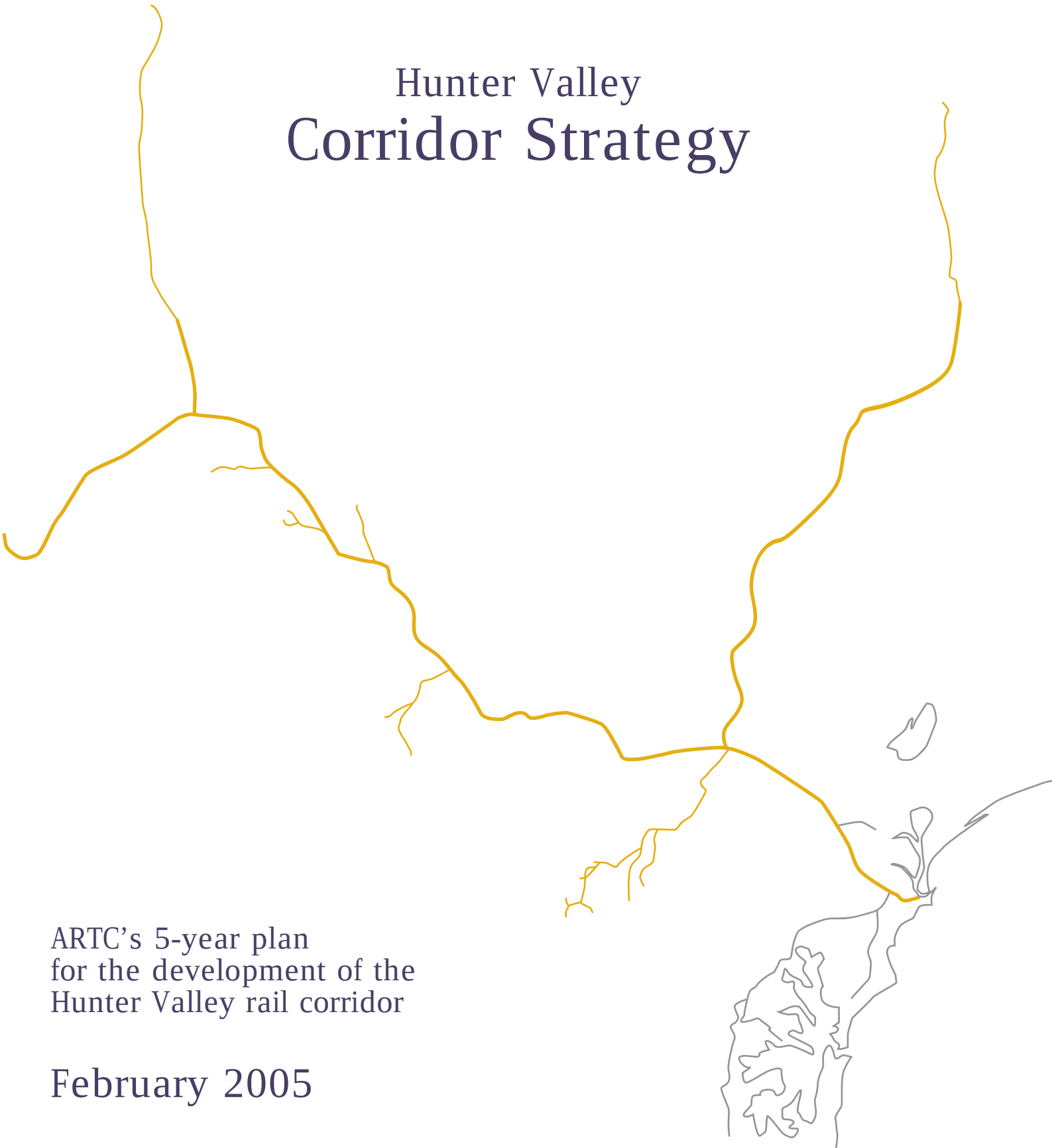
ARTC

Hunter Valley
Corridor Strategy



ARTC's 5-year plan
for the development of the
Hunter Valley rail corridor

February 2005

Executive Summary

Introduction

On 5 September 2004, the Australian Rail Track Corporation (ARTC) commenced a 60 year lease of the NSW interstate and Hunter Valley rail lines. ARTC 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 the majority of the interstate rail network under ARTC

In 2002, ARTC developed a detailed infrastructure investment program for the NSW network in the context of the lease proposal to NSW. This investment program was worth $872 million including complementary investment on the Melbourne – Albury corridor.

It is now 3 years since ARTC's NSW investment program was developed and it needed to be reviewed and revised in light of subsequent developments, in particular the rapid growth in coal demand in the last 2 years.

This report and attached papers set out the position in regard to planning enhancement of capacity on the Hunter Valley coal network.

Current Position

At present the rail system into the Newcastle Ports has an annual capacity of around 85 million tonnes per annum (mtpa), with a surge capacity of around 10 % higher sustainable over a period of some weeks. Forecasts indicate that demand of 100 mtpa is anticipated in 2007 with a further potential rise to around 115 mtpa by 2009.

Rail capacity on the Hunter Valley network is uneven. The bulk of the coal traffic runs on the line between Whittingham (near Singleton) and the ports. North of Whittingham the coal tonnage progressively reduces as various mines and loaders are passed. The section between Whittingham and the ports has been the main focus in the plan for enhanced capacity, with other sections being attended to as appropriate to their task.

Approach

The strategy ARTC is adopting is to address existing capacity bottlenecks in the short-term and to then ensure that Hunter Valley capacity is delivered ahead of likely demand.

The basic approach has been to develop an ability throughout the length of the lower Hunter Valley to run trains at no more than 10 minute headways. In fact, detailed analysis indicates that only two sections, Minimbah Bank near Whittingham and Nundah Bank north of Singleton, currently have coal train headways in excess of 10 minutes. We are proposing to raise capacity at Minimbah, initially by raising approach speeds to 80 km/h, and then by reconfiguration of the signaling to respond to the headway issue. Similar treatment is proposed for Nundah Bank

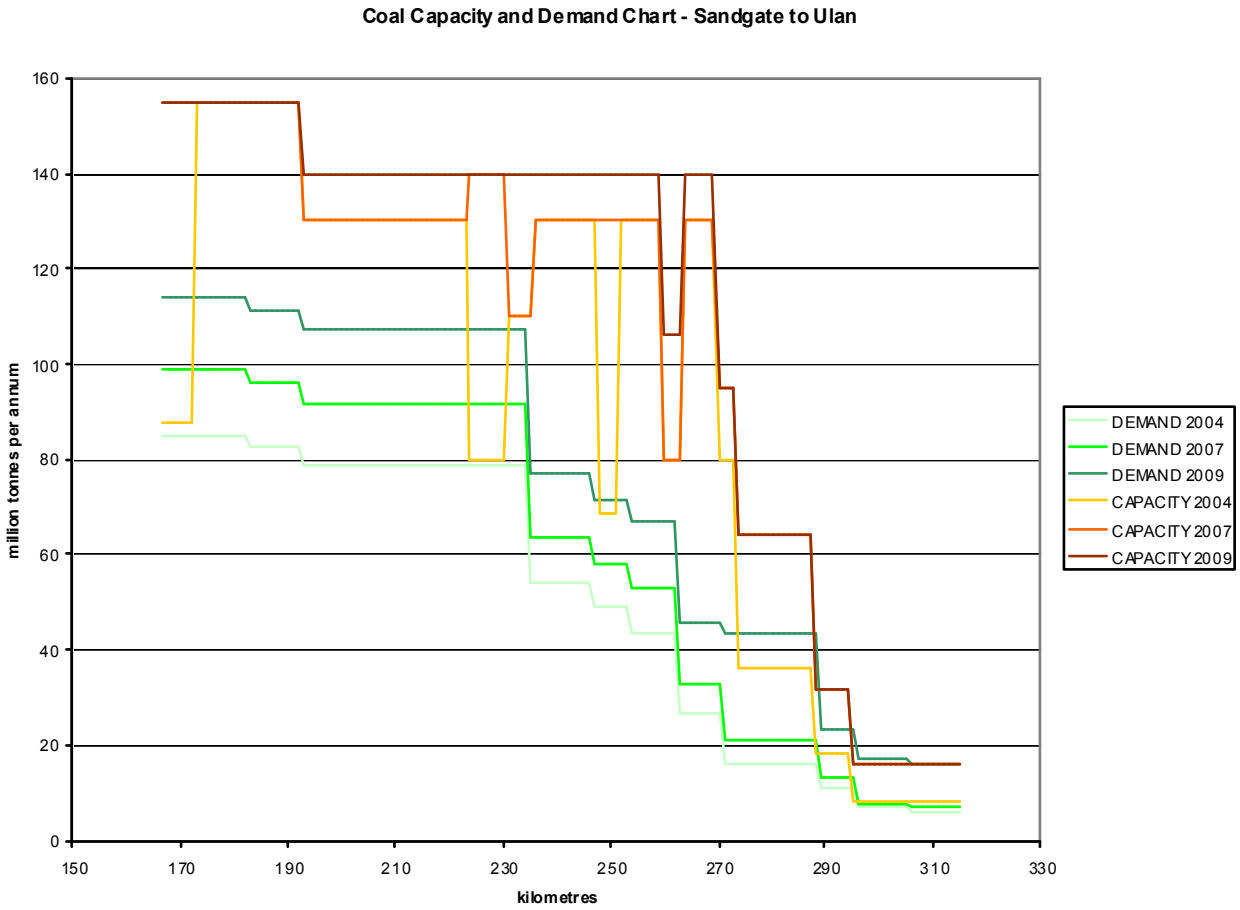
Throughout the plan there is a concept of harmonisation – making the various parts of the network compatible with demand and compatible between themselves. In this context the 10 minute headway is carried right up the lower Hunter Valley even where the demand is significantly lower than that nearer the ports. By this means it is planned to have a consistent capacity of around 140 mtpa from Drayton Junction to the ports, with subsequent extension back to the junction at Muswellbrook as that section is duplicated.

Focussing on the highest volume section, between Whittingham and the ports, the proposed projects have a capacity timeline as follows:

Project	Time	CAPACITY (mtpa)	DEMAND (mtpa)
Existing	February 2005	85	85
Minimbah 80 kmh	September 2005	90	90
Sandgate Grade Separation	March 2006	102	90
Re-signal Minimbah	December 2007	110	100
Bi-di signalling Maitland -Branxton	December 2007	115	100
Whittingham flyover	June 2008	140	115

Looking more broadly at the Hunter Valley system as whole, ARTC is proposing the scope of projects set out in table 1.

The volume that these projects are expected to deliver and the timeframe for delivery of that volume against anticipated demand can be shown graphically as follows:



Conclusion

In summary, once Sandgate grade separation is completed, the planned enhancement program will progressively move ahead of the anticipated demand through to 2009.

Table 1

ARTC Hunter Valley Capacity Improvement Projects

Priority	Project	Scope	Benefit	Approximate Timing	Notes	Capacity pre work MTPA	Capacity after work MTPA
1	80km/hr running for "120T" coal trains	a) Introduce 4th signal aspect where required for braking from 241 km to 228 km (north of Singleton to near Minimbah)	Overall capacity increase estimated to be 17 to 22 MTPA due to capacity increase on upgrades and longer trains. Saving of at least 2.5 minutes on 'ruling' headway. Return by PNL to 60 and 91 wagon trains will contribute to capacity gains	6 to 8 months		80	102
		b) Introduce 4th signal aspect where required for braking from 264.2 km to 249 km (Newdell Junction to near Nundah)		6 to 8 months		69	86
		c) Introduce 4th signal aspect where required for braking at other locations along route.		3 years			
2	Minimbah Bank Resignalling	Resignalling from Whittingham to 224 km (2.5 km past summit) with two aspect (two active signal heads) would provide for 10 minute headways with coal trains while allowing existing train speeds for fast trains (130kph on bank) to remain. Signal spacing would be proportional to coal train speed on the bank with signal spacing at 550-800 m on the top 3km of the grade.	Capacity increase of around 35 MTPA due to improving headway to 10 minutes with potential for 8 minutes.	18 months.	Issue is one of headway not stalling on grade. Existing 'ruling' headway (53 wagons @ 60kph max) is 16.2 min (approx 18.0 min for 80 wagons). Increasing approach track speed to 80kph would reduce these figures by around 3.5 minutes (but Mt Thorley trains starting from Whittingham Junction would not achieve 80kph). Two aspect signalling would give five aspects compared to existing three or four with single aspect signalling. Design signalling to accommodate future 3rd track.	102	140
3	Nundah Bank Resignalling	Equivalent to Minimbah Bank resignalling (#2).	Capacity increase of around 50 MTPA due to improving headway to 10 minutes with potential for 8 minutes.	18 months	Although lower train numbers the same headway is required so paths are harmonised along the whole line	96	140
4	Ulan Line CTC	Replace electric staff working with CTC.	Gives direct benefit of 4 MTPA plus an additional 4MTPA when Muswellbrook Yard (5) taken into account	18 months	Need to allow for follow on moves and for additional loop requirements for future tonnage increases.	8	16
5	Muswellbrook Yard	Project to raise speeds at north end of yard to increase capacity, provide a full length crossing loop, reduce maintenance.	This project will increase capacity on both the main and branch lines (including some small gains from reduced on track maintenance time) and enhance overall reliability.	24 months	Reduce single track section length toward Ulan and toward Werris Creek.	in Ulan CTC	in Ulan CTC
6	Antienne to Muswellbrook Duplication (2 Sections)	a) Upgrade (and reconfigure) Antienne turnout	Staged approach proposed, constructing Muswellbrook Loop (see (5)) and easier part of Grasstree - Antiene section early then remainder when necessitated by tonnage. Antiene turnout restricts headways between there and Drayton Jn and is high wear	18 months	Issues include Antienne turnout (which junction remains, Muscle Creek bridges (4 no.), bi-directional or up/down signalling. Note MacGen facility branch near Antienne.	36	38
		b) Extend double track 2.5 km eastwards from Grasstree		30 months		38	64
		c) Infill 2 remaining single track sections (6 km)		5 years			
7	Newdell Junction and Branch	Replacement of low speed junction turnouts with heavy duty high speed turnouts.	Times taken for a train exiting the branch will reduce from around 4.5 minutes now to around 2.25 minutes, effectively reducing the junction conflict time – in effect the junction could handle twice as many branch trains or an estimated increase of 7 northbound main line trains within the existing junction conflict time. Increasing junction speed for trains joining the main line will facilitate operation of 10 minute headways (projects 2 and 3). Reduced maintenance will increase paths available over a typical year (not quantified). New junction should increase capacity by equivalent of 10 loaded trains	18 months	Increase main line train speeds from 60 to 80kph for coal and branch speeds from 25 to 75kph. Faster speeds and less on track maintenance will allow branch configuration to remain - standing empty train on main can be bypassed using bi-directional running.	90	108
8	Drayton Junction	Similar to Newdell Junction (#7) but junction should be able to be reduced to 3 turnouts (plus one reverse direction crossover?) by using bi-directional running to bypass waiting empty train.	Times taken for a train exiting the branch will reduce from around 6.0 minutes now to around 3.0 minutes, effectively reducing the junction conflict time – in effect the junction could handle twice as many branch trains or an estimated increase of 8 northbound main line trains within the existing junction conflict time. At the same time renewal of the main line crossover and junction turnout and abandoning the branch crossing loop will be possible with faster junction conflict times, saving two turnouts in the new arrangement. Increasing junction speed for trains joining the main line will facilitate operation of 10 minute headways (projects 2 and 3). Reduced maintenance will increase paths available over a typical year (not quantified). New junction should increase capacity by equivalent of 8 loaded trains.	3 years		80	95
9	Maitland - Branxton Bi-Directional Signalling		It is assumed (subject to better data yet to be obtained) that two paths per week would be saved, equivalent to around 0.5 million tonnes per annum. In addition the project would give the ability to bypass trains under failure conditions (greater reliability).	3 years		139	140
10	Whittingham to Newdell Bi-Directional Signalling		As for Maitland - Branxton Bi-directional Signalling (#9) plus empty trains standing at junction could be bypassed by other empty trains by using opposing track reducing need for loops or duplication on branch lines (Camberwell, Mt Owen, Newdell/Ravensworth).	3 years		139	140
11	Newdell Junction to Antienne Bi-Directional Signalling		As for Maitland - Branxton Bi-directional Signalling (#9) plus simplified Drayton Junction Renewal.	3 years		139	140
12	Mt Thorley Branches Crossing Loop or duplication	Possible flyover at junction. Train running over the 7km single track section and conflicts at the main line junction as train numbers grow will determine what if any work is required.	Flyover for loaded trains to cross over empty northbound track, will reduce conflict delays and estimated to increase capacity by equivalent of 15 loaded trains	Long term	Jerry's Plains branch will complicate train running even with no change of tonnage.	115	140
13	Extended Loops between Muswellbrook and Boggabri	Project to allow longer trains for coal and grain (subject to limitations at Ardglen) to release paths used by existing short trains south of Muswellbrook. Anticipate need for significant capacity improvement over Liverpool range from about 2010	More detailed study required. Potential saving of 5 daily coal paths would be worth around 9 million tonnes per annum over the main coal trunk. Amalgamation of grain trains into longer consists should enable saving of an additional path.	Long term	Ardglen grade will be line capacity constraint at as low as 6 loaded coal trains daily. 65 km/h speed on loaded '100 t' coal wagons and speed limiting track configuration at Scone are secondary issues	7	12
14	Kooragang Island Arrival Road Upgrade	This project needs to be considered as part of an overall coal terminal ssystem review. Further study required		TBD			

Introduction

NSW Lease

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In 2002, ARTC developed a detailed infrastructure investment program for the NSW network in the context of the lease proposal to NSW. This investment program was worth $872 million including complementary investment on the Melbourne – Albury corridor.

It is now 3 years since ARTC's NSW investment program was developed and it needed to be reviewed and revised in light of subsequent developments, in particular the rapid growth in coal demand in the last 2 years.

This study is designed to identify the constraints to higher coal capacity on rail in the Hunter Valley, the options to resolve the constraints and the proposed course of action to achieve increased coal throughput. The fundamental approach by ARTC has been to achieve increased capacity with a reserve surge capability that will be sufficient to meet the anticipated demand for export coal while achieving operational harmony between the capacities of the various line sections of the Hunter Valley rail network.

The Hunter Valley Coal Network

At present the Hunter Valley rail network has an annual capacity of around 85 million tonnes per annum (mtpa) of export coal, with a surge capacity of around 10 % higher sustainable over a period of some weeks. Forecasts indicate that demand of 100 mtpa is anticipated in 2007 with a further potential rise to around 115 mtpa by 2009.

All but a very small proportion of the export coal shipped through Newcastle is transported to the port by rail for shipping from either Carrington (Port Waratah) or Kooragang Island. The majority of this coal comes from a series of mines and loaders strung out along the Hunter Valley and is conveyed to the port on the railway that runs between Muswellbrook and Newcastle. Coal also feeds into this line from Ulan, Gunnedah, Stratford, Pelton and the southern suburbs of Newcastle, complementing the large volume of coal originating on the line itself.

Domestic coal is also transported over the same network. This sector is comparatively small but is anticipated to grow substantially within the five year forecast period.

The route consists of a dedicated double track 'coal line' between Port Waratah and Maitland with a shared double track line from there to Antiene and basically single track from that point north and west. The heaviest coal volumes are at the lower end of the Hunter Valley, with around 80 million tonnes out of the 85 million tonnes arriving at the port being railed over the track south from Whittingham (near Singleton).

The Hunter Valley network is capable of handling rolling stock with 30 tonne axle loading (120 tonne gross wagons and 180 tonne locomotives) with some of the outlying track sections being rated for 25 tonne axle load (100 tonne wagons and 150 tonne locomotives). There are currently 17 export coal trains made up of '120 tonne' wagons and 8 made up of '100 tonne' wagons. Across the whole fleet the average coal capacity is around 5,200 tonnes per train load. At the existing coal volumes an average of around 45 loaded trains per day (one every 32 minutes) are required to be run. Train lengths vary from around 1000 metres to 1550 metres apart from a small group of 'short' trains of 760 metres dedicated to Stratford and Gunnedah services. An additional six coal train consists are planned to be introduced over the next year or so, all with '120 tonne' wagons.

Trains made up of '120 tonne' wagons are restricted to 60 km/h, while all other freight trains including '100 tonne' coal trains are allowed 80 km/h on the core coal network. As a consequence of the mix of trains, with 70% being '120 tonne', the coal network tends to move at the slower speed.

The whole Hunter Valley coal chain is inter-related. The stockpiling and loading capability of the mines will have an impact on the trains, the trains will influence the rail infrastructure and so on.

Study Methodology

The Hunter Valley Coal Capacity Enhancement Project has involved determining the capacity of the existing Hunter Valley rail network for transport of export coal to the port of Newcastle; comparing the current capacity with the anticipated demand to identify existing and future likely constraints; reviewing options previously proposed to address these constraints and where necessary proposing additional options and selecting the preferred action to address each constraint identified.

Capacity of the rail system is fundamentally dependent of two factors:

1. The number of trains able to be run over a track section in a given time (headway)

2. The carrying capacity of the trains.

This project deals primarily with the capacity of the rail infrastructure and therefore is mainly concerned with the numbers of trains. However it recognises that a number of track issues will have an impact on the carrying capacity of trains and these are also considered.

The starting point for the definition of the projects necessary to enhance capacity of the system to meet anticipated demand has been the identification of the existing capacity of the network in terms of the numbers of coal trains able to run through each track section making up the network (track section being either plain track or a junction). This has been done by calculating the underlying headway achievable, less an allowance for the effect of conflicts at junctions and then making a deduction for the track capacity required for non-coal trains on the line and for maintenance access to the track.

The second step in project identification was to harmonise capacity along the length of the line, so that headways were either the same as the adjacent track sections or were a multiple of the adjacent achievable headway. This process tends to provide higher than required capacity as the distance from the ports increases but allows trains to be timetabled straight through with no waste capacity arising from mismatches of headways or capacity. The third step was to relate the existing and potential capacities (the latter dependent on the options available) to the likely future demand to identify likely constraints to the export of coal through the Hunter Valley rail network.

Previously identified options for addressing each of these constraints were then reviewed and where necessary additional options were also considered and a preferred option identified for implementation or more detailed investigation.

Frequently the capacity increments available as a result of improvements are large, so that significant spare local capacity will become available when a project is completed. It is generally then the case that some capacity constraint elsewhere will become the critical constraint for the line.

In this way various projects have been identified that will increase rail capacity, reduce track closure required for maintenance, and/or build reliability into the Hunter Valley coal network.

The study assumes that the existing coal throughput of 85 mtpa will rise to 100 mtpa by 2007 and as high as 115 -120 mtpa by 2009. Estimates that originated from the coal producers early in 2004 were used as a basis for these estimates, with the addition of prospective tonnes from the Gunnedah area that were not available when the earlier forecasts were created. [Note: Revised forecasts, showing higher potential demand, have become available and the study is being updated to consider these revised forecasts.]

These forecasts were used since they represent the high end of expectation – mining, loader, rail and port capacity will have to all be considered in achieving these tonnages. Should the growth in tonnage not occur at the forecast rate the various capacity enhancement projects can be slowed from the timings projected in this report. Should growth be faster, most projects can be accelerated, particularly those in later years.

The following qualifications apply to the conclusions of the study:

- No recommendations have been made in relation to Kooragang Yard. Kooragang Yard has been considered to be part of the interface between the rail network and the port which needs to be examined separately as a system and in the light of developments that are likely to become clearer during 2005.

- The capacity gains are local to the area affected by each project, although in general the line section between the project and ports will have sufficient latent capacity to allow a reasonable proportion of the gain to be immediately achieved.

- The capacity gains take no account of the capabilities of loading and unloading interfaces – the identified rail capacity will be available at the conclusion of each project even if the coal chain is at that stage unable to make use of that capacity. The capacity gains are planned to be in line with forecasts

- Various projects have a synergy with other projects – the time line of capacity gains is based on the priority order identified here and will almost certainly change if the sequence is altered.

- The two aspects of frequency of trains (headways) and train capacity have been regarded as the drivers of rail capacity and have been given priority. The proposals are planned to target a system capacity on rail of up to 140 million tonnes per annum by 2009.

- The Sandgate grade separation, which is currently in the process of implementation, has been assumed to have been completed. Apart from the existing capability of the coal line between Maitland and Sandgate to provide 10 minute headways, there will also be the availability of at least 50 additional freight paths on the adjacent main lines as a result of the removal of flat crossing conflicts at Sandgate. These paths will be useful for through freight trains as well as trains to Port Waratah making use of the Warrabrook or Waratah crossovers. The section between Maitland and Sandgate will have no apparent impediment to carrying the forecast tonnes, nor will that section hinder the achievement of capacities planned for the route north-west from Maitland.

- Train number estimates are based on forecast tonnes and assumed average train coal carrying capacities as at 2004, with the exception that Pacific National trains will revert to 60 or 91 wagons from 53 or 80, QR will run Mt Arthur coal in 74 wagon trains from mid 2005 and that Werris Creek line trains will be increased from 42 wagons to 72 wagons toward the end of the forecast period.

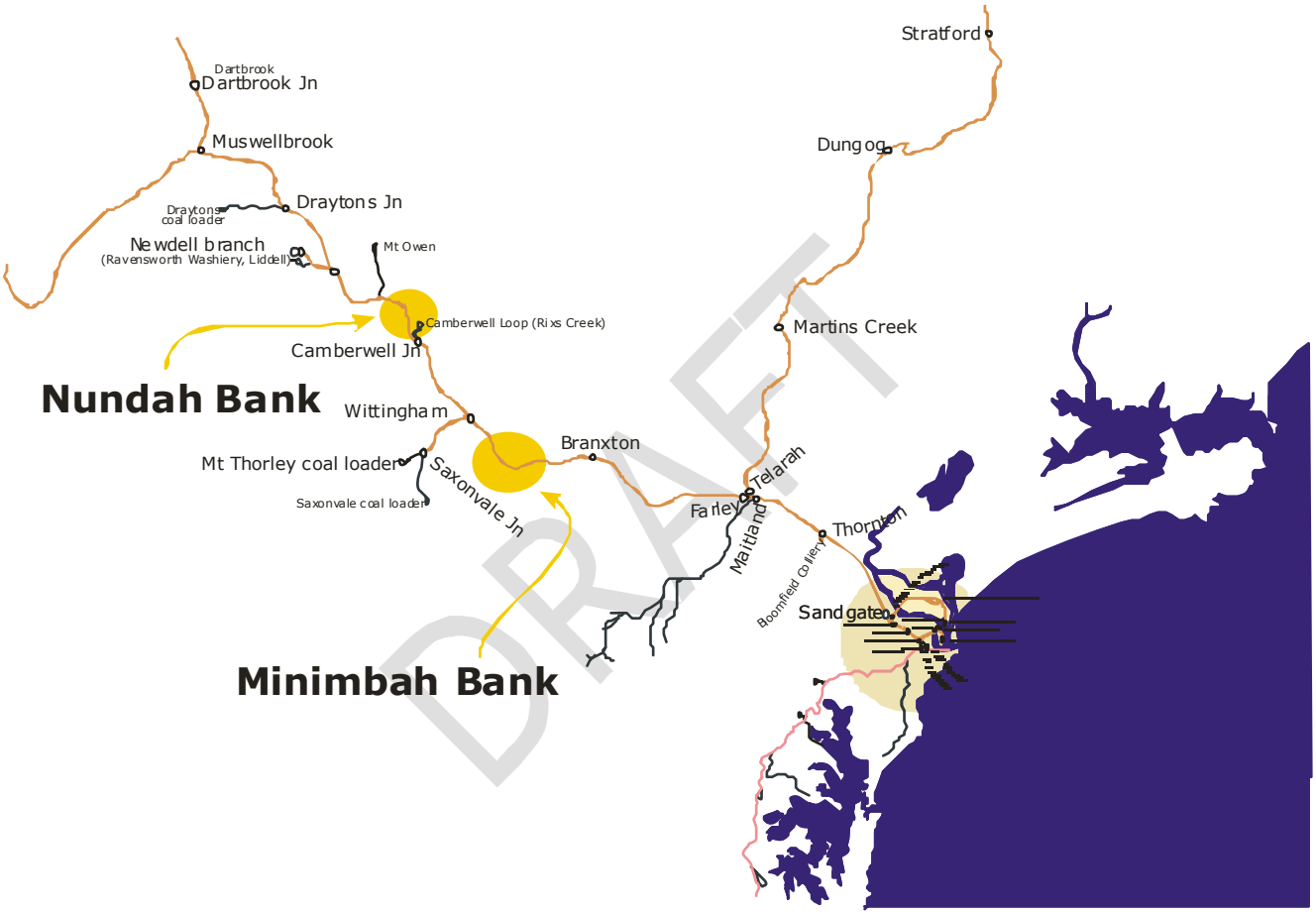
The following is a summary of the constraints to increased capacity which were identified in the study and the options considered for each constraint.

1. Need for Reduced Headways

The Constraint

The route between Muswellbrook and Sandgate has a minimum headway at the present time of around 20 minutes on Nundah Bank and 17 minutes on Minimbah Bank. Apart from a section immediately south of Muswellbrook (which will be attended to in conjunction with other work in that area) these are the only sections with a coal train headway greater than 10 minutes.

Reduction of headways at Nundah and Minimbah to ten minutes would harmonise these sections with the remainder of the system and enable the whole line from Drayton Junction to Sandgate (the junction for the two ports) to have the ability to path at 10 minute intervals.



Options

Four options have been identified to remove the headway constraint. These were:

- A track deviation with reduced grades.
- Additional tracks on the grades.
- Re-signalling on the grade to allow 10 minute headways for loaded coal trains.
- Permit increased speeds for loaded 120 tonne coal trains approaching the grades.

Track deviations would have a high capital cost, require several years to complete, would be unable to be staged, and would still need carefully designed signalling to resolve the headway issue. For these reasons deviations are not attractive as a capacity solution.

The option of a third track at Minimbah has the advantage of allowing overtaking moves as well as facilitating robust short headways, but this option has a relatively high cost and long lead time.

The last two options are low cost and relatively quick to implement.

It is proposed initially to institute limited signalling enhancements to allow '120 tonne' coal trains to run at 80 km/h on the approach to these two grades, which will reduce headways by 2.5 minutes while permitting trains to return to their former 60 or 91 wagon consists. This project will only take a matter of months to implement.

As a second stage it is proposed that headways be reduced to 10 minutes at the two restrictive locations, initially by changes to signalling to allow closer headways. Introduction of additional signalling indications over Minimbah Bank and Nundah Bank would allow closer headways for coal trains without having to compromise allowable speeds for passenger trains and faster freight trains. A later option of a third track on the grade to allow overtaking and parallel running over the slow speed sections would further enhance capacity and flexibility when required.

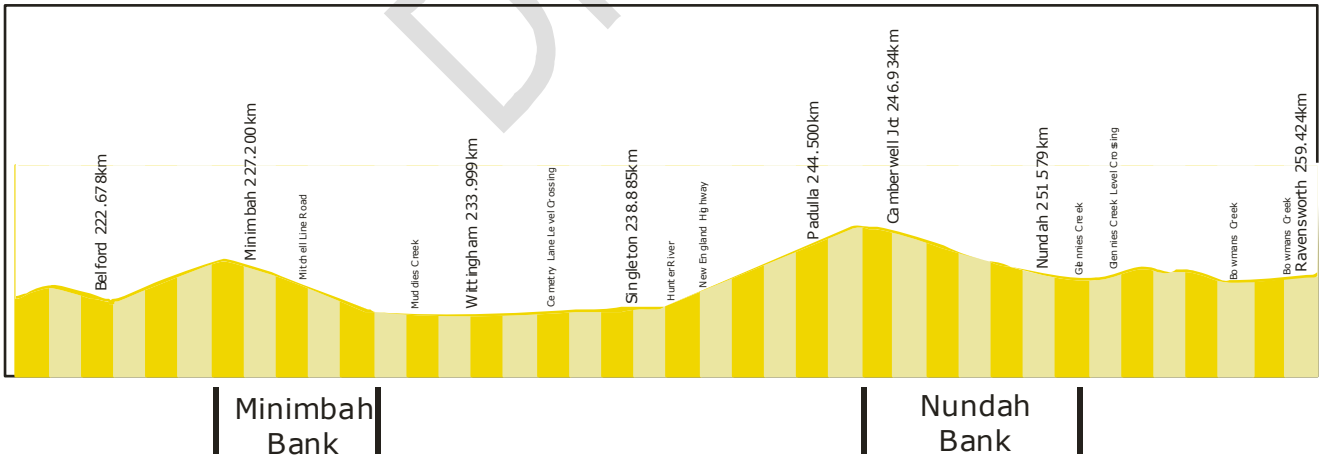
Around 60% of Hunter Valley coal trains negotiate Nundah Bank compared to 90% at Minimbah. However in order that pathing is harmonised over the length of the main coal network it is proposed that headways be reduced to 10 minutes over both grades .

The speed restricted Bowmans Creek bridge at 259 km will need to be restored or rebuilt for the headway harmonisation project to succeed.

The net outcome of the higher approach speed and reconfigured signalling would be to lift the line capacity from around 70 mtpa at Nundah and 80 mtpa at Minimbah to 140 mtpa at both.

This is based on 50 % of the available paths at 10 minute headways being allocated for coal working, with the remaining 50% shared between passenger, grain, ore and general freight trains and maintenance windows. Restoration of Pacific National '120 tonne' trains to their former length is included in the capacity enhancement estimate.

Trains departing from a stand at Whittingham (mainly from the Mt Thorley branch) will be unable to achieve the higher approach speeds at Minimbah and therefore will continue to take longer than through main line trains. This is likely to reduce the benefit arising from 80 km/h by around 5 mtpa. However, trains originating from Newdell Junction and Mt Owen Junction will both be able to achieve the higher approach speeds at Nundah.



2. Junction Conflicts

The Constraint

There are a number of junctions on the Hunter Valley rail network where trains travelling from coal loading branches have material conflict with empty trains travelling in the opposite direction on the main line due to slow junction speeds and the frequency of train movements. The three junctions that stand out as having this constraint are Whittingham, Newdell and Drayton. The latter two junctions also have high maintenance turnouts which result in excessive on track maintenance time and additional train delays.

Options

Options identified to remove this constraint were:

- Relay junctions with new high speed, low maintenance turnouts.
- Provide separate entry / exit tracks.
- Grade separation.

The three junctions have very different traffic patterns and each will require different treatment to achieve the best result.

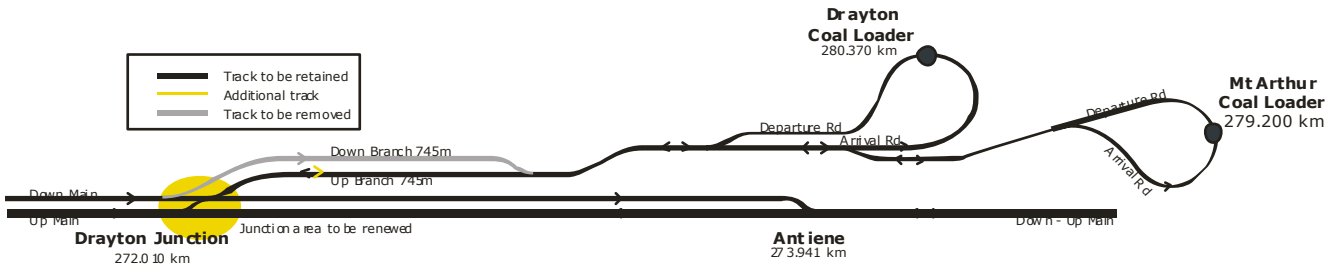
Relaying with high speed turnouts will enable reduced junction occupancy times as well as reducing ongoing maintenance costs. This is an obvious and simple option. Faster speeds through junctions may also allow simplification of the junction arrangements which would have further benefits in first cost, installation time and ongoing maintenance.

Separation of entry and exit tracks is appropriate where it is desirable to be able to hold an arriving empty clear of the main line, but may be partially offset by higher junction speeds. In general this option will have higher cost and in some cases be complicated by track ownership issues.

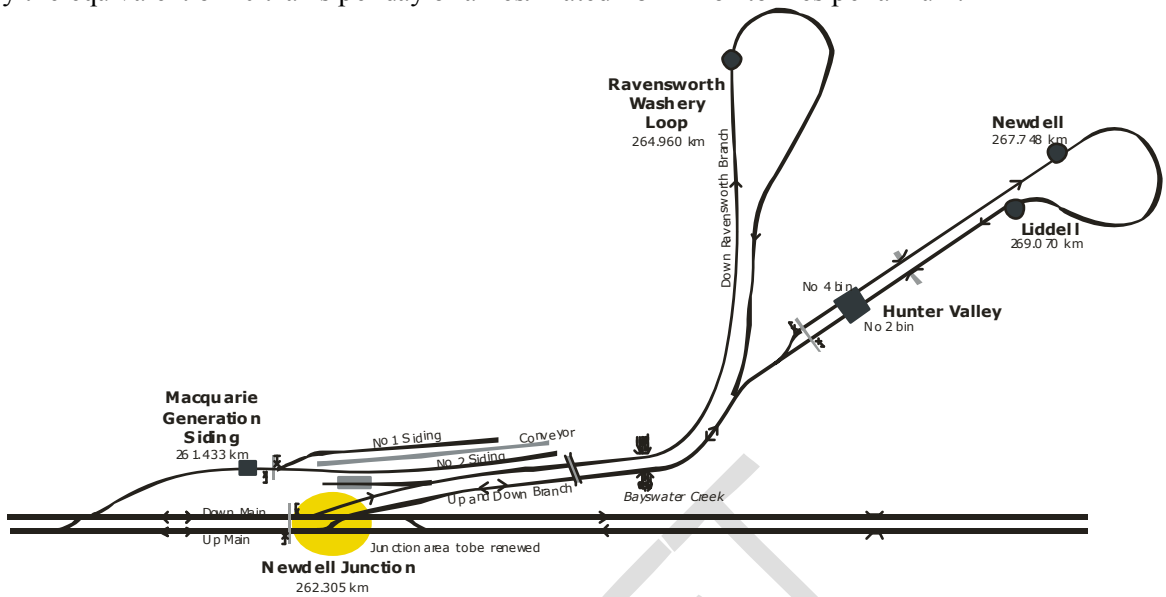
Grade separation is high cost but where train frequency is high could be justified to reduce conflicting moves and reduce the wear from loaded coal trains on main line turnouts and crossovers.

An initial assessment indicates that the first option is likely to be preferred for Newdell and Drayton Junctions, both of which have slow speed and high maintenance turnouts.

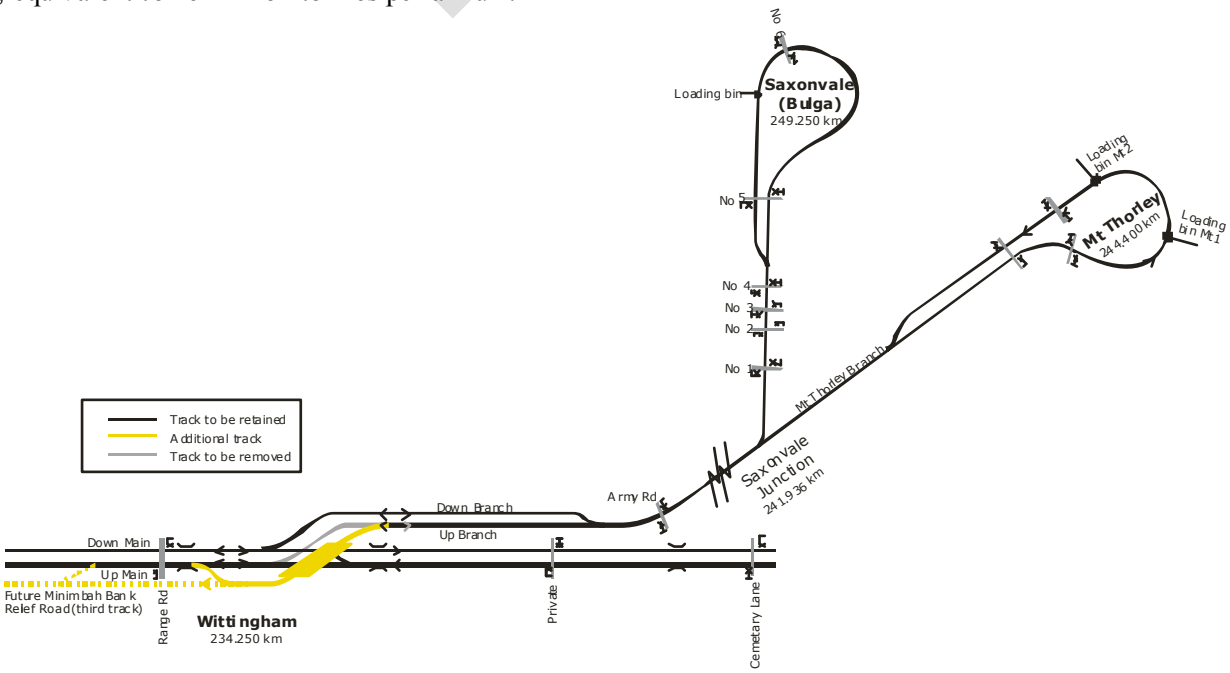
It is proposed that Drayton Junction also be renewed with 1:18 swing nose turnouts raising branch junction speeds from 25 km/h to 75 km/h. Times taken for a train exiting the branch will reduce from around 6.0 minutes now to around 3.0 minutes, effectively reducing the junction conflict time – in effect the junction could handle twice as many branch trains or an estimated increase of 8 northbound main line trains within the existing junction conflict time. Renewal of only the main line crossover and junction turnout will be required allowing removal of the branch crossing loop as a result of faster junction times, saving two turnouts in the new arrangement. Increasing junction speed for trains joining the main line will also facilitate operation of 10 minute headways. This project will increase loaded train capacity through the junction (on either the branch or main line) by the equivalent of 8 trains per day or an estimated 15 million tonnes per annum.



It is proposed that Newdell Junction be renewed with 1:18 swing nose turnouts raising branch junction speeds from 25 km/h to 75 km/h. Times taken for a train exiting the branch will reduce from around 4.5 minutes now to around 2.25 minutes, effectively reducing the junction conflict time – in effect the junction could handle twice as many branch trains or an estimated increase of 7 northbound main line trains within the existing junction conflict time. Increasing junction speed for trains joining the main line will also facilitate operation of 10 minute headways. This project will increase loaded train capacity through the junction (on either the branch or main line) by the equivalent of 10 trains per day or an estimated 18 million tonnes per annum.



The Mt Thorley branch line consists of about 8 km of single track between a branch crossing loop at Whittingham and the junction for the two (soon to be three) balloon loops near Mt Thorley. Main line turnouts are swing nose high speed units with a number of 55 km/h speeds associated with a curve and turnout adjacent to the main line. Initial estimates indicate that the single line section will be adequate for predicted train numbers to 2009, but conflicts at the Whittingham Junction are likely to become a constraint around that time. (coal train numbers at Whittingham are forecast to grow from 53 to 72 trains each way daily over the 5 year period). A flyover from the Mt Thorley line to join the up main line is proposed to be investigated to address this constraint. The flyover would remove conflicts with northbound main line trains, reduce the number of turnouts being used by loaded (high wear) trains and give loaded trains from Mt Thorley a small downgrade speed benefit approaching the Minimbah Bank. Reduction of junction conflicts and a marginally better approach speed to Minimbah Bank are initially estimated to improve junction capacity by the equivalent of 15 loaded trains per day, equivalent to 26 million tonnes per annum.



3. Single Track Sections between Antiene and Muswellbrook

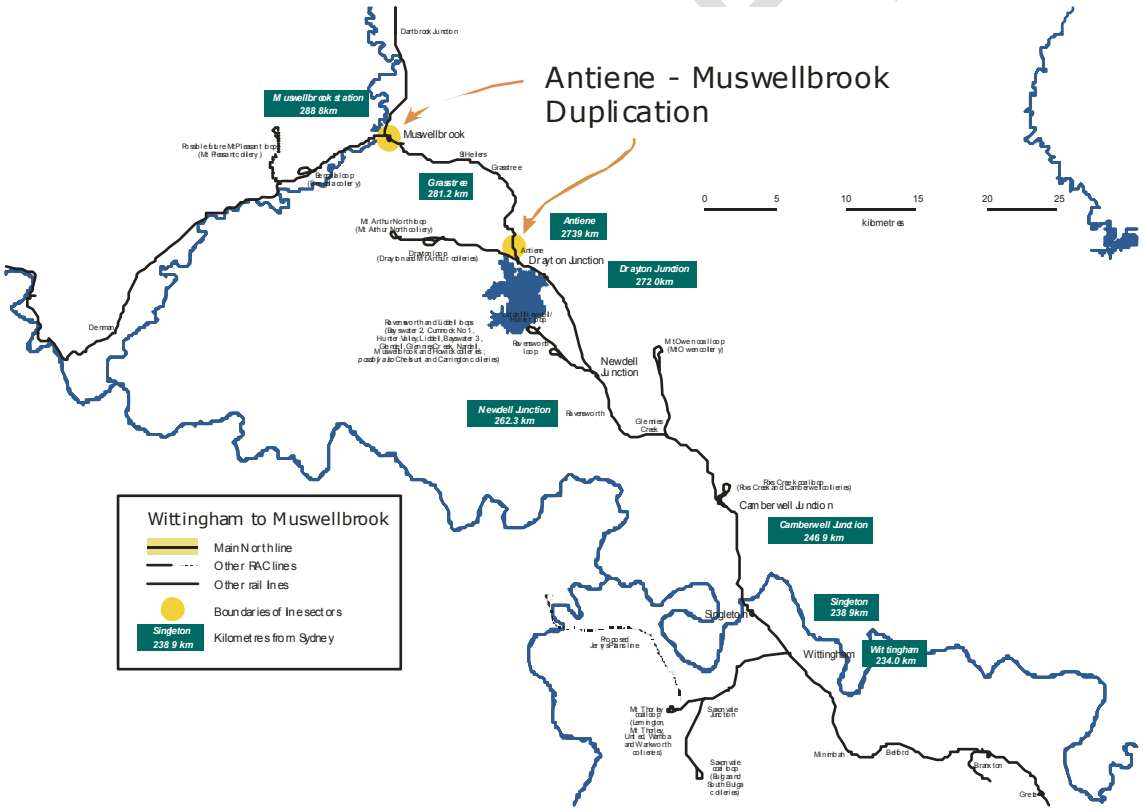
The Constraint

The two single track sections between Antiene and Muswellbrook have limited capacity compared to the adjacent track. Duplication work on this section was part completed when work stopped in the 1950's. Rock excavation at the southern end of this section and three Muscle Creek bridges between St Heliers and Muswellbrook remain to be done although most of the earthworks were constructed. While it is likely that substantial remediation work would be required to bring these formations up to contemporary standards for duplication, there will be a time and cost saving in not having significant cut and fill to perform adjacent to an operating track.

Coal developments on the Ulan line and proposed for Murrurundi, Werris Creek, Gunnedah and Boggabri would increase the numbers of coal trains through this area by 200% or more in the next 5 years. The existing track configuration (with single track Antiene to Grasstree (7 km) and St Heliers to Muswellbrook (4 km) restricts train numbers through this section to around 70 trains per day in total.

The centre of gravity of coal extraction in the Hunter is moving slowly north so that a disproportionate share of the growth tonnage is expected to occur at the northern end of the coal network.

Specific mining projects that are expected and will impact the existing single track sections are the very substantial domestic coal traffic from Wilpinjong (near Ulan) to Antiene, and new export tonnages from Anvil Hill (near Denman), Bickham (Murulla), Werris Creek, Gunnedah and Boggabri. If these projects are all realised it is anticipated that capacity of the single track section will not be sufficient by about 2008 .



Options

Options identified to remove this constraint were:

- Full duplication.
- Staged duplication (see also Muswellbrook Yard constraint).
- Deviation of the Ulan line from Antiene further to the west.
- Fewer, longer trains.

Full duplication would technically provide a jump in capacity from a nominal 36 mtpa to over 100 mtpa, but due to constraints on the "feeder" lines, capacity would be effectively limited to 25 mtpa, increasing to 60 mtpa with enhancements to the feeder lines.

Partial duplication as a result of the new long loop at the south end of Muswellbrook (see next constraint) would reduce the single track between St Heliers and Muswellbrook to 2 km, leaving the other single track section as the capacity controlling section.

Duplication of this section between Grasstree (280.5 km) and the summit at 278 km (2.5 km) on the largely cleared formation from the 1950's would leave two nominal 5 minute single track sections. Construction work on these sections would be considerably more complicated and expensive due to rockwork at the Antiene end and three bridges at the St Heliers end.

This configuration would be capable of handling the high end forecast train numbers (103 trains per day) for 2009, although with little margin. By adopting a staged approach, capacity can be ramped up in line with the growth of coal tonnage, rather than having a long lead time until any capacity relief can be provided. Partial duplication would provide capacity in line with the capacity required for the combined Ulan and Werris Creek lines. Full duplication would then be completed when required for growth in train numbers to give an ultimate capacity of around 140 million tonnes per annum.

Deviation of the Ulan line west of the town of Muswellbrook would run into significant problems with mine subsidence areas, mining leases and the normal environmental and planning processes. It would only partially solve the immediate capacity issue since the Werris Creek line would need to be retained and enhanced.

Provision of longer trains will only work to a limited degree. The longest '120 tonne' trains on the network already run to Ulan, Bengalla and Dartbrook as a matter of course. Lengthening Gunnedah line trains (which currently are short at 42 x 100 tonne wagons) will help, but not to the extent that work on the single track sections could be avoided.

An initial assessment indicates that the second option is likely to be preferred.

4. Muswellbrook to Ulan Single Track

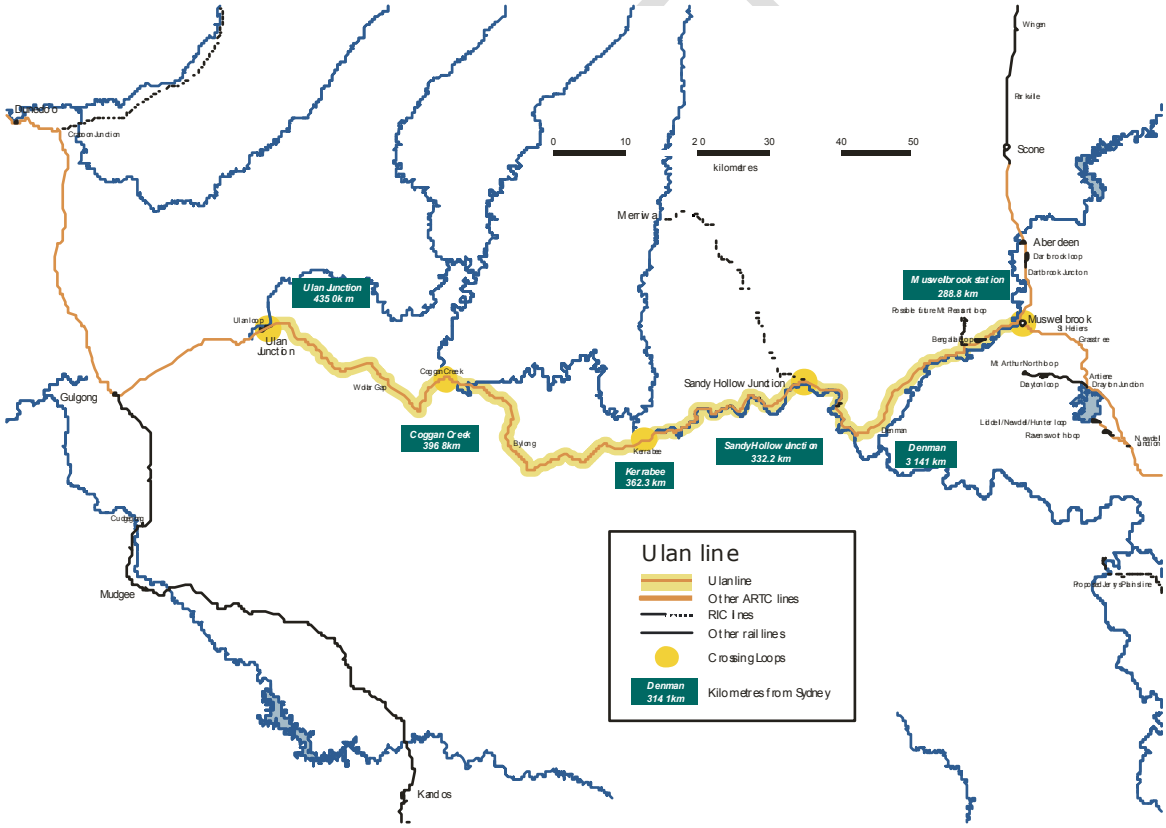
The Constraint

The Ulan line beyond Muswellbrook Staff Hut (7 km west of Muswellbrook) is operated under electric staff working and there are long distances between loops. In addition the section St Heliers to Muswellbrook Staff Hut adds significantly to the length of the busiest single line section since the loop at Muswellbrook is too short for normal coal working on this line.

Electric staff requires at least 60 minutes of avoidable delay to coal trains in each direction between St Heliers and Ulan. This entails 40 minutes dwell time each way as well as an estimated 25 minutes momentum stopping and restarting, thus reducing the line capacity.

The longest section on the line between (usable) crossing loops is between St Heliers and Sandy Hollow. This section includes Muswellbrook station which has a 50 km/h turnout at the south end and 25 km/h turnouts at the north end.

The crossing facility at Muswellbrook where the traffic to and from Ulan and Werris Creek merges needs to be a full length crossing loop to avoid the capacity constraint arising when Werris Creek and Ulan line trains need access to the Muswellbrook – St Heliers section at the same time. Provision of such a loop would also act as partial duplication of the section to St Heliers. Based on current forecast demand, additional loops on the existing Ulan line infrastructure will be required from around 2006.



Options

Options identified to remove these related constraints were:

- Installation of CTC remote signalling.
- Increasing train speeds.
- Additional loops.
- By-pass Muswellbrook to the west.

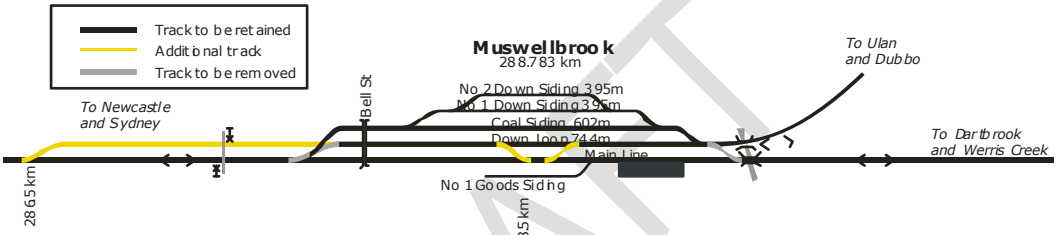
Installation of CTC will eliminate the currently required dwell times, thus reducing the cycle times for coal trains by up to 2 hours. This will have a significant effect on both capacity and reliability.

Provision of intermediate follow on signals (not possible with the existing system) would provide additional capacity by allowing flighting of trains in one direction at a time.

Increasing coal train speeds would not have a great effect on times overall (there is significant curvature and gradients on the Ulan line), but increasing track speeds through Muswellbrook will have a significant effect in the longest single line section.

Increasing track speeds through Muswellbrook depends on rationalising the north end of Muswellbrook station, but in so doing it will improve train speeds on both the Ulan and Werris Ck lines. It will also facilitate provision of a long crossing loop capable of handling all trains. A secondary (social) benefit is the removal of much of the crossing activity away from the immediate town area.

Based on Ulan line trains running at 50 km/h at the north end of Muswellbrook station (instead of 25 km/h, improved as a result of removing the north end junction from its current location entirely) coupled with a crossing loop with normal 1:18 swing nose turnouts between 286.5 km and 288.5 km, there will be a saving of 7 minutes in run time as well as reduction of the longest single line section from 57 to 49 minutes. This will enable capacity of the Ulan line to be raised by 4 trains per day.



Capacity of the Werris Ck line will also be enhanced by increasing north end track speed from 35 km/h to 60-70 km/h while having a similar benefit from the new crossing loop. Capacity on this line, which includes typically up to 10 grain and general freight trains and one long distance and three local passenger trains (a fourth terminates at Muswellbrook) in each direction will be enhanced by a lesser amount but would amount to around 3 trains per day.

The remaining single track section between Muswellbrook and St Heliers would be around 2 km long, but would include three of the Muscle Creek bridges that are in need of remediation or renewal (one of the Muscle Ck bridges is just on the double track at St Heliers but may be able to be more effectively renewed by moving the junction south by around 150 metres).

By-passing Muswellbrook to the west is only realistic for the Ulan line (as noted in Section 3). The Werris Creek line would gain no operational advantage in by-passing Muswellbrook.

An initial assessment indicates that the first and second options are likely to be preferred.

With CTC the capacity will rise to 15 trains per day (7-8 each way). This is still below the expected demand after Wilpinjong and Anvil Hill are in full production. Follow-on signalling capability, which can be provided with new intermediate loops, will assist in expanding capacity by perhaps one additional train each way daily.

Completion of the Muswellbrook yard improvements will enhance capacity to an estimated 20 trains per day (10 each way) by shortening the long Sandy Hollow – St Heliers section from 57 minutes to 49 minutes, This is just adequate for the high end forecast train numbers at 2009. Intermediate crossing loops will be required by around 2008 between Muswellbrook - Sandy Hollow and Kerrabee - Coggan Ck to cater reliably for the 2009 forecast tonnages.

CTC, overlaid on the existing infrastructure and coupled with the Muswellbrook Yard project will allow coal tonnes on the line west of Bengalla Junction to be increased from 5.85 million tonnes now to around 16 million tonnes per annum with a further 5 million tonnes capacity available by installing two intermediate loops.

5. Conflict between Maintenance and Train Running

The Constraint

The requirement for on track maintenance inevitably results in some loss of capacity for coal trains, becoming more significant as coal tonnages increase (higher maintenance requirement with greater loss of coal capacity for same time on track).

Options

Options identified to remove this constraint were:

- Additional tracks to allow more on track time while retaining train running capacity.
- Bi-directional signalling, allowing some train running while maintenance is being carried out.

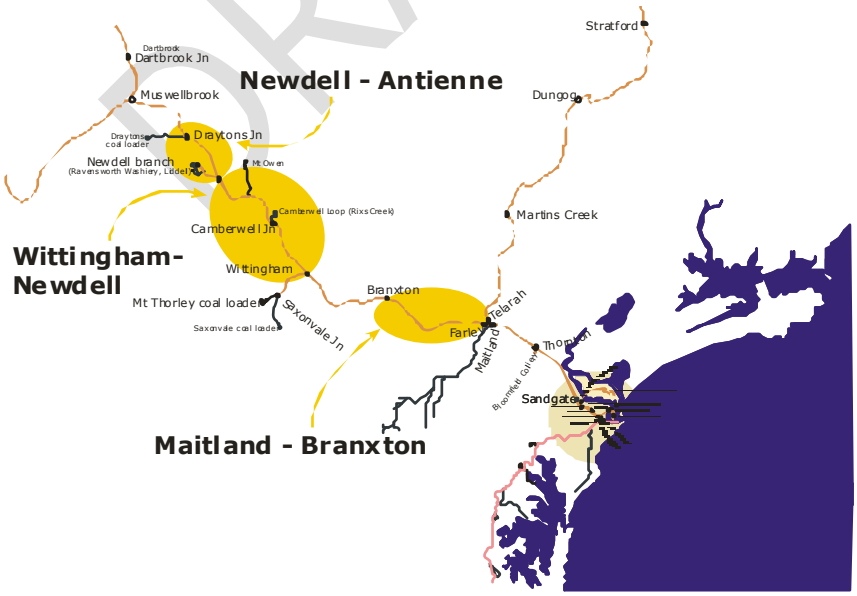
For both of these options a secondary benefit is the ability generally to recover from train or track failures more quickly than would be the case with a single track or with uni-directional track.

Provision of an additional track is a high-cost, long lead-time option that would only be appropriate where capacity enhancement is approaching its limit with the existing number of tracks. Bi- directional signalling, while not cheap, provides a degree of operational flexibility without the cost of extra track and will allow postponement of track enhancement in some cases.

An initial assessment indicates that the second option is likely to be preferred.

If it is adopted it is envisaged that bi-directional signalling would be implemented in three stages:

a) Maitland to Branxton
b) Whittingham to Newdell Junction
c) Newdell Junction to Antiene



These projects would interface with the bi-directional signalling already installed between Branxton and Whittingham. They would avoid the loss of paths due to maintenance and failures rather than add capacity as such. It is estimated that the projects would between them release track capacity equivalent to around 3 mtpa associated with planned work. Each of the three projects would release a further 1.5 mtpa each 'saved' from failures and short notice maintenance. The total benefit of the combined projects is therefore estimated to be in the order of 7.5 mtpa..

Stages b) and c) would also facilitate the operation at coal branch junctions by allowing standing empty trains to be by-passed by following trains.

6. Limited Capacity on the Main North Line beyond Dartbrook

The Constraint

Coal and grain trains from the Werris Creek line are limited to around 750 metres by loop lengths and the severe grades over the Liverpool Range. These short trains occupy a relatively high number of coal paths both north and south of Muswellbrook.

The severe grades are only encountered on the short section between Murrurundi and Willow Tree but dictate limits for train operation for the whole Werris Creek to Newcastle line. The requirement for 'banker' locomotives over this section for coal and grain means that this section will reach capacity earlier than the remainder of the line because the return of banker locomotives adds 50% to train numbers that need to be handled.

Options

Options identified to remove the related constraints of train lengths and severe grades were:

- Lengthening selected loops between Muswellbrook and Boggabri to allow consolidation of coal and grain into longer but fewer trains.
- Re-alignment over the Liverpool Range to increase capacity at that location.
- Duplication of track on the north face of the Liverpool Range.

The need for implementation of any of these options will be dependent on future growth of coal tonnages shipped by mines on this line.

Lengthening of crossing loops is an option that can be implemented progressively provided future train lengths and eventual train frequencies are established with reasonable certainty at an early stage. If the Liverpool Range section is to remain, the technical length limit for trains will be in the region of 1300 metres due to issues with in-train forces on the steep grades. If that section is to be by-passed the length limit will be at least 1550 metres, but could be longer using distributed power.

Lengthening of trains cannot realistically be implemented until at least some crossing loops are capable of accommodating them.

Re-alignment over the Liverpool Range on a new route is likely to be the more expensive option, but would have the advantage of removing the grade as a constraint.

Duplication of the existing north face track to provide capacity for the 'banker' operation would probably be quicker and lower cost than re-alignment, but would not remove the root cause of the capacity problem.

An initial assessment indicates that the new route at the Liverpool Range may be desirable in the longer term, provided that a mainly surface route can be located. Anecdotal evidence indicates that this is possible by tracking west of the existing route between Blandford and Willow Tree

Simulation indicates that 4/3000 hp locomotives, with 3/2000 hp (enhanced) locomotives as pushers over the Liverpool Range, should be able to convey loads of 72 x 100 tonne wagon trains, compared to the existing 42 wagon trains.

Regardless of the type of train employed, there will be a need to enhance infrastructure if the high end 2009 forecasts are realised. Initial analysis suggests that extending loops to accommodate longer trains would be the preferred strategy since it will provide a gain of 5 loaded paths per day south of Muswellbrook by 2009 (worth around 9 mtpa) as well as keeping operations north of that location within realistic technical bounds. Consolidation of grain trains into longer consists should enable saving of an additional path.

It is estimated that 6-7 loop extensions would eventually be needed between Muswellbrook and Werris Creek with a further two from there to Boggabri to allow running of longer coal (and grain) trains.

The high end 2009 forecast tonnages will create significant problems between Willow Tree and Murrurundi over the Liverpool Range. Bank engine working will create localised track capacity problems while rolling stock and track limitations will limit the ultimate capacity over the range on the existing track alignment.

Loop extension should start from the south end to take advantage of the immediate ability to run Bickham traffic in longer trains – these trains load south of the Liverpool Range and do not require the 'banking' that is required for Gunnedah Basin trains.

Secondary issues that need to be dealt with are:

- The restriction of loaded 100 tonne coal wagons to 65 km/h. This restriction adds to the section times and makes train handling over the undulating sections of track harder than would be the case with 80 km/h.
- The speed restricting configuration of Scone Loop which has an asymmetric configuration, and a short loop that is only of real use for passenger working.

8. Wagon Capacity and Train Length Limitations

The Constraint

The core Hunter coal network is now operating to a 30 tonne axle load standard. Coal wagons making use of this limit are built to the full width and height allowable for standard rolling stock outlines. Increasing axle loading to higher limits would allow more coal to be hauled for a given number of trains. To achieve additional loading while retaining similar wagon lengths to now will require wider and higher rolling dimensions than are now able to be run. A secondary issue is the inability to acquire and run standard design heavy haul locomotives and wagons 'off the shelf', resulting in long acquisition lead times and additional acquisition costs.

Secondary coal routes in the Hunter network have a 25 tonne axle load limit. It would be desirable to bring lines at this standard that serve mining areas with long life reserves up to the same standard as the core of the network.

Options

Options considered are:

- Increase axle loading to the American standard of '286,000 lb' (= 32.5 tonnes axle load).
- Increase axle load to higher than 32.5 tonnes.
- Enlarge the coal route rolling stock outline to AAR plate E outline (15ft 9in by 10ft 8in)
- Bring selected 25 tonne axle load lines up to the same standard as the core network

Increasing axle loading to the American standard in conjunction with an enlarged rolling stock outline would allow up to 12 tonnes additional coal per wagon within the same train length constraints as now (i.e. 60 wagon trains would go from 5700 to 6420 tonnes of coal). Increasing to higher than 32.5 tonne axle loads would tend to get back into purpose built rolling stock with similar lead times and costs as now.

Lifting 25 tonne lines to 30 tonne axle load standard (with ability to go higher when that becomes the standard) will allow significantly more efficient train operations on these lines – notably, this would apply on the route between Muswellbrook and Boggabri.

The higher axle load and larger rolling stock outline are projects that will be a long time in realisation. Their benefit will come when the existing infrastructure is reaching its technical capacity and track amplification or other high cost response is the answer. However both projects, which should ideally be done conjointly, need to be established as goals early on and progressively implemented with every project that involves track or structures. For instance provision of newly duplicated track, new main line crossovers and rebuilding bridges will all involve adjustment to meet the new dimension and strength standards.

Recommended Projects

The projects listed in **Table 1** are recommended for implementation as the preferred options for addressing the constraints of:

1) Restricted headways on Minimbah and Nundah Banks.
2) Muswellbrook to Ulan Electric Staff running and long distances between passing loops.
3) Speed restrictions and inadequate loop at Muswellbrook.
4) Junction conflicts at Newdell and Drayton Junctions.
5) Single track between Antiene and Muswellbrook.

Table 1: Recommended Projects

Priority	Project	Benefit	Approximate Time to Complete	Capacity pre work MTPA	Capacity after work MTPA
1	80km/hr running for "120T" coal trains	Overall capacity increase estimated to be 17 to 22 MTPA due to capacity increase on upgrades and longer trains. Saving of at least 2.5 minutes on 'ruling' headway. Return by PNL to 60 and 91 wagon trains will contribute to capacity gains	6 to 8 months	80	102
			6 to 8 months	69	86
			3 years		
2	Minimbah Bank Resignalling	Capacity increase of around 35 MTPA due to improving headway to 10 minutes with potential for 8 minutes.	18 months.	102	140
3	Nundah Bank Resignalling	Capacity increase of around 50 MTPA due to improving headway to 10 minutes with potential for 8 minutes.	18 months	96	140
4	Ulan Line CTC	Gives direct benefit of 4 MTPA plus an additional 4 MTPA when Muswellbrook Yard (5) taken into account	18 months	8	16
5	Muswellbrook Yard	This project will increase capacity on both the main and branch lines (including some small gains from reduced on track maintenance time) and enhance overall reliability.	24 months	incl in Ulan CTC	incl in Ulan CTC
6	Antienne to Muswellbrook Duplication (2 Sections)	Staged approach proposed, constructing Muswellbrook Loop (see (5)) and easier part of Grasstree - Antiene section early then remainder when necessitated by tonnage. Antiene turnout restricts headways between there and Drayton Jn and is high wear	18 months	36	38
			30 months	38	64
			5 years		
7	Newdell Junction and Branch	Times taken for a train exiting the branch will reduce from around 4.5 minutes now to around 2.25 minutes, effectively reducing the junction conflict time – in effect the junction could handle twice as many branch trains or an estimated increase of 7 northbound main line trains within the existing junction conflict time. Increasing junction speed for trains joining the main line will facilitate operation of 10 minute headways (projects 2 and 3). Reduced maintenance will increase paths available over a typical year (not quantified). New junction should increase capacity by equivalent of 10 loaded trains	18 months	90	108
8	Drayton Junction	Times taken for a train exiting the branch will reduce from around 6.0 minutes now to around 3.0 minutes, effectively reducing the junction conflict time – in effect the junction could handle twice as many branch trains or an estimated increase of 8 northbound main line trains within the existing junction conflict time. At the same time renewal of the main line crossover and junction turnout and abandoning the branch crossing loop will be possible with faster junction conflict times, saving two turnouts in the new arrangement. Increasing junction speed for trains joining the main line will facilitate operation of 10 minute headways (projects 2 and 3). Reduced maintenance will increase paths available over a typical year (not quantified). New junction should increase capacity by equivalent of 8 loaded trains	3 years	80	108

The projects listed in **Table 2** are recommended for detailed definition to address the constraints of:

1) Conflict between maintenance and train running between Maitland and Branxton.
2) Conflict between maintenance and train running between Whittingham and Newdell Junction.
3) Conflict between maintenance and train running between Newdell Junction and Antiene.
4) Mt Thorley branches congestion.
5) Limited capacity on Main North Line beyond Dartbrook.
6) Wagon capacity and train length limitations.

Table 2: Projects for Further Development

Priority	Project	Benefit	Approximate Time to Complete	Capacity pre work MTPA	Capacity after work MTPA
9	Maitland-Branxton Bi-Directional Signalling	It is assumed (subject to better data yet to be obtained) that two paths per week would be saved, equivalent to around 0.5 million tonnes per annum. In addition the project would give the ability to bypass trains under failure conditions (greater reliability).	3 years	136	140
10	Whittingham to Newdell Bi-Directional Signalling	As for Maitland - Branxton Bi-directional Signalling (#9) plus empty trains standing at junction could be bypassed by other empty trains by using opposing track reducing need for loops or duplication on branch lines (Camberwell, Mt Owen, Newdell/Ravensworth).	3 years	136	140
11	Newdell Junction to Antienne Bi-Directional Signalling	As for Maitland - Branxton Bi-directional Signalling (#9) plus simplified Drayton Junction Renewal.	3 years	136	140
12	Mt Thorley Branches Crossing Loop or duplication	Flyover for loaded trains to cross over empty northbound track, will reduce conflict delays and estimated to increase capacity by equivalent of 15 loaded trains	Long term	115	140
13	Extended Loops between Muswellbrook and Boggabri	More detailed study required. Potential saving of 5 daily coal paths would be worth around 9 million tonnes per annum over the main coal trunk. Amalgamation of grain trains into longer consists should enable saving of an additional path.	Long term	7	12
14	Deviation or regrade over Liverpool Range	More detailed study required.	Long Term - high end forecasts	6	20
15	Adopt Higher Axle Loads	Capacity increase for wagons from 120 tonnes gross to 130 tonnes gross. This would allow a progressive improvement over time as rolling stock is replaced. It could result in 10 to 12% increase in train capacity if introduced in conjunction with AAR outline gauge. Adoption of these standards would allow importation of 'off the shelf' equipment from just about anywhere in the world, with potential for reduced equipment costs.	Long term	140	156
16	Adopt AAR Rolling Stock Outline (Plate E)	Adoption of these standards would allow importation of 'off the shelf' equipment from just about anywhere in the world, with potential for reduced equipment costs. It would also permit additional width and height of wagons which would give higher axle loads without the requirement to lengthen wagons.	Long term		included in project 16

The busiest section of the Hunter Valley route is between Whittingham (junction for Mt Thorley) and Sandgate. This line section handles 90-95% of export coal passing through the Newcastle Port. The critical constraints are located on this section, at Sandgate (flat crossing of the main lines – being replaced by a grade separation) and on the Minimbah Bank. The time line for capacity enhancement on this line section relative to (forecast) demand is as follows

Table 3: Coal Capacity Timeline – Whittingham to Newcastle

Project	Completion	Project Capacity (mtpa)		Route Capacity	Demand
		from	to	(mtpa)	(mtpa)
Existing	February 2005			**85**	**85**
Minimbah 80 kmh	September 2005	85	102	**90**	**90**
Sandgate Grade Separation	March 2006	90	155	**102**	**90**
Re-signal Minimbah	December 2007	102	140	**110**	**100**
Bi-di signalling Maitland –Branxton (a)	December 2007	135 (110)	140 (115)	**115**	**100**
Whittingham flyover	June 2008	115	140	**140**	**115**

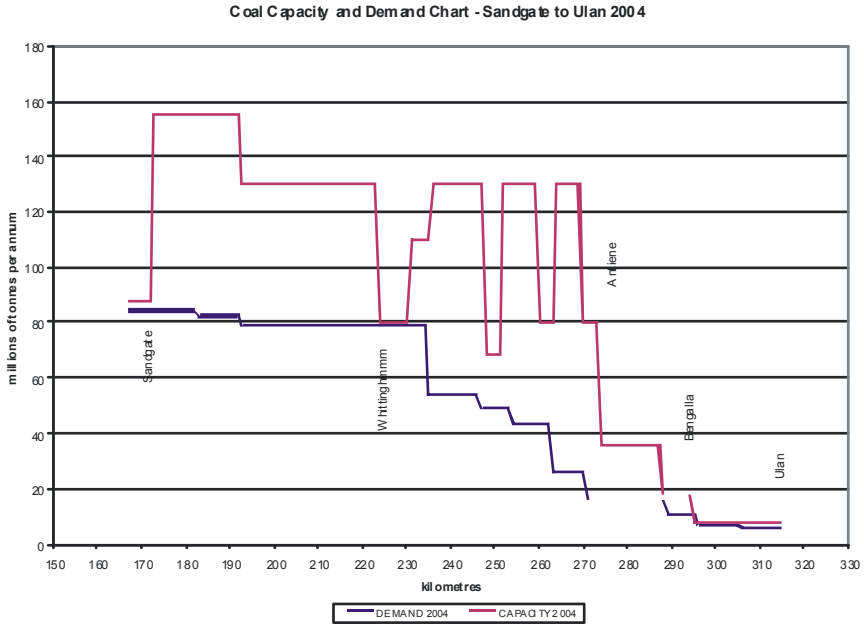
NOTE (a): the bi-di signalling will have a relative effect on top of whatever capacity exists on the route (bracketed numbers flag initial benefit, clear numbers the eventual benefit)

In summary, capacity on rail will be broadly in line with capacity of the rest of the coal supply chain until the Sandgate grade separation is completed. After that time the planned enhancement program will progressively move ahead of the anticipated demand through to 2009.

Coal Demand and Capacity

The following chart (Chart 1) illustrates the required and available capacity of the Hunter Valley rail network for delivery of export coal to the port of Newcastle in 2004.

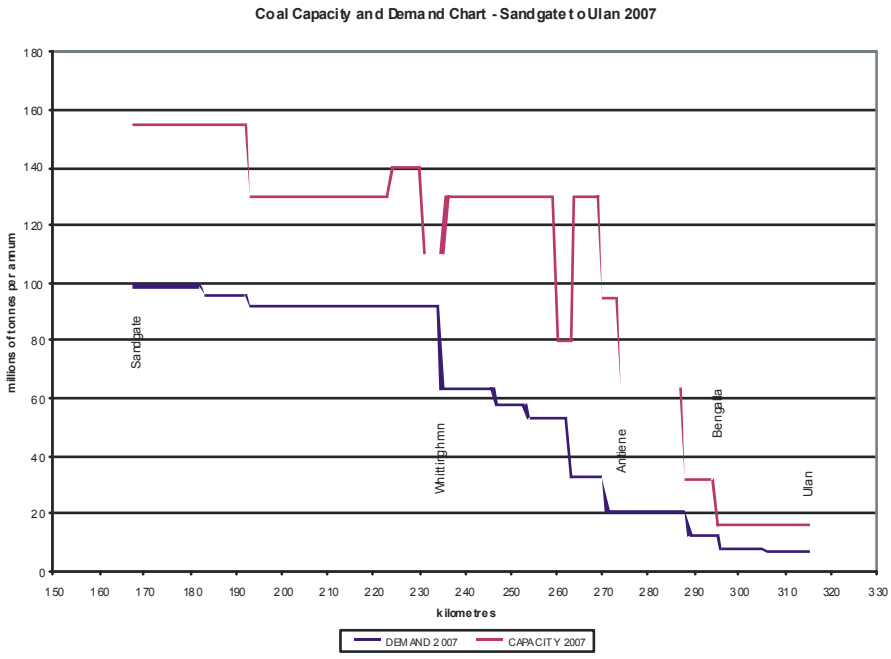
Chart 1: Capacity and demand as at 2004 (85 mtpa)



It will be noted that capacity is quite uneven along the length of the line, with several notable 'intrusions' that are current constraints on coal throughput. The most significant are at Sandgate, Minimbah Bank and the Ulan line.

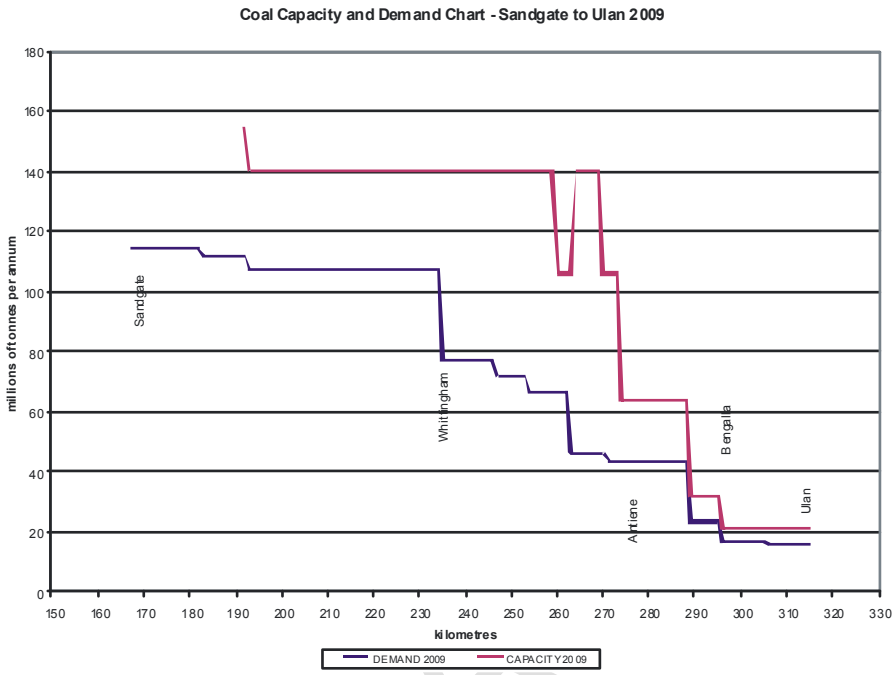
The following chart (Chart 2) illustrates the required and available capacity of the Hunter Valley rail network for delivery of export coal to the port of Newcastle in 2007 if the projects listed in Table 1 are implemented in accordance with the Implementation Program.

Chart 2: Capacity and demand as at 2007 (100 mtpa)



Projects planned for early completion (including Sandgate, which is external to this report) are planned to smooth the capacity line and in all cases to lift it above the demand line that has been identified by the industry. The following chart (Chart 3) illustrates the required and available capacity of the Hunter Valley rail network for delivery of export coal to the port of Newcastle in 2009 if the projects listed in Tables 1 and 2 are implemented in accordance with the Implementation Program.

Chart 3: Capacity and demand as at 2009 (115 mtpa)



By 2009 the capacity line will be substantially smoothed, with sufficient cushion to allow further capacity enhancement in line with new coal output development.

Along the length of the Hunter Valley coal route there will be a 'cushion' capacity sufficient to allow significant short term surge traffic and/or to allow time for further enhancement of capacity while coal volumes are still growing.