Aurizon Network 2013 Draft Access Undertaking

Engineering Technical Assessment of Maintenance, Operating and Capital Expenditure Forecast

QUEENSLAND COMPETITION AUTHORITY

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SINCLAIR KNIGHT MERZ

SKM

Engineering Technical Assessment of Aurizon Network's Maintenance, Operating and Capital Expenditure

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Assessors	Andy Henry, Hope Stevens
Prepared by:	Andy Henry, Hope Stevens
Reviewed by:	Benjamin Wells
Approved by:	Stephen Hinchliffe
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Sinclair Knight Merz
ABN 37 001 024 095
Cnr of Cordelia and Russell Street
South Brisbane QLD 4101 Australia
PO Box 3848
South Brisbane QLD 4101 Australia

Tel: +61 (07) 3026 7100
Fax: +61 (07) 3026 7300
Web: www.globalskm.com

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Executive summary

The Queensland Competition Authority (the Authority) engaged Sinclair Knight Merz (SKM) to undertake an engineering technical assessment of forecast maintenance expenditure, operating expenditure and the asset renewals component of capital expenditure which is proposed by Aurizon Network Pty Ltd (Aurizon Network) in the 2013 draft access undertaking (UT4) for the Central Queensland Coal Region (CQCR).

SKM's primary deliverables were:

1. review of forecast maintenance expenditure including:
    - assessment of Aurizon Network's forecast maintenance expenditure and benchmarking against similar below rail operations as well as historical actual maintenance expenditure for the CQCR, including consideration for productivity improvements; and
    - identification of any irregularities, such as 'double counting' and adjusting the forecast maintenance costs as required.
2. assessment of the reasonableness of Aurizon Network's proposed incremental maintenance reference tariff component (AT_1 reference tariff);
3. review of forecast operating expenditure including:
    - assessment of Aurizon Network's operating expenditure forecast for reasonableness based on historical actual operating expenditure for the CQCR; and
    - benchmarking of forecast operating expenditure against similar below rail operations.
4. review of forecast asset renewal component of capital expenditure including:
    - assessment of Aurizon Network's forecast renewals expenditure, with particular focus on the relationship between asset renewals and maintenance expenditure; and
    - assessment of Aurizon Network's forecast asset renewals programme on the basis of reasonableness.

Maintenance expenditure review

Aurizon Network's forecast maintenance costs for the UT4 period were found to be reasonable in the context of forecast tonnages, although reductions were proposed by SKM to reflect:

- a constrained ballast undercutting scope; and
- additional savings, which should be realised from Aurizon Network's productivity assumptions for turnout rail grinding.

To provide transparency on the efficiency of forecast and actual maintenance activities, SKM recommended that Aurizon Network distinguish on a yearly basis (i) the location of its planned preventative maintenance activities for the coming year (i.e. those areas where condition-based projections have identified the need for intervention), (ii) the location of its unplanned preventative maintenance activities for the past year (i.e. those areas, different from the planned preventative maintenance locations, where condition-based assessments have identified an unexpected need for intervention) and (iii) the locations of its corrective maintenance activities for the past year.

SKM also proposed adjustments to the maintenance cost expenditure to account for the impact of alternate volumes as forecast by Energy Economics1 during the UT4 period, as well as a maintenance cost estimate for the 2017/18 financial year. The adjustments proposed by SKM (in real terms) are commensurate to the adjustments which could apply (on a system-wide basis) using Aurizon Network's proposed system allowable revenue adjustment methodology as described in Schedule F of Volume 1 of the UT4 and adjusted for inflation. However, it is noted that SKM's approach is based on mtpa while Aurizon Network's approach is based on gtk.

[1] In a separate commission for the Authority.

Energy Economics' forecast suggests reductions in mtpa but does not provide an estimate of the corresponding reduction in gtk. When comparing the two adjustment mechanisms, SKM has assumed that a reduction in mtpa would result in a similar reduction in gtk.

Incremental maintenance tariff (AT_1 reference tariff) review

SKM found that the structure of Aurizon Network's maintenance cost curve is likely to have altered since the Authority's 2001 decision and as such, Aurizon Network's proposed AT_1 reference tariffs may not reflect incremental maintenance costs for the UT4 period. SKM investigated three scenarios to derive an AT_1 reference tariffs, for which higher AT_1 reference tariffs than proposed by Aurizon Network were observed. The three scenarios investigated were:

1. The AT_1 reference tariffs which would apply if forecast maintenance expenditure and forecast gross tonne kilometres (gtk) are assumed as equal to the forecast provided by Aurizon Network;
2. The AT_1 reference tariffs which would apply if the scope of ballast undercutting is limited subject to Aurizon Network's demonstrated acquisition of additional spoil wagons and upgrades to existing wagons; and
3. Actual tonnages are lower than forecast by Aurizon Network, based on the forecast provided by Energy Economics on behalf of the Authority. The cost curve for this scenario is based on SKM's proposed adjustment to account for reduced tonnages.

Operating expenditure review

SKM proposed adjustments to Aurizon Network's forecast commercial development expenditure and utilities expenditure (other system costs) for the UT4 period. SKM also recommended that:

- Aurizon Network adjusts the system allocation of train control, safeworking and operations costs to ensure costs are efficiently allocated. This recommendation arose from SKM's review on an individual system basis which indicated that train control, safeworking and operations for the Moura system has become less efficient compared to the UT3 period, while the unit cost for other systems is indicating improved efficiencies;
- the Authority seeks to confirm that costs of compliance with the Coal Dust Management plan and changes to Queensland Workplace Health and Safety laws are appropriately reflected in both Infrastructure Management and Regulation and Policy cost forecasts;
- the Authority obtains an estimate of the value of expensed project costs associated with labour intensive operations during capital works, and that these costs are excluded from the approved operating expenditure forecast; and
- the Authority seeks to gain further evidence from Aurizon Network to support estimated cost savings associated with regenerative braking trials which have been published in Aurizon Network's Investor Briefing dated 18 July 2013 ($2.5 million).

SKM also conducted a review of Aurizon Network's forecast derailments frequency and dewirements annual cost. SKM concluded that the derailments frequency is reasonable in the context of benchmark operators but is likely overstated since improvements should apply (in particular) from the preventative resurfacing regime proposed for the UT4 period, and also from the inclusion of severe weather events in the historical data set. SKM was unable to provide a proposed adjustment since detailed data was not provided. SKM proposed an adjustment to the annual dewirements cost to remove the impact of severe weather events which occurred in 2011 from the historical data set.

Asset renewals review

SKM found that Aurizon Network's forecast asset renewals expenditure was derived on a top-down basis. Given the lack of available asset information on age, condition and remaining capability, SKM found the proposed forecast to be reasonable in the context of the value of the regulated asset base (RAB) and in comparison to forecast maintenance expenditure. In regards to Aurizon Network's Asset Maintenance and Renewal Policy document, SKM recommends that the Authority review the policy in accordance with Schedule E of the UT4.

SKM also found that the planned asset renewals program could reasonably occur (based on a typical breakdown of asset renewals each year provided by Aurizon Network), given the available human and plant resources, during the planned track closures as detailed in asset renewals work program.

Stakeholder submissions

In August 2013 the Authority issued a Consultation Paper inviting submissions in response to Aurizon Network's UT4 submission. The Authority's purpose was to assist interested parties / stakeholders through the public consultation phase, with submissions to focus on "those matters where Aurizon Network has proposed new approaches or where it appears to have sought to substantially alter existing rights, obligations and responsibilities"[2]

The Authority also noted that the review should focus on "promoting the economically efficient operation of, use of and investment in regulated infrastructure, with the effect of promoting competition in other markets (e.g. the above-rail haulage market)"[3] as well as the legitimate business interests of Aurizon Network, the interests of access seekers and the general public.

In response to stakeholder submissions, the Authority requested that SKM review and provide opinion on the issues raised in relation to forecast maintenance costs, operating costs and the capital indicator from the following stakeholders:

- Queensland Resources Council
- Rio Tinto Coal Australia
- BHP Billiton Mitsubishi Alliance and BHP Billiton Mitsui Coal
- Asciano

The appendices to this report provide SKM's opinion in the context of stakeholder submissions which are relevant to SKM's review.

General observations of maintenance, operating, capital expenditure (asset renewals) forecasts, and future access undertakings

At the start of the commission, Aurizon Network's asset managers and cost estimators presented an overview of the UT4 asset management strategy and a detailed breakdown of the methodology for estimating the maintenance costs for the UT4 period. SKM noted that there are some areas within the CQCR with less age and condition data. A detailed understanding of assets reaching the end of their life expiry as well as the overall condition of assets on the network was unknown. It was also noted that Aurizon Network are planning significant asset data collection improvements to address these issues, which is a positive development and should enable further planning and renewal cost improvements, particularly related to ballast and formation renewal during the next undertaking period (UT5). To this end, SKM noted that Aurizon Network is currently developing a Network Asset Management System (NAMS) tool to assist with the management of maintenance and asset renewal activities.

SKM's review of all productivity improvements assumed by Aurizon Network indicated that most of the planned productivity improvements were achievable; however forward planning would be paramount in ensuring the proposed savings are realised during both the current UT4 period and future UT5 undertaking. In addition, SKM noted that savings from Aurizon Network's transition from unplanned preventative maintenance to planned preventative maintenance would also realise maintenance cost savings during the next undertaking period (UT5).

[2] The Authority, 2013, piii

[3] The Authority, 2013, p2

1. Glossary

Abbreviations and definitions used in this document (including Appendices) are listed in **Table 1-1**.

Table 1-1 : Abbreviations, acronyms and terminology

Abbreviation, Acronyms and Terminology	Description / Definition
AC	Alternating Current
APCT	Abbot Point Coal Terminal
ARR	Annual revenue requirement
ARTC	Australian Rail Track Corporation
AT_1	Incremental maintenance tariff (based on 1000 gtk)
AT_2	Incremental capacity component that is levied on a Train Path basis
AT_3	Pricing component that is levied on a ntk basis
AT_4	Pricing component that is levied on a nt basis
AT_5	Electric access tariff that is levied on an egtk basis
Aurizon Network	On 3 December 2012, QR Network Pty Ltd changed its name to Aurizon Network Pty Ltd.
BMA and BMC	BHP Billiton Mitsubishi Alliance and BHP Billiton Mitsui Coal
CPI	Consumer price index
CQCN	Central Queensland Coal Network
CQCR	Central Queensland coal region
CQCR	Central Queensland coal region
CQIRP	Central Queensland Integrated Rail Project
CWR	Continuous welded rail
DAU	Draft Access Undertaking
DC	Direct Current
DCF	Discounted Cash Flow
DORC	Depreciated Optimised Replacement Cost
EC	Electric energy component
EVP Network	Executive Vice President Network
FTE	Full time equivalent
FY	Financial year
GAPE	Goonyella to Abbot Point system
GPR	Ground penetrating radar
gtk	Gross tonne kilometre
HVCN	Hunter Valley Coal Network
MAR	Maximum allowable revenue
MCI	Maintenance cost index
MGT	Million gross tonnes
mt	Million tonnes
MTPA / mtpa	Million tonnes per annum
MWh	Mega Watt hours
NAMS	Network Asset Management System
nt	Net tonnes

Abbreviation, Acronyms and Terminology	Description / Definition
ntk	Net tonne kilometre
OBS	Organisational Breakdown Structure
Q1	Quarter 1
QRC	Queensland Resources Council
QRC	Queensland Resources Council
RAB	Regulated asset base
RFI	Request for Information
RTCA	Rio Tinto Coal Australia
SKM	Sinclair Knight Merz
STS	Specialised Track Services
tal	Tonne axle load
The Authority	Queensland Competition Authority
tp	Train paths
UT	Ultrasonic testing
UT3	2010 Access Undertaking (2009/10 – 2012/13)
UT4	2013 Access Undertaking (2013/14 to 2016/17)
UT5	2017/18 -2020/21 Access Undertaking
WACC	Weighted Average Cost of Capital
WICET	Wiggins Island Coal Export Terminal
WIRP	Wiggins Island Rail Project

2. Introduction

2.1 Background

The Authority is an independent statutory body responsible for the implementation of competition policy in Queensland, and is responsible for the economic regulation of the below-rail infrastructure owned by Aurizon Network. Aurizon Network operates the below-rail coal network in the CQCR and is a wholly owned subsidiary of Aurizon Holdings Limited. The CQCR comprises four systems, namely, Moura, Blackwater, Goonyella and Newlands. Aurizon Network also operates the Goonyella to Abbot Point Expansion system (GAPE) which connects the Goonyella and Newlands systems.

Aurizon Network is subject to an access undertaking for the CQCR which is approved by the Authority and sets out the terms and conditions under which Aurizon Network will provide access to rail infrastructure covered by the undertaking. These include reference tariffs for coal-carrying train services for the CQCR and processes to establish access charges for new train services. The undertaking also sets out the process required for an access seeker to negotiate access to the infrastructure and how any disputes in relation to access are to be resolved.

Aurizon Network's current access undertaking which applied for the UT3 period expired on 30 June 2013. Accordingly, Aurizon Network submitted a replacement undertaking to the Authority on 30 April 2013 for the four-year regulatory period between 2013-14 and 2016-17 (the UT4 period).

2.2 Task description and report structure

SKM was engaged by the Authority to conduct a review of forecast maintenance, operating and asset renewals expenditure for the CQCR.

This report provides a summary of the results of SKM's assessment and provides recommendations for the Authority's consideration. The individual assessments prepared for the individual tasks as per the Authority's brief are enclosed in **Attachment A** to **Attachment F** to this main report, as follows:

- **Attachment A**: High level and detailed review of forecast maintenance costs;
- **Attachment B**: Review of incremental maintenance reference tariff component;
- **Attachment C**: Benchmarking of specific aspects of the operating expenditure forecast;
- **Attachment D**: Specialist opinion on specific aspects of the operating expenditure forecast;
- **Attachment E**: Technical advice on trade-off between asset renewals and maintenance expenditure; and
- **Attachment F**: Review of the asset renewals work program.

3. Assessment results and recommendations

This section provides a summary of SKM's task description, methodology, and assessment results and recommendations in relation to maintenance, operating and asset renewals expenditure forecast by Aurizon Network for the UT4 period.

3.1 High level and detailed review of forecast maintenance costs

3.1.1 Task description and methodology

SKM's review of forecast maintenance costs combined the high level and detailed review outlined in the brief provided by the Authority and includes:

- the outcomes of the assessment of Aurizon Network's forecast expenditure in the context of Aurizon Network's forecast volumes;
- SKM's proposed maintenance expenditure for the 2017/18 financial year; and
- SKM's proposed adjustment for revised volumes during the UT4 period based on the forecast provided by Energy Economics on behalf of the Authority.

At the start of the commission Aurizon Network's asset managers and cost estimators presented an overview of the UT4 asset management strategy and a detailed breakdown of the methodology for estimating the maintenance costs for the UT4 period. This presentation and the subsequent meetings with Aurizon Network staff provided a general understanding of Aurizon Network's processes to derive and refine their below-rail infrastructure maintenance activities and costs.

Following the presentation, SKM requested the following information from Aurizon Network which has been utilised as part of this review:

- historical and forecast maintenance expenditure by major cost category, on an individual system and regional basis, including confirmation of the price year;
- historical and forecast operating volumes, specifically gross tonne kilometres (gtk) and million tonnes per annum (MTPA) on a system and regional basis;
- detailed information on Aurizon Network's expected productivity improvements for the UT4 period which have been built into the cost base; and
- key assumptions underpinning the maintenance cost forecast for the UT4 period, including unit costs for major cost categories and the extent of the scope of works (for example, kilometres of rail grinding).

All costs were requested exclusive of corporate overheads and SKM has utilised the cost estimates provided by Aurizon Network in Microsoft Spreadsheet format to undertake this review.

Attachment A provides the high level and detailed review of forecast maintenance costs and gives more detail on the methodology applied by SKM, including escalation of costs to real financial year 2011/12 dollars (the maintenance cost base year) and the normalisation methodology applied for the benchmarking exercise.

3.1.2 Conclusions and recommendations

SKM found that the forecast maintenance costs are efficient for the UT4 period when accounting for Aurizon Network's forecast volumes; however recommendations have been made to:

- limit the scope of the ballast undercutting task until such time that the additional spoil wagons are acquired; and
- realise additional savings (although not significant) from Aurizon Network's productivity assumptions for turnout rail grinding.

Table 3-1 provides a summary of SKM's findings.

Table 3-1 Summary of findings – high level and detailed review of maintenance cost forecast

Review	Summary of findings
Forecast maintenance expenditure compared to historical levels	SKM found that the forecast maintenance for the CQCR and individual systems is reasonable on the basis of: • declining unit costs compared to the UT3 period; • the cost composition compared to historical actuals, noting that the cost and maintenance basis includes consideration for costs incurred and the scope of maintenance task achieved in the 2011/12 financial year; and • the cost per track kilometre compared to tonnage over 8 years between the UT3 and UT4 period, which reflects allocations of maintenance expenditure across individual systems which would be expected based on size, tonnage and system characteristics.
System allocation of costs	SKM found that system characteristics are similar across the CQCN and that Aurizon Network's allocation to individual systems is reasonable based on the size and condition of individual systems and the forecast volumes.
Ballast undercutting scope	SKM found that Aurizon Network's proposed ballast undercutting scope and costs are reasonable in the context of historical ballast fouling and the impact of new volumes. However, recommendations were made to limit the scope of the ballast undercutting task until Aurizon Network acquires the additional ballast wagons proposed in the UT4 Maintenance Submission.
Benchmarking	SKM found that Aurizon Network's forecast maintenance cost is appropriate in the context of the benchmarking exercise against the ARTC's forecast maintenance costs for the HVCN. The benchmarking exercise indicates that costs are efficient when considering the size of the networks and the purchase price of key maintenance materials / consumables.
Double counting of maintenance costs	SKM found that the approach employed by Aurizon Network (as recommended by GHD in as part of the review of maintenance costs for the UT3 period) is a reasonable approach to mitigate the risk of misappropriation of maintenance costs (including from above rail activities) since it provides a means for individual cost centres to ensure that expensed costs refer to particular sections of track and for specific maintenance products.
Productivity improvements	SKM's review of the productivity improvements assumed by Aurizon Network indicated that most of the planned productivity improvements are achievable; however forward planning is paramount in ensuring savings are realised. In addition, SKM made an adjustment for savings which should be realised from improved productivity assumed by Aurizon Network for the turnout rail grinding maintenance task.
Depreciated Optimised Replacement Cost (DORC)	SKM found that adjustments to the RAB in the context of a DORC evaluation may be required since the proposed maintenance strategy (in particular, the level of ballast undercutting and the transition to a planned preventative maintenance regime) would reasonably be expected to leave the CQCR in a better state than during the UT3 period.

Table 3-2 summarises Aurizon Network's total proposed maintenance expenditure in financial year 2011/12 dollars compared to SKM's proposed expenditure.

Table 3-2 SKM's total proposed allowable maintenance expenditure ($FY12)

Year	2013/14	2014/15	2015/16	2016/17
Aurizon Network Proposed Maintenance				
Aurizon Network's total proposed maintenance expenditure	$189,510,015	$204,260,394	$210,332,434	$213,914,647
SKM Adjustments				
Less ballast undercutting adjustment	-	-$9,461,855	-$11,150,448	-$12,227,242
Less productivity improvement for turnout rail grinding	-$35,023	-$35,023	-$35,023	-$35,023
SKM's proposed total allowable maintenance	$189,474,992	$194,763,517	$199,146,964	$201,652,382

Measurement of planned and unplanned maintenance activities

To provide transparency on the efficiency of forecast and actual maintenance activities, SKM recommended that Aurizon Network distinguish on a yearly basis (i) the location of its planned preventative maintenance activities for the coming year (i.e. those areas where condition-based projections have identified the need for intervention), (ii) the location of its unplanned preventative maintenance activities for the past year (i.e. those areas, different from the planned preventative maintenance locations, where condition-based assessments have identified an unexpected need for intervention) and (iii) the locations of its corrective maintenance activities for the past year.

2017/18 maintenance cost forecast

SKM provided an indicative forecast for efficient maintenance costs for the CQCR in the 2017/18 financial year, which assumes constant volumes as forecast by Aurizon Network in the 2016/17 financial year. SKM proposed a maintenance cost allowance of $196.7 million compared to Aurizon Network's forecast for the 2016/17 financial year of $213.9 million in financial year 2011/12 dollars.

SKM noted that the forecast will likely be subject to change by Aurizon Network when more information is known about forecast volumes for the 2017/18 financial year. However, SKM recommended that the Authority review if the forecast includes savings from the planned preventative maintenance strategy which will be implemented during the UT4 period. Specifically, savings should be observable for rail grinding, resurfacing and general track in terms of:

- total absolute dollars;
- a reduction in the actual scope; and
- a reduction in the unit cost of maintenance.

Impact of revised volumes

SKM provided recommendations for reductions in the allowable maintenance costs associated with Energy Economics forecast of lower volumes for the UT4 period. The total recommended adjustment is provided in **Table 3-3** and is based on Aurizon Network's forecast (i.e. they do not include the impact of SKM's proposed adjustments outlined in **Table 3-2**).

Table 3-3 SKM's recommended total adjustment for reduced volumes on the CQCR ($FY12)

2013/14	2014/15	2015/16	2016/17
-$4.88	-$8.44	-$8.78	-$7.00

3.2 Review of incremental maintenance reference tariff component

3.2.1 Task description and methodology

Aurizon Network's forecast maintenance cost is a significant component of Aurizon Network's annual revenue requirement (ARR) and, therefore, the reference tariffs for coal train services.

Reference tariffs for coal train services are determined in order to recover Aurizon Network's costs (ultimately approved by the Authority) over the regulatory period. There are four components for non-electric tariffs (AT_1, AT_2, AT_3 and AT_4) and one component for electric tariffs (AT_5).

The AT_1 tariff component reflects the portion of Aurizon Network's forecast maintenance cost that varies with usage (i.e. the incremental maintenance cost at the base tonnage). Each of the coal systems in the CQCR has a unique AT_1 tariff based on the incremental maintenance cost of that system, expressed on a $/'000 gtk basis.

The current AT_1 reference tariff for each CQCR system was determined in the Authority's 2001 decision, based on an analysis of Aurizon Network's incremental costs as a function of tonnage and train characteristics and on overseas rail system benchmarks. Aurizon Network has largely applied this charge since that decision, inflating it by actual CPI, and proposes to continue this approach in Aurizon Network's UT4 submission.

In this context, the Authority engaged SKM to determine whether the proposed AT_1 reference tariff (for each coal system in the CQCR) is reasonable based on:

- assessing Aurizon Network's proposed data, methodology and supporting information;
- benchmarking Aurizon Network's proposed forecast incremental maintenance costs against relevant industry comparators (on a $/'000 gtk basis); and
- any other factor SKM considers relevant.

SKM undertook a review of typical rail maintenance activities in order to determine:

1. the appropriateness of Aurizon Network's proposal to roll-forward the current AT1 reference tariff in light of what factors may have changed since these rates were set in 2001; and
2. whether the proposed AT1 reference tariff and/or SKM's observed AT1 reference tariff aligned to relevant industry comparators (benchmarking against the Australian Rail Track Corporation's (ARTC's) Hunter Valley Coal Network (HVCN)).

Attachment B contains a full review of the incremental maintenance tariff component.

3.2.2 Conclusions and recommendations

SKM found that the structure of Aurizon Network's maintenance cost curve is likely to have altered since the Authority's 2001 decision and as such, Aurizon Network's proposed AT_1 reference tariffs may not reflect incremental maintenance costs for the UT4 period.

Therefore, SKM conducted an assessment to derive proposed AT_1 reference tariffs for each system per year based on the best fit cost curves and resulting incremental cost curves for the following scenarios:

1. forecast maintenance expenditure and forecast gtk are assumed as equal to the forecast provided by Aurizon Network (Scenario 1);
2. the scope of ballast undercutting is limited based on SKM's recommendation that the scope should be limited subject to Aurizon Network's demonstrated acquisition of additional spoil wagons and upgrades to existing wagons (Scenario 2); and
3. actual tonnages are lower than forecast by Aurizon Network, based on the forecast provided by Energy Economics on behalf of the Authority (Scenario 3). The cost curve for this scenario is based on SKM's proposed adjustment to account for reduced tonnages.

While there are some limitations noted with the approach, SKM concludes that Aurizon Network's maintenance cost curve is likely to have significantly altered since the Authority's 2001 decision and that the AT_1 reference tariffs should be updated accordingly. **Figure 1** provides the best fit cost curves and incremental cost curves observed by SKM based on Aurizon Network's forecast maintenance expenditure and volumes (Scenario 1).

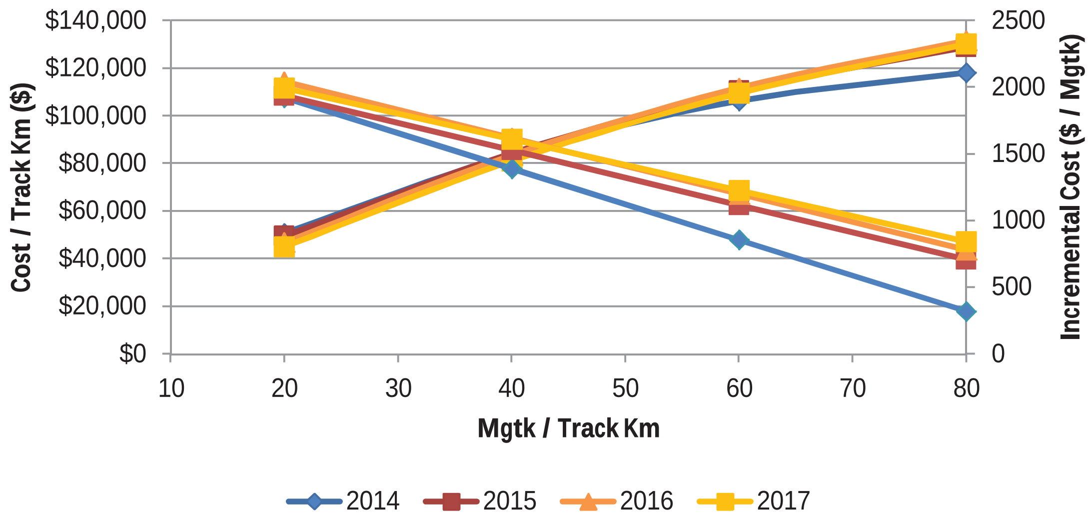

Figure 1 Best fit maintenance cost curves and incremental maintenance cost curves ($2011/12)

Table 3-4 provides SKM's observed AT_1 reference tariffs for individual scenarios compared to Aurizon Network's proposed AT_1 reference tariffs. The AT_1 reference tariffs are provided in nominal dollars based on Aurizon Network's forecast maintenance cost index (MCI) for the UT4 period, which is subject to an additional review. The AT_1 reference tariffs were derived by escalating the forecast maintenance costs in line with the proposed MCI and observing the associated incremental cost. SKM found that this approach is more accurate than indexing an approved tariff from the 2013/2014 financial year, since it takes into account Aurizon Network's cost structure for individual years and the incremental cost at the base tonnage for each year of the UT4 period. The observed reference tariffs are higher than the values proposed by Aurizon Network, which will position a greater portion of the maintenance expenditure outside of the revenue cap.

Table 3-4 Summary of AT_1 reference tariff options ($FY2012)

Financial Year	Scenario 1	Scenario 2	Scenario 3
Moura			
2013/14	$2.1045	$2.2200	$2.1045
2014/15	$2.0467	$2.0055	$2.0360
2015/16	$2.1685	$2.4491	$2.1376
2016/17	$2.0844	$2.4115	$2.0452
Newlands (excl. GAPE)			
2013/14	$2.0424	$1.9642	$2.0424
2014/15	$2.0146	$1.9254	$2.0048
2015/16	$2.1026	$2.3414	$2.0746
2016/17	$2.0150	$2.3604	$1.9798
Blackwater			
2013/14	$1.6783	$1.2999	$1.6783
2014/15	$1.7192	$1.3314	$1.7167
2015/16	$1.7436	$1.8624	$1.7312
2016/17	$1.6634	$1.9729	$1.6485
Goonyella			
2013/14	$1.5662	$1.0618	$1.5662
2014/15	$1.6018	$1.1779	$1.6022

Financial Year	Scenario 1	Scenario 2	Scenario 3
2015/16	$1.6578	$1.7778	$1.6491
2016/17	$1.6103	$1.8995	$1.5985
GAPE			
2013/14	$1.5355	$0.9659	$1.5355
2014/15	$1.4953	$0.7809	$1.4983
2015/16	$1.5142	$0.9209	$1.5118
2016/17	$1.4468	$1.1854	$1.4445

Source: SKM, based on information provided by Aurizon Network on 28 August 2013 and 20 September 2013 and information provided by the Authority on 10 October 2013

3.3 Benchmarking of specific aspects of the operating expenditure forecast

3.3.1 Task description and methodology

Aurizon Network's proposed Maximum Allowable Revenue (MAR) for the UT4 period includes an allowance for recovery of operating costs which reflect the efficient standalone costs of operating the below rail coal network (the CQCR). The total proposed allowance for the CQCR includes:

- system wide and regional costs (which includes the cost of operating the network and an allowance for corporate costs);
- risk and insurance (which Aurizon Network has developed consistent with the UT3 methodology);
- transmission connection costs;
- electricity on selling costs; and
- working capital.

SKM conducted a review of specific aspects of the operating expenditure forecast, including benchmarking against relevant below rail coal operators and benchmarking against Aurizon Network's historical actual expenditure, excluding corporate overheads. Specifically, the Authority requested that SKM provide an assessment of the reasonableness of the following sections of Chapter 10 of Volume 3 of UT4 explanatory materials:

- train control, safeworking and operations and associated costs; and
- infrastructure management and associated costs.

As part of the review, the brief required SKM to:

- identify whether reasonable steps have been taken in balancing service and cost and identifying the appropriate level of service for the optimised network;
- explain the reasons for any differences identified between historical and operating costs, and costs of the benchmark operator;
- determine a forecast for reasonable operating costs for the 2017/18 financial year; and
- assess the appropriateness of proposed operating expenditure for revised volumes.

Attachment C provides the full review 'Benchmarking of specific aspects of the operating expenditure forecast' and detail on the methodology applied by SKM, including escalation of costs to real financial year 2012/13 dollars (the operating cost base year).

3.3.2 Conclusions and recommendations

SKM found that Aurizon Network's forecast operating expenditure (excluding corporate overheads) for the UT4 period was reasonable, subject to the following adjustments (cost adjustments are in real 2012/13 dollars). SKM recommended:

- that the Authority adjust the allowable commercial development expenditure for the UT4 period to the values proposed by SKM.
- that Aurizon Network adjust the system allocation of train control, safeworking and operations costs to ensure costs are efficiently allocated. This recommendation arose from SKM's review on an individual system basis which indicated that train control, safeworking and operations for the Moura system has become less efficient compared to the UT3 period, while the unit cost for other systems is indicating improved efficiencies.
- that the Authority revise the allowable utilities expenditure to reflect the average for the UT3 period ($0.8 million per year).
- that the Authority seeks to confirm that costs of compliance with the Coal Dust Management plan and changes to Queensland Workplace Health and Safety laws are appropriately reflected in Infrastructure Management and Regulation and Policy cost forecasts.
- that the Authority obtain an estimate of the value of expensed project costs associated with labour intensive operations during capital works, and that these costs are excluded from the approved operating expenditure forecast. SKM has attempted to obtain this information from Aurizon Network and but the information was not provided.
- that the Authority seek to gain further evidence from Aurizon Network to support estimated cost savings associated with regenerative braking trials which have been published in Aurizon Network's Investor Briefing dated 18 July 2013 ($2.5 million). While differential pricing is difficult due to limitations associated with monitoring individual train contributions, SKM found that these savings should still be reflected in the total operating cost forecast. If Aurizon Network does not provide evidence that the savings have already been accounted for, SKM recommended that the allowable operating expenditure for the UT4 period is revised down by $2.5 million, since this would reflect the ongoing minimum saving which would be expected from continuing regenerative braking trials.

2017/18 forecast

SKM found that Aurizon Network's breakdown of operating expenditure indicates that the operating costs are unresponsive to volumes[4]. SKM provided an operating expenditure estimate for the 2017/18 financial year based on Aurizon Network's estimate for the 2016/17 financial year, with the following adjustments:

1. SKM reduced the train control, safeworking and operations costs to the historical actuals from the 2012/13 financial year, since SKM the increase in costs for the UT4 period includes costs associated with training for succession planning;
2. SKM adjusted the allowable utilities expenditure to the average for the UT3 period;
3. the cost for commercial development was assumed as equal to SKM's proposed allowable commercial development expenditure for the 2016/17 financial year; and
4. regulation and policy costs were estimated as the average for the 2013/14 and 2014/15 forecast since the 2016/17 year includes increases associated with preparation of access undertaking submissions.

Table 3-5 provides SKM's estimate of operating expenditure for the 2017/18 financial year, which is provided in real financial year 2012/13 terms. SKM notes that this estimate will need to be revised by Aurizon Network if operating conditions significantly alter, including any significant changes in volumes and if coal vs. non-coal volumes significantly alter.

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[4] Costs are unresponsive for the level of volumes forecast by Aurizon Network although significant changes in volumes would be expected to alter the operating costs.

Table 3-5 SKM's estimate of operating costs for the 2017/18 financial year ($2012/13)

Operating cost (excl. corporate overhead)	SKM estimate for 2017/18
Total	$53,367,802.70

Source: SKM forecast based on information provided by Aurizon Network on 4 November 2013 and Chapter 10 of Volume 3 of the UT4 explanatory materials

SKM's 2017/18 operating expenditure forecast should also be further adjusted to ensure the estimate does not reflect expensed project costs and to ensure that savings associated with regenerative braking are realised.

Impact of revised volumes for the UT4 period

In order to review the efficiency of Aurizon Network's forecast operating expenditure in the context of revised volumes, SKM provided an estimate of total train paths on an individual system basis based on the forecast volumes provided by Energy Economics and Aurizon Network's reference train characteristics (average payload) for individual systems. **Table 3-6** provides SKM's estimate of total train paths in the context of revised volumes, which includes loaded and empty running trains, compared to Aurizon Network's forecast.

Table 3-6 SKM's estimate of train paths for revised volumes

System	SKM Estimate of Train Paths				Difference to Aurizon Network Forecast			
	2014	2015	2016	2017	2014	2015	2016	2017
Blackwater	14,392	14,678	15,206	15,926	722	-792	-1,956	-2,912
Goonyella	19,324	19,950	19,930	20,934	-56	-1,238	-2,376	-2,352
Moura	3,730	3,826	4,080	4,752	-276	-338	112	98
Newlands	4,604	4,256	4,924	5,216	292	-358	-16	-222
GAPE	2,070	3,324	4,516	4,808	-3,934	-4,072	-3,380	-3,652
Total	**44,120**	**46,034**	**48,656**	**51,636**	**-3,252**	**-6,798**	**-7,616**	**-9,040**

Source: SKM calculations based on Energy Economics (July 2013) and average payloads per system

SKM found that the forecast operating expenditure remains more efficient than the UT3 period even in the context of revised volumes (see **Figure 2**).

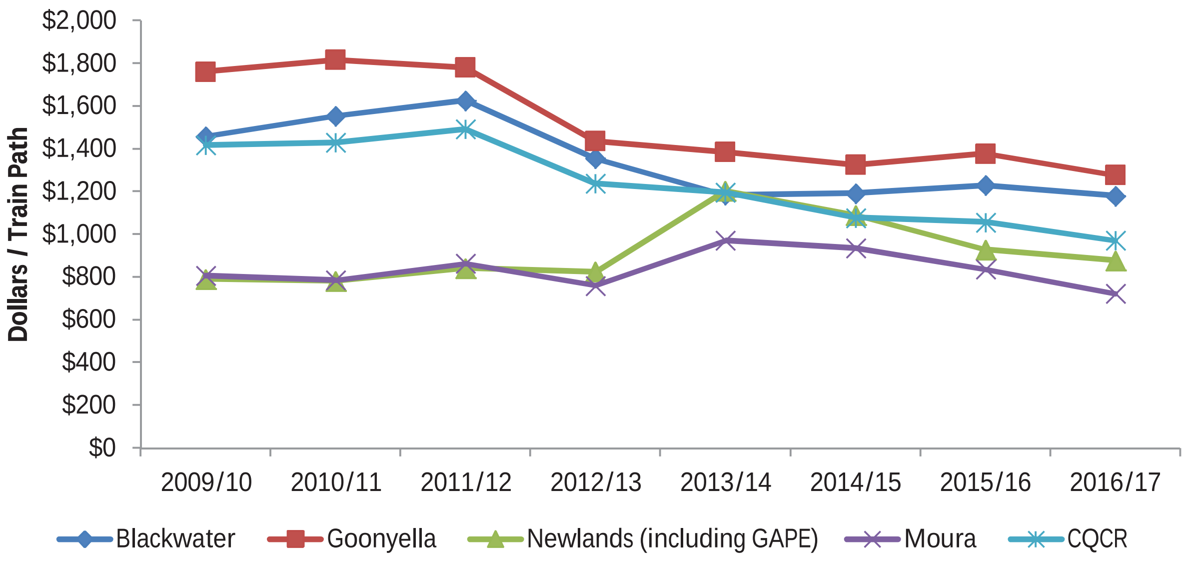


Figure 2 Dollars per train path (total operating expenditure) - revised volumes

Source: SKM graph based on Energy Economics (July 2013) and information provided by Aurizon Network on 4 November 2013

Aurizon Network has already proposed savings for most cost categories compared to the UT3 period, and SKM found that it would be difficult to realise any further savings, especially since operations is labour intensive and will not necessarily decline with the change in forecast volumes provided by Energy Economics. Specifically, SKM does not consider that the reduction in volumes will have a material impact on operations. However, given that Aurizon Network operates as a functional unit within Aurizon Holdings Limited, SKM found that the allocation of total costs to the regulated below rail infrastructure could be revised. **Table 1-1** provides SKM's proposed adjustment to the operating expenditure for the CQCR.

Table 3-7 SKM's proposed adjustment for revised volumes, operating expenditure ($2012/13)

	2014	2015	2016	2017
Train control, safeworking and operations (CQCR)	-$80,588.58	-	-	-
Total adjustment required to regulation and policy (CQCR)	-$14,461.41	-$38,187.82	-$2,373,297.51	-$1,502,759.03
Total adjustment required to commercial development (CQCR)	-$54,995.35	-$152,332.83	-$82,831.08	-$87,683.00
Total adjustment for revised volumes (CQCR)	-$150,045.34	-$190,520.65	-$2,456,128.59	-$1,590,442.03

SKM found that cost adjustments were not required for:

- all categories with an allocation of 100 per cent, since this indicates no opportunity for cost sharing and it would be difficult to realise any further savings for operations;
- infrastructure management, since the remaining allocations in financial year 2013/14, which are not part of the operating expenditure for CQCR, represent an allocation to capital works and is not impacted by changing train paths for normal operations; and
- EVP Network, since the allocation is stable during the UT4 period and is not impacted by change in train paths, and is shared across Aurizon Network as a stand-alone subsidiary within Aurizon Holdings Limited.

3.4 Specialist opinion on specific aspects of the operating expenditure forecast

3.4.1 Task description and methodology

Aurizon Network's forecast operating expenditure for the UT4 period includes allowance for risk and insurance, specifically:

- a premium for relevant specifically insured risks under the Industrial and Special Risks policy;
- a premium for corporate insurances which have been costed on the basis of Aurizon Network being a stand-alone entity; and
- a premium based on the costs of insuring key below-rail risks such as derailments, dewirements, weather events and below-deductible liability losses.

The Authority engaged SKM to provide specialist opinion on the reasonableness of:

- forecast derailments risk; and
- forecast dewirements annual cost.

SKM's review of the reasonableness of Aurizon Network's proposed derailments and dewirements risk was undertaken through:

- a review of Aurizon Network's key assumptions including analysis of the forecast change in risk and consequence (cost), noting that the derailments risk and dewirements annual cost was prepared by Finity Consulting on behalf of Aurizon Network;
- a review of key factors impacting derailments and dewirements risk, to inform the assessment of the reasonableness of Aurizon Network's forecasts, with specific focus on Aurizon Network's proposed maintenance program and operating conditions and the expected impact on derailments and dewirements risk; and
- a benchmarking exercise to inform the assessment of reasonableness, based on a review of international literature outlining historical derailments and dewirements risk. Where possible, SKM has attempted to obtain information for comparable heavy-haul / coal networks. However, it is noted that derailments and dewirements risk is generally not impacted by the type of haulage. Rather, the actual exposure and severity of consequence is impacted[5].

Based on the tasks outlined above, SKM concluded on the reasonableness of Aurizon Network's forecast derailment frequency and dewirements annual cost.

Attachment D contains SKM's specialist opinion on specific aspects of the operating expenditure forecast.

3.4.2 Conclusions and recommendations

Derailments

SKM found that Aurizon Network's forecast derailment risk is reasonable in the context of historical derailment rates from other operators reviewed in the benchmarking exercise (see **Figure 3**).

[5] It should be noted that while benchmarking provides a reasonable indicator as to the relative efficiency of specific aspects Aurizon Network's forecast operating expenditure, there are limitations associated with this approach. Specifically, differences in operational and system characteristics will impact on the cost structure across various operators. Therefore, SKM supplemented the benchmarking exercise with specialist opinion as to the appropriateness of forecasts, based on our knowledge of Aurizon Network's operational and system characteristics, including planned maintenance activities.

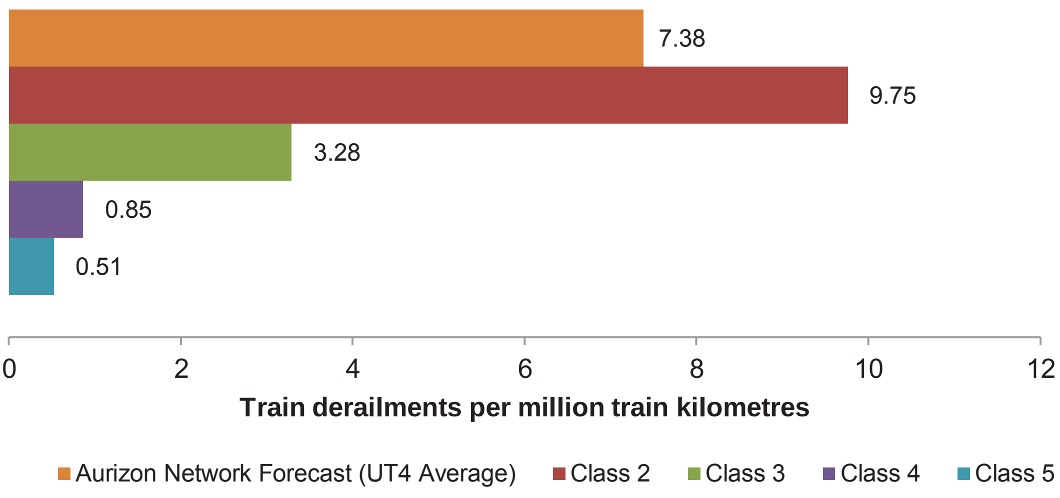


Figure 3 Aurizon Network's forecast derailment rate compared to US railroads

*Source: SKM graph summarising information provided in **Attachment D***

However, based on the review of Aurizon Network's proposed maintenance strategy for the UT4 period, SKM found that there are a number of proposed maintenance activities for the UT4 period which should result in a decline in the forecast running line derailment risk (no change is expected for yards / sidings).

SKM recommended that Aurizon Network seek an understanding of specific causes of derailments on the CQCR, which can be assessed against proposed preventative maintenance activities to determine the improvement in derailment risk which should occur. Alternatively, it was recommended that the Authority request that improvements are realised in the UT5 period (i.e. the derailment frequency should decline on a gtk basis from implementation of maintenance improvements and the size of loss could also reduce[6]).

Additionally, while the derailments frequency is reasonable relative to benchmark operators, SKM found that inclusion of severe weather events which occurred in 2011 is likely resulting in an over-statement of the derailments risk, since a probabilistic analysis has not been conducted by Aurizon Network to determine the likelihood of re-occurrence of severe weather events on an average annual basis, particularly considering that the CQCR was recently characterised by severe droughts and there was insufficient data from this period to utilise in the analysis.

SKM was unable to propose an adjustment to the derailments risk to remove the impact of severe weather events as the data utilised by Finity Consulting was not made available. Therefore, SKM recommended that the Authority further explore the impact of severe weather conditions which occurred in the UT3 period to determine if the forecast derailments frequency is overstated. Alternatively, the Authority may consider utilising the track derailments risk (frequency) forecast from the UT3 period.

Dewirements

SKM found that Aurizon Network's proposed methodology to forecast dewirements based on historical occurrences was reasonable, since maintenance and operation practices have a limited impact on the frequency of dewirements. However, the impact of severe weather conditions which occurred during the UT3 period (in 2011) was potentially distorting the historical frequency of dewirements.

SKM proposed a revised dewirements cost estimate to exclude the impacts of flood events in 2011. **Table 3-8** summarises SKM's recommended dewirements self-insurance for the UT4 period.

[6] Depending on the type of derailments impacted and the severity of consequences.

Table 3-8 SKM's recommended dewirements cost

Cost	2013/14	2014/15	2015/16	2016/17
Cost per km per year ($2013)	$96	$96	$96	$96
Estimated cost (millions, $2013)	$0.16	$0.16	$0.18	$0.18

Potential for double-counting

In order to ensure total self-insurance costs are not overstated, it was recommended that the Authority seek to confirm with Aurizon Network that forecast self-insurance from weather related events does not include costs of derailments and dewirements which are caused from weather related events. In this regard, SKM recommended that costs from derailments and dewirements are excluded from self-insurance for weather events, since these impacts are already captured in the derailments and dewirements forecast and there is considerable potential for 'double counting'.

Impact of revised volumes

SKM proposed a reduction to the forecast derailments self-insurance to account for revised volumes as forecast by Energy Economics, which equates to a total adjustment of approximately -$2.14 million over the UT4 period. SKM's revised total allowable self-insurance for derailments is produced in **Table 3-9**.

Table 3-9 Total allowable self-insurance for derailments based on revised volumes

SKM's proposed derailments self-insurance ($December 2013)	2013/14	2014/15	2015/16	2016/17
Track (excl. Large)	$1,076,852	$1,113,775	$1,172,293	$1,241,234
Yards / Sidings (excl. Large)	$520,785	$538,642	$566,942	$600,283
Large	$1,704,555	$1,763,001	$1,855,629	$1,964,756
Total	$3,302,192	$3,415,418	$3,594,864	$3,806,273
Reduction from Aurizon Network proposed	-$227,808	-$534,582	-$655,136	-$723,727

SKM noted that dewirements frequency is not impacted by train paths / volumes and no adjustment was provided for revised volume forecasts provided by Energy Economics.

3.5 Technical advice on the trade-off between asset renewals and maintenance expenditure

3.5.1 Task description and methodology

The Authority engaged SKM to assess the reasonableness of the Section 8.4 of Chapter 8 of Volume 3 of UT4 explanatory materials. Specifically, the Authority requested that SKM:

- assess the validity of discussion about the trade-off between renewals and maintenance expenditure;
- advise the Authority on whether Aurizon Network's forecast asset renewal expenditure is justified, having regard to Aurizon Network's proposed forecast maintenance expenditure; and
- assess the reasonableness of Aurizon Network's forecast asset renewals.

SKM undertook a review of Section 8.4 of Chapter 8 of Volume 3 of UT4 explanatory materials and supporting information provided by Aurizon Network and determined the following key assumptions underpinning:

- the method utilised by Aurizon Network to forecast asset renewals expenditure;
- Aurizon Network's approach to assessing the trade-off between asset renewals and maintenance; and
- Aurizon Network's Asset Management Policy, including intervention levels for renewals and maintenance and the approach to justification of capital expenditure.

SKM assessed reasonableness in the context of specialist knowledge on the value of asset renewals as a proportion of the RAB, the reasonableness of the Asset Management Policy and the validity of Aurizon Network's discussion on the trade-off between asset renewals and maintenance. SKM also provided a review of asset renewals on a unit cost basis per gtk, compared to the unit cost of maintenance per gtk from the UT3 period compared to the forecast for the UT4 period. This comparison informs the assessment on the validity of the trade-off between asset renewals and maintenance.

Attachment E provides SKM's review of the technical validity of the trade-off between asset renewals and maintenance expenditure.

3.5.2 Conclusions and recommendations

SKM found that Aurizon Network's forecast asset renewals expenditure is reasonable in the context of the value of the RAB and in comparison to forecast maintenance expenditure (see **Figure 4**). **Figure 4** shows that Aurizon Network's unit cost of asset renewals is declining relative to the UT3 period and is mostly constant during the UT4 period (reflective of Aurizon Network's approach to asset renewals based on gtk). **Figure 4** also shows that maintenance unit costs are declining, which means that Aurizon Network is effectively implementing a combined asset renewals and maintenance strategy, although it is noted that the declining maintenance unit costs also reflects Aurizon Network's forecast productivity improvements for the maintenance task, rather than the asset renewals strategy.

Overall, SKM concluded that the level of asset renewals proposed by Aurizon Network was unlikely to have a significant impact on maintenance costs in terms of forecast savings. For example, the typical breakdown of renewals which includes track formation renewal of 5 kilometres out of 2,667 kilometres on the network is not significant.

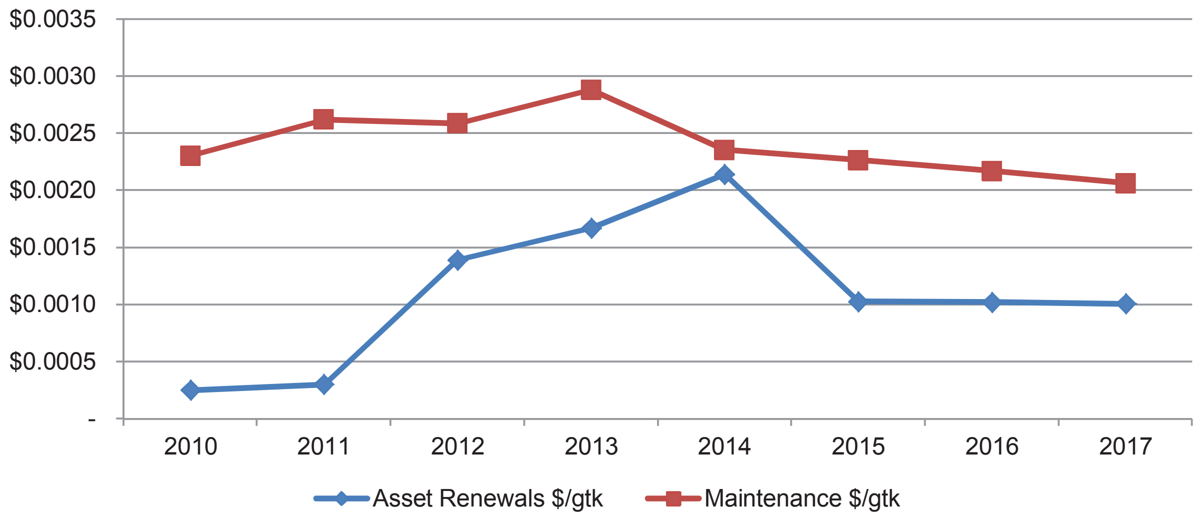


Figure 4 Unit cost of asset renewals compared to maintenance

*Source: SKM graph summarising information provided in **Attachment E***

SKM concluded that a top down approach has been applied by Aurizon Network, to determine its asset renewal requirements. Given that Aurizon Network does not yet have a detailed understanding of the actual allocation of renewals expenditure to specific projects; SKM has been unable to review the prudency of individual projects. SKM's review of Aurizon Network's Asset Maintenance and Renewal Policy and Stage Gate process provides confidence that prudency of expenditure with regards to scope standard and cost can be appraised. The Asset Maintenance and Renewal Policy (although still currently draft and un-approved by the Authority in accordance with Schedule A of the UT3 and Schedule E of the UT4) would provide a robust and consistent framework for asset management decision making.

SKM also conducted a review of Aurizon Network's proposed changes to asset lives and recommended that the Authority require Aurizon Network to re-instate a useful life of 40 years for power distribution assets, since power distribution assets are not impacted by tonnage. SKM also found that it would not be appropriate for Aurizon Network to re-adjust the useful life of assets again in the UT5 period, without robust evidence demonstrating the age and condition of all assets on the network, which should also be independently verified.

In regards to Aurizon Network's Asset Maintenance and Renewal Policy document, SKM recommends that the Authority review the policy in accordance with Schedule E of the UT4.

3.6 Review of the asset renewals work program

3.6.1 Task description and methodology

The Authority engaged SKM to assess the scope of Aurizon Network's forecast asset renewals expenditure in the context of:

- the proposed maintenance work program;
- the proposed major growth projects;
- Aurizon Network's human resources, in particular track staff;
- Aurizon Network's plant resources (e.g.: access to tampering machines); and
- the track closure times that would be necessary to achieve the proposed asset renewals and maintenance work programs as well as deliver the major projects.

Accordingly, SKM undertook a review of the track closure calendars in order to determine:

- the possible track closure times for Aurizon Network's asset renewal activities and works associated with proposed major growth projects; and
- the required human resources and plant resources to complete the works in the available track closure times.

For the purpose of this assessment, SKM assumed that all planned maintenance and capital expenditure activities (asset renewal, system enhancements) would occur during the planned track closure periods shown. SKM noted that opportunities exist for Aurizon Network to complete planned maintenance and capital expenditure activities (asset renewal, system enhancements) during unplanned track closures (due to weather related incidents or derailments, dewirements) and/or unplanned port and mine closures.

Attachment F provides SKM's review of the asset renewals work program.

3.6.2 Conclusions and recommendations

SKM found that the planned activities could reasonably occur, given the available human and plant resources, during the planned track closures as detailed in asset renewals work program.

As stated in Section 8.4.1.4 in Chapter 8 of Volume 4 of UT4 explanatory materials, Aurizon Network noted that inherent uncertainty associated with asset management meant that it was not possible to forecast the precise nature, amount and timing of renewals expenditure across the four years of the regulatory period, and that a top-down approach to estimating asset renewals requirements was normal in the rail industry. SKM agreed that a degree of judgment needs to be applied in prioritising and planning renewal activities, which can be impacted by changes in tonnages and asset condition, as well as significant weather events. SKM appreciated that the timing of renewal works could also change to maximise delivery efficiencies.

SKM noted that Aurizon Network state that every individual asset renewal project will be subject to the requirements of Aurizon Network's Capital Allocation Funding Framework, including the stage gate process (including completion of a business case, which may be subject to independent peer review and is designed to address the prudency tests for capital expenditure approval contained in Schedule A of the UT3 and Schedule

E of the UT4). SKM found that this was a reasonable approach to demonstrating justification for asset renewal activities. However, SKM found that greater emphasis on capability of assets (i.e. how long since particular asset were installed, how many tonnes/train passes assets have been subject to etc.) would assist with confirmation of prudency of scope. To this end, SKM noted that Aurizon Network is currently developing a NAMS tool to assist with the management of maintenance and asset renewal activities.

Attachment A: High level and detailed review of forecast maintenance costs

Contents

1. Glossary

Abbreviations and definitions used in this document are listed in **Table 1.1**.

Table 1.1: Abbreviations and Terminology

Abbreviation, acronyms and terminology	Description / definition
ARTC	Australian Rail Track Corporation
AT_1	Incremental maintenance tariff ($ per ‘000 gtk)
Aurizon Network	On 3 December 2012, QR Network Pty Ltd changed its name to Aurizon Network Pty Ltd.
BMA and BMC	BHP Billiton Mitsubishi Alliance and BHP Billiton Mitsui Coal
CQCN	Central Queensland Coal Network
CQCR	Central Queensland Coal Region
FY	Financial year
GAPE	Goonyella to Abbot Point
GPR	Ground penetrating radar
gtk	Gross tonne kilometre
HVCN	Hunter Valley Coal Network
MCI	Maintenance cost index
MGT	Million gross tonnes
MTPA / mtpa	Million tonnes per annum
Q1	Quarter 1
QRC	Queensland Resources Council
RAB	Regulated asset base
RFI	Request for Information
RTCA	Rio Tinto Coal Australia
SKM	Sinclair Knight Merz
tal	Tonne axle load
The Authority	Queensland Competition Authority
UT	Ultrasonic testing
UT3	2010 access undertaking
UT4	2013 access undertaking
UT5	2017 access undertaking
WIRP	Wiggins Island Rail Project

2. High level and detailed review of forecast maintenance costs

2.1 Task overview and background

SKM has been engaged by the Queensland Competition Authority (the Authority) to provide a review of Aurizon Network's forecast maintenance costs for the Central Queensland Coal Region (CQCR) for the UT4 undertaking period. SKM's review of forecast maintenance costs combines the high level and detailed review outlined in the brief provided by the Authority.

2.1.1 Adequacy of information provided and general comments

At the start of the commission Aurizon Network's asset managers and cost estimators presented an overview of the UT4 asset management strategy and a detailed breakdown of how they had built their maintenance cost forecasts. A copy of the presentations is included in **Appendix A.** This presentation and the subsequent meetings with Aurizon Network staff was very informative and provided a general understanding of Aurizon Network's processes to derive and refine their below-rail infrastructure maintenance activities and costs.

Following the presentation, SKM requested the following information from Aurizon Network which has been utilised as part of this review:

- historical and forecast maintenance expenditure by major cost category, on an individual system and regional basis, including confirmation of the price year;
- historical and forecast operating volumes, specifically gross tonne kilometres (gtk) and million tonnes per annum (MTPA) on a system and regional basis;
- detailed information on Aurizon Network's expected productivity improvements for the UT4 period which have been built into the cost base; and
- key assumptions underpinning the maintenance cost forecast for the UT4 period, including unit costs for major cost categories and the extent of the scope of works (for example, kilometres of rail grinding).

All costs were requested exclusive of corporate overheads. SKM has utilised the cost estimates provided by Aurizon Network in Microsoft Spreadsheet format to undertake this review. **Table 2-1** provides the total costs by major cost categories in 2011/12 dollars which were provided by Aurizon Network.

Table 2-1 Aurizon Network's forecast maintenance costs for the UT4 period ($millions, $FY2012)

CQCR	2013/14	2014/15	2015/16	2016/17
Ballast Undercutting	$62.8	$73.2	$74.6	$75.3
Mechanised Resleepering	-	-	-	-
Mechanised Resurfacing	$19.0	$19.0	$20.9	$20.9
Rail Grinding - Mainline	$9.7	$10.6	$11.0	$11.5
Rail Grinding - Turnouts	$2.9	$2.9	$2.9	$2.9
Track Geometry Recording	$0.4	$0.4	$0.4	$0.4
Ultrasonic Testing Ontrack Machine	$1.4	$1.5	$1.6	$1.5
Track, structures and facilities	$55.9	$58.0	$59.9	$61.8
Trackside systems	$28.0	$29.0	$29.5	$29.9

Traction	$9.6	$9.6	$9.6	$9.6

Source: Aurizon Network provided in response to SKM's RFIs detailed in Appendix B

2.1.2 Escalation of costs

Aurizon Network's forecast maintenance costs are provided in financial year 2011/12 price year. The price years for the historical maintenance expenditure (UT3) are based on the relevant submission period – for example, historical costs for the 2010/11 financial year are priced in 2010/11 dollars. Overall, costs range from a price year of 2009/10 to 2012/13 depending on the reporting year.

SKM has escalated the historical maintenance expenditure provided by Aurizon Network to a base year of 2011/12[1], utilising the Authority's approved weightings for the maintenance cost index between 2009/10 and 2012/13 (noting that 2012/13 is still subject to approval). All historical costs presented in this report are in real terms, reflecting SKM's indexation to the base year of 2011/12.

The weighted maintenance cost index is intended to more closely align with maintenance cost drivers, and includes consumables, labour, accommodation, fuel and assets. **Table 2-2** provides SKM's derived escalation indices which were utilised to escalate (or de-escalate) the costs to a base year of 2011-12.

Table 2-2 Cost escalation

2009/10 – 2011/12	2010/11 – 2011/12	2011/12	2012/13 – 2011/12 (De-escalation)
1.06	1.02	No adjustment required	1.03

Source: SKM calculations based on ABS sources outlined in Appendix B and information provided by the Authority on 10 October 2013

2.1.3 Benchmarking

SKM has obtained forecast maintenance expenditure for the Hunter Valley Coal Network (HVCN), which includes fixed and variable maintenance costs. These costs are benchmarked against Aurizon Network's historical (UT3 actual expenditure) and forecast maintenance costs (UT4 forecast expenditure) in **Section 2.2.5** of this report.

Maintenance cost estimates for the HVCN were sourced from the Australian Rail Track Corporation (ARTC) forecast for the 10-year period between 2011 and 2020 (inclusive). For consistency, as this analysis covers an 8 year period between UT3 and UT4, SKM has considered the ARTC's forecast costs between 2011 and 2018 (inclusive), noting that the ARTC's reporting period for the HVCN is based on calendar years rather than fiscal years. The reporting period is not expected to result in significant differences in the overall cost of operations compared to the CQCR, especially in regards to the unit costs.

SKM has made adjustments to the ARTC's forecast expenditure to a base year of 2011/12 (the ARTC's estimates have been escalated each year with the consumer price index and therefore SKM has also applied the same index). To note, Aurizon Network's MCI has not been applied to ARTC's forecast in order to de-escalate costs since ARTC's real cost estimate has been indexed with the consumer price index. Therefore in order to derive ARTC's real cost base the same index (the consumer price index) must be utilised.

Forecast gtk and MTPA of coal have also been obtained from the same source.

[1] Historical expenditure for the financial year 2013/14 has been deflated to a price year of 2011/12.

2.1.4 Normalisation methodology

Benchmarking is a useful exercise to assess the relative efficiency of Aurizon Network's operations compared to similar operators. However, SKM recognises that there are a number of characteristics of the individual coal systems which may not closely align with operating conditions on the Hunter Valley Coal Network (HVCN). As such, normalisation of maintenance cost estimates is required.

SKM has applied the normalisation approach detailed in '*Benchmark Heavy Haul Line – International and National Comparison*' report developed by Worley Parsons (2008). This normalisation formula is applied to ARTC's forecast maintenance costs for the HVCN between 2011 and 2018 (inclusive), noting that the ARTC's reporting period for the HVCN is based on calendar years rather than fiscal years. The reporting period is not expected to result in significant differences in the overall cost of operations compared to the CQCR, especially in the unit costs.

The normalisation formula is outlined below:

Multiplicative normalisation factor = 1 / (A + B – C) x D

Appendix C provides more detail on the components of the normalisation formula.

SKM recognises that there are some limitations associated with this normalisation approach, which is outlined below:

- the normalisation formula does not consider the impact of different train consists on the maintenance task;
- the normalisation formula does not account for the impact of differing levels of gtk on the maintenance task;
- the normalisation formula does not provide a definition of factors such as 'average grade', curvature and drainage conditions. Therefore due to potential variation of the definition of such factors, accurate normalisation may not be possible; and
- the normalisation formula does not account for relative size of the coal networks and constraints associated with undertaking maintenance in remote geographic locations.

Despite these limitations, SKM finds that this normalisation formula would provide some level of comparison; however further explanation on observed cost variances across operators is required.

Table 2-3 provides key inputs to the normalisation process, including SKM's derived normalisation factors for the CQCR compared to the HVCN.

Table 2-3 Normalisation factors[2]

Criteria	Blackwater	Goonyella	Moura	Newlands	HVCN
Track with Poor Drainage (%)	-	-	-	-	-
Length Curved Track	426.1	510.4	131.0	100.2	149.0
% Curved Track	38.5%	52.2%	50.4%	30.5%	38.0%
Track Grade > 1:100	-	-	-	-	-

[2] Source: Evans and Peck (October 2012) Operating and Maintenance Costs: Investigation and Benchmarking – Final Report and Aurizon Network (30 April 2013) UT4 Maintenance Submission (Confidential)

Factor A (formations)	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**
Number of switch & crossing units (#)	530.0	468.0	125.0	157.0	106.0
Length (km)	1,107.0	978.0	260.0	328.0	392.0
Number of tracks (#)	2.0	2.0	1.0	1.0	2.0
Length of welded turnouts	79.7	70.4	37.4	47.2	16.1
Length of welded turnouts (%)	7.2%	7.2%	14.4%	14.4%	4.1%
Total bridge length (km)	4.6	3.7	1.1	1.4	9.0
Length of tunnels & underbridges (%)	0.4%	0.4%	0.4%	0.4%	2.3%
Factor B (Structures)	**0.08**	**0.08**	**0.15**	**0.15**	**0.09**
Concrete sleepered track (%)	97.0%	100.0%	90.0%	90.0%	94.0%
Track with elastic fastenings (%)	97.0%	100.0%	90.0%	90.0%	100.0%
Track with CWR (%)	100.0%	100.0%	90.0%	90.0%	100.0%
Factor C (Track Quality)	**0.005**	**0.005**	**0.005**	**0.005**	**0.005**
Track gauge (mm)	1,067.0	1,067.0	1,067.0	1,067.0	1,435.0
Factor D (Track Gauge)	**1.03**	**1.03**	**1.03**	**1.03**	**1.00**
Normalisation Factor (Multiplication)	**1.174**	**1.173**	**1.079**	**1.080**	**1.199**

Source: SKM calculations, UT4 Maintenance Submission and Evans and Peck (2012)

2.1.5 Maintenance cost basis

SKM has undertaken a review of Aurizon Network's maintenance strategy and the maintenance costs basis for the UT4 period. Based on the outcomes of this review, SKM has identified two key points which we have taken into consideration as part of the review of forecast maintenance expenditure:

1. Aurizon Network is currently transitioning from an unplanned to a planned preventative maintenance approach.

   SKM notes that rail infrastructure owners around the world apply preventive maintenance techniques by performing planned maintenance and condition-based maintenance before faults occur. SKM also notes that Aurizon Network's actual maintenance spend systematically exceeds the forecast spend which suggests that they are not properly planning their maintenance tasks. Indeed, Aurizon Network has stated that the 2013/14 financial year and subsequent years of the UT4 period will be the first time that Aurizon Network intends to realise a planned approach to the maintenance task, which means that the maintenance effort is currently transitioning to preventative / planned approach. As part of this approach, the forecast UT4 maintenance expenditure is determined by Aurizon Network based on the unit cost of maintenance efforts for the 2011/12 financial year, and the level of maintenance task (scope) is planned in accordance with coal supply chain demands.

   SKM considers that asset knowledge (i.e. condition and capability information) is essential to developing a rigorous preventative maintenance program. Aurizon Network has demonstrated that it has developed a bottom-up forecast of its planned maintenance task over the UT4 period. However, SKM finds that Aurizon Network does not have the detailed asset knowledge required to program condition-based maintenance. SKM finds that Aurizon Network knows what level of preventative maintenance they expect to do in the UT4 period, but cannot predict where it will be required.

   In the interest of transparency, SKM recommends that Aurizon Network detail for each year of the UT4 period (i) the forecast condition of their infrastructure assets by location and (ii) state the location of its intended preventative maintenance activities. At the end of each year, SKM recommends Aurizon Network provide details and locations of actual maintenance spend.

Provision of this information would allow an objective measurement of planned and actual performance. SKM considers that this effort will result in a more robust cost estimate, and variations from the forecast would be minimised.

Although it is noted that in many circumstances the condition of its assets is unknown, SKM considers that Aurizon Network's approach to the development of the cost base which utilised 2011/12 actual costs to translate to a planned scope for the UT4 period is reasonably robust, although some levels of unplanned preventative maintenance may increase if it becomes apparent that the network is more degraded than anticipated.

SKM notes that availability of planned preventative maintenance activities would assist Aurizon Network to maximise potential efficiencies when responding to unplanned incidents that require corrective maintenance activities.

In summary, SKM recommends that on a yearly basis Aurizon Network provide the following information:

- the location of its planned preventative maintenance activities (i.e. those areas where condition-based projections have identified the need for intervention)
- the location of its unplanned preventative maintenance activities (i.e. those areas, different from the planned preventative maintenance locations, where condition-based assessments have identified the need for intervention); and
- the locations of its corrective maintenance activities

2. SKM notes that Aurizon Network has stated that the maintenance philosophy is centred on two key principles; safety and meeting the demands of the supply chain.

   According to Aurizon Network the forecast maintenance effort therefore incorporates consideration for:

   - ensuring the long-term integrity and safety of the network; and
   - ensuring that the network is maintained to a standard maximising supply chain efficiency, catering for volume growth and new mine development, and maintaining the level of service desired by users.

Aurizon Network's philosophy for maintenance and the planned approach to delivery of maintenance tasks means that the network should be maintained in a steady state condition which addresses the needs of access seekers. Despite this, SKM recognises that there are a number of factors which may result in total maintenance costs increasing each year. These include increased volumes on the network, safety requirements, the condition of assets and the quantity of assets to be maintained.

SKM notes that Aurizon Network states that increased volumes result in more limited access to conduct maintenance activities, and therefore maintenance crews can spend less time on track at any given time.

Increased volumes equal more train paths, which in turn will inevitably mean less track time available for maintenance activities. This means that Aurizon Network will require more staff and/o more shifts to undertake the maintenance task. The cost impact of more staff and/or shifts is further exacerbated depending on the location of works to be undertaken, since certain remote regions of the CQCR will mean that transport and accommodation costs would increase, which SKM considers is reasonable since there is less productive time per shift and more transport required. However, it is important to note that due to the planned approach to the maintenance task; efficiencies in the unit cost should be observable compared to the UT3 period.

The age (condition) of the assets is also a factor, since maintenance tasks associated with asset failures will increase with declining track quality. With this in mind, SKM notes that Aurizon Network's maintenance cost assumptions indicate that the forecast maintenance task accounts for the significant asset renewals program planned for the UT4 period. Therefore, some improvement in corrective general track maintenance should be observable. However, SKM has also undertaken a review of the proposed level of asset renewals and noted that the scope is not significant such as to have a significant impact on maintenance costs.

While asset condition and volumes are important in considering the maintenance scope, SKM notes that inspection activities will be required at similar levels as a mandatory requirement to ensure rail safety.

Other factors which would impact on total maintenance costs for the UT4 period include extensions to the quantity of assets associated with the WIRP expansion project (planned for implementation in 2014/15). However, SKM finds that this impact should be minimal during the UT4 period since these extensions would not be degraded and would therefore require minimal maintenance effort relative to other sections.

In line with the above considerations, SKM finds that the maintenance cost composition will differ across systems, and should take into account the factors identified by in the Authority's brief and discussed by SKM in **Table 2-4** below.

It is important to note that Aurizon Network's UT4 submission includes a detailed description about the characteristics impacting on the maintenance task for the CQCR and individual systems. Therefore unless SKM considers key points to be inaccurate or unsubstantiated in the submission than the information provided by Aurizon Network has informed SKM's assessment of reasonableness.

Table 2-4 Maintenance task drivers

Extent and configuration of systems	An overview of the extent and configuration of individual systems is provided in **Section 2.2.3** and SKM's assessment of reasonableness considers the various characteristics of the systems.
Age profile and condition of assets	SKM notes from Aurizon Network's UT4 submission and from our knowledge of the CQCR that weather conditions (such as heavy rainfall on all systems and salt spray around the port areas) will have an impact on the condition of assets and the maintenance effort required, particularly through issues associated with drainage, breakdowns in the ballast structure, deterioration of sleepers, corrosion of fastenings and poor top and line. SKM also notes Aurizon Network's submission about historical issues associated with the quality of the formation, particularly for the Moura systems, which results in an increased maintenance effort for resurfacing and general maintenance tasks. Additionally, the concrete sleepers used throughout the CQCN were traditionally designed for lower tonne axle loads of 22.5tal. With increasing traffic and tonnages the operating environment has become more onerous and sleepers are now required to accommodate 30tal on some systems. Sleepers that have been designed for 26.5tal can safely transport 30tal rollingstock albeit with comparable accelerated wear, and the appreciated effect of a

	resulting reduction in their average service life, and increased need for rail grinding[3]over the ageing sleepers to enhance the overall performance of rail, hence utilise the full life of the rails. Ageing sleepered track exacerbates periodic rail defects such as Short-wave corrugations –these defects are often associated with heavier axle loads and surface fatigue experienced on the rail of poor aligned or poor sleeper conditioned track. These periodic defects are frequently found on the field side of the low rail in curves.
Current capacity	Increasing tonnages each year will have an impact on the level of deterioration for individual systems. In addition, there are cost implications of access constraints to undertake the maintenance task, noting that infrastructure maintenance costs differ from above rail costs of operating trains as they are not directly variable with volume, but rather have a fixed and variable cost which is impacted by total tonnages. Costs associated with access constraints are primarily a result of limited possession periods which means that more shifts are required, impacting on labour costs as well as accommodation and transport costs. In addition, limited possession periods mean that a transition to preventative maintenance is more difficult. Therefore, a sophisticated asset management system including predictive maintenance data is required.
Geographic location of systems	Travelling to the more remote locations within systems such as the Blackwater and Goonyella systems can often mean accommodation is required for Aurizon Network's maintenance teams. In addition, it is not uncommon for insufficient local accommodation to be available which necessitates field crews having to travel extensively. The impacts of this include additional costs including from a reduction in productive work time and increased complexity for fatigue management. SKM notes the cost implications are particularly prevalent when considering that travel is undertaken during shift time to avoid unsafe travelling behaviour. Therefore the number of productive hours per shift will be lower than for systems where extensive travel is not required.
Type of maintenance strategy employed with regards to a preventative or corrective approach.	Aurizon Network has indicated that historically, maintenance for the CQCN has been based on an unplanned approach, which was suited to an environment where access to track was more readily available the economic and performance impacts on the supply chain of unplanned maintenance were substantially less. Therefore, maintenance tasks were often undertaken with available 'emergency' time. SKM finds that a unplanned maintenance approach in the existing operating environment on the CQCN would potentially result in inefficiencies through lack of planning to cater to track availability for each work location. Conversely, a preventative (or planend) maintenance approach creates cost efficiencies through the ability to plan maintenance resources (labour and machinery) to deliver maintenance tasks based on pre-determined track access, and to deliver more maintenance at a given time. Therefore, while unit costs of maintenance will generally remain stable or sometimes even increase utilising an unplanned maintenance approach, it is reasonable to expect that Aurizon Network's transition to a planned maintenance approach during the UT4 period will result in a reduction in the unit costs. SKM notes that Aurizon Network has access to an extensive fleet of maintenance equipment supporting its major scheduled planned and

[3] Asset renewals (component replacement) will also increase as a result.

	unplanned preventative maintenance and corrective maintenance activities. The equipment falls into four main categories: • major mechanised equipment (Tampers, ballast regulators, rail grinders, on track inspection vehicles, ultra sonic testing vehicles); • Hi-Rail vehicles (Hi-Rail trucks, cranes, inspection vehicles); • hand tools and specialised equipment (rail saws, grinders, non-destructive testing equipment); and • specialised maintenance rolling stock (special maintenance wagons purpose-built to carry rail, sleepers, ballast etc.). SKM finds that field engineering practices such as rail management (monitoring of rail wear) and GPR (Ground penetrating radar) to detect ballast contamination levels and percentage void contamination to plan ballast cleaning currently adopted by Aurizon Network can be considered as industry leading, and should result in a much clearer indication of the level of ballast contamination on the network, which will result in fewer assumptions needing to be adopted in predicting the scope of works required. However, it is important to note that while at present some assumptions are required as to determine the forecast scope, SKM considers that Aurizon Network's planned intervention levels are appropriate.
Above rail	As previously noted, increased tonnages on the network can mean that long possession periods are becoming increasingly difficult to obtain. Therefore, in order for the maintenance program to be compiled Aurizon Network has made assumptions and requests regarding the number and timings of track possessions that will be available for major work. SKM finds that this is reasonable approach to ensuring that above rail operations do not impact significantly on the unit cost of maintenance, since it places expectations and requirements with the operators and permits long term programming and resource allocation. SKM also finds that this will also assist in the realisation of a planned maintenance approach. In addition, a more scientific approach to data collection from technology such as ground penetrating radar will mean that the maintenance effort can be planned in advance around the above rail requirements.

Source: SKM specialist knowledge and UT4 Maintenance Submission

In line with the considerations outlined in this section, Aurizon Network's UT4 maintenance submission notes (and SKM agrees) that 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. With this in mind, Aurizon Network's revised approach for the UT4 period includes assumptions about improved productivity, and the maintenance task is planned in advance to ensure new approaches to delivery of the maintenance task are incorporated.

Therefore, while SKM recognises that total costs may increase in some circumstances, it is reasonable to assume that unit costs should remain stable or decline with increased tonnages, since an increase would imply inefficiency or over-maintenance of the network.

However, SKM does not consider it reasonable for Aurizon Network to significantly alter the scope of individual maintenance tasks in order to deliver a certain 'level' of maintenance. That is, SKM's review is based on the scope of maintenance activities (such as ballast undercutting, rail grinding etc.) detailed in the UT4 submission and supporting information provided to SKM by Aurizon Network. Significant deviations from planned scope would not be reasonable. This is particularly true considering the significant increase in the scope for ballast undercutting proposed by Aurizon Network, and the historical under-delivery of scope which has been noted by SKM as part of this

review.

2.1.6 Cost categories

Aurizon Network's historical and forecast maintenance expenditure for the UT4 period is defined within the cost categories outlined in **Table 2-5**. As a proportion of total costs, ballast undercutting; track structures and systems; trackside systems and resurfacing have historically comprised the majority of total maintenance expenditure (see **Figure 2.2**).

Table 2-5 Maintenance cost categories

Ballast undercutting	A ballast cleaner (also known as a ballast undercutter) is a machine that specialises in cleaning the railway track ballast (gravel, blue stone or other aggregate) of impurities. Over time, ballast becomes worn, and loses its angularity, becoming rounded. This hinders the tessellation of pieces of ballast with one another, and thus reduces its effectiveness. Fine pieces of granite, like sand, are also created by attrition, known simply as "fines". Combined with coal fouling water in the ballast, these fines stick together, making the ballast like a lump of concrete. This hinders both track drainage and the flexibility of the ballast to constrain the track as it moves under traffic. SKM notes that one of the key differences endured by Aurizon Network's rail systems is its exposure to fines (such as coal dust) and consequently ballast contamination. Aurizon Network carries a large volume of freight traffic, and is subject to greater levels of contamination in comparison to the HVCN due to its friable coal and greater transit lengths and as such, has a greater requirement for ballast cleaning treatment. Ballast treatment includes ballast cleaning, shoulder cleaning and stone blowing. Ballast cleaning removes this worn ballast, screens it and replaces the "dirty" worn ballast with fresh ballast. The advantage of ballast cleaning is that it can be done by an on-track machine without removing the rail and sleepers, and it is therefore cheaper than a total excavation. A cutter bar runs beneath sleeper level excavating all of the ballast under the sleepers to a specified, variable depth. A conveyor then moves the ballast into the cleaner, where it gets forced through a mesh by a shaking chamber. Pieces of ballast which are smaller than the mesh size fall through and are rejected; those that are bigger than the mesh are returned to the track along with fresh ballast. Some ballast cleaners have both ballast and spoil wagons attached to it, to which the materials are fed by a series of conveyor belts. Others simply undercut the ballast, and allow for a work train to place fresh ballast. This process can be done in short possessions, meaning that track life can be considerably extended with the minimum of disruption. SKM considers that Aurizon Network's forecast ballast undercutting task is partially corrective for levels of degradation from previous undertaking periods. The bulk of the mechanised ballast undercutting task is completed by the RM900 machine, supplemented by approximately 25km by a smaller, off track consist machine. Aurizon Network propose to enhance the scope of ballast undercutting which would be possible during the UT4 period only through acquisition of 24 spoil wagons and the upgrade of 54 ballast wagons. Other recent initiatives (which SKM considers to be industry leading) include Aurizon Network's introduction of ground penetrating radar (GPR) to detect ballast contamination levels and allow for planning of ballast undercutting tasks prior to ballast failure. SKM notes that the introduction of GPR technology is currently in its infancy on the CQCR, and therefore the benefits of improved accuracy and scoping

	of ballast cleaning maintenance work programs are unlikely to be realised until Aurizon Network has gained an improved understanding of the condition of ballast across the CQCR via the GPR results. Aurizon Network has indicated that the improved understanding is likely to be realised during the UT5 period, although the exact year is unknown. However, it will be important for the Authority to monitor the results of GPR on the network and ensure that future scope is reasonable. **Section 2.2.4** provides a detailed review of Aurizon Network's proposed ballast undercutting scope and cost for the UT4 period.
Resurfacing	Aurizon Network has indicated that the resurfacing task is conducted to maintain track geometry in the steady state condition and the absolute level of resurfacing required is tonnage driven. SKM has reviewed the scope and cost of the resurfacing task as well as Aurizon Network's maintenance intervention levels and considers that the scope is appropriate. Mechanised resurfacing (tamping) is one of a few different maintenance products that maybe used to treat a particular area or defect depending on the required response time, the underlying cause of the defect and the inherent track condition. Resurfacing for the CQCR is currently on the limits of intervention, meaning that the resurfacing strategy is a mix of both unplanned and planned preventative maintenance. Aurizon Network plans to reach a preventative state by the UT5 period. SKM notes that preventative resurfacing strategies provide increased efficiencies through planning which allows for more resurfacing at any given time, meaning that the unit cost declines. Corrective and/or unplanned resurfacing strategies cause inefficiencies due to poor utilisation of track access, which can also effect on the volume of resurfacing achieved due to short possession times. Therefore, SKM finds that a preventative approach to resurfacing is appropriate. SKM notes that the majority of Aurizon Network's mechanised resurfacing fleet has reached the end of its useful life. As such, Aurizon Network's forecast maintenance cost incorporates the purchase of new machines which will result in higher productivity and therefore lower unit maintenance costs. SKM recognises that a reduction in the unit cost will only be achieved if the proposed machines are acquired, since the current life expired machines are slower and therefore less efficient. Therefore it is important that the Authority monitors if the acquisition of new machines is realised by Aurizon Network. The new machines are: • two new switch (turnout) tamping machines to be operational from October 2013, replacing two existing machines; and • five new mainline machines which will be brought on line progressively from October 2014 to July 2015 – again replacing the existing machines.
Rail grinding	Rail grinding is a mechanised high production process of establishing and maintaining rail head profile on plain line and turnouts. It is undertaken by mechanised rail plant grinders and is an essential function on heavy haul rail systems, and is an internationally recognised best practice maintenance function. The objectives of rail grinding are to efficiently introduce and maintain appropriate rail head profiles, and to remove small surface fatigue cracks (which have the potential to lead to rail breakages and derailments).The correct use of a rail grinding strategy enables a substantial increase in the life of the rail asset. Additional benefits which are applicable to the below rail maintenance task include reducing resurfacing cycles (particularly for turnouts). Given that rail renewal costs are a significant maintenance expense, SKM finds that without a substantial rail grinding strategy, the quantity of rail replacement would increase markedly, especially under increasing tonnage conditions. SKM notes that while Aurizon Network's UT4 submission includes adjustments to the Regulated Asset Base associated with asset renewals, these refer to already life expired assets and therefore are still required even in the context of a preventative rail grinding strategy. Also, the level of renewals as a proportion of the total network is

	not significant[4]. However, as the rail grinding task predominantly extends the life of the rail, there should be benefits from reduced capital expenditure for asset renewals in the future. In addition, SKM would expect the preventative rail grinding strategy employed in the UT4 period means that costs for general track maintenance and resurfacing of turnouts should decline in the UT5 period.
Track recording	Track recording refers to inspections of the track which are completed by maintenance staff to monitor the condition of the asset. These inspections allow locations where track condition is deteriorating to be identified, and planned and unplanned preventative 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; and • riding the track in the driver's cabin of a train. SKM notes that track recording is conducted as a routine (time based) activity, and therefore variations in total cost per year should not be observed or should be minimal.
Ultrasonic testing	Ultrasonic Testing (UT) is the practice of examining rail tracks for flaws that could lead to catastrophic failures, and is standard procedure for rail maintenance globally. Ultrasonic Testing (UT) uses high frequency sound energy to conduct examinations and make measurements. Ultrasonic inspection can be used for flaw detection/evaluation, dimensional measurements, material characterization, and more in rail. UT is carried out by skilled operators with very little change in equipment requirements so costs should remain reasonably steady except for changes associated with increases in system size. However, SKM notes that the Ultrasonic testing car (and the geometry track recording car) is externally procured with limited market supply, and there is a high short term risk on price due to lack of market alternatives.
Track, structures and facilities	Track, structures and facilities includes: • general track maintenance; • structures management; and • facilities, which refers to fence lines, gang huts, walkways, vegetation clearance, level crossing maintenance, signage etc. The general track maintenance component comprises the primarily non-mechanised component of track maintenance. This work is relatively labour intensive compared to that of mechanised disciplines. General track maintenance involves both preventative inspection type work and corrective, fault repair type work. As such, the scope of general track maintenance can be based on time (e.g. periodic inspections) or the life of the asset, as well as historical data with respect to the faults compared to tonnage. Likewise, the structures management component comprises preventative

[4] Refer to SKM's report titled "Technical advice on the trade-off between asset renewals and maintenance expenditure".

	inspection works and corrective, fault repair works. Increases in maintenance tasks such as rail grinding, particularly where the scope is planned preventative, and ballast undercutting should result in a reduction in the cost of corrective repairs for track and structures; however, SKM recognises that the transition from unplanned to planned prevenative rail grinding during the UT4 period means that savings will be realised in the UT5 period. Likewise, the scope for increased ballast undercutting during UT4 will also result in savings during the UT5 period. These savings should be comprised as a reduction in total costs, not just a reduction in unit costs. This is true because a reduction in unit costs implies greater efficiency, not a reduction in the scope required. However, SKM notes that increased tonnages over time will offset some of the cost reductions, as the assets are subject to greater fault frequencies.
Trackside systems and traction	Activities in signalling, traction and telecommunication maintenance relate to the overall performance of the systems and the associated infrastructure. These activities are required to ensure the systems are maintained to a safe and appropriate operating level. 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 (e.g. weighbridge maintenance, signal cleaning, cable route maintenance, trackside monitoring equipment etc.). Maintenance products included under traction power maintenance 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 (e.g. overhead line maintenance, feeder station maintenance, track section location cabins etc.). Maintenance products which are included under telecommunication maintenance products are those relating to the overall performance of the telecommunication infrastructure (e.g. the telecommunication backbone, fibre optics etc.).
Traction	

Source: SKM specialist knowledge and UT4 Maintenance Submission

2.2 Review components

2.2.1 Historical and forecast maintenance expenditure – CQCR

Table 2-6 provides Aurizon Network's historical and forecast maintenance expenditure (millions) in 2011/12 price terms, noting that Aurizon Network's forecast indicates that there is no requirement for sleeper replacement on the Newlands or Moura systems during the UT4 period.

Table 2-6 Historical and forecast maintenance costs, CQCR

Maintenance task	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Ballast Undercutting	\$32.0	\$40.9	\$45.5	\$47.0	\$62.8	\$73.2	\$74.6	\$75.3
Mechanised Resleepering	\$0.7	\$0.1	(\$0.0)	-	-	-	-	-
Mechanised Resurfacing	\$19.8	\$18.9	\$18.7	\$20.3	\$19.0	\$19.0	\$20.9	\$20.9
Rail Grinding - Mainline	\$9.1	\$8.3	\$8.8	\$9.0	\$9.7	\$10.6	\$11.0	\$11.5
Rail Grinding - Turnouts	\$2.3	\$1.7	\$1.8	\$1.7	\$2.9	\$2.9	\$2.9	\$2.9

Track Geometry Recording (RRV /UGMS)	$0.7	$0.8	$0.9	$1.2	$0.4	$0.4	$0.4	$0.4
Track Geometry Recording (UGMS)	-	-	-	-	-	-	-	-
Ultrasonic Testing Ontrack Machine	$1.0	$1.7	$1.8	$2.6	$1.4	$1.5	$1.6	$1.5
Track, structures and facilities	$64.1	$54.5	$52.4	$56.7	$55.9	$58.0	$59.9	$61.8
Trackside systems	$27.1	$28.4	$30.4	$29.6	$28.0	$29.0	$29.5	$29.9
Traction	$12.3	$13.1	$10.7	$11.2	$9.6	$9.6	$9.6	$9.6

Source: Aurizon Network, provided in response to SKM's RFI (See Appendix B)

Figure 2.1 provides a graphical representation of Aurizon Network's historical and forecast total maintenance expenditure for the CQCR, as well as the unit cost per gtk. A review of total costs as well as unit costs for maintenance is useful in outlining:

- whether total costs are forecast to increase, decrease or remain stable, which will inform further assessment of various maintenance cost categories (particularly those which are contributing to changes in the total cost) to determine reasonableness of the forecast; and
- to determine if the maintenance task is forecast by Aurizon Network to become more efficient, either in terms of doing the same level of maintenance at a lower cost, or doing more maintenance but achieving economies of scale. In terms of the unit cost, the efficiency of the maintenance task is heavily dependent on the volume of traffic, since an increase in costs which exceeds the increase in volumes would indicate that the network is being 'over maintained'. However, in some circumstances, and particularly on some sections of track, SKM notes that fixed maintenance costs where there are relatively low volumes may result in apparent inefficiencies of the maintenance cost.

Figure 2.1 shows that Aurizon Network forecasts that total costs will increase in real terms for the 2013/14 financial year compared to costs incurred for the 2012/13 financial year. Costs are also forecast by Aurizon Network to increase each year to 2016/17, which reflects an increased maintenance scope in line with increasing forecast volumes as forecast by Aurizon Network for the UT4 period.

Conversely, the unit cost is forecast to decline each year of the UT4 period (and compared to the average for the UT3 period), which indicates that Aurizon Network anticipates to undertake more maintenance overall, but at a more efficient cost (total costs are increasing at a lower rate than total gtk). This demonstrates economies of scale for the maintenance task and the productivity improvements which Aurizon Network has factored in the maintenance cost (see **Section 2.2.7**).

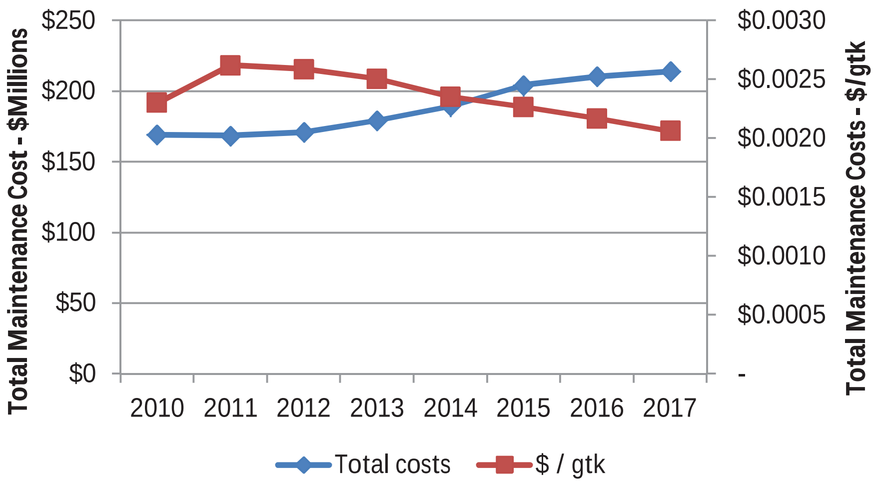


Figure 2.1 Historical and forecast maintenance costs - CQCR

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (See Appendix B)

Figure 2.2 depicts SKM's interpretation of the composition of total costs for the UT3 and UT4 period, based on historical and forecast data provided by Aurizon Network. An analysis of the cost composition over time is useful in identifying the specific maintenance activities which are contributing to the increase in total costs, and also the maintenance activities which are becoming relatively less important over time as a proportion of total costs.

Specifically, compared to the UT3 period, Aurizon Network's forecast ballast undercutting costs will increase substantially during the UT4 period, from 19 per cent of total costs in 2009/10 to 35 per cent of total costs in the 2016/17 financial year. In terms of absolute dollars, ballast undercutting is forecast to more than double in real terms, from $32 million in 2009/10 to $75 million in 2015/16. Other costs remain relatively stable or decline slightly as a proportion of total costs, which indicates that it is primarily increased ballast undercutting which is contributing to the increase in total maintenance costs. Therefore, SKM has provided a detailed review of ballast undercutting costs in **Section 2.2.4**.

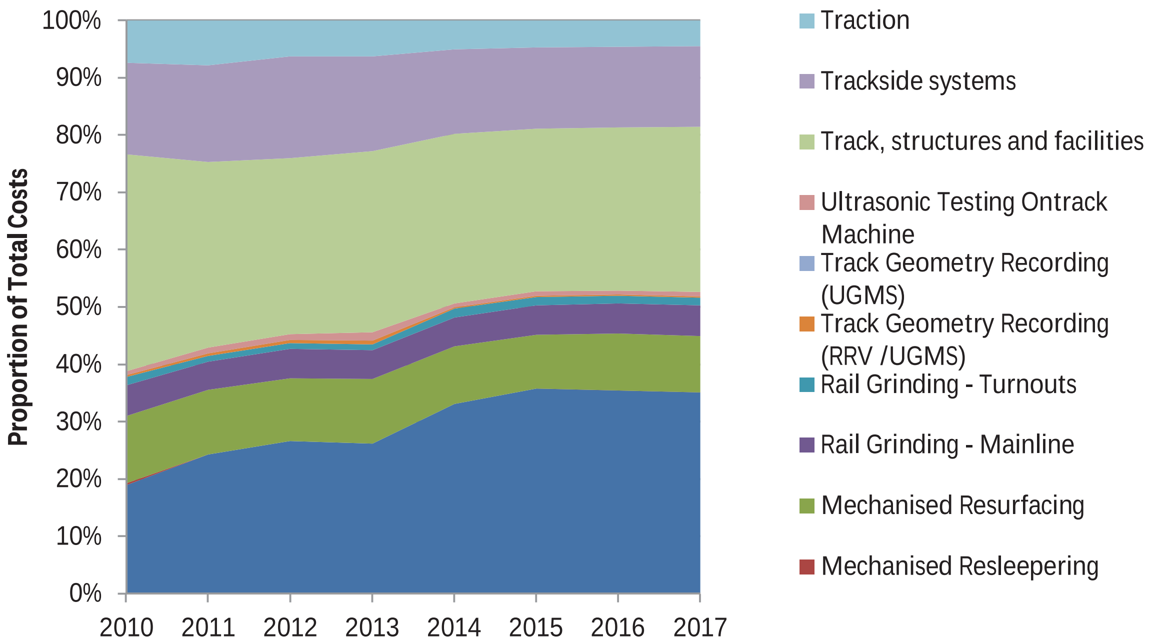


Figure 2.2 CQCR maintenance cost composition

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (See ***Appendix*** A)

2.2.2 Historical and forecast maintenance expenditure - individual systems

Table 2-7 provides Aurizon Network's historical and forecast maintenance expenditure (millions) in 2011/12 price terms on a system basis.

Table 2-7 Historical and forecast maintenance cost, systems

Blackwater	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Ballast Undercutting	$8.8	$15.3	$20.8	$20.7	$23.7	$27.8	$29.5	$30.3
Mechanised Resleepering	$0.2	$0.1	-	-	-	-	-	-
Mechanised Resurfacing	$10.7	$10.1	$9.1	$9.0	$9.0	$9.0	$10.1	$10.2
Rail Grinding - Mainline	$3.0	$4.0	$3.7	$2.9	$3.9	$4.3	$4.7	$5.0
Rail Grinding - Turnouts	$0.8	$0.5	$0.8	$0.6	$1.3	$1.3	$1.4	$1.4
Track Geometry Recording (RRV /UGMS)	$0.4	$0.4	$0.5	$0.5	$0.2	$0.3	$0.3	$0.3
Track Geometry Recording (UGMS)	-	-	-	-	-	-	-	-
Ultrasonic Testing Ontrack Machine	$0.6	$0.8	$0.9	$1.3	$0.5	$0.6	$0.6	$0.6
Track, structures and facilities	$24.2	$22.7	$21.2	$26.6	$23.4	$25.4	$28.1	$25.1
Trackside systems	$11.9	$11.8	$13.1	$12.5	$9.3	$9.7	$10.1	$10.4

Traction	$4.7	$4.2	$4.3	$4.4	$3.5	$3.5	$3.5	$3.5
Goonyella	2010	2011	2012	2013	2014	2015	2016	2017
Ballast Undercutting	$23.2	$22.7	$22.6	$24.7	$27.5	$31.9	$32.0	$31.5
Mechanised Resleepering	$0.0	$0.0	$0.0	-	-	-	-	-
Mechanised Resurfacing	$5.7	$6.5	$6.4	$7.0	$7.0	$6.9	$7.6	$7.4
Rail Grinding - Mainline	$5.0	$3.6	$3.1	$3.9	$4.0	$4.3	$4.4	$4.5
Rail Grinding - Turnouts	$1.0	$0.9	$0.7	$0.7	$1.3	$1.3	$1.3	$1.3
Track Geometry Recording (RRV /UGMS)	$0.3	$0.3	$0.3	$0.5	$0.1	$0.1	$0.1	$0.1
Track Geometry Recording (UGMS)	-	-	-	-	-	-	-	-
Ultrasonic Testing Ontrack Machine	$0.6	$0.7	$1.0	$1.1	$0.6	$0.6	$0.6	$0.6
Track, structures and facilities	$27.4	$22.1	$22.2	$22.9	$21.3	$20.7	$20.8	$25.4
Trackside systems	$11.3	$12.9	$13.4	$13.2	$10.0	$10.4	$10.5	$10.5
Traction	$7.6	$8.9	$6.4	$6.8	$6.1	$6.1	$6.1	$6.1
Moura	2010	2011	2012	2013	2014	2015	2016	2017
Ballast Undercutting	-	$0.2	$0.7	$0.4	$3.0	$3.2	$3.0	$3.1
Mechanised Resleepering	$0.0	-	-	-	-	-	-	-
Mechanised Resurfacing	$1.9	$1.0	$2.1	$2.5	$0.9	$0.9	$0.9	$1.0
Rail Grinding - Mainline	$0.6	$0.5	$1.4	$1.1	$0.6	$0.6	$0.6	$0.7
Rail Grinding - Turnouts	$0.2	$0.1	$0.0	$0.1	$0.1	$0.1	$0.1	$0.1
Track Geometry Recording (RRV /UGMS)	$0.0	$0.1	$0.1	$0.1	$0.0	$0.0	$0.0	$0.0
Track Geometry Recording (UGMS)	-	-	-	-	-	-	-	-
Ultrasonic Testing Ontrack Machine	$0.1	$0.1	$0.1	$0.1	$0.2	$0.3	$0.3	$0.3
Track, structures and facilities	$4.9	$4.3	$4.1	$3.0	$4.8	$5.0	$3.7	$3.9
Trackside systems	$1.9	$1.9	$1.6	$1.4	$1.1	$1.2	$1.2	$1.2
Traction	-	-	-	-	-	-	-	-
Newlands (incl. GAPE)	2010	2011	2012	2013	2014	2015	2016	2017
Ballast Undercutting	-	$2.6	$1.4	$1.2	$8.6	$10.3	$10.2	$10.3
Mechanised Resleepering	$0.5	-	-	-	-	-	-	-
Mechanised Resurfacing	$1.4	$1.2	$1.2	$1.7	$2.1	$2.1	$2.3	$2.3

Rail Grinding - Mainline	$0.5	$0.1	$0.6	$1.0	$1.2	$1.4	$1.4	$1.4
Rail Grinding - Turnouts	$0.3	$0.2	$0.2	$0.3	$0.2	$0.2	$0.2	$0.2
Track Geometry Recording (RRV /UGMS)	$0.0	$0.0	$0.0	$0.1	$0.0	$0.0	$0.0	$0.0
Track Geometry Recording (UGMS)	-	-	-	-	-	-	-	-
Ultrasonic Testing Ontrack Machine	$0.1	$0.1	$0.2	$0.1	$0.1	$0.1	$0.1	$0.1
Track, structures and facilities	$7.3	$5.5	$4.5	$4.3	$6.5	$7.0	$7.2	$7.5
Trackside systems	$1.9	$1.8	$2.2	$2.4	$2.2	$2.3	$2.3	$2.4
Traction	-	-	-	-	-	-	-	-

Figure 2.3 provides a graphical representation of Aurizon Network's historical maintenance costs from the UT3 period and forecast maintenance costs for the UT4 period on an individual system basis. **Figure 2.3** shows that Aurizon Network forecasts that costs will increase for all systems. In total absolute dollars, the impact is most pronounced for the Newlands (including GAPE) system and the Blackwater system. Costs for the Newlands system are forecast by Aurizon Network to increase from an average of $11 million in the UT3 period to $23 million in the UT4 period, while Blackwater is forecast by Aurizon Network to increase by $10.9 million per year on average across the undertaking periods. **Figure 2.4** and the accompanying text explore the validity of these apparent inefficiencies.

Total maintenance costs for the Goonyella and Moura systems are forecast to remain relatively stable on average compared to the UT3 period.

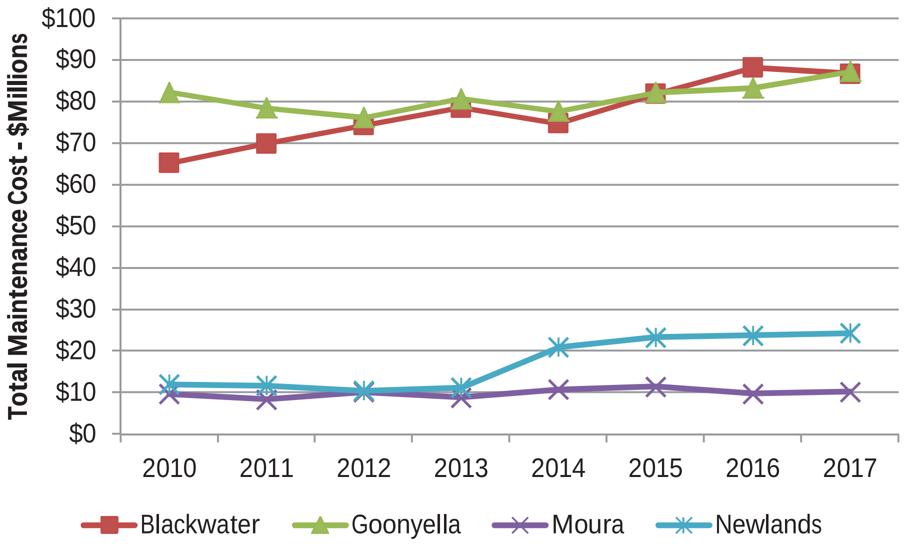


Figure 2.3 Historical and forecast maintenance costs (total absolute dollars) - individual systems

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (See Appendix B)

Figure 2.4 provides the unit cost for maintenance of individual systems on a dollars per gtk basis. The forecast unit cost is provided for the UT4 period compared to historical unit costs from the UT3 period, and indicates that Aurizon Network's maintenance allocation on an individual system basis will result in improved productivity, as measured through a declining unit cost. **Figure 2.4** also indicates that maintenance tasks for individual systems are operating at varying levels of efficiency, with the Moura system trending higher on a dollars per gtk basis than other systems. It is therefore important to note that although the total cost is increasing for the Newlands and Blackwater systems, the unit cost is more efficient compared to the UT3 period and therefore it indicates that the increase in costs is appropriate compared to the increase in volumes forecast by Aurizon Network. There is also an increase in the unit cost observed for the Moura system in 2013/14, although this is due to a slight a slight reduction in volumes forecast for this year which would not necessarily be offset by decreased total costs since total costs are relatively stable. Since the volumes on this system are relatively low small fluctuations in volumes will impact the efficiency of the unit cost due to the inability to offset fixed costs.

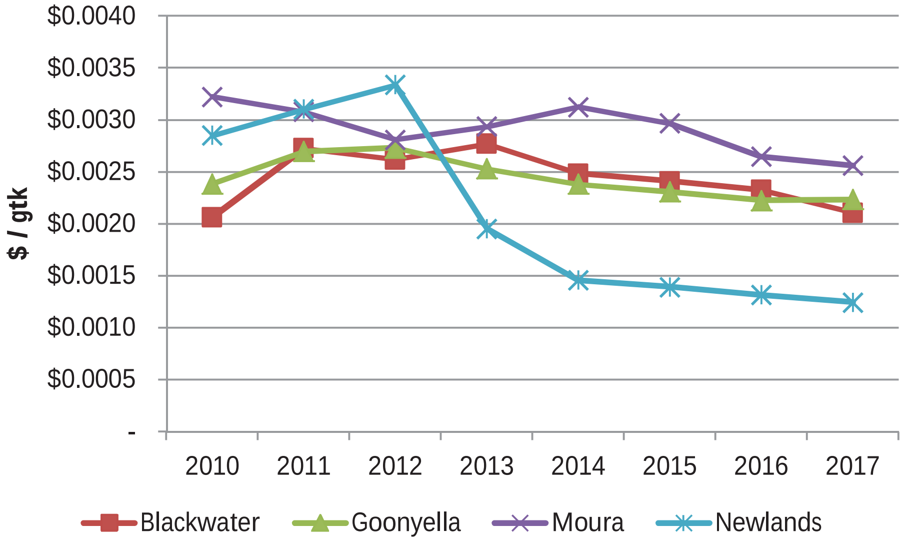


Figure 2.4 Historical and forecast maintenance costs ($/gtk) – individual systems

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (See Appendix B)

SKM appreciates that it is also useful to consider the unit cost basis in terms of the dollars per track kilometre compared to the tonnage profile, to provide an indication of whether allocations of maintenance tasks are appropriate in the context of increasing or decreasing tonnages. It also provides an indication of the impact of system size (including expansions) on the overall maintenance cost. Specifically, it will be more expensive to maintain a rail system which is larger than a comparative system, even if the total tonnes hauled are consistent. This is due to increases in costs associated with routine maintenance activities such as general inspections. **Figure 2.5** provides the total maintenance cost per track kilometre, compared to the tonnage per year. The data indicates:

- maintenance costs are consistent for the Moura system, which indicates that the system has reached a steady state maintenance costs (which shows why small fluctuations in volumes will impact the unit cost), and also that Aurizon Network forecasts that there is very little impact from change in tonnage profiles on the maintenance costs, although this would be expected to change with a significant change in tonnages. This is also observable when reviewing total costs in **Figure 2.3**.
- Aurizon Network forecasts that maintenance costs per track kilometre increase with tonnage for all other systems, although the impact is less substantial for the Goonyella and Blackwater systems compared to the Newlands system. SKM finds that this is most likely due to historical

maintenance efforts having been focussed on Goonyella and Blackwater since they are larger systems, which means that a proportional increase in expenditure with increased tonnage is not always justified, while a ramp up of costs for the Newlands system would be required. Further, at lower tonnages it is common to observe that marginal costs are higher compared to marginal costs associated with high tonnage levels, where economies of scale are realised. Economies of scale are realised on a unit cost basis as fixed costs are spread across a greater tonnage profile.

- increasing costs for the Newlands system reflect more emphasis on maintenance as tonnage increases, but with costs per track kilometre remaining below the Blackwater and Goonyella systems, which have a higher tonnage profile. This indicates that the cost increase is appropriate relative to other systems' size and the increased tonnage, and also that a reduced maintenance effort is required relative to other systems as the GAPE project means that portions of the system are less degraded (this is also demonstrated in **Figure 2.4** which shows that the Newlands system has the lowest forecast unit cost for the UT4 period).

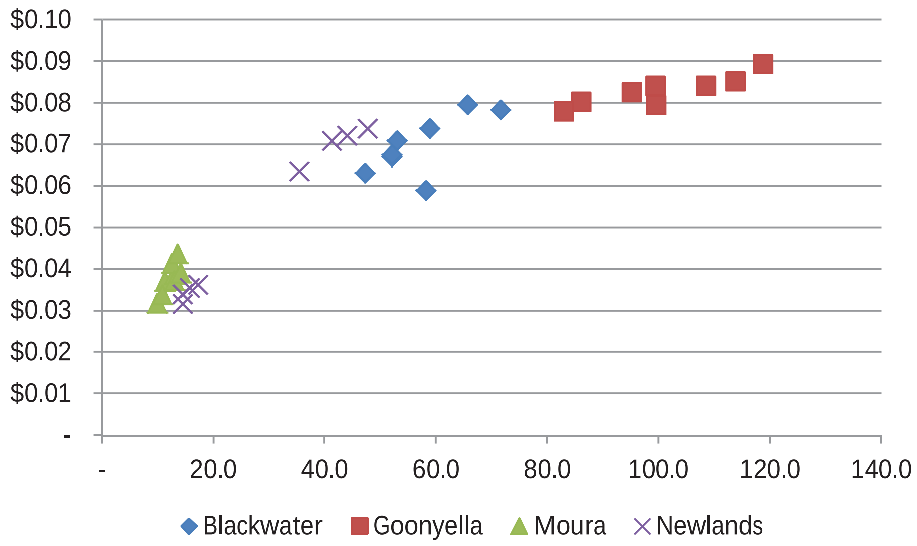


Figure 2.5 Maintenance cost compared to tonnage

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (See Appendix B)

Importantly, **Figure 2.5** also indicates that although the Moura system appears to be inefficient in terms of the maintenance task compared to other systems (when measured on a dollars per gtk basis in **Figure 2.4**) the maintenance cost per track kilometre is much lower than other systems, and is reflective of a lower tonnage profile and smaller system size. This also indicates that routine maintenance activities which are independent of tonnage (such as inspections) are also important considerations, since the unit cost in dollars per gtk will appear relatively inefficient for systems with lower gtk.

2.2.3 System characteristics and composition of costs

Blackwater

Aurizon Network's forecast maintenance allowance for the Blackwater system represents approximately 41 per cent of the CQCN allowance, and SKM notes that the allocation is determined based on the size as well as the individual maintenance requirements: These include (as noted in Aurizon Network's UT4 submission):

- coal product fouling and the requirement for ballast undercutting;
- narrow gauge line - more forces are applied to a smaller area on the track, putting additional pressure on these areas, and over time more damage is caused to track and coal wagons and locomotives. This requires more frequent maintenance, and smaller timeframes between maintenance efforts. In particular, a regular problem for narrow gauge railways is the fact that they lack the physical space to grow: the initial inexpensive construction means that they are engineered only for the initial traffic demands at the time of construction, whilst a standard or broad gauge railway could more easily be upgraded to handle heavier and faster traffic. Therefore ‘rough riding’ of coal wagons and locomotives is a common problem on narrow gauge railways, and lateral movements may result in reductions in operating speeds in severe cases.
- 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. SKM finds that a 10MGT intervention level is reasonable for preventative grinding on tight radii curves in comparison with the preventative rail grinding frequencies of other below rail operators in Australia, South Africa, India, and the United Kingdom.

Figure 2.6 provides the historical cost composition for the Blackwater system, which shows that ballast undercutting is becoming increasingly important, and is forecast by Aurizon Network to increase from $21 million in the 2012/13 financial year to $30 million by 2016/17. The allocation of increased ballast undercutting expenditure to the Blackwater system comprises 38 per cent of the total increase for the CQCR during the UT4 period compared to the UT3 period, and 39 per cent of the total allowance for the UT4 period.

Rail grinding is also forecast to increase, but there is no observed reduction in general track and structures expenditure which would be expected from improved asset conditions and reductions in the need for corrective maintenance. SKM considers that this occurs because the rail grinding task is only currently transitioning into a planned preventative approach, and savings are not likely to be realised until the UT5 period. Therefore the increase in the rail grinding task associated with a transition to preventative maintenance offsets savings which could be realised from increased ballast undercutting. Additionally, as the Blackwater is the oldest of the systems and the condition is relatively poor with high annual tonnages, benefits will take longer to be realised than other systems due to the effort required correcting previous defects and bringing maintenance to a preventative state.

There is however a small decrease in mechanised resurfacing, which indicates some benefits from increased ballast undercutting scope.

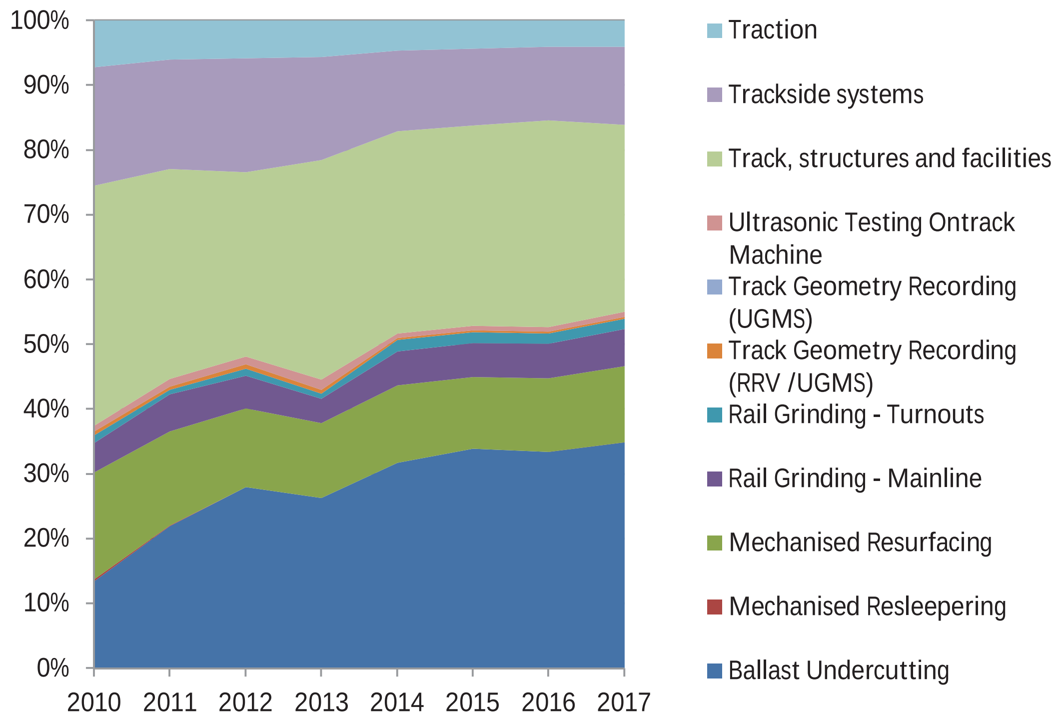


Figure 2.6 Maintenance cost composition – Blackwater

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (See Appendix B)

Goonyella

Aurizon Network's forecast maintenance allocation for the Goonyella system represents approximately 40 per cent of the CQCN forecast. The characteristics which impact the maintenance allocation as noted by Aurizon Network in the UT4 maintenance submission include:

- maintenance implications associated with coal product fouling and the subsequent requirement for ballast undercutting;
- high wear rates associated with narrow gauge line, curvature (approximately 52 per cent of the track is curved) and increased tonnages over the last 25 years;
- electrification – the maintenance effort for the Goonyella system is greater due to risk of damage to overhead lines from bird strikes, outages caused by snakes hunting birds' nests and mining equipment travelling through level crossings above the allowable height. SKM notes that this consideration applies to the maintenance effort required for the systems in regards to associated track closures and the loss of planned maintenance tasks due to responding to these incidents, not the cost of replacement due to weather and animal strikes, therefore this does not comprise double counting for Aurizon Network's self-insurance for dewirements;
- track duplication - 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; and
- location and geography - due to the location and geography of the Goonyella system, it experiences weather conditions that can affect the condition of the assets and therefore require increased maintenance. An additional challenge associated with delivering the maintenance task

for the Goonyella system is that many of its areas are remote and have poor road access which creates challenges for any specialist large plant requirements on site.

Figure 2.7 provides the historical cost composition for the Goonyella system, which shows that ballast undercutting is also becoming increasingly important for this system, and is forecast by Aurizon Network to increase from $25 million in the 2012/13 financial year to $32 million by 2016/17. The allocation of increased ballast undercutting expenditure to the Goonyella system comprises 25 per cent of the total increase for the CQCR in the UT4 period compared to the UT3 period, and 43 per cent of the total allocation for the UT4 period.

Rail grinding and mechanised resurfacing are also forecast by Aurizon Network to increase by a similar amount as the Blackwater system. Unlike the Blackwater system, there is an observable reduction in costs associated with track and structures maintenance, although costs are forecast by Aurizon Network to increase again by 2016/17. The increase in costs is attributable to remedial works which will be required by that stage.

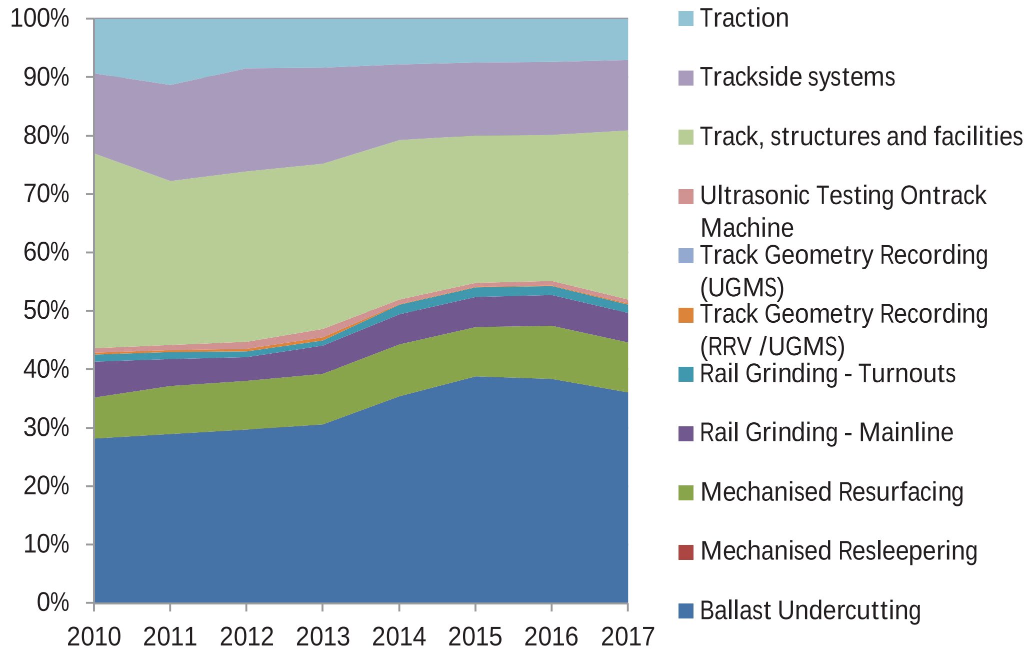


Figure 2.7 Maintenance cost composition – Goonyella

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (See Appendix B)

Newlands

Aurizon Network's maintenance allocation for the Newlands system comprises approximately 11 per cent of the CQCN allowance. The characteristics which impact the maintenance allocation as noted by Aurizon Network in the UT4 maintenance submission and noted by SKM include:

- coal product fouling and associated ballast undercutting requirement;
- high wear rates associated with narrow gauge line, gradients, curvature and increasing tonnages; and
- old rail and formation - 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.

Figure 2.8 provides the maintenance cost composition for the Newlands system.

SKM notes that Aurizon Network's UT4 maintenance submissions highlights the following attributes of the Newlands system which impact on maintenance costs:

- 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, from damage caused over these extreme weather periods;
- the Newlands system is also one of the most remote of all systems in the CQCN. Access to the system is restricted from a lack of highways or sophisticated road systems. In addition, the system 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; and
- 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.

SKM agrees that these factors contribute to the increased total maintenance cost which is forecast by Aurizon Network during the UT4 period (see **Figure 2.3**), since more maintenance will be required to cope with the increase in volumes, and **Figure 2.8** shows that (unlike other systems) almost all expenditure categories are forecast by Aurizon Network to increase during the UT4 period compared to the UT3 period.

Ballast undercutting represents the most significant increase, from approximately $1 million in 2012/13 to almost $9 million in 2013/14 and $10 million by 2016/17. This represents a significant increase in the ballast undercutting task for the Newlands system, and comprises over 28 per cent of the total increase for the CQCR during the UT4 period, but only 14 per cent of the total allowance for the CQCR. SKM finds that this increase is reasonable due to significant increases in tonnage for the Newlands system since the introduction of the GAPE system and since the ballast undercutting expenditure has historically been very low this indicates there would be some backlog of works required. However, it is noted that the scope will only be achievable from acquisition of the additional ballast wagons proposed by Aurizon Network.

Mechanised resurfacing is forecast by Aurizon Network to increase compared to financial year 2012/13 values, although not significantly. Rail grinding also increases slightly, but is not pronounced considering Aurizon Network proposes to transition to a preventative rail grinding strategy. SKM finds that this approach to the maintenance task is reasonable, since preventative rail grinding is an appropriate strategy to enable a substantial increase in the life of the rail asset by extending rail life, reducing resurfacing cycles (particularly for turnouts), and extending track component life.

Aurizon Network also proposes to increase expenditure for the track, structures and facilities category from $4.3 million in 2012/13 to $6.5 million in 2013/14 and $7.5 million by 2016/17. SKM finds that this increase in expenditure is reasonable, given the significant forecast increase in tonnes hauled for the Newlands system during the UT4 period compared to the UT3 period (tonnes are forecast by Aurizon Network to increase from an average of 17 mtpa to 42 mtpa during the UT4 period). Further, the unit cost has fallen significantly (refer back to **Figure 2.4**), indicating that the increase in the maintenance effort is efficient with regards to the increase in volumes. Like other systems, a reduction in general track maintenance costs during the UT5 period should be realised from the transition to preventative rail grinding.

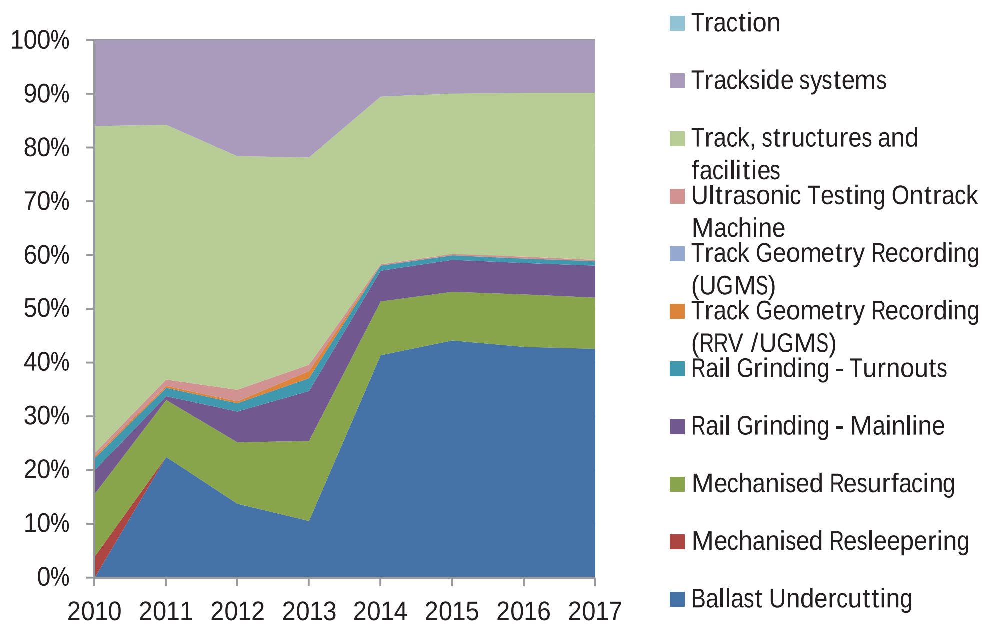


Figure 2.8 Maintenance cost composition – Newlands

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (See Appendix B)

Moura

Aurizon Network's maintenance allocation for the Moura system comprises approximately 5 per cent of the CQCN allowance. The characteristics which impact the maintenance allocation as noted by Aurizon Network in the UT4 maintenance submission include:

- coal product fouling and associated ballast undercutting requirement;
- tonne axle load – originally the system was built for 15 tonne axle loads but the system now runs 2.6 tal, which places pressure on the structures of the system;
- high wear rates associated with narrow gauge line, gradients, curvature and increasing tonnages; and
- formation and drainage – risks associated with rainfall on the Moura system include formation related issues as 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 mud-holes.

Figure 2.9 provides the maintenance cost composition for the Moura system. Aurizon Network's maintenance allocation for the UT4 period includes a significant increase in ballast undercutting in terms of the proportion of total costs, however SKM notes that the level of ballast undercutting for the Moura system has historically been very low, at approximately $300,000 per year on average during the UT3 period. SKM believes that ballast for the Moura system suffers from existing fouling since Aurizon Network has indicated that the system experiences issues associated with poor drainage and SKM has observed that the ballast undercutting expenditure has historically been very low. Accordingly a ramp up of expenditure for the UT4 period would be required. On average, Aurizon Network forecasts to spend approximately $3 million per year on ballast undercutting for the Moura system, compared to over $27 million on average for the Blackwater and Goonyella systems, and this highlights the backlog of works required but for a smaller system size. The allocation of ballast undercutting expenditure to the Moura system comprises 9 per cent of the total increase for the CQCR in the UT4 period compared to the UT3 period. The differential in ballast undercutting across systems is appropriate, since the Moura system is smaller than the Goonyella and Blackwater systems, and since the tonnage profile is a significantly lower and therefore coal fouling would be less significant, although it is reasonable to expect that some 'catch-up' works would be required due to historically low expenditure.

In terms of other cost categories, Aurizon Network forecasts to approximately halve expenditure for mechanised resurfacing on the Moura system, from $2 million on average per year during the UT3 period to approximately $900,000 on average per year during the UT4 period. SKM finds that this is reasonable in the context of increased ballast undercutting relative to previous years. Given the Moura system is the smallest system and SKM considers that the assets are better condition than Blackwater and Goonyella, benefits from the increased ballast undercutting will be realised more quickly than other systems. However, the maintenance costs for track, structures and facilities are not forecast to decline during the UT4 periods, which means that these maintenance activities for the Moura system has already reached a steady state for most maintenance activities (excluding ballast undercutting which is likely experiencing a deficit) and increases in costs in later years should only be observed with significant increases in volumes. That is, the average cost will be relatively stable at this tonnage profile.

Costs associated with accommodation and shift times are also less for the Moura system relative to other systems, since the geographic location is more accessible, and this is evidenced in lower total costs of maintenance per track kilometres against tonnes compared to other systems (refer back to **Figure 2.5**). The size of the system is also a key factor which is contributing to lower costs since fixed maintenance requirements such as general track inspections are significantly lower for the smaller system, although the unit cost may at times appear inefficient since the volumes are also lower.

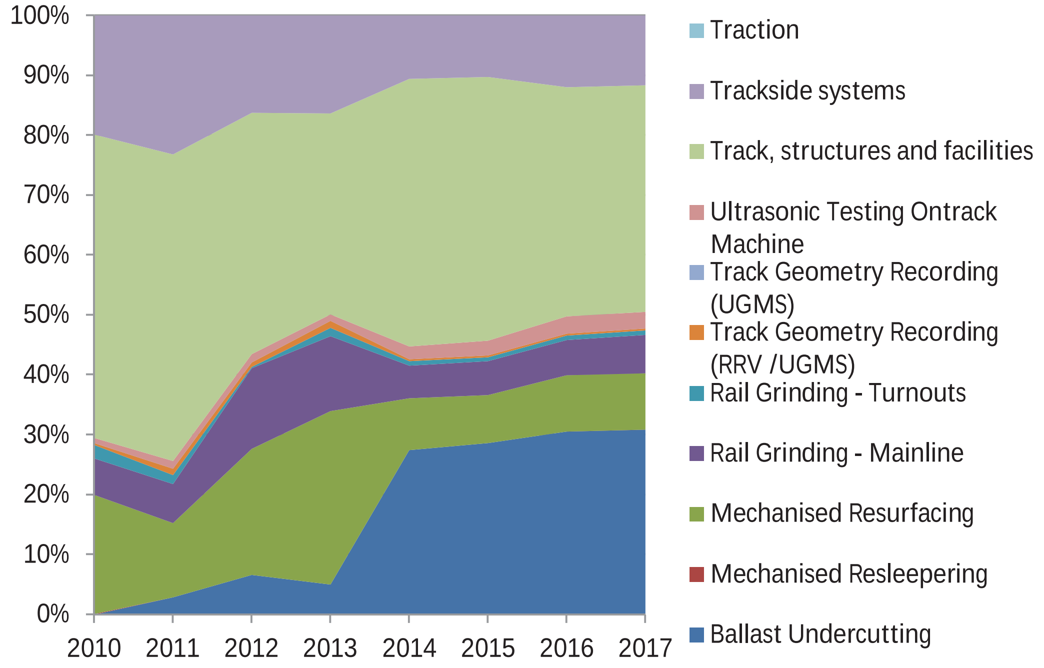


Figure 2.9 Maintenance cost composition – Moura

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (See Appendix B)

2.2.4 Ballast undercutting

SKM's review of maintenance cost allocations for the CQCR (including at an individual system level) has shown that increased expenditure for ballast undercutting is a significant contributor to Aurizon Network's forecast increase in maintenance expenditure for the UT4 period. In fact, a number of other maintenance categories are actually declining in absolute dollars relative to the UT3 period, or the increases are not substantial when considering increased forecast volumes.

Accordingly, this section provides a review of the reasonableness of the proposed increase in expenditure for the ballast undercutting task, which is forecast by Aurizon Network to increase by 72 per cent in total absolute dollars or approximately $120 million over the UT4 period compared to the UT3 period. Importantly, Aurizon Network's forecast increase in ballast undercutting costs occur from an increased in planned scope (i.e. kms of ballast undercutting) not from an increase in the unit cost of delivery (see **Figure 2.13** in the following paragraphs).

SKM notes that the CQCR is subject to greater levels of ballast contamination compared to that of the HVCN which occurs as a result of friable coal and greater transit distances and there are a number of factors which contribute to the cost of ballast cleaning and undercutting, including the condition of and volume of ballast to be cleaned / undercut. SKM notes that Aurizon Network is exposed to financial penalties associated with coal dust on the CQCR, and have therefore implemented a Coal Dust Management Plan which is intended to reduce the amount of coal dust through initiatives such as coal veneering.

Both Aurizon Network and SKM consider that implementation of the Coal Dust Management Plan will result in a reduction of coal dust and coal spillage. Aurizon Network forecasts that the coal dust management initiatives will result in a 10 per cent reduction in the rate of ballast fouling and the scope for ballast undercutting. SKM notes that Aurizon Network has developed the scope for the ballast undercutting to reflect a reduction in ballast fouling contributed by the introduction of veneering and profiling across the system, and to reflect the results of the initial GPR assessments . This reduced fouling rate has been modelled to apply from the beginning of UT4 in so far as further fouling on the network will be at a lower rate. The introduction of GPR testing will validate this assumption over the period.

However, SKM recognises that total coal volumes will increase over the UT4 period relative to the UT3 period and therefore coal fouling will continue to be an issue. Further, SKM considers that the ballast undercutting task is corrective for previous fouling and therefore the reduction from environmental controls would therefore not be observable; however, it is reasonable to assume that without the coal dust management initiatives the level of fouling would be worse than with the initiatives and that the forecast costs would be higher. In this regard, it is important to note that SKM finds that the scope of the ballast undercutting task is reasonable for the UT4 period, since it is likely that there is existing fouling associated with non-delivery of the full forecast ballast undercutting task during the UT3 period.

Therefore, SKM finds that the total forecast cost for the 2013/14 financial year is likely to increase relative to the 2012/13 actuals. However, as ballast undercutting is corrective rather than preventative, efforts should not necessarily be incurred in the same year as increased tonnages. **In this regard, SKM finds that a preventative maintenance strategy for ballast undercutting is not appropriate in the context of increasing the scope of ballast undercutting before tonnages increase.** That is, since ballast contamination occurs after increased coal spillage, increased costs should follow in the year after increased tonnage (unless there is already a deficit, like the case for the CQCN).

While it is probable that total costs would increase each year following increased coal tonnages, it is also necessary to review the unit cost of ballast undercutting and cleaning on a dollars per gtk basis, which provides an indication of the efficiency of costs and the reasonableness of increased costs with increased tonnage. **Figure 2.10** provides the unit cost for the CQCR and shows that the unit cost of ballast undercutting has been increasing since 2009/10 (although there was a decline in 2012/13), and is not forecast to decline until 2015/16. This indicates that Aurizon Network has become less efficient at ballast undercutting over time.

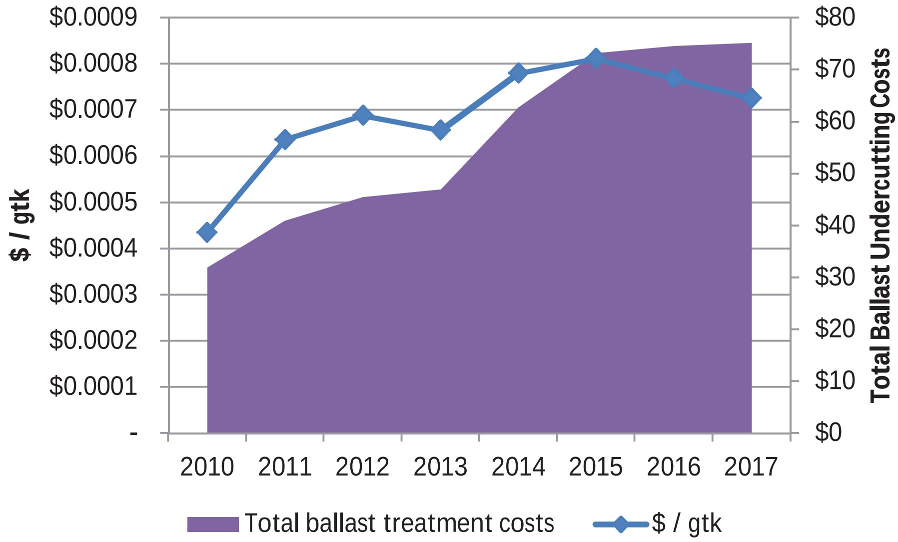


Figure 2.10 Ballast undercutting costs

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (See Appendix B)

However, although **Figure 2.10** indicates inefficiency of the ballast undercutting task, SKM has considered factors which may impact on increased unit costs of ballast undercutting. One significant consideration is the level of access to the network by maintenance staff, which is restrictive in both time and location depending on access requirements by above rail operators. Therefore if the required access is not possible then the ability to achieve the quantities required will be compromised and efficient planning of works (including rosters) is important. In addition, access for maintenance staff will contribute to costs associated with travel, productive hours on track and logistical support – specifically lower access times means that the maintenance activity will need to be disaggregated and economies of scale will not be achieved.

Figure 2.11 plots the growth in ballast undercutting costs relative to the growth in MTPA of coal, which shows that during the UT4 period, costs increase at a greater rate per year when tonnages increase at a higher rate. While this may seem intuitive when considering access costs, it is important to note that overall total volumes increase each year, even at a declining rate. Therefore, SKM expects that growth in total costs for the 2015/16 and 2016/17 periods would be higher than for 2013/14 and 2014/15 if track access was the most important cost driver, since access becomes increasingly restricted when considering cumulative growth to the end of the UT4 period. Therefore, it is unlikely that it is access costs which are contributing to the increased unit cost each year.

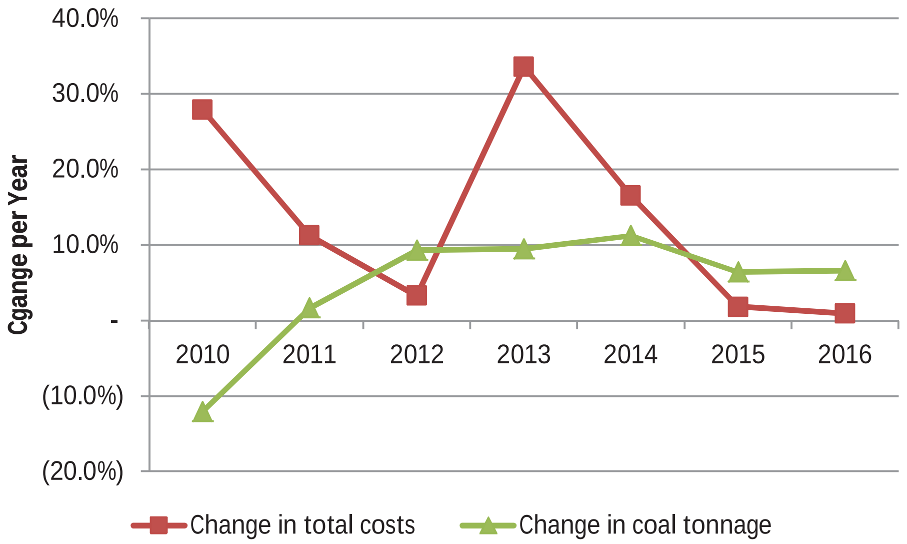


Figure 2.11 Growth in ballast undercutting costs compared to tonnage

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (See Appendix B)

In order to further assess the apparent inefficiency (or over scoping) of ballast undercutting tasks, **Figure 2.12** provides an adjusted $/gtk curve, which assigns the ballast undercutting costs in a given year to the volume (gtk) in the previous year. For example, costs for the 2013/14 financial year are assigned to volumes in the 2012/13 financial year. This curve indicates that costs are falling by 2014/15 and that during the UT4 period the ballast undercutting task is generally planned for increased volumes in previous years.

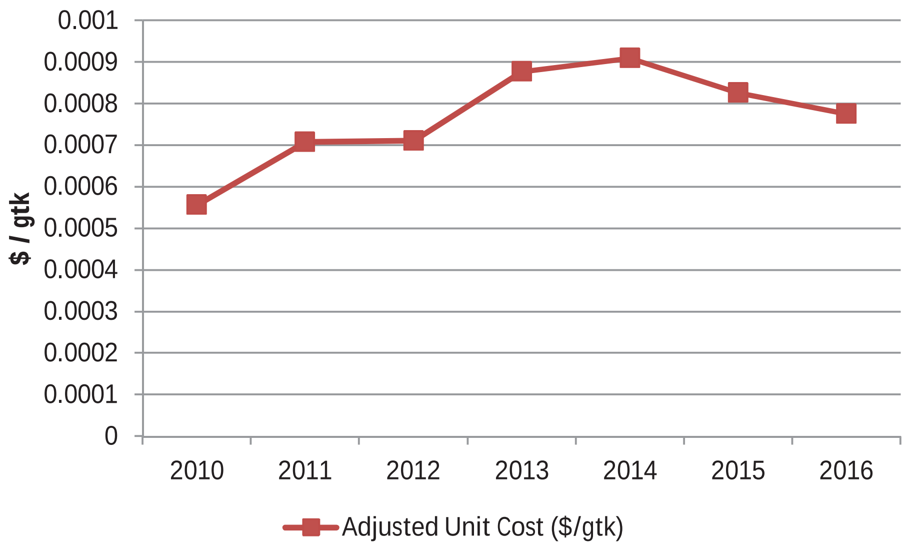


Figure 2.12 Adjusted ballast undercutting unit cost

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (see Appendix B)

SKM finds that the scope of the ballast undercutting task for the UT4 period is reasonable, although it is important to note that the increase in costs would not be reasonable without the presence of existing fouling. That is, the scope for the UT4 period is only reasonable because of the under-delivery of ballast undercutting in previous undertaking periods. In this regard, it would not be appropriate for Aurizon Network to under-deliver on the forecast ballast undercutting scope for the UT4 period and to transfer the ballast undercutting allocation to other maintenance activities.

While SKM finds that the planned scope ballast undercutting is reasonable for the UT4 period, Aurizon Network is limited by the machinery available and therefore the scope should not increase without the acquisition of additional machinery, since this would surely result in under-delivery of the forecast scope.

Figure 2.13 shows that Aurizon Network's total forecast volume of ballast undercutting increases each year of the UT4 period. The changes are comprised of increased mechanised ballast undercutting utilising Aurizon Network's RM900 train. The increased volume of mechanised ballast undercutting after 2013/14 is attributable to Aurizon Network's proposed acquisition of 32 additional ballast wagons in the first quarter of the 2014/15 financial year. These ballast wagons were also proposed by Aurizon Network to be purchased in the UT3 period, and maintenance as well as capital allowance was approved, although the acquisition was not realised.

In addition, ballast undercutting efforts on turnouts are also forecast by Aurizon Network to increase each year, which means that more labour hours are required to achieve this increase.

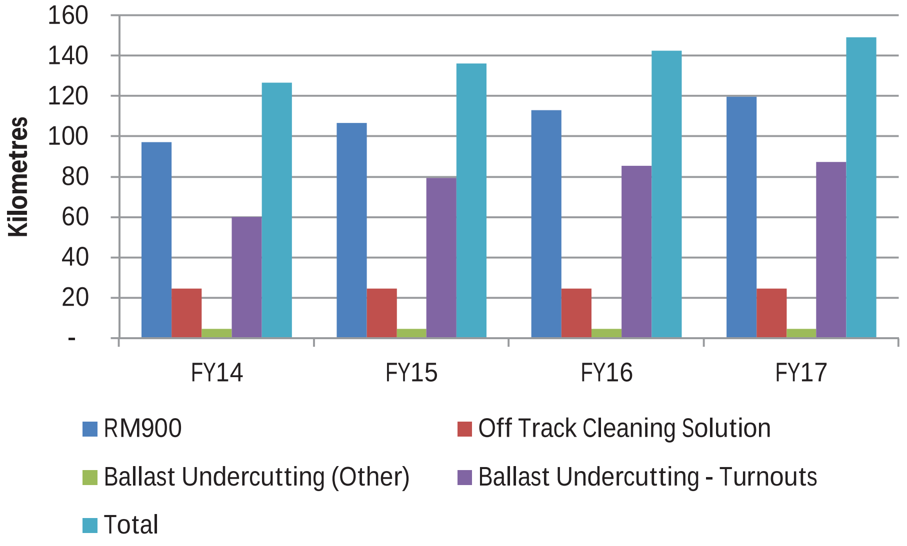


Figure 2.13 Aurizon Network's planned ballast undercutting scope

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (see Appendix B)

SKM recommends that the Authority does not approve additional volume of mechanised ballast undercutting associated with the proposed upgrade of existing wagons and acquisition of new spoil wagons[5], until such time that Aurizon Network can demonstrate the acquisition and upgrade has been realised. Once realised, SKM would suggest Aurizon Network submit a proposal to amend the annual revenue requirement to realise additional ballast undercutting scope.

SKM has therefore provided a revised adjustment of total costs for mechanised ballast undercutting which is undertaken utilising the RM900 ballast train which reflects a reduced scope post 2013/14. As a minimum, SKM's adjusted RM900 scope for the ballast undercutting task should be delivered by Aurizon Network during the UT4 period.

SKM's system allocations are based on Aurizon Network's original system allocations as a proportion of the total volume of ballast undercutting undertaken utilising the RM900 train each year, which are provided in **Table 2-8**. The unit cost per kilometre of ballast undercutting is set as equal to the cost of mechanised ballast undercutting in 2013/14[6], recognising there is limited opportunity for productivity improvements without the acquisition of additional wagons.

Table 2-8 System allocations - ballast undercutting

Year	Blackwater	Goonyella	Moura	Newlands
2013/14	39%	43%	4%	13%
2014/15	39%	43%	4%	14%
2015/16	41%	42%	4%	14%
2016/17	42%	41%	4%	14%

Source: Information provided by Aurizon Network in response to SKM's RFI (See Appendix B)

Table 2-9 provides SKM's adjusted scope and cost for ballast undercutting utilising the RM900 train.

[5] Aurizon Network proposes to ugrade 56 ballast wagons and acquire 24 new spoil wagons

[6] Provided by Aurizon Network in response to RFIAUR-006.

Table 2-9 SKM's proposed allowable RM900 undercutting scope

Year	Blackwater	Goonyella	Moura	Newlands	Total (SKM)	Total (Proposed by Aurizon Network)	Unit Cost ($/km)	Total Allowable Cost ($) Proposed by SKM
2013/14	38	42	4	13	97	97	[redacted]	[redacted]3
2014/15	38	42	4	14	97	107	[redacted]	[redacted]
2015/16	40	41	4	13	97	113	[redacted]	[redacted]
2016/17	40	40	4	13	97	120	[redacted]	[redacted]

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (see Appendix B) and information regarding unit cost provided on 15 November 2013

In terms of Aurizon Network's forecast increase in the volume of ballast undercutting on turnouts, SKM notes that this will only be possible through increased labour since ballast undercutting on turnouts is a manual labour task. **Table 2-10** provides the increased labour requirement (shifts) which is assumed by Aurizon Network compared to the forecast increased scope. The information implies one extra shift per one kilometre of increased scope. SKM finds that this increase is reasonable and the scope is achievable. Maintenance crews will also be assisted by a smaller off track consist machine. Therefore Aurizon Network should be required to deliver the forecast scope for turnouts during the UT4 period.

Table 2-10 Scope of ballast undercutting (turnouts) compared to implied shifts

Financial Year	2013/14	2014/15	2015/16	2016/17
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Source: Aurizon Network provided in response to SKM's RFI (see Appendix B)

Table 2-11 provides the total ballast undercutting scope and cost for the UT4 period, which includes adjustments made by SKM to reduce the scope of ballast undercutting undertaken by the RM900 train. SKM finds that no adjustments are necessary to the proposed scope for turnouts, the off track cleaning solution or the ballast undercutting undertaken by the asset maintenance division (ballast undercutting other).

Table 2-11 Total ballast undercutting allowance

Off Track Cleaning Solution	Total Cost
2013/14	[redacted]
2014/15	[redacted]
2015/16	[redacted]
2016/17	[redacted]
RM900	Total Cost
2013/14	[redacted]
2014/15	[redacted]
2015/16	[redacted]
2016/17	[redacted]
Ballast Undercutting Other	Total Cost
2013/14	[redacted]

2014/15	[redacted]
2015/16	[redacted]
2016/17	[redacted]
Ballast Undercutting - Turnouts	Total Cost
2013/14	[redacted]
2014/15	[redacted]
2015/16	[redacted]
2016/17	[redacted]
Total Ballast Undercutting Allowance	Total Cost
2013/14	[redacted]
2014/15	[redacted]
2015/16	[redacted]
2016/17	[redacted]

Source: SKM calculations based on information provided by Aurizon Network in response to SKM's RFI (see Appendix B)

2.2.5 Benchmarking

SKM has undertaken a benchmarking exercise to assess the relative efficiency of maintenance for the CQCR compared to the HVCN. **Section 2.1.3** and **Section 2.1.4** provides SKM's methodology for undertaking the benchmarking task.

Figure 2.14 provides normalised historical and forecast maintenance expenditure in total absolute dollars for the CQCR (and disaggregated for individual systems) compared to the HVCN. Note that due to the normalisation of maintenance costs, the Blackwater system appears close to and sometimes more expensive to maintain than the CQCR as a whole. It is important to note that in practice, the Blackwater system is not more expensive to maintain than the CQCR on a total absolute dollar basis, but is more expensive to maintain on average compared to the CQCR (the unit cost). That is due to varying characteristics across the network (including condition and volumes) the unit cost for the CQCR is lower than for the Blackwater system.

The variation in total costs which is depicted in **Figure 2.14** highlights that the size of the network (i.e. group of systems) is a key factor impacting on maintenance costs, since a larger network means maintenance costs will increase, including from increased consumables and the labour intensity required. In addition, the location of some systems within the CQCR and the availability of skilled labour in remote regions mean that accommodation and transport costs are high.

Despite the geographical constraints of the CQCR compared to the HVCN, Aurizon Network forecasts indicate that the CQCR is only 5 times more expensive to maintain than the HVCN, although the network is over 6 times larger. This indicates that Aurizon Network's maintenance effort is relatively efficient compared to the ARTC. In fact the Newlands system, which is the closest in size to the HVCN (approximately 328 kilometres of track), is approximately 1.7 times less expensive to maintain (after normalisation).

In addition, the HVCN is subject to greater opportunity for cost sharing of routine maintenance tasks between coal, non-coal freight and passenger services. Therefore, the cost of routine / fixed maintenance tasks may be relatively lower on a unit cost basis compared to the CQCR, although variable maintenance associated with freight volumes would not be impacted if costs are appropriately allocated. This further indicates that the maintenance task for the CQCR is relatively efficient compared to the HVCN.

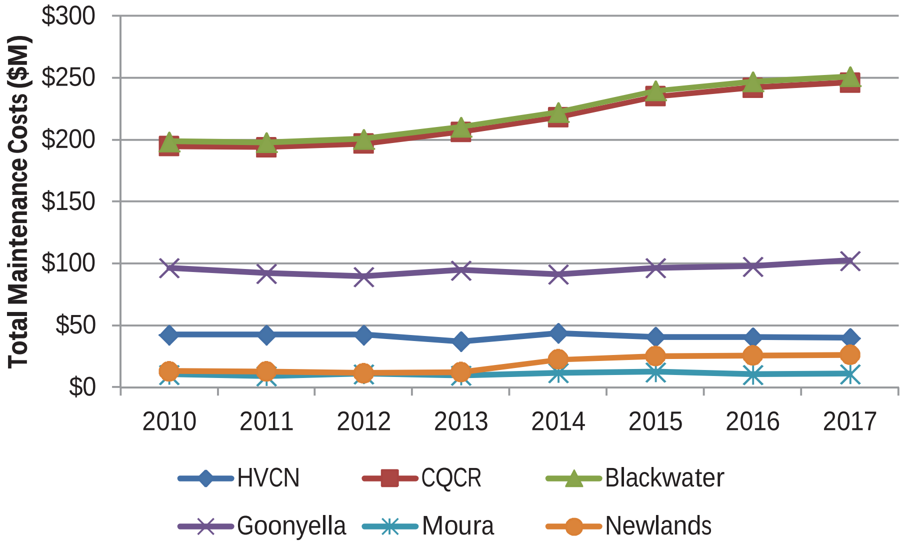


Figure 2.14 Normalised maintenance costs – total absolute dollars

Source: SKM calculations, Aurizon Network (in response to SKM's RFI in Appendix B, Evans and Peck (2012)

While size of the network is an important factor, SKM recognises that the concentration of volumes on the HVCN is significantly greater on the CQCR, and therefore the HVCN would be subject to a greater deterioration. Therefore, it is appropriate to review the unit cost on a dollars per gtk basis, although the size will continue to be a factor with this approach. **Figure 2.15** provides the normalised unit cost (dollars per gtk) for the CQCR compared to the HVCN, which indicates that none of the systems are trending below the HVCN on a unit cost basis and therefore the CQCR is potentially inefficient compared to the HVCN.

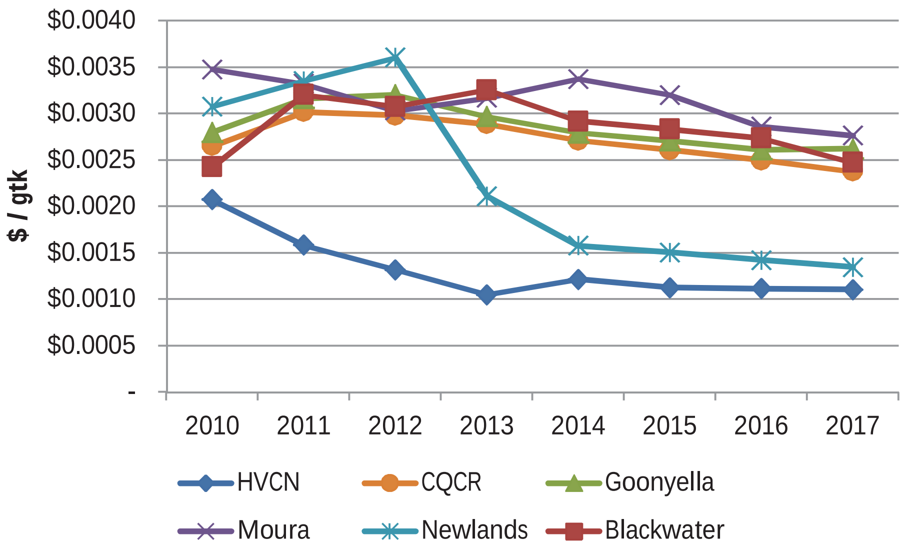


Figure 2.15 Normalised maintenance costs - $/gtk

Source: SKM calculations, Aurizon Network (in response to SKM's RFI in ***Appendix*** A*, Evans and Peck (2012)*

Since both the size of the network and the concentration of volumes is important to the maintenance effort which is required, SKM has attempted to capture some of the implications of maintaining the larger CQCR which has less concentration of volumes on average. This has been assessed through a review of the maintenance costs per track kilometre against million tonnes of coal per annum (MTPA) for the CQCR compared to the HVCN. The results are provided in **Figure 2.16**, and indicate that the historical and forecast maintenance expenditure for the Goonyella, Newlands and Moura systems are relatively efficient compared to the HVCN, although the Blackwater system is more expensive to maintain per track kilometre compared to the HVCN, and at a lower volume. SKM finds that this apparent inefficiency is justified when considering that the location of the Blackwater system relative to other systems on the CQCN and relative to the location of the HVCN means that transit times, accommodation requirements and possessions will be an issue. In addition, the Blackwater system is the oldest of all systems (having been in operation since 1886) and by that nature alone will require a higher maintenance effort.

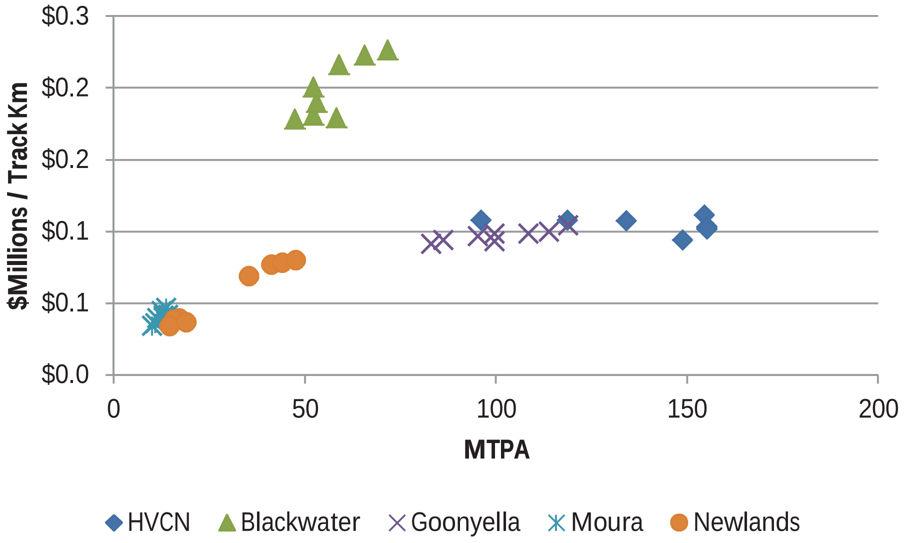


Figure 2.16 Normalised unit cost of maintenance - $millions / track km compared to MTPA

Source: SKM calculations, Aurizon Network (in response to SKM's RFI), Evans and Peck (2012) and ARTC (2010)

SKM notes that the maintenance effort on the HVCN is likely more expensive than individual systems on the CQCR (as depicted in **Figure 2.16**) since track access would be a problem due to the concentrated volumes of haulage. This explains some of the higher cost of maintenance per track kilometre compared to the CQCR. When considered in this context, SKM finds that the CQCR and the HVCN are operating at similar levels of efficiency. Aurizon Network's forecasts are performing well against the HVCN, especially when considering the CQCR is subject to greater exposure to coal fouling and associated costs of ballast undercutting. However it is important to note that in the next undertaking period it is expected that the ballast undercutting scope would decline significantly as the maintenance effort for the UT4 period will address current fouling on the network, while including an additional allowance for additional volumes. Therefore maintenance costs are likely to fall closer to the levels forecast by the ARTC for the HVCN.

Purchase prices

SKM has also obtained estimates of the price paid by Aurizon Network for key maintenance materials/consumables, which are compared to prices paid by the ARTC for the Willow Tree Passing Loop Project, which was part of the Hunter Valley Corridor Capacity Improvement (2007) Strategy Program. The unit costs comprise the cost of the maintenance consumable only including delivery via road; excluding costs associated with placing, and are compared to prices assumed by Aurizon

Network for the UT4 maintenance cost basis. The cost comparison is provided in **Table 2-12** and includes the price of concrete sleepers (including jewellery), head hardened rail and track ballast.

The benchmarking task shows that the cost of ballast for the CQCN is much lower than the price paid by the ARTC, which is likely a reflection of a greater requirement for ballast replacement on the CQCN and associated buying power, as well as efficiencies passed on from suppliers. Conversely, the cost of concrete sleepers and head hardened rail is relatively comparable across operators. SKM finds that the benchmarking task therefore indicates that Aurizon Network's purchase price for key maintenance materials/consumables is efficient in comparison to the HVCN, and that the differences in total maintenance costs for the CQCN and the HVCN are attributable to size, geographic location of systems and the resulting transport and accommodation costs.

Table 2-12 Purchase price benchmarking

Comparison	Aurizon Network	ARTC
Concrete sleeper (including jewellery)	[redacted]	[redacted]
Head hardened rail	[redacted]	[redacted]
Ballast	[redacted]	[redacted]

Source: Aurizon Network and ARTC [redacted]*)*

2.2.6 Double counting of maintenance costs

SKM recognises that there is potential for inappropriate allocations of costs to the engineering maintenance area. In particular, costs associated with capital works where resources (labour and equipment) are shared with the maintenance task can lead to incorrect allocations of costs within internal recording systems. In addition, there is the potential to allocate costs to the maintenance effort which should be capitalised (such as was observed in SKM's review of forecast operating expenditure, where safeworking operations associated with capital projects were allocated by Aurizon Network to the operating budget rather than being capitalised).

To target the potential for misappropriation of costs, Aurizon Network has employed the following strategy to develop the maintenance cost allocation for the 2013/14 financial year[7]:

- where a cost relates to a single product, that cost was deemed a cost of that product (a direct cost),
- where 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; and
- where a cost related 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 tools.

In addition, after eliminating capital and excluded products (see **Table 2-11**) the "customer" was identified and where the customer was not part of the CQCN costs were removed from the cost base.

Once Aurizon Network completed this exercise for the 2013/14 financial year, the exercise was repeated for the balance of the UT4 period.

Table 2-13 demonstrates how Aurizon Network has allocated costs to the maintenance task for the below rail coal network to ensure no double counting occurs.

[7] Source: Page 110, UT4 Maintenance Submission.

Table 2-13 UT4 maintenance product make-up

Item	Count
Number of Product Codes	[redacted]
Number of Excluded Products (Capital and Excluded Products)	[redacted]
Number of Non-Excluded Products	[redacted]
Number of Products without Hours Booked for FY12	[redacted]
Number of Products with Hours Booked for FY12	[redacted]
Number of Products without Significant Hours	[redacted]
Number of Products Modelled	[redacted]

Source: Aurizon Network, provided in response to SKM's RFI (see Appendix B)

In the context of ascertaining whether any double counting or inappropriate allocations have been made for the UT4 maintenance submission SKM notes that it is difficult to determine if inappropriate allocations have been made to the maintenance task, since this would generally be undertaken as part of a review of expensed costs or through a detailed audit of costs one a line by line basis. However, SKM finds that the approach employed by Aurizon Network (as described above) is a reasonable approach to mitigate the risk of misappropriation of maintenance costs since it provides a means for individual cost centres to ensure that expensed costs refer to particular sections of track and for specific maintenance products. SKM notes that this recommendation was made by GHD as part of review of proposed maintenance costs for the UT3 period, and SKM has evidenced that this strategy has been implemented. It is also noted that Aurizon Network engaged GHD to assist with scope development, and Deloitte Touche Tohmatsu for financial modelling, which further verifies the integrity of the process.

2.2.7 Productivity

Aurizon Network's forecast maintenance expenditure for major cost categories includes various assumptions about improved productivity, which translates to forecast reductions in the cost of maintenance compared to the UT3 period. In addition, SKM notes that Aurizon Network's external procurement process will likely lead to productivity gains, providing there is sufficient competition in the market. Although Aurizon Network undertakes procurement locally for individual systems and therefore the level of competition may be reduced somewhat, given the relative buying power of Aurizon Network, it is likely that economies of scale will be achieved through bulk purchases.

Table 2-14 provides Aurizon Network's specific productivity assumptions, which are not applicable to the procurement process.

Table 2-14 Aurizon Network's productivity assumptions

Activity	Unit	UT3	UT4	Aurizon Network's forecast cost saving	Reasonableness
Mechanised ballast undercutting utilising the RM900 train	Production per shift (km)	0.44	0.49	[redacted]	SKM finds that Aurizon Network's assumed productivity improvement for mechanised ballast undercutting utilising the RM900 train is reasonable following the acquisition of the additional spoil wagons. However, SKM recognises that these costs cannot be committed until such time that the spoil wagons are purchased. An adjustment to the ballast undercutting scope for the annual maintenance requirement has therefore been provided in **Section2.2.4**. SKM also recognises that further productivity improvements for the ballast undercutting task will be realised as data from GPR becomes more substantial and allows for improved maintenance task planning.
Mainline resurfacing	Production per shift (km)	1.22	2.04	[redacted]	SKM finds that these productivity improvements are achievable in the context of Aurizon Network's acquisition of five new mainline resurfacing machines which will be brought on line progressively between October 2014 and July 2015. The productivity improvements will also be realised through more accurate data gathering from the track recording unit, preventative resurfacing planning and possession planning.
Mainline rail grinding	Production per shift (km)	16.4	20.00	[redacted]	SKM finds that these productivity improvements are achievable through improved train path planning and from the preventative grinding strategy (which consists of a single pass/grind as opposed to unplanned and/or corrective grinding which consists of several pass grinding occupying more track time).
Turnout rail grinding	Production per shift (# of turnouts)	4.99	5.40	-	SKM recognises that turnout grinding is a more arduous and technical maintenance task and therefore productivity is lower than mainline rail grinding. Despite this, Aurizon Network has allowed for productivity improvements associated with the transition to a preventative grinding strategy. Aurizon Network has stated that the existing machine has capacity to undertake additional scope, therefore the saving is realised through reductions in disruption to above rail services. However, SKM finds that there should be a cost saving which is

					attributable to reduced number of shifts. SKM has therefore made an adjustment (refer to **Table 2-15**) to revise the maintenance allowance down to cater for the reduction in shifts.
Re-railing	Cost per km	$344,272	$331,127	[redacted]	The productivity improvements associated with the reduction in unit costs for the re-railing task are associated with a reduction by Aurizon Network of the project management allowance which SKM finds is a reasonable and achievable saving.
Non-mechanised maintenance	Labour productivity	N/A		[redacted]	SKM notes that the assumption on improved labour productivity is likely a result of the recent downsizing of Aurizon Network's workforce, which means that Aurizon Network will undertake the same or greater levels of maintenance in some instances with a reduced workforce. However, this strategy is unlikely to continue to yield results, without accompanying strategies for realisation or technology improvements. That is, further downsizing in the UT5 period will unlikely be appropriate. In the context of improved productivity of professional services, SKM finds that this will only be realised where market prices adjust accordingly.

Source: Aurizon Network, provided in response to SKM's RFI (see Appendix B)

SKM's review of the productivity improvements assumed by Aurizon Network indicates that most of the productivity improvements are achievable; however forward planning is paramount in ensuring savings are realised. In addition, SKM finds that further savings should be made from improved productivity assumed by Aurizon Network for the turnout rail grinding maintenance task. **Table 2-15** provides SKM's adjustment to the total allowable maintenance to account for these savings.

Table 2-15 Adjustment for rail grinding (turnout) productivity

UT4 scope (no. of turnouts)	[redacted]
Production UT4 (turnouts per shift)	[redacted]
Production UT3(turnouts per shift)	[redacted]
UT4 shifts	[redacted]
UT3 shifts	[redacted]
Cost per shift (10 contractors at $1,100 per day)	[redacted]
Savings	[redacted]

Source: SKM calculations based on information provided by Aurizon Network (see Appendix B)

X- Factor

Aurizon Network's UT4 maintenance submission also states productivity improvements are inherent in the cost basis, since in excess of 50 per cent of the maintenance task will be procured externally. SKM notes that Aurizon Network's word choice 'task' is not entirely accurate, rather a portion of the labour is externally procured and the materials / consumables are externally procured.

Regardless, Aurizon Network suggests that the efficiency factor (the X-Factor) applied in the previous maintenance cost index for the UT3 period is no longer appropriate. SKM finds that this is reasonable, on the basis that productivity assumptions have been built into Aurizon Network's cost basis at a product / individual maintenance task level (see **Table 2-14** above). SKM finds these assumptions are more realistic and more likely to be realised since they provide specific targets for various maintenance tasks, rather than an X-Factor which is applied to total overall cost. However, with regards external procurement, while this will provide some efficiencies if the market is competitive, Aurizon Network will be required to closely manage the delivery of the maintenance effort to ensure the targets in **Table 2-14** are achieved.

2.2.8 Reasonableness of the maintenance cost forecast for the UT4 period

SKM has conducted a review of Aurizon Network's forecast maintenance expenditure for the CQCN and individual systems on the basis of:

- the composition of costs;
- the total cost and unit cost (dollars per gtk), in the context of historical expenditure;
- the total cost and unit cost (dollars per gtk and dollars per track kilometre compared to tonnage) in the context of a benchmarking exercise against the ARTC's Hunter Valley Coal Network;
- the purchase price of key maintenance consumables compared to the ARTC's Willow Tree Project;
- allowance for productivity improvements;
- Aurizon Network's maintenance strategy; and
- the appropriateness of the maintenance cost allocation based on the extent and configuration of assets, the age and condition of assets, geographic considerations, the potential for double counting and the impact of above rail operations on the maintenance task.

The results indicate that Aurizon Network's unit cost of maintenance is demonstratively improving compared to the UT3 period, which indicates that in some circumstances Aurizon Network forecasts to undertake the same level of maintenance at a more efficient price. For maintenance tasks that are increasing in scope, the unit cost is declining relative to the UT3 period which indicates Aurizon Network forecasts to achieve economies of scale during the UT4 period, and the increase in maintenance scope is appropriate compared to the growth in forecast tonnages. The benchmarking analysis indicates that Aurizon Network's maintenance efficiency is at least as good as, and in some circumstances better than, the ARTC's Hunter Valley Coal Network.

However, it is important that the Authority monitors if the actual expenditure during the UT4 period is closely aligned to the cost categories forecast by Aurizon Network, since this will impact on the delivery efficiency and will also provide for a means of highlighting 'efficiency improvements' forecast for the UT5 period. Deviations from planned scope of individual maintenance activities would also impact on SKM's assessment of reasonableness, since the assessment has been undertaken by considering where increases/decreases are forecast by Aurizon Network.

SKM's review of total costs and the maintenance cost composition indicates that an increase in the scope of ballast undercutting is the significant contributor to the increase in total costs which is forecast by Aurizon Network for the UT4 period. SKM has undertaken a review of the proposed ballast undercutting scope, and finds that the scope is reasonable in the context of historical ballast contamination. In addition, there is forecast productivity improvements associated with the acquisition of 24 additional spoil wagons during the UT4 period. However, since the increase in the scope of ballast undercutting is only achievable from the acquisition of additional wagons which were originally proposed during the UT3 period, SKM has made an adjustment to the annual allowable maintenance requirement to remove the impact of increased scope until such time that Aurizon Network demonstrates the acquisition of the additional spoil wagons. At this time, SKM finds that Aurizon Network should submit a proposal for variation to the allowable revenue if additional scope is still required. SKM's adjusted ballast undercutting allowance for the CQCN is reproduced in **Table 2-16** below.

Table 2-16 SKM's proposed total ballast undercutting allowance

Total Ballast Undercutting Allowance	Total Cost
2013/14	$62,830,117
2014/15	$63,765,562
2015/16	$63,414,744
2016/17	$63,034,836

Source: SKM calculations based on information provided by Aurizon Network (see Appendix B)

SKM has made further adjustments to the forecast maintenance task to account for cost savings which should be realised from improved productivity assumed by Aurizon Network for turnout rail grinding. This adjustment represents a reduction in the total maintenance allowable revenue during the UT4 period of approximately $140,000.

In terms of the overall cost forecast, it is noted that there is some risk of not realising productivity gains assumed for professional services. Other productivity improvements are only achievable through forward planning. However, given the manner which maintenance costs have been developed by Aurizon Network for the UT4 period (on a unit cost basis which is linked to the scope of maintenance task) SKM finds that there should be little variation between the forecast and actual expenditure for the UT4 period.

In the context of the maintenance strategy, SKM finds that Aurizon Network's approach to asset management including engineering judgement and the development of the maintenance cost basis is sound, and the maintenance process and plans are comparable with SKM's understanding of other operators and international trends. Some practices employed by Aurizon Network, such as GPR, can be considered industry leading and should begin to provide considerable savings through more efficient allocation of resources when Aurizon Network's information on asset condition is enhanced. Maintenance activities which will benefit from a transition from unplanned to planned preventative maintenance include rail grinding, resurfacing and general track and structures (since preventative rail grinding and resurfacing will result in a reduction in track and structures faults. However, SKM finds that a preventative maintenance strategy for ballast undercutting is not appropriate in the context of increasing the scope before tonnages increase. Therefore the ballast undercutting scope for the UT5 period should only reflect the extent that is required for volumes over that period (and any remaining historical fouling).

Table 2-17 provides SKM's proposed total allowable maintenance cost for the UT4 period, noting that the ballast undercutting task has been adjusted subject to Aurizon Network's demonstration of acquisition of the additional spoil wagons proposed in the UT4 maintenance submission.

Table 2-17 Total allowable maintenance expenditure

Year	2013/14	2014/15	2015/16	2016/17
Aurizon Network Proposed Maintenance				
Ballast Undercutting	$62,830,116.6	$73,227,416.7	$74,565,191.6	$75,262,077.9
Mechanised Resleepering	-	-	-	-
Mechanised Resurfacing	$18,978,808.1	$19,015,082.1	$20,866,699.1	$20,926,536.2
Rail Grinding - Mainline	$9,650,084.0	$10,618,170.7	$11,048,481.1	$11,509,514.4
Rail Grinding - Turnouts	$2,863,329.1	$2,897,796.1	$2,909,162.0	$2,925,911.2
Track Geometry Recording	$394,628.4	$405,537.8	$405,537.8	$405,537.8
Ultrasonic Testing Ontrack Machine	$1,353,867.2	$1,544,492.2	$1,558,848.0	$1,541,282.3
Track, structures and facilities	$55,927,427.4	$57,983,206.9	$59,920,775.7	$61,811,783.4
Trackside systems	$27,956,204.3	$28,971,118.0	$29,459,743.9	$29,935,001.7
Traction	$9,555,549.6	$9,597,573.0	$9,597,994.6	$9,597,001.8
Aurizon Network's total proposed maintenance expenditure	**$189,510,014.7**	**$204,260,393.7**	**$210,332,433.7**	**$213,914,646.6**
SKM Adjustments				
Less ballast undercutting adjustment	-	-$9,461,854.7	-$11,150,447.6	-$12,227,241.9
Less productivity improvement for turnout rail grinding	-$35,022.55	-$35,022.55	-$35,022.55	-$35,022.55
SKM's proposed total allowable maintenance	**$189,474,992.2**	**$194,763,516.5**	**$199,146,963.6**	**$201,652,382.2**

Source: SKM calculations based on information provided by Aurizon Network (see Appendix B)

Reasonableness of system allocations of maintenance expenditure

SKM notes that Aurizon Network's cost basis is built utilising a 'bottom up' unit cost approach based on the scope of works required, and that the maintenance task is allocated to highest and best use considering the condition of the network and access to the track. Therefore, the appropriate allocation of the maintenance effort to individual sections of the network is very important, although it is important to note that Aurizon Network has indicated that there is no instance during the UT4 period where it would be preferred to undertake maintenance however the scope is limited by resources.

Based on a review of system characteristics noted in the UT4 submission, SKM finds that the characteristics which affect the maintenance task are very similar across systems, and therefore the cost allocation should be determined based on system size, condition, forecast volumes and inefficiencies associated with geographic location.

Table 2-18 highlights Aurizon Network's system allocation of costs compared to size, volumes and condition. SKM finds that Aurizon Network's maintenance cost allocation on an individual system basis is appropriate, based on the size and condition of the systems and the volumes hauled. For example, the Blackwater system, although carrying a relatively low volume of tonnages compared to the Goonyella system, is the largest of systems and is in the worst condition due to the age of the asset. Conversely, the Goonyella system which is in better condition compared to the Blackwater system and is slightly smaller but has approximately double the tonnages has the same allocation of maintenance expenditure as the Blackwater system. The relatively smaller allocations of maintenance expenditure for the Moura and Newlands system reflect the size and condition and the lower volumes compared to other systems and are therefore appropriate. Although Moura and Newlands are similar in size, Newlands is larger and carries more volumes and therefore the maintenance is greater than for the Moura system.

Table 2-19 shows that this pattern of allocations is consistent across all major maintenance cost categories. SKM finds that this demonstrates that the cost composition is reasonable and also that Aurizon Network's approach to delivery of a planned maintenance effort for the UT4 period will ensure that the maintenance allocation for individual systems is distributed to systems where the maintenance task will be most effective.

Table 2-18 Cost allocation to compared to size, volumes and condition

System	Size	% of total UT4 tonnages (MTPA)[8]	SKM's condition ranking (1-4, where 1 is best)	UT4 maintenance allowance (% of CQCN) [9]
Blackwater	• 1107 km of bidirectional track, of which 807 km of the track is electrified • 41.5% of the CQCN	27%	4	41%
Goonyella	• 978 km of electrified track. The Goonyella system includes bi-directional duplicated track between Dalrymple Junction and Wotonga, with the remainder being single line. • 36.7% of the CQCN	49%	3	40%
Newlands	• 320 km of single track • 12.0% of the CQCN	19%	2	11%
Moura	• 260 kilometres of single line track • 9.8% of the CQCN	6%	1	5%

Source: UT4 Maintenance Submission and SKM's specialist opinion

Table 2-19 Aurizon Network's allocation of maintenance cost categories for individual systems

Scope of works	Blackwater	Goonyella	Moura	Newlands	Total
Ballast Undercutting	38.9%	43.0%	4.3%	13.8%	100.0%
Mechanised Resurfacing	48.0%	36.3%	4.6%	11.1%	100.0%
Rail Grinding - Mainline	41.7%	40.0%	5.7%	12.6%	100.0%
Rail Grinding - Turnouts	46.9%	43.7%	2.7%	6.7%	100.0%

[8] May not total 100% since based on averages during the UT4 period.

[9] May not total 100% since based on averages during the UT4 period.

Track Geometry Recording	62.9%	27.9%	8.4%	0.8%	100.0%
Ultrasonic Testing Ontrack Machine	38.9%	38.8%	17.6%	4.7%	100.0%
Track, structures and facilities	43.3%	37.4%	7.4%	12.0%	100.0%
Trackside systems	33.9%	35.6%	4.0%	7.9%	100.0%
Traction	36.6%	63.4%	-	-	100.0%

Source: SKM calculations based on information provided by Aurizon Network (see Appendix B)

Depreciated optimised replacement cost (DORC)

SKM notes that Aurizon Network's submission includes a proposal to utilise an approach to asset valuation known as the 'gross replacement value' (GRV) approach rather than the DORC approach. The DORC approach is an approach to asset valuation under which the regulatory asset base is periodically "re-valued" to be equal to the price of building or buying a modern equivalent asset, depreciated to reflect the shorter remaining life of the existing assets[10]. The GRV approach involves restating the cost of each asset to its new gross replacement value, thereby reflecting the total economic benefits embodied within the asset; although estimation of the economic useful life is still required.

It should be noted that SKM's assessment does not include an evaluation of the suitability of a DORC versus GRV approach since this reflects a financial / pricing consideration which is out of the scope of the engineering assessment. Rather SKM's approach considers if re-evaluation may be required in the context of consideration for the useful life of the asset.

SKM notes the following from Aurizon Network's UT4 maintenance submission (page 115):

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.

In the context of this requirement, SKM notes that the review of forecast maintenance costs is necessary to ensure that the maintenance task is efficient with respect to consideration for safety, the size of the network and volumes hauled. In this regard, SKM's review of forecast maintenance costs for the UT4 period has demonstrated that the forecast maintenance cost is reasonable, with a demonstrative improvement in the unit cost compared to the UT3 period. SKM also finds that the actual scope of maintenance works (for example, kms of rail grinding) is reasonable based on the limited understanding of current asset condition and forecast volumes.

However, SKM finds that changes to the maintenance approach during the UT4 period should leave the network in a better condition than during the UT3 period. In particular, the transition to a preventative rail grinding approach will prolong the life of the rail, and therefore adjustments to the useful life of the asset for the purpose of a DORC evaluation or GRV evaluation may be required to the extent that preventative maintenance will prolong the useful life of assets. In addition, the level of ballast undercutting proposed by Aurizon Network would surely result in an improvement in the condition of the network.

[10] OECD, 2005 http://stats.oecd.org/glossary/detail.asp?ID=6735

3. Aspects of the maintenance expenditure forecast raised in stakeholder submissions

The Authority also requested that SKM review and provides opinion on the issues raised by QRC, RTCA, BMA and BMC and Asciano in relation to forecast maintenance costs. The following provides SKM's opinion on specific issues which were raised in the submission, categorised according to the type of issue.

3.1 Increase in maintenance costs relative to the UT3 period

Stakeholders expressed concerns about significant increases in maintenance expenditure relative to the UT3 period, noting that consideration should be given to determine if forecast maintenance costs are efficient. While industry notes and supports Aurizon Network's forecast efficiency improvements on a gtk basis, it also notes similar improvements were forecast in previous periods and did not eventuate due to lower than forecast system activity levels*

**Asciano, QRC, BMA and BMC*

SKM has undertaken a review of the efficiency and reasonableness of Aurizon Network's forecast maintenance expenditure, and SKM's recommendations are summarised in **Section 5.1**. It is noted that much of SKM's findings in regards to cost efficiency are dependent on a declining unit cost relative to the UT3 period, which is expressed on a $/gtk basis. In this regard, system volumes will have important implications for cost efficiency, and the Authority therefore requested that SKM provide an adjustment to maintenance costs to account for reduced volumes as forecast by Energy Economics, (provided in **Section 5**).

It should also be noted that Aurizon Network has provided evidence of the method by which productivity improvements have been factored into the cost base which SKM has reviewed **in Section 2.2.7**. The productivity assumptions results in unit cost savings which are irrespective of volumes, where unit costs are measured by the scope of maintenance (for example kilometres of rail grinding). Risks associated with this approach are outlined below:

1. If the productivity improvements are not achievable, Aurizon Network may request an adjustment to the allowable revenue requirement for the maintenance task; and/or

2. If the productivity improvements are not achievable, Aurizon Network would have an incentive to deliver lower cost maintenance tasks in place of the proposed maintenance program, therefore not delivering on the scope proposed and effectively overspending on the approved efficient maintenance cost.

SKM therefore recommends that the Authority closely monitor the actual expenditure by maintenance cost category compared to proposed expenditure to ensure the scope is efficient. SKM also recommends that a detailed maintenance plan is published on an annual basis for which Aurizon Network is held accountable (see stakeholder submissions in **Section 3.2** below).

Stakeholders expressed concerns that forecast costs for the UT4 period are disproportional to the increase in tonnages in the UT4.*

**BMA and BMC*

Figure 3.1 provides a graphical representation of the change in maintenance costs (real $2012) compared to the change in gtk and mtpa and includes historical actuals from the UT3 period and forecasts for the UT4 period. **Figure 3.1** shows that during the UT4 period, total maintenance costs reviewed by SKM[11] are forecast by Aurizon Network to increase at a lower rate than both gtk and mtpa, and this has also historically been the case (although it is noted that actual expenditure in 2010/11 declined at a much lower rate than the decline in volumes indicating cost or scope inefficiencies in that financial year).

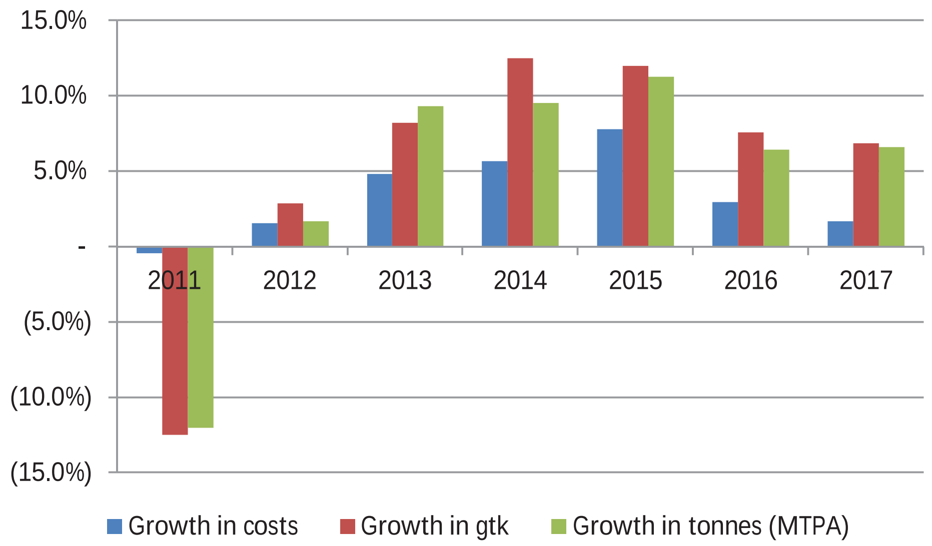


Figure 3.1 Growth in costs compared to growth in volumes

SKM has also proposed an adjustment to maintenance costs in **Section 5** if volumes are lower than forecast by Aurizon Network (based on the forecast provided by Energy Economics).

3.2 Maintenance program

Stakeholders indicated they would like greater transparency of the maintenance program / plan, which would include a rolling 5 year plan with detailed 12 month plan and approval by an agreed majority (75%) of established 'rail capacity groups' and/or the Authority (including approval for any changes to the plan). Stakeholders also recommended that the maintenance plan should include strategies to competitively tender the maintenance task where there is potential value to be gained, and that the annual maintenance allowance should be approved based on the detailed 12 month plan.*

Stakeholders also requested regular reporting of performance to the plan, holding Aurizon Network accountable for non-delivery of scope (except where non-delivery is reasonably out of the control of Aurizon Network).*

**QRC, RTCA, BMA and BMC[12]*

[11] Which exclude corporate overheads and return on assets.

[12] BMA and BMC did not specifically recommend a rolling 5-year plan, although transparency around the planned maintenance scope and delivery accountability was strongly recommended.

SKM finds that a detailed 12 month maintenance plan would be an effective means of ensuring that maintenance tasks are efficient and appropriately allocated to highest and best use on the network. It would also allow for a more detailed review of proposed maintenance scope, since the current process only allows for a review of maintenance costs in the context of historical actual expenditure and trends in the unit cost as a determination of efficiency (that is, it is difficult to determine if the scope is actually required without information on planned location of maintenance works).

However, SKM recommends that the Authority conduct a detailed review of the costs and benefits of the recommendation that the maintenance plan should be reviewed by a majority of established 'rail capacity groups' to ensure that:

- the costs of negotiation would not be so excessive to outweigh the benefits of industry engagement;
- the network would be maintained at a level to ensure long-term longevity and not short term cost minimisation; and
- established 'rail capacity groups' would reflect the views of all access seekers and would not favour specific customer groups.

SKM also finds that Aurizon Network should be held accountable for non-delivery of planned maintenance scope (except where non-delivery was reasonably out of the control of Aurizon Network), through adjustments to the annual allowable maintenance revenue. This will ensure that Aurizon Network is not recovering revenue which is greater than efficient costs which would be required to maintain the network.

Stakeholders expressed concerns about the potential for timing of maintenance tasks to be used in subtle ways to degrade the service quality of third party operators' service offerings.*

**Asciano*

SKM notes that it is possible that the timing and location of maintenance efforts could potentially be used to constrain third party operations. However, SKM has been unable to assess the efficiency of delivery of the maintenance scope as it relates to track access, since Aurizon Network has not provided a detailed scope breakdown by track section, or by expected implementation timeframe. SKM therefore recommends that the Authority require an annual maintenance scope plan, supporting stakeholder requests for further transparency and allowing for review of access implications for individual access seekers / third party operators.

3.3 Validity of Aurizon Network's benchmarking exercise

Stakeholders expressed concerns about the benchmarking approach utilised by Aurizon Network for the UT4 period, noting specifically:*

- *the unit for benchmarking is inconsistent across operators ($/track km vs. $/gtk); and*
- *the validity of cost comparison with US Class 1 railroads.*

In line with these concerns, stakeholders recommended that the Authority commission an independent assessment of Aurizon Network's maintenance cost efficiency.

**QRC, RTCA*

SKM finds that utilising different benchmark parameters for different operators is not appropriate. Although it is appropriate to consider how different operating characteristics will impact on the apparent relative efficiency of various operators, it is only appropriate to do so by considering the impact of parameter adjustments across all operators. For example, SKM has undertaken the benchmarking exercise to consider:

- total costs;
- unit costs on a dollars / gtk basis; and
- unit costs on a dollars / gtk basis against track kilometres

however, the various parameters are compared to against the one benchmark operator (the ARTC's HVCN). In this regard, transparency around the benchmarking process is more apparent, and it is useful to draw out how system characteristics such as size would impact on the relative efficiency of the maintenance task. Therefore Aurizon Network's benchmarking submission in support of the proposed maintenance expenditure should be reviewed as informative only.

3.4 Non-delivery of maintenance scope

Stakeholders expressed concerns about non-delivery of maintenance scope in previous undertakings, noting that this represents overspend by Aurizon Network of the maintenance cost allowance. Of particular concern raised by stakeholders was the significant under-delivery of the ballast undercutting scope in the UT3 period.*
Stakeholders also questioned if non-delivery of the maintenance scope could be factored into the annual allowable revenue for the maintenance task.

**QRC, RTCA, BMA and BMC*

SKM supports stakeholder concerns about non-delivery of the proposed maintenance scope, and has proposed adjustments to the allowable maintenance revenue where it is evident that the maintenance scope cannot be delivered without an upgrade to or acquisition of new machinery (the ballast undercutting scope).

SKM also supports adjustments to the annual allowable revenue in the event that Aurizon Network does not deliver on the proposed maintenance scope, and recommends that the Authority consider the extent to which non-delivery might accelerate asset degradation resulting in an increased maintenance or asset renewal requirement in the future.

In addition, SKM strongly recommends that a thorough review is undertaken to ensure that Aurizon Network's actual maintenance scope for the UT4 period reflects the maintenance cost categories proposed for the UT4 period, since significant deviations from planned scope would not be efficient as reviewed by SKM, and would result in inappropriate allocations of resources to maintenance tasks. Specifically, it is only appropriate that the maintenance task increases so much from the UT3 period because of the level of ballast undercutting required to address previous fouling.

3.5 Forecast volumes for the UT4 period

Stakeholders expressed concerns that Aurizon Network's tonnage forecast is overstated, noting that Energy Economics' forecast is more reflective of current conditions. Stakeholders recommended that Aurizon Network's maintenance scope and budget is reviewed to consider a lower tonnage profile.*

**QRC, RTCA*

SKM has provided a proposed adjustment to the maintenance cost allowance to account for reduced volumes as forecast by Energy Economics in **Section 5**.

3.6 Proposed ballast undercutting scope / cost

Stakeholders expressed concern about the increasing cost of ballast undercutting during the UT4 period and question whether:*

- *the non-delivery of proposed scope should be taken into account when assessing the proposed UT4 allowance; and*
- *the scope of ballast undercutting can be reduced, particularly if tonnage forecasts during the UT4 period are reduced*

**QRC*

Stakeholders expressed concerns that Aurizon Network's UT4 ballast undercutting proposal is an attempt to reverse the Authority's previous decision that QR Network (not users) should bear the higher costs associated with QR Network's imprudent ballast maintenance practices.*

**RTCA*

SKM has undertaken a review of ballast the proposed ballast undercutting scope and finds that the proposed ballast undercutting scope is efficient for:

- historical levels of contamination; and
- contamination from increasing volumes.

In this context therefore it would be appropriate for the Authority to give consideration as to whether Aurizon Network should be required to bear the cost of non-delivery of the ballast undercutting scope from the previous undertaking (the 2010 DAU). Given that there is such significant contamination on the network however; SKM recommends that even if the allowable maintenance expenditure is reduced, that Aurizon Network should be required to undertake a level of ballast undercutting for which access seekers have already incurred costs.

In the event that the Authority approves full recovery of costs during the UT4 period, SKM has made proposed adjustments to the allowable maintenance revenue until such time that Aurizon Network demonstrably implements upgrades to and acquisition of additional spoil wagons to ensure the ballast undercutting task is achievable.

As noted above, SKM also supports stakeholder recommendations to hold Aurizon Network accountable for non-delivery of the proposed maintenance scope each year, and that any significant deviations from the forecast maintenance task breakdown (for example rail grinding, ballast undercutting) should be justified and the impact on future maintenance costs outlined.

Stakeholders indicated that the cost of ballast undercutting could potentially be reduced by re-using more cleaned ballast and reviewing the cost of some input services, such as logistics costs.

**QRC*

SKM notes that cleaning ballast as opposed to ballast replacement is an effective means of cost reduction, provided it is safe to do so (i.e. the engineering standard of formations are maintained). However, in the absence of a detailed maintenance scope by track section, and given that the condition of ballast across various sections of track is presently unknown to SKM, SKM has been unable to identify if further cost savings are achievable (noting that Aurizon Network estimates 60 per cent of ballast will be replaced compared to 40 per cent being re-used). In this regard it would therefore be appropriate for the Authority to consider reviewing the annual expenditure for purchase of ballast to ensure that Aurizon Network is not recovering revenue in excess of efficient maintenance costs (i.e. to determine if the 60/40 estimate is in fact reasonable).

In addition to the above, it should also be noted that SKM's review has shown that:

- ballast undercutting costs are forecast by Aurizon Network to decline on a unit cost basis ($/gtk) relative to the UT3 period and SKM has proposed adjustments in **Section 5** to account for reduced volumes); and
- Aurizon Network's purchase price for ballast is efficient compared to the ARTC's purchase price for the HVCN (**Section 2.2.5**).

Stakeholders expressed concern about the lack of a comprehensive strategy to resolve ballast contamination in the long term, suggesting that this will allow track systems to achieve their design life with minimal intervention*

**QRC*

SKM notes that ballast cleaning represents a significant proportion of Aurizon Network's maintenance budget. It is not likely though that there is a case of overspend in this area – but what is unknown at the present time is an accurate picture of the regions ballast cleaning requirements.

To better manage this issue of ballast fouling, Aurizon Network have analysed 1170 km of Ground Penetrating Radar data on the Central Queensland Coal Network which represents the most highly trafficked tracks on the four systems including the North Coast Line, Central Line, Rocklands to Burngrove, Hay Point to Goonyella and the Oaky Creek Branch. This represents about 80% of the ballast cleaning requirements of the network. This analysis has enabled a determination that the rate 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. Ballast Fouling rates have been determined in terms of % PVC per 100Mnt of coal carried. These rates range between 1% and 15% with an overall average of about 4.5%.

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.

SKM also notes that the methodology for determining the long term forecast for Ballast Undercutting Machine work relies on ballast fouling rates for each km of the track and applying these to the forecast coal tonnages for Draft Access Undertaking. Beyond this period a 5% pa tonnage increase is applied. Where rates of fouling are not able to be determined because of insufficient historical information or other reason a default average of 5% PVC per 100 Mnt is applied. Whilst this is not a comprehensive strategy to resolve ballast contamination in the long term, SKM is of the opinion that this is reasonable to address the issue in the short term until ballast cleaning reaches a preventative maintenance mode during UT5. This would be achieved by procuring new enhanced machines, and by the results gained from veneering improvements.

3.7 Maintenance cost productivity / efficiency

Stakeholders expressed concerns that the 2013 DAU does not provide sufficient incentive for efficiency gains, and that the maintenance cost forecast for the UT4 period does not include a real price adjustment described as CPI less a productivity 'X-factor' (CPI-X). Stakeholders submit that the objective of a CPI-X price adjustment in regulated industries is to ensure a regulated business prices its outputs as it would in a competitive market, and that the CPI-X adjustment should be re-instated for the UT4 period.*

SKM does not support the inclusion of productivity 'X-factor' and considers that it is more appropriate for Aurizon Network to identify cost savings from specific and achievable changes to delivery of the maintenance task, provided that these productivity improvements have been built into the cost base. This approach provides a focus for where cost savings should be realised, while an 'X-factor' is applied to total cost and does not provide a focus for realisation of savings.

Further, SKM does not consider that ongoing inclusion of a productivity 'X-factor' is sustainable as an organisation matures and further cost savings (in total absolute dollars) will be difficult to realise. In this context, SKM has undertaken a review of the reasonableness of Aurizon Network's proposed productivity improvements for the UT4 period, the findings of which are outlined in **Section 2.2.7**.

Stakeholders requested that the Authority undertake work to identify quantifiable efficiency gains which should be achieved independent of any volume changes. **QRC*

SKM has undertaken a review of Aurizon Network's proposed productivity improvements for the UT4 period in **Section 2.2.7**, and that these improvements are assumed by Aurizon Network to occur independent of tonnages. Specifically, the productivity assumptions are built into the cost basis through consideration for the scope of works (for example, kilometres of rail grinding) not based on expected railings.

However, it is noted that these assumptions comprise Aurizon Network's internal assumptions for productivity improvements, which has not been supplemented by a review commissioned by the Authority to identify quantifiable efficiency gains, although SKM recognises that this would be difficult to achieve for a privately operated company.

Stakeholders expressed concerns that the cost/benefit of internal sourcing has not been demonstrated by Aurizon Network. Stakeholders noted that the claim by Aurizon Network that internal sourcing results in cost savings of 20 per cent has not been evidenced. Stakeholders also suggested that Aurizon Network should be required to report to established 'rail capacity groups' on elements of work subject to competitive tendering compared to internal sourcing.* **RTCA* *Stakeholders* requested that the Authority assess the margins applied on services provided by Aurizon Operations to network maintenance, including the provision of hook and pull services for work trains.* **QRC*

SKM notes that there is considerable opportunity for internal sourcing to result in cost inefficiencies if prices do not reflect prices which would occur in the competitive market, which would result in costs which are greater than the efficient level of expenditure required to maintain the network. However, it is also important to note that internal sourcing allows Aurizon Network to control expected productivity improvements (which have been outlined by SKM in **Section 2.2.7**), while external sourcing means that the efficiency of delivery is controlled by external suppliers / contractors.

Therefore it would be appropriate for the Authority to review the cost/benefit of internal sourcing compared to external procurement.

4. 2017-18 maintenance forecast

Table 4-1 provides SKM's suggested maintenance allowance for the 2017/18 financial year in 2011/12 dollars compared to the 2016/17 financial year.

Table 4-1 2017/18 maintenance forecast

	2016/17	2017/18
Ballast undercutting	$75.3	$61.7
Rail grinding	$14.4	$13.9
Resurfacing	$20.9	$20.1
Track Geometry Recording	$0.4	$0.4
Ultrasonic Testing Ontrack Machine	$1.5	$1.5
Track, structures and facilities	$61.8	$59.6
Trackside systems	$29.9	$29.9
Traction	$9.6	$9.6
Total	**$213.9**	**$196.7**

Source: SKM calculations based on information provided by Aurizon Network (see ***Appendix*** *A) and SKM's specialist knowledge*

SKM's estimate of reasonable maintenance costs for the 2017/18 financial year is based on the following assumptions:

- constant volumes in the 2017/18 financial year which are forecast by Aurizon Network in the 2016/17 financial year. In the absence of volume forecasts for the 2017/18 financial year SKM considers that this is a reasonable approach to outline savings which might be expected from implementation of a preventative maintenance regime in the UT4 period and the level of ballast fouling;
- a constant unit cost from the 2016/17 financial year reflecting productivity improvements already realised;
- savings in the track, structure and facilities category from the transition to a preventative maintenance approach which are outlined in **Table 4-2**;
- adjustments to the ballast undercutting, rail grinding and resurfacing scope as outlined in **Table 4-3**; and
- no change in the costs for track geometry recording, ultrasonic testing, trackside systems and traction categories.

Table 4-2 Track, structures and facilities work savings in 2017/18

Track, structures and facilities work	FY18 Assumption
Earthworks - Non Formation	Constant
Fencing	Constant
Rail Joint Management	Constant
Re-Railing	6% less than FY17 due to preventative rail grinding undertaken during UT4 period
Turnout Maintenance	5% less than FY17 due to preventative turnout grinding undertaken during UT4 period
Minor Yard Maintenance	Constant
Monument/Signage Maintenance	Constant

Maintenance Ballast	8% less than FY17 due to better condition of ballast throughout systems following cleaning/undercutting undertaken in the UT4 period
Sleeper Management	6% less than FY17 due to better condition (longer life) following extensive ballast cleaning/undercutting undertaken in the UT4 period
Fire & Vegetation Management	Constant
Rail Stress Adjustment	Constant
Rail Flaw Detection - Manual	Constant
Track Inspections	Constant
Track CleanUp	Constant
Rail Lubrication	Constant
Top & Line Spot Resurfacing	4% less than FY17 due to increased resurfacing undertaken in the UT4 period which will result in less track faults
Rail Repair	8% less than FY17 due to increased resurfacing, ballast cleaning/undercutting, and preventative rail grinding undertaken in the UT4 period which will result in less track faults occurring
Level crossing maintenance	Constant
Repairs Concrete Bridges	Constant
Repairs Timber Bridges	Constant
Structures Inspections	Constant
Drainage maintenance	Constant

Source: SKM specialist knowledge and planned maintenance approach outlined by Aurizon Network

Table 4-3 Ballast undercutting, rail grinding and resurfacing assumptions for the 2017/18 financial year

Maintenance task	2016/17 Km	2017/18 Km	Unit cost
Ballast undercutting			
C01 scope	145	116	$458,607.9
C02 scope	4.7	4.53	$932,693.0
C03 scope	88	82	$51,579.7
Rail grinding			
Rail grinding mainline	4,448	4,300	$2,587.6
Rail grinding turnouts	835	800	$3,505.1
Resurfacing			
Mainline resurfacing	2,226	2130	$7,185.5
Turnout resurfacing	419	397	$6,284.1
Stone blowing	150	150	$15,323.1

Source: SKM specialist knowledge and planned maintenance approach outlined by Aurizon Network

5. Impact of revised volumes during the UT4 period

In May 2013 the Authority engaged Energy Economics to assist in verifying the reasonableness of Aurizon Network's traffic volume forecasts for the UT4 period. **Table 5-1** summarises the total volume forecasts provided by Energy Economics in MTPA compared to Aurizon Network's forecast, which indicates that, on average, the forecasts provided by Energy Economics are 10 per cent lower than those of Aurizon Network over the UT4 period[13]. The Authority has therefore requested that SKM provide an assessment on Aurizon Network's forecast maintenance costs for the UT4 period which would be applicable in the event that tonnages are 10 per lower than Aurizon Network's forecast.

Table 5-1 Revised volume forecast

Energy Economics	2013/14	2014/15	2015/16	2016/17
Blackwater	59.0	60.2	62.3	65.3
Goonyella	97.0	100.2	100.1	105.1
Newlands	15.8	14.6	16.9	17.9
GAPE	7.1	11.4	15.5	16.5
Moura	11.7	12.0	12.8	14.9
Total	190.6	198.3	207.6	219.7
Aurizon Network	2013/14	2014/15	2015/16	2016/17
Blackwater	54.4	60.9	67.4	73.4
Goonyella	97.3	106.4	112.0	116.9
Newlands	14.8	15.8	17.0	18.7
GAPE	20.6	25.4	27.1	29.0
Moura	12.5	13.6	13.0	14.1
Total	199.6	222.2	236.5	252.1
Difference (EE-AN)	2013/14	2014/15	2015/16	2016/17
Blackwater	8.5%	-1.2%	-7.5%	-11.0%
Goonyella	-0.3%	-5.9%	-10.7%	-10.1%
Newlands	6.7%	-7.8%	-0.3%	-4.1%
GAPE	-65.6%	-55.1%	-42.8%	-43.2%
Moura	-6.8%	-12.0%	-1.4%	5.7%
Total	-4.5%	-10.7%	-12.2%	-12.9%

Source: Energy Economics (2013) provided by the Authority

SKM has conducted a review of Aurizon Network's Draft Asset Policy Maintenance and Renewal document to identify and evaluate impacts and issues for maintenance requirements and costs associated with Aurizon Network's approach to asset management and maintenance planning. The policy documents provides information on Aurizon Network's time based estimates for asset lives and the required intervention levels to mitigate asset deterioration arising from traffic haulage. Based on this policy, Aurizon Network determines the level of intervention required (in terms of volume triggers) for maintenance works. These intervention strategies (in terms of the scope of maintenance required (are then applied by Aurizon Network to the cost estimation of maintenance work requirements. The

[13] SKM notes significant differences in production forecasts for individual mines in the Energy Economics and Aurizon Network forecasts. For example, (i) the Energy Economics report includes two greenfield coal mines that Aurizon Network have not listed in their estimates (Middlemount and Daunia), (ii) the Energy Economics report have factored in production from Springsure Creek and Aurizon Network have not listed, and (iii) the Energy Economics report forecasts "substantial mine expansions" at Collinsville and Cook, Aurizon Network have forecast stable production.

application of the processes and rules outlined differ 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. Aurizon Network has developed the costs for these products 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 which means that degradation will occur at a lesser rate with lower tonnages;
- The ability to access the network (given the forecast higher tonnages), which means that track availability for maintenance tasks will improve with less train paths from lower tonnages and the cost of delivering the maintenance task will decline;
- The expansion of the network; i.e. WIRP1 from FY15; and
- The impact of an increased capital/renewals effort, reducing the need for and/or frequency of some unplanned maintenance, primarily in the General Track environment.

Whilst nearly all maintenance activities are tonnage driven, it is also widely accepted that less tonnes will provide more opportunity for more cost effective and efficient maintenance, since access opportunities will increase. This is extremely important in the context of the CQCN, since more opportunities for effective and efficient delivery of the maintenance task will be required to address (in particular) the known accelerated degradation of the asset, and potential loss of structural integrity caused by ballast fouling. 10 per cent less tonnage for the CQCN will therefore drive effective working periods and in turn affect the cost efficiency of maintenance tasks, and the preventative maintenance strategy proposed by Aurizon Network will be achieved at an accelerated rate.

Based on these considerations and the methodology employed by Aurizon Network in determining the scope and associated cost of non-homogenous maintenance activities, it is reasonable to assume that some components of the annual allowable maintenance expenditure would decline with a reduction in volumes on the CQCN. The following sections therefore provide an overview of SKM's findings on aspects of the maintenance task which would be expected to decline in regards to the actual scope.

To inform the assessment of the impact of tonnages on Aurizon Network's forecast maintenance task, SKM has undertaken an assessment of Aurizon Network's cost elasticity of maintenance categories to determine the extent that Aurizon Network has forecast changes in total maintenance costs each year compared to changes in total tonnage. Elasticity is quantified as the ratio of the percentage change in one variable to the percentage change in other variables. In this regard, SKM has calculated Aurizon Network's maintenance cost elasticity based on the following equation:

Equation 1 Maintenance cost elasticity with respect to volumes

$$Maintnenance\ cost\ elasticity\ with\ respect\ to\ volumes = \frac{\%\ change\ in\ costs}{\%\ change\ in\ volumes}$$

Table 5-2 provides an interpretation of cost elasticity factors with respect to volumes which are provided in this section.

Table 5-2 Elasticity factor interpretation

Elasticity Factor	Interpretation
0	Changes in volumes have no impact on costs
>0, <1	Total costs increase / decrease with an increase / decrease in volumes, at a lower rate than the change in volumes
1	Changes in costs are directly proportional to changes in volumes
>1	Total costs increase / decrease with an increase / decrease in volumes, at a higher rate than the change in volumes

It is important to note that the cost elasticity does not represent the incremental cost with respect to tonnage. The cost elasticity measures an average change in costs per percentage change in volumes between two points, not the slope of the cost curve at the base tonnage (the incremental cost). Therefore, SKM finds that the cost elasticity is not an appropriate representation of the AT_1 reference tariff and should not be viewed in this manner.

Ballast undercutting

Given the current condition of ballast on the CQCN, SKM finds that it is not likely that there is a case of over scoping of the ballast undercutting task with reference to Aurizon Network's forecast volumes.

However, it is recognised that an accurate picture of the current level of fouling is unknown by Aurizon Network, and therefore it is difficult to plan the location of works required, and the level of effort in terms of the ballast depth. In response to information constraints, Aurizon Network's maintenance strategy includes provision for ground penetrating radar (GPR) to enable a clearer understanding of the condition of ballast and to plan maintenance efforts in advance. The result is that the ballast undercutting scope in the UT5 period should be completely driven by new growth, that is, the unplanned maintenance required for previous undertaking periods will no longer be required. As previously stated, SKM finds that a purely preventative strategy for ballast undercutting is not appropriate, since coal fouling occurs after spillage and is therefore driven by the train paths / volumes hauled. Therefore, the ballast undercutting task in the UT5 period should be planned to address fouling from new volumes hauled during the UT5 period, and the ballast undercutting task in the UT4 period should be corrective only for previous fouling and planned for new growth.

It is therefore reasonable to assume that Aurizon Network's proposed provision of ballast undercutting for the UT4 period includes both corrective maintenance for current fouling and maintenance for forecast levels of fouling which will be caused by growth in volumes during the UT4 period. Aurizon Network's UT4 maintenance assumptions indicate that 60 per cent of ballast will be replaced[14], while 40 per cent of the ballast will be cleaned over the UT4 period. The ballast which will be replaced is severely degraded, and therefore indicates that this is the portion of the ballast undercutting allowance for the UT4 period which is corrective for previous fouling. SKM has therefore undertaken a review of the cost elasticity with respect to volumes for the remaining 40 per cent of the ballast undercutting allowance to determine an adjustment for reduced volumes. It should be noted that the level of ballast undercutting allowance for new volumes is not assumed to be a 'preventative' approach in the sense that ballast cleaning is are undertaken before train paths on the network, rather it represents planned maintenance based on expected volumes. Therefore, it is appropriate to adjust this estimate based on cost elasticity for the portion of costs attributable to new volumes.

Table 5-3 provides SKM's adjustment for the ballast undercutting task to account for a reduction in volumes. The cost of GPR has been removed from the total cost for new volumes, since this task

[14] Source: Aurizon Network in response to RFI AUR-006

occurs irrespective of volumes and is an innovative method which will ensure Aurizon Network will have a detailed understanding of the condition of ballast in future undertaking periods.

The cost elasticity with respect to volumes for the 2015/16 financial year has been set to zero and no adjustment has been made to the allowable ballast undercutting task since it is not reasonable that the allowance would increase for lower volumes. The negative cost elasticity occurs from SKM's deduction of the GPR scope and indicates that Aurizon Network plan to undertake the same level of ballast undercutting that is planned for the 2014/15 financial year even though there is some increase in forecast volumes.

Table 5-3 Ballast undercutting adjustment for reduced tonnages - CQCR

	FY14	FY15	FY16	FY17
Total Proposed UT4 allowance	$62.8	$73.2	$74.6	$75.3
Proportion corrective for existing fouled ballast	$37.70	$43.94	$44.74	$45.16
Proportion planned for new volumes	$25.13	$29.29	$29.83	$30.10
Allowance for GPR	$0.7		$0.7	
Total cost for new volumes	$24.43	$29.29	$29.13	$30.10
Growth in costs for new volumes	29.9%	19.9%	(0.6%)	3.4%
Growth in volumes	9.5%	11.3%	6.4%	6.6%
Cost elasticity with respect to volumes	3.1	1.8	0	0.5
Reduction in volumes	-4.50%	-10.70%	-12.20%	-12.90%
Cost adjustment ($m)	-$3.45	-$5.53	$0	-$1.97

Source: SKM calculations based on information provided by Aurizon Network (see ***Appendix*** A)

Rail grinding

SKM has undertaken a review Aurizon Network's key assumptions relating to the rail grinding task. Of particular importance to this assessment are noted below:

- Aurizon Network's scope for the rail grinding task includes a 44 per cent increase in mainline rail grinding production for the 2013/14 financial year compared to the 2011/12 financial year and a 18 per cent increase in turnout rail grinding – this scope increase represents the kilometres of mainline grinding achieved and the number of turnout rail grinding achieved *not* the increase in costs; and
- the cost of delivery is based on Aurizon Network's assumptions of productive time per shift, which are based on levels observed in the 2011/12 financial year, with an assumed productivity factor applied.

SKM finds that the rail grinding scope could reduce with a reduction in tonnages; however it is important to note that the increase in scope noted above also includes the impact of a transition to a preventative rail grinding strategy. Therefore it is more appropriate to consider the actual scope of task, in terms of the kms of grinding which is undertaken per MTPA of coal. **Table 5-4** provides Aurizon Network's forecast rail grinding scope compared to forecast tonnes, which shows that the number of kms of grinding per million tonnes each year is close to equal over the UT4 period, which indicates that the allowance for a preventative grinding strategy is included in each year and is directly proportional to volumes.

Table 5-4 Aurizon Network's proposed rail grinding scope

	2013/14	2014/15	2015/16	2016/17
Aurizon Network's forecast tonnes (mtpa)	199.6	222.2	236.5	252.1

Mainline				
Proposed	3,463.7	3,879.7	4,149.9	4,447.9
Number of kms per million tonnes	17.3	17.5	17.5	17.6
Turnout				
Proposed	666	738	784	835
Number of kms per million tonnes	3.3	3.3	3.3	3.3

Source: SKM calculations based on information provided by Aurizon Network (see Appendix B)

SKM's proposed adjustment to the rail grinding scope is provided in **Table 5-5**, and is adjusted based on the unit cost provided by Aurizon Network for each year. This approach will ensure that cost efficiencies each year are still realised in terms of a reduction in the unit cost.

Table 5-5 Rail grinding adjustment for reduced tonnages

	2013/14	2014/15	2015/16	2016/17
Reduction in tonnes	-4.50%	-10.70%	-12.20%	-12.90%
New forecast tonnes (mtpa)	190.7	198.4	207.6	219.6
Revised mainline grinding scope (km)	3,307.8	3,464.5	3,643.6	3,874.1
Mainline grinding unit cost per km	$2,786.1	$2,736.9	$2,662.3	$2,587.6
Revised mainlining grinding cost ($m)	$9.2	$9.5	$9.7	$10.0
Revised turnout grinding scope	636.0	659.0	688.4	727.3
Turnout grinding unit cost per km	$4,296.7	$3,927.2	$3,709.4	$3,505.1
Revised mainlining grinding cost ($m)	$2.7	$2.6	$2.6	$2.5

*Source: SKM calculations based on information provided by Aurizon Network (see **Appendix** A)*

A summary of the cost adjustment for rail grinding is provided in **Table 5-7** below.

Table 5-6 Summary of rail grinding adjustment for reduced tonnages

	2013/14	2014/15	2015/16	2016/17
Cost adjustment (mainline) - $m	-$0.43	-$1.14	-$1.35	-$1.48
Cost adjustment (turnout) - $m	-$0.13	-$0.31	-$0.36	-$0.38
Total cost adjustment (rail grinding) - $m	-$0.56	-$1.45	-$1.70	-$1.86

Source: SKM calculations based on information provided by Aurizon Network (see Appendix C)

Resurfacing

Aurizon Network is currently employing a mix of unplanned and planned preventative resurfacing maintenance, and SKM notes that resurfacing is tonnage driven, and designed to keep the network at a steady state. Lower tonnages would result in a reduction of the scope of resurfacing required. **Table 5-7** provides SKM's adjustment for the allowable resurfacing task. The cost for the 2013/14 financial year does not require adjustment, since the cost elasticity is negative which indicates that Aurizon Network has applied efficiencies to the cost estimation, but increased the scope of resurfacing in each subsequent year, and it would not be appropriate to utilise the negative cost elasticity to increase costs with decreased tonnages.

Table 5-7 Resurfacing adjustment for reduced tonnages - CQCR

	2013/14	2014/15	2015/16	2016/17
Cost elasticity of resurfacing with respect to tonnages	(0.67)	0.02	1.51	0.04
Reduction in tonnages	-4.50%	-10.70%	-12.20%	-12.90%

Total resurfacing allowance proposed by Aurizon Network ($m)	$19.0	$19.0	$20.9	$20.9
Cost adjustment ($m)[15]	No adjustment required	-$0.03	-$3.85	-$0.12

Source: SKM calculations based on information provided by Aurizon Network (see Appendix B)

Track, structures and facilities

SKM finds that the scope of general track maintenance should reduce since it is reasonable to assume that track and/or component faults would decline with reduced tonnages. However, the majority of general track maintenance is relatively labour intensive compared to that of mechanised disciplines and also includes fixed (preventative) costs such as inspections (which are usually time based), and unplanned, fault repair works (which are volume based). As such, although there would be some reduction in general track maintenance costs, the cost impact would not be on a one for one basis. That is to say that less tonnage will not impact on the amount of track inspections required, solely the amount of faults and failures that would occur.

Structures maintenance should also reduce as less tonnage would mean less stress/faults and less impact. Like general track maintenance, the structures management group involves both preventative maintenance works (which are usually time based) and unplanned maintenance works (which are volume based). Therefore, the reduction in costs is not one for one for a reduction in volumes.

SKM finds that there should be some reductions in the following maintenance tasks within the track, structures and facilities categories associated with reduced volumes:

- re-railing;
- turnout maintenance;
- minor yard maintenance;
- maintenance ballast;
- sleeper management;
- top & line spot resurfacing;
- rail repair;
- repairs of concrete bridges; and
- repairs of timber bridges.

Table 5-8 provides Aurizon Network's cost allowance for the categories above. SKM's adjustment based on reduced volumes from the Energy Economics report is also provided, and represents the total reduction required for the CQCR.

Table 5-8 Track, structures and facilities adjustment for reduced tonnages - CQCR

Maintenance Task	2013/14	2014/15	2015/16	2016/17
Re-Railing	$15.3	$15.1	$15.7	$16.1
Turnout Maintenance	$5.41	$5.91	$6.19	$6.49
Minor Yard Maintenance	$0.18	$0.20	$0.21	$0.22
Maintenance Ballast	$1.97	$2.11	$2.21	$2.33
Sleeper Management	$2.60	$2.89	$3.03	$3.20

[15] Elasticity * Reduction in tonnages * Total resurfacing allowance proposed by Aurizon Network

Top & Line Spot Resurfacing	$2.25	$2.47	$2.54	$2.66
Rail Repair	$4.68	$5.12	$5.45	$5.77
Repairs Concrete Bridges	$0.31	$0.35	$0.36	$0.38
Repairs Timber Bridges	$0.12	$0.13	$0.14	$0.16
Total Allowance proposed by Aurizon Network ($m)	**$32.79**	**$34.23**	**$35.86**	**$37.36**
Cost elasticity with respect to tonnages[16]	0.6	0.4	0.7	0.6
Reduction in tonnages	-4.50%	-10.70%	-12.20%	-12.90%
Cost adjustment ($m)	**-$0.87**	**-$1.43**	**-$3.23**	**-$3.05**

Source: SKM calculations based on information provided by Aurizon Network (see Appendix B)

Signals, Communications, and Traction

SKM finds that no adjustment is required to signals, communications and traction maintenance since activities in this category relate to the overall performance of systems and the associated infrastructure. These activities are required to ensure the systems are maintained to a safe and appropriate operating level and are not responsive to volumes.

Total impact from reduction in volumes

Table 5-9 provides a summary of SKM's adjustments for the total maintenance allowance for the CQCR to account for reduced volumes forecast by Energy Economics. The total adjustment is calculated as the sum of proposed adjustments outlined in the paragraphs above, which is based on the analysis of cost elasticity with respect to volumes. The total proposed cost adjustment over the UT4 period is approximately $29.1 million in 2011/12 dollars over the UT4 period, of which the majority is comprised of adjustments to ballast undercutting allowance and the allowance for maintenance of track, structure and facilities.

Table 5-9 Total adjustment for reduced tonnages

	2013/14	2014/15	2015/16	2016/17
Ballast undercutting	-$1.50	-$5.53	$0.00	-$1.97
Rail grinding	-$0.56	-$1.45	-$1.70	-$1.86
Resurfacing	No adjustment required	-$0.04	-$3.84	-$0.11
Track, structures and facilities	-$0.87	-$1.43	-$3.23	-$3.05
Total adjustment	**-$4.88**	**-$8.44**	**-$8.78**	**-$7.00**

Source: SKM calculations based on information provided by Aurizon Network (see Appendix B)

5.1 Conclusions and recommendations

SKM has provided a review of Aurizon Network's forecast maintenance cost for the UT4 period. Based on this review, SKM finds that the forecast maintenance costs are reasonable for the UT4 period when accounting for Aurizon Network's forecast volumes; however recommendations have been made to:

[16] The cost elasticity for the 2013/14 financial year is based on the average for the three years following as detailed historical costs were not provided for the 2012/13 financial years.

- limit the scope of the ballast undercutting task until such time that the additional spoil wagons are acquired; and
- realise additional savings (although not significant) from Aurizon Network's productivity assumptions for turnout rail grinding.

In addition, SKM has also provided recommendations for reductions in the allowable maintenance costs associated with Energy Economics forecast of lower volumes for the UT4 period. The total recommended adjustment is reproduced in **Table 5-10**.

Table 5-10 Total adjustment for reduced volumes

	2013/14	2014/15	2015/16	2016/17
Total adjustment for reduced volumes	-$4.88	-$8.44	-$8.78	-$7.00

Source: SKM calculations based on information provided by Aurizon Network (see Appendix B)

SKM has also provided an indicative forecast for reasonable maintenance costs for the CQCR in the 2017/18 financial year, which assumes (without more detailed forecasts) constant volumes as forecast by Aurizon Network in the 2016/17 financial year. The total proposed maintenance cost is $196.7 million compared to Aurizon Network's forecast for the 2016/17 financial year of $213.9 million.

A summary of SKM's findings and recommendations is provided in **Table 5-11**.

Table 5-11 Summary of findings

Review	Summary of findings
Forecast maintenance expenditure compared to historical levels	SKM finds that the forecast maintenance for the CQCR and individual systems is reasonable on the basis of: • declining unit costs compared to the UT3 period; • the cost composition compared to historical actuals, noting that the cost and maintenance basis includes consideration for costs incurred and the scope of maintenance task achieved in the 2011/12 financial year; and • the cost per track kilometre compared to tonnage over 8 years between the UT3 and UT4 period, which reflects allocations of maintenance expenditure across individual systems which would be expected based on size, tonnage and system characteristics.
System allocation of costs	SKM finds that system characteristics are similar across the CQCN and that Aurizon Network's allocation to individual systems is reasonable based on the size and condition of individual systems and the forecast volumes.
Ballast undercutting scope	SKM finds that Aurizon Network's proposed ballast undercutting scope and costs are reasonable in the context of historical ballast fouling and the impact of new volumes. However, recommendations have been made to limit the scope of the ballast undercutting task until Aurizon Network acquires the additional ballast wagons proposed in the UT4 Maintenance Submission. Additionally, SKM finds that the Authority should not approve deviations from the forecast expenditure by maintenance category, since SKM's review is based on the reasonableness of proposed scope for individual maintenance types.
Benchmarking	SKM finds that Aurizon Network's forecast maintenance cost is appropriate in the context of the benchmarking exercise against the ARTC's forecast maintenance costs for the HVCN. The benchmarking exercise indicates that costs are reasonable when considering the size of the networks and the purchase price of key maintenance materials / consumables.
Double counting of maintenance costs	SKM finds that the approach employed by Aurizon Network (as recommended by GHD in as part of the review of maintenance costs for the UT3 period) is a reasonable approach to mitigate the risk of misappropriation of maintenance costs (including from above rail activities) since it provides a means for individual cost centres to ensure that expensed costs refer to particular sections of track and for specific maintenance products.

Productivity improvements	SKM's review of the productivity improvements assumed by Aurizon Network indicates that most of the planned productivity improvements are achievable; however forward planning is paramount in ensuring savings are realised. In addition, SKM has made an adjustment for savings which should be realised from improved productivity assumed by Aurizon Network for the turnout rail grinding maintenance task. Therefore it is appropriate that the Authority monitor realisation of productivity improvements, and the significant level of detail which Aurizon Network has undertaken in developing the maintenance cost base means that deviations from forecast expenditure should not occur without significant justification (for example much higher than forecast volumes or extreme weather events which cause deterioration of assets and for which impacts are not captured in the self-insurance allowance). SKM also finds that the productivity 'X-factor' included in the UT3 submission is not required since specific productivity targets provide a much more robust and considered method of setting targets for savings. The appropriateness of the X-factor will further be explored as part of SKM's review of Aurizon Network's proposed MCI for the UT4 period.
Depreciated Optimised Replacement Cost (DORC)	SKM finds that adjustments to the RAB in the context of a DORC evaluation may be required since the proposed maintenance strategy (in particular, the level of ballast undercutting and the transition to a preventative maintenance regime) would be expected to leave the CQCN in a better state than during the UT3 period.
2017/18 Maintenance cost forecast	SKM has provided an indicative maintenance cost forecast for the 2017/18 financial year which includes savings which would reasonably be expected to be realised from a transition to a preventative maintenance approach. The level of ballast undercutting is also reduced to account for 'catching up' for old fouling that will occur during the UT4 period.
Impact on UT4 maintenance cost forecast from reduced volumes	SKM has provided recommended adjustments to Aurizon Network's forecast maintenance costs for the UT4 period which reflect revised volumes provided by Energy Economics.

Source: SKM conclusions based on information provided by Aurizon Network (see Appendix B)

SKM's review notes that the savings from Aurizon Network's transition to a preventative maintenance regime should realise savings during the UT5 period.

A successful transition to a preventive maintenance program would enable the establishment of consistent practices specifically designed to improve the performance and safety of the infrastructure and prevent further incidents and track defects before they occur or fail.

Preventative maintenance would also help to improve infrastructure and component life and aid the avoidance of increased unplanned maintenance activities going forward. It also enables the determination of specific works which are required, where that work should be focused, and the efficient timing of works to minimise impacts on the supply chain while minimising maintenance costs. As such efficiencies in machine operations and maintenance quantities would be achieved. Other benefits of preventative maintenance enable the ability to evaluate future maintenance needs, prioritize maintenance projects by track performance, identify areas of high costs or repeated repairs, enable better management and deployment of maintenance operations and resources, and achieve significant reductions in track geometry defects.

Therefore it is recommended that the Authority consider reviewing if savings have been realised for rail grinding, resurfacing and general track in terms of:

- total absolute dollars;
- a reduction in the actual scope; and
- a reduction in the unit cost of maintenance.

In addition, a review of the extent to which actual expenditure aligns to forecast expenditure by individual maintenance tasks will indicate the success of Aurizon Network's planned maintenance task and also the reasonableness of expenditure.

Appendix A. Documents provided by Aurizon Network

Asset Renewal & Maintenance

QCA and SKM Briefing

22 August 2013

AURIZON.

Program

Technical review:

- Spot light on ballast management
- Spot light on wheel rail management

Overview of UT4 asset maintenance and renewals per asset class

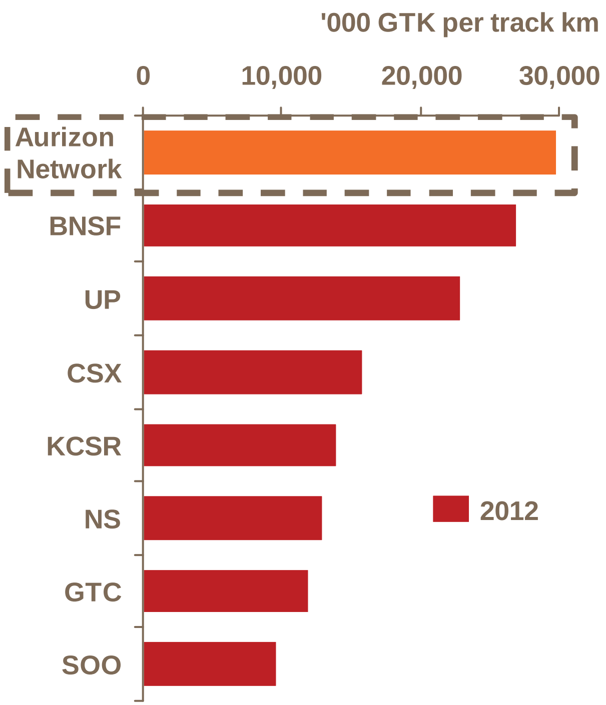
Technical review:

- Spot light on asset renewals
- Spot light on signalling and track systems

AURIZON

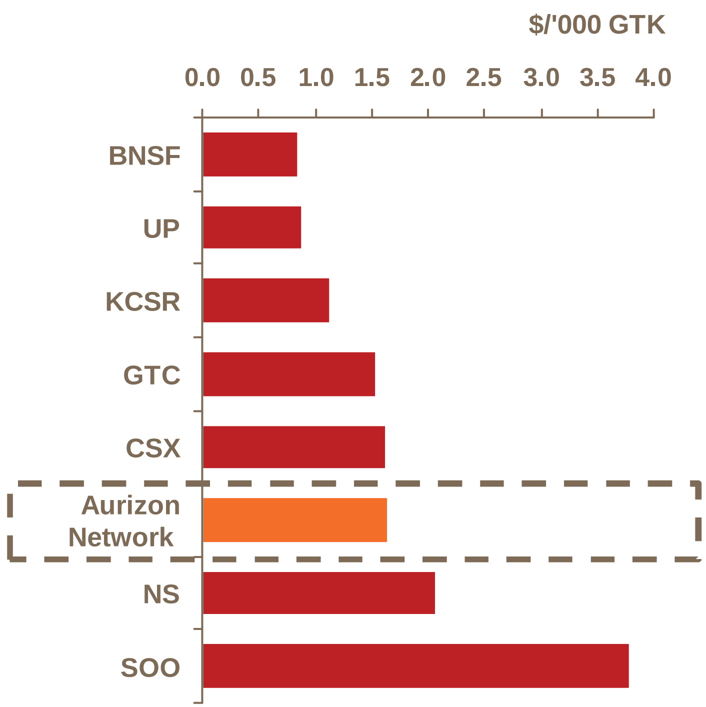
Aurizon's Network business is in the zone of Class 1's

Track utilisation



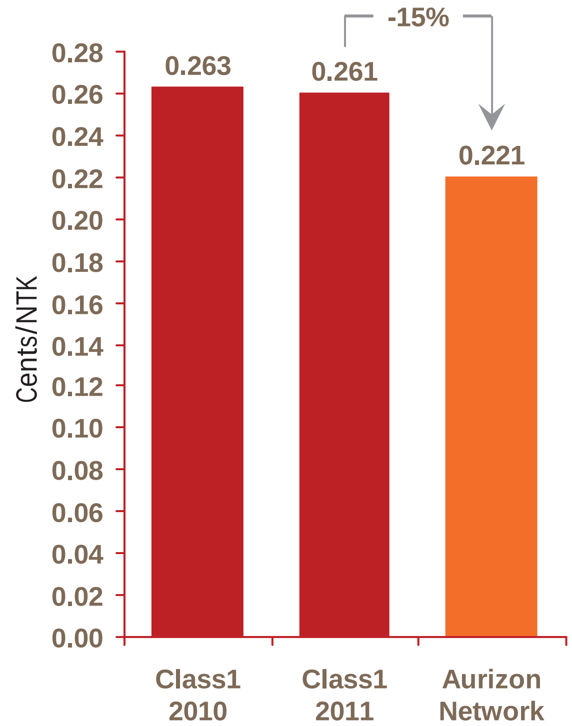
Network operate a higher average density network

Maintenance cost [1]



Competitive, with opportunities for improvement

Renewal spend



$150m pa renewal spend is less than Class 1 average

1. Maintenance costs adjusted for contract tonnes and A$ impacts, no adjustment to renewal costs

Source: Network Function Financial Performance data

Class 1 data sourced from Surface Transportation Board Annual Reports

Spotlight on Aurizon Network’s

Ballast Management

Old method

New method
Calibration process
Output of analysed data
Veneering
RESULTS

AURIZON

Old Method - Sampling

- Sampling typically at:
  - centreline,
  - 500m or 1km intervals,
- Sampling requirements:
  - track closure,
  - 70 litre sample of ballast,
- Sampling is a destructive testing method,
- Sampling and testing: ~8 per day, ~200 per year, total ~2000,
- Sample sent to GEO tech lab
- Ballast screenability determined from presence of clay in side of sample pit from visual assessment.

Sampling of Ballast by Destructive Means

AURIZON

New Method - GPR

- Conducted by external contractors Zetika Rail who perform this from UK base for customers across the world.
- GPR PVC values: 3 offsets at 5m intervals,
- GPR data formats:
  - pdf charts,
  - excel
- Vastly more data
- Advantages compared to PVC sampling and testing program:
  - Faster, safer and lower cost data capture,
  - More data from one time period available,
  - Non-destructive testing method,
  - Better identification of fouling level interfaces.

GPR Testing Vehicle

AURIZON

Calibration (2011)

- Test track panel constructed at Yukan, near PVC laboratory:

– 14 x 2m sub-sections,
  - 11: PVC: 0% to 100%,
  - 3: clean and spent ballast combinations

– GPR testing during wet and dry conditions

– PVC sampling and testing to confirm PVC values

– GPR PVC calibration curve developed.

Yukan Test Panel

AURIZON

Veneering

- Mines have access to Katestone Web site with veneering reports (www.nws-katestone.com.au)
  - Ongoing access can be provide through Jason Livingston in the Bug/Mugs
  - Mines only have access to their own information through web site user rights.
- Examples of dust monitoring from quarterly report to DEHP follow.
- DEHP (old DERM) quote:

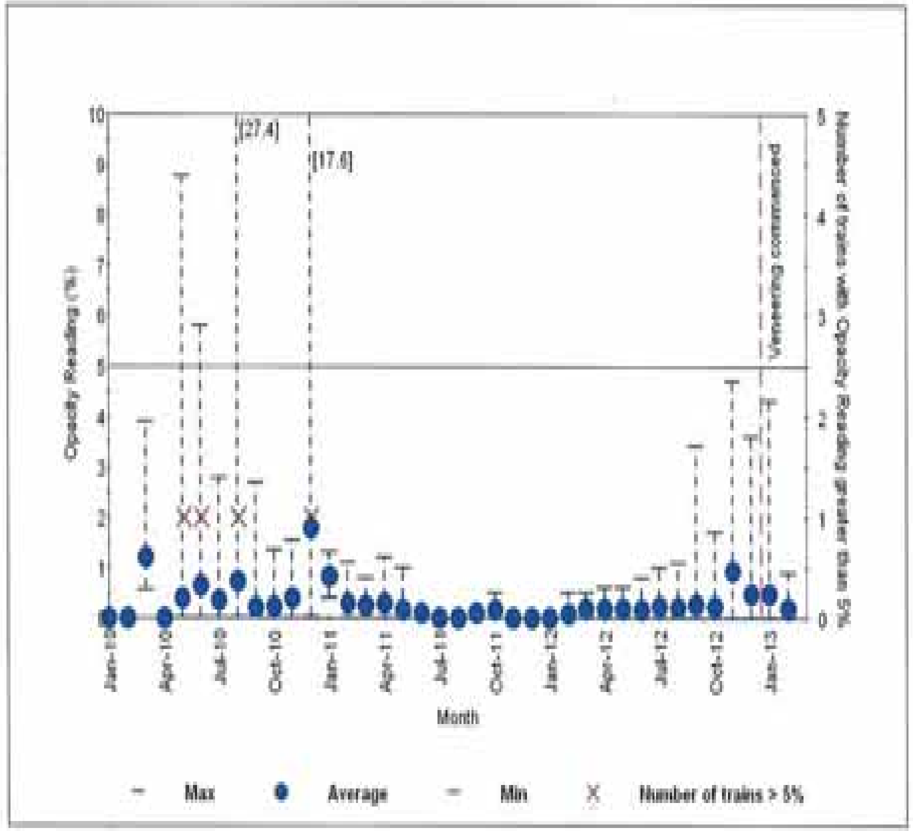
  "Central Qld now leads Australia in management of train related coal loss with load profiling and veneering as industry best practice"

- Need agreement with mines to veneer through TFL to ensure end of year delivery date achieved.

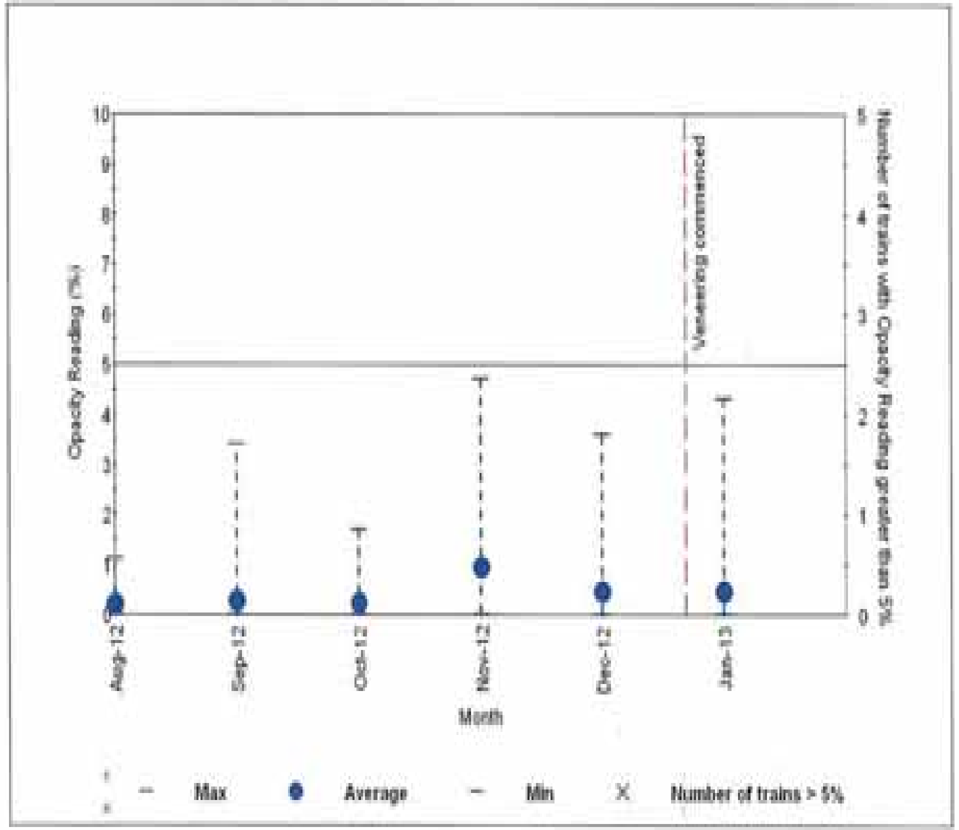
Veneering Station Installation - 1

Historical Data

Veneering station installation date: 19 December 2012

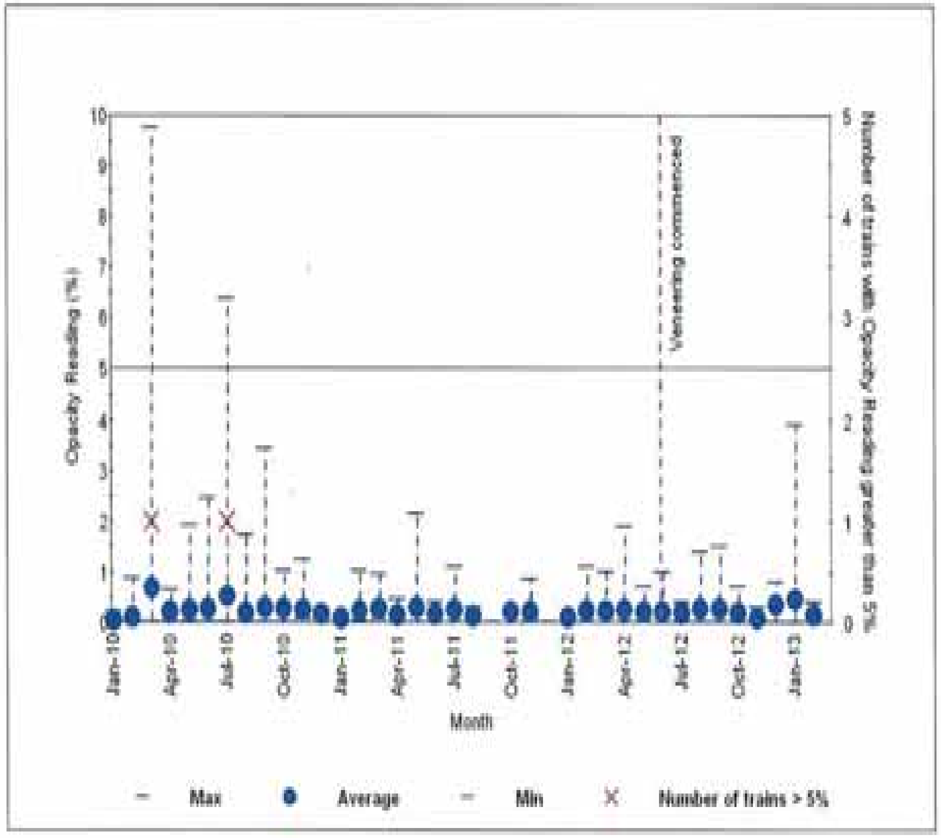


Six-Monthly Data

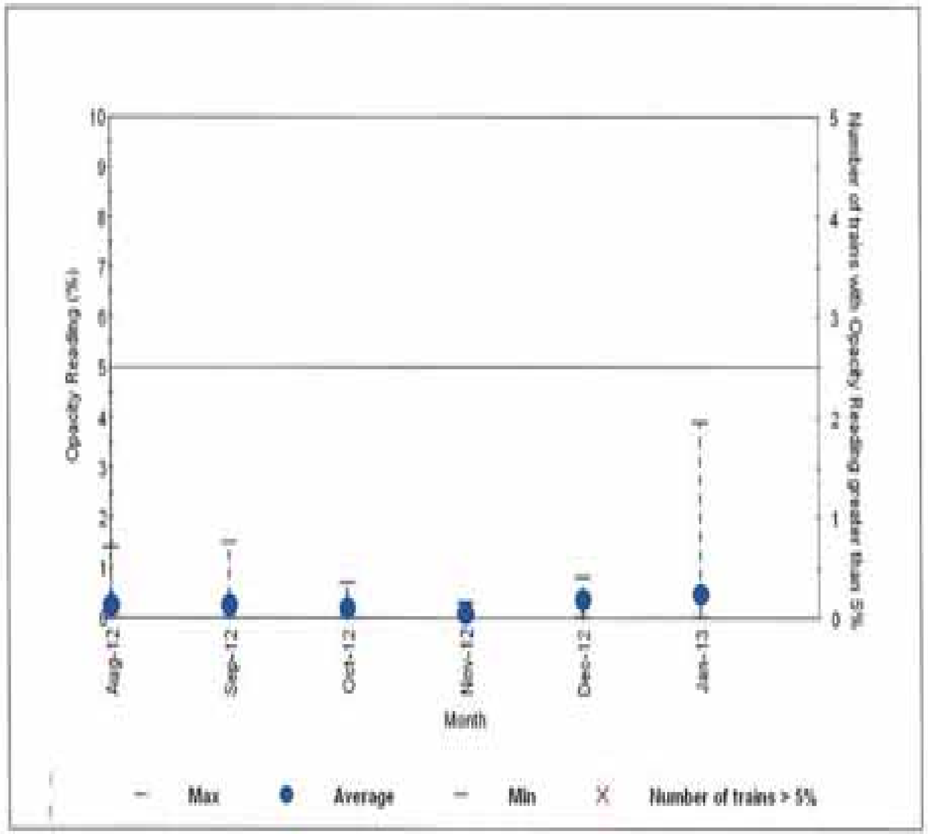


Veneering Station Installation - 2

Historical Data
Veneering station installation date: 05 June 2012



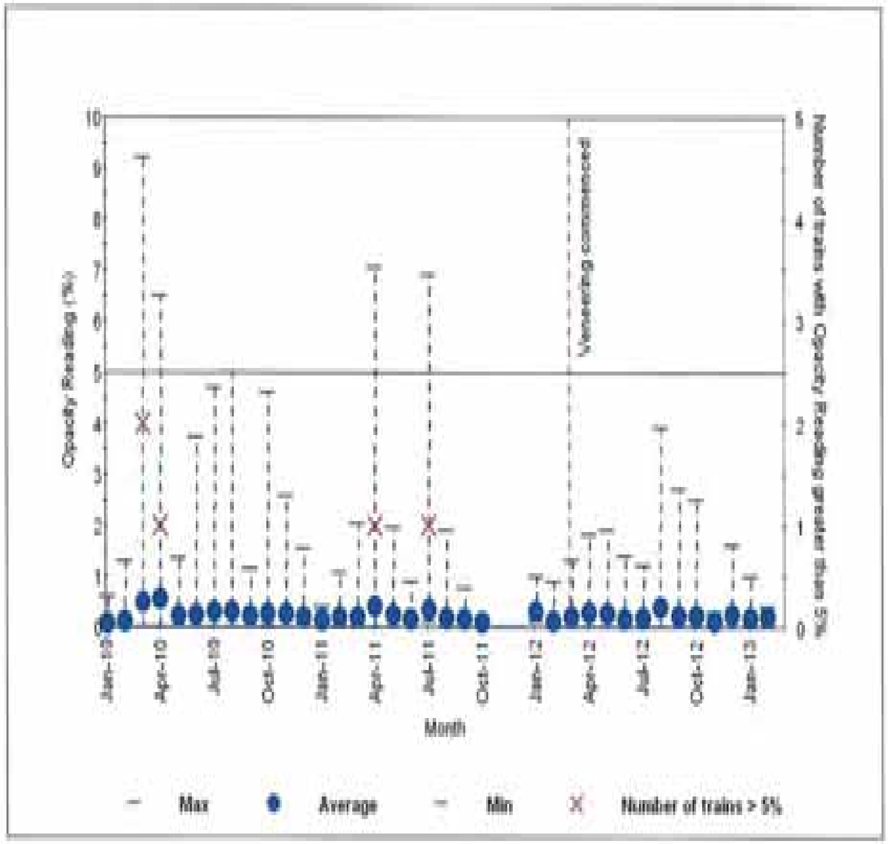
Six-Monthly Data



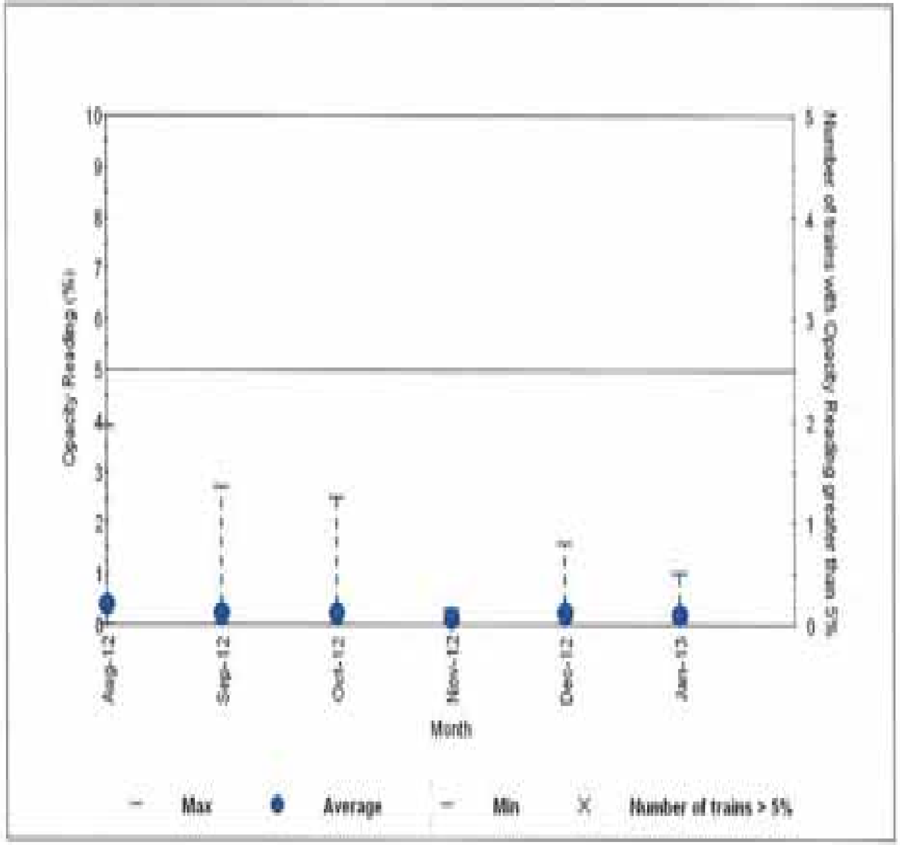
Veneering Station Installation - 3

Historical Data

Veneering station installation date: 6 March 2012

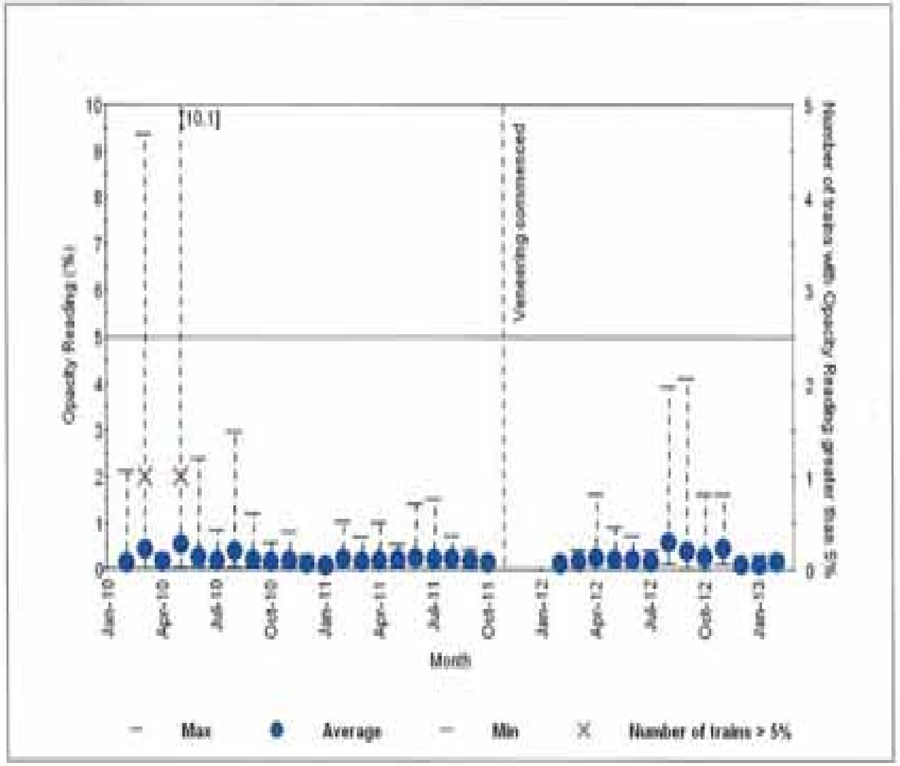


Six-Monthly Data

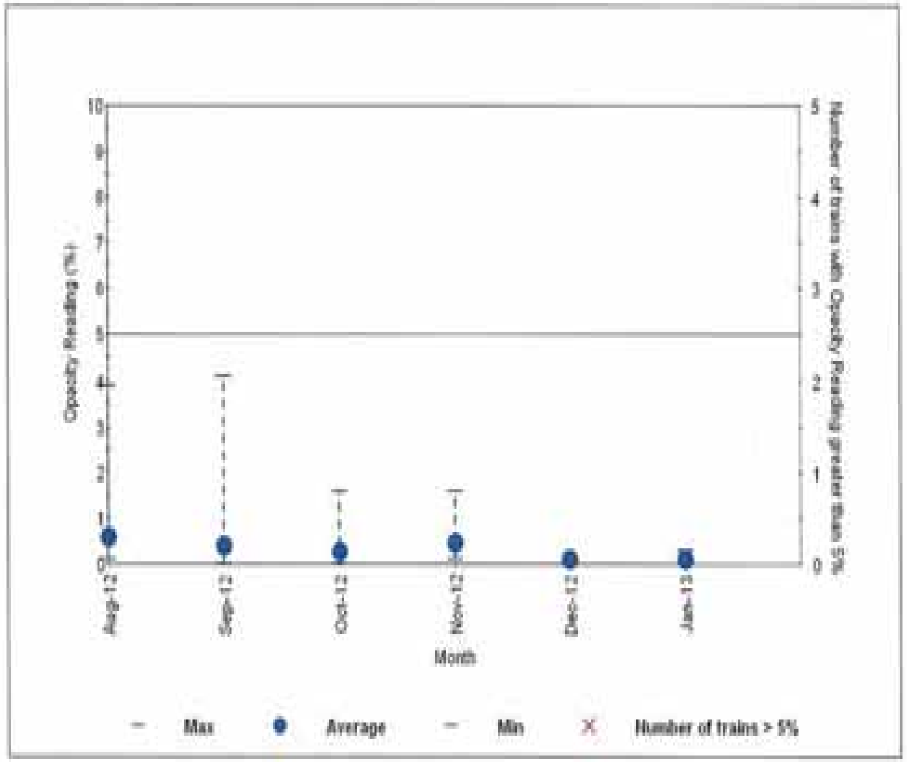


Veneering Station Installation - 4

Historical Data
Veneering station installation date: 27 October 2011



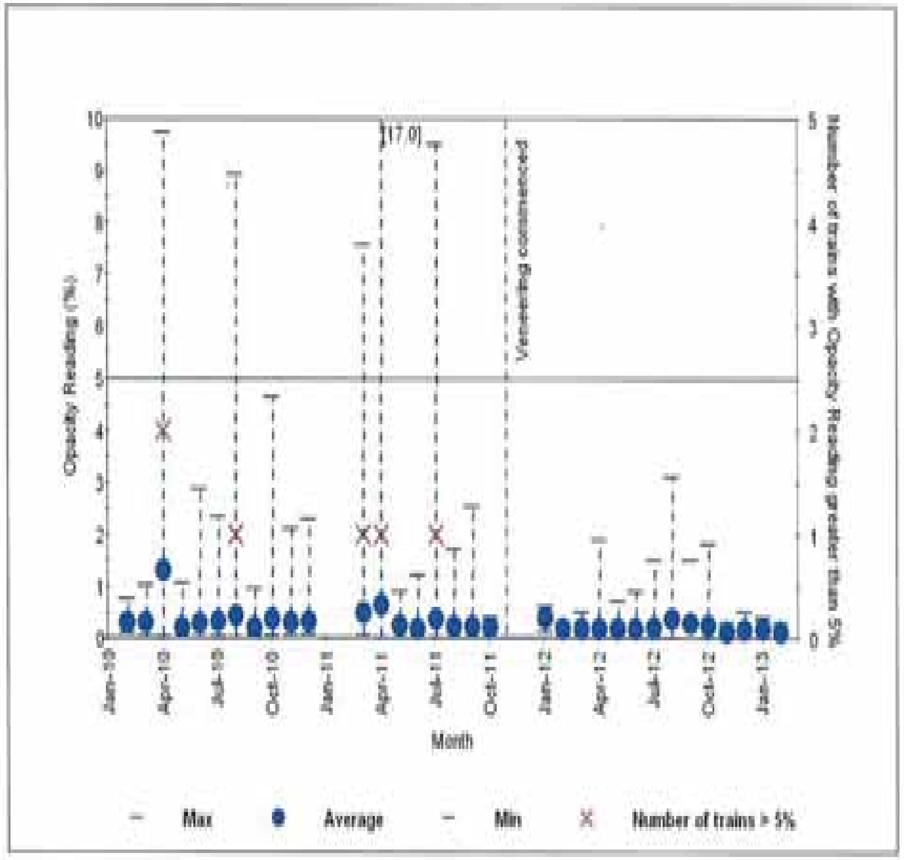
Six-Monthly Data



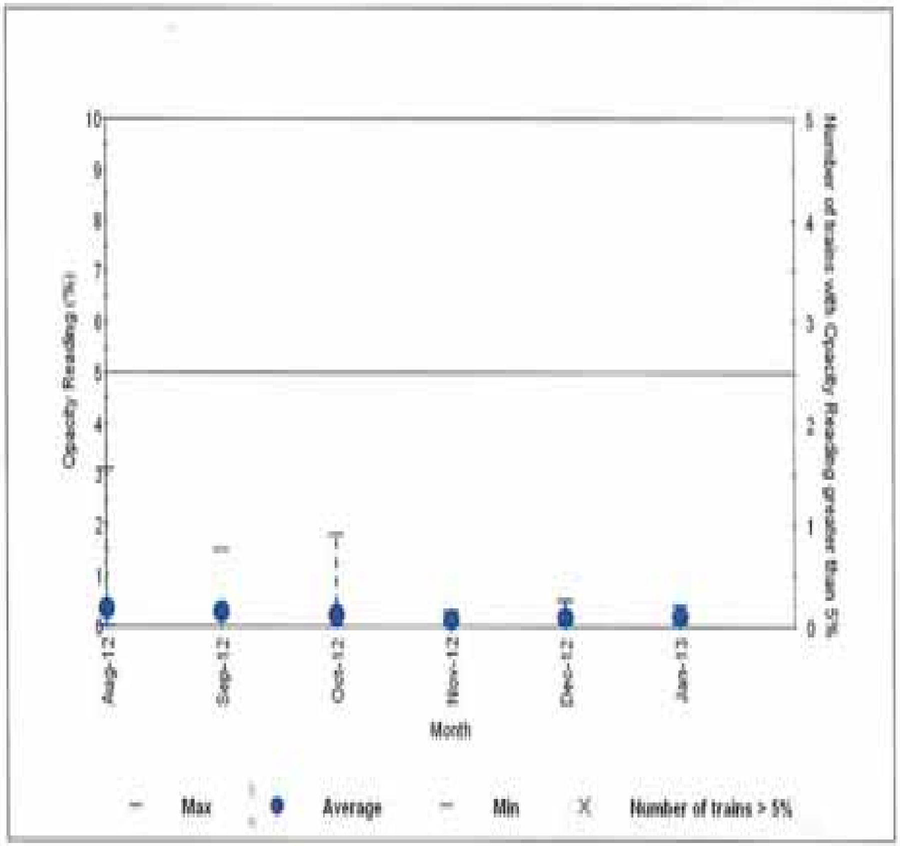
Veneering Station Installation - 5

Historical Data

Veneering station installation date: 26 October 2011



Six-Monthly Data



Progress of execution Undercutting Plan

Plan	Status	
Purchase 24 spoil wagons	RFP closing 17^{th} May.	Gradual delivery, finalising 2014.
Modify existing ballast wagon fleet.	Specification and prototype design completed.	More effective ballast drop.
Extend ballast sidings to allow large ballast trains. 4 locations.	Design complete.	Remove major constraints on train length.
Interim off track undercutting plant hire. (Main line and turnouts)	Tender to be issued this month.	Plant on site new financial year. Best for turnouts and short run leaving main BCM to only do long runs. -10% less BCM possession next year.
Mtce shutdown and design improvements existing BCM	June shutdown Upgrade over next 6 months	Increase reliability and speed.
New BCM	[redacted].	[redacted]

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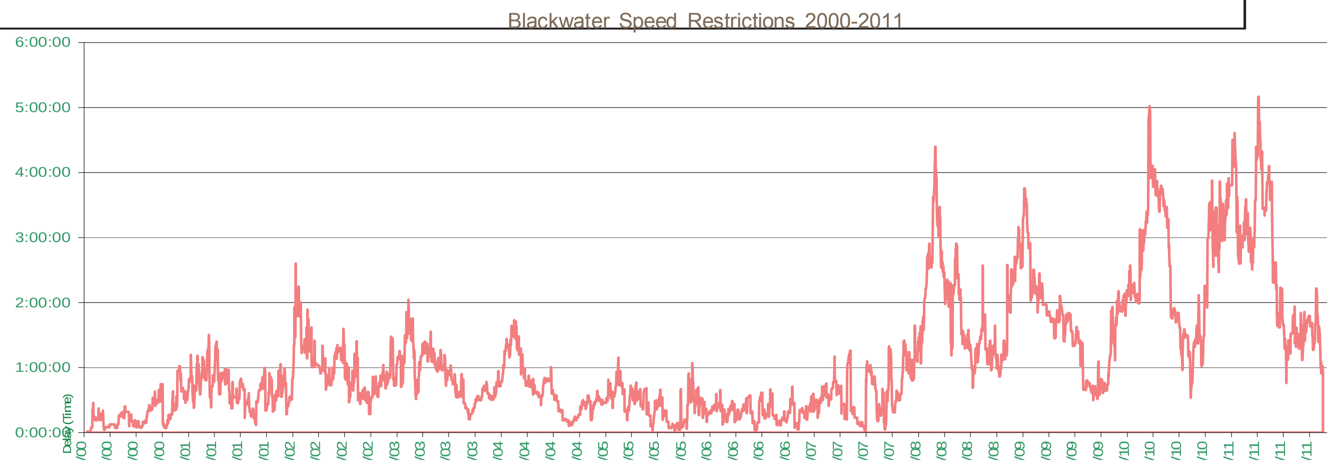
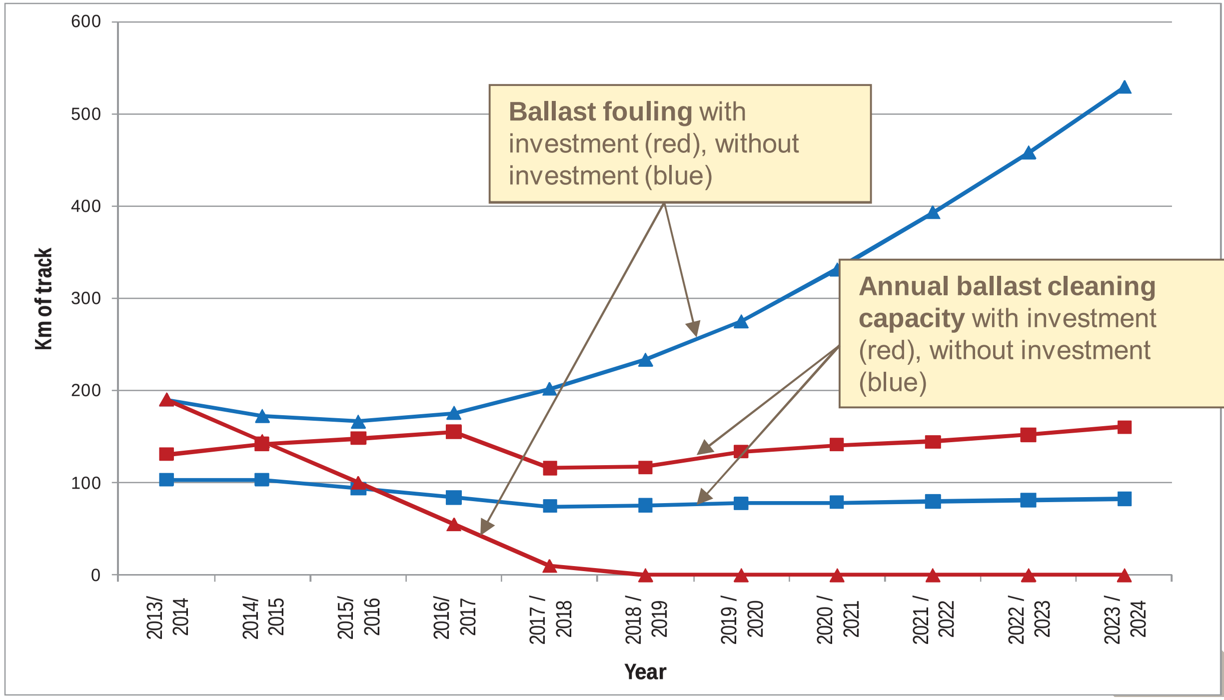
Impact of Ballast Cleaning Strategy

- Investment is required to address the existing ballast fouling rate and meet ongoing demand.

- Boosting ballast cleaning production by investing in logistics to remove bottlenecks, and supplementing production with off-track ballast cleaning solutions will address ballast fouling levels over UT4. (note that this chart includes non-mechanised capacity)





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Spotlight on Aurizon Network's

Wheel Rail Management in CQCN - a four-tiered approach of:

- Preventative rail grinding
- Long term rail replacement strategy based on cross sectional area and ultrasonic testing
- Rail lubrication
- Wheel impact monitors and weighbridges

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Engineering Data – Qld Coal Fields

Asset	Overview
Track Length	2,770km
Gauge	1,067mm
Rail Size	60kg/m
Sleepers	22 and 28.5 tonne
Power	25kV /50kV Auto Transformer System
Signalling	RCS (Remote)
Train Length	2,080m
Train Weight	10,000 net Tonnes
Axle Load	26.5t

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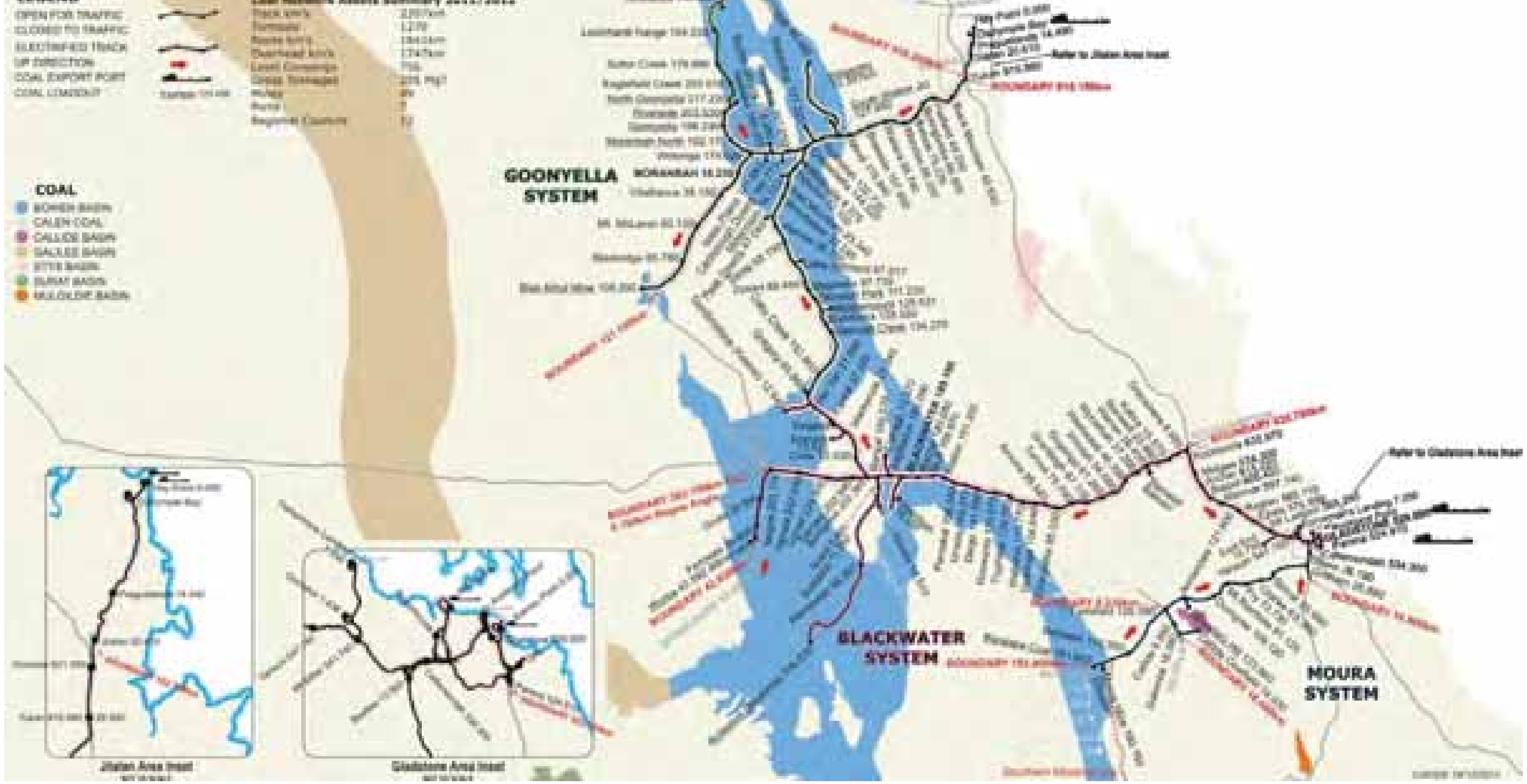
Central Queensland Coal Network



The Challenge: More than 70MNTpa of committed additional system capacity

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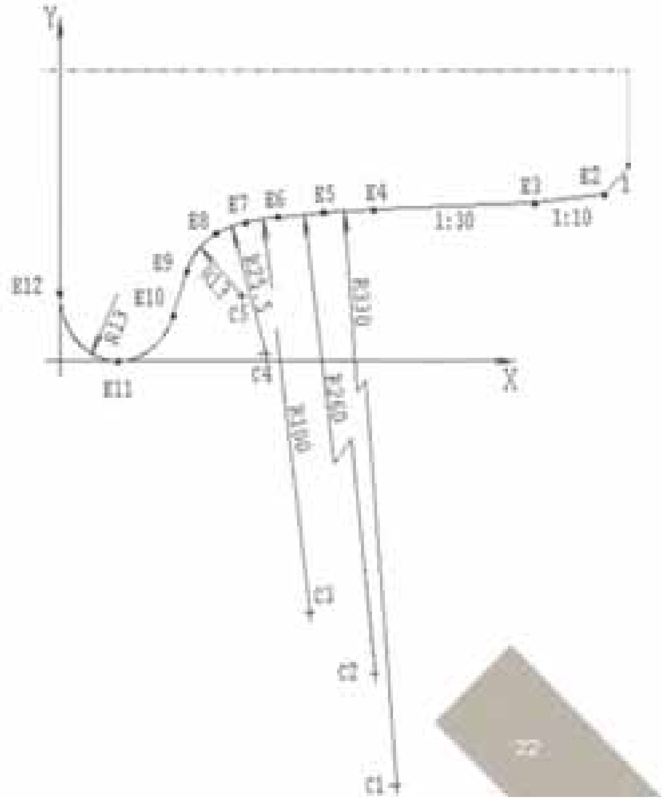
Preventative Rail Grinding

- Preventative cyclic grinding based on gross tonnages.
  - o 10MGT – Curves <1001m Radius
  - o 20MGT – Curves >1000m but <2501m
  - o 40MGT – All remaining track
- Worn wheel profiles are used
- Three typical profiles:
  1. high leg;
  2. low leg; and
  3. > 1000 metre radius
- A compatible wheel profile is controlled contractually and inspection regime.



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Rail Replacement Strategy

- Rail wear limits
- Corrosion affecting rail integrity
- Crack clusters detected by Non-destructive testing.

Track	Projected Rail Life (Mgt)
60kg/m rail – tangent	2500
60kg/m rail – curves 1001-2500m radius	1800
60 kg/m rail – curves 601m to 1000m radius	700
60 kg/m rail – curves 200-600m radius	400
60 kg/m HH rail – curves 200m to 600m radius	700
60 kg/m HH rail – curves 601m to 1000m radius	1100

Rail Wear Limits

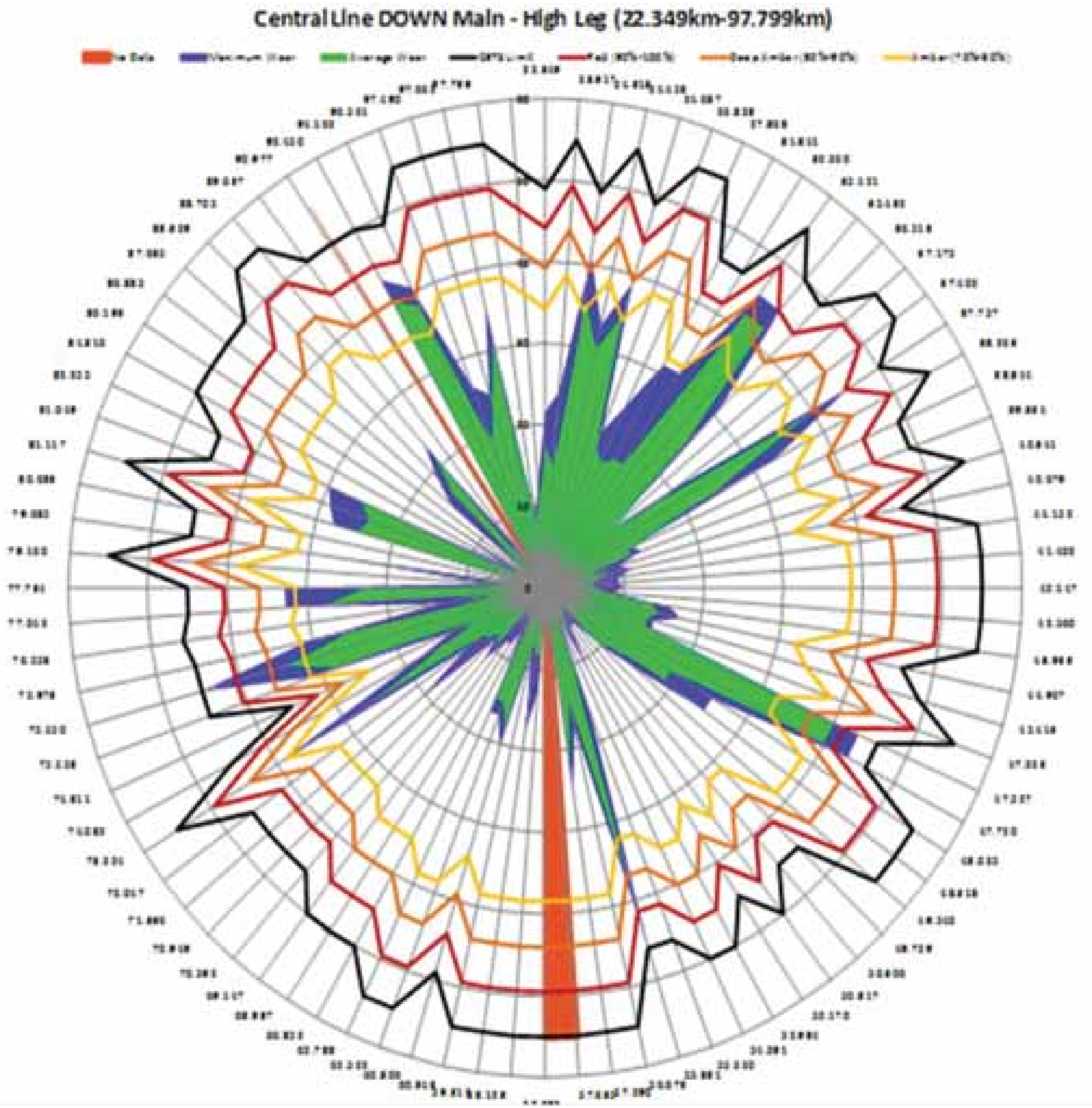
- Rail profile measured every 2 metres on curves and 8 metres on tangent track
- Area of rail head calculated
- Trends calculated and renewal scope defined
- Combined with renewal of opposite leg
- Long term renewal view has significant savings in unit rates, scope packaging and track access efficiency

Curve Radius	Limit of Rail Head Wear (%)			
	60kg/m S.C.		60kg/m H.H.	
	Low Leg	High Leg	Low Leg	High Leg
≤160	47	27	47	27
>160 & ≤ 212	47	29	47	29
>212 & ≤ 305	50	35	50	45
>305 & ≤ 415	50	35	50	45
>415 & ≤ 542	50	36	50	45
>542 & ≤ 848	50	46	50	50
>848 & ≤ 1000	50	49	50	50
>1000 & Tangent	55	55	55	55

Legend
- Black line wear limit
- Red line 80- 90%
- Orange line 70- 80%
- Yellow line 60-70%
- Blue is maximum wear measure across the curve

90 Percentile average

Each track curve is a data point across the track km.



Ultrasonic testing and intervention

- Ultrasonic testing every 10 MGT
- Both horizontal and longitudinal test probes used
- Crack cluster identification used in rail renewal prioritisation

Intervention level

- Above 35 mm is immediate removal
- 19mm to 35 mm crack results in a seven day removal
- Under 19mm is a one month removal regime

Lubrication Plan

- Electric lubricators selected due to reliability, better control of grease delivery and can be remotely monitored
- Reduces attendance and single units can grease multiple tracks
- Mechanical and hydraulic lubricators to be phased out in the next 18 months
- Maintenance now includes carry inspection with adjustment lubricator blades as rail wears

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Lubricant Selection

- Lubricant selected by field trials and laboratory tests. Lubricant then underwent extended field trials.
- Lubricants compared by benchmarking coefficient of friction, consumption, cost and lubricant carry distance.
- Located 50 metres into tangents due to grinding and wheel contact stability when between curves.
- Lubricators placed on tangent track for grinding and wheel/rail contact reasons.
- Lubricate every curve below 600m radius
- Predict $11 million p.a. saving with a one year payback.

Lubrication Effectiveness
Assessment Required Regularly

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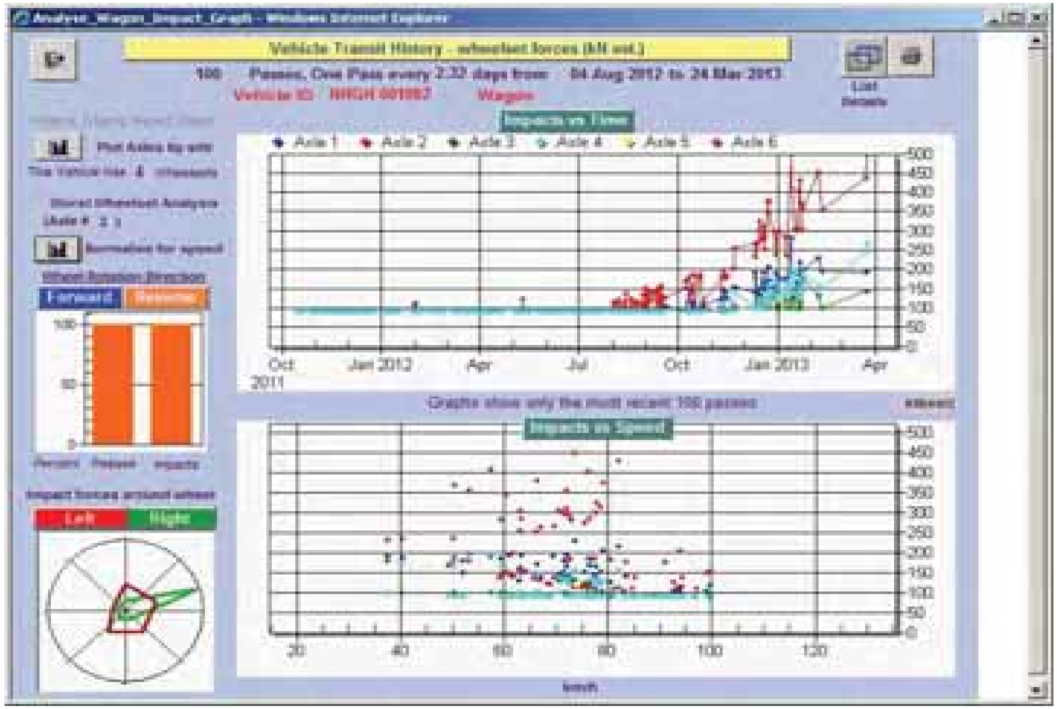
Wheel Impact and Load Detection

- Rolling stock measured in 70-250hz band (includes P1 and P2 forces)
- Monitor between 25km/h and line speed
- Trending data available
- Overload limits apply at point of loading: 4% overload is restricted and 8% is stopped
- Enable greater wear limits, longer rail life and identify potential derailments

Extreme	>550KN	Stop operation
High	>450KN	Max 60kph to depot & inspection
Medium	>330KN	Operator inspection as soon as practical
Low	>200KN	Monitor trend



Overview on Aurizon Network's

UT 4 Maintenance and Renewals by Asset Class

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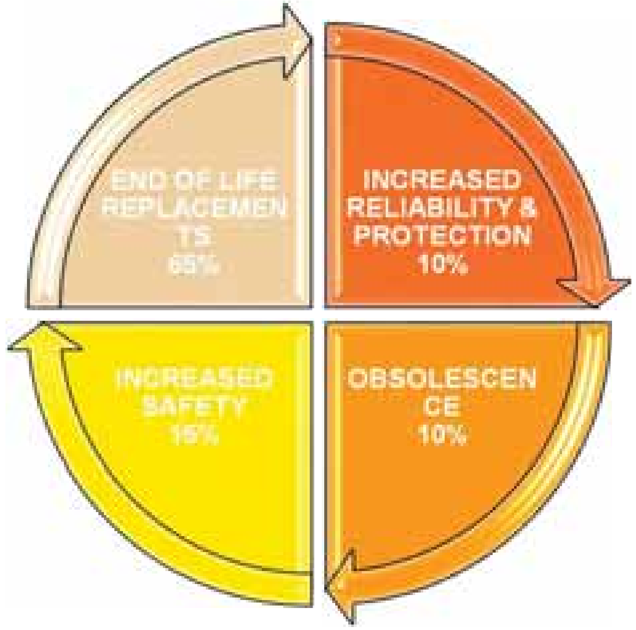
Asset Renewals Overview

Asset Renewal Groups
- Civil Assets
- Electrical Assets
- Telecommunications Assets
- Signalling and Trackside Systems Assets

✓ Programs of works for each group
✓ Managed by a dedicated Asset Manager
✓ Project Managed by Project Manager for efficient delivery

✓ Enable reliable train services
✓ Improve competitive cost base
✓ Enable increased system velocity
✓ Improve operational safety
✓ Leverage proven technology

Our renewals investment breakdown



The CQCN has a considerable asset base requiring forward looking asset management

ASSET TYPE	TOTAL ASSET AMOUNT IN NETWORK	AVERAGE LIFE OF ASSET	TYPICAL RENEWALS PER ANNUM
Track	2,677 km 10,000 culverts	40 – 50 years (concrete)	5 km of formation renewals 20 culvert renewal
Sleepers	4.4 million sleepers across 2,677km of track (sleeper every 610cm)	50 years (concrete) 40 years (steel) 20 years (timber)	30 km of re-sleepering
Rail	5,354 km	2,000 MGT (straight) 1,000 MGT (curve)	50 km of re-railing
Turnouts	975 turnouts	1,000 MGT	15 turnouts
Telecommunications	1,413 transmission nodes 1,123 power supplies 359 Computer Rooms 33 Weighbridges 108 asset protection monitors 2,400 km of optic fibre	10 years 10 years 10 – 15 years 10 years 20 years 30 years (old), 50 years (new)	• Component renewal. • End of life replacement such as radio transmitter nodes
Traction System	1,820 km 42 Switching stations 265 Autotransformers 42 Supply Transformers	60 years (wiring) 25 years 25 years (old), 40 years (new) 35 years	End of life replacement Equipment renewal Improved access systems Reliability improvement
Level Crossings and Track signage.	158 Public Crossings 606 Private Crossings	20 years	Enact agreements Over-height detection Upgrades
Signalling	174 Interlockings 1,578 Electrical signals 647Mechanical signals 842 Electric Points Machines	35 years 30 years 20 years 20 years	Renew components Replace end of life

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*** 71.5 billion GTK through the CQCN in FY14**

Track & Civil Program – Maintenance & Renewal

Asset Renewal Category	$'000
Sleeper Upgrade	27,401
Culverts	15,525
Turnout Upgrades	10,841
Level Crossings Upgrades	8,305
Track lubrication	4,200
Formation	2,930
Full Track upgrade	2,513
Crew Change	2,053
Access Roads	1,030
Fencing	913
Other Civil Projects	4,131
Total	**79,842**

Maintenance Category	$'000
Mechanised	
Ballast undercutting	55,271
Resurfacing	18,979
Rail Grinding	12,513
General Track	47,319
Re-railing	15,267
Structures	2,650
Total	**151,999**

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* Maintenance shown in FY12 $

Wear limits, historical and forecast wear rates are used to generate rail replacement strategy

Limit of Rail Head Wear (%)

Curve Radius	60kg/m S.C.		60kg/m H.H.	
	Low Leg	High Leg	Low Leg	High Leg
≤160	47	27	47	27
>160 & ≤ 212	47	29	47	29
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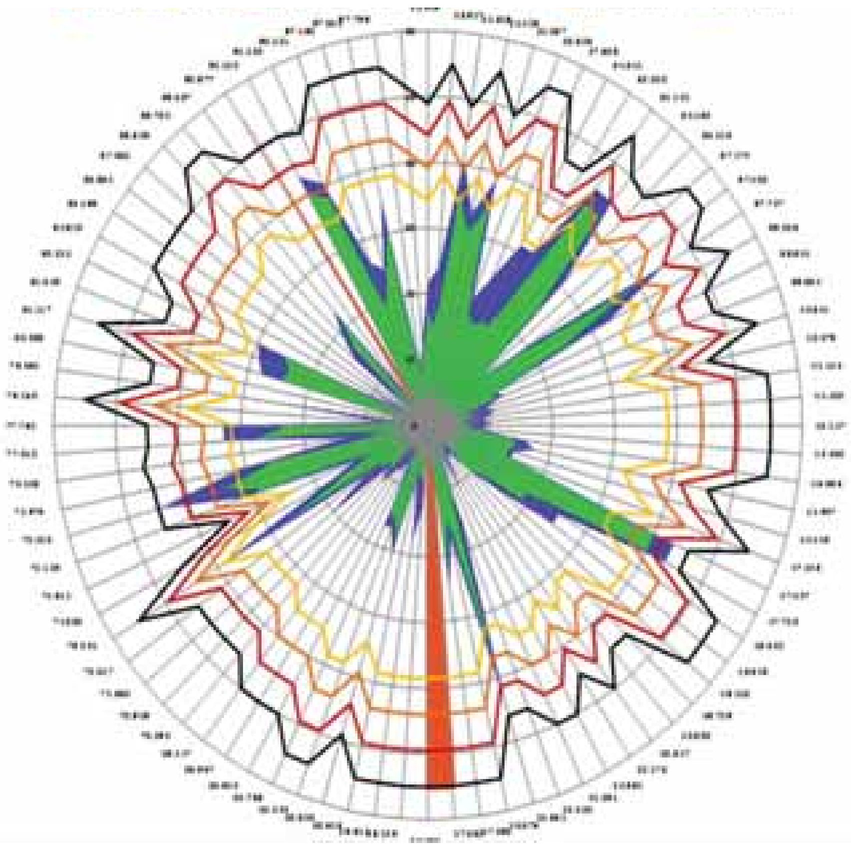
>542 & ≤ 848	50	46	50	50
>848 & ≤ 1000	50	49	50	50
>1000 & Tangent	55	55	55	55

Central Line DOWN Main – Curve Wear



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Quality real time asset diagnosis is key to asset analysis confidence and a predictive focus

Ground Penetrating Radar

Note: Whole Network complete

Track Defect Inspection Reporting

Note: Tendering for remote recording equipment for locomotives with automatic download

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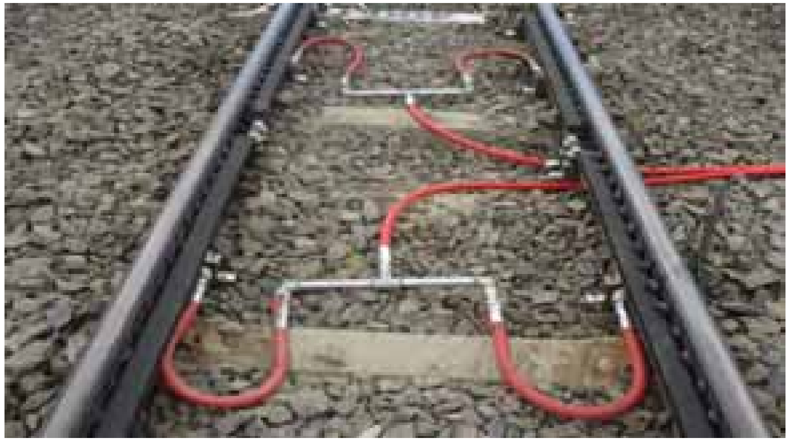
Trading end of life, for predictive, remote monitoring assets and a more productive network

End of life Mechanical Rail Lubricator

New Electric Rail Lubricator



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Electrical Program – Maintenance & Renewal

Asset Renewal Category	$'000
Overhead Equipment	117
Transformer Refurb	2,198
Section Insulators	1,681
Neutral Section	490
Feeder Station Protection	135
Cantilevers	750
Traction Asset	2,145
Electrical Other	3,713
Total	**7,156**

Maintenance Category	$'000
Preventative OH	4,168
Corrective OH	2,535
Preventative FS & TS	1,499
Corrective FS & TS	921
Overhead Isolators	104
Power Systems Control	329
Total	**9,556**

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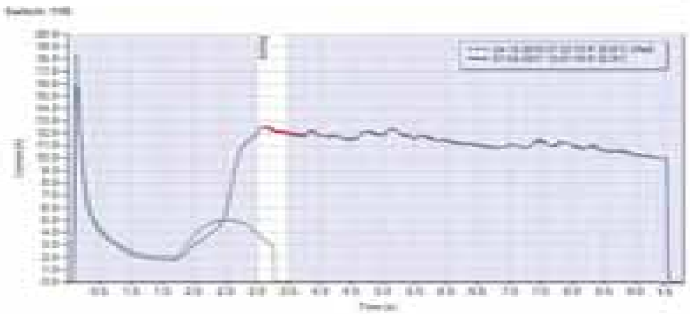
* Maintenance shown in FY12 $

Signalling & Trackside Systems Program – Maintenance & Renewal

Asset Renewal Category	$'000
Train Detection	5,290
Telemetry	3,296
Signalling Other	1,547
Power Supplies	1,562
Points Monitoring	172
Level Crossing	138
S&TSS other	1,582
Total	**12,005**

Maintenance Category	$'000
Preventative Sig Field	8,551
Corrective Sig Field	8,474
Weighbridge	1,845
Sig Level Crossing Project	534
Sig Control Systems	555
Cable Route	782
Sig Train Protect System	112
Wayside Monitoring Systems	1,738
Total	**22,591**

New LED points indicators



Current graph – variance indicates specific imminent fault type

CDSRail's MiniLogger HD

Strukton's Prevention Maintenance & Fault Diagnosis System (POSS)

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* Maintenance shown in FY12 $

Telecommunications Program – Maintenance & Renewal

Asset Renewal Category	$'000
Optic Fibre	2,960
Microwave	4,724
SCADA	2,356
Lan Wire	713
Radio Systems	110
Power Supply	115
Other	1,394
Total	**11,595**

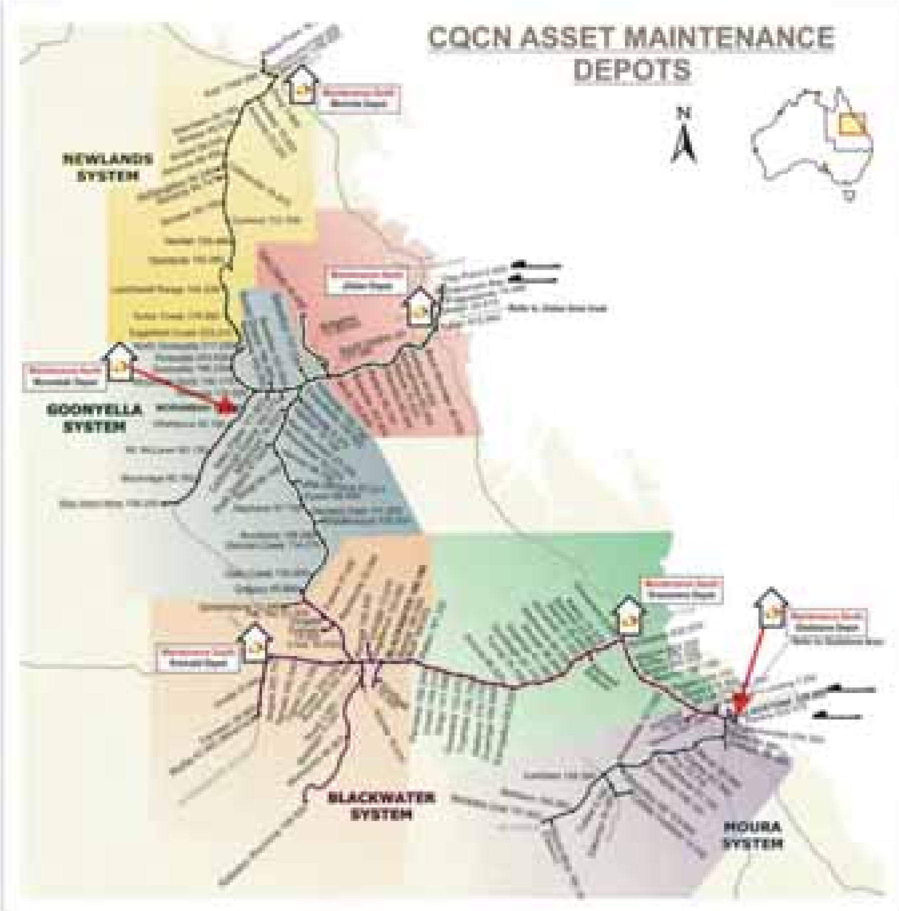
Maintenance Category	$'000
Telco Backbone	5,302
Phone/Data	63
Total	**5,365**

Obsolete telemetry systems replaced old for new

AURIZON

* Maintenance shown in FY12 $

Network's maintenance depots are located for timely response and effectiveness



- Region split into North & South
- 6 major, strategically located depots
- 450 maintenance staff
    - Repair & Response
    - Civil & Track
- Significant use of specialist contractors & variable labour
- This has resulted in a decrease in delays > 15min in 3 out of 4 corridors

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Spotlight on Aurizon Network's

Asset Renewals

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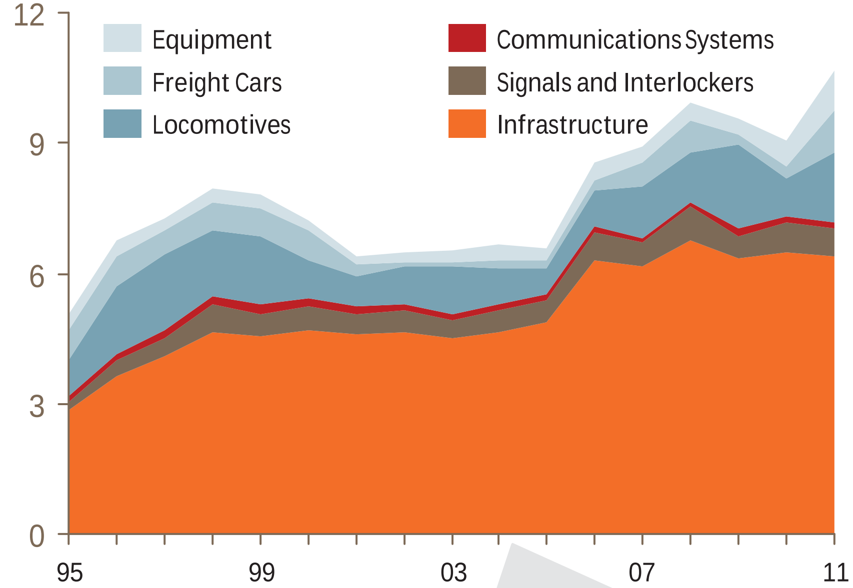
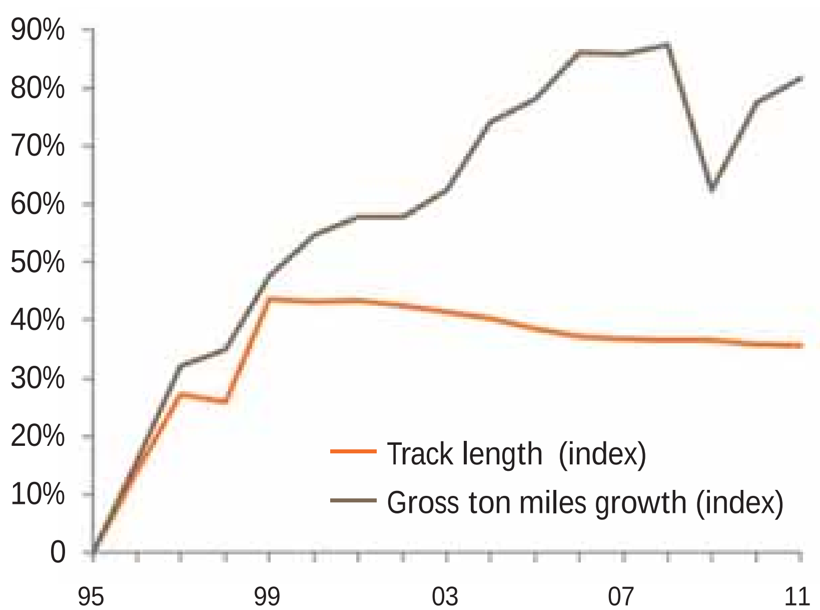
Capital investment has a proven track record in delivering improved asset quality and increased capacity in Class 1 Railroads

Class 1s directed capex to infrastructure...



... Improving asset quality and allowing more traffic on less track



Infrastructure investments included:
- Precision grinding and track welding
- Capacity increases for double stacking
- Double and triple tracking key corridors
- De-bottlenecking at major junctions

Note: Figures shown are an aggregation of UP, CSX, BNSF, NS and KCS (does not include Canadian National or CP as only USA operations reported to AAR).
All dollar figures expressed in terms of 2011 AUD.
Source: AAR data

[redacted]

AURIZON

Class 1 benchmarking for renewal investment identifies equivalent CAPEX spend of $120m p.a. for CQCN at today's tonnages.

- Class 1 North American railroads' annual renewal spend is relatively consistent over time.
- Average investment in renewals across Class 1's is a ratio of $2.60 per '000 NTK
- FY12 NTK in CQCN was 46,000M NTK. 46,000 x $2.60 = $120M
- At 180 MTpa, $120M p.a. would be an equivalent capital investment level for the CQCN, while volumes of 260MTpa would require $170M p.a.

		Union Pacific	BNSF	Kansas City Southern	CSX Transportation	Grand Trunk Corp	Norfolk Southern	Soo Line Railroad	Average Class 1
2009	CAPEX Spend								7,300
	Million NTK								2,701,987
	CAPEX/000 NTK								**$2.70**
2010	CAPEX Spend	2,422	2,100	240	1,342	362	1,195	194	7,854
	Million NTK								2,982,415
	CAPEX/000 NTK								**$2.60**
2011	CAPEX Spend	2,202	2,213	307	1,550	434	1,071	170	7,945
	Million NTK								3,049,436
	CAPEX/000 NTK								**$2.60**

Class 1 Railroad figures have been converted to AUD ($) and Kilometres

[redacted]

AURIZON

$120M addresses reliability across multiple asset classes, replacing 3.5% of assets p.a.

ASSET TYPE	TOTAL ASSET AMOUNT IN NETWORK	TYPICAL RENEWALS PER ANNUM	TYPICAL COST PER ANNUM
Track	2,677 km 10,000 culverts	5 km of formation renewals 20 culvert renewal	$6 million $10 million
Sleepers	4.4 million sleepers across 2,677km of track (sleeper every 610cm)	30 km of re-sleepering	$15 million
Rail	5,354 km	50 km of re-railing	$18 million
Turnouts	975 turnouts	15 turnouts	$8 million
Telecommunications	1,413 transmission nodes 1,123 power supplies 359 Computer Rooms 33 Weighbridges 108 asset protection monitors 2,400 km of optic fibre	• Component renewal. • End of life replacement such as radio transmitter nodes	$20 million
Traction System	1,820 km 42 Switching stations 265 Autotransformers 42 Supply Transformers	• End of life replacement • Equipment renewal • Improved access systems • Reliability improvement	$15 million
Level Crossings and Track signage.	158 Public Crossings 606 Private Crossings	• Enact agreements • Over-height detection • Upgrades	$3 million
Signalling	174 Interlockings 3,263 Electrical signals 655 Mechanical signals	• Renew components • Replace end of life	$12 million
Miscellaneous		Examples: access roads, fencing, crew change platforms.	$13 million

[redacted]

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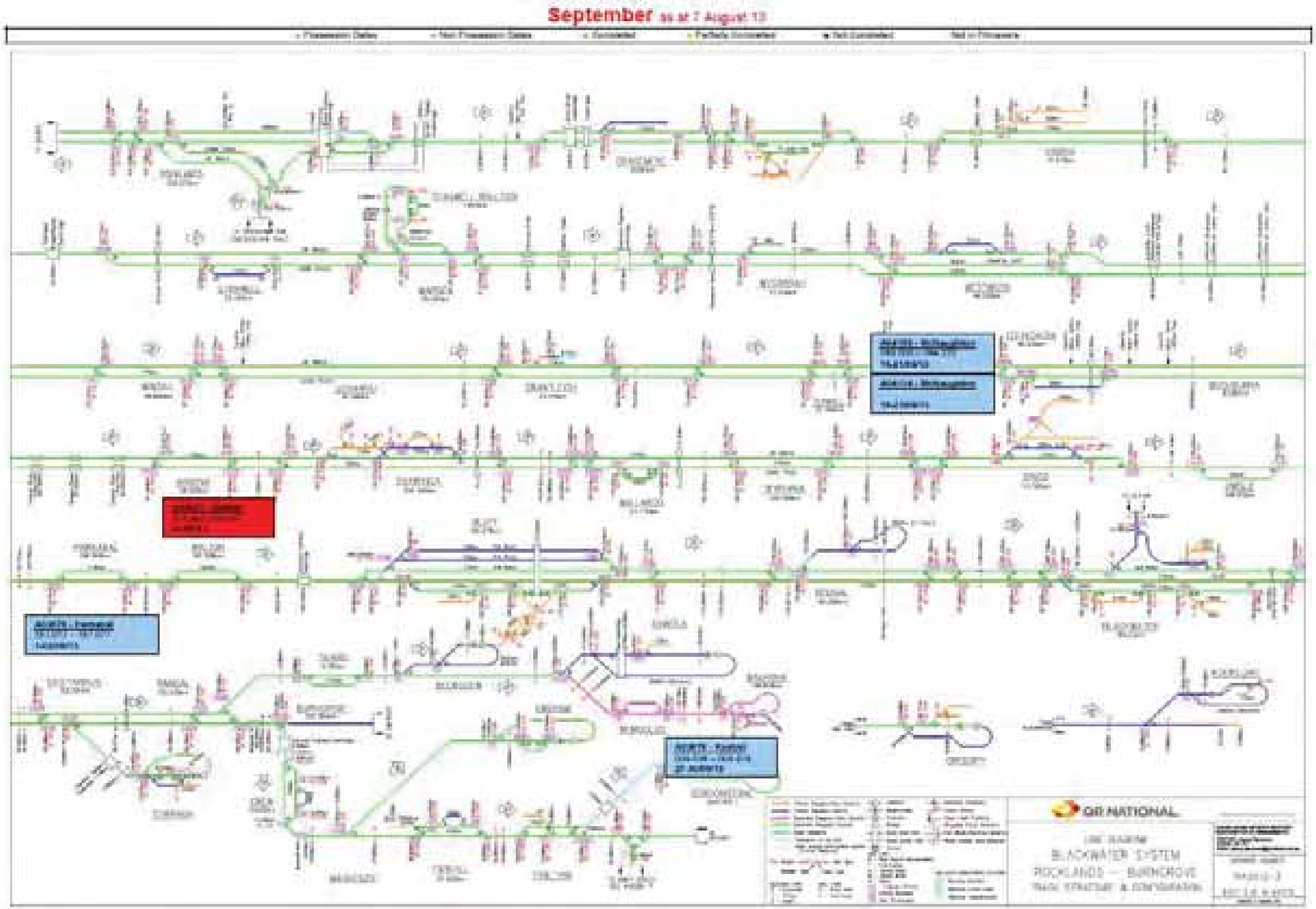
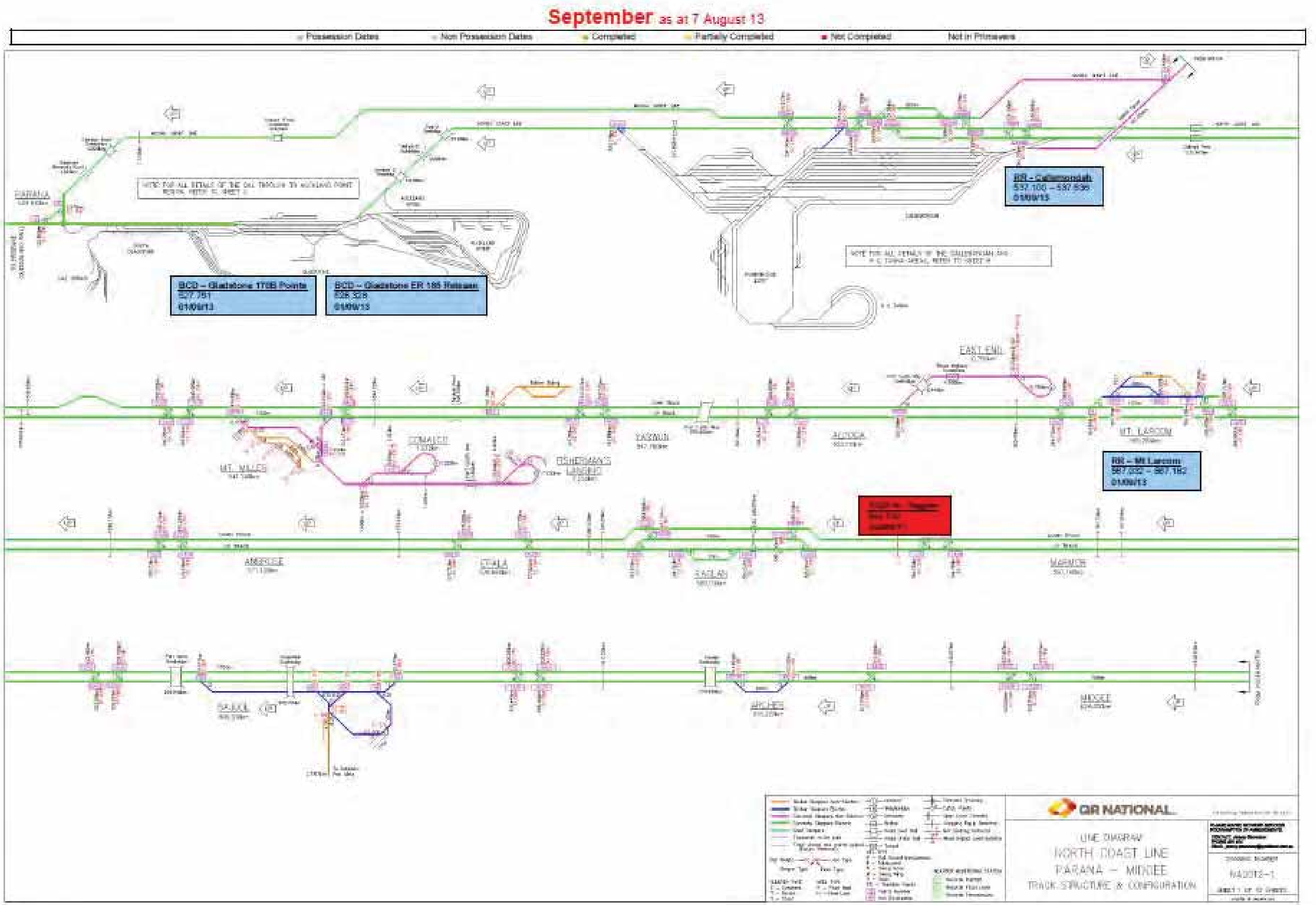
Construction Plans for Blackwater – September 2013



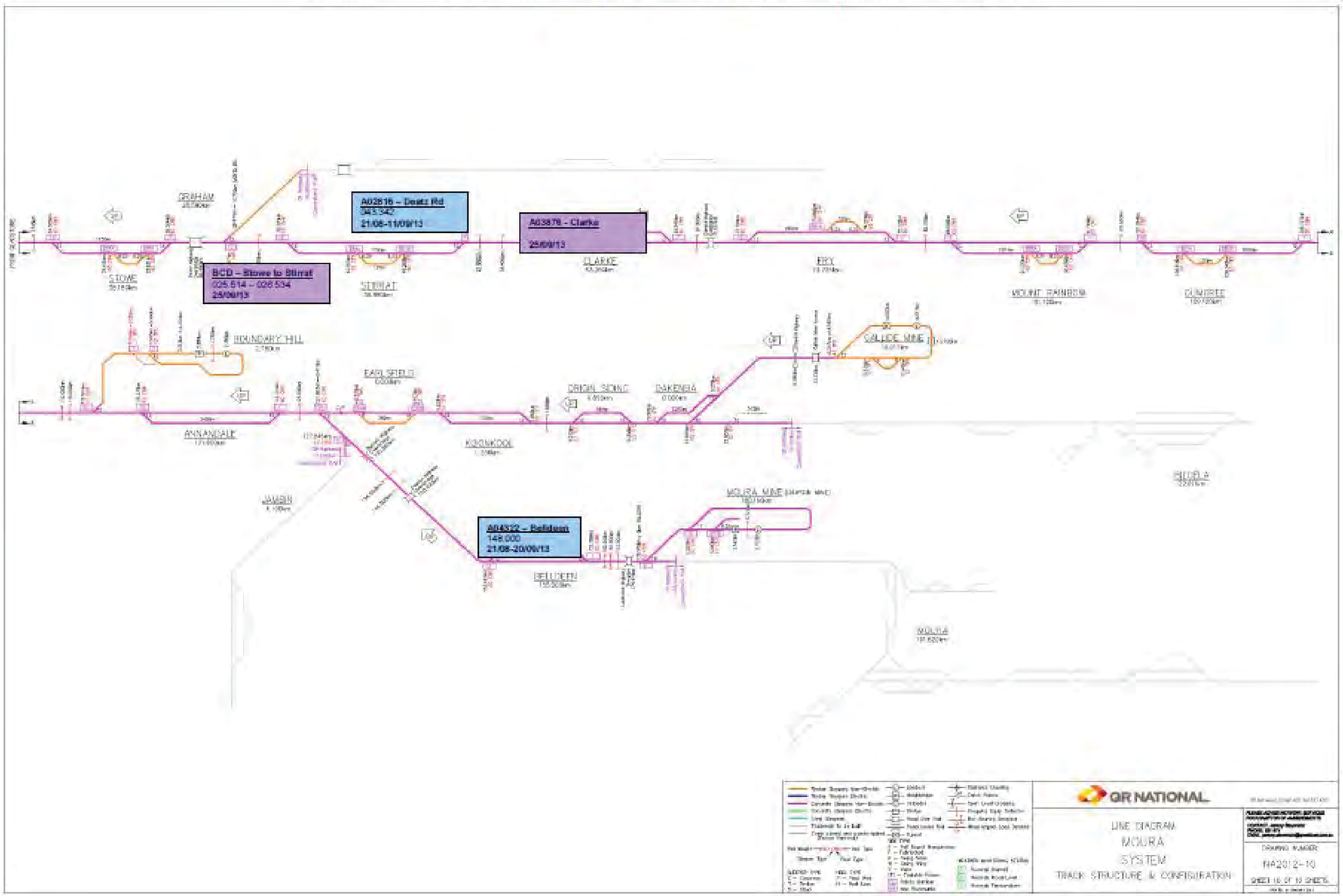
Construction Plans for North Coast Line – September 2013



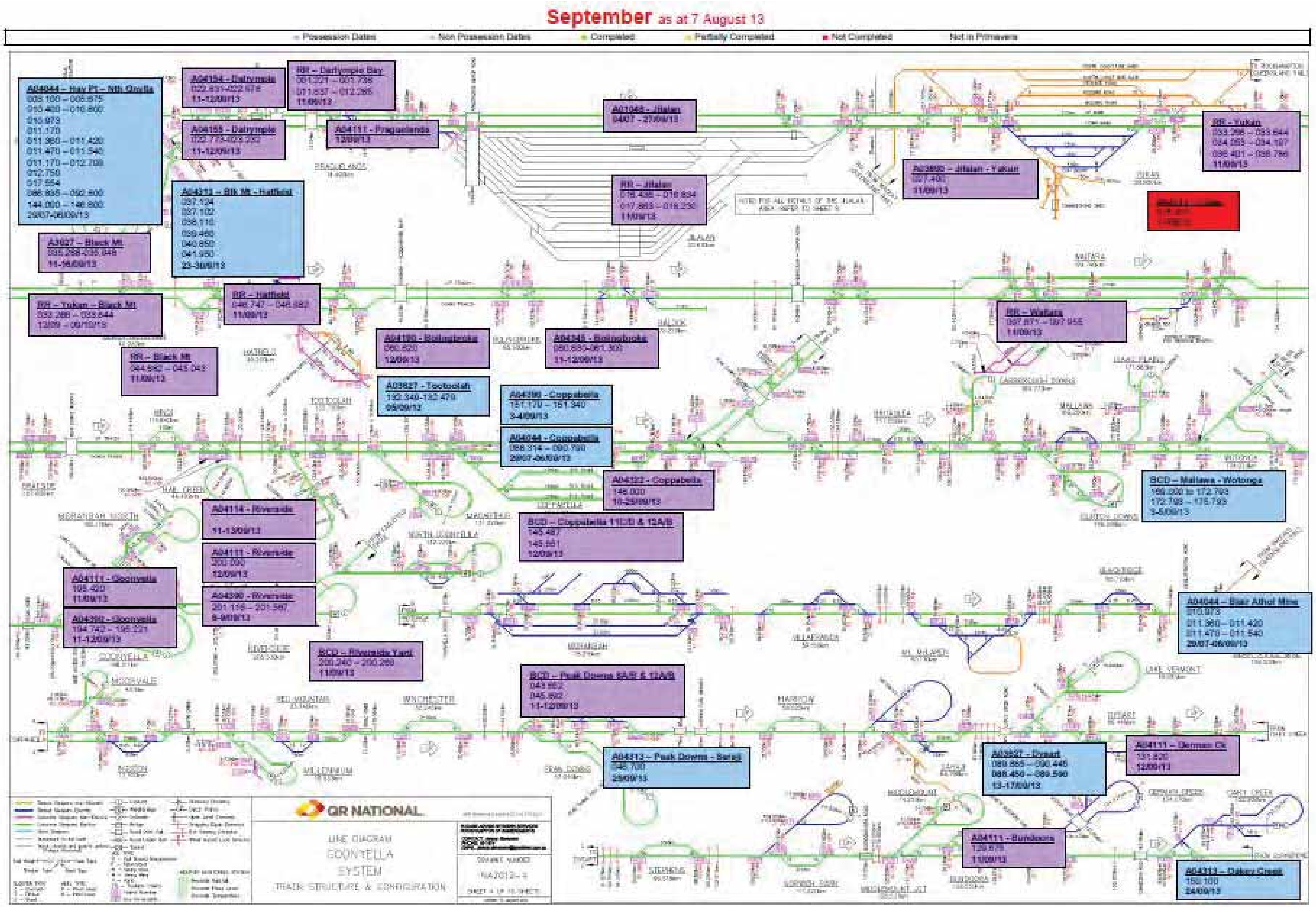
Construction Plans for Moura – September 2013

September as at 7 August 13

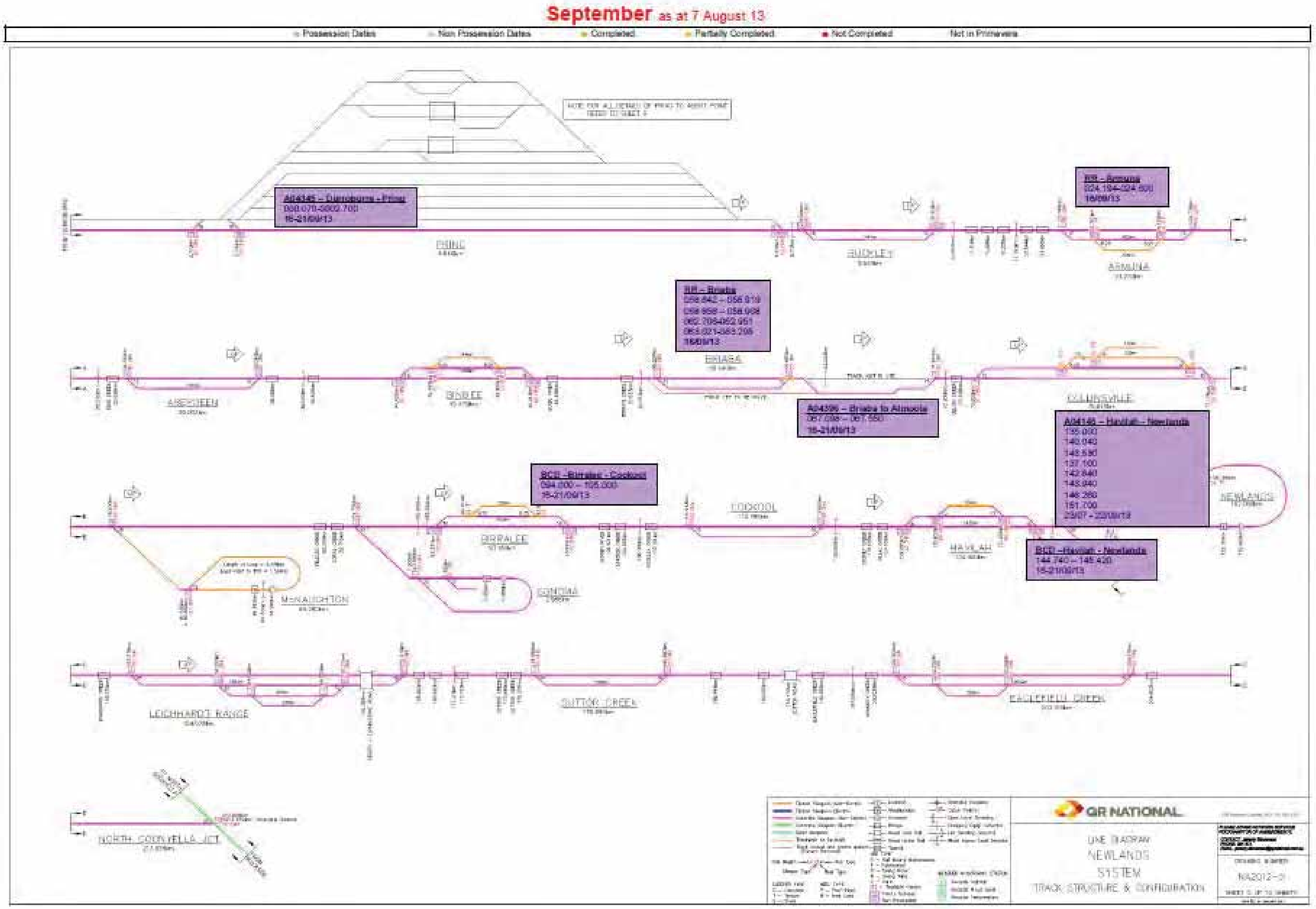
▫ Possession Dates ▫ Non Possession Dates ▪ Completed ▪ Partially Completed ▪ Not Completed Not in Primavera



Construction Plans for Goonyella – September 2013



Construction Plans for Newlands – September 2013



Spotlight on Aurizon Network's

Asset Renewal Program: Signalling and Trackside Systems

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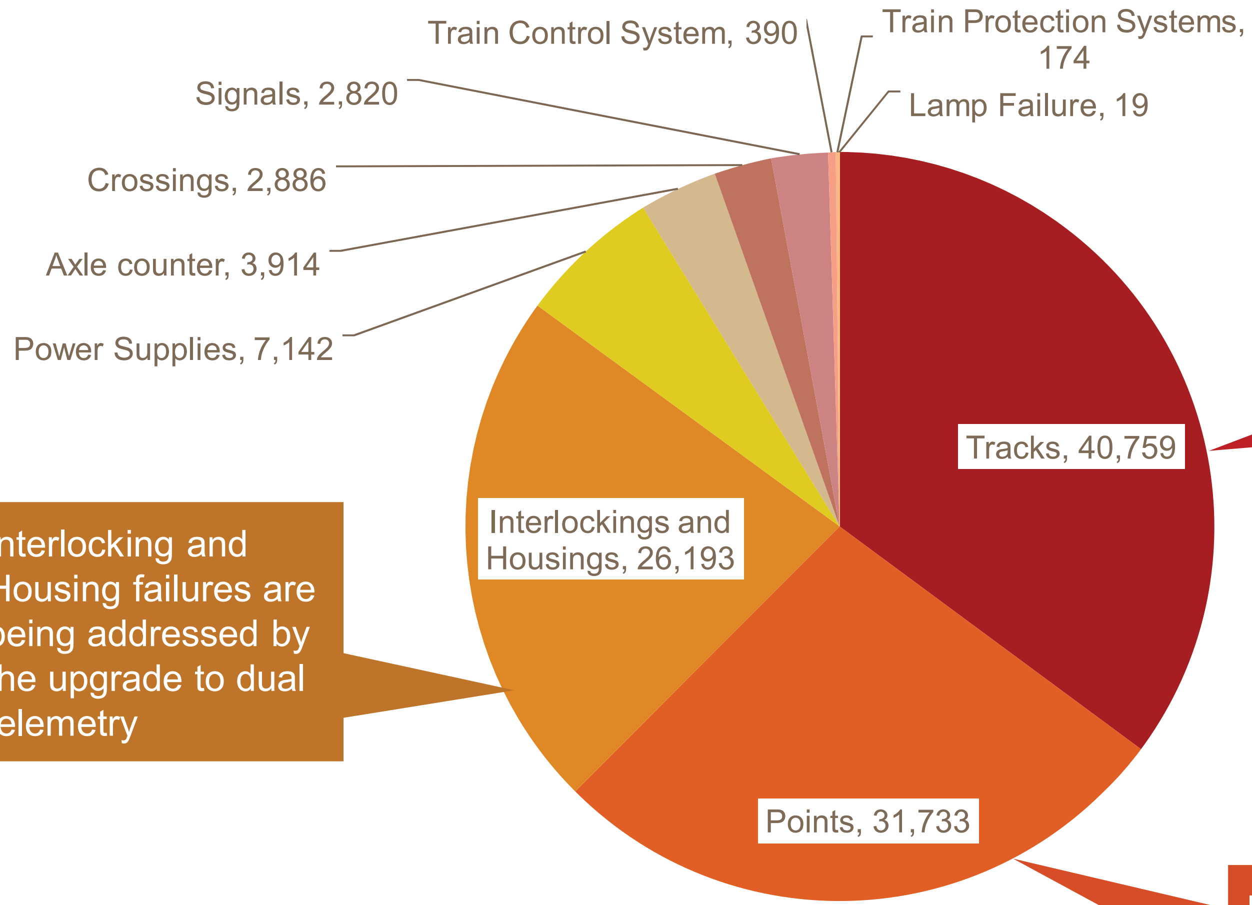
Key Terms

Colours align to performance graphs

Key Term	Definition
Tracks (Track Detection)	Track Circuits – detects presence of wheels across rails for the purpose of train location
Axle Counter (Train Detection)	Counts wheels for the purpose of train location
Points	Used to control changing direction of a train from one track to another
Crossings	Level Crossings
Interlockings and Housings	Electronics used to control points and signals, housed beside track
Lamp Failure	Lamps used in signals
Power Supplies	Power supplies to all signalling equipment
Signals	Signals to train drivers for operations
Train Control System	Universal Traffic Control (UTC) - ground frames and local signalman's cabins
Train Protection Systems	Only used on North Coast Line

[redacted]

Train Delay Minutes per Signalling Equipment Category
January – June 2013



Track failures are being addressed by the digital upgrades of analogue equipment

Interlocking and Housing failures are being addressed by the upgrade to dual telemetry

Points failures are being addressed by the installation of condition monitoring on 100 critical point ends

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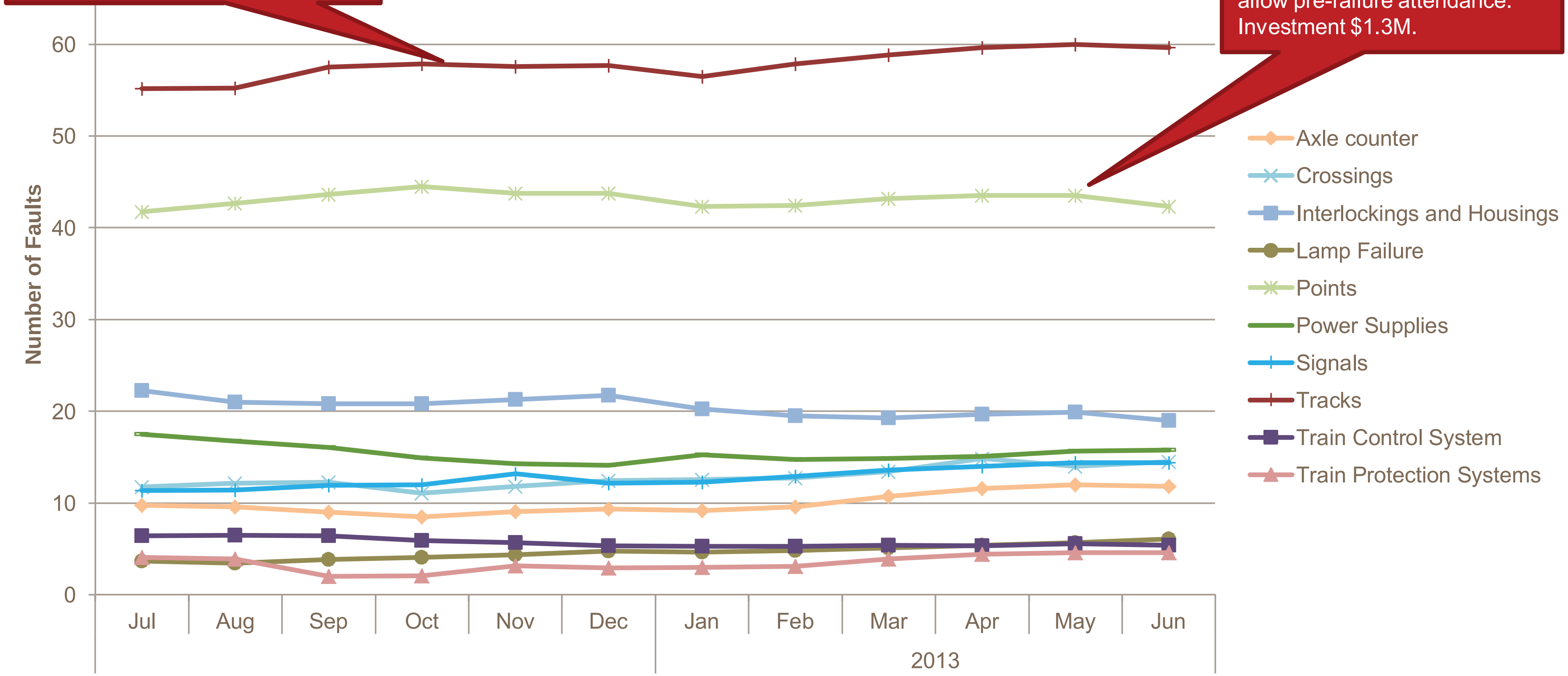
[redacted]

Blackwater Signalling Faults – 12 month Rolling

CSEE digital track circuit trial $680K approved, to be completed June 2014.
Pending trial success Rocklands to Callemondah considered for CSEE digital track circuit upgrade.

Condition monitoring to be installed at 34 critical turnouts by end 2013 to provide detailed diagnostics information and allow pre-failure attendance. Investment $1.3M.



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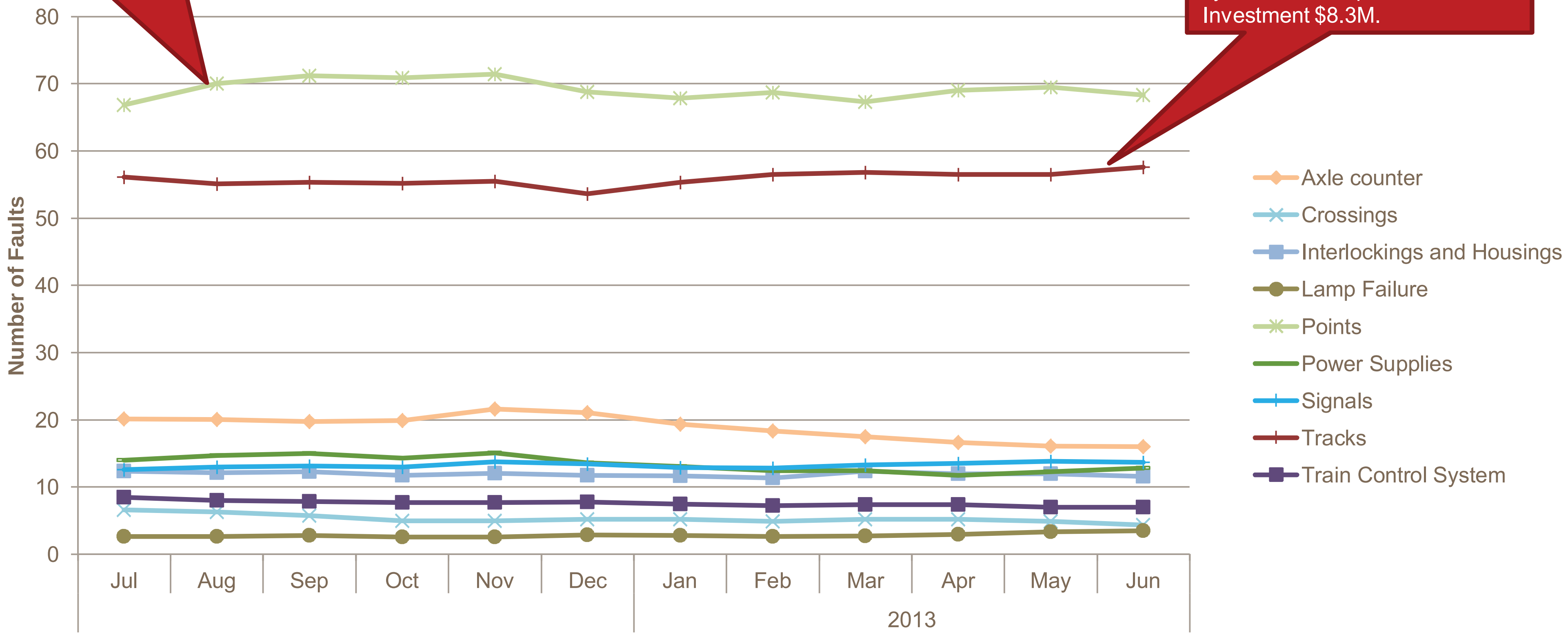
[redacted]

Goonyella Signalling Faults – 12 Month Rolling Average

Condition monitoring to be installed at 66 critical turnouts by end 2013 to provide detailed diagnostics information and allow pre-failure attendance. Investment $1.4M

Analogue TI21 track circuits Coppabella to Ports will be replaced by digital units, project has commenced completion due Jun 2014. Will improve performance as the analogue system is life expired. Investment $8.3M.



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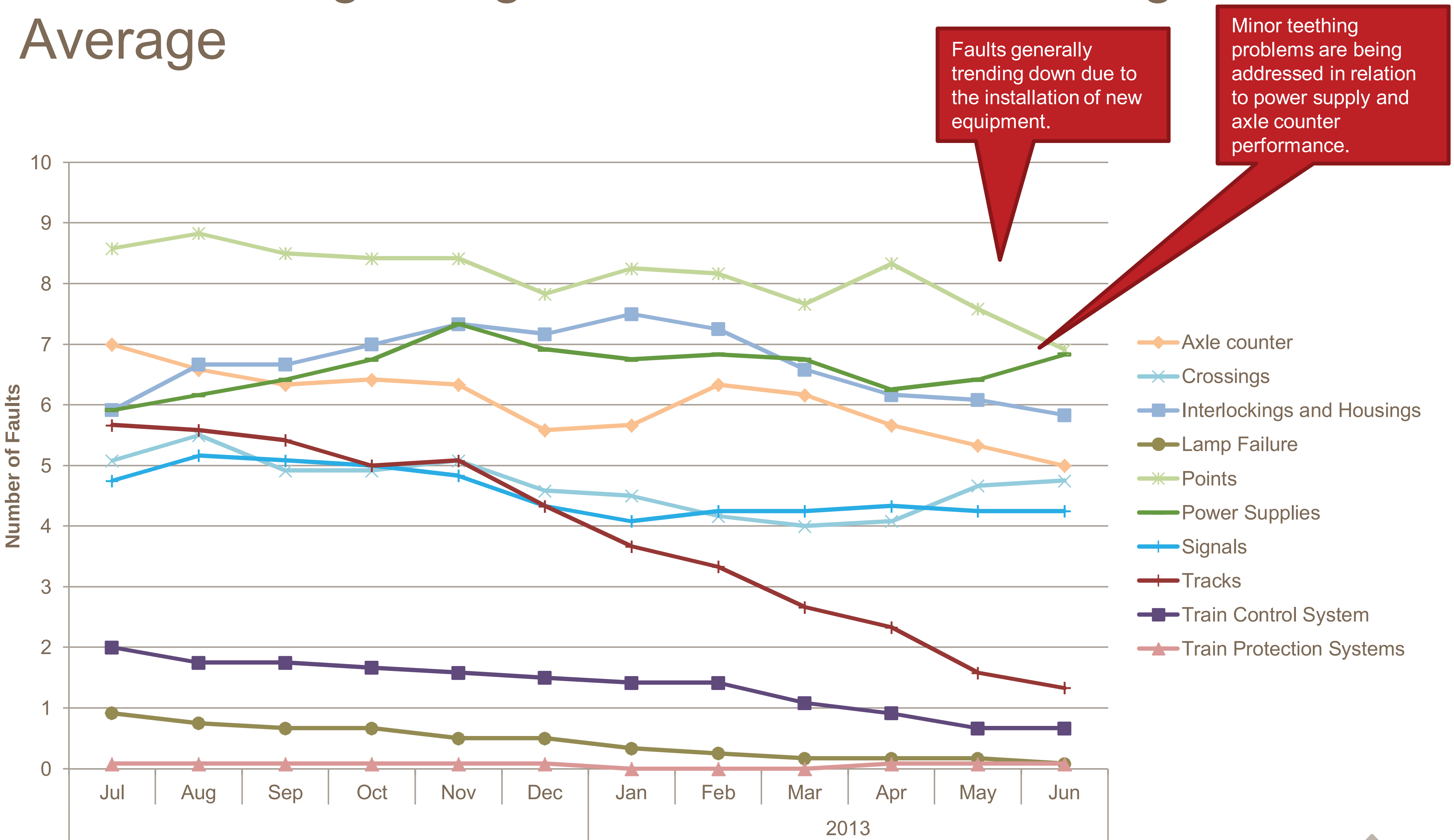
Newlands Signalling Faults – 12 Month Rolling Average



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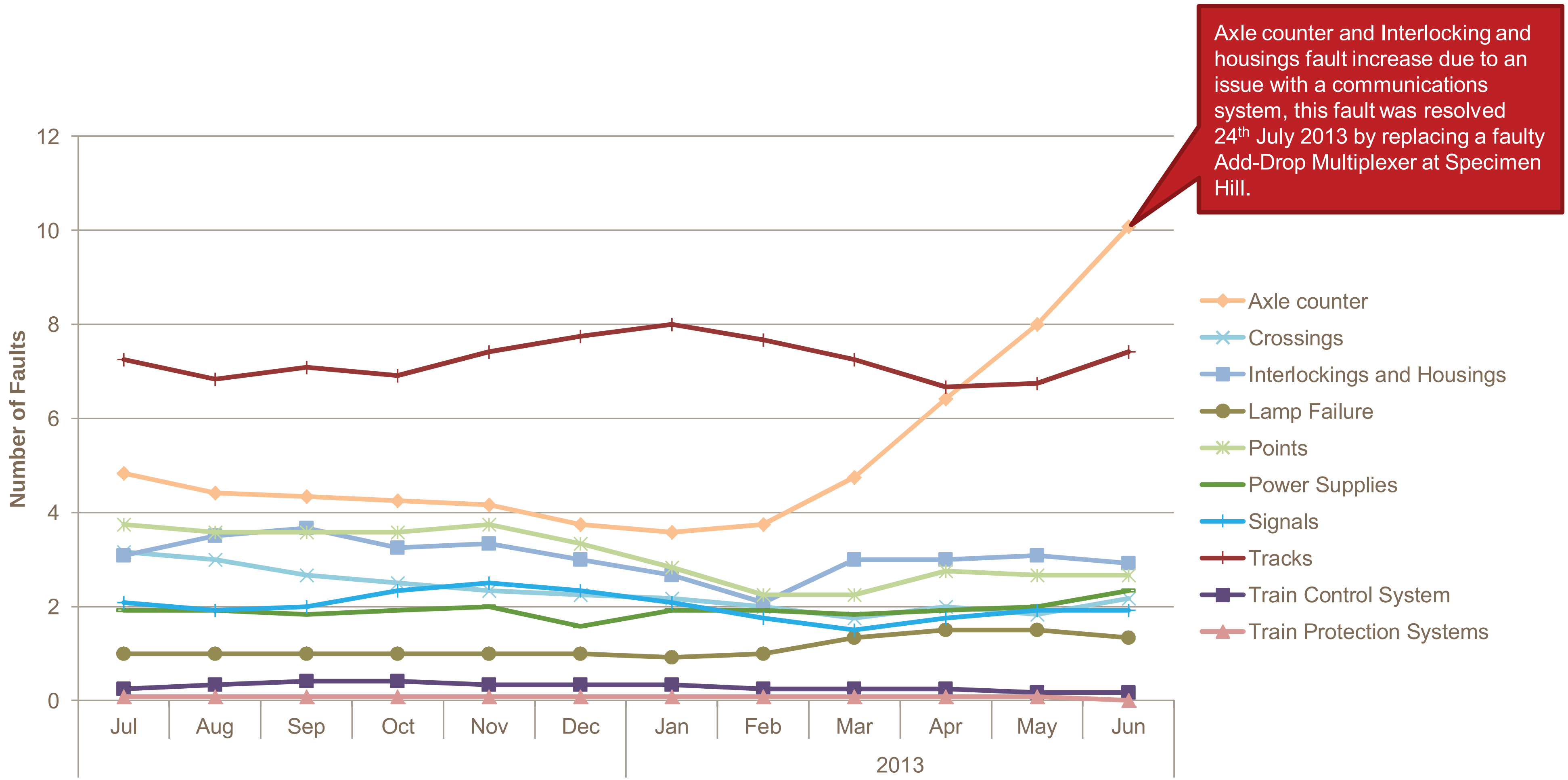
Moura Signalling Faults – 12 Month Rolling Average



[redacted]

CQCN Asset Renewals Signalling & Trackside Systems Program progress update

Project	Update
Points Condition Monitors Installed	POSS Point Condition Monitors Installation in Blackwater System 90% complete, 34 critical sites expected to be fully operational later this year CDS Rail Points Condition Monitoring Installation in Goonyella System 90% complete, 66 critical sites expected to be fully operational later this year
Track Circuit Upgrades	CSEE Track Circuit Renewal – Blackwater System, trial site to be selected, currently resolving bonding issues Digital TI21 Track Circuit upgrade - Coppabella to Haypoint, Materials on-site, Installation work to commence August 2013
AzS600 Axle Counters Replacement (Goonyella)	Frauscher axle counter trial successful, anticipate type approval later this year
Dual Telemetry upgrade	Work as per program, expected completion November 2014
Duaringa Flood Detection	Completed July 2013

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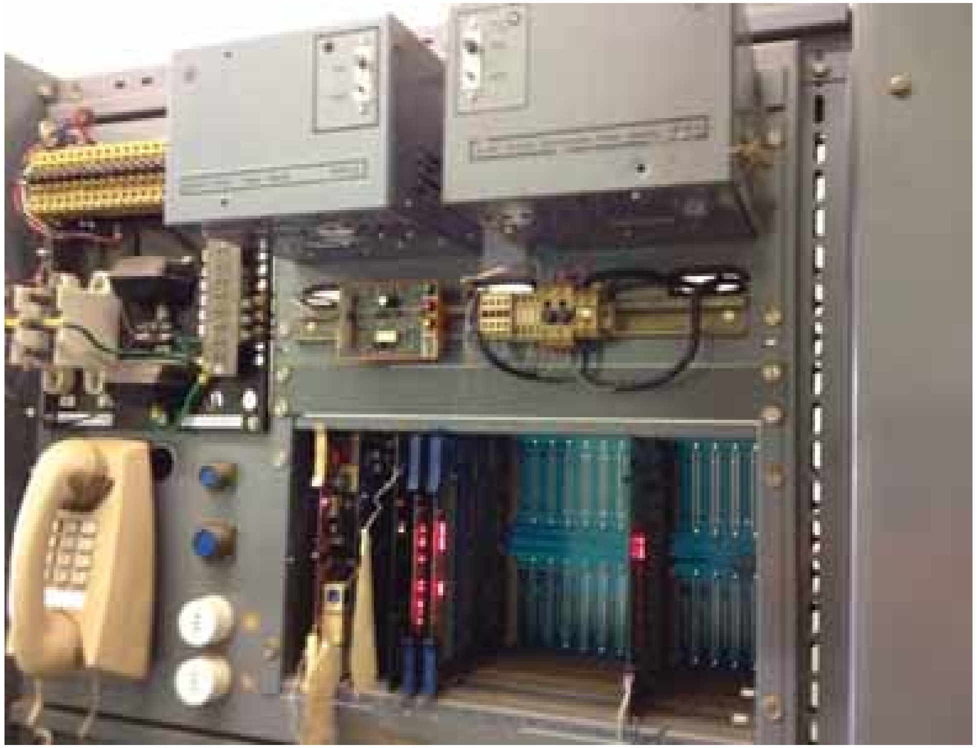
Delivering Major Track Signalling Improvements – Obsolescence

Old telemetry system



New telemetry system

[redacted]

Delivering Signalling System Improvements

Improving Staff productivity and safety:

1. Signalling maintenance check sheet review completed July 2013, new maintenance regime to commence August 2013
   - Significant rationalisation of existing check sheets was carried out
   - All interval changes risk assessed and peer review approved
2. Vital Disabling release trail at Mt Larcom Installed July 2013
   - Removes requirement for signal electricians to implement temporary circuit modifications for civil works at or around active level crossings
   - Activated via control switch on site by track protection officer (as illustrated on next slide)
3. Remote restriction lift for axle counter at Burngrove July 2013
   - Allows restricted axle counter to be reset remotely via 3G modem
   - Removes requirement for signal electrician to attend site to lift restriction
4. Trailers implementing Long Block capability utilised for WIRP July 2013
   - Allowed trains to run Rocklands to Archer while intermediate interlocking Midgee was not operational
   - To be relocated for future RGKW and future construction

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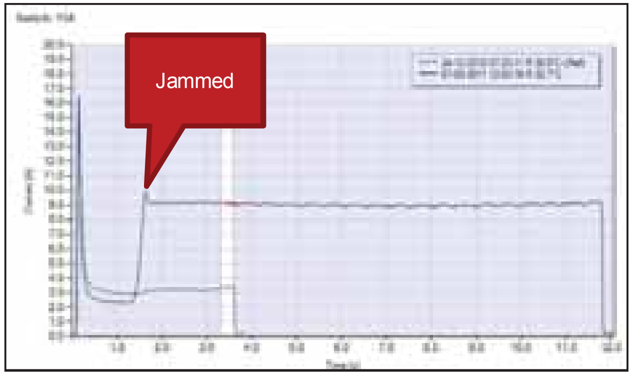
[redacted]

Delivering Efficiency Improvement - Mt Larcom Vital Disabling Release at Level Crossing

Activated via control switch on-site by track protection officer. Removes need for temporary circuit modifications when conducting works or around at Level Crossings

Delivering Reliability Improvements – Points Monitoring



Points condition monitors to be installed at 100 key sites by June 2014

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[redacted]

End

[redacted]

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Appendix B. Information sources

This review is based on information sourced from documents as shown in **Table 2.3** and **Table 2.4** below.

Table 2.3: Information sources – task specific

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
Aurizon Network	Volume 4 of 4 – UT4 Explanatory Materials	UT4 Maintenance Submission	R-Aurizon-QR2013DAU-ExMatMaint-0513	PDF	Confidential Version 30 April 2013
Aurizon Network	UT4 Explanatory Materials, Annexures of Volume 4	Evans and Peck - Operating and Maintenance Costs: Investigation and Benchmarking	Annex N (Confidential) Evans and Peck Operating and Maint.PDF	PDF	Final Report, October 2012.
Australian Competition and Consumer Commission	-	Revised 2010 HVAU – Hunter Valley Forecast 2011-2020[17]	Revised 2010 HVAU – Hunter Valley Forecast 2011-2020.pdf	PDF	Unknown
Asciano	-	Submission to the Queensland Competition Authority in Relation to the 2013 Aurizon Network Draft Access Undertaking	R-Asciano-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	October 2013
BMA and BMC	-	Issues and Concerns with Aurizon Network's (AN's) 2013 Draft Amending Undertaking (DAU)	R-BMABMC-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	10 October 2013
QRC	-	QRC UT4 Submission on Maintenance	R-QRC-Submission-Pricing-AurizonNetwork2013DAAU-Att04-1013.pdf	PDF	10 October 2013
QRC	-	QRC Submission – Main Submission	R-QRC-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	10 October 2013

[17] http://transition.accc.gov.au/content/item.phtml?itemId=995027&nodeId=37807b7485ec0734277b2a8024263ddd&fn=Revised%202010%20HVAU%20-%20Hunter%20Valley%20Forecast%202011-2020.pdf

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
RTCA	-	Submission to the Queensland Competition Authority in response to Aurizon Network proposed 2013 draft access undertaking (UT4)	R-RTCA-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	10 October 2013
The Authority (prepared by Energy Economics)		Central Queensland Coal Railings Forecast (Confidential Version)	2013-07-31 Queensland railings UT4 main – CONFIDENTIAL (598613_1).PDF	PDF	July 2013

Table 5-12 Producer price indexes comprising Aurizon Network's MCI

Index	Measure		Particulars	Issue
Consumables Index	Non-Building Construction	Name:	Output of the General Construction Industry, Index Numbers and Percentage Changes	Quarterly
		No:	15, Road and Bridge Construction Australia	
		Ref:	6427	
	Basic Metal Products	Name	Articles Produced by Manufacturing Industries, Index Numbers and Percentage Changes	
		No:	10-11, Primary Metal and Metal Product Production	
		Ref:	6427	
	Transport Equipment & Parts	Name:	Articles Produced by Manufacturing Industries, Index Numbers and Percentage Changes	
		No:	10-11, Transport Equipment Manufacturing	
		Ref:	6427	
	Fabric Metal Products	Name:	Articles Produced by Manufacturing Industries, Index Numbers and Percentage Changes	
		No:	10-11, Fabricated Metal Product Production	
		Ref:	6427	
	Consumer Price Index	Name	CPI: Groups, Index Numbers by Capital City - Brisbane All Groups	Quarterly
		No:	Table 5, All groups, Brisbane	
		Ref:	6401	
Labour	Queensland All Industries	Name:	Average Weekly Earnings, Australia	Annually
		No:	Table 13c, Full Time Adult Ordinary time earnings	
		Ref:	6302	
	Mining; Private and	Name:	Average Weekly Earnings, Australia	Annually

	Public; All occupations;	No:	Table 10G, Full Time Adult Ordinary time earnings, Mining	
		Ref:	6302	
	Construction; Private; All occupations;	Name:	Average Weekly Earnings, Australia	
		No:	Table 10G, Full Time Adult Ordinary time earnings, Construction	
		Ref:	6302	
Accommodation		Name:	Hotels, Motels and Serviced Apartments by Tourism Region QLD (Central Qld and Mackay District)	Quarterly
		No:	3, Average Takings per room night occupied	
		Ref:	8635.3.55.001	
Fuel			AAA Pricing Summary Unleaded Petrol (cents per litre) (Emerald 20%, Gladstone 20% and Mackay 20%)	Quarterly
			AIP Terminal Gate Prices Historical Averages Brisbane, Unleaded (20%) and Diesel (20%)	Daily

Source: The Authority

Table 2.4: Information sources – general

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
The Authority		Terms of Reference, Engineering Technical Assessment of Maintenance, Operating and Capital Expenditure Forecast	QCA Terms of Reference_UT4 Engineer(565631_4)	PDF	27 June 2013
Aurizon Network	Volume 1 of 3 – The Access Undertaking and Schedules	Schedule E – Regulatory Asset Base	R-Aurizon-QR2013DAU-Vol1-0513	PDF	April 2013
Aurizon Network	Volume 1 of 4 – UT4 Explanatory Materials	Overview and Summary	R-Aurizon-QR2013DAU-ExMatOvr-0513	PDF	30 April 2013
Aurizon Network	Volume 2 of 4 – UT4 Explanatory Materials	The 2013 Undertaking Proposal	R-Aurizon-QR2013DAU-ExMatSub-0513	PDF	30 April 2013
Aurizon Network	Volume 3 of 4 – UT4 Explanatory Materials	Maximum Allowable Revenue and Reference Tariffs	R-Aurizon-QR2013DAU-ExMatBB-0513	PDF	30 April 2013
Aurizon Network	Volume 4 of 4 – UT4 Explanatory Materials	UT4 Maintenance Submission	R-Aurizon-QR2013DAU-ExMatMaint-0513	PDF	Confidential Version 30 April 2013

B.1.1 Request for information (RFI)

The following information was provided by Aurizon Network in response to RFIs issued by SKM.

Owner	Document Name	Electronic File Name	Document Type	Relevant RFI
Aurizon Network	UT4 Maintenance – Summary Output	Product Make-Up, inc Exclusions	Microsoft Excel	RFI AUR-006

			Workbook	
Aurizon Network	UT4 Maintenance Cost Analysis – Efficiency Improvements Built into Submission Costs	Productivity improvements – 3 Sept 2013	Microsoft Excel Workbook	RFI AUR-006
Aurizon Network	UT4 Product Costs	Reporting Module – 30 April lodgement -$189m – SKM	Microsoft Excel Workbook	RFI AUR-007, RFI AUR -012, RFI AUR-013, RFI AUR-014 AND RFI AUR- 015
Aurizon Network	UT4 Maintenance - Rules for Translating FY12 Actual Scope to UT4 FY14 Scope	Scope Translation Rules – 18 January 2013	Microsoft Excel Workbook	RFI AUR-007, RFI AUR -012, RFI AUR-013, RFI AUR-014 AND RFI AUR- 015
Aurizon Network	UT4 Maintenance SKM – Reconciliation of 30 April Submission to Sept 2013 View	SKM – Reconciliation to 30 April Submission - 7 Sep– 2013	Microsoft Excel Workbook	RFI AUR-007, RFI AUR -012, RFI AUR-013, RFI AUR-014 AND RFI AUR- 015
Aurizon Network	UT4 Maintenance Cost Analysis	Summary STS Scope and Assumptions - $189m – 30 April 2013	Microsoft Excel Workbook	RFI AUR-005
Aurizon Network	UT4 Maintenance Cost: Core Assumptions	UT4 Assumptions – Maintenance – 30 April 2013 Submission	Microsoft Word Document	RFI AUR-006

Appendix C. Normalisation formula

The following provides more detail on the components of the normalisation formula outlined in **Section 2.1.4** which was obtained from *Appendix N (Confidential) Evans and Peck - Operating and Maintenance Costs: Investigation and Benchmarking – Final Report, October 2012.*

Multiplicative normalisation factor = 1 / (A + B – C) x D

Where:

A = 1 for average track with average grade, curvature and drainage conditions,
B = an increase to allow for additional characteristics requiring extra maintenance,
C = a decrease to allow for characteristics requiring less maintenance,
D = 1 for standard gauge, 0.97 for broad gauge and 1.03 for narrow gauge.

$$A = 0.75 + \frac{(0.5 \text{ x Track with Poor Drainage}) + (1 \text{ x \% Curved Track}) + (0.25 \text{ x \% Track Grade } > 1{:}100)}{200}$$

Where:

- 0.75 is a constant to ensure the result > 0.
- 0.5, 1 and 0.25 are assumed weightings based on the relative effect the weighted item has on the
- maintenance effort.
- 200 is a constant applied to assign a unit value to the average track.

$$B = \frac{(1 \times Length\ welded\ turnouts) + (2 \times Length\ tunnels\ and\ underbridges)}{main\ line\ kms}$$

Where:

- 1 and 2 are assumed weightings based on the relative effect the weighted item has on the total maintenance effort.

$$C = \frac{(0.2\ X\ \%\ of\ Concrete\ sleepered\ Track) + (0.05 \times \%\ of\ track\ with\ elastic\ fastenings) + (0.75 \times \%\ of\ track\ with\ CWR)}{200}$$

Where:

- 200 is a constant based on the assumption that CWR on concrete sleepered track with elastic fastenings requires only 50% of the maintenance required for track without these benefits.

Attachment B: Review of incremental maintenance tariff component

Contents

1. Glossary

Abbreviations and definitions used in this document are listed in **Table 1.1**.

Table 1.1 Abbreviations and Terminology

Abbreviation, Acronyms and Terminology	Description / Definition
ARR	Annual revenue requirement
ARTC	Australian Rail Track Corporation
AT_1	Incremental maintenance tariff ($ per '000 gtk)
AT_2	Incremental capacity component that is levied on a Train Path basis
AT_3	Pricing component that is levied on a ntk basis
AT_4	Pricing component that is levied on a nt basis
AT_5	Electric access tariff that is levied on an egtk basis
Aurizon Network	On 3 December 2012, QR Network Pty Ltd changed its name to Aurizon Network Pty Ltd.
BMA and BMC	BHP Billiton Mitsubishi Alliance and BHP Billiton Mitsui Coal
CPI	Consumer price index
CQCR	Central Queensland coal region
CWR	Continuous welded rail
GAPE	Goonyella to Abbot Point system
gtk	Gross tonne kilometre
HVCN	Hunter Valley Coal Network
MAR	Maximum allowable revenue
MCI	Maintenance cost index
mtpa	Million tonnes per annum
nt	Net tonnes
ntk	Net tonne kilometre
QRC	Queensland Resources Council
RFI	Request for Information
RTCA	Rio Tinto Coal Australia
SKM	Sinclair Knight Merz
The Authority	Queensland Competition Authority
UT3	2010 Access Undertaking
UT4	2013 Draft Access Undertaking
WACC	Weighted Average Cost of Capital

2. Review of incremental maintenance reference tariff component

2.1 Task description and methodology

Aurizon Network's forecast maintenance cost is a significant component of Aurizon Network's annual revenue requirement (ARR) and, therefore, the reference tariffs for coal train services.

Reference tariffs for coal train services are determined in order to recover Aurizon Network's costs (ultimately approved by the Queensland Competition Authority (the Authority)) over the regulatory period. There are 4 components for non-electric tariffs (AT_1, AT_2, AT_3 and AT_4) and 1 component for electric tariffs (AT_5)[1].

The AT_1 tariff component reflects the portion of Aurizon Network's forecast maintenance cost that varies with usage (i.e. the incremental maintenance cost at the base tonnage). Each of the coal systems in the central Queensland coal region (CQCR) has a unique AT_1 tariff based on the incremental maintenance cost of that system, expressed on a $/'000 gross tonne kilometre (gtk) basis.

The current AT_1 reference tariff for each CQCR system was determined in the Authority's 2001 decision, based on an analysis of Aurizon Network's incremental costs as a function of tonnage and train characteristics and on overseas rail system benchmarks. Aurizon Network has largely applied this charge since that decision[2], inflating it by actual CPI, and proposes to continue this approach in Aurizon Network's 2013 draft amending undertaking (UT4).

In this context, the Authority engaged Sinclair Knight Merz (SKM) to:

- determine whether the UT4 proposed AT_1 reference tariff (for each coal system in the CQCR) is reasonable based on:
  - assessing Aurizon Network's proposed data, methodology and supporting information;
  - benchmarking Aurizon Network's proposed forecast incremental maintenance costs against relevant industry comparators (on a $/'000 gtk basis); and
  - any other factor SKM considers relevant.

2.1.1 Background to this report

On 6 September 2013, SKM submitted a draft review of Aurizon Network's proposed AT_1 reference tariffs to the Authority. Subsequent to this task, the Authority requested that SKM provide an updated review to reflect:

- the incremental maintenance cost per system exclusive of maintenance of electrical infrastructure, since these costs are recovered as part of the AT_5 reference tariff; and
- the incremental maintenance cost which would apply if volumes were 10 per cent lower (on average) than Aurizon Network's forecast, based on the forecast provided by Energy Economics.

Table 2.1 provides the maintenance costs forecasts which were originally provided by Aurizon Network (which include maintenance of electrical infrastructure) and informed the report submitted to the Authority on 6 September 2013. **Table 2.1** also provides the costs associated with maintenance of electrical infrastructure, and the resulting maintenance costs which have been utilised in this review (assuming constant volumes as forecast by Aurizon Network).

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[1] Excluding the electric charge component that recovers the electricity transmission costs.

[2] In 2007, Aurizon Network proposed, and the Authority approved, a 10% increase in the AT_1 tariff component. For more details on this, see http://www.qca.org.au/rail/2006auammend/coalsysmaintcosts.php .

Table 2.1 Costs associated with maintenance of electrical infrastructure

Maintenance costs including maintenance of electrical infrastructure				
Financial year / system	**2013/14**	**2014/15**	**2015/16**	**2016/17**
Moura ($m)	$10.8	$11.4	$9.7	$10.2
Newlands (excl. GAPE) ($m)	$7.7	$7.7	$7.8	$8.1
GAPE ($m)	$13.2	$15.6	$15.9	$16.2
Blackwater ($m)	$74.8	$81.9	$88.2	$86.8
Goonyella ($m)	$77.8	$82.2	$83.3	$87.3
Maintenance of electrical infrastructure				
Financial year / system	**2013/14**	**2014/15**	**2015/16**	**2016/17**
Moura ($m)	-	-	-	-
Newlands (excl. GAPE) ($m)	-	-	-	-
GAPE ($m)	-	-	-	-
Blackwater ($m)	$3.5	$3.5	$3.5	$3.5
Goonyella ($m)	$6.1	$6.1	$6.1	$6.1
Maintenance costs excluding electrical infrastructure				
Financial year / system	**2013/14**	**2014/15**	**2015/16**	**2016/17**
Moura ($m)	$10.8	$11.4	$9.7	$10.2
Newlands (excl. GAPE) ($m)	$7.7	$7.7	$7.8	$8.1
GAPE ($m)	$13.2	$15.6	$15.9	$16.2
Blackwater ($m)	$71.3	$78.4	$84.7	$83.2
Goonyella ($m)	$71.7	$76.1	$77.2	$81.2

Source: Aurizon Network, 20 September 2013

Table 2.2 provides SKM's proposed adjustment (outlined in the report titled *High level and detailed review of forecast maintenance costs*, submitted to the Authority on 25 October 2013) to account for a reduction in volumes as forecast by Energy Economics. The adjustment was provided for the CQCR. **Section 2.2.3** provides SKM's suggested allocation of cost adjustments to individual systems for the purpose of deriving the AT_1 reference tariffs.

Table 2.2 SKM's proposed cost adjustment for reduced volumes (CQCR)

Maintenance Task	2013/14	2014/15	2015/16	2016/17
Ballast undercutting	**-$1.50**	**-$5.53**	**$0.00**	**-$1.97**
Rail grinding	-$0.56	-$1.45	-$1.70	-$1.86
Resurfacing	No adjustment required	-$0.04	-$3.84	-$0.11
Track, structures and facilities	**-$0.87**	**-$1.43**	**-$3.23**	**-$3.05**
Total adjustment	-$2.93	-$8.45	-$8.77	-$6.99

Source: SKM, 25 October 2013

In addition, this report provides a review of the AT_1 reference tariffs which would apply if the scope of ballast undercutting is limited, as per SKM's proposed adjustment in the report titled *High level and detailed review of forecast maintenance costs*, submitted to the Authority on 25 October 2013. Under this assumption, volumes are assumed as equal to the forecast provided by Aurizon Network, and the scope of ballast undercutting is only limited until such time that Aurizon Network demonstrates acquisition of the additional spoil wagons proposed in the UT4 submission. **Table 2.3** provides SKM's proposed total allowance to the RM900 ballast undercutting scope. **Section 2.2.4** provides SKM's suggested allocation of cost adjustments to individual systems for the purpose of deriving the AT_1 reference tariffs.

Table 2.3 SKM's proposed ballast undercutting adjustment

Financial year	2013/14	2014/15	2015/16	2016/17
Total (SKM)	$44.1	$44.1	$44.1	$44.1
Total AN	$44.1	$48.5	$51.3	$54.4
Total Adjustment	-	-$4.4	-$7.3	-$10.3

Source: SKM, 25 October 2013

2.1.2 Methodology

SKM has undertaken a review of typical rail maintenance activities in order to determine:

- the appropriateness of Aurizon Network's proposal to roll-forward the current AT_1 rates in light of what factors may have changed since these rates were set in 2001 (**Section 2.2.1**); and
- whether the proposed AT_1 rate, and/or SKM's observed AT_1 rate, aligns to relevant industry comparators (benchmarking against the Australian Rail Track Corporation's (ARTC's) Hunter Valley Coal Network (HVCN)) including consideration for normalisation (**Section 2.2.6**).

2.1.3 Adequacy of information provided and general comments

SKM requested the following information from Aurizon Network which has been utilised as part of this review:

- forecast maintenance expenditure on an individual system basis, excluding costs associated with electrical infrastructure;
- forecast track kilometres (kms) on an individual system basis; and
- forecast gross tonne kilometres (gtk) on a system and regional basis, noting that Aurizon Network's forecast gtk for pricing purposes differs from the forecast which is utilised to develop the maintenance cost estimates[3], as outlined in the 2013 DAU.

SKM also requested a copy of the report and supporting data provided by Energy Economics which outlines differences in forecast volumes compared to Aurizon Network's forecast.

Appendix A provides other information sources which have been utilised in this review.

[3] In some circumstances, new customers have contracted access rights at a particular level of capacity ("full utilisation"), but it may take a couple of years before they're operating at that capacity ("ramp-up period"). Aurizon Network states that it is reasonable to require that maintenance cost forecasts (which flow into allowable revenue) are estimated on the basis of expected utilisation, i.e. what is reasonably expected to rail, based on ramp-up volumes. Specifically, if ramp-up volumes were used to determine pricing, reference tariffs for the system would be higher in circumstances where the capital costs associated with new customers are socialised with existing customers. Existing users would effectively be forced to pay a greater contribution towards these capital costs, until new customers reach full utilisation. Therefore, Aurizon Network employs an approach where the pricing forecast is linked to contracted capacity to help ensure a fairer pricing outcome between new and existing customers in these circumstances.
Source: Information provided by Aurizon Network on 19 November 2013.

2.2 Assessment of Aurizon Network's proposed AT_1 reference tariff for each CQCR

2.2.1 Aurizon Network's proposed data, methodology and supporting information

The purpose of this section is to provide a review of Aurizon Network's proposed data, methodology and supporting information for the proposed AT_1 reference tariffs per system over the UT4 period. In conducting this review, SKM has considered the following:

- what are the key assumptions underpinning Aurizon Network's proposed AT_1 reference tariff?
- what are the changes to the CCQR including at an individual system level since the Authority's 2001 decision which would potentially impact the structure of the maintenance cost curve?

These questions are addressed in the following sub-sections.

Key assumptions underpinning Aurizon Network's proposed AT1 reference tariffs for the UT4 period

As previously noted, Aurizon Network's AT_1 reference tariffs were originally set in 2001 for each of the Moura, Newlands, Blackwater and Goonyella coal systems. Since then, these rates have formed the basis for AT_1 rates set under each of the subsequent undertakings.

The AT_1 rates Aurizon Network has proposed for UT4 are based on:

- the AT_1 rates approved as part of the 2010 undertaking (as at 1 July 2009); and
- escalated by MCI to bring them up to the beginning of the UT4 period (1 July 2013).

Aurizon Network proposed that the AT_1 rates be escalated by CPI annually over the UT4 period.

Table 2.4 provides Aurizon Network's proposed AT_1 reference tariffs for the UT4 period, including the relevant forecast gtk ('000).

Table 2.4 Aurizon Network's proposed AT1 reference tariffs

Financial Year	2013/14		2014/15		2015/16		2016/17	
System	AT_1 ($)	Gtk ('000)	AT_1 ($)	Gtk ('000)	AT_1 ($)	Gtk ('000)	AT_1 ($)	Gtk ('000)
Moura	1.75	3,438,649	1.79	3,832,505	1.83	3,653,129	1.88	3,965,176
Blackwater	0.94	30,117,969	0.96	33,985,924	0.99	37,876,747	1.01	41,168,179
Goonyella	0.65	32,649,600	0.67	35,622,580	0.68	37,444,831	0.70	39,077,779
Newlands	1.82	3,255,724	1.86	3,413,741	1.91	3,596,255	1.96	3,950,946
GAPE	1.46	8,892,466	1.50	10,964,348	1.54	11,643,616	1.58	12,373,578

Source: pp. 237, 238, 241, 243, 245, 246, 248, 249, 251 and 252 of the Volume 1 of 3 of UT4 explanatory materials.

Table 2.5 provides the total track kms per system, as provided by Aurizon Network, including planned expansions for the Blackwater system over the UT4 period. Maintenance cost estimates (excluding maintenance of electrical infrastructure) have been provided in **Section 2.1.1**).

Table 2.5 Track kms

System	2013/14 (km)	2014/15 (km)	2015/16 (km)	2016/17 (km)
Moura	260.0	260.0	260.0	260.0
Blackwater	1,032.0	1,107.0	1,107.0	1,107.0
Goonyella	978.0	978.0	978.0	978.0
Newlands (Excl. GAPE allocation)	209.4	209.4	209.4	209.4
GAPE	110.6	110.6	110.6	110.6

Source: Aurizon Network, 28 August 2013

Analysis of appropriateness of Aurizon Network's proposed methodology

SKM finds that the structure of Aurizon Network's cost curve is likely to have altered since the Authority's 2001 decision. As such, Aurizon Network's proposed methodology may not reflect incremental maintenance costs for the UT4 period. In particular, some of the changes that would impact Aurizon Network's maintenance cost curve (and resulting incremental maintenance cost at the base tonnage) include, but are not limited to:

- construction of the Goonyella to Abbot Point Expansion project;
- privatisation of the CQCR which has led to changes in the asset management strategy, including a focus on asset renewals and preventative maintenance activities. Maintenance costs should fall as the organisation matures and becomes more efficient with continuous improvement (maintenance costs will fall as maintenance reaches a steady state);
- improvements in resurfacing and rail grinding should be seen at a point in the near future following the extensive ballast cleaning and rail grinding programmes of UT3 (and proposed in UT4) by the realisation of less differential settlement, better track geometry, and better rail profile retention;
- real escalation of maintenance costs since 2001– real price increases associated with maintenance activities for the CQCR may have resulted in an upwards shift of Aurizon Network's cost curve which is not in line with CPI over the same period;
- more detailed bottom up cost estimation since 2001 (and since UT3) which more closely reflects the costs involved with maintenance for each system, and accounts for (not limited to) improvements in productivity, increasing labour costs, costs associated with limited access to site for some systems and a significant increase in tonnages / access requirements; and
- changes in technology utilised by Aurizon Network since 2001 (and since 2009/10) which reflect changes in the composition of mechanised vs. non-mechanised maintenance tasks. Aurizon Network's current proposed split of mechanised and non-mechanised maintenance is approximately 60% and 40% respectively (totalling 100% of maintenance costs). This is likely to have an impact on the structure of the cost curve as efficiency is improved through the use of mechanised approaches to maintenance.

2.2.2 Estimation of the AT_1 reference tariff – Scenario 1

This section provides an estimated AT_1 reference tariff for individual systems assuming:

- maintenance costs are equal to the costs provided by Aurizon Network and summarised in **Table 2.1**; and
- volumes (gtk) are equal to the volume forecasts provided by Aurizon Network and summarised in **Table 2.4**.

SKM has derived Aurizon Network's maintenance cost curves for the UT4 period based on proposed maintenance expenditure per system. It is reasonable to expect that the shape of the cost curve would reflect an increase in costs for increased task (tonnes hauled) but at a declining rate, comprising fixed costs which are incurred regardless of the haulage task, and incremental costs which (although increasing) reflect economies of scale with increasing task.

Figure 1 provides Aurizon Network's maintenance cost forecast for the UT4 period, expressed as million gtk (mgtk) / track km against cost per km (total cost / track km).

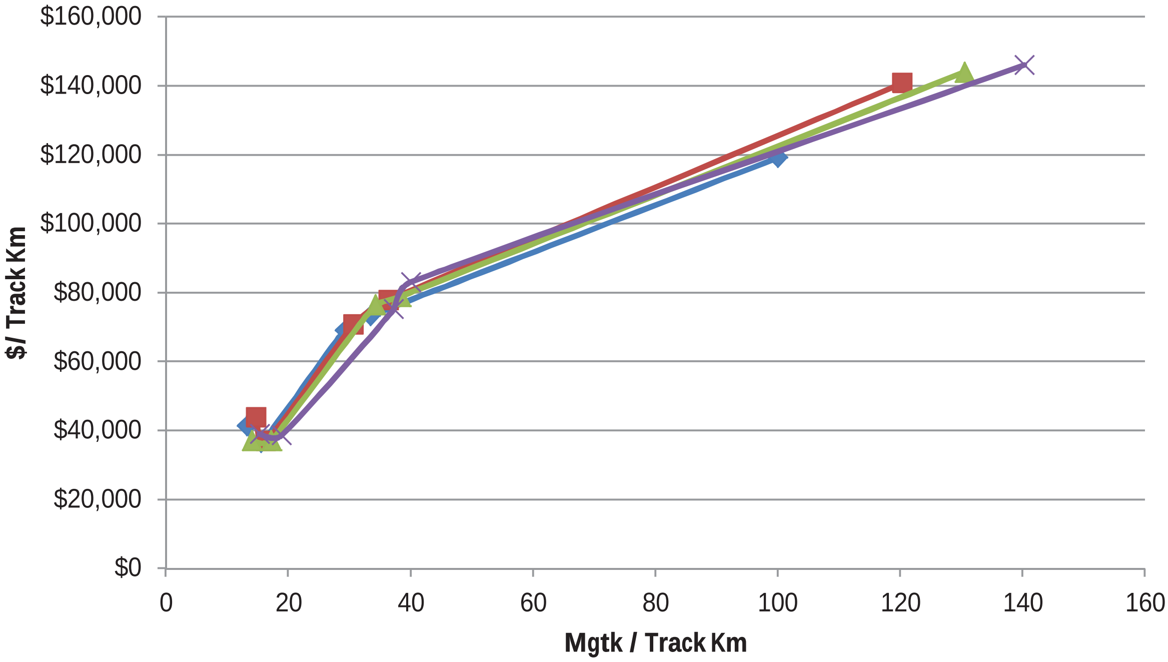


Figure 1 Aurizon Network's maintenance forecast, 2013-14 to 2016-17 (real $2011/12)

Source: SKM, based on information provided by Aurizon Network on 28 August 2013 and 20 September 2013

Figure 1 shows that Aurizon Network forecasts that the Newlands system is less expensive to maintain than the Moura system on a dollars per track kilometre basis, although at a slightly higher tonnage. This occurs as a result of cost allocation which occurs for GAPE users on the Newlands system. Specifically, in addition to construction of the Northern Missing Link (NML) the "GAPE project" included a number of upgrades/enhancements in the Newlands system to facilitate the additional volumes. Therefore, when determining the capital value that is attributable (for pricing purposes) to GAPE customers, it was deemed reasonable to allocate a proportion of Newlands costs to the GAPE system, even though the infrastructure enhancements were geographically located in the Newlands system. As a consequence, the GAPE system is effectively a 'cost allocation' system.

Similarly, while UT4 maintenance cost estimates for the Newlands system were based on the expected utilisation of the track geographically located in the Newlands system, this includes traffic originating in both the Newlands system and GAPE and hence some of the UT4 maintenance costs forecast for the Newlands system are directly attributable to GAPE customer utilisation. Accordingly, these costs have been allocated to the GAPE system and therefore when comparing costs on a dollars per track km basis, the costs attributable to the GAPE system may appear high because it includes an allocation of costs GAPE customers will incur for the Newlands portion of their total haul. Conversely, costs for the Newlands system appear lower.

Figure 2 provides the best fit cost curves and incremental cost curves based on the forecast maintenance costs depicted in **Figure 1**.

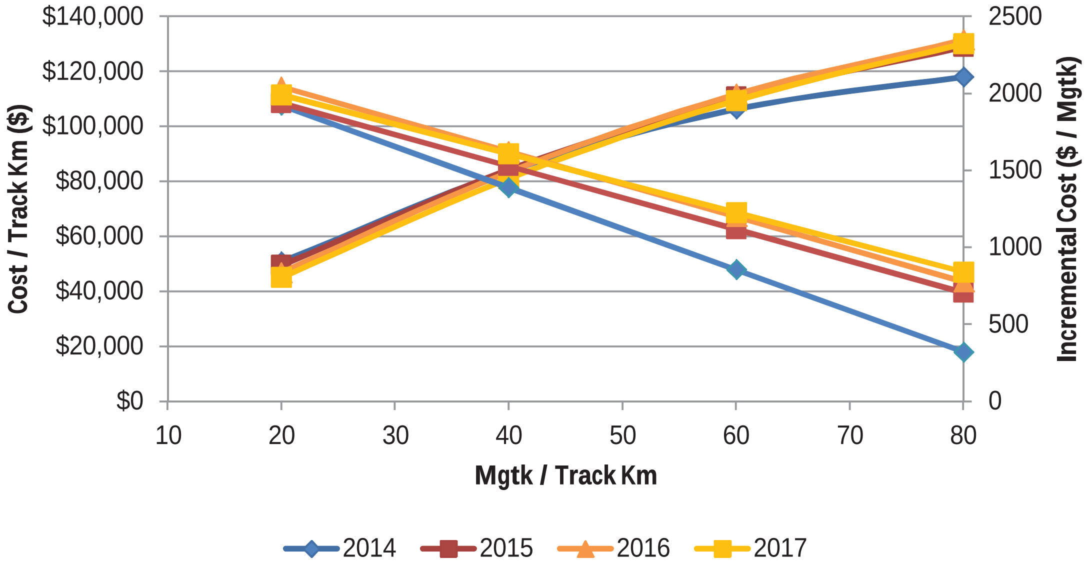


Figure 2 Best fit maintenance cost curves and incremental maintenance cost curves

Source: SKM, based on information provided by Aurizon Network on 28 August 2013

Table 2.6 provides SKM's observed AT_1 reference tariffs ($FY11-12) for individual systems, which have been derived based on the incremental cost curves provided in **Figure 2**.

Table 2.6 Observed AT_1 reference tariffs ($FY11-12)

System	2013/14	2014/15	2015/16	2016/17
Moura	$2.1045	$2.0467	$2.1685	$2.0844
Newlands (excl. GAPE)	$2.0424	$2.0146	$2.1026	$2.0150
Blackwater	$1.6783	$1.7192	$1.7436	$1.6634
Goonyella	$1.5662	$1.6018	$1.6578	$1.6103
GAPE	$1.5355	$1.4953	$1.5142	$1.4468

Source: SKM calculations based on information provided by Aurizon Network on 28 August 2013

Escalation of the AT_1 reference tariffs

SKM recognises that Aurizon Network's driver which underpins proposed escalation in line with the forecast CPI reflects a desire to maintain pricing structure which is consistent with UT3. However, escalation based on CPI has implications for Aurizon Network's Maximum allowable revenue (MAR). Specifically, a lower AT_1 reference tariff which is escalated with CPI will result in a lower portion of the annual revenue requirement which is outside of the revenue cap.

Therefore SKM finds that the AT_1 reference tariffs should be escalated utilising the forecast MCI for the UT4 period, which is subject to an additional review.

2.2.3 AT_1 reference tariff for reduced volumes – Scenario 2

This section provides an estimated AT_1 reference tariff for individual systems assuming:

- total CQCR volumes are equal to the volumes forecast by Energy Economics and not the volumes proposed by Aurizon Network; and

- the total maintenance costs are adjusted to reflect SKM's proposed adjustment for reduced volumes which has been summarised in **Table 2.2**.

In order to estimate a unique AT_1 reference tariffs for individual systems, it is necessary to allocate the cost adjustment provided in **Table 2.2** to individual systems. SKM's proposed allocation of cost adjustments for reduced volumes to individual systems is based on an individual system's contribution to total absolute volume changes, noting that some systems are forecast by Energy Economics to have greater volumes than the forecast provided by Aurizon Network and therefore SKM's cost allocation shows increased costs for those systems. **Table 2.7** provides the absolute difference in forecast volumes (mtpa) provided by Energy Economics compared to Aurizon Network's forecast, and the allocation of cost adjustments to individual systems.

Table 2.7 Allocation of cost adjustment to individual systems

Absolute difference (mtpa)				
System	**2013/14**	**2014/15**	**2015/16**	**2016/17**
Blackwater	4.6	-0.7	-5.1	-8.1
Moura	-0.9	-1.6	-0.2	0.8
Newlands	1.0	-1.2	-0.1	-0.8
GAPE	-13.5	-14.0	-11.6	-12.5
Goonyella	-0.3	-6.2	-11.9	-11.8
Total	**-9.0**	**-23.8**	**-28.9**	**-32.4**
Proportion of absolute difference / allocation of cost adjustments to individual systems				
System	**2013/14**	**2014/15**	**2015/16**	**2016/17**
Moura	9.5%	6.9%	0.6%	-2.5%
Newlands	-11.0%	5.2%	0.2%	2.4%
GAPE	149.5%	58.7%	40.2%	38.7%
Blackwater	-51.4%	3.1%	17.6%	25.0%
Goonyella	3.4%	26.2%	41.4%	36.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Energy Economics (2013) provided by the Authority on 10 October 2013

Table 2.8 provides the cost adjustment for individual systems based on SKM's adjustment at a system-wide level, and the revised maintenance costs per system.

Table 2.8 SKM's adjusted maintenance costs for volume changes – individual systems (real $2011/12)

System-wide cost adjustment	2013/14	2014/15	2015/16	2016/17
CQCR ($m)	-$4.88	-$8.44	-$8.78	-$7.00
System adjustment	2013/14	2014/15	2015/16	2016/17
Moura ($m)	-$0.46	-$0.58	-$0.06	$0.17
Newlands (excl. GAPE) ($m)	$0.54	-$0.44	-$0.02	-$0.17
GAPE ($m)	-$7.30	-$4.96	-$3.53	-$2.71
Blackwater ($m)	$2.51	-$0.26	-$1.54	-$1.75
Goonyella ($m)	-$0.17	-$2.21	-$3.63	-$2.55
Revised system costs	2013/14	2014/15	2015/16	2016/17
Moura ($m)	$11.14	$12.14	$11.25	$12.59
Newlands (excl. GAPE) ($m)	$8.88	$8.15	$9.08	$9.63
GAPE ($m)	$6.36	$11.94	$14.42	$16.37
Blackwater ($m)	$79.55	$87.65	$96.98	$98.85
Goonyella ($m)	$77.10	$82.88	$85.80	$95.45

Source: SKM, based on information provided by Aurizon Network on 28 August 2013 and 20 September 2013 and information provided by the Authority on 10 October 2013

Table 2.9 provides the change in forecast volumes per system as provided by Energy Economics compared to Aurizon Network's forecast. For the purpose of this review it is assumed that the change in volumes (mtpa) will result in a one for one change in gtk for each system and **Table 2.9** also provides the adjusted gtk assumed in deriving the AT_1 reference tariffs.

Table 2.9 Revised gtk for volume adjustments

Change in forecast volumes / assumed change in gtk	2013/14	2014/15	2015/16	2016/17
Moura	-6.85%	-11.99%	-1.44%	5.66%
Newlands	6.74%	-7.78%	-0.33%	-4.12%
GAPE	-65.55%	-55.10%	-42.82%	-43.19%
Blackwater	8.54%	-1.19%	-7.52%	-11.04%
Goonyella	-0.32%	-5.86%	-10.65%	-10.09%
Revised volumes (gtk, 000s)	2013/14	2014/15	2015/16	2016/17
Moura	3,203,144	3,373,022	3,600,502	4,189,469
Newlands	3,475,060	3,148,160	3,584,223	3,788,206
GAPE	3,063,392	4,923,337	6,658,176	7,029,858
Blackwater	32,689,523	33,580,521	35,028,788	36,625,153
Goonyella	32,546,465	33,535,813	33,455,852	35,136,083

Source: SKM, based on information provided by Aurizon Network on 28 August 2013 and information provided by the Authority on 10 October 2013

Table 2.10 provides SKM's proposed AT_1 reference tariffs which are based on the adjusted maintenance costs and gtk for changes in volumes as forecast by Energy Economics.

Table 2.10 Observed AT_1 reference tariffs ($FY11-12) – volume changes

System	2013/14	2014/15	2015/16	2016/17
Moura	$2.2200	$2.0055	$2.4491	$2.4115
Newlands (excl. GAPE)	$1.9642	$1.9254	$2.3414	$2.3604
Blackwater	$1.2999	$1.3314	$1.8624	$1.9729
Goonyella	$1.0618	$1.1779	$1.7778	$1.8995
GAPE	$0.9659	$0.7809	$0.9209	$1.1854

Source: SKM, based on information provided by Aurizon Network on 28 August 2013 and 20 September 2013 and information provided by the Authority on 10 October 2013

2.2.4 AT_1 reference tariff for limited ballast undercutting scope - Scenario 3

This section provides an estimated AT_1 reference tariff for individual systems assuming:

- the scope of the ballast undercutting task is limited as per SKM's recommendation in **Table 2.3** and in the report titled *High level and detailed review of forecast maintenance costs*; and
- the volumes are assumed as equal to Aurizon Network's forecast.

Like the reduction in costs associated with reduced volumes, it has been necessary to allocate SKM's proposed ballast undercutting adjustment to individual systems for the purpose of estimating unique AT_1 reference tariffs. **Table 2.11** provides SKM's proposed adjustment to the ballast undercutting scope on and individual system basis. For the purpose of this exercise, it is assumed that there is no reduction in scope for the GAPE system, since Aurizon Network's detailed maintenance scope breakdown has been provided combining the GAPE and Newlands systems, and therefore the proportional allocation of ballast undercutting scope is unknown.

Table 2.11 Ballast undercutting reduction for individual systems

Financial year / system	2013/14	2014/15	2015/16	2016/17
Moura	$0.0	-$0.2	-$0.3	-$0.4
Newlands (excl. GAPE)	$0.0	-$0.6	-$1.0	-$1.4
GAPE	$0.0	$0.0	$0.0	$0.0
Blackwater	$0.0	-$1.7	-$3.0	-$4.3
Goonyella	$0.0	-$1.9	-$3.1	-$4.2
Total	$0.0	-$0.8	-$1.2	-$1.8

Source: SKM, based on information provided by Aurizon Network on 28 August 2013 and 20 September 2013 and information provided by the Authority on 10 October 2013

Table 2.12 provides the resulting maintenance cost estimates from which the AT_1 reference tariffs are derived.

Table 2.12 SKM's total maintenance cost allowance with limited ballast undercutting scope

Financial year / system	2013/14	2014/15	2015/16	2016/17
Moura ($m)	$10.8	$11.2	$9.4	$9.8
Newlands (excl. GAPE) ($m)	$7.7	$7.1	$6.8	$6.7
GAPE ($m)	$13.2	$15.6	$15.9	$16.2
Blackwater ($m)	$71.3	$76.7	$81.7	$79.0
Goonyella ($m)	$71.7	$74.3	$74.2	$77.0

Source: SKM, based on information provided by Aurizon Network on 28 August 2013 and 20 September 2013 and information provided by the Authority on 10 October 2013

Table 2.13 provides SKM's observed AT_1 reference tariffs in real terms, accounting for SKM's proposed adjustment to the ballast undercutting scope.

Table 2.13 Observed AT_1 reference tariffs ($FY11-12) – limited ballast undercutting scope.

System	2013/14	2014/15	2015/16	2016/17
Moura	$2.1045	$2.0360	$2.1376	$2.0452
Newlands (excl. GAPE)	$2.0424	$2.0048	$2.0746	$1.9798
Blackwater	$1.6783	$1.7167	$1.7312	$1.6485
Goonyella	$1.5662	$1.6022	$1.6491	$1.5985
GAPE	$1.5355	$1.4983	$1.5118	$1.4445

Source: SKM, based on information provided by Aurizon Network on 28 August 2013 and 20 September 2013 and information provided by the Authority on 10 October 2013

2.2.5 Limitations

In interpreting SKM's observed AT_1 reference tariffs it is recommended that the Authority should take into consideration the following limitations.

1. The derived maintenance cost curve may not reflect the maintenance cost structure of individual systems at different tonnage profiles.

Although network wide costs (costs applicable across the CQCR which cannot be directly allocated to one system) are excluded from the maintenance cost build up, SKM notes that the nature of the derived maintenance cost curve reflects the cost structure of the CQCR as a whole, rather than individual systems. This is true because the maintenance cost curves per year are derived based on observed costs compared to tonnage levels for each system. Therefore, although the derived maintenance cost curve and the observed AT_1 reference tariffs reflect a more updated cost structure; the slope of the curve (the incremental cost) reflects the change in cost for varying levels of tonnage on a network wide level, not a system wide level.

The limitations associated with this approach result primary from the complexities of delivering maintenance tasks across different systems, particularly in regards to geographic location and the constraints associated with labour availability, travel requirements and accommodation provisions. In addition, weather constraints and differing train configurations across systems will also impact the incremental cost of maintenance across systems.

Ultimately, while there are limitations associated with this approach, SKM notes that the AT_1 reference tariffs for each system for the Authority's 2001 decision have been derived in a similar manner and SKM's derived maintenance curve based on UT4 forecasts somewhat reflects recent changes in the maintenance cost environment.

2. The maintenance cost curve should extend from very low tonnages to very high tonnages and include the base tonnage, but is derived from a limited set of data points based on individual systems

In the absence of detailed estimates which outline potential maintenance costs which could be incurred for various levels of task (from very low to very high), SKM's cost curve are based on Aurizon Network's forecast maintenance costs for the individual systems each year, noting that Aurizon Network develops the maintenance cost forecast to account for the impact of changing volumes on individual systems. SKM recommends that the Authority seek to provide an update to the 2001 Working Paper which would provide a more accurate representation of the maintenance cost structure. Where possible, this should be conducted at an individual system level.

2.2.6 Benchmarking of proposed forecast incremental maintenance costs against relative industry comparators

In order to assess the applicability of SKM's observed AT_1 reference tariffs; SKM has undertaken a review of the ARTC's incremental maintenance cost. **Table 2.14** provides ARTC's estimated incremental maintenance cost and corresponding gtk for the 2009/10 financial year, which SKM has obtained through desktop research.

Table 2.14 also provides an equivalent $2011/12 rate which has been derived based on the MCI for NSW proposed by Sapere Research group (2013). This enables some comparison to the observed AT_1 reference tariffs for the CQCR which are also estimated in $2011/12 values.

Table 2.14 Incremental maintenance cost, ARTC

	$2009-10	$2011-12
Incremental maintenance cost ($'000 gtk)	$1.73	$1.85
Mgtk	18,800	

Source: ARTC (2012) and Sapere Research Group (2013)

For comparative purposes, SKM has estimated the incremental maintenance cost which might apply for Aurizon Network assuming similar levels of gtk to the HVCN in 2009/10. **Table 2.15** provides the resulting incremental maintenance cost for the three scenarios estimated by SKM.

Table 2.15 Benchmarking

Scenario	Description	Incremental Maintenance Cost
HVCN Benchmark		$1.85
CQCR Scenario 1	• Maintenance costs are equal to the forecast provided by Aurizon Network (excluding maintenance of electrical infrastructure) • Total volumes to derive the cost curve are equal to Aurizon Network's forecast gtk • Total volume to derive the incremental cost is equal to the HVCN for comparative purposes	$1.98
CQCR Scenario 2	• Maintenance costs are adjusted by SKM based on the volume forecast provided by Energy Economics • Total volumes to derive the cost curve are adjusted based on the forecast provided by Energy Economics • Total volume to derive the incremental cost is equal to the HVCN for comparative purposes	$2.19
CQCR Scenario 3	• Maintenance costs are adjusted by SKM to limit the scope of the ballast undercutting task. • Total volumes to derive the cost curve are equal to Aurizon Network's forecast gtk • Total volume to derive the incremental cost is equal to the HVCN for comparative purposes	$1.98 NB: The incremental cost is based on Aurizon Network's cost curve for the 2013/14 financial year, therefore there is no different in costs for Scenario 1 and Scenario 3, since the ballast undercutting is not limited until 2014/15.

Source: SKM, based on information provided by Aurizon Network on 28 August 2013 and 20 September 2013, information provided by the Authority on 10 October 2013, ARTC (2012) and Sapere Research Group (2013)

Table 2.15 shows that Aurizon Network's incremental cost may be higher than for the HVCN. However, SKM notes that characteristics which may affect the outcome of these results include:

- Aurizon Network's unit cost is a weighted average across each of its coal systems which vary in size and tonnage;
- pricing pressures for maintenance of the CQCR are likely to exceed those for the HVCN, largely characterised by the high price of labour associated with resources extraction projects in Queensland and the geographic constraints associated with attracting and retaining skilled labour, as well as costs associated with staff travel and accommodation;
- exposure to fines (such as from coal dust) due to the CQCR's friable coal and consequently ballast contamination requiring an increased maintenance intensity; and
- other environmental factors such as adverse inclement weather.

With these characteristics in mind, and considering there is not a significant difference in the observed incremental maintenance tariffs for the CQCR compared to the HVCN, SKM concludes that the methodology used by SKM to derive the AT_1 reference tariffs is reasonable on the basis of comparison with the HVCN. It has not been possible to directly compare Aurizon Network's proposed AT_1 reference tariffs since there is no corresponding volume on any of the systems which is close to the volumes on the HVCN.

3. Aspects of the AT_1 reference tariff raised in stakeholder submissions

The Authority also requested that SKM review and provides opinion on the issues raised by QRC, RTCA, BMA and BMC and Asciano in relation to the AT_1 reference tariff. The following provides SKM's opinion on specific issues which were raised in the submission, categorised according to the type of issue.

3.1 Transference of volume risk to users

Stakeholders indicated in submissions that Aurizon Network's proposal to transfer the AT_1 reference tariff into the revenue cap is not supported by industry since:*

- *the incremental maintenance tariff was designed to keep variable costs variable;*
- *there is insufficient evidence to suggest that variable costs would not be variable in the short run, or could not be offset by savings in later years;*
- *there is no evidence to support or justify this major change in tariff structure;*
- *industry does not support that the AT_1 reference tariff should reflect a long run variable cost;*
- *inclusion of the AT_1 reference tariff in the revenue cap eliminates the last meaningful exposure of Aurizon Network to a minimal level of volume risk[4], in an environment where maintenance costs are increasing and volumes have been consistently over-estimated in Aurizon Network's forecasts; and*
- *inclusion of the AT_1 reference tariff in the revenue cap provides an incentive for Aurizon Network to maximise forecast volumes and no incentive to maximise actual volumes.*

**Asciano, BMA and BMC, QRC, RTCA*

SKM does not support inclusion of the AT_1 reference tariff in the revenue cap for the reasons noted by stakeholders. In particular, from an engineering perspective, SKM does not support that there would be no variable costs for rail maintenance, although it is recognised that some costs for planned maintenance would be difficult to offset. However, given a significant portion of the maintenance task is undertaken by external contractors / suppliers, there should be some ability to offset maintenance which is not required from a reduction in volumes.

Further, SKM finds that risks associated with volumes should in fact be included in the WACC (as noted by Stakeholders), and therefore Aurizon Network's proposed inclusion of the AT_1 reference tariff in the revenue cap would likely result in 'double counting' of the costs of maintaining the network and would therefore not be consistent with efficient costs. However, although SKM's brief provided by the Authority has included assessing potential for double counting of costs, an analysis of pricing implications from risk transference / changes to pricing mechanisms has not been assessed, and therefore SKM is unable to comment in great detail.

3.2 Misallocation of costs between tariff components

Stakeholders expressed concerns that there has been a misallocation of costs between tariff components, which is demonstrated by a reduction in the proportion of revenue represented by the incremental maintenance tariff component.*

**Asciano*

The reduction in the proportion of revenue represented by the incremental maintenance tariff component which is observed in Aurizon Network's 2013 DAU results from a proposed increase in total maintenance costs, while

[4] Which should be reflected in the WACC

the AT_1 reference tariffs are proposed by Aurizon Network to be held consistent with the Authority's approved decision from the 2010 undertaking. SKM's review has shown that Aurizon Network's actual incremental cost during the UT4 period is likely to exceed the approved tariffs from the 2010 undertaking, and this therefore results in a reduction in the proportion of revenue represented by the AT_1 reference tariffs.

SKM has made a series of recommendations for the Authority's consideration as part of determination of the AT_1 reference tariffs for the UT4 period which are summarised in **Section 4**, which include an increase in the AT_1 reference tariffs to the levels observed by SKM.

Stakeholders indicated that they support a process whereby that incremental tariffs (AT_1 and AT_2) periodically reviewed by the Authority to ensure they are a true reflection of the costs of providing a train service.*

**Asciano*

SKM's review has shown that the incremental maintenance tariffs (the AT_1 reference tariffs) proposed by Aurizon Network for the UT4 period are unlikely to reflect the actual incremental cost of maintenance at the base tonnage, since the AT_1 reference tariffs are based on the approved rates from the 2010 undertaking and do not reflect the current environment on the CQCN. In this regard, SKM's review has shown that the incremental costs based on Aurizon Network's own maintenance cost estimates are greater than the AT_1 reference tariffs proposed. Therefore Aurizon Network's proposed AT_1 reference tariffs reduce the level of revenue risk relative to SKM's estimates. SKM has therefore made a series of recommendations for the Authority to consider as part of determination of the AT_1 reference tariffs for the UT4 period which are summarised in **Section 4**.

4. Conclusions and recommendations

SKM has developed a best fit cost curve for Aurizon Network's maintenance costs for the UT4 period based on proposed maintenance expenditure compared to forecast tonnage profiles and observed AT_1 values have been provided.

While there are some limitations noted with the approach, SKM concludes that Aurizon Network's maintenance cost curve is likely to have significantly altered since the Authority's 2001 decision and that the AT_1 reference tariffs should be updated accordingly.

Therefore, SKM has conducted an assessment to derive proposed AT_1 reference tariffs for each system per year based on the following scenarios:

- forecast maintenance expenditure and forecast gtk are assumed as equal to the forecast provided by Aurizon Network;
- the scope of ballast undercutting is limited based on SKM's recommendation that the scope should be limited subject to Aurizon Network's demonstrated acquisition of additional spoil wagons and upgrades to existing wagons; and
- actual tonnages are 10 per cent lower (on average) compared to Aurizon Network's forecast and maintenance costs account for SKM's adjusted estimates.

SKM notes that the approved AT_1 reference tariffs will be subject the Authority's recommendation of the appropriate scenario to determine the annual revenue requirement. However, SKM recommends that the approved AT_1 reference tariffs are established based on SKM's approach of escalating the cost curves with MCI and deriving the resulting incremental cost at the base tonnage each year. Conversely, the previous approach of escalating an approved AT_1 reference tariff from the first year of the undertaking period does not account for the impact on costs at different base tonnages.

Table 4.1 provides SKM's observed AT_1 reference tariffs for individual scenarios in real terms ($FY2012).

Table 4.1 Summary of AT_1 reference tariff options

Financial Year	Scenario 1	Scenario 2	Scenario 3
Moura			
2013/14	$2.1045	$2.2200	$2.1045
2014/15	$2.0467	$2.0055	$2.0360
2015/16	$2.1685	$2.4491	$2.1376
2016/17	$2.0844	$2.4115	$2.0452
Newlands (excl. GAPE)			
2013/14	$2.0424	$1.9642	$2.0424
2014/15	$2.0146	$1.9254	$2.0048
2015/16	$2.1026	$2.3414	$2.0746
2016/17	$2.0150	$2.3604	$1.9798
Blackwater			
2013/14	$1.6783	$1.2999	$1.6783
2014/15	$1.7192	$1.3314	$1.7167
2015/16	$1.7436	$1.8624	$1.7312
2016/17	$1.6634	$1.9729	$1.6485
Goonyella			
2013/14	$1.5662	$1.0618	$1.5662
2014/15	$1.6018	$1.1779	$1.6022
2015/16	$1.6578	$1.7778	$1.6491

Financial Year	Scenario 1	Scenario 2	Scenario 3
2016/17	$1.6103	$1.8995	$1.5985
GAPE			
2013/14	$1.5355	$0.9659	$1.5355
2014/15	$1.4953	$0.7809	$1.4983
2015/16	$1.5142	$0.9209	$1.5118
2016/17	$1.4468	$1.1854	$1.4445

Source: SKM, based on information provided by Aurizon Network on 28 August 2013 and 20 September 2013 and information provided by the Authority on 10 October 2013

4.1 Suggested further study

SKM recommends that the Authority seek to commission an update to the analysis conducted in 2001 (*Working Paper 2: Usage-related infrastructure maintenance costs in railways*) to address the limitations outlined in **Section 2.2.2** of this report and therefore providing a more accurate estimation of incremental costs for the CQCR. Specifically, it is recommended that an update would consider maintenance costs for various tonnage profiles (from very low to very high tonnages) on an individual system basis.

Appendix A. Information sources

A.1 Provided documentation

This review is based on information sourced from documents as shown in **Table 2.1** and **Table 2.2** below.

Table 2.1: Information sources – task specific

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
The Authority		Working Paper 2: Usage-related infrastructure maintenance costs in railways	Working Paper 2	PDF	December 2000
The Authority	Report for QR Network Access Undertaking	Assessment of Operating and Maintenance Costs for UT3	R-2009DAU-GHD-AssessOpMaint-1209	PDF	September 2009
Aurizon Network	UT4 Explanatory Materials, Annexures of Volume 4	*Benchmark Heavy Haul Line – International and National Comparison*' report developed by Worley Parsons (2008)	Annex V (Confidential) Worley Parsons – Benchmark Heavy Haul	PDF	Version D – Final Issue, 16 August 2008
Aurizon Network	Volume 1 of 3 – The Access Undertaking and Schedules	Schedule E – Regulatory Asset Base	R-Aurizon-QR2013DAU-Vol1-0513	PDF	April 2013
Aurizon Network	Volume 4 of 4 – UT4 Explanatory Materials	UT4 Maintenance Submission	R-Aurizon-QR2013DAU-ExMatMaint-0513	PDF	Confidential Version 30 April 2013
IPART		RailCorp compliance with NSW Rail Access Undertaking for the 2010-11 year – Final report to IPART	Consultant_Report_-_Final_Report_-_Sapere_Research_Group_--July_2013[1].pdf	PDF	Final 8 July 2013
Australian Rail Track Corporation		2010-11 SUBMISSION (amended April 2012) to the Independent Pricing and Regulatory Tribunal in respect of Hunter Valley Regulatory Network Roll Forward Asset Base Ceiling Test Unders and Overs Account	Proposal_-_ARTC_-Hunter_Valley_Regulatory_Network_-_November_2011[1].pdf	PDF	April 2012

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
The Authority (prepared by Energy Economics)		Central Queensland Coal Railings Forecast (Confidential Version)	2013-07-31 Queensland railings UT4 main – CONFIDENTIAL (598613_1).PDF	PDF	July 2013
Asciano	-	Submission to the Queensland Competition Authority in Relation to the 2013 Aurizon Network Draft Access Undertaking	R-Asciano-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	October 2013
BMA and BMC	-	Issues and Concerns with Aurizon Network's (AN's) 2013 Draft Amending Undertaking (DAU)	R-BMABMC-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	10 October 2013
QRC	-	QRC UT4 Submission on Maintenance	R-QRC-Submission-Pricing-AurizonNetwork2013DAAU-Att04-1013.pdf	PDF	10 October 2013
QRC	-	QRC Submission – Main Submission	R-QRC-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	10 October 2013
RTCA	-	Submission to the Queensland Competition Authority in response to Aurizon Network proposed 2013 draft access undertaking (UT4)	R-RTCA-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	10 October 2013

Table 2.2: Information sources – general

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
The Authority		Terms of Reference, Engineering Technical Assessment of Maintenance, Operating and Capital Expenditure Forecast	QCA Terms of Reference_UT4 Engineer(565631_4)	PDF	27 June 2013
Aurizon Network	Volume 1 of 4 – UT4 Explanatory Materials	Overview and Summary	R-Aurizon-QR2013DAU-ExMatOvr-0513	PDF	30 April 2013
Aurizon Network	Volume 2 of 4 – UT4 Explanatory Materials	The 2013 Undertaking Proposal	R-Aurizon-QR2013DAU-ExMatSub-0513	PDF	30 April 2013
Aurizon Network	Volume 3 of 4 – UT4 Explanatory Materials	Maximum Allowable Revenue and Reference Tariffs	R-Aurizon-QR2013DAU-ExMatBB-0513	PDF	30 April 2013

A.2 Requests for Information

The following information was provided by Aurizon Network in response to RFIs issued by SKM.

Owner	Document Name	Electronic File Name	Document Type	Relevant RFI
Aurizon Network	SKM Request for Information (RFI No. AUR-013) Review of AT1 Reference Tariff Aurizon Network Response	RFI AUR-013 – Aurizon Response (2) 130828	Microsoft Word, received via email on 28 August 2013	RFI AUR-013: Information review requirements – Data requirements and confirmation of information for review of the AT_1 reference tariff
Aurizon Network	Costs associated with maintenance of electrical infrastructure	-	Provided via email by Michael Bray on 20 September 2013	RFI AUR-013: Information review requirements – Data requirements and confirmation of information for review of the AT_1 reference tariff

Attachment C: Benchmarking of specific aspects of the operating expenditure forecast

Contents

1. Glossary

Abbreviations and definitions used in this document are listed in **Table 1.1**.

Table 1.1: Abbreviations and Terminology

Abbreviation, Acronyms and Terminology	Description / Definition
AC	Alternating Current
ARTC	Australian Rail Track Corporation
Aurizon Network	On 3 December 2012, QR Network Pty Ltd changed its name to Aurizon Network Pty Ltd.
BMA and BMC	BHP Billiton Mitsubishi Alliance and BHP Billiton Mitsui Coal
CQCN	Central Queensland coal network
CQCR	Central Queensland coal region
DAU	Draft Access Undertaking (i.e. UT4)
DC	Direct Current
DCF	Discounted Cash Flow
EC	Electric energy component
EVP Network	Executive Vice President Network
FTE	Full time equivalent
GAPE	Goonyella to Abbot Point system
HVCN	Hunter Valley Coal Network
MAR	Maximum Allowable Revenue
mt	Million tonnes
MWh	Mega Watt hours
NAMS	Network Asset Management System
QRC	Queensland Resources Council
RTCA	Rio Tinto Coal Australia
SKM	Sinclair Knight Merz
The Authority	Queensland Competition Authority
tp	Train paths
UT3	2010 Access Undertaking (2009/10 – 2012/13)
UT4	2013 Access Undertaking (2013/14 to 2016/17)
UT5	2017/18 -2020/21 Access Undertaking
WIRP	Wiggins Island Rail Project

2. Benchmarking of specific aspects of the operating expenditure forecast

2.1 Task description and methodology

Aurizon Network's proposed Maximum Allowable Revenue (MAR) for the UT4 period includes an allowance for recovery of operating costs which reflect the efficient standalone costs of operating the below rail coal network (the Central Queensland Coal Region (CQCR)). The total proposed allowance for the CQCR includes:

- system wide and regional costs (which includes the cost of operating the network and an allowance for corporate costs);
- risk and insurance (which Aurizon Network has developed consistent with the methodology applied in UT3);
- transmission connection costs;
- electricity on selling costs; and
- working capital.

SKM has been engaged by the Queensland Competition Authority (the Authority) to conduct a review of specific aspects of the operating expenditure forecast, including benchmarking against relevant below rail coal operators and benchmarking against Aurizon Network's historical actual expenditure.

The Authority has engaged SKM to conduct a review of system wide and regional operating costs, exclusive of corporate overheads. Specifically, the Authority requested that SKM provide an assessment of the reasonableness of the following sections of Chapter 10 of Volume 3 of UT4:

- train control, safeworking and operations (section 10.2.3.2) and associated costs (table 75 of section 10.2.5.3); and
- infrastructure management (section 10.2.3.3) and associated costs (table 75 of section 10.2.5.3).

As part of the review, the brief requires that SKM:

- identify whether reasonable steps have been taken in balancing service and cost and identifying the appropriate level of service for the optimised network;
- explain the reasons for any differences identified between historical and operating costs, and costs of the benchmark operator; and
- determine a forecast for reasonable operating costs for the 2017/18 financial year.

SKM has also provided specialist opinion on the reasonableness of derailments and dewirements insurance in an accompanying report (*Specialist Opinion on Specific Aspects of the Operating Expenditure Forecast*).

2.1.1 Adequacy of information provided and general comments

Aurizon Network has provided detailed historical operating expenditure for the financial years 2009/10, 2010/11, 2011/12 and 2012/13 (the UT3 period). Historical actual operating expenditure has been provided in nominal dollars, while forecast operating expenditure has been provided in financial year 2012/13 dollars.

It should be noted that costs provided within this report do not reflect the totals presented in Table 75 within Chapter 10 of Volume 3 of UT4 explanatory materials submission, since the costs in this report are presented in real terms in order to asses Aurizon Network's relative operating efficiency each year. In addition, SKM's review excludes corporate overheads.

SKM also requested that Aurizon Network provide detailed information on the cost of succession planning for train control staff during the UT4 period; however this information was not provided by Aurizon Network in a timely manner and was therefore not considered as part of this review. SKM has therefore assumed that the full cost increase for train control, safeworking and operations during the UT4 period relative to financial year 2012/13 represents the cost of succession planning, and adjustments have been made accordingly for the 2017/18 forecast.

SKM also requested that Aurizon Network provide the value of expensed project costs (safeworking costs) during the UT4 period so that these could be removed from the allowable expenditure. This information has not been provided. SKM's report therefore still includes a recommendation that the Authority obtain this information and remove these costs from the allowable operating expenditure.

Appendix A provides further detail on information sources utilised for this review.

2.1.2 Background to this report

SKM submitted a draft review to the Authority on the reasonableness of Aurizon Network's proposed system wide and regional operating expenditure on 8 October 2013. This report provides an update to the draft report previously submitted. The contributing factors which have necessitated an update to the report are outlined below.

In-accurate historical operating cost estimates and cost escalation

Subsequent to SKM's submission of the draft version of this report, Aurizon Network advised the Authority that the historical operating cost expenditure for the UT3 period which was provided by Aurizon Network to SKM for the purpose of this review was inaccurate. The Authority has therefore requested that SKM provide an updated report which reflects the accurate historical costs.

In addition, SKM has received information that the price years assumed for the previous analysis were also inaccurate. This report has therefore been developed based on the following assumptions which have been confirmed with Aurizon Network:

- historical cost estimates provided by Aurizon Network are in nominal dollars and have been escalated to a base year of 2012/13 utilising historical actuals for the consumer price index[1]; and
- forecast expenditure provided by Aurizon Network for the UT4 period is in real financial year 2012/13 dollars.

Table 2.1 provides historical operating costs which have been utilised in this review.

Table 2.1 Historical operating expenditure

System	Nominal				Real ($2012/13)			
	2010	2011	2012	2013	2010	2011	2012	2013
Blackwater	$21.4	$18.7	$21.2	$18.1	$22.8	$19.3	$21.7	$18.1
Goonyella	$34.1	$30.7	$29.2	$27.8	$36.4	$31.6	$29.8	$27.8
Newlands (incl. GAPE)	$5.4	$4.7	$4.5	$4.6	$5.7	$4.8	$4.6	$4.6
Moura	$3.6	$3.0	$4.1	$3.0	$3.9	$3.1	$4.2	$3.0
Total	$64.4	$57.2	$59.1	$53.6	$68.8	$58.8	$60.2	$53.6

Source: Aurizon Network, provided on 4 November 2013

[1] ABS (2013) Index Numbers, All groups CPI; Brisbane, series A2325816R

Revised volumes

The Authority has also requested that SKM provide an assessment of the reasonableness of Aurizon Network's forecast operating expenditure in the context of volume forecasts provided to the Authority by Energy Economics in July 2013. **Table 2.2** outlines the volume forecast provided by Energy Economics (mtpa) compared to Aurizon Network's forecast.

Table 2.2 Revised volume forecast

System	Energy Economics				Aurizon Network			
	2014	2015	2016	2017	2014	2015	2016	2017
Blackwater	59.0	60.2	62.3	65.3	54.4	60.9	67.4	73.4
Goonyella	97.0	100.2	100.1	105.1	97.3	106.4	112.0	116.9
Moura	11.7	12.0	12.8	14.9	12.5	13.6	13.0	14.1
Newlands	15.8	14.6	16.9	17.9	14.8	15.8	17.0	18.7
GAPE	7.1	11.4	15.5	16.5	20.6	25.4	27.1	29.0
Newlands + GAPE	22.9	26.0	32.4	34.4	35.4	41.2	44.1	47.7
Total	190.6	198.3	207.6	219.7	199.6	222.2	236.5	252.1

Source: Energy Economics (July 2013) provided by the Authority on 10 October 2013

2.1.3 Benchmarking

SKM has sourced forecast operating expenditure for the Hunter Valley Coal Network (HVCN), including network control costs and asset management costs which are benchmarked against Aurizon Network's forecast train control, safeworking and operations expenditure and Aurizon Network's forecast infrastructure management expenditure.

CQCR Forecast Expenditure	HVCN Comparable Estimate
Train control, safeworking and operations	Network control
Infrastructure management	Asset management

Benchmark estimates were sourced from the Australian Rail Track Corporation (ARTC) forecast for the 10 year period between 2010 and 2020. For consistency, as this analysis covers an 8 year period (Aurizon Network's historical UT3 and proposed UT4 periods), SKM has considered the ARTC's forecast costs between 2010 and 2017 only, noting that the ARTC's reporting period for the HVCN is based on calendar years rather than fiscal years. The reporting period is not expected to result in significant differences in the overall cost of operations compared to the CQCR, especially the unit cost per train path.

SKM has made adjustments to the ARTC's forecast expenditure to a base year of 2011/12 (the ARTC's estimates have been escalated each year with the consumer price index). Train paths for the HVCN have been estimated at 44,000 per year, based on historical information from the ARTC that the HVCN runs approximately 22,000 loaded trains per year. SKM notes the limitations associated with this approach since train paths are likely to grow in the HVCN between 2010 and 2020, and this is reflected in increasing real operating costs. Therefore the cost per train path for the HVCN appears to be increasing each year. However, this is not necessarily correct since total train paths are unlikely to remain stable. Therefore, SKM recommends that costs are viewed 'on average' over the period compared to Aurizon Network's forecast expenditure.

SKM notes that benchmarking is a useful exercise to assess the relative efficiency of Aurizon Network's operations compared to similar operators. However, it is noted that there are significant differences in the operating environment which are likely to impact on costs of operations for the CQCR. These include and are not limited to:

- commodity transported;

- haul distance;
- type and mix of traffic;
- traffic density;
- system complexity;
- train control systems used; and
- rail electrification.

The benchmarking exercise should therefore be viewed as indicative of relative efficiency when considering the relative operating expenditure.

SKM has been unable to obtain benchmark estimates for savings associated with regenerative braking. We have therefore provided an assessment of Aurizon Network's UT4 proposal based on engineering specialist opinion.

2.2 Statements around UT4 operating expenditure forecast

Table 2.3 provides an overview of key statements in Aurizon Network's proposed UT4 operating expenditure forecast which SKM considers are relevant to be addressed as part of this review.

Table 2.3 Aurizon Network's statements around UT4 operating expenditure

UT4 supporting information (Aurizon Network)	SKM assessment of reasonableness
Aurizon Network states that operating expenditure forecasts reflect diminishing economies of scale as a result of separation of QR National (including the coal network) and Queensland Rail, which has resulted in the establishment of below rail functions which were previously shared.	SKM finds that this statement is reasonable to a certain extent, but that as the organisation matures efficiencies of operations should be observable.
Aurizon Network states that the CQCR environment remains capacity constrained, however every endeavour to meet customer requirements and facilitate railings of coal tonnages is made. The growth in demand, the expansion and development of new port terminals and the increasing integration of the coal systems has continued to see a material increase in network complexity and the demand on resources. Notably, many mines have (or will have) more than one choice of port. As a result, Aurizon Network indicates that the operational modelling that applies now is fundamentally different to the operational models considered in previous assessments of benchmarking efficient below rail costs. Thus, the below rail network system wide and regional costs prior to the separation and listing of the business in the second half of 2010 are not considered by Aurizon Network to be an appropriate benchmark for UT4 operating expenses.	SKM has undertaken the review of Aurizon Network's forecast operating expenditure including benchmarking based on historical costs from the 2009/10 financial year. SKM recognises that these costs do not necessarily reflect existing operating conditions; however the majority of historical costs assessed refer to the UT3 period after separation. Therefore, Aurizon Network's trends in operating efficiency should be observable over time. With regards to the complexities of the operating environment, SKM finds that some increase in costs is to be expected with increased coal tonnages. However, significant increases should only be observed in the context of related increases in tonnage. Aurizon Network's unit cost of operations (dollars per train path) is therefore expected to decline due to increasing economies of scale during the UT4 period, since the forecasts reflect the revised operating environment for the four financial years during the UT4 period and increased tonnages (and therefore train paths) during UT4 are not sufficient to severely constrain the network.

Source: Chapter 10 of Volume 3 of the DAU for the UT4 period

2.3 Total operating costs (excluding corporate overheads)

2.3.1 Historical and forecast operating expenditure – regional and individual systems

Figure 1 provides Aurizon Network's historical total operating expenditure[2] for the CQCR, compared to forecast operating expenditure for the UT4 period. Data is provided in total absolute dollars and dollars per train path and includes:

- train control, safeworking and operations;
- other systems costs (utilities costs);
- infrastructure management;
- EVP Network;
- business management;
- regulation and policy; and
- commercial development.

[2] Adjusted by SKM to reflect a price year of 2012/13

Figure 1 shows that the average total cost is forecast by Aurizon Network to decline during the UT4 period compared UT3 actuals. The unit cost of operations (dollars per train path) is also forecast by Aurizon Network to decline relative to the UT3 period, and is declining for each year of the UT4 period. This indicates that operations are becoming more efficient even with a forecast increase in traffic on the network.

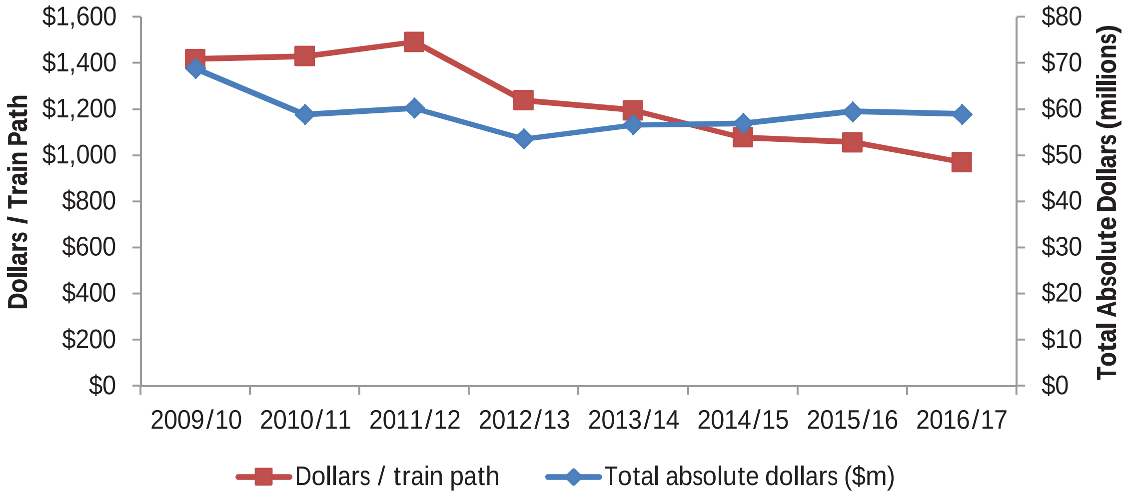


Figure 1 Historical and forecast total operating expenditure – absolute dollars and dollars / train path (CQCR)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013

Figure 2 charts the total historical and forecast train paths for the region (including the total per system as well as cross system train paths), which indicates that total train paths per year are forecast by Aurizon Network to increase from an average of 43,445 train paths per year in the UT3 period to an average of 54,288 per year during the UT4 period. By 2016/17, total forecast train paths are expected to reach 60,676 for the year, representing an increase of 40 per cent compared to actual train paths in 2012/13.

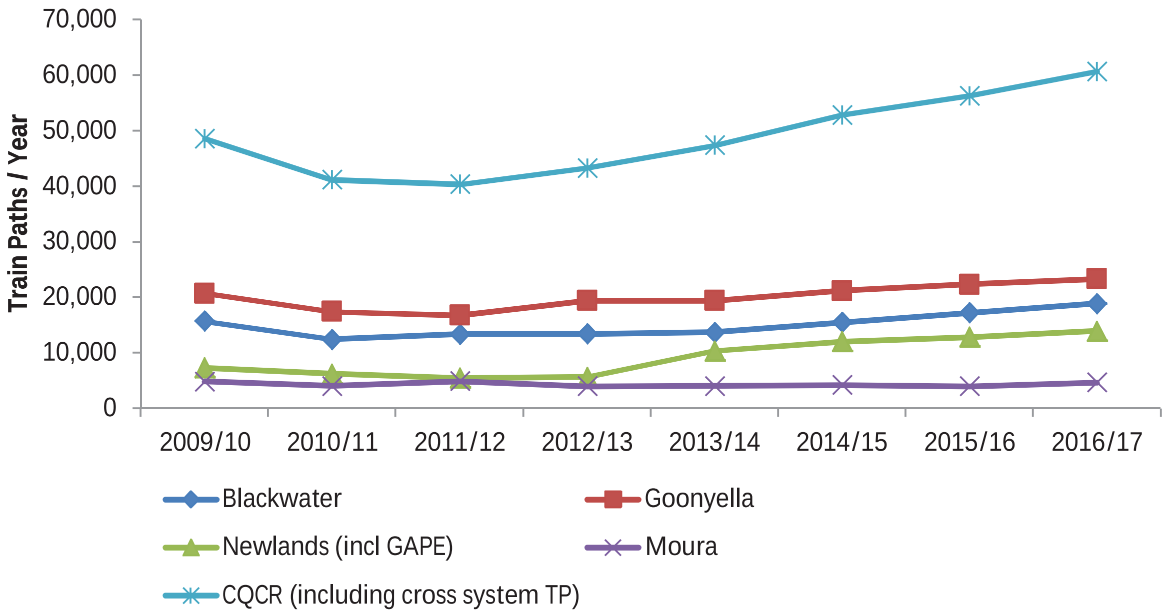


Figure 2 Historical and forecast train paths per year (CQCR and individual systems)

Source: SKM graph based on information provided by Aurizon Network on 25 September 2013

Figure 3 charts the growth in total operating expenditure per year compared to the total growth in train paths, which indicates that prior to the 2013/14 financial year[3]; there is no observed relationship between increases in total operating expenditure in line with an increase in train paths. For example, during the 2012/13 financial year, total operating expenditure is forecast to decline while train paths are increasing. During the UT4 period, total operating expenditure tends to increase with train paths, although at a lower rate, which is reflected in the improving unit cost shown in **Figure 1**. By 2016/17, Aurizon Network forecasts that total operating expenditure will actually decline relative to 2015/16, although train paths are increasing. The saving in the 2016/17 financial year forecast by Aurizon Network occurs from a reduction in regulation and policy expenditure relative to 2015/16 (see **Table 2.4**), which occurs because Aurizon Network intends to undertake the bulk of development of the UT5 submission in the 2015/16 financial year.

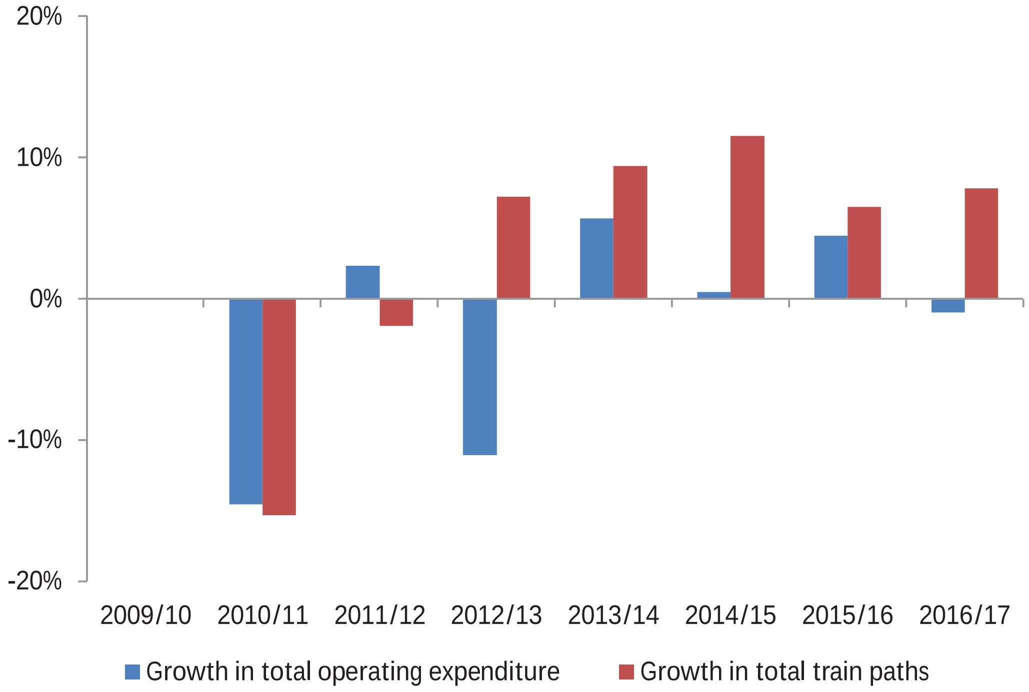


Figure 3 Growth in total operating expenditure compared to growth in train paths

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013

[3] Except for the 2010/11 financial year

Figure 4 charts Aurizon Network's historical[4] and forecast total operating expenditure on an individual system basis. Similarly to total cost for the CQCR, total costs for the Blackwater and Goonyella systems are forecast to decline on average compared to the historical average during the UT3 period. The Newlands (including GAPE) system is forecast to increase relative to historical actuals in the UT3 period. This increase in the costs for Newlands is due to increasing volumes (and train paths) for the GAPE system as the system matures, which require more intensive operations and therefore a greater proportion of operating costs is allocated to this system. The forecast average total cost for the Moura system during the UT4 period is equal to the UT3 period.

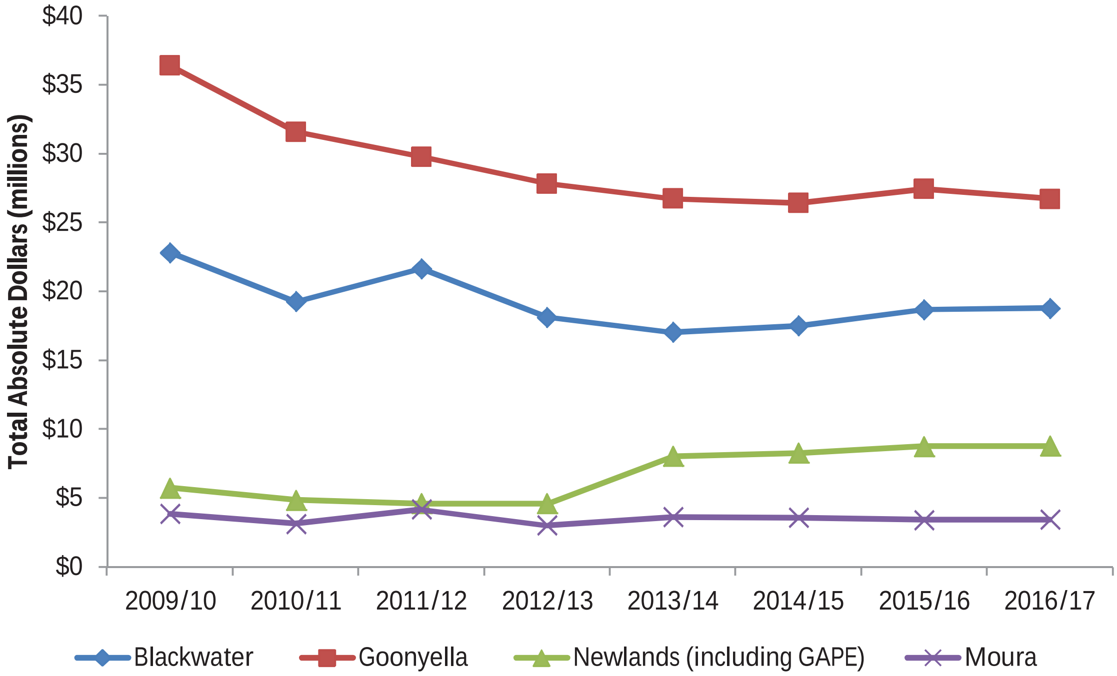


Figure 4 Historical and forecast total operating expenditure – absolute dollars (systems)

Source: Aurizon Network, provided on 4 November 2013

[4] Adjusted by SKM to reflect a price year of 2012/13.

The average cost per year measured as dollars per train path (**Figure 5**) is forecast to decline for all systems during the UT4 period. The exception is the 2015/16 for the Moura system, which shows an increase in the unit cost compared to the previous year. However the change is not significant, increasing by only 50 cents per train path and is due to a slight decline in train paths in this year which would not be expected to significantly offset total operating costs.

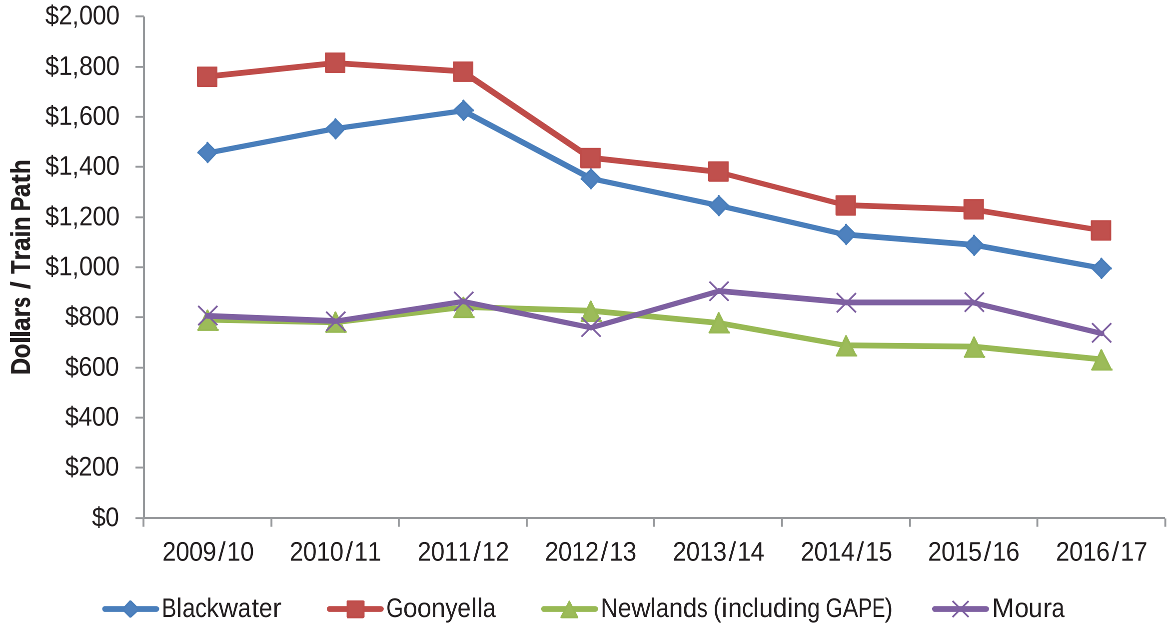


Figure 5 Historical and forecast total operating cost - dollars per train path (systems)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013

2.3.2 Composition of total operating expenditure

Figure 6 shows the composition of total operating expenditure over time, which is useful in assessing underlying cost drivers for total operational expenditure.

The data shows that Aurizon Network forecasts that the following operations tasks are becoming increasingly important as a proportion of total operating expenditure:

- train control, safeworking and operations (increasing from an average of 46 per cent of total operations expenditure in the UT3 period to 51 per cent in the UT4 period);
- other system / utilities costs (increasing from an average of 1 per cent of total operations expenditure in the UT3 period to 2 per cent in the UT4 period); and
- commercial development costs (increasing from an average of 10 per cent of total operations expenditure in the UT3 period to 13 per cent in the UT4 period).

Conversely, infrastructure management costs and EVP Network costs are forecast by Aurizon Network to become less important as a proportion of total expenditure, while business management costs and regulation and policy costs remain relatively stable as a proportion of total expenditure.

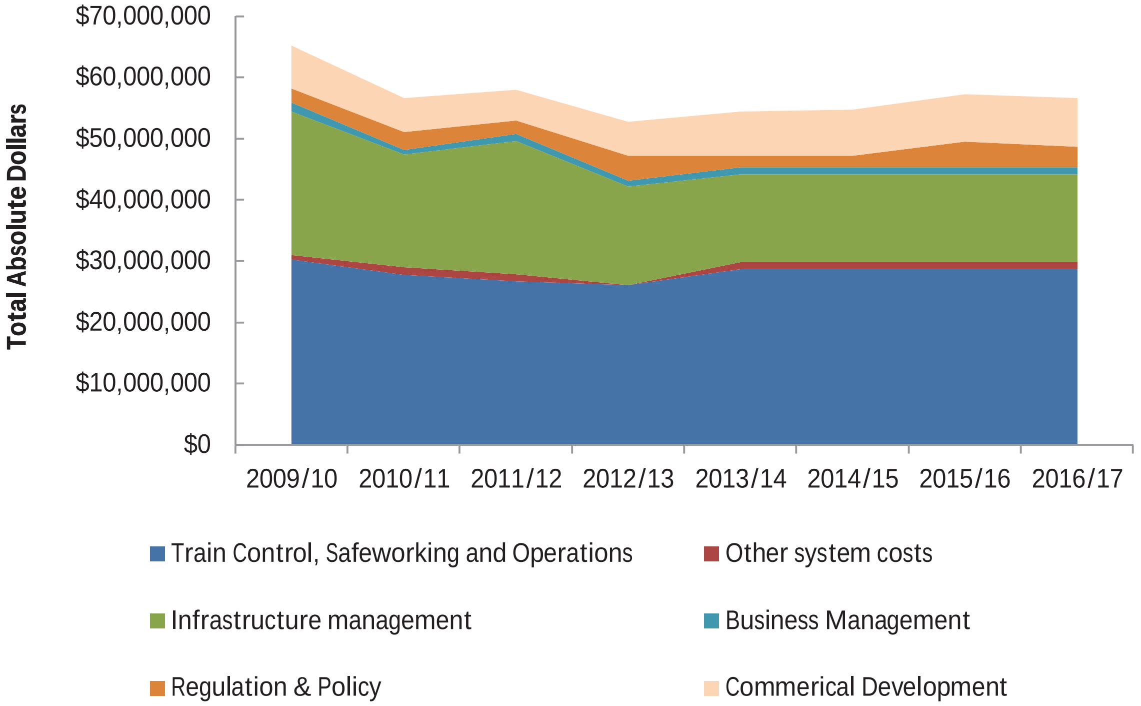


Figure 6 Composition of total operating expenditure – total absolute dollars

Source: Aurizon Network, provided on 4 November 2013

Given that costs are presented in real terms (financial year 2012/13), it is appropriate to conduct an assessment of Aurizon Network's forecast to determine what types of costs are varying over the period, compared to SKM's opinion on costs which would reasonably vary with changes in task. This analysis is provided in **Table 2.4** overleaf.

Table 2.4 depicts Aurizon Network's forecast operating expenditure (in millions of dollars). Analysis of the data in **Table 2.4** reveals that in real terms, most of the cost categories are expected by Aurizon Network to remain stable each year over the UT4 period. Compared to the UT3 period, train control, safeworking and operations is forecast by Aurizon Network to increase in total absolute dollars, as are other system costs and commercial development costs. However, overall the total operating expenditure declines on average, due to savings in infrastructure management costs and EVP Network costs.

Table 2.4 Reasonableness of components of Aurizon Network's forecast operating expenditure (millions)

Operating cost (excl. corporate overhead)	UT3 average (average actual expenditure over four years)	UT4 average (average forecast expenditure over four years)	Aurizon Network Forecast				SKM's assessment of reasonableness
			2014	2015	2016	2017	
Train control, safeworking and operations	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Train control, safeworking and operations costs would be expected to increase with increased train paths, and the magnitude of costs presented are reasonable since the growth in expenditure is less than the growth in train paths for the UT4 period. It is also noted that part of this cost increase represents costs incurred for succession planning and labour intensive safeworking during capital works therefore not all of the increase during the UT4 period is due to increased train paths. SKM's detailed assessment of the reasonableness of train control, safeworking and operations is provided in **Section 2.4.1**.
Other system costs (utilities costs)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Utilities costs would be expected to remain consistent regardless of growth in train paths, and this is observed in the UT4 forecasts each year. However, SKM notes that total costs increase relative to the UT3 period, which is due to for which SKM has been unable to determine a justification upon reviewing Aurizon Network's DAU for the UT4 period. SKM therefore finds that forecast utilities costs should be adjusted downwards to reflect the average for the UT3 period ($0.8 million per year).
Infrastructure management	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SKM expects that infrastructure management costs would be affected by growth in volumes and increasing network complexities although not significantly. However, a review of the historical UT3 actuals indicates that Aurizon Network has incorporated expected savings into the UT4 forecast, with the average total cost declining in the UT4 period relative to the UT3 period. This is likely due to savings associated with recent organisational restructures including a review of staff numbers. **Section 2.4.2** provides a more detailed assessment of forecast infrastructure management costs.
EVP Network	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Aurizon Network has included 50% of the EVP Network costs based on a reasonable assessment that the EVP Network time and costs are shared between the Operations and Commercial areas, and Engineering & Project Delivery (E&PD) and Specialised Track Services (STS). SKM finds that costs are commensurate with our knowledge of salaries and expenses associated with this role.

Business management	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SKM expects that business management costs would remain stable even with growth in train paths. Therefore given the forecast appears to have been determined based on UT3 actuals of $1.1 million per year SKM finds that this estimate is reasonable.
Regulation & policy	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Aurizon Network is subject to over 43 pieces of legislation, including Commonwealth and State regulatory requirements and compliance. Therefore it is expected that the cost of Regulation and Policy compliance would be material, but would remain stable for the duration of the UT4 period. However, SKM notes that increased costs for the 2015/16 and 2016/17 financial year is results from development of regulatory submissions for the following access undertaking period (UT5). SKM notes that Aurizon Network intends to undertake the bulk of development of the UT5 submission during the 2015/16 financial year, and this is reflected by greater costs than other years. SKM also notes that that the average for the UT4 period does not exceed the average for the UT3 period and in fact the total forecast cost is slightly lower ($11.45 million compared to $11.55 million). SKM therefore finds that no adjustments to the regulation and policy forecast are required. In addition to the costs noted here, Aurizon Network's cost forecasts for infrastructure management also include costs associated with regulatory compliance with the Coal Dust Management Plan and changes to Queensland Workplace Health and Safety Laws. SKM recommends that the Authority seeks to confirm that these costs are appropriately accounted for in the Regulation and Policy forecast.
Commercial development	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Commercial management costs are expected to increase slightly as access requests and negotiations increase with train paths. However, SKM would not expect the unit cost would increase on average. SKM finds that the unit costs have increased in the UT4 forecast compared to the UT3 actuals (see **Figure 7** below). SKM therefore proposes an adjustment to commercial development costs which is outlined in **Table 2.5**).

Source: Aurizon Network, provided on 4 November 2013

At this initial review, SKM finds that the forecast total costs for the CQCR during the UT4 are mostly reasonable since they reflect increased economies of scale through:

- declining costs for the 2013/14 period relative to the UT3 period;
- growth in total costs per year which is lower than growth in forecast train paths; and
- consistent cost estimates per year for categories which SKM would expect to remain stable or decline as the organisation matures.

However, SKM recommends that adjustments should be made to the forecast commercial development expenditure, since although costs might be expected to increase with train paths; SKM does not consider that the unit cost should worsen on average. **Figure 7** provides the unit cost of commercial development expressed as dollars per train path in real 2012/13 financial year dollars, which shows that the spike in costs in the 2013/14 financial year and overall during the UT4 period results in an average unit cost for the UT4 period which exceeds the UT3 period (the average unit cost in the UT3 period is $133.2 compared to $140.8 in the UT4 period).

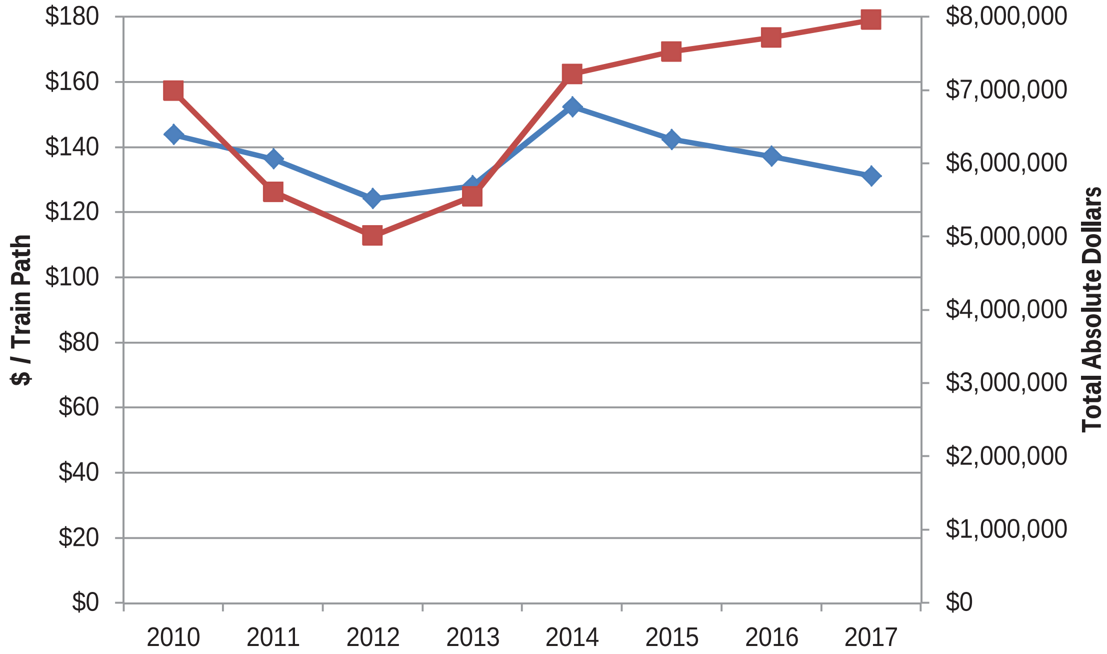


Figure 7 Commercial development costs - total absolute dollars and dollars per train path

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013

SKM therefore recommends that total commercial development expenditure is adjusted downwards to reflect the unit cost in the UT3 period. SKM has provided a recommended adjustment in **Table 2.5**.

Table 2.5 SKM's proposed total allowance for commercial development expenditure

Financial year	2014	2015	2016	2017	Total
Aurizon Network proposed expenditure	$7,221,954.6	$7,525,923.1	$7,721,272.4	$7,961,633.4	$30,430,783.4
Aurizon Network forecast train paths	47,372	52,832	56,272	60,676	217,152
SKM proposed allowable commercial development expenditure	$6,309,043.4	$7,036,210.9	$7,494,353.0	$8,080,881.5	$28,920,488.7

Source: SKM adjustment based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013

Table 2.6 provides SKM's proposed allocation of total allowable commercial development expenditure to individual systems, which is based on Aurizon Network's allocation.

Table 2.6 SKM's proposed allocation of allowable commercial development expenditure to individual systems

System	2014	2015	2016	2017
Blackwater	$1,689,141.70	$1,909,277.14	$2,118,289.48	$2,333,846.42
Goonyella	$3,081,129.23	$3,390,390.24	$3,568,711.21	$3,766,425.13
Newlands (incl. GAPE)	$1,144,605.24	$1,305,547.24	$1,396,506.95	$1,529,305.40
Moura	$394,167.22	$430,996.23	$410,845.35	$451,304.52

Source: SKM adjustment based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013

SKM's assessment of reasonableness for the total operating expenditure forecast is also subject to:

- confirmation of costs allocated to regulation and policy to ensure no double counting has occurred; and
- the detailed review of train control, safeworking and operations costs and infrastructure management costs in **Section 2.4**.

2.4 Specific aspects of operating expenditure forecast

2.4.1 Train control, safeworking and operations

Aurizon Network operates a Network Control Centre that manages the daily movements of more than 70 trains across a 2,300 kilometre network. Network Control as part of below rail coal operations includes train control, safeworking and operations and in general, costs would be expected to increase with increased tonnages and train paths.

SKM appreciates this is a resource intensive activity, and costs are expected to increase with the development of Goonyella to Abbot Point Expansion Project and Wiggins Island Rail Project (WIRP) and with increased train paths more generally across the CQCR. These increases occur as more control boards are added to control traffic growth. Safeworking costs are also expected to increase with increased traffic and activities in the yards.

With regards to operational planning, SKM believes these costs would be expected to increase in line with complexities associated with growth in volumes and the integration between systems (cross system train paths). These demands are expected to continue to rise with continued volume growth and the commissioning of new port terminals.

Figure 8 provides Aurizon Network's historical actual train control, safeworking and operations expenditure for the CQCR during the UT3 period, compared to forecast train control, safeworking and operations expenditure for the UT4 period. Data is provided in total absolute dollars and dollars per train path.

On a regional level, the total expenditure for train control, safeworking and operations is forecast to increase on average compared to historical levels observed for the UT3 period, although the forecast expenditure remains stable each year of the UT4 period. Given that Aurizon Network's DAU for the UT4 period indicates savings in train control associated with consolidation of Mackay and Rockhampton train control centres, SKM finds that this increase in costs is attributable to succession planning and associated training for new train controllers during the UT4 period. SKM requested that Aurizon Network indicate the exact value of training / succession planning costs in the UT4 operating expenditure forecast but this information was not provided. Therefore, SKM has been unable to verify this finding.

Despite the increase in total expenditure, the unit rate is declining which indicates that the increase is efficient compared to the growth in train paths. Improvements in Aurizon Network's operating efficiency as the organisation matures are also evident given the unit cost was increasing during the early years of the UT3 period, before trending downwards.

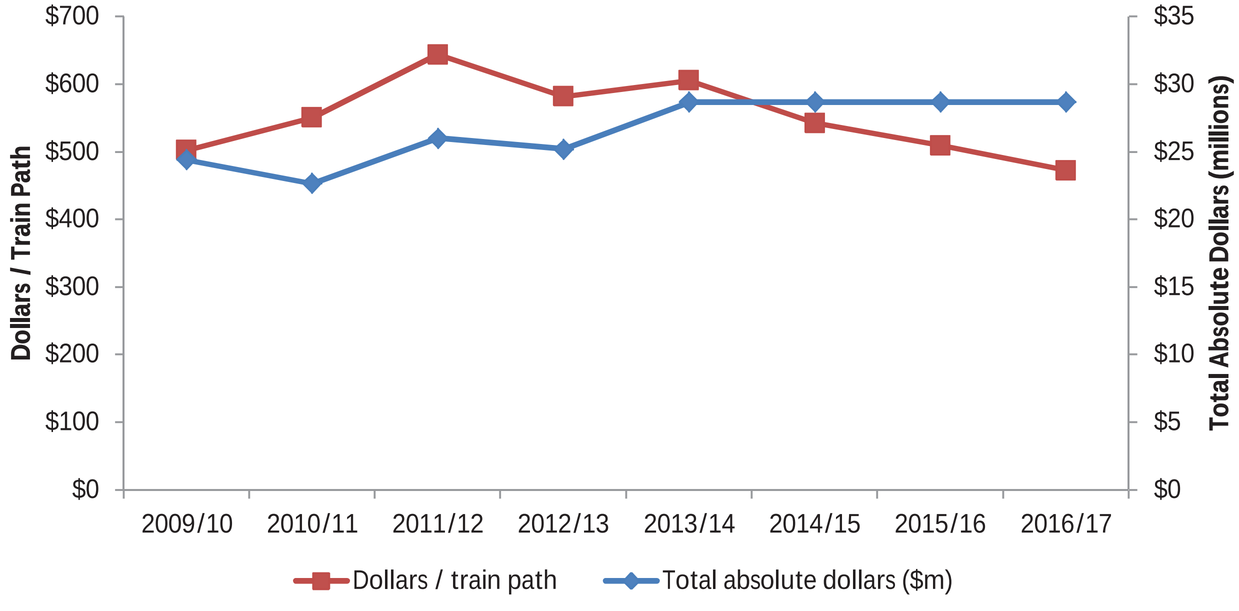


Figure 8 Historical and forecast train control, safeworking and operations (CQCR)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013

Figure 9 provides Aurizon Network's historical actual train control, safeworking and operations expenditure for the UT3 period on an individual system basis, compared to forecast expenditure for the UT4 period. The data indicates increasing costs for all systems on average compared to the UT3 period.

SKM recognises that the forecast increase in total costs for the Newlands system is due to a larger allocation of total operating costs for the Newlands system associated with construction of the GAPE system in 2011/12. The increase in operating expenditure for the Newlands system including GAPE is not immediately observed, as 2011/12 and 2012/13 experienced much lower volumes on the GAPE system compared to forecast volumes for the UT4 period.

The Moura system is also forecast by Aurizon Network to have increasing costs on average, although the difference is not significant, increasing from $1.4 million on average during the UT3 period to $1.8 million during the UT4 period. Overall, forecast train control, safeworking and operations expenditure is the lowest for Moura system, which is expected given the size of the system relative to other systems.

The increase in average costs for the Blackwater system is relatively insignificant, increasing by approximately $300,000 between the UT3 and UT4 periods. Operating costs for the Goonyella system are forecast by Aurizon Network to increase by $0.7 million on average.

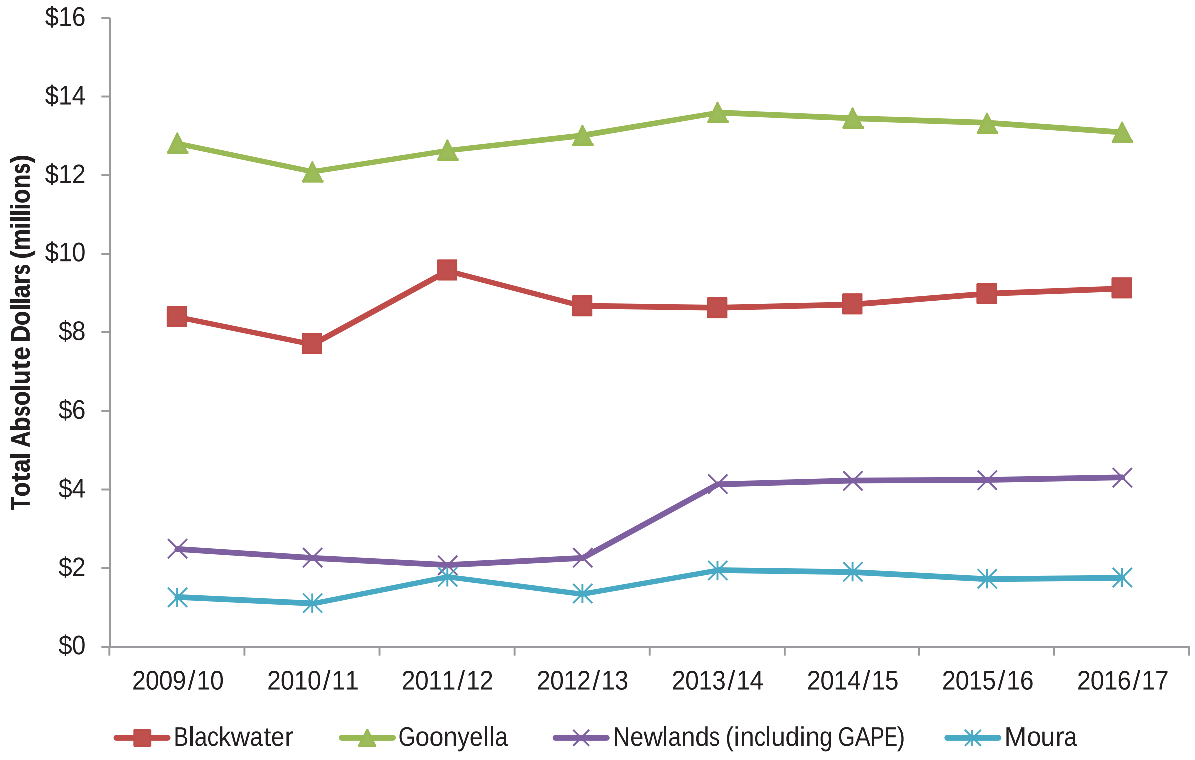


Figure 9 Historical and forecast train control, safeworking and operations – total absolute dollars (systems)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013

Since total costs are increasing for all systems, it is appropriate to review the unit cost of operations which provides an indication of whether price increases and system allocations are efficient. **Figure 10** charts Aurizon Network's historical and forecast train control, safeworking and operations expenditure in dollars / train path, which indicates that individual systems continue to operate at varying levels of efficiency (as measured by the cost per train path).

Figure 10 shows that the price increases forecast by Aurizon Network are efficient for all systems except the Moura system, which is evidenced in a declining unit cost during the UT4 period for the Blackwater, Goonyella and Newlands (incl. GAPE) systems compared to the UT3 period.

The inefficiency of unit costs for the Moura system is due to fluctuations in forecast train paths during the UT4 period which result in a lower average number of train paths compared to the UT3 period (refer **Figure 2**). Given total costs increase slightly, this causes a decline in efficiency in the context of dollars per train path.

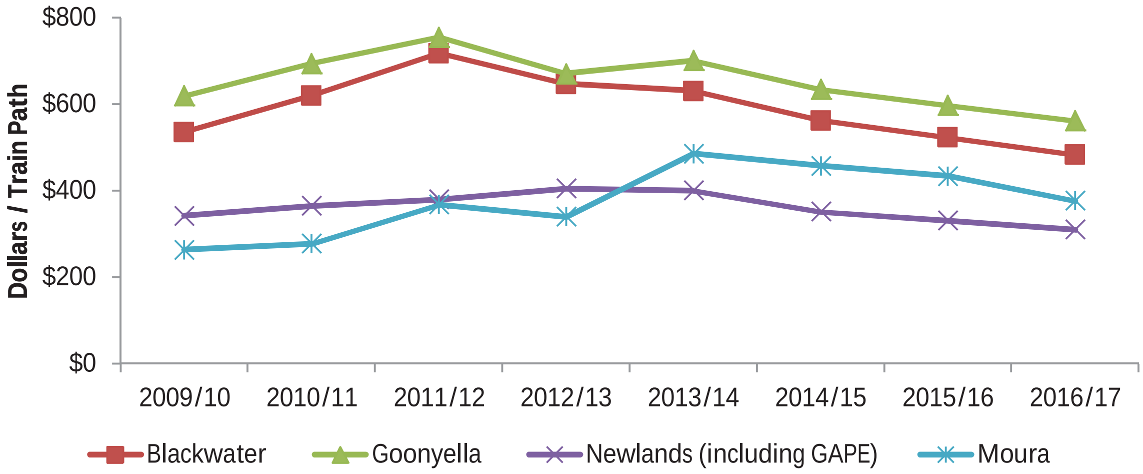


Figure 10 Historical and forecast train control, safeworking and operations - dollars per train path (systems)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013

It is important to note that the historical unit costs are dependent on Aurizon Network's allocation of total operating expenditure to individual systems. The historical cost estimates which were provided by Aurizon Network were allocated by Aurizon Network to individual systems based on the percentage for the UT4 period. Therefore, a review of the historical compared to forecast expenditure is somewhat redundant on an individual system basis, and it is more appropriate to focus on a review of operating efficiency for the whole of the CQCR (refer back to **Figure 8**), which SKM has shown is becoming more efficient.

Therefore, given that trends in the unit costs are dependent on the system allocation of costs (including allocation of increasing costs), it is important to determine if the allocations are appropriate and efficient. To do this, SKM has provided a graphical representation of unit costs described as dollars per train path against total track kilometres in **Figure 11** overleaf.

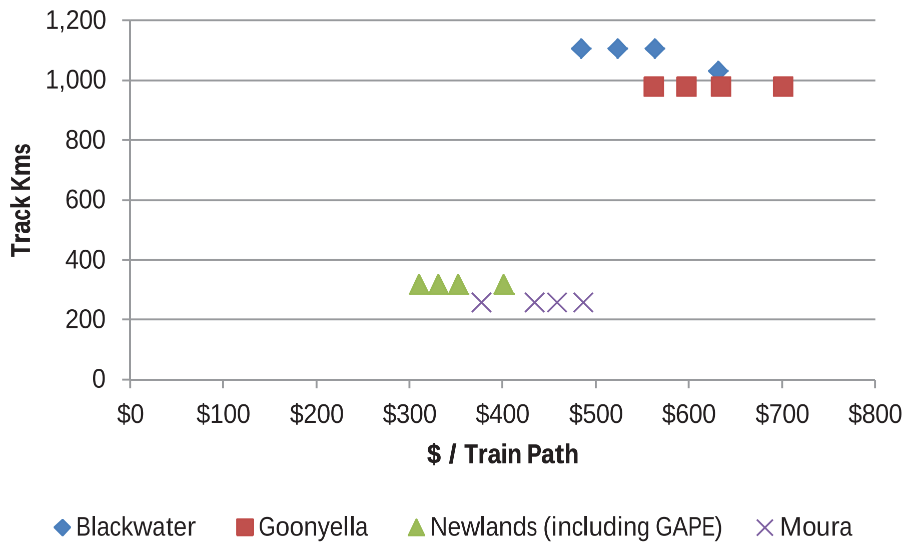


Figure 11 Dollars per train path compared to system size – train control, safeworking and operations

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013

Figure 11 shows that the unit costs for individual systems are mostly appropriate in the context of system size. Specifically, larger systems require more resources for train control, safeworking and operations, and this is evidenced by viewing the Blackwater and Goonyella systems. However, **Figure 11** also shows that the Moura system, which is smaller than the Newlands system and operates at a higher unit cost, is inefficient. This is also evidenced in the increasing unit costs for the Moura system compared to the UT3 period which SKM has shown in **Figure 10**. **Figure 10** also shows that the Goonyella system allocation is potentially inappropriate since the unit cost is higher than Blackwater but the track size is smaller. Given that the overall unit cost for the CQCR is efficient on the basis of historical levels, SKM recommends that Aurizon Network should review the system allocations of train control, safeworking and operations costs to ensure that costs are efficiently allocated to individual systems, particularly since the Moura system is becoming less efficient over time.

Benchmarking

Table 2.7 provides the ARTC's forecast network control expenditure for the HVCN in nominal terms, which includes the cost labour and materials associated with delivery of the following functions:

- train control and signalling;
- train planning and programming;
- operations and customer management; and
- train communication costs.

The HVCN network control costs also include terminal management costs associated with delivery of yard control, signalling and incident management.

Table 2.7 Hunter Valley Coal Network forecast network control costs

Pricing Zone	2010	2011	2012	2013	2014	2015	2016	2017
Pricing Zone 1 Central Constrained	$5.36	$6.52	$7.40	$7.89	$7.95	$7.87	$7.78	$7.70
Pricing Zone 2 Ulan Constrained	$1.52	$1.98	$2.15	$2.21	$2.19	$2.17	$2.16	$2.14
Pricing Zone 3 Werris Creek	$0.57	$0.65	$0.82	$0.85	$0.85	$0.85	$0.85	$0.85
Total Network Control	**$7.45**	**$9.15**	**$10.37**	**$10.95**	**$10.99**	**$10.90**	**$10.79**	**$10.69**

Source: Australian Competition & Consumer Commission

Figure 12 provides SKM's adjusted total network control cost for the HVCN to financial year 2011/12 dollars compared to Aurizon Network's historical and forecast train control, safeworking and operations expenditure for the CQCR, and shows that the cost of train control, safeworking and operations for the CQCR is much higher than for the HVCN, and is increasing during the UT4 period while the HVCN is forecast to decrease beyond 2014.

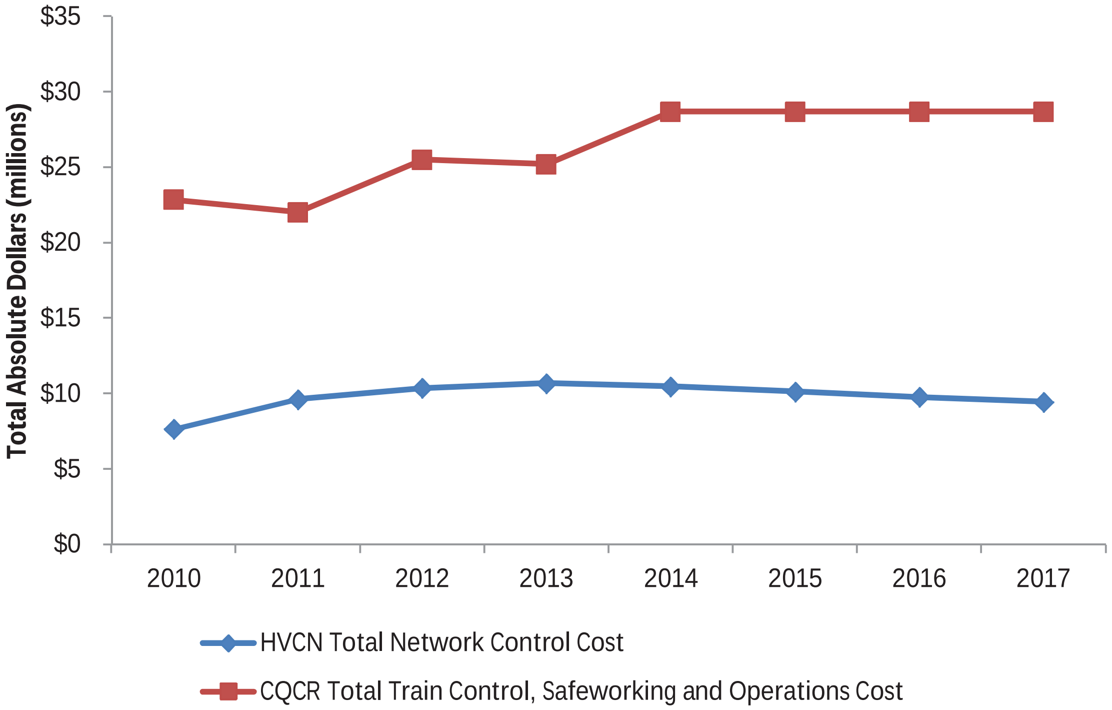


Figure 12 Benchmarking Train Control, Safeworking and Operations – total absolute dollars (CQCR and HVCN)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and Australian Competition & Consumer Commission

Figure 13 provides the dollars per train path in the HVCN compared to the CQCR. The data indicates that the HVCN may be running more efficiently in terms of network control / train control, safeworking and operations. However, although network control required for the HVCN is more complex in terms of traffic density, path and traffic mix, overall haul lengths are shorter and the overall network size is smaller and therefore operations for the HVCN are likely to require less personnel for train scheduling compared to operations for the CQCR. In order to assess the efficiency in the context of network size of the Network, **Figure 14** shows the unit cost per train path compared to network size, which shows that the unit cost for the CQCR is less than 3 times higher than for the HVCN although the network is over 6 times larger. This indicates that Aurizon Network is operating at economies of scale, since train paths are relatively similar (noting that train paths for the CQCR are forecast by Aurizon Network to be slightly higher than for the HVCN).

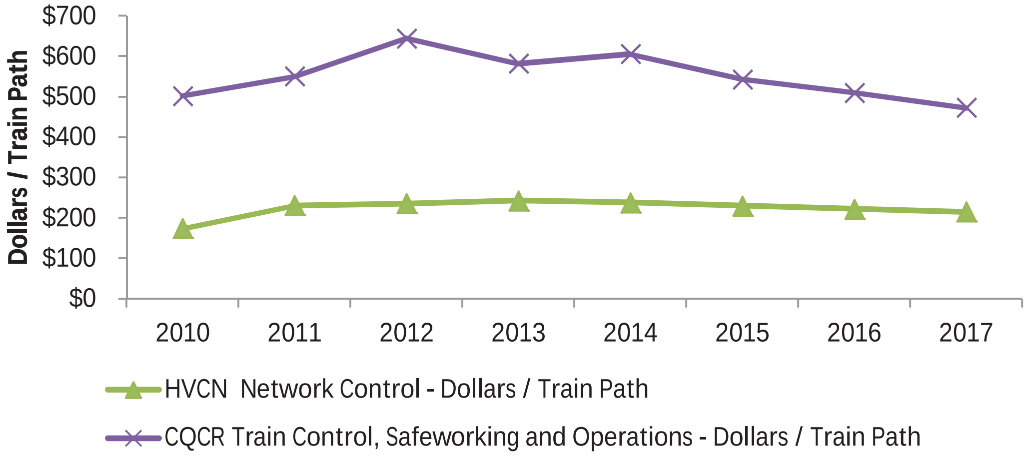


Figure 13 Benchmarking Train Control, Safeworking and Operations - dollars / train path (CQCR and HVCN)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013 and Australian Competition & Consumer Commission

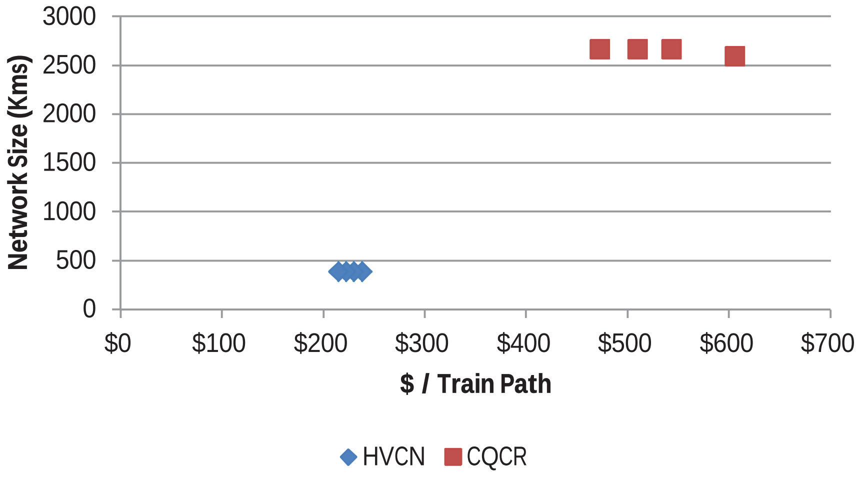


Figure 14 Benchmarking Train Control, Safeworking and Operations - dollars / train path compared to system size (CQCR and HVCN)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013 and Australian Competition & Consumer Commission

Other factors which are impacting on Aurizon Network's relative inefficiency compared to the HVCN are outlined below:

- **Succession planning -** Aurizon Network's proposed UT4 forecast includes costs associated with employing and training additional persons to the minimum personnel necessary, in recognition of the age demographic of existing train control staff. SKM finds that this is an appropriate risk mitigation strategy to ensure ongoing reliability of access in the medium to long term.

- **Coal volumes –** coal traffic on the HVCN comprises approximately 60 per cent of traffic compared to 90 per cent for the CQCR. With this in mind, there is increased opportunity for cost sharing of train control, scheduling and operations between coal and non-coal traffic for the HVCN relative to the CQCR, since in particular, train control of specific track segments will be undertaken by the same person regardless of the traffic mix. Therefore, both the total overall cost and unit cost for the CQCR can be expected to be inflated relative to the HVCN.

- **Expensed project costs -** Aurizon Network's forecast for safeworking/yard operations includes expensed capital project costs associated with suspension of normal signalling and safeworking systems, which are replaced with labour-intensive manual systems over the affected sections during construction. Aurizon Network's proposed UT4 submission indicates that these costs are not included in the capital works estimates since they are incurred for operational reasons during construction activity. The magnitude of these costs is not clear; however it is noted that the HVCN forecast for network control excludes expensed project costs and this may be contributing to Aurizon Network's relatively higher costs for train control, safeworking and operations. Ultimately, SKM finds that these costs should not be included as part of operating expenditure forecasts, since they would not be incurred if the capital 'construction' activities were not being undertaken. In addition, capital projects are subject to a separate approval process outside of the operating cost review. That is to say that if capital projects were not approved by the Authority, the allowable revenue from operating expenditure would be greater than required. Therefore SKM recommends that the Authority require Aurizon Network to adjust the proposed operating cost to remove expensed project costs, and include them in submissions for capital works.

Source: Chapter 10 of Volume 3 of the DAU for the UT4 period and SKM industry knowledge

Concluding remarks

In the context of efficiency improvements for the CQCR compared to historical expenditure during the UT3 period, SKM finds that Aurizon Network's forecast decline in costs per train path for train control, safeworking and operations are considered reasonable on the basis that:

- operations should become more efficient over time as the organisation matures; and

- there are savings associated with consolidating train control centres in Rockhampton and Mackay.

On the basis of the benchmarking exercise, SKM finds that the total forecast cost for train control, safeworking and operations is reasonable for the CQCR, subject to the exclusion of expensed project costs associated with forecast capital projects. However, SKM recommends that Aurizon Network should review the system allocation of operating expenditure to ensure cost allocations are efficient.

2.4.2 Infrastructure management

Infrastructure management costs include managing safety, reliability, availability and utilisation of the rail assets. The main activities include:

- asset business management;

- asset assurance management;

- electrical assets management;
- telecommunications and signalling assets management;
- asset strategy; and
- corridor assets management.

Source: Aurizon Network, Volume 3 Maximum Allowable Revenue and Reference Tariffs, Section 10.2.3.3

Figure 15 provides Aurizon Network's historical actual infrastructure management expenditure[5] for the CQCR, compared to forecast infrastructure management expenditure for the UT4 period. Data is provided in total absolute dollars and dollars per train path. On a regional level, the total expenditure for infrastructure management is forecast to decline on average compared to the UT3 period, and the cost per year is stable during the UT4 period. As seen in **Figure 15 t**hese forecast reductions in costs are translating to a significant decline in the unit cost for the UT4 period.

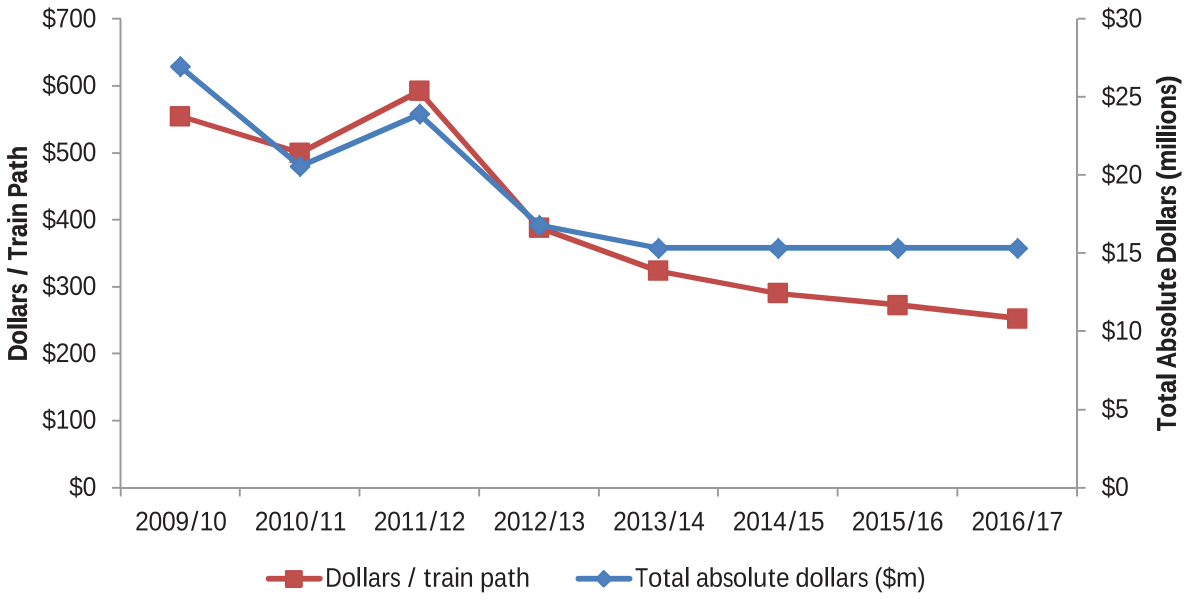


Figure 15 Historical and forecast infrastructure management expenditure (regional)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013

[5] Adjusted by SKM to a financial year 2012/13 price year

Figure 16 charts Aurizon Network's historical actual infrastructure management expenditure for the UT3 period on an individual system basis, compared to forecast expenditure for the UT4 period. In terms of total absolute dollars per system, SKM's analysis of Aurizon Network's forecast infrastructure management expenditure indicates:

- a decline in total cost for all systems relative to the average during the UT3 period, except for the Newlands system which is forecast to increase from $1.7 million on average per year during the UT3 period to $2.0 million on average per year during the UT4 period, which reflects an increased allocation associated with greater volumes on the GAPE system and the planned WIRP. Cost savings for other systems are associated with recent organisational restructures including a review of staff numbers; and

- variations in total infrastructure management costs per year for all system, which is reasonable given the allocations would be determined based on changing complexities in infrastructure management associated with growth in volumes.

As with train control, safeworking and operations, the Moura system has the lowest forecast cost for infrastructure management over the UT4 period due to the overall size of the system relative to other systems, and this has also been observed historically.

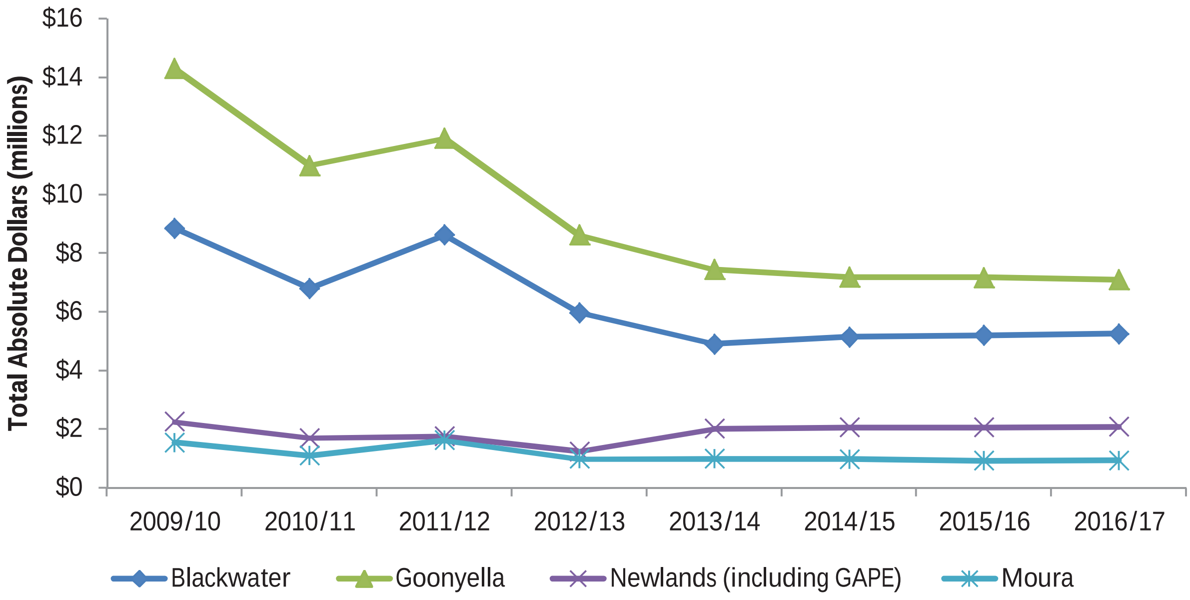


Figure 16 Historical and forecast infrastructure management costs– total absolute dollars (systems)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013

Figure 17 charts Aurizon Network's historical and actual unit cost of infrastructure management expenditure for the UT3 and UT4 periods, measured as dollars per train path. Like the analysis of total operating expenditure as well as train control, safeworking and operations, the historical expenditure and forecast expenditure for infrastructure management indicates that individual systems are operating at varying levels of efficiency. SKM notes that the unit cost is forecast to decline substantially for all systems compared to the UT3 period, and continues to trend downwards to the end of UT4. This reflects the cost reduction forecast by Aurizon Network in total absolute dollars.

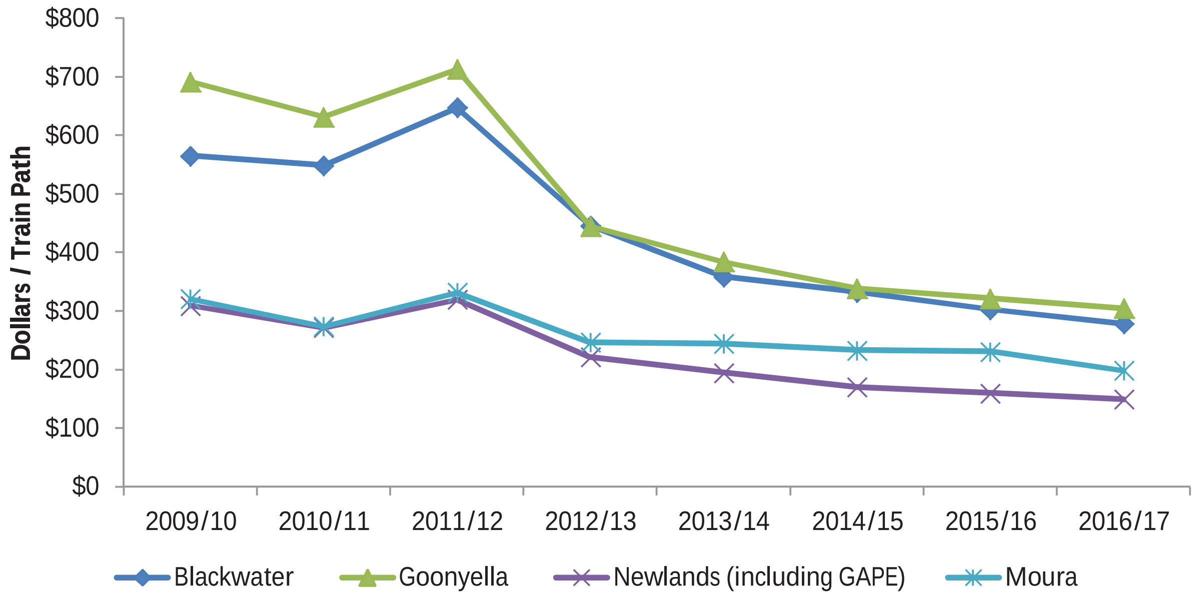


Figure 17 Historical and forecast infrastructure management costs– dollars / train path (systems)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013

Benchmarking

Table 2.8 provides the ARTC's forecast asset management expenditure for the HVCN in nominal terms, which excludes corporate overheads.

Table 2.8 Hunter Valley Coal Network forecast asset management costs

Pricing Zone	2010	2011	2012	2013	2014	2015	2016	2017
Pricing Zone 1 Central Constrained	$13.47	$16.30	$18.33	$19.60	$19.73	$19.47	$19.20	$18.98
Pricing Zone 2 Ulan Constrained	$3.81	$4.76	$5.05	$5.11	$5.04	$5.00	$4.98	$4.96
Pricing Zone 3 Werris Creek	$1.07	$1.28	$1.74	$1.80	$1.78	$1.78	$1.77	$1.77
Total Network Control	$18.35	$22.34	$25.12	$26.50	$26.56	$26.25	$25.95	$25.71

Source: Australian Competition & Consumer Commission

Figure 18 charts SKM's adjusted total forecast asset management cost for the HVCN to financial year 2011/12 dollars compared to Aurizon Network's historical and forecast infrastructure management expenditure for the CQCR. **Figure 19** provides the dollars per train path in the HVCN compared to the CQCR.

The results of the benchmarking exercise suggest that Aurizon Network's infrastructure management operations are more efficient in terms of both the total absolute cost and dollars per train path for the UT4 period, compared to asset management for the HVCN. It is noted that the forecast for the HVCN does not account for increasing train paths (**refer Section 2.1.3**). However, given the forecast expenditure for the CQCR in total absolute dollars is below the forecast expenditure for the HVCN, SKM finds that Aurizon Network's operations in relation to infrastructure management will remain competitive compared to ARTC's forecasts. Even when held stable from the 2011 period (when total train paths are known), the HVCN costs remain above the forecast costs for the CQCR.

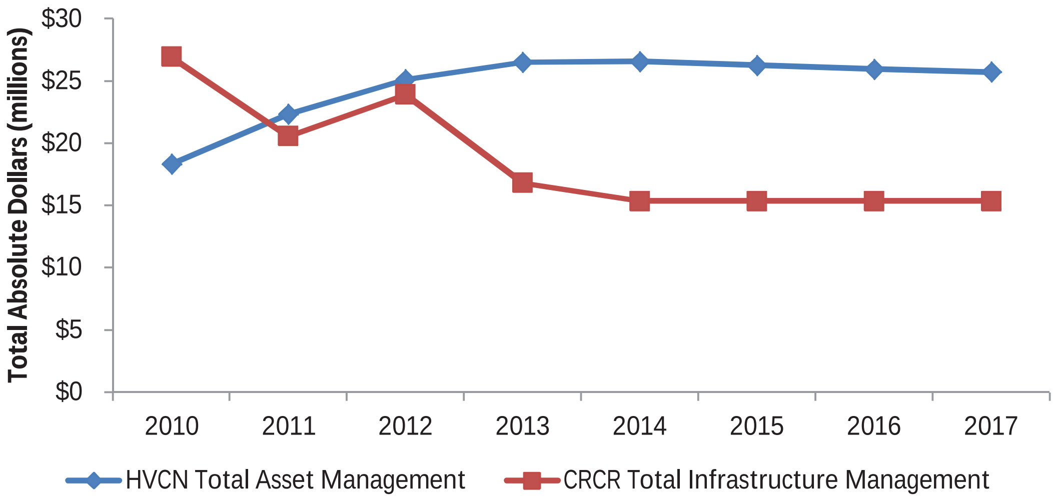


Figure 18 Benchmarking Infrastructure Management – total absolute dollars (CQCR and HVCN)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and Australian Competition & Consumer Commission

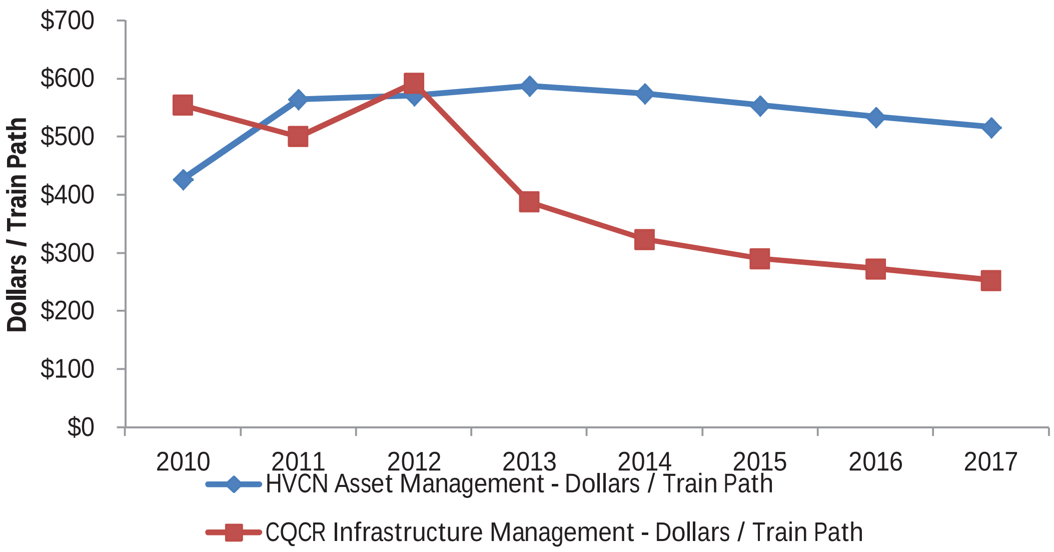


Figure 19 Benchmarking Infrastructure Management - dollars / train path (CQCR and HVCN)

Source: SKM graph based on information provided by Aurizon Network on 4 November 2013 and 25 September 2013 and Australian Competition & Consumer Commission

Concluding remarks

SKM finds that the cost of infrastructure management is reasonable on the basis of improving efficiency compared to historical levels in an increasingly complex operating environment, and on the basis of the benchmarking exercise, where the forecast costs for the CQCR are significantly lower than for the HVCN. SKM also finds that the system allocation of infrastructure management costs is reasonable.

2.4.3 Regenerative breaking

Pricing strategy

Regenerative braking is a mechanism equipped on modern AC traction locomotives which allow some of the trains breaking force to be transferred from the brakes in the wagons to the traction motors in the electric powered trains. The electricity generated is transferred through the locomotive pantograph into the overhead power system. This electricity is either consumed within the network by another train in the same electrical section drawing on a concurrent load or through distribution loses between the point of generation and the point of connection with the electricity grid, or is exported back to the electricity grid.

SKM notes that Aurizon Network is currently undertaking regenerative breaking trials in the Goonyella system to assess the system performance stability and ensure the minimum technical standards prescribed in its connection agreements with its transmission network service provider continue to be satisfied. Similar trials are expected to commence in the Blackwater system in 2013/14. Aurizon Network has stated that it will require access seekers operating trains with regenerative breaking capability to have meters installed by 1 July 2016.

The proposed UT4 access undertaking notes that efficiencies from these trails should be realised during the UT5 access undertaking period. In this regard, Aurizon Network's pricing strategy for the UT4 period currently reflects a uniform electric tariff price based on gross tonne kilometres, and therefore the average load approach does not necessarily provide an EC price which is reflective of the net energy characteristics of a train which is regenerating electricity back into the overhead power system compared to a train without regenerative braking capability. In addition, uniform pricing may also result in inequities associated with two trains which each have regenerative braking capability, since the amount of energy explored depends on numerous factors including driver behaviour and any installed above rail technology such as Electronically Controlled Pneumatic Breaks or regenerative breaking.

As an example, electric trains currently operating, and expected to be operating in the future in the Goonyella system are AC traction with regenerative breaking capabilities, therefore an EC[6] tariff based on net energy demand in that system would reflect the train operations of that system. However, and in contrast, older DC traction electric locomotives will continue to operate within the Blackwater system and therefore a continuation of a uniform EC tariff arrangement across both systems would not lead to an allocation of costs between train services that would suitably represent the incremental cost of that individual train service.

With this information in mind, SKM finds that although differential pricing is preferred, Aurizon Network is currently unable to derive rates that reliably and accurately represent electricity savings due to a number of factors outlined below:

- Aurizon Network is unable to reliably determine the amounts of energy generated by an individual train service;
- there is inherent variability in the regenerative amounts per individual train service;
- there is complexity and variability in measuring and allocating system losses; and
- the amount of energy generated and returned to the overhead power system is highly dependent on where the train service is operated and more importantly the drivers breaking behaviour.

[6] Electric energy component

Therefore, SKM finds that Aurizon Network's proposal to mandate installation of on-train meters to enable recording of electricity regeneration and allow the crediting of net export amounts to the operator is reasonable. Consistent with the views of Aurizon Network, SKM considers that this will only be feasible when all trains with regenerative breaking are equipped with on-train meters. SKM finds that until such time as the above conditions have been realised the amounts exported from the overhead power system would be reflected in the common EC tariff rate.

A three year period for the fitting of meters and establishment of the necessary billing, maintenance and compliance arrangements is proposed by Aurizon Network. SKM finds that this reflects a reasonable time period for above rail operators to become compliant.

SKM recommends on-train metering for trains with regenerative breaking capabilities by 1 July 2016 be mandated, in line with Aurizon Network's proposal. However, it is recommended that this is subject to a review by the Authority that the cost of installation is cost effective (ie the reduction in electricity costs through the EC tariff give the required rate of return, on a discounted cash flow (DCF) basis on the investment in on-train metering) such as to not distort above rail operations. Where the cost is not prohibitive, and benefits to operators can reasonably be expected to outweigh the costs of installation (on a DCF basis), the capping of indirect benefits from regenerative breaking credits applicable to operators that have not installed on-train meters by the 1 July 2016 is deemed to be fair and reasonable (however, this would be substantially more complex than the arrangement with a 100 per cent operator compliance).

SKM therefore recommends that the Authority seeks to confirm the results of the regenerative braking trials on the Goonyella and Newlands system, with a view to assessing the benefits and costs of meter installation, and the savings which would be expected to result in reduced operational costs for the UT5 period.

Savings already realised

Aurizon Network's proposed UT4 submission includes an overview of historical regenerative braking and export energy between June and December 2012, including estimated savings which have been realised over this trial period. These savings are derived based on an estimated purchase price of $50 per MWh. This is considered a reasonable price based on historical prices in Queensland in 2011[7], although savings should be estimated on current prices where possible. In addition, Aurizon Network's Investor Briefing dated 18 July 2013 advised of an estimated savings of $2.5 million from existing trials on the Goonyella system. It is not clear where or if these cost savings have been included in the proposed UT4 submission. SKM therefore recommends that the Authority seeks to confirm if cost savings have been included and if not that the quantum of these savings is subtracted from the approved expenditure, regardless of the interim pricing strategy. While differential pricing may not yet be feasible due to limitations associated with monitoring individual train contributions, SKM finds that these savings should still be reflected in the operating cost forecast.

2.5 Balancing service and cost of optimised network

SKM finds that Aurizon Network has taken reasonable steps to balance the service and cost of the optimised network. This view is based on the key points below:

- Aurizon Network's forecast operating expenditure for the UT4 period indicates increasing economies of scale relative to the UT3 period, with unit costs generally declining per year although there are increasing train paths. This demonstrates Aurizon Network's improved efficiency, whilst maintaining expectations of customers / access seekers.

- Aurizon Network's statement to investors dated 18 July 2013 includes a number of proposed service metrics which, if delivered upon, are likely to significantly improve the satisfaction of access seekers. These include reductions in planning alterations from 40 (at its highest point) to 2 per day on the Goonyella system, reductions in speed restrictions, reductions in below rail delays and increased path

[7] AEMO, 2011a

availability associated with better alignment of asset activities and smoothing constraints which create 745 additional paths for the Goonyella system.

In addition, SKM finds that Aurizon Network has undertaken a series of initiatives that have or will deliver increased efficiencies. These initiatives are a mixture of short (immediate), medium and long term changes. The proposed or already implemented changes have been provided by Aurizon Network and are outlined below. It is noted that there is some overlap between operating and maintenance costs for the initiatives presented however; SKM considers that they are useful in providing an understanding of how operations and customer satisfaction could improve over the short to long term.

- Aurizon Network's consolidation of the train control functions into one location has delivered economies of scale in both staff and resource utilisation. Having the one centre has enabled substantive improvements by standardising systems and processes that have been supported by a more flexible workforce. Similar efficiencies have also been achieved with combining of the two Electrical Control Centres. These improvements have been built on by reconfiguring the Control Boards to separate out the Far West and the Ports from the remaining Boards. Overall there has been an improvement in Safeworking breaches from 16 in 2011 to 4 in 2013, while delivering an increased tonnage profile.
- Aurizon Network has implemented changes to the asset management structure which are intended to better align with the asset needs. In this regard the separation of the traditional maintenance activities (inspection, testing and fix on fail) have been separated from capital works activities. This has allowed for the improved utilisation and targeted focus of both the maintenance and constructions services. This separation has been underpinned by the reallocation of all engineering services under the control of Asset Management team. The Asset Management team has been structured into the Engineering disciplines that support the supply chain.
- Aurizon Network has also transitioned to a series of Asset; Tonnage and Cost Estimating systems that are intended to deliver greater insight and understanding of the lineal asset elements of the CQCN. Moving forward over the medium and long term Aurizon Network has committed to a Network Asset Management System (NAMS). The overarching objective is to address some of the significant asset management challenges Aurizon Network faces including an incomplete understanding of the condition of all assets and the capability of the infrastructure to meet future capacity demands. This will be achieved by recording and measuring the physical assets, better managing track closures, reduced unplanned works, increased asset life (deferral of the need for asset renewals), improved predictive maintenance approach and improved supply chain cycle times.
- Finally, restricting of operations means that the Finance and Commercial functions continue to deliver their services with a reduced FTE number.

3. Aspects of the operating expenditure forecast raised in stakeholder submissions

The Authority also requested that SKM review and provide opinion on the issues raised in relation to forecast operating costs by QRC, RTCA, BMA and BMC and Asciano. SKM has reviewed the submissions and notes that stakeholders have expressed significant concerns about increases in operating expenditure relative to the 2010 access undertaking (AU). The following provides SKM's opinion on specific issues raised, which are categorised according to the type of issue.

3.1 Allocation of corporate overhead costs

Stakeholders have raised concerns about the appropriateness of Aurizon Network's allocation of corporate overhead costs based on efficient stand-alone costs of operating the below rail network, which has implications in terms of the competitive advantage for the above rail business managed by Aurizon Holding Ltd. as well as the potential for costs not reasonably attributable to the provision of access on the CQCN to flow to below rail businesses. Stakeholders have submitted that the 2013 DAU therefore fails to meet the requirements of economically efficient operations and promoting effective competition in upstream and downstream markets.*

**QRC, RTCA, BMA and BMC and Asciano*

SKM notes that the allocation of corporate overhead costs for the UT4 period has a significant impact on total operating costs relative to the UT3 period. While SKM supports the premise that a detailed review of the appropriateness of corporate cost allocations should be undertaken (including potential revisions to the costing manual to address efficiencies associated with Aurizon Network as a vertically integrated above and below rail business, it is noted that corporate overhead costs are subject to a separate review by another consultancy. Therefore SKM has not provided comment on the reasonableness of stakeholder concerns.

3.2 Operational efficiency

Stakeholders have expressed concerns that the 2013 DAU does not provide sufficient incentive for efficiency gains, and that the forecast for the UT4 period does not include a real price adjustment described as CPI less a productivity 'X-factor' (CPI-X). Stakeholders submit that the objective of a CPI-X price adjustment in regulated industries is to ensure a regulated business prices its outputs as it would in a competitive market, and that the CPI-X adjustment should be re-instated for the UT4 period.*

**The issue of the productivity X-factor was specifically raised in submissions by QRC and BMA and BMC; however it is noted that RTCA's submission endorses the views of the QRC.*

SKM notes that the review of operating cost escalation for the UT4 period will be undertaken by another consultancy. However, it is appropriate for SKM to comment on the proposed inclusion of the productivity 'X-factor' since SKM's review has considered the efficiency of operating costs relative to historical levels and during the UT4 period.

SKM does not support the inclusion of a productivity 'X-factor' and considers that it is more appropriate for Aurizon Network to identify cost savings from specific and achievable changes to the operating environment, provided that these productivity improvements have been built into the cost base. This approach provides a focus for where cost savings should be realised, while an 'X-factor' is applied to total cost and does not provide a focus for realisation of savings. Further, SKM does not consider that ongoing inclusion of a productivity 'X-factor' is sustainable as an organisation matures and further cost savings (in total absolute dollars) will be difficult to realise.

In the context then of SKM's findings regarding the productivity 'X-factor', it is important that Aurizon Network demonstrates that the cost base includes operating efficiencies relative to historical expenditure. SKM's review of total expenditure comprising train control, safeworking and operations, utilities costs, infrastructure management costs, EVP network costs, business management costs, regulation and policy costs and commercial development costs has shown that in real dollar terms, Aurizon Network has built efficiencies into operating costs for the UT4 period on both a total absolute dollar basis and a unit cost basis, and that the increases in operating costs observed by stakeholders are attributable to costs which are reviewed outside of this report (for example, corporate overheads and self-insurance).

In terms of individual cost categories, SKM has undertaken a review of the average expenditure during the UT3 period compared to the forecast expenditure for the UT4 period to determine if costs are increasing, declining or remaining stable. SKM finds that it is more appropriate to review the average expenditure from the UT3 period compared to the UT4 period rather than the expenditure for a particular year since this will account for fluctuations in costs which occur in different stages of the regulatory period. For example, regulation and policy costs increase towards the latter half of the undertaking period during the preparation of access undertaking submissions. Therefore it would not be appropriate (for example) to compare costs in real terms from the beginning half of the UT3 period to the latter half of the UT4 period.

SKM's review has shown that costs are declining in total absolute dollars, or remain stable, compared to the average expenditure for the UT3 period for the following categories:

- infrastructure management;
- EVP network;
- business management; and
- regulation and policy.

SKM notes that total costs are forecast by Aurizon Network to increase for the following cost categories:

- train control, safeworking and operations;
- utilities costs; and
- commercial development costs.

While train control, safeworking and operations costs increase in real terms, the unit cost is more efficient than the UT3 period, and SKM has considered the fact the total costs include the cost of succession planning for train control staff (although Aurizon Network has not verified the value of these costs). SKM has therefore found that costs are efficient on the basis of the declining unit costs, although recommendations have been made for Aurizon Network to remove the value of expensed project costs.

SKM has proposed adjustments to Aurizon Network's forecast utilities costs and commercial development costs which SKM's review has shown are increasing in real terms[8] and are considered by SKM to be reasonable or efficient. Other recommendations made by SKM are outlined in **Section 3**.

Stakeholders have raised concerns about the incentive for Aurizon Network to improve operating efficiency, recommending that the 2013 DAU should be amended to provide for the development and implementation of incentive mechanisms which must include:*

- *performance metrics and KPIs which are linked to performance, contracted access entitlements and regulatory framework outcomes (such as System Allowable Revenue and Reference Tariffs);*
- *linkages to individual operators rather than whole of system performance to ensure that differential treatment of operators is not hidden by aggregated system performance; and*
- *a degree of symmetry between the incentives linked to over performance and under performance.*

**Asciano*

[8] The unit cost for commercial development is also increasing compared to the UT3 period and this is not conducive to a maturing organisation.

SKM has outlined in **Section 2.5** the steps which Aurizon Network has undertaken to balance service and cost for the CQCN and SKM recommends that the Authority monitor implementation of and effectiveness of the proposed service improvements, including any potential disparities across operators. SKM considers that the options outlined above from the stakeholder submissions would provide a reasonable means for monitoring service enhancements, but that the proposal should be subject to a thorough review by the Authority.

For information purposes, it is useful to note that Network Rail in the UK is entitled to retain the benefit of financial performance (for example, where income is higher than forecast and/or actual expenditure is lower than forecast) provided that the company has delivered on required train performance targets. Likewise, Network Rail bears the consequences of financial underperformance.

Targets include train punctuality, reliability and the level of disruption from planned engineering works. Where targets have not been met, an assessment is undertaken to determine the extent to which any under-spend is related to the company's non-delivery of required levels of service.

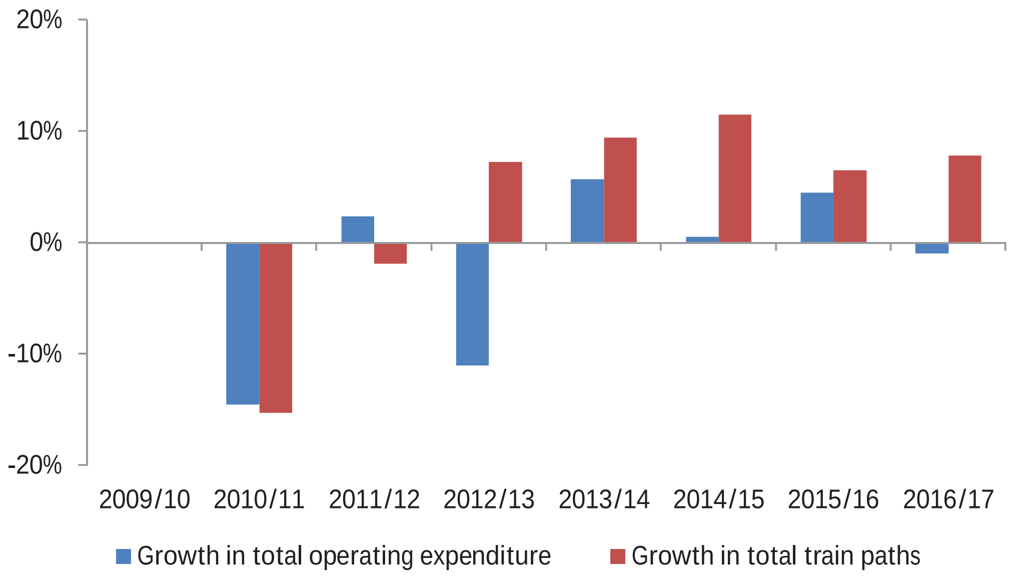
Source: Office of Rail Regulation (2013)

Stakeholders submitted concerns that Aurizon Network's forecast operating expenditure for the UT4 period does not include increases in operating costs which are disproportional to increases in tonnages during the UT4 period.*

**QRC, RTCA, BMA and BMC and Asciano*

SKM's review has shown that Aurizon Network's forecast operating expenditure which is comprised of train control, safeworking and operations costs, utilities costs, infrastructure management costs, EVP network costs, business management costs, regulation and policy costs and commercial development costs is declining on a unit cost basis, which means that cost changes are not disproportionate to change in tonnages. However, SKM recognises that the increase in costs noted by stakeholders is largely due to corporate overhead costs (reviewed by another consultancy) and increases in other costs such as self-insurance, which SKM has reviewed in the report titled "*Specialist opinion on specific aspects of the operating expenditure forecast*".

For reference, **Figure 3** from **Section 2.3** is reproduced below which shows that operating costs are forecast to grow at a lower rate than train paths.



3.3 Benchmarking as a useful exercise to determine efficient costs

Stakeholders submitted that while they support the view that benchmarking is an appropriate means of identifying efficient costs, this is only true when costs are compared to appropriate benchmark operators and that limited weight should be placed on rail operators from different markets with different operational structures (including the vertically integrated, un-regulated US railways).* **RTCA*

As per the Authority's brief, SKM has undertaken a benchmarking exercise for Aurizon Network's forecast train control, safeworking and operations and infrastructure management costs compared to the ARTC's HVCN and has found that after consideration for different operating environments, Aurizon Network's forecast costs are relatively efficient. SKM is unable to comment on the relative efficiency of other costs (such as corporate overhead costs or commercial management costs) since a benchmarking exercise for these costs was not undertaken.

4. Conclusions and recommendations for UT4 period

SKM finds that Aurizon Network's forecast operating expenditure (excluding corporate overheads) for the UT4 period is reasonable, subject to the following adjustments and/or recommendations (cost adjustments are recommended in real 2012/13 dollars):

1. SKM recommends that the Authority adjust the allowable commercial development expenditure for the UT4 period to the values proposed by SKM in **Table 2.5**.
2. SKM recommends that Aurizon Network adjust the system allocation of train control, safeworking and operations costs to ensure costs are efficiently allocated. This recommendation arises from SKM's review on an individual system basis which has indicated that train control, safeworking and operations for the Moura system has become less efficient compared to the UT3 period, while the unit cost for other systems is trending downwards.
3. SKM recommends that the Authority revise the allowable utilities expenditure to reflect the average for the UT3 period ($0.8 million per year).
4. SKM recommends that the Authority seeks to confirm that costs of compliance with the Coal Dust Management plan and changes to Queensland Workplace Health and Safety laws are appropriately reflected in both Infrastructure Management and Regulation and Policy cost forecasts.
5. SKM recommends that the Authority seeks to obtain an estimate of the value of expensed project costs associated with labour intensive operations during capital works, and that these costs are excluded from the approved operating expenditure forecast. SKM has attempted to obtain this information from Aurizon Network and to date this information has not been received.
6. It is recommended that the Authority seek to gain further evidence from Aurizon Network to support estimated cost savings associated with regenerative braking trials which have been published in Aurizon Network's Investor Briefing dated 18 July 2013 ($2.5 million). While differential pricing may not yet be feasible due to limitations associated with monitoring individual train contributions, SKM finds that these savings should still be reflected in the operating cost forecast. If Aurizon Network does not provide evidence that the savings have already been accounted for, SKM recommends that the allowable operating expenditure for the UT4 period is revised down by $2.5 million, since this would reflect the ongoing minimum saving which would be expected from continuing regenerative braking trials.

SKM also recommends that the Authority monitor Aurizon Network's implementation of service enhancements outlined in **Section 2.5**.

5. 2017/18 operating expenditure forecast

Aurizon Network's breakdown of operating expenditure has indicated that the operating costs are unresponsive to volumes (refer to **Table 2.4**). SKM has therefore provided an operating expenditure estimated for the 2017/18 financial year based on Aurizon Network's estimate for the 2016/17 financial year, although subject to the following:

- SKM has reduced the train control, safeworking and operations costs to the historical actuals from the 2012/13 financial year, since SKM notes that the increase in costs for the UT4 period includes costs associated with training for succession planning. SKM requested detailed information from Aurizon Network (cost per year and year of completion) however this was not provided. SKM has therefore assumed that the full increase reflects succession planning costs and that these costs will no longer be incurred by 2017/18;
- SKM has adjusted the allowable utilities expenditure each year to the average for the UT3 period;
- the cost for commercial development has been assumed as equal to SKM's proposed allowable commercial development expenditure for the 2016/17 financial year in **Table 2.5**; and
- regulation and policy costs are estimated as the average for the 2013/14 and 2014/15 forecast since the 2017/18 year what not include increases in costs which are seen for the latter half of the UT4 period and are associated with preparation of access undertaking submissions.

Table 5.1 provides SKM's estimate of operating expenditure for the 2017/18 financial year, which is provided in real financial year 2012/13 terms. SKM notes that this estimate will need to be revised by Aurizon Network if operating conditions significantly alter, including any significant changes in volumes and if coal vs. non-coal / regulated vs. non-regulated volumes significantly alter.

Table 5.1 SKM's estimate of operating costs for the 2017/18 financial year ($2012/13)

Operating cost (excl. corporate overhead)	SKM estimate for 2017/18
Train control, safeworking and operations	[redacted]
Other system costs (utilities costs)	[redacted]
Infrastructure management	[redacted]
EVP Network	[redacted]
Business management	[redacted]
Regulation & policy	[redacted]
Commercial development	[redacted]
Total	[redacted]

Source: SKM forecast based on information provided by Aurizon Network on 4 November 2013 and Chapter 10 of Volume 3 of the DAU for the UT4 period

SKM's 2017/18 operating expenditure forecast should also be further adjusted to ensure the estimate does not reflect expensed project costs and to ensure that savings associated with regenerative braking are realised.

6. Impact of revised volumes during the UT4 period

This section provides a review of the reasonableness of Aurizon Network's forecast operating expenditure in the context of revised volumes for the CQCR and individual systems. SKM's review of operating costs in the context of revised volumes does not consider SKM's proposed cost adjustments for commercial development at a regional level (recommendation number 1) since this proposal was made in the context of Aurizon Network's forecast volumes. The efficiency of system allocations (recommendation number 2) will be reviewed in the context of volume changes in this section.

However, SKM recommends that the Authority still pursue recommendations 3, 4, 5, 6 and the final recommendation outlined in **Section 4** regardless of the impact of this analysis for volume changes.

6.1.1 Train paths

In order to review the efficiency of Aurizon Network's forecast operating expenditure in the context of revised volumes; SKM has provided an estimate of total train paths on an individual system basis based on the forecast volumes provided by Energy Economics. **Table 6.1** provides Energy Economics' forecast volumes for individual systems compared to Aurizon Network.

Table 6.1 Volume forecast, CQCR

System	Energy Economics				Aurizon Network			
	2014	2015	2016	2017	2014	2015	2016	2017
Blackwater	59.0	60.2	62.3	65.3	54.4	60.9	67.4	73.4
Goonyella	97.0	100.2	100.1	105.1	97.3	106.4	112.0	116.9
Moura	11.7	12.0	12.8	14.9	12.5	13.6	13.0	14.1
Newlands (excl. GAPE)	15.8	14.6	16.9	17.9	14.8	15.8	17.0	18.7
GAPE	7.1	11.4	15.5	16.5	20.6	25.4	27.1	29.0
Total	190.6	198.3	207.6	219.7	199.6	222.2	236.5	252.1

Source: Energy Economics (July 2013) provided by the Authority on 10 October 2013 and Aurizon Network, provided on 25 September 2013

Forecast train paths have been estimated by SKM based on the average payload for reference trains on individual systems outlined in **Table 6.2**.

Table 6.2 Average train payloads per system

System	Average Payload (tonnes)
Blackwater	8,211
Goonyella	10,055
Moura	6,269
Newlands	6,871
GAPE	6,871

Source: Volume 1 of The 2013 Undertaking – The Access Undertaking and Schedules

Table 6.3 provides SKM's estimate of total train paths in the context of revised volumes, which includes loaded and empty running trains, compared to Aurizon Network's forecast. **Appendix B** provides SKM's detailed estimates.

Table 6.3 SKM's estimate of train paths for revised volumes

System	SKM Estimate of Train Paths	Aurizon Network Forecast Train Paths	Difference

	2014	2015	2016	2017	2014	2015	2016	2017	2014	2015	2016	2017
Blackwater	14,392	14,678	15,206	15,926	13,670	15,470	17,162	18,838	722	-792	-1,956	-2,912
Goonyella	19,324	19,950	19,930	20,934	19,380	21,188	22,306	23,286	-56	-1,238	-2,376	-2,352
Moura	3,730	3,826	4,080	4,752	4,006	4,164	3,968	4,654	-276	-338	112	98
Newlands	4,604	4,256	4,924	5,216	4,312	4,614	4,940	5,438	292	-358	-16	-222
GAPE	2,070	3,324	4,516	4,808	6,004	7,396	7,896	8,460	-3,934	-4,072	-3,380	-3,652
Total	**44,120**	**46,034**	**48,656**	**51,636**	**47,372**	**52,832**	**56,272**	**60,676**	**-3,252**	**-6,798**	**-7,616**	**-9,040**

Source: SKM calculations based on Energy Economics (July 2013) and average payloads per system

6.1.2 Unit cost of operations

Figure 20 provides the revised unit cost of operations for the CQCR and individual systems in dollars per train path based on SKM's estimate of the number of train paths which would apply for revised volumes. The graph is developed based on Aurizon Network's forecast operating expenditure and excludes the adjustments proposed by SKM as outlined in **Section 4**. The purpose of this approach is to conduct an initial review of whether the proposed adjustments are still valid in the context of revised volumes, and whether adjustments will be required for other systems.

The graph shows that operating costs for the CQCR as a whole will remain efficient compared to the UT3 period even in the context of revised volumes and the train paths estimated by SKM and this is reflective of savings already proposed by Aurizon Network for the UT4 period.

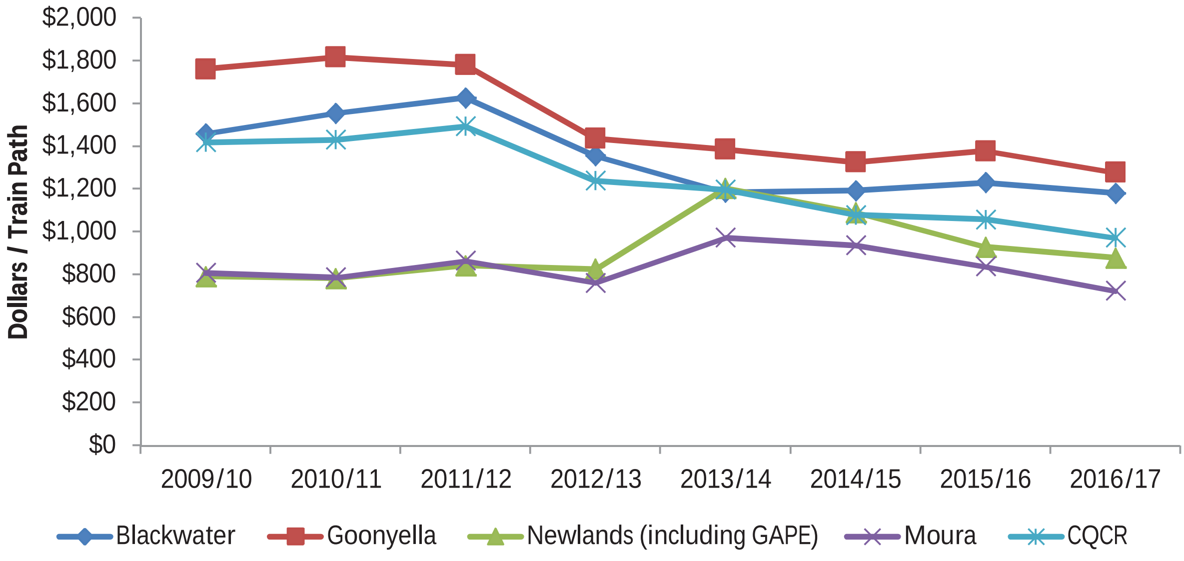


Figure 20 Dollars per train path (total operating expenditure) - revised volumes

Source: SKM graph based on Energy Economics (July 2013) and information provided by Aurizon Network on 4 November 2013

Figure 20 also shows that on an individual system basis, the Blackwater and Goonyella systems will remain relatively more efficient in the UT4 period compared to the UT3 period even in the context of revised volumes. Conversely, the Newlands (including GAPE) system will become less efficient, as depicted in **Figure 20** where the unit cost is increasing relative to the UT3 period. **Figure 20** also shows that the Moura system remains inefficient in the UT4 period compared to the UT3 period.

Table 6.4 provides the estimated change in train paths for all systems, which shows that the inefficiency for the Newlands (including GAPE) system is caused by a significant decline in train paths for the GAPE system associated with revised volumes. This is particularly true given the only reason that the increase in operating expenditure for the Newlands (including GAPE system) is initially justified is because of the expected increase in volumes on the GAPE system.

Table 6.4 Change in train paths for revised volumes

System	2014	2015	2016	2017
Blackwater	5.3%	-5.1%	-11.4%	-15.5%
Goonyella	-0.3%	-5.8%	-10.7%	-10.1%
Moura	-6.9%	-8.1%	2.8%	2.1%
Newlands	6.8%	-7.8%	-0.3%	-4.1%
GAPE	-65.5%	-55.1%	-42.8%	-43.2%
Total	-6.9%	-12.9%	-13.5%	-14.9%

Source: SKM calculations based on Energy Economics (July 2013) and average payloads per system and information provided by Aurizon Network on 25 September 2013

While **Figure 20** and **Table 6.4** shows that some systems will become inefficient in the context of revised volumes, SKM finds that Aurizon Network has already proposed savings for most cost categories compared to the UT3 period, and that it would be difficult to realise any further savings, especially since operations is labour intensive and will not necessarily decline with the change in forecast volumes. This is particularly evident when reviewing Aurizon Network's FTE forecast for the UT4 period, which shows that labour costs are allocated to systems based on the allocation of total costs to individual systems, and often this means that (for example) less than 1 FTE will be allocated to a particular system for a particular task (see **Appendix C** for Aurizon Network's detailed labour allocations). In regards to the train control role particularly, based on a review of total FTEs SKM finds that a reduction in proposed tonnages of approximately 10 per cent on average will not result in a reduction in costs since the number of control boards will remain the same regardless of the reduced train paths that are required. In some circumstances there is a direct relationship between the number of train control staff and the size of the train control task that may exist, but that relationship varies with system and operational size, and SKM does not consider that the reduction in volumes will have a material impact on operations. In addition, given that operating costs are mostly stable each year of the UT4 period (see **Table 2.4**); this shows that there is very little room for savings associated with reductions to train paths. Further, **Figure 20** shows that the unit cost is still more efficient across the CQCR compared to the UT3 period.

While it is unlikely that further savings can be realised for some categories, SKM finds that the system allocation of costs would need to be revised by Aurizon Network in the context of revised volumes. In addition, given that Aurizon Network operates as a functional unit within Aurizon Holdings Limited Group, the allocation of total costs to the regulated below rail infrastructure could be revised. **Table 6.5** provides Aurizon Network's operating cost allocation for the CQCR, which indicates that allocations could be revised where the current allocation is less than 100 per cent.

Table 6.5 Aurizon Network's allocation of costs to the CQCR

Cost Centre	Description	FY14	FY15	FY16	FY17
Train Control, Safeworking and Operations					
Network Operations South					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Network Operations North					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Other systems costs					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Infrastructure management					
Network Assets					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EVP Network					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Business Management					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Regulation & Policy					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Commercial Development					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Source: Aurizon Network, provided on 4 November 2013

SKM finds that adjustments are not required to allocators for the following cost categories:

- all categories with an allocation of 100 per cent, since this indicates no opportunity for cost sharing and SKM finds it would be difficult to realise any further savings for operations;
- infrastructure management, since the remaining 24 per cent in financial year 2013/14 represents an allocation to capital works and is therefore not impacted by changing train paths for normal operations;
- EVP Network, since the allocation is stable during the UT4 period and is not impacted by change in train paths, and is shared across Aurizon Network as a stand-alone subsidiary within Aurizon Holdings Limited.

However, SKM finds that allocations could be revised for Network Operations North and South where the allocator is less than 100 per cent since this reflects allocations to non-coal train services for train control and scheduling. In addition, allocation of commercial development and regulation and policy costs can be adjusted based on the statement below, particularly since the volume forecast provided by Energy Economics impacts the GAPE system:

> *"It is recognised that costs directly incurred in relation to the earning of above regulatory returns (i.e. for GAPE and WIRP) should not be included in the operating costs forecasts for the calculation of reference tariffs. The above regulatory returns are fees that supplement Aurizon Network's regulatory tariff income and are earned from the same paths. It is somewhat difficult to isolate costs that relate solely to the earning of the above regulatory return when those costs are so inextricably linked to the costs relating to the regulatory returns.*
>
> *This is particularly so for labour costs when time records are not kept to be able to apportion costs. An allowance has been made for costs that should not be included in reference tariffs by reducing the budgeted costs by the percentage of non-regulated revenue as a portion of total Aurizon Network revenue (which varies over the 4 years of the UT4 period between 10% and 13%)."*

Source: Note 4, pp 209-210 of Volume 3 of Aurizon Network's DAU for the UT4

6.1.3 Adjustment to train control, safeworking and operations for revised volumes

In order to adjust the allocation of train control cost in the Rockhampton centre to coal vs. non-coal volumes, SKM has calculated the indicative non-coal volumes based on Aurizon Network's volume forecast for the CQCR and the allocator indicated in **Table 6.5**.

Table 6.6 SKM's proposed coal allocator for train control costs (Rockhampton)

Aurizon Network coal allocation (Rockhampton Train Control Centre)	91%
Aurizon Network forecast coal volumes (mt)	199.6
Indicative total volumes (coal and non-coal)	219.34
Indicative non-coal volume (mt)	19.741
New forecast coal volume (Energy Economics) (mt)	190.6
Indicative non-coal volume (mt)	19.741
Indicative total volumes	210.34
Allocator	90.6%

Source: SKM adjustment based on information provided by Aurizon Network on 4 November 2013 and Energy Economics (July 2013) provided by the Authority on 10 October 2013

SKM's adjustment for train control costs based on the revised allocator is provided in **Table 6.7** below, and is presented in real 2012/13 dollars for the financial year 2013/14.

Table 6.7 SKM's proposed adjustment to train control costs for revised volumes

	Total
NSNP Train Control Centre Rockhampton Costs (AN)	$18,333,902.51
NSNP Train Control Centre Rockhampton Costs (SKM)	$18,253,313.93
Total adjustment required (CQCR)	-$80,588.58

Source: SKM adjustment based on information provided by Aurizon Network on 4 November 2013 and Energy Economics (July 2013) provided by the Authority on 10 October 2013

6.1.4 Adjustment to commercial development and regulation and policy costs for revised volumes

SKM has noted above that Aurizon Network's DAU for UT4 period includes an adjustment to account for budgeted costs based on the percentage of non-regulated revenue for the GAPE system[9]. SKM has employed a

[9] The Wiggins Island Rail Project (WIRP) is also referenced however the total volume forecasts for the purposes of pricing in table 1 of Volume 3 of the DAU for the UT4 period excludes WIRP and therefore SKM has also excluded WIRP, particularly since no forecasts have been provided by Energy Economics.

similar approach utilised for the adjustment to costs for the train control centre in Rockhampton. Specifically, SKM assumes that Aurizon Network's allocator represents a proportion of total volumes which are regulated, since the allocator is based on a proportion of regulated revenue. **Table 6.8** provides the resulting adjustments to the allocator based on SKM's assumptions.

Table 6.8 SKM's proposed coal allocator for regulation and policy and commercial development costs

	2014	2015	2016	2017
Proportion regulated costs (AN allocator)	87%	88%	89%	90%
Indicative total volumes (regulated and not regulated) (mt)	229.4	252.5	265.7	280.1
Indicative non-regulated volumes (mt)	29.8	30.3	29.2	28.0
New forecast regulated volume (Energy Economics) (mt)	190.6	198.3	207.6	219.7
New total volumes (regulated + non-regulated) (mt)	220.4	228.6	236.8	247.7
Revised allocator for regulation and policy and commercial development costs	86.5%	86.7%	87.7%	88.7%

Source: SKM adjustment based on information provided by Aurizon Network on 4 November 2013 and Energy Economics (July 2013) provided by the Authority on 10 October 2013

SKM's adjustment for regulation and policy and commercial development costs based on the revised allocator is provided in **Table 6.7** below, and is presented in real 2012/13 dollars for the financial year 2013/14.

Table 6.9 SKM's proposed adjustment to regulation and policy and commercial development costs for revised volumes

	2014	2015	2016	2017
Regulation and policy costs (AN)	$1,899,063.12	$1,886,648.88	$4,239,166.25	$3,428,343.12
Regulation and policy costs (SKM)	$1,884,601.71	$1,848,461.06	$1,865,868.73	$1,925,584.09
Total adjustment required to regulation and policy (CQCR)	-$14,461.41	-$38,187.82	-$2,373,297.51	-$1,502,759.03
Commercial development costs (AN)	$7,221,954.56	$7,525,923.08	$7,721,272.37	$7,961,633.42
Commercial development costs (SKM)	$7,166,959.22	$7,373,590.25	$7,638,441.28	$7,873,950.41
Total adjustment required to commercial development (CQCR)	-$54,995.35	-$152,332.83	-$82,831.08	-$87,683.00

Source: SKM adjustment based on information provided by Aurizon Network on 4 November 2013 and Energy Economics (July 2013) provided by the Authority on 10 October 2013

Appendix A. Information sources

This review is based on information sourced from documents as shown in **Table 2.1** and **Table 2.2** below.

Table 2.1: Information sources – task specific

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
Aurizon Network	Volume 3 of 4 – UT4 Explanatory Materials	Maximum Allowable Revenue and Reference Tariffs	R-Aurizon-QR2013DAU-ExMatBB-0513	PDF	30 April 2013
Aurizon Network	-	Aurizon Investor Briefing 18 July 2013	-	PDF	18 July 2013
Australian Competition and Consumer Commission	-	Revised 2010 HVAU – Hunter Valley Forecast 2011-2020[10]	Revised 2010 HVAU – Hunter Valley Forecast 2011-2020.pdf	PDF	Unknown
Office of Rail Regulation	-	Annual efficiency and finance assessment of Network Rail 2012-13	nr-annual-assessment-2012-13.pdf	PDF	September 2013
Asciano	-	Submission to the Queensland Competition Authority in Relation to the 2013 Aurizon Network Draft Access Undertaking	R-Asciano-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	October 2013
BMA and BMC	-	Issues and Concerns with Aurizon Network's (AN's) 2013 Draft Amending Undertaking (DAU)	R-BMABMC-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	10 October 2013
QRC	-	QRC UT4 Submission on Operating Expenditure	R-QRC-Submission-Pricing-AurizonNetwork2013DAAU-Att04-1013.pdf	PDF	10 October 2013
RTCA	-	Submission to the Queensland Competition Authority in response to Aurizon Network proposed 2013 draft access undertaking (UT4)	R-RTCA-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	10 October 2013
The Authority (prepared by Energy Economics)		Central Queensland Coal Railings Forecast (Confidential Version)	2013-07-31 Queensland railings UT4 main – CONFIDENTIAL (598613_1).PDF	PDF	July 2013

Table 2.2: Information sources – general

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date

[10] http://transition.accc.gov.au/content/item.phtml?itemId=995027&nodeId=37807b7485ec0734277b2a8024263ddd&fn=Revised%202010%20HVAU%20-%20Hunter%20Valley%20Forecast%202011-2020.pdf

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
The Authority		Terms of Reference, Engineering Technical Assessment of Maintenance, Operating and Capital Expenditure Forecast	QCA Terms of Reference_UT4 Engineer(565631_4)	PDF	27 June 2013
Aurizon Network	Volume 1 of 3 – The Access Undertaking and Schedules	Schedule E – Regulatory Asset Base	R-Aurizon-QR2013DAU-Vol1-0513	PDF	April 2013
Aurizon Network	Volume 1 of 4 – UT4 Explanatory Materials	Overview and Summary	R-Aurizon-QR2013DAU-ExMatOvr-0513	PDF	30 April 2013
Aurizon Network	Volume 2 of 4 – UT4 Explanatory Materials	The 2013 Undertaking Proposal	R-Aurizon-QR2013DAU-ExMatSub-0513	PDF	30 April 2013
Aurizon Network	Volume 3 of 4 – UT4 Explanatory Materials	Maximum Allowable Revenue and Reference Tariffs	R-Aurizon-QR2013DAU-ExMatBB-0513	PDF	30 April 2013
Aurizon Network	Volume 4 of 4 – UT4 Explanatory Materials	UT4 Maintenance Submission	R-Aurizon-QR2013DAU-ExMatMaint-0513	PDF	Confidential Version 30 April 2013

A.1 Requests for information

SKM raised the following RFIs to address specific areas of required information:

Owner	Document Name	Electronic File Name	Document Type	Relevant RFI
Aurizon Network	SKM UT4 costs including escalation	SKM UT4 costs including escalation.xlsx	Microsoft Excel Workbook	AUR-010
Aurizon Network	Operational 2009 to 2013	Operational 2009 to 2013.xlsx	Microsoft Excel Workbook	AUR-015
Aurizon Network	Operational metrics as per UT4 maintenance submission	Operational metrics as per UT4 maintenance submission April 13130925-mick bray.xlsx	Microsoft Excel Workbook	AUR-015

Attachment D: Specialist opinion on specific aspects of the operating expenditure forecast

Contents

1. Glossary

Abbreviations and definitions used in this document are listed in **Table 1.1**.

Table 1.1: Abbreviations and Terminology

Abbreviation, Acronyms and Terminology	Description / Definition
Aurizon Network	On 3 December 2012, QR Network Pty Ltd changed its name to Aurizon Network Pty Ltd.
BMA and BMC	BHP Billiton Mitsubishi Alliance and BHP Billiton Mitsui Coal
CQCN	Central Queensland coal network
CQCR	Central Queensland coal region
DAU	Draft Access Undertaking
MAR	Maximum Allowable Revenue
mt	Million tonnes
QRC	Queensland Resources Council
RTCA	Rio Tinto Coal Australia
SKM	Sinclair Knight Merz
The Authority	Queensland Competition Authority
tp	Train paths
UT3	2010 Access Undertaking (2009/10 – 2012/13)
UT4	2013 Access Undertaking (2013/14 to 2016/17)
UT5	2017/18 -2020/21 Access Undertaking

2. Specialist opinion on specific aspects of the operating expenditure forecast

2.1 Task description and methodology

Aurizon Network's forecast operating expenditure for the UT4 period includes allowance for risk and insurance, specifically:

- a premium for relevant specifically insured risks under the Industrial and Special Risks policy;
- a premium for corporate insurances which have been costed on the basis of Aurizon Network being a stand-alone entity; and
- a premium based on the costs of insuring key below-rail risks such as derailments, dewirements, weather events and below-deductible liability losses.

The Queensland Competition Authority (the Authority) engaged SKM to provide specialist opinion on the reasonableness of the following sections of Chapter 10 of Volume 3 of UT4:

- Derailments (Section 10.5.5.1); and
- Dewirements (Section 10.5.5.3).

SKM's review of the reasonableness of Aurizon Network's proposed derailments and dewirements risk has been undertaken through:

- review of Aurizon Network's key assumptions outlined in Section 10.5.5.1 and Section 10.5.5.3 of Chapter 10 of Volume 3 of the 2013 DAU including analysis of the forecast change in risk and consequence (cost). The review is further informed by information sources outlined in **Appendix A**;
- review of key factors impacting derailments and dewirements risk, to inform the assessment of the reasonableness of Aurizon Network's forecasts, with specific focus on Aurizon Network's proposed maintenance program and operating conditions and the expected impact on derailments and dewirements risk; and
- a benchmarking exercise to inform the assessment of reasonableness, based on a review of international literature outlining historical derailments and dewirements risk. Where possible, SKM has attempted to obtain information for comparable heavy-haul / coal networks. However, it is noted that derailments and dewirements risk is generally not impacted by the type of haulage. Rather, the actual exposure and severity of consequence is impacted.

Based on the tasks outlined above, SKM has drawn conclusions on the reasonableness of Aurizon Network's forecast derailment frequency and dewirements annual cost.

It should be noted that while benchmarking provides a reasonable indicator as to the relative efficiency of specific aspects Aurizon Network's forecast operating expenditure, there are limitations associated with this approach. Specifically, differences in operational and system characteristics will impact on the cost structure across various operators. Therefore, SKM has supplemented the benchmarking exercise with specialist opinion as to the appropriateness of forecasts, based on our knowledge of Aurizon Network's operational and system characteristics, including planned maintenance activities.

2.1.1 Requests for Information and adequacy of information provided

- SKM requested more detail on the methodology for determining the risk of derailments and dewirements (and associated costs). Aurizon Network has provided an excerpt of the report prepared by Finity Consulting outlining key assumptions / basis of calculations for the forecast dewirements self-insurance. SKM was not provided with a complete version of the report and therefore has been unable to review data and assumptions informing the forecast derailments frequency and cost.

- SKM also requested estimates of forecast train kilometres for the UT4 period, which were subsequently provided by Aurizon Network. This information was required to convert the forecast derailment frequency to a rate per train kilometre travelled, for comparison to other operators as part of the benchmarking exercise.

2.2 Risks of derailments

2.2.1 Factors impacting on derailment risk

Train derailments occur due to a variety of different causes, and will vary in frequency and severity depending on operating conditions. Derailment frequency itself is a product of derailment rate and traffic exposure. Factors impacting derailment severity include the mass and speed of a train, where greater force indicates a greater potential impact in terms of property damage, casualties and environmental impact.

Broken rails or welds are generally the most common causes of derailments for main line running (excluding shunts) on heavy haul railways, although effectiveness of derailment prevention strategies and activities may vary in different track systems. Upgrading track quality has been identified as one possible strategy for preventing derailments. However, while upgrades to track infrastructure and quality are expected to prevent certain track related derailments, it may also increase the risks from certain types of equipment failure (for example failures of turnouts and crossovers) that are more likely to occur at higher speeds.

Efficient allocation of resources to prevent derailments on heavy haul railways therefore requires an understanding of specific factors and circumstances which contribute to derailment risk (and the extent of contribution), the forecast frequency of occurrences and the potential severity. Severity is measured through consideration of acceptable levels of safety, service and monetary damages for system repairs caused by derailment. Repair costs alone are subject to a number of variables, such as the cost difference between repairing ‘regular’ track versus ‘special’ track. Examples of ‘special’ track include junctions, turnouts and crossovers.

With this information, an optimal level of safety improvements, reductions in operational disruptions and repair cost minimisation is achievable through evaluation of the benefits of derailment prevention strategies and activities compared to their cost, where the severity of derailments on individual track systems is used to assess the benefit of derailment mitigation. In practice, standards of service and safety are determined outside of the cost benefit analysis, and monetary severity is generally used to assess the effectiveness of derailment prevention, and to allocate levels of insurance (including self-insurance) where it is more economical than prevention.

Aurizon Network’s maintenance and operating practices – impact on derailment risk

SKM has conducted a review of Aurizon Network’s proposed maintenance program and asset renewals strategy to assess the impact on risk of derailments. A number of factors have been observed which should result in an improvement in derailment frequency over the UT4 period, compared to historical levels. Importantly, this includes a transition from corrective to preventative maintenance activities, some of which are outlined below:

- Aurizon Network’s increased use of technology such as ground penetration radars[1] is expected to provide enhanced information about the condition of assets across the network. Over time, this

[1] Ground penetration radars are used to survey conditions of trackbed superstructures with regard to quality and water content, providing information for planning maintenance and renewal.

information should in turn result in early identification of the need for preventative maintenance which would reduce derailment risks from contaminated ballast;

- increased undercutting – in the UT3 period, Aurizon Network proposed to purchase more ballast wagons; however these are now expected in the UT4 period. While the current intervention levels for ballast fouling will remain, the improved understanding of the ballast condition obtained through the GPR data and the improved delivery of service will reduce the level of ballast contamination which is expected to result in a decreased risk of derailments caused by top/twist and line defects

- increased resurfacing – Aurizon Network's proposed maintenance activities include an increase in resurfacing compared to historical levels, which should result in a decrease in the risk of derailments caused by top/twist and line defects. To further enhance its future resurfacing capability, Aurizon Network proposes to purchase 5 new mainline tampers and 2 switch tampers during the UT4 period, the benefits of which should be observed in UT4 and UT5 forecasts;

- rolling stock mounted equipment – Aurizon Network has commenced a program of analysing data from equipment on the Rail Grinding Consist which allows for enhanced information on rail condition and track geometry to enable preventative maintenance which will reduce derailment rates; and

- improved track and flange lubrication to further reduce friction between the rail and wheel flange and subsequently reduce the risk of derailment in difficult geometries (such as small radius curves).

In addition to preventative maintenance activities, Aurizon Network proposes a change in the asset management strategy for the UT4 period, which they claim will result in a significant increase in renewals expenditure for this period[2]. It is noted that some renewals are also required for replacement of end of life assets. Nevertheless, improvements in track condition across the network would be expected to result in a decline in the forecast derailment risk compared with levels observed in the UT3 period and before.

In terms of consideration for derailment risk compared to other operators, the following observations are provided:

- maintenance of narrow gauge track structures – narrow gauge structures provide less resistance to lateral displacement compared to standard gauge structures, which result in the requirement for a stricter tolerance and increased safe maintenance intervention requirements. SKM notes that these practices have not have altered significantly from the UT3 period, and therefore while narrow gauge track structures may have an impact on derailment risk relative to other operators, Aurizon Network's overall derailment risk associated with narrow gauge track structures should not be significantly different from the UT3 period ;

- speed / narrow gauge relationship – Aurizon Network notes in the UT4 maintenance submission that implications of trains with a narrower wheel base compared to standard gauge may impact on the stability and safe speed on both straights and curves. The use of world class heavy haul trains means that safe travelling speeds are generally not impacted; however, SKM notes that the overall impact on stability may result in an increased derailment risk relative to other operators. It is noted that these operating conditions have not changed since the UT3 period and should therefore not result in changes to the forecast derailment risk; and

- weather conditions – The CQCR is characterised by heavy rain and flooding across some systems, which could reasonably increase the risk of derailments associated with track inundation and formation issues ,although this is risk is managed through speed restrictions. While the CQCR has experienced higher than average historical rainfall during the UT3 period, it is unreasonable for SKM to predict with any amount of certainty if this pattern will continue.

[2] Section 8.4 Volume 3 of UT4 explanatory materials

2.2.2 Overview of Aurizon Network's indicated derailment risk and self-insurance

Table 2.1 provides Aurizon Network's proposed risk of derailments (by type) including the size of loss for the UT4 period. Data is also provided for the UT3 period forecast as a comparison.

Aurizon Network's forecast derailment frequency is provided on a gross tonne kilometre (gtk) basis, and price years for the UT3 forecast are in current dollar terms (for example, 2009/10 are in 2009/10 dollars) while the UT4 forecast is provided in December 2013 dollars, based on the forecast undertaken by Finity Consulting (Actuarial and Insurance Consulting).

Table 2.1 CQCR derailment risk / frequency[3]

Year / derailment Type	UT3				UT4			
	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Track (excl. Large)								
Frequency (per billion gtk)	0.06	0.06	0.06	0.06	0.12	0.12	0.12	0.12
Size of loss	165,000	165,000	165,000	165,000	117,000	117,000	117,000	117,000
Yards / Sidings (excl. Large)								
Frequency (per billion gtk)	1.1	1.1	1.1	1.1	0.97	0.97	0.97	0.97
Size of loss	12,500	12,500	12,500	12,500	7,000	7,000	7,000	7,000
Large*								
Frequency (per billion gtk)	0.016	0.016	0.016	0.016	0.024	0.024	0.024	0.024
Size of loss	460,000	460,000	460,000	460,000	926,000	926,000	926,000	926,000

**For the UT4 period Large has been defined as a derailment with a below-rail cost of more than $500,000, whereas in the UT3 period it was defined as a derailment with a total cost (above and below-rail) of more than $1 million.*

SKM has therefore requested information from Aurizon Network to determine the escalation factors assumed by Finity Consulting, which SKM has applied to UT3 forecasts to bring them to a base year of December 2013. The yearly escalation factors provided by Aurizon Network are outlined in **Table 2.2**.

Table 2.2 Yearly inflation

Year	Yearly inflation
2009	3.6%
2010	3.9%
2011	2.7%
2012	3.5%
2013	3.5%

Source: Aurizon Network, provided on 20 November 2011

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Table 2.3 provides the resulting escalation factors which SKM has applied to UT3 costs, based on the data in **Table 2.2** and the methodology described by Aurizon Network which has been utilised by Finity Consulting. As an example, the escalation factor for costs presented in 2009/10 is derived based on **Equation 1**:

Equation 1 Example of methodology utilised to derive escalation factors

$$Escalation\ factor\ for\ 2009/10\ costs = (1.036 \times 1.039 \times 1.027 \times 1.035 \times 1.035)^4$$

[3] Source: Section 10.5.5.1 of Volume 3 of 4 – UT4 Explanatory Materials, Maximum Allowable Revenue and Reference Tariffs

[4] (1+yearly escalation for 2009) * (1+yearly escalation for 2010)…..

Table 2.3 Escalation factors

Year	Escalation Factor
2009/10	1.184
2010/11	1.143
2011/12	1.100
2012/13	1.071

Source: SKM table based on information and data provided by Aurizon Network on 20 November 2011

Table 2.4 provides the adjusted forecast size of loss for the UT3 period to reflect a price year of December 2013.

Table 2.4 Adjusted size of loss ($December 2013)

Derailment Type	UT3				UT4			
	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Track (excl. Large)	195,394	188,604	181,524	176,752	117,000	117,000	117,000	117,000
Yards / Sidings (excl. Large)	14,803	14,288	13,752	13,390	7,000	7,000	7,000	7,000
Large	544,734	525,805	506,068	492,764	926,000	926,000	926,000	926,000

Source: SKM table based on information provided by Aurizon Network on 20 November 2011

With regards to frequency, the data provided by Aurizon Network (as outlined in **Table 2.1**) indicates:

- a significant increase in the forecast frequency of track (excl. large) derailments compared to the average over the UT3 period, from 0.06 derailments per billion gtk forecast for the UT3 period to a forecast 0.12 derailments per billion gtk during the UT4 period. This represents an increase in forecast track derailment (excl. large) of 100 per cent in the UT4 period compared to that forecast for the UT3 period;

- a forecast decline in the frequency of yards / sidings (excl. large) derailments of approximately 12 per cent over the UT4 period compared to that forecast for the UT3 period. The explanatory notes accompanying Aurizon Network's proposed UT4 access undertaking notes that the decline is attributable to a focus on improvements in risk management and safety awareness. SKM notes that this improved safety awareness includes, but is not limited to, safer shunting practices, lower speeds in yards and capital upgrades to yard infrastructure (such as capital upgrades to the Jilalan Yard); and

- a significant increase in the forecast frequency of large derailments (50%) over the UT4 period compared to the forecast for the UT3 period.

It is important to note that the comparisons provided above represent a change in forecast derailments, not a change in actual derailments. Specifically, the forecast for the UT3 period was derived for the 2010 DAU based on actual derailment occurrences for the four year period between 2005 and 2008, while the derailments forecast for the UT4 period is based on a longer timeframe (the 8 year period between 2005 and 2012). Therefore the forecast for the UT4 period includes the same data as the UT3 period, but could be considered more accurate due to the longer timeframe for the forecast which would capture changes in the operating environment compared to the UT3 forecast. The forecast for the UT4 period also includes the impacts of considerable rain and flooding which occurred in 2011 and 2013, and this is therefore contributing to the increase in forecast derailments.

Figure 1 provides a graphical representation of Aurizon Network's forecast derailment frequencies for the UT4 period compared to the forecast made for the UT3 period.

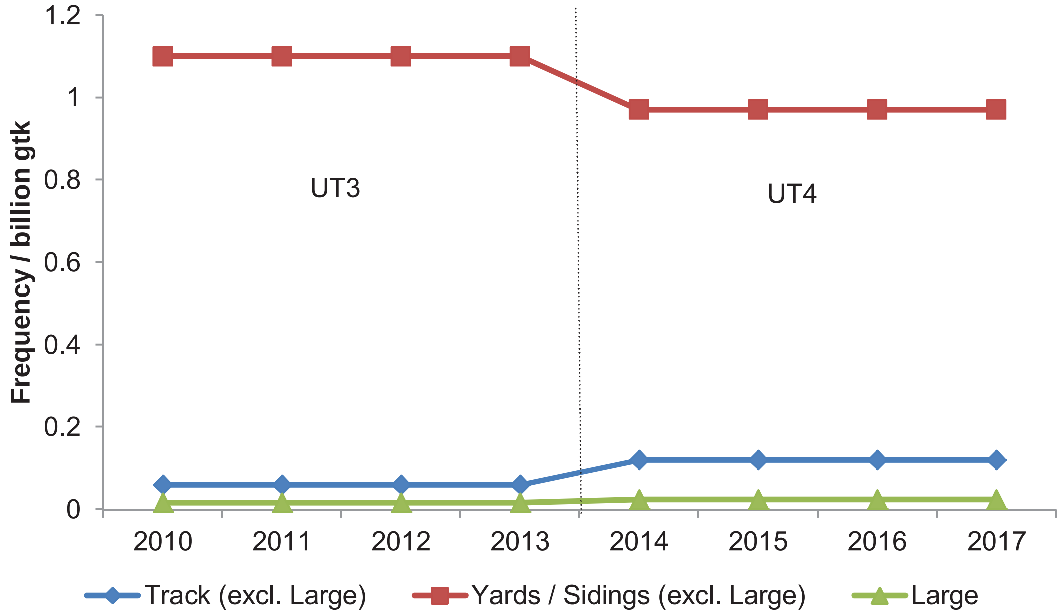

Figure 1 Aurizon Network's forecast derailment frequencies

Source: SKM graph based on data from Table 88 on page 266 of Volume 3 of the 2013 DAU, Maximum Allowable Revenue and Reference Tariffs

With regards to the size of loss by derailment type, the data provided by Aurizon Network (as outlined in **Table 2.1**) indicates:

- a forecast 37 per cent reduction in the average cost of track (excl. large) derailments over the UT4 period compared to the forecast made for the UT3 period (in real terms). Aurizon Network's explanatory notes accompanying the proposed UT4 access undertaking notes that the forecast reduction in average cost is due in part to an increase in frequency of derailments of this type, and is partially due to redefinition of large track derailments;
- a forecast 50 per cent decrease in the average cost of yards / sidings (excl. large) derailments (in real terms) over the UT4 period compared to the forecast made for the UT3 period; and
- a substantial increase in the forecast average cost of large derailments, increasing from an average of $517,343 to a forecast $926,000 in the UT4 period. This represents a 79 per cent increase from the forecast for the UT3 period. Aurizon Network's proposed UT4 access undertaking indicates that this increase is most likely due to the change in definition for the previous period and a small number of losses resulting in sensitivity to the size of individual losses.

Figure 2 provides a graphical representation of Aurizon Network's average forecast consequence of derailments (size of loss) for the UT4 period compared to the forecast for the UT3 period.

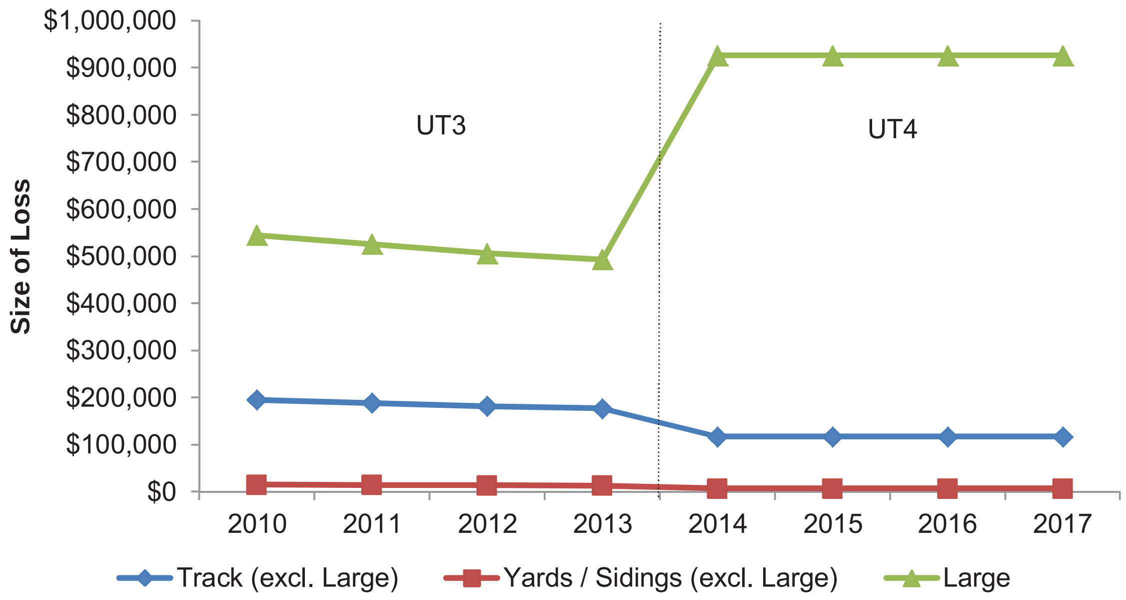

Figure 2 Aurizon Network's forecast derailment consequence

Source: SKM graph based on data from Table 88 on page 266 of Volume 3 of the 2013 DAU, Maximum Allowable Revenue and Reference Tariffs

Table 2.5 provides Aurizon Network's proposed self-insurance against derailments in the UT4 period, based on the frequency and size of loss outlined in **Table 2.1**. Aurizon Network's self-insurance costs per year are increasing each year over the UT4 period due to a forecast increase in gtk and resulting associated increased exposure to derailments.

Table 2.5 Aurizon Network's proposed self-insurance against derailments

Year / derailment type	2013/14 ($m)	2014/15 ($m)	2015/16 ($m)	2016/17 ($m)
Track (excl. Large)	1.16	1.3	1.4	1.49
Yards / Sidings (excl. Large)	0.55	0.61	0.66	0.7
Large	1.82	2.04	2.19	2.34

Source: Table 90 on p267 of Volume 3 of the 2013 DAU, Maximum Allowable Revenue and Reference Tariffs

2.2.3 Reasonableness of forecast derailments and size of loss

Observations

Aurizon Network's proposed UT4 access undertaking notes that derailment frequency by type has been forecast based on historical frequency of derailments per billion gtk. The proposed UT4 access undertaking does not provide specific detail on historical derailment frequency or the formula for frequency derivation. SKM has therefore made the following observations based on a review of the information provided in **Section 2.2.2**.

Track derailments (excl. large derailments):

- As previously noted, the historical derailments frequency from which the UT4 forecast was derived includes the impact of severe weather events which occurred in 2011 and 2013. The impact of these weather events is evidenced by a forecast increase in the frequency of track derailments for the UT4 period. Although SKM concedes that inclusion of a greater number of years from which the forecast is developed should provide an enhanced level of accuracy, it is not apparent that the forecast has been undertaken to assess the probability of the reoccurrence of severe weather events, and therefore the forecast for the UT4 period is potentially overstated[5], since it is not reasonable to assume that severe weather events will continue to occur at a rate of every four years (two years out of the eight year forecast) without a detailed statistical analysis. Since SKM has not been provided a full copy of the report conducted by Finity Consulting, SKM has been unable to verify if the forecast has in fact included a probabilistic analysis, however given that the 2013 DAU discusses a 'smoothed approach' to the forecast based on eight years of data it seems unlikely that this has occurred;

- The transference of some derailments not previously categorised as large would be expected to result in a decline in the frequency per billion gtk of track derailments (excl. large derailments) over the UT4 period. This is not observed in the forecasts, although SKM notes that the UT4 forecast is based on a longer timeframe and therefore this impact may not be readily observable or may be offset by increased frequency from historical weather events; and
- As a more general observation, although Aurizon Network attributes the forecast decline in average cost per occurrence to forecast increase in frequency, this is more likely attributable to some derailments now being categorised as large and therefore reducing the overall average cost. The average cost (size of loss) from track derailments (excl. large derailments) would only decrease with an increase in frequency of derailment occurrences of smaller consequence, which has not necessarily been demonstrated in Aurizon Network's proposed UT4 access undertaking, although SKM has received information from Aurizon Network which suggests that forecast decline in average cost is attributable to a combination of both a higher frequency of lower cost events and the transfer of some derailments to the 'large' classification.

Yards / sidings derailments (excl. large derailments):

Aurizon Network's proposed UT4 access undertaking attributes a portion of the decline in track / sidings derailments to the fact that many of these are very small incidents. Aurizon Network's observation is reproduced below:

"The number of derailments occurring in yards or sidings each year is much higher than the number occurring on track, particularly as many of these yard/siding derailments are very small incidents" (Aurizon Network, Section 10.5.5.1 of Volume 3 of 4 – UT4 Explanatory Materials, Maximum Allowable Revenue and Reference Tariffs, p267).

SKM notes that the nature of the derailment as measured by the consequence (size of loss) would have no bearing on the frequency, unless preventative maintenance activities are adjusted such to suggest that the economic cost of preventing low consequence derailments does not outweigh the benefit of a reduction in exposure. In this instance, the frequency of lesser scale events would be more common as the maintenance regime would 'allow' them to occur. Therefore, SKM finds that that the forecast reduction in frequency is attributable to improvements in risk management and safety awareness (also noted as factors by Aurizon Network in the proposed UT4 access undertaking). It should also be noted that yards / sidings derailments would not be particularly impacted by severe weather events, and this is reflected in a decline in forecast frequency while the forecast frequency for other derailment types are increasing.

Large derailments:

- SKM notes that some of the increase in frequency of large derailment occurrences is attributable to transference of derailments previously not categorised as large derailments in the UT3 period. However, it is difficult to determine the magnitude of the impact that this would have on the frequency without detailed historical data, and particularly since the track derailment (excl. large derailments) are forecast to increase relative to the UT3 forecast. There is no observed proportional decline in derailment frequency per billion gtk for track derailments (excl. large derailments) compared to the increase in large derailments. However, SKM notes that it is difficult to make accurate comparisons of the change in derailment risk over time since the data presented represents a comparison of two forecasts, and

[5] This is reflected in the 100 per cent increase in forecast track derailments (excl. large) and 50 per cent increase in forecast large derailments.

therefore it is not reasonable to assess a 'change' in actuals compared to the UT3 period. SKM also notes that the substantial increase in forecast large derailments is more likely attributable to severe weather events;

- The substantial increase in the forecast large derailment cost (size of loss) from an average of $517,343 to $926,000 on average does not appear to be substantiated based on the information provided in Aurizon Network's Access proposed UT4 access undertaking, and supporting information. Aurizon Network states in Section 10.5.5.1 that this increase in average cost is attributable to inclusion of derailments previously not categorised as 'large', however SKM finds that this is likely to have the opposite effect. Large derailments were previously categorised as total above and below rail cost of $1 million, whereas in the proposed UT4 access undertaking, large derailments are defined as derailments with a below-rail cost of more than $500,000. Therefore, all else being equal, the inclusion of lower cost incidents should drive the average cost down not up (as the minimum cost declines). In response, Aurizon Network has provided commentary to SKM that the increase in average cost occurs from an increased historical occurrences of high cost derailments between 2008 and 2012. Specifically, Aurizon Network noted that because the actual occurrence of incidents is very small, the forecast is therefore sensitive to one large incident impacting on the average. This again highlights the need for a probabilistic analysis which considers the weighted impact of various derailment types rather than a smoothed average; and

- Similarly, SKM has been unable to determine why in the UT3 period the average cost (size of loss) per incident would have been less than the minimum value required for definition as a 'large' derailment (the average cost in the UT3 period was $517,343, although the definition of a 'large' derailment comprised derailments with a consequence greater than $1 million). Therefore, it is recommended that further detail be provided as to the derivation of incident costs per category, as these observations cast some uncertainty around forecast estimates. SKM notes that these estimates were derived externally of Aurizon Network[6] and have therefore been independently verified. Also, it is possible that the UT3 forecast has been presented by Aurizon Network to include the re-classification of incidents and therefore the average cost is less than $1 million, although this has not been verified by Aurizon Network.

Benchmarking

SKM has undertaken a review of publically available information to obtain a suitable benchmark which will inform the assessment of appropriateness of Aurizon Network's forecast derailment frequency and has selected average derailment frequencies for United States (US) Class 1 railroads to inform the assessment of appropriateness of Aurizon Network's derailment frequency. This selection is largely informed by information which is readily available to the public, as well as information from Aurizon Network indicating that as below rail operators the organisation holds the US Class 1 coal railroads as a benchmark of acceptable level of service.

SKM has obtained an average train derailment rate for US Railroads[7], Classes 1 – 5. These derailment rates are compared to Aurizon Network's forecast frequency in **Table 2.6**. The historical derailment rate (risk) for US Class 1 Railroads is provided as train derailments per million freight train miles. In order to provide a comparable unit rate, SKM has converted the US historical derailment risk to a rate per train kilometre travelled. An estimate of total forecast train kilometres for the UT4 period from which derailments risk per train kilometre can be derived has been provided by Aurizon Network. More generally, SKM proposes that this measure is more effective since the tonnage profile (weight) does not impact the risk of derailment, rather the severity is impacted. As such, derailment risk per train kilometre travelled provides a more suitable unit measure of derailment risk which can be compared with other operators.

[6] Aurizon Network engaged Finity Consulting (Actuarial and Insurance Consultants) to derive the self-insurance estimates

[7] Lui, X., Barkan C.P.L and Rapik Saat, M.

Table 2.6 Aurizon Network's forecast derailment risk per million train kilometres compared to US operators

Aurizon Network	2013/14	2014/15	2015/16	2016/17
Forecast total derailments[8] per billion gtk	1.1	1.1	1.1	1.1
Total gtk (billion)	80.5	90.2	97	103.7
Forecast no. of derailments	89.7	100.5	108.1	115.5
Forecast train kilometres (millions)	12.2	13.6	14.7	15.9
Total train derailments per million freight train kilometres	7.4	7.4	7.4	7.3
US historical derailment rates	**Total train derailments per million train miles**		**Total train derailments per million train kilometres**	
Class 1	48.54		78.12	
Class 2	6.06		9.75	
Class 3	2.04		3.28	
Class 4	0.53		0.85	
Class 5	0.32		0.51	

Source: Lui, X., Barkan C.P.L and Rapik Saat, M and Chapter 10 of Volume 3, Section 10.5.5.1

Figure 3 provides a graphical representation of Aurizon Network's forecast derailment risk compared to US Class 1 operators. It is noted that the published derailment rate for Class 1 railroads appears disproportionately high compared to other railroads. The Class 1 historical derailment risk is therefore not reported in **Figure 3**, but has been provided in **Table 2.6**. Overall, Aurizon Network's forecast derailment risk appears reasonable on the basis of the benchmarking exercise.

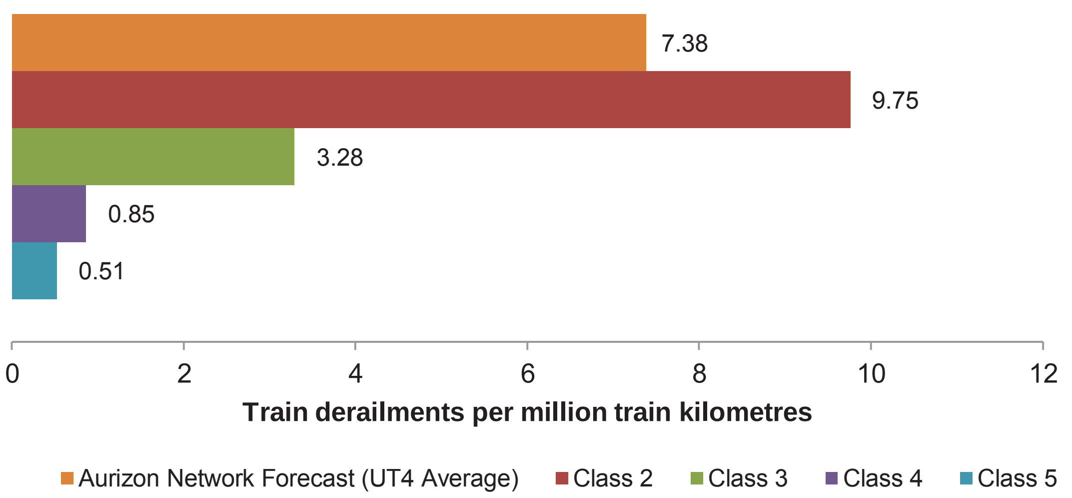

Figure 3 Aurizon Network's forecast derailment rate compared to US railroads

*Source: SKM graph based on information provided in **Table 2.6***

SKM has also obtained publically available data from the Independent Transport Safety Regulator in NSW which reports 22 notifications of running line freight train derailments in 2010-11, representing a derailment rate of 1.22 derailments per million freight train kilometres travelled. This value has been compared with Aurizon Network's forecast track (excl. large) and large derailments (yards / sidings derailments are not reported in the

[8] Sum of track (excl. large), yards / sidings (excl. large) and large derailments.

data published by the Independent Transport Safety Regulator) in **Table 2.7**. The results indicate that Aurizon Network's forecast running line derailment rates are reasonable compared to historical occurrences in NSW, with Aurizon Network performing slightly better than the NSW average running line freight train derailments.

Table 2.7 Aurizon Network's forecast running line derailment risk per million train kilometres compared to NSW freight operators

NSW – running line derailments per million freight train kilometres	Aurizon Network running line derailments per million freight train kilometres			
2010/11	**2013/14**	**2014/15**	**2015/16**	**2016/17**
1.22	0.95	0.96	0.95	0.94

Source: Independent Transport Safety Regulator (2012) and Aurizon Network (2013)

Concluding remarks

SKM has provided a review of observed trends in the forecast derailment risk and consequence. Overall, Aurizon Network's forecast derailment risk appears reasonable on the basis of the benchmarking exercise. However, there are a number of planned / proactive maintenance practices which should reduce the running line derailment risk in the UT4 period (noting that derailment risk is forecast to increase for running line derailments and decrease for derailments in yards / sidings). These include:

- preventative maintenance activities such as increased undercutting and resurfacing and improved track and flange lubrication;
- improved information from the use of ground penetration radar and asset condition monitoring devices included on grinding machine, which should allow for early identification of defects which may cause train derailment; and
- asset renewals which improve the condition of the track and therefore reduce the risk of derailment from structural failures.

SKM notes that the UT4 forecast is based on historical derailment frequencies and has therefore not accounted for improvements which should occur from improved operating conditions from the proposed maintenance and asset renewals program. In addition, the historical derailments frequency includes the impacts of severe weather events which occurred in 2011 and 2013, for which Aurizon Network has not demonstrated that a probabilistic analysis has been undertaken to inform a weighted frequency based on the likelihood of re-occurrence. In this regard, there is a significant possibility that the forecast derailments risk is over-stated, although without detailed data within the Finity Consulting report SKM has been unable to make proposed adjustments.

Despite the likelihood of an overstated forecast, SKM notes that the actual forecast occurrences of track derailments is small compared to yards / sidings derailments. Therefore, while it would be useful to consider removing the impact of severe weather events from the forecast or to conduct a detailed probabilistic analysis, given that the benchmark frequency is relatively similar to other operators, SKM recommends that no adjustments are made at this stage to the forecast frequency. However, SKM does recommend that consideration is made for a potential reduction in volumes (as forecast by Energy Economics) on the total insurance premium for derailments. Although it is difficult to know the exact impact on gtk from a reduction in net tonnes (due to differing origin-destination points), SKM has made some estimates in **Table 2.8** which assumes an equal reduction in gtk for the forecast reduction in tonnes.

Table 2.8 SKM's revised derailment self-insurance for lower volumes

Exposure (gtk)	2013/14	2014/15	2015/16	2016/17
Total gtk (billion) – Aurizon Network Forecast	80.5	90.2	97	103.7
Total reduction in tonnes based on Energy Economics forecast	(4.7%)	(12.1%)	(13.9%)	(14.7%)

Revised gtk (billion) forecast	76.7	79.3	83.5	88.4
Forecast frequency per billion gtk	**2013/14**	**2014/15**	**2015/16**	**2016/17**
Track (excl. Large)	0.12	0.12	0.12	0.12
Yards / Sidings (excl. Large)	0.97	0.97	0.97	0.97
Large	0.024	0.024	0.024	0.024
Forecast occurrences	**2013/14**	**2014/15**	**2015/16**	**2016/17**
Track (excl. Large)	9.2	9.5	10.0	10.6
Yards / Sidings (excl. Large)	74.4	76.9	81.0	85.8
Large	1.8	1.9	2.0	2.1
SKM's proposed derailments self-insurance ($December 2013)	**2013/14**	**2014/15**	**2015/16**	**2016/17**
Track (excl. Large)	$1,076,851.8	$1,113,774.9	$1,172,292.7	$1,241,233.8
Yards / Sidings (excl. Large)	$520,785.2	$538,641.8	$566,942.1	$600,283.3
Large	$1,704,555.1	$1,763,000.9	$1,855,629.1	$1,964,756.4
Total	$3,302,192.1	$3,415,417.6	$3,594,863.8	$3,806,273.4
Reduction from Aurizon Network proposed	-$227,807.90	-$534,582.41	-$655,136.17	-$723,726.57

Source: SKM table and Energy Economics (2013)

SKM also recommends that the Authority does not approve a derailments forecast for the next undertaking period (UT5) for which a detailed statistical analysis has not been undertaken to assess the impact of weather events.

2.3 Risk of Dewirements

2.3.1 Factors impacting on dewirements risk

Dewirements generally refer to a major failure of overhead line electrification equipment for electrified rail networks. Although some cases of dewirements are caused by trains themselves (such as pantograph entanglement), it is important to note that dewirements may not necessarily involve or require the presence of a pantograph (or the presence of the rollingstock itself). More specifically, dewirements can be caused by environmental factors such as extreme weather, wildlife intervention, vandalism or ongoing deterioration leading to out of gauge equipment or 'static' component failure. With this in mind, although increased train kilometres travelled may result in some increase in the risk of dewirements from pantograph entanglement, SKM considers that the estimates of the frequency and annual cost of dewirements are appropriate as a cost per electrified track kilometre, since a number of dewirements occur in the absence of rollingstock.

In the case of pantograph entanglement as a cause of dewirements, these are most common in complex areas such as crossovers, where the pantograph must negotiate two wires and could become entangled. Other common areas include tunnels or underbridges, where the pantograph must decrease in height to cater for reduced electrical clearance. Component failures include insulator failures and worn contact wire.

Aurizon Network's maintenance and operating practices – impact on dewirements risk

SKM notes that there are few operational activities which can reduce the risk of dewirements from environmental factors, although there are some on-train monitoring systems which can detect issues with the overhead line. There are also some monitoring systems for pantograph failures which include trackside monitoring systems that detect out-of-spec pantographs.

There is very little preventative maintenance which can be conducted to prevent dewirements, although asset renewals will have some impact if they include replacement of overhead lines or components.

Overall, SKM notes that Aurizon Network has not proposed any new planned maintenance or operational practices for the UT4 period which would be likely to reduce dewirements risk. The extent that asset renewals will impact on dewirements frequency is insignificant, since a number of dewirements are caused by external factors such as extreme weather.

2.3.2 Overview of Aurizon Network's indicated risk of dewirements and self-insurance

Table 2.9 provides Aurizon Network's indicated annual dewirements cost per track kilometre which was derived for the proposed UT4 access undertaking based on historical data from the four years to 2012. Page 269 of Volume 3 of the proposed UT4 access undertaking indicates that the forecast cost of dewirements (including labour costs) is excluded from the UT4 maintenance cost estimate.

Aurizon Network's proposed dewirements cost is $101 per track km, and has been derived as follows:

1. review of historical annual losses from dewirements per track kilometre; and
2. application of selected annual dewirements losses per electrified track kilometre to projected electrified track kilometres.

Table 2.9 Aurizon Network's forecast annual dewirements cost

Variable	2013/14	2014/15	2015/16	2016/17
Estimated CQCN electrified track (km)	1,701	1,701	1,905	1,905
Cost per km per year ($2013/14)	101	101	101	101
Estimated cost (millions, $2013/14)	0.17	0.17	0.19	0.19

Source: Table 92 on p268 of Volume 3 of the 2013 DAU, Maximum Allowable Revenue and Reference Tariffs

[redacted]

- due to a lack of reliable data prior to the UT3 period, the dewirements frequency per year has been forecast based on the four year period to 2012;
- the historical data indicated an average frequency of 0.78% per electrified track kilometre per year, based on observations in 2009, 2010, 2011 and 2012. These observations are reproduced in **Table 2.10** below (excluding Moura and Newlands which are not electrified);
- the annual cost of dewirements per track kilometre was estimated based on the average claim size from 2009, 2010, 2011 and 2012, which was $13,000, multiplied by the estimated frequency and converted to a cost per electrified track kilometre. Historical average dewirements costs are reproduced in **Table 2.11** (excluding Moura and Newlands which are not electrified).

Table 2.10 Central Queensland Coal Region historical dewirements frequency

Year	Frequency per electrified track kilometre			
	Blackwater	Goonyella	Unknown	Total
2009	[redacted]	[redacted]	[redacted]	[redacted]
2010	[redacted]	[redacted]	[redacted]	[redacted]
2011	[redacted]	[redacted]	[redacted]	[redacted]
2012	[redacted]	[redacted]	[redacted]	[redacted]
Total (average over 4 year period)	[redacted]	[redacted]	[redacted]	[redacted]

Source: Finity Consulting, p34

Table 2.11 Central Queensland Coal Region historical average dewirements cost

Year	Cost ($'000)			
	Blackwater	Goonyella	Unknown	Total
2009	[redacted]	[redacted]	[redacted]	[redacted]
2010	[redacted]	[redacted]	[redacted]	[redacted]
2011	[redacted]	[redacted]	[redacted]	[redacted]
2012	[redacted]	[redacted]	[redacted]	[redacted]
Total (average over 4 year period)	[redacted]	[redacted]	[redacted]	[redacted]

Source: Finity Consulting, p34

SKM has applied the assumed average dewirements frequency of 0.78% per track kilometre to derive the assumed frequency of occurrences. The results indicate a forecast dewirements frequency of 13 dewirements per year in 2013/14 and 2014/15, and 15 dewirements per year in 2015/16 and 2016/17.

It should be noted that SKM's proposed adjustment to self-insurance should not give rise to the potential for Aurizon Network to make an additional claim for damage associated with weather events similar to the Authority's decision on the December 2010 and January 2011 flooding Review Event which stated:

> *"As a consequence, while holding some concerns regarding QR Network's approach to demonstrating the adequacy or otherwise of its self-insurance arrangements (especially the late provision of additional analysis by Finity), the Authority accepts that the flood review event damage costs are not covered by the existing self-insurance arrangements and thus are eligible to be recovered via adjustments to Reference Tariffs.*
>
> *However, the Authority is concerned that significant uncertainty regarding the coverage and nature of the self-insurance arrangements continues to exist."*[9]

Rather, SKM is suggesting that a detailed probabilistic assessment has not been undertaken by Aurizon Network to provide a weighted likelihood of re-occurrence of severe weather events, and therefore the level of insurance should be reduced somewhat to reflect the likely overstatement. This is particularly true when considering that the CQCR was subject to prolonged drought in previous years[10].

2.3.3 Reasonableness of forecast dewirements and size of loss

Observations

The forecast dewirements cost is based on historical annual cost for the four years to 2012. As this period is categorised by severe weather events the overall annual cost per track kilometre for the UT4 period may be

[9] Source: The Authority, cited on page 257 of Volume 3 of the 2013 DAU, Maximum Allowable Revenue and Reference Tariffs
[10] See page 256 of Volume 3 of the 2013 DAU, Maximum Allowable Revenue and Reference Tariffs

distorted, since the cost per kilometre is based on historical frequency of dewirements. This impact is observable when reviewing **Table 2.10**, which shows that dewirements frequency in 2011 were greater than previous years (0.85 per cent compared to an average of 0.44 per cent for the previous two years and 0.74 per cent for the average of 2009, 2010 and 2012). SKM has also reviewed the excerpt of the report from Finity Consulting which shows that 3 out of 4 dewirements from 2011 were related to a flood event (the cause of the fourth event is unknown).

SKM recommends that Aurizon Network's forecasts should include a detailed analysis to determine historical dewirements incidents which can be attributable to severe weather events, and assess the likelihood of re-occurrence. However, in the absence of this analysis, SKM has proposed an adjustment to the dewirements cost to remove the impact of flood events in 2011 in the concluding remarks section below.

Benchmarking

SKM has approached a number of operators and regulatory agencies with mind to obtaining average dewirements frequency and/or annual cost for the benchmarking exercise. Agencies / operators approached include:

- Australian Rail Track Corporation
- The Australian Consumer and Competition Authority
- US Class 1 operators (BNSF, UP, CSX, KCSR, NS, GTC, SOO)
- United States Surface Transportation Board

To date, no information has been provided from the operators and agencies noted. SKM has attempted to supplement information required with a review of literature; however dewirements frequencies and/or annual costs were unable to be obtained. Therefore, SKM has drawn conclusions based on our internal specialist knowledge.

Based on our specialist industry knowledge, we would expect significant dewirements on the CQCR to be in the order of approximately 5 occurrences per year. Total dewirements, including significant and non-significant are expected to be in the order of approximately 10 per year.

Concluding remarks

SKM concludes that there are limited maintenance and/or operational practices which would potentially impact on dewirements risk and associated annual cost, and therefore forecast dewirements risk and average cost is generally acceptable based on historical information. It is noted however that severe weather events which occurred during the UT3 period may be distorting the overall estimated frequency of dewirements. It is therefore recommended that the Authority consider:

- requiring that Aurizon Network conduct a probabilistic analysis of the likelihood of re-occurrence of flood events; or
- removing the observed frequency and average cost from 2011 from the historical data set to account for potential distortions from extreme weather events. In this instance, SKM has provided a revised dewirements cost per track kilometre in **Table 2.12** below, based on the key assumptions outlined in the report prepared by Finity Consulting.

Table 2.12 Revised dewirements estimate

Variable	SKM revised estimate							
	2013/14	2014/15	2015/16	2016/17	2013/14	2014/15	2015/16	2016/17
Estimated CQCN electrified track (km)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

No. of dewirements	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Average cost per incident	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Cost per km per year ($2013/14)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Estimated cost (millions, $2013/14)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Source: SKM table based on p24 of the Finity Consulting report

SKM notes that dewirements frequency is not impacted by train paths / volumes and therefore no adjustment has been provided for revised volume forecasts provided by Energy Economics.

3. Aspects of dewirements and derailments self-insurance raised in the stakeholder submissions

The Authority also requested that SKM review and provides opinion on the issues raised by QRC, RTCA, BMA and BMC and Asciano in relation to the forecast self-insurance for derailments and dewirements.

SKM notes that there were no specific submissions in relation to the forecast derailments and dewirements insurance. However, stakeholders[11] expressed an overall concern about the forecast level of insurance (including self-insurance) relative to the 2010 DAU which can be discussed in the context of derailments and dewirements self-insurance. These submissions are outlined and discussed below.

3.1 Prudency of forecast insurance costs

Stakeholders expressed concerns that Aurizon Network's forecast insurance may not be prudent and efficient when considering the forecast maintenance, capital expenditure and historical incident rates.*

**BMA and BMC, QRC*

Stakeholders expressed concerns about the rising cost of risk and insurance in the UT4, querying the appropriateness and efficiency of Aurizon Network's self-insurance and and its relationship to forecast maintenance and capital programs. Stakeholders were also concerned about the significant cost of self-insurance as a proportion of the total risk and insurance allowance.*

**BMA and BMC, QRC, RTCA*

SKM has provided a review of reasonableness of the forecast derailment frequency and the forecast dewirements cost per track kilometre in this report.

Accordingly, SKM has expressed concerns that the forecast derailments risk is not prudent when considering the forecast maintenance and asset renewals program. Specifically, although the derailments risk is based on historical actual occurrences and therefore provides some level of accuracy, Aurizon Network has not demonstrated that a statistical analysis has been undertaken to assess the impact of the proposed preventive maintenance regime and asset renewals on risk of derailments. SKM has not been provided detailed data from the Finity Consulting report which would allow for an analysis of specific cases of derailments for which the risk may be reduced with the proposed increase in maintenance and asset renewals expenditure.

In addition, SKM considers that the forecast derailments risk is potentially overstated due to the impact of severe weather events which occurred in 2011. As detailed data has not been provided from the Finity Consulting report, SKM has been unable to make adjustments to the forecast derailments risk to remove the impact of severe weather events (since it is not reasonable to assume this pattern of weather events would continue without a detailed probabilistic analysis).

It is important to note however; that while it is probable that the derailments risk may be overstated to some extent, the forecast frequency is consistent with benchmark operators, and therefore it is potentially the severity / consequence of incidents which is overstated, given the forecast increase in costs for large derailments.

With regards to dewirements risk, it should be noted that the risk of dewirements is not necessarily impacted by the maintenance program or asset renewals program, since dewirements are also caused by weather events, bird strikes, vehicles travelling under overhead wires. However, SKM considers that the dewirements risk is potentially overstated due to inclusion of severe weather events in 2011, and SKM has therefore provided an

[11] BMA and BMC, QRC, RTCA

adjustment to the forecast dewirements self-insurance to remove the impact of severe weather events in 2011, although the impact is not substantial.

3.2 Potential for 'double-recovery' of costs

Stakeholders expressed concerns about potential 'blurring' of costs between self-insurance claims and maintenance cost allowances and opportunities for 'double recovery'.*

**BMA and BMC, QRC*

SKM has conducted a review of both derailments and dewirements risk as well as the proposed maintenance expenditure and does not consider that there has been a forecast 'double recovery' of derailments and dewirements insurance within the maintenance cost allowances. However, when considering that the derailments insurance allowance does not consider a potential reduction in frequency or severity associated with the preventative maintenance program this could be considered double counting.

In addition, SKM considers that there is considerable opportunity for double recovery of losses from weather related incidents (see **Section 4.2.1**), when considering that Aurizon Network has made a separate insurance allowance for weather related events, while the derailments and dewirements insurance also includes incidences caused by weather conditions. In this regard, it would be appropriate for Aurizon Network to remove all weather related occurrences from the derailments and dewirements historical actuals.

3.3 Transparency around forecasts

Stakeholders expressed concern about the level of transparency to support forecast insurance and risk arrangements.*

**BMA and BMC, QRC, RTCA*

SKM considers that it would be appropriate for Aurizon Network to provide the complete version of the Finity Consulting report in the public domain to allow for a more detailed review of the appropriateness of assumptions and the forecast level of insurance, and would also allow for a review to determine if adjustments are required in the context of the proposed maintenance and asset renewals program and the impact of weather events.

4. Conclusions and recommendations

SKM has conducted a review of Aurizon Network's proposed derailments frequency and dewirements annual cost, including consideration for stakeholder submissions. The resulting conclusions and recommendations are outlined below.

4.1 Derailments

SKM finds that Aurizon Network's forecast derailment risk is reasonable in the context of historical derailment rates from other operators. However, based on the review of Aurizon Network's proposed maintenance strategy for the UT4 period, SKM finds that there are a number of proposed maintenance activities for the UT4 period which should result in a decline in the forecast running line derailment risk (no change is expected for yards / sidings).

SKM therefore recommends that Aurizon Network seek an understanding of specific causes of derailments on the CQCR, which can be assessed against proposed preventative maintenance activities to determine the improvement in derailment risk which should occur. Alternatively, it is recommended that the Authority request that improvements are realised in the UT5 period (i.e. the derailment frequency should decline on a gtk basis and the size of loss would potentially decline also).

While the derailments frequency is reasonable relative to benchmark operators, SKM finds that inclusion of severe weather events which occurred in 2011 is likely resulting in an over-statement of the derailments risk, since a probabilistic analysis has not been demonstrated by Aurizon Network. SKM has been unable to propose an adjustment as the whole report prepared by Finity Consulting was not made available. It is recommended that the Authority further explore the impact of severe weather conditions which occurred in the UT3 period to determine derailments forecast which is not overstated. Alternatively, the Authority may consider utilising the track derailments risk (frequency) forecast from the UT3 period.

However, SKM has proposed an adjustment to account for revised volumes as forecast by Energy Economics, which is outlined in **Table 4.1** and equates to a total adjustment of approximately -$2.14 million over the UT4 period.

Table 4.1 SKM's proposed derailments self-insurance for revised volumes

SKM's proposed derailments self-insurance ($December 2013)	2013/14	2014/15	2015/16	2016/17
Track (excl. Large)	$1,076,851.8	$1,113,774.9	$1,172,292.7	$1,241,233.8
Yards / Sidings (excl. Large)	$520,785.2	$538,641.8	$566,942.1	$600,283.3
Large	$1,704,555.1	$1,763,000.9	$1,855,629.1	$1,964,756.4
Total	$3,302,192.1	$3,415,417.6	$3,594,863.8	$3,806,273.4
Reduction from Aurizon Network proposed	-$227,807.90	-$534,582.41	-$655,136.17	-$723,726.57

4.2 Dewirements

SKM finds that Aurizon Network's proposed methodology to forecast dewirements based on historical occurrences is reasonable, since maintenance and operation practices have a limited impact on the frequency of dewirements. However, the impact of severe weather conditions which occurred during the UT3 period (in 2011) is potentially distorting the historical frequency of dewirements.

SKM has proposed a revised dewirements cost estimate to exclude the impacts of flood events in 2011, which is reproduced in **Table 4.2**.

Table 4.2 SKM’s recommended dewirements cost

Cost	2013/14	2014/15	2015/16	2016/17
Cost per km per year ($2013/14)	$96	$96	$96	$96
Estimated cost (millions, $2013/14)	$0.16	$0.16	$0.18	$0.18

4.2.1 General

In order to ensure total self-insurance costs are not overstated, it is recommended that the Authority seek to confirm with Aurizon Network that forecast self-insurance from weather related events does not include costs of derailments and dewirements which are caused from weather related events. In this regard, SKM recommends that costs from derailments and dewirements are excluded from self-insurance for weather events, since these impacts are already captured in the derailments and dewirements forecast and therefore there is considerable potential for ‘double counting’.

Appendix A. Information sources

Table 4.3 Information sources – task specific

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
Aurizon Network	Volume 3 of 4 – UT4 Explanatory Materials	Maximum Allowable Revenue and Reference Tariffs	R-Aurizon-QR2013DAU-ExMatBB-0513	PDF	30 April 2013
Aurizon Network	Volume 4 of 4 – UT4 Explanatory Materials	UT4 Maintenance Submission	R-Aurizon-QR2013DAU-ExMatMaint-0513	PDF	Confidential Version 30 April 2013
BMA and BMC	-	Issues and Concerns with Aurizon Network's (AN's) 2013 Draft Amending Undertaking (DAU)	R-BMABMC-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	10 October 2013
Finity Consulting, prepared for Aurizon Network	Volume 3 of 4 – UT4 Explanatory Materials	Central Queensland Coal Network, except only (pp31-36)	-	PDF	August 2012, Final
Lui, X., Barkan C.P.L and Rapik Saat, M	N/A	Analysis of Derailments by Accident Cause	N/A	N/A	N/A
European Railway Agency	N/A	Freight Train Derailment: Functional and Performance Assessment	N/A	PDF	Rev 02, 12 April 2011
QRC	-	QRC UT4 Submission on Operating Expenditure	R-QRC-Submission-Pricing-AurizonNetwork2013DAAU-Att04-1013.pdf	PDF	10 October 2013
Rail Safety and Standards Board Research Programme	N/A	Engineering – Investigating the potential for improvements in the electrification systems – Summary Report	N/A	PDF	August 2007
RTCA	-	Submission to the Queensland Competition Authority in response to Aurizon Network proposed 2013 draft access undertaking (UT4)	R-RTCA-Submission-AurizonNetwork2013DAAU-1013.pdf	PDF	10 October 2013
The Authority (prepared by Energy Economics)		Central Queensland Coal Railings Forecast (Confidential Version)	2013-07-31 Queensland railings UT4 main – CONFIDENTIAL (598613_1).PDF	PDF	July 2013

Table 4.4 Information sources – general

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
The Authority		Terms of Reference, Engineering Technical Assessment of Maintenance, Operating and Capital Expenditure Forecast	QCA Terms of Reference_UT4 Engineer(565631_4)	PDF	27 June 2013
Aurizon Network	Volume 1 of 3 – The Access Undertaking and Schedules	Schedule E – Regulatory Asset Base	R-Aurizon-QR2013DAU-Vol1-0513	PDF	April 2013
Aurizon Network	Volume 1 of 4 – UT4 Explanatory Materials	Overview and Summary	R-Aurizon-QR2013DAU-ExMatOvr-0513	PDF	30 April 2013
Aurizon Network	Volume 2 of 4 – UT4 Explanatory Materials	The 2013 Undertaking Proposal	R-Aurizon-QR2013DAU-ExMatSub-0513	PDF	30 April 2013
Aurizon Network	Volume 3 of 4 – UT4 Explanatory Materials	Maximum Allowable Revenue and Reference Tariffs	R-Aurizon-QR2013DAU-ExMatBB-0513	PDF	30 April 2013

Appendix B. Excerpt of Finity Consulting report

Attachment E: Technical advice on the trade-off between asset renewals and maintenance expenditure

Contents

1. Glossary

Abbreviations and definitions used in this document are listed in **Table 1.1**.

Table 1.1: Abbreviations and Terminology

Abbreviation, Acronyms and Terminology	Description / Definition
Aurizon Network	On 3 December 2012, QR Network Pty Ltd changed its name to Aurizon Network Pty Ltd.
AT_1	Incremental maintenance tariff (based on 1000 gtk)
BMA and BMC	BHP Billiton Mitsubishi Alliance and BHP Billiton Mitsui Coal
CPI	Consumer price index
CQCR	Central Queensland coal region
DAU	Draft Access Undertaking
gtk	Gross tonne kilometre
NAMS	Network asset management system
QRC	Queensland Resources Council
RAB	Regulatory Asset Base
RFI	Request for Information
RTCA	Rio Tinto Coal Australia
SKM	Sinclair Knight Merz
The Authority	Queensland Competition Authority
UT3	2010 Access Undertaking
UT4	2013 Access Undertaking

2. Technical advice on the trade-off between asset renewals and maintenance expenditure

2.1 Task description and methodology

2.1.1 Background to this report

The Queensland Competition Authority (the Authority) engaged Sinclair Knight Merz (SKM) to assess the reasonableness of the Section 8.4 of Chapter 8 of Volume 3 of UT4. Specifically, the Authority requested that SKM:

- provide the Authority with expert opinion on the validity of discussion about the trade-off between renewals and maintenance expenditure;
- advise the Authority on whether Aurizon Network's forecast asset renewal expenditure is justified, having regard to Aurizon Network's proposed forecast maintenance expenditure; and
- assess the reasonableness of Aurizon Network's forecast asset renewals.

2.1.2 Methodology

SKM has undertaken a review of Section 8.4 of Chapter 8 of Volume 3 of UT4 and supporting information provided by Aurizon Network to determine key assumptions underpinning:

- the method utilised by Aurizon Network to forecast asset renewals expenditure;
- Aurizon Network's approach to assessing the trade-off between asset renewals and maintenance; and
- Aurizon Network's Asset Management Policy, including intervention levels for renewals and maintenance and the approach to justification of capital expenditure (see **Appendix B and Appendix C**).

SKM has assessed reasonableness in the context of specialist knowledge on the value of asset renewals as a proportion of the RAB, the reasonableness of the Asset Management Policy and the validity of Aurizon Network's discussion on the trade-off between asset renewals and maintenance. SKM has also provided a review of asset renewals on a unit cost basis per gtk, compared to the unit cost of maintenance per gtk from the UT3 period compared to the forecast for the UT4 period, which informs the assessment on the validity of the trade-off between asset renewals and maintenance.

2.1.3 Adequacy of information provided and general comments

SKM requested the following information from Aurizon Network which has been utilised as part of this review:

- proposed asset renewals expenditure and price year;
- breakdown of asset renewal expenditure;
- regulatory drivers underpinning the proposed renewals expenditure; and
- Aurizon Network's most recent Asset Management Policy.

SKM also requested relevant scope / options analysis reports pertaining to the development of the Asset Renewals Capital Expenditure Program; however Aurizon Network has indicated that the forecast renewals expenditure provides an indication of total expenditure for renewals including an indicative breakdown by asset type and investment type. Therefore a detailed breakdown of the actual scope of renewals expenditure is unknown at this stage.

In addition to the information requested by SKM, Aurizon Network has provided evidence and examples of their Stage Gate Process which acts as an internal business case for justification of capital expenditure (see **Appendix D** for an example). SKM has provided an overview of the Stage Gate Process in **Section 2.3.4**. **Section 2.4** provides an analysis of the Stage Gate Process as it relates to prudency of expenditure and the trade-off between asset renewals and maintenance expenditure. Aurizon Network also conducted a presentation for SKM and representatives from the Authority to discuss their approach to asset renewals and provide an indicative breakdown of asset renewals expenditure.

Appendix A provides a list of information sources and specific RFIs which have been utilised for this review.

2.2 Aurizon Network's proposed renewals expenditure for the UT4 period

Table 2.1 provides Aurizon Network's proposed asset renewals expenditure for the UT4 period, which equates to approximately $512 million in total over the four years during the UT4 period, or an average of $128 million per year. The renewals expenditure each year represents 2.7% of the opening RAB.

Table 2.1 Aurizon Network's proposed asset renewal expenditure ($m)

Asset Category	2013/14	2014/15	2015/16	2016/17	TOTAL
Asset renewals (track and civil assets)	150.30	84.20	91.50	120.00	**446.00**
Telecoms	0.02	0.02	0.02	-	**0.06**
Network control systems	31.20	15.90	18.9-	-	**66.00**
Total	**181.52**	**100.12**	**110.42**	**120.00**	**512.06**

Source: Aurizon Network, 2013 Draft Access Undertaking, Volume 3: Maximum Allowable Revenue and Reference Tariffs, p177, Table 49

In a recent presentation to both SKM and The Queensland Competition Authority, Aurizon Network demonstrated that its renewals investment cost allocation breakdown consists of the following breakdown:

- end of life replacements - 65%;
- increased reliability and protection - 10%;
- increased safety - 15%; and
- obsolescence - 10%.

SKM was also provided a breakdown of the asset renewals program by investment type for the 2013/14 financial year by Aurizon Network which is reproduced below. SKM notes that these proportions do not correspond to the proportions noted above, and therefore it is assumed that the breakdown by investment type noted previously represents an average for the UT4 period.

- end of life replacements - 74%;
- increased reliability and protection - 11%;
- increased safety - 10%; and
- obsolescence - 5%.

Table 2.2 provides a 'typical' asset renewals cost and breakdown by asset type provided by Aurizon Network. The 'typical cost' of $120 million was determined by Aurizon Network through a benchmarking exercise against US Class 1 railways, where the average renewals spend across the US Class 1 railways in the financial years from 2009 to 2011 was $2.60 per thousand ntk. Based on this benchmark, Aurizon Network has derived a 'typical cost' of $120 million per annum based on 46 million ntk of throughput in the 2011/12 financial year. The breakdown by asset type was determined by Aurizon Network having regard to the CQCR's size and traffic task and the likely renewal requirements in each asset class.

Table 2.2 Typical renewals expenditure

Asset type	Total asset amount in network	Typical renewals per annum	Typical cost per annum
Track	2,677 km 10,000 culverts	5 km of formation renewals 20 culvert renewal	$6 million $10 million
Sleepers	4.4 million sleepers across 2,677km of track (sleeper every 610cm)	30 km of re-sleepering	$15 million
Rail	5,354 km	50 km of re-railing	$18 million
Turnouts	975 turnouts	15 turnouts	$8 million
Telecommunications	1,413 transmission nodes 1,123 power supplies 359 Computer Rooms 33 Weighbridges 108 asset protection monitors 2,400 km of optic fibre	• component renewal. • end of life replacement such as radio transmitter nodes	$20 million
Traction System	1,820 km 42 Switching stations 265 Autotransformers 42 Supply Transformers	• end of life replacement • equipment renewal • improved access systems • reliability improvement	$15 million
Level Crossings and Track signage.	158 Public Crossings 606 Private Crossings	• enact agreements • over-height detection • upgrades	$3 million
Signalling	174 Interlockings 3,263 Electrical signals 655 Mechanical signals	• renew components • replace end of life	$12 million
Miscellaneous		Examples: access roads, fencing, crew change platforms.	$13 million
TOTAL			**$120 million**

Source: Provided by Aurizon Network in a presentation to SKM and the Authority on 29 August 2013.

Based Aurizon Network's forecast renewables expenditure in **Table 2.1** and the 'typical breakdown' in **Table 2.2** we can conclude that the breakdown of asset renewals for the UT4 period could look something like the values in **Table 2.3** below.

Table 2.3 Breakdown of Aurizon Network's forecast renewals expenditure based on 'typical cost per annum' ($m)

Asset Category	2013/14	2014/15	2015/16	2016/17	Total
Track	31.79	17.81	19.36	25.38	94.35
Sleepers	43.36	24.29	26.39	34.62	128.65
Rail	52.03	29.15	31.67	41.54	154.38
Turnouts	23.12	12.95	14.08	18.46	68.62
Total asset renewals (track and civil assets)	**150.30**	**84.20**	**91.50**	**120.00**	**446.00**
Total telecoms	**0.02**	**0.02**	**0.02**	**-**	**0.06**
Traction systems	15.60	7.95	9.45	0.00	33.00
Level Crossings and track signage	3.12	1.59	1.89	0.00	6.60
Signalling	12.48	6.36	7.56	0.00	26.40
Total network control systems	**31.20**	**15.90**	**18.90**	**0.00**	**66.00**
Total	**181.52**	**100.12**	**110.42**	**120.00**	**512.06**

2.3 Aurizon Network's key assumptions for the asset renewals program

The following outlines key assumptions which are outlined in Chapter 8.4 of Volume 3 of the DAU for the UT4 period. SKM has provided an overview of the key assumptions / statements in order to provide context for the reader. In addition, the key assumptions inform SKM's assessment of the validity of the discussion on the trade-off between asset renewals and maintenance expenditure, and the reasonableness of the proposed asset renewals expenditure.

Key assumptions which are outlined are grouped according to the following categories:

- Aurizon Network's basis for the asset renewals strategy;
- asset lives and quantity of assets; and
- trade-off between asset renewals and maintenance.

SKM has also provided an overview of the investment assessment process undertaken by Aurizon Network for all capital projects (including renewals), referred to by Aurizon Network as the 'Stage Gate Process' which informs SKM's assessment of the likelihood that renewals expenditure will be prudent in scope, standard and cost.

2.3.1 Basis for the asset renewals strategy

The objective of a long term maintenance and renewal policy is to provide a decision framework for the maintenance and renewals work programme. The framework should consist of several rules that are guidelines leading the mid-term management to achieving a minimal infrastructure cost over the life cycle, and decision guidelines include:

- annual ratio's between renewal and maintenance (lengths and expenses);
- thresholds (intervention levels) for renewal action (age or accumulated load);
- type of material to use at the time of renewals; and
- the quality level of infrastructure required.

These guidelines should either be defined by strategic business goals or be adjusted through an optimisation process. Aurizon Network's states that the renewals strategy for the UT4 period has been informed by significant improvements (which are continually evolving) in the ability to recognise when an asset has reached end of life as well as a greater understanding of failure modes and drivers of asset failure. Gross tonne kilometres remain the predominant driver of renewal and maintenance activities, although some assets are categorised according to useful life in years.
Overall, the asset management strategy addressed four key objectives, specifically:

1. improving operational safety and operational performance by renewing assets before end of life failures;

2. enabling reliable train services through consistent renewals expenditure which increases asset resilience;

3. maximising existing assets to enable reduced cycle times through renewals which result in increased network velocity;

4. improved cost effectiveness through proactive renewals and a relatively constant ('smoothed') expenditure profile which will reduce costly renewals through:

    a. a reduction in unanticipated failures;

    b. a reduction in the unit cost of consumables through increasing economies of scale;

c. facilitating development of long term supplier relationships through a more predictable work program;

d. maximising the efficiency and effectiveness of planned network closures; and

e. reductions in the need for significant capital expenditure in a given year which has pricing implications for access seekers.

2.3.2 Asset lives and quantity of assets

An asset valuation was undertaken for the CQCN in 2000 as part of the divestment of the below rail network to Aurizon Network (formerly QR Network) which reflected a total track length of 1,918 kilometres across the CQCN compared to approximately 2,667 kilometres by the financial year 2014/15. Aurizon Networks UT4 submission states that the current total track length on the CQCN is approximately 2,590 kilometres. Aurizon Network notes that as the asset matures larger renewal investments will be necessary and that the current age profile of the assets means that many of the assets are nearing end of economic life. However, SKM notes that end of economic life assets are also approaching due to Aurizon Network's revision of asset lives for the UT4 period, reproduced in **Table 2.4** below.

Table 2.4 Aurizon Network's adjustment to asset lives

Asset Class	Assumed Asset Life at Valuation	Useful Remaining Life at Valuation	RAB Remaining Life at July 2012	UT3 Adjusted Asset Lives	Effective RAB Life Remaining at July 2012
Goonyella					
Track	40	24	12	35	7
Signals	30	19	7	30	7
Electrical System Equipment	25	16	4	35	14
Power Distribution	40	16	4	35	0
Blackwater					
Track	40	21	9	35	4
Signals	30	20	8	30	8
Electrical System Equipment	25	18	5	35	15
Power Distribution	40	18	5	35	0

Source: Aurizon Network, 2013 Draft Access Undertaking, Volume 3: Maximum Allowable Revenue and Reference Tariffs, p161

It should be noted that the adjusted asset lives above are average economic lives. There is a differentiation between asset lives used for financial depreciation purposes (for revenue) and the useful remaining life of specific asset (and at a level below "track" such as rail). The real asset (or sub-asset such as rail) demonstrate a distribution of asset life about this average economic life (e.g. curves vs straight track) and it is this which drives the renewals budget profile requirements.

SKM notes that the adjustment in useful life of assets includes reductions in the useful life of track assets and power distribution assets. Aurizon Network states that revision of asset lives was necessary due to:

1. Material increases in tonnages since the original asset valuation and substantially more than was envisaged when the remaining asset lives were initially determined back in the year 2000; and

2. Railing of tonnages and train densities which are well above the original design criteria, causing some assets to wear faster than their design specification.

The useful life of electrical system equipment has been increased by Aurizon Network from 25 to 30 years and the useful life of signals remains constant.

Overall, the remaining asset lives for the majority of assets on the CQCN are commensurate with a large proportion of the RAB being installed within a reasonably narrow period of time.

2.3.3 Trade-off between asset renewals and maintenance

Aurizon Network notes that maintenance works can be implemented to maximise the life of the asset and defer upgrades / replacements, however timely asset replacement can reduce the maintenance task over time, reducing whole of life cycle costs. Despite this statement, Aurizon Network states that it is important to note that increased renewals expenditure will not necessarily translate to a 'compensating' reduction in maintenance costs in the short or long run in terms of the full asset. This is because assets being renewed due to end of engineering life do not necessarily have any significant impact on maintenance cost (e.g. new rail still needs to be ground to manage wear and defect rates) particularly if the overall average age/condition profile of the asset is changed insignificantly. In this regard, Aurizon Network states that the proposed maintenance and renewables allowance has been prepared on the assumption of achieving 'steady state' asset depreciation, and that underinvestment in renewals would necessitate higher levels of maintenance than estimated for UT4.

In the previous DAU submitted in 2009 (known as the UT3 period), Aurizon Network highlighted trade-offs between capital and maintenance expenditure, and these have been reproduced by Aurizon Network in the DAU for the UT4 period, noting that recognising trade-offs does not imply that renewals is better than ordinary maintenance or vice versa. **Table 2.5** provides advantages and disadvantages of high maintenance and deferred renewals compared to high renewals and lower maintenance, as outlined by Aurizon Network in the DAU for the UT4 period.

Table 2.5 Aurizon Network's documented trade-off between asset renewals and maintenance

High maintenance and deferred renewals	High renewals and lower maintenance
Advantages	
• Deferred renewals expenditure keeps access charges lower in the short term (although this will be offset by higher maintenance costs in the medium to long term). • Reduces technological obsolescence as spare parts should always be readily available for new equipment.	• Limits the amount of on-track time required for future maintenance. • More likely to ensure the safety and integrity of the asset. This is still dependent on an appropriate maintenance regime however the asset should require less maintenance to perform at the required standard. • Reduces vulnerability of the delivery of the maintenance program to labour shortages (and/or spike in labour costs).
Disadvantages	
• Deferring renewals expenditure could lead to unsupported systems being relied upon due to technological obsolescence. This can have a detrimental impact on network performance if delays are experienced because spare parts aren't available. • A more intensive maintenance regime will be difficult to implement in a capacity constrained environment. An increase in the number and/or duration of maintenance possessions will reduce network availability and supply chain performance. • An increased requirement for maintenance in an environment where skilled labour is already scarce may adversely impact the ability to achieve the	A more significant renewals program will increase access charges for users in the short term; however this should be offset by lower maintenance costs.

maintenance plan.	

Source: Aurizon Network, 2013 Draft Access Undertaking, Volume 3: Maximum Allowable Revenue and Reference Tariffs, p163, Table 43

In reference to the advantages and disadvantages of each approach as outlined above, Aurizon Network states that both a renewal and maintenance approach form an essential part of asset management, and that an appropriate balance must be achieved. In this regard, SKM requested information on intervention levels for maintenance compared to renewals from Aurizon Network. The information provided is reproduced in **Appendix C** and is taken from Aurizon Network's Asset Policy Maintenance and Renewal draft document dated 15 August 2012.

Cost-effectiveness of renewals compared to maintenance

In support of the planned renewals expenditure for the UT4 period including implementing a proactive renewals approach, Aurizon Network has quoted a study conducted by Grimes and Barkan in 2006 which examined the cost-effectiveness of renewals strategies in US Class 1 railways. The study notes that in the past 20 years operators have increased their renewals expenditure relative to maintenance, and that the fundamental differences between renewals and maintenance from an engineering perspective relate to asset condition. Specifically:

- renewals-based maintenance results in better average asset condition over the life of the asset but greater variation in asset quality (assuming lumpy renewals investment); and
- selective ordinary maintenance is generally used to maintain the track at a consistent minimum standard.

The study concluded that renewals based asset management is more cost effective, due to:

- productivity improvements from the use of large mechanised production gangs in limited track possession time; and
- the ability to plan and predict upfront.

The study also noted that maintenance will continue to be an important part of the asset management regime, but that under-investment in renewals could lead to higher costs in the long run through higher asset failure rates and less productive interventions (failure leads to unplanned interventions which are typically costly).

2.3.4 Stage Gate process

Aurizon Network's asset management policy includes provision for a 'stage gate process' which acts as an internal business case for justification of capital (including renewals) expenditure. The stage gate process includes a number of key steps which are reviewed and the subsequently justification is authorised. The key panel reviewers include the GM Network Assets, the Divisional Finance Manage, the VP Network Operations, the VP Network Finance, and for investments greater than $10million, the EVP Network. Key steps within the stage gate process from which SKM has sighted an example[1] are outlined below:

- key issues (need for the investment) and scope of the proposed investment;
- summary of any changes to scope following the pre-feasibility assessment;
- overview of the rationale supporting the project and the activities to be undertaken (for example, hydrological assessments and gap analysis);
- the strategic alignment of the proposed investment in line with Aurizon Network's national pillars (safety, customer service, growth, commercial capability, people);
- project interdependencies;

[1] For the Newlands Culvert Upgrade Project (A.04145) October 2012

- financial analysis including key assumptions;
- expected financial savings;
- options analysis (investment design alternatives);
- procurement process;
- assessment of how the project meets criteria for prudency of scope, prudency of standard and prudency of cost;
- stakeholder consultation process;
- organisational capability to deliver the project; and
- project schedule.

2.4 Assessment of reasonableness of proposed asset renewals

In order to determine the reasonableness of Aurizon Network's forecast renewals expenditure for the UT4 period, SKM has undertaken a review of:

- the asset renewals strategy (including asset lives and intervention levels) and the likelihood that the once completed, the asset renewals will be found prudent in regards to scope, standard and cost.
- the validity of Aurizon Network's discussion about the trade-off between renewals and maintenance; and
- the reasonableness of costs proposed.

2.4.1 Asset renewal strategy and prudency of scope, standard and cost

Careful asset condition monitoring and detailed long term planning are essential for successful asset management. In this regard, Aurizon Network states that the asset renewal strategy for the CQCR is informed by significant improvements in the ability to recognise when an asset has reached end of life as well as a greater understanding of failure modes and drivers of asset failure. SKM recognises that Aurizon Network's proposed implementation of the Network Asset Management System (NAMS) is a significant step on the journey to achieved enhanced asset management capabilities and notes that Aurizon Network have indeed determined install dates for all network turnouts and overhead renewals. This data is then used to build the maintenance models and better inform the renewals forecasts, but not the actual jobs required. However, SKM finds that Aurizon Network has not demonstrated an actual awareness of the age and condition of assets on the CQCN. While Aurizon Network has adjusted the life expectancy of CQCN assets for the proposed UT4 period, SKM notes that Aurizon Network has not demonstrated the capability of its assets (i.e. the remaining life of its assets) in support of the adjustment and the estimated useful life remaining. Instead, Aurizon Network has indicated that the adjustments occur from material increases in tonnages and train densities which do not coincide with original design characteristics. Given there is no specific information on the quantity of assets which have reached life expiry, SKM has been unable to determine if the level of renewals for life expired assets is appropriate.

In terms of the proposed useful lives overall, SKM finds that the adjustments proposed by Aurizon Network for the Blackwater and Goonyella systems[2] (**Table 2.4)** are appropriate, except for the adjustment to power distribution infrastructure. SKM has drawn this conclusion since the useful life of power distribution assets is not impacted by tonnage or train consists, and therefore the useful life should be re-instated to 40 years, which is normal for power distribution infrastructure. In terms of the impact on power distribution asset renewal expenditure from re-instating a useful life of 40 years, SKM has been unable to determine this cost since Aurizon Network has not provided a detailed breakdown of age of assets on the CQCN, and the specific assets

[2] It is assumed that these proposed adjustments are applicable to all systems.

which will be renewed from life expiry. This is likely due to Aurizon Network's own lack of information on the age of assets.

- SKM finds that the useful life for power distribution assets should be adjusted back to 40 years, not 35 years.
- SKM finds that it would not be appropriate for Aurizon Network to adjust the useful life of assets again in the UT5 period.

In terms of the overall asset management strategy, SKM has undertaken a review of Aurizon Network's Asset Management Policy and finds that engineering judgement is sound, and that the proposed approach to 'smoothing' the renewals profile is reasonable in regards to improving cost-effectiveness of capital works and reducing impacts on users from variations in access tariffs which would apply if a significant majority of assets reached end of life in a given year. Normally, in order to determine the asset renewal requirement, an asset's condition is assessed and projections are used to determine the remaining useful asset life and the likely renewal year, and therefore funding requirements will vary year by year. While the 'smoothing' process is reasonable to minimise tariff implications, renewal delivery, and asset availability implications, it will need to be supported with regular condition assessments to determine remaining useful life.

In terms of engineering judgement, SKM finds that the intervention levels for asset renewals are reasonable (refer **to Appendix C**). However, SKM notes that although a 'typical' investment profile in terms of the asset type has been provided by Aurizon Network (refer back to **Table 2.2**), a similar level of detail has not been provided for forecast asset renewals for the UT4 period, and it is unclear exactly where the renewals expenditure will be allocated. That is, Aurizon Network has not indicated the quantity of assets which will be renewed based on intervention / trigger points.

SKM notes that the inherent uncertainty associated with asset renewal decisions means that it is not possible to forecast the precise nature, amount and timing of renewals expenditure across the four years of the regulatory period. In this regard, SKM finds that the approach to forecasting asset renewals expenditure for the UT4 period has been determined by Aurizon Network utilising a 'top-down' estimating approach based on a unit cost per gtk which was benchmarked against US Class 1 railways. SKM finds that this approach is reasonable and will protect users from any over investment in asset renewals in the context of not having a detailed understanding of the condition of assets, and since it is likely that the forecast expenditure has also been determined based on available track possessions and plant capacity[3].

Although SKM finds that the 'top-down' approach is reasonable and is standard across industry, it is imperative that that asset renewal expenditure is allocated to the highest and best use across the network. SKM notes that while Aurizon Network is implementing a NAMS approach, a degree of judgment will still need to be applied in prioritising and planning renewal activities, which can be impacted by changes in tonnages and asset condition, as well as significant weather events. The timing of works will also need to be assessed to maximise delivery efficiencies. Therefore, to determine the likelihood that asset renewal expenditure will be allocated to the highest and best use (and will be prudent in regards to scope, standard and cost) SKM has undertaken a review of Aurizon Network's Stage Gate process for capital expenditure.

SKM finds that the Stage Gate process is adequate in ensuring that capital projects are prudent in regards to scope, standard and cost. However, it is not apparent how the projects are identified in terms of allocating the expenditure to highest and best use. Although Aurizon Network has provided intervention levels or 'trigger points' for asset renewals, in reality track possessions and plant capacity will determine allocation of renewals, which is typical across the rail industry. This is demonstrated by the fact that the 'typical renewal breakdown' provided by Aurizon Network includes only five kilometres of track formation renewal from a total of 2,667 on the CCQN. SKM recognises that allocation will also be determined based on safety requirements and customer performance demands, which is reasonable but will do little to ensure cost-effectiveness of renewals. SKM suggests that this potential exposure be clarified further by Aurizon Network's Formation Strategy Group which are focussing on this issue.

[3] SKM has provided a review of the capacity to undertake the proposed asset renewals program in the report titled "Review of Asset Renewals Work Program" submitted to the Authority on 8 November 2013.

Therefore, while the Stage Gate process provides a useful indication of the implementation processes and guidelines used within Aurizon Network, it would be beneficial to have a more in-depth understanding of the process undertaken to identify individual projects which are progressed through the Stage Gate process.

2.4.2 Trade-off between asset renewals and maintenance

SKM has undertaken a review of Aurizon Network's discussion on the trade-off between asset renewals and maintenance, and finds that the points provided by Aurizon Network (including the advantages and disadvantages of each approach) are valid. However, the UT4 does not demonstrate an actual analysis has been undertaken to determine the trade-off in terms of financial savings as well as reliability benefits for customers. SKM has therefore undertaken a review of examples of renewals projects which have been reviewed internally by Aurizon Network through the Stage Gate process in order to determine how the trade-off is assessed.

As an example, the Powerhouse Roads 1,2 & Loop Track Upgrades / asset renewals was estimated by Aurizon Network to result in the following savings compared to a capital cost of approximately $7 million:

- reduced maintenance costs and risks of derailment due to track failure, valued at upwards of $600,000 per.annum; and
- performance improvements valued at $1.3 million per annum from the ability to run trains in the reverse direction[4].

SKM finds that the Stage Gate process provides a reasonable mechanism for assessing the trade-off between maintenance and renewals, although it is noted that the actual immediate maintenance savings are low compared to the capital investment amount for the Powerhouse Roads 1,2 & Loop Track Upgrades and an analysis has not been conducted by Aurizon Network to determine the ongoing savings.

Overall however SKM finds that the Stage Gate process will assist in allocating funds to the highest and best use based on a review of financial trade-offs, but will not provide a means for ensuring that forecast maintenance costs are efficient, since specific renewals projects are determined after the asset life has expired. This is particularly important given that Aurizon Network are required to adjust the value of the RAB if capital projects are not delivered, while the maintenance task allowance is only adjusted in response to volume variations[5] and is not subject to evidence of delivery of the forecast maintenance task.

While SKM agrees with Aurizon Network's statement that asset renewals will not necessarily result in a commensurate reduction in maintenance costs in the short run, it is useful to review trends in the unit cost of renewals compared to maintenance on a gtk basis. **Figure 1** provides this in graphical format, and is produced by SKM based on the following assumptions:

- forecast renewals expenditure provided by Aurizon Network (**Table 2.1**) is in nominal terms each year, derived from a base year of 2011/12;
- historical renewals expenditure is sourced from page 162 of Volume 3 of the DAU; and
- the historical and forecast renewals expenditure has been adjusted by SKM to real dollars (2011/12 financial year for comparison with maintenance costs) based on the consumer price index. Use of the CPI is consistent with Aurizon Network's approach to estimation of the asset value on page 162 of Volume 3 of the DAU. The historical actuals are indexed to base year utilising historical actual CPI[6] and the forecast renewals expenditure for the financial years 2014/15, 2015/16 and 2016/17 is adjusted down to a base year of 2011/12 assuming annual inflation of 2.5%. These assumptions have been

[4] While this is not a maintenance cost saving and is therefore not directly relevant to the validity of the trade-off discussion it is useful in demonstrating that Aurizon Network considers network performance as part of the renewals strategy.

[5] Based on the approved incremental maintenance cost tariff (AT_1 reference tariff)

[6] ABS (2013) Catalogue no. 6401.0 Consumer Price Index, Brisbane All Groups

confirmed with Aurizon Network on 7 November 2013 as reflective of the cost base for actual and forecast asset renewals expenditure.

Table 2.6 provides Aurizon Network's historical and forecast renewals expenditure and SKM's adjustments to bring the estimates to real terms. Aurizon Network's historical and forecast gtk is also provided. The value of forecast telecommunications renewals has been removed by SKM from the UT4 estimate for comparative purposes since the historical actuals on page 162 of the DAU excludes telecommunications renewals.

Table 2.6 Adjusted renewals costs for comparison with maintenance costs

Financial year	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Historical and forecast renewals expenditure, ($m)	17.50	19.00	91.80	121.80	181.52	100.12	110.42	120.00
Index	95.9	99.6	100.5	102.5	N/A	N/A	N/A	N/A
Assumed escalation per year for forecast	N/A	N/A	N/A	N/A	2.5%	2.5%	2.5%	2.5%
Inflation factor	1.05	1.01	1.00	0.98	0.95	0.92	0.90	0.87
Inflation adjusted renewals expenditure ($m)	$18.3	$19.2	$91.8	$119.4	$172.3	$92.4	$99.0	$104.2
Telecoms ($m)	-	-	-	-	0.02	0.02	0.02	0.00
Telecoms ($m), adjusted for inflation	-	-	-	-	0.019	0.018	0.018	-
Total renewals for comparison to maintenance, inflation adjusted and excluding telecoms	$18.34	$19.17	$91.80	$119.42	$172.31	$92.40	$98.94	$104.23
Total maintenance expenditure for comparison to renewals ($m, FY2012)	$169.1	$168.4	$171.0	$206.2	$189.5	$204.3	$210.3	$213.9
Million gtk	73,463.2	64,282.1	66,128.0	71,571.9	80,513.0	90,171.8	97,003.7	103,674.1

Source: SKM calculations based on ABS (2013) and information provided by Aurizon Network as outlined above

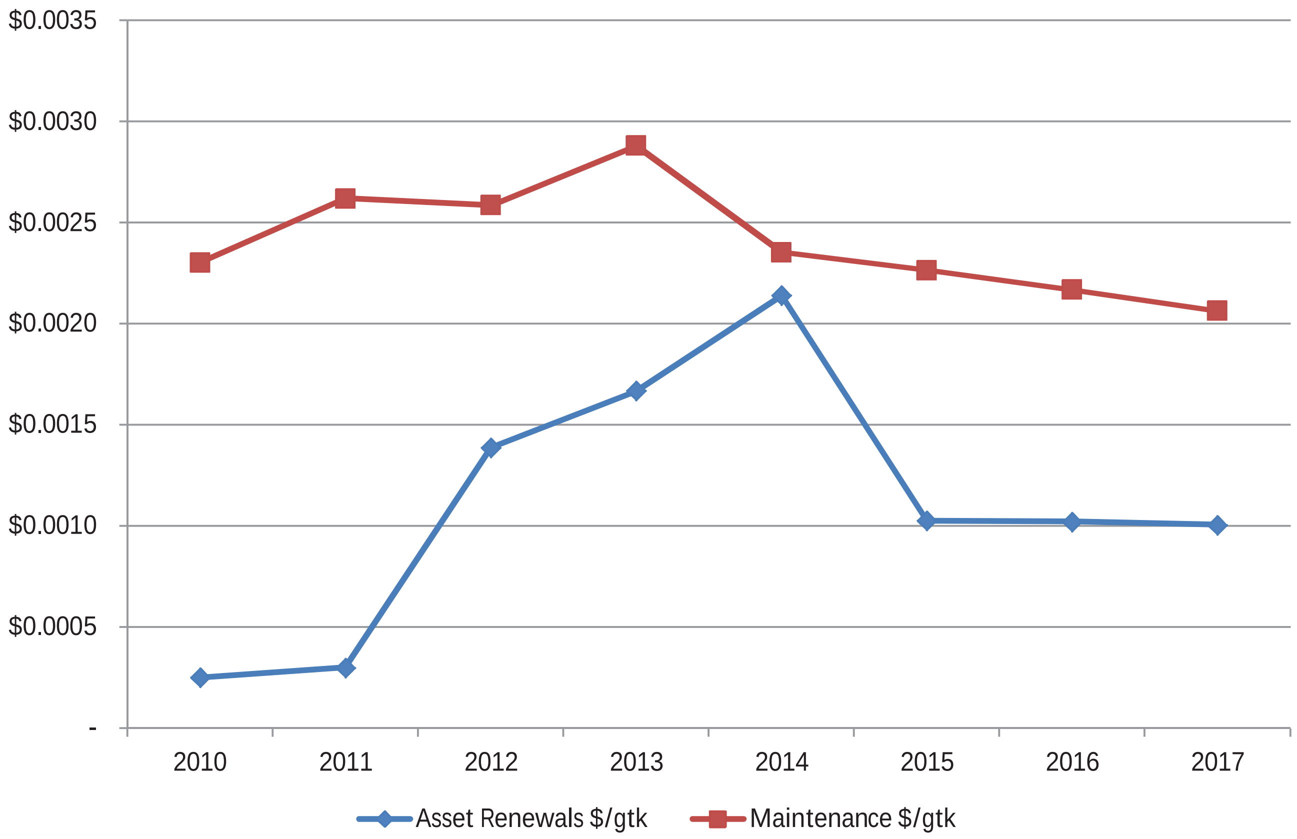

Figure 1 Unit cost of asset renewals compared to maintenance

Source: SKM graph based on the assumptions listed above and the data in ***Table 2.6***

Figure 1 shows that Aurizon Network's unit cost of asset renewals is declining relative to the UT3 period and is mostly constant during the UT4 period (reflective of Aurizon Network's approach to asset renewals based on gtk). **Figure 1** also shows that maintenance unit costs are declining, which means that Aurizon Network is effectively implementing a combined asset renewals and maintenance strategy, although it is noted that the declining maintenance unit costs also reflects Aurizon Network's forecast productivity improvements for the maintenance task.

It is important to note that while the unit cost of maintenance and renewals is declining, SKM does not believe that the level of asset renewals proposed for the UT4 period will have a significant impact on maintenance cost savings. For example, the typical breakdown of renewals which includes track formation renewal of 5 kilometres out of 2,667 kilometres on the network is not significant. Despite this, SKM recognises that renewals need to be undertaken and that the scope is limited by track possessions. That is, the renewals expenditure should be set to allow for:

- reasonable resource allocations;
- a limited amount of track access; and
- an allowance for customer service requirements.

While the maintenance cost benefit will not be significant, there will be benefits from reduced expenditure associated with unplanned failures (which is difficult to quantify and includes consideration for the level of service required by access seekers). Taking into account the condition of the network and the requirement to optimise maintenance and renewals whilst providing the level of service required by access seekers, SKM finds that Aurizon Network's asset renewals forecast compared to maintenance is efficient. While SKM finds that the trade-off between maintenance and renewals will not be significant at this level of renewals expenditure, it is noted that implementation of the NAMS (which will be rolled out as a trial in early 2014) will assist Aurizon Network to monitor the benefits of the proactive renewals strategy.

2.4.3 Reasonableness of costs

Although Aurizon Network has not provided a specific breakdown of renewals expenditure, SKM finds that the proposed magnitude of asset renewals costs is reasonable as a proportion of the RAB, based on SKM's industry knowledge that asset renewals for comparable operators are typically around 3 per cent of the value of the RAB, compared to Aurizon Network's 2.7 per cent.

SKM has also determined the unit cost of renewals expenditure for track, sleepers, rail and turnouts (see **Table 2.7** below) based on the typical cost breakdown provided by Aurizon Network and finds that these costs are reasonable. SKM has been unable to determine a unit cost for telecommunications and network control systems since Aurizon Network's typical cost breakdown includes multiple expenditure types for each category; however the magnitude of total costs appears reasonable.

Table 2.7 Unit cost of asset renewals

Asset type	Unit cost ($m)	Unit
Track formation renewals	$1.2	km
Track culvert renewals	$0.5	Number
Re-sleepering	$0.5	km
Re-railing	$0.4	km
Turnouts	$0.5	Number

Source: Provided by Aurizon Network in a presentation to SKM and the Authority on 29 August 2013.

3. Aspects of the asset renewals / capital expenditure program raised in stakeholder submissions

The Authority also requested that SKM review and provides opinion on the issues raised by QRC, RTCA, BMA and BMC and Asciano in relation to proposed asset renewals / capital indicator. The following provides SKM's opinion on specific issues which were raised in the submission, categorised according to the type of issue.

It should be noted that SKM's review includes consideration for submissions which relate directly to engineering considerations (prudency of scope, standard and cost) for the proposed asset renewals program, and the trade-off between asset renewals and maintenance. SKM has not been engaged to undertake a review of the entire capital works program or to consider pricing implications as they relate to derivation of reference tariffs[7]. Therefore, SKM has not considered pricing implications raised in the submissions (such as the implications of revenue smoothing for the purposes of calculating reference tariffs[8]), although it is noted that consideration should be made for the net present cost of access charges which would result from a smoothed approach compared to annual pricing. For example, annual pricing where investment in the earlier years of a regulatory period is greater will result in an increased net present cost and vice versa.

3.1 Prudency of scope, standard and cost

Stakeholders raised concerns about the incentive for 'over-investment' in the network (i.e. 'gold plating'), noting that an incentive mechanism for focused on efficiencies in capital investment would be supported.* **Asciano*

SKM's review has included an overview of consideration for the reasonableness of Aurizon Network's 'Stage Gate process' which is undertaken for all proposed capital investment. SKM's findings have been that the 'Stage Gate process' provides a reasonable mechanism to ensure prudency of scope, cost and standard, and will provide a reasonable means for identifying potential cost efficiencies. In addition, specific capital projects are subject to a review by the Authority to determine prudency of scope, standard and cost and therefore over-investment is unlikely. However, there exists a risk that capital investment may not be allocated to the highest and best use on the network since:

- an accurate picture of asset condition is unknown; and
- the renewals program comprises only a very small portion of total assets on the CQCN.

However, SKM has undertaken a review of Aurizon Network's Asset Maintenance and Renewal Policy and finds that engineering judgement is sound, and this therefore minimises the risk that expenditure will not be allocated to the highest and best use.

Stakeholders expressed concerns that the proposed level of capital expenditure proposed by Aurizon Network is not consistent with efficient costs.* **Asciano*

SKM has a review of the proposed asset renewals expenditure and finds that the levels proposed by Aurizon Network are reasonable, including assessment for the trade-off between maintenance and renewals. It should be noted that SKM was not engaged as part of this commission to undertake a review of the entire capital works program for the UT4 period.

[7] Excluding estimating a value for the incremental maintenance tariff.

[8] Raised by QRC in relation to the capital indicator, maintenance and operating expenditure.

3.2 Asset management

Stakeholders expressed concerns that the 2013 DAU includes a proposal that Aurizon Network 'may' prepare a proposed asset management plan for submission to the CQA describing the standards that Aurizon Network will apply in determining whether to incur capital expenditure for asset renewals rather than ongoing maintenance of those assets.*

**Asciano*

SKM has undertaken a review of Aurizon Network's intervention levels for maintenance compared to asset renewals and finds that the engineering judgement is sound (intervention levels are reproduced in **Appendix B** and **Appendix C**). However, SKM notes that the Asset Maintenance and Renewal Policy is currently in draft form and it is recommended that any proposed changes are communicated to the Authority for consideration.

Stakeholders expressed concern about the level of transparency and involvement by coal producers in the capital planning process, recommending an approved capital planning process that provides transparency, certainty and stability.*

**RTCA, QRC*

SKM considers that an improved capital planning process as it relates to asset renewals would be beneficial to be communicated with stakeholders. For example, Aurizon Network has provided a 'typical asset renewals program' which has the potential to substantially differ to the actual asset renewals program which is delivered for the CQCN during the UT4 period. In this regard, SKM has been unable to determine prudency of scope, standard and cost for individual projects, rather the level of renewals in terms of total expenditure has been reviewed. SKM therefore recommends that Aurizon Network submit a detailed asset renewal plan on an annual basis as part of the undertaking process which will allow the opportunity for consideration of the Authority (and it's consultants) and stakeholders. It would also allow for a greater level of transparency around the trade-off between asset renewals and maintenance.

Stakeholders expressed concerns that the 2013 DAU includes provisions that the Authority must accept capital expenditure as prudent in scope and standard if it is in accordance with Aurizon Network's asset management plan, noting that an asset management plan is a high level plan which does not include sufficient detail to assess prudency of scope or standard.*

**QRC*

SKM has undertaken a review of Aurizon Network's Asset Maintenance and Renewal Policy and finds that engineering judgement for intervention levels as they relate to asset renewals is sound. However, SKM does not consider that this policy alone will ensure prudency of standard and scope. Although capital expenditure is also subject to Aurizon Network's Stage Gate process, SKM finds that an assessment by the Authority to determine prudency of expenditure is still warranted.

4. Conclusion and recommendations

SKM finds that Aurizon Network's forecast asset renewals expenditure is reasonable in the context of the value of the RAB and in comparison to forecast maintenance expenditure. While a top down approach has been applied SKM finds that this is normal practice across comparable operators and the actual magnitude is appropriate. Given that Aurizon Network does not yet have a detailed understanding of the actual allocation of renewals expenditure to specific projects; SKM has been unable to review the prudency of individual projects. However, SKM's review of Aurizon Network's Asset Maintenance and Renewal Policy and Stage Gate process indicates that expenditure will be appropriately allocated to highest and best use and will be found prudent with regards to scope, standard and cost. The Asset Maintenance and Renewal Policy (although still currently draft and un-approved by the Authority in accordance with Schedule A of the UT3 and Schedule E of the UT4) will provide a robust and consistent framework for asset management decision making., Given the inherent uncertainty underpinning asset management, SKM finds that a considerable degree of judgment will still need to be applied, informed by practical experience and historical events, but the Stage Gate process will assist with this process.

SKM recognises that there are some areas within the CQCR with less age and condition data and therefore a detailed breakdown of assets reaching life expiry is unknown. These include ballast, formation, drainage and some turnout components. It is noted that Aurizon Network is planning significant asset data improvements to address these issues, which is a positive development and should enable further planning and renewal cost improvements to be made, particular related to ballast and formation renewal.

In regards to asset lives, SKM recommends that the Authority require Aurizon Network to re-instate a useful life of 40 years for power distribution assets, since power distribution assets are not impacted by tonnage. SKM also finds that it would not be appropriate to re-adjust the useful life of assets again in the UT5 period, without robust evidence demonstrating the age and condition of all assets on the network, which should be independently verified.

In regards to Aurizon Network's Asset Maintenance and Renewal Policy document, SKM recommends that the Authority review, and approve the policy in accordance with Schedule E of the UT4.

Appendix A. Information sources

This review is based on information sourced from documents as shown in **Table 2.1** and **Table 2.2** below.

Table 2.1: Information sources – task specific

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
Aurizon Network	Volume 3 of 4 – UT4 Explanatory Materials	Maximum Allowable Revenue and Reference Tariffs	R-Aurizon-QR2013DAU-ExMatBB-0513	PDF	30 April 2013
Aurizon Network	Volume 4 of 4 – UT4 Explanatory Materials	UT4 Maintenance Submission	R-Aurizon-QR2013DAU-ExMatMaint-0513	PDF	Confidential Version 30 April 2013
Aurizon Network	-	Stage Gate Process: Capital Expenditure Feasibility Investment Approval Request – Newlands Culvert Upgrade Project (A.04145) October 2012	-	Word	Version Issue Date July 2012
Aurizon Network	-	Asset Policy Maintenance and Renewal	1st Revision – Asset Policy Mtce Renewal 15 August 12 (2)	Word	DRAFT 15 August 2012
Australian Bureau of Statistics	-	Consumer Price Index, CPI: Groups, Index Numbers by Capital City - Brisbane All Groups, Table 5, All groups, Brisbane,	640103	Microsoft Excel	Latest ISSUE Released at 11:30 AM (CANBERRA TIME) 23/10/2013

Table 2.2: Information sources – general

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
The Authority		Terms of Reference, Engineering Technical Assessment of Maintenance, Operating and Capital Expenditure Forecast	QCA Terms of Reference_UT4 Engineer(565631_4)	PDF	27 June 2013
Aurizon Network	Volume 1 of 3 – The Access Undertaking and Schedules	Schedule E – Regulatory Asset Base	R-Aurizon-QR2013DAU-Vol1-0513	PDF	April 2013
Aurizon Network	Volume 1 of 4 – UT4 Explanatory Materials	Overview and Summary	R-Aurizon-QR2013DAU-ExMatOvr-0513	PDF	30 April 2013
Aurizon Network	Volume 2 of 4 – UT4 Explanatory Materials	The 2013 Undertaking Proposal	R-Aurizon-QR2013DAU-ExMatSub-0513	PDF	30 April 2013

A.1.1 Requests for Information

SKM raised the following RFIs to address specific areas of required information:

Owner	Document Name	Electronic File Name	Document Type	Relevant RFI
Aurizon Network	UT4 Maintenance – Summary Output	Product Make-Up, inc Exclusions	Microsoft Excel Workbook	RFI AUR-006
Aurizon Network	UT4 Maintenance - Rules for Translating FY12 Actual Scope to UT4 FY14 Scope	Scope Translation Rules – 18 January 2013	Microsoft Excel Workbook	RFI AUR-007, RFI AUR - 012, RFI AUR-013, RFI AUR-014 AND RFI AUR-015
Aurizon Network	Information review requirements – Asset Policy Maintenance and Renewal	Chapter 8, Volume 3 of the UT4	PDF	RFI AUR-001
Aurizon Network	Information review requirements – Asset Policy Maintenance and Renewal	Asset Policy Maintenance and Renewal	Microsoft Word	RFI AUR-002
Aurizon Network	Information review requirements – Asset Policy Maintenance and Renewal	Detailed description of scope of asset renewals was not available.	-	RFI AUR-003

Appendix B. Maintenance intervention levels

B.1 Mechanised Track Maintenance

Maintenance Product	Frequency Required	Unit
Ballast Undercutting	[redacted]	Single track km
Ballast Undercutting - Turnouts	[redacted]	Turnout
Ballast Undercutting (Other/Shoulder)	[redacted]	Single side km
Rail Grinding - Straights	[redacted]	Single track km
Rail Grinding - Curves 1001 to 2500 metres radius	[redacted]	Single track km
Rail Grinding - Curves less than 1000 metres radius	[redacted]	Single track km
Track Resurfacing	[redacted]	Single track km
Turnout Grinding	[redacted]	Turnout
Turnout Resurfacing	[redacted]	Turnout
Stone Blowing	[redacted]	Single track km

B.2 General Track Maintenance

Maintenance Product	Frequency Required	Unit
Track Geometry Recording	[redacted]	Single track km
General Track Maintenance Activities	[redacted]	Single track km
Track Inspections	[redacted]	Single track km
	[redacted]	Turnout/Year
	[redacted]	Turnout
Turnout Maintenance	[redacted]	Turnout
Rail Flaw Detection	[redacted])	Single track km
	[redacted]	100m / 100 single track km/yr
	[redacted]	Turnout
Rail Lubrication - Curves Only	[redacted]	Single track km / year
General Earthworks Mtce (Incl access roads)	[redacted]	Route km / year
Fencing	[redacted]	Route km / year
Fire and Vegetation Control	[redacted]	Route km / year
All other	[redacted]	Route km / year

B.3 Structures and Facilities Maintenance

Maintenance Product	Frequency Required	Unit
Inspections	[redacted]	100 Route km / year
Culvert Repairs	[redacted]	Culvert / year
Concrete Bridge Repairs	[redacted]	Linear metre / year
Steel Bridge Repairs (Including Painting)	[redacted]	Linear metre / year
Timber Bridge Repairs	[redacted]	Linear metre / year
Retaining Wall Repairs	[redacted]	Linear metre / year

B.4 Signalling Maintenance

Maintenance Product	Frequency Required	Unit
Signals (electric, including long range pts indicator and mechanical)	[redacted]	Head
Points / Points Motors (mechanical, electric, hydraulic)	[redacted]	Motor
Signal Gantry and Cantilever	[redacted]	Structure
Level Crossing Warning Control	[redacted]	Set/year
Underground Copper Cable Route	[redacted]	SER/CER Site
Housings (Apparatus Case & Hut, SER, CER, PER, ALT)	[redacted]	Case, Room, Hut
Interlocking	[redacted]	Set
Monitor (RMS HG Sender – Flashing Lights)	[redacted]	Set/year
Weather Station (RMS HG Sender & Receiver, Remote Station)	[redacted]	Set/year
Overload Detectors	[redacted]	Static Verification
Trade Verified Weighbridges	[redacted]	Dynamic Verification
Remote Weigher Interface, Train Load out Application, Automatic Equipment Identification.	[redacted]	Unit
Rolling Stock Monitors (DED's, HBD's, HWD's, TADS)	[redacted]	Set/year
Alternator	[redacted]	Set
Uninterrupted Power Supply (UPS)	[redacted]	Unit
Axle Counters	[redacted]	Counter
Track Circuits	[redacted]	Circuit
UTC (Workstation, Switch, Receiver, Telemetry, ZRS, LAN)	[redacted]	Unit
ATP (Westect, Radio, Transponder Group)	[redacted]	Site
Systems (DTC signs, Local Panel, Mech Lever Frame, Switch Locked Points)	[redacted]	Unit
SCADA Power Supervisory	[redacted]	Site

B.5 Traction Power System Maintenance

Maintenance Product	Frequency Required	Unit
Substations	[redacted]s	Site
Transformers	[redacted]	Unit
Switchgear	[redacted]	Unit
DC Power Supply	[redacted]	Unit
HV Protection	[redacted]	Panel
Monitoring Systems	[redacted]	Unit
Overhead Line Equipment	[redacted]	Unit
Contact Wire	[redacted]	Single track km (tension length)
Recording Car	[redacted]	Single track km
Height and Stagger Measurements	[redacted]	Section/year
Electrical Sectioning	[redacted])	Section

B.6 Telecommunications Maintenance

Maintenance Product	Frequency Required	Unit
Rolling Stock Monitors (HBD/HWD Radio, Auto Brake Examiner, DED Systems Radio, Loadout Alarm Systems, WILD)	[redacted]	Monitor
Train Speed Indicator Radio Site	[redacted]	Site
Environmental Monitors	[redacted]	Monitor
Fixed Radio Systems	[redacted]	Station/location/ year
Telecommunication Sites (CER)	[redacted]	Site
Electric Power Systems	[redacted]	Unit
Transmission Towers	[redacted]	Tower
Transmission (Copper Based System) - Interface	[redacted]	Unit
Transmission (Microwave Radio)	[redacted]	Transmitter/Receiver Set
Transmission (Optic Fibre Systems)	[redacted]	Transmitter/Receiver Set
LAN & Other Network Data Equipment	[redacted]	Unit
Switching (PABX)	[redacted]	Unit
Switching (Voice)	[redacted]	Unit

Appendix C. Renewals intervention levels

C.1 Civil Track Asset Renewal

Asset	Life	Unit
60 kg/m Rail - Straights	[redacted]	Single rail km
60 kg/m Rail – Curves (1001 to 2500 metre radius)	[redacted]	Single rail km
60 kg/m Rail – Curves (601 to 1000 metre radius)	[redacted]	Single rail km
60 kg/m Rail – Curves (200 to 600 metre radius)	[redacted]	Single rail km
60 kg/m Rail – HH Curves (200 to 600 metre radius)	[redacted]	Single rail km
60kg/m Rail – HH Curves (601 to 1000 metre radius)	[redacted]	Single rail km
53 kg/m Rail - Straights	[redacted]	Single rail km
53 kg/m Rail – Curves (1001 to 2500 metre radius)	[redacted]	Single rail km
53 kg/m Rail – Curves (601 to 1000 metre radius)	[redacted]	Single rail km
53 kg/m Rail – Curves (200 to 600 metre radius)	[redacted]	Single rail km
50 kg/m Rail - Straights	[redacted]	Single rail km
50 kg/m Rail – Curves (1001 to 2500 metre radius)	[redacted]	Single rail km
50 kg/m Rail – Curves (601 to 1000 metre radius)	[redacted]	Single rail km
50 kg/m Rail – Curves (200 to 600 metre radius)	[redacted]	Single rail km
47 kg/m Rail - Straights	[redacted]	Single rail km
47 kg/m Rail – Curves (1001 to 2500 metre radius)	[redacted]	Single rail km
47 kg/m Rail – Curves (601 to 1000 metre radius)	[redacted]	Single rail km
47 kg/m Rail – Curves (200 to 600 metre radius)	[redacted]	Single rail km
22.5 Tonne Axle Load PSC Concrete Sleepers	[redacted]	Track km
28.0 Tonne Axle Load PSC Concrete Sleepers	[redacted]	Track km
Timber Sleepers	[redacted]	Track km
Steel Sleepers	[redacted]	Track km
Timber Sleeper Turnout Sets (1 in 12)	[redacted]	Set
Replace Sleeper Fastenings (10kms from Coast)	[redacted]	Single track km
Ballast	[redacted]	Track km
1 in 8.25 (53 kg/m) Fabricated Points and Crossing	[redacted]	Complete Turnout
1 in 12 (47 kg/m) Fabricated Points and Crossing	[redacted]	Complete Turnout
1 in 12 (53 kg/m) Fabricated Points and Crossing	[redacted]	Complete Turnout
1 in 12 (53 kg/m) RBM Points and Crossing	[redacted]	Complete Turnout
1 in 12 (60 kg/m) RBM Points and Crossing	[redacted]	Complete Turnout
1 in 16 (60 kg/m) RBM Points and Crossing	[redacted]	Complete Turnout
1 in 12 (60 kg/m) Swing Nose Points and Crossing	[redacted]	Complete Turnout
1 in 16 (60 kg/m) Swing Nose Points and Crossing	[redacted]	Complete Turnout
1 in 25 (60 kg/m) Swing Nose Points and Crossing	[redacted]	Complete Turnout
1 in 12 (60 kg/m) Swing Wing Crossing	[redacted]	Complete Turnout

C.2 Civil Structure Asset Renewal

Asset	Life	Unit
Pre-stressed Concrete Bridge	[redacted]s	Linear metre
Steel Bridge	[redacted]	Linear metre
Timber Bridge	[redacted]	Linear metre
Reinforced Concrete Box Culverts (RCBC)	[redacted]	Linear metre
Reinforced Concrete Pipes (RCP)	[redacted]	Linear metre

Concrete Pipes (Unreinforced)	[redacted]	Linear metre
Concrete In situ Arch	[redacted]	Linear metre
Small Corrugated Metal Pipes (<2000mm dia)	[redacted]	Linear metre
Large Corrugated Metal Pipes (>2000mm dia)	[redacted]rs	Linear metre
Precast Concrete Deck Drain	[redacted]	Linear metre
Concrete Retaining Walls	[redacted]	Linear metre
Pedestrian Overbridge (Steel)	[redacted]	Linear metre

C.3 Civil Right of Way Asset Renewal

Asset	Life	Unit
Fencing	[redacted]	Single side km
Public Level Xing Refurbishment (signage, drainage, road surface)	[redacted]	Single track level xing
Occupational Level Xing Refurbishment (signage, drainage, road surface)	[redacted]	Single track level xing
Stock Xing Refurbishment (signage, drainage, road surface)	[redacted]	Single track level xing
Pedestrian Foot Xing Refurbishment (signage, drainage, road surface)	[redacted]	Single track level xing
Formation Strengthening	[redacted]	Track km
Formation Re-building	[redacted]	Track km
Timber Noise Barriers	[redacted]	Linear metre
Concrete Noise Barriers	[redacted]	Linear metre

C.4 Signal Equipment Asset Renewal

Asset	Life	Unit
Dragging Equipment Detector	[redacted]	Unit
Level Crossing Monitors	[redacted]rs	Unit
Weather Station	[redacted]	Unit
Hot Bearing and Hot Wheel Detectors	[redacted]	Unit
Wheel Impact Load Detector (WILD)	[redacted]	Unit
Weighbridges	[redacted])	Unit
Diesel Standby Alternators	[redacted])	Unit
UPS	[redacted]	Unit
Level Crossings (Vehicle & Pedestrian)	[redacted]rs	Set
Walk in Location Case (Level Xings), Equipment Room, Location Cases	[redacted]	Unit (fitted out)
Relay Interlockings	[redacted]	Station set
Processor Based Interlockings	[redacted]	Station set
Points Machines	[redacted]	Unit
Signal Posts	[redacted]	Post
Signal Gantry	[redacted]	Gantry
Long Range Points Indicator	[redacted]	Post
DC & Impulse Track Circuits	[redacted]	Power/Receiver set
Jointless Track Circuits	[redacted]	Power/Receiver set
Axle Counter Counting Head and Evaluators	[redacted]	Unit
S2 Telemetry Unit	[redacted]	Unit (complete)
Train Protection Systems (ATP)	[redacted] [redacted])	Track km
Copper cable (inside station yards)	[redacted]	Route km
Copper cable (outside station yards)	[redacted]	Route km

C.5 Traction Power Equipment Asset Renewal

Asset	Life	Unit
Harmonic Filters	[redacted]	Substation Site
Traction Power Systems Transformers	[redacted]	Single Unit
Original Autotransformers (installed 1985)	[redacted]	Single Unit
New Autotransformers	[redacted]	Single Unit
Auxiliary Supply Transformers	[redacted]	Unit
Traction Power Systems Switchgear	[redacted]	Unit
Motorised Isolator	[redacted]	Unit
Isolator -Standard and Critical	[redacted]	Unit
Neutral Section Insulators	[redacted]	Unit
Contact Wire	[redacted])	Single track km (tension length)
Catenary, Feeder and Earth Wires	[redacted]	Single track km
Insulators	[redacted]	Unit
Electrification Masts, Cantilever Rods, Support Gantries	[redacted]	Unit

C.6 Telecommunications Asset Renewal

Asset	Life	Unit
Data – LAN - Switch Routers	[redacted]	Unit
Radio Systems – TCR & MSR	[redacted]	Transceiver Unit
Radio Systems - Hand Held Radio	[redacted]	Unit
Switching - Large PABX (<4000 extensions)	[redacted]	Unit
Switching - Medium PABX (<250 extensions)	[redacted]	Unit
Switching - Small PABX (<100 extensions)	[redacted]	Unit
Radio Tower	[redacted]	Tower
Microwave Tower	[redacted]	Tower
Digital Microwave Radio (DMR)	[redacted]	Transmitter & Receiver Unit
Active Terminal Equipment (PDH, SDH)	[redacted])	Unit
Original Fibre Optic Cable (installed 1985)	[redacted]	Route km
New Fibre Optic Cable	[redacted]	Route km

Appendix D. Example of Stage Gate process

Attachment F: Review of asset renewals work program

Contents

1. Glossary

Abbreviations and definitions used in this document are listed in **Table 1.1**.

Table 1.1: Abbreviations and Terminology

Abbreviation, Acronyms and Terminology	Description / Definition
APCT	Abbot Point Coal Terminal
Aurizon Network	On 3 December 2012, QR Network Pty Ltd changed its name to Aurizon Network Pty Ltd.
BMA and BMC	BHP Billiton Mitsubishi Alliance and BHP Billiton Mitsui Coal
CQCR	Central Queensland coal region
CQIRP	Central Queensland Integrated Rail Project
GAPE	Goonyella to Abbot Point system
gtk	Gross tonne kilometre
mtpa	Million tonnes per annum
NAMS	Network Asset Management System
ntk	Net tonne kilometre
OBS	Organisational Breakdown Structure
QRC	Queensland Resources Council
RAB	Regulatory Asset Base
RFI	Request for Information
RTCA	Rio Tinto Coal Australia
SKM	Sinclair Knight Merz
STS	Specialised Track Services
The Authority	Queensland Competition Authority
tp	Train paths
UT3	2010 Access Undertaking
UT4	2013 Access Undertaking
WICET	Wiggins Island Coal Export Terminal
WIRP	Wiggins Island Rail Project

2. Review of the asset renewals work program

2.1 Task description and methodology

2.1.1 Background to this report

The Queensland Competition Authority (the Authority) engaged Sinclair Knight Merz (SKM) to assess system-wide and system-specific forecast asset renewals for reasonableness.

This report provides SKM's opinion on the scope of the asset renewals work program in the context of:

- the proposed maintenance work program;
- the proposed major growth projects (Section 8.3 of Chapter 8 of Volume 3 of UT4 explanatory materials);
- Aurizon Network's human resources, in particular track staff;
- Aurizon Network's plant resources (e.g.: access to tampering machines); and
- the track closure times that would be necessary to achieve the proposed asset renewals and maintenance work programs as well as deliver the major projects.

2.1.2 Methodology

SKM has undertaken a review of the track closure calendars in order to determine:

- the possible track closure times for Aurizon Network's asset renewal activities and works associated with proposed major growth projects; and
- the required human resources and plant resources to complete the works in the available track closure times.

For the purpose of this assessment, SKM has assumed that all planned maintenance and capital expenditure activities (asset renewal, system enhancements) will occur during the planned track closure periods shown in **Section 2.1.3** below. SKM notes that opportunities exist for Aurizon Network to complete preventative maintenance and capital expenditure activities (asset renewal, system enhancements) during unplanned track closures (due to weather related incidents or derailments, dewirements) and/or unplanned port and mine closures.

2.1.3 Adequacy of information provided and general comments

SKM requested the following information from Aurizon Network which has been utilised as part of this review:

- maintenance work program;
- detailed information on proposed capital expenditure projects (scope, location and cost);
- number of staff available to undertake the work proposed;
- number and type of plant resources available to complete the work proposed; and
- proposed track closure information by system.

2.2 Key information

2.2.1 Proposed capital expenditure projects (asset renewals and system enhancement projects)

Details of the proposed capital expenditure projects (including asset renewals and system enhancement projects) were provided in Sections 8.3 and 8.4 of Chapter 8 of Volume 3 of UT4 explanatory materials.

Aurizon Network proposes capital expenditure of $1.95 billion over the four years of UT4. The expenditure includes:

- upgrades and renewals expenditure; and
- major growth projects.

The total value of capital expenditure over the UT4 period is provided in **Table 2.1** below.

Table 2.1 Aurizon Network's proposed capital expenditure during UT4 ($m)

System	2013/14	2014/15	2015/16	2016/17	Total	% of Total
Blackwater	97,564	1,070,153	96,093	71,418	1,335,228	68%
Goonyella	191,203	109,582	99,975	69,495	470,254	24%
Moura	12,350	61,635	11,301	8,076	93,361	5%
Newlands	10,233	6,649	9,364	6,692	32,937	2%
GAPE	19,805	--	--	--	19,805	1%
TOTAL	331,154	1,248,019	216,732	155,681	1,951,586	

Source: Aurizon Network, Chapter 8 of Volume 3 of UT4 explanatory materials

SKM notes that investment in the Goonyella and Blackwater systems represents 92% of the total capital expenditure. Excluding the WIRP project, capital expenditure amounts to around $1,000 million or $250 million per year for 4 years.

Proposed asset renewal expenditure

With regards the asset renewals component of the capital expenditure projects, Aurizon Network provided the summary shown in **Table 2.3** below during an initial presentation of the UT4 submission to representatives of SKM and the Authority, as well as in Section 8.4.1.4, Volume 4 of UT4 explanatory materials. **Table 2.2** represents a 'typical' asset renewal cost per annum and includes a likely breakdown by asset type. The 'typical cost' of $120 million was determined by Aurizon Network through a benchmarking exercise against US Class 1 railways, where the average renewals spend across the US Class 1 railways in the financial years from 2009 to 2011 was $2.60 per thousand ntk. Consistent with the Class 1s, Aurizon Network states that this amount is also more aligned with depreciation. Based on this benchmark, Aurizon Network has derived a 'typical cost' of $120 million per annum based on 46 million ntk of throughput in the 2011/12 financial year. The breakdown by asset type was determined by Aurizon Network having regard to the CQCR's size and traffic task and the likely renewal requirements in each asset class.

Table 2.2 Overview of Aurizon Network's renewal projects

Asset type	Total asset amount in network	Typical renewals per annum	Typical cost per annum
Track	2,677 km 10,000 culverts	[redacted]	$6 million $10 million
Sleepers	4.4 million sleepers across 2,677km of track (sleeper every 610cm)	[redacted]	$15 million

Rail	5,354 km	[redacted]	$18 million
Turnouts	975 turnouts	[redacted]	$8 million
Telecommunications	1,413 transmission nodes 1,123 power supplies 359 Computer Rooms 33 Weighbridges 108 asset protection monitors 2,400 km of optic fibre	• [redacted]. • [redacted]	$20 million
Traction System	1,820 km 42 Switching stations 265 Autotransformers 42 Supply Transformers	• [redacted] • [redacted]	$15 million
Level Crossings and Track signage.	158 Public Crossings 606 Private Crossings	• [redacted]	$3 million
Signalling	174 Interlockings 3,263 Electrical signals 655 Mechanical signals	• [redacted]	$12 million
Miscellaneous		Examples: access roads, fencing, crew change platforms.	$13 million
TOTAL			**$120 million**

Source: Provided by Aurizon Network in a presentation to SKM and the Authority on 29 August 2013.

In Section 8.4 of Volume 4 of UT4 explanatory materials, Aurizon Network's forecast renewals expenditure, as detailed in **Table 2.3** below, is as follows. The forecast renewals expenditure for the UT4 period is different to the 'typical cost' per annum, as it defines the level of renewals forecast by Aurizon Network for the UT4 period, having regard to forecast tonnage and life span of the asset.

Table 2.3 UT4 forecast renewals expenditure ($m) (nominal dollars)

Asset Category	2013/14	2014/15	2015/16	2016/17	TOTAL
Asset Renewals	150.30	84.20	91.50	120.00	**446.00**
Telecoms	0.02	0.02	0.02	-	**0.06**
Network Control Systems	31.20	15.90	18.9-	-	**66.00**
TOTAL	**181.52**	**100.12**	**110.42**	**120.00**	**512.06**

Source: Aurizon Network, 2013 Draft Access Undertaking, Volume 3: Maximum Allowable Revenue and Reference Tariffs, p177, Table 49

Maintenance works program and track closure calendars

Aurizon Network provided a high level CQCN calendar for activities between April 2013 and December 2014. Aurizon Network also provided a detailed Critical Asset Alignment Calendar (CAAC) for activities on the Newlands and Goonyella systems and an example program of activities, as well as location plans for all renewal activities on all the various systems during September and October 2013.

SKM has reviewed the maintenance works program and planned track closures provided by Aurizon Network, in particular the CQCN calendar as shown in **Figure 1** below.

Figure 1 Aurizon Network's CQCN calendar

Source: SKM, Aurizon Network response to RFI 005.

SKM notes that activities are not showing as occurring concurrently on different systems. **Table 2.4** provides a summary (by system) of Aurizon Network's proposed track closures from their CQCN calendar (2014).

Table 2.4 Aurizon Network's proposed track closures January 2014 to December 2014

Month	Blackwater	Goonyella	Moura	Newlands / GAPE	Total
January	2	2	1	2	**7**
February	4	2	1	1	**8**
March	3	2	1	1	**7**
April	3	2	1	2	**8**
May		2	1	2	**5**
June			1		**1**
July	3	2	1	1	**7**
August		3	1	1	**5**
September	3	2	2	6	**13**
October	3	2	1	1	**7**
November		2	3	1	**6**
December		2	1	1	**4**
Total	**21**	**23**	**15**	**19**	**78**

Source: Aurizon Network response to RFI 005 (SKM table).

For the Newlands and Goonyella systems, Aurizon Network provided their CAAC weekly planning summary up to August 2014 (example shown in **Figure 2** below) which demonstrates how the dates of the planned maintenance activities (summarised in the **Table 2.4** above) occur and the corresponding reductions in available weekly train paths.

Figure 2 Example of CAAC weekly planning summary for Goonyella system

Source: Aurizon Network response to RFI 005.

2.3 Assessment of Aurizon Network’s proposed asset renewals work program

2.3.1 Review of Aurizon Network’s planned maintenance program

SKM notes that Aurizon Network is claiming to only undertake between 15 and 23 days of planned track closures on the different systems in its network. As way of comparison, and drawing on SKM’s review of Aurizon Network’s capital expenditure 2011/12, SKM notes that Aurizon Network anticipated 7 days of planned downtime and 5 days of unplanned downtime when planning the Goonyella to Abbot Point expansion project. For information, **Figure 4** shows how Aurizon Network Pty Ltd arrived at 298 days/year availability forecast based on claimed analysis of 5 years of operational data.

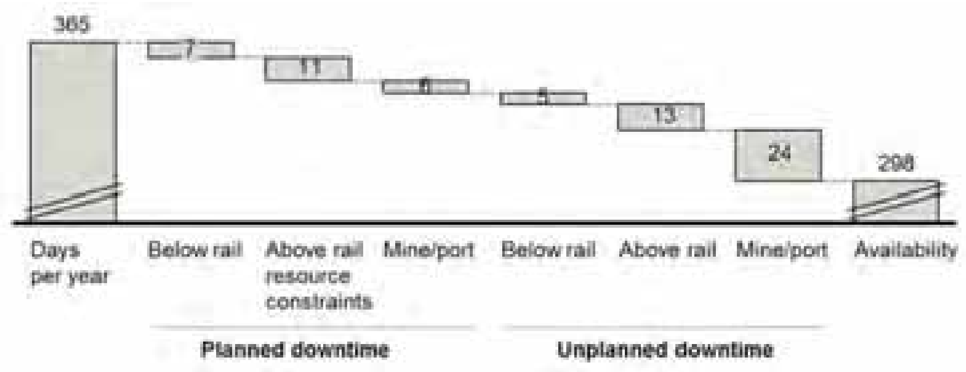

Figure 4 Aurizon Network’s historical day/year availability after planned and unplanned downtimes

Source: SKM review of Aurizon Network’s capital expenditure 2011/12 (GAPE project).

SKM finds the number of track closures in the different systems detailed in **Table 2.4** (i.e. between 15 and 23 days) to complete the planned maintenance activities to be reasonable for Aurizon Network’s planned asset renewal task. Our assessment of reasonableness is based on a review of Aurizon Network’s weekly planning summary. For example, the Goonyella CAAC weekly planning summary indicates activities such as system maintenance and outlines the impact of these activities on weekly train paths. For information, SKM finds the average weekly impact on train paths in the Goonyella system corresponds to a 5.7 per cent reduction in capacity[1].

2.3.2 Review of Aurizon Network’s proposed capital expenditure projects and work program

SKM notes that Aurizon Network’s proposed capital expenditure includes asset renewal and system enhancement projects.

Review of asset renewals projects

Aurizon Network has provided typical renewal quantities per annum for track, sleepers, rail and turnouts, as shown in **Table 2.2** above. SKM finds that whilst the typical cost per annum is reasonable, the quantities per annum as a function of the total asset amount in network appear low. For example, typical formation renewals per annum of 5km, represents 0.2 per cent of total asset amount. Similarly, typical turnout renewals of 15 turnouts, represents 1.5 per cent of total asset amount.

Aurizon Network has provided a breakdown of the UT4 forecast renewals expenditure shown in **Table 2.3**. SKM finds that Aurizon Network has not demonstrated an actual awareness of the age of assets on the CQCN, although the life expectancy of CQCN assets has been adjusted downwards by Aurizon Network for the proposed UT4 period. SKM notes that Aurizon Network has not demonstrated the capability of its assets (i.e.

[1] 16181 train paths out of a possible 17160 train paths between week 9, 2013 and week 8, 2014.

the remaining life of its assets) in support of this adjustment. SKM therefore finds that Aurizon Network has determined its forecast renewals expenditure as a function of the RAB (i.e. using a top-down method). Specifically, Aurizon Network's forecast renewals expenditure of $512 million represents 2.7% of the opening UT4 RAB against an expected average of 3.0% (for a 30 to 35 year physical asset life). SKM finds that a bottom-up method (as Aurizon Network have used for calculating forecast maintenance expenditure) would be more appropriate if detailed asset capability (i.e. how long since particular asset were installed, how many tonnes/train passes assets have been subject to etc.) was available. In absence of this information, SKM finds the proposed top-down will provide an approximate forecast of requirements, and is therefore a reasonable approach to forecasting a potential level of renewals for the UT4 period. It is also noted (based on SKM's specialist industry knowledge) that a top-down approach to forecasting asset renewals is standard across industry, although it is imperative that the asset renewal expenditure is allocated to the highest and best use across the network[2].

SKM also notes that Aurizon Network are embarking on the establishment of an Network Asset Management System (NAMS) and suggest that, as with the use of ground penetrating radar to identify areas where ballast cleaning is required, this system should target the provision of objective data to support the asset replacement activities.

Review of system enhancement projects (major projects)

SKM suggests Aurizon Network could complete the connection works associated with the planned system enhancement projects during the planned track closures detailed in **Table 2.1** above, which would result in cost savings that should be explored as part of detailed project identification and scheduling.

Projects not included in the capital expenditure program

SKM notes that Aurizon Network has not included potential costs in UT4 for the following potential projects:

- WIRP Stage 2: the expansion of rail network to support a 30mtpa expansion of WICET. Financial close of this project has been deferred until at least late 2014;
- WIRP Stage 3: the second expansion of 30mtpa of WICET;
- Central Queensland Integrated Rail Project (CQIRP): Aurizon Network is investigating the potential to develop an integrated rail network from the Galilee Basin to Central Queensland ports, in particular Abbot Point. Aurizon Network's proposal will seek to optimise existing rail infrastructure through upgrades to the Newlands coal system, and thereby minimise the extent of new or 'greenfield' railway;
- Northern Port (Bowen Basin Expansion): Aurizon Network was advised by Dudgeon Point Project Management Pty Ltd in March 2012 of the total 68 mtpa development to be carried out in two stages of 34 mtpa each. The responses from the Request for Proposal process for Dudgeon Point will determine the timeframe and sequence of rail infrastructure requirements. This project has recently been deferred; and
- Abbot Point Coal Terminal (APCT) expansion: APCT expansion projects cater for the new terminals T0 and T2 at the Port of Abbot Point and also the potential expansion of the existing T1 terminal. In total Aurizon Network is looking to support a 50 mtpa to 135 mtpa tonnage growth. Potential projects include a bypass around Collinsville, new loops at APCT, duplications and other works to cater for Goonyella length trains.

Aurizon Network has stated that should these projects be advanced and expected to be commissioned within the UT4 period it will submit a Review Event or Draft Amending Access Undertaking as necessary to establish a new reference tariff or increase the relevant system allowable revenue. SKM finds that should these projects be

[2] Discussed in SKM's report titled "Technical advice on the trade-off between asset renewals and maintenance expenditure".

advanced, Aurizon Network would need significant external resources to complete these projects, if Aurizon Network's own capacity to deliver planned asset renewal projects is not to be detrimentally affected.

2.3.3 Consideration of reasonableness of track closures for proposed work program

SKM finds the number of track closures in the different systems detailed in **Table 2.4** (i.e. between 15 and 23 days) to complete the planned capital expenditure activities (asset renewals and system enhancement projects) to be reasonable.

2.3.4 Review of Aurizon Network's human resources

Categorisation of human resources

Aurizon Network has reorganised their human resources for the UT4 period as shown in the organisation chart (**Figure 3**). These resources are designated as either Brisbane based or geographically disbursed to the various depots in Maintenance North or Maintenance South areas as shown in **Figure 5** and **Figure 6** below.

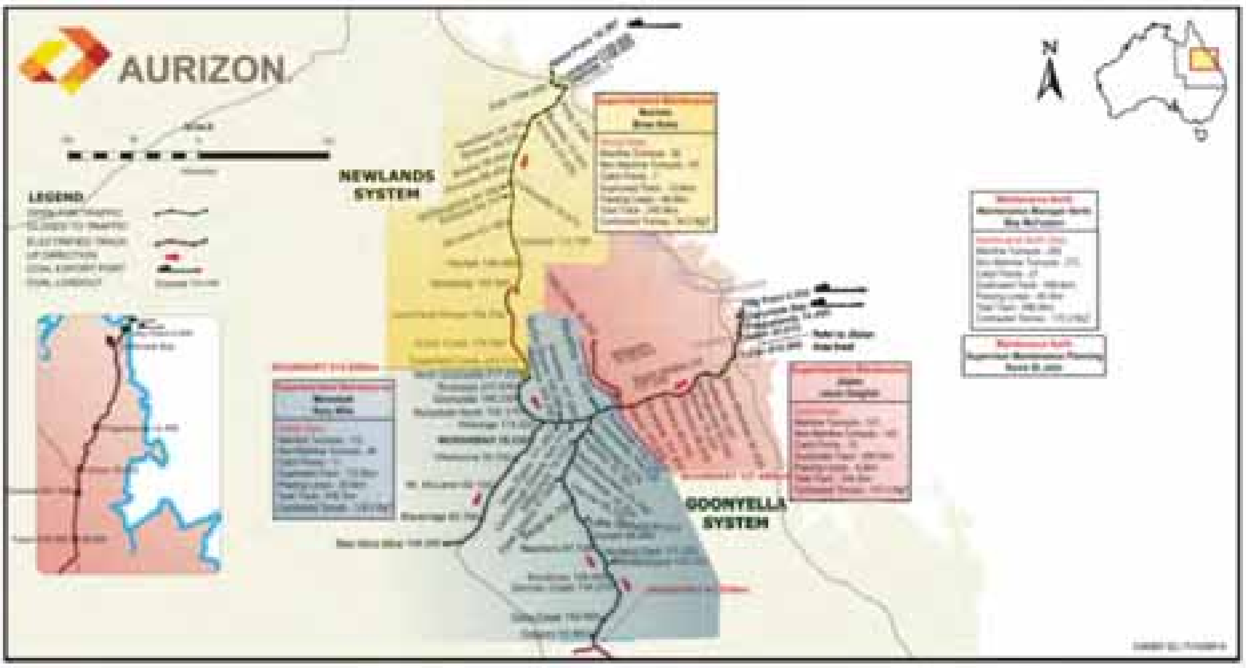

Figure 5 Aurizon Network's Depots in Maintenance North area

Source: Aurizon Network, page 82, Volume 4 of UT4 explanatory materials.

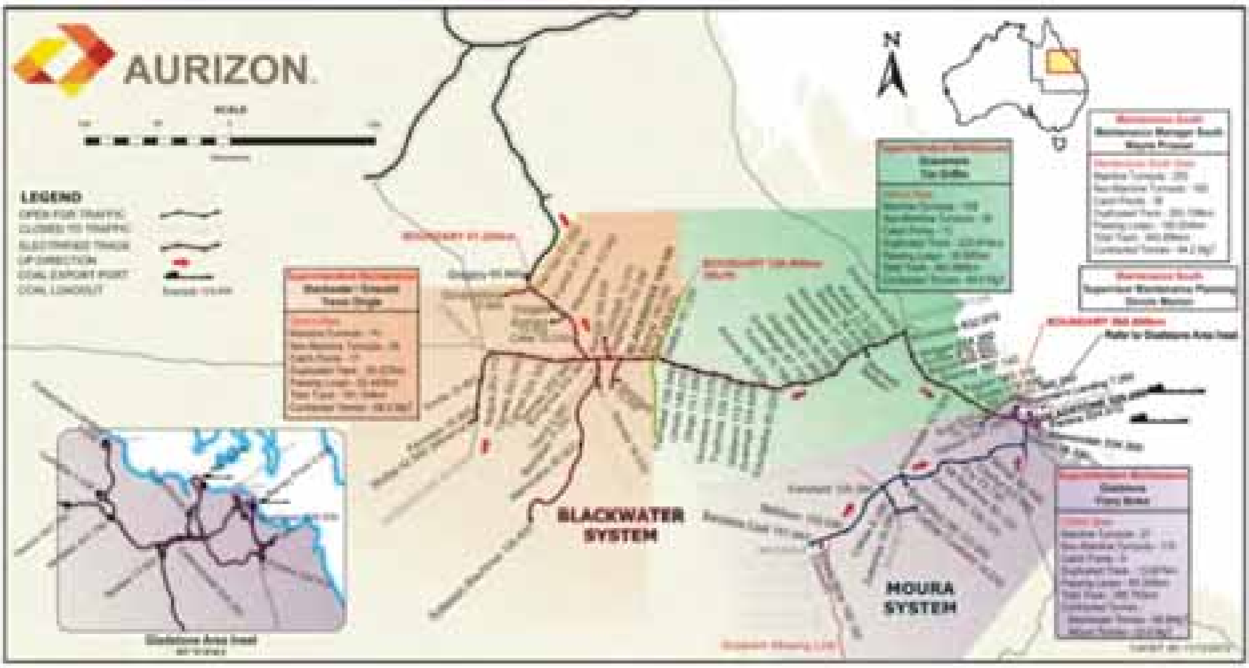

Figure 6 Aurizon Network's Depots in Maintenance South area

Source: Aurizon Network, page 83, Volume 4 of UT4 explanatory materials.

[redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Source: Aurizon Network response to RFI 005 (SKM graph)

[redacted]

Source: Aurizon Network response to RFI 005 (SKM graph)

Risk associated with human resources

In Section 11 of Volume 4 of UT4 explanatory materials, Aurizon Network highlights that the availability of qualified personnel could adversely affect its operations. SKM agrees that changes in demographics, training requirements and the availability of qualified personnel, particularly engineers and plant operators could negatively impact Aurizon Network ability to meet demand for rail maintenance and asset renewals.

Aurizon Network states that 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.

SKM recognises the use of multiple service providers, where available, will assist in ensuring competent and capable resources are available.

2.3.5 Review of Aurizon Network's plant resources

Categorisation of plant resources

SKM finds that Aurizon Network procures specialised plant through normal commercial means on the open market, in particular earthmoving plant, such as backhoes. Specialised railway track and overhead plant is purchased and owned by Aurizon Network.

Aurizon Network has access to an extensive fleet of maintenance equipment supporting its major scheduled preventative maintenance and corrective maintenance activities. As stated in Section 3.3.6 of Volume 4 of UT4 explanatory materials, Aurizon Network classifies equipment 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. Numbers of plant resources

A summary of the number and value of the various plant resources owned by Specialised Track Services (STS) are shown in **Figure 2.11** and **Figure 2.12** below.

SKM finds that Aurizon Network have a significant number of heavy track equipment plant resources including tampers, ballast cleaners, ballast regulator, track resurfacing machine, track laying machines and rail grinders. SKM finds the available plant resources are is

Risks related to plant resources

In Section 11 of Volume 4 of UT4 explanatory materials, Aurizon Network states that considerable delays are being experienced in the procurement process for delivery of new plant (in particular large on-track plant) and claim that two years is a realistic allowance for delivery.

SKM agrees that 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. In this regard, Aurizon Network may be liable to provide an adjustment to the RAB if the full scope is not achievable.

Again in Section 11 of Volume 4 of UT4 explanatory materials, Aurizon Network highlights the reliance on one nearly life expired ballast cleaning machine (RM900) as a risk factor. Aurizon Network states that its undercutter machine is 11 years old, and the typical asset life for this machine is 10-15yrs and as such expected expiry is 2016/17.

SKM recognises the increased likelihood of machine breakdown as serviceable life cycle of existing plant approaches and finds that there is a risk that if the machine itself becomes unserviceable, in which case Aurizon Network will be unable to deliver the forecast ballast cleaning function. Access to track would become a greater safety risk, since whilst a replacement RM900 is being acquired, Aurizon Network would continue ballast cleaning by increasing resurfacing, stoneblowing and major track panel works involving ballast excavating.

Until the new undercutter is delivered in FY17, Aurizon Network claims to be investing in the support assets of the RM900 to improve efficiencies and increase production. Aurizon Network has provided the undercutting rates shown in **Figure 2.13** below.

SKM finds that Aurizon Network's proposed undercutting rates are achievable in the context of the proposed mitigation strategies. If Aurizon Network fails to acquire the additional spoil wagons or implement upgrades to existing machinery as indicated during the UT4 period the ballast cleaning program will not be achievable and adjustments to the RAB may be required.

[redacted]

Figure 2.13 Aurizon Network's ballast cleaning / undercutting rates
Source: Aurizon Network, presentation on 29 August 2013.

2.3.6 Consideration of reasonableness of resources for proposed work program

SKM appreciates that the maintenance and asset renewals activities are completed by the same resources and use the same track closures. SKM finds that the numbers and dispersed locations of human resources are appropriate and reasonable to complete the proposed asset renewal work program. SKM also finds that the plant resources are appropriate and reasonable to complete the proposed asset renewal work program, but there are risks associated with the existing ballast undercutter.

3. Aspects of the asset renewals program raised in stakeholder submissions

The Authority also requested that SKM review and provides opinion on the issues raised by QRC, RTCA, BMA and BMC and Asciano in relation to the asset renewals program. SKM has undertaken a review of stakeholder submissions and has determined that there were no specific references to the asset renewals program in regards to the capability for Aurizon Network to deliver the proposed asset renewals. SKM has provided opinion on stakeholder submissions relating to the prudency of forecast asset renewals expenditure in the report titled "*Technical advice on the trade-off between asset renewals and maintenance expenditure*".

4. Conclusions and recommendations

SKM finds that the planned activities can reasonably occur, given the available human and plant resources, during the planned track closures as detailed in asset renewals work program.

As stated in Section 8.4.1.4 in Chapter 8 of Volume 4 of UT4 explanatory materials, Aurizon Network's notes inherent uncertainty associated with asset management means that it is not possible to forecast the precise nature, amount and timing of renewals expenditure across the four years of the regulatory period, and that a top-down approach to estimating asset renewals requirements is normal in the rail industry. SKM agrees that a degree of judgment will still need to be applied in prioritising and planning renewal activities, which can be impacted by changes in tonnages and asset condition, as well as significant weather events. SKM appreciates that the timing of renewal works could also change to maximise delivery efficiencies.

SKM notes that Aurizon Network state that every individual asset renewal project will be subject to the requirements of Aurizon Network's Capital Allocation Funding Framework, including the stage gate process (including completion of a business case through the Stage Gate Process, which may be subject to independent peer review, designed to address the prudency tests for capital expenditure approval contained in Schedule A of Access Undertaking). SKM finds that this is a reasonable approach to demonstrating justification for asset renewal activities. SKM finds that greater emphasis on capability of assets (i.e. how long since particular asset were installed, how many tonnes/train passes assets have been subject to etc.) would assist with confirmation of prudency of scope. To this end, SKM notes that Aurizon Network is currently developing a NAMS tool to assist with the management of maintenance and asset renewal activities.

Appendix A. Information sources

A.1 Provided documentation

This review is based on information sourced from documents as shown in **Table A.1** and **Table A.2** below.

Table A.1: Information sources – task specific

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
Aurizon Network	RFI 005	CQCN Calendars_120613	CQCN Calendars_120613	PDF	29/10/2013
Aurizon Network	RFI 005	Critical Asset Calendars - Distribution 260813	Critical Asset Calendars - Distribution 260813	Excel	29/10/2013
Aurizon Network	RFI 005	UT4 costs	UT4 costs	Excel	29/10/2013
Aurizon Network	RFI 005	NMP 2013-2014 Budget By Product - SAP Details	NMP 2013-2014 Budget By Product - SAP Details	Excel	29/10/2013
Aurizon Network	RFI 005	Asset Management Staff Numbers - Oct 2013	Asset Management Staff Numbers - Oct 2013	Excel	29/10/2013
Aurizon Network	RFI 005	ROA - AM Assets Jul 2012 - 24012013 - WDV	ROA - AM Assets Jul 2012 - 24012013 - WDV	Excel	29/10/2013
Aurizon Network	RFI 005	ROA - STS - July 2012 - 24012013 - WDV	ROA - STS - July 2012 - 24012013 - WDV	Excel	29/10/2013

Table A.2: Information sources – general

Owner	Referenced in	Document Name	Electronic File Name	Document Type	Version and date
The Authority		Terms of Reference, Engineering Technical Assessment of Maintenance, Operating and Capital Expenditure Forecast	QCA Terms of Reference_UT4 Engineer(565631_4)	PDF	27 June 2013
Aurizon Network	Volume 1 of 3 – The Access Undertaking and Schedules	Schedule E – Regulatory Asset Base	R-Aurizon-QR2013DAU-Vol1-0513	PDF	April 2013
Aurizon Network	Volume 1 of 4 – UT4 Explanatory Materials	Overview and Summary	R-Aurizon-QR2013DAU-ExMatOvr-0513	PDF	30 April 2013
Aurizon Network	Volume 2 of 4 – UT4 Explanatory Materials	The 2013 Undertaking Proposal	R-Aurizon-QR2013DAU-ExMatSub-0513	PDF	30 April 2013
Aurizon Network	Volume 3 of 4 – UT4 Explanatory Materials	Maximum Allowable Revenue and Reference Tariffs	R-Aurizon-QR2013DAU-ExMatBB-0513	PDF	30 April 2013
Aurizon Network	Volume 4 of 4 – UT4 Explanatory Materials	UT4 Maintenance Submission	R-Aurizon-QR2013DAU-ExMatMaint-0513	PDF	Confidential Version 30 April 2013