ATTACHMENT 5 – WorleyParsons Review of the West Moreton Reference Tariff Capital and Maintenance Costs – Redacted

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AU1

West Moreton Reference Tariff Submission Review

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AU1
WEST MORETON REFERENCE TARIFF SUBMISSION REVIEW

SYNOPSIS

Queensland Rail is transporting coal from the West Moreton region to the Port of Brisbane. The quantum of transport charges has to be approved by the Queensland Competition Authority, the approved rate being derived from capital and operating costs approved by the QCA. Queensland Rail has submitted their initial programme of works to QCA for four years until 2017, and has requested WorleyParsons to examine and support the submission. WorleyParsons has examined the submitted documents, background documents, has inspected the track and structures, and had several discussions with Queensland Rail staff to develop this document. In many aspects, WorleyParsons supports Queensland Rail's proposition but several questions were raised concerning some aspects, and further clarification was sought.

PROJECT 301001-01731 - AU1

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
D	Issued for client review	I Nibloe / C Tetther	J Portwood	N/A	3-Sep-13	N/A	
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CONTENTS

1 INTRODUCTION

1.1 Background

The access undertaking currently applicable to Queensland Rail's network, via a Transfer Notice on 1 July 2010 and part of the separation of Queensland Rail Limited into Aurizon (formerly Queensland Rail National) and Queensland Rail, is titled 'QR Network's Access Undertaking (2008) June 2010' (Temporary Undertaking).

The Temporary Undertaking is due to expire on the 31 December 2013. Queensland Rail has drafted a replacement access undertaking entitled 'Queensland Rail's Access Undertaking 1' (AU1), which is currently being considered by the Queensland Competition Authority (QCA). As part of AU1, Queensland Rail has developed a building block approach reference tariff for coal carrying train services in the West Moreton System. The reference tariff will replace the existing tariff that has applied under the Temporary Undertaking. The revised tariff is proposed to apply from 1 July 2013 to 30 June 2017.

1.1.1 QCA

The QCA is an independent Statutory Authority established by the Queensland Competition Authority Act 1997 (QCA Act). The QCA is aimed at forging a national approach to the implementation of competition policy. Its primary role is to monitor and recommend prices, terms and conditions for government monopoly and near-monopoly businesses, including rail (Queensland Competition Authority, 2013).

1.1.2 Location and Characteristics

The West Moreton System spans 314km from Rosewood to Miles and connects the Surat Basin coal mines (as far west as Columboola near Miles) with the Port of Brisbane (Fisherman Islands). The system has a 15.75 tonne track axle load, a narrow track gauge and the majority is single track configuration.

The rail system was initially designed to cater for non-coal traffics. Investment in infrastructure improvements from both Queensland Rail and West Moreton System end-users has been necessary to accommodate coal carrying train services. Additional challenges were identified from the rail system being built on a black soil plain and the Toowoomba and Little Liverpool Ranges having tight radius curves. The system is currently used by both coal and non-coal freight trains.

1.1.3 Existing Reference Tariff

Queensland Rail has reference tariffs in place for coal traffic on the West Moreton System. The access charges for non-coal freight traffic are negotiated according to the pricing principles in the Undertaking. Currently two tariff schemes apply to the West Moreton System, detailed in Table 1.

Table 1 - Existing Tariff Schemes

Scheme	Area Applied	Tariff
Two-part tariff	Surat Basin	• AT1 a volume and distance based charge levied at $8.41 per 000 GTKs ($2009/10); and • AT2 a capacity based charge levied at $3,962.00 per train path ($2009/10).
One-part tariff	Closer-in West Moreton mines	• $16.81 per 000 GTKs ($2009/10)

The Access Undertaking currently in place lists Macalister, Jondaryan and Ebenezer (located in the Brisbane Metropolitan Region) as nominated loading facilities. Coal carrying train services from Columboola are contracted at an access charge equivalent to the reference tariff.

1.2 Project Brief

As part of the process for the development of AU1, Queensland Rail committed to industry and the QCA to submit a reference tariff reset for the West Moreton System by 30 June 2013. Setting a secure and fair price will set a cost reliable rail route for miners and ensure proper maintenance of the system.

Through development of the reference tariff, Queensland Rail has paid consideration to ensuring a transparent and repeatable methodology that can be incorporated into future regulatory periods. Additionally, the proposed tariff includes Columboola as a nominated loading facility.

The AU1 West Moreton Reference Tariff Submission Review (the Review) will cover documents comprising the Queensland Rail's Western System Reference Tariff Reset Submission to the QCA:

- AU1 West Moreton Reference Tariff Reset Overall Submission;
- AU1 West Moreton Reference Tariff Reset Capital Submission; and
- AU1 West Moreton Reference Tariff Reset Maintenance Submission.

The Review will determine the prudency of the following components of the capital expenditure (CAPEX) and operational expenditure (OPEX) reviews:

- scope of projects not pre-approved by customers is appropriate;
- standard of all projects; and
- costs of all projects.

Prudency will be determined in the Review through completing the following activities:

- a peer review of forecast capital and maintenance expenditure;
- a review to identify efficient cost for the forecast capital and maintenance task and to demonstrate if forecast expenditure is appropriate;
- gap identification in documentation or methodology; and
- where possible (and/or appropriate) a comparative analysis with a similar system and/or corridor.

1.3 Limitations on the Brief

It is to be noted that the Review document and consequential outcomes are limited to the quality and quantity of information provided by Queensland Rail

When information is not available, discussions have been held between the WorleyParsons team and relevant Queensland Rail staff to come to a resolution. Site visits were undertaken to substantiate findings, however site visits were not available for every single project and overall assessment had to be made based upon the selected sites visited.

A list of reference documents sighted and used in this assessment is included in Appendix 1.

2 METHODOLOGY

2.1 Assessment Process

Due to the amount of projects and time available for the assessment the following process was followed.

A detailed assessment was carried out on eleven out of 15 CAPEX submissions or 94% of the total submission. The detailed assessment included wherever possible a visual sighting and review of supportive documentation such as:

- Completion certification where appropriate;
- Business cases and justification analysis where appropriate;
- Project plans; and
- Budget breakdowns.

A general assessment was carried out on the remaining projects in the submission. A general assessment included a review of the given information (substantiated if required by discussions with relevant Queensland Rail staff) under the criteria for review detailed in this section.

Findings and analysis were based upon a combination of information from:

- the Queensland Rail submission;
- supportive information such as that listed above;
- discussions with relevant Queensland Rail staff; and
- observations made on site.

WorleyParsons considers this combination of resources to be sufficiently reliable to enable a review of prudency and reasonableness for the purposes of this assessment.

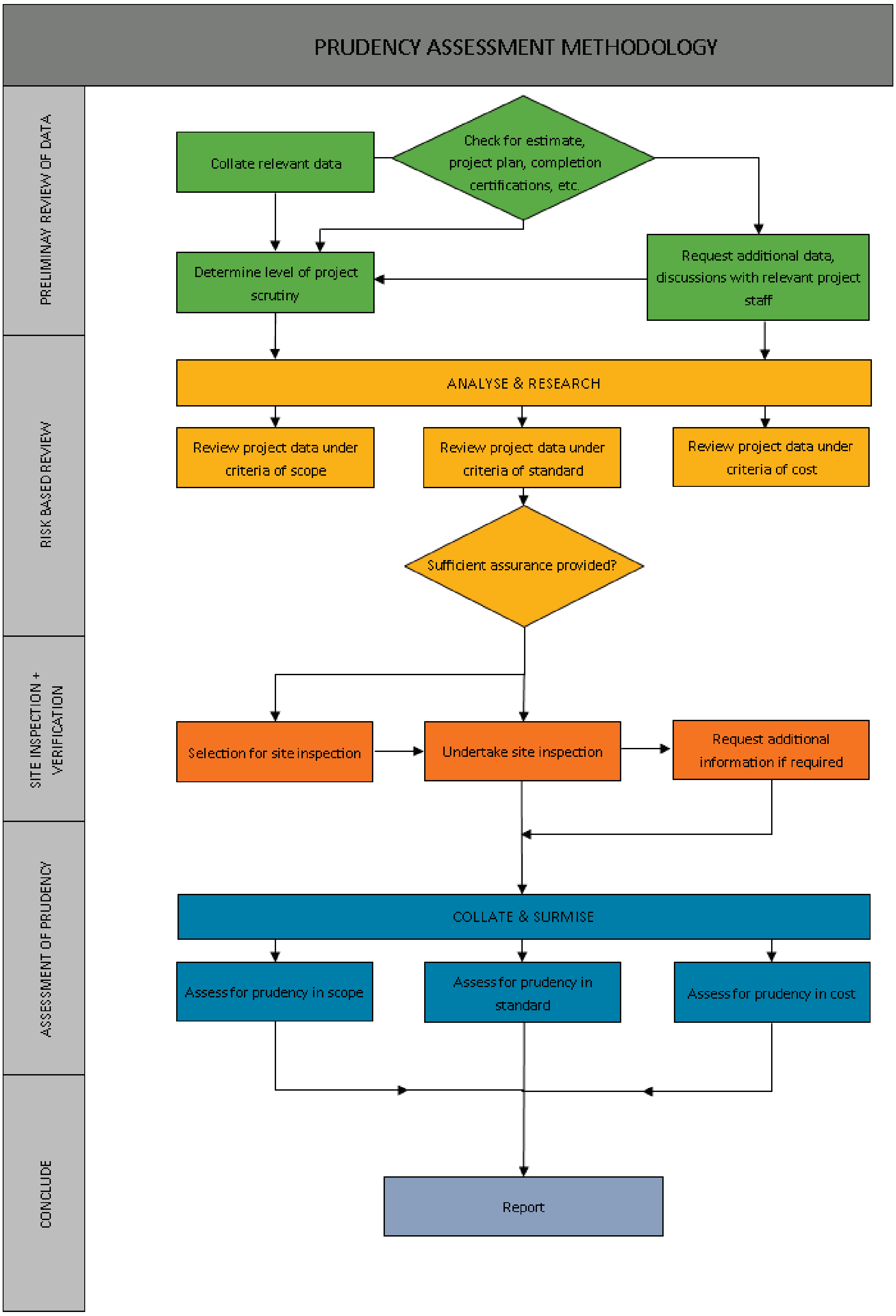

Figure 1 - Methodology Flow Chart

2.2 Criteria for review

As detailed in Section 1.2 an assessment of prudency is made based on the results of the review of each individual project under a set of approved criteria. These criteria have been developed to enable a robust definition of "prudency" for the purpose of this assessment. The criteria are based on Schedule FB of the Queensland Rail Network Access Undertaking October 2009 which identifies three aspects of prudency:

- Prudency of scope;
- Prudency of standard; and
- Prudency of cost.

Key elements of assessment are listed in Table 2.

Table 2 - Key Elements

Aspect	Key elements
Scope	The projects are: • "Below rail" infrastructure; • Capital expenditure and not maintenance where specified as capital expenditure • Maintenance expenditure and not capital expenditure where specified as maintenance expenditure • An assessment of the appropriateness of processes used to evaluate alternatives. • The asset replacement expenditure or maintenance reparation is consistent with asset age and composition. • Customer specific capital expenditure has been approved by the customer concerned.
Standard	The projects are: • Of a reasonable standard to meet the scope and not overdesigned • Consistent with existing standard and configuration of adjacent infrastructure (to the extent that the existing infrastructure has been accepted as reasonable). • In circumstances where there is a departure from existing standards other

Aspect	Key elements
	considerations have been assessed and the appropriate risks considered
Cost	The project costs are reasonable for the scope and standard considering: • Scale, nature and complexity; • Market conditions; • Procurement policies; and • Project management aspects.

2.3 Site visits

An on-track inspection was carried out by two WorleyParsons senior engineers in company with senior Queensland Rail officers. This was conducted on Wednesday 24 July to Friday 26 July 2013. The objective was to travel the full length of the track from Rosewood to Miles on track and allow the opportunity to more closely examine various sites during road travel.

Site inspections were carried out on the HiRail bus to provide the opportunity for the project team to view the full section of track assessed. Where possible, stops were made along route to inspect specific sites as requested by the project team. The following itinerary was taken for the site inspections:

➢ Wednesday 24th July:

HiRail Rosewood to Toowoomba with following sites inspected:

- Culvert;
- Check rails;
- Rerailing section; and
- Bridge replacement.

➢ Thursday 25 July

HiRail Toowoomba to Chinchilla with following sites inspected

- Timber bridge ;
- Turnout replacement;
- Culvert replacement; and

➢ Friday 26 July.

HiRail Miles to Chinchilla with the following sites inspected:

- Charley's Creek Bridge 164.350

Overall the track was found to be fair considering the year of construction, type of track structures and current usage and axle loading imposed.

The full site inspection report can be found in Appendix 2.

3 OVERVIEW AU1 CAPITAL EXPENDITURE SUBMISSION

3.1 General

The Queensland Rail submission for capital expenditure totals $78,938,000 of which $73,885,000 has been assessed in detail by WorleyParsons for prudency, amounting to 94% of the total submission. The remaining smaller projects have undergone a general assessment for prudency under the criteria listed in Section 1.2.

The majority of projects are asset replacement projects with some enhance projects which include replacement of timber and steel bridges, slope stabilisation and enhanced radio communications strategy.

Table 3 below provides a summary of the project types and cost claims of the projects assessed

Table 3 - Summary of Projects Assessed

Item	Cost
Item 1 - Slope Stabilisation on Toowoomba Range	$7,793,000
Item 2 - Formation Repairs	$13,250,000
Item3 – Timber Bridge Strengthening and Elimination	$10,504,000
Item 4 – Replace Timber and Steel Bridges with Reinforced Concrete Box Culverts	$2,522,000
Item 5 – Drain Renewals	$515,000
Item 6 – Check Rail Curves Toowoomba Range and Little Liverpool Range	$12,220,000
Item 7 – Relay Program (4km Oakey to Jondaryan)	$4,727,000

Item	Cost
Item 8 – Rerailing Program	$1,872,000
Item 9 Western System Asset Replacement	$15,563,000
Item10 – Level Crossing Compliance Program	$2,430,000
Item 14 – Radio Communications Strategy	$2,489,000

In general the projects put forward were found to be prudent in standard and scope. In general costs were found to be reasonable in relation to industry expectations although some of the costs were assessed as being in the higher end of an acceptable range. Further details are given within each project summary in Section 5.

4 OVERVIEW AU1 OPERATIONAL EXPENDITURE SUBMISSION

4.1 General

The following table summarises the total Queensland Rail operational expenditure.

Table 4 - Summary of total maintenance costs

West Moreton Coal Maintenance	2013/14	2014/15	2015/16	2016/17
Track (excl. Mechanised Resleepering)	16,237	15,094	15,887	15,425
Mechanised Resleepering	0	0	14,497	9,384
Trackside Systems	2,300	2,288	2,271	2,250
Facilities	144	150	156	162
Structures	2,004	2,001	2,315	1,951
TOTAL	**20,686**	**19,533**	**35,126**	**29,172**

From previous research it is has been shown that the section of track over the range may be one of the most expensive track sections in Queensland to maintain[1] and this has been substantiated by what was observed on site visits undertaken as part of this review and in discussions with relevant Queensland Rail staff.

In general this review concurred that:

[1] *Cost effective track maintenance on Queensland Railways*, F.Bell published in "Cost-effective maintenance of railway track" Institution of Civil Engineers, 1993, edited R.A.Vickers pp 203

- Despite the age of the asset, the overall condition is generally adequate to fair;
- Turnouts are generally in fair condition across the system with the exception of a number inspected on the Toowoomba to Columboola section, which appear to be a poorer condition due to rail size and age. These had been listed for renewals in this coming AU1 period;
- Significant formation reparation works and ballast replacement programs are required across the system to ensure ballast formation and integrity, particularly due to contamination from black soil/ mud. The extensive ballast contamination is causing mud holes and pumping of sleepers – this was particularly evident on the range (between Helidon and Toowoomba) and between Toowoomba and Columboola;
- Surfacing and track condition across the range is generally in a fair to poor condition due to difficulty in conducting mechanised maintenance at some locations and issues with poor drainage due to inherent soil conditions;
- Drainage is poor due to the extensive run off from steeper slopes across the range and the poor drainage of the black soil/clays in the existing foundation. Queensland Rail have been proactive in this regard ensuring that drainage pipes and culverts are cleared regularly thus minimising the risks of blockage and overtopping. This work has been outsourced using a competitive tender process;
- There is a very high incident of breakage of bolts tying down check rails on tight curves throughout the range. The reasons for this are unknown, however Queensland Rail have been extremely proactive in trying to find a solution to this problem and are currently trialling a "Swiss Schwihag" system in three curves. Results to date have been satisfactory; and
- There are a large number of pre 1980's timber structures throughout the system, which require extensive monitoring and maintenance to minimise any risk of catastrophic failure caused by compromise in structural integrity due to fatigue or other structural compromise. Queensland Rail is currently undertaking a competitive tender process to award a consultant to undertake extensive structural analysis so that the exact structural capacity of these structures is known. This will maximise the effectiveness of future monitoring and maintenance programs developed for these structures and subsequently minimise future risks of failure.

Infrastructure management and maintenance procedures appear to be generally robust with several cost saving programs being currently implemented such as:

- Trial of the Schwihag system over the curves on the range; and

- Structural analysis of existing timber structures.

However, there appears to be an increased requirement for preventative maintenance programs such as resurfacing, and top and line spot resurfacing.

This indicates an overall increasing requirement to rectify track and ineffective ballast across the system. It is considered that this may be due to a combination of the age and type of infrastructure, poor foundations and large quantities of black soils, poor access to enable major reparation of ballast and formation across specific sections (i.e. the range) and increased usage over the system.

Notwithstanding WorleyParsons considers that the operational processes currently applied are and will continue to maintain the infrastructure fit for purpose provided;

- Infrastructure management and maintenance regimes continue to be robust; and
- Continuing focus on strategies which can be adopted, where necessary to step up maintenance and /or replace infrastructure in line with asset deterioration

5 ASSESSMENT OF CAPITAL EXPENDITURE PROJECTS

5.1 General Assessed Projects

5.1.1 Assessment of project scope

In general, each of the 15 items listed in the CAPEX document is based on a need for replacing some component of the railway. From the information assessed WorleyParsons considers that the scope put forward for each of the 15 items is reasonable.

5.1.2 Assessment of standard

Regarding trackworks, standards are based on Queensland Rail's Civil Engineering Track Standards for the applicable traffic. These standards have been reviewed by the Transport Technology Center Inc. and have been assessed as "comprehensive", "adequate" and "thorough".

It is understood from discussion that Queensland Rail will adopt a minimum of 20 tal as the design load for replacement structures. Such structures will fit in with future upgrade of traffic parameters for more efficient transport. Earthworks on the Toowoomba Range are designed by a reputable geotechnical Consultant selected via competitive tender evaluation process.

5.1.3 Assessment of cost

Although it is noted that some of the costs are in the higher end of an industry expected range, the reasons for this appear appropriate in that the higher costs are mainly due to access and terrain constraints (for example access to many sections over the range is limited). Overall the costs provided are considered reasonable for the environmental conditions, constraints and types and ages of infrastructure.

5.2 Slope Stabilisation on Toowoomba Range

5.2.1 Overview

The track across the Toowoomba Range from Helidon to Toowoomba was constructed about 1866. Curves, numbering some 43, are nominally 100 m radius and the general grade on the track is 2%. In many places, the formation is constructed in side cut with high rock cutting faces on the right hand side in the direction of travel, and cutting material spilled to the left. The track has been reasonably stable until recently. The alignment also involves nine tunnels.

With increases in traffic and modern track maintenance practices, it was necessary to widen the formation some 20 years ago to provide road access for maintenance and emergencies. It appears that this widening may not have been installed and compacted to modern earthworks, hydrological and hydraulic standards (for example the effects of climate change and increased inclement weather events experienced in the last decade may not have been forecasted or considered) and hence during the recent extreme rainfall events in December 2011 and January 2013, water cascading from higher reaches has caused major slippages in several locations. Subsidence of the access road and cracking indicating face movement of embankments has also occurred.

Figure 2 - Slip of face of access road embankment at 142.5 km ML

Figure 3 - Cracking on edge of access road at 144.6 km ML

Figure 4 - Slump in access road from white post to foreground 142.5 km ML

Following the 2011 events, Queensland Rail have been receiving advice from Golders, a reputable geotechnical consultant, and major repair works have been completed, particularly at Rangeview and Ballard. This damage required closure of the track for a period of about three months.

Figure 5 - Washout rectification at Rangeview 155 km ML

Queensland Rail have made known the cost of the repair works that have been carried out to date, and it is evident that major sites have been repaired for between $1M and $2.5M. Also spreadsheets have been seen which define much work still to be done. Priorities are listed as 2 and 3, but locations such as the major cracking at 144.6 km ML are a concern that they may fail at any time.

Golders are at present reviewing the defects on the range, and it is expected that these studies will define a number of works which should be attended to soon.

5.2.2 Assessment of project scope

As mentioned above, the geotechnical advice is awaited at this time, following which it should be possible to define the works that are urgently required and to estimate more accurately the costs of the works to be done in the AU1 timeframe. The costs which have been shown in the CAPEX document are at best, tentative estimates but from comparison with previous works, it is expected that significant works will be able to be carried out for the figures estimated. Such estimates will be reviewed following receipt of the Golder report.

5.2.3 Assessment of standard

The standard of work is being designed by a reputable geotechnical consultant who has been involved with works in the Toowoomba Range area previously, and it would be expected, the repairs recommended will be effective and not excessive.

5.2.4 Assessment of cost

As mentioned above, it is considered the works have not been able to be adequately scoped at this time, and the estimated costs have to be considered as forecasts of what might have to be done.

5.3 Formation repairs

5.3.1 Overview

The section of the track from near Rosewood to Grandchester was the first railway constructed in Queensland in 1865, the railway reaching Toowoomba in 1867 and Roma in 1880. Construction methods were limited to basic considerations such as shovel and wheelbarrow so embankment construction was limited to use of local soils and minimum compaction.

The majority of the railway from Rosewood to Columboola is founded on expansive clays, known normally as “black soils”. John Kerr in his book “Triumph of Narrow Gauge” sums it up in these words:

“*Building a railway over the notorious black soil of the western downs presented problems. In wet weather black soil absorbs water and becomes like glue. Even today, drivers of rubber tyred vehicles find it nearly as treacherous as did the early teamsters. Fitzgibbon (first Chief Engineer of Queensland Rail) specified that one foot of clay be placed on all the black soil embankments and rolled before the ballast and rails were placed on top. Plews (who followed Fitzgibbon) dispensed with* *the clay and Higinbotham (Engineer-in-Chief of Victorian Railways) confirmed that the Victorian Railways had found it unnecessary*."

The result is that the formation is sub-standard even for a semi-heavy haul operation, and the track at present requires regular resurfacing (of the order of once every three to four months). The improvement from resurfacing in top and line soon deteriorates. Areas where the major weakness in the foundation occurs start pumping and the black soil mud soon permeates the track structure. Rails under traffic will deflect 25 mm or more over a mudhole location, water will pump to the surface, and locations have been seen where a train causes geysers to squirt mud and water a metre or so above the track. The result is speed restrictions and eventually derailments.

While mud holes predominately occur in the black soil plains, they are also found to develop in other areas, mainly where drainage is inadequate, and several severe examples are found on the Toowoomba Range where foundation should be of a better standard than black soil. On the inspection, particular note was made of mature mudholes in at least 14 different major locations, the worst being six mudholes on the Toowoomba Range and in the 4 km west of Toowoomba station. RIMS lists 106 locations totalling 17.4 km of mudholes requiring attention between three months to three years.

Resurfacing is at the best, a short term fix and it is essential to treat the root causes of the problem. For continuing safe traffic, it is necessary in these sections under consideration to remove the track over a short section, remove the deteriorated foundation material, replace this with competent filling, and replace the track. While carrying out these works, it is essential that drainage be designed and constructed to remove water from the track. The fix is necessarily expensive and resource intensive and hence only short sections can be attended to in the available windows.

5.3.2 Assessment of project scope

The CAPEX document, page 16, mentions that RIMS at present lists 13.8 km total length of mudholes, and this is considered to be a reasonable assessment. The RIMS total is actually 17.4 km in over 100 mature and incipient locations. Project scope is to attend to 5 km of such locations each year which should eliminate the worst examples and progressively reduce the total incidents. This intention is also agreed with.

5.3.3 Assessment of standard

The only standard that has been found dealing with formation and control of mudholes is the ARTC's Guideline ETH-10-01. It is understood that an Australian Standard 7638 for Railway Earthworks, including mudholes, will soon be issued by RISSB and this is awaited expectantly. However, during the inspection, discussions were held with Queensland Rail staff, which indicated that removal of deteriorated foundation to a depth of some one metre below formation level to dispose of material which may have had a CBR value as low as one, replacement with material with a CBR closer to 30 - 40, and reworking drainage systems to dispose of water, was the intention in this programme.

This work will improve the foundation markedly, with a long life expectancy.

5.3.4 Assessment of cost

Queensland Rail has submitted a spreadsheet indicating how the estimated cost to replace a kilometre of mudhole affected track was developed. In discussions, Queensland Rail officers have explained the costings of labour, materials and plant, including the labour estimated between normal time (preparation works) and overtime (work during closures). However it is noted that under current awards, both normal and overtime are paid at the same rates.

It was noted that some of the plant rates used for Queensland Rail owned plant were considered high in comparison with industry expectations for similar equipment. The reason for this is that these rates are calculated by allocating an annual cost (inclusive of acquisition/holding cost, ongoing maintenance and fuel usage) over on-site usage hours. Hence where plant is irregularly used the hire rate of the plant will appear relatively high. Although it may seem reasonable to assume that in such cases it would be more cost effective to outsource this plant from local contractors it is understood that in some instances where plant is already owned by Queensland Rail it is prudent to make use of it wherever possible. However wherever possible Queensland Rail outsource these works through a competitive tendering process using formal panel contracts, for example, currently approximately 90% of earthworks undertaken are outsourced.

5.4 Timber Bridge Strengthen and Elimination

5.4.1 Overview

Records show that, at present, the following bridges exist between Rosewood and Columboola. The steel and timber bridges include Oakey Creek Bridge at 30.680 km WL and Charley's Creek Bridge at

164.350 km WL. The concrete bridges include three original bridges between Helidon and Toowoomba, in addition to more modern psc bridges on the complete section (refer Table 5).

Table 5 - Summary of bridge types on West Moreton System

	Underbridges	Overbridges	Footbridges
Timber ML	50	1	1
Timber WL	55	0	0
Steel & Concrete ML	3	1	0
Steel & Concrete WL	4	0	1
Prestressed Concrete ML	8	5	0
Prestressed Concrete WL	5	1	0
TOTALS	125	8	2

At this time, there remains a significant number of timber bridges under track. Timber of suitable size and quality is becoming increasingly difficult to obtain and the cost of such members is increasing accordingly. In addition, tradesmen skilled in working with timber structures are becoming rarer, and the cost of labour involved in inserting new timber members is also increasing. As a further consideration, the timber bridges in Queensland Rail were originally designed for a maximum of 12 tal steam locomotive loadings, which was considered as 15 tal in recognition of the elimination of hammer blow with modern diesel electric locomotives. This has been extended to 15.75 tal by revised calculations. Even at 15.75 tal, this does not represent an efficient mode of transport in a modern railway, and while 20 tal could be considered as the minimum appropriate for the coal traffic from the West Moreton, there is no possibility of achieving this while persisting with the existing design of timber bridges. For similar reasons, all bridge structures built since the 1950's by Queensland Rail have involved steel or concrete construction, now designed for a capacity of 30 tal to allow for further increases in loading.

Queensland Rail has engaged in major expenditures over the last 50 years which have eliminated or replaced in steel or concrete a significant proportion of the bridges that existed in 1960. It is very desirable, economically and operationally, that this practice be continued in the West Moreton region as quickly as funds may allow.

The current proposals in the CAPEX document, item 3, are a very small application of this programme, contributing two bridges being eliminated while persisting with strengthening timber in another two.

5.4.2 Assessment of project scope

The project scope for this item has been sized, bearing in mind the likely available funds and the priority in other items. It is disappointing that only four structures have been able to be nominated, two for replacement structures and two for strengthening the existing timber spans in timber.

The bridges nominated for replacement, situated at 83.190 and 84.000 ML, are both double track bridges with restricted clearance beneath the girders. The first bridge is of six spans which are estimated to be about 6 m long, while the second is five similar spans.

RIMS records show the following condemned timbers (Refer Table 6).

Table 6 - RIMS summary of timber defects on bridges at 83.192km and 84.0km

Bridge Location/ Defects	83.191 km ML	84.000 km ML
Piles	7	9
Girders	4	3
Corbels	3	1
Headstocks	2	-
Bank Ends	1	2
Transoms	All spans complete	-
Vegetation to clear	Yes	Yes

In addition, several piers in the first bridge are leaning in different directions while in the second bridge, all piers are leaning towards Helidon, that is, leaning into the traffic. In addition, pier 1 of the bridge at 83.191 km ML is temporarily supported with a pig sty.

The bridges are in very poor condition and are good candidates for renewal. It is possible other bridges on the section are in similar or worse condition, but verbal advice received was that these bridges were proposed for this programme on the basis that they were among the most deteriorated. This advice was confirmed by relevant bridge personal. The replacement work is defined only as "Replace with culverts". No indication is given as whether waterway calculations have been made, and what form the culverts might take. Queensland Rail have confirmed that the replacement culvert structures will be designed for at least 20 tal (and potentially 30 tal as per AS 5100) so that when the standard of the tracks is upgraded, the culverts will not be less than the improved capacity. This is considered to be a prudent approach. A breakdown of how the replacement costs have been calculated was provided as part of the supportive documentation for this review.

The two other works in this item involve strengthening the timber spans in the bridge over Oakey Creek (30,680 km WL) and Charley's Creek (164.350 km WL). Oakey Creek Bridge has a span in steel over the waterway, while the remaining spans of undefined length consist of two double girders on three pile timber piers. The RIMS report mentions a span 13, which would seem to indicate the length of the bridge while span 6 is the steel work. Charley's Creek Bridge consists of a half through truss span over the waterway, with a steel girder spans to the western side. The total length of the bridge is at least 12 spans. Again, it is proposed to strengthen the timber spans with centre girders.

The RIMS records showed that Oakey Creek Bridge had many significant defects, but major maintenance work has been carried out in the last years and the timber work is now in reasonable order.

In Charley's Creek, the timbers are in better overall condition with 4 girders and 3 sills being the main items.

From site observations WorleyParsons considers that strengthening of the structures would be prudent despite the fact that currently there is no indication of the design capacity of the existing structures or written statements of why strengthening is required. However, Queensland Rail have recently awarded a tender to undertake a structural assessment of all existing timber bridges. The information from this assessment will provide the design capacity required to enable future reparation and strengthening works to be planned and prioritised with greater rigour. Queensland Rail has advised further as follows in this regard:

"*Generically*

> *Wood being a biological material, it is subject to various types of degradation; fungal decay, wood destroying insects, weathering and fire, all of which can lead to hazardous situations. Concrete and steel are largely immune to this problem. The defects for timber are difficult to identify and manage. Typically any weakening through defects of the structure with three girders, the loads redistribute themselves to the three members, however with two girders there is less likely to be an acceptable redistribution of loads. Therefore two girder timber work has a higher level of inherent risk than three girder timber work. Similarly there is a higher level of risk for timber transoms distributing the rolling stock loads to two girder work than three girder work. With the increased coal tonnages which have occurred over the last decade the risk will be managed by converting two girder or two double girder work to three girder or three double girder work.*

Specifically

> *Oakey Creek has continuous top and line issues and the addition of a third member will decrease the risks at this location; and*

> *Charley's Creek had top and line issues prior to the coal traffic and these issues are now being amplified under the additional tonnages. The girders have been braced to the pier however the girders continue to shift such that the bridge alignment has become an issue. The addition of a third member will decrease the risk at this location."*

The problems under traffic would be justification for the strengthening.

5.4.3 Assessment of standard

It is understood the four existing structures would have been designed for 12 tal steam locomotives, which Queensland Rail has considered as equivalent to 15 tal diesel electric locomotive loadings in the light of hammer blow not occurring in DEL's. This limit has been stretched to 15.75 tal.

Verbal advice was that replacement culverts at 83.191 km and 84.000 km ML will be designed to a minimum 20 tal standard which is a step in the direction of better train capacity. However, the Australian Standard for design of bridges and other structures suggests that the design load for new structures should be to 30 tal, and this requirement has been adopted in the design of bridges in

Queensland for coal and other main line traffic. If traffic from mines in the South Western area is to expand to 15 Mtpa as has been suggested, structures built to the 20 tal now proposed may have to be replaced. Hence it is currently considered that Queensland Rail will adopt the default design load for freight, coal and mixed lines of 30 tal (300A as per AS 5100). The move away from the original loading is justified as the cost saving during construction is relatively small in comparison with the replacement value or future cost upgrade to a structure.

Regarding the upgrading of Oakey creek and Charley's Creek bridges, the Queensland Rail standard drawings to which these bridges were probably built were viewed, and it was noted the drawings are dated 1954 and 12 tal steam loading. It was advised in discussions that the structures are proving incapable of carrying the sustained loading of the coal traffic, and a number of piers, particularly in Charley's Creek Bridge have had to be reconstructed on concrete bases because the previous piles were sinking in the poor foundations. The deck of the bridges consist of two double girders, providing two point support to the transoms which two point support has not been allowed in new bridge designs for 50 years. It is agreed that the bridge structures need to be upgraded.

5.4.4 Assessment of cost

The bases of costing produced by Queensland Rail are on the higher end of an industry average, $50,000 per metre for a double track culvert and $10,000 per metre for insertion of centre girders and strengthened headstocks for timber bridges. From discussions with bridge and estimating staff it appears this figure has been obtained historically and it is acknowledged that at the concept level being discussed here use of average costs based on historic expectations is a reasonable approach. At WorleyParsons' request, Queensland Rail officers have produced bottom up estimates that confirm the general figures used for bridge elimination and strengthening.

5.5 Replace Timber and Steel Bridges with Reinforced Concrete Box Culverts

5.5.1 Overview

This item deals with the replacement of seven drainage structures with RCBC's. Four of the units are flood openings, very minor structures, and the other three are timber bridges. The difference between this item and item 3 is not really appreciated, and the remarks in the overview section of item 3 apply equally here.

The project benefits referred to on page 21 of the CAPEX document are also relevant, with the added benefit that removing relatively short structures eliminates fixed points in the top of the track that the tamping has to take into account when resurfacing. This leads to an unnecessary dip in the track resulting in vertical acceleration of traffic.

5.5.2 Assessment of project scope

As stated in the previous chapter, elimination of timber and minor steel structures reduces costly bridge renewals. While only two timber structures were removed under item 3, it will be of great benefit to remove a further three timber structures under this item.

The structures proposed for renewal by QR include:

- Flood opening at 83.930 ML Up Road;
- Flood opening at 83.930 ML Down Road;
- Timber Bridge at 46.900 WL;
- Timber Bridge at 47.410 WL;
- Timber Bridge at 63.040 WL;
- Steel Flood at 111.380 WL; and
- Steel Flood at 113.190 WL.

Because of traffic, it was not possible to stop at 83.930 ML, so these structures were not examined in the inspection.

The bridges at 46.900 km and 47.410 were found to be low structures, the first of four spans and the second of 2 spans. The main defect observed in the bridge at 46.900 km was the far bank end collapsing. The bridge at 63.040 km is similar with four spans and both bank ends collapsing.

The flood opening at 111.380 km WL was not inspected, but the opening at 113.190 km which was examined is understood to be similar. This consists of two concrete piers to formation level with a short steel span of the order of a metre in length. The dip in the track top was quite evident.

Figure 6 - Dip in Rail Track

RIMS data for all timber structures in the track has been made available, although at this time, the condition of these seven structures has not been reviewed.

5.5.3 Assessment of standard

The same remarks made in section 5.4.3 apply in this case also.

5.5.4 Assessment of cost

It is understood that Queensland Rail has used historical data in arriving at an unit cost like the $50,000 per metre referred to in the supporting data for chapter 3 of the CAPEX document.

5.6 Drain Renewals

This item proposes the replacement of badly deteriorated and/or life expired existing reinforced concrete box culvert drains because of reported calcium chloride attack.

Figure 7 - Culvert at 55.270 km WL

Figure 8 - Culvert at 55.270 km WL

A selection of nine (in total) culverts were submitted for review, some with suspected calcium chloride attack. WorleyParsons inspected two of the culverts (60.140 km ML and 63.901 km WL) during the site inspection and were provided with photographs of the extent of damage on the other seven culverts. One of the culverts at 55.270 WL (see Figure 7 & 8) is significantly deteriorated and although this damage would not be specifically due to calcium chloride attack the damage is similar, with large sections of the culvert spalling and a significant area of reinforcement being exposed.

Queensland Rail have subsequently assessed and prioritised the culvert at 55.270 WL for replacement in the AU1 period. In view of the damage apparent in this structure and the evident movement/settlement over the length of the structure (see Figure 7) WorleyParsons considers this appropriate.

5.7 Check Rail Curves

5.7.1 Overview

The Civil Engineering Track Standards (CETS) adopted by Queensland Rail require that all Queensland Rail curves of radius 120 m or sharper must be fitted with a check rail to reduce the effects of the centrifugal forces on the high leg, unless certain provisions apply. (Clause 5.4.2) There are 7 such curves in the Little Liverpool Range area and some 40 on the Toowoomba Range. The length of sharp curves is 1.055 km for the first area and 7.895 km in the second, a total of 8.950 km.

During the inspection, it was noted that there are frequent piles of broken bolts on the side width and in one instance, 15 missing bolts in a row were found. It is reported that track workers are constantly replacing bolts and the cost of these replacements recently has been recorded as $900,000 pa. The situation demonstrates the in-track transverse forces applied by this traffic which has nearly reached heavy haul proportions on heritage track. Tests have been conducted unsuccessfully to attempt to find a bolt that will withstand these loads.

Queensland Rail have made available details of the engineers' well defined submission to management, indicating research around the world to find a system of rail support that might alleviate this problem. A Swiss product made by Schwihag has been chosen, incorporating a cast block in a concrete sleeper design to support the check rail. A six month trial was recommended, which is now in hand, to relay three curves on the Toowoomba Range as follows:

- Curve at 136.721 to 136.849 – 128 metre long
- Curve at 136.989 to 137.093 – 104 metre long, and
- Curve at 155.180 to 155.345 – 165 metres long.

These curves were examined during the inspection, and after three months of the trial, no maintenance attention has been required. Assuming this continues to the end of the six months, Queensland Rail proposes to progressively expand the application over the next five years.

Figure 9 - Existing curve with check rail (and mudhole)

It is noted that these works will result in savings over a 30 year life span which will provide a NPV benefit of $2.1M.

5.7.2 Assessment of project scope

Assuming the trial with three curves on the Toowoomba Range is successful, the remaining curves on the Toowoomba and Little Liverpool Ranges would be programmed for replacement. A total of 7.160 km has been allowed during the AU1 period, and the remainder in 2017/18. The work will include full reconstruction of the track, including improvements to drainage and removal of mudholes. This is considered to be appropriate.

5.7.3 Assessment of standard

The upgraded track will include 50 kg/m rail (head hardened for the sharp curves), special concrete sleepers to incorporate the special Schwihag base plates, with improvements to formation and drainage. This is also considered appropriate.

5.7.4 Assessment of cost

Queensland Rail have made available a detailed estimate for upgrading a curve from 155.498 km to 155.639 km, and reduced this to a rate per kilometre of [redacted] The estimate is apparently based on the costs incurred in the trials. The only item that required some explanation relates to the quantity of UIC33 check rail, which Queensland Rail officers explained related to the length of check rail associated with each special sleeper. Other than this, the estimates appear reasonable.

5.8 Relay Program (Oakey – Jondaryan)

5.8.1 Overview

The track between Oakey and Jondaryan on the Western Line consists of 41 kg/m rail on interspersed steel and timber sleepers generally at the rate of 1 in 2. Rails are 110 m LWR with fishplated joints, most of which are dipped or battered. There are locations of significant pumping, and top and line are poor or worse, which reflects the absence of a significant embankment above the general black soil. A 25 km/h speed restriction has been applied near Jondaryan.

In 2011 Queensland Rail engaged the Transportation Technology Centre, Inc. (TTCI) from USA to comment on the works required to bring the West Moreton tracks to standard for the traffic. One recommendation of TTCI was that the section between Oakey and Jondaryan was sub-standard and the section required to be relaid, with formation works.

5.8.2 Assessment of project scope

The distance between Oakey and Jondaryan is about 12 km, and of this, the proposed programme will upgrade 4 km of the worst areas. The work will provide for reconstruction of 2 km of defective foundation, 50 kg/m rail on concrete sleepers, and formation shaping and drainage. The whole section should be relaid but funds in this programme work will only permit the first 4 km of poor track and formation to be targeted.

The results of ultrasonic testing show 26 defects in this section, more than two per km, including one rated as A priority.

The project scope is appropriate.

5.8.3 Assessment of standard

The track standard will be 50 kg/m rail on full depth concrete sleepers, in accordance with the requirements of CETS Table 7.1. The formation repairs are advised verbally to provide sufficient competent material below formation (generally 1 m) to negate effects of the black soil.

These standards are appropriate.

5.8.4 Assessment of cost

A breakdown of costs has been made available for this item, and a rate o[redacted] for trackwork would seem appropriate. The formation work would be cheaper than $600k because the track structure is removed in the above formation work, so a rate for the 2 km foundation reconstruction of [redacted] is reasonable also.

5.9 Rerailing program

5.9.1 Overview

The intention of Queensland Rail in this item is to upgrade 41kg/m rail with 50 kg/m rail on existing concrete sleepers. It will provide 4 km of new rail, 2.5 km between Rosewood and Toowoomba on low profile sleepers and 1.5 km between Toowoomba and Oakey on full strength concrete sleepers. The location of the works between Rosewood and Toowoomba is intended on the heavily loaded Down track where it will be of greater benefit. The section for attention on the Western Line is just outside Toowoomba in the vicinity where attention to mudholes will also be necessary.

The installation of 50 kg/m rail will permit welding continuously in accordance with CETS Tables 2.9 (straights) and 2.10 (curves). This will improve the top and line considerably and should reduce the frequency of resurfacing.

5.9.2 Assessment of project scope

The item will improve track quality and reduce resurfacing requirements, and it is agreed that this work is necessary.

5.9.3 Assessment of standard

The track construction is intended to be in accordance with the standards set out in CETS.

5.9.4 Assessment of cost

Queensland Rail has provided a costing for 20 km of rerailing, equating to less than [redacted] per kilometre which appears to be reasonable. This rate has been escalated over the four year period, resulting in a total estimated cost of $1.937M.

5.10 Western System Asset Replacement

5.10.1 Overview

As described previously, the section of track which is the subject of this series of projects is amongst the oldest in the railways of Queensland and in many regards, it demonstrates the weaknesses resulting from early primitive construction practices and materials persevering unto the current age. Track alignments and track foundations particularly would not be tolerated today.

The original rails and sleepers have been improved so that now there is 41 kg/m and heavier rail in many places, original timber sleepers have been replaced with steel and concrete materials. The primitive alignments and foundations largely still remain. Even with the upgrade in some components, the track is not well suited to carry what could be classified as minimal heavy haul traffic. Such tracks could well be required to carry traffic expanding into a full blown heavy haul operation if anticipated increases in the railings of coal are achieved.

Figure 10 - Typical timber bridge (83.190 km ML)

Figure 11 - Typ. 41 rail, steel & timber sleepers, plated joint, pumping

Figure 12 - Comparison of Up and Down tracks, Main Line

Figure 13 - Typical Top & Line problems west of Toowoomba

When this traffic began to be offered, Queensland Rail had options concerning how to accommodate the traffic. In a "do nothing" option, it could reasonably be expected that all maintenance costs would escalate exponentially, increasing maintenance required would result in reduced numbers of train paths for the paying traffic, speed restrictions would become more common, and transit times would increase. Additionally, as was proved in the late 1960's in Central Queensland, when such increasing traffic is carried on sub-standard track, a plethora of derailments is inevitable.

Such an option would result in unreliable transport schedules and loss of credibility with customers.

Alternatives would be to rebuild the railway to the same standards as the coal railways in Central Queensland at costs out of proportion to the traffic task required at this time, or to upgrade the existing railway to a modern standard progressively as income would permit. This is the option that Queensland Rail has adopted.

With the improvements that have been installed in the last 50 years, the West Moreton coal railway before upgrading for coal began consisted largely of old 41 kg/m rail on a timber sleepers. Ballast was generally crushed rock but foundations remain as they were originally constructed. Bridging was mainly low level timber structures, many of which have been replaced over the years by culverts or modern bridging.

The upgrading works proposed under WASR and commenced in 2006/7 include progressive replacement of light, worn rail with 50 kg/m HH rail on concrete sleepers and new modern turnouts in 60 kg/m rail on concrete bearers. The new track structures are expected to reduce the possibility of track related derailments. Maintenance effort will be reduced and life of assets will be extended. To date, prior to AU1, 26 turnouts and 10,943 m of track have been upgraded.

The project has been reviewed by the Transportation Technology Centre Inc in USA and the concepts agreed.

5.10.2 Assessment of project scope

This WASR project is planned to replace 13.597 km of track and 16 turnouts between 2013 and 2016. The locations of the segments of work are given in a spreadsheet titled WASR Activities All Years (length of track actually 13.379 km in the spreadsheet). This spreadsheet indicates that considerable thought has gone into locating works where they are required and costing the items reasonably.

In the supporting documentation provided to WorleyParsons, repeated reference is made that locations where WSAR work will be carried out will reflect the locations of “high priority defects identified” or that Queensland Rail will “target highest priorities first”.

These comments are further explained in the following advice from Queensland Rail.

Queensland Rail has advised that

“the following factors are taken into account in determining where upgrade work is required:

- *Curves to take priority over straights*
- *Tighter radius curves to take priority over greater radius*
- *Timber sleepered track to take priority over patterned track (mixture of timber and steel)*
- *Patterned track to take priority over 100% steel track.*
- *41kg rail on timber or steel to take priority over 50kg rail on timber or steel.*
- *Short straights less than 20m between upgraded curves to be included in the curve upgrades.*

- *The following dot points show the rationale behind the short term upgrade programme (month to month)*
- *Changes in track condition (as determined by Track Planner priorities).*
- *Allocation of available possession windows.*
- *Available resources (Men and Materials, delivery lead times).*
- *Time available within possession windows. ie 12 hour or 48 hour closures.*
- *Weather conditions affecting rescheduling of closures.*

Changes to track condition as determined by Track Planner Priorities, regarding the following factors particularly:

- *Rail condition*
- *Sleeper condition*
- *Ballast condition*
- *Formation condition*
- *Gauge*
- *Top and Line*
- *Buckling and pull apart potential.*

Provided that the deterioration remains within standards laid down in CETS, the priority will not change. When any deterioration approaches the limits within CETS, the job would be allocated a higher priority within the short term programme or remedial work carried out, or a TSR applied.

We are now approaching the latter years of the total project. That is, the majority of the work remaining is tangent track between already upgraded curves."

It is considered that Queensland Rail has adopted appropriate practices in developing the scope and priorities of work under this item.

5.10.3 Assessment of standard

The works will be carried out in accordance with CETS and Queensland Rail standards, and are of an appropriate standard. Track will be 50 kg/m rail on concrete, and turnouts 60 kg/m rail on concrete. Rail for turnouts of 60 kg/m is chosen because 60 kg/m rail in small quantities is of the same order of cost as 50 kg/m, while providing a stronger and longer lasting turnout structure.

5.10.4 Assessment of cost

The costs are recorded in the spreadsheet and work out roughly of the order of [redacted] per turnout and [redacted] per km of track. These appear reasonable.

5.11 Level Crossing Compliance Program

5.11.1 Overview

Safety at level crossings is a high political priority in Queensland, and it is imperative that Queensland Rail is seen to be improving infrastructure at the many level crossings in the system to avoid interactions between road and rail vehicles. Because of the number, it is not possible to upgrade every crossing immediately, but Queensland Rail has to determine priorities to ensure the most dangerous crossings are attended to as finance can be made available.

Queensland Rail has conducted reviews of many crossings, including all public level crossings in the trackwork of the West Moreton coal traffic, to determine the priority of works, using the Australian Level Crossing Assessment Model (ALCAM). The object is to bring these OLC's to the standard described in Australian Standard 1742 part 7.

These reviews have identified three level crossings in the area under current consideration which should be upgraded from passively protected crossings to crossings with flashing lights and boom gates. These crossings are:

- Malu Quarry Access Road, at 48.760 WL
- Macalister/ Bell Road at 107.700 WL
- Taylor Street Warra at 127.740 WL

Figure 14 - Open level crossing Malu 48.760 km WL

Figure 15 - Open level crossing Macalister 107.700 km WL

Figure 16 - Open level crossing Warra 127.741 WL

The report on the ALCAM examinations shows the following specific problems at each crossing:

- Malu 48.760 km
    - 2 tracks – masking issues;
    - Insufficient S3 sight distance due to loop and masking issues; and
    - Very high volume heavy vehicles - up to Type 1.

- Macalister/Bell Road 107.700 km
    - Loops within 80m east and west of crossing – masking issues;
    - Insufficient S3 sight distance;
    - Close proximity to a school drop off area;
    - School has requested higher level of control; and
    - Crossing near miss history.

- Warra 127.740 km
    - 2 tracks – masking issues;

- LCSTWG recommendation and approval in May 2007 to install flashing lights; and
- Agricultural machinery uses crossing.

The introduction of flashing lights and boom gates reduces the risk at each site to acceptable levels.

5.11.2 Assessment of project scope

The work has been defined in accordance with Queensland Rail's practices and is reasonable for the road and rail traffic at each site.

5.11.3 Assessment of standard

The resulting infrastructure will be in accordance with Australian Standards.

5.11.4 Assessment of cost

The costs are reasonably to be expected. The apparently anomalous cost for the crossing at Malu compared with the others ($1M compared with $600-700k) reflects the different signalling design required with respect to the passing loop, sidings and angle nearby. It is not indicated if the estimates include civil works, fencing, pavement repair, and other ancillary works.

5.12 Siemens AZ S 600 Axle Counter Replacement

5.12.1 Overview

This is a project that was given superficial consideration only. However, our advice is that the existing Siemens axle counters are life-expired and are not supported with spares by the manufacturer. Replacement is necessary, but there are a few points to be made concerning the proposal to replace the existing axle counters with Siemens products.

There are products of several other manufacturers used in other railways at present, and it is understood that Queensland Rail is conducting an investigation concerning the types of axle counters that are used in other comparable railways. One consideration would be cost.

The costs allowed in the estimates are considered to be in the proper range.

5.13 ATP Encoder Replacement

5.13.1 Overview

Again our advice is that replacement of this equipment is required by expired life and lack of support. In addition the computer operating system based on DOS is inefficient. However, in this case, it is necessary that the replacement equipment is equivalent to the existing Westinghouse equipment or the cost of replacement will be increased by a large factor.

It is considered that cost may be underestimated.

5.14 Wayside Equipment Projects

5.14.1 Overview

The equipment proposed in this item is intended to detect failures or faults that would result in damage to the infrastructure. For instance, an Overload and Imbalanced Load Detector will weigh each wheel of a train to determine if the maximum load conforms to the loading standard of the railway, and whether there is significant unevenness in the loading that could result in the wagon becoming unstable. The object is to locate problems in a train early so they can be rectified or to minimise the damage that such problems may cause to the infrastructure.

As it is critical that the equipment is placed strategically to allow network controllers and above and below rail operators to take a proactive approach in preventing asset damage and ensuring rail safety the siting of the equipment is being revised so that traffic from all three mines is checked.

Again, it is considered that the total cost may be underestimated.

5.15 Telecommunications Strategy

5.15.1 Overview

Without going into great detail, it is known that the Australian Communications and Media Authority (ACMA) is making the staged changes mandatory across Australia and this will affect all radio users in the country, including the rail industry. It would be expected that all existing Queensland Rail radio equipment will need replacing to conform to the ACMA requirements for narrow band operation, in addition to the need to replace equipment because it is life expired. Generally, there is agreement with all the comments in the Queensland Rail CAPEX document.

5.15.2 Assessment of project scope

The project is a mandated requirement of the ACMA.

5.15.3 Assessment of standard

The standards to be followed are mandated by the ACMA.

5.15.4 Assessment of cost

Without analysing the estimates in detail, the capital costs appear to be in the right quantum. As the changes are now overdue, it would be preferable to bring some of the costs forward to achieve compliance. There have been discussion between the ARA and the ACMA to have extensions for the rail industry, but the outcome of these is not known. It is presumed there is a component of Project Management costs included, as the replacement of equipment and licences with take a significant effort to coordinate. It will involve coordination with ACMA, rail regulator, all rail operators, service providers, operations departments, and suppliers.

It should be noted that these requirements are not unique to this corridor, and the costs may well be included in an overall 400MHz Band Changes project by Queensland Rail. Queensland Rail should advise on this aspect.

5.16 Backbone Strategy

5.16.1 Overview

This item is intended to provide reliable radio connection between various trackside equipments and controllers and drivers. It will replace existing facilities on the Toowoomba Range and Miles at a reasonable price.

6 ASSESSMENT OF OPEX (MAINTENANCE) EXPENDITURE PROJECTS

6.1 Maintenance strategy

Queensland Rail have stated that *"the track standard and alignment are lower than that which would be constructed for a new stand-alone heavy haul railway built specifically for coal carrying services"*. As a consequence of this the track is heavily depreciated and requires a higher cost maintenance regime in order to maintain it fit for purpose, that is to safely and reliably deliver contracted tonnages.

Site inspections undertaken as part of this assessment and a review of the asset data available coupled with discussions with relevant professionals substantiate the statement above. In addition, an assessment undertaken in 2011 by the Transportation Technology Centre Inc (TTCI) detailed several sections that were considered sub-standard on the system, further substantiating the diagnosis given on the current condition of the asset[2].

Large sections of the track were built about 150 years ago, and these early lines consisted of small rails (40-60lb/yd) dog spiked directly to timber sleepers. Although all these original rails have been upgraded the predominant track structure in the system is still relatively light with 41, 47, or 50kg rail on timber sleepers and many original timber bridges.

The system carries 6.65M tonnes per year with an axle load of 15.75 tonnes and an average per train payload of 1925 tonnes.

In summary it is considered that the strategies and maintenance programs being put forward by Queensland Rail demonstrate a clear understanding of railway engineering best practice (in terms of the existing asset type, age, condition and environmental and operational constraints) required to maintain the asset fit for purpose in terms of safety and operational objectives.

Table 7 shows the summary of type of track on the system.

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[2] "*TTCI Evaluation of Queensland Rail West Moreton Coal Corridor P-10-042*" , 2010, Transportation Technology Center Inc – a subsidiary of AAR, USA, David Read

Table 7 - Summary of type of track structure

	Rosewood to Helidon	Helidon to Toowoomba (the range)	Toowoomba to Columboola
Track Configuration	Duplicated track	Single track	Typically single track with passing loops
Track Gauge	1067	1067	1067
Rail Section (main line)	Dn: 50kg/m Up:41kg/m	Mainly 50kg/m	Mainly 41kg/m
Rail Section (Sidings and Passing Loops)	Mix 50kg/m - 41kg/m	50 kg/m	41kg/m
Rail Type	Dn: CWR typically Up: Jointed	CWR typically	LWR 110m jointed (fishplate joints)
Rail Fastenings	Dn: Pandrol Up: Dog/Screw spikes	Pandrol	Dog/Screw spikes
Sleeper Type	Dn: concrete Up: mainly steel sleepers with interspersed sections of steel and timber (1 in 2 or 1 in 3 steel) or concrete	Concrete	Steel and timber (mainly 1 in 2, some 1 in 3 steel)
Turnouts	Mainly 60kg/m on concrete bearers	Mainly 60kg/m on concrete bearers	Mainly 60kg/m with some 41kg (Columboola to Miles, Toowoomba Yard)

It is clear that Queensland Rail is working towards a mainline standard of 1067 mm gauge, 50kgm rail on concrete sleepers. In line with this strategy Queensland Rail have focused on upgrading the more heavily used Down Main line section between Toowoomba and Rosewood first. WorleyParsons considers this to be a prudent strategy.

It is acknowledged that the track west of Toowoomba also needs to be improved to ensure efficient operation, but without the resources and finance to enable high levels of capital works throughout this section (i.e. full renewal and foundation work), this can only be achieved by considerable resurfacing and other preventative field maintenance works to the foundations and track structure in the short term.

6.1.1 Overview

Table 8 summarises the number of assets on each section on the West Moreton System.

Table 8 - Asset Overview (from Fixed Asset Register (FAR))

Asset Class	Criteria	Section		
		Rosewood to Helidon	Helidon to Toowoomba (the range)	Toowoomba to Columboola
Turnouts	Total (light/medium)	27	18	56
Culverts	Concrete Box culvert	15 < 0.9 46 > 0.9	100 < 0.9 2 > 0.9	178 < 0.9 6 > 0.9
	Pipe concrete culvert	42 < 0.9 6 > 0.9	71 < 0.9 66 > 0.9	37 < 0.9 9 > 0.9
	Armco culvert	8	25	5
Tunnels		1	9	0
Bridges	Timber	26	18	63
	Steel	1	4	4
	Concrete	4	4	11

As can be seen the Helidon to Toowoomba (range) section has a relatively high number of culvert structures and a significant number of tunnels. Track maintenance through tunnels is usually more costly due to limited access and structural constraints. In addition, 63% of the alignment consists of curves with radii less than 400m and curves of less than 120m (check rail curves) account for almost 20% of the total distance.

Due to the alignment and geotechnical features of the range it is critical that culverts and other drainage structures remain clear and at full capacity. This constant maintenance requirement for both railway structures and track, coupled with access constraints along many parts of the range adds to the expense of maintaining this section of track.

> *"It is important to note the severity of the grades and curvatures on the Toowoomba Range is extraordinary for a modern main line freight system. Unfortunately, at present there is no opportunity for significant alignment changes or tunnel removal due to Heritage designation of the line[3]."*

The diagram below shows the results of a study undertaken to compare the costs of maintenance per kilometre of track throughout the Queensland Rail Network. Although the study was conducted in 1992, the results are of interest as they show the relative expense of maintaining the Helidon to Toowoomba section of track in comparison with all other track in Queensland. Despite the age of the study it is considered reasonable to assume that the multipliers remain relevant (i.e. the level of increased maintenance required on this section in relation to other section remains relatively consistent), indicating that due to geotechnical and environmental attributes this section of the West Moreton system may be one of the most expensive sections in Queensland to maintain.

[3] "*TTCI Evaluation of Queensland Rail West Moreton Coal Corridor*" David Read, 2010 for Queensland Rail, Australia

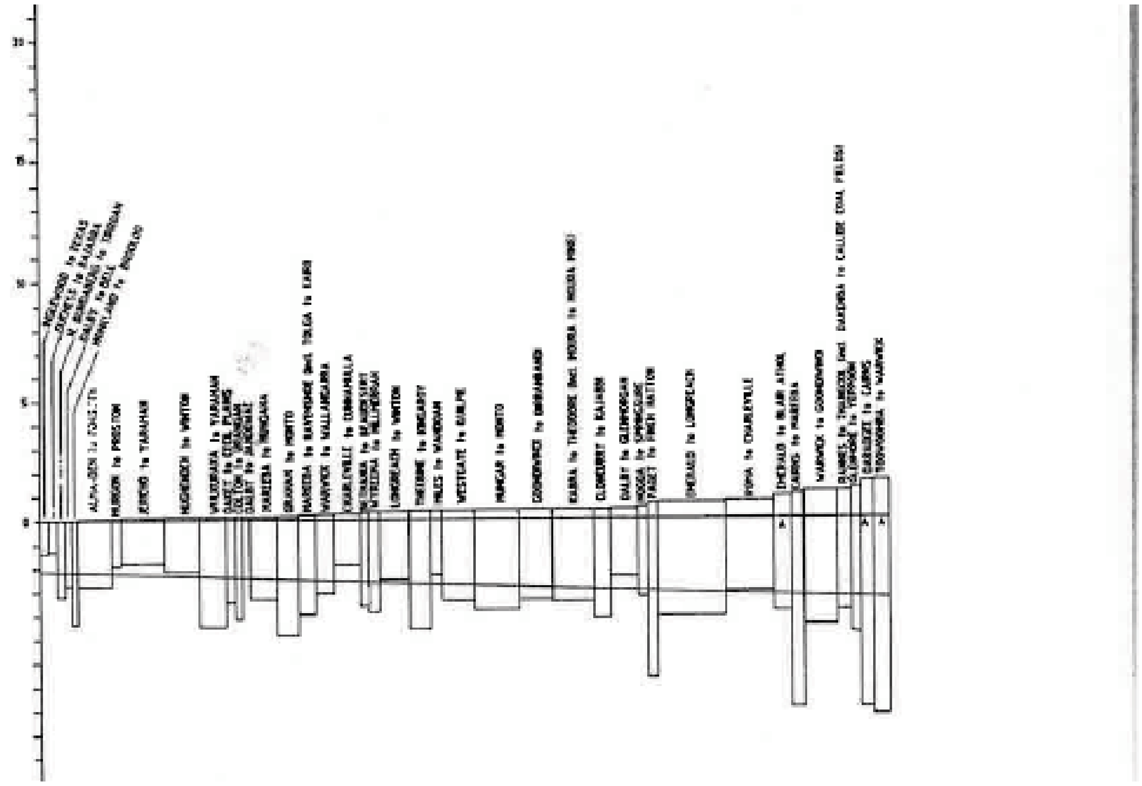

Figure 17 - Track Maintenance Cost Verses Tonnage Queensland Rail 1993 (Part A)[4]

[4] *Cost Effective Maintenance of Railway Track*, 1992, Cost Effective Track Maintenance on Queensland Railways, F Bell, pp 205-206.

Fig. 2. contd.

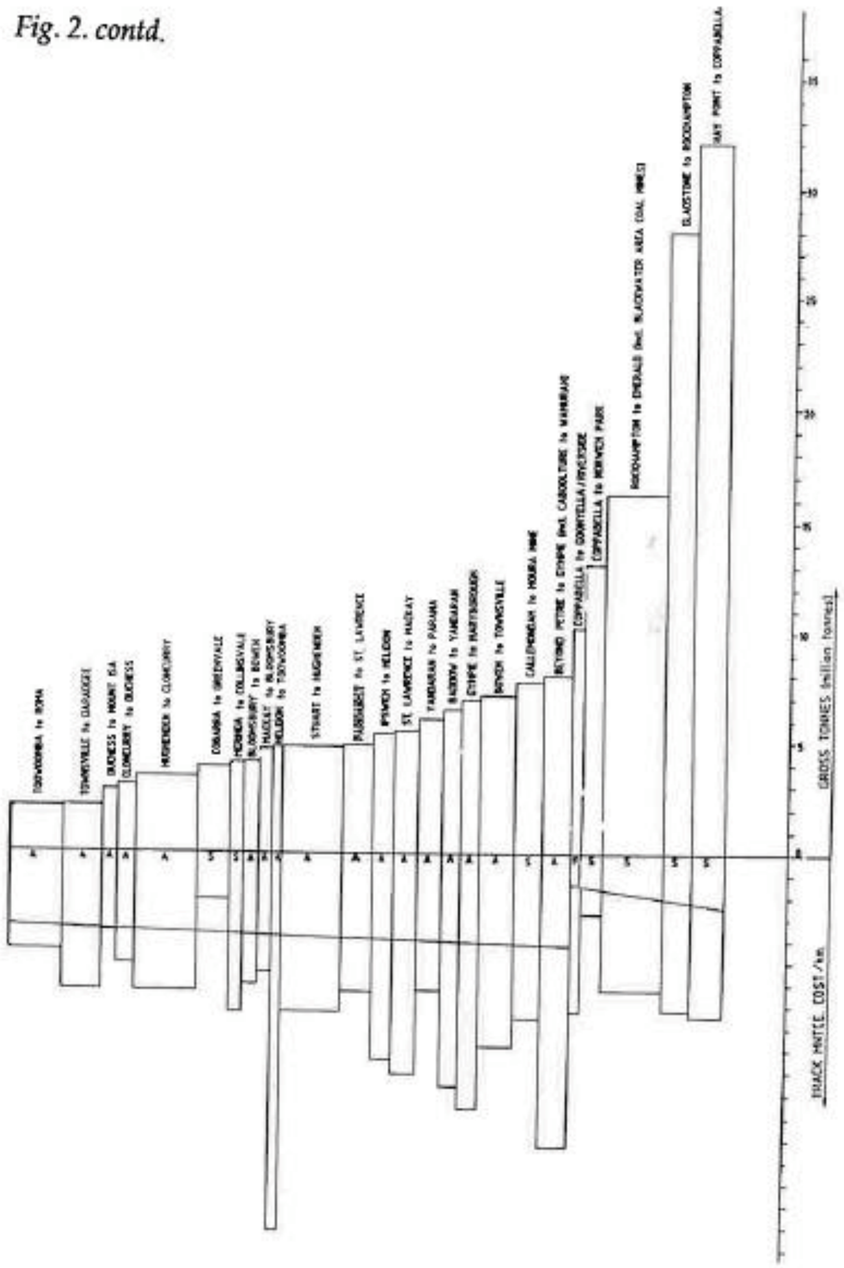

Figure 18 - Track Maintenance Cost Verses Tonnage Queensland Rail 1993 (Part B)[5]

[5] *Cost Effective Maintenance of Railway Track*, 1992, Cost Effective Track Maintenance on Queensland Railways, F Bell, pp 205-206.

The Toowoomba to Columboola section does not have the access and geotechnical constraints present on the range, however restricted drainage, black soils and a high number of timber bridge structures increase the maintenance requirements on this section.

Figure 19 - Defective timbers marked for reparation

6.2 Condition of the asset

As part of this review site inspections were conducted. Although the amount of time and level of inspection did not allow for a detailed assessment of the condition of individual assets and components a general overview of the condition was obtained. Full details of the site inspection are given in Appendix 2; however this section provides a summary of what was observed.

6.2.1 Track

Rosewood to Helidon

Apart from a 10 metre length of severe track wear at the level crossing adjacent to Rosewood station, the Down track from Helidon was in reasonable condition. The Up track with 110 metre length LWR and fishplated joints evidenced many dipped and battered fishplate joints and welds.

Figure 20 - Typical track structure Rosewood to Helidon

Rail

Rail on the Down line mainly consisted of 50kg/m rail on concrete sleepers and appeared to be in reasonable condition.

Rail on the Up line mainly consisted of 41kg/m rail on steel interspersed with timber sleepers and generally appeared to be in reasonable condition.

Figure 21 - Top and line fair

Sleepers

Although no close inspections were carried out on concrete or steel sleepers they mainly appeared to be in fair to reasonable condition.

Figure 22 - Typical 50 kg rail on concrete sleepers

Some deterioration was noted in timber sleepers; however sleepers were generally in fair condition for the level of service required.

Figure 23 - Deterioration of Timber Sleepers and ballast contamination

Ballast

Ballast within both roads generally appeared to be in reasonable condition along the section (refer figures 21 and 22).

Turnouts

Turnouts appeared to be generally in very good condition.

Figure 24 - Typical Turnout Condititions

Helidon to Toowoomba

The three main features of concern in this section are:

- The condition of the earthworks, with major slips formed during recent extreme weather events and cracking and slumping indicating initiating/development of future problems;
- The continuous and multiple failure of bolts installed to tie the guard rail to the lower rail in very sharp curves, and
- The mudholes which have formed in several areas, failing to provide suitable support to the tracks under current traffic.

Figure 25 - Typical track section and curvature

Figure 26 - Typical tunnel structure (heritage listed)

Figure 27 - Typical mudhole and evidence of bolts snapping at checkrail

Figure 28 - Bolts protruding/snapping at checkrails

Rail

Despite aging infrastructure, unstable geotechnical conditions and sharp curves (generally around 100m but some recorded as 88m radius) the track was considered as generally maintained fit for purpose. The high legs of very sharp curves were severely side worn, but in many places, replacement new and/or serviceable 50 kg/m rail has been laid out ready for installation.

Sleepers

Overall sleepers were observed as being maintained to a reasonable condition. A large portion of sleepers had been damaged due to a derailment in the section 137km to 145 km, however temporary timber sleepers had been placed between the damaged concrete items to maintain the integrity of the track.

Ballast

Some coal contamination was observed, however the biggest problem was the occurrence of mudholes formed by contamination of the ballast by black soils and clays within the foundation. Wet weather aggravates the situation due to the poor drainage of the underlying soil and foundation.

Figure 29 - Contaminated ballast

Figure 30 - Contaminated ballast and poor drainage causing pooling adjacent to track

Turnouts

Turnouts at the six stations in the range territory are all modern designs with RBM frogs and all were observed to be in reasonable condition.

Figure 31 - Typical turnout

Summary

It is considered that this section of track is extremely difficult to maintain and a large portion of the section would benefit from a strategy of increased programs of formation repairs and ballast renewals. However, access remains a significant constraint and in the circumstances resurfacing is often the only option available to maintain the levels of service required, despite the fact that this can increase the deterioration of the track structure, especially when the ballast has deteriorated and lost angularity.

Figure 32 - An example of pooling adjacent to track

Toowoomba to Columboola

The major part of this section is through level plains with black soil foundations. It is evident that drainage of the soil is poor with significant pooling occurring on either side of the track (despite the fact that rains had stopped for over 24 hours in the area). It is off note that much of the adjacent highway was still in flood (see Figure 34).

Figure 33 - Much of the adjacent highway was still flooded despite rains having stopped over 24 hours previously

Figure 34 - Flooding and pooling of highway adjacent to culvert opening

The overall track condition, particularly west of Toowoomba needs to be improved for efficient operation of both the current and proposed levels of traffic. This can only be achieved by considerable work to the foundations and drainage of the tracks in the short term.

Rail

Trackwork west of Toowoomba is generally 41 kg/m rail on interspersed steel and timber sleepers either at the rate of 1 in 2 or 1 in 3. Rails are 110 m LWR lengths with fishplated joints which are displaying dipping and battering.

Considering the poor soil conditions and age and type of the infrastructure the rail was generally in fair condition with some sections in poor condition due to recent rains which has caused significant pooling adjacent to the track and aggravated mudholes. Dips in top and line (some significant) along the section were also experienced (see figure 35).

Figure 35 - Dip in top and line due to loss of structure integrity

Sleepers

Although no detailed inspection of sleepers was carried out, it was noted that some deterioration was evident. However, overall the condition was considered fair in view of the age of the asset and the environmental conditions.

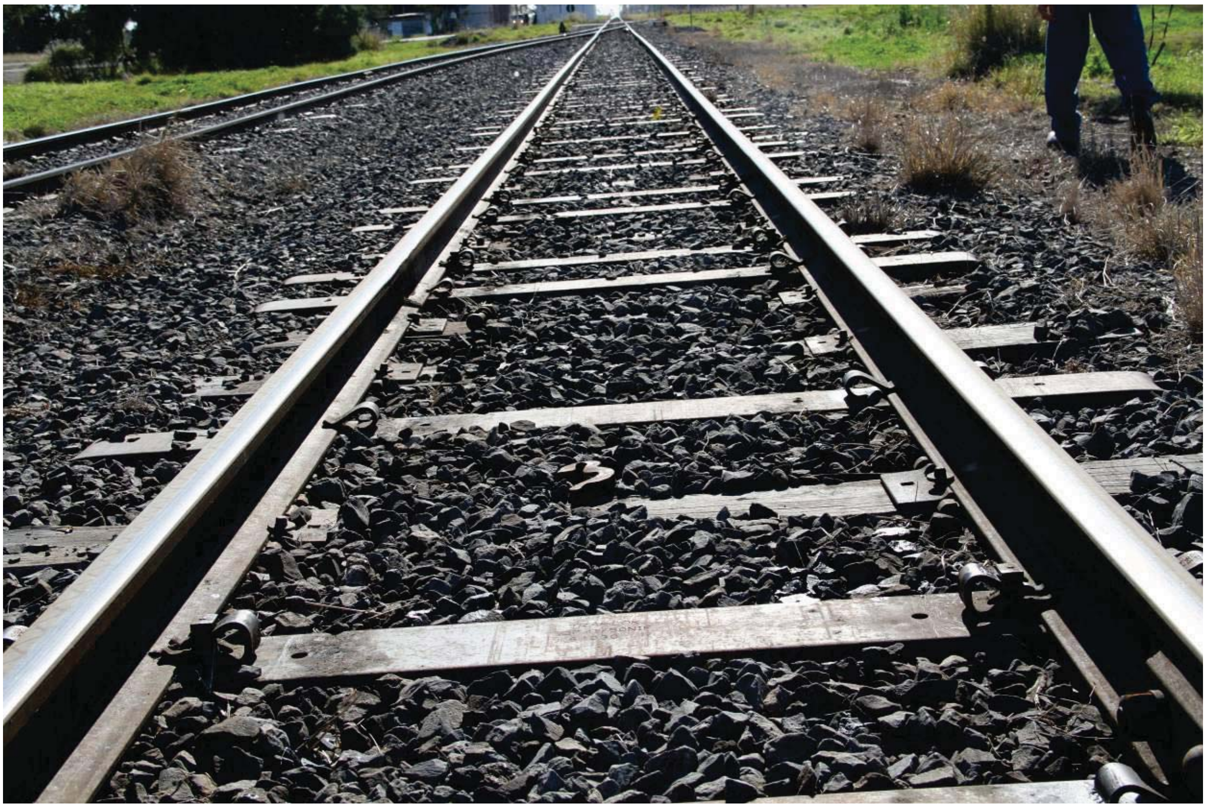

Figure 36 - Typical track section

Figure 37 - Steel sleepers were generally in fair condition although some signs of corrosion and aging generally evident

Ballast

Mudholes, poor ballast coverage and contaminated ballast were seen in several places.

Figure 38 - Removal of top thin layer of ballast often revealed level of contamination underneath

Figure 39 - Typical mudholed section

Turnouts

Some turnouts were found to be in relatively poor condition (i.e. Oakey 30.25km), however these were listed to be replaced or for significant reparatory works. Exclusive of these, turnouts overall were found to be in fair condition.

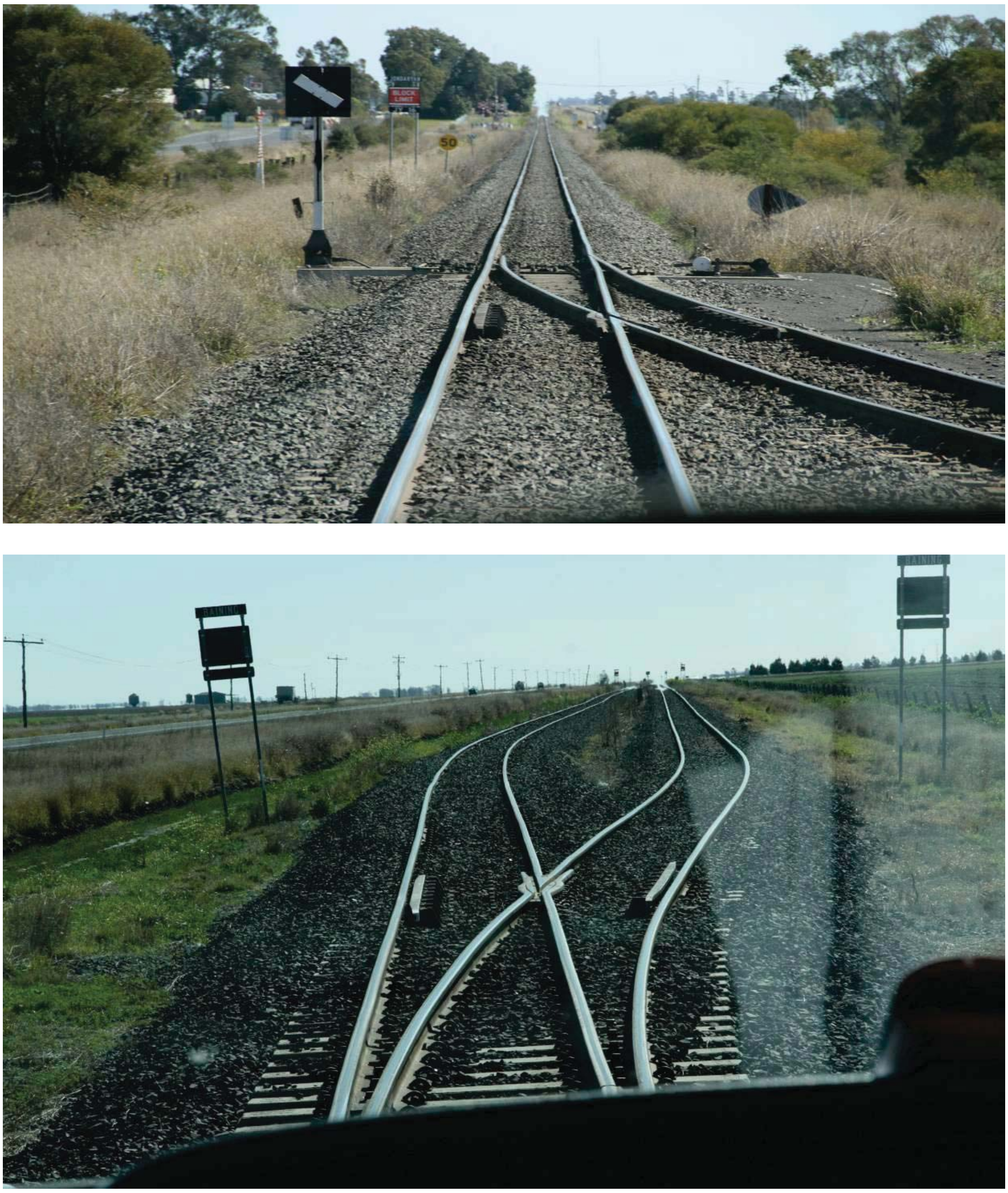

Figure 40 - Typical turnouts condition

6.2.2 Structures

Overall the concrete structures observed appeared to be in reasonably good condition and well maintained (i.e. channels were clear and not obstructed, evidence of recent placement of rip rap where there were visual risks of scouring, vegetation cleared adjacent to structure, etc)

Some deterioration was observed at the timber bridges inspected, with indications of rot and deterioration on several of the girders, piles and headstocks.

Figure 41 - Damaged Timbers

Figure 42 - Typical Timber Structure

6.3 Maintenance Products

6.3.1 Overview

In order to make assessment of the maintenance task the ten highest maintenance cost elements were calculated and extracted for assessment. These are as shown on Table 9. Combined these products add up to 70% of the overall operational maintenance submission budget.

Table 9 - Summary of top maintenance expenditure items

No	Product	Percentage from total maintenance task
1	Track Structure Management: Mechanised resleepering	23%

No	Product	Percentage from total maintenance task
2	Track Structure Management: Mechanised resurfacing	17.7%
3	Structures Management: Major repairs timber bridges	5.5%
4	Preventative Signalling Field Maintenance	5.1%
5	Off track maintenance management: Fire and vegetation control	4.7%
6	Major Earthworks – non-formation & formation	3.27%
7	Maintenance ballast	2.7%
8	Rail grinding (mainline & turnouts)	2.65%
9	Top & Line resurfacing	2.4%
10	Major rail joint elimination	2.3%

6.3.2 Track Structure Management: Mechanised resleepering

Mechanised resleepering consists off the bulk mechanised replacement of life expired or defective sleepers. Mechanised resleepering is undertaken on five to six year cycle with the next planned to be undertaken in 2016 and 2017. The 2015/16 planned resleepering program will replace approximately:

- 9,000 timber sleepers on the track section between Rosewood to Toowoomba;
- 7,231 timber sleepers between Jondaryan to Dalby; and
- 26,512 timber sleepers between Macalister to Miles.

The 2016/17 program will replace approximately:

- 6,000 timber sleepers on the track section between Rosewood to Toowoomba;
- 4,500 timber sleepers on the Willowburn loop;
- 4,877 timber sleepers on the Toowoomba to Jondaryan section; and

- 11,252 timber sleepers on the Jondaryan to Dalby section.

The resleepering program detailed above is based on a 5% sleeper deterioration across the network.

Assessment of maintenance task scope

As detailed previously in this report all the sections listed above for timber resleepering comprise sections of track of one comprise sections of track of one timber and one steel nominally in every two sleepers. It is considered that in some sections the interspersed steel track structure may be too light for current coal traffic and hence it is expected deterioration rates of the timber sleepers may be increased from the "normal" life expectancy of 20 years. A deterioration rate of 5% across the timbered/steel sleeper track on the system is not considered unreasonable.

Assessment of maintenance task standard

Sleeper inspection and monitoring is undertaken as per the track inspection standards in CETS Module 1 – Track Monitoring, this standard is considered comprehensive and aligns with the recently published National RISSB Standard AS 7640 Track Management.

Assessment of maintenance task cost

Average costs over the period equate to:

- 42,743 sleepers replaced for $14,497,000; and
- 26,629 sleepers replaced for $9,384,000

Averaging this out to a per kilometre cost shows that overall the costs for these works are within an expected industry range for similar type activities.

6.3.3 Track Structure Management: Mechanised resurfacing (mainline and turnouts)

Rail resurfacing restores the geometry of the track by lifting the track to the appropriate level and compacting ballast underneath the sleeper.

Inadequate maintenance of track geometry may cause accelerated deterioration of track components. For example sleepers may skew or break, fastenings may loosen or defects may occur in rail surface. Poor track geometry may necessitate speed restrictions which has costly flow-on effects for system capacity and transit time.

Mechanised resurfacing is a critical standard railway function applied to keep track within geometry parameters. Office of Research (ORE) research in the 1990's established without doubt that mechanised resurfacing could improve the quality of a section of track to more or less a constant value, which was not affected by the quality before maintenance[6]. This research confirms that Queensland Rail is implementing best known practice to maintain the asset life where it may not be possible to renew and operational requirements need to be maintained.

A global benchmark study conducted by WorleyParsons and Transport Technology Corporation Inc (TTCI) in 2006 found that for several similar heavy haul operations mechanised resurfacing was one of the top five maintenance expense items[i], However as a percentage of the total maintenance cost it was found to be around 6-7%, whereas the total percentage of resurfacing forecasted for AU1 across the West Moreton system is approximately 17.7%. It is noted however that due to the high contamination of the ballast from the foundation soils traditional undercutting (which usually accounts for around 25 – 35% of the total maintenance budget) is not carried out, and track is resurfaced to maintain fit for purpose top and line until full renewal is required. Hence it is considered that given the circumstances, constraints and the approach that is required to maintain operations this relatively high percentage cost of resurfacing is appropriate.

Assessment of maintenance task scope

Queensland Rail's revised Civil Engineering Track Standards do not specify an intervention level for rail resurfacing; however traditionally in Queensland heavy haul systems the intervention level is set at 40MGT. Current scope appears to indicate that a major portion of the system will be resurfaced annually, with some particularly poor sections requiring resurfacing every 3 to 4 months. Given the tonnage combined with the poor support structure these intervention levels do not seem unreasonable.

Assessment of maintenance task standard

Guidelines for resurfacing are given in the Civil Engineering Track Standards and these are considered robust and adequate. It is considered that where sections of track are severely deteriorated resurfacing may increase the deterioration of the ballast and the more appropriate action would be to completely remove the contaminated ballast and track. However discussions with

[6] Shenton MJ (1990), "Track Maintenance Planning and the Estimation of the Effect of Increased Axle Loads" Proceedings of Workshop on Heavy Axle Loads, October 14-17 Pueblo, Colorado, Association of American Railroads

Queensland Rail staff indicate that the full removal of contaminated sections in this manner is mainly constrained by lack of track time and resources, with only one two day closure being available per month to undertake all the works. In view of the time and resource constraints it is considered that resurfacing at the current intervention levels is the only option available to ensure user demand levels of service.

Assessment of maintenance task cost

Table 12 shows the forecasted scope, cost and average unit rate obtained for mechanised resurfacing over the system (excluding turnouts).

Table 10 - Summary of scope and cost forecast

Financial Year	Forecast scope	Forecast cost ($'000)	Average unit rate ($/km)*
FY14	290 + 43 turnouts	[redacted]	
FY15	305 + 45 turnouts		
FY16	310 + 45 turnouts		
FY17	320 + 50 turnouts		

* Note: Has not taken into account escalation cost index in average unit rate calculation

Expected industry costs for resurfacing vary immensely based on condition of the track, travel time to site and shift duration amongst other factors. Kilometre unit costs range from [redacted] kilometre to [redacted] per kilometre indicating that the forecast unit costs are within the accepted range.

6.3.4 Structures Management: Major repairs timber bridges

Aged timber bridges are notoriously difficult and expensive to maintain and as is evident on Table 8 there are numerous remaining timber bridges throughout the system. All timber pre 1980's bridges were originally designed for a *"B16 12 ton (imperial) axle load with steam impact*". This loading was checked and found adequate for 15.75 tonne (refer notes Queensland Rail Standard Timber Bridges Drawing No. 1932 Issue B 1980). Notwithstanding, it is reasonable to assume that the analysis techniques at the time would not have included the complex dynamic analysis computations carried out today, or may not have included safety and loading factors required to comply with AS 5100. In addition the analysis would not have predicted the current level of usage and hence may not have considered structural fatigue. The potential overloading of a structure can lead to loss of structural integrity and hence a high level of monitoring and maintenance is critical to minimise any risks of catastrophic failure[7].

Assessment of maintenance task scope

Section 5.4.1 of this report gives some background on the current condition of timber bridges on the system and assesses that there may possibly be other bridges on the section that are in similar or worse condition to those being put forward for renewal in the AU1 period. Site inspections of existing timber structures on the network substantiated this view and an analysis of the Fixed Asset Register (FAR) indicates that existing timber structures were built before 1960 and therefore have a remaining book life not exceeding 3 – 5 years.

Some of the timber bridges are of relatively long spans and Table 11 below summarises the number of large span timber bridges across the system.

Table 11 - Summary of timber bridges

No. of Spans	Rosewood to Helidon	Helidon to Toowoomba (the range)	Toowoomba to Columboola
1 – 3 spans	14	8	29
4 - 7 spans	11	8	15
> 7 spans	1 (13 span)	2	19

Considering the condition and the criticality of these structures in ensuring safe ongoing rail operations, it is considered that the scope of this task is reasonable.

Assessment of maintenance task standard

It is considered that all of these structures were built to B16 12 ton (imperial) axle load with steam impact and may be currently below standard. However, as it is considered unreasonable to budget

[7] Refer Section 5.4.1 for additional details on timber bridges on the West Moreton system

rebuilding 107 timber bridges in the short term – a high maintenance and monitoring regime is critical to minimise failure risks.

Assessment of maintenance task cost

The maintenance of timber structures is rapidly becoming a specialised and expensive area of structural maintenance. Not only are the costs of high strength timber members increasing, tradesmen and bridge engineers skilled in working with timber are becoming rarer.

Considering the age, number, usage and original construction of these timber bridges it is not unreasonable that this item is amongst the top five expenditure items and the rate of 5.5% of the total maintenance budget appears appropriate.

6.3.5 Signalling Maintenance Products: Preventative Signalling Field Maintenance

Assessment of maintenance task scope

The signalling system is understood to be many years old and probably due for upgrade in the reasonably foreseeable future. Comments in the categories below are made against this backdrop. Against this it is understood that track circuit operated remote control signalling is only installed within a part of the system.

Assessment of maintenance task standard

All signalling work is carried out in accordance with Queensland Rail and National standards and in alignment with the current arrangements and standards utilised across the West Moreton coal network.

From the information reviewed and in WorleyParsons opinion the standard of the preventive signalling maintenance task is considered prudent.

Assessment of maintenance task cost

Review of the budget allocated for preventative maintenance suggests that it should adequately provide the level of activity required to maintain reliable product throughput, assuming that sufficient track closure or 'between trains' track access can be provided to the staff engaged on this activity.

The budget available for corrective signalling maintenance is typically between one third and half of the budget allocated to preventative maintenance. In theory, on a system where the former activities are being undertaken on a planned regular basis this allocation should be sufficient for 'fix on failure' work arising during the reset period. In practice, however, the unpredictable cost and nature of required corrective works arising, particularly on the ranges where planned track access is comparatively difficult, means that this accurate assessment of the adequacy of this allocation is challenging.

6.3.6 Off track maintenance: Fire & Vegetation control

While this activity covers a broad scope the allocated budget seems high when compared with other systems. As acknowledged in previous sections, corridor access is likely to be difficult and expensive over sections of track in the ranges but it is considered that fire and vegetation works in these locations would most likely be undertaken in conjunction with non-formation earthworks activities. In such locations work is likely to be confined to periods of track closure but in other areas it is noted that this scope would normally be undertaken with the corridor open to rail traffic.

Assessment of maintenance task scope

Burning off and slashing are the biggest activities within the fire and vegetation control scope. Slashing is undertaken by outsourced contractors, whilst burning off is undertaken by Queensland Rail staff. The importance of maintaining fire controlled vegetation areas in horticultural and urban areas where high winds and hot temperatures can be experienced is well understood and accepted in Queensland.

In addition it is noted that large amounts of vegetation growing along the toe of the ballast may inhibit lateral drainage through the ballast shoulder if not cleared and kept under control. In many sections where drainage is already constrained due to aged track structure and geotechnical attributes this factor would only serve to aggravate the existing situation, potentially causing greater ponding in mudholes and in the cess.

From the information reviewed and in WorleyParsons opinion the scope for this maintenance activity appears reasonable.

Assessment of maintenance task standard

This activity is undertaken by a mix of inhouse Queensland Rail staff (brush control, burning and herbicide application) and contractors outsourced using a competitive tender bid process (slashing and firebreak construction).

From the information reviewed and in WorleyParsons opinion the standard of both inhouse and contractor works undertaken for fire and vegetation control is considered prudent.

Assessment of maintenance task cost

In comparison with similar railways it would appear that the cost for this item is in the higher end of an expected range for a similar railway. However it is noted that in comparison with other areas of the state the West Moreton system operates on prime agricultural land conducive to growing prime horticultural product. Hence the types and levels of sprays and herbicides need to be controlled and managed more carefully than in areas which are not used for horticulture.

Currently three runs of herbicide per year are required and slashing is regularly required throughout the system. Burning is undertaken regularly throughout the corridor with burning on the range costing significantly more than elsewhere due to the challenges of the terrain on the range.

For the financial period 2012/13 some 8,722 hours in total was expended by both Queensland Rail staff and contractors on the West Moreton System in undertaking fire and vegetation control. If these historic hours continue over the period, the average hourly cost for fire and vegetation control average (including labour plant and materials) ranges approximately $85 - $133/hr. This is considered a reasonable cost rate for this type of activity.

6.3.7 Track Structure Maintenance Ballast

This item is 5 - 11% of the overall track structure management cost and consists of the procurement, transport and placing of ballast for ballast profile only. The following table summarises the increases in this item in actuals and through to the forecasts for AU1.

Table 12 - Summary Actual and Forecast Costs for Maintenance Ballast Activity

Financial Year	Cost	% of cost from total track structure management budget
2011 (actual)	[redacted]	[redacted]
2012 (actual)	[redacted]	[redacted]
2013 (forecast)	[redacted]	[redacted]
2014 (forecast)	[redacted]	[redacted]

Financial Year	Cost	% of cost from total track structure management budget
2015 (forecast)	[redacted]	
2016 (forecast)		
2017 (forecast)		

Assessment of maintenance task scope

From the information reviewed it appears the forecast quantities used to build the scope are based on historic actuals. This is considered an appropriate approach where the cost and nature of required corrective works which may arise is reasonably unpredictable, particularly on the ranges where planned track access is comparatively difficult and harsh environmental conditions can accelerate the ballast deterioration.

Assessment of maintenance task standard

Ballast inspection, monitoring and placement is undertaken as per the track inspection standards in CETS Module 1 – Track Monitoring, this standard is considered comprehensive and aligns with the recently published National RISSB standard AS 7640 Track Management.

Assessment of maintenance task cost

Ballast is mainly sourced from Malu (a Boral run contractor) and this contractor was appointed through a competitive tendering process. The contract is currently being renewed and is in the process of going through the tender evaluation for the award of the new contracts for the next financial year.

Forecast costs appear to be based on historical actuals which is considered a reasonable approach to estimating.

Based on the documents and information reviewed the total cost allowance for this product, the procurement methodology and the method used for forecasting forward appear reasonable.

6.3.8 Rail Management: Rail Grinding

Rail grinding removes micro cracks and small surface defects from the rail surface and restores a profile that spreads the contact band and positions it for better wheelset tracking. Failure to grind at regular intervals can result in severe rail defects and in extreme cases may cause derailments.

Table 13 shows the forecasted scope, cost and average unit rate obtained for rail grinding over the system (excluding turnouts).

Table 13 - Assessment of average $/km costs for rail grinding

Financial Year	Forecast scope	Forecast cost ($'000)	Average unit rate ($/km)*
FY14	[redacted]		
FY15			
FY16			
FY17			

*Note: has not taken into account escalation cost index in average unit rate calculation

Assessment of maintenance task scope and standard

A global benchmark study undertaken by WorleyParsons and TTCI in 2008 found that similar railways performed grinding on curved rail from 10MGT to 30MGT[8] indicating that the current intervention levels adopted by Queensland Rail are within an industry accepted range. The study found that rail life on Queensland Rail tangent track and MTBD (Mean Time Between Defects) appeared to be longer than on other similar railways and this was considered to be partially due to shorter grinding intervals used on Queensland Rail track. Despite the split between Queensland Rail and QR National (Aurizon) the civil engineering track standards (CETS) and grinding intervention levels reviewed in the 2008 study still appear to apply, this is considered a strategic and efficient approach.

The scope has been developed based on the intervention levels developed in CETS, which are:

- 10 million gross tonners (MGT) on curves less than 1,000m radius
- 20 MGT on curves between 1,001 and 2,500 m radius
- Every 40 MGT on other track

Based on the information reviewed and global research on the benefits and potential reduction of MTBD achieved through appropriate rail grinding intervention levels, WorleyParsons considers the grinding program scope and standard prudent.

Assessment of maintenance task cost

The average calculated rate for grinding is [redacted] per kilometre which lies at the higher end of an industry expected rate.

During the split of Queensland Rail and QR National (Aurizon), grinding plant and resources were allocated to Aurizon. At the time of the split a contract was put in place between the organisations to enable continuity of business. This contract is coming to an end and the grinding work will be soon to put out to industry for a competitive tender bid, it is anticipated that this will occur within the AU1 period.

In view of the current condition of the track structure and growing traffic requirements it is appropriate to assume that the cost submission and scope is reasonable and in fact may be likely (and potentially beneficial) to be exceeded within the period.

6.3.9 Rail Management: Rail Joint Management

Rail Joint management includes all activities associated with the maintenance of a rail joint. In view of the current track support structure and the level of dipped joints experienced along the section, it would be reasonable to conclude that this item is critical.

[8] "*Benchmarking Track Maintenance on Queensland Coal Networks*",AusRail 2009, J. Tunna (TTCI) & C.Tetther

Assessment of maintenance task scope and standard

The present CETS (Civil Engineering Track Standards) only allow for 110m length rails, however Queensland Rail have recently worked through a derogation to this standard allowing for lengths of 220m rails[9].

Rail joint management is considered a time consuming and costly activity and badly dipped joints are often considered a primary factor in causing derailment mechanisms. The strategy in reducing the amount of LWR joints by converting to 220m LWR is considered prudent.

Assessment of maintenance task cost

This activity varies significantly in cost over the period. This is due to the fact that welding to longer lengths will reduce the number of joints, thus reducing maintenance requirements in addition to reducing risks of derailment. As the number of 110m length rails reduces so does the number of joints to weld and maintain decrease, hence the scope and costs associated with this item reduces over the period.

6.3.10 Earthworks: Formation and non-formation repairs

Formation works

This item includes the renewal of the top 600mm of the formation, installation of drains and track reinstatement (inclusive of any welding and resurfacing associated). It does not include CAPEX formation renewals which include the total removal and repair of long lengths of section formation inclusive of geotechnical design and often to a greater depth than the top 600mm.

Historically the actual expenditure for this item has varied significantly (20% of total track maintenance budget in FY11 to 3% in FY12). This is due to a fundamental change in strategy moving the majority of the formation works which involve significant renewal of foundation, sub ballast and ballast to CAPEX.

In view of the site observations of the poor quality of the formation and drainage in major portions of the line sections, the costs submitted for these works do not seem unreasonable.

Non-formation works

[9] This strategy was put in place following recommendations from Transport Technology Centre Inc site inspections, refer "TTCI evaluation of Queensland Rail West Moreton Coal Corridor", 2010 David Read pp 17-18.

This category of earthworks is essential to the safe and punctual delivery of train service through the system. Given the topography, site access to undertake this work is likely to be difficult, and the proximity to the running line dictates that the activities can only be safely undertaken during times of track closure. Given the combination of these factors these works are likely to be expensive when compared with similar activities in less challenging terrain.

The expected intensity of maintenance activity required could potentially be reduced by the installation of a rock anchor system at targeted locations where this type of problem is known to recur. Notwithstanding this, the allocated budget in a typical year appears sufficient to cover the costs of a four man gang for 80% of the working week.

6.3.11 Level Crossing Construction and Maintenance (1%)

Correctly constructed, signed and maintained level crossings are a critical element in the safeguarding those members of the public needing to cross the railway corridor at defined points where the topography is not suited to the provision of a bridge.

It is understood that in recent years Queensland Rail have invested heavily in the upgrade and, where possible, removal of level crossings. As with many other initiatives, however, effort is focussed on areas of higher population and, as a result, the crossings on the West Moreton corridor have not seen the same level of investment.

Following site inspection the overall condition of the level crossing asset base is believed to be poor to fair.

Given the breadth of the scope covered in level crossing construction and maintenance the allocated budget of 1% of total track maintenance spend for this suite of activities may be exceeded during the AU1 period.

Appendix 1 Reference Documents

AU1 WM Rail

Information Requests

Project Number: 301001-01731

Item No#	PROJECT	Information Requested	Date Requested	Requesat Details	Requested from	Required by Date	Date Received	Comments	Updated versions/ information received
	CAPEX								
1	Slope stabilisation on Toowoomba Range	Project Plan/Scope	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	19/07/2013		
2		Business Case (or other case supporting documents)	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	19/07/2013		
3		Breakdown of costs	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	19/07/2013		
4	Formation repairs	Project Plan/Scope	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	
5		Business Case (or other case supporting documents)	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	
6		Breakdown of costs	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	
7	Timber Bridge Strengthen and eliminate	Project Plan/Scope	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	2/02/2013
8		Business Case (or other case supporting documents)	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	2/02/2013
9		Breakdown of costs	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	2/02/2013
10	Check Rails Curves	Project Plan/Scope	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	2/02/2013
11		Business Case (or other case supporting documents)	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	
12		Breakdown of costs	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	19/07/2013		
13	Rerailing program	Project Plan/Scope	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	
14		Business Case (or other case supporting documents)	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	19/07/2013		
15		Breakdown of costs	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	
16	Western System Asset Replacement	Project Plan/Scope	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	17/07/2013		
17		Business Case (or other case supporting documents)	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	17/07/2013		
18		Breakdown of costs	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	17/07/2013		
19	Radiocommunications Strategy	Project Plan/Scope	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	26/07/2013		
20		Business Case (or other case supporting documents)	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	26/07/2013		
21		Breakdown of costs	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	26/07/2013		
	MAINTENANCE								
22	System Maintenance Programs	Rerailing Program	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	
23		Resleepering Program	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	19/07/2013		
24		Grinding Program	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	
25		Undercutting Program	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	
26	Condition Reports/Test/Inspection Sheets	Track Recording Car report	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013		As discussed at the meeting Michael Ryan has already provided the Track Recording Information	
27		Ultrasonic Report	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013		has been covered within the advise we provided for item 14 Email 19/07/2013	
28		Inspection program/routine	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013		Extract from item 30 & 31 Email 19/07/2013	
29		Bridge/Structure Inspection Reports (especially Timber bridges in CAPEX program)	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	
	MISCALLANEOUS								
30	Standards	CETS (current)	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	12/07/2013		
31		CESS (current)	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	12/07/2013		

Item No#	PROJECT	Information Requested	Date Requested	Requesat Details	Requested from	Required by Date	Date Received	Comments	Updated versions/ information received
32	Justification for 15.75t design	Capacity study or Cost Benefit analysis or other documentation around using the 15.75	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013		We need to progress the discussion around the context of the 15.75 tal statement (the track inspection would be a good time to do this) Email 19/07/2013	
33	Tonnages	Traffic parameters now and future forecasts	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013		undertaking is only to cover the present paradigm of 15 MGT email - 19/07/2013	
34		Confirmation of future train parameters	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013		undertaking is only to cover the present paradigm of 2 x 90 tonne locos and 41 wagons Email 19/07/2013	
35	System	Speed Tables	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	18/07/2013	received by CD	
	OVERALL DOCUMENT								
36	Page 7 second paragraph	Review explanation re cost splitting	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013		Doug Jasch was to clarify this item	
	CAPITAL WORKS DOCUMENT								
37	Page 9 Project Scope last line	Replace "60 kg steel" by "60 kg rail"	11th Jul 2013	New request	MR	19th Jul 2013	19/07/2013		
38	Page 27 Project Scope second line	Define type of concrete sleeper (low profile or heavy design.				19th Jul 2013	19/07/2013		
	MAINTENANCE WORKS DOCUMENT								
39	Page 16 Table 6.1 Items 3 to 5	Explain how resurfacing prolongs ballast life	10th Jul 2013	Requested at start up meeting	MR	19th Jul 2013	19/07/2013		
40	Page 18 Product 2	Explain "where track formation has decreased" - should it read "where track formation problems have decreased"?	11th Jul 2013	New request	MR	19th Jul 2013	19/07/2013		
41	Page 33 Product 4	Painting of steel bridges is major item - mention, even though no painting schedule this period.	11th Jul 2013	New request	MR	19th Jul 2013	18/07/2013	received by CD	
42	Page 41/2 Clause 7.5	Three inspectiob methods listed - only expand ultrasonic testing. Expand other inspections. Regular on-track inspections by track staff not mentioned.	11th Jul 2013	New request	MR	19th Jul 2013	19/07/2013		
	Other								
	Relay_TSC III Cost Estimates 20.11.12					19th Jul 2013	2nd August 2013	Email	2/02/2013
	Replace Timber Bridge					19th Jul 2013	2nd August 2013	Email	2/02/2013
	P-10-042 Queensland Rail West Moreton Coal Corridor					19th Jul 2013	2nd August 2013	Email	
	NRW Costs x System (WM Only) x Product x Provider 10-11xls V5.xls		2nd August 2013			23rd July	2nd August 2013	Email	
	Concrete Checkrail NPV		2nd August 2013			23rd July	2nd August 2013	Email	
	Business Case for Concrete Checkrail Sleeper Curve vs Traditional Timber		2nd August 2013			23rd July	2nd August 2013	Email	
	Estimated Cost for Replacing Timber Bridges with RCBC on the Coal Corridor-Unit Cost Double Track		2nd August 2013			23rd July	5th August 2013	Email	
	Estimated Cost for Replacing Timber Bridges with RCBC on the Coal Corridor-Unit Cost Single Track		2nd August 2013			23rd July	5th August 2013	Email	
	Defects removed Oakey Creek Bridge		2nd August 2013			23rd July	14th August 2013	Email	
	Geotech Expenditure 4 projects		2nd August 2013			23rd July	15th August 2013	Email	
	Typical Breakdown Vegetation Control (Product C44) Activities for Year 13/14 West Moreton System		13th August 2013			23rd July	14th August 2013	Email	
	Drains Toowoomba - QR site inspection photographs		25th July 2013			23rd July	17th August 2013	Email	

Appendix 2 Inspection Report

1. General

An inspection was made of the track sections between Rosewood and Miles on 24 to 26 July 2013. Travel was provided by Queensland Rail in the hi-rail bus, carrying in addition to the driver, eight Queensland Rail senior personnel with a vested interest in these tracks, together with Clara Tetther and Ian Nibloe from WorleyParsons. The 24th was spent between Rosewood and Toowoomba, the 25th between Toowoomba and Chinchilla, and the 26th between Miles and Chinchilla.

The inspection commenced at Rosewood, running on the UP track of the Main Line (where track was duplicated, essentially to Helidon) and on the single line sections west of Toowoomba. Stops were made in both sections to pass several coal trains, and where traffic permitted, inspection members were able to leave the car and inspect places of concern in more detail. After arriving in Toowoomba at 1300 hours on 24th July, a return was made to view tracks on the Toowoomba Range between Holmes and Harlaxton.

Comments are provided in more detail of the perceived track and structure condition in the following sections.

2. Rosewood to Toowoomba

2.1 Rosewood to Helidon Double Track

Apart from the section over the Little Liverpool Range and through the Yarongmalu Tunnel, the track from Rosewood to Helidon is double track. The Down or northern track of the Main Line, which carries the loaded coal trains, is generally 50 kg/m rail on concrete sleepers, while the Up track is, again generally, 41 kg/m rail on steel sleepers (the major portion of the length), interspersed steel and timber sleepers (either 1 in 2 or 1 in 3 steel) or isolated sections of concrete sleepers. Quantities of new 50 kg/m rail have been laid out for insertion in the ongoing WASR project. Turnouts are 60 kg/m rail on concrete bearers, with the frogs either rail bound manganese or swing nose crossings.

No close inspection was made of turnouts but from the bus, all turnouts appeared to be in very good condition.

Apart from a 10 metre length of severe track flogging at the level crossing adjacent to Rosewood station, the Down track from Helidon was in reasonable condition. This track consists generally of

CWR. The Up track with 110 metre length LWR and fishplated joints evidenced many dipped fishplates and dipped welds. It was advised that a derogation had been requested to weld the rails into 220 m lengths, which would improve the track condition somewhat.

2.2 Rosewood to Helidon Structures

There are eight reasonably new prestressed concrete underbridges on this section, amongst the 50 timber bridges and 3 steel bridges. Elimination programmes have replaced some of the timber bridges with concrete culverts.

The Capital Works document, section 5 on page 22, lists a culvert at 60.140 ML for replacement because of calcium chloride attack in the concrete. The inspection party stopped at this site, and despite a shallow depth of water on the base slabs, it was possible to have a good view of the concrete units. No indication of cracking or bulging could be seen, and the question was raised whether this culvert is one intended for replacement[10]. Also on this section are two low timber bridges to be replaced with culverts. These are situated at 83.190 (5 spans) and 84.000 (six spans), both in poor black soil territory. In the first bridge, several piers are leaning in different directions and in the second bridge, every pier is leaning severely towards Helidon. As the predominating traffic is the coal trains from Helidon direction, as there is a flat grade and as trains do not brake here, it is difficult to appreciate why the piers lean as they do. The near bank end at 84.000 is temporarily supported with a pigsty, while at the far end, the pier is bearing hard into the bank end. As noted from the RIMS report, 4 girders, 7 piles, 3 corbels, a sill, 2 headstocks and one bankend are condemned in the first bridge and 3 girders, 9 piles, 1 corbel, and 2 bank ends are condemned in the second bridge, so the bridges are prime candidates for replacement. It is understood that other bridges may be in similar condition, but since finances do not allow wholesale replacement of bridges, these two have been selected for this programme to progress the works of elimination of timber.

2.3 Helidon to Toowoomba

The three main features of concern in this section are:

- The condition of the earthworks, with major slips formed during recent extreme weather events and cracking and slumping indicating that there are future problems initiating

[10] Please note that subsequently to the site inspections, a further review was carried out and a different culvert is now proposed for replacement (see Section 5.6)

- The extreme number of bolts supposedly tying the guard rail to the lower rail in very sharp curves but which are failing continuously, and
- The mudholes which form in several areas, failing to provide suitable support to the tracks under current traffic.

These matters are expanded below.

2.3.1 Helidon to Toowoomba Track

The track structure between Helidon and Toowoomba is generally 50 kg/m rail on concrete sleepers. A large number of concrete sleepers have been severely damaged by a derailment in the vicinity of 137 km to 145 km, and track holding is provided by temporary timber sleepers inserted between the damaged concrete where necessary. The high legs of very sharp curves are severely side worn, but in many places, replacement 50 kg/m rail has been laid out.

Turnouts at the six stations in the range territory are all modern designs with RBM frogs, in reasonable condition.

Curves on the ranges are generally as sharp as 100 m radius, but some curves are sharper than this with the sharpest recorded as 88 m radius. There are 47 curves that come into this very sharp category, 7 in the Little Liverpool Range territory and 40 on the Toowoomba range. These range in length from 28 m to 399 m. The Civil Engineering Track Standards (Clause 5.4) prescribe that check rails must be provided in 1067 mm gauge track for curves equal to or sharper than 120 m radius, and all of the 47 curves on the ranges come into this category.

Despite trials with differing details of the bolts (diameter, metallurgical composition, etc), it has been the experience under the coal traffic that myriads of bolts continue to fail. In recent years, the expenditure in replacing bolts has amounted to $900k to $1M per year. On our inspections, it was found that there are piles of broken bolts every 10 m or so, and contiguous breakages amounted to 15 bolts in a row.

Queensland Rail has investigated alternative fastening system, including systems from overseas, and has chosen a Swiss Schwihag system to trial in three curves. This system incorporates support for the check rail in a major casting, fixed to the concrete sleeper. The trials commenced some three months ago and have proved entirely successful so far. Allowance has been made in the CAPEX works to expand this usage, assuming no defects are identified in the remaining trial period.

Queensland Rail state in their Business Case that full implementation would cost $21.4M with savings of $2.1M (NPV) over 30 years. This saving appears to be well understated compared with the present expenditure of $900K per year.

2.3.2 Helidon to Toowoomba Earthworks

There were major weather events in the Toowoomba region at the end of 2011 and again in January 2013. Extremely heavy rainfall occurred at the top of the range which resulted in major washaways to the formations along the range. Traffic on the range was closed for some three months in 2012. One bridge at the bottom of the range was completely washed away, but this has now been replaced by a prestressed concrete bridge. Golders have been retained by Queensland Rail to advise on geotechnical reconstruction and extensive work at one location at Rangeview particularly has been completed. This has involved a heavy toe wall and batter reconstruction with heavy rock protection. Another slip has been repaired at 148 km approximately.

During the inspection, it was pointed out where the access road in the vicinity of 142.5 km is subsiding and this will require remedial work which Golders are presently investigating. At 144.6 km, there is a significant crack along the edge of the access road which will also require attention. Allowance has been made in the CAPEX document for remedial works but until the Golder report is received, these costs can only be preliminary estimates at this stage.

As a result of the water which has come off the range topside, very pronounced mudholes have developed, particularly in the vicinity of Helidon, about 172.7 km, 147.25 km near Tunnel 4, and at 155 km near Rangeview. These mudholes need to be cut out by reconstruction of the formation and the track.

2.3.3 Helidon to Toowoomba Structures

Structures between Helidon and Toowoomba are concrete or prestressed concrete, and no work is programmed to these bridges in the present documents.

2.4 Toowoomba to Columboola

2.4.1 Toowoomba to Columboola Trackwork

Trackwork west of Toowoomba is generally 41 kg/m rail on interspersed steel and timber sleepers either at the rate of 1 in 2 or 1 in 3. Rails are 110 m LWR lengths with fishplated joints which are displaying dipping and battering. In most places, formation is constructed of black soil won on the right of way, and following rain previous to the inspection, these are forming long lagoons. Consequently, top and line can only be described as poor to fair. A resurfacing gang is working on the section, and where work has recently been completed, top and line is fair, ballast is well regulated, but this is reported to deteriorate quickly to the previous conditions and track is resurfaced at intervals of three to four months. Temporary speed restrictions as low as 25 km/h are in place. It is evident that reconstruction of formation is necessary to slow the deterioration rate and expand the times between tamping.

Mudholes were seen in several places, for instance near Toowoomba, at Gowrie, near Gowrie Creek Bridge and so on.

Fencing along the right of way is generally in poor condition except for the Rabbit Fence near Rywung, and new fencing near 153 km.

2.4.2 Toowoomba to Columboola Structures

Underbridges on these sections include 50 timber bridges, four steel bridges and five prestressed concrete bridges. Work on structures has been programmed at the following sites, which were inspected during the trip:

- Steel and timber bridge at 30.680 km (Oakey Creek) to have timber spans strengthened
- Timber bridge at 46.900 km to be replaced by culverts
- Timber bridge at 47.410 km to be replaced by culverts
- Timber bridge at 63.040 km to be replaced by culverts
- Drain at 63.910 km to be replaced by culverts
- Flood opening at 111.380 km to be replaced by culverts
- Flood opening at 113.190 km to be replaced by culverts
- Steel and timber bridge at 30.680 km (Charley's Creek near Chinchilla) to have timber spans strengthened

Both Oakey Creek and Charley's Creek bridges are of significant length with steel in the main span or spans. Funds are not likely to be available at this time to replace the whole of the structures, so strengthening of the spans with two double timber girders to three double girders is seen by Queensland Rail as the most appropriate way of providing adequate capacity for the coal traffic. RIMS reports have been supplied which indicate that 13 existing girders, 3 piles, 4 sills, 3 headstocks and a bank end are marked out at Oakey Creek, but only 4 girders and 3 sills are condemned at Charley's Creek. The condition of the timber in the Oakey Creek Bridge may justify complete replacement and Queensland Rail should advise why it is proposed to perpetuate the existing form. Strengthening at Charley's Creek appears to be a reasonable short term option.

Work at these bridges is shown in the CAPEX programme, item 3. page 18 although Queensland Rail has not stated at this time, why the timber spans need strengthening.

The drain replacement at 63.910 is listed in the CAPEX programme, item 5. page 22, while the other five items are listed in the CAPEX programme, item 4. pages 20 and 21. Each of these structures was examined during the inspection except for the flood opening at 111.380 km which had to be passed over.

The existing drain at 63.190 km consists of culverts with reputedly Calcium Chloride attack, but no evidence of these could be seen from the superficial examination. Queensland Rail staff is to reconsider this structure.

The bridges at 46.900 km and 47.410 km are short timber bridges. The far bank end of the first bridge is collapsing, but no RIMS reports have been received regarding further condemnations or justification for replacement.

The two flood openings form very short dips in the track which cannot readily be worked out in resurfacing.

2.5 Summary

Overall, the track condition, particularly west of Toowoomba needs to be improved for efficient operation of the current and proposed levels of traffic. This can only be achieved by considerable work to the foundations and drainage of the tracks in the short term.