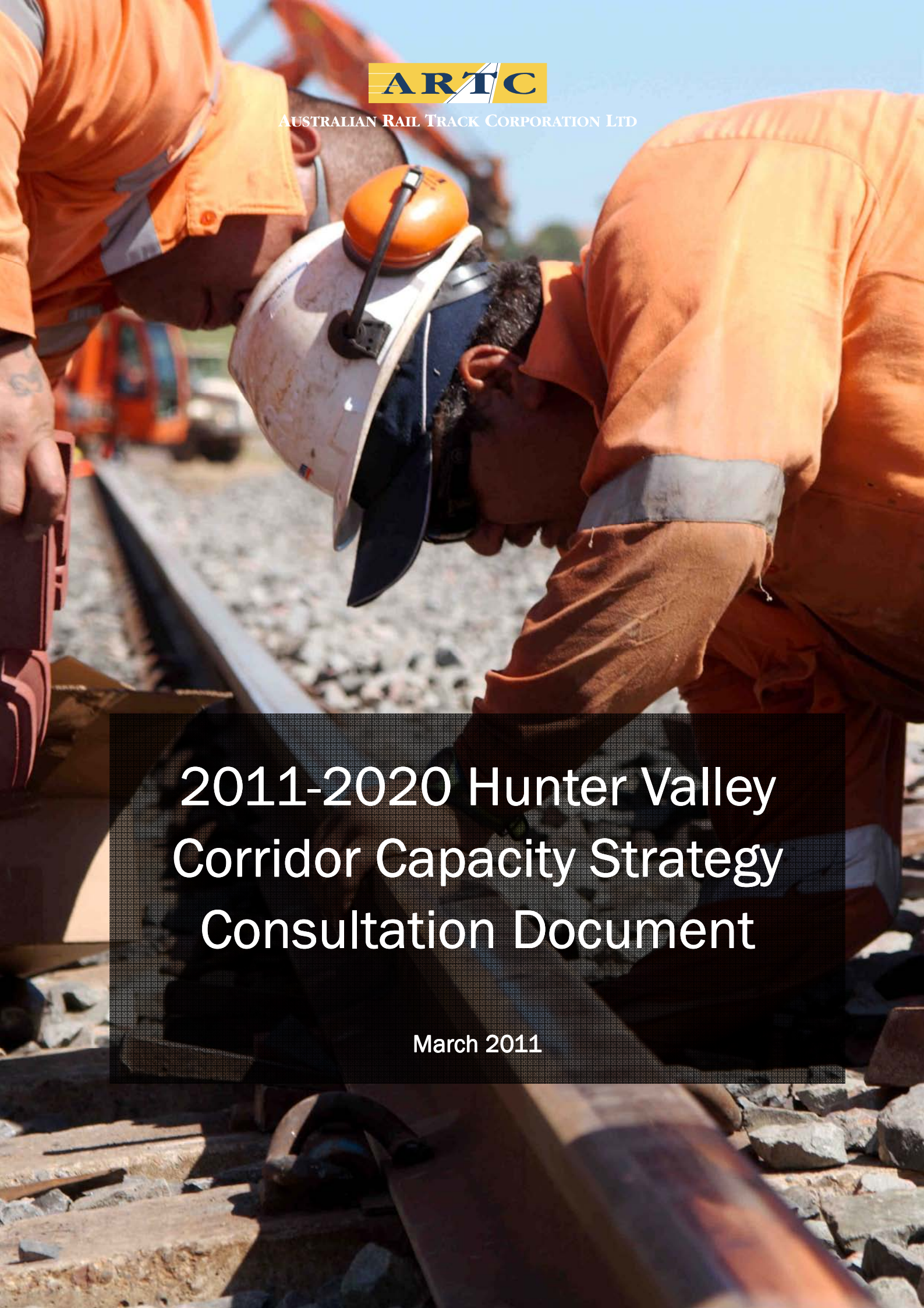

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2011-2020 Hunter Valley Corridor Capacity Strategy Consultation Document

March 2011

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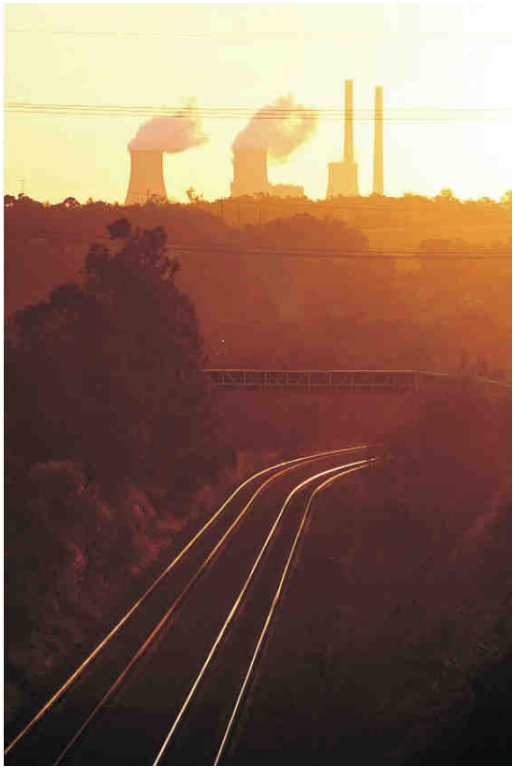

2011-2020 Hunter Valley Corridor Capacity Strategy Consultation Document

March 2011

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1

Introduction

On 5 September 2004, the Australian Rail Track Corporation (ARTC) commenced a 60-year lease of the interstate and Hunter Valley rail lines in New South Wales.

ARTC had previously controlled the interstate rail network within the area bounded by Albury on the NSW/ Victoria border, Kalgoorlie in Western Australia and Broken Hill in western NSW. The commencement of the NSW lease consolidated control of most of the interstate rail network under ARTC.

In early 2005, ARTC began to release annual Hunter Valley infrastructure enhancement strategies setting out how ARTC planned to ensure that rail corridor capacity in the Hunter Valley would stay ahead of coal demand.

This Hunter Valley Corridor 2011 - 2020 Capacity Strategy is the fifth of these annual strategies. It updates the 2009 - 2018 Hunter Valley Corridor Capacity Strategy, and the 2010 Hunter Valley Strategy Update, using revised forecasts of coal demand and the results of further analysis during the past year.

In common with the earlier strategies, it identifies the constraints on the coal network's capacity in the Hunter Valley, the options to resolve these constraints and a proposed course of action to achieve increased coal throughput.

For much of the period since the first strategy, the infrastructure solutions have been comparatively straightforward. The rapid growth in demand meant that the primary focus was on delivery of projects to meet the growth. ARTC believes that it has now reached the point where its ability to deliver projects is comfortably ahead of demand and it is increasingly focussed on optimising the management of the delivery program. It has also coincided with increasing complexity for many projects as the more straightforward options have already been exhausted. This is particularly true on the Ulan line.

The fundamental approach of ARTC in developing this Strategy has been to provide sufficient capacity to meet indicative contractual nomination volumes based on the principles of the draft ARTC Hunter Valley Access Undertaking, while also having regard to and identifying those projects that would be desirable to accommodate prospective volumes that have not yet been the subject of an indicative contractual nomination.

In developing the strategy ARTC has also been mindful of the dependencies that exist in the coal chain and therefore has been careful to match capacity programs against known developments and timing of mine, above rail, terminal and port capacity and will continue to monitor those plans and adjust the strategy as required.

Volume Forecasts

With the move to the new Hunter Valley contractual alignment model there is much greater certainty over volume forecasts than in previous years.

Indicative contractual nominations provided to ARTC by producers are for export coal demand from the Hunter Valley of about 135 mtpa in 2011. This is projected to increase to around 163 mtpa in 2012, 190 mtpa in 2013, 209 mtpa in 2014 and 216 in 2015 before stabilising at around this level.

In addition, ARTC is aware of a number of mines that are in the initial stages of planning. The volumes from these mines are referred to as prospective volumes throughout this Strategy, and would be dependent on the proposed Terminal 4 or other new export facilities. The total prospective volume has been estimated by ARTC at around 1 mtpa in 2013, 7.5 mtpa in 2014, 10.5 mtpa in 2015, 30 mtpa in 2016, 36 mtpa in 2017 and then stabilising at 46 mtpa from 2018.

Even when prospective volumes are taken into account, volume forecasts are lower than in the previous strategy. Specifically, indicative contractual nomination volume in 2011 is down by 24 million tonnes, while 2012 volume is reduced by 27 million tonnes and 2013 by 36 million tonnes.

The Hunter Valley Coal Chain Coordinator (HVCCC) declared capacity for 2011, which represents the capacity of the chain as an integrated operation, is 125.1 million tonnes.

Traffic Patterns

All but a very small proportion of the export coal shipped through Newcastle is transported by rail for shipping from Carrington (Port Waratah), or one of the two terminals on Kooragang Island.

Most of this coal comes from a series of mines and coal loaders strung out along the Hunter Valley, conveyed to the ports on the railway that runs between Muswellbrook and Newcastle. Coal also feeds onto this line from Ulan and Gunnedah, west and northwest of Muswellbrook respectively, and, much closer to the port, from Stratford, Pelton and the southern suburbs of Newcastle (Figure 1).

Domestic coal is also transported over the same network. This sector is growing rapidly, especially on the Ulan and Upper Hunter lines. The largest volume is for Macquarie Generation at Drayton, which is receiving growing volumes of coal originating from mines on the Ulan line.

Export coal also arrives at the port from the Newstan and Teralba mines to the south of Newcastle. This traffic operates on the RailCorp network as far as Broadmeadow. There are no capacity issues for this coal on the short section of the ARTC network which it traverses and the Strategy assumes there are no capacity issues for this coal on the RailCorp section. Accordingly this strategy does not specifi-

Figure 1 - The general location of the Hunter Valley network on the east coast of Australia.

cally discuss these volumes.

The Hunter Valley coal network consists of a dedicated double track 'coal line' between Port Waratah and Maitland, a shared double track line with some sections of third track from Maitland to Muswellbrook, and a shared single track with passing loops from that point north and west.

The heaviest coal volumes are at the lower end of the Hunter Valley, but the expected growth in coal mining along the Ulan line and in the Gunnedah basin is producing high rates of growth in percentage terms (Figure 2 and Figure 3[1]), necessitating a strong focus in this Strategy on the single track sections of the network.

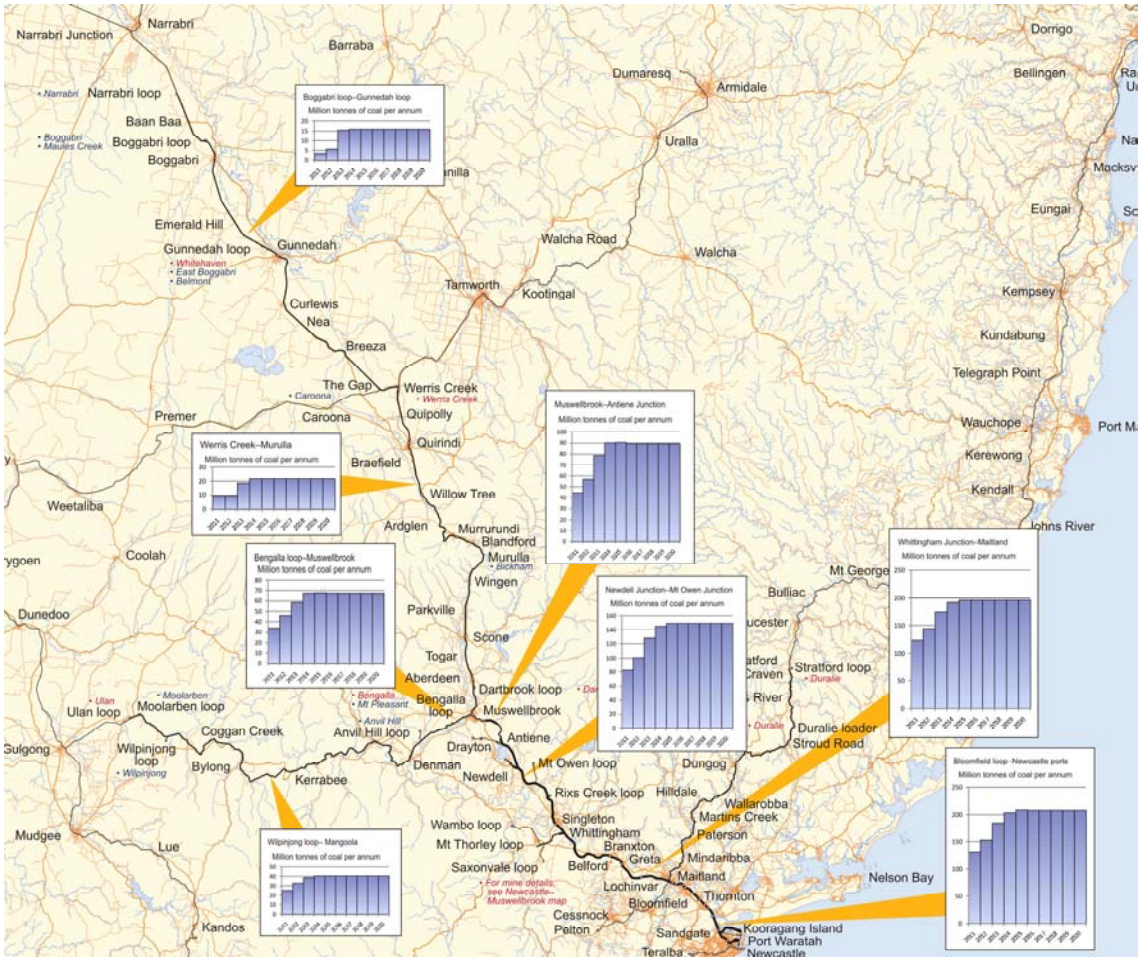

Figure 2 - Volume forecasts by line sector

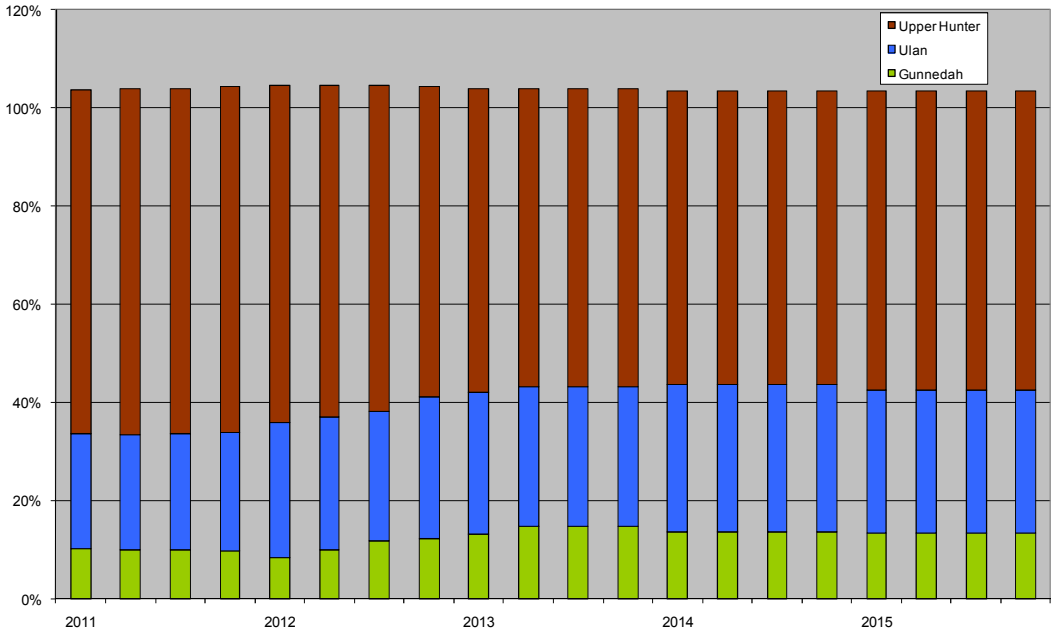

Figure 3 - Percentage of Trains by Sub-Network, by Year. (Note: Numbers do not sum to 100% due to domestic coal.)

1. Note total train numbers in figure 3 are calculated as trains from each of the three zones as a proportion of all trains arriving at the port. The total number of trains exceeds 100% due to domestic coal.

Operations

Most of the Hunter Valley coal network is capable of handling rolling stock with 30 tonne axle loadings (i.e. 120 gross tonne wagons), but the corridor from Dartbrook Junction (near Muswellbrook) to the Gunnedah Basin is only rated for 25 tonne axle loads (100 tonne wagons).

As at the time of writing this Strategy, the Hunter Valley was serviced by:

- 22 trains of 91 x 120 tonne wagons (8500 nominal net tonnes)
- 8 trains of 74 x 120 tonne wagons (7200 nominal net tonnes)
- 4 trains of 72 x 100 tonne wagons (5400 nominal net tonnes)
- 3 trains of 60 x 120 tonne wagons (5500 nominal net tonnes)
- 4 trains of 42 x 100 tonne wagons (3000 nominal net tonnes)
- 2 trains of 2000 nominal net tonnes, composed of non-standard wagons

This 299,300 tonnes of coal train capacity compares to 207,035 tonnes of capacity as at the time of writing the 2009-2018 Strategy.

At the 2011 declared capacity, an average of around 54 loaded trains need to be planned each day, or one every 27 minutes. Allowing for cancellations, this equates to approximately 49 actual trains per day, or one train every 29 minutes. This is a significant increase in train frequency compared to the 2009-2018 Strategy, reflecting the increase in port capacity .

Train lengths vary from around 1,000 metres to 1,550 metres, apart from the small group of trains servicing the Stratford and Austar mines.

Trains made up of '120 tonne' wagons are generally restricted to 60 km/h loaded and 80 km/h empty, while '100 tonne wagon' coal trains are allowed to travel at 80 km/h. Because most of the coal trains are '120 tonne wagon' trains, the coal network tends to move at 60 km/h in the loaded direction and 80 km/h in the empty direction.

The established operators, Pacific National (PN) and QR National (QRN), were joined in 2011 by X-Rail, a joint venture between Xstrata and Freightliner which will service a portion of the Xstrata task. Southern Shorthaul (SSR) has also entered the market hauling coal from Newstan to Newcastle and Port Kembla for Centennial Coal, while Qube Logistics (through its acquisition of Southern and Silverton) provides containerised coal haulage for a number of producers.

How this Strategy has been developed

The development of this Hunter Valley Corridor 2011-2020 Capacity Strategy largely retains the methodology of the 2009 – 2018 Strategy.

Coal rail capacity is analysed using a set of principles for the practical utilisation of track. Capacity is calculated using headways. On single track it is then reduced to 65% to reflect practical rather than theoretical capacity. After removing capacity lost to background trains, saleable paths are calculated as 75% of available coal paths. This adjustment covers maintenance, cancellations and surge capacity and reflects maximum capacity allocation principles adopted under the ARTC proposed Hunter Valley Access Undertaking.

The use of a 75% rate rather than individual adjustments for maintenance, cancellations and surge, represents a change from the methodology adopted in previous strategies, though it produces similar results.

Port Capacity

Critical to the volume forecasts is port capacity.

There continues to be a high level of activity on identifying and analysing port development options. ARTC's understanding is that the current best thinking is that NCIG will proceed with development to its full 66 mtpa potential and that PWCS will proceed with a fourth dump station. Indicative contract nominations to ARTC are consistent with the capacity delivered by these projects. Terminal 4 remains more speculative, though design concepts are proceeding on the basis that provision is made for its future construction. This strategy has identified prospective volumes that would potentially use T4.

ARTC's understanding of expected approximate port capacity is as follows:

- Q1 2011 – Full commissioning of NCIG Stage 1 lifts capacity to 140 mtpa (from 110 mtpa prior to start-up).
- Q1 2012 – MPC expansion of PWCS Kooragang Island increases overall capacity to 160 mtpa.
- Q4 2012 – KCT Stage 4 (PWCS 4th dump station) expansion results in a capacity increase of 15 mtpa, resulting in an overall capacity of 175 mtpa.
- Q1 2013 – NCIG Stage 2A is expected to be complete, raising capacity to 196 mtpa.
- Q1 2014 – NCIG full Stage 2 is expected to be complete, increasing capacity to 209 mtpa.
- Q1 2016 – PWCS T4 potentially available, raising capacity to between 254 mtpa and 309 mtpa. For illustrative purposes this Strategy has assumed the availability date and a capacity of 60 mtpa, which comfortably covers demand.

Indicative contractual volume nominations require both NCIG Stage 2 and the fourth dump station. The fourth terminal would only be required to accommodate prospective volume.

Previous strategies have needed to address mismatches between producer forecasts and forecast port volume. With the move to the Hunter Valley contractual alignment model, this problem has been largely eliminated. The Strategy now plans to deliver capacity for indicative contractual nomination volumes on the basis that these volumes have matching port capacity. Projects required to accommodate prospective volumes, which do not have a port allocation, are separately identified.

Producer forecasts provided to ARTC now show planned production to be relatively closely aligned to port capacity until Q1 2014. The relationship between nominations and port capacity is shown in Figure 4.

Terminal 4 (T4)

As already discussed above, there is a proposal to develop a fourth terminal on Kooragang Island. Whilst T4 development is being advanced there is considerable uncertainty as to volume that would be accommodated and timing. Infrastructure planned in this strategy does not provide for volume associated with T4, though an indicative scope of works has been identified for the Gunnedah and Ulan lines.

As T4 plans are further developed, ARTC will seek to seek to firm up scope, timings and cost for track expansion that will provide capacity to meet potential T4 volume scenarios

Continuous Review

ARTC is continuously analysing and reviewing the available options to ensure that the value for money of projects is optimised. This process continues right up to the commencement of construction., in close consultation with the coal industry.

As such, this strategy only represents a snapshot in time. Although the formal written strategy is only produced annually, in practice it is regularly reviewed internally to reflect the best available information and analysis.

Project Costs

This document is a strategy document and the indicative project costs are generally orders of magnitude only unless a project is in or close to construction. Costs are not ARTC's anticipated outturn costs as there are too many unknowns at the strategy phase to attach any reliability to the estimates. Scope and construction conditions are progressively better defined through the project approval stages until a project cost is established. Each project stage is brought to the industry for approval in accordance with ARTC's access undertaking.

HVCCC Master Planning

The Hunter Valley Coal Chain Coordinator is responsible for the co-ordination of coal chain planning on both a

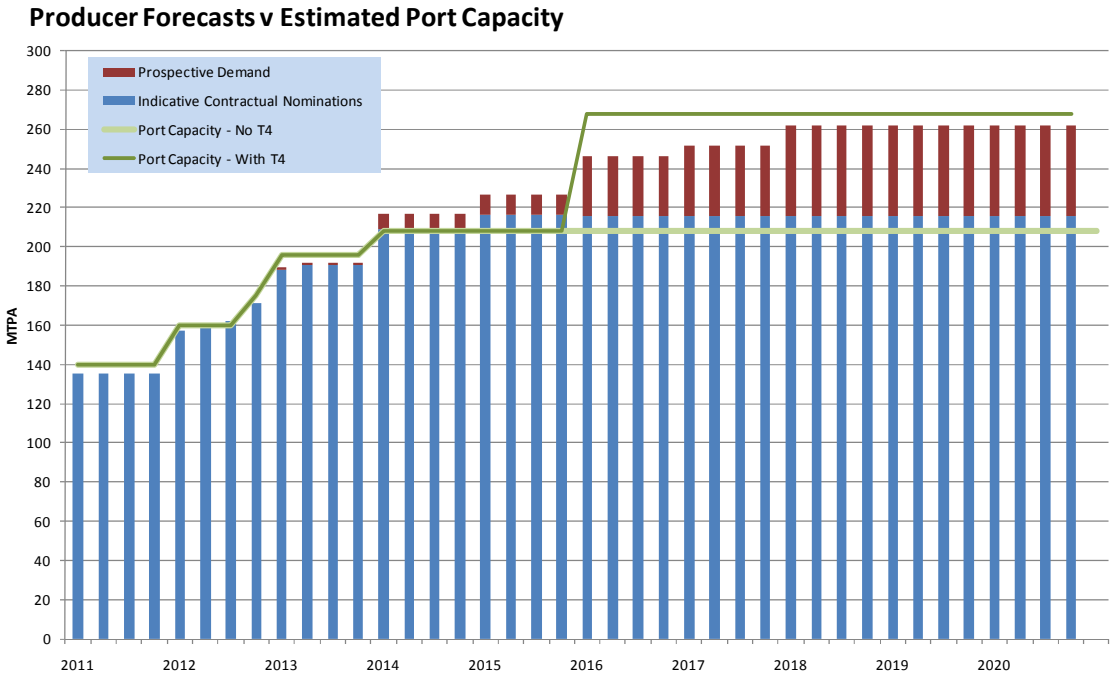

Figure 4 - Forecast volume at Newcastle Port compared to estimated port capacity (mtpa)

day-to-day and long term basis. It is continuously developing a Hunter Valley Master Plan that deals with the optimisation of capacity enhancements across all elements of the coal chain with a view to providing an integrated planning road map for the logistics chain.

HVCCC are turning their attention to looking at congestion and disruption planning as the network gets increasingly busy, and there is then the need not only to optimize capacity, but also to optimize operational efficiency.

ARTC is strongly supportive of this master planning process. It sees this Hunter Valley Corridor Capacity Strategy as both needing to provide the supporting rail infrastructure analysis for the master planning process, and to respond to the investment options identified in the master plan.

Advanced Train Management System (ATMS)

ARTC's ATMS project is currently in the proof of concept stage, with benchtop trials having been successfully completed and field trials underway on the Crystal Brook – Port Augusta section. Subject to the trials being successful, the ATMS system could be available for full implementation in the timeframe of this Strategy. Analysis of how it might be deployed in the Hunter Valley, and whether there is a business case to do so, is currently underway.

At indicative contractual nominations there are no projects required for capacity that are of a purely signalling nature. Such projects will, however, be required to meet prospective volumes and it may be desirable to adopt ATMS at that time. There may also be a good case for extending bi-directional operation from Whittingham Junction to Drayton Junction to mitigate the effect of maintenance. This project has not be pursued at this time given the significant potential cost savings if it was implemented as part of an ATMS roll-out.

Other Assumptions and Qualifications

The following additional qualifications apply to the analysis and proposals in this Strategy:

- The capacity gains referred to in this Strategy take no account of the capabilities of loading and unloading interfaces, including the capabilities of private rail sidings and loops. In other words, at the conclusion of each project the identified rail capacity will be available, but this does not necessarily mean the coal supply chain will be able to make use of this capacity at that stage.
- Estimates of the numbers of trains required to carry the forecast coal tonnages are based on train consists nominated by producers under the indicative contractual volume nomination process. Assumed average train capacity by section by year is shown in Table 1.
- Trains are, on average, loaded to 98% of their theoretical capacity.
- It is assumed that track closures for maintenance purposes will require the same amount of time as at present. In practice, the growing tonnages will result in greater impact on the track . ARTC has a project underway to develop maintenance strategies under a 200 mtpa volume scenario.
- Infrastructure is treated as being available for a quarter (or year) if it is projected to be available by the end of the first month of the quarter (or year). If it is not expected to be available until later than the first month of the quarter it is treated as being available in the following quarter. For example, if a project is projected to be completed by 30 April, it is treated as being available for the second quarter. If it will not be competed until 1 May it would be treated as being available for the third quarter.

	2011	2012	2013	2014	2015	2016
Narrabri—Boggabri	5,439	5,733	5,733	5,733	5,733	5,733
Boggabri - Gunnedah	5,439	5,733	5,733	5,733	5,733	5,733
Gunnedah - Werris Creek	5,439	5,733	5,733	5,733	5,733	5,733
Werris Creek - Murulla	5,439	5,733	5,733	5,733	5,733	5,733
Murulla - Dartbrook	5,439	5,733	5,733	5,733	5,733	5,733
Dartbrook - Muswellbrook	5,621	5,907	5,824	5,812	5,812	5,812
Ulan - Moolarben	8,330	8,330	8,330	8,330	8,330	8,330
Moolarben - Wilpinjong	7,542	7,497	7,657	7,657	7,657	7,657
Wilpinjong - Mangoola	7,625	7,580	7,673	7,640	7,640	7,640
Mangoola - Mt Pleasant	7,704	7,686	7,777	7,745	7,745	7,745
Mt Pleasant - Bengalla	7,704	7,686	7,777	7,745	7,745	7,745
Bengalla - Muswellbrook	7,758	7,744	7,835	7,833	7,835	7,835
Muswellbrook - Antiene	7,112	7,321	7,207	7,200	7,204	7,204
Antiene - Drayton	7,112	7,321	7,207	7,200	7,204	7,204
Drayton - Newdell	7,092	7,214	7,152	7,149	7,151	7,151
Newdell - Mt Owen	7,308	7,421	7,361	7,340	7,346	7,346
Mt Owen - Camberwell	7,372	7,468	7,404	7,379	7,384	7,384
Camberwell - Whittingham	7,409	7,495	7,428	7,401	7,406	7,406
Whittingham - Maitland	7,493	7,557	7,490	7,462	7,465	7,465
Branxton - Allandale	7,493	7,557	7,490	7,462	7,465	7,465
Allandale - Maitland	7,493	7,557	7,490	7,462	7,465	7,465
Maitland - Bloomfield	7,147	7,217	7,213	7,210	7,215	7,215
Bloomfield - Sandgate	7,165	7,236	7,229	7,233	7,238	7,238
Sandgate - Kooragang	7,188	7,255	7,244	7,253	7,264	7,264
Sangate - Port Waratah	7,188	7,255	7,244	7,253	7,264	7,264
Total Export Volume	7,188	7,255	7,244	7,253	7,264	7,264

Table 1 - Average Train Size (tonnes)

2

What has changed between the last strategy and this one

This section summarises the key methodology, assumption and outcome changes between the 2009-2018 Strategy and this 2011–2020 Strategy to allow ready comparison between the two

Saleable Paths Adjustment

As already discussed in Chapter 1, ARTC has during the last year established a principle in its proposed ACC Access Undertaking that it will not sell more than 75% of practical coal paths. This adjustment covers maintenance, cancellations and surge capacity. This has led to a small change in the methodology for calculating capacity, though the results are similar.

Volume forecasts

Volume forecasts have been updated based on indicative contractual nominations. A distinction has now been drawn between those volumes that are subject to an indicative contractual nomination and those that are associated with projects that are in the initial planning phase. The latter category has been referred to as prospective volumes.

Figures 5 to 8 compare the forecast volumes from the 2009 – 2018 Strategy with the forecasts used for this Strategy. A comparison is made at the port, at Muswellbrook, for the Wilpinjong – Mangoola section (which is the majority of the Ulan line), and Werris Creek – Murulla (which is representative of most of the Gunnedah basin line).

Completed Projects

The following projects have been completed since the release of the 2009 – 2018 Strategy and the benefits of the projects are now built into the starting assumptions:

- Baerami (Worondi), Murumbo (Aerosol Valley) and Yarrawa (Radio Hut) loops on the Ulan line.
- Braefield and Parkville loops on the Gunnedah basin line.
- Minimbah bank third track.
- Newdell Junction upgrade

Train Path Data

A number of parties have requested that more information be provided on capacity levels and the nature of that capacity, in particular that there be visibility of train path numbers as well as tonnage numbers. This Strategy therefore provides capacity outcomes in terms of both train paths and tonnes.

Effective Loading

Previous strategies have assumed that wagons are on average loaded to 95% of their theoretical capacity. Since the last strategy this assumption has been reviewed using data on actual loading (as weighed by dump station belts) against nominal train loads. On the basis of this evidence a less conservative assumption of 98% effective loading has now been made.

Simulation Modelling

Recent HV Strategies have used operational simulation to:

- validate capacity models

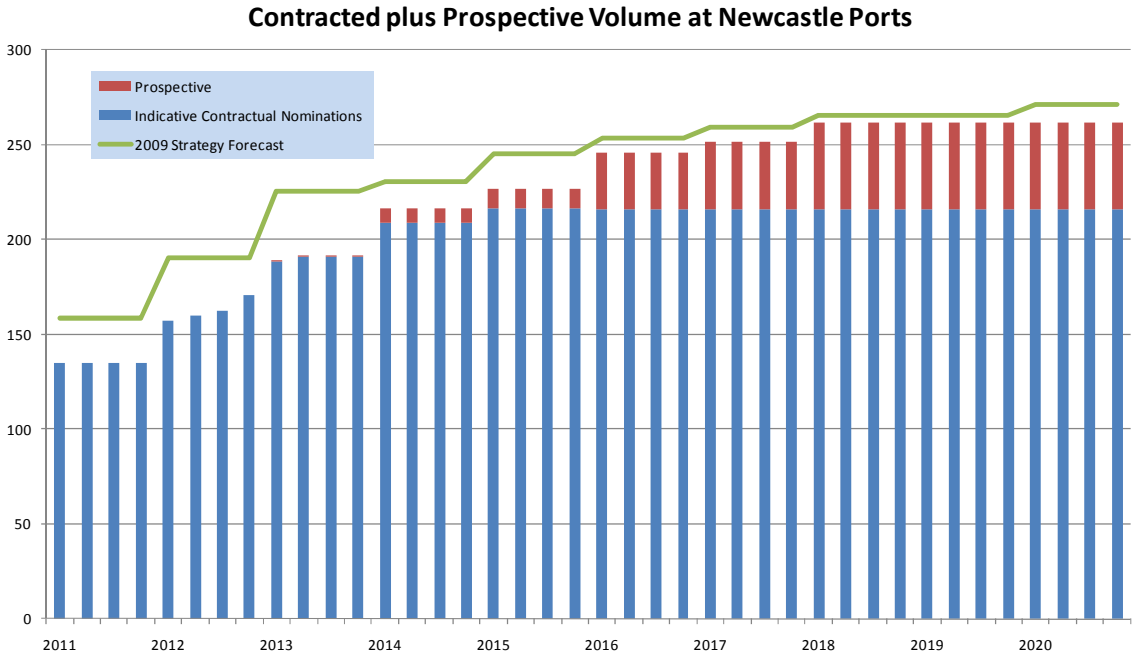

Figure 5: Current Volume Forecasts vs 2009-18 Volume Forecast, Newcastle Ports (mtpa)

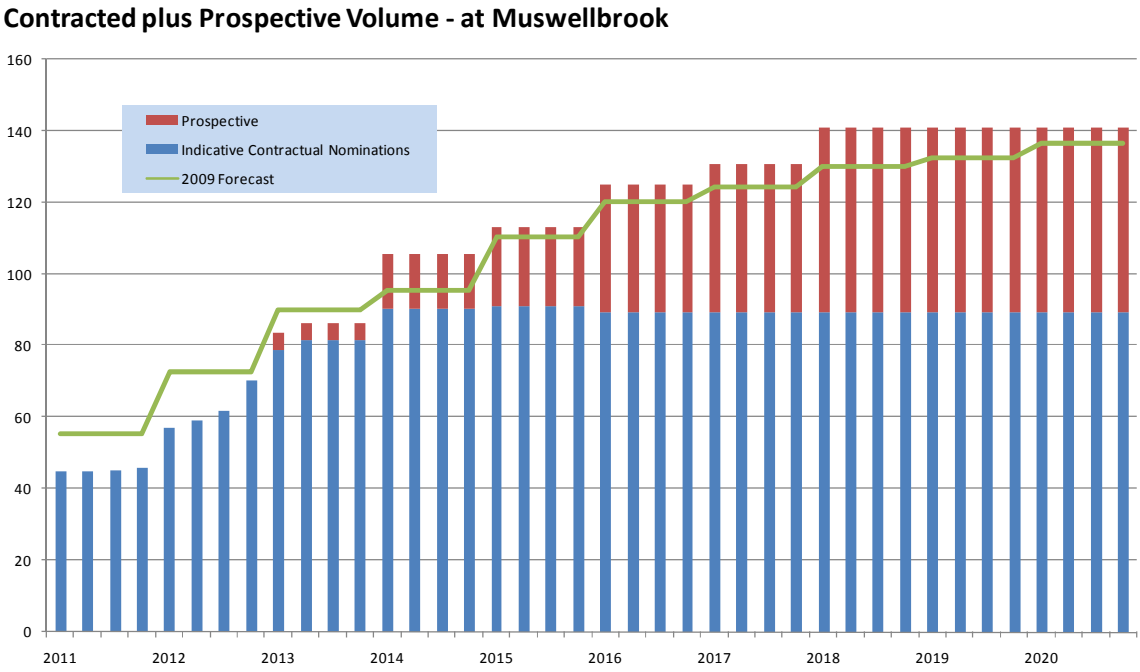

Figure 6: Current Volume Forecasts vs 2009-18 Volume Forecast, Muswellbrook (mtpa)

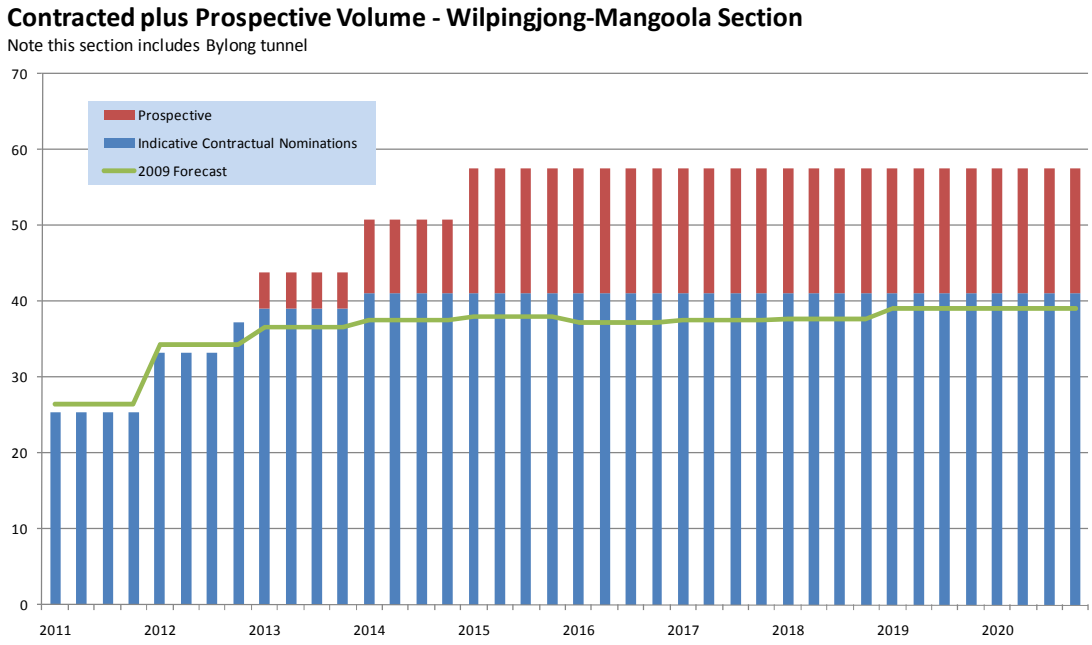

Figure 7: Current Volume Forecasts vs 2009-18 Volume Forecast, Wilpinjong—Mangoola (mtpa)

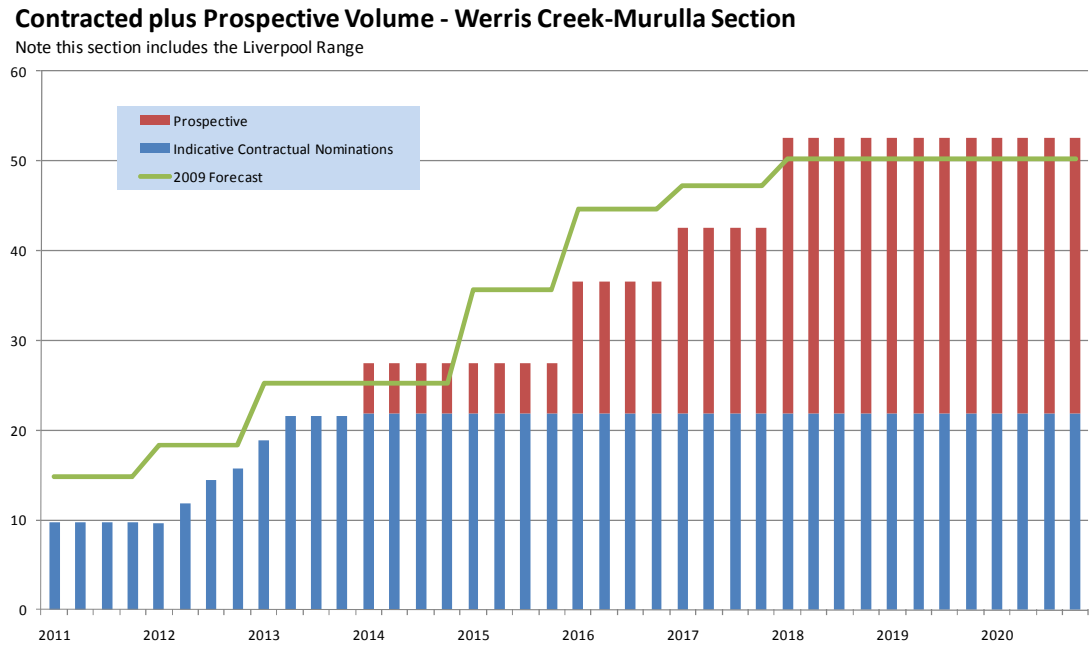

Figure 8: Current Volume Forecast vs 2009-18 Volume Forecast, Werris Creek—Murulla (mtpa)

- look at levels of operational delay on the network, and the operational robustness of the network, to highlight opportunities for improved operational performance on top of the provision of sufficient capacity.

This simulation modelling has identified that the capacity models do generate reasonably robust conclusions. It has also become apparent that current and potential levels of operational delay on the below rail network are relatively inconsequential in comparison with other sources of delay in the above-rail operation.

In light of these conclusions, simulation modelling has not been undertaken for this version of the Strategy. Simulation modelling will be done for future versions of the Strategy as appropriate to ensure that the capacity models continue to be robust and valid.

Recommended Projects and Timing

A summary of the recommended projects comparing previous and new proposed delivery timeframes is shown in Table 10 in Chapter 8

3

Terminals and capacity to Maitland

Context

The Hunter Valley coal industry is now serviced by three coal loader terminals, PWCS Carrington (CCT), PWCS Kooragang Island (KCT) and NCIG Kooragang Island. While the coal loaders are owned by Port Waratah Coal Services (PWCS) and the Newcastle Coal Infrastructure Group (NCIG), most of the track in and around the terminals is leased by ARTC and all train operations are controlled by ARTC.

The Carrington loader is the oldest of the facilities and is located in the highly developed and constrained Port Waratah yard area, with extensive rail facilities servicing a variety of activities. This includes steel products for One Steel, grain for the GrainCorp loader, ore for the Pasminco loader, general freight through Toll / R & H Transport and other minor customers. There are also locomotive and wagon servicing and maintenance facilities.

The Carrington coal facilities include 3 arrival roads and 2 unloaders. While there are nominally 10 departure roads, these range in length from 414 metres to 863 metres, all of which are shorter than all coal trains, other than the short trains used for Stratford and Pelton services. Only two of the 3 arrival roads can accommodate 80 wagon and longer trains.

The Carrington facility has a capacity of 25 mtpa, with no expectation of expansion.

PWCS Kooragang Island is better configured for modern rail operations. However, while it has 6 departure roads for its three dump stations, there is only one arrival road for each dump station. As a result, trains need to queue on the mainline before being called forward into the arrival road as the preceding train moves through the dump station.

The other critical current issue at PWCS Kooragang is the use of the departure roads for stabling trains while locomotives are serviced and fuelled and trains are examined, and for holding trains where there is a time delay before their next run.

The PWCS Kooragang Island facility has a program in place to increase capacity up to the order of 105 mtpa. A fourth dump station on the existing PWCS Kooragang Island loop would potentially add around 13 mtpa to capacity, bringing its capacity to around 118 mtpa, and 143 mtpa for PWCS as a whole.

Development of dump station 4 will exacerbate the existing problems, and poses significant issues in terms of providing adequate and suitably configured arrival and departure capacity.

The first stage of the NCIG terminal has a capacity of 30 mtpa. Further planned developments would take capacity up to 66 mpta. There are different options for how this might be staged but for the purposes of this Strategy it is assumed that the further expansion would take place as a single Stage 2, albeit with a ramp-up period.

A major issue that has emerged more recently is the medium term development of Kooragang Island. PWCS has been granted a lease of the remaining vacant land on Kooragang Island, which sits immediately to the west of the existing PWCS facility and to the north of the NCIG rail facility, for the development of a terminal 4 (figure 9). Getting an appropriate configuration for rail access into this facility is complex due to the constraints of current infrastructure and the environmentally sensitive areas around Kooragang Island.

Closely related to this is the track configuration for the development of NCIG Stage 2. The junction for NCIG stage 1 has been built as a simple at-grade crossing. ARTC has a long-standing position that stage 2 will require grade separation of the junction as the volume of trains will exceed what can be reasonably accommodated while maintaining system robustness.

The 2009 – 2018 Hunter Valley Strategy included a lengthy discussion of the congestion issues arising from growth in the task, given the limited availability of arrival roads and the use of queuing on the mainline. The HVCCC has more recently been highlighting the congestion consequences of equipment failures at the coal terminals and the disruption these cause. HVCCC is signalling a significant and growing system capacity loss as a result of this congestion. HVCCC is also currently investigating other causes of this congestion. While this is a whole-of-system issue, there may be opportunities for rail infrastructure to mitigate some of this problem.

Each of the key issues for this part of the network are discussed in turn in the following sections.

Provisioning

The Kooragang Island departure roads include a fuelling and provisioning facility on No 3 road. This requires trains to be stabled while the locomotives are detached, moved to No 3 road, fuelled and provisioned, and then returned to their train.

The departure tracks are used for stabling trains while locomotives are serviced and fuelled, trains are examined, and while waiting a path. There are six departure roads, but each of the three dump stations requires a departure road to be vacant for a train to feed onto as it unloads. One departure road is effectively occupied with fuelling activities.

This causes considerable congestion.

As the throughput rate of the Kooragang Island facility has progressively increased, so too has the scale of occupation of the departure tracks, leading to congestion and the potential for unloading activities to be compromised by the lack of a suitable departure track to feed onto.

One solution would be to provide fuelling facilities on additional, and potentially all, departure roads. However, this would still result in trains occupying departure roads for an extended time, which as volume through the terminal increases, will cause unacceptable congestion. Also, the NCIG terminal will have no provisioning facilities, meaning that locomotives would need to shuttle between NCIG and Kooragang for provisioning if the facility remains at Kooragang.

Relocation of fuelling and other provisioning and inspection activities away from the terminal has therefore long been considered the best solution.

ARTC, with industry support, developed a concept for a provisioning centre at Rutherford. This facility was conceived as a multi-user facility offering fuelling, sanding, shunting and some stabling, with the option for maintenance centres to be co-located on the site.

In parallel with this, Pacific National developed a proposal for a provisioning facility on land it acquired at Greta, while QR National had a concept for a provisioning facility on land it owned at Hexham.

ARTC presented the results of its analysis to industry in May 2010 including the intention of operators to pursue a strategy of provisioning centres being provided by them. This meant there was not a business case for a multi user facility and with industry agreement ARTC has not pursued the Rutherford multi-user facility any further.

Pacific National has advised the industry that the Greta facility will be available by June 2012. At this stage it is uncertain when the QRN Hexham facility will be completed. However, in the meantime QRN has set up a provisioning facility at the Ashton mine loader loop. PN has also set up provisioning facilities at a number of mine loop locations in the Gunnedah basin. It is expected that X-Rail's new operation will provision exclusively at mine loading loops, and the first facility has been established at Mt Owen.

The consequence of these developments is that the use of Kooragang Island as a provisioning facility will be reduced to six fuelling events a day in the short term – four by PN on Number 3 Departure Road and two by QRN on the cripple siding. This level of fuelling will still contribute significantly to congestion for departing trains and inhibit the implementation of a 'dump and go' approach at the terminal and the HVCCC view is that for congestion to be eliminated all fuelling events must be removed from the terminal.

Congestion

The 2009 – 2018 Strategy included an extensive discussion of the importance of providing a constant flow of trains to the coal terminals, and the likely increase in the amount of queuing as volumes grow. It noted that resequencing of trains would become both increasingly necessary and increasingly difficult at higher volumes. To mitigate this it recommended the construction of two holding roads on or near Kooragang Island in the short-term, with a further two to be considered depending on the final solutions adopted for NCIG Stage 2 and the fourth dump station / fourth terminal for PWCS.

Since that time, 'congestion' has become an increasing source of concern and discussion. The HVCCC is continuing to look at the issue from a whole of system perspective to develop recommendations for optimised mitigation measures.

In the meantime ARTC has done a further review of the issue, with a specific focus on the effects of dump station / stacker stream failures, and the effect of random variation in the times that trains present to the ARTC network from load points.

This analysis has concluded that when a dump station fails the key requirement is to be able to bypass any trains for that dump station that are already queued, and to be able to hold out of the way the three to five loaded trains that are likely to have commenced their journey during the time that the dump station stream is down. It also identified that even with seven dump stations, the probability of two failing simultaneously is small at the mean time between failure (MTBF) and mean time to recovery (MTTR) rates that the HVCCC has identified as appropriate targets.

The analysis of natural variation identified that the projected growth in the task is unlikely to have a large impact on the amount of resequencing required. The level of variation in the time that trains present to the network has a much larger impact, and better control of this variability could achieve significant reductions in the amount of resequencing required. Under current forecast volume and variability, the

overwhelming majority of trains would only need to bypass one or two other trains to be correctly positioned in the queue.

These conclusions reaffirm that the recommendation of the 2009 – 2018 Hunter Valley Strategy, that between 2 and 4 holding roads are required, was valid, though this depends on the assumption around the future level of variability of trains presenting to the network and the MTTR and MTBF rates.

Specifically, three holding tracks should be able to accommodate all but around 2% - 4% of the resequencing moves required up to around 180 mtpa, and address the resequencing required when used in conjunction with the Whittingham – Maitland third track and loops beyond Muswellbrook for holding back trains affected by a failure.

Therefore the strategy recommends the construction of 3 holding tracks at Hexham. As volume moves above 200 mtpa, there is an increasing justification for a fourth holding track.

The HVCCC is undertaking more 'whole-of-system' modelling to validate the number of holding tracks required at Hexham, which will be used to help determine a final proposal for industry consideration.

Kooragang Island Configuration

As noted in the context section, NCIG Stage 2, the potential fourth dump station and potential Terminal 4 create a number of significant challenges for the configuration of the network on Kooragang Island.

From ARTC's perspective, these issues revolve around two considerations:

- As already discussed under congestion, there is a need for holding tracks to be built in the vicinity of the port. These could either be independent and off the Island, or they could be integrated with the terminals.
- The volume of trains into NCIG under stage 2 requires a grade separated junction. Depending on the terminal configuration and volume, the same may be true of Terminal Four.

ARTC's site investigations for the holding tracks suggest that there are no good sites for construction of these tracks. ARTC's analysis has concluded that the best available option is at Hexham, where it is believed that up to five tracks could be built, largely on land leased by ARTC with a small sliver of land currently owned by QRN also needing to be acquired.

None of the potential sites on Kooragang Island are likely to be straightforward from either a construction or environmental perspective. However, it is understood that current Terminal 4 planning may open-up an opportunity for additional arrival roads to be constructed for KCT, with the environmental issues addressed in the context of the larger project. At this stage though this option is too speculative and the timing of construction potentially too late to justify delaying the Hexham solution.

In regard to the at-grade junctions, there are essentially two options. The long-standing position is that NCIG Stage 2 should provide for the KCT outbound track to fly-over the NCIG arrival roads.

The alternative is to construct a new outbound track around the outside of NCIG. This would effectively mean that NCIG would be on the inside of a larger loop, effectively eliminating the at-grade junction. This also has the advantage that the existing outbound track from PWCS could be reconfigured as a second inbound track.

Ultimately these issues and the preferred solution are a matter for the terminal operators and their shareholders. While ARTC sees advantages in the second option (the loop around NCIG with the current outbound track becoming a holding road) rather than the flyover solution, it is understood that current plans are likely to preclude that option.

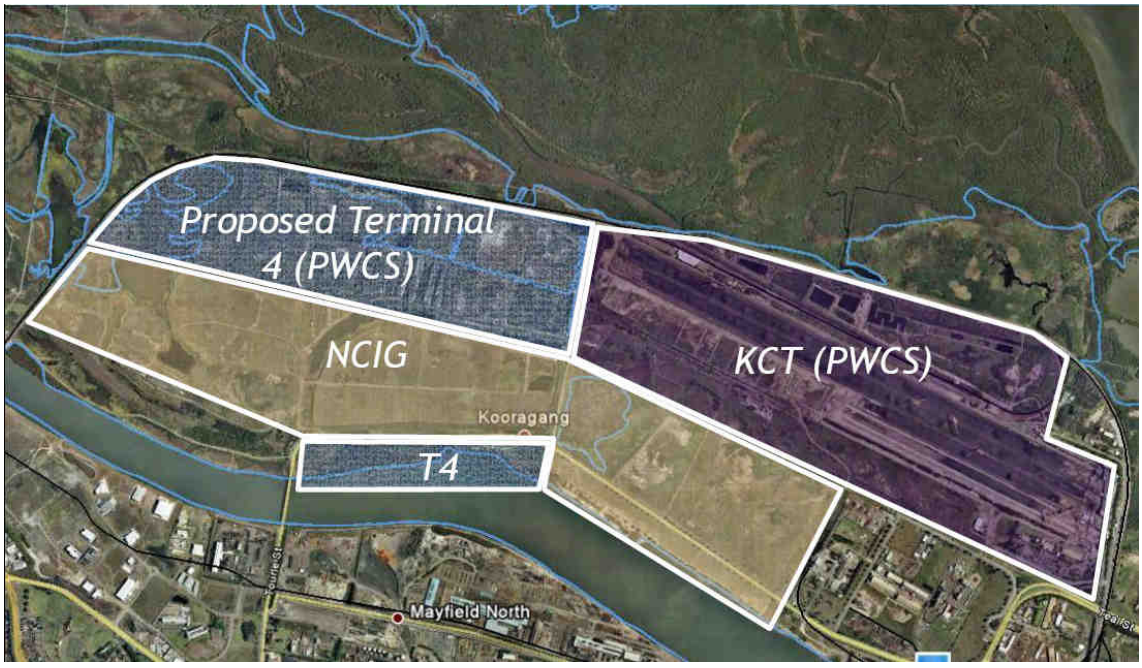

Figure 9: PWCS Terminal 4 site

4

Increasing capacity between Maitland and Muswellbrook

Context

The major issues affecting the line between Maitland and Muswellbrook are:

- Headways
- Junctions
- Continuous flow of trains

Headways are fundamentally a function of signal spacing and design. Drivers should ideally only ever see a green signal, so that they do not slow down in anticipation of potentially encountering a red signal. To achieve this outcome, a train needs to be at least 4 signals behind the train in front so that the signal a driver encounters, and the next one beyond, are both at green. Signal spacing also needs to take into account train speed and braking capability. Signals need to be spaced such that a train travelling at its maximum speed and with a given braking capability can stop in the distance between a yellow and a red signal. In some cases these constraints start to overlap, in which case it becomes necessary to go to a fifth signal, with a flashing yellow indication, between trains.

Ideally, headways on the whole corridor from Muswellbrook to the Port should be consistent so that trains can depart at regular intervals, and as additional trains join the network they can slot in to a spare path without impacting a mainline train. Given projected volumes, and hence train frequency, this headway target needs to be around 8[2] minutes. This has been tightened from the 10 minute frequency proposed in early Hunter Valley Strategies.

While this principle has been adopted in the signalling design for new works, there have not as yet been any specific projects directed at reducing signal spacing. At this stage effective headway is at around 8 minutes south of Whittingham, but increases further up the line. Spacing is as high as 16 minutes in the vicinity of Drayton Junction.

There are three major banks (sections of steep grade) on the Muswellbrook - Maitland section that particularly affect the headways for trains; Nundah Bank, Minimbah Bank and Allandale Bank (Figure 10). The steep grades on these banks slow down trains to such an extent that it is not possible to obtain an adequate frequency of trains irrespective of how closely the signals are spaced. This requires a third track to be constructed at the banks.

2. Signal clearance times depend on the length and speed of trains, so there is no single absolute number for actual signal spacing.

The third track on Minimbah bank has been completed. Nundah bank will become a capacity constraint in 2013 and is discussed in more detail below. Allandale bank is relatively modest and is effectively being triplicated by the Minimbah – Maitland third track project, also discussed below.

There are numerous **junctions** on the Hunter Valley rail network where train conflicts at the at-grade interfaces impact on capacity (Figure 11).

The connection between the main lines north of Maitland and the main lines to the east is through a set of old slow-speed high-maintenance turnouts. There are also a number of similar turnouts on the city side of Maitland. The main issue this raises is the amount of possession time required to maintain these turnouts. Congestion is also exacerbated by the slow speed turnouts, but at current forecast volumes this is manageable. There is also a small amount of conflict with Austar trains off the South Maitland Railway branch line.

Whittingham junction turnout speeds were upgraded to 70 km/h in conjunction with the 80 km/h approach to Minimbah bank project, and the junction now has a three track configuration as a result of the Minimbah bank third track project. This allows loaded trains to exit the branch without needing to find a slot between mainline trains. Accordingly this junction is now highly efficient.

Mt Owen and Camberwell Junctions have slow speed turnouts. Camberwell Junction will be upgraded to high speed turnouts in conjunction with the Nundah bank third track project. The modest volume from Mt Owen means that its junction does not have a significant impact on capacity.

Since the last Strategy, Newdell Junction has been upgraded with high-speed, low maintenance turnouts. While this was primarily maintenance driven, the speed upgrade means that this junction is now highly efficient.

Drayton Junction has slow-speed high-maintenance turnouts. While the main short-term issue is the unreliability, cost and possession time for maintenance of these turnouts, the significant forecast volume growth from the Drayton branch will place increasing pressure on this junction.

With the strong growth of coal volume from both the Ulan and Gunnedah basin lines, the junction of these two lines at Muswellbrook will come under increasing pressure

A key issue for efficiency at the port is the need for the dump stations to receive a **continuous flow of trains**. When the flow of trains at the dump station is interrupted, this creates a direct unrecoverable loss of coal chain capacity, except to the extent that maintenance downtime can be aligned. A critical consideration for the coal chain as a whole is therefore maximising the continuity of

trains rather than simply total track capacity.

The main factors that interrupt the continuous flow of trains are maintenance possessions and incidents, as discussed in detail in Section 3.

The following sections discuss in turn each of the major projects arising from these issues:

Minimbah—Maitland Third Road

The long section of track between Minimbah and Maitland carries the highest volume on the Hunter Valley network and is constructed on relatively poor formation. As a result it requires a significant maintenance effort, which is a major contributor to interrupting the continuous flow of trains. The bi-directional signalling project completed in 2009 eased the effect of maintenance on this section, but as volumes grow it becomes increasingly difficult to make use of the opposing direction track.

To provide a better solution, a third track between Minimbah and Maitland, connecting to the Minimbah bank third track, was proposed. Though this track is technically not required for capacity purposes, it provides the least cost method of providing incremental capacity to the network from an holistic perspective. In addition, it will provide valuable opportunities to queue and resequence trains during disruption.

This project has now moved with industry support into Phase 5. Following a review of the scope as part of Phase 2, a decision was taken to move forward on the basis of a reduced scope that provides for two sections of third track, excluding the section between Greta and Branxton. The excluded section is approximately 5.5km long and eliminates the need for costly work at both Greta and Branxton Stations and associated track slews, as well as the replacement of the Nelson Street Bridge. The third track has also been cut back by 1.2 km at the Maitland end, to the north of Wollombi Road. This removed the need for a significant bridge over Wollombi Road and Stoney Creek, a retaining wall, and a significant relocation of the Jemena Gas main. The sections where a third track is not going to be built will have the existing loaded direction track upgraded as part of the scope so as to minimise the requirement for maintenance going forward.

The project will now be delivered in stages (Minimbah – Branxton and Greta – Farley) with capacity available from Q4 2012.

Nundah Bank

Nundah Bank, approximately 10km north-west of

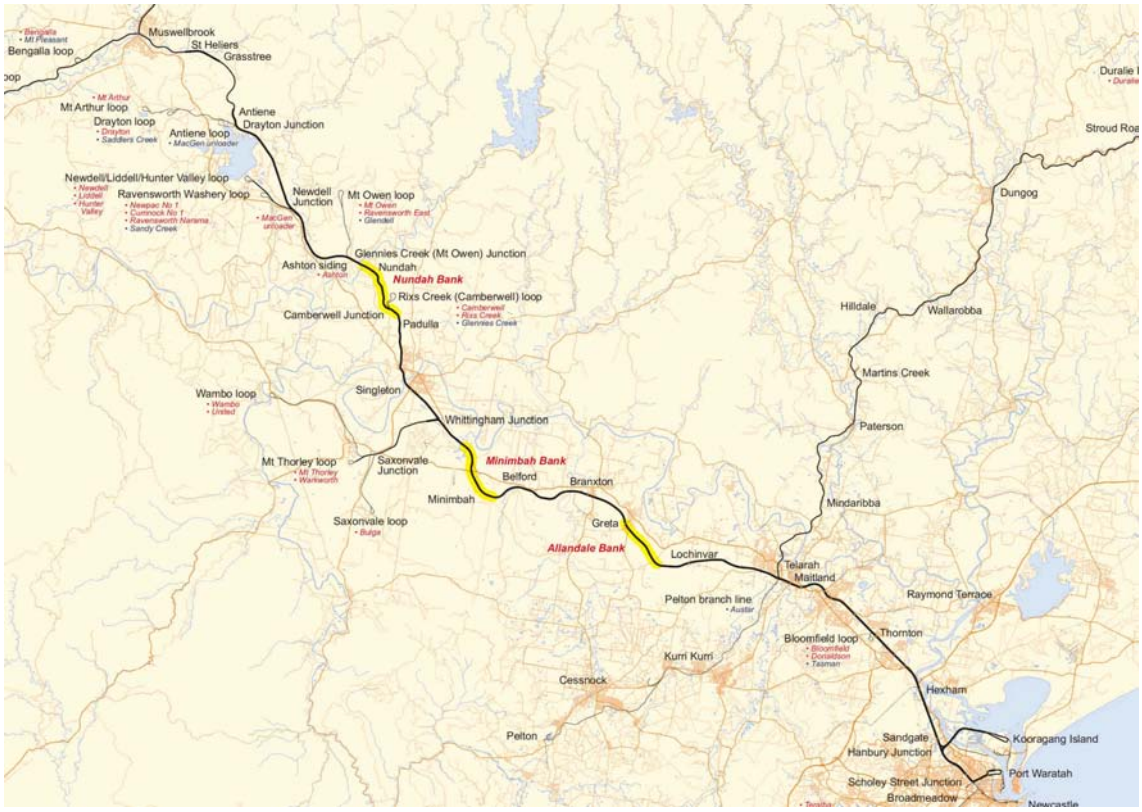

Figure 10 - The Nundah, Minimbah and Allandale Banks.

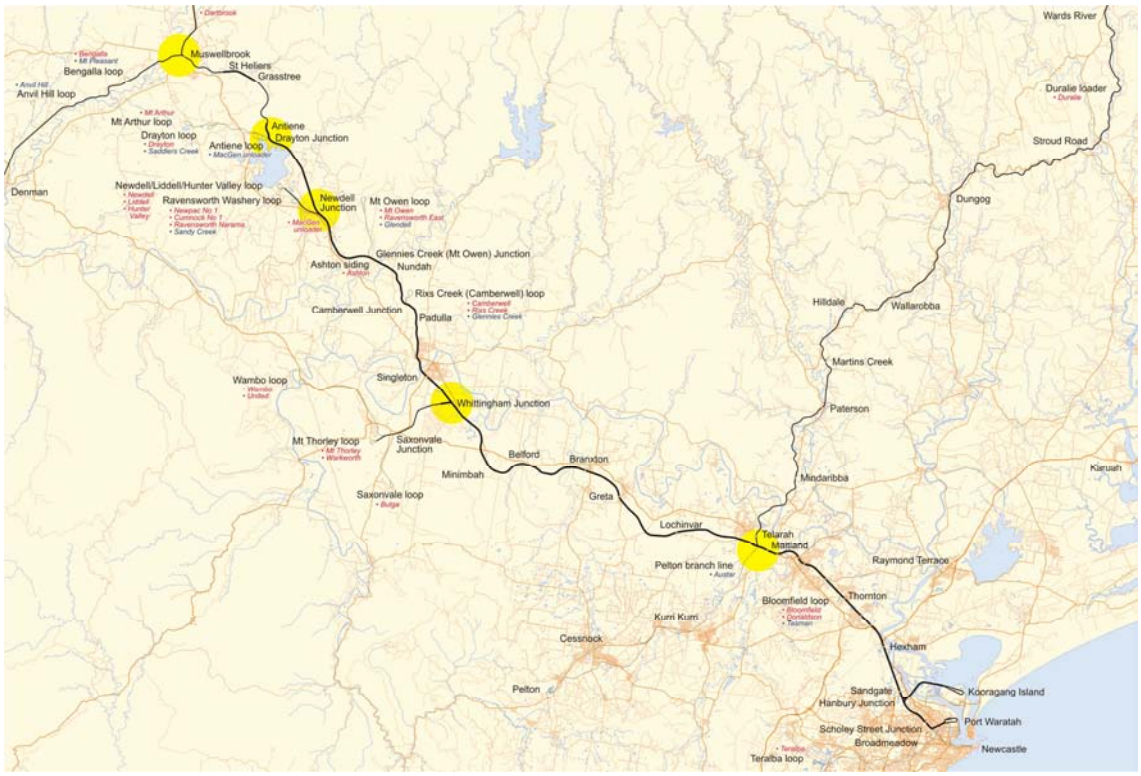

Figure 11— Maitland, Whittingham, Newdell, Drayton and Muswellbrook Junctions

Singleton, has been identified as a future constraint on the network due to the steep rising grade on the Up (loaded direction) track, which results in large headways.

Two options are available to increase capacity on Nundah bank:

- Re-signalling of the current track to reduce signal spacing.
- An additional (third) track.

Provision of a third track will allow alternate trains to be directed to opposite tracks, effectively doubling the capacity. This option would also:

- Allow two trains to be on the grade without the risk of the second train needing to come to a stand.
- Provide greater recovery flexibility if a train stalls on the grade.
- Reduce the impact of the capacity "shadow" caused by passenger trains, by allowing passenger services to overtake coal trains on the grade, where the speed differential is greatest.
- Permit re-sequencing of coal trains if this is required.

The alternative option of resignalling was rejected as it would have only provided a temporary solution and carried significant risk.

The project is scheduled for opening in November 2012.

Drayton Junction

The previous Strategy proposed that Drayton Junction be renewed with 1:18 turnouts, raising the junction speeds for trains moving onto and off the branch line from 25 km/h to 60 km/h.

With further research and analysis, it was concluded that a better short-term solution was to improve the condition of the existing turnouts, which also allowed the speed for trains exiting the branch to be increased to 40 km/h. This has allowed the turnout upgrades to be deferred till Q1 2013.

Indicative contractual nominations from the Drayton branch are expected to increase significantly as the Mount Arthur North mine expands. BHP is currently assessing options for its mine loading facilities and this may have implications for the branch and the junction. The deferral of the Drayton Junction upgrade project will allow alignment of the junction upgrade scope with coal producer requirements.

Muswellbrook Junction

In the medium term, the continuing growth from both the Ulan and Gunnedah basin lines means that the capacity of the at-grade junction at Muswellbrook will become stretched. The 2009 – 2018 Strategy noted that this issue required further detailed modelling, but that a solution was likely to be required as volumes exceed 100 mtpa at the junction.

Current indicative contractual nominations fall short of 100 mtpa at Muswellbrook, but some 'order of magnitude' theoretical analysis of the junction at forecast peak volume has been undertaken. At this peak volume there will be an average of 24 trains per day from the Ulan line. While coal volumes from the Gunnedah basin line are smaller, train numbers are also 24 due to the smaller average train size and the volume of passenger and general freight trains.

This 'order-of-magnitude' analysis identified three primary issues:

- Southbound trains arriving at the junction from each branch are likely to conflict with southbound trains from the other branch 20% of the time and to be delayed for an average of 6 minutes.
- Northbound trains for the Ulan line are likely to experi-

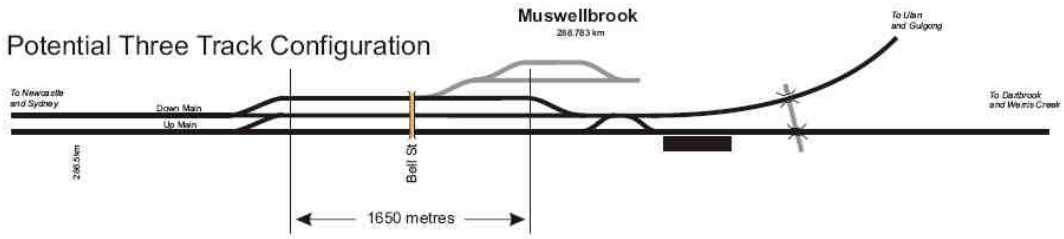

Figure 12— Muswellbrook Junction Configuration

ence a conflict with a southbound Ulan line train, or be held behind a delayed Gunnedah basin train, a total of 16% of the time and to be delayed for an average of 10 minutes.

- Northbound trains for the Gunnedah basin line are likely to conflict with a southbound train from the Gunnedah or Ulan lines, or to be held behind a delayed northbound Ulan line train, a total of 20% of the time and be delayed an average of 10 minutes.

These delays do not include train stopping and starting time, which can add up to five minutes.

While these levels of delay are material, they do not reach a level where they are likely to have a major negative impact on capacity, or the efficient operation of the coal chain.

On this basis it would be possible to do nothing at Muswellbrook for indicative contractual nomination volumes.

However, the HVCCC has floated the concept of having some holding / resequencing capacity in the vicinity of Muswellbrook. This relates to the issue of congestion discussed in Chapter 3. While ARTC leans to the view that the proposed Hexham holding roads and the resequencing capacity provided by the Nundah and Whittingham – Maitland third tracks is likely to be adequate to address the congestion issues, it is also true that additional capacity at Muswellbrook must necessarily create benefit.

Accordingly, a configuration for Muswellbrook that combines a three track junction with capacity to hold a loaded coal train from either branch has been developed, as shown in figure 12. It is proposed that this configuration be subjected to further feasibility analysis and costing to determine whether the cost is justified by the operational flexibility it would provide.

A conceptual design for a flyover in Muswellbrook has also been developed. However, while the flyover design allows for reduced congestion and delay, it offers less flexibility for resequcncing trains and is unlikely to be attractive until volumes significantly exceed current indicative contractual nominations. There are also likely to be significant environmental challenges with a flyover solution.

There is also a long-standing concept to bypass Muswellbrook by connecting the Drayton branch to the Ulan line in the vicinity of Bengalla. This would reduce the volume of trains through Muswellbrook and shift the junction conflicts to the less built-up area at Drayton. The increased volume at Drayton may require grade separation of this junction. A high-level review of the feasibility of this concept, particularly in the context of BHP's upgrade of Mount Arthur North, is being undertaken, and indicative costs developed to determine whether it warrants further consideration.

Maitland Junction

ARTC is currently undertaking an holistic review of the Maitland Junction area to identify the optimum track configu-

ration. The primary issues at Maitland are related to the maintenance of the old slow-speed turnouts and accordingly the primary focus of the review is the most effective way to replace these turnouts with low-maintenance high-speed units. The secondary objective is to leverage this renewal to increase capacity by improving train speeds and reducing crossing conflicts.

In the meantime, a project to replace the old Maitland relay signalling with computer based interlocking has been commissioned. This project will make the upgrade of Maitland Junction cheaper and less risky.

Nundah - Whittingham

The 2009 – 2018 Strategy commented that longer-term consideration should be given to building a third track of approximately 10 km between the top of Nundah bank and Whittingham Junction, to provide a continuous three tracks from Nundah bank to Maitland. While this section does not constrain capacity, it does impose material additional delay.

The delay associated with this section arises primarily from the prospective volumes. With the move to clarity between indicative contractual nominations and prospective volumes, this project no longer forms part of the required scope of work. As prospective volumes firm up in the future it is a project that will deserve reconsideration.

Proposal

It is proposed that:

- The Minimbah – Maitland third track be completed in two stages by Q1 2013 to minimise the impact of possessions on the continuous flow of trains to the port and provide resequencing opportunities.
- A 4.26 km third track be constructed on Nundah bank, to reduce headways to 10 minutes or better, with completion by Q1 2013.
- Drayton Junction be upgraded with high-speed swing-nose turnouts, with completion targeted for Q1 2013, but with timing to be kept sufficiently flexible to allow alignment with any upgrading work undertaken on the private Drayton branch .
- A three track configuration be further considered for Muswellbrook, with completion potentially by 2014.
- An holistic solution for Maitland be developed to reduce the impact of maintenance, with consequential benefits for capacity to be exploited.

5

Increasing capacity between Muswellbrook and Ulan

Context

The Ulan line extends approximately 170 km, between Muswellbrook in the upper Hunter Valley, and Gulgong, west of the Dividing Range (Figure 13).

It is a single track line, with passing loops at Mangoola, Yarrawa, Sandy Hollow, Kerrabee, Baraemi, Murrumbo, Bylong, Coggan Creek, Wollar and Ulan (though the Ulan loop is only 980 m). The line was upgraded from electric staff working to CTC during 2007/08.

Although the line is used mainly by coal trains, it is also used by one or two country ore and grain trains per day and occasionally by interstate freight trains that are bypassing Sydney during possessions. The line services long-standing mines at Bengalla and Ulan. The Wilpinjong mine has recently commenced operation.

Three new mines, Moolarben, Mangoola (formerly Anvil Hill), and Mount Pleasant are expected to start up over the next few years. Another new mine at Cobbora, approximately 33 km north-west of Gulgong, has been proposed and may produce coal suitable for domestic power generation by 2013. The Cobbora Coal Project is a NSW government initiative and is linked to the privatisation of the NSW electricity industry. Recent issues with both the privatisation and Cobbora mine have made the future of this project uncertain. Domestic and export coal volumes advised by the proponents have been included in the prospective volumes. Another new mine in the vicinity of Bylong, Mt Penny, has recently moved into the planning phase.

The mines on this sector are clustered either at the start of the line near Muswellbrook (Bengalla, Mangoola, Mt Pleasant) or at the end of the line around Ulan (Ulan, Wilpinjong, Moolarben, Mt Penny). This gives rise to a long section in the middle with homogenous demand.

Coal demand on the line is forecast to increase rapidly for both export coal and for domestic coal to Hunter Valley power stations, in particular the new Antiene unloading loop.

The construction of additional loops and CTC in recent years has allowed the line to accommodate growth to date and places the line in a good position to meet demand to

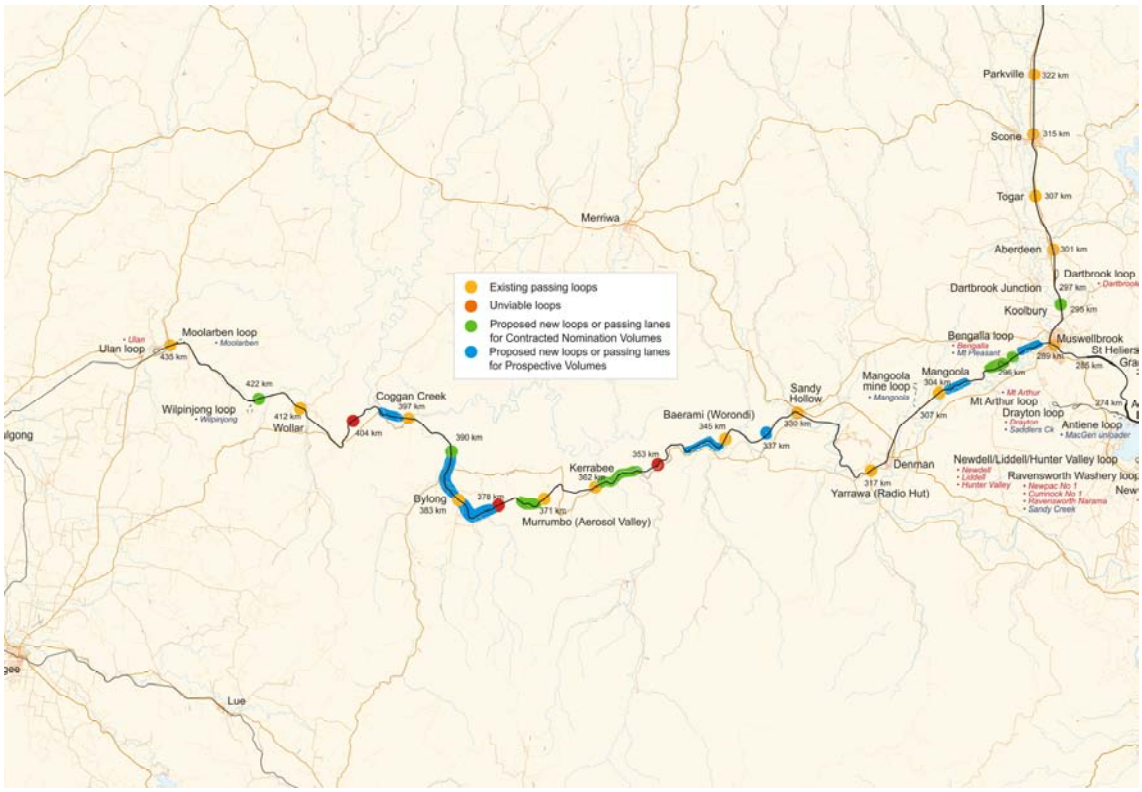

Figure 13: - Ulan Loops

Q1 2012. At that time, the line becomes constrained at each end. Any further growth would place pressure on the capacity of the middle section.

Since the last Strategy, all section running times have been re-simulated using the latest actual end points for the newly constructed loops, and a set of benchmark trains that reflects the new rollingstock now being delivered into the system.

Proposed loop locations in the 2009-18 Strategy were based on optimisation of section running times and were nominal only, as no site investigations had been undertaken. The Ulan line has some difficult geography which constrains the location of loops. As sections become shorter, the scope to adjust the location of the loop declines. Accordingly, as investigation of nominal sites has progressed, it has become necessary to consider alternative solutions. Specifically, in some cases it will probably be necessary to construct "passing lanes", which are effectively short sections of double track. These will necessarily be materially more expensive than straightforward loops.

An unusual capacity constraint is posed by the ventilation in the tunnels on the Ulan line, in particular the Bylong tunnel. Although the line only opened in 1982, the four tunnels were built as part of the original uncompleted construction of the line which commenced in 1915. Accordingly the tunnels were built to a relatively small outline and ventilation in the tunnels is a problem. Train spacing and track maintenance are limited by the 'purge times' for air in the tunnel. Current loop spacing limits following loaded trains to operating at around 45 minutes apart and opposing loaded and empty trains to around 24 minutes apart. However, an operating rule currently limits trains to operating at a 30 minute minimum frequency. There is a critical need to move beyond this limitation by investing in operating or investment solutions.

This analysis of the Ulan line assumes that there is no change to the current pattern of limited background (non-coal) trains on this line.

The following sections discuss each of the key investment solutions.

Additional Passing Loops / Passing Lanes

Additional passing loops represent the main mechanism to deliver further incremental increases in capacity on the line.

The 2009 – 2018 Strategy identified a requirement for up to 9 additional mid-point loops on the Ulan line as follows:

By 2010	By 2011	By 2012	By 2013	By 2014
Yarrawa		Bengala	390 km	404 km
		Wilpinjong	353 km	Mt. Pleasant
		337 km		
		378 km		

Table 2 - Proposed Loops, 2009-2018 Strategy

As already noted, topography issues with several of these nominal sites make them problematic from an engineering/cost perspective. Additionally, there are practical operational considerations with several of these mid-point proposals where they produce short remnant single track sections. As such, a more detailed assessment has been undertaken of each line section to identify practical capacity improvement solutions.

At the Muswellbrook end of the line there is expected to be large growth with the Bengalla mine being joined by Mount Pleasant and Mangoola. The Muswellbrook – Bengalla section is only 5.5 km long and would most logically be enhanced by double tracking rather than by splitting the section with a loop. However, as this section is built across floodplain the cost of double-track proved unjustified for the operational benefit it would deliver in the short-term. Accordingly, a single loop toward the Bengalla Junction end is the preferred solution and is currently under construction with the target of being commissioned by Q4 2011.

To accommodate prospective volumes a further reduction in the section length would be required. To achieve this it would be proposed to extend the loop two kilometres towards Muswellbrook, which will result in this section being effectively double tracked, other than across the Hunter River into Muswellbrook.

The 2009-18 Strategy proposed a loop on the short section between Bengalla Junction and the proposed Mount Pleasant mine junction. The requirement for this loop was primarily driven by the development of the large Mt Pleasant mine. It is understood that the preferred solu-

tion for loading at this mine is now to use the Bengalla balloon loop.

With this change, the Bengalla – Mangoola section capacity falls just short of peak indicative contractual nominations, with this shortfall occurring in Q1 2014.

To address the shortfall the most likely solution is to extend the Bengalla loop approximately 1 km westward, taking it beyond Bengalla Junction. Retaining the connection into the mine off both tracks would allow this loop to be used to both cross two Bengalla trains, and have a train for mines to the west access the loop while a Bengalla train was entering or exiting the mine, making this a very flexible arrangement.

In the case of prospective volume there is a requirement to further shorten the section between the Mangoola and Bengalla loops. This section, at around 11 km, is becoming short, raising questions about the operational effectiveness of it being split with an additional loop. The option to further extend the Bengalla loop towards Mangoola is proving expensive from a constructability perspective. The better option may be to extend the Mangoola loop approximately 2.5 km eastward in the event that the prospective volumes eventuate.

The loop at Yarrawa (formally known as Radio Hut) has been completed. However, due to topographical constraints it was built closer to Denman than originally proposed. This has left a longer section from Yarrawa to Sandy Hollow than previously expected. The existing configuration provides capacity that is borderline with indicative contractual nominations from 2013.

Significant additional capacity can be provided by duplicating 1.5km westward from Yarrawa. Another option that has been identified is to build a bypass around Denman, starting at 306.89 kms, heading west, and re-joining the original track at 327.13kms, just short of Sandy Hollow. This option would reduce the transit time, reduce fuel consumption and increase the track availability, culminating in improved capacity for the line. The bypass option provides more benefits than extending the loops, but requires further investigation to determine whether it is commercially justified. Given that capacity on this section is borderline at indicative contractual nominations, the Strategy does not make provision for any further investment in this section, but the bypass option will be subjected to further analysis to assess its suitability for providing the next increment of capacity.

The current infrastructure between Sandy Hollow and Baraemi is adequate to meet indicative contractual nominations. The modelled capacity falls short of prospective demand from 2013. The mid-point loop at nominally 337 km is physically feasible to construct and provides sufficient capacity to meet forecast prospective volumes to 2018. If the mid-point loop proves operationally undesirable, then an alternative for consideration is to duplicate eastward from Baraemi loop to approximately 337.55km.

The 2009-2018 Strategy provided for a loop at nominally 353 km to break-up the Baraemi – Kerrabee section. It is not considered feasible to construct a standard loop at the nominal mid-point location, due to tight track geometry and adjacent topography (high rock cutting on the Up side and steep embankment on Down side falling to the Goulburn River). The current capacity is insufficient for indicative contractual nominations or prospective demand beyond 2013. The options are an asymmetrically positioned loop at 354.6km to 356.4km, or a 4.2 km eastward extension of Kerrabee (from 361.5 km to 357.3km) to form a passing lane. For prospective volumes it will be necessary to further reduce the section. This would necessarily be by track duplication from Baraemi, with the most likely solution identified as approximately 5.4 km of duplication.

The notional mid-point loop at 378km on the Murrumbo – Bylong section is not feasible as it sits in part in the Bylong tunnel. Even if moved 500m westward, clear of the tunnel, it would not be viable as the Up trains would be starting from the loop on the ruling 1:80 grade. The alternative options being investigated are a loop at 373.1km to 374.9km and a passing lane from Murrumbo (371.2km) to 374.9km. A solution to ease capacity constraints is required by Q1 2014 for indicative contractual nominations.

For prospective volumes it will be necessary to also extend Bylong loop toward Bylong tunnel. However, there is limited distance for such an extension before reaching the 1 in 80 grade. It will almost certainly be necessary therefore to construct a passing lane on a new alignment with a rising grade from approximately the current end point of the Bylong loop. This would allow the new loaded direction track to crest around 1 km before the western portal of Bylong tunnel so that loaded trains were starting on a gentle grade when averaged across the train. It would also mean that trains could shut-off power as they entered the tunnel, significantly helping with the tunnel ventilation issue.

A mid-point loop at 390km is feasible from an engineer-

ing perspective and provides sufficient capacity to meet indicative contractual nominations. It is borderline for prospective volumes. From an operational perspective, the loop creates short sections on either side. An alternative is to duplicate westward from Bylong to 390km. This will provide sufficient capacity for both prospective and indicative contractual nomination volumes. There are no obvious engineering concerns for this duplication option. Both options are currently being investigated.

The Coggan Creek to Wollar section provides sufficient capacity to accommodate the indicative contractual nominations. Thus, the proposed nominal 404 km loop is not required in the short term. Under the prospective volumes scenario, current capacity falls short of demand from 2013. Extensive grade easing would be required for a crossing loop at the nominal location as the existing track gradient is -1:46 for trains in the Up direction which is too steep to stop a loaded train with confidence. The construction of a passing lane extending westward from Coggan Creek to approximately 403km provides another option to meet the prospective demand and would be required by 2014.

The proposed loop at Wilpinjong (422.18 - 420.31km) remains viable and provides 50mtpa capacity between Wollar and Ulan, which is sufficient for all indicative contractual nomination and prospective volumes. It is proposed to be constructed by Q1 2012.

If the volumes from the Cobbora mine do eventuate, the existing Ulan loop would need to be extended westward to a full 1.8 km length by Q1 2014.

Tunnel Ventilation

The tunnel ventilation issue remains under investigation. Air quality testing has progressed and is now being analysed to determine the scale of the issue and the potential mitigation measures.

A further review of options has been completed, with the key options being:

- Management of the issue through more sophisticated operational practices based on real-time air quality monitoring.
- A portal fan system to flush the tunnel.
- Changes to train consists to reduce the generation and distribution of pollutants.
- Tunnel duplication together with double track from 374.9km to Murrumbo. This would provide for current and prospective volumes as well as addressing the ventilation issue.
- Duplication on a grade-eased alignment from Bylong Loop to the western portal, with a view to minimising the ventilation issue as trains would be able to coast though the tunnel on minimum power. This concept is also discussed under options for Bylong loop above.

No decision has been made on a preferred way forward. However, better management and the portal fan system are the most cost effective solutions in the short to medium term. In the longer term, duplication from Bylong to the western tunnel portal on a new alignment has attractions for its additional capacity benefits, but this is not a low-cost solution.

It is a desirable for a solution to be in place by Q1 2012, though the issue could continue to be managed until Q4 2012. ARTC will have a more detailed understanding of the options, based on detailed air quality monitoring, by mid-2011.

Increasing Train Speed

The default solution for increasing capacity is to build additional loops or track. However, there is also an option to reduce section running times, and hence increase capacity, by lifting train speed, and for completeness the potential benefit of this approach has again been reviewed since the last Strategy.

A 33% increase in loaded coal train speeds on the Ulan line from 60 km/h to 80 km/h would give a transit time reduction of around 15 minutes, or 8%. This is comparatively low as the tight curves and significant gradients on much of the line limit the ability of trains to make use of the increase in the maximum speed. Average section times would reduce by about 1.5 minutes. Increasing maximum speed would involve significant and costly upgrades to track condition.

Increasing the maximum permissible speed of the empty trains from 80km/h to 100 km/h does not produce any significant transit time reductions due to the constraints of curvature across most of the corridor.

Looking at the transit time effects in detail, increasing speed limits has some benefits at both ends of the line, but has no material impact in the middle sections. From a program perspective, the only effect would be to allow the proposed loop at (nominally) 353km to be deferred by one year. While this is an option, the benefit of a one year deferral is relatively small compared to the cost and complexities of increasing train speed. The preferred solution is therefore to continue with the passing lanes/loops program. If circumstances change in the future, this alternative option can be re-visited again.

Proposal

Table 3 summarises the previously nominated loops, the revised options and their ability to meet indicative contractual nomination and prospective volumes.

A preferred solution for Bylong tunnel has not yet been determined, but an initial stage solution is desirable by Q1 2012 with a potential second stage solution in the future as volumes increase further.

Nominal Loop	Indicative Contractual Nomination Volumes	Prospective Volumes
Wilpinjong	Viable as a loop, Required by Q1 2012	Requirement met with proposed loop
404 km	Not required	Passing lane from Coggan Creek westwards to 403km
390 km	Viable as a loop, Required by Q1 2013	Duplicate track westwards from Bylong to 390km
378 km	Mid-point loop not feasible, options are loop at 373.1km to 374.9km or passing lane from 371.2km to 374.9km; required by Q1 2013	Passing lane from western portal of Bylong tunnel to Bylong loop
353 km	Loop not feasible due to topography & track geometry, proposed passing lane from 357.3km to Kerrabee or loop at 354.6km to 356.4km; required by Q1 2013	Track duplication 5.4 km westward from Baerami
337 km	Not required	Mid point loop or track duplication eastward from Baerami loop to 337.55km
Mt Pleasant	Extend Bengalla loop westward to beyond Bengalla Junction	Track duplication 2.5 km eastward from Mangoola
Bengalla	Viable as a loop, required by Q1 2012	Passing lane from Bengalla loop eastward to near the Hunter River (289.7km)

Table 3 - Revised options for loops

6

Increasing capacity between Muswellbrook and Narrabri

Context

The single-track Muswellbrook–Werris Creek–Narrabri line is highly complex.

In addition to its coal traffic, it carries passenger trains (CityRail services to and from Scone and CountryLink services to and from Moree and Armidale) and a proportionately high level of grain, cotton and flour train activity. This 'background' traffic is up to 10 trains each way per day as far as Scone, then up to seven each way to Gunnedah and six each way to Narrabri.

Coal demand on the line has already increased significantly and is forecast to continue to increase very rapidly. Considerable increases in capacity will be needed to accommodate this growth.

There are now four coal train origins and destinations along the route, at Werris Creek, Gunnedah, Boggabri and Turrawan[3]. Three major new mines are proposed for the Gunnedah basin: Caroona, Watermark, and Maules Creek. For the purposes of the Strategy it has been assumed that if these projects proceed Caroona and Watermark will load from new load points in the vicinity of Watermark (35kms south-east of Gunnedah). Maules Creek is assumed to load at the existing Boggabri loader. To the extent that the actual load points vary it may require some adjustment to the extension of loops in the immediate vicinity

The Ardglen bank, crossing the Liverpool Range, is a particular impediment on this corridor. The severe grades on the short section between Willow Tree and Murrurundi dictate limits for train operations on the whole Werris Creek to Newcastle route. The need to use 'banker' locomotives for loaded coal and grain trains on this section means it will reach its capacity limits earlier than the rest of the line, because the return of the 'banker' locomotives adds a northbound train path for each southbound coal or grain train, though this is mitigated to some extent by the ability of bank engines to use the short loop at Kankool.

The existing passing loops on the Muswellbrook–Narrabri route (Figure 14) have highly variable lengths.

Figure 14: - Muswellbrook to Narrabri Loops

3. The Dartbrook mine is currently closed but may reopen during the course of this Strategy

Many are around 650–750 m, some are as short as 400 metres and there is an increasing number of 1350 m – 1450 m loops developed to accommodate the increase in train length to 1250 metres.

The track north of Dartbrook is only rated for 25 tonne axle loads (i.e. '100 tonne' wagons), compared to 30 tonnes on the rest of the network.

All of the network carrying coal is CTC controlled.

The Gap - Narrabri section of the route is managed by ARTC on behalf of the NSW Country Regional Infrastructure Authority (CRIA), and decisions on investments in this section have been a matter for CRIA. However, ARTC has now decided to exercise an option to include this line in its lease network and anticipates taking direct management control on 1 July 2011.

Liverpool Range

In 2007 ARTC completed a study looking at options for a new rail alignment across the Liverpool Range in the vicinity of Ardglen. This report assessed four tunnel options and two surface alignment options as well as duplication of the existing alignment. The tunnel alignments connect Willow Tree to Murrurundi while the surface alignments would connect Willow Tree to Ardglen (and would include the duplication of the existing track section between Ardglen and Murrurundi). In June 2010, ARTC completed a re-evaluation of the various options for the new alignment and their costs to bring them into line with contemporary data.

The different options for the Liverpool Range alignment identified and evaluated by ARTC include:

- 'Surface options' that are new alignments with reduced grades on the Western side of the Range and make use of the existing tunnel at Ardglen.
- 'Tunnel options' that are new alignments with reduced grades on both sides of the Range with all including a major new tunnel through the Liverpool Ranges at a lower elevation than the existing tunnel.
- 'Duplication of Existing' involves the duplication of the existing track using essentially the same grades and geometry as the existing alignment.

The studies conducted by ARTC identified the following alignment options (Figure 15):

- Borambil Creek surface alignment
- Doughboy Hollow surface alignment
- Western Tunnel
- Central Tunnel
- Eastern Tunnel - High
- Eastern Tunnel - Low
- Duplication of Existing Track

Based on the 2010 concept assessment report and cost assessment, the three most viable alignments are:

- *Duplication of the Existing Alignment* – involves duplicating the existing track using essentially the same grades and geometry on both sides of the Range and includes making use of the existing single track tunnel at Ardglen. This option would retain bank engines. It should be noted that due to the steep and curving nature of the gradient, the staging options are limited as there are few suitable reconnection points.
- *Borambil Creek Surface Alignment* - with reduced grades (1:80) to the West of the Range that run predominantly on the surface, makes use of the existing single track tunnel at Ardglen and includes the duplication of the existing alignment to the East of the Range.
- *Eastern – High Tunnel Alignment* - with reduced grades (1:80) on both sides of the Range and includes a major new tunnel through the Range at a lower elevation than the existing tunnel.

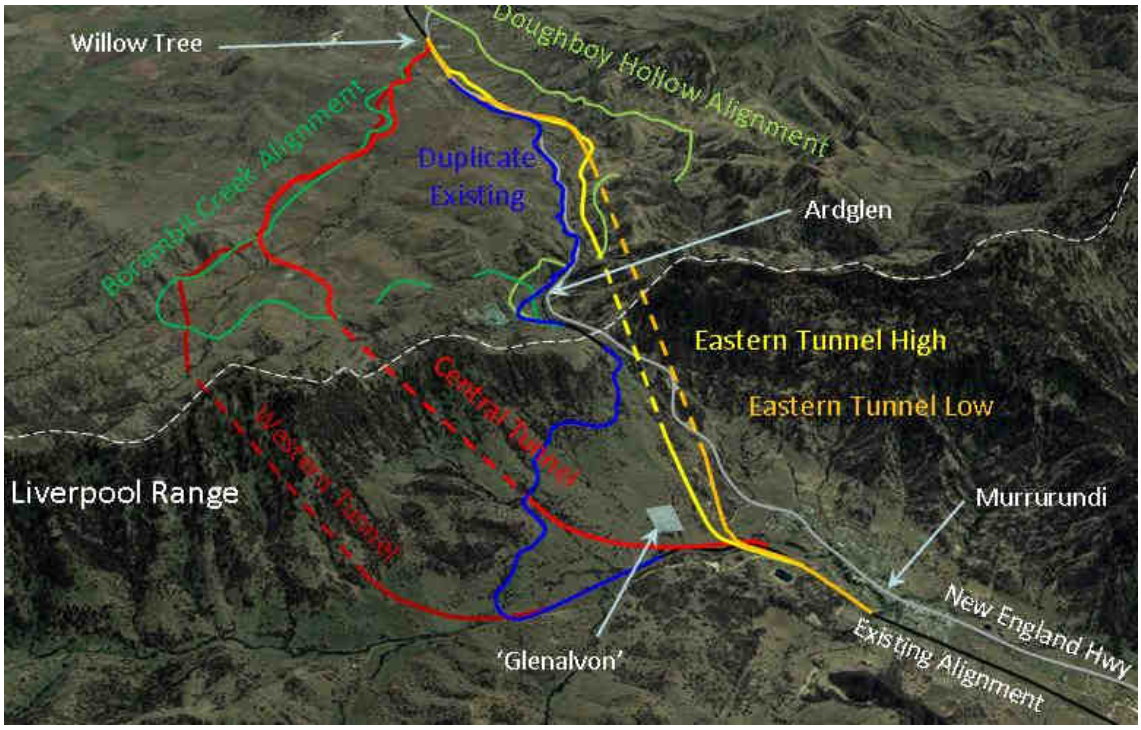

Figure 15: - Liverpool Range Alignment Options

The duplication of the existing alignment and to a lesser extent the Borambil Creek alignment can be staged. The benefit of this approach is that it allows for incremental increases in capacity and capital expenditure in line with the required capacity increases. Whilst different environmental and planning approval issues would arise with a greenfield site compared to the existing brownfield site no major issues were discovered with any of the alignments that would result in them being ruled out due to environmental constraints. It should be noted that there are different environmental costs & risks associated with each option.

ARTC and the industry agree that the preferred option is staged duplication and planning & delivery will proceed on that basis.

The Borambil Creek Surface Alignment and the Eastern High Tunnel alignment will be retained as future alternatives but no further work will proceed on them.

The current coal capacities on the section between Willow Tree and Murulla are as follows:

- Willow Tree to Ardglen – 16.0 mtpa
- Ardglen to Murulla – 12.4 mtpa

There are two options available to increase the capacity of the East side. The first option is to construct the Murrurundi Loop Extension. This was the option recommended in the 2009-18 Strategy and aside from making use of existing infrastructure, minimised the risk of stranded assets if a tunnel option was pursued for the Liverpool Range. The second option is to construct the Pages River Loop (on the country side of Murrurundi between 353.8km and 355.5km) in lieu of the Murrurundi Loop Extension.

Murrurundi loop extension delivers 21 mtpa in the Ardglen to Murulla section, which falls short of the indicative contractual nominations in Q2 2013. Pages River is required to meet capacity constraints at this time.

From a capacity point of view the Murrurundi loop extension becomes technically redundant following the construction of Pages River loop. While the loop extension will provide some flexibility for holding and sequencing coal trains and reduces the length of the section to Murulla, neither of these benefits is strictly necessary to meet the required capacity.

Timing for the Murrurundi Loop Extension was by Q1 2012. Constructing Pages River Loop in preference to Murrurundi means the capacity will not be available until Q3 2012. However, there is adequate capacity up to this point based on the latest indicative contractual nominations. ARTC is confident that building Pages River in preference to Murrurundi provides the most effective overall solution.

Following the construction of Pages River loop, the section between Willow Tree and Ardglen, on the West side, becomes the capacity constraint with a capacity of 16 mtpa. The proposed Chilcotts Creek Loop is at the base of the grade up the Liverpool Range and would become the new bank engine attach point. It raises the capacity between Willow Tree and Ardglen to 23mtpa. It is proposed to design Chilcotts Creek Loop to cater for storage of two sets of bank engines as it is likely that as volumes grow it will be necessary to introduce this second set of bankers. Chilcotts Creek Loop is required in Q4 2012.

Beyond these two projects, the following works can be implemented to meet prospective volumes:

East Side

Pages River Loop (355.5km) is planned to be extended to Pages River North (356.7km) comprising 1.2km of duplication and raising the capacity between Murrurundi and Ardglen to 31mtpa.

Duplication from Pages River North (356.7km) to Pangela (359.8km), providing section capacity of 41 mtpa

Duplication of 2.5km from Pangela (359.8km) to Ardglen Tunnel (362.3km) providing a section capacity of 61 mtpa.

West Side

Construction from Ardglen (364.7km) to Kankool (368.5km),comprising 3.8km of duplication, will provide section capacity of 49mtpa.

Construction from Kankool (368.5km) to Chilcotts Creek (371.0km),comprising 2.5km of duplication, provides section capacity of 49mtpa.

Beyond the duplication of the range, construction between Chilcotts Creek and Willow Tree and joining of the existing Murrurundi Loop to the completed duplication will increase capacity to 63mtpa. Duplication of the Ardglen tunnel would raise capacity to 87mtpa with 15min headways or 136mtpa with 10min headways, which would cap the capacity over the Liverpool Range.

Loop Extensions / New Loops

Progressive lengthening of selected existing passing loops and constructing additional passing loops will be necessary for the projected volumes to be accommodated. This process has been underway for some years now with 12 loops already extended to a nominal length of 1350 metres.

Scope and location of proposed passing loops remains as per the 2009-2018 Strategy except for the section between Braefield and Werris Creek. This was proposed to be eased by extending loops at Quipolly and Quirindi and splitting the section into three. On further analysis, it was gauged that the three sections would be closely spaced, thus losing effectiveness and reducing the capacity benefits. The alternative of building a new midpoint loop at Bells Gate, splitting the section into two, was found to provide better capacity utilisation. This alternative also provides the option of extending the loop into a passing lane in the future to enhance capacity.

The following loops and loop extensions are proposed on the basis of addressing the capacity constraint on each local section as demand requires. However, increments in volume are usually lumpy, generating a requirement for a number of projects to be completed simultaneously. This creates resourcing issues and inefficiencies for ARTC and accordingly ARTC has put to the industry a proposition that loop construction be brought forward in some cases for resource levelling, with these adjustments kept under review.

- The Parkville Loop Extension was brought forward for resource levelling and has now been completed.
- By 2012, construction of a new loop at Koolbury.
- By 2013, construction of new loops at Pages River, Burilda, and Bell's Gate.
- By 2014, the construction of new loops at Watermark and South Gunnedah.

Werris Creek Bypass

72 wagon coal trains standing in Werris Creek loop create operational complexities at Werris Creek, where a large proportion of non-coal trains need to access the yard and which is blocked by a coal train in the loop. While this can be mitigated by standing the coal train on the mainline, a longer term solution is desirable.

An opportunity exists to resolve this problem and achieve a number of other desirable operational outcomes through reopening and reconfiguration of the alternative Gap – Werrris Creek line. This line is understood to have been constructed in the 1940's to allow trains from the cross-country line from Dubbo to proceed toward Tamworth (and ultimately

Brisbane) without reversing. It fell into disuse during the 1980's but was partially reinstated in 2005 to provide the track for the Werris Creek mine coal loader.

If the line was reinstated the full way to Gap and a triangle connection established at the Werris Creek end, it would provide an effective bypass of Werris Creek. It would also give operational flexibility, with trains able to cross through the use of both lines. If a triangle connection was established at the Gap end it would also create a balloon loop configuration for use by Werris Creek coal trains.

This configuration would also have potential benefits for grain services, with the Werris Creek sub-terminal effectively located on a balloon loop for trains from both the north and the south.

A final enhancement would provide a second track for an appropriate distance either side of the Werris Creek mine coal loader, so that loading operations could be undertaken without interfering with the operation of through trains.

Since the 2009-2018 Strategy, this project has been through preliminary design and costing. The conclusion of this exercise was that the relatively high costs of the project do not justify the benefits it provides compared to the alternative of a new loop at Burilda. Accordingly, Burilda has now been given priority with completion planned by Q1 2012.

Werris Creek bypass is not required for indicative contractual nominations, but would be required for prospective volume.

Scone Reconfiguration

The passing loop at Scone is short (410 m) and has an asymmetric layout, requiring all trains to negotiate a curved turnout leg and slowing speeds through the station area to 25 km/h. Level crossings and the proximity of the town make an extension of the loop unattractive.

Passenger trains are the only services that stop at Scone. It is therefore proposed that the track arrangement at Scone should be altered to give an unrestricted run for through trains. This would save approximately 4 minutes in the section between Togar and Parkville.

Capacity in this section becomes constricted in 2013. Reconfiguration of Scone will provide sufficient increment in capacity on this section to accommodate all indicative contractual nomination volumes.

Axle Load Increase

Axle loads beyond Dartbrook are currently limited to 25 tonnes. Increasing axle loads to 30 tonnes would permit the use of 120 tonne wagons and thus increase the carrying capacity of each train. This would deliver significant cost savings as well as allowing some capacity projects to be deferred.

CRIA has recently undertaken considerable resleepering of the Gap – Gunnedah section in concrete. ARTC has commenced relaying the Dartbrook—Werris Creek section with concrete sleepers on a four year program.

ARTC is working toward providing producers with an indicative access charge increase for the introduction of 30 tonne axle loads, which will then allow them to make a commercial judgement as to its merits given potential above-rail operating cost savings and potential deferral of capacity projects. Take-up by ARTC of the Werris Creek—North Star line will considerably simplify the way forward on a decision on 30 tonne axle loads.

In the meantime, all capacity analysis has been done on the basis of retaining 25-tonne axle loads.

Passing Lanes

If the identified prospective mines are developed, volume on the line to the Gunnedah basin begins to reach a level where the current loop pattern becomes insufficient. Loops are spaced at around 8 km – 10 km and at this spacing, questions arise as to whether it is economic to split a section with an intermediate loop, both because of the high fixed cost of the infrastructure, and the "transaction time" at the loop. It may therefore become preferable to move to double track/passing lanes.

ARTC has adopted passing lanes of nominally 7 km to enhance capacity on part of the Sydney – Melbourne corridor. The average speed of trains on the Muswellbrook – Narrabri section is relatively slower than the trains on the Sydney - Melbourne section, due to the topography and speed limits imposed because of the heavy axle loadings. Slower speeds enable shorter passing lanes to be built and provide the same benefit as longer passing lanes for faster trains. In addition, trains are slower when going uphill, especially if they are loaded. This is important as more benefit per km is achieved by building double track going up a hill in the loaded direction, particularly toward the top.

To accommodate the high-end prospective volumes nominally forecast to be achieved in 2018 will require 23 coal paths per day, assuming no material change to train configuration. This frequency of trains will require single track sections of no greater than 7.6 minutes running time.

A preliminary desktop analysis suggests that the most cost effective way of achieving this outcome (given the positioning of loops that will be built to accommodate indicative contractual nomination volumes) is a mix of additional loops and converting some loops into passing lanes. The approximate scope of works in addition to those required for indicative contractual nominations and assuming that the Caroona and Watermark mines establish their loading points in the vicinity of the proposed Watermark loop, would be along the lines of:

- 292 km – Koolbury loop (approximately 1.5 km)
- Aberdeen loop extension toward Muswellbrook (0.8 km)
- Togar – 310.5 (approximately 3 km)
- 317.5 km – Parkville (approximately 3 km)
- 329 km – Wingen (approximately 1 km)
- New loop at Blandford (1.4 km)
- Pages River – Ardglen Tunnel Portal (approximately 6.7 km)
- Ardglen—Kankool (approximately 3.8 km)
- Willow Tree – 379 (approximately 2 km)
- Braefield - 390 km (approximately 4.5 km).
- 395.5 km – Bells Gate (approximately 3 km)
- 406 km – Werris Creek Bypass (approximately 2 km).
- Werris Creek bypass (approximately 5.6 km)
- Werris Creek bypass – 419 km (approximately 4 km)
- Burilda – 428.5 km (approximately 2 km)
- Breeza – 438 km (approximately 2 km)
- 504 km loop (approximately 1.4 km)

This is a total of approximately 47.7 km of new construction and provides an order-of-magnitude indication of the works required to meet prospective volume. Staging would of course be dependent on the actual timing of the volume increments.

Train Lengths

Refinement of wagon designs has led to the recent introduction of new wagons that are materially shorter than the existing fleet. Approximately 80 – 82 of these wagons can fit in the loops built for 72 wagon trains.

Approval has now been granted for the operation of 82 wagon trains and for the purposes of capacity calculations it has been assumed that this new train configuration will represent 60% of trains into the future.

The 2009-18 Strategy also raised the option of a further significant increase in train length as an option to accommodate the high-end volumes.

Train length represents a trade-off between the operational and capacity efficiency of running a longer train, and the inefficiency of having wagons effectively idle while the longer train spends more time loading and unloading. The further the train needs to travel the larger the operating and capacity efficiencies are, while the inefficiency of longer loading and unloading time is essentially fixed. Hence, the greater the journey length the better the case to increase train length.

The obvious option for the Gunnedah Basin region is to go to either 111 wagons (ie a 50%, or one locomotive, increase in the standard QRN train) or 121 wagons (ie a 33%, or 1 locomotive, increase in the standard PN train). Assuming a 50% / 50% split between these two train types, this change would give a 51% increase in capacity compared to the 74-wagon trains assumed to operate if 30 tonne axle loads are introduced. It is assumed that these longer trains would operate with distributed power to appropriately manage in-train forces.

However, increasing train length has an array of implications. This includes the need to reconfigure load points and the dump station tracks at the port, increase loop length, and potentially adjust signal spacings.

The Liverpool Range is a particular concern. Previous Strategies have assumed that the grade on the Liverpool Range would be eased, allowing longer trains to operate. However, the grade easing option has now been rejected. The alternative option is to use 'distributed' power, with one or more locomotives in the middle of each train rather than at the front. This presents technical and practical complexities and has previously been regarded by ARTC as unlikely. However, improving technology is making this solution increasingly attractive.

The option of a step-change increase in train length only really becomes an issue for prospective volumes. As discussed above, there is a relatively clear passing lanes strategy that should be able to meet prospective volumes with a manageable scale of additional construction and is assumed to be the default option. However, it will be worth continuing to keep train length options under review to optimise infrastructure costs.

Proposal

The proposed sequence of projects to meet indicative contractual nominations is:

Project Name	Expected Completion
Burilda	By Q3 2012
Bell's Gate (Quipolly)	By Q1 2013
Scone	By Q4 2011
Pages River (in lieu of Murrurundi)	By Q2 2012
Chilcott's Creek *(Formerly covered by New Liverpool Range Alignment)*	By Q3 2012
Koolbury	By Q4 2011
Watermark	By Q2 2013
South Gunnedah	By Q2 2013

Table 4 - Proposed sequence of projects

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Network capacity with revised project scope and timing

Demand and capacity by sector, based on the project timings recommended in this Strategy, and using the calculation methodology set out in Chapter 1, is shown in Figures 16, 17 and 18.

Following the release of the last Strategy there were a number of requests for capacity to be shown in train number terms as well as tonnage terms. Tables 5 and 6 set out this information.

Figure 19 shows theoretical capacity of the rail network to deliver export coal to the Port. This graph has been created by calculating the capacity of each line section in a given period, adding forecast volumes from below that section, and then identifying the section with the smallest combined volume. The calculation is therefore highly dependent on the distribution of volume between load points and does not indicate an absolute limit to capacity in a given period. For instance, if the capacity limiting sector is Mt Own Junction – Camberwell Junction, volumes could be still be increased from the Mt Thorley branch, thereby increasing the volume delivered to the port. Care should therefore be exercised in interpreting this graph.

In the 2009-2018 Strategy this section included a statistical analysis of delay on the network. As discussed in Chapter 2, the statistical analysis has not been undertaken for this year's Strategy. The value of including the analysis will be reassessed for the next version.

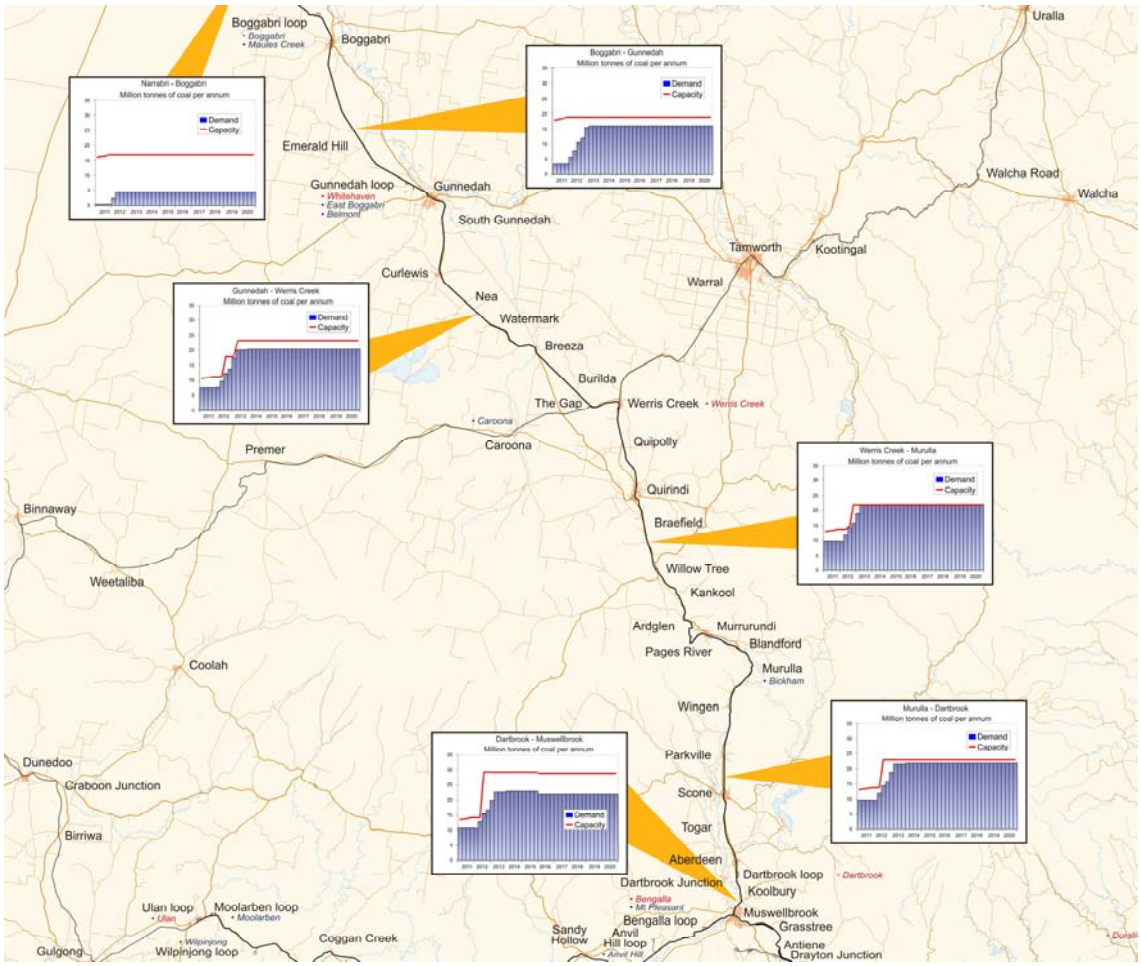

Figure 16 — Demand and Theoretical Capacity: Gunnedah Basin

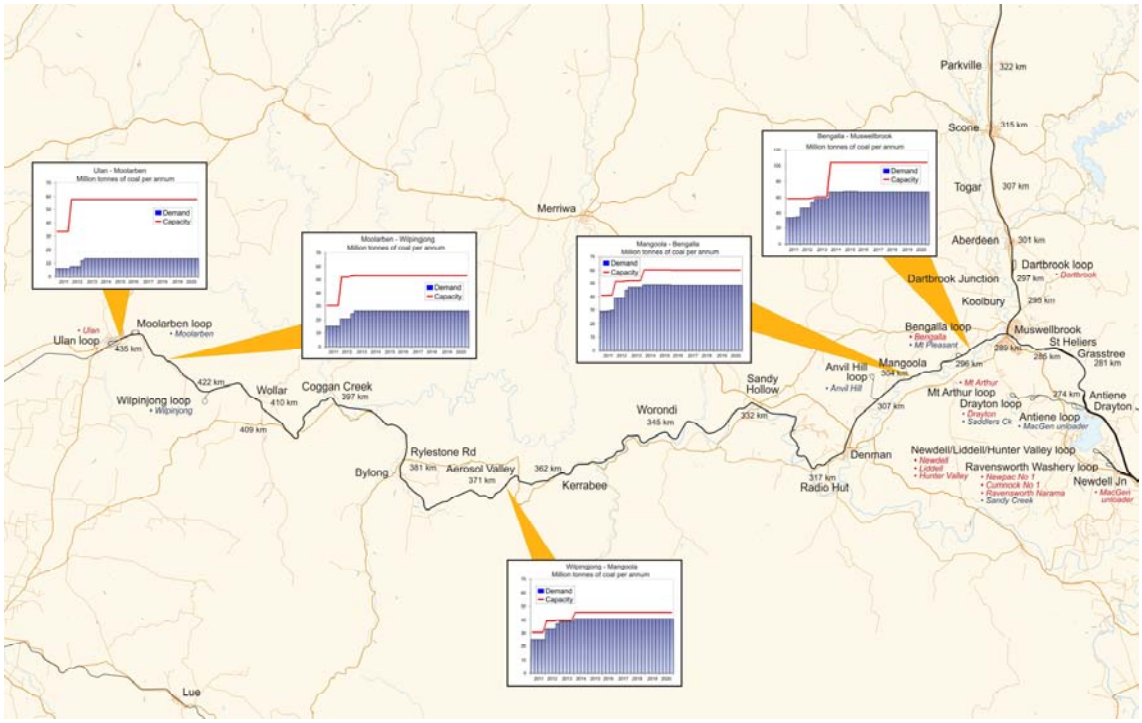

Figure 17 - Demand and Theoretical Capacity: Ulan Basin

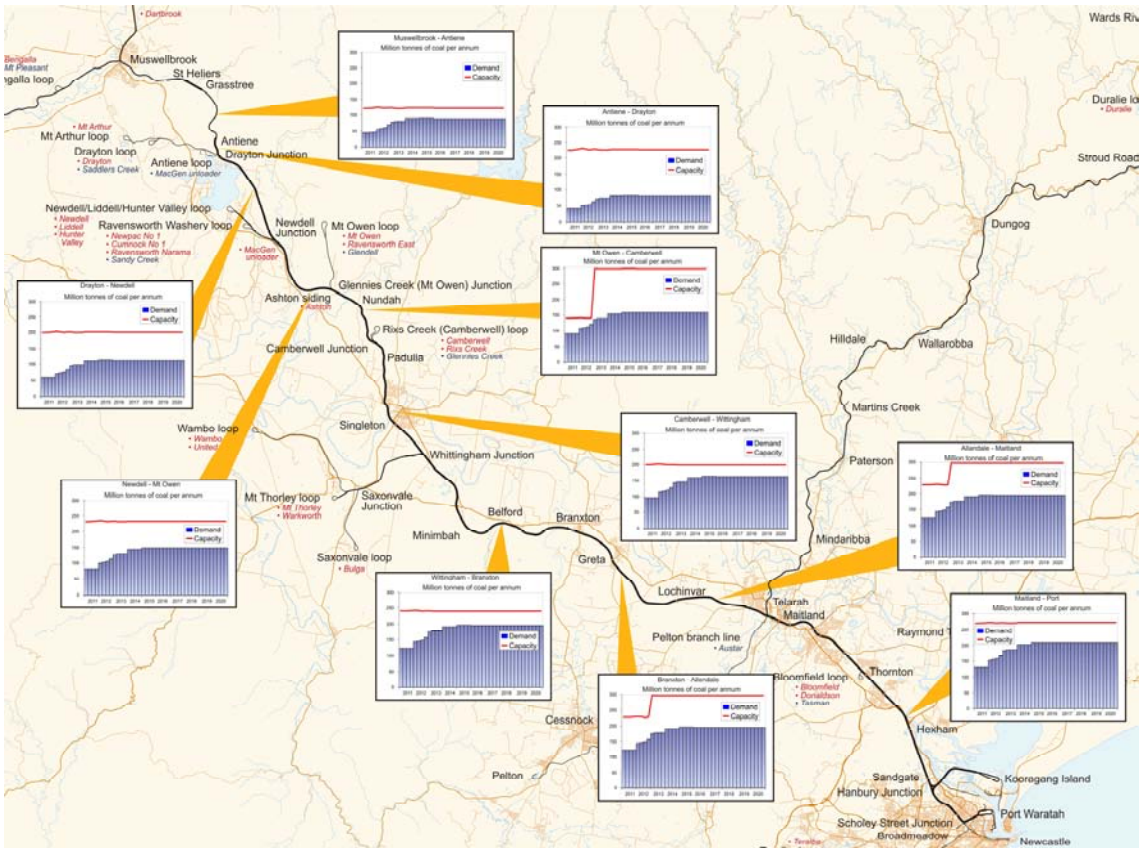

Figure 18 - Demand and Theoretical Capacity: Muswellbrook to Ports

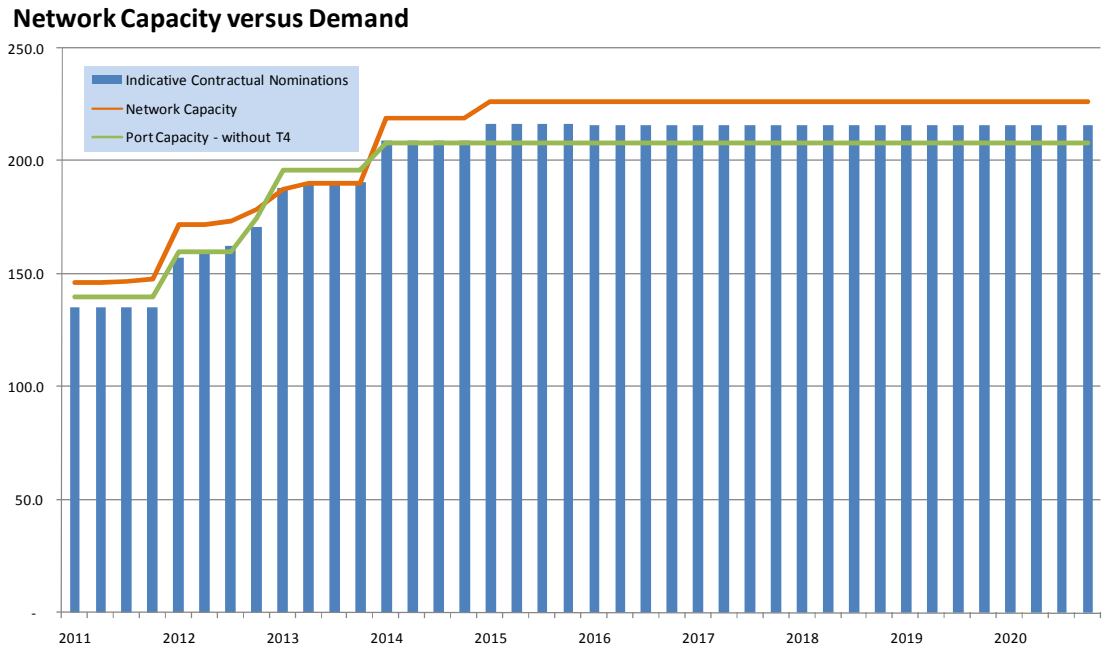

Figure 19 - Rail Capacity and Indicative Contractual Demand (mtpa)

	2011				2012				2013				2014				2015			
Narrabri - Boggabri	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Boggabri - Gunnedah	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Gunnedah - Werris Creek	5	5	5	5	5	5	9	9	9	11	11	11	11	11	11	11	11	11	11	11
Werris Creek - Murulla	7	7	7	7	7	7	7	10	10	10	10	10	10	10	10	10	10	10	10	10
Murulla - Dartbrook	7	7	7	7	7	7	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Dartbrook - Muswellbrook	7	7	7	7	7	7	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Ulan - Moolarben	11	11	11	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
Moolarben - Wilpinjong	11	11	11	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
Wilpinjong - Mangoola	11	11	11	11	14	14	14	14	14	14	14	14	16	16	16	16	16	16	16	16
Mangoola - Mt Pleasant	15	15	15	15	18	18	18	18	18	18	18	18	21	21	21	21	21	21	21	21
Mt Pleasant - Bengalla	15	15	15	15	18	18	18	18	18	18	18	18	22	22	22	22	22	22	22	22
Bengalla - Muswellbrook	21	21	21	21	21	21	21	21	21	21	21	21	36	36	36	36	36	36	36	36
Muswellbrook - Antiene	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47
Antiene - Drayton	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87
Drayton - Newdell	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
Newdell - Mt Owen	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87
Mt Owen - Camberwell	52	52	52	52	52	52	52	52	111	111	111	111	111	111	111	111	111	111	111	111
Camberwell - Whittingham	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
Whittingham - Branxton	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88
Branxton - Allandale	83	83	83	83	83	83	83	83	109	109	109	109	109	109	109	109	109	109	109	109
Allandale - Maitland	83	83	83	83	83	83	83	83	109	109	109	109	109	109	109	109	109	109	109	109
Maitland - Bloomfield	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103
Bloomfield - Sandgate	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103
Sandgate - Kooragang	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91
Sandgate - Port Waratah	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91

Table 5 - Capacity in Train Numbers (trains per day)

	2011				2012				2013				2014				2015			
Narrabri - Boggabri	16	16	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
Boggabri - Gunnedah	18	18	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
Gunnedah - Werris Creek	11	11	11	11	11	11	18	18	18	23	23	23	23	23	23	23	23	23	23	23
Werris Creek - Murulla	13	13	13	14	14	14	15	22	22	22	22	22	22	22	22	22	22	22	22	22
Murulla - Dartbrook	13	13	13	14	14	14	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Dartbrook - Muswellbrook	13	14	14	14	14	14	29	29	29	29	29	29	29	29	29	29	29	29	29	29
Ulan - Moolarben	33	33	33	33	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Moolarben - Wilpinjong	30	30	30	30	52	52	52	53	53	53	53	53	53	53	53	53	53	53	53	53
Wilpinjong - Mangoola	31	31	31	31	39	39	39	40	40	40	40	40	46	46	46	46	46	46	46	46
Mangoola - Mt Pleasant	41	41	41	41	51	51	51	52	52	52	52	52	60	60	60	60	60	60	60	60
Mt Pleasant - Bengalla	41	41	41	41	51	51	51	52	52	52	52	52	63	63	63	63	63	63	63	63
Bengalla - Muswellbrook	59	59	59	59	59	59	59	59	61	61	61	61	104	104	104	104	104	104	104	104
Muswellbrook - Antiene	121	121	122	123	124	123	122	123	122	121	121	121	122	122	122	122	122	122	122	122
Antiene - Drayton	226	227	228	230	232	230	228	230	229	227	227	227	229	229	229	229	229	229	229	229
Drayton - Newdell	200	200	201	202	203	202	200	202	201	200	200	200	201	201	201	201	201	201	201	201
Newdell - Mt Owen	232	233	233	234	236	234	233	233	234	232	232	232	233	233	233	233	233	233	233	233
Mt Owen - Camberwell	140	141	141	141	142	141	140	141	300	298	298	298	299	299	299	299	299	299	299	299
Camberwell - Whittingham	200	200	201	201	202	201	200	200	200	199	199	199	199	199	199	199	199	199	199	199
Whittingham - Branxton	240	240	241	241	242	241	240	240	240	239	239	239	239	239	239	239	240	240	240	240
Branxton - Allandale	228	228	228	229	230	229	227	228	298	296	296	296	297	297	297	297	297	297	297	297
Allandale - Maitland	228	228	228	229	230	229	227	228	298	296	296	296	297	297	297	297	297	297	297	297
Maitland - Bloomfield	270	270	271	271	272	271	270	271	272	271	271	271	272	272	272	272	272	272	272	272
Bloomfield - Sandgate	270	271	271	272	273	272	271	272	272	271	271	271	272	272	272	272	273	273	273	273
Sandgate - Kooragang	239	240	240	241	242	241	240	241	241	240	240	240	242	242	242	242	242	242	242	242
Sandgate - Port Waratah	239	240	240	241	242	241	240	241	241	240	240	240	242	242	242	242	242	242	242	242

Table 6 - Capacity in Tonnage Terms (mtpa)

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Overview of the recommended projects

A summary of projects by availability date is provided in Table 9 and a summary of the recommended projects comparing previous and new proposed delivery timeframes is shown in Table 10.

Table 11 shows current project cost estimates by the year in which the project is proposed to be completed. The level of detail in these budget estimates varies, with the earlier timed projects developed to a higher level of accuracy.

The projects set out in this Strategy amount to $854.8 million over the next five years. This includes investment on the Werris Creek to Narrabri section which ARTC anticipates taking-over from CRIA on 1 July 2011. This document is a strategy document and the indicative project costs are generally orders of magnitude only unless a project is in or close to construction. Costs are not ARTC's anticipated outturn costs as there are too many unknowns at the strategy phase to attach any reliability to the estimates. Scope and construction conditions are progressively better defined through the project approval stages until a project cost is established. Each project stage is brought to the industry for approval in accordance with ARTC's access undertaking. All project costs are in 2011 dollar terms and no effort has been made to inflate them.

This 5 year forecast spend of $854.8 m is significantly less than the previous Strategy number of $1,472 m. This is due to some significant projects being completed (Minimbah Bank, Maitland - Branxton bi-di and 6 loops), the industry decision to not pursue a multi-user provisioning facility, and lower cost solutions for Nundah Bank and the Liverpool Ranges being identified.

Beyond 2014, all of the projects are associated with prospective volumes. While the potential projects required to accommodate prospective volumes are discussed in the relevant sections, these have not been costed as the requirement and timing of the projects is, at this stage, highly uncertain.

	2011	2012	2013	2014
Q1		Wilpinjong	Maitland–Minimbah 3rd Track Area A/B	Port Holding Roads Stage 1 and 2
			Nundah Bank	Muswellbrook Junction
			390 km Loop (Standard Loop)	Bengalla loop extension
			Bell's Gate (Quipolly)	
Q2	Maitland CBI	Pages River	Drayton Junction	
			Bylong Tunnel	
			378 km Loop (Passing Lane @ 371.2 km–374.9 km)	
			390 km Loop (Bylong Loop Extension)	
			Watermark	
			South Gunnedah	
Q3		Chilcott's Creek		
		Burilda		
Q4	Bengalla	Maitland–Minimbah 3rd Track Area C	378 km Loop (Loop @ 373.1 km–374.9 km)	
	Koolbury		353 km Loop (Loop @ 354.6km–356.4km or Passing Lane @ 357.3km–Kerrabee)	
	Scone			

Table 9 - Proposed investment program by quarter/year each project is proposed to be available.

	2009-2018 HV Strategy	2011-2020 HV Strategy – Required	2011-2020 HV Strategy Proposed	Change 2009 Strategy to 2011 Strategy Proposed
Central Hunter				
Port Holding Roads Stage 1	By 2012	ASAP	By Q1 2014	+24 months
Port Holding Roads Stage 2	Not specified	By Q1 2014	By Q1 2014	N/A
Maitland CBI	-	Enabling Project	By Q2 2011	N/A
Minimbah—Maitland 3rd Track	By 2012	ASAP	By Q4 2012 (Maitland to Branxton)	+9 months
			By Q1 2013 (Greta to Farley)	+12 months
Hunter Valley Provisioning Facility	By 2012	Deleted	Deleted	N/A
Nundah Bank	By 2013	By Q1 2013	By Q1 2013	Nil
Drayton Junction	By 2011	Maintenance Project	By Q2 2013	+27 months
Muswellbrook Junction	By 2015	By 2014	By Q1 2014	- 12 months
Ulan Line				
Bylong Tunnel	By 2010	Interim ASAP	By Q2 2013	+39 months
Bengalla	By 2012	By Q1 2012	By Q4 2011	-3 months
Wilpinjong	By 2012	By Q1 2012	By Q1 2012	Nil
337 km loop	By 2012	-	-	N/A
378 km loop	By 2012	By Q1 2014	By Q2 2013	+15 months
353 km loop	By 2013	By Q1 2014	By Q4 2013	+9 months
390 km loop	By 2013	By Q1 2014	By Q1 2013	Nil
Mt Pleasant loop	By 2014	Deleted	Deleted	N/A
Bengalla loop extension	Replaces Mt Pleasant loop	By Q1 2014	By Q1 2014	N/A
404 km loop	By 2014	-	-	-
Gunnedah Basin Line				
Koolbury	By 2011	By Q3 2012	By Q4 2011	+9 months
Scone	By 2011	By Q1 2013	By Q2 2011	+9 months
Murrurundi	By 2011	Deleted	Deleted	N/A
Chilcott's Creek	-	By Q4 2012	By Q3 2012	N/A
Bell's Gate (Quipolly)	By 2011	By Q4 2012	By Q1 2012	+24 months
Werris Creek Bypass	By 2011	-	-	-
Burilda	By 2012	By Q3 2012	By Q3 2011	+9 months
Watermark	By 2011	By Q2 2013	By Q2 2013	+18 months
Wingen	By 2012	-	-	-
Pages River	Formerly covered by New Liverpool Ranges Alignment	By Q2 2012	By Q2 2012	N/A
Quirindi	By 2012	Deleted	Deleted	N/A
South Gunnedah	By 2012	By Q2 2013	By Q2 2013	+15 months
New Liverpool Range Alignment	By 2013	Deleted	Deleted	N/A
504 km Loop	By 2015	-	-	-

Table 10 - Comparison of project timings between the 2009-2018 and 2011-2020 Hunter Valley Capacity Strategies.

$ 2011 M - (indicative costs)	2011	2012	2013
Central Hunter			
Maitland CBI	9.6	-	-
Minimbah—Maitland 3rd Track	-	355	-
Nundah Bank	-	59.6	-
Drayton Junction	-	-	18
Muswellbrook Junction	-	-	40
Port Holding Roads Stage 1	-	-	70
Port Holding Roads Stage 2	-	-	20
Ulan Line			
Bengalla	20	-	-
Wilpinjong	20	-	-
390 km Loop	-	20	-
378 km Loop	-	-	35
353 km Loop	-	-	35
Bengalla loop extension			15
Bylong Tunnel	-	-	25
Gunnedah Basin Line			
Koolbury	18	-	-
Scone	3.6	-	-
Chilcott's Creek	-	16	-
Bell's Gate (Quipolly)	-	19	-
Burilda	-	13	-
Pages River	-	17	-
Watermark	-	-	13
South Gunnedah	-	-	13
Total	**71.2**	**499.6**	**284**

Note: All the above projects (including scope, timing, and funding arrangements) are subject to consultation with and endorsement by the industry.

Note: Dollar estimates are based on current known: Scope; Survey and geotechnical knowledge; legislation and tax regimes. Project dollars are order of magnitude estimates only and do not represent concluded project dollars.

Note: Amounts are shown in the year preceding the year in which the project will be available on the basis that this is the year in which the majority of investment will occur.

Table 11 - Proposed investment program expenditure by year in which construction completed.