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Annex W

(Confidential) Worley Parsons – North Queensland Coal Systems: Site Visit Record, 18 August 2008

WorleyParsons
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QR NETWORK

UT3 Parallel Active Comparison Exercise

Supporting Document

Northern Queensland Coal Network Systems

Site Visit Record: May 2008

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Synopsis

As part of the UT3 parallel active comparison exercise QR Network commissioned WorleyParsons and TTCI (Transport Technology Center Inc.) to conduct site visits and random asset audits as supporting confirmation of asset conditions and processes as defined in the submission.

This report includes pictorial and descriptive details by the Consultants during these visits and hence forms a supporting document to the summary of these findings which is included in the final UT3 parallel active comparison exercise report.

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CONTENTS

EXECUTIVE SUMMARY

WorleyParsons was commissioned by QR to review the UT3 submission for the next maintenance period. Due to increasing traffic and transport volume some parameters like track condition and maintenance needs and costs are changing.

As supporting evidence to the desktop review being conducted a field visit was undertaken at the end of March 2008. This was undertaken primarily to:

- Confirm conditions and fundamental engineering to maintain 'fit-for-purpose' requirements on site;
- Confirm asset conditions; and
- Discuss processes and methods with field staff for benchmark comparisons and discussions on efficiencies and appropriateness.

The above processes also assisted the Consultant in the desktop review of engineering maintenance costs. Costs are a product of the work that is necessary, and the justification of these costs is made through confirmation that the fundamental engineering reasoning behind the volume and scope of works is appropriate and efficient in relation to surrounding circumstance.

During this visit the main issue to arise was the significant and intensive coal spillage from coal cars. Spillage was worst after loading and unloading facilities, and dependent on the used loading and unloading technology and construction of these facilities.

From the site inspections coal spillage was found to be mainly occurring due to:

- Coal spilling from wagon bottoms:
  - Most examined wagons with bottom discharge doors were not closing tight and gaps up to more than one centimetre were seen. It is assumed that the major part of coal spillage is caused by these leaking bottom doors.
- Coal spilling and blowing from railcar tops.
  - Filling of the wagons varied from mine to mine and was dependent on the coal wagon size. However many old smaller wagons were sited topped up with hungry boards to allow more loading capacity. Some wagons were overfilled and with spillage over wagon edges.
- Other miscellaneous wagon body openings.

- o Some wagon platforms and boogies were covered with coal dust due to driving through coal dust at loading and/or unloading area.

1. INTRODUCTION

Purpose

1.1 Part of the UT3 review involves the justification of the costs of work which are products of the work that is necessary. This work must continue under some unchangeable constraints:

- Standards;
- Safety regulations; and
- Labour and plant constraints (resourcing, availability, etc)

Additionally work must also continue under some inherent environmental constraints, for example;

- Poor foundations, black soils etc;
- Heavy rain conditions.

Although engineering solutions exist for many environmental constraints the costs of implementing these solutions can sometime be prohibitive. Operations must continue, albeit perhaps inefficiently, under some of these conditions until the cost of implementing a solution is justified over the additional work costs incurred.

1.2 A desktop review backed only by theory and what is considered as efficient practice does not always reveal the truth out on site, where it becomes evident that often, it is not so easy to implement certain practices and efficiencies. Historic evidence can quote many a situation where unforeseen costs end up outweighing the desktop benefits which were originally calculated.

Site visits and discussion with field staff can often identify underlying problems which are specific to the area and justify processes which though desktop assessment may not be considered 'norm', in addition to confirming that fundamental reasoning is appropriate and efficient.

Approach

1.3 The approach taken to review the final outcome, i.e. the justification of final costs consisted of the logic shown in Figure 1.

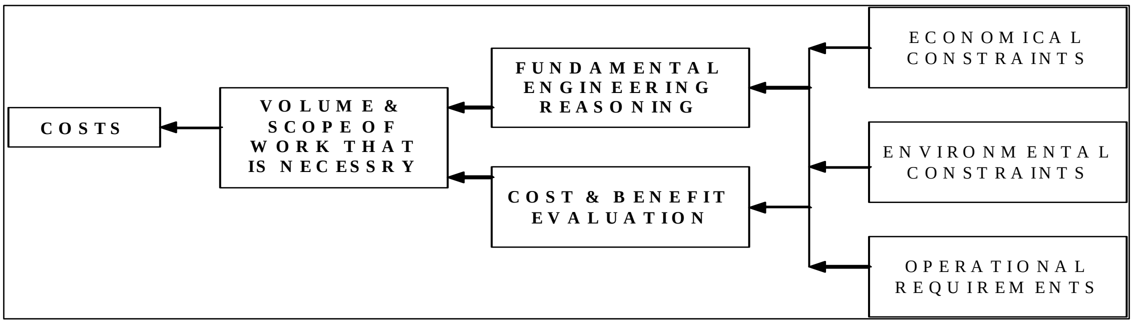


Figure 1 Logical justification of cost build up

From this a logical approach for overall review of appropriateness was taken (Figure 2)

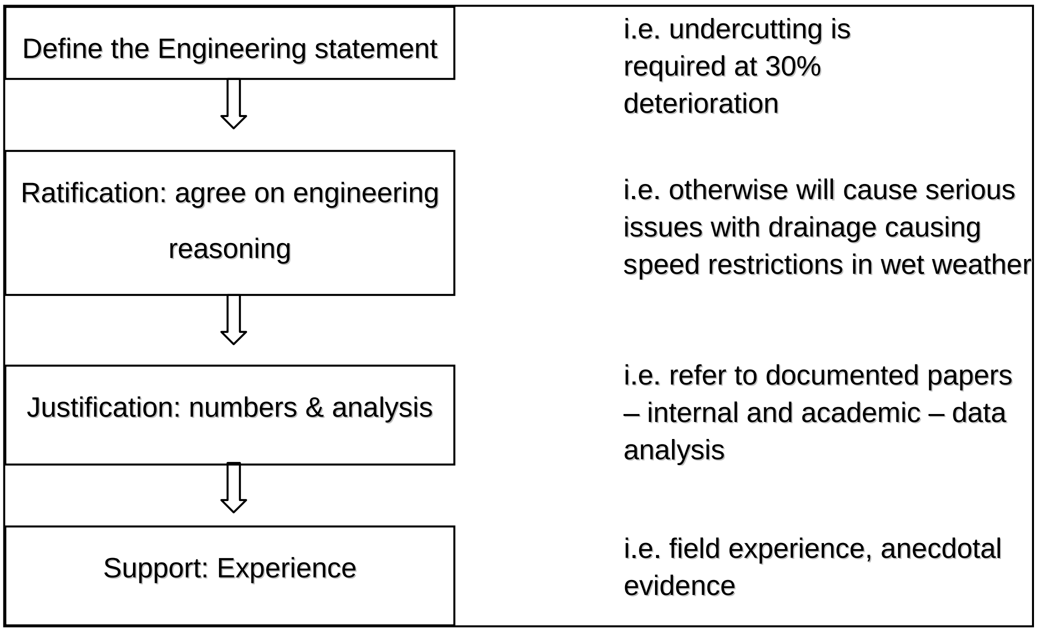


Figure 2 Approach for appropriateness and engineering reasoning review

The site visits were a necessary item to support the foundation evidence i.e. field experience and anecdotal evidence.

Site visits were undertaken separately for distinct rail disciplines. As can be expected there were significant pictorial and anecdotal findings from the track and structures site visit and asset audits and these have been included in this report.

2. BACKGROUND[1]

2.1 Australia is the world's largest exporter of coal and QR National Coal moves more than any other rail transport company in the country.

In 2006/07, QR hauled more than 176.9 million tonnes of coal throughout Australia; this was up 8.6% or 14 million tonnes from the previous year.

2.2 QR currently operates 500 coal train services on average per week in Queensland, with around 50 services per week in New South Wales. The scale of assets and capability allows QR to provide customers with a unique depth of service.

2.3 QR National Coal has committed to a massive investment program that will allow it to remain the preferred rail operator for the coal industry as it moves through this "super-cycle" of demand.

Tonnes railed 2006/07	Million Tonnes Per Annum (mtpa)
Blackwater	49.2
Goonyella	98.8
Moura	11.9
Newlands	11.2
West Moreton	4.7
Queensland Total	164.7
NSW Hunter ValleyTotal	12.2
QR National Coal Total	176.9

Table 1 Tonnes railed 2006/2007

Table 1 indicates the high tonnages railed through the Northern Queensland Coal Network in comparison to other national networks. Trains operate 24 hours a day, seven days a week, each half hour a train from the mine to the port. Loading and unloading process are designed to allow a maximum of output.

[1] www.freight.qr.com.au/freight_services/coal/coal.asp

Goonyella System

	$ per ton	ton per car	cars per train	tons per train	Value per train	Percentage
Mining	50	80	122	9,809	490,440	31%
Market Price	160	80	122	9,809	**1,569,408**	100%
QR Revenue	8	80	122	9,809	78,470	5%
Spillage					156,941	10%

Blackwater System

	$ per ton	ton per car	cars per train	tons per train	Value per train	Percentage
Mining	50	80	101	8,120	406,020	31%
Market Price	160	80	101	8,120	**1,299,264**	100%
QR Revenue	8	80	101	8,120	64,963	5%
Spillage					129,926	10%

Table 2 Coal tonnages and costs

2.4 A possession of 8 hours for maintenance, costs in the region of $ 12.5 million losses for the mining company and $ 0.5 millions for QR.

This highlights how possession planning far in advance and a sufficient maintenance regime is crucial for best output.

Supply chain

2.5 In Queensland, QRNational Coal transports coal from 39 coal mines to six domestic coal terminals and six export coal ports:

- Newlands to Abbot Point
- Goonyella to Hay Point & Dalrymple Bay
- Blackwater to Gladstone
- Moura to Gladstone
- West Moreton to Brisbane

These services are operated on QRNetwork Access' interconnected coal network of over 2000km of track, 75% of which is electrified.

Most of QRNational Coal's product from both Queensland and NSW is exported to the global market to places such as Japan, India, Brazil, South Korea and China.

QRNational Coal's total rolling stock fleet consist of 330 locomotives and 7100 wagons with projects currently in place to expand the rolling stock fleet.

2.6 QRNational Coal operates electric locomotives in the two largest Queensland systems, Goonyella and Blackwater. Diesel electric locomotives operate in the Newlands, Blackwater, Moura, West Moreton and Hunter Valley systems.

This report focuses on the Goonyella and Blackwater systems as sited in April 2008.

Figure 1 QR Coal System Northern Queensland

3. ROLLING STOCK

Train lengths

3.1 Goonyella

In the Goonyella system the typical train length includes 122 wagons with a total length of 2100 m.

Blackwater

In the Blackwater system the typical train length includes 101 wagons with a total length of 1700m.

Rolling Stock

3.2 Rolling stock sited on the system included:

- VSHL
  - This wagon is built of Stainless steel, the width is 3.20m, the tare mass is 23.6ton. The loaded wagon weighs 104 tons, with four axles has a total axle load of 26tons.
- VSN
  - This wagon is built of stainless steel. The loaded wagon weights 90 tons, with four axles has a total axle load of 22.5 tons.
- VAN
  - This wagon is an Aluminium light-weight wagon. The addition of hungry boards allows the load to be increased to 85 tons. caries more coal due to less tare mass. There are existing problems with micro-cracks in the aluminium structure.

4. COAL SPILLAGE

4.1 Coal spillage occurs when wagons are over-filled above the top edge of the wagon or when they are poorly loaded, causing spillage onto couplings or other wagon surfaces that can then subsequently slide off in transit.

During loading procedures, if coal is overloaded, even those wagons with cowls/raves that are intended to reduce spillage from within the wagon will cause problems if coal is spilt onto the top of the raves. This coal can easily slide or be blown off when the train gathers sufficient speed.

Similar problems can occur during unloading when discharged coal has been allowed to build up as the wagons pass over the discharge hoppers, and under-frames and running gear are not cleared before the train leaves the discharge point.

4.2 Typical problems caused by coal spillage are as follows:

- points failures due to switch blades being obstructed;
- ballast blocked by coal dust leading to wet beds;
- track circuit failures due to wet coal slurry shorting out the rails; and
- reduced life of track components, e.g. rail corrosion due to sulphur content and moisture retention and shortened ballast life.

These problems lead to increased delay minutes and increased maintenance and renewal costs, e.g. to employ additional maintenance gangs to clean sets of points, to shorten asset life and bring forward renewals.

4.3 Coal spillage was sighted during the site visit due to:

- Coal spilling from wagon bottoms;
- Coal spilling from wagon tops;
- Coal blowing from tops of wagon; and
- Other miscellaneous wagon body openings.

4.4 Examples of the effect of coal spillage on the condition of ballast and its effect on asset condition are shown in the following pages.

Figure 2 Coal corrodes fishplates

Figure 3 Coal corrodes clips

Figure 4 Coal dust contamination of track between mine and port, as can be seen this was taken at considerable distance to unloading & loading facilities

Figure 5 Coal dust contamination - Cess

Figure 6 Coal dust contamination approaching accommodation crossing

Figure 7 Coal contamination at crossing

Figure 8 Coal contamination, little remains of the ballast (this location was not near unloading or loading facilities)

Figure 9 This ballast appears healthier but close examination reveals considerable contamination fairly low beneath surface level

Figure 10 In contrast, ballast from newly ballast cleaned site

Figure 11 In contrast clean ballast

Coal spilling from wagon bottoms

4.5 Bottom spillage may have more of a negative impact on ballast fouling, compared to blowing off the top, since the leakage is directly above and near the ballast.

Several examples of leakage from leaking bottom doors were taken. These are shown in the following pages.

Although these photos were taken from the same train it is to be noted that each photograph is off a different wagon, and these were only a small handful of the photos taken. Unfortunately it is not possible to see the falling specks of coal from the bottom of the wagons, as the camera used was not able to capture this. However it was fairly evident to the naked eye.

Figure 12 Wagon A

Figure 1 Wagon B

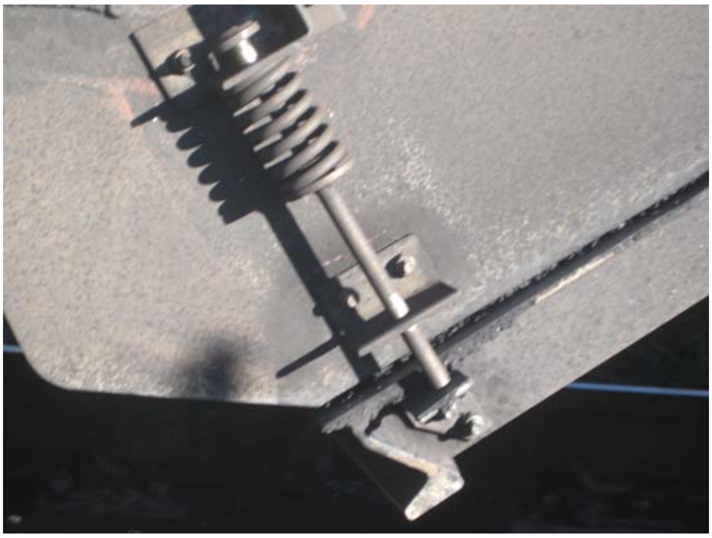


Figure 2 Wagon C, substantial fines were seen falling from these gaps which appeared to be in the range of 5-20mm

Figure 3 Wagon D

Figure 4 Wagon E

Figure 5 Wagon F

Coal spilling and blowing from wagon tops

4.1 Coal spillage and blowing from wagon tops is usually due to poor loading practices. Several examples were sighted.

Figure 6 Spillage on wagon platforms can easily be blown or shaken off on route – this was commonly sighted

Figure 7 As previous

Figure 8 Coal left on edge of wagon from loading process

Figure 9 Coal contamination after loading zone

Example: Peak Down – Winchester

4.2 The track has been constructed 1997. The ballast is filled onto top with coal dust after just 50 MGT per year. After 500 MGT 40 cm of ballast is contaminated. This would mean that per year an approximate 0.08mm of ballast depth will be contaminated per MGT with coal dust due to spillage.

MGT in million per year	Time in years	Contamination	Contamination in mm	Speed
1	0.02	0.2%	0.08 mm	0.08 mm per MGT
50	1	10%	4 mm	4 mm / year
500	10	100%	40 mm	4 mm / year

Fines developing by tamping and traffic load

4.3 Fines develop during permanent way maintenance works. Tamping causes the development of 1.8 – 3.9 kg of fines per sleeper below the rail supports. Furthermore, fines develop due to grain chamfering under traffic load. After 1 million tons of load alternations, the fines per sleeper developed under a 16 ton axle amount to 3.6 kg and under a 32 ton axle 5.2 kg.

Fines developing due to sediments from air

4.4 These sediments usually consist of very fine sand or dust particles smaller than 1.18 mm. The portion of fines being deposited per m² and year on the track amount up to 0.8 kg. This value corresponds to a quantity of 2.4 kg of fines per sleeper and year.

Fines developing during transportation

4.5 Goods trains transporting minerals or coal can lose material. Up to 3.6 kg/m² per year or 10.6 kg per sleeper and year may derive from such sources.

Other sources for the development of fines are:

- fines arising from the subsoil (if bearing capacity and the filter layer are insufficient)
- abrasion of the concrete sleepers as a result of operational loads
- organic materials from vegetation
- residues of mineral and lubrication oils; and

- abrasion due to wheel/rail and rail/brake wear.

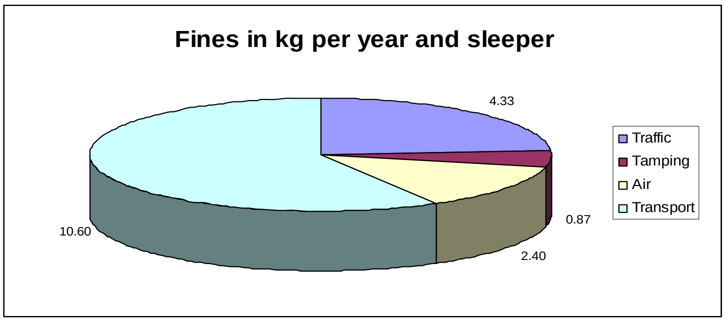
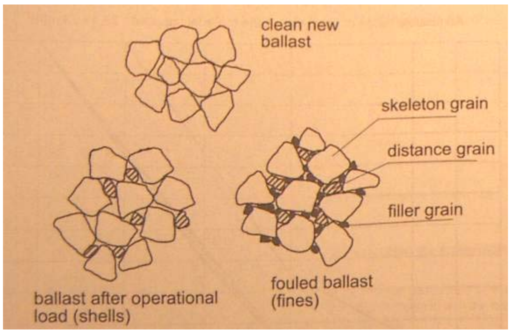


Figure 10 Fines in kg per year and sleeper[1]

Effect of ballast fouling with coal

4.6 Over a period of time in the track the ballast degradation typically becomes greater as the larger ballast particles will break into smaller particles and ional smaller particles from a variety of sources will infiltrate the voids between the ballast particles. The process is known as fouling. Five categories of fouling material have been identified:

- Particles entering from the surface such as wind/blown sand or coal fines falling out of wagons
- Products of wood or concrete tie wear
- Breakage and abrasion of the ballast particles by train loading
- Particles migrating upward from the granular layer underlying the ballast
- Migration of particles from the subgrade



When the voids become completely filled with fines, the ballast begins to take on the characteristics of the fines, with the ballast particles acting as filler. Soaked fines represent mud and hence the ballast becomes soft and deformable. When wet fouled ballast becomes frozen the resiliency is lost. When the fines become dried but still moist, they act as a stiff binding agent for the crushed rock particles. This also causes loss of resiliency. All of these conditions prevent proper track surfacing.

[1] Source: Track Compendium

Study results indicate that coal dust accumulations in the ballast at turnouts range up to 30%. Study results also demonstrate that the ballast/coal mixture has the capacity to retain water, lose compressive strength, and ultimately cause track surface irregularities.

5. LOADING AND UNLOADING FACILITIES

Loading process (Mine)

5.1 Two mine loading facilities were visited. Both loading stations showed that the loading process is critical both to:

- minimise spillage from the top of the wagon; and
- reduce spillage to other parts of the wagon, which may be blown off on transit.

Inefficient loading operations were sighted with coal heights on top of wagons not adequately levelled, so that the back of a wagon was still empty whilst the front of the wagon was overfilled.

Figure 1 Wagons were found to be often heavily loaded at the front of the car whilst empty at the back

Figure 2 Loading process

Figure 3 Some wagons were altered with an addition of a metal strip to allow additional loading capacity, as can be noted spillage is already occurring from this wagon

Figure 4 Wagon overloaded spillage occurring

Figure 5 Further example of highly loaded wagons leaving the loading facilities

Figure 6 Coal dust on wheel set springs after loading process

Unloading process (Port)

5.2 The unloading process was observed at Gladstone. The system is mechanised, where bottom doors are automatically opened when rolls touch a fixed unloading blank sheet. After unloading, the bottom doors close automatically through pressure of a bottom door spring.

Figure 7 Unloading with mechanical barrier

Figure 8 Light can be seen filtering from the bottom of the wagon confirming significant gaps in the doors on completion of the unloading process

Figure 9 Gap and residual fines left on the bottom of wagon on completion of unloading process

Improvements were sighted in unloading facility design in the new unloading facility sited at Gladstone. This consisted of the construction of slab track immediately after the unloading process. The slab track facilitated cleaning of the immediate track directly after the unloading process hence reducing the cost of maintenance for this section of track

Figure 10 Slab track facilitates cleaning of spillage after unloading processes

6. MAINTENANCE ACTIVITIES

Ballast cleaning

6.1 The ballast cleaning machine shown in Figure 34 is currently the only ballast cleaning machine owned by QR. To maximise efficiency the machine has been upgraded and modified several times. However, due to limited capacity for attached ballast wagons the machine's performance is limited.

The machine works by scooping up the 'dirty ballast' and screening it to remove fines and other contaminates. Reusable ballast is returned to the track, whilst the contaminated ballast is removed.

Figure 11 The machine has a ballast cleaning capacity of 900m3 per shift

Figure 12 Hauling six ballast wagons; the total length of the machine is 1500m

Figure 13 Screen for separating the fine parts and damaged ballast from reusable ballast

Tamping

6.2 Tamping measurements have shown for QR that a two-tamping hammer machine is the most efficient in quality.

Figure 14 Tamping machine at work

Turnout Vacuuming

6.3 Due to intensive coal spillage and subsequent potential failure, it is necessary to vacuum turnouts periodically. Such maintenance is critical to maintain operations and minimise risk of failure of the turnout mechanism and signal operation.

Figure 15 Vacuuming of turnouts

Figure 16 As previous

7. BLACKWATER

7.1 The following paragraphs have been sourced from QR Network Access. Information packs[1] and are included in this report to give the reader a general background of the system and operations.

7.2 The Blackwater System is located in Central Queensland between the latitudes °8' S and °54' S and longitudes 148°' E and 151°15' E.

The system primarily services coal mines off the Central Line and carries the product through to Stanwell Power Station, Gladstone Power Station and the Port of Gladstone via the North Coast Line. The Blackwater System is bi-directional duplicated track with crossovers between Callemondah and Rocklands, between Westwood and Windah, between Tunnel and Aroona and between Duaringa and Wallaroo, with the remainder being single line.

7.3 Loading balloon loops are located at East End, Boonal, Koorilgah, Laleham, Curragh, Boorgoon, Kinrola, Ensham, Gordonstone and Gregory with a spur line at Fairhill for Yongala. Dual unloading balloons are located at Golding, with unloading balloons at Stanwell Powerhouse, Fishermans Landing, Gladstone Powerhouse, Auckland Point and Barney Point.

The Blackwater System is electrified by an autotransformer system with the overhead line equipment operating at 5 000 volts, 50 Hertz, alternating supply (5 kV, 50 Hz, ac).

7.4 The Blackwater System is electrified by an autotransformer system with the overhead line equipment operating at 5 000 volts, 50 Hertz, alternating supply (5 kV, 50 Hz, ac). Distribution is via a contact wire suspended from a catenary wire and these two wires are held in place by supporting structures to maintain ideal pantograph/contact wire interaction.

Typically, the autotransformer system also uses a 25 kV AC feeder wire run on the back of the supporting structure which is used for voltage support throughout the electrified network.

The dual wire distribution system is automatically tensioned to maintain a constant wire tension and requires a pantograph uplift force of 80 N ± 10 N for smooth spark-less current collection.

The contact wire height may vary from 4400 mm to 5850 mm above rail level.

Typically in the Blackwater System the traction system uses both rails for return current.

[1] www.networkaccess.qr.com.au/Images/Blackwater_SystemInfoPack-Issue2_1_tcm10-2860.pdf

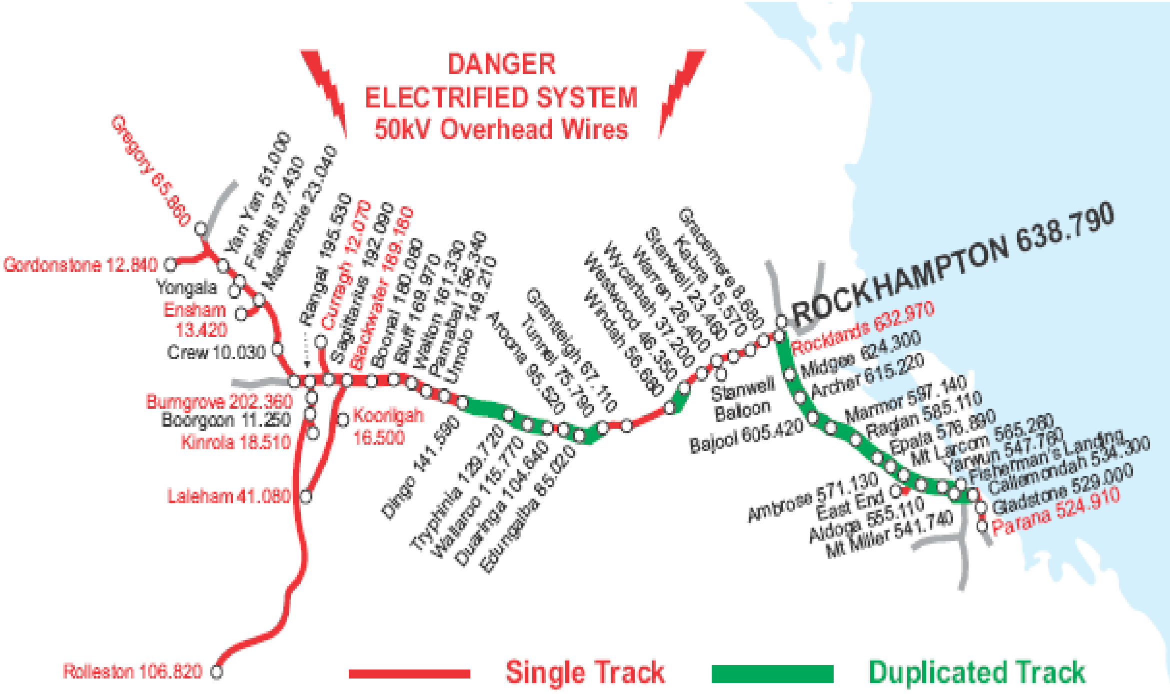


Figure 1 Blackwater System[2]

Axle Loadings

7.5 Maximum axle loads used throughout this document refer to wheel configurations that generate loadings as specified in the ANZRC Railway Bridge Design Manual - 1974. In summary :- Maximum axle load Wheel configuration consistent with or otherwise generating a loading equivalent to 26 tal M 220, 20 tal M 160, 15.75 tal M 130.

Dragging Equipment Detectors (DED)

7.6 Dragging equipment detectors are placed at strategic locations along the route to give early warning of rolling stock defects and minimise the effect of any derailment incident

Wheel Impact Load Detectors

7.7 Flat wheel detection equipment operates on the North Coast Line between Epala and Raglan at 581.233km.

Operators are required to stop immediately if advised of a dragging equipment, hot box/hot wheel detection by the train controller.

[2] www.qr.com.au

Axle Counters

7.8 Axle counters are used west of Bluff on branch lines.

Other field observations and facts

Traffic model split

7.9 Infrastructure and Rolling stock are separated companies within the same holding of QR National Coal.

Traction

7.10 Operation with half electrical and half diesel locomotives.

Coal prices

7.11 QR's revenue for coal is $6 to $8 per ton of coal.

Mining approx. $50 to $60 per ton.

Market price for coal $160.

Coal Spillage

7.12 There is no water used to clean the wagons from coal dust because of water penetration into bearings which causes corrosion. At approximately 10 km away from the mines coal stones were observed in turnouts and track, up to 7cm in diameter. The Goonyella System has about half the deterioration rate of the Blackwater system because of less spillage.

Ballast cleaning

7.13 Almost all fouling (expected are 80 – 95%) of fouling is caused by coal dust due to spillage.

Ballast cleaning is required every 800 million net tonnes which means a ballast cleaning cycle is in average 6 – 7 years. The actual ballast cleaning rate is 110 km per year. The required quantity would be 150 to 160 km per year.

Track design unloading zone

7.14 Due to massive spillage after unloading stations a new track design with slab track is being trialled September 2007.

Pandrol clips

7.15 Pandrol clips corrode because of aggressive coal dust after a very short time. The normal service life of a Pandrol clips is in average on normal track 25 years (no coal). Due to corrosion the actual service life for galvanized pandrol clips lasts between 5 and 10 years.

There have been no trials on using plastic coverage to protect the clips. Currently fastenings have to be renewed at least every 10 years.

Figure 2 Pandrol clip corrosion left: galvanised, right: threatened

8. GOOYNELLA

8.1 The following paragraphs have been sourced from QR Network Access Information packs[3] and are included in this report to give the reader a general background of the system and operations.

8.2 The Goonyella System is located in Central Queensland between the latitudes 21°18' S and 23°09' S and longitudes 147°1' E and 149°17' E.

The system services the Bowen Basin in Central Queensland and carries product to the ports at Hay Point and other destinations by way of connections to the North Coast Line at Yukan and the Central Line via Gregory to Burngrove (see Blackwater System).

The Port of Hay Point consists of two separate coal terminals, the Dalrymple Bay Coal Terminal and the Hay Point Coal Terminal. Port statistics are available via the internet at the following site:-

http://www.pcq.com.au/2004/ports_haypoint.cfm

8.3 The Goonyella System is bi-directional duplicated track with crossovers between Dalrymple Junction (7.975 km) and Broadlea (157.050 km) with the remainder being single line. The junction for the Peak Downs, Saraji, Norwich Park, German Creek and Oaky Creek line is at Coppabella (144.520 km), whilst the junction for the Blair Athol line is at Wotonga (174.020 km).

Balloon loops are located at MacArthur, Burton Coal, Moranbah North, Goonyella, Riverside, North Goonyella, Blair Athol Mine, Peak Downs, Saraji, Norwich Park, German Creek and Oaky Creek. The South Walker loading facility comprises a dead end with loading pad.

8.3 There is a single line connection from Oaky Creek to Gregory linking the Goonyella System with the Blackwater System. Dual unloading balloons are located at Hay Point and Dalrymple Bay. Access from the Goonyella System to the North Coast Line occurs at Yukan enabling product to travel to other destinations within the State.

The Goonyella System is electrified by an autotransformer system with the overhead line equipment operating at 25 000 volts, 50 Hertz, alternating supply (25 kV, 50 Hz, ac).

The origin point (0.000 km) for the Goonyella System is the centre of the unloader on the inner balloon loop at Hay Point.

[3] www.networkaccess.qr.com.au/Images/Goonyella_Issue%202_1February_2007_tcm10-2858.pdf

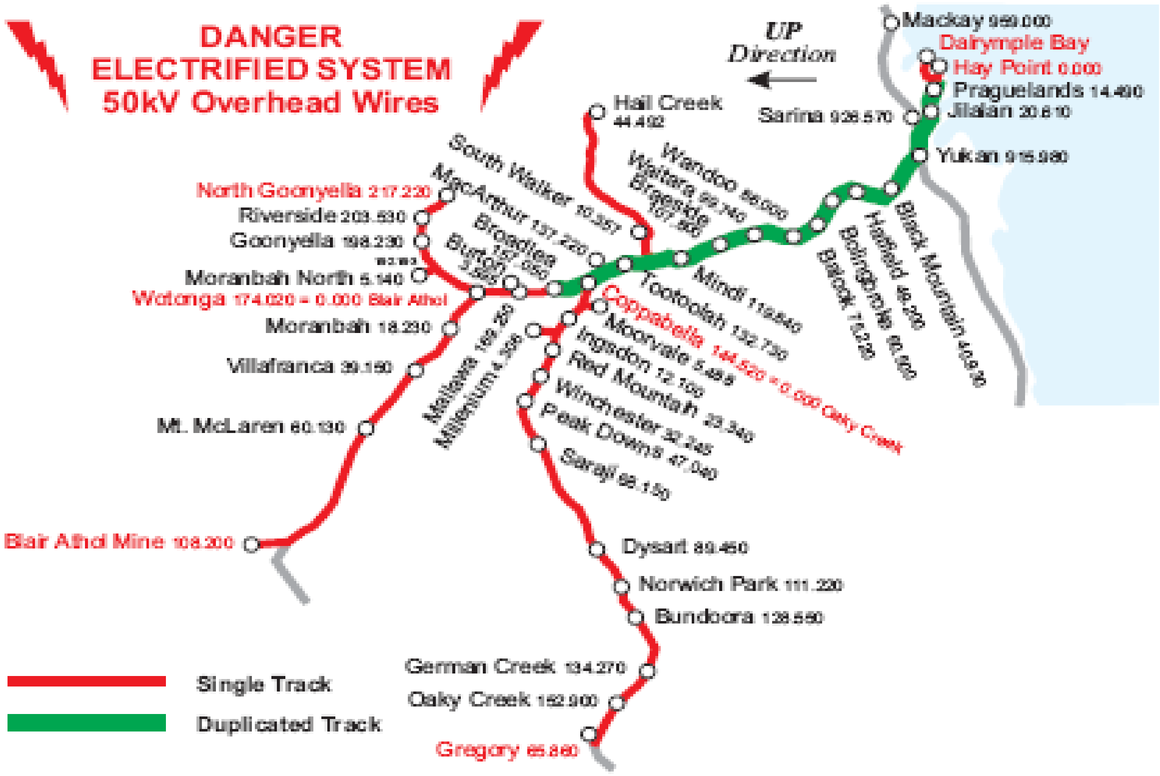


Figure 3 Goonyella System[4]

Weather Monitoring System

8.4 On the Goonyella System, pluviometers have been strategically located on the Hatfield Range at 8km and 49 km to allow Infrastructure Managers and Train Controllers to monitor rainfall.

[4] www.qr.com.au

Figure 4: Rainfall density measurement

Description of the Railway

8.5 The track (1067 mm gauge) on the main trunk route from Hay Point to North Goonyella is generally 60 kg/m rail with concrete sleepers. Bridges allow the passage of 104 t (26 tal) wagons at 80 km/h.

Axle Loadings

8.6 Maximum axle loads used throughout this document refer to wheel configurations that generate loadings as specified in the ANZRC Railway Bridge Design Manual - 1974. In summary :- Maximum axle load Wheel configuration consistent with or otherwise generating a loading equivalent to 26 tal M 270 / M 220*

Electrification

8.7 The Goonyella System is electrified by an autotransformer system with the overhead line equipment operating at 25 000 volts, 50 Hertz, alternating supply (25 kV, 50 Hz, ac). Distribution is via a contact wire suspended from a catenary wire and these two wires are held in place by supporting structures to maintain ideal pantograph/contact wire interaction.

Typically, the autotransformer system also uses a 25 kV AC feeder wire run on the back of the supporting structure which is used for voltage support throughout the electrified network.

The dual wire distribution system is automatically tensioned to maintain a constant wire tension and requires a pantograph uplift force of 80 N ± 10 N for smooth sparkless current collection.

The contact wire height may vary from 4400 mm to 5850 mm above rail level.

Typically in the Goonyella System, the traction system uses both rails for return current.

Hot Box / Hot Wheel Detectors (HBD/HWD)

8.8 Hot Box / Hot Wheel Detectors are located at the following locations:- Hay Point - North Goonyella,

Coppabella - Gregory Junction, Wotonga - Blair Athol Mine

Other field observations and facts

Mountainous terrain

8.9 Steep grades, narrow curves through the ranges, civil engineering is often required to avoid damage to track because of falling rock and earth.

High rainfall area

8.10 Many creek crossings. Land slides are common and protection systems for remote diagnoses in case of slides are installed (electric fence system). Rainfall is measured at several places. Flooding is a big issue. Water levels even in small creeks can rise very fast with large and often deep catchment areas. After rain track gets often instable and needs speed restrictions, high correlation to rainfall density.

Blacksoil

8.11 Unstable clay material which exhibits significant shrinkage and swelling in combination with changing humidity ratio. Swells when humidity ratio increases. This material has to be replaced when bearing capacity for track construction is insufficient or where track instability increases due to misalignments. Significant higher maintenance required for resurfacing/tamping.

9. QUALIFICATION

9.1 In preparing this report WorleyParsons has exercised the degree of skill and care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering design principles.

9.2 WorleyParsons has used all reasonable endeavours to inform itself of the parameters and requirements of the project and has taken all reasonable steps to ensure that the report estimate is as accurate and comprehensive as possible given the information upon which it is based.

9.3 It is not intended that this report represent a final assessment of the feasibility of the project.

9.4 WorleyParsons reserves the right to review and amend all calculations, cost estimates and/or opinions included or referred to in the report if:

(a) Additional sources of information not presently available (for whatever reason) are provided or become known to WorleyParsons; or

(b) WorleyParsons considers it prudent to revise the report in light of any information which becomes known to it after the date of submission.

9.5 WorleyParsons does not give any warranty nor accept any liability in relation to the completeness or accuracy of the report.

9.6 If any warranty would be implied whether by law, custom or otherwise, that warranty is to the full extent permitted by law excluded.

9.7 All limitations of liability shall apply for the benefit of the employees, agents and representatives of WorleyParsons to the same extent that they apply for the benefit of WorleyParsons.

9.8 This report is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this report and cost estimate.

9.9 If any claim or demand is made by any person against WorleyParsons on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the report and cost estimate or information therein, WorleyParsons will rely upon this provision as a defence to any such claim or demand.