe condition and access to the asset is conducted in a safe manner at all times

> Maintain a highly reliable world-class rail network with safety as its core value

> Continuously monitor and manage the asset quantity and condition to achieve sustainable long-term value for the coal supply chain

> Retain flexibility in the maintenance planning to adapt and respond to customer needs through a range of market cycles

> Maximise the asset's life as it is affected by customer usage

- Proactively manage asset preventative maintenance requirements to minimise infrastructure faults including effectively scheduling track maintenance tasks across the network
- Provide an effective and responsive approach to corrective maintenance to minimise disruption and limit unplanned closures
- Ensure accredited competent resources and the right plant and equipment are available when required
- Make step changes in the efficiency of maintenance operations particularly in material consumption, labour requirements and track availability
- Provide a robust inspection and audit regime ensuring delivery and compliance with the above.

Achieving these objectives will deliver a rail network capable of fully and efficiently meeting our customer commitments.

As documented in Section 10 - Assumptions, the scope of the current submission includes the CQCN as it currently exists plus the rail infrastructure presently being commissioned for the Wiggins Island Coal Export Terminal - WIRP Stage 1. It does not include other planned rail projects currently still in the planning or early project initiation stages, and final infrastructure configuration has not been determined and therefore the maintenance requirements are indeterminable.

3.3 Maintenance Planning Approach

Planning the network maintenance tasks is a complex process involving many operational and commercial drivers, which need to be simultaneously considered to deliver on the customer and stakeholder requirements established through the totality of the customer engagement processes, involving:

- The contractual framework and associated obligations
- Mine, port and railway operator issues
- Various stakeholder forums.

As the asset owner for the Central Queensland Coal Network, Aurizon Network has developed detailed construction and maintenance specifications for the infrastructure. These requirements form the basis of the engineering standards of the Safety Management System in the form of Standards. The contents of the Standards are translated into three plans which are then integrated with the Access Plans and processes.

- Annual Network Maintenance Plan – Details the required maintenance for the next 12 months and is provided to stakeholders and those engaged (internally and externally) to complete the works. In practice this plan provides for maintenance and renewals for the 12 month period and is called the Network Maintenance and Renewal Plan (NMRP)
- Network Maintenance Plan 5 year forecast – Similar to the Annual plan, but covers a 5 year rolling forecast, which is incorporated into Aurizon Network's corporate plan. For the purpose of the Regulatory Period a four (4) year plan is also developed and is consistent with the 5 year forecast
- Asset Maintenance and Renewal Policy - Documents Aurizon Network's policies on how the asset will be managed including strategic asset life.

3.3.1 Determining Scope and Quality

Asset quantity

The total quantity of maintenance required across the CQCN at a strategic level, is determined from total quantity of assets deployed. In this determination, Aurizon Network uses information and records from asset registers and databases, as-constructed drawings, audits and inspection records, as well as contemporary information, such as data made available through the Goonyella Abbott Point Expansion project, and historical information dating back to the asset's inception, which, in some cases is more than 50 years ago.

To appreciate the size of the network, CQCN consists of over 2,667 km of track and signalling infrastructure, over 2000km of the network is electrified, in excess of 2,000 signals, over 750 level crossings with 158 having full active protection, 1780km of electrical overhead with associated transformer and insulators and 1456 km of fibre optic network. These systems can be further broken down into sub-components, each with its own discrete maintenance regime.

Maintenance Frequency

Nature of the asset

The CQCN is a relatively old asset, for example the Blackwater system is the oldest of all the systems, having been in operation since 1886.

Most individual assets in the network are a significant portion through their original design life. In the same way most of these assets were originally designed for a different task to requirements of today. Furthermore, the asset is subject to a range of environmental conditions not common across Australia. These factors are critical in assessing the appropriate maintenance regime for the type of asset.

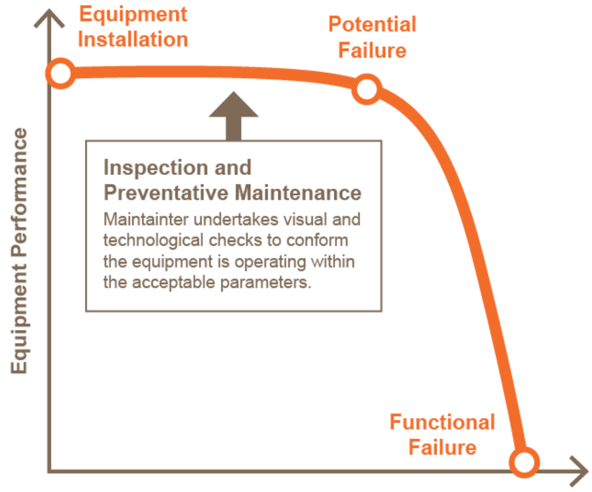


Figure 24: Installation, potential failure, functional failure (IPF) curve

However, as an advantage of having a relatively long performance history, Aurizon has extensive knowledge of the asset capabilities. With vast experience Aurizon Network's engineering and maintenance staff are able to discern the most appropriate intervention practices, taking into account manufacturer recommendations unlikely to adequately assess the usage and conditions to which the CQCN asset is subject.

Determining the maintenance task frequency

The next stage of understanding the maintenance task at a strategic level is to determine the maintenance activity and associated frequencies. Each asset component has a defined set of maintenance activities to be carried out to ensure continued functional performance, see Figure 24.

Functional Failure is a state where the asset is no longer able to perform as designed. It is important to understand the implications of functional failure upon the supply chain production capabilities.

Example: A break in the rail can potentially derail a train causing very significant damage to rail infrastructure and rollingstock, cause coal spillage, create environmental impacts and cause personal injury, not to mention incur the associated legislative penalties pecuniary and criminal for responsible parties.

As functional failure will have different ramifications for each asset type, the inspection regime needs to reflect the nature of the asset.

It is therefore appropriate to put a majority of focus on inspection and preventative maintenance to ensure as smooth an operation as possible. In respect to corrective maintenance, it is important to ensure the right assets and expertise is available to prevent a fault from worsening, from both an operational and a commercial view point.

Aurizon Network's definition of each is:

> Inspection and preventative maintenance is maintenance undertaken at regular programmed intervals to maximise availability and reliability. It is a more proactive approach to anticipate the likely maintenance effort required based on an understanding of the asset's characteristics and the impact of throughput on its performance. Further, this assessment is augmented by regular asset monitoring and analysis.

> Corrective maintenance is performed in response to a failure, noting assets can fail unexpectedly for a number of reasons, including incidents on the network. This will generally need to be prioritised depending on the risks arising from the failure. Immediate corrective maintenance will be undertaken where the failure has a potentially significant safety, environmental or operational risk. Deferred corrective maintenance, which may be identified during the course of preventative maintenance, is

performed where the potential risk is not significant. The maintenance may be deferred because of the scale and scope of work required, and the impact to Aurizon Network's stakeholders.

The maintenance regime for each asset is dependent on the above concepts, the application of reliability-centred maintenance practice and an understanding of the individual failure modes.

A failure mode is defined as a systematic series of sequential and interrelated causal steps that can lead to the failure of an asset. This can be either a usage or a time-based effect, as is illustrated in Figure 24 above. For example, a common failure for electronic circuit boards is capacitor dry-out, which is driven by time and operating environment e.g. humidity, temperature extremes and cycle time.

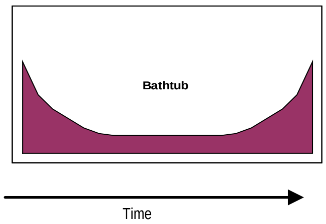
By understanding failure modes and identifying those most likely to drive a given asset to fail in its operating environment, Aurizon Network is able to:

> Focus assessment activities on those attributes of the asset that provide the most indicative failure signatures, what to monitor

> Select and apply the most appropriate techniques and technologies measuring the dominant failure characteristics and indicators, which technology to use to monitor

> Schedule the assessment in the most cost effective way, using risk based methodologies, when to monitor.

Age Related Failures

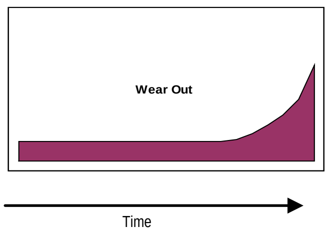


Characteristics

Bathtub

This curve is highlighted by an initial sharply declining failure rate, followed by a prolonged constant-average failure rate, after which the failure rate again increases sharply.

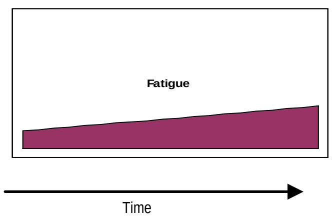
Simply, the bathtub curve consists of three periods; an infant mortality period with a decreasing failure rate followed by a normal, "useful ", life period with a low, relatively constant failure rate and then concluding with a wear-out period that exhibits an increasing failure rate.



Wear Out

This failure-rate curve shows conditional probability of failure against operating age.

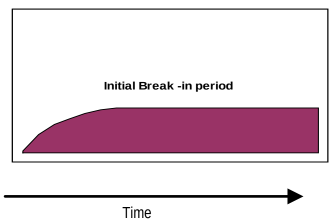
Wear-out is unavoidable due to fatigue or depletion of materials, such as lubrication depletion in bearings.



Fatigue

This failure-rate curve shows slowly increasing probability of failure with no specific wear out age.

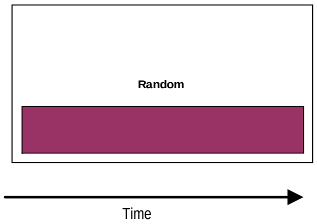
Random Failures



Characteristics

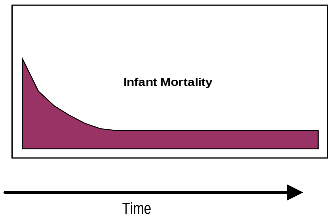
Initial Break-in period

This failure-rate curve shows low probability to begin with, then a rapid increase to a constant level.



Random

This failure-rate curve shows constant probability of failure at all ages.



Infant Mortality

This failure-rate curve starts with high infant mortality and drops eventually to a constant or very slowly increasing failure probability.

Failures during infant mortality are highly undesirable and are almost always caused by defects and errors such as material defects, design issues, errors in assembly, etc.

The resulting analysis determines the maintenance activity required for each subcomponent. This is then continually reviewed and updated to reflect contemporary practice and respond to the unique conditions prevailing in the CQCN. This process is a collective exercise using the vast experience of Aurizon Network's Asset Engineers and maintenance service providers. The following table details the guidelines that assist in this exercise.

Table 9: Asset Maintenance and renewal management guidelines

Key Activity	Management Approach	Classification and measurement
Mechanised track maintenance:	Intervention level based on specified traffic levels for:	Preventative maintenance measured in volume and unit track km based on deterioration due to:
• Ballast cleaning • Rail Grinding • Track Resurfacing	• Net tonnes • Gross tonnes • Gross tonnes • Gross tonnes	• Ballast contamination and degradation • Component wear • Component wear
General Track Maintenance	Intervention level based on specified frequencies for maintenance activity. Various technique applied, including track recording car, inspections, hi-rail and non-destructive testing to confirm infrastructure is within safe tolerance	Preventative maintenance measured in unit track km based on deterioration due to component wear
Structures Maintenance	Specified frequencies for inspection and scheduled repair activities and fix on failure	Preventative maintenance measured in combination of km, numbers achieved and linear metres per year
Signalling maintenance	Components are subjected to specified frequencies for inspection and/or fix on failure approach	Preventative maintenance measured in component replacement, numbers achieved per year
Traction power system maintenance	Specified frequencies for activities and fix on failure	Preventative maintenance measured in section, numbers achieved, km per year
Civil Track Asset Renewals - Rail (straights and curves)	Replacement based on deterioration assessed by traffic volume in gross tonnes, and rail section weight	Renewal measured in track km
Civil Track Asset Renewals - Ballast	Replacement based on deterioration measured on basis of specified expected life	Renewal measured in track km
Civil Track Asset Renewals – Points	Replacement based on deterioration assessed by traffic volume in gross	Renewal measured in complete turnout replacement

Key Activity	Management Approach	Classification and measurement
and Crossings	tonnes and type of crossing (fabricated RBM, swim nose and rail section weight	
Civil Structure Asset Renewal	Replacement based on deterioration measured on basis of specified expected life	Renewal measured in linear metre replacement
Civil Right Of Way Track Asset Renewals	Replacement typically based on deterioration measured on basis of specified expected life	Renewal measured through single unit replacements and through track km and linear metres
Signal Equipment Asset Renewal	Replacement based on deterioration measured on basis of specified expected life	Renewal typically measured through unit or component replacement and through track or route km
Traction Power Equipment Asset Renewal	Replacement typically based on deterioration measured on basis of specified expected life	Renewal typically measured through unit or component replacement and through track km
Telecommunications Asset Renewal	Replacement typically based on deterioration measured on basis of specified expected life	Renewal typically measured through unit or component replacement and through track or route km

Continuous improvement

In addition to the above, the Rail Safety Act places particular safety performance obligations on Aurizon Network to ensure the asset is safely maintained and operated at all times. In particular, Aurizon Network must ensure the Rail Infrastructure is safe for use by above rail train operators, internal and external maintenance staff and general public interfacing with the rail corridor.

Aurizon Network is proud to demonstrate its significant focus on safety in recent years has resulted in exceptional performance improvements across the network. This has also resulted in changes to the maintenance task. For example, Safety Alerts provide on-going modification and improvement of maintenance activity across the network. Recent examples include:

> Equipment & Infrastructure:
  - Asbestos in Boom Gate and Points Mechanisms - addresses the issue of aged equipment in the network
  - Restricted Access Requirements into Siemens Switching Buildings in the Blackwater System - Monitoring equipment performance and trends
  - Grinding Stone / Disc Shatters - incident lessons from other railways

> Safety Access to Network
  - Fatigue Management Limits - constraint on Aurizon Network's workforce to comply with Queensland's Transport Rail Safety legislation dealing with fatigue management
  - Driving Hazards on Access Roads - speed limits on access roads, constrains response times and impacts on total cost as travel is a significant cost component
  - Working Rail Traffic in Flooded Area - managing the integrity of the network when flooding occurs

> Safe Site Establishment Process Improvement
  - Communication Protocols: Track Worksite Identification - clear communication to confirm worksite location
  - Confirmation of Locations - additional protocol to confirm worksite location
  - Mandatory use of track circuit clips to confirm location - secondary physical system to confirm worksite location.

Full copies of these Safety Alerts are provided in Appendix AA – Safety Alert Examples.

The above items support maintenance worker safety and also support the supply chain by minimising the risk of safety incidents on the network that could disrupt traffic. These improvements impose additional responsibilities onto the maintenance staff and require higher levels of workforce capability and at times incur a higher cost.

Aurizon Network has also been focussed on a number of business transformation initiatives. An example of this is an 81 week leadership development project undertaken with the assistance of Newport Consulting from 2010 through 2012 to develop more effective leadership behaviours in frontline asset maintenance managers. This project was had direct sponsorship from Aurizon Network's executive management team:

"As we move towards creating a more customer focused and driven business aimed at maximising Aurizon Network's strength in the marketplace we have been striving to identify and implement better ways of working."
Paul Hoffmann, Group General Manager Infrastructure Services.

Figure 25: Frontline Leadership Behaviour Model

Benefits derived from the program and the substantial investment in the capabilities of Aurizon Network's maintenance leaders included:

> A significant increase in the planned volume of jobs completed per system closure
> A significant increase in the planned volume of jobs completed in non-system closure access
> A significant increase in the volume of jobs completed per system closure
> Improved frequency of on-time return to operation after system closure.

Results from these initiatives have been positive. As illustrated in the following graphs there has been a 23% increase in shut planned jobs completed in the Goonyella system, a 117% in RIMS jobs closed in the southern region and a 68% increase in RIMS jobs closed in the northern region.

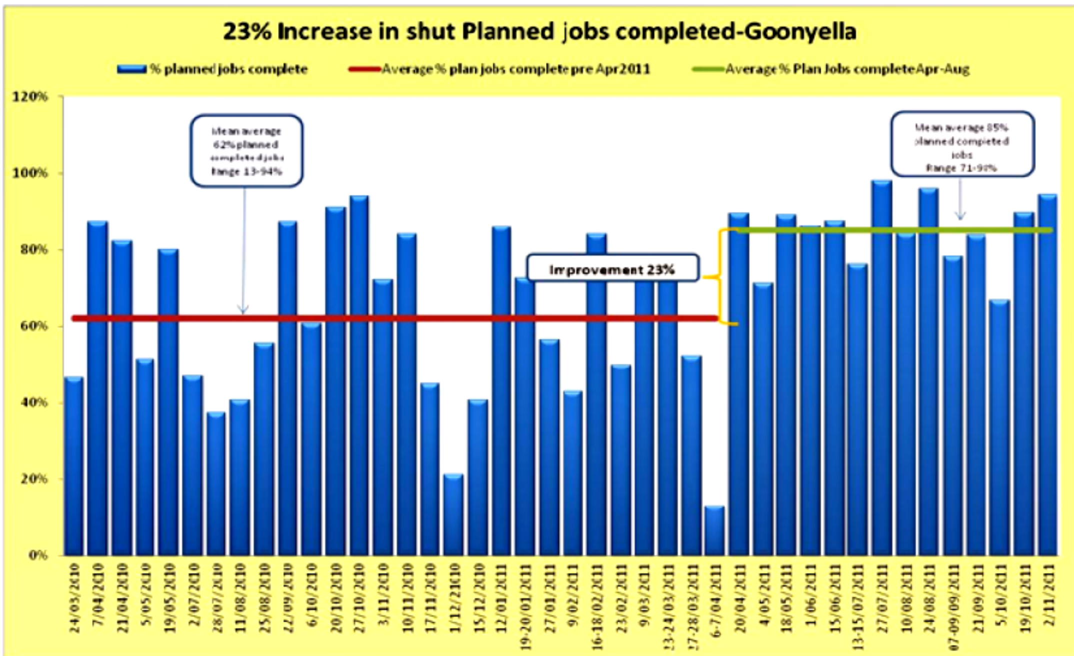


Figure 26: Increase in shut planned jobs completed - Goonyella

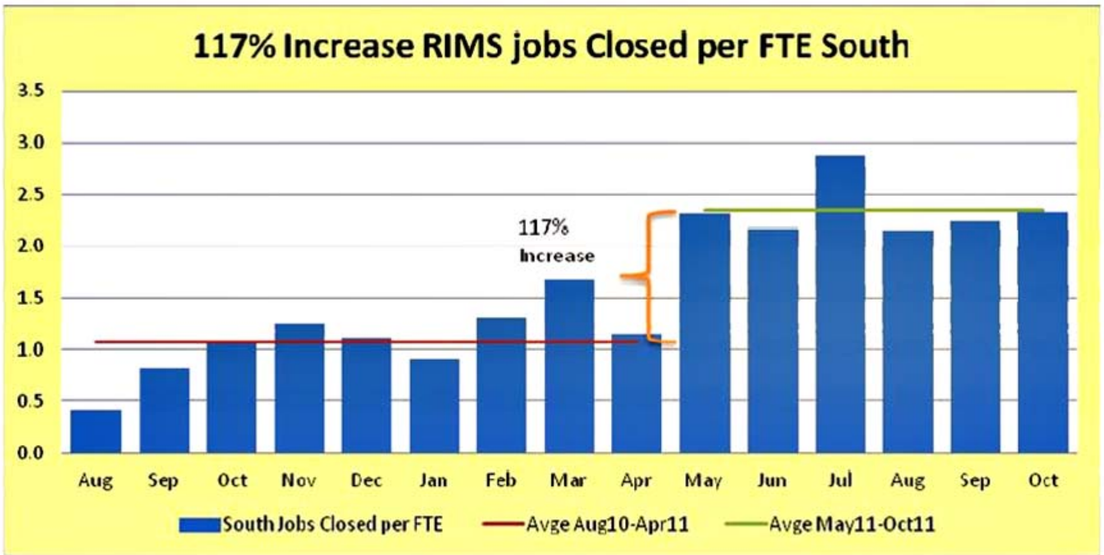


Figure 27: Increase in RIMS jobs closed per FTE - South

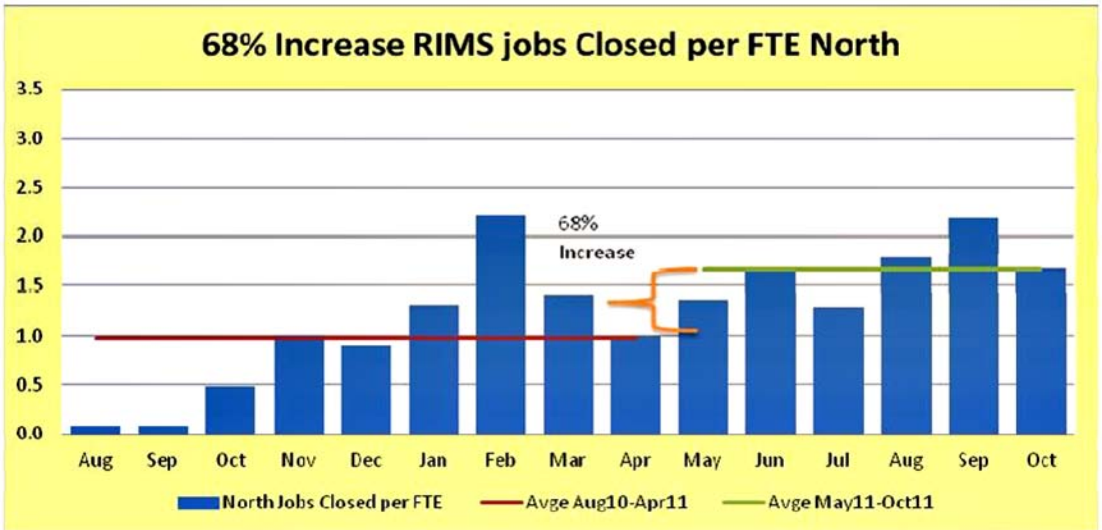


Figure 28: Increase in RIMS jobs closed per FTE - North

Aurizon Network conducts periodic reviews of the performance characteristics and levels of the CQCN. These are led by asset managers from the various technical disciplines who engage with the relevant field experts to analyse historical fault patterns, assess short-term environmental impacts and develop measures to manage any undesirable trends.

The above process is particularly effective due to the experienced resources with longstanding intimate knowledge of the CQCN and, as a consequence, is able to quickly pin point issues, identify anomalies and develop appropriate optimised solutions for the unique conditions and infrastructure.

Further assurance the maintenance task is meeting the legislative safety obligations is gained through the external independent audits conducted by DTMR.

Tonnage projections

The predicted tonnage profile identified in Appendix O was used to determine the frequency and total amount of maintenance task required for strategic planning purposes. Importantly, this influences long-term commitments such as plant procurement, fixed resource capability, contracting frameworks, logistical considerations (depot locations, disposition of plant and materials, and sourcing of raw materials). In many cases, the resources required are in scarce supply due to the economic conditions in Central Queensland and therefore demand long term commitment to assure availability, optimise efficient operations and control maintenance costs.

However, the maintenance task is not simply defined by total tonnes throughout the network, rather by the intensity of use of the individual assets. This inevitably dictates greater maintenance workload on eastern CQCN assets located near to the port terminal facilities where traffic is most dense. In this respect, the changing dynamics of source mine production – variations in which mines are dictating the tonnage profile – means the asset task can vary significantly from plan as the usage is redistributed across the CQCN. Aurizon Network therefore continually assesses the tonnages actually carried on individual sections of the CQCN and schedules the maintenance activity based on the latest tonnage and condition data. In practice, this may mean significant deviations from the original asset maintenance plans with respect to activity location and consequent closure requirements.

Aurizon Network identifies certain critical assets based on their importance to the supply chain, the consequence of failure and high levels of utilisation. Critical assets receive higher priority and faster response times in the event of failure. These assets typically have the highest tonnage profile, wear out the quickest, and have the least closure and access windows for maintenance activities.

3.3.2 Customer Engagement Process

User Expectations

Aurizon Network understands the needs of its customers and the complexity of the interdependent needs in the coal network, the domestic and international markets. We are continually engaged with the market through formal and informal processes, including regular meetings, business surveys and scheduled forums as described in Table 10. The understanding this brings is crucial to ensure continued network fitness and reliability, and is considered by Aurizon Network in its management of the overall maintenance scope.

As a part of Aurizon Network's on-going engagement with industry, Aurizon Network conduct periodic surveys of perceptions about the services provided. A strong response to Aurizon Network's most recent survey of key mine, rail and ports managers conducted in early 2012 indicated current performance for reliability, availability and safety were rated highly across all coal network components. Refer to Appendix AD for more detail. Respondents rated Below Rail reliability consistently highly across all three dimensions of availability, reliability and safety when compared to the other components of the coal supply chain i.e. Ports and Shipping, Train Operations, and Mine load-out Infrastructure. While opinions concerning improvement priorities showed more variability than the perceptions of current performance, the preference to improve reliability was consistently higher than either Availability or Safety for Ports and Shipping, Train Operations and Below Rail. After that Safety was indicated to be of a higher priority than availability. Overall, the survey responses evidenced three consistent themes for all users of the network and their desire for:

> A safe and reliable network

> Delivery of agreed train paths and services

> The ability to control the flow of product relative to their position in the supply chain.

It is evident the different users of the network have their own business drivers impacting on the operations of the network:

> Mining entities have an emphasis on the safe loading/unloading of train services, assurance the designated train path will not be affected by unscheduled interruptions to the network and their payload will be delivered on time

> Above Rail operators consider train path assurance is important, but the safety of the network is a greater priority so as to protect their assets and workers. Because of this, the Above Rail operators are more likely to accept delays in train operations for maintenance services if it will deliver a higher level of safety.

> Exporters and Port Authorities priorities are based on volumes and continuity of supply from the overall supply chain

> Domestic users are driven by a desire for a reliable supply of coal to meet their consumption therefore reliable delivery of service is paramount.

These findings are consistent with the view Reliability and Safety are the primary value drivers of the Below Rail infrastructure for the supply chain. The challenge for Aurizon Network is to optimise the maintenance cost without compromising safety and reliability of the network.

Customer Engagement

As a part of the Open Access Regime, Aurizon Network actively engages with all parties requiring access to the CQCN. In order to determine the right levels of maintenance and availability are achieved, Aurizon Network engages and consults with all stakeholders (as discussed below).

This engagement ensures priorities are shared between parties, and it:

> Addresses the requirements for access and closure regimes

> Assists in understanding the volumes planned across the track, and its impact on track wear and tear

> Ensures the required levels of reliability and safety are understood and achieved

> Ensures efficient cost planning associated with these maintenance operations.

This activity has proven successful as demonstrated by the recent support provided by stakeholders to requests for additional equipment and proposals for new closure regimes.

"Great to see this work is being done, and capitalising on the outage caused by the strikes. Thanks go to your team for the nimble way you mobilised resources and materials at such short notice. Please pass on BMA's thanks."

BMA

"QR was a public utility, and was trying to move a large organisation into the commercial world. This takes time to do. They have succeeded in doing this in the last 12 months, as there has been a real change in focus".

Rio Tinto

As part of Aurizon Network's commitment to continually improving Aurizon Network's processes and performance, Aurizon Network maintains relationships with stakeholders and above-rail operators, and is involved in various industry benchmarking groups and committees. Some of these committees (as detailed in the table below) focus on the short and long term planning between all parties which assist in determining maintenance issues and programming, rail asset management standards, and possessions planning, leading to the optimisation of the rail network to meet the supply chain requirements. Apart from commercial matters reporting to stakeholders is carried through the consultation process.

Table 10: Scheduled stakeholder meetings

Group	Attendees	Purpose
BMA Quarterly Performance Meeting External/Quarterly	Company representatives from BMA/BHP, Aurizon Coal North, Aurizon Network Services as well as company representatives from each Hay Point user group	To update attendees on current performance, issues and upcoming impacts to the supply chain (e.g. maintenance shut downs etc.) Also an open forum for participants to raise issues and changes to future operations
Newlands User Group Meeting External/Quarterly	Company representatives from Abbot Point Coal Terminal, Aurizon Coal North, Aurizon Network Services as well as company representatives from each Abbot Point Coal Terminal user	
Stakeholder Operational Management Meeting External/Monthly	Company representatives from DBCT (Dalrymple Bay Coal Terminal), Aurizon Coal North, Aurizon Network Services, Pacific National, ILC (Integrated Logistics Company) as well as company representatives from each DBCT user	
ILC Leadership Team Meeting (Integrated Logistics Company Pty Ltd) External/Monthly	Company representatives from DBCT, Aurizon Coal North, Aurizon Network Services, Pacific National, ILC as well as company representatives from each DBCT user	

<table>
<tr><th>Group</th><th>Attendees</th><th>Purpose</th></tr>
<tr><td>Integrated Planning Team (IPT)
External/Monthly</td><td>Company representatives from DBCT, Aurizon Coal North, Aurizon Network Services Planning and Production, Pacific National, ILC as well as company representatives from each DBCT user</td><td>To update attendees on current performance, within Day of Operations environment, issues and upcoming impacts to the supply chain (e.g. maintenance shut downs etc.) Also an open forum for participants to raise issues and changes to immediate operations</td></tr>
<tr><td>Infrastructure Planning Forum
Internal, Monthly</td><td>Company representatives from Aurizon Network Services Planning, Infrastructure Services and Construction Services</td><td>To update attendees on current performance, issues and upcoming impacts to the supply chain (e.g. maintenance shut downs etc.) Also an open forum for participants to raise issues and changes to medium to long term future operations, with an internal perspective</td></tr>
<tr><td>Gladstone Coal Export Executive</td><td>Company Executives from all areas of the supply chain</td><td>Attendees look at the performance of the components of the supply chain and overall performance. Strategic issues for individual parties are tabled and discussed.</td></tr>
<tr><td>Capricornia Coal Chain Steering Committee</td><td>Senior Mangers from supply chain participants</td><td>This forum operates as a pre-cursor to the Gladstone Coal Export Executive and reviews operational performance by all participants.</td></tr>
<tr><td>Long term/Tactical Planning Meeting
External, Monthly</td><td>Company representatives from DBCT, Aurizon Coal North, Aurizon Network Services Planning, Pacific National and ILC</td><td rowspan="2">To update attendees on current performance, issues and upcoming impacts to the supply chain (e.g. maintenance shut downs etc.) Also an open forum for participants to raise issues and changes to medium to long term future operations</td></tr>
<tr><td>Long-term/Tactical Planning Meeting
External, Monthly</td><td>Company representatives from GPC and domestic ports, Aurizon Coal South, Aurizon Network Services Planning, Pacific National and ILC</td></tr>
<tr><td>Blackwater User Group (BUG) Planning Meeting
External/2 Monthly</td><td>QRN Planning & Production, PN, Aurizon Coal, Company representatives from Mines and Ports</td><td rowspan="4">To update attendees on current performance, issues and upcoming impacts to the supply chain in a weekly environment (e.g. maintenance shut downs etc.) Also an open forum for participants to raise issues and changes to immediate future operations</td></tr>
<tr><td>Moura User Group (MUG) Planning Meeting
External/2 Monthly</td><td>QRN Planning & Production, PN, Aurizon Coal, Company representatives from Mines and Ports</td></tr>
<tr><td>Operational Planning Meeting
External, weekly</td><td>Company representatives from DBCT, Aurizon Coal North, Aurizon Network Services Planning, Pacific National and ILC</td></tr>
<tr><td>Operational Planning Meeting
External, weekly</td><td>Company representatives from GPC and domestic ports, Aurizon Coal South, Aurizon Network Services Planning, Pacific National and ILC</td></tr>
</table>

Operator Delivery

Aurizon Network has a contractual obligation with Access Holders to minimise Below Rail Transit time. However, operators also want:

> A known cap on the number, location and time interval between track possessions

> Best possible response times to any network disruption, including force majeure events
> Some spare capacity for peak production rates, or catch up capacity
> Co-ordinated supply chain shutdowns and track possessions.

Aurizon Network aims to meet these Access Holders requirements, which Aurizon Network believe to also be the demands of coal customers, by limiting the number of speed restrictions and the total number of unavailable days for train traffic. However, these can also be impacted by factors not within the control of Aurizon Network.

3.3.3 Maintenance Scheduling

The maintenance program is overseen by the Asset Leadership Team under the General Manager Assets and the Vice President Track Services with support from the Maintenance Manager North and Maintenance Manager South. The Asset Leadership Team coordinates all maintenance activities across the networks and allocates resources as required to deliver the network maintenance plan.

Asset Monitoring

Asset monitoring and analysis is a very important part of accurate maintenance planning and delivery. Asset monitoring technology and the associated analytical tools are becoming increasingly sophisticated; delivering more accurate and robust data directly fed into the maintenance planning process. Aurizon Network operated its own Asset Management toolset for this purpose, which has been internationally benchmarked to conform to regulatory requirements and industry standards.

Utilising those tools provides more accurate monitoring of potential defects enabling a successful preventative maintenance program, which in turn, generates efficiencies over the longer term. Section 2. Network Maintenance Philosophy has more information on Aurizon Network's asset management process and the technology.

3.3.4 Maintenance Planning

Access planning involves two inter-related processes covering:

> Planning for the maintenance activities
> Coordinating Access Holder's rights to access the corridor.

Associated sub-process provides for customer engagement and confirmation of the closure regime to ensure alignment of all stakeholders in respect to a firm lock-in of the closure particulars, including start time, outage duration and maintenance tasks that are permitted to be undertaken. These processes are underpinned by the content and intent of Engineering Standards contained within the Safety Management System.

Planning Approach

The planning process is an evolutionary process and as time elapses, elements of the plans will migrate through the various time phases. To achieve an effective five-year maintenance plan critical data on planned infrastructure enhancements, critical asset calendar, access entitlements, rollingstock plan and network capacity modelling are taken and analysed to create the:

> Critical asset alignment calendar
> Capacity profile
> Supply chain maintenance strategy which is then used during the tactical planning stage of the process.

These plan elements are reviewed on a yearly basis via the consultative forums. The resultant one and two year plans, are then subject to a 18 month rolling consultation program with strategic (non-day-of-operations) members of the coal supply chain forums (refer section 3.3.2). The delivery of the maintenance plan from a 12-month time frame through to day-of-operations transitions through the same forums, with the focus moving planning to service delivery.

> The diagram below provides a simplified process flow of the system planning activities.

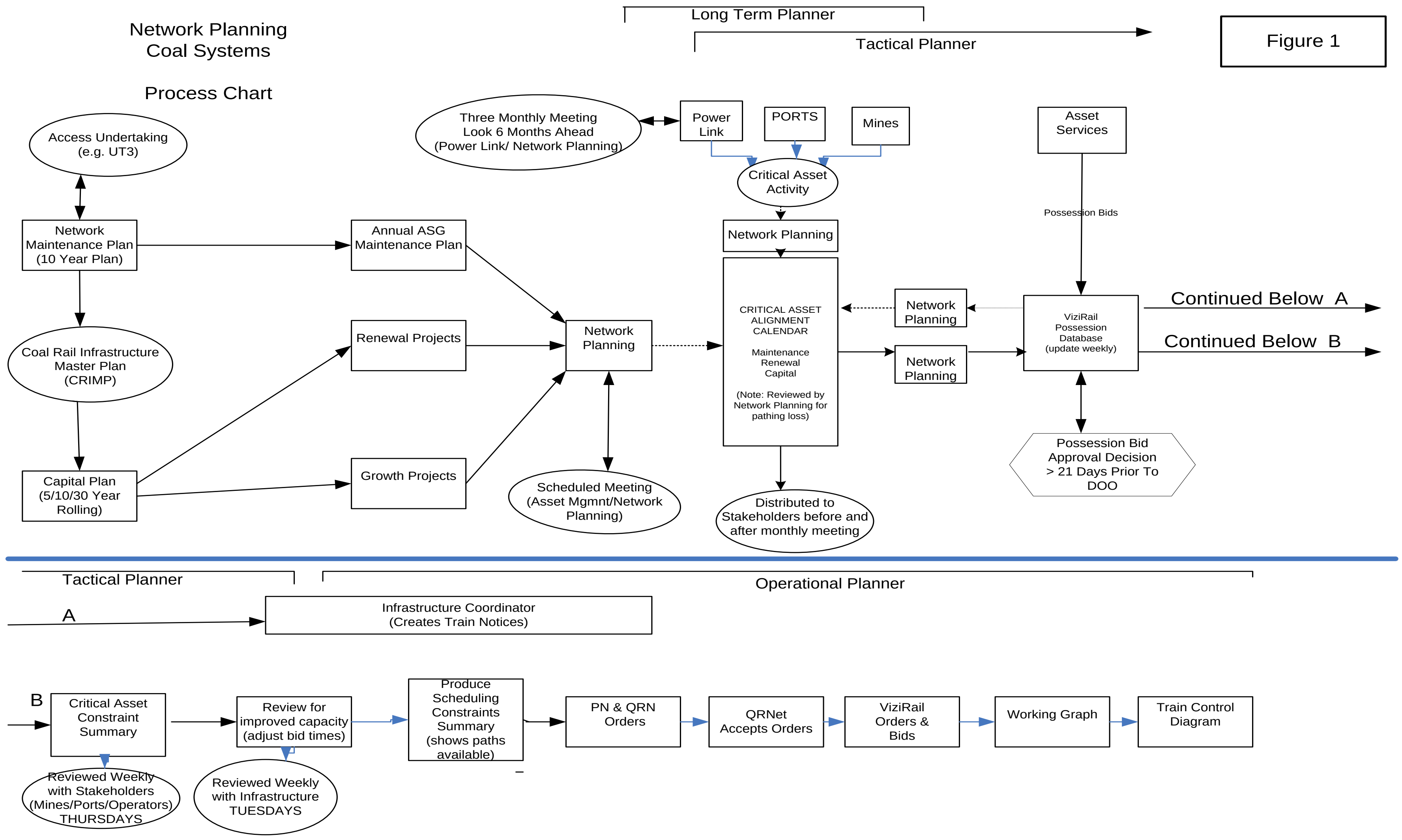


Figure 29: System planning process chart

Critical Assets Calendar

Aurizon Network has developed and maintains a Critical Asset Calendar in conjunction with members of the coal supply chain. The Critical Asset Calendar is a visual representation of when key network, mine and port infrastructure will be “off line” and is an essential tool in Aurizon Network’s management and delivery of optimal network operations.

An example of a Critical Asset Calendar for the Goonyella System is provided in Appendix AB – Critical Asset Calendar.

Access Agreements and System Rules

One of Aurizon Network’s fundamental functions is to facilitate the planning and scheduling activities within and across the Central Queensland Coal Network. In delivering this service, the key objective is to ensure equitable distribution of network capacity amongst the maintenance teams and access holders, and to ensure the supply chain is performing at its optimal ability.

Aurizon Network develops System Rules for each of the coal systems through a consultative process with the various mines, ports and system operators involved. These rules deal with operational matters such as departure procedures, delay management, train control; operations and other matters. Specific System Rules for each of the individual systems are documented in Sections 6-9 of this submission. The System Rules support:

- Master train planning process
- Intermediate planning process
- Scheduling process
- Plan implementation/operation
- Performance management.

To assist with planning, access seekers must submit a Conceptual Operating Plan dealing with train origin, train destination, dwell times in both directions, consist configuration and various other matters. A capacity analysis is then undertaken considering matters such as: can the loading facility handle the product, does the operator have sufficient rolling stock and are there any safety interface issues. Static modelling is conducted to review queuing and associated contractual matters. Negotiation is undertaken on applicable tariffs and other commercial matters. Capacity management provides for the Master Train Plan, Weekly Train Plan, Daily Train Plan, Traffic Decision Matrix, Conflicted train path rules and the System Rules, declaration of system paths, submission of train orders, defining train path availability.

Aurizon Network must also coordinate the planning complications resulting from Access Entitlements being transferred among members of the supply chain. A chronological representation of the planning process follows:

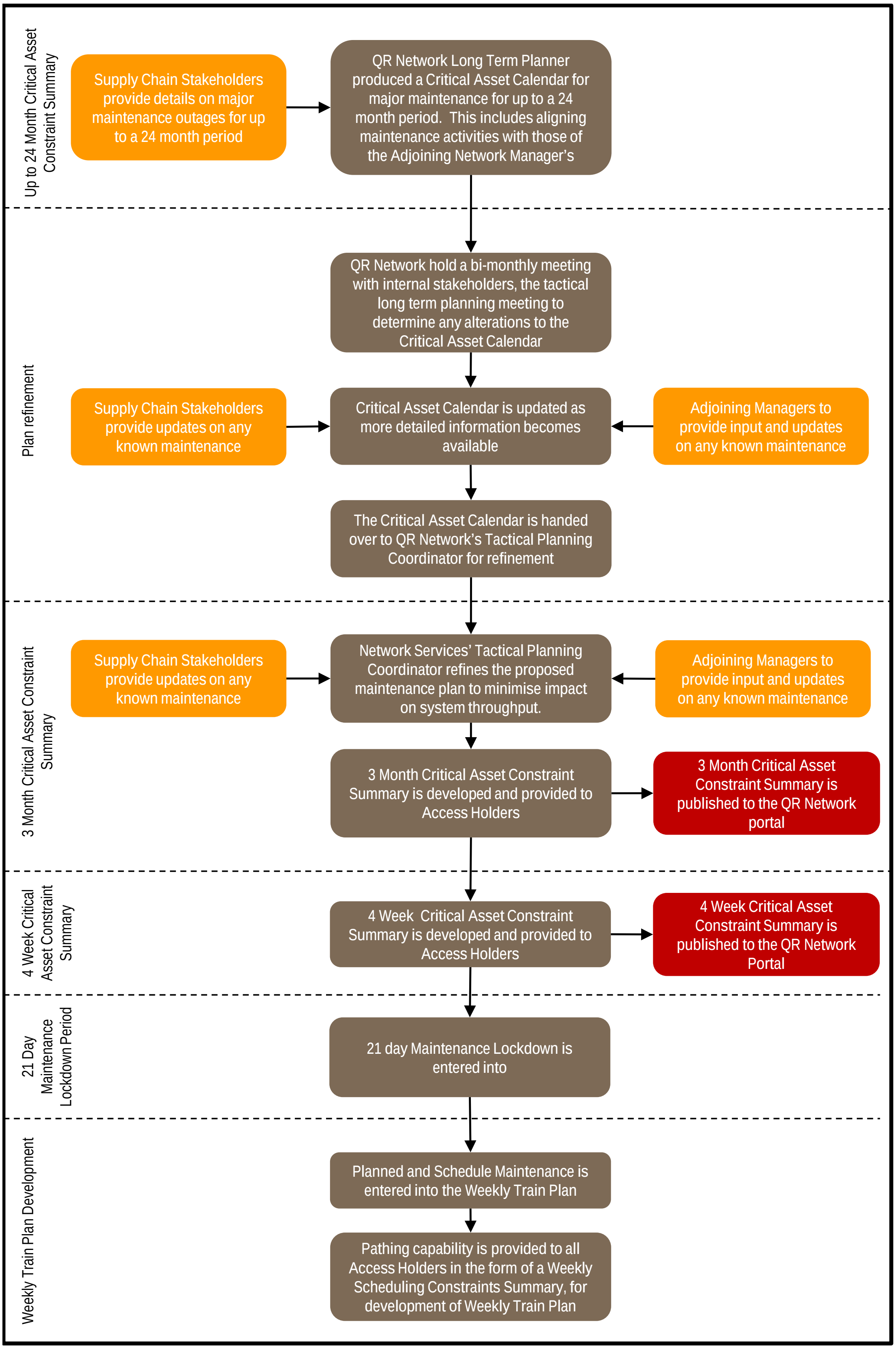


Figure 30: 24 month network planning process

3.3.5 Implications of the Current Environment for Maintenance

Some of the key implications of the current demand environment for maintenance include:

> Maintaining an aging network to a suitably high standard to minimise the risk of asset failures and network incidents. This is particularly prevalent as we enter into the next Access Undertaking period, as the forecast tonnage profile has increased considerably

> The effective management of available possessions and minimising disruptions to network availability for both planned and unplanned maintenance

> Maintaining sufficient flexibility in the maintenance regime in order to be able to:

- Accommodate customer needs, for example, rescheduling Planned Possessions to enable a customer to meet its schedule at the port
- Provide sufficient resources to respond to faults with the infrastructure or rail incidents
- Respond quickly to unanticipated issues and incidents to minimise disruptions to the network

> The growth demand driving this environment which is also placing pressure on the costs of doing maintenance.

In order to be able to respond to these challenges, flexibility is imperative to be able to continue to investigate ways of delivering maintenance more efficiently, including being able to do more maintenance with the same (or fewer) resources and/or being able to mobilise resources to maximise the limited maintenance windows available. This necessitates maintaining sufficient capacity in management and planning capability in order to be able to investigate new and/or alternative ways of doing things while continuing to deliver the maintenance plan.

Figure 31 below illustrates how maintenance resource efficiency increases significantly in relation to longer system shutdown durations. Currently it is considered the resource availability limitations, associated incremental labour cost, disruption to the supply chain and risk of asset failure between larger shutdowns outweigh the productivity benefit. Further discussion is underway with the supply chain participants.

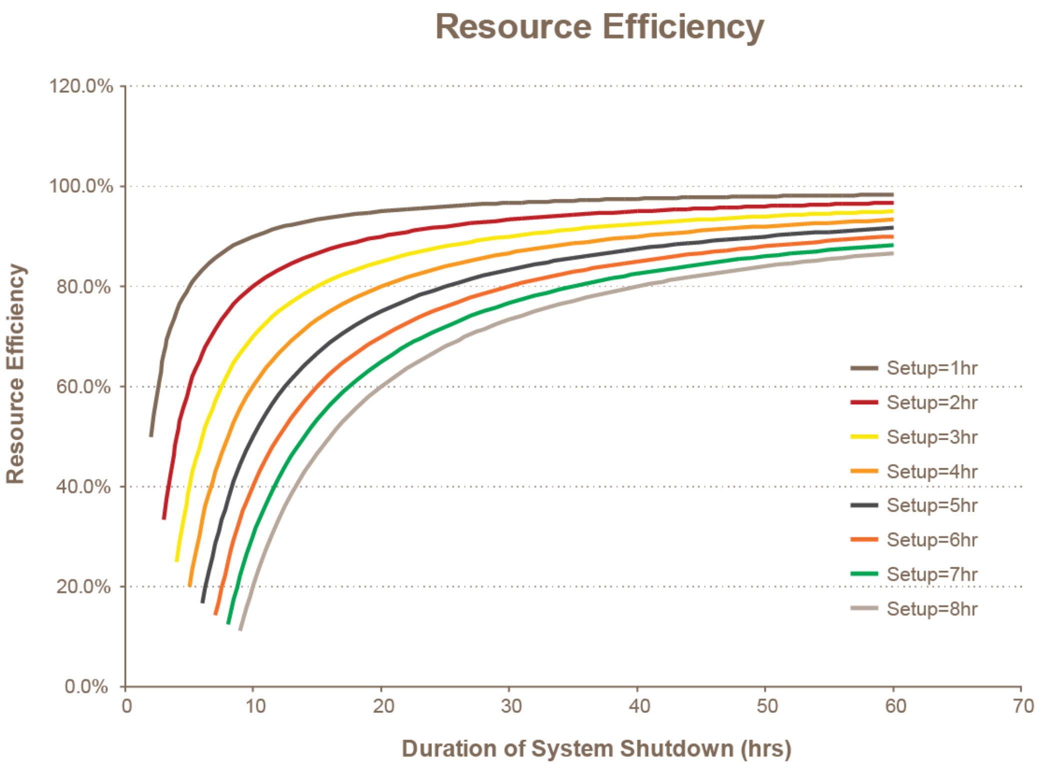


Figure 31: Resource efficiency as a function of system shutdown duration

Table 11 represents the number of train paths undertaken on the network over the twelve month period ending 30th June 2012.

Table 11: Train paths during last three year period

	FY10	FY11	FY12
Blackwater	7,911	6,583	7,055
Goonyella	10,346	9,073	8,519
Moura	2,421	2,025	2,444
Newlands	3,776	3,070	2,712
Total	24,454	20,751	20,730

Table 12 represents the number of occasions where track possession was taken by maintenance staff to undertake necessary works on the Goonyella System for the FY12.

Table 12: Possessions taken to undertake necessary works

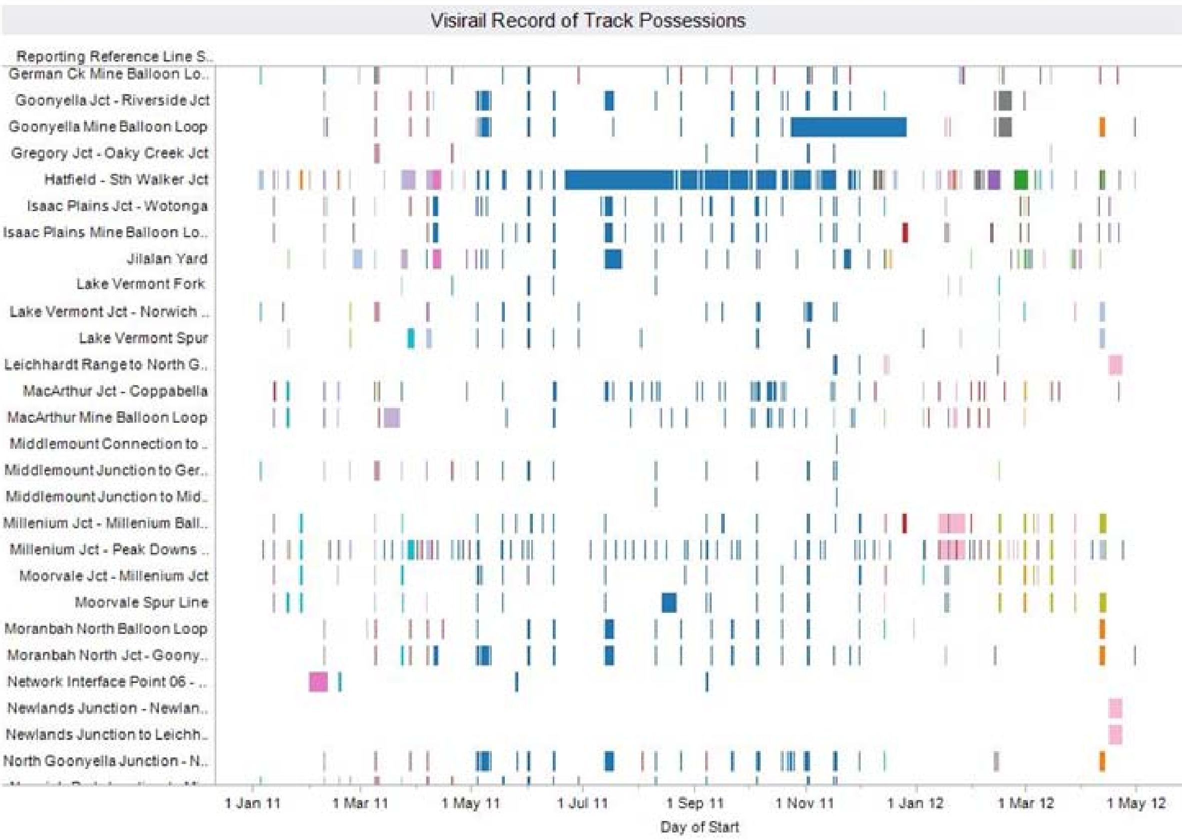


Figure 32 to Figure 35 depicts the system capacity in the form of a “Waterfall” graph which highlights the capacity of each system, which is then discounted by the various influencers that impact network performance leaving the network capacity not utilised.

MOURA OPERATIONAL PERFORMANCE (FY 2012/13)

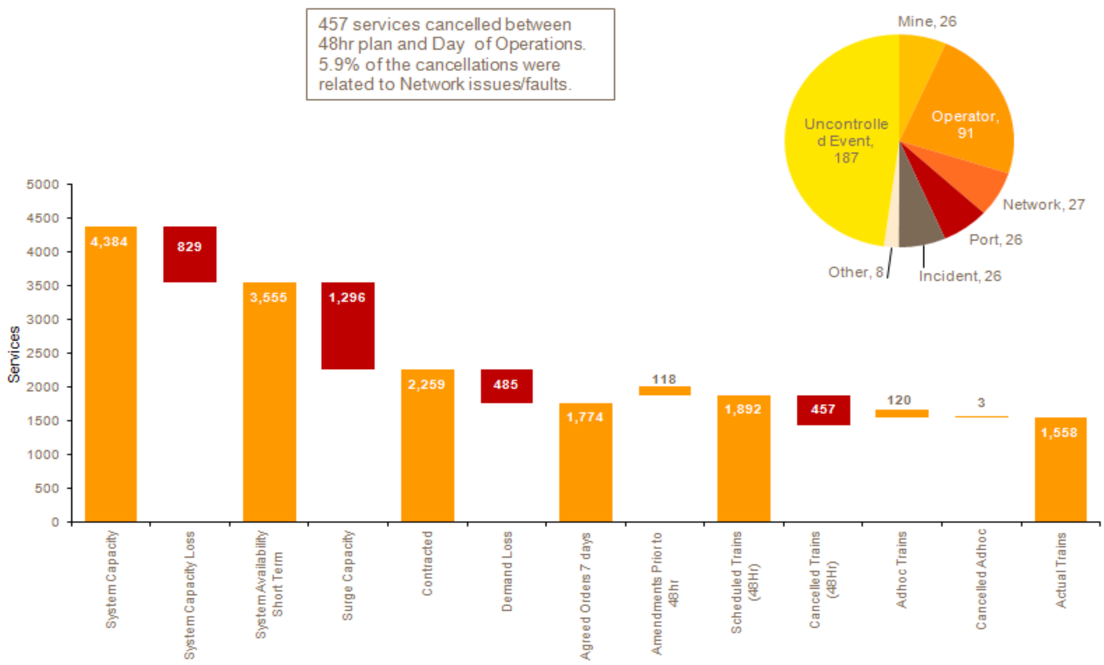


Figure 32: Capacity waterfall graph for the Moura system

BLACKWATER OPERATIONAL PERFORMANCE (FY 2012/13)

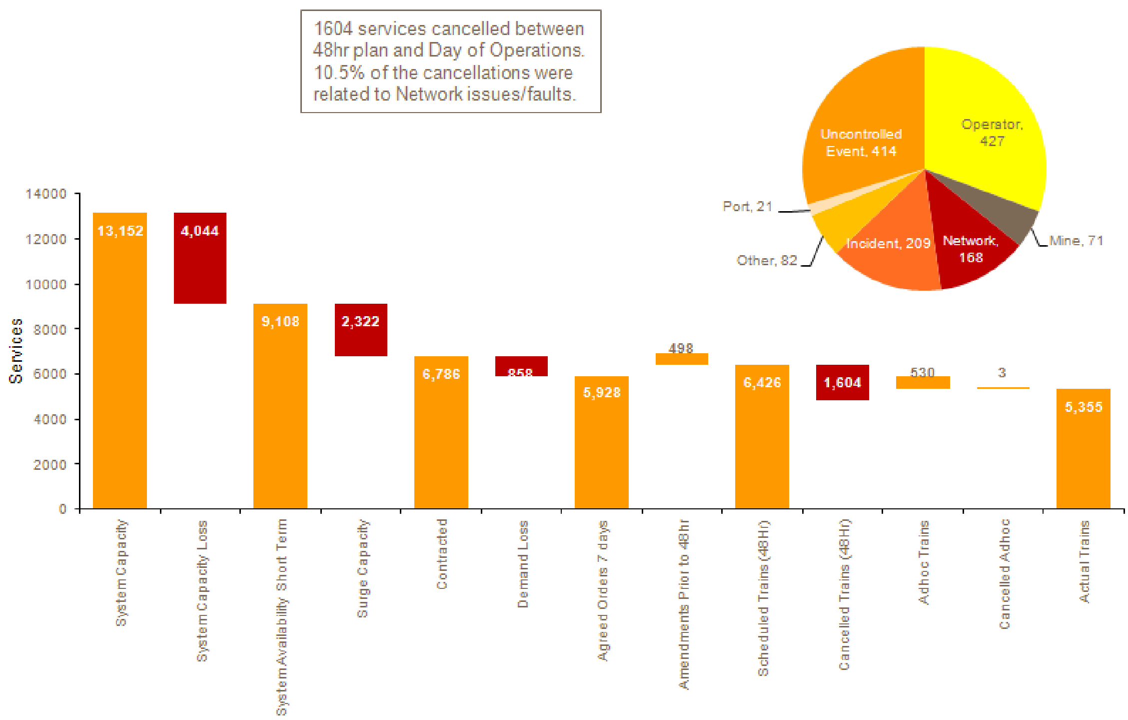


Figure 33: Capacity waterfall graph for the Blackwater system

AURIZON

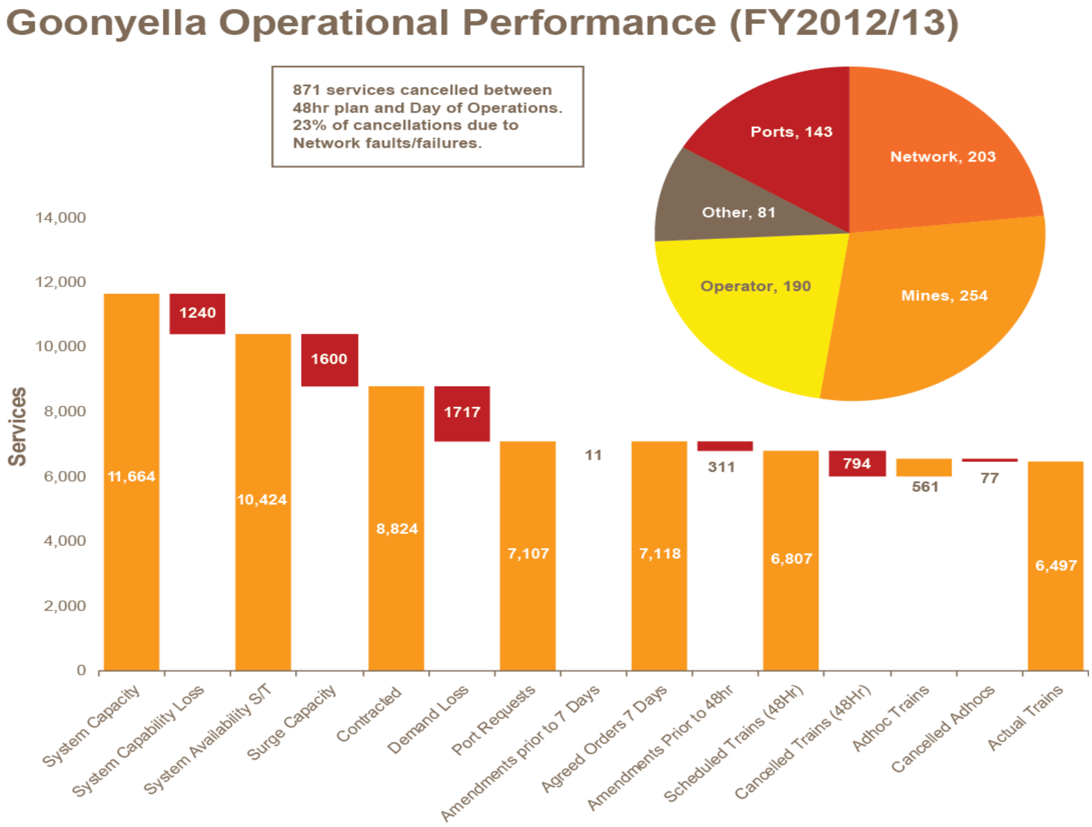


Figure 34: Capacity waterfall graph for the Goonyella system

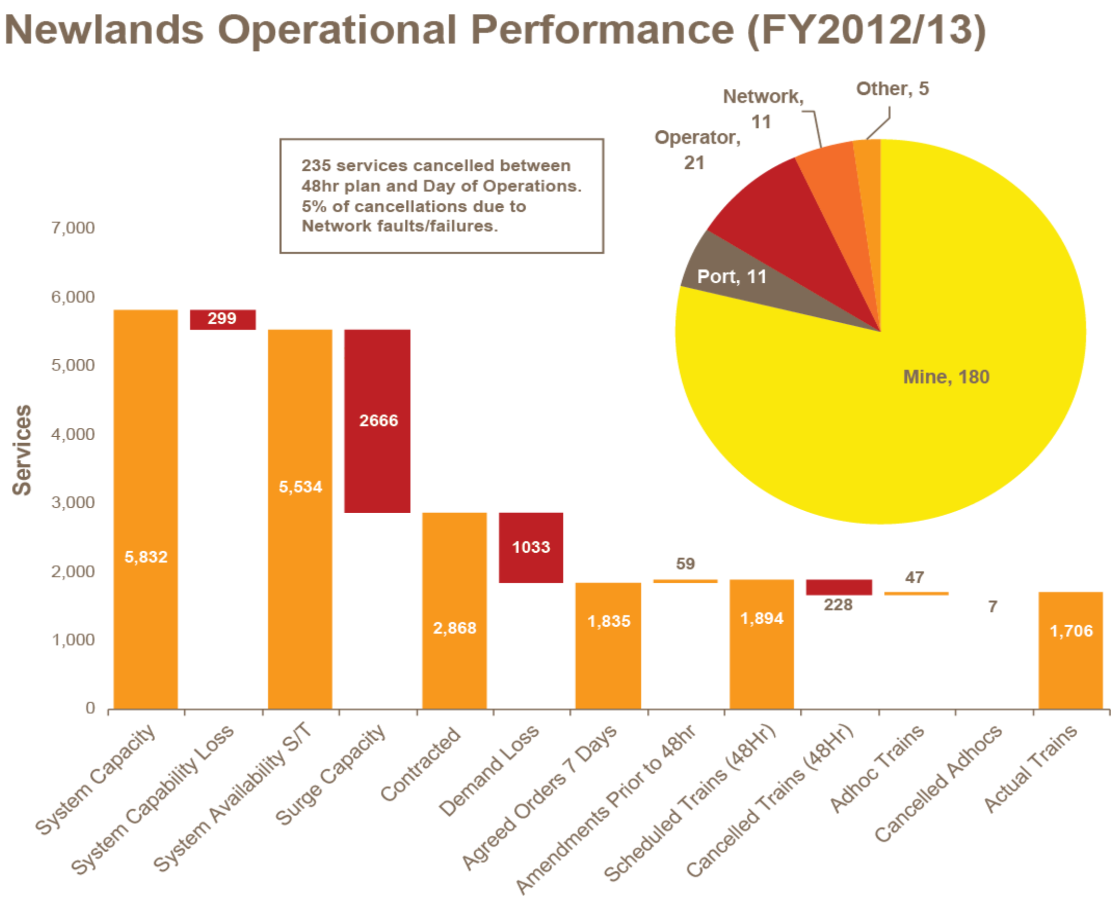


Figure 35: Capacity waterfall graph for the Newlands system

Coal chain impacts on delivery

The current contract structure enables supply chain participants to contract tonnes at peak periods regardless of whether the supply chain can accommodate the sum of all these access requests. This situation is aggravated when various parties assess supply chain capacity using different assumptions that in practice do not result in the operation of even railings. Customers wishing to rail tonnage in excess of available capacity place pressure on Aurizon Network to restrict track possessions, which will impact the delivery of the maintenance program and increase the risk in relation to the network availability and reliability. Aurizon Network acknowledges these pressures and endeavours to manage resource and capability to accommodate these requests as negotiated through the various stakeholder engagement forums.

There are a number of situations and practices beyond the control of Aurizon Network which can have an effect on the cost of services delivered (as described in Table 13 below) and the scope of tasks required to maintain the asset for use over its design life. Some examples are outlined below.

Table 13: Situations that can impact maintenance delivery

Situation	Description
Coal Ploughing at Ports	Coal unloading practices at the port that cause coal to remain on rail wagon bogies on exit from the port has an impact on the condition of the rail around the exit of the mine.
Weather	The central Queensland climate is subject to long periods of relatively stable weather which are interrupted by irregular bouts of extreme rainfall that typically require the maintainer to shift from preventative to corrective maintenance activities for extended periods. These rain events typically occur during the summer months and as an asset manager Aurizon Network plans for them by ensuring its staff and contractors have the available resources and flexibility to cope with these rain events.

Cost Implications of Interruptions to Maintenance

Where Aurizon Network defines a scope of maintenance activity for a period and this is subsequently interrupted due to factors not foreseen by Aurizon Network e.g. flooding of part of the network, maintenance costs can increase in one or more of the following ways:

> In line with stand-down and re-tool time required for both labour and consumables used in the activity

> Future maintenance costs rise due to missing planned possessions, including the costs associated with re-scheduling the activity to a future time/date. This can also include additional travel and accommodation expenses.

Due to the specialised nature of the equipment used for major track maintenance and the requirement to move this from other parts of the coal system, the establishment costs associated with these activities are high, although much of these costs are fixed.

Where maintenance staff are resourced for specific activities and it is in line with planned track possession arrangements, any change to the scope of activities or track possession, for any reason, can increase the delivery cost due to ‘repeat’ attendance to finalise the work. In addition, failure to perform scheduled preventative maintenance can result in:

> A reduction in throughput due to speed restrictions

> The need for remedial maintenance which limits customer throughput

> A deficit in asset performance in the future.

Corrective maintenance, however, must be undertaken immediately in order for the safe working of trains on the coal system.

Building in flexibility

Maintaining the capability to carry out immediate corrective maintenance requires a sufficient amount of flexibility in the maintenance regime. This includes having adequate resources that can be readily deployed to rectify failures while minimising disruption to the already busy network, ensuring disruptions to availability are minimised without compromising the safety and integrity of the network.

The retention of flexibility in the maintenance regime is also very important in a cargo assembly operating environment (from a whole of supply chain perspective). For example, Aurizon Network has sought to revise Planned Possessions in order to enable a customer to access the track to fulfil the requirements of the port.

This clearly has flow-on implications, not only for the rescheduled activity but also for activities in other parts of the network requiring the same resources. For example, planned use of the ballast cleaning machine on an electrified system requires electrical isolation of three sections of rail, the one being maintained and those at each end of the section, for staff and operational safety. To do this linesmen are on site to isolate the required track along with track teams and maintenance machine operators. The opportunity cost of not using these resources is significant and can also lead to higher costs through the flow-on effects of machine availability for future maintenance activities.

3.3.6 Delivery Structure

Governance:-Coal Link Alliance

The Coal Link Alliance is responsible for the efficient and timely delivery of the maintenance tasks and activities covered by this submission. The alliance is chaired by the GM Network Assets who is responsible for the delivery of a safe and reliable network. The meeting is attended by the VP Specialised Track Services, Manager Maintenance South and the Manager Maintenance North who collectively deliver all the maintenance tasks and activities for the network. The Manager Network Operations South and Manager Operations North also attend and are responsible for the planning and coordination of all traffic and works on the network. It is the responsibility of the Manager Network Operations South and Manager Operations North to liaise with the coal supply chain in the negotiation of track availability. Refer to Section 3.3.2 Customer Engagement process for more detail on how Aurizon Network works in partnership with all supply chain entities.

The Aurizon Network operational structure is designed to focus capability and resources on core maintenance, repair, response and recovery services delivering better maintenance of the network and reducing unplanned disruptions. Accountability for the Maintenance and Specialised Track Services teams sits within the Aurizon Network business group. To ensure focus on improving system reliability through maintenance, the Network Assets (Engineering) team has aligned with regionally-based maintenance staff to provide key Asset Management strategies and support functions to ensure optimal asset value. (Please see Figure 2: Aurizon Network organisational structure for a graphical view of the personnel within the business).

The Management and Deployment of Resources – People and Plant

While technological advances continue to enhance the way maintenance is undertaken and improves productivity, it is still a very labour intensive activity. The effective establishment, management and deployment of teams are a critical part of the maintenance strategy and are also fundamental to the ability to retain sufficient flexibility to cope with challenges discussed above.

Internal Capability

The move to a District Management structure in 2012 has provided a stronger planning focus with enhanced links between required network performance and the planned work on the assets. Dedicated resources for liaison with the network capacity managers has resulted in better integration of capacity requirements into the maintenance planning process.

The restructure has resulted in the following outcomes:

> Increased productivity by:
  - More efficient planning work focused on customer needs
  - More efficient use of resources by viewing them as a single pool rather than restricting some groups to limited activities or areas

> Better reporting of performance against plan to increase confidence the right work is being done in the correct time frame

> Increased emphasis on staff development by establishing dedicated workforce development resources in each district aimed at enhancing workplace competencies

> A section dedicated to assets, finance and inventory to ensure better business management of these important items

> An operations team focused on delivery of the maintenance task and delivery to the required level of quality and cost by adopting flexible work practices.

The maintenance teams are deployed from a network of 15 depots distributed across the network as pictured.

The two major centres are located in Rockhampton and Mackay. These Centres contain maintenance management and planning staff, with the management team in Rockhampton overseeing the Blackwater and Moura systems, and the team in Mackay overseeing the Goonyella and Newlands systems. Disciplines are situated in the following locations:

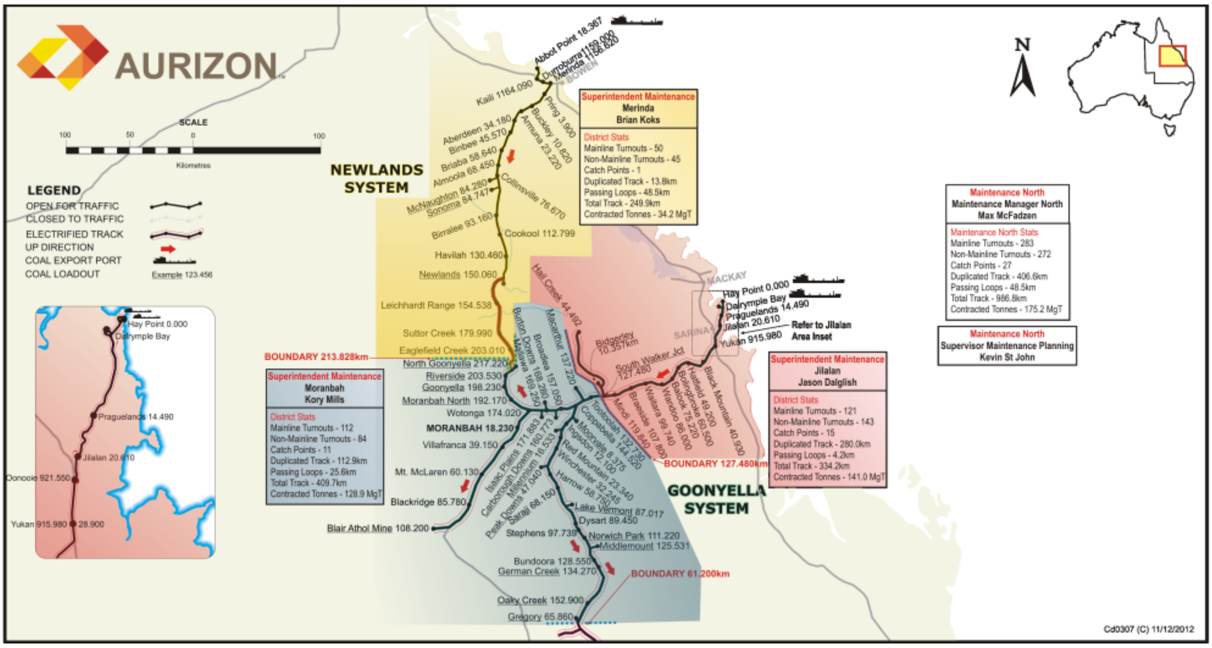


Figure 36: Depots in Newlands and Goonyella Systems

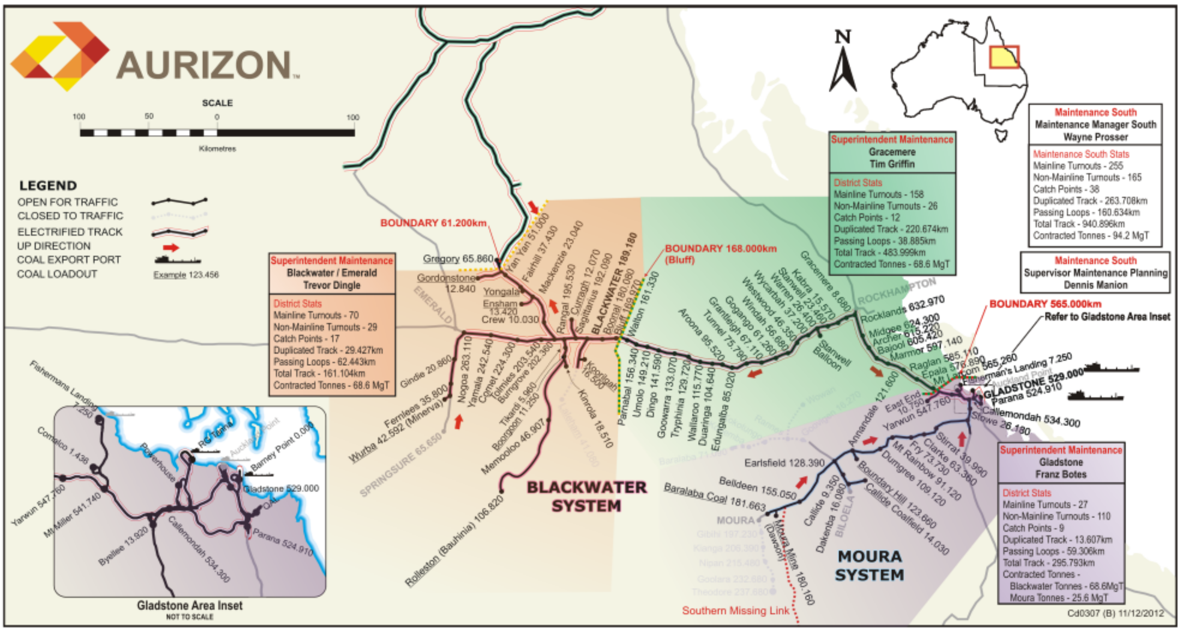


Figure 37: Depots in the Blackwater and Moura Systems

Specific workforce locations include:

> Infrastructure management specialist teams are based in both Rockhampton and Mackay

> Specialist staff for general track and production maintenance are located in Rockhampton and Mackay, and also in major depots at Sarina, Gladstone and Jilalan

> General maintenance teams are located throughout the system

The location and staffing of depots is driven by a number of factors:

> It reflects the historical evolution of an established network, some parts of which have been in operation for many years

> It is influenced by the supporting infrastructure in towns and major centres across the central Queensland coalfields, which can be a key factor in attracting and retaining staff

> Depots need to be located near the most complex and critical parts of the network, such as the ports and major yards like Jilalan

> Other staff need to be located closer to the coalfields to enable quick response times.

The location and staffing of depots for key activities underpinning the UT4 cost forecasts, as well as the resources used by the maintenance teams, is explored in more detail in Section 5 Maintenance Cost

The effectiveness of these actions has contributed to the improved maintenance performance showing there has been a 23% increase in planned jobs completed in the Goonyella system, a 117% in RIMS jobs closed in the southern region and a 68% increase in RIMS jobs closed in the northern region. Further detail on these improvements is contained in Section 3.3.1.

Equipment Fleet

Aurizon Network has access to an extensive fleet of maintenance equipment supporting its major scheduled preventative maintenance and corrective maintenance activities. The equipment falls into four main categories:

> **Major Mechanised Equipment** - This category includes high-production mainline resurfacing machines (tampers and ballast regulators), rail grinding capability for both

mainline and turnouts, switch tampers and on-track inspection vehicles (track geometry recording car and ultra-sonic non-destructive testing (NDT) vehicles)

> **Hi-Rail Vehicles** - These categories includes vehicles not permanently running on track, but are placed on track using their own special wheel arrangement. This category includes hi-rail inspection 4WDs, hi-rail work trucks with cranes mounted on board and elevated platform overhead traction wiring vehicle

> **Hand Tools and Specialised Equipment** - This category includes hand-held motorised tools such as rail saws, rail borers, rail grinders, hand-held non-destructive testing equipment, measuring devices and all specialised tools required for multi-disciplined maintenance of a rail spur

> **Specialised Maintenance Rollingstock** - This category includes special maintenance wagons purpose-built for carrying heavy track components such as rail, concrete sleepers and ballast. Aurizon Network has existing commercial arrangements with Aurizon haulage divisions to provide locos and crews to haul these work trains on a regular basis

Currently Aurizon Network outsource the delivery of the services of Track Recording Car and Non destructive Testing Vehicles.

3.3.7 Procurement

Aurizon Network is a major commercial participant in Queensland and in particular the Central Queensland Coal Region and as such demands the benefit of its superior buying power. To leverage this capacity Aurizon Network has developed a world class commercially focussed approach to procurement.

The Enterprise Procurement team exists to lower Aurizon Network's cost base and provides process governance and improve the company's operating efficiency through the professional way they engage and manage the supply market. This is achieved by:

> Targeting best cost outcomes through a sustainable and systematic sourcing process while maintaining or improving levels of quality, service and technology

> Reducing the contracting cycle through master agreements with key suppliers

> Providing governance and process control through a separation of financial duties

> Managing and reporting on supply data

> Rigorously negotiating

> Guiding the Inventory Management program (explained further in Section 5)

> Executing the disposals and returns process

> Actively managing recurring categories of expenditure through a multifaceted category management program designed to engage suppliers, Aurizon business units and the relevant market.

This disciplined, systematic process for determining the best cost of externally purchased materials, goods and services while maintaining/improving levels of quality service and technology, results in:

> Introduction of new vendors, creating competitive tension

> Standardised products, thereby reducing the likelihood of redundant goods and materials

> Introduction of functional versus technical specification

> Consolidated buying power

> Innovative solutions to complicated service requirements

The practical benefit of this aggressive approach to procurement is contained in Section 5 where the procurement effort is discussed further. The overall process model is depicted below.

Define Initiative → Strategic Sourcing → Category Management

Key Activities:	Define requirements	Understand the scope	Analysis	Strategies	Engage Market and Negotiation	Implementation and Category Management
Customers:	• Define and determine material requirement • Demand forecast • Delivery time frame	• Aware procurement process • Provide operational knowledge input	• Aware procurement process • Receive findings	• Aware procurement process • Review sourcing strategy and evaluation outcome	• Aware of procurement process • Review negotiation outcome	• Business case sign off to award contract • Operational implementation of sourcing outcome and KPI's • Manage day-to-day operational supplier relationship to meet KPI's • Day-to-day management of operational issues • Highlight innovation opportunities
Technical:	• Review technical specs & standards	• Provide technical support and knowledge input	• Provide market knowledge • Pre-qualify potential suppliers • Supplier site visit	• Qualify potential suppliers • Conduct testing and/or trial if required	• Provide testing results and material approval	• Provide ongoing technical support • Issue escalation point for technical matters • Provide ongoing input into assessing the technical aspects of continual improvement and innovation
Procurement:	• Provide knowledge input to users	• Spend analysis • Stakeholder analysis • Idea generation • Review hypothesis to define scope • Engagement pack #1 sign off	• Data analysis to support Hypothesis • Supplier and market analysis • Develop TCO & cleansheet • Supplier site visit	• Risk assessment • Develop sourcing and negotiation strategies • Engagement pack #2 sign off • Supplier idea generation	• Develop RFP, T & Cs • RFP evaluation • CSFB negotiation • Make recommendations • Engagement pack #3 sign off	• Award contract • Engagement pack #4 • Ongoing contract review and issue escalation management • Ongoing non-operational commercial supplier management • Collaborative review of innovative opportunities • Periodic management reporting
Inbound Supply Chain:	• Assist customer with demand forecast & inventory management	• Provide supply chain knowledge input	• Aware procurement process • Receive findings	• Review sourcing strategy and align supply chain process	• Support on negotiation strategy	• Ongoing logistic management • Inventory forecasting and stockholding reduction management • Improvement opportunity review and implementation
Legal:	• Aware customer requirements	• Aware procurement process	• Aware procurement process	• Legal advice on contracts	• Develop and review contract terms & conditions	• Provide ongoing legal support • Review and advice of escalated major issues

Figure 38: Aurizon Network's procurement process overview

3.3.8 Environmental Considerations

Coal Fouling

The Central Queensland Coal Network intervention limit of 30% Percentage Volume Contamination (PVC) is in line with intervention levels of other coal fouled railways of similar operating parameters. Coal dust fouling represents a condition considerably more debilitating to rail track performance than clay, sand or silt contamination. Exceeding this limit increases risk of track support failure to unacceptable levels which may result in derailment. Where damage to formation is caused this may incur costs of repair four or more times more costly than ballast cleaning and significant capacity reduction.

Ground Penetrating Radar (GPR) measurement of PVC has enabled a determination that the rates of fouling is highly variable across the network ranging from 1% to 15% Percentage Volume Contamination per 100 Million Net Tonnes (MNT) of coal carried.

The suggested average rate of fouling for planning purposes is 5% PVC per 100MNT coal. This equates to a ballast cleaning intervention frequency of 600 MNT hauled on the section of track.

A more detailed discussion of coal fouling is provided in Appendix AC- Ballast Fouling.

Dust

In Australia, the last 20 to 30 years has seen suburbia creeping closer to the mines, rail corridors and shipping ports. The demand in recent years has also seen coal production increase significantly. As a consequence, dust complaints from the community have also increased.

Coal dust emissions are influenced by a number of factors such as: coal type, particle size, moisture content, ambient temperature, humidity and wind speeds. Add to that issues stemming from rail transportation, loading and unloading and this makes the control of dust emissions a complex problem.

Aurizon Network has been working in partnership with supply chain participants in investigating the issue of coal dust emissions in the CQCN, with a view of implementing solutions to address the increasing community concerns. Aurizon Network conducted research into dust, its causes, and possible mitigation measures as part of the company's Coal Loss Management Project. Aurizon Network also conducted extensive laboratory and field tests to identify dust sources and dust types.

Besides quantifying the problem, the Coal Loss Management Project researched the use of dust suppressing chemicals and or veneers on dust emanating from the top of coal wagons. This involves the treatment of the coal surface in rail wagons with a chemical which effectively forms a spiders-web or crust over the coal surface, minimising coal dust escape over the journey.

Amongst other mitigation measures, Aurizon Network planted trees and grass, built fences, improved drainage and graded formations using different methods. It also looked at ways to better empty and profile coal wagons.

More recently, Aurizon Network has established a Coal Dust Management Plan (CDMP). Implementation of the Coal Dust Management Plan will benefit the community by minimising coal dust, and it will provide long-term benefits to the Central Queensland Coal Region.

Aurizon Network has installed ambient air monitoring units throughout the Central Queensland Coal Network which has improved Aurizon Network's coal dust management process. Aurizon Network's Access Agreements have been redrafted to include planned mitigation methods.

Bushfire Risk

With diesel trains running on several lines there is a risk of sparking, resulting in bushfire, particularly in the very dry hot months. Aurizon Network mitigates this by incorporating fire management into the maintenance regime. Firebreaks are created and maintained along the corridor, and scrub close to the track is kept to a minimum.

Corrosion

The CQCN systems are susceptible to corrosion for 2 reasons:

> Their proximity to coastal areas

> Coal fouling, which contains sulphur, mixing with the moisture in the air of that area creates a very acidic compound.

Both of these aspects cause issues with accelerated asset deterioration. This can impact on the frequency of minor replacement of components following spot failure or result in wholesale early asset failure and renewal works. This becomes an increasingly important consideration as general infrastructure in coastal areas has the highest use and tonnage and therefore the most significant, consequently affecting the supply chain throughput.

As an example of impact, Fist fasteners can pose a risk as these are generally buried by the ballast, and they go unnoticed until they completely corrode.

Livestock

Across the board for the CQCN, there are livestock issues with an average of three cows per day being reported on the track and approximately one incident per week of a train actually hitting a cow that has strayed onto the tracks. This can cause issues for the track and the rollingstock involved and often requires follow-up corrective maintenance. On-going fence maintenance is also required due to damage caused by livestock.

Darwin termites

Darwin termites are an aggressive termite found in Queensland, particularly in the Goonyella region, and pose a significant risk to Aurizon Network's civil structures. They can disable a timber bridge or timber sleepers, and even dig through concrete in a very short period of time, meaning constant checking and inspection of network structures is required.

4. ASSET MAINTENANCE PRODUCTS

Chapter 4 - Key points

> The maintenance task described in this section is required to deliver a high reliable world class rail network

> The maintenance products are defined into six groupings and detailed descriptions of each product are provided and embedded in the Safety Management System

- Mechanised Maintenance
- General Track
- Structures
- Signalling
- Traction Power
- Telecommunications

> The product definition and required activities are consistent with the QCA approved prudent and efficient UT3 works and further supported by

- Worley Parsons and Transport Technology Centre Parallel comparison exercise.
- Evans & Peck Investigation and Benchmarking on Operational and Maintenance Cost
- Queensland Transport Rail Infrastructure Management Accreditation requirements.

The activities undertaken to maintain the CQCN are comprised of the following six product groupings:

> Mechanised Maintenance

> General Track

> Structures

> Signalling

> Traction Power

> Telecommunications.

The following sections provide descriptions of the maintenance products in each of the main disciplines.

4.1 Mechanised Maintenance

Mechanised maintenance is work undertaken using specialised mechanical plant, and comprises the following product:

> Ballast cleaning

> Rail grinding – mainline and turnouts

> Track resurfacing – mainline and turnouts.

4.1.1 Ballast Cleaning

Ballast cleaning is the mechanical excavation of deteriorated and fouled ballast from beneath the sleepers, after which fresh ballast is added to the track and tamped to restore the track to the correct height and ballast depth. The operation includes associated support activities such as ballasting, earthworks pre and post operation, resurfacing and track protection. Track closures are required to carry out these works.

The scope for mechanised ballast cleaning is divided into three sub-products

> Core mechanised ballast cleaning, undertaken by the dedicated ballast cleaning consist
> Ballast cleaning – Turnouts, undertaken by specialised turnout machines
> Ballast cleaning – Other, undertaken by specialised mainline machines.

The primary function of ballast is to resist vertical, lateral and longitudinal forces applied through traffic and axle loads to the sleepers to retain the track to its required position. Ballast comprises pieces of crushed rock which knit together to form a resilient bed beneath the sleepers (ties), which spreads the weight of trains over the ground (sub grade) the track is laid on.

Over time ballast deteriorates by fracturing into smaller pieces, losing its sharp edges and becoming contaminated with dirt and mud rising from below the ballast. In the case of the CQCN, coal product spilt or blown from wagons contributes heavily to ballast fouling. The principal degradation mechanism on the ballast in this particular network is the loss of voids and poor drainage, with other effects detailed below:

> Coal dust has similar properties to clay, which affects the strength of the ballast and formation when coal dust becomes saturated with water
> Coal dust can hold excessive amounts of moisture, thereby preventing free draining of the ballast and acts as a lubricant between ballast stones, causing movement
> The chemical consistency of the coal dust has caustic effects on the concrete and steel structures of the CQCN.

With this in mind, ballast cleaning is a critical infrastructure maintenance activity. It improves both above and below rail costs and efficiency through:

> Minimising track related speed restrictions
> Reducing the risk of derailment
> Avoiding premature replacement of formation, sleepers, rail and fastenings
> Reusing valuable ballast
> Extending service life of the whole track and its components.

In addition to this, Aurizon Network also has an environmental responsibility to ensure local communities are as protected from coal dust as possible and will perform ballast cleaning activities more frequently in these areas. The amount of coal dust fouling on the track is directly related to the volume travelling the track, increased axle loads and projected tonnage gains will necessitate significant additional ballast cleaning and renewal work in the future.

The ballast supplied to Aurizon Network is of good quality and is up to the task demanded with some exceptions. When ballast does reach the end of its life through degradation or fouling, timely replacement is required to avoid impact damage to both track and rollingstock and to reduce track resurfacing frequencies. This is particularly relevant to heavy haul lines.

Figure 39: Aurizon Network ballast cleaning operation, RM900 ballast cleaning machine working in CQCN

Measuring Ballast Contamination (PVC testing)

Since 2002-03, Aurizon has used Percentage Void Contamination (PVC) testing to assist in determining whether ballast cleaning is required at any given site.

Research was carried out to determine a suitable ballast cleaning criterion. The results of this work showed ballast cleaning is deemed necessary when the depth of effective ballast below the sleeper drops under 100 mm. This equates to a PVC value of 30%, which is supported by international expert opinion. An extract from the study is shown below.

Alternative testing method for the measurement of Ballast fouling: Percentage Void Contamination

(Frank Feldman & Darryl Nissen, Queensland Rail, 2002)

"It is known that when fouling reaches the bottom side of sleeper (PVC = 50%, in concrete sleeper track with 250 mm of ballast) the substructure starts to fail. Therefore the limit of contamination must be less than 50%. Also, the bottom side of sleepers will have much higher wear rate due to increased attrition between foul ballast and sleeper. For minimal stability and operation of the superstructure, a minimum ballast depth of 100 mm is required, reducing the allowable limit for contamination or PVC to 30%. When the extent of fouling has reached this limit, the ballast-cleaning process must be initiated to maximise the cost effectiveness of track maintenance. This allowable limit of PVC will change for different track standards and different ballast depths. The PVC on 9.5 mm sieve is the most relevant selection compared with other sieve sizes. It has a more realistic relationship between visual inspection and actual void contamination. Sampling and testing should be completed every two kilometres in three year cycles for coal lines and six year cycles for freight lines to fully comprehend the rate of contamination and effectively predict ballast cleaning programmes."

It should be noted the investigation was based on a mixed-traffic railway with a 15 year life and traffic task of 30 mgtpa (Million Gross Tonnes Per Annum), the ballast showed little wear and was still sharp and angular after 15 years. It is reasonable to expect a purely bulk freight railway to have a higher percentage of wagon spillage. Increases in tonnage would have a similar effect.

Coal Loss Management Project to help contain ballast fouling

The Coal Loss Management Project (CLMP) was initiated in 2007 when Aurizon identified the extent of the required ongoing maintenance program required for tonnage growth under the existing coal loss management practices. This led to the need to investigate and propose possible solutions both in terms of environmental impact and assessment of appropriate ballast cleaning volumes. Further to this, investigations by the Environmental Protection Agency raised the profile of the issue and added impetus.

Consultants, Katestone Environmental and Connell Hatch, were engaged to undertake a series of studies to determine:

> The sources of coal loss
> Potential solutions to prevent coal loss
> The costs and benefits of these treatments.

Given the timeline the EPA imposed on Aurizon Network, priority was given to investigating those areas which would have the greatest input into measuring and improving the environmental impact. In this regard, coal loss in the form of coal dust was the primary concern from an environmental perspective.

Investigation work included:

> Wind tunnel testing of model coal wagons with various modifications
> Wind tunnel testing of different coal types and spray treatments
> The installation of dust measuring equipment to various residential locations
> A full literature review (including previous Aurizon investigations).

Results to date have shown generally the dust limits (the basis of the EPA's investigation) are only just exceeded in very specific conditions, such as extreme weather conditions, e.g. hot and windy, and at the corridor boundary, for the few minutes a single train takes to pass.

Other results are aiding how we look at fugitive coal held in the ballast and the impact it has on ballast cleaning.

Measures to mitigate fugitive coal include:

> Concept designs for wagon washing at the port
> Measurement of existing ballast contamination from samples
> Calculation of rates of contamination
> Modified coal wagon door loss measurement mechanisms have been designed and deployed.

Scope Development

The scope of Aurizon Network's ballast cleaning requirement is based on a number of key productivity drivers and takes into consideration the following assumptions:

> That ballast cleaning will be carried out when the PVC test results exceed 30%
> Access to the system, both in time and location are restrictive. If the required access is not available then the ability to achieve the quantities required will be compromised
> Ballast cleaning is just one of several techniques used to address ballast contamination and drainage issues.

It is anticipated the outcome of the Coal Loss Management Plan will result in a reduction of the rate of contamination. The anticipated net effect of these controls is predicted to be in the order of a -10% reduction in ballast fouling. However, given the increased tonnage forecast for the UT4 period coal fouling will continue to be an issue for our partners in the CQCN. The scope and cost components for this product are reported in Section 5.11.

4.1.2 Rail Grinding

Rail Grinding is a mechanised high production process of establishing and maintaining the rail head profile on mainline track and turnouts. It is undertaken by mechanised rail grinders and is an essential maintenance function on heavy-haul coal systems.

The objectives of rail grinding are to efficiently introduce and maintain appropriate rail profiles, and to remove small surface fatigue cracks. It is considered the most effective maintenance practice to control the effects of rolling contact fatigue (which has potential to lead to rail breakage and derailment), to restore rail profile and maximise value from the rail asset.

Rail Grinding is an internationally recognised best practice maintenance function that is necessary to:

> Correct the rail head profile
> Improve efficiency in the rail-wheel contact interface
> Promote efficient vehicle steering
> Reduce surface stresses that initiate cracking which can lead to rail breakage.

The correct use of a rail grinding strategy enables a substantial increase in the life of the rail asset. Other benefits include:

> Extending rail life
> Reducing resurfacing cycles (predominately for turnouts)
> Extending track component life
> Reducing wear rates on rolling stock wheels
> Reducing fuel usage for locomotives through promoting better rollingstock steering
> Reducing wheel squeal and flange noise.

It is important Aurizon Network's established rail grinding program is maintained so the benefits gained from optimising the wheel/ rail interaction, reduced wheel wear costs and increased rail life, are continued.

Rail Renewal costs are a significant maintenance expense. Without this current grinding strategy, the quantity of rail replaced would increase markedly, subject to all other relevant maintenance activities being done, especially under heavy and increasing tonnage conditions. Overseas data from Burlington Northern indicates that rail grinding can double the life of rail in tangent track, and extend the life of curve rail by three to four times when compared to pre-grinding days.

Rail Grinding is a highly specialised operation carried out by most railways throughout the world and not all of the railways resource their grinding programs internally. The provision of this service through the Coal Link Alliance (refer to Section 3.3.6 for details) has seen Aurizon Network's operating costs continue to run at below industry standard. More detail on this matter can be found in the Evans & Peck report in Appendix N. Australian railways are amongst the world leaders in the application of rail profiling and Aurizon operates one of the largest rail rectification programs in the southern hemisphere.

The different types of rail grinding work carried out are as follows:

> Profile establishment, i.e. modification of rail head shape to establish a new shape
> Profile maintenance, i.e. grinding of rail to maintain rail profile shape
> Corrective profiling, i.e. rails with surface defects

> Profile modification, i.e. stress reduction to allow increased axle loads

> Removal of rail corrugations.

Rail Wear and Surface Defects

Wear and surface defects are the dominant factors in determining the life of rails and wheels. Rail and wheel profiles are designed to maintain a controlled average 'contact band', with sufficient contact radii to cater for a range of wear conditions. It is therefore imperative wheel/rail contact be accurately maintained to within prescribed limits. Wheels are generally purchased to a specified profile and throughout their life; they are re-profiled on special wheel lathes to ensure the correct shape, avoiding defects such as hollow wheels, which can damage the rail. New rails are not able to be purchased to asymmetric profiles and must be profiled after installation in track and thereafter maintained to the design profile.

Figure 40: Post -grinding profile

Figure 41: Pre grinding profile

The shape of the new rail head requires considerable modification to conform to the design "average" profile. Similarly, worn rails require the removal of metal from undesired locations on the rail head to maintain rail profiles. Due to the requirement for vehicle steering, most rail profiling is carried out on curves. Stresses transferred to the rail in these locations by traffic cause:

> Wear and flow in the contact zone

> The profile 'flattens out', with consequent widening of the contact band

> Loss of rolling radius difference and therefore, loss of curving performance.

The introduction of appropriate rail profiling reduces side wear in rails and flange wear in wheels. As the rail is no longer wearing as quickly as would have occurred had wheel and rail profiles not been matched, surface fatigue defects, which were previously worn away, need to be managed to ensure the integrity of the rail is maintained. Rail profiling programs then become partly or wholly driven by surface fatigue grinding needs. Subsurface fatigue defects will then ultimately become the primary cause of rail replacement premature of wear limits having been reached. The frequency of rail profile maintenance is based on the need to minimise surface fatigue defects.

Mainline Rail Grinding Cycles

The maintenance grinding frequency is determined by the combined effects of the factors shown below. However, curvature and traffic loads are the dominant factors in deciding return frequencies.

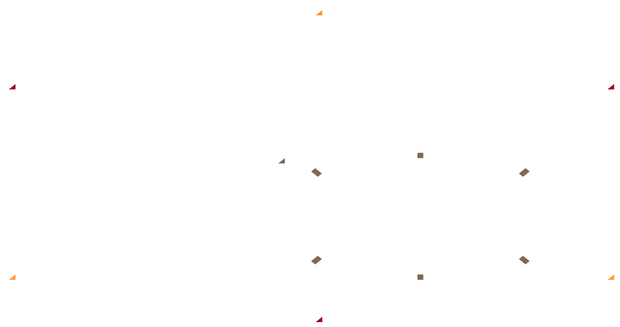


Figure 42: Grinding frequency depends on the combined effects of the facts shown below

Research indicates frequent light grinding is preferable to infrequent heavy corrective grinding. Frequent grinding has been proved to minimise and control the depth of fatigue micro-cracking.

Determining the extent of metal removal per cycle is ideally a case by case process given Rolling Contact Fatigue and rail profile shape is influenced by many wheel and rail factors such as hardness, lubrication, prevalence of moisture, curvature and axle load. Unlike many rail managers using rail grinding to extend wheel and rail life, Aurizon Network does not restrict the grinding cycles to a standardised look-up table approach. The approach adopted is based on actual performance data from test curves, defect information shared at specialist committees and a bi-annual track inspection by Aurizon Network rail experts. The process is under continuous review by staff with designated responsibilities for optimising rail performance.

The approach described above, coupled with practical constraints of programming rail grinding machines, has primarily resulted in cycles that are generally standardised across the network. In the CQCN, rail grinding is currently performed every 10 million gross tonnes (MGT) on curves less than 1000 m radius, 20 MGT on curves between 1001 m and 2500 m radius, and every 40 MGT on other track.

Through implementing this rail grinding regime, rail life is extended to approximately 800 MGT. Without rail grinding, the life of the rail is drastically reduced and may introduce significant safety risks. From a risk perspective, without an adequate rail grinding program, the risk of the rail breaking due to the propagation of surface initiated cracking defects, increases dramatically.

Turnout Grinding Cycles

As with mainline track, turnouts are ground on a gross tonnage basis. Due to their position in track (located close to signals/ yards), they generally experience higher traction forces than open track. This can cause more defects to form on the turnout. With the cost of a turnout being approximately 20 times greater than open track, the operation has become a very important preventative maintenance practice for Aurizon Network.

Grinding Plant

Rail grinders are unique, specialised machines. They work under severe conditions, with heavy loads and high temperatures and pressures. As such, servicing, maintenance and repairs are a normal part of operation and typically require about 15-20% of working time.

The machines require maintenance by skilled, experienced staff that is familiar with the machines. Operators are usually preferred to be of mechanical or electrical trade background or knowledge. Complicated hydraulic and electrical systems on the old grinders have been replaced with less complicated, modern technologies. This leads to less frequent service intervals and allows ease of access to maintainable parts, many of which can be replaced with substitute parts enabling the components to be serviced at the depot whilst the machine is returned to service.

Both rail grinding machines are maintained to a individually designed preventative maintenance schedules, and are shut down every six months for planned major servicing. As a result consistent machine availabilities in the order of 95% are achieved.

Rail grinding operations spend a considerable amount of money per working shift on consumables. The major consumables specific for rail grinding operations are:

> Grinding stones

> Diesel fuel

> Oils, hydraulic fluids and filters

> Water.

Rail grinders use large grinding stones or wheels set at differing angles to cut a series of facets which will make up the rail profile. Each of these stones can remove between 0.1 - 0.2 mm in depth per pass depending on contact width. Grinders currently operate at speeds between 3 and 16 km/h, depending on required metal removal to complete the desired rail profile.

To support rail grinding operations, it is necessary to have either storage and or transport facilities for fuel, oil and spare parts in addition to grinding stone storage. In some cases this can mean the use of a mobile workshop to service the machine when working long distances from the Home Station of Paget.

Under dry Australian weather conditions, typically those found in central and western Queensland, it is necessary to use a special fire tender truck to follow the Grinder to control grass and timber sleeper fires due to the rail grinders producing streams of sparks when in operation. The fire truck obtains water locally and supplies water for the reservoirs onboard the Grinder. New generation machines are fitted with high powered remote water cannons and spray systems. The scope and cost components for this Product are detailed in Section 5.11.

Figure 43: Rail Grinder in operation

4.1.3 Track Resurfacing

Track infrastructure experiences multiple loads with the main sources of stress coming from the forces transmitted under traffic through the wheels of rollingstock. The forces increase when the vehicle is in motion creating dynamic loads in addition to the static load of the vehicle when stationary. The higher the train speed and axle load combination, the higher the forces transmitted to the track. Surface irregularities in the running surface, created by the plane between the two running rails, also have an influence on the dynamic load and resulting vibrations. Therefore, poor track quality accelerates track deterioration if not properly maintained.

Resurfacing maintenance operations are broken into two distinct products:

> Mechanised Resurfacing – Mainline

> Mechanised Resurfacing – Turnouts.

Mechanised resurfacing is a standard railway maintenance function applied to keep track within the design geometry parameters. It assures correct levelling and lining, which keeps vertical and lateral forces and accelerations within acceptable limits. It restores the geometry of the track by lifting it to the appropriate level and compacting the ballast underneath the sleeper. If track geometry is not corrected to a standard fit for the traffic task, track components deteriorate leading to a marked increase in the need to perform other maintenance on the track. Examples of deterioration include:

> Rails developing surface irregularities and defects

> Fastenings may work loose or break

> Sleepers may skew or even break

> Ballast and formation deteriorates.

This kind of deterioration contributes to poor track geometry, and can lead to speed restrictions being imposed. Speed restrictions can then limit the available capacity of the network and increase train transit time.

Under normal conditions, ballasted track displaces slightly out of its original position under traffic and changes of the horizontal and vertical positions initially occur at low rates. Over time, however, with the passage of more traffic, the development of track geometry irregularities accelerate the rate of geometry deterioration, and requires corrective work in order to restore the track geometry and assure safe running.

A further factor that has a considerable impact on the ability of the track to hold its line and structure is rainfall and the ability of the track to drain. In areas of heavily fouled ballast due to coal contamination, it may be necessary to treat areas of poor top and line through repeat resurfacing of relatively short lengths until such time that the ballast cleaning operation is programmed to remediate the ballast profile and associated track drainage.

Mechanised resurfacing is performed as part of the initial construction of the track and subsequently at intervals depending on the speed, tonnage and deterioration rate of the track. The task is completed using self-propelled on-track machines that are able to lift and line the track to a pre-determined level, and compact the ballast under the rail seat to support the track position.

Scope Development

The scope of the two resurfacing products has been forecast based on the historical performance of the asset whilst taking into account growth in tonnages and the new track infrastructure required to be maintained over the duration of the undertaking. The scope for mechanised resurfacing is generally driven by the:

> Gross tonnes across the track

> Standard of track construction, e.g. rail size, sleeper type, etc
> Current condition of the track components
> Historical performance of the infrastructure in service.

Track geometry recording outputs, along with asset performance parameters such as the Overall Track Condition Index (OTCI)[8], percentage of track under speed restriction, and transit time delays are all used to determine the amount of resurfacing planned for delivery each year.

Seasonal weather events also have the potential to greatly influence the occurrence of track geometry faults which are repaired via resurfacing or stoneblowing. Variations in demand for resurfacing capacity caused by seasonal weather events will be managed through mobilising machines from nearby rail systems (i.e. North Coast Line, Maryborough) in the instance machines operating within the coal systems are unable to meet peak demand levels within short periods of time.

Inspection of the track is completed by maintenance staff to monitor its condition. These inspections allow locations where track condition is deteriorating to be identified, and corrective maintenance work can be programmed, ideally before the locations become unsafe for normal speed train operations and require speed restriction.

The methods used for track inspection include:

> Track walking and detailed measurement of geometry conditions on site
> Patrol on hi-rail vehicles and planned frequencies of inspection
> Programmed cyclic inspections one or more times per year in order to assess or monitor particular features of track maintenance condition
> Monitoring by track recording cars. Track recording cars measure geometry parameters and describe how regular the track geometry is within thresholds documented as part of Aurizon Network's Safety Management System. Outputs of the recording car provide detailed printouts of the track geometry condition and remediation plans.
> Riding the track in the driver's cabin of a train.

Information gathered through track inspection is assessed in a number of ways:

> At the time of inspection, the information is analysed to identify any critical track conditions requiring immediate corrective action
> Defects in the track are identified and prioritised according to the likelihood of contributing to unsafe track conditions
> Areas of poor track condition or rough track are identified for programmed maintenance works such as mechanised resurfacing
> The effectiveness of previous maintenance work in repairing defects or restoring areas of rough track geometry is assessed
> The overall condition of track is assessed over time to identify trends of deterioration and to assess whether the appropriate level of maintenance resources is being applied in the right way.

The planning of track maintenance works, particularly to maintain track geometry, requires considerable skill and experience to achieve cost-effective outcomes. Mechanised resurfacing is one of a few different maintenance products that may be used to treat a particular area depending on the required response time to the defect, the underlying

[8] A measure of the quality of the geometry of the track calculated from track geometry recording vehicle outputs.

cause of the defect and the inherent track component condition. The following table gives an example of the geometry defect, cause and potential remedial treatment:

Table 14: Routine maintenance defect treatment

Geometry Exception	Typical Causes	Typical Routine Maintenance Treatments
Top/Twist Defects	> Settlement of ballast > Change in track stiffness (e.g. bridge ends)	Lift track and packing or tamping ballast under sleepers by mechanised or manual means
Line Defects	> Ineffective ballast around sleepers	Realign track laterally to design alignment and pack ballast around sleepers by mechanised or manual means

Other track defects may cause geometry exceptions, for example, areas of poor drainage or failed formation. These defects cannot be treated by resurfacing as the cause of the defect is still present and the defect will continue to occur.

From a network wide perspective, the quantities planned and delivered are within planning tolerances and the combined machine capabilities (up to 20%). The actual locations are dependent on track geometry recording data which is captured and analysed twice a year, and localised asset condition factors such as ballast fouling levels and the ballast cleaning program.

Other factors difficult to predict include rain events, and the impact on short-term resource utilisation to ensure speed restrictions are kept within acceptable levels.

The need for more frequent track geometry recording and subsequent improvement in planning is an important factor in delivering the future resurfacing task in the network. This will also increase the efficiency of track possession utilisation and task completion. This data assists in deciding what type of resurfacing is required as described in the table below:

Table 15: Resurfacing options

Resurfacing Type	Details
Long term cyclic resurfacing	Long-term cyclic resurfacing is planned where geometry data demonstrates a trend where intervention by resurfacing is required. This can be planned over longer timeframes, and possessions are generally locked down 21 days prior to the work occurring. Cyclic resurfacing allows the most efficient use of machines as the possession requirements are well understood and planned, and the sites are of reasonable length which leads to good production rates.
Response (or chase tamping)	Response (or chase) tamping is required where geometry exceptions are identified within the 21 day planning timeframes and are usually caused by isolated track defects[9]. These sites are generally relatively short in length and at discrete locations and therefore do not allow for the most efficient utilisation of a machine. Response tamping is, however, an important

[9] Such as poor pockets of deteriorated ballast or bridge ends where the stiffness of the track changes from the earth formation to the bridge deck which creates higher dynamic loads in the track structure

Resurfacing Type	Details
	maintenance strategy to ensure that restrictions are kept to a minimal level so that cycle times required by supply chain participants are met.

The quality of the data available through track recording cars has increased significantly with over twelve data collections per year which will allow for even closer monitoring of deterioration rates.

Since UT3, this data has allowed the resurfacing program to move to a significantly more proactive maintenance program. However, it is noted there will be a requirement to allow some flexibility in terms of resource availability to allow the system to cope with periods of extreme wet weather.

The scope and cost components for this Product are detailed in Section 5.11.

4.2 General Track

The General Track product group comprises the primarily non-mechanised component of track maintenance. This work is relatively labour-intensive, compared to the mechanised discipline, and involves both preventative inspection-type work and corrective, fault repair work. As such, the scope can be based on time, e.g. periodic inspections, or the life of the asset coupled with historical data with respect to the faults to be expected given the tonnage. The General Track product group includes the following:

Table 16: General track products

Product	Purpose	Definition	Scope
Track Geometry Recording	Record the physical geometric characteristics of track to remedy issues before failure	Operation of specialist track vehicles or rollingstock to measure and record the physical geometric characteristics of track and traction wiring. Includes onboard vehicle ride accelerometers.	
Rail Joint Corrective Maintenance	Remove 'dipped' joints, allow thermal movement	The maintenance / spot replacement of a rail joint. Includes flashbutt welding, thermit welding of joints, bolt and fish plate maintenance, lifting and lining joints.	
Maintenance Ballast	Keep ballast profile to adequate levels.	The purchase, freight and distribution of ballast for restoration of ballast profile. Excludes ballast utilised for other work/products as these are included in the relevant product costs.	
Sleeper Management	Maintain Sleepers to minimise track defects.	Spot insertion of sleepers, reboring and regauging by local track teams. Includes local sleeper tests, resleepering components/fastenings, and sleepers. Includes activities related to spot resleepering such as spot tamping, reboring, regauging, replating, freight, distribution of sleepers, re-spacing, flagging and cascading of part worn sleepers. Ballast and rail are not renewed during the resleepering process.	
Rail Stress Adjustment	Control thermal movement	The standalone activity of rail stress testing and adjustment. Includes rail stress testing, creep marker monitoring, rail stress adjustment and documentation. Excludes rail stress	

Product	Purpose	Definition	Scope
		adjustment included as part of other products.	
Track Clean-Up	Limit contamination of Network	Investigating and rectifying the localised spillage of coal and other materials (including animal remains) on the rail network. Excludes clean-ups associated with derailment.	
Top & Line Resurfacing	To keep track within the design geometry parameters.	Localised top and line to track using manual or mechanically-assisted processes, but excluding those undertaken by the major production resurfacing machines. Involves restoring top and line on bridge ends, open track, using manual processes or small spot tampering machinery e.g. modified bobcat, portable tamper, etc.	
Rail Repairs	Removal of defective rail	Spot repairs, equal or less than 12m in length, to rail due to identified defects, such as wheel burns, defective welds, internal rail defects, other associated activities such as distribution, unloading rail, flagging.	
Re-Railing	Replacement of worn rail	Standalone rail replacement in a section of track due to fatigue and wear outside of Civil Engineering Track Standards (CETS) limits. Works include related rail restressing, transport and unloading of rail, preparation of site and welding. Excludes rail replacement associated with major track replacement including sleeper, ballast or formation renewal.	
Track Inspections	Identify network maintenance priorities	All inspections of track. CETS inspections such as engineering inspections, road patrols, engine inspections, turnout, walking, track stability, track clearance, level crossings, hot weather, yard inspections, callout inspections, sleeper inspections.	
Turnout Maintenance	To keep the track safe train operations	Repair or replacement of minor components such as associated jewellery including bolts, chair lubrication, spot tie replacement (manual), maintenance welding, top and line (manual). Excludes renewal of major component.	
Rail Flaw Detection	Detection and prioritisation of rail defects	Ultrasonic testing of rail and associated components by on-track testing vehicles as well as rail testers using handheld non-destructive testing equipment to validate defects from the vehicle.	
Rail Flaw Detection - Manual NDT Verification	Detection and prioritisation of rail defects	Manual ultrasonic testing of rail and other non-destructive testing methods. Works includes rail testers, ultrasonic testing of rail, turnout components and welds.	
Rail Lubrication	Prevent premature rail wear	Lubrication of track on straights and curves, maintenance and filling of any lubrication systems or devices.	
Earthworks –	To keep the rail	Non-formation-related earthworks and	

Product	Purpose	Definition	Scope
Non Formation	corridor clear for safe train operations	drainage maintenance and localised repair. Involves spot failure of access roads and walkways, disposal of surplus materials, drain clearing and cleaning of debris, maintaining cuttings and embankments.	
Fencing	To maintain visible and physical barrier to people and animals onto the rail corridor	Repair of existing fencing equal or less than 3 post repair including associated signage, gate repair and wire tensioning.	
Fire & Vegetation Management	To keep the rail corridor clear for safe train operations	Vegetation control by chemical, mechanical and burning off operations to eliminate interference with train running and track maintenance. Includes vegetation control around bridges, slashing, brush cutting, both hi-rail and manual herbicide treatment, tree surgery, fire and vegetation management, fire breaks, burning off, tree planting, fire fighting, pest management plans.	
Monument / Signage Maintenance	To keep the signage in the rail corridor visible for safe train operations	All activities associated with repair of track monuments, mast information plaques, creep markers and general signage such as speed boards etc.	
Level Crossing Maintenance	To keep the rail corridor clear for safe train operations	Minor Repair of level crossings including spot road repair, repair of existing signage and resurfacing of track at the crossing interface. Excludes refurbishment works conducted under a renewals programme.	
Minor Yard Maintenance	To keep the rail corridor clear for safe train operations	All day to day maintenance works performed within Network minor rail yards and sidings that do not have their own corridor code or functional location (specific location). This includes any maintenance performed by local or mechanised work groups regardless of the product being undertaken.	

As reported within the Evans & Peck Report (refer Appendix N) there are unique characteristics both with the existing assets and the operational environment that impact heavily on the maintenance tasks to be undertaken by Aurizon Network.

"Two of the works paths identified that the unique characteristics of the CQCN, such as relatively high annual tonnages, significant temperature ranges, periods of extreme weather, high operating speeds, spillage of coal, poor formation support and narrow gauge track configuration all result in distinctive management and maintenance challenges for Aurizon Network, and consequently contribute significantly to the magnitude of Aurizon Networks maintenance task. A one size fits all" maintenance strategy will not always provide the most efficient solution as maintenance strategies need to appropriately account for unique network characteristics and the operating regime".

4.3 Structures Management

The Structures Management product group involves both preventative inspection-type work and corrective, fault repair work. As such, the scope can be based on time (e.g. periodic inspections), or the life of the asset coupled with historical data with respect to the faults to be expected given the tonnage.

The Structures Management product group includes activities relating to the maintenance effecting structures that support:

> Rail over road crossings

> Road over rail crossings

> Structures that provide drainage under the track.

A list of the key activities and their purpose are shown below as well as an individual description for each product.

Table 17: Structures management products

Product	Purpose	Definition	Scope
Concrete Bridge Repairs	Maintain safe and effective structures throughout the rail corridor	This product involves the minor repair of concrete bridges which results in the repair or replacement of a minor component.	
Timber Bridge Repairs	Maintain safe and effective structures throughout the rail corridor	This product involves the minor repair of concrete bridges which results in the repair or replacement of a minor component. Maintenance of timber bridges includes regular “screwing up” of bolts due to timber deflections, regular inspections for white ant infestation and regular treatment.	
Steel Bridge Repairs	Maintain safe and effective structures throughout the rail corridor	This product involves the minor repair of concrete bridges which results in the repair or replacement of a minor component. Maintenance of steel bridges includes regular painting and corrosion correction and any collision damage repairs.	
Structures Inspections	Maintain safe and effective structures throughout the rail corridor	This product involves monitoring and maintenance to ensure the condition of structures stays within intended limits and that each structure to can safely perform its required function.	
Drainage Maintenance	Provide safe and effective structures throughout the rail corridor	The minor repair of drainage structures or temporary support to allow scheduling of renewal works.	

4.4 Signalling Maintenance

Signalling provides the mechanism for issuing train movement authorities for the safe movement of trains on the network.

Activities included in Signalling Maintenance are those relating to the overall performance of the signalling infrastructure. These activities ensure the signalling system is maintained to a safe and appropriate operating level.

A list of the key activities and their purpose is shown below as well as an individual description for each activity.

Table 18: Signalling Maintenance Products

Product	Purpose	Definition	Scope
Field Maintenance: Preventative	Preventative maintenance is undertaken for all field equipment associated with signalling control at regular programmed intervals to maximise its availability and reliability.	This activity primarily involves inspections of equipment and where necessary replacement of individual worn parts.	
Field Maintenance: Corrective	Corrective maintenance is undertaken for all field equipment associated with signalling control to correct an identified fault and restore network availability.	This product primarily involves a response based service with a significant proportion of the signalling equipment being maintained on a 'fix on failure' basis. Corrective maintenance is performed on a hierarchical priority basis considering the seriousness of reported problems, current work tasks and available equipment and manpower.	
Weighbridge Maintenance	Rail weighbridge maintenance is undertaken to maintain the accuracy of the weighbridges by undergoing a regular testing program to ascertain that they as fit for their designed use.	This product involves the inspection, testing, calibration and maintenance of in-motion weighing equipment used for commodity measurement and overload detection.	
Level Crossing Protection Maintenance	Level Crossing Protection maintenance is undertaken to determine the early detection of operating anomalies and irregularities in the network to ensure the safety of rail, road and pedestrian traffic.	Inspection and maintenance of level crossing infrastructure including pedestrian gates, boom gates, flashing lights and associated circuitry.	
Control Systems	Signalling Control Systems Maintenance is undertaken to determine the early detection of	This Product covers the maintenance of control centre based equipment relating to the signalling and power systems	

Product	Purpose	Definition	Scope
	operating anomalies and irregularities to provide a safe and operating signalling system.	control of trains including the central computer systems: Universal Train Control (UTC).	
Cable Route Management	Cable Route Management applies to the signal cabling infrastructure within our Network system and specifies the minimum requirements for the inspection and testing of signal and signal power cables owned by Aurizon Network.	This Product includes the maintenance and repair of cableways, markers, troughing and cables with the exception of fibre testing and repairs.	
Train Protection Systems	Train Protection Systems Maintenance is undertaken to ensure the performance and reliability of our early warning devices.	This Maintenance product applies to the Train Protection within Aurizon Network. This Maintenance covers the inspection, operation and performance servicing of the components and equipment: involved with the Automatic Warning System (AWS) and Westect Automatic Train Protection (Westect ATP).	
Wayside Monitoring Systems Maintenance	Wayside Monitoring Systems Maintenance is undertaken to determine the early detection of operating anomalies and irregularities to provide a safe and reliable operating system.	This Product includes any activities requiring the maintenance and repair of trackside monitoring and measuring equipment. Maintenance covers the inspection, operation and performance servicing of the following equipment: Dragging Equipment Detector (DED) Hot Bearing and Hot Wheel Detectors (HBD and HWD) and lubricate. Wheel Impact and Load Detector (WILD Weather Monitors Stations	

4.5 Traction Maintenance Activities

Products included under Traction Power Maintenance Products are those relating to the overall performance of the traction infrastructure. These products ensure the traction system is maintained to a safe and appropriate operating level. A list of the activities and their purpose is shown below as well as an individual description for each product.

Table 19: Traction Maintenance Products

Product	Purpose	Definition	Scope
Overhead Maintenance:	Preventative maintenance is undertaken for all field	This product primarily involves inspections of overhead equipment,	

Product	Purpose	Definition	Scope
Preventative	equipment associated with overhead control at regular programmed intervals to maximise its availability and reliability.	performance servicing and where necessary spot replacement of early failure of damaged components. This includes inspections of critical equipment such as section insulators, neutral sections, isolators, balance weights (position and condition) and other specialised equipment	
Overhead Maintenance: Corrective	Corrective maintenance is undertaken for all field equipment associated with overhead control to correct an identified fault and restore network availability.	This product primarily involves a response based service with a significant proportion of the overhead equipment being maintained on a 'fix on failure' basis. Corrective maintenance of the overhead network includes isolations that are required for repairs following failures, repair of traction bonds, height and stagger adjustment	
Feeder Stations and Track Sectioning Cabins Maintenance: Preventative	Preventative maintenance is undertaken for all equipment associated with feeder stations and track sectioning cabins at regular programmed intervals to maximise its reliability.	This product involves the maintenance inspection, operation and performance servicing of all the power system equipment and substation equipment. This includes transformers and Feeder Stations, Track Sectioning Cabins, Motorised Isolator mechanisms and ancillary equipment, as well as control system RTU's and Fault locators.	
Feeder Stations and Track Sectioning Cabins Maintenance: Corrective	Corrective maintenance is undertaken for all equipment associated with feeder stations and track sectioning cabins to correct any identified faults and restore network availability.	Maintenance for this product covers the inspection, operation and performance servicing of all the power system equipment and substation equipment. This includes transformers and Feeder Stations, Track Sectioning Cabins, Motorised Isolator mechanisms and ancillary equipment, as well as control system Remote Terminal Unit (RTU) and Fault locators.	
Power Systems Control	Power Systems Control Maintenance is undertaken to determine the early detection of operating anomalies and irregularities to provide a safe and operating power system.	This Product covers the maintenance of field and master station control centre based equipment relating to the power systems control of trains (including the Power Supervisory Control System (SCADA system).	

4.6 Telecommunications Maintenance Products

Products included under Telecommunication Maintenance Products are those relating to the overall performance of the telecommunication infrastructure. These products ensure the telecommunication system is maintained to a safe and appropriate operating level. A list of the products and their purpose is shown below as well as an individual description for each product.

Table 20: Telecommunications Maintenance Products

Product	Purpose	Definition	Scope
Telecommunications Backbone: Preventative	Preventative maintenance is undertaken to maintain the accuracy of the voice and data services by undergoing a regular testing program to ascertain that they as fit for their designed use.	This product includes preventative maintenance of the major bearer systems and infrastructure providing bandwidth for voice and data services as well as the base network for train control and maintenance radio systems.	
Telecommunications Backbone: Corrective	Corrective Telecoms Backbone Network Maintenance is undertaken for all field equipment associated with the base network for train control and radio systems to correct any identified faults and to restore network availability.	This product includes corrective maintenance of the major bearer systems and infrastructure providing bandwidth for voice and data services as well as the base network for train control and maintenance radio systems.	

5. MAINTENANCE COST

Chapter 5 - Key Points

> The cost development process accounts for:
  - An increase in quantity of assets since UT3 up to and including WIRP1 in FY15
  - An increase in tonnage of 18% from FY12 to 14 with an overall 48% increase from FY12 to FY17
  - Cost drivers for internal and external procured resources

> Cost escalation for the UT4 period is developed using appropriate indexes representative of the industry and Central Queensland, as identified by BIS Shrapnel

> Efficiency improvements have been factored into the cost development to reflect continuous improvement challenges supporting industry including but not limited to:
  - Non-mechanised labour efficiency improvement of 3.75%
  - Plant Production improvements through greater utilisation of closure outages estimated to be between 10-30%
  - Higher predicted on-face repair works versus spot repair than experienced in FY12 (assumes prevailing dry conditions in comparison)
  - High reliability and turn-around on plant maintenance
  - Adjustment to intervention levels on various products

> The proposed mix of internal and external procured resources balances rail specific

5.1 Overview

This section describes how the maintenance costs have been developed. The methodology applied uses a building blocks approach based on the costs expected to be incurred for the defined maintenance scope over the access undertaking period. As such, the cost is a function of:

> Direct cost inputs, coupled with the use of relevant cost drivers, such as labour resources and costs, to calculate the required maintenance spend for the defined scope

> A return on the inventory, working capital and fixed assets employed in the completion of the maintenance task

> An allowance for corporate costs.

The output is a cost per maintenance discipline, by coal system, per year. (Refer Table 22). The cost does not include any profit margin on internally sourced direct costs, nor is there any mark-up applied to the estimated input cost of externally sourced services or materials. It also excludes any allowance for the cost of derailments, flood repairs and overhead dewirements, which are addressed in the Operating Expenditure section of the Maximum Allowable Revenue and Reference Tariffs chapter of the submission.

This Maintenance Submission represents an efficient cost for services as confirmed by the Evans & Peck report. Aurizon Network is conscious that a fully outsourced maintenance delivery model increases the risk to our responsiveness to major events e.g. flood, dewirements and derailment. Evidence recently gathered on sample comparable specialised track plant hire indicates cost savings in the order of 20% are achieved through the current in-house delivery model.

The efficient delivery of the maintenance task also provided for a number of factors that are specific to Central Queensland Coal Network including:

> Higher tonnage profile, increase traffic density which reduces access time to the track for maintenance activities

> improved safety requirements requiring greater effort in accessing the track and in conducting maintenance activities e.g. people and plant separation

> extensions to and increases in the quantity of assets across the network which demand additional maintenance effort

> aging of the Network as compared to UT3 resulting in the potential for an increase in faults and/or asset failures

> accommodation constraints resulting in cost pressures both in terms of direct costs, increased travel times and consequently reduced production time

In contrast to these influencers Aurizon Network is confident it can provide a reliable railway at an efficient cost by better managing the resources at its disposal. As such productivity factors have been applied to the cost base of this submission and include:

> a 3.75% improvement in labour costs

> a 10-30% plant production improvements
> an increase in use of external procured resources to above 50% of the cost base.

These efficiency factors have been included in the base cost build up and sustained across the UT4 period. The enhanced Maintenance Cost Index (MCI) developed in conjunction with BIS Shrapnel provides for an improved model reflecting Central Queensland cost escalation. Noting that in excess of 50% of maintenance costs will be procured externally, the model inherently captures efficiency improvement driven by market pressures. With this in mind, Aurizon Network suggest that the efficiency factor applied in the previous Undertaking to MCI escalation is neither appropriate nor reflective of economic reality.

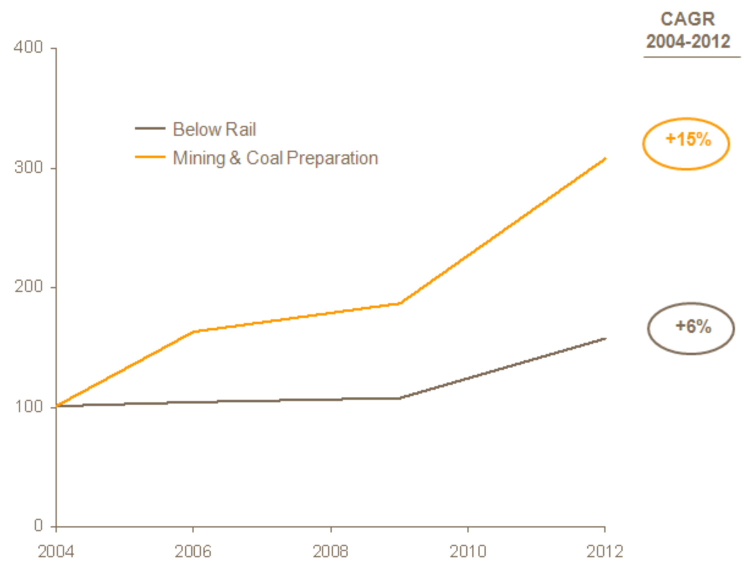
5.2 Working in Partnership in a Range of Market Cycles

This Maintenance Submission will deliver a prudent and efficient portfolio of maintenance services in an environment with our partners in the supply chain are being overwhelmed with cost increases. In the Wood Mackenzie Cost and Margin Report of 2013 it was identified that on site mining costs escalated at a Compound Annual Growth Rate (CAGR) of 15% over an Eight year period. This was driven by:

> Rising labour costs
> Rising diesel costs
> Depletion of low cost resources e.g. higher stripping ratios
> Declining productivity.

In comparison to the rise in mining costs Below Rail costs for the CQCN mines have only risen by 6 % over the same time period. Refer to the Figure below for more detail on this discussion.

Weighted average Below Rail and Mining & Coal Preparation Cash Costs for Central Queensland Coal Network Mines ($AU/t Indexed)



Key insights

- On-site mining costs escalated at a CAGR of 15% over the past eight years. Escalation has been driven by a range of issues including:
  - Declining productivity
  - Rising labour costs
  - Rising diesel costs
  - Depletion of low cost resources (e.g. higher stripping ratios)

Note: Below Rail costs are in financial years, while Mining and Coal Preparation are in calendar years

Source: Wood Mackenzie Cost and Margin Tool, February 2013 (and prior releases), Aurizon Network Financial Results, Aurizon analysis

Figure 44: Comparative mining cost and below rail costs

Using these positive results Aurizon Network has used the financial results from FY12 as the base line for calculating this Maintenance Submission.

5.3 The Maintenance Disciplines

As detailed in Section 4: Asset Maintenance Products, the maintenance costs are structured into the following disciplines:

> Mechanised – mechanised ballast cleaning, resurfacing and rail grinding

> General Track – a variety of track-related products, primarily non-mechanised, including:

- Inspections and testing
- Management of sleepers, turnouts, rail, including rail joints, stress and lubrication, ballast, formation, fire and vegetation, fencing, earthworks, level crossings, signage
- Re-railing and Top and line resurfacing

> Structures – inspections and engineering assessments, bridge and culvert repairs, and drainage maintenance

> Signalling – preventative and corrective maintenance, together with maintenance of weighbridges, signalling components of level crossings, cable routes, and train protection and wayside monitoring systems

> Traction – preventative and corrective maintenance, together with maintenance of feeder stations, track section cabins and power control systems

> Telecommunications – primarily preventative and corrective maintenance on the telecommunications backbone, together with telephone and data maintenance.

The product breakdown outlined above is based on packages of work that warrant individual costing because:

> Their maintenance objective is different; e.g. ballast cleaning vs. sleeper repair, preventative vs. corrective maintenance
> The costs are significant within the total maintenance scope.

5.4 Basis of Cost Development

The 18% increase in tonnages from FY12 to FY14 and 48% to FY17 means the resources required to complete the UT4 maintenance scope are higher than the FY12.

The cost base for the UT4 maintenance price has been developed using the actual cost for the maintenance scope completed in FY12 as the starting point. All inputs in the FY12 maintenance cost were reviewed by product, resulting in Aurizon Network having a clear understanding of the cost drivers and actual costs for FY12 maintenance. Each relevant cost input was then uplifted to reflect the initial like-for-like resource requirements for the UT4 scope of works, and then discounted to bring efficiencies into the costs.

After the elimination of non-maintenance related works (primarily capital projects and external works), the main inputs considered were:

> Internal labour costs and hours worked, together with associated labour-related costs; e.g. motor vehicles, personal protection equipment, training, travel and accommodation
> External labour
> Specialised mechanised plant shifts and production rates, together with new plant acquisitions, and the associated machine maintenance requirements
> General plant and machinery costs
> Materials, such as rail, ballast, sleepers, grindstones, and associated freight
> Fuel for plant, trucks and motor vehicles
> Tools and machine components
> Professional and technical advice and services, together with licensing/certification fees
> Utility charges; i.e. power, water, telecommunications, local authority charges; and
> Minor consumables; e.g. office supplies, medical supplies.

With some costs incurred across multiple products, rules were applied to ensure each product cost accurately reflected the resources used. Specifically where:

> A cost related to a single product, that cost was deemed a cost of that product (a Direct Cost)
> A cost related to a group of products, the total cost was assigned to each of those products based on the most appropriate causal relationship; e.g. labour-related costs are based on labour hours worked per product, while plant depreciation and fuel costs are based on number of machine shifts completed for each product; (an Assigned Cost)
> A cost relates to all products, that cost was allocated across those products based on the share of labour hours across the individual products (an Allocated Cost). This was restricted to management and planning resource pools.

Once the resource requirements and associated cost for FY14 was developed, the exercised was repeated for the balance of the four years of the undertaking.

5.5 Link to Scope

The application of the processes and rules outlined above differed across the total maintenance scope, contingent on the nature of the work.

In some cases, the scope is homogenous - it is output based with a consistent unit of measure; e.g. kilometres of undercutting or grinding, turnouts resurfaced or ground, or inspections undertaken. The cost for these products was developed based on cost inputs for the unit of measure (whether they be labour hours, plant shifts or a combination of both), and productivity rates, including assumptions with respect to work locations, the need for travel and time on track.

In the cases of non-homogenous products such as repairs historical data was coupled with specific UT4 assumptions to arrive at estimated costs for the forecast level of maintenance. These assumptions included:

> The impact on the assets of the increase in above rail tonnages

> The ability to access the network (given the higher tonnages)

> The expansion of the network; i.e. WIRP1 from FY15

> The impact of an increased capital/renewals effort, reducing the need for and/or frequency of some corrective maintenance, primarily in the General Track environment.

5.6 Maintenance Cost (FY12 $s)

The cost for each of the maintenance disciplines is as follows:

Table 21: UT4 Cost of Maintenance Disciplines

Maintenance Discipline	FY14 ($m)	FY15 ($m)	FY16 ($m)	FY17 ($m)
Forecast Net Tonnes	**196.6**	**218.3**	**231.5**	**246.5**
Mechanised Maintenance				
• Ballast undercutting	$55.271	$64.859	$65.883	$66.361
• Resurfacing	$18.979	$19.015	$20.867	$20.927
• Rail Grinding	$12.513	$13.516	$13.958	$14.435
General Track Maintenance	$47.319	$50.472	$52.004	$53.581
Re-railing	$15.267	$15.061	$15.722	$16.144
Structures	$2.650	$2.769	$2.841	$2.935
Signalling	$22.591	$23.457	$23.944	$24.417
Traction Power	$9.556	$9.598	$9.598	$9.597
Telecommunications	$5.365	$5.514	$5.516	$5.518
Direct Costs	**$189.510**	**$204.260**	**$210.332**	**$213.915**
Return on Inventory, Working Capital & Fixed Assets Employed	$10.774	$12.765	$12.431	$12.325
Corporate Costs	$12.090	$12.090	$12.090	$12.090
Total (Real $FY12)	**$212.374**	**$229.115**	**$234.853**	**$238.329**

Maintenance Discipline	FY14 ($m)	FY15 ($m)	FY16 ($m)	FY17 ($m)
Cost per NTK Exc Mech. Ballast U/C, Traction Power & Telecommunications	2.42	2.25	2.18	2.09

A breakdown of the above costs by coal system is provided in the system-specific sections of this submission (Sections 6 to 9), except for Telecommunications, which is treated as network-wide cost (approximately 2.5% of total product costs).

5.7 Cost Drivers

The cost of each product is aligned to the maintenance required to ensure the safe and efficient operation of the network, coupled with the constraints that an operational railway provides to the maintenance function. The overall maintenance cost is therefore a function of the scope, the actual costs incurred (e.g. salary and wages, materials, plant and associated maintenance, etc), and the productivity that is able to be achieved within these constraints. As such, it is critical to understand that the maintenance cost is developed from the scope using certain key assumptions, the main ones being:

> Resources - including the nature of the market, the availability of skilled staff and specialised machines for certain works

> Track access - the ability of the maintenance function to access the network

> Work locations - including the need to travel, obtain accommodation and if necessary resources close by, and to gain access to the actual work locations to complete the tasks safely and efficiently.

Below is a breakdown by the main cost categories, with the costs split between internal labour, external resources procured through the market and depreciation; i.e. those costs related to past (and future) plant investment decisions.

Table 22: Main cost categories

Cost Category FY12 $s)	FY14 ($m)	FY15 ($m)	FY16 ($m)	FY17 ($m)
Internal labour and associated on-costs	$80.093	$80.148	$80.907	$81.603
Externally Procured Resources				
• Plant hire	$20.084	$27.987	$28.278	$29.224
• Network materials	$20.336	$21.224	$22.181	$23.043
• Plant componentary	$10.321	$12.678	$12.910	$13.170
• Trade/Professional Services	$ 9.900	$13.704	$15.150	$15.220
• Travel & Accommodation	$ 6.853	$ 6.944	$ 6.980	$ 7.149
• Fuel (net of rebate)	$ 4.111	$ 4.335	$ 4.460	$ 4.602
• Labour-related costs; e.g. PPE	$ 3.515	$ 3.724	$ 3.832	$ 3.959
• Other costs	$14.703	$15.136	$15.403	$15.647
	$95.823	$105.733	$109.194	$112.014
Depreciation	$13.594	$18.379	$20.231	$20.298
Total	**$189.510**	**$204.260**	**$210.332**	**$213.915**

Table 23: Percentage breakdown of key costs

Cost Category	FY14	FY15	FY16	FY17
Internal labour and associated on-costs	42%	39%	38%	38%
Externally Procured Resources	51%	52%	52%	52%
Depreciation	7%	9%	10%	10%
Total	**100%**	**100%**	**100%**	**100%**

5.8 Return on Assets Employed

The Return on Assets (ROA) figures included in the cost table in section 5.6 above comprise a return on the fixed assets, inventory and working capital employed in the maintenance function.

5.8.1 Gross Replacement Value

The Aurizon Network maintenance function is split into two key areas, being the Mechanised and Asset Maintenance groups. The Specialised Track Services (Mechanised) group generally delivers specialised below rail major maintenance and re-construction, further categorised by specialised track services including ballast cleaning, resurfacing and rail grinding. As a result, the group consists of assets that constitute the majority of total asset value and are usually represented by larger rail plant such as heavy track tampers, rail grinders and track laying equipment.

The Asset Maintenance group undertake minor maintenance activities. By comparison its assets are higher in quantity, but substantially lower in total aggregate value and usually include assets within asset classes such as road/rail trucks, earthmoving equipment and building related items.

S.168A of the *Queensland Competition Authority Act 1997*, requires that the price of access to a service should generate expected revenue for the service that is at least enough to meet the efficient costs of providing access to the service and include a return on investment commensurate with the regulatory and commercial risks involved. As such, it is also necessary that the costs or prices of the inputs required to provide the service are consistent with this requirement.

Aurizon Network has previously demonstrated that the rate of return, or the asset beta, for technical services firms is substantially different from the operation of the declared service. In particular, many of the maintenance services undertaken by Aurizon Network or a related party in relation to the declared service is contestable and provided internally as this provides benefits to the users of the declared service through economies of scale in plant and people and economies of scope in expertise. As such an efficient price for maintenance should reflect what would prevail in a competitive market.

The theory of contestable markets underpins the use of replacement cost by regulators in the determination of efficient prices (removing the assumption of barriers to entry or exit what price would be determined in that market). Aurizon Network notes there are two material flaws in the costing methodology employed in the determination of the UT3 maintenance costs.

Firstly, the rate of return applied to the plant was the post tax nominal WACC without further provision in the costing for tax costs. Accordingly, the applied rate of return was neither commensurate with that which would expect to prevail in the relevant market or adequately reflects the post tax return required to support investment in plant.

Second, the rate of return was applied to book values. The resultant plant charges arising from this approach yields effective costs which would not be expected to prevail in a competitive market. This principle is reflected in the Schedule A., clause 1.3(b) of the *2010 Access Undertaking* which requires that where additional sections of existing rail infrastructure are incorporated into the Regulated Asset Base (RAB), they will be valued in accordance with a Depreciated Optimised Replacement Cost (DORC) methodology. The objective of this requirement is that efficient costs are represented by the value of the next best use of the resource. Replacement costs ensure that prices appropriately reflect the opportunity costs of providing the service. To the extent that the QCA seeks to constraint the return on plant associated with the provision of maintenance services to that applied to the RAB, it should ensure that the asset valuation used to determine the rate of return is comparable to those used in the valuation of the RAB.

Aurizon Network notes that there are three generally accepted methodologies for establishing prices on replacement cost, including:

- Deprival value;
- a DORC based valuation methodology; or
- a Gross Replacement Value (GRV) annuity approach.

Deprival value typically represents the value the firm would be unable to realise if it was deprived of the use of the asset, or alternatively, the value that could be alternatively be obtained from using the resources elsewhere. However, the approach is typically subjective and therefore, generally expected to be constrained to DORC or GRV as being the ‘bypass’ or economic duplicate price. For example, if prices for maintenance activities did not reflect market value it would be more profitable for the regulated firm to either sell the plant to realise market value or redeploy the capital to a profitable purpose and outsource the activity with pass through reflecting an efficient competitive market price.

The DORC based approach is also not a suitable or preferred methodology for determining plant charges in maintenance costs as:

- it is information intensive and in contrast to fixed rail infrastructure assets, the objective is to price the services being provided, and not the actual assets being used to provide the service which may otherwise be interchangeable or redeployed to other purposes;
- the use of a DORC based approach also requires the development of regulatory accounting principles and establishing processes for capitalising plant renewals, refurbishment and disposals. As noted in the previous point this would also limit efficient maintenance practices if it became necessary to constrain nominated plant solely to CQCR maintenance; and
- the plant charges and therefore the maintenance costs do not reflect the manner in which prices under a service agreement would be expected to be derived. This is

demonstrated in the following graph which shows the difference between DORC and GRV approaches. Efficient prices in a service agreement would not be expected to be high early in the service agreement and low late in the service agreement. To the extent that the service agreement is aligned to the life of the plant, the renegotiation or retendering of the service would not be expected to result in a material price increase in the repricing relative to the cost of service provision in the last year of the agreement.

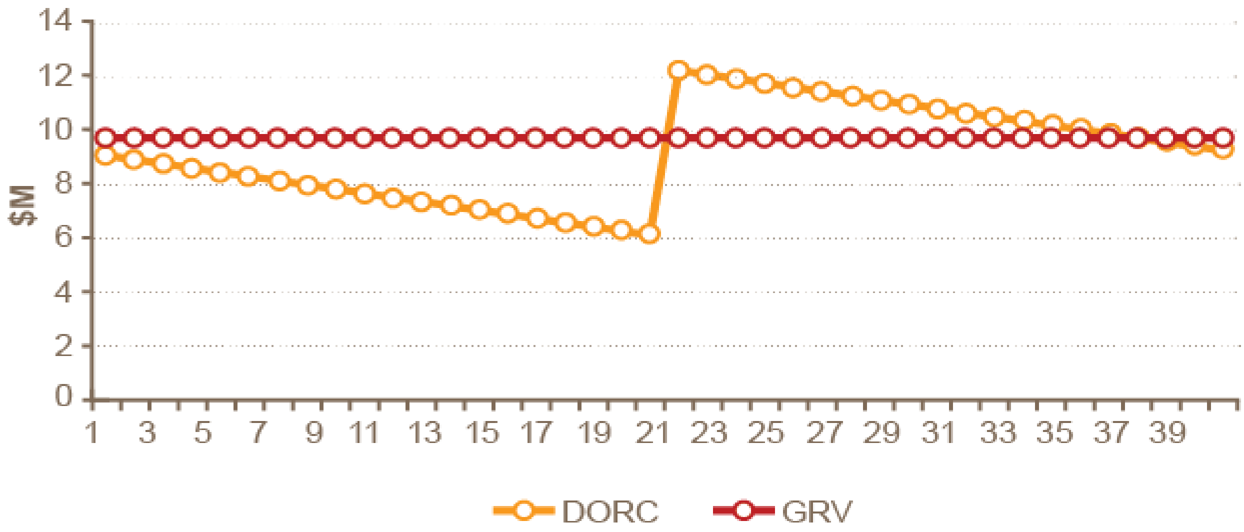


Figure 45: DORC versus GRV

Source: ERAWA (2002), pg. 7

The Gross Replacement Annuity (GRV) approach does not suffer from these deficiencies. In addition, the profile of the expected plant charges and the periodic assessment of both replacement cost and modern engineering equivalent under the GRV approach ensures that the maintenance costs support the ongoing investment and renewal of plant. For the purpose of determining plants charges for maintenance costs, Aurizon Network has therefore employed the Gross Replacement Value (GRV) method.

The GRV method involves restating the cost of each asset to its new gross replacement value, thereby reflecting the total economic benefits embodied within the asset. Replacement value is "…measured by reference to the lowest cost at which the gross future economic benefits of that asset could currently be obtained in the normal course of business (AASB 136, paragraph Aus 32.2)."

Application

When combined with other asset variables including economic life and Weighted Average Cost of Capital (WACC), the GRV method calculates an annuity for each asset utilising the PMT functionality within Microsoft Excel. As the value is an annuity, the value is equivalent across every year of the asset's economic useful life and in turn, each of the years within the UT4 access period. This is calculated as:

GRV Annuity = PMT (rate, nper, pv, fv, type)

Where:	rate	= Real Pre-tax Weighted Average Cost of Capital (6.83%)
	nper	= Economic useful life of the asset (varies between assets)
	pv	= Gross replacement value of the asset (varies between assets)

fv = Indicates the value of the asset at the end of its economic useful life ($0)

type = Indicates when payments are due (0 = at the end of the period)

It is recognised that Aurizon has shifted away from an accounting cost valuation methodology previously applied within the UT3 for its ROA calculation on its maintenance assets. Based upon Depreciated Optimised Replacement Cost (DORC) principles, both the GRV and DORC asset valuation methodologies "…use a current cost approach which is usually justified on the basis that it results in prices which more closely reflect the cost of replacing capacity or providing additional capacity (ERAWA, 2002)", one of the differences between the two approaches exists in the calculation of operating costs. [10] Specifically

> "…under DORC, assuming that operating costs are prudent and reflect best practice, all such expenditures are usually allowed. On the other hand, the Code's approach to valuing assets using GRV that is regularly reset requires an operating cost profile that is consistent with that required for a permanently new network (ERAWA, 2002)."

Another difference exists in how the approaches determine the return on asset calculation. Specifically, DORC applies a WACC based upon the depreciated asset value, decreasing as the asset value approaches the end of its economic useful life. By contrast and as previously indicated, GRV calculates a constant annuity payment. But when undertaking the maintenance function upon the CQCN, maintenance activity is generally expected to increase as the asset life decreases. Hence, an economic mismatch in activity would be observed. Nonetheless, both the DORC and GRV approaches yield similar valuations provided the depreciation profiles between the two methodologies are consistent. The Economic Regulation Authority of Western Australia (ERAWA) currently permits its railway owners to calculate efficient costs utilising the GRV asset value methodology.

It is for these reasons why Aurizon has applied a GRV methodology in calculating its return on assets for its maintenance function. However it is also important to note, that in applying the GRV methodology, a gross replacement value that reflects "…cost of the modern engineering equivalent replacement asset (QR Network, 2010, pg. 131)" is used.[11]

Modern Equivalent Asset or MEA, reflects a theoretical asset with which an existing asset's service potential could be restored using the most modern technology. However due to technological improvements, a MEA could retain different characteristics that impact upon its capacity or output, the quality of output or even the asset's expected useful life. As such, if a modern equivalent asset is used as a reference, an adjustment to MEA value that is substituted for asset's gross replacement value needs to be made to reflect any difference between the asset and the modern equivalent if service potential differs.[12,13] For instance, if a modern equivalent rail grinder is able to restore rail condition

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[10] ERAWA (2002), *A Brief Comparison of the WA Rail Access Code approach to calculating ceiling cost with the Depreciated Optimised Replacement Cost methodology,* 19th July 2002, available at www.erawa.com.au

[11] QR Network, 2010, *2010 Access Undertaking,* 5th October 2010, available at www.qca.org.au

[12] CPA, 2012, *Guide to Valuation and Depreciation Under the International Accounting Standards for the Public Sector (DRAFT),* 16th July 2012, available at www.cpaaustralia.com.au

[13] HM Treasury, 2007, *Guidance on Asset Valuation,* 9th October 2007, available at www.hm-treasury.gov.uk

3 times more efficiently than an older asset, yet cost the organisation a sum of AUD$100 million dollars, a gross replacement value of only AUD$33 million could be utilised in the calculation of the GRV Annuity. Aurizon has recognised such efficiencies in new plant acquisition via adjusting the gross replacement value of the assets.[14,15]

Utilising the GRV methodology and applying a real pre-tax WACC of 6.83%, a total ROA of $117m was calculated across the UT4 access period (2014-2017). When split across the maintenance functions, the Mechanised group accounted for approximately 93% of the total ROA value (thus reflecting the value and size of assets within the specialised track services), with the Non-Mechanised group accounting for the remainder. However, as depreciation is already included in the determination of product costs as per Aurizon accounting principles, accounting depreciation charges where removed from the total ROA calculation so as to not double-count for depreciation charges. Total ROA adjusted for depreciation equalled $38m.

5.8.2 Inventory

To arrive at the return on inventory held, depots were firstly defined as either maintenance, construction or mixed, with construction depots excluded.

For inventory held at maintenance or mixed depots, the value of stock was assigned to below rail coal maintenance based on the work performed by that area; the mix of labour hours booked in FY12. This ranged from 100% for dedicated below rail coal maintenance locations, down to 52% for areas which perform work for other customers; e.g. capital projects. In some cases, a more specific assignment was provided by Aurizon Network's Material Logistics Unit. These were primarily the large depots, where the stock on hand is mainly used for capital projects, so the maintenance inventory allocation was as low as 20%.

A Real Pre-Tax Weighted Average Cost of Capital of 6.83% has been applied to the maintenance inventory base developed above, with the amount then held constant across all UT4 years.

It is assumed there is no material change in the inventory held across the period (real $s), even though the maintenance task is increasing.

5.8.3 Working Capital

A Real Pre-Tax Weighted Average Cost of Capital of 6.83% has been applied to 1/12th of the total annual spend; e.g. $189m in FY14.

5.9 Corporate Costs

An amount of $12.090m per annum has been included to cover the cost of corporate overhead and corporate services. This figure includes the following functions excluded from the direct cost build-up:

- Office of the Chief Executive Officer and the Board
- Human Resources

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[14] Ergon Energy, 2000, *Queensland Electricity Distribution Corporations ORDC Valuation of Electricity Supply Assets*, 20th September 2000, available at www.qca.org.au

[15] NSW Treasury, 2012, *Accounting Policy: Valuation of Physical Non-Current Assets at Fair Value*, 12th March 2012, available at www.treasury.nsw.gov.au

> Finance
> Procurement
> Information Systems
> Systems Development (particularly safety standards)
> Legal
> Audit.

The corporate cost figure of $12.090m is a combination of two pieces of work undertaken in conjunction with Deloitte Touche Tohmatsu. The first was a bottom-up cost build-up based on a hypothetical maintenance business, while the second was a benchmarking exercise centred on regulated businesses.

This work provides for calculation of Corporate Costs associated with a business delivering Maintenance Service of approximately $200M. These costs have been isolated from and independently calculated from the remaining UT4 submission.

Deloitte's report indicated that recent regulatory decisions on average provide for an allowance of 7%. The $12.090m proposed is considered conservative equating to approximately 6%.

It is assumed there is no material change in the corporate costs across the period (real $s), even though the maintenance task increases.

A copy of the Deloitte Touché Tohmatsu report is attached at Appendix AE.

5.10 Cost Indexation

Consistent with the approach employed in UT3 maintenance cost submission, Aurizon Network has compiled will apply a Maintenance Cost Index (MCI) to escalate the forecast maintenance costs based in 2011-12 dollars to derive a nominal maintenance cost allowance for the UT4 access period.

Originally developed by QR Network for use in the 2010 Access Undertaking, the MCI aims to provide a more relevant forecast maintenance cost escalation measure than the standard Consumer Price Index (CPI). Hence similar to the CPI, the MCI is a macro-level index comprised of a 'basket' of services that more accurately reflect the costs incurred by Aurizon Network in performance of its maintenance responsibilities and requirements across the Central Queensland Coal Network. Consisting of five cost categories or drivers, each cost driver is weighted based upon a detailed cost assessment from cost data prepared by Aurizon Network.

Four key steps where used in determination of the MCI. This comprised the assignment of maintenance costs to the MCI cost drivers (Accommodation, Consumer Price Index (CPI), Consumables, Fuel and Labour); the calculation of weights based upon the proportional split of maintenance costs to the cost drivers; the determination of the MCI via the application of weights to the cost driver indices; and the application of the MCI to the maintenance costs across each year in the access period. These are described in further detail below:

> Step 1: To determine the forecast MCI, Aurizon Network derived five key cost drivers from de-escalated maintenance costs from the UT3. These included: (1) Accommodation; (2) Consumer Price Index (CPI); (3) Consumables; (4) Fuel; and (5)

Labour. Once derived, all costs pertinent to the Aurizon maintenance function were allocated to a relevant cost driver.

> Step 2: Upon allocation of costs to each of the cost drivers, an aggregate figure for each cost driver was subsequently determined. From the aggregate figure, a percentage weight for each driver was then calculated, thereby indicating the influence that each cost driver has upon the makeup of the MCI. Expressed mathematically, this was calculated as follows:

$$\text{Cost Driver Weight \%} = \text{Maintenance costs assigned to cost driver} \div \text{Total maintenance costs}$$

> Step 3: Each cost driver references a specific index or group of indices. For instance, due to the location of the CQCN and its maintenance activities, the Accommodation MCI cost driver was equally assigned based across accommodation data from the Fitzroy and Mackay regions. Underlying index values for each of these regions where sourced from the Australian Bureau of Statistics (ABS), particularly Catalogue 8635.3 – Tourist Accommodation, Small Area Data. Once both the proportions and underlying indices had been determined for each cost driver, a base index value as at June 2012 was calculated. This was determined as follows:

$$\begin{aligned}\text{Cost Driver Base Index Value} = {} & \text{Underlying Index as at June 2012} \times \text{Proportional Allocation}^{n} + {} \\ & \text{Underlying Index as at June 2012} \times (1 - \text{Proportional Allocation}^{n}) + \text{etc}\ldots\end{aligned}$$

With values for the base elements determined, the MCI was calculated, with cost driver weight %'s applied to each cost driver base index value as follows:

$$\begin{aligned}\text{MCI} = {} & (\text{Accommodation Base Index Value} \times \text{Accommodation Weight \%}) + {} \\ & (\text{CPI Base Index Value} \times \text{CPI Weight \%}) + {} \\ & (\text{Consumables Base Index Value} \times \text{Consumables Cost Driver Weight \%}) + {} \\ & (\text{Fuel Base Index Value} \times \text{Fuel Cost Driver Weight \%}) + {} \\ & (\text{Labour Base Index Value} \times \text{Labour Cost Driver Weight \%})\end{aligned}$$

> Step 4: The MCI was then applied to nominal costs across each year in the UT4 access period.

The above process used to calculate and apply the MCI graphically outlined in Figure 2 below, with Table 1 indicating the weightings assigned to each cost driver index value, the associated cost groupings and the data sources used to derive the relevant cost driver base indices as at 30 June 2012. Lastly Table 24 details each of the elements of the MCI and the value of the MCI across each of the years in the access period.

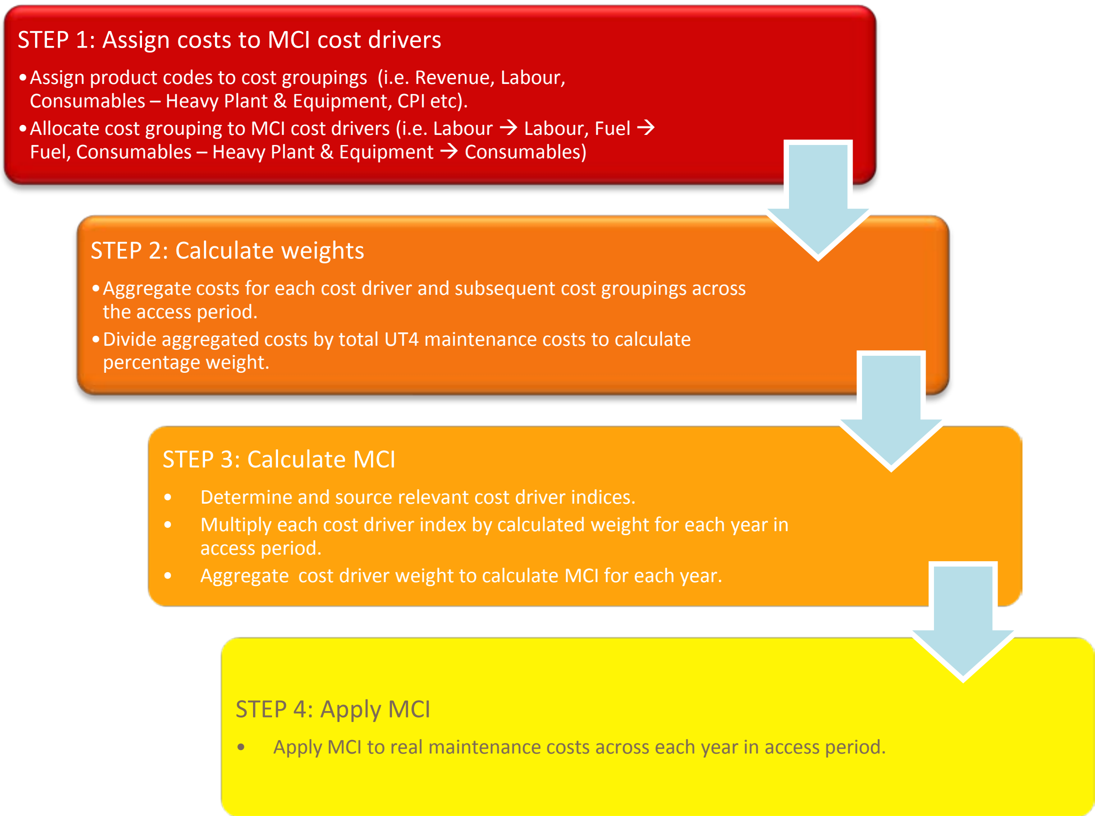

Figure 46: Steps in calculating the MCI

With the costs provided in Table 24 shown in dollars of the 2011/12 financial year, the Maintenance Cost Index has been used to escalate these costs to provide nominal cost forecasts across the years for inclusion in the relevant reference tariffs. The forecast were obtained from BIS Shrapnel, including the relevant Australian Bureau of Statistics indices. The indices themselves and the escalation factors applied to the specific cost categories are as follows:

Table 24: Maintenance Cost Index

Index	Cost Categories	FY13 Escalation	FY14 Escalation	FY15 Escalation	FY16 Escalation	FY17 Escalation
Labour						
Average Weekly Earnings (AWOTE) - Mining Queensland	Internal labour External labour hire Labour-related costs; e.g. PPE, employee expenses	6.2%	7.4%	7.6%	7.2%	5.8%
Accommodation						
Average Room Rate - Fitzroy	Accommodation	2.8%	1.6%	-2.6%	-5.0%	-3.2%
Average Room Rate - Mackay	Airfares	2.8%	1.5%	-2.6%	-5.0%	-3.1%

Index	Cost Categories	FY13 Escalation	FY14 Escalation	FY15 Escalation	FY16 Escalation	FY17 Escalation
Fuel AAA Pricing Unleaded Petrol (Retail) Emerald Gladstone Mackay	Fuel (both diesel and petrol) for plant, trucks and motor vehicles	4.5% 4.6% 4.6%	3.3% 4.0% 3.1%	3.3% 3.3% 3.1%	1.3% 1.2% 1.6%	-1.3% -1.4% -1.5%
Plant and Equipment Hire of Heavy Plant and Equipment – Australia	Plant and machinery hire	0.4%	0.4%	-0.2%	-0.5%	0.2%
Plant Componentry Transport Equipment and Parts Australia	Componentry for on track machines, tools and maintenance machinery	0.6%	-0.8%	0.8%	1.0%	0.7%
Materials Fabricated Metal Products – Australia	Rail, Sleepers, Ballast and other track materials	0.8%	-1.4%	-1.4%	0.3%	6.4%
Consumer Price Index – Brisbane	All other cost groupings not specifically included above	3.4%	3.0%	3.3%	2.9%	2.5%
Weighted Average As per OPEX submission	Corporate Costs Working Capital	4.4% 4.4%	3.4% 3.3%	4.7% 4.5%	4.6% 4.5%	4.2% 4.6%

A copy of the BIS Shrapnel report is attached at Appendix AF.

5.11 Specific Product Groups

The scope and main cost components for the product groups are as follows:

5.11.1 Mechanised Ballast Undercutting

Table 25: Scope and cost for Mechanised Ballast Undercutting

	FY14	FY15	FY16	FY17
Scope – volume (mc)				
Scope – linear distance (km)				
Scope – linear distance equivalent to std				

	FY14	FY15	FY16	FY17
300mm depth (km)				
Cost ($m)	**$55.271**	**$64.859**	**$65.883**	**$66.361**

The main cost components for ballast undercutting are:

- Labour, both operational and plant maintenance, including accommodation and travel
- Capital; undercutter and supporting track machines
- Ballast and associated freight
- Earthworks plant
- Fuel
- Machine componentry
- Management, planning and administrative functions.

The key productivity drivers are:

- Efficient planning of works, including rosters, knowledge of track condition (including formation), the work location
- The volume of ballast to be cleaned, particularly the percentage of standard 300mm depths, as opposed to depths greater than that
- The condition of ballast (and the associated formation), to be cleaned
- Plant reliability
- Time on track; both number of shifts and productive time within those shifts
- Ability to access the work locations
- Ability to dispose of ballast spoil efficiently
- Skill and experience of machine operators and maintainers
- Logistical support, including ballast trains, site protection, overhead isolations
- The need to travel
- Location and quality of maintenance facilities.

The bulk of the mechanised ballast undercutting task will be completed by the RM900 machine, supplemented by approximately 25km being completed by a smaller, off-track consist that will be ready for operation from Q1 of FY14. The capacity of the RM900 will be increased through the acquisition of 24 spoil wagons and upgrade of 56 ballast wagons in Q1 of FY15. As such, the above maintenance costs incorporates the cost of the larger RM900 consist and associated costs, together with the new off-track operation and the associated labour and machine maintenance.

5.11.2 Resurfacing

Table 26: Scope and cost for Resurfacing

	FY14	FY15	FY16	FY17
Mainline – Scope (km)				
Mainline - Cost ($m)	$16.635	$16.390	$18.238	$18.294
Turnouts - Scope				
Turnouts - Cost ($m)	$2.344	$2.625	$2.629	$2.633

	FY14	FY15	FY16	FY17
Total Cost	**$18.979**	**$19.015**	**$20.867**	**$20.927**

The main cost components for resurfacing are:

> Labour, both operational and plant maintenance, including accommodation and travel
> Capital; mainline and turnout tampers (and associated ballast regulators)
> Fuel
> Machine componentry
> Management, planning and administrative functions.

The key productivity drivers are:

> Efficient planning of works, including rosters and frequency of moving between jobs
> Mix of planned cyclical work vs. need for emergency response work
> Time on track; both number of shifts and productive time within those shifts
> Quality and timeliness of track condition information (Track Recording Car)
> General track and formation condition
> Plant reliability
> Skill and experience of machine operators and maintainers
> The need to travel
> Location and quality of maintenance facilities
> Weather/Environmental conditions; negatively impact by wet weather
> Impact of other major network maintenance or capital works.

The core of the mechanised resurfacing fleet has reached the end of its useful life. As such, the above maintenance cost incorporates the new machines, together with their higher productivity and lower maintenance costs. Specifically, the figures above are based on:

> Two new switch (turnout) tamping machines being operational from 1 October 2013, replacing existing machines
> Five new mainline machines will be brought on line progressively from October 2014 to July 2015; again replacing existing machines.

5.11.3 Rail Grinding

Table 27: Scope and cost for Rail Grinding

	FY14	FY15	FY16	FY17
Mainline - Scope (km)				
Mainline - Cost ($m)	$9.650	$10.618	$11.049	$11.510
Turnouts - Scope				
Turnouts - Cost ($m)	$2.863	$2.898	$2.909	$2.926
Total Cost	**$12.513**	**$13.516**	**$13.958**	**$14.436**

The main cost components for rail grinding are:

> Labour, both operational and plant maintenance, including accommodation and travel
> Capital; mainline and turnout grinder, track inspection vehicle
> Grindstones
> Fuel
> Machine componentry
> Management, planning and administrative functions.

The key productivity drivers are:

> Efficient planning of works, including rosters, knowledge of track condition (including formation), the work location
> Engineering specifications
> Time on track; both number of shifts and productive time within those shifts
> Quality and timeliness of rail condition information (scope is closely correlated to tonnage)
> Plant reliability
> Skill and experience of machine operators and maintainers
> The need to travel
> Location and quality of maintenance facilities
> Weather/environmental conditions; i.e. risk of fire
> Impact of other major network maintenance or capital works.

The costings assume there is no material change in the grinding plant for the UT4 period.

5.11.4 General Track

Table 28: Cost for General Track

	FY14	FY15	FY16	FY17
General Track ($m)	$47.319	$50.472	$52.004	$53.581
Re-railing ($m)	$15.267	$15.061	$15.722	$16.144
Total Cost ($m)	**$62.586**	**$65.533**	**$67.726**	**$69.725**

General track maintenance is less mechanised, with labour the major cost component, although some plant and machinery is required for most tasks. Other costs include:

> Track componentry
> Accommodation and travel
> Capital; general plant and machinery such as excavators, graders, end loaders, bobcats, scissor lifts, trucks and motor vehicles
> Fuel
> Track materials; e.g. ballast, rail, sleepers
> Management, planning and administrative functions.

The key productivity drivers are:

> Efficient planning of works, including rosters and frequency of moving between jobs

> Mix of planned cyclical work vs. need for emergency response work , including performing preventative work in accordance with the relevant standards
> Time on track; both number of shifts and productive time within those shifts
> Quality and timeliness of track condition information
> General track and formation condition
> Skill and experience of plant operators
> Logistical support; e.g. availability of overhead isolations and signal frigging
> The need to travel
> Weather/environmental conditions; negatively impacted by wet or hot weather, ability to weld is constrained by temperature
> Impact of other major network maintenance or capital works.

5.11.5 Structures

Table 29: Cost for Structures

	FY14	FY15	FY16	FY17
Cost ($m)	$2.650	$2.769	$2.841	$2.935

Structures maintenance is also labour intensive. Other costs include:

> Accommodation and travel
> Capital; general plant and machinery
> Fuel
> Componentry and materials
> Management, planning and administrative functions.

The key productivity drivers are:

> Efficient planning of works, including rosters and logical sequencing
> Mix of planned preventative work vs. need for emergency response work, including performing preventative work in accordance with the relevant standards
> Time on track; both number of shifts and productive time within those shifts
> Quality and timeliness of track condition information (Track Recording Car)
> General condition of the assets
> The need to travel
> Weather/Environmental conditions; negatively impacted by wet weather
> Impact of other major network maintenance or capital works.

5.11.6 Signalling

Table 30: Cost for Signalling

	FY14	FY15	FY16	FY17
Cost ($m)	$22.591	$23.457	$23.944	$24.417

The vast majority of the cost of signalling maintenance is labour. Other minor costs include:

> Componentry and materials
> Accommodation and travel
> Fuel
> Management, planning and administrative functions.

The key productivity drivers are:

> Efficient planning of works, including rosters and logical sequencing
> Mix of planned preventative work vs. need for emergency response work, including performing preventative work in accordance with the relevant standards
> (Where relevant) Track access; completing the job in a single event, rather than on/off the track numerous times
> Staff with appropriate qualifications, skills and experience
> General condition of the track, impacting the condition of the signalling equipment
> Condition/age of the signalling equipment; e.g. access to it is poor on account of coal fouling
> The need to travel
> Impact of other major network maintenance or capital works.

5.11.7 Traction

Table 31: Cost for Traction

	FY14	FY15	FY16	FY17
Cost ($m)	$9.556	$9.598	$9.598	$9.597

The vast majority of the cost of traction power maintenance is labour. Other minor costs include:

> Componentry and materials
> Accommodation and travel
> Fuel
> Management, planning and administrative functions.

The key productivity drivers are:

> Efficient planning of works, including rosters and logical sequencing
> Mix of planned preventative work vs. need for emergency response work, including performing preventative work in accordance with the relevant standards
> Track access; completing the job in a single event, rather than on/off the track numerous times
> Staff with appropriate qualifications, skills and experience
> Condition/age of the traction power equipment
> The need to travel
> Impact of other major network maintenance or capital works.

5.11.8 Telecommunications

Table 32: Cost for Telecommunications

	FY14	FY15	FY16	FY17
Cost ($m)	$5.365	$5.514	$5.516	$5.518

The vast majority of the cost of telecommunications is labour. Other minor costs include:

> Componentry and materials

> Accommodation and travel

> Fuel

> Management, planning and administrative functions.

The key productivity drivers are:

> Efficient planning of works, including rosters and logical sequencing

> Mix of planned preventative work vs. need for emergency response work, including performing preventative work in accordance with the relevant standards

> (Where relevant), track access; completing the job in a single event, rather than on/off the track numerous times

> Staff with appropriate qualifications, skills and experience

> Condition of access roads required to access off-track equipment; e.g. microwave equipment

> The need to travel

> Impact of other major network maintenance or capital works.

6. BLACKWATER SYSTEM PLAN AND COSTS

6.1 Blackwater System General Information

6.1.1 Blackwater System Overview

The Blackwater System is located in Central Queensland and services the Bowen Basin coal region. It is the oldest of all the systems, having been in operation since 1886 and is the largest of the four coal systems, carrying the second highest tonnages on the network after the Goonyella system.

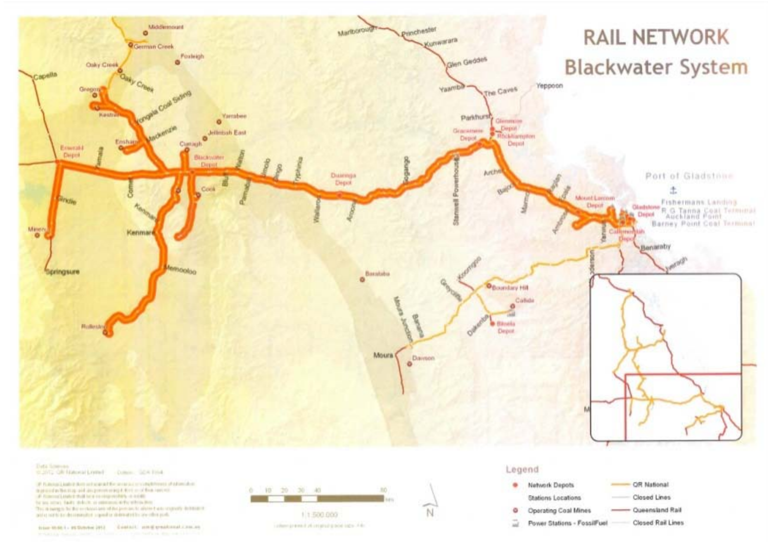

Figure 47: Blackwater coal system map

The Blackwater system is the longest network in the CQCN with 1107 km of bi-directional track, of which 807 km of the track is electrified. This system links mines to the two export terminals at the Port of Gladstone; RG Tanna Coal Terminal, and Barney Point Coal Terminal. The Blackwater system also services a number of domestic users including Stanwell and Gladstone Power Station, Cement Australia and the Yarwun Refinery (Rio Tinto Alcan). Callemondah Yard is used to provision train services. The system is operated from the Rockhampton Control Centre utilising two safe working systems - Remote Control Signalling (RCS) and Direct Traffic Control (DTC).

Originally, this system was built to transport wool, which is a great deal lighter than coal, and as such the rail dealt mainly with 12 tonne axles load at a maximum. It now primarily services 15 mines carrying 60 million tons of coal, on 26 tonne axle loads, from sources operated by BMA, Xstrata, Rio Tinto, Curragh, Ensham, Felix, and Jellinbah. This system links mines to the two export terminals at the Port of Gladstone; RG Tanna Coal Terminal, and Barney Point Coal Terminal. The Blackwater system also services a number of domestic users including Stanwell and Gladstone Power Station, Cement Australia and the Yarwun Refinery (Rio Tinto Alcan).

Electrification uses an autotransformer system with the overhead line equipment operating at 25 000 volts. The bi-directional duplicated track has crossovers between Callemondah and Rocklands, between Stanwell and Dingo and between Bluff and Rangal, with the remainder being single line. Because of changed traffic tasks (coal), this system now incorporates the section of track from Burngrove to Nogoa to Minerva (previously part of the Central West System).

Loading balloon loops are located at East End, Boonal, Koorilgah, Curragh, Boorgoon, Kinrola, Ensham, Gordonstone, Rolleston, Minerva and Gregory with a spur line at Fairhill for Yongala. Triple unloading balloons are located at Golding, with unloading balloons at Stanwell Powerhouse, Fisherman's Landing, Gladstone Powerhouse, Auckland Point, Barney Point and Yarwun.

6.2 Current Asset Condition.

A key indicator of the networks performance is the Below Rail Transit Time (BRTT) and is provided for in all Access Agreements. The BRTT for the Blackwater System is:

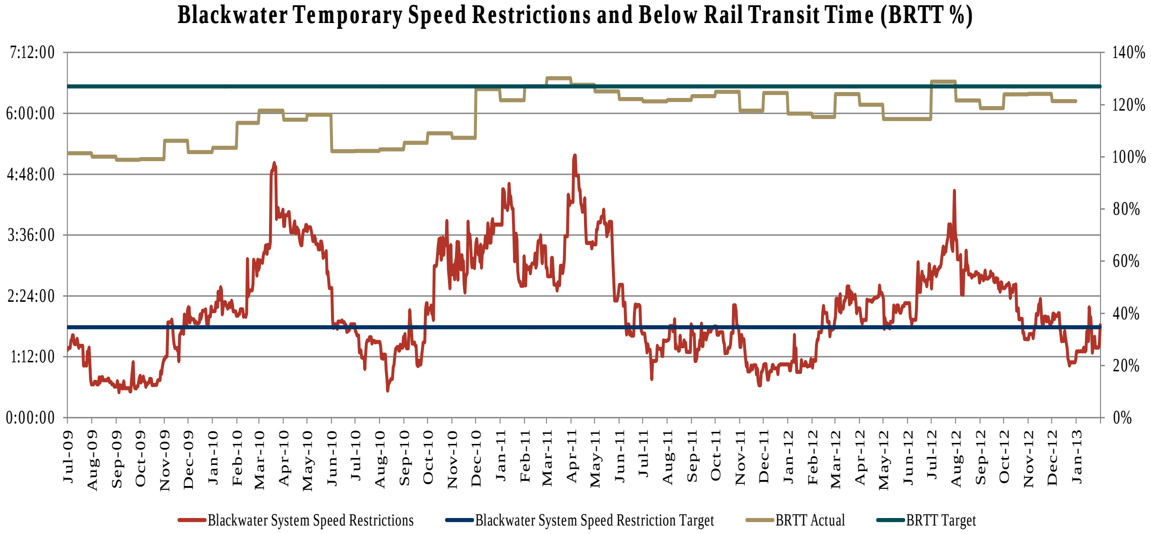

Figure 48: Blackwater System BRTT up to Jan 2013

In addition to the above measure Aurizon Network also provides the QCA with the Overall Track Condition Index. A copy of the Blackwater System OTCI as below:

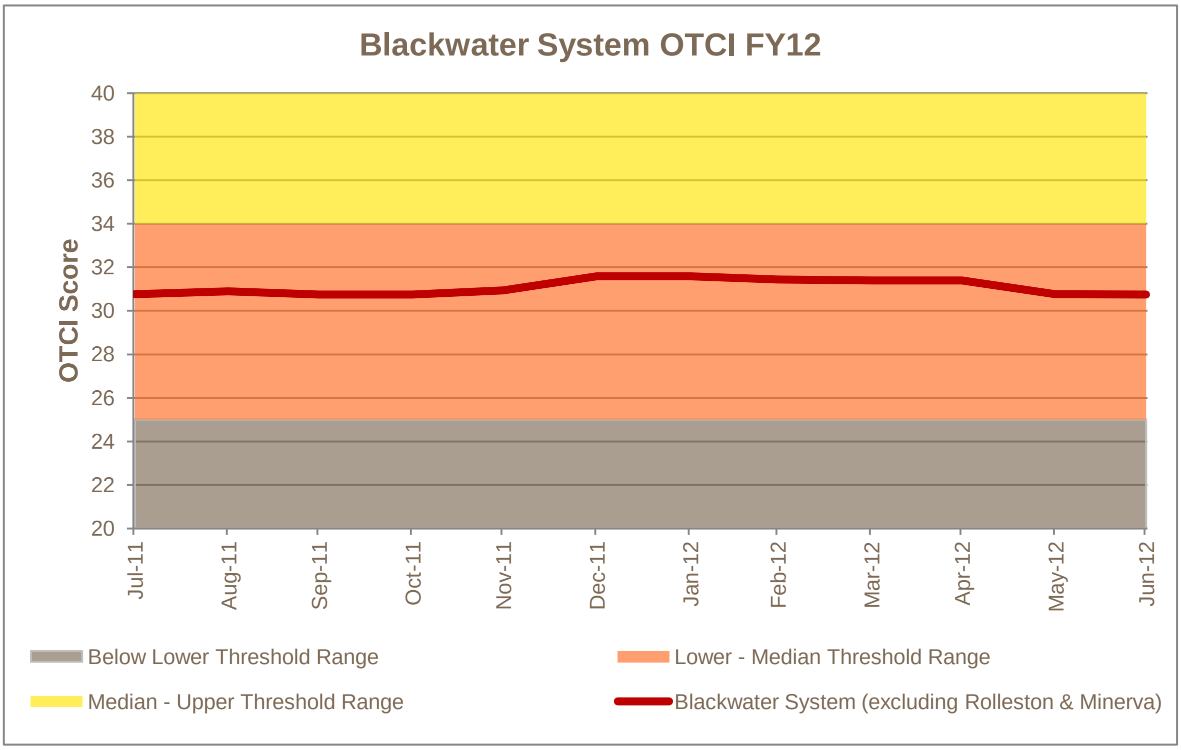

Figure 49: Blackwater System OTCI FY12

6.3 Maintenance Challenges

The maintenance budget for Blackwater represents approximately 40% of the entire CQCN allowance, not only due to its size but also because of its unique requirements in maintaining the line.

In addition to soil issues, signal maintenance, coal product fouling and ballast maintenance works, which affects all systems on the CQCN and are discussed in earlier sections, there are a variety of specific maintenance challenges across the Blackwater system. These include:

> Track stress
> Soil composition
> Overhead line and level crossing issues
> Corrosion
> Weather
> Flood plains
> Safety challenges
> Environmental considerations
> Incident response and remote location challenges.

6.3.1 Track Stress

Overall, general wear rates of the track on this system are higher than standard railways due to the following elements:

> Narrow gauge line - More forces are applied to a smaller area on the track, putting additional pressure on these areas. This requires unique maintenance requirements, and smaller timeframes between maintenance efforts

> Curvature - Originally the track was built for smaller, lighter wagons. In addition to this, the traffic task and frequency has changed considerably, but the curvature of the track has not, which puts a great deal of pressure on the track as these wagons really require a longer turning radius. Rail grinding is required at twice the frequency on these curves (20MGT for general curves and 10MGT for tight curves), as it is for straight track (40MGT). On the Blackwater system, approximately 38% of the track is curved. The table below shows the number and length of curves categorised by the curve radius. This highlights the amount of curved track that exists and the extent of rail wear monitoring and management that is required to be undertaken.

Table 33: Curve Details - Blackwater System

Curve Radius	No. of Curves	Total Curve Length (m)
≤ 160	8	669m
> 160 and ≤ 212	15	3801m
> 212 and ≤ 305	71	17,772m
> 305 and ≤ 415	52	18,840m
> 415 and ≤ 542	58	9,206m
> 542 and ≤ 848	188	41,452m
> 848 and ≤ 1000	95	16,088m
> 1000	489	105,225m
Total	976	213,053m
Total Curved Rail Length		426.106 km

> Gradients - Similarly to Curvature, the size and weights of the wagons cause track stress with their momentum, pushing the track forward, particularly in the downward motion. This is managed by applying ruling grade restrictions in the effected parts of the Blackwater network (mainly in the Ranges)

> Increased tonnages travelling the line – Over the last 25 years the carried tonnages on the line have increased, meaning more traffic and heavier loads are using the track, putting additional pressure on and increasing track wear. The table below details those increases in 5 year increments:

Table 34: Blackwater system tonnage increases

Blackwater	1993	1998	2002	2007	2012
Tonnages (Million Net Tonnes)	19.259	26.849	38.567	49.016	55.076

6.3.2 Overhead Line and Level Crossing

With the large areas of electrification on the network, there is risk of damage to overhead line. The most common incidents requiring corrective maintenance include:

> Bird strikes on the overhead, short circuiting the line. Similarly, several outages are caused by snakes hunting for bird nests

> Mining equipment travelling through level crossings without consideration for the height of the equipment arms and aerials which can de-wire, or damage the overhead lines.

Any dewirements or circuit issues can take a great deal of time to restore services, due to the safety procedures and site isolations that need to occur before maintenance can be undertaken.

6.3.3 Weather Challenges

Due to the location and geography of the Blackwater system, it experiences weather conditions that can affect the delivery of services, and also have a high impact on the maintenance budget, due to the damage caused over these extreme weather periods.

Speed restrictions are in place in extreme heat conditions (as detailed in Section 1.6.2) which the Blackwater system experiences as the line travels inland.

Rainfall and Flooding

In addition, the Blackwater system can suffer from flooding in certain areas with the track crossing major river flood plains, and particularly in the Dawson River (Jaringa) area. When this occurs, it has a major impact to track and its supporting structures and ballast. In order to prevent water damage as much possible, Aurizon Network constructs gabion baskets in high risk areas to limit the flow of water.

6.3.4 Safety on the Blackwater System

Because of the electrification of this system, electrical safety becomes a significant issue and as such requires more of maintenance effort and possession time than any other activity.

This is because of the time it takes to isolate a site which includes ensuring specialist personnel are on site to manage this critical safety aspect. Isolating sites also need to occur for general maintenance activities such as lifting for turnouts, so there is no altercation with the overhead line.

Duplicated track is subject to other safety requirements that must be adhered to. Specifically, no work is to be done within 3 metres of a live track and in situations where there are 2 tracks within 4 metres of each other both need to be shut and isolated to complete any maintenance works. These safety requirements can necessarily affect the service for operators.

6.3.5 Incident Response and Remote Location Challenges

Although the Blackwater system is a very large system, Aurizon Network has various depots throughout to ensure as fast a response as possible, particularly in emergency situations. What also assists in the ability to get to site quickly is that the Blackwater line generally has a highway running in parallel, which makes the movement of plant and machinery much more efficient.

While it can still take a great deal of time to get to site to assess the situation, any isolations or blocks required from that point can add to that time, which can also mean, due to Aurizon Network's Safe Working Practices, a limited amount of work can be undertaken in the day that remains. Examples of how this may affect service include:

- Between Callemondah and Rocklands on the North Coast Line, it is anticipated that a minor incident could result in disruption to services for 6 hours and a major incident for 2 days
- Between Rocklands and Burngrove on the Central Line, it is anticipated that a minor incident could result in disruption to services of 8 hours and a major incident for 3 days.

On all branch lines, it is anticipated that a minor incident could result in disruption to services of 8 hours and a major incident for 3 days. The impact of incidents may be lessened on duplicated track between Callemondah and Rocklands on the North Coast Line and on the Central Line over the 3 duplicated sections Westwood - Windah, Tunnel - Aroona and Duaringa - Wallaroo.

Accommodation

Travelling to the more remote locations can often mean accommodation is required for Aurizon Network's maintenance teams. The challenges generally found when looking for accommodation are that they are in a mining area, which has limited accommodation options due to many options being at capacity, or because of the demand for accommodation there, substantial expense is incurred. Rooms can cost up to $250 per night. It is not uncommon for insufficient local accommodation to be available which necessitates field crews having to travel extensively at the start and end of their shift. The impacts of this include, additional costs, a reduction in productive work time and increased complexity for fatigue management. as required by the Transport Rail Safety Act 2010.

6.4 Maintenance and Operational System information.

6.4.1 Track possessions and closures process specific to the Blackwater System

In addition to the general possessions and track closure process that is relevant for the entire CQCN, Blackwater has some specific planning guidelines that should be used when planning possessions outside of the nominated closure times.

Table 35: Blackwater possession planning guidelines

Access	Comments
North Coast Line: Callemondah – Rocklands	

Access	Comments
Monday	Single worksite – 6 hours on a single section (including isolation and closure). Two worksites – 2x3 hour (isolation and closure). Worksites to be separated by a minimum of 5 sections.
Tuesday-Sunday	Safety critical works only
West: Rocklands – Burngrove	
Thursday	Safety critical works only (Thursday is a busy day for freight services).
Friday-Wednesday	Single worksite – 4 hours on one leg of duplicated track ((including isolation and closure). Worksite to be 2 sections clear of single line section. Two worksites – 2x3 hour (isolation and closure) on one leg of duplicated track. Worksites to be 5 sections apart and 2 sections clear of single line section.

6.4.2 Trackside Detection Equipment:

Dragging Equipment Detectors (DED)

Dragging equipment detectors are placed at strategic locations along the route to give early warning of rolling stock defects and minimise the effect of any derailment incident.

Operators are required to stop immediately if a train controller advises of a dragging equipment detection. Locations of DEDs are detailed in Table 36 below.

Table 36: Blackwater system Dragging Equipment Detector locations

Locations			
Rocklands – Stanwell	Warren – Boonal	Sagittarius – Curragh	Burngrove – Gregory
2.803 km - 1 track	32.720 km - 2 track	4.000 km - 1 track (Curragh Balloon)	5.251 km - 1 track
4.219 km - 1 track	42.804 km - 2 tracks	12.763 km - 1 track (Curragh Balloon)	19.000 km - 1 track
12.381 km - 1 track	51.213 km - 2 tracks		27.000 km - 1 track
15.889 km - 2 tracks	61.254 km - 2 tracks	Rangal – Kinrola	42.243 km - 1 track
20.173 km - 1 track	70.623 km - 2 track	3.064 km - 1 track	44.000 km - 1 track
2.356 km - 1 track (Stanwell Balloon)	79.894 km - 2 tracks	8.426 km - 1 track	56.300 km - 1 track
	90.084 km - 2 tracks	12.060 km - 1 track	65.840km - 1 track (Gregory Balloon)
Blackwater - Koorilgah	100.329 km - 2 tracks	14.040 km - 1 track	13.680 km - 1 track (Ensham Balloon)
6.400 km - 1 track	109.812 km - 2 tracks	3.588 km - 1 track (Boorgoon Balloon)	3.500 km - 1 track (Gordonstone Line)
10.885 km - 1 track	123.424 km - 2 tracks	18.763km - 1 track (Kinrola Balloon)	13.834 km - 1 track (Gordonstone Balloon)
4.700 km - 1 track (Koorilgah Balloon)	133.829 km - 2 tracks		
	146.149 km - 1 track	Kinrola Junction – Rolleston	Rangal to Emerald
Blackwater – Rangal	152.748 km - 1 track	5.601 km - 1 track	198.980 km - 1 track
190.982 km - 2 tracks	158.957 km - 1 track	42.440 km - 1 track	200.200 km - 1 track
190.990 km - 2 tracks	165.314 km - 1 track		
194.388 km - 2 tracks	176.053 km - 1 track		
	178.561 km - 2 tracks		
	184.448 km - 2 tracks		
	180.580 km - 1 track (Boonal Siding)		

Locations		
	53.106 km - 1 track	Nogoa - Minerva
	56.456 km - 1 track	3.061 km - 1 track
	99.400 km - 1 track	

Hot Box / Hot Wheel Detectors (HBD/HWD)

Hot Box / Hot Wheel Detectors are located at the following locations:

Rocklands – Rangal

38.674 km - 2 tracks (HWD) 110.069 km - 2 tracks (HBD) 152.171 km - 1 track (HWD)

173.285 km - 1 track (HBD) 192.011 km - 1 track (HWD)

Wheel Impact Load Detectors (WILD)

Flat wheel detection equipment operates on the North Coast Line between Epala and Raglan at 581.233 km.

6.4.3 Weighbridges

In general weighbridges are located on balloon loop immediately after the load out station for the purpose of overload detection.

Blackwater System weighbridges are located at: Gregory, Gordonstone, Yongala, Ensham, Curragh, Koorilgah, Kinrola, Boorgoon and East End.

At East End the overload protection for wagons is provided in the form of a Belt Weigher (Beltometer). The maximum permitted speed of trains over weigh-in-motion weighbridges is 10 km/h.

6.4.4 Operational Systems and Train Control

The system is operated from the Rockhampton Control Centre utilising two safe working systems - Remote Control Signalling (RCS) and Direct Traffic Control (DTC).

The Blackwater system is operated by Remote Control Signalling (RCS), with train movements controlled from Rockhampton, except for:

- Gladstone Yard — RCS and Rail Operator (RO) Controlled
- Auckland Point — Rail Operator (RO) Controlled
- Barney Point and QAL — Rail Operator (RO) Controlled
- Callemondah — Gladstone Powerhouse and Callemondah - Golding are controlled from the Callemondah signal cabin.

The train control map provided in Figure 50 below shows which areas use which system.

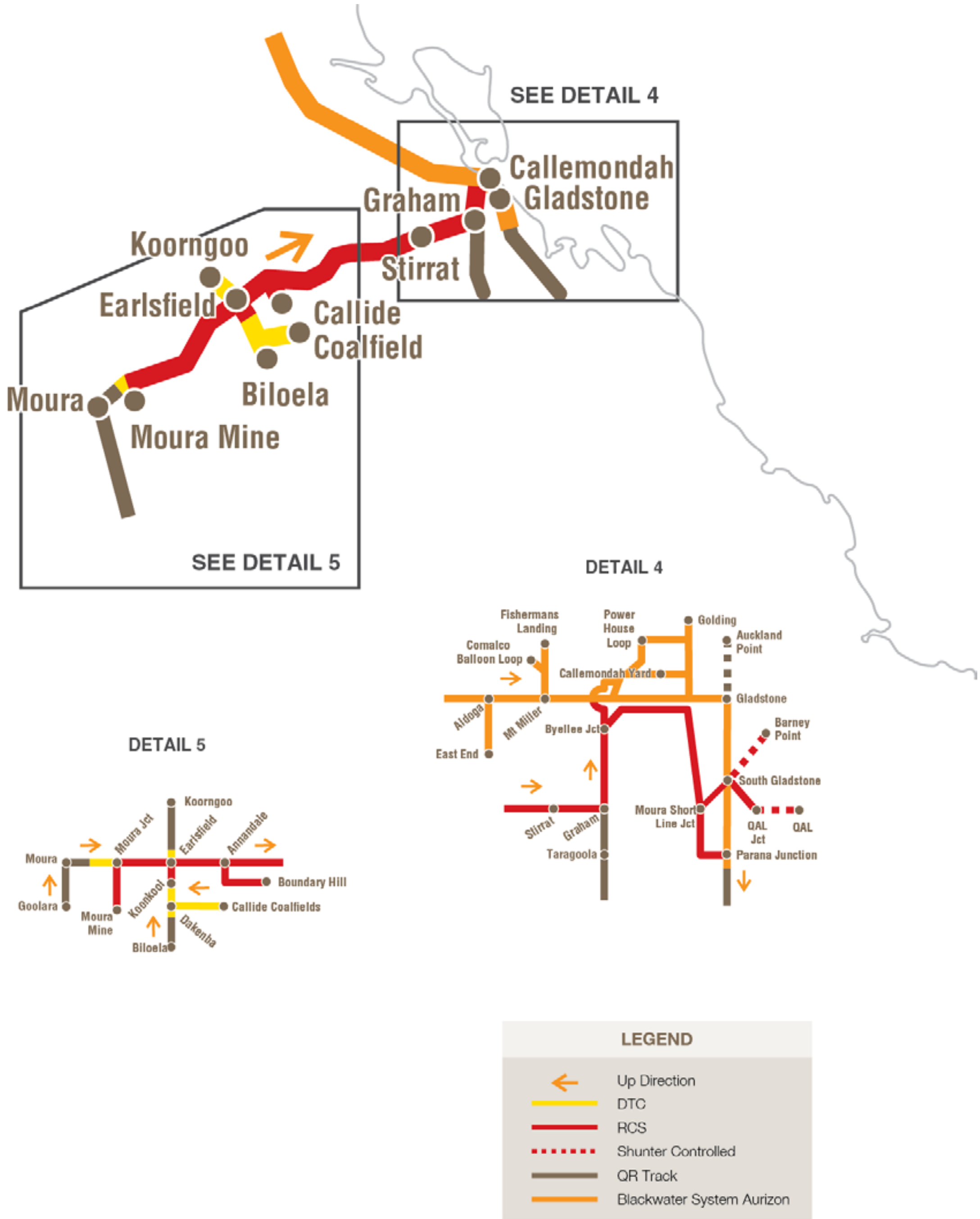

Figure 50: Train control systems for the Blackwater System

6.4.5 Communications

Communications on the Blackwater System between Driver and Controller is via a UHF radio system (Train Control Radio - TCR) utilising a number of Aurizon Network channels and frequencies. Transceivers “auto” switch channels to suit geographical location. Frequency specification and coverage details are available as part of the “Access Enquiry Process”.

All current locomotives (including Multiple Units and Miscellaneous Vehicles such as Rail Motors) carry and all units new to the system will be required to carry a UHF radio operating on Aurizon Network Channel 1. This provides on-board and wayside communications including end to end, train to train and train to track gangs over a distance on average of 8 - 10 km.

Communications on board locomotives must conform to Aurizon Network Safety and Security Standard SAF/STD/0014/TEL - Mobile Voice Radio Communications Systems.

Telecommunications

Shown in the figure below is a schematic diagram of the Goonyella/Blackwater telecommunications network, they are shown jointly as they are interconnected to provide route diversity and redundancy.

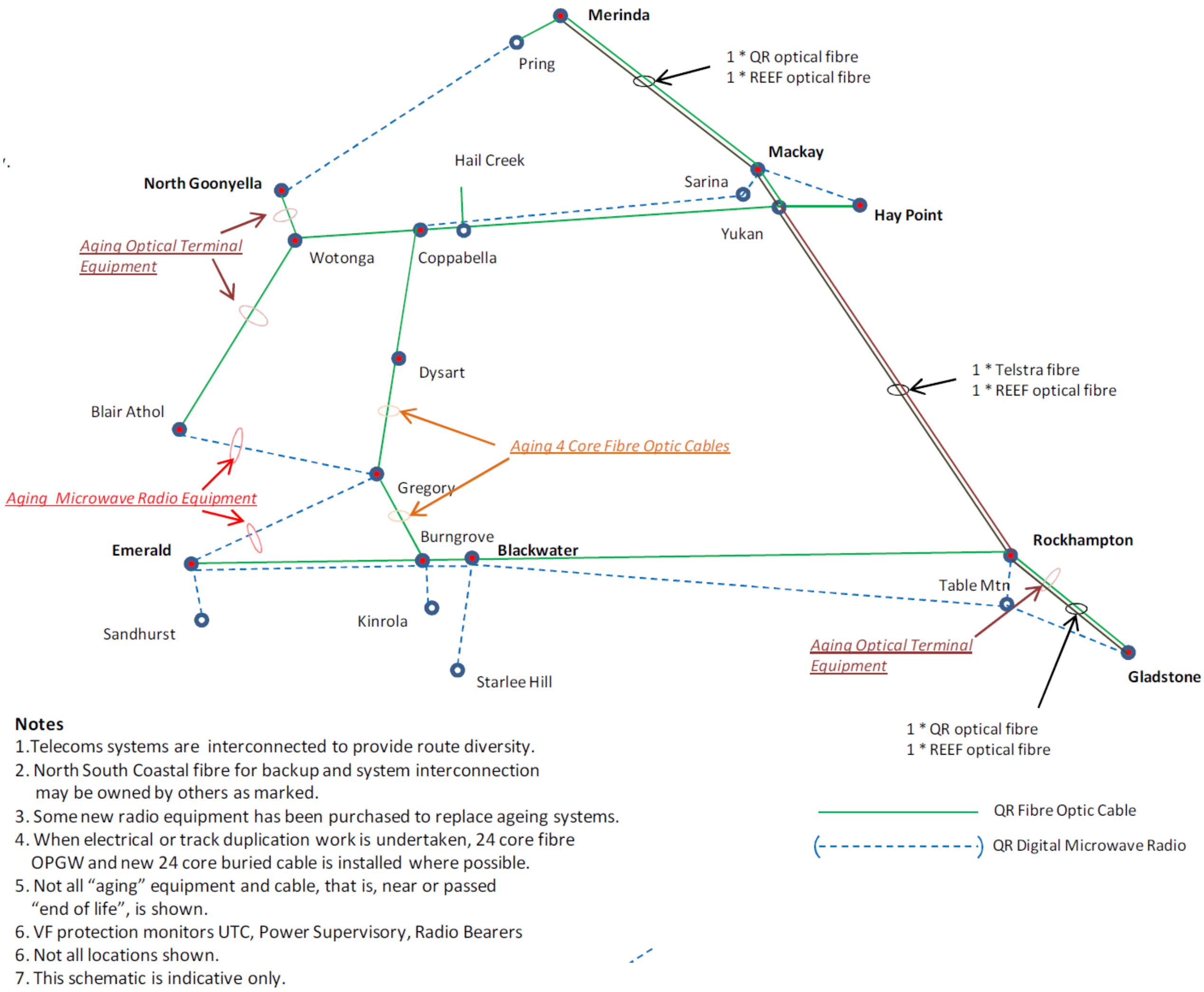

Figure 51: Goonyella/Blackwater system telecommunications schematic diagram

6.5 Specific Point to Point Details

Rail on the Blackwater System is predominately 60 kg/m with only some small sections of 53 kg/m, 47 kg/m and to a lesser extent 41 kg/m rails with the associated sleeper types namely concrete and some timber on crushed rock ballast. The rails are continuously welded except where glued insulated joints are used for train detection using track circuits. Generally, the maximum permissible axle load is 26.5 tonnes, unless stated otherwise.

Details on the full extent of the Blackwater system tabled below.

Table 37: Blackwater system point to point details

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
Callemondah to Rocklands (98.6 km)	This section from the Callemondah Complex on the North Coast Line, north of Gladstone to the junction of the North Coast Line and Central Line at Rocklands consists of duplicated track with crossovers signalled for bidirectional running. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	60 kg/m rail on concrete sleepers	Freight: 100 km/h running @ 20 tal Mineral (Heavy Haul) 80 km/h running @ 26.5 tal Locomotive hauled Passenger Services: 100 km/h running Inter City Express Services: 120 km/h running Tilt train Passenger Services: 160 km/h running	The maximum grade (not compensated for horizontal alignment) that a Down train (northbound) will encounter is 1 in 57 whilst for an Up train (southbound) is 1 in 66.	Running line: 402 m Siding and depots: 140 m
Rocklands to Burngrove (202.3km)	This section from Rocklands on the North Coast Line to Burngrove on the Central Line consists of single track with duplicated sections Stanwell to Dingo and Bluff to Rangal, all signalled for bi-directional running. Passing loops are located at the following locations Gracemere, Kabra, Stanwell, Warren, Westwood, Umolo, Parnabal, Walton, Bluff and Blackwater. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (30 %) and medium to good (70 %).	60 kg/m rail on concrete sleepers	General Freight: 100 km/h running @ 20 tal Mineral (Heavy Haul) 80 km/h running @ 26.5 tal Locomotive hauled Passenger Services: 100 km/h running	The maximum grade (not compensated for horizontal alignment) that a Down train (eastbound) will encounter is 1 in 49 whilst for an Up train (westbound) is 1 in 50.	Running line: 250 m Siding and depots: 140 m
Burngrove to Gregory	This section from Burngrove (202.284 km) on the Central Line to Gregory Mine consists of single track with passing loops at Crew, Fairhill and Yan	60 kg/m rail on concrete	The maximum allowable speed is:	The maximum grade (not compensated for horizontal alignment) that	Running line: 1400 m Balloon loop: 400 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
(65.8 km)	Yan and balloon loop at Gregory. Existing minimum nominal horizontal curve radii are as follows: Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (30 %) and medium to good (70 %).	sleepers.	80 km/h for 26.5 tonne axle load 100 km/h for 20 tonne axle load.	an Up train (northbound) will encounter is 1 in 72 whilst for a Down train (southbound) is 1 in 100.	Siding and depots: 140 m
Gordonstone Junction – Gordonstone [Kestrel Mine] (12.8 km)	This railway has its junction with the Gregory Branch Line at 52.120 km, near Yan Yan and consists of single track with balloon loop at Gordonstone. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	53 kg/m rail on steel and concrete sleepers	This section of track caters for block trains with a line speed of 60 km/h	The maximum grade (not compensated for horizontal alignment) that a Down train (eastbound) will encounter is 1 in 114 whilst for an Up train (westbound) is 1 in 118.	Running line: 850 m Balloon loop: 300 m Siding and depots: 140 m
Mackenzie to Ensham (13.4 km)	This railway has its junction with the Gregory Branch Line at Mackenzie (23.043 km) and consists of single track with balloon loop at Ensham. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	53 and 60 kg/m rail on concrete sleepers.	80 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train (westbound) will encounter is 1 in 65 whilst for a Down train (eastbound) is 1 in 1538.	Running line: 850 m Balloon loop: 299 m Siding and depots: 140 m
Yongala Siding (2.0 km)	This railway is a dead-end off the southern end of Fairhill Passing Loop at 36.468 km on the Gregory Branch line.	47 kg/m rail on timber sleepers.	This section of track caters for block trains with a line speed of 10 km/h.	The maximum grade (not compensated for horizontal alignment) that a Down train (southbound) will encounter is 1 in 309 whilst for an Up train	N/A

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
				(northbound) is 1 in 116.	
Rangal to Kinrola (18.5 km)	This railway has its junction with the Central Line at Rangal (195.556 km) and consists of single track with passing loop at Tikardi and balloon loop at Kinrola. A balloon loop off the Kinrola Line at 9.552 km runs parallel with the main line to service the mine at Boorgoon. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %)	60 kg/m rail on concrete sleepers.	60 km/h	The maximum grade (not compensated for horizontal alignment) that a Down train (northbound) will encounter is 1 in 100 whilst for an Up train (southbound) the maximum grade is 1 in 75.	Running line: 400 m Balloon loop: 201 m Siding and depots: 140 m
Kinrola Junction to Rolleston (108.5 km)	This railway has its junction with the Rangal to Kinrola railway at 14.745 km and consists of single track with passing loop at Memooloo and balloon loop at Rolleston. The bridges on this railway are not fitted with walkways or handrails. This corridor is completely fenced using 4 strand barbed wire and is good condition.	50 kg/m rail on concrete sleepers.	80 km/h	The maximum grade (not compensated for horizontal alignment) that a Down train (northbound) will encounter is 1 in 81 (15 kp) whilst for an Up (southbound) the maximum grade is 1 in 50.	Running line: 1200 m Balloon loop: 300 m Siding and depots: 140 m
Blackwater to Laleham (16.99 km)	This railway has its junction with the Central Line at 188.724 km and consists of single which Aurizon Network's network ends at the 16.99 km point. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	Predominantly 47 kg/m rail on timber sleepers with some 53/60 kg/m rail on concrete and timber sleepers	60 km/h.	The maximum grade (not compensated for horizontal alignment) that a Down train (northbound) will encounter is 1 in 102 whilst for an Up train (southbound) the maximum grade is 1 in	Running line: 400 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
		between Blackwater and Taurus.		76.	
Taurus to Koorilgah Balloon (5.8 km)	A balloon loop off the Laleham Line at Taurus (12.886 km) services the mine at Koorilgah. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	47 kg/m rail on timber sleepers.	This section of track caters for block trains with a line speed of 25 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train (eastbound) will encounter is 1 in 80 whilst for a Down train (westbound) travels on a downgrade to Taurus, the junction on the Laleham Line.	Running line: 457 m Balloon loop: 304 m Siding and depots: 140 m
Boonal Loop (3.4 km)	This railway has its junction with the Central Line at 178.567 km and consists of single track with balloon loop servicing mines within the local area.	41 kg/m rail on timber sleepers.	This section of track caters for block trains with a line speed of 50 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train (westbound) train will encounter is 1 in 120 whilst for a Down train (eastbound) the grades are falling.	Balloon loop: 199 m
Sagittarius to Curragh (12.0 km)	This railway has its junction with the Central Line at Sagittarius 192.023 km and consists of single track with balloon loop at Curragh. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (30 %) and medium to good (70 %).	53 kg/m rail on concrete sleepers.	This section of track caters for block trains with a line speed of 80 km/h.	The maximum grade (not compensated for horizontal alignment) that a Down train (southbound) will encounter is 1 in 203 whilst for an Up train (northbound) the maximum grade is 1 in 90.	Running line: 1200 m Balloon loop: 300 m Siding and depots: 140 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
Warren to Stanwell Powerhouse Balloon Loop (5.1 km)	A balloon loop off the passing loop at Warren to service the Stanwell Powerhouse consisting of single track. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (30 %) and medium to good (70 %).	60 kg/m rail on concrete sleepers.	This section of track caters for block trains with a line speed of 25 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train (southbound) will encounter is 1 in 116 whilst for a Down train (northbound) the grades are falling.	Running line: 450 m Balloon loop: 300 m Siding and depots: 140 m
Aldoga to East End (11.9 km) Non electrified	A railway off the North Coast Line at Aldoga (557.299 km) to service the balloon loop at East End, consisting of single track. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	53 kg/m rail on concrete sleepers.	This section of track caters for block trains with a line speed of 80 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train (eastbound) will encounter is 1 in 100 whilst for a Down train (westbound) train the maximum grade is 1 in 80.	Running line: 450 m Balloon loop: 300 m Siding and depots: 140 m
Mt Miller to Fisherman's Landing (8.267 km) Non Electrified and Yarwun Balloon Loop	A railway off the North Coast Line at Mt. Miller (542.454 km) to service the balloon loop at Fisherman's Landing consisting of single track. The Yarwun balloon loop branches off this line at 1.438 km. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	53 kg/m rail on concrete sleepers.	This section of track caters for block trains with a line speed of 60 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train (eastbound) will encounter is 1 in 112 whilst for a Down train (westbound) train the maximum grade is 1 in 85.	Running line: 212 m Balloon loop: 220 m Siding and depots: 140 m
Callemondah – Gladstone – Parana	This section of single track is part of the North Coast Line, running north from Parana through	Parana to Callemondah is 60 kg/m rail	Freight: 100 km/h running @ 20 tal	The maximum grade (not compensated for horizontal alignment) that	Running line: 400m Parana connection:

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
(9.3 km)	Gladstone Yard to Callemondah. Maximum permissible axle load is 20 tonnes	on concrete sleepers with the track through Gladstone Yard being 47 kg/m rail on timber sleepers.	Bypass: Locomotive hauled Passenger Services: 100 km/h running Inter City Express Services: 120 km/h running Tilt train Passenger Services: 160 km/h running	an Up train (southbound) will encounter is 1 in 50 whilst for a Down train (northbound) the maximum grade is 1 in 55. At Parana, a connection from the North Coast Line to the Moura Short Line permits traffic to travel via the Moura Short Line bypassing Gladstone Yard and linking with the North Coast Line at Callemondah. An Up train (southbound) will encounter downgrades whilst for a Down train (northbound) the maximum grade (not compensated for horizontal alignment) is 1 in 54.	402m
Gladstone Precincts	Within the precincts of Gladstone station there are destinations for both general freight and block trains. General traffic uses the balloon loops and sidings at Auckland Point with block (mineral) trains using Barney Point balloon loop and sidings. Traffic using Barney Point balloon loop travels through South Gladstone yard via a dedicated	Barney point balloon loop is 53 kg/m rail on timber and concrete sleepers QAL Junction is 47 kg/m rail	Line speed to QAL Junction (2.3 km) is 25 km/h, QAL Junction to the Moura Short Line junction (1.6 km) the line speed is 60 km/h Gladstone yard and	The steepest grades in this area are 1 in 134 against the Up train (southbound).	Running line: 260 m Siding and depots: 140 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
	route allowing 26.5 tal at 25 km/h, QAL Junction, over the North Coast Line and connects with the Moura Short Line west of Parana. The section Barney Point to Moura Short Line is electrified. The main access roads in the Gladstone yard and Auckland Point balloon loops area are also electrified.	on timber sleepers. Throughout Gladstone yard and Auckland Point balloon loops the track structure varies from 31, 41 and 47 kg/m rail on timber sleepers	Auckland Point balloon loops – 15.75 tal at a line speed of 25 km/h.		
Callendondah Yard, Powerhouse and Golding Loops	Callemondah yard is the holding yard for trains accessing the Powerhouse Loop and the three balloon loops at Golding, with all roads electrified. Kwik Drop Door (KDD) triggers have been installed at all coal unloading facilities. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	Track structure is a mix of 60 kg/m on concrete sleepers and 47 kg/m rail on timber sleepers	This section of track caters for traffic with a maximum speed of 25 km/h.	The maximum grade (not compensated for horizontal alignment) that a Down train (westbound) will encounter is 1 in 90 whilst for an Up train (eastbound) the grade is 1 in 96.	Running line: 140 m Balloon loop: 300 m Siding and depots: 140 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
Nogoa to Springsure	This single track railway heads south from Nogoa paralleling the Gregory Highway all the way to Springsure (elevation 325 m). At Gindie (elevation 227 m) the railway runs between the Gregory Highway and Fairbairn Dam. The maximum permissible axle load Nogoa to Wurba Junction is 20 tonnes and Wurba Junction to Springsure is 15.75 tonnes. With the railing of coal from Minerva Mine the section from Nogoa to Wurba Junction is now considered part of the Blackwater System There are four passing loops on this section namely Ballast Siding, Gindie (private track), Fernlees and Springsure. Fencing along this corridor compliments adjacent land usage and will be maintained at its current standard.	Track structure is a mix of 41 and 47 kg/m rail on timber sleepers	The maximum allowable speed is 60 km/h to the Wurba Junction and 40 km/h past the Wurba Junction.	The maximum grade (not compensated for horizontal alignment) that both the Up train (northbound) and Down trains (southbound) will encounter is 1 in 33 (Sandhurst Creek).	Running line: 150 m Minimum nominal horizontal radius for new track or upgrade existing tracks is as follows: Running line: 2170 m 160 km/h running 1662 m 140 km/h running 1221 m 120 km/h running 848 m 100 km/h running 542 m 80 km/h running Balloon loop: 300 m minimum radius Siding and depot: 140 m

6.6 Blackwater System - Scope

6.6.1 Specific Maintenance Requirements

Table 38: Blackwater system specific maintenance requirements

Activity	FY14	FY15	FY16	FY/17
Net Tonnes (m)	54.4	60.9	67.4	73.4
Ballast Cleaning Per cubic metre Per km				
Mechanised Resurfacing – Mainline (km)				
Mechanised Resurfacing – Turnouts (T/O)				
Grinding – Mainline (km)				
Grinding – Turnouts (T/O)				

6.7 Blackwater System – Cost

Table 39: Blackwater System cost breakdown

Maintenance Discipline	FY14 ($m)	FY15 ($m)	FY16 ($m)	FY17 ($m)
Mechanised Maintenance				
Ballast undercutting	$21.551	$25.365	$26.849	$27.566
Resurfacing	$ 8.978	$ 9.028	$10.048	$10.216
Rail Grinding	$ 5.233	$ 5.646	$ 6.063	$ 6.368
General Track Maintenance	$17.997	$19.384	$20.485	$21.409
Re-railing	$ 7.176	$ 8.097	$ 9.911	$ 5.974
Structures	$ 1.102	$ 1.167	$ 1.231	$ 1.288
Signalling	$ 9.235	$ 9.643	$10.013	$10.345
Traction Power	$ 3.495	$ 3.516	$ 3.517	$ 3.518
Total Cost	$74.767	$81.846	$88.117	$86.684
% of Total Cost *	39.5%	40.0%	41.9%	40.5%

** The above excludes system-wide telecommunication costs*

7. GOONYELLA SYSTEM PLAN AND COSTS

7.1 Goonyella System General Information

7.1.1 Goonyella System Overview

The Goonyella system is located in Central Queensland, and services the Bowen Basin coal region. It carries coal to the Hay Point Coal Terminal, the Dalrymple Bay Coal Terminal and the About Point Coal Terminal, as well as transporting products to other destinations by way of connections to the North Coast Line at Yukan and the Central Line via Gregory to Burngrove. The Goonyella Coal Chain services a number of mines and domestic users.

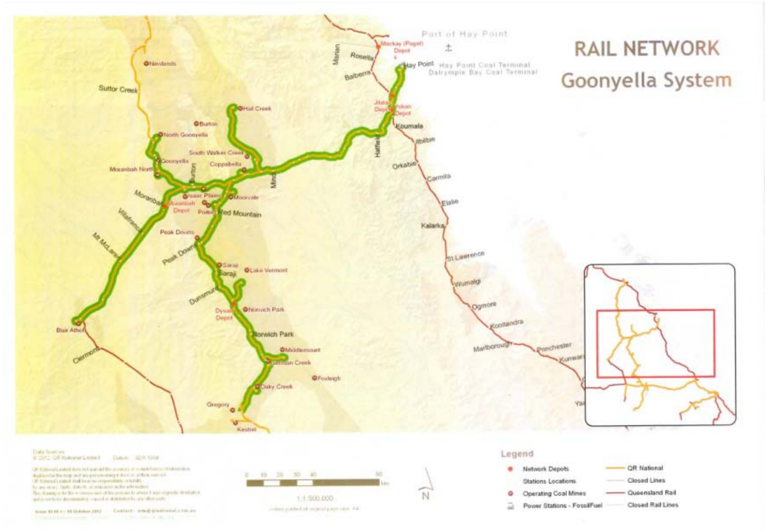

Figure 52: Goonyella coal system map

The Goonyella system comprises approximately 978 km of track, all of which is electrified by an autotransformer system with the overhead line equipment operating at 25 000 volts, 50 Hertz alternating supply. The track is bi-directional duplicated track between Dalrymple Junction and Wotonga, with the remainder being single line. There is also a single line connection from Oaky Creek to Gregory linking the Goonyella System with the Blackwater System. Triple unloading balloons are located at Dalrymple Bay, Dual unloading balloon at Hay Point, and other balloon loops located at Goonyella, Riverside, North Goonyella, Moorvale, Millennium, Carborough Downs and Isaac Plains. The supporting yards are located at Coppabella and Jilalan. The yards of Coppabella and Jilalan are used for provisioning of train services.

Purposefully built as an S Class line to transport coal, the Goonyella system was constructed in the late 1960's, with later stages added in the 1980's (including electrification). It was, however, built to cater to a maximum of 15 tonne axle loads. It now carries over 100 million tonnes of product a year on 26.5 tonne axle loads to the Hay Point Coal Terminal, the Dalrymple Bay Coal Terminal and the About Point Coal Terminal, as well as transporting products to other destinations by way of connections to the North Coast Line at Yukan and the Central Line via Gregory to Burngrove.

One of the major challenges of the Goonyella system is the terrain in some areas. To ensure safety of the users and longevity of the line the East of Coppabella loaded trains are constrained by the descent down the Connors range at Black mountain. This has been the site of a major derailment in 2001 and operational constraints are in place to mitigate the risk of future incidents.

7.2 Current Asset Condition

A key indicator of the networks performance is the Below Rail Transit Time (BRTT) and is provided for in all Access Agreements. The BRTT for the Goonyella System is:

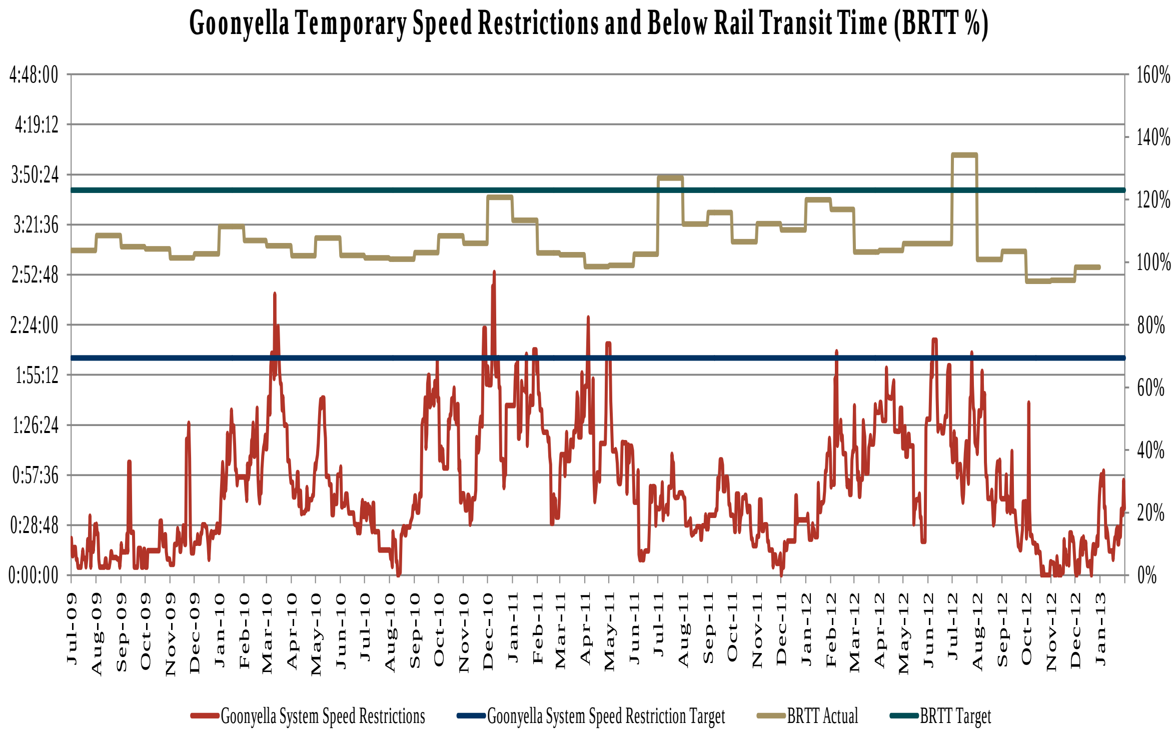

Figure 53: Goonyella System BRTT up to Jan 2013

In addition to the above measure Aurizon Network also provides the QCA with the Overall Track Condition Index. A copy of the Goonyella System OTCI as below:

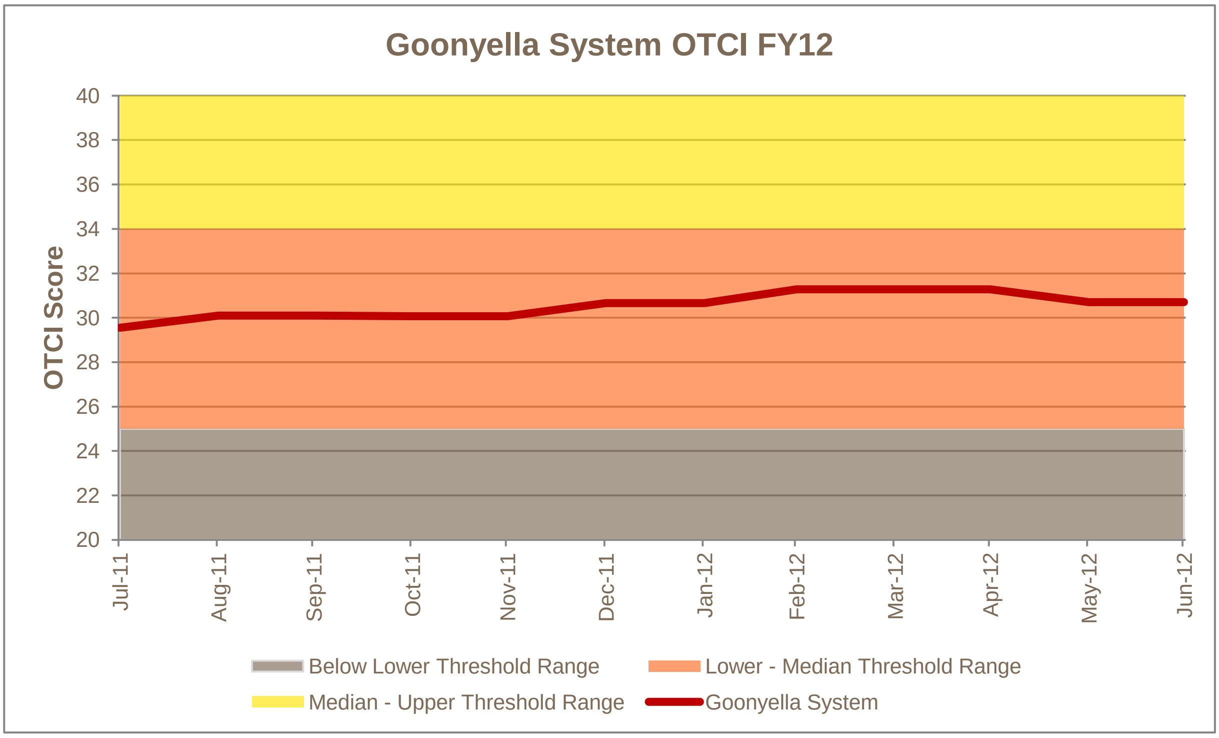

Figure 54: Goonyella System OTCI FY12

7.3 Maintenance Challenges

The maintenance budget for Goonyella represents approximately 41%of the entire CQCN allowance. In addition to coal product fouling and ballast maintenance works, which affects all systems on the CQCN, there are a variety of specific maintenance challenges across the Goonyella system. These include:

> Track stress

> Overhead line and level crossing issues

> Corrosion

> Weather

> Safety

> Environmental considerations

> Incident response and remote location.

7.3.1 Track Stress

Overall, general wear rates of the track on this system are higher than standard railways due to the following elements:

> Narrow gauge line - More forces are applied to a smaller area on the track, putting additional pressure on these areas. This requires unique maintenance requirements, and smaller timeframes between maintenance efforts

> Curvature – The original track alignment of the system included a large number of short tight curves as the original design requirements were to cater for smaller, lighter wagons.

Consequently on the Goonyella system, approximately 52% of the track is curved. The table below shows the number and length of curves categorised by the curve radius. This highlights the amount of curved track that exists and the extent of rail wear monitoring and management that is required to be undertaken. Note that rail on the curves on the main trunk route from Coppabella to the two ports experiences the most wear.

Table 40: Curve Details - Goonyella System

Curve Radius	No. of Curves	Total Curve Length (m)
> 160 and ≤ 212	19	4764
> 212 and ≤ 305	91	38289
> 305 and ≤ 415	33	7811
> 415 and ≤ 542	76	21338
> 542 and ≤ 848	138	49535
> 848 and ≤ 1000	49	15692
> 1000	216	117762
Total	622	255191
Total Curved Rail Length		510.382 km

> Gradients - Similarly to Curvature, the size and weights of the wagons cause track stress with momentum, pushing the track forward, particularly in the downward motion. This is managed by applying ruling grade restrictions in the effected parts of the Goonyella network (mainly in the Ranges)

- Increased tonnages travelling the line – Over the last 25 years the carried tonnages on the line have increased, meaning more traffic and heavier loads are using the track, putting additional pressure on and increasing track wear. The table below details those increases in 5 year increments:

Table 41: Goonyella system tonnage increases

Goonyella	1993	1998	2002	2007	2012
Tonnages (Million Net Tonnes)	42.302	50.951	71.188	86.965	84.031

7.3.2 Overhead Line and Level Crossing

With the large areas of electrification on the network, there is risk of damage to overhead line. The most common incidents requiring corrective maintenance include:

- Bird strikes on the overhead, short circuiting the line. Similarly, several outages are caused by snakes hunting bird's nests
- Mining equipment travelling through level crossings without consideration for the height of the equipment arms or aerials which can de-wire, or damage the overhead lines.

Any de-wirements or circuit issues can take a great deal of time to restore services, due to the safety procedures and site isolations that need to occur before maintenance can be undertaken.

7.3.3 Weather Challenges

Due to the location and geography of the Goonyella system, it experiences weather conditions that can affect the delivery of services, and also have a high impact on the maintenance budget, due to the damage caused over these extreme weather periods.

Speed restrictions are in place in extreme heat conditions (as detailed in Section 1.6.2) which the Goonyella system does experience as the line travels inland.

Rainfall and Flooding

Highest rainfall occurs on the seaward side of the Great Dividing Range. However, at times in summer, the inland extension of low-level moist airflow, combined with intense surface heating, produces significant thunderstorm activity.

Flooding of low lying areas is likely to occur during these periods of extreme rainfall, and the Goonyella System is closed on average for 2 days every 3 years due to flooding.

During periods of prolonged rainfall it may be necessary to halt trains to permit checking of the Hatfield Range section. Over the last 10 years a closure of 7 days duration has been necessary to repair slips on the Hatfield Range that occurred as a consequence of sustained rainfall. To assist in monitoring the Hatfield Range, pulsimeters have been strategically in various locations to allow Infrastructure Managers and Train Controllers to monitor rainfall. Another monitoring station is planned for installation through a capital project to assist with flood monitoring.

7.3.4 Safety on the Goonyella System

The Goonyella system has quite unique safety requirements, which include:

- Electrification issues
- Rock fall and track slip dangers
- Extreme gradient issues when trains travel down the Ranges.'

Electrification

Because of the electrification of this system, the main safety risks are electrical, and as such it requires much more of a maintenance effort and possession time than any other activity.

This is because of the time it takes to isolate a site which includes ensuring specialist personnel are on site to manage this critical safety aspect. Isolating sites also need to occur for general maintenance activities such as lifting for turnouts, so there is no altercation with the overhead line.

Other safety aspects which are required to be adhered to in this area relate to the duplicated track. There is no work to be done within 3 metres of a live track. In situations where there are 2 tracks within 4 metres of each other, and maintenance is required on one of those tracks, both needs to be shut and isolated to complete the works, which can affect service for operators.

Rock fall and track slip dangers

As mentioned in the previous section, the weather systems that travel across the Goonyella network can impact land stability leading to rock fall incidents, and track slips. Goonyella has monitoring equipment and rock fall sensors established within the ranges to assist in mitigating these safety threats.

Extreme gradient issues

Because of the steep gradient in some areas of the Connors range. Aurizon Network has put specific protocols and speed restrictions in place to avoid the chances of a ‘runaway train’ or derailment occurring. This is also required to assist in limiting the stress on the track of sudden and intensive braking.

7.3.5 Incident Response and Remote Location Challenges

Based on history and experience, it is anticipated that a minor incident on the Goonyella System could result in disruption to services for 6 hours and a major incident for 2 days. Incident recovery is dependent on the nature, severity and location of each unique incident that may occur on this system.

One of the challenges of the Goonyella system is that many of its areas are remote, without the benefit of having advanced roading systems or highways following the line. Maintenance teams need to use dirt access roads and pathways to get to the track.

This creates challenges for any specialist large plant requirements on site, and in some cases, a pathway needs to be constructed to get the machinery in safely.

Accommodation

Travelling to the more remote locations can often mean accommodation is required for Aurizon Network’s maintenance teams. The challenges generally found when looking for accommodation are that they are in a mining area, which has limited accommodation options due to many options being at capacity, or because of the demand for accommodation there, substantial expense is incurred. Rooms, if available, can cost up to $250 per night.

7.4 Maintenance and Operational System information

7.4.1 Track possessions and closures process specific to the Goonyella System

In addition to the general possessions and track closure process that is relevant for the entire CQCN, Goonyella has some specific planning guidelines that should be used when planning possessions outside of the nominated closure times.

Table 42: Goonyella possession planning guidelines

Access	Comments
Duplicate Track – HPCT and DBCT to Wotonga	
Single section closures	Acceptable. If adjacent to Coppabella or Jilalan yard, ensure that the closure doesn't impact on yard operations. Consideration should also be given to the location, duration and frequency of closures. Track Closures between Hatfield and the Ports (high impact areas) should be limited to 10 hours duration and not scheduled on consecutive days.
Dual section closure (consecutive sections0	Not recommended due to the impact on network capacity. Preferred scheduling should align with System Maintenance Days or during periods of reduced demand.
2 separate closures	Not recommended outside maintenance days If required ensure a minimum of 3 sections separation between closures and that Overhead Traction feeding arrangement don't compromise network capacity. If the closure involves any protection on adjacent track, a minimum of 5 section separation is required between closures. Hatfield or Waitara should be used as a point of separation.
Waitara to Braeside closures	If OH isolation is required, ensure the Waitara up or down road is also included in possession bid geography. When either the up or down sections are required, a closure, a closure on the relevant up or down road to Waitara yard will also be required. The middle road is not to be taken at the same time.
Black Mt. – Hatfield Closures	If overhead isolation is required ensure the Hatfield up or down road is also included in possession bid geography. When either the up or down sections are required, a closure on the relevant up or down road in the Hatfield yard will also be required. The middle road is not to be taken at the same time.
Note: The location of the worksite in relation to the Coal terminals is relative to the impact on capacity – the closer to the terminals the greater the potential impact.	
Single Line Sections: Coppabella to Gregory, Broadlea to Blair Athol and North Goonyella	
Coppabella to Gregory	• Ensure no closures are scheduled on the Coppabella to Blair Athol / North Goonyella leg • Minimum 3 months notification for any closures outside maintenance days • To reduce the impact on capacity, closure duration should be kept to a minimum for worksites between Peak Downs and Gregory • Track closures between Coppabella and Peak Downs should be scheduled to align with the System Maintenance Day (4 to 6 hour closures may be available with 21 day lead time and flexible start times • Closure duration should not exceed 10 hours.
Coppabella to Blair Athol / North Goonyella	• Ensure no closures are scheduled on the Coppabella to Gregory leg • Minimum 3 months notification for any closures outside maintenance days • Dual track closures between Coppabella and Wotonga should be scheduled to align with the System Maintenance Days • Track Closures on the Wotonga to North Goonyella Branch should be scheduled outside of Blair Athol Train Load-out (TLO) maintenance days • Isolations and Closures between Wotonga and Blair Athol should align with Blair Athol TLO maintenance days.

7.4.2 Trackside Detection Equipment:

Dragging Equipment Detectors (DED)

Dragging equipment detectors are placed at strategic locations along the route to give early warning of rolling stock defects and minimise the effect of any derailment incident.

Operators are required to stop immediately if advised of a dragging equipment detection by the train controller. Locations are detailed in Table 43 below.

Table 43: Goonyella system Dragging Equipment Detector locations

Locations		
Hay Point Balloon 2 tracks 4.240 km 1 track Dalrymple Bay Balloon (0.047 km) 3 tracks Coppabella - Gregory 5. 550km - 2 tracks 16.400 km - 1 track 17.100 km - 1 track 28.500 km - 1 track 42.102 km - 1 track 53.021 km - 1 track 67.560 km - 1 track 77.280 km - 1 track 78.400 km - 1 track 88.097 km - 1 track 91.976 km - 1 track 115.400 km - 1 track 138.000 km - 1 track 47.087 km - 1 track (Peak Downs Balloon) 68.159 km - 1 track (Saraji Balloon) 111.231 km - 1 track (Norwich Prk Balloon) 134.327 km - 1 track (German Crk Balloon)	Praguelands - Coppabella - North Goonyella 10.648 km - 2 tracks 16.680 km - 2 tracks 27.707 km - 2 tracks 35.725 km - 2 tracks 44.595 km - 2 tracks 54.874 km - 2 tracks 66.570 km - 2 tracks 81.760 km - 2 tracks 92.422 km - 2 tracks 104.325km- 2 tracks 114.496 km - 2 tracks 126.648 km - 2 tracks 130.668 km - 2 tracks 135.360 km - 2 tracks 139.365 km - 2 tracks 154.184 km - 2 tracks 160.735 km - 1 track 184.838 km - 1 track 197.738 km - 1 track 207.000 km - 1 track 5.056 km - 1 track (Mrnbh North Balloon) 198.323 km - 1 track (Goonyella Balloon) 203.560 km - 1 track (Riverside Balloon) 217.221 km - 1 track (North Gnylla Balloon)	Wotonga - Blair Athol 8.562 km - 1 track 28.715 km - 1 track 45.000 km - 1 track 55.550 km - 1 track 65.962 km - 1 track 76.458 km - 1 track 94.490 km - 1 track 108.300 km - 1 track

Hot Box / Hot Wheel Detectors (HBD/HWD)

Hot Box / Hot Wheel Detectors are located at the following locations:

Hay Point - North Goonyella	Coppabella - Gregory Junction	Wotonga - Blair Athol Mine
33.987 km - 2 tracks (HWD) 76.780 km - 2 tracks (HBD) 123.027 km - 2 tracks (HBD/HWD) 150.620 km - 2 tracks (HBD/HWD) 173.837 km - 1 track (HBD)	5.227 km - 1 track (HBD/HWD) 30.017 km - 1 track (HBD) 53.040 km - 1 track (HBD) 94.200 km - 1 track (HBD) 115.400 km - 1 track (HBD)	44.567 km - 1 track (HBD) 76.400 km - 1 track (HBD)

Wheel Impact Detectors

Flat wheel detection equipment operates on the Goonyella Line west of Waitara at 102.324 km.

7.4.3 Weighbridges

In general weighbridges are located on balloon loop immediately after the loadout station for the purpose of overload detection.

On the Goonyella System weighbridges are located at:

- North Goonyella
- Goonyella
- Riverside
- Burton
- Blair Athol Mine
- Peak Downs
- Saraji
- Norwich Park
- German Creek
- Oaky Creek
- Hail Creek
- South Walker
- Macarthur
- Moranbah North
- Moorvale
- Carborough Downs
- Isaac Plains
- Millennium
- Lake Vermont.

The maximum permitted speed of trains over weigh-in-motion weighbridges is 10 km/h.

7.4.4 Operational Systems and Train Control

The Goonyella system is operated by Remote Control Signalling (RCS), with train movements controlled from Rockhampton.

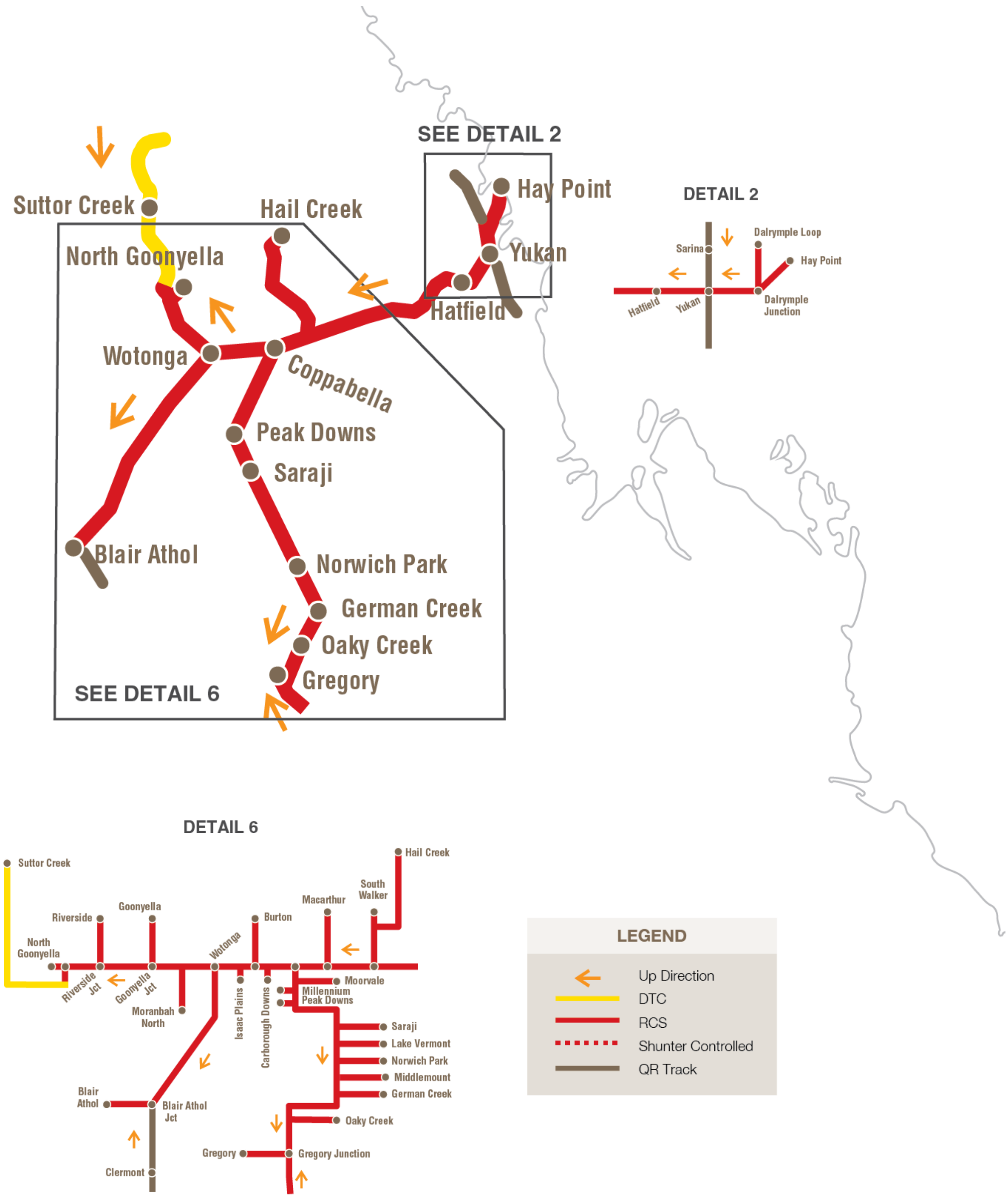

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Figure 55: Train control systems for the Goonyella System

7.4.5 Communications

Communications on the Goonyella System between Driver and Controller is via a UHF radio system (Train Control Radio - TCR) utilising a number of Aurizon Network channels and frequencies. Transceivers “auto” switch the channels to suit geographical location. Frequency specification and coverage details are available as part of the “Access Enquiry Process”.

In addition, all current locomotives (including Multiple Units and Miscellaneous Vehicles such as Rail Motors) carry, and all units new to the system will be required to carry, a UHF radio operating on QR Channel 1. This provides on-board and wayside communications including end to end, train to train and train to track gangs over a distance on average of 8 - 10 km.

For Goonyella telecommunications detail, see Figure 51: Goonyella/Blackwater system telecommunications schematic diagram in Section 6.

7.5 Specific Point to Point Details

The track (1067 mm gauge) on the main trunk route from Hay Point to North Goonyella is generally 60 kg/m rail with concrete sleepers, with the rest of the rail on the Goonyella System being a mix of 60 kg/m, 53 kg/m, and 47 kg/m, also all on concrete sleepers. The rails are continuously welded except where glued insulated joints are used for train detection using track circuits. Generally, the maximum permissible axle load is 26.5 tonnes, unless stated otherwise in the below table.

Details on the full extent of the Goonyella system are described in the table below:

Table 44: Goonyella system point to point details

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
Hay Point to Coppabella (114.5 km)	This section comprises uploading balloon loops at Hay Point and Dalrymple Bay, connecting via single track to double track crossovers at 7.875 km, a distance of 4.438 km, then bi-directional double track to Coppabella. There is a balloon loop at MacArthur (137.216km) and a spur at 127.475km that connects to South Walker Balloon Loop as well as Hail Creek Balloon Loop, all feed into the Goonyella System on this section. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (40 %) and medium to good (60 %).	53 kg/m and 60 kg/m rail on concrete sleepers	The maximum speed for trains between the balloon loops at Hay Point / Dalrymple bay and Dalrymple Junction is 60 km/h. The section of track from Dalrymple Junction to Coppabella has a maximum speed of 80 km/h for block trains (26.5 tal) and 100 km/h for freight trains (20 tal). The speed of loaded trains heading towards Yukan on either track is restricted to 40 km/h between 45.701 km and 36.219 km (Hatfield Range).	The maximum grade (not compensated for horizontal alignment) that an Up train - (westbound) will encounter is 1 in 45 (43 km) whilst for a Down train (eastbound) is 1 in 66 (26km).	Running line: 300 m Balloon loop 200 m Siding and depots: 140 m
Dalrymple Bay	This section comprises three balloon loops at Dalrymple Bay, connecting via double track crossovers at 8.215 km	53 kg/m and 60 kg/m rail on concrete	This section of track caters for block trains with a maximum speed of 60	The maximum grade (not compensated for horizontal alignment) that a Down train	Running line: 427 m Balloon loop 280 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
	(Dalrymple Junction) on the Hay Point to Coppabella corridor, then joining bi-directional double track to Coppabella. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (40 %) and medium to good (60 %).	sleepers	km/h in the balloon loops and 80km/hr on exit side to Dalrymple Junction.	(eastbound) will encounter is 1 in 150 whilst for an Up train (westbound) is 1 in 302.	Siding and depots: 140 m
South Walker Creek Branch (11.1 km)	This 11.1 km spur and balloon loop has its junction with the Goonyella Line at 127.475 km. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (40 %) and medium to good (60 %).	60 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 80 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train (northbound) will encounter is 1 in 66 (6.8 km) whilst for a Down train (southbound) is 1 in 105 (5 km).	Running line: 550 m Balloon loop 300 m Siding and depots: 140 m
Hail Creek Branch (46.7 km)	This 46.7 km spur and balloon loop has its junction with the South Walker spur at 6.326 km (Bidgerley Junction). Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (40 %) and medium to good (60 %).	60 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 80 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train (northbound) will encounter is 1 in 100 (10 km & 33 km) whilst for a Down train (southbound) is 1 in 125 (35 km).	Running line: 850 m Balloon loop 300 m Siding and depots: 140 m
MacArthur Balloon Loop (5.1 km)	This balloon loop has its junction with the Goonyella line at 137.216 km. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (40 %) and medium to good (60 %).	60 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 50 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train (northbound) will encounter is 1 in 83 whilst a Down train (southbound) will encounter falling grades to the Goonyella Line.	Running line: 300 m Balloon loop 300 m Siding and depots: 140 m
Coppabel	The bi-directional double track from east	Track	This section of track	The maximum grade (not	Running line: 498 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
la to North Goonyella (72.7 km)	of Coppabella extends beyond Coppabella to Wotonga at 174.024 km, then reverts to single track and continues to the North Goonyella balloon loop at 213.754 km. There are balloon loops at Burton Coal, Carborough Downs, Isaac Plains, Moranbah North, Goonyella, Riverside and North Goonyella. The Blair Athol Mine railway junctions at Wotonga. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (80 %) and medium to good (20 %).	structure is predominantly 60 kg/m with 53 kg/m rail on concrete sleepers with some 47 kg/m rail on concrete sleepers.	caters for block trains with a maximum speed of 80 km/h.	compensated for horizontal alignment) that an Up train (westbound) will encounter is 1 in 56 (173 km) whilst for a Down train (eastbound) the grade is 1 in 95 (153 km).	Balloon loop 300 m Siding and depots: 140 m
Burton Balloon Loop (5.0 km)	This balloon loop has its junction with the Goonyella Line at 168.280 km and consists of a single track balloon loop. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (80 %) and medium to good (20 %).	53 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 50 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train (northbound) will encounter is 1 in 227 whilst for a Down train (southbound) the grades are falling to the Goonyella Line.	Running line: 300 m Balloon loop 300 m Siding and depots: 140 m
Moranbah North Balloon Loop	This balloon loop has its junction with the Goonyella Line at 192.193 km and consists of a single track balloon loop. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (80 %) and medium to good (20 %).	60 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 50 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up (westbound) train will encounter is 1 in 161 whilst for a Down train (eastbound) the maximum grade is 1 in 301.	Running line: 300 m Balloon loop 300 m Siding and depots: 140 m
Goonyella Balloon	The bi-directional double track from east of Coppabella extends beyond	Track structure is	This section of track caters for block trains with	The maximum grade (not compensated for horizontal	Running line: 498 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
	Coppabella to Wotonga at 174.024 km, then reverts to single track and continues to the North Goonyella balloon loop at 213.754 km. There are balloon loops at Burton Coal, Carborough Downs, Isaac Plains, Moranbah North, Goonyella, Riverside and North Goonyella. The Blair Athol Mine railway junctions at Wotonga. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (80 %) and medium to good (20 %).	predominantly 60 kg/m with 53 kg/m rail on concrete sleepers with some 47 kg/m rail on concrete sleepers.	a maximum speed of 80 km/h.	alignment) that an Up train (westbound) will encounter is 1 in 56 (173 km) whilst for a Down train (eastbound) the grade is 1 in 95 (153 km).	Balloon loop 300 m Siding and depots: 140 m
Riverside Balloon (7.4 km)	This balloon loop shares section of the Goonyella Line between 197.784 km and 200.629 km with traffic from Goonyella North and consists of a single track balloon loop. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (80 %) and medium to good (20 %).	Track structure is predominantly 47 kg/m rail on concrete sleepers with some 53 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 50 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train (westbound) will encounter is 1 in 333 whilst for a Down train (eastbound) the grades are falling to the Goonyella Line.	Running line: 800 m Balloon loop 300 m Siding and depots: 140 m
Wotonga to Blair Athol Mine (108.2 km)	This 108.2 km spur junctions with the Goonyella Line at Wotonga (173.903 km) and terminates in a balloon loop at Blair Athol Mine. A junction at 103.596 km connects this railway to Clermont and Emerald. The maximum permissible axle loading is 26.5 tonnes for block trains and 20 tonnes for freight trains. Fencing along this corridor complements	53 kg/m rail on concrete sleepers.	This section of track caters for a maximum speed of 100 km/h and 80 km/hr for 26.5 tal.	The maximum grade (not compensated for horizontal alignment) that a Down train (northbound) will encounter is 1 in 100 (43km) whilst for an Up train (southbound) the maximum grade is 1 in 50 (20km).	Running line: 1500 m Balloon loop 400 m Siding and depots: 140 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
	adjacent land usage and is maintained at the following standard, poor (80 %) and medium to good (20 %).				
Coppabella to Gregory Junction (164.8 km)	This 164.8 km connection joins the Goonyella System at Coppabella (145.551 km) with the Blackwater System at 60.978 km on the Gregory Line and includes balloon loops at Moorvale, Peak Downs, Saraji, Millennium, Lake Vermont Norwich Park, German Creek and Oaky Creek. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (80 %) and medium to good (20 %).	60 kg/m rail on concrete sleepers with the exception of Peak Downs to Saraji which is 53 kg/m rail on concrete	This section of track caters for a maximum speed of 80 km/h for block trains and 100 km/h for freight trains.	The maximum grade (not compensated for horizontal alignment) that a Down train (northbound) travelling between Oaky Creek and Coppabella will encounter is 1 in 100 whilst for an Up train (southbound) the maximum grade is 1 in 50. The maximum grade (not compensated for horizontal alignment) that a southbound train travelling between Oaky Creek and Gregory Junction will encounter is 1 in 86 whilst for a northbound train the maximum grade is 1 in 99	Coppabella to Oaky Creek: Running line: 402 m Siding and depots: 140 m Oaky Creek to Gregory Junction: Running line: 1200 m Siding and depots: 140 m
Moorvale Branch (6.1km)	This 6.1 km spur and balloon loop has its junction with the Coppabella to Saraji section at 8.375 km. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, good (100 %).	60 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 80 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train (southbound) will encounter is 1 in 259 whilst for a Down train (northbound) is 1 in 183.	Running line: 550 m Balloon loop 300 m Siding and depots: 140 m
Millennium Balloon (4.9 km)	This balloon loop has its junction with the Coppabella to Saraji section at 16.533 km. Fencing along this corridor complements adjacent land usage and is maintained at	60 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 50 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up and down train will encounter is 1 in 85.	Running line: 550 m Balloon loop 300 m Siding and depots: 300 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
	the following standard, poor (80 %) and medium to good (20 %).				
Peak Downs Balloon (5.6 km)	This single track balloon loop has its junction with the Coppabella to Oaky Creek Line at 43.652 km. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (80 %) and medium to good (20 %).	47 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 25 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train will encounter is 1 in 86 whilst for a Down train the grades are falling to the Coppabella Oaky Creek Line.	Running line: 300 m Balloon loop 200 m Siding and depots: 140 m
Saraji Balloon (5.5 km)	This single track balloon loop has its junction with the Coppabella to Oaky Creek Line at 64.798 km. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (80 %) and medium to good (20 %).	47 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 25 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train will encounter is 1 in 194 whilst for a Down train the grades are falling to the Coppabella Oaky Creek Line.	Balloon loop 200 m Siding and depots: 140 m
Lake Vermont (16.4 km)	This single track balloon loop connects to the Coppabella to Oaky Creek Line via an angle at the 85.698 km and 87.017 km. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, medium (25 %) and good (75 %).	60 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 60 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train will encounter is 1 in 114 whilst for a Down train the grade is 1 in 110.	Running line: 550 m Balloon loop 300 m Siding and depots: 300 m
Norwich Park Balloon (4.4 km)	This single track balloon loop has its junction with the Coppabella to Oaky Creek Line at 108.024 km. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (80 %) and	47 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 25 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train will encounter is 1 in 83 whilst for a Down train the grades are falling to the	Balloon loop 300 m Siding and depots: 140 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
	medium to good (20 %).			Coppabella Oaky Creek Line.	
German Creek Balloon (6.7 km)	This single track balloon loop has its junction with the Coppabella to Oaky Creek Line at 129.695 km. This balloon loop has a southern connection, radius 270 m that permits trains from German Creek to travel south to Gregory Junction which is the connection with the Blackwater System. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (80 %) and medium to good (20 %).	47 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 25 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train will encounter is 1 in 272 whilst for a Down train the grade is 1 in 145.	Running line: 700 m Balloon loop 300 m Siding and depots: 300 m
Oaky Creek Balloon (6.1 km)	This single track balloon loop has its junction with the Coppabella to Oaky Creek Line at 148.824 km. This balloon loop has a southern connection, radius 230 m that permits trains from Oaky Creek to travel south to Gregory Junction which is the connection with the Blackwater System Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (80 %) and medium to good (20 %).	47 kg/m rail on concrete sleepers.	This section of track caters for block trains with a maximum speed of 50 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train will encounter is 1 in 301 whilst for a Down train the grade is 1 in 158.	Running line: 1000 m Balloon loop 300 m Siding and depots: 140 m Minimum nominal horizontal radius for new or upgrade works is as follows: running line 2170 m 160 km/h running 1662 m 140 km/h running 1221 m 120 km/h running 848 m 100 km/h running 542 m 80 km/h running Balloon loop 300 m minimum radius Siding and depot 300 m minimum radius

7.6 Goonyella System - Scope

7.6.1 Specific Maintenance Requirements

Table 45: Goonyella system specific maintenance requirements

Activity	FY14	FY15	FY16	FY/17
Net Tonnes (m)	97.3	106.4	112.0	116.9
Ballast Cleaning Per cubic metres Per km				
Mechanised Resurfacing – Mainline (km)				
Mechanised Resurfacing – Turnouts (T/O)				
Grinding – Mainline (km)				
Grinding – Turnouts (T/O)				

7.7 Goonyella System – Cost

Table 46: Goonyella System cost breakdown

Maintenance Discipline	FY14 ($m)	FY15 ($m)	FY16 ($m)	FY17 ($m)
Mechanised Maintenance Ballast undercutting Resurfacing Rail Grinding	 $24.091 $ 6.987 $ 5.223	 $27.970 $ 6.948 $ 5.571	 $27.882 $ 7.594 $ 5.669	 $27.429 $ 7.434 $ 5.714
General Track Maintenance	$18.534	$19.554	$19.912	$20.070
Re-railing	$ 6.234	$ 5.146	$ 5.100	$ 9.448
Structures	$ 0.596	$ 0.603	$ 0.607	$ 0.610
Signalling	$ 10.045	$10.355	$10.463	$10.527
Traction Power	$ 6.061	$ 6.082	$ 6.081	$ 6.078
Total Cost	$77.771	$82.229	$83.308	$87.310
% of Total Cost *	41.0%	40.3%	39.6%	40.8%

- ** The above excludes system-wide telecommunication costs*

8. MOURA SYSTEM PLAN AND COSTS

8.1 Moura System General Information

Moura System Overview

The Moura line was the first purpose built coal line in Queensland, opening in 1968. The Moura system includes 260 kilometres of track and services industrial and rural communities of the Dawson and Callide Valleys.

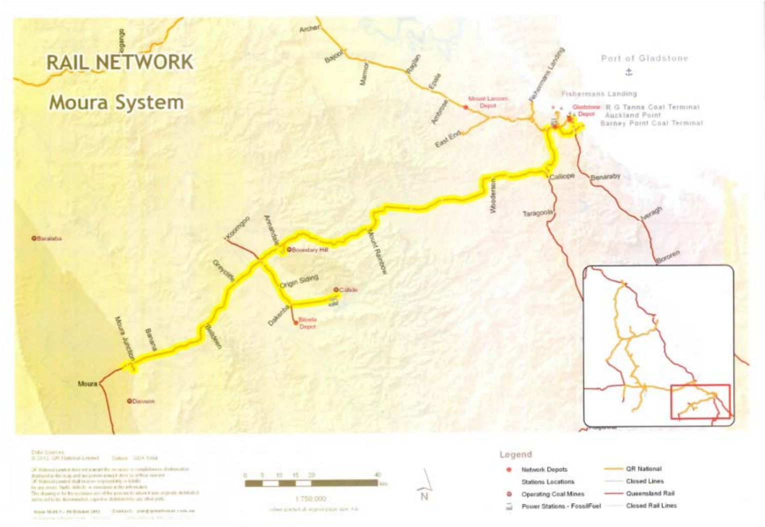

Figure 56: The Moura System

The Moura system is coupled with the Blackwater system to form the Capricornia Coal Chain. It is located in Central Queensland, south west of Gladstone. The system services the industrial and rural communities of the Dawson and Callide Valleys in Central Queensland. The system's coal is transported to Gladstone Power Stations, Yarwun Refinery (Rio Tinto Alcan), Queensland Alumina Limited (QAL) and Cement Australia and the RG Tanna and Barney Point coal terminals at the Port of Gladstone. There are a number of mines and domestic users for the Moura system.

The Moura system consists of 260 km of track servicing four mines operated by Anglo Coal, hauling product to export facilities at R G Tanna Terminal, Auckland Point and Barney Point or to intrastate destinations via the North Coast Line. It connects to the Blackwater system at Callemondah to form the Capricornia Coal Chain.

All trains are hauled by diesel locomotives over single line sections with balloon loops at Boundary Hill, Callide Coalfields, and Dawson Mine. Trains destined for the RG Tanna Coal Terminal or the Gladstone Power Station travel via the Byellee flyover through Callemondah Yard, and into the Blackwater system. Trains destined for the Yarwun Refinery (Rio Tinto Alcan), Barney Point Coal Terminal, and Queensland Alumina Limited (Gladstone) bypass Callemondah to the north and south en route to their destinations.

8.2 Current Asset Condition

A key indicator of the networks performance is the Below Rail Transit Time (BRTT) and is provided for in all Access Agreements. The BRTT for the Moura System is:

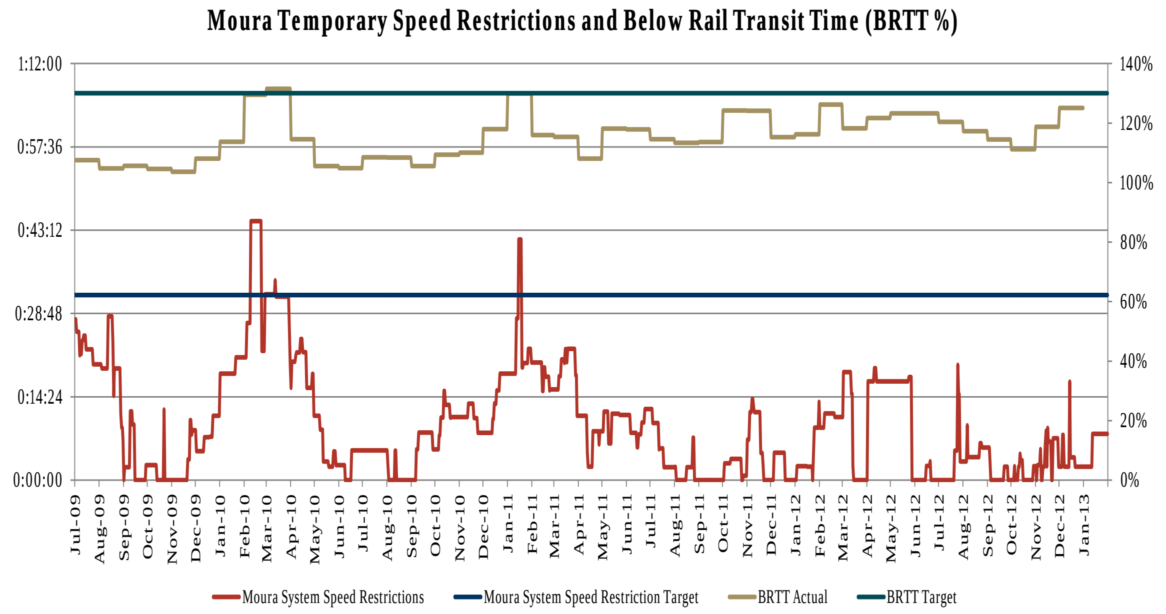

Figure 57: Moura System BRTT up to Jan 2013

In addition to the above measure Aurizon Network also provides the QCA with the Overall Track Condition Index. A copy of the Moura System OTCI as below:

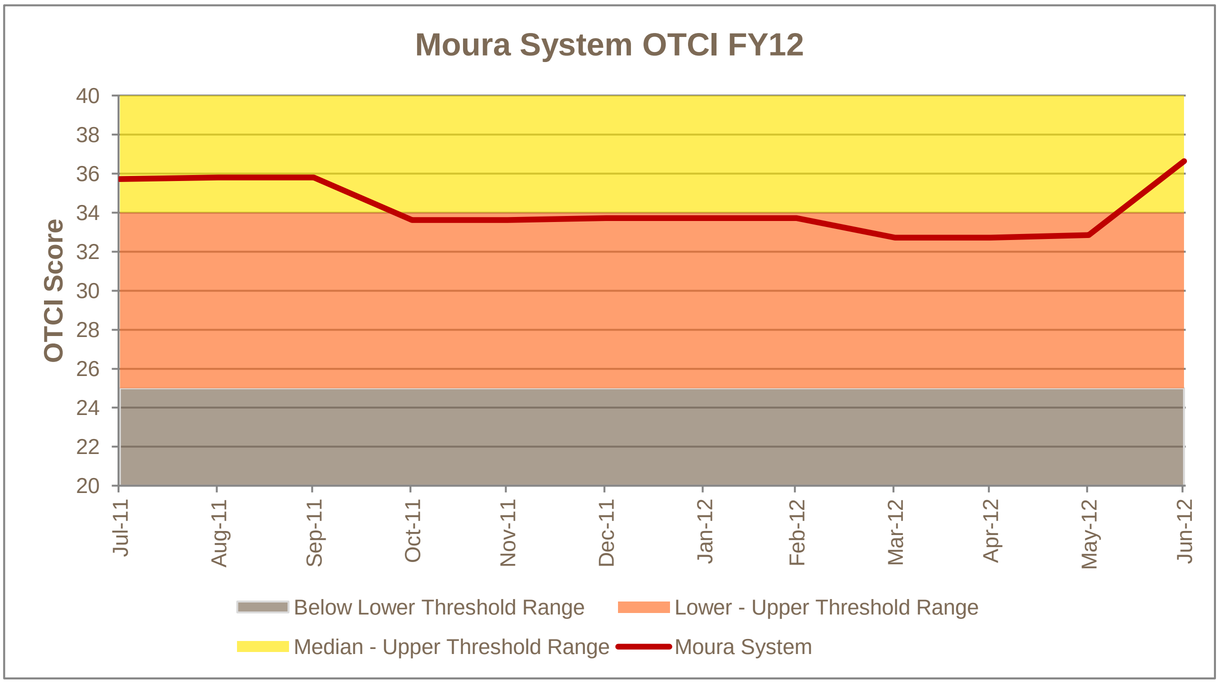

Figure 58: Moura System OTCI FY12

8.3 Maintenance Challenges

The maintenance budget for Moura represents approximately 6% of the entire CQCN allowance. In addition to coal product fouling and ballast maintenance works, which affects all systems on the CQCN, there are a variety of specific maintenance challenges across the Moura system. These include:

> Track and bridge stress
> Soil composition
> Overhead line and level crossing issues
> Signalling
> Corrosion
> Weather
> Safety challenges
> Environmental considerations
> Incident response and remote location challenges.

8.3.1 Track and Bridge Stress

Because this line was specifically built for 15 tonne axle loads, the additional traffic and associated weight of the rolling stock now using this line is putting pressure on the structures of this system. Overall, general wear rates of the track on this system are higher than standard railways due to the following elements:

> Narrow gauge line - More forces are applied to a smaller area on the track, putting additional pressure on these areas. This requires unique maintenance requirements, and smaller timeframes between maintenance efforts

> Curvature - Originally the track was built for smaller, lighter wagons. In addition to this, the traffic task and frequency has changed considerably, but the curvature of the track has not, which puts a great deal of pressure on the track as these wagons really require a longer turning radius. Rail grinding is required at twice the frequency on these curves (20MGT for general curves and 10MGT for tight curves), as it is for straight track (40MGT)

The table below shows the number and length of curves categorised by the curve radius. This highlights the amount of curved track that exists and the extent of rail wear monitoring and management that is required to be undertaken.

Table 47: Curve Details - Moura System

Curve Radius	No. of Curves	Total Curve Length (m)
≤ 160	14	1,408
> 160 and ≤ 212	19	2,045
> 212 and ≤ 305	160	31,167
> 305 and ≤ 415	56	16,404
> 415 and ≤ 542	39	12,023
> 542 and ≤ 848	214	52,485
> 848 and ≤ 1000	22	2,527
> 1000	53	12,893
Total	577	130.952km

> Gradients - Similarly to Curvature, the size and weights of the wagons cause track stress with momentum, pushing the track forward, particularly in the downward motion. This is managed by applying ruling grade restrictions in the effected parts of the Goonyella network (mainly in the Ranges)

> Increased tonnages travelling the line – Over the last 25 years the carried tonnages on the line have increased, meaning more traffic and heavier loads are using the track, putting additional pressure on and increasing track wear and bridge stress. The table below details those increases in 5 year increments:

Table 48: Moura system tonnage increases

Moura	1993	1998	2002	2007	2012
Tonnages (Million Net Tonnes)	5.449	7.939	9.756	11.629	12.986

8.3.2 Overhead Line

While the Moura line only has small sections of electrification, there are still some challenges with regards to bird and snake strikes on the overhead, and any soil movement which can cause de-wirements of the rollingstock pantograph. Any de-wirements or circuit issues can take a great deal of time to restore services, due to the safety procedures and site isolations that need to occur before maintenance can be undertaken.

8.3.3 Weather Challenges

Due to the location and geography of the Moura system, it experiences weather conditions that can affect the delivery of services, and also have a high impact on the maintenance budget, due to the damage caused over these extreme weather periods.

Rainfall and Flooding

The main risk that rainfall poses in this region is that the moisture from the rain is unable to drain efficiently. In addition to fairly poor drainage, the vibration of the trains travelling the track causes a hydrostatic reaction, drawing moisture back up through the ballast. In turn it keeps the black soil, or clay, damp, which in turn can cause sinkholes.

8.3.4 Safety on the Moura System

In some aspects of the Moura network, there are dangers with rock falls, particularly after major periods of rainfall. Because it isn't a prolific as Goonyella's rock fall dangers, there are not yet any rock fall sensors on the line, however close maintenance inspections are frequently held to ensure stability in known high risk areas.

8.3.5 Incident Response and Remote Location Challenges

Based on history and experience, it is anticipated that a minor incident on the Moura System could result in disruption to services for up 6 hours and a major incident for 5 days. Incident recovery is dependent on the nature, severity and location of each unique incident that may occur on this system.

While some areas are more remote than others, having Gladstone as a central base assists in quicker response times, and generally allows a time of up to one hour to get to any given site for assessment.

Accommodation

Requiring accommodation is less of a need on the Moura system due to the proximity of Gladstone to the network. In addition, there isn't as many mines on this network, leading to less of a requirement for the provision of accommodation for mine employees, so accommodation prices aren't as expensive on the Moura system as they are on other CQCN systems.

8.4 Maintenance and Operational System information

8.4.1 Track possessions and closures process specific to the Moura System

There are no special requirements for the Moura system, outside of those already described in Section 1.

8.4.2 Trackside Detection Equipment:

Dragging Equipment Detectors (DED)

Dragging equipment detectors are placed at strategic locations along the route to give early warning of rolling stock defects and minimise the effect of any derailment incident.

Operators are required to stop immediately if advised of a dragging equipment detection by the train controller.

Locations are as follows:

Dragging equipment detectors are placed at the following strategic locations along the route to give early warning of rolling stock defects and minimize the effect of any derailment incident:

Moura Short Line - Parana to Byellee:	7.515 km	-	1 track
Moura Junction - Moura Mine:	3.485 km	-	1 track
Graham – Taragoola:	19.400 km	-	1 track
Annandale - Boundary Hill:	3.730 km	-	1 track
Earlsfield - Callide Mine:	1.994 km	-	1 track

Hot Box / Hot Wheel Detectors (HBD/HWD)

Hot Box / Hot Wheel Detectors are located at the following locations:

Byellee Flyover - Moura Mine:	112.100 km	-	1 track (HBD)
	160.000 km	-	1 track (HBD)

Other locations:

7.515km	-	1 track	(HBD)	115.000k	-	1 track	(HBD)
32.600km	-	1 track	(HBD)	125.000k	-	1 track	(HBD)
45.900km	-	1 track	(HBD)	134.500k	-	1 track	(HBD)
54.400km	-	1 track	(HBD)	146.300k	-	1 track	(HBD)
69.000km	-	1 track	(HBD)	161.800k	-	1 track	(HBD)
82.700km	-	1 track	(HBD)	173.900k	-	1 track	(HBD)
102.600k	-	1 track	(HBD)				

Operators are required to stop immediately if advised of dragging equipment, hot box/hot wheel detection by the train controller.

8.4.3 Weighbridges

In general weighbridges are located on balloon loop immediately after the loadout station for the purpose of overload detection.

On the Moura System weighbridges are located at

> Moura Mine - overload detector

> Callide Coalfield - overload detector

> Boundary Hill - overload detector.

The maximum permitted speed of trains over weigh-in-motion weighbridges is 10 km/h.

8.4.4 Operational Systems and Train Control

The Moura system is operated by Remote Control Signalling (RCS) for the majority of the system with the sections Graham to Taragoola, Earlsfield to Koorngoo, Moura to Goolara and Koonkool south operated using Direct Traffic Control (DTC) with train movements controlled from Rockhampton.

Operations at QAL, Barney Point and Auckland Point are shutter controlled.

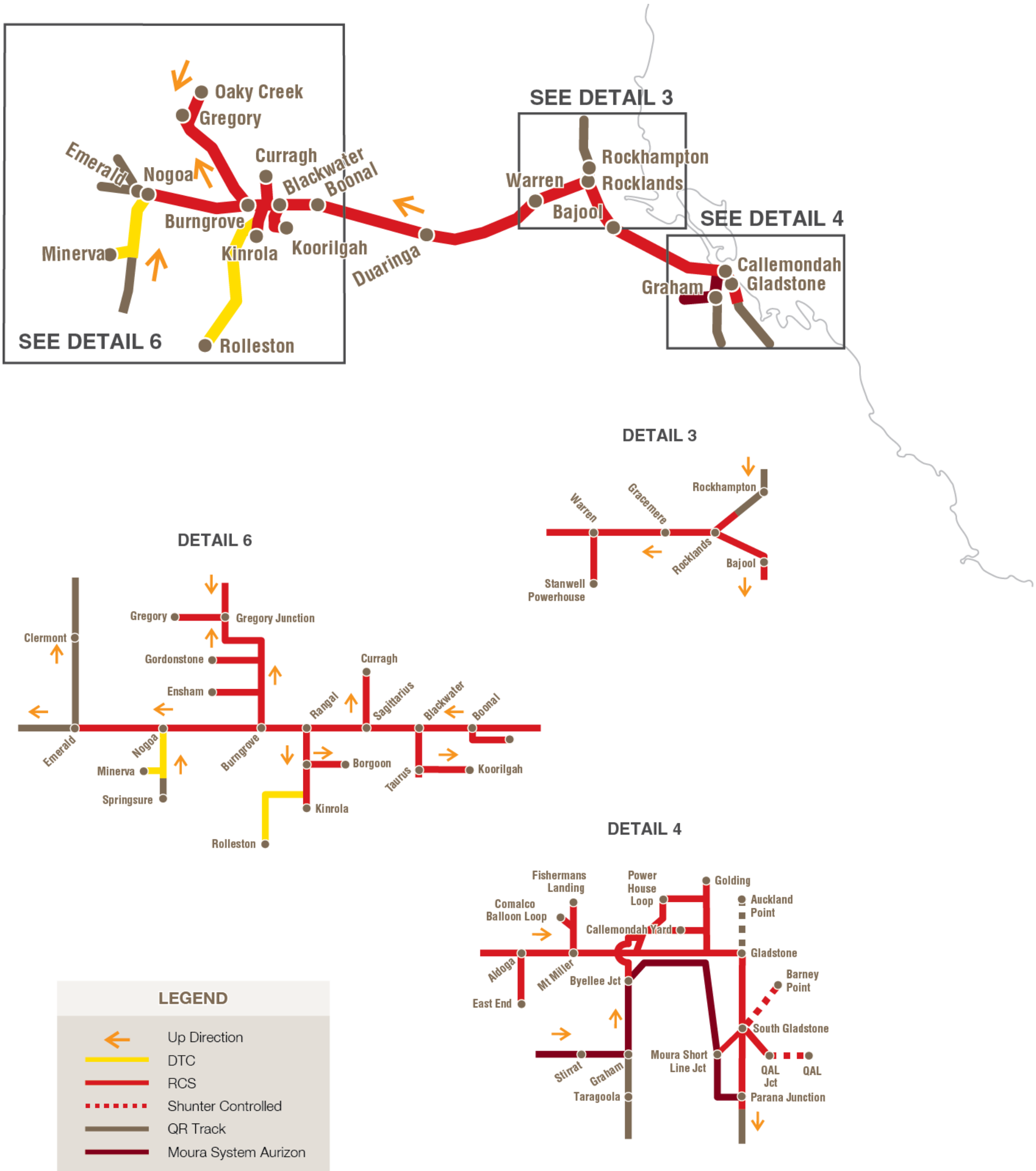

Figure 59: Train control systems for the Moura System

8.4.5 Communications

Communications on the Moura System between Driver and Controller is via a UHF radio system (Train Control Radio - TCR) utilising a number of Aurizon Network channels and frequencies. Transceivers "auto" switch the channels to suit geographical location. Frequency specification and coverage details are available as part of the "Access Enquiry Process".

In addition, all current locomotives (including Multiple Units and Miscellaneous Vehicles such as Rail Motors) carry, and all units new to the system will be required to carry, a UHF radio operating on QR Channel 1. This provides on-board and wayside communications including end to end, train to train and train to track gangs over a distance on average of 8 - 10 km.

Telecommunications

Moura telecommunications relies upon digital microwave radio and UHF links to track side towers and has limited capacity of only 4 channels and no redundancy. The schematic diagram of the Moura telecommunications backbone is pictured in Figure 60 below.

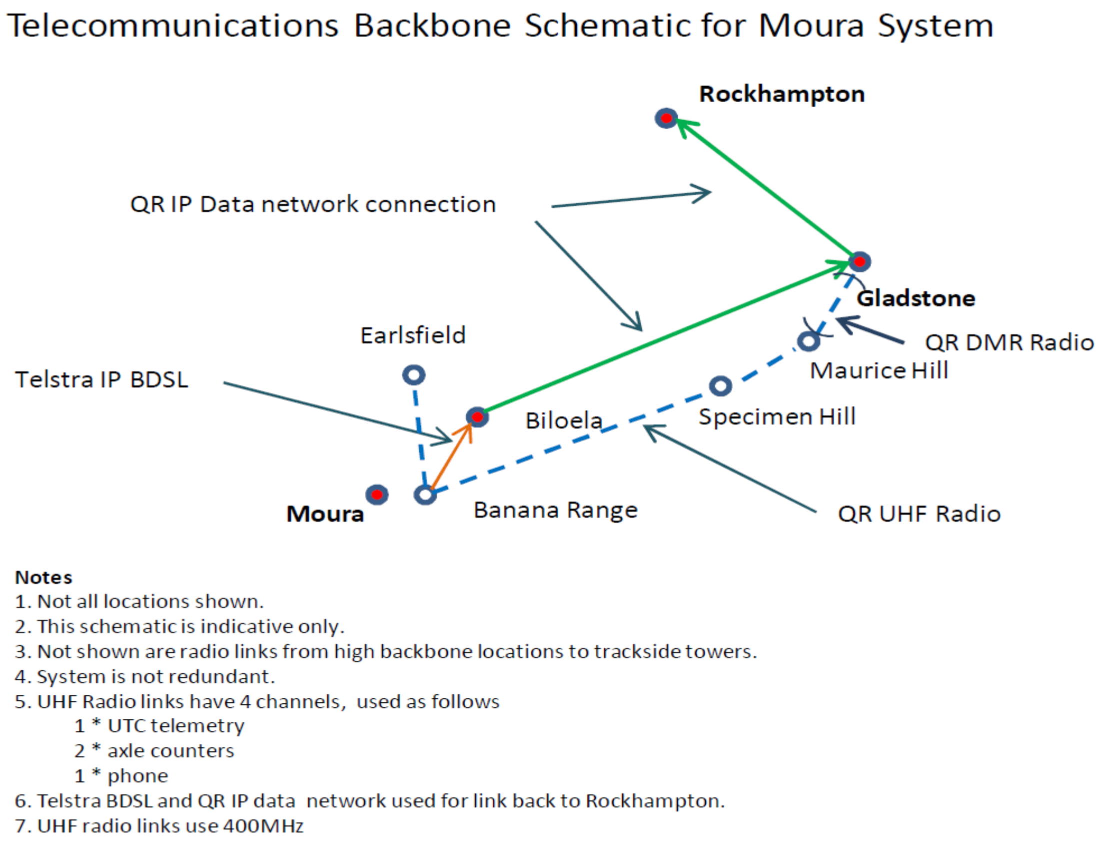

Figure 60: Moura system telecommunications backbone schematic

8.5 Specific Point to Point Details

The track on this system is a mix of 60 kg/m, 53 kg/m, 47 kg/m and to a lesser extent 41 kg/m and 31 kg/m rails with the associated sleeper types namely concrete and timber on crushed rock ballast. 60 kg/m and 53 kg/m rails are generally continuously welded, whilst 47 kg/m rail is generally long welded into 110 m lengths and 41 kg/m and 31 kg/m rails are mechanically jointed in varying lengths of less than 110 m. Glued insulated joints are used for train detection using track circuits.

Details of Moura system are provided in Table 49 below.

Table 49: Moura system point to point details

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
Callemondah (Byellee Flyover) to Moura Mine Junction (168 km)	This section of the single tracked Moura Line from Callemondah to Moura Mine Junction connects with the Monto Branch at Graham (28.6 km), the Boundary Hill balloon loop at Annandale (119.5 km) and the Biloela and Koorngoo Branches at Earlsfield (128.4 km). Block trains enter and leave Callemondah via the Byellee Flyover at the northern end of the yard. Access (in an emergency) can also be gained via the Moura Short Line and North Coast Line crossovers at the southern end of the yard. There are eight passing loops on this section, namely Stowe, Stirrat, Clarke, Fry, Mt Rainbow, Dumgree, Annandale and Belldeen. The maximum permissible axle loading is 26 tonnes. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	60 kg/m rail on concrete sleepers with some 53 kg/m on concrete and 41 kg/m on timber sleepers on sidings only.	The maximum speed for 26 tonne axle load traffic is 80 km/h. The speed of block trains heading towards Callemondah is restricted to 40 km/h between 90.489 km and 80.120 km (Calliope Range).	The maximum grade (not compensated for horizontal alignment) that a Up train - (eastbound) will encounter is 1 in 63 (23 kp) whilst for a Down train (westbound) is 1 in 50 (several locations).	Running line: 300 m Siding and depots: 140 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
Moura Mine Junction to Moura (11.3 km)	The maximum permissible axle loading is 15.75 tonnes. From Moura Mine Junction to Moura it is Remote Controlled Signalling (RCS) to 189.747km and Direct Traffic Control to Moura. From Moura to Moura Mine Junction it is DTC to 181.896km then RCS to Moura Mine Junction. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (30 %) and medium to good (70 %). Track south of 83.400km is owned by Queensland Rail. Track from Moura Station to Goolara is owned by Queensland Rail.	This section of the single track has been constructed using 47 / 41 / 30 kg/m rail on timber sleepers.	This section of track caters for a maximum speed of 40 km/h to Moura.	The maximum grade (not compensated for horizontal alignment) that a Up train - (northbound) will encounter is 1 in 70 (180 kp) whilst for a Down train (southbound) is 1 in 52 (189 kp).	Running line: 360 m Siding and depots: 140 m
Moura Mine Junction to Moura Mine (5.6 km)	The maximum permissible axle loading is 26 tonnes. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	This single track and balloon loop has been constructed using 60 kg/m rail on concrete sleepers.	This section of track caters for block trains running at a maximum speed of 50 km/h.	The maximum grade (not compensated for horizontal alignment) that a Up train - (northbound) will encounter is 1 in 124 whilst for a Down train (southbound) is 1 in 126.	Running line: 271 m Balloon loop: 300m Siding and depots: 140 m
Earlsfield to Koorngoo (11.3 km)	This section of the single track is owned by Queensland Rail.				
Earlsfield to Callide Mine (30.4 km)	The maximum permissible axle loading is 26 tonnes. There are two passing loops on this section, namely Koonkool and Dakenba (which is also the junction with the Biloela Branch).	This single track section is 53 kg/m rail on concrete sleepers, with the balloon loop using 47 kg/m rail on		The maximum grade (not compensated for horizontal alignment) that a Up train - (northbound) will encounter is 1 in 80 whilst for a Down train	Running line: 160 m Balloon loop: 140 m Siding and depots: 140 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
	Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	timber sleepers.		(southbound) is 1 in 50.	
Dakenba to Biloela (8.6 km)	This section of the single track is owned by Queensland Rail.				
Annandale to Boundary Hill Balloon (5.9 km)	This single track and balloon loop has its junction with the Moura Line at 119.541 km just east of Annandale. The maximum permissible axle loading is 26 tonnes. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (30 %) and medium to good (70 %).	47 kg/m rail on timber sleepers	This section of track caters for block trains running at a maximum speed of 25 km/h.	The maximum grade (not compensated for horizontal alignment) that an Up train - (northbound) will encounter is 1 in 300 whilst for a Down train (southbound) is 1 in 53.	Running line: 300 m Balloon loop: 300m Siding and depots: 140 m
Moura Short Line (10.5 km)	This single track electrified section connects the North Coast Line at Parana (522.8 km) with the Byellee Flyover connection from Callemondah, bypassing Barney Point, Auckland Point and Gladstone. The section of track north of the passing loop on the Moura Short Line at Callemondah to the connection with the Moura Line is not electrified. The maximum permissible axle loading is 26 tonnes. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	60 kg/m rail on concrete sleepers.	This section of track caters for traffic with a maximum speed of 80 km/h.	The maximum grade (not compensated for horizontal alignment) that a Down train (northbound) will encounter is 1 in 50 whilst for an Up train (southbound) is 1 in 80.	Running line: 300 m Siding and depots: 140 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
Graham to Taragoola (14.4 km)	Graham to 16.800km is owned by Aurizon Network. Remainder of Monto branch is owned by Queensland Rail. This single track railway heads south to Taragoola (elevation 65 m) the southern boundary with the Maryborough System, a distance of 14.4km. The maximum allowable axle load is 15.75 tal. Fencing along this corridor complements adjacent land usage and is at the following standard, poor (5 %), medium (35 %) and good (60 %). Fencing will be maintained at its current standard.	Track structure is a mix of nominal 30 kg/m rail on timber sleepers.	The maximum allowable speed is 50 km/h.	The maximum grade (not compensated for horizontal alignment) that a northbound (Up) train will encounter is 1 in 50 whilst for a southbound (Down) train, the maximum grade is 1 in 50.	Running line: 200 m
Gladstone Precincts	Within the precincts of Gladstone station there are destinations for all traffic types. General traffic and block trains use the balloon loops at Auckland Point whilst block trains use the Barney Point balloon loop. Kwik Drop Door (KDD) triggers have been installed at all coal unloading facilities. Traffic using Barney Point travels through South Gladstone yard to QAL Junction, over the North Coast Line and connects with the Moura Short Line west of Parana. Gladstone main line (North Coast Line) has a maximum allowable axle load of 20 tal. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	Barney Point to QAL Junction: 41 kg/m and 47 kg/m rail on timber sleepers Gladstone yard and the Auckland Point balloon loops: Track structures include 31 kg/m, 41 kg/m and 47 kg/m rail on timber sleepers.	Barney Point to QAL Junction: The maximum permissible speeds on this section are 25 km/h from Barney Point to QAL junction (2.3 km) and 60 km/h from QAL Junction to the Moura Short Line junction at Parana. Gladstone yard and the Auckland Point balloon loops: The maximum permissible speed on these sections is 25 km/h.	The steepest grade in this area is 1 in 134 against the southbound train.	Running line: 260 m Siding and depots: 140 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
Callemondah Yard, Powerhouse and Golding Loops	Callemondah yard is the holding yard for trains accessing the Powerhouse Loop and the three balloon loops at Golding, with all roads electrified. Kwik Drop Door (KDD) triggers have been installed at all coal unloading facilities. The maximum permissible axle loading is 26.5 tonnes. Fencing along this corridor complements adjacent land usage and is maintained at the following standard, poor (50 %) and medium to good (50 %).	A mix of 60 kg/m on concrete sleepers and 47 kg/m rail on timber sleepers	This section of track caters for traffic with a maximum speed of 25 km/h.	The maximum grade (not compensated for horizontal alignment) that a down train (that is westbound) will encounter is 1 in 90 whilst for an up train (that is eastbound) the grade is 1 in 96.	Running line: 140 m Balloon Loop: 300 m Siding and depots: 140 m Minimum nominal horizontal radius for new or upgrade works is as follows: Running line 2170 m 160 km/h running 1662 m 140 km/h running 1221 m 120 km/h running 848 m 100 km/h running 542 m 80 km/h running Balloon loop 300 m minimum radius Siding and depot 140 m minimum radius

8.6 Moura System - Scope

8.6.1 Specific Maintenance Requirements

Table 50: Moura system specific maintenance requirements

Activity	FY14	FY15	FY16	FY/17
Net Tonnes (m)	12.5	13.6	13.0	14.1
Ballast Cleaning Per cubic metres Per km				
Mechanised Resurfacing – Mainline (km)				
Mechanised Resurfacing – Turnouts (T/O)				
Grinding – Mainline (km)				
Grinding – Turnouts (T/O)				

8.7 Moura System – Cost

Table 51: Moura System cost breakdown

Maintenance Discipline	FY14 ($m)	FY15 ($m)	FY16 ($m)	FY17 ($m)
Mechanised Maintenance				
Ballast undercutting	$2.269	$2.613	$2.360	$2.492
Resurfacing	$ 0.906	$ 0.890	$ 0.880	$ 0.924
Rail Grinding	$ 0.662	$ 0.721	$ 0.641	$ 0.727
General Track Maintenance	$ 3.746	$ 3.880	$ 3.831	$ 4.001
Re-railing	$ 1.584	$ 1.647	$ 0.356	$ 0.361
Structures	$ 0.418	$ 0.432	$ 0.428	$ 0.443
Signalling	$ 1.140	$1.160	$1.154	$1.175
Traction Power	-	-	-	-
Total Cost	$10.725	$11.343	$9.650	$10.123
% of Total Cost *	5.7%	5.5%	4.6%	4.7%

** The above excludes system-wide telecommunication costs*

9. NEWLANDS SYSTEM PLAN AND COSTS

9.1 Newlands System General Information

Newlands System Overview

The Newlands system is located at the northern end of the Bowen Basin in North Queensland. It incorporates part of the North Coast Line between Durroburra and Kaili as well as the line to the port at Abbot Point. The system services mines conveying export coal to Abbot Point Coal Terminal and domestic coal to the Queensland Nickel Refinery and the Bowen Coke Works.

The Newlands coal system is the northernmost of the systems, located at the northern end of the Bowen Basin in North Queensland. It was originally built as far as Collinsville in the early 1960s , with the remainder of the line constructed in the 1980s.

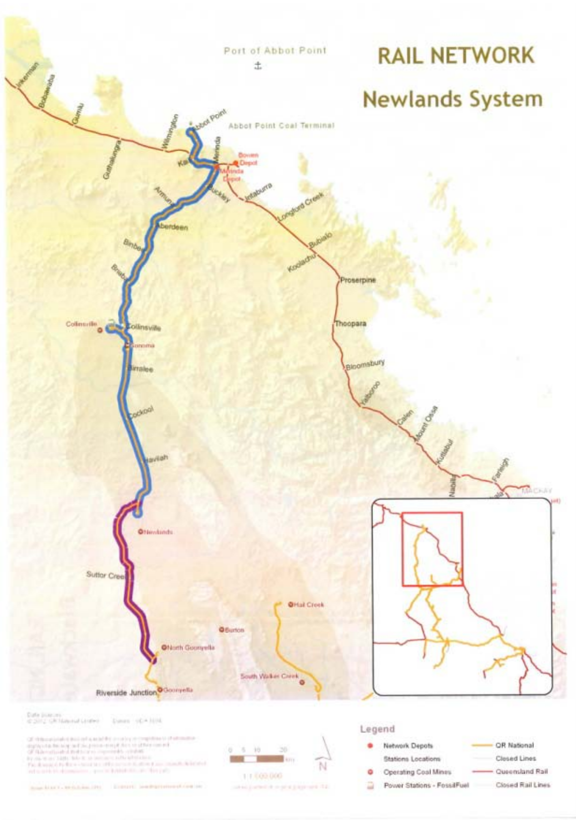

Figure 61: Newlands coal system map

The Newlands System consists of 320 km of single track, 1067 mm gauge railway servicing balloon loops at Newlands, McNaughton and Abbot Point, is not electrified, and is capable of running diesel trains. The system is operated from the Rockhampton Control Centre utilising two safe working systems - Remote Control Signalling (RCS) and Direct Traffic Control (DTC). Between Abbot Point and Collinsville and between Collinsville and McNaughton the railway is operated by Remote Controlled Signalling (RCS) and power operated points. The North Coast Line and Newlands system traffic share the same tracks for approximately 6 kilometres between Kaili and Durroburra. There is flexibility for this to be managed, as the current forecast tonnages for the Newlands system are less than 20 trains a day in total. A rail yard located at Pring caters for the provisioning of train services.

The system services mines operated by Xstrata, Peabody and QCoal, at McNaughton, Newlands, Collinsville and Sonoma, conveying export coal to Abbot Point Coal Terminal and domestic coal to the Queensland Nickel Refinery and the Bowen Coke Works.

The Goonyella and Abbot Point Expansion (GAPE) Project has been completed and connects the Newlands and the Goonyella systems. This project includes approximately 69 kilometres of new construction and upgrading of the Newlands system to enable it to take 106 tonne coal wagons with 26.5tal. These works also support the expansion of Abbot Point to 50 Mtpa.

9.2 Current Asset Condition

A key indicator of the networks performance is the Below Rail Transit Time (BRTT) and is provided for in all Access Agreements. The BRTT for the Newlands System is:

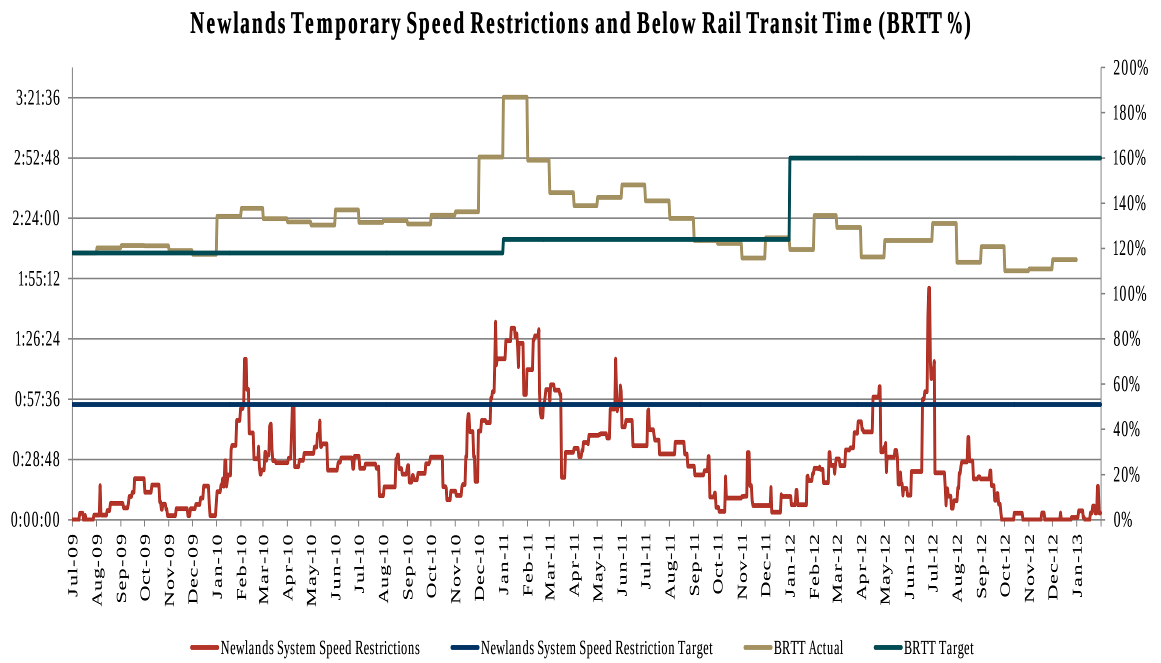

Figure 62: Newland System BRTT up to Jan 2013

In addition to the above measure Aurizon Network also provides the QCA with the Overall Track Condition Index. A copy of the Newlands System OTCI as below,

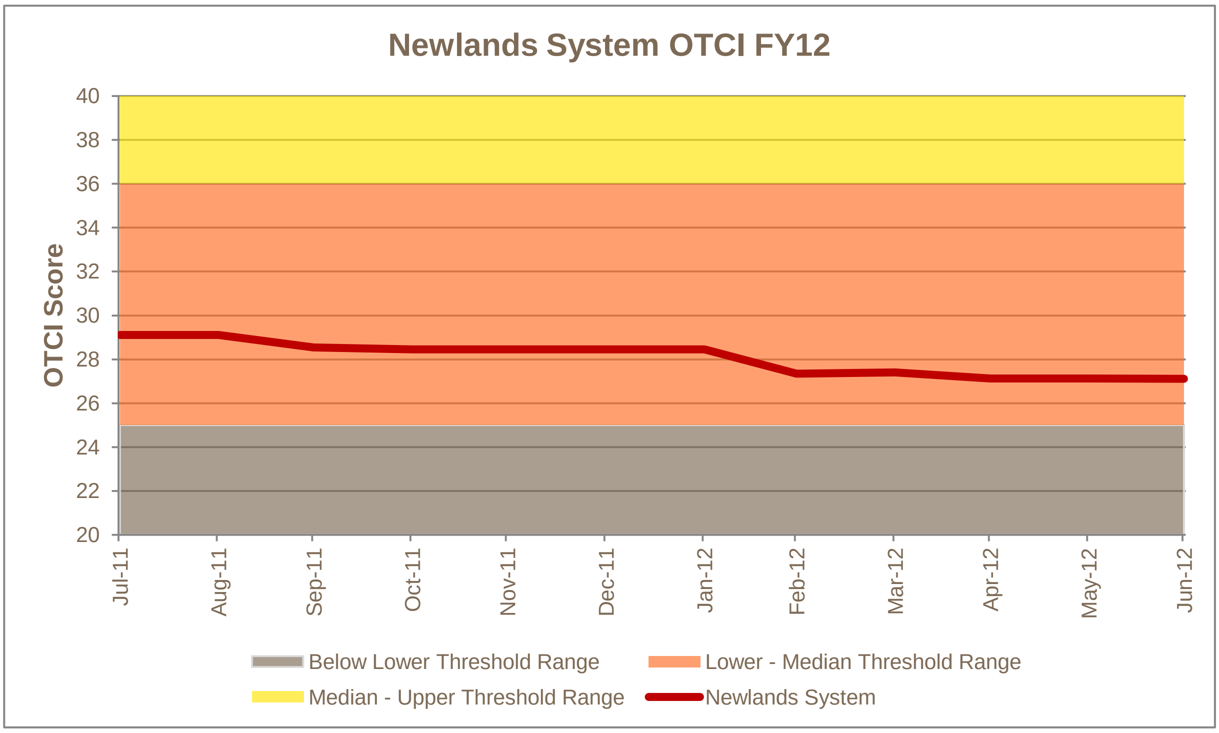

Figure 63: Newlands System OTCI FY12

9.3 Maintenance Challenges

The maintenance budget for Newlands represents approximately 11% of the entire CQCN allowance. In addition to coal product fouling and ballast maintenance works, which affects all systems on the CQCN, there are a variety of specific maintenance challenges across the Newlands system. These include:

- Track stress
- Soil composition
- Overhead line and level crossing issues
- Signalling
- Corrosion
- Weather
- Safety challenges
- Environmental considerations
- Incident response and remote location challenges.

9.3.1 Track Stress

Overall, general wear rates of the track on this system are higher than standard railways due to the following elements:

- Narrow gauge line - More forces are applied to a smaller area on the track, putting additional pressure on these areas. This requires unique maintenance requirements, and smaller timeframes between maintenance efforts
- Curvature - Originally the track was built for smaller, lighter wagons. In addition to this, the traffic task and frequency has changed considerably, but the curvature of the track has not, which puts a great deal of pressure on the track as these wagons really require a longer turning radius. Rail grinding is required at twice the frequency on these curves (20MGT for general curves and 10MGT for tight curves), as it is for straight track (40MGT)

The table below shows the number and length of curves categorised by the curve radius. This highlights the amount of curved track that exists and the extent of rail wear monitoring and management that is required to be undertaken.

Table 52: Curve Details - Newlands System

Curve Radius	No. of Curves	Total Curve Length (m)
> 212 and ≤ 305	18	3,240
> 305 and ≤ 415	11	4,967
> 415 and ≤ 542	12	4,146
> 542 and ≤ 848	45	15,324
> 848 and ≤ 1000	12	4,380
> 1000	55	18,030
Total	153	50,087
Total Curved Rail Length		100.174 km

- Gradients - Similarly to Curvature, the size and weights of the wagons cause track stress with momentum, pushing the track forward, particularly in the downward motion. This is managed by applying ruling grade restrictions in the effected parts of the Goonyella network (mainly in the Ranges)
- Increased tonnages travelling the line – Over the last 25 years the carried tonnages on the line have increased, meaning more traffic and heavier loads are using the track, putting additional pressure on and increasing track wear. The table below details those increases in 5 year increments:

Table 53: Newlands system tonnage increases

Newlands	1993	1998	2002	2007	2012
Tonnages (Million Net Tonnes)	5.867	7.203	12.255	11.156	14.636

9.3.2 Port Kembla Rail Issues and Emergency Upgrade Works

Some areas of the Newlands system still have Port Kembla Rail. This is an old type of rail that has some quality and breakage issues due to its age. Faults related to this rail represent one of the most common reasons of emergency maintenance requirements on this system.

9.3.3 Weather Challenges

Due to the location and geography of the Newlands system, it experiences weather conditions that can affect the delivery of services, and also have a high impact on the maintenance budget, due to the damage caused over these extreme weather periods.

Rainfall and Flooding

Flooding of low lying areas of this network is likely to occur during periods of extreme rainfall, and the Newlands System is closed on average for 2 days every 4 years due to flooding. This is an average figure and closure periods of greater duration are possible in any one year.

9.3.4 Environmental Considerations unique to the Newlands System

Noise issues through Collinsville

Over the last UT3 period, the community of Collinsville have raised concerns over the level of noise from the line. Aurizon Network invests in community consultations to ensure issues are heard and resolved for the best outcome for all. As a result of the Collinsville community concerns, Aurizon Network is considering a deviation around this area in the next undertaking period.

9.3.5 Incident Response and Remote Location Challenges

The Newlands system is one of the most remote of all systems in the CQCN. It doesn't have highways or sophisticated road systems to get to sites, and is single track, which makes it very difficult to get equipment to site. Maintenance teams need to use dirt access roads and pathways with a substantial part of the maintenance budget being spent in obtaining access and building pathways for plant and machinery.

Between Abbot Point and Collinsville, it is anticipated that a minor incident could result in disruption to services for 6 hours and a major incident for 2 days. Between Collinsville and Newlands, it is anticipated that a minor incident could result in disruption to services of 8 hours and a major incident for 3 days. Incident recovery is dependent on the nature, severity and location of each unique incident that may occur on this system.

Accommodation

There is very little accommodation in this region, which means that maintenance teams need to travel to get to site. This will directly relate to the amount of maintenance time spent on the track, as travel time is included in working hours in adherence to Aurizon Network's safe site procedures. For example, a maintenance team is required to travel 2 hours to site, leaving only 3-4 hours of production time, to allow for the trip back. A 6 hour maintenance task would then need to be done over 2 days.

9.4 Maintenance and Operational System information

9.4.1 Track possessions and closures process specific to the Newlands System

In addition to the general possessions and track closure process that is relevant for the entire CQCN, Newlands has some specific planning guidelines that should be used when planning possessions outside of the nominated closure times.

Table 54: Newlands system possession planning guidelines

Access	Comments
Newlands System	Track Closures in the Newlands System should align with the monthly Abbot Point maintenance day.

9.4.2 Trackside Detection Equipment:

Dragging Equipment Detectors (DED)

Dragging equipment detectors are placed at strategic locations along the route to give early warning of rolling stock defects and minimise the effect of any derailment incident.

Operators are required to stop immediately if advised of a dragging equipment detection by the train controller.

Locations are as follows:

Newlands to Collinsville:	**Collinsville to Durroburra**
206.870 km - 1 track	1158.840 km - 2 tracks
183.930 km - 1 track	72.200 km - 1 track
158.600 km - 1 track	52.075 km - 1 track
152.060 km - 1 track	38.159 km - 1 track
149.200 km - 1 track	29.500 km - 1 track
139.850 km - 1 track	17.793 km - 1 track
116.980 km - 1 track	12.400 km - 1 track
87.000 km - 1 track	8.110 km - 1 track
84.320 km - 1 track	0.118 km - 1 track
81.300 km - 1 track	
McNaughton:	**Kaili to Abbot Point**
84.320 km - 1 track	18.420 km - 2 tracks

Hot Box / Hot Wheel Detectors (HBD/HWD)

There are no Hot Box / Hot Wheel Detectors on this System.

9.4.3 Weighbridges

There are two weighbridges in use on this system:

> McNaughton - in motion / trade certified Newlands -in motion / trade certified

> Sonoma - overload detector.

9.4.4 Operational Systems and Train Control

The system is operated from the MacKay Control Centre utilising two safe working systems - Remote Control Signalling (RCS) and Direct Traffic Control (DTC).

> Between Abbot Point and Collinsville and between Collinsville and McNaughton the railway is operated by Remote Controlled Signalling (RCS) and power operated points.

> Between Abbot Point and Collinsville and between Collinsville and McNaughton the railway is operated by Remote Controlled RCS Signalling (RCS) and power operated points. Train Control for the entire System is provided from Mackay.

> Between Collinsville and Newlands (including Sonoma), the railway is operated under Direct Traffic Control (DTC) with trailable facing points.

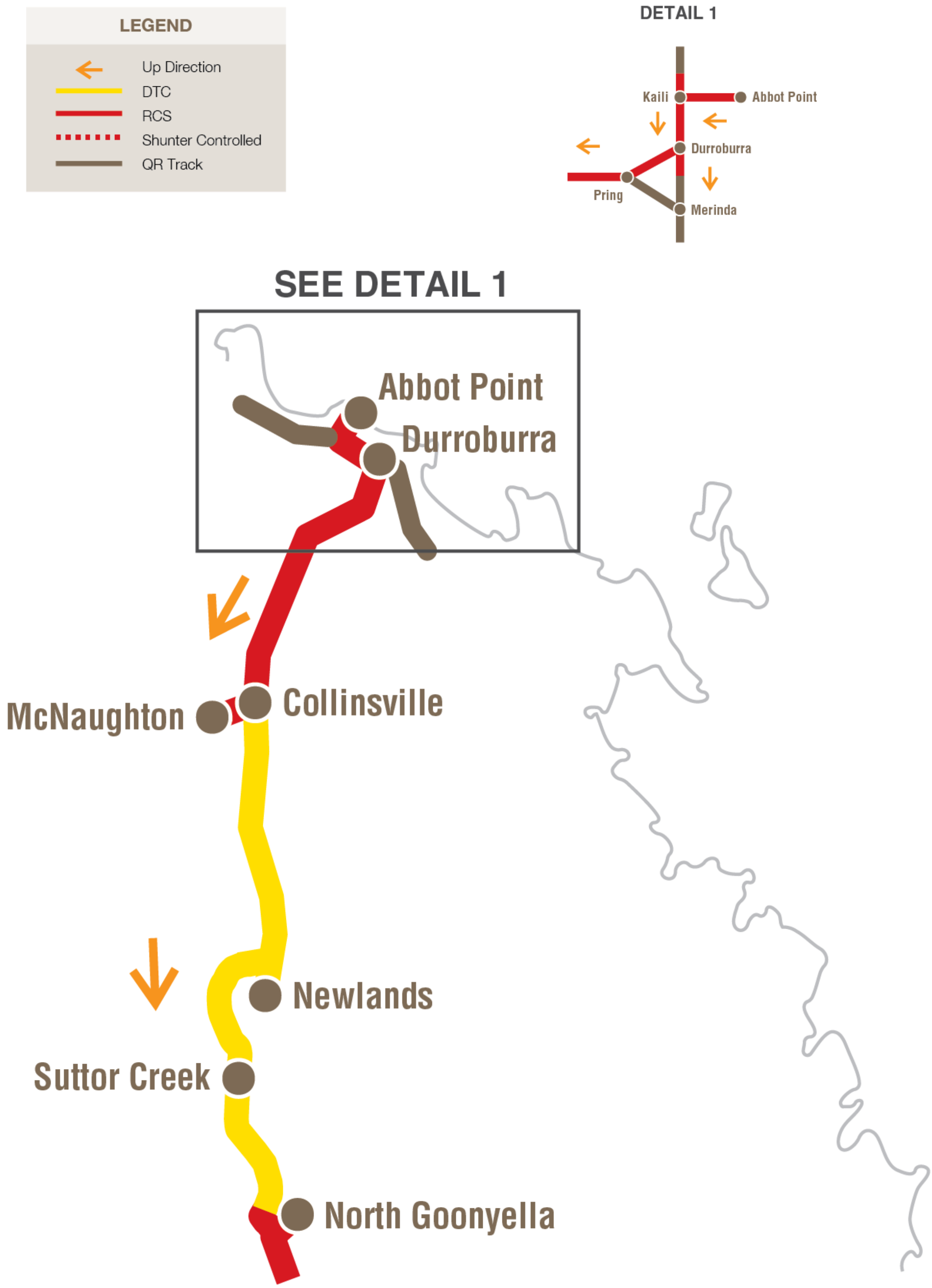

Figure 64: Train control systems for the Newlands System

9.4.5 Communications

Communications on the Newlands System between Driver and Controller is via a UHF radio system (Train Control Radio - TCR) utilising a number of Aurizon Network channels and frequencies. Transceivers “auto” switch the channels to suit geographical location. Frequency specification and coverage details are available as part of the “Access Enquiry Process”.

In addition, all current locomotives (including Multiple Units and Miscellaneous Vehicles such as Rail Motors) carry, and all units new to the system will be required to carry, a UHF radio operating on QR Channel 1. This provides on-board and wayside communications including end to end, train to train and train to track gangs over a distance on average of 8 - 10 km.

Telecommunications

The figure below is a schematic diagram of the Newland telecommunications backbone. The system is currently working reliably but there is concern over an ageing open wire pole route from Collinsville to Abbot Point that will require reviewing over the UT4 period.

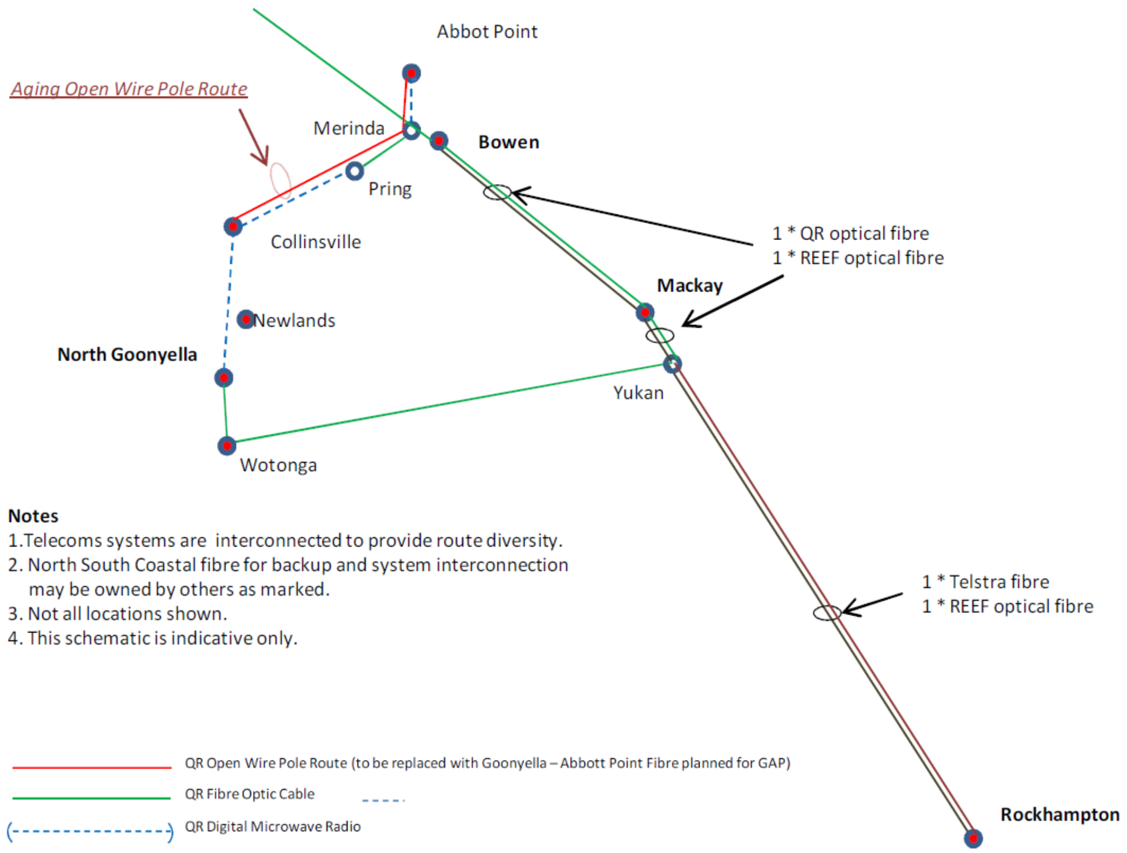

Figure 65: Newlands system telecommunications backbone schematic

9.5 Specific Point to Point Details

The track on the Newlands systems is predominantly 53 kg/m and 50 kg/m rails on concrete sleepers with some 47 kg/m rail on timber sleepers all on crushed metal ballast. The rails are continuously welded except where glued insulated joints are used for train detection using track circuits. Speeds through the curved leg of turnouts are governed by the angle of that turnout

Details on the full extent of the Newlands system is described in the table below:

Table 55: Newlands system point to point details

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
Abbot Point to Kaili (13 km)	This section is from the port at Abbot Point to Kaili, the junction of the North Coast Line. There is a balloon loop with an unloading pit for unloading coal from bottom discharge (Kwik Drop Door) wagons at Abbot Point. There is a passing loop at Kaili, but there are no intermediate passing loops between Kaili and the balloon loop. The maximum allowable axle load is 20 tonnes. The distances on this section are measured from the junction with the North Coast Line at 1164.093 km (start of Passing Loop). The terrain is generally flat. Fencing along this corridor complements adjacent land usage and is at the following condition poor (20%) to medium (50%) to good (30%). Fencing will be maintained at its current standard.	53 kg/m rail on concrete sleepers.		The maximum grade (not compensated for horizontal alignment) that a northbound (Down) train will encounter is 1 in 826 whilst for a southbound (Up) train the maximum grade is 1 in 94.	Running line: 500 m Balloon loop 309 m Siding and depots: 140 m
Kaili to	This section is part of the North Coast	Track structure is		The maximum grade (not compensated	Running line: 240 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
Durroburra (5km)	Line running from Brisbane to Cairns, and is between 1164.093 km and 1158.220 km (distances measured from Roma Street). Durroburra is the junction of the North Coast line and the Collinsville Line; there are no passing loops on this section. Being part of the North Coast Line this section carries all types of traffic including North Coast Line and Newlands System trains. The terrain is undulating. The maximum allowable axle load is 20 tonnes. Fencing along this corridor complements adjacent land usage and is at the following condition poor (20%) to medium (50%) to good (30%). Fencing will be maintained at its current standard.	53 kg/m rail on concrete sleepers.		for horizontal alignment) that a northbound (Down) train will encounter is 1 in 99 whilst for a southbound (Up) train the maximum grade is 1 in 66.	
Durroburra to Collinsville (77km)	This section extends from Durroburra (junction with the North Coast Line at 1158.220 km), past the old junction of the North Coast Line at Merinda, and the marshalling yard and depot at Pring along flat country before climbing the Clarke Range to Collinsville. Passing loops are provided at Pring, Armuna, Binbee, Briaba and Collinsville. The maximum allowable axle load is 20 tonnes. Fencing along this corridor complements adjacent land usage and is at the following condition poor (20%) to medium (50%) to good (30%). Fencing will be	53 kg/m rail on concrete and timber sleepers.		The maximum grade (not compensated for horizontal alignment) that a northbound (Down) train will encounter is 1 in 50 whilst for a southbound (Up) train the maximum grade is 1 in 50.	Running line: 240 m

Area	Description	Track Structure	Allowable speed	Grade	Existing Minimal Horizontal Curve Radii
	maintained at its current standard.				
Collinsville to Newlands (73km)	This section includes the spur line to the McNaughton Mine balloon loop, the junction of which is approximately one kilometre beyond Collinsville, and extends to the balloon loop at Newlands Mine. There are intermediate passing loops at Birralee and Havilah. The terrain is undulating. Fencing along this corridor complements adjacent land usage and is at the following condition poor (20%) to medium (50%) to good (30%). Fencing will be maintained at its current standard.	Track structure from Collinsville to Newlands is 53 kg/m rail on a mix of concrete and timber sleepers whereas Collinsville to McNaughton is a mix of 47/53 kg/m rail on concrete and timber sleepers.		The maximum grade (not compensated for horizontal alignment) that a northbound (Down) train will encounter is 1 in 100 whilst for a southbound (Up) train the maximum grade is 1 in 51. Existing minimum nominal horizontal curve radii are as follows:	
Northern Missing Link (68km)	Maximum allowable axle load is 26.5 tonnes.	60km\m rail on concrete sleepers.		The maximum grade (not compensated for horizontal alignment) that a northbound (Down) train will encounter is 1 in 55 whilst for a southbound (Up) train the maximum grade is 1 in 105 also.	
Sonoma Balloon Loop (3.5km)	Runs parallel to the Collinsville - Newlands railway with its junction at 84.747km. The maximum allowable axle load is 26.5 tonnes.	Track structure is 50 kg/m rail on concrete sleepers		The maximum grade (not compensated for horizontal alignment) that a northbound (Down) train will encounter is 1 in 400 whilst for a southbound (Up) train the maximum grade is 1 in 400 also.	Running line: 600 m Balloon loop 300 m Minimum horizontal curve radius for new or upgrade works is as follows: Running line: 300 m Sidings and depots 300 m

9.6 Newlands System - Scope

9.6.1 Specific Maintenance Requirements

Table 56: Newlands system specific maintenance requirements

Activity	FY14	FY15	FY16	FY/17
Net Tonnes (m)	32.4	37.4	39.1	42.1
Ballast Cleaning Per cubic metre Per km				
Mechanised Resurfacing – Mainline (km)				
Mechanised Resurfacing – Turnouts (T/O)				
Grinding – Mainline (km)				
Grinding – Turnouts (T/O)				

9.7 Newlands – Cost

Table 57: Newlands system cost breakdown

Maintenance Discipline	FY14 ($m)	FY15 ($m)	FY16 ($m)	FY17 ($m)
Mechanised Maintenance				
Ballast undercutting	$ 7.360	$ 8.910	$ 8.792	$ 8.874
Resurfacing	$ 2.107	$ 2.149	$ 2.344	$ 2.352
Rail Grinding	$ 1.394	$ 1.576	$ 1.585	$ 1.626
General Track Maintenance	$ 7.042	$ 7.654	$7.776	$ 8.102
Re-railing	$ 0.272	$ 0.172	$ 0.356	$ 0.361
Structures	$ 0.534	$ 0.566	$ 0.575	$ 0.594
Signalling	$ 2.171	$ 2.299	$ 2.314	$ 2.370
Traction Power	-	-	-	-
Total Cost	$20.880	$23.326	$23.742	$24.279
% of Total Cost *	11.0%	11.4%	11.3%	11.3%

** The above excludes system-wide telecommunication costs*

10. ASSUMPTIONS

The high level assumptions used in the development of this submission are detailed below:

Table 58: Assumptions

#	Assumption	Comment
	The scope in part is based on forecast tonnes provided for within the Access Agreements.	The forecast is conservative relative to contracted tonnage during the UT4 period. Importantly, the scope is dependant on not only the total system tonnage, but the projected tonnage that operates over individual sections. The detailed tonnage profile is included in Appendix O.
	The time-based and usage-based maintenance activities are as specified in the Safety Management System.	Changes to frequency or standard of maintenance activity require Engineering analysis conducted by an RPEQ with specific experience in the particular asset class which is coupled with appropriate Asset Management governance practices.
	The mechanised maintenance involved a mix of leased and owned equipment.	A list of plant is available to the QCA upon request.
	The price provides for the procurement of additional external resources to meet the scope.	External sourcing of competent resources is subject to internal procurement practices and market availability noting the specialized nature of rail competent workers and narrow gauge rail plant.
	Aurizon Network has assumed that the implementation of the Coal Loss Management Plan by industry will reduce the fouling rate.	If these associated strategies are unsuccessful or otherwise not readily implemented by the responsible industry parties, then coal fouling rates and the requirements for ballast cleaning may increase above the scope allowance provided herein.
	Scope for maintenance based on existing asset condition data and the estimated asset deterioration.	Extreme weather events such as flood have both an immediate and longer term impact on infrastructure reliability and the maintenance productivity. This submission assumes a significant increase in preventative maintenance that will require dryer conditions then have been experience in UT3 and more in line with previous undertaking periods.

11. RISKS

The risk factors detailed below may result in a variation in the planned maintenance costs.

Table 59: Risks

#	Risk Factor	Description	Consequence	Mitigation
	Adverse economic conditions	Significant, extended negative changes in domestic and global economic conditions could impact the producers and consumers of coal and have an adverse effect on the Aurizon Network's operating results, financial condition or liquidity.	Declines in or muted manufacturing activity, economic growth and international trade could result in reduced revenues. Challenging economic conditions may not only affect revenues due to reduced demand for many goods and commodities, but could result in payment delays, increased credit risk and possible bankruptcies of customers. Railways are capital-intensive and must finance a portion of the building and maintenance of infrastructure as well as locomotives and other rail equipment. Economic slowdowns and related credit market disruptions may adversely affect the Aurizon Network cost structure, its timely access to capital to meet financing needs and costs of its financings.	Regulator decision to ensure adequacy of funding in accordance with 168a, reflective regulatory and market risk.
	Legislative impacts	The Aurizon Network operations are subject to extensive federal, state and local environmental laws and regulations in particular, associated with Coal Loss and fouling of waterways etc. Governments may change the legislative framework within which QRN operates without providing QRN with any recourse for any adverse effects that the change may have on its business.	Failure to comply with applicable laws and regulations could have a material adverse effect on Aurizon Network's maintenance program. Potentially government regulations may require the Company to obtain and maintain various additional licenses, permits and other authorizations. Economic quantification of such changes are typically difficult to assess during an Undertaking period or substantiate.	Network to maintain sufficient competency to monitor and implement legislative changes that impact maintenance requirements. Applicable changes will be required to be reflected in the SMS, BI and/or asset policy. Any economic assessment and allocation must not frustrate Network in its ability to comply with legislation. Note, no allowance has been

#	Risk Factor	Description	Consequence	Mitigation
				included for any legislative changes that may impacts on maintenance requirements, administration or governance.
	Environmental	Emission regulations could also adversely affect fuel efficiency and increase operating costs. Further, local concerns on emissions and other forms of pollution could inhibit Aurizon Network ability to build facilities in strategic locations to facilitate growth and efficient operations. Environmental liability can extend to previously owned or operated properties, leased properties and properties owned by third parties, as well as to properties currently owned and used by the Aurizon Network.	The Aurizon Network operating results, financial condition or liquidity could be adversely affected as a result of any of the foregoing, and it may be required to incur significant expenses to investigate and remediate environmental contamination. The risk in this is twofold. Firstly if Aurizon Network's assumptions don't become reality then additional maintenance will be required, and secondly if the EPA mandates QRN to take additional action. No allowance has been made for these events.	Aurizon Network is currently working with industry to implement the responsibilities detailed in the Coal Loss Management Plan. These obligations place responsibility on various entities across the supply chain to implement measures that reduce airborne coal contamination including such activities as veneering and profiling required at mine loadouts. An ambitious allowance has been made for a reduction in fouling rates through the successful implementation of these recommendations.
	Changes in government policy	Changes in government policy could negatively impact demand for the Aurizon Network services, impair its ability to price its services or increase its costs or liability exposure. For example, changes in clean air laws or regulation of carbon dioxide emissions could reduce the demand for coal and revenues from the coal transportation services provided by Aurizon. Federal or state spending on infrastructure	Developments and changes in laws and regulations as well as increased economic regulation of the rail industry through legislative action and revised rules and standards applied by the Regulators in various areas, including rates and services, could adversely impact the Aurizon Network ability to determine prices for rail services and significantly affect the revenues, costs and profitability of the Aurizon Network business. Additionally, because of the significant costs to maintain its rail network, a reduction in profitability	Aurizon Network actively participate in industry forums and engage in discussion with government department and regulatory bodies to understand upcoming impacts. Other: Refer to legislative impacts.

#	Risk Factor	Description	Consequence	Mitigation
		improvements or incentives that favour other modes of transportation could also adversely affect the Aurizon revenues.	could hinder the Aurizon Network ability to maintain, improve or expand its rail network, facilities and equipment.	
	Availability of staff	The availability of qualified personnel could adversely affect the Aurizon Network operations. Changes in demographics, training requirements and the availability of qualified personnel, particularly engineers could negatively impact Aurizon Network ability to meet demand for rail maintenance. Recruiting and retaining qualified personnel, particularly those with expertise in the railway industry, are vital to operations. Plant operator retention has been a major concern in the past 12 months, as a general coal industry skills shortage impacts on Aurizon Network. Effective mechanised teams require a combination of skilled staff.	Although Aurizon Network has adequate personnel for the current business environment, unpredictable increases in demand for railways experience from the mining sector may exacerbate the risk of not having sufficient numbers of trained personnel, which could have a negative impact on operational efficiency and otherwise have a material adverse effect on the Aurizon Network operating results, financial condition or liquidity. Inability to recruit could result in existing staff experiencing more maintenance overtime.	Prudent use of multiple service providers, where available, assist in ensuring competent and capabille resources are still available as demand increase in Central Queensland. However, this can increase cost due to competence development requirements. Use of longer term engagement can moderate market supply fluctuations but do impose flexibility cost penalties.
	Industrial relations	Most of the Aurizon Network employees are represented by unions and failure to successfully negotiate enterprise bargaining agreements may result in strikes, work stoppages or substantially higher ongoing labour costs. A significant majority of Aurizon's employees are union-represented. Aurizon Network employees work under enterprise bargaining agreements. The existing agreements remain in effect until 31st	While previous EBA negotiations have not yet resulted in any extended work stoppages, if Aurizon is unable to negotiate acceptable new agreements, it could result in strikes by the affected workers, loss of business and increased operating costs as a result of higher wages or benefits paid to union members, any of which could have an adverse effect on the Aurizon Network operating results, financial condition or liquidity. Network is reliant on service providers providing	Wages, health and welfare benefits, work rules and other issues have traditionally been addressed through industry-wide negotiations. These negotiations have generally taken place over an extended period of time and have previously not resulted in any extended work stoppages.

#	Risk Factor	Description	Consequence	Mitigation
		December 2013 and will continue to remain in effect until new agreements are reached.	continuity of service and is at risk in particular with critical services being subject to disruption.	
	Severe weather and natural disasters	Severe weather and natural disasters could disrupt normal business operations, which would result in increased costs and liabilities and decreases in revenues.	Not meeting Aurizon Network's programmed maintenance schedule with dedicated resources redeployed to emergency response. Aurizon Network's success is dependent on its ability to operate its rail network system efficiently. Severe weather and natural disasters, such as cyclones, flooding and earthquakes could cause significant business interruptions and result in increased costs and liabilities and decreased revenues. In addition, damages to or loss of use of significant aspects of the Aurizon Network infrastructure due to natural or man-made disruptions could have an adverse effect on the Aurizon Network operating results, financial condition or liquidity for an extended period of time until repairs or replacements could be made. Additionally, during natural disasters, the Aurizon Network workforce may be unavailable, which could result in further delays. Extreme swings in weather could also negatively affect the performance of locomotives and wagon rollingstock.	Aurizon Network has made allowances for limited wet weather during the UT4 period. However, no allowance has been made for sustained periods of abnormally wet weather or intense extreme events. The immediate effects of material infrastructure damage to climate are addressed through review event process. However on-going maintenance productivity and reliability impacts are not addressed. Aurizon Network however maintains flexibility in its structure through a core competency of skilled internal resources capable of responding rapidly to network disruption minimising network outages and service disruption to the supply chain.
	Fluctuating demand	Manage Fluctuating Demand for Aurizon Network's Services and Network Capacity. Aurizon Network must manage Fluctuating Demand for Aurizon Network's Services and Network Capacity – Short term significant demand increases for Aurizon	In the event that Aurizon Network experience significant reductions of demand for rail services, Aurizon Network may experience increased costs associated with resizing Aurizon Network's operations, including higher unit operating costs and costs for the storage of plant and other	Although Aurizon Network continues to improve its network plan, add capacity, and improve operations at rail yards and other facilities, Aurizon Network cannot be sure that these measures will fully or

#	Risk Factor	Description	Consequence	Mitigation
		Network's services that exceed the designed capacity of Aurizon Network's network, Aurizon Network may experience network difficulties, including congestion and reduced speed that could compromise the level of service we provide to Aurizon Network's customers. This level of demand may also compound the impact of weather and weather-related events on Aurizon Network's operational efficiency throughout the network. Short term reduction in demand results in reduced revenue however Network has limited ability to scale cost quickly.	equipment; and any work-force related adjustments; which could have a material adverse effect on Aurizon Network's results of operations, financial condition, and liquidity. Within an undertaking period Aurizon Network Network's maintenance costs are largely considered fixed over a one to two year period. The risk Aurizon Network needs to manage is to ensure it does not over capitalise on investments, but has enough spare capacity to deliver increased tonnes if required by the customer.	adequately address any service shortcomings resulting from demand exceeding Aurizon Network's. Ongoing engagement with industry provides a level of signalling of impending fluctuations in demand. Maintenance planning process can to a limited degree respond to these signs.
	Network capacity	Aurizon Network is has a relative high usage of capacity compared to previous undertaking periods. Increasing tonnages and the resultant increase in train path numbers and shorter times between train paths limit access to the track.	Inability to meet Aurizon Network's programmed maintenance schedule. Increased wear on the network with asset life expected to shorten and maintenance spend will increase significantly, in particular for new plant, such as Tamper and Resurfacing machine. A hastening of Capital Renewals requirements impact on track availability for maintenance activity.	Improved planning and schedule protocols for both Capital and Maintenance activities complemented by enhanced predicative tools such as GPR and rail wear profile modelling. Engagement with industry to optimise system outages to maximise long term total system throughput.
	Ballast cleaning machine age	Ballast cleaning reliance on one Machine (RM900) Age of current Undercutter is: 11 years asset life 10-15yrs expected expiry is 2016/17 Increased likelihood of Machine	Access to track becomes a greater safety risk. Low productivity / high failure rate is expected for existing undercutter machine as it approaches expiry of its useful life. This would result in a significant period (whilst a replacement RM900 is purchased) of increased resurfacing, stoneblowing and major track panel	Aurizon Network is investing heavily in the support assets of the RM900 to improve efficiencies and increase production. Aurizon Network has proposal of investing in a new Undercutter to improve efficiencies and increase

#	Risk Factor	Description	Consequence	Mitigation
		breakdown (serviceable life cycle of existing plant).However there is a risk that if the machine itself becomes unserviceable Aurizon Network will be unable to deliver the required ballast cleaning function.	works involving ballast excavating.	production. However the risk is for possible technological obsolescence – dependent upon procurement strategy and availability of new undercutter model. Full utilisation of new machine for duration of project expected to be over 3 to 4 years. Ownership model recommended will impact maintenance costs
	Equipment procurement lead times	Considerable delays are being experienced in the procurement process for delivery of new plant (in particular large on-track plant) where two years is a realistic allowance for delivery.	With long lead times for delivery of new plant, Aurizon Network may find itself in a position where delivery of full scope is difficult to achieve. Ability to source short term hire of narrow gauge plant from the marketplace is limited and at a premium.	With an aging resurfacing fleet Aurizon Network is currently investing in new plant to support the tonnage increases.
	Network Derailments or Accidents	Major derailments totalling $5.3m had an impact on maintenance scope and costs during 2010/11. There were five major derailments in 2010/11 causing major track and infrastructure damage to the Network; this is in line with the long term average.	Recovery for these incidents is dependent on the relative distance and infrastructure damaged during the derailment, e.g. damaged turnouts require extensive repairs and equipment.	Internal resource provide for a minimum capacity to respond to incidence subject to severity and location (supplemented when possible by external resource)
	Inflation	The boom in coal prices has led to significant expansion in the mining industry which in turn has led to increases in fuel, accommodation, labour and consumables far in excess of prediction.	Maintenance cost increases beyond ability for Network to recover from industry.	The proposed MCI better reflects current cost drivers for Network in CQCN.
	Availability of raw materials (e.g. ballast)	Hired plant is exceptionably difficult to acquire and needs to be booked at least two to three months in advance of the programmed maintenance closure.	Inefficient use of closure especially where scheduling has been adjusted to accommodate supply chain requests.	Ensure Aurizon Network has options for delivery and lock in contracts for guaranteed supply over longer term where available and prudent.

#	Risk Factor	Description	Consequence	Mitigation
	Availability of crew accommodation	The limited availability of accommodation, due to high demand, to perform maintenance on the network has been a significant issue since 2010/11.	The result was that many crews had to travel long distances to complete maintenance tasks, adding to cost and introducing greater fatigue management issues.	Further investigation currently underway for alternative accommodation but is primarily reliant on market forces increasing availability in Central Queensland.