Maldon-Dombarton Rail Link Feasibility Study

Final Working Paper 1: Demand and Engineering

Prepared for the Department of Infrastructure and Transport

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Hyder

ACIL Tasman

Economics Policy Strategy

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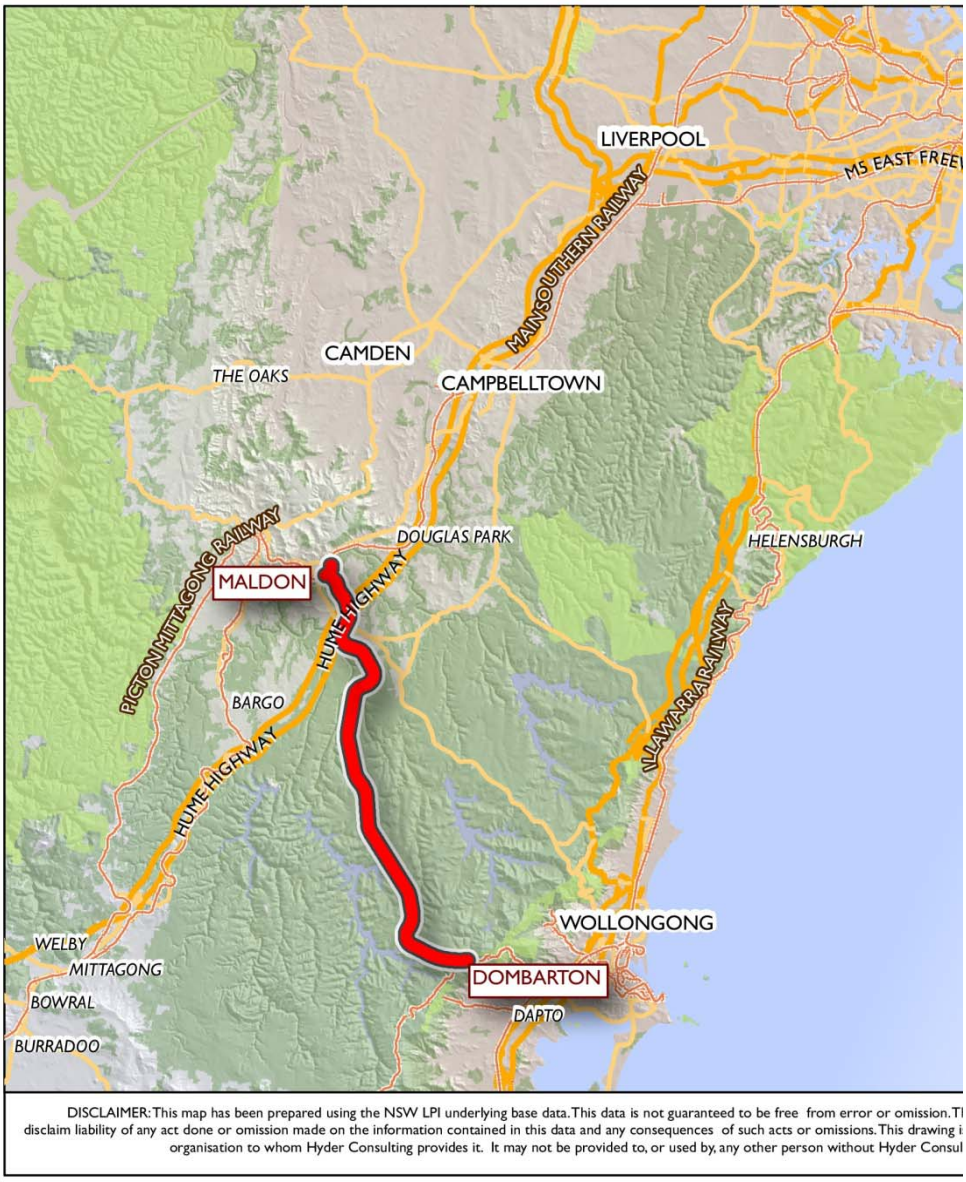
Executive summary

A Maldon-Dombarton rail line would link Port Kembla to the main southern rail line near Picton, NSW. It would provide a new route and additional capacity between the port and its hinterland, including coal mines and the growing area of south-west Sydney. The route is shown on the following map.

Location of Maldon-Dombarton rail line



[a] Source: Hyder Consulting

Construction began but was abandoned by the NSW Government in 1988 because the line was considered to be uneconomic. Export coal demand has increased in recent years, and a pre-feasibility study of completing the line was undertaken in 2009. On 22 January 2010 the Commonwealth Minister of Infrastructure and Transport announced that ACIL Tasman and Hyder would undertake a full feasibility study.

This study is part of the bigger picture of freight services to and from Port Kembla. The port initially served the steelworks there, and now also handles other exports (e.g. coal) and imports (e.g. cars). Freight services are provided on the Illawarra (coastal) line, the Moss Vale-Unanderra line, and by road.

This Working Paper covers engineering and demand aspects of the feasibility study. A second Working Paper will cover environmental, and economic and financial aspects.

Demand

Estimates of demand for a potential Maldon-Dombarton rail line need to consider:

- current and future demand for freight to and from Port Kembla, irrespective of route or mode
- new demand that would be induced by a Maldon-Dombarton rail line but would probably not otherwise move
- the preferred means of transport (road, or a particular rail route) for each component of demand
- capacity limits or other constraints on road freight and on the existing rail lines
- relevant rail capacity issues elsewhere in the Sydney area
- competition between ports, and developments at ports, that could result in diversion of sea freight to Port Kembla.

The demand forecasts were converted into forecast road freight, and to forecast train numbers by route, after allowing for capacity constraints. The train numbers forecast for a potential Maldon-Dombarton rail line are a combination of trains serving demand that would naturally use that route, and trains that overflow from other routes when capacity on them is reached.

Passenger services were found to be uneconomic in an earlier pre-feasibility study and are not included in the terms of reference.

Coal

The most important type of freight a potential Maldon-Dombarton rail line would carry is coal, both in terms of tonnage and revenue (a rail access price for coal is usually higher than for some other types of freight).

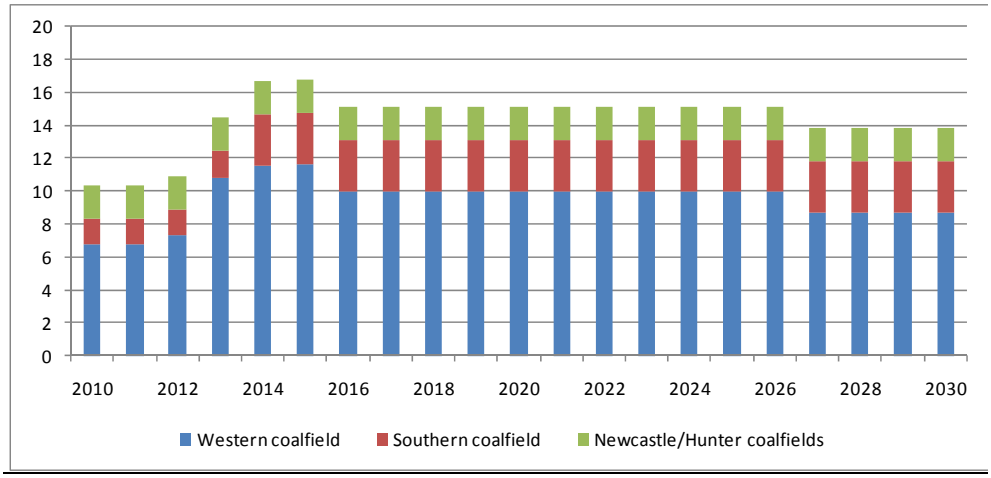
Two coal districts are relevant to a potential Maldon-Dombarton rail line:

- the Southern Coalfield, effectively the Port Kembla hinterland. About half of this coal is exported through Port Kembla while the other half is sold to the steel, coke, cement and other industries. The relevant mines include Tahmoor and Appin/West Cliff, both near Maldon. There are also coal deposits under northern part of the line itself, at East Bargo although little is known about minable quantities in this area.

  Most other mines in the Southern Coalfield are either on other lines (Moss-Vale-Unanderra, Illawarra) and would not use a potential Maldon-Dombarton rail line, or are small. No new mines are expected to become operational in the Southern Coalfield, although upside scenarios will be modelled in the cost benefit analysis to determine the impacts of coal from an East Bargo deposit or from Sutton Forest.
- The southern part of the Western Coalfield, around Lithgow. Output in this area is expected to grow intially as new mines open or expand, assuming favourable international coal prices continue, and decline later in the study period as older mines get depleted – though upside scenarios involving growth are also modelled. Some is used for power stations and the rest moves to Port Kembla on the Blue Mountains line, part of the Sydney freight network and the Illawarra line, all of which are congested. There is potential for some or all of this coal to divert to the potential Maldon-Dombarton rail line. It is expected that coal further north in the Western Coal District will continue to be exported through Newcastle and not switch to Port Kembla.

Future coal output relevant to a potential Maldon-Dombarton rail line has been estimated on the basis of the trends over the past decade, with no allowance for the more speculative sources such as East Bargo. The forecasts are summarised in the figure below. These tonnages would be lower to the extent that coal continued to be carried on the Illawarra and Moss Vale-Unanderra lines. They would be higher if East Bargo could be exploited or if Appin/West Cliff switched from road to rail.

Projected volume of coal to Port Kembla relevant to the Maldon-Dombarton rail line, by coalfield, 2011 to 2030



Grain

The grain industry considers Port Kembla an efficient grain exporting port, both because of the port facilities and the convenience of the Moss Vale-Unanderra line. It is preferred to the Port of Newcastle which has inefficient rail arrangements at the port and is served by the congested Hunter Valley line.

Grain output is growing only slowly, a trend of around 1% a year. The portion of grain output that is exported from NSW is typically 40% but depends on the harvest, as domestic demand is served first. In bad years very little is exported while in good years up to 70% of the crop is exported, with trucks carrying the overflow that railways cannot handle in peak months.

Export grain from southern New South Wales is sent through Melbourne or Port Kembla. Export grain from central New South Wales is mainly railed via Cootamundra and Moss Vale and exported from Port Kembla. Grain from northern New South Wales is mainly exported through Newcastle but some is exported through Brisbane and some through Port Kembla via Cootamundra.

A Maldon-Dombarton rail line would not be as convenient as the Moss Vale-Unanderra line, because the grain comes in from the west and Maldon would be a detour. Hence, although we expect grain exports through Port Kembla to remain steady at around 1.0-1.5 Mtpa in a typical year, there is no grain tonnage in our forecasts for the potential Maldon-Dombarton rail line.

There is a regular domestic grain service moving approximately 0.5 Mtpa of grain from Manildra, Narrandera and Gunnedah to Manildra's starch plant at Bomaderry. These 6 services per week are expected to remain on the Illawarra line.

Gold, copper

Gold and copper is exported from:

- Cadia Hill near Orange, through Port Kembla via the Illawarra line
- Northparkes near Parkes, through Port Kembla via the Moss Vale-Unanderra line.

Both producers expect to increase output substantially, and the Cadia Hill output (at present 0.35 Mtpa) could switch to a Maldon-Dombarton rail line. There would be up to six trains per week from the Cadia mine and up to three trains per week from Northparkes.

Iron ore

Iron ore deposits are being explored around Cobar, inland from Dubbo, and at Lockhart, south-west of Wagga Wagga, as well as larger desposits further away in the Broken Hill region. Potential output is up to 2 Mtpa and 20 Mtpa respectively. Port Kembla is the preferred port and says it could install the necessary facilities by 2013 if the demand was there.

In principle either the Moss Vale-Unanderra or potential Maldon-Dombarton rail lines could be used for additional iron ore freight. The former could cope with tonnages at the lower end of the forecast range but it may be necessary to construct a Maldon-Dombarton rail line or upgrade the Moss Vale line if the higher tonnages eventuated. Furthermore if the higher tonnage forecasts of iron ore eventuated a Maldon-Dombarton rail line would need to be built for higher capacity than in the basic design discussed later in this Working Paper through additional passing loops.

At this stage iron ore freight is speculative and is not included in our base forecasts. However it offers a major potential upside for a Maldon-Dombarton rail line and should be built into future planning in ways discussed in Working Paper 2.

Cement and Limestone

Cement Australia would use the Maldon-Dombarton rail line, if it was economical, for cement from their Port Kembla plant to Sydney and possibly Canberra markets. Annual tonnages would build up to around 800,000 tonnes p.a. The alternative is trucks. The input commodities come by ship.

Blue Circle Southern has cement plants in Maldon and Berrima. It also supplies limestone from Marulan. They see their potential use of a Maldon-Dombarton rail line as 500,000 tonnes p.a.

Kaolin

Sydney Construction Materials is planning to export an initial volume of 0.5 Mtpa, growing to 1.5 Mtpa, from Lithgow to Port Kembla. This could use the proposed Maldon-Dombarton rail line for up to 3 train services per week.

Biofuel

Manildra produce ethanol at Bombaderry, south of Port Kembla; any implications for rail are relatively minor and long term.

National Biofuels is developing a soybean biodiesel plant in Port Kembla. In the longer term approximately 1.3 Mt of soy beans will be brought in from three areas in NSW, some using the proposed Maldon-Dombarton rail line. Some of the biodiesel output would also be transported on the line.

Steel

Bluescope Steel's plant at Port Kembla uses iron ore brought in by ship, limestone railed from Marulan, and coal railed from nearby for blending, from Newcastle. The steel from the plant is mainly transported by sea and rail; the Illawarra line is preferred because its ruling gradient of 1:75 is much less steep than on the Maldon-Dombarton or Moss Vale – Unanderra lines (both 1:30).

Cars

Pork Kembla is NSW's car import port. The auto logistics companies use trucks to get the cars to Sydney and elsewhere in NSW, on economic grounds related to double handling rolling stock investment costs. One company has an interest in using rail, but it is a marginal decision, without the others there is unlikely to be enough critical mass. The Illawarra line is available and the Maldon-Dombarton rail line would not change the "pick up and delivery" cost ("PUD cost") problem which makes rail freight of automotives unprofitable.

Containers

Port Kembla's new Outer Harbour development is suitable for container trade if served on the land side by rail (for space reasons only a small portion could be handled by truck). Some secondary trades (e.g. Pacific Islands) are starting to use Port Kembla.

The major shipping companies prefer to stay at Port Botany. That port is being expanded and there are proposals to improve its congested road and rail connections. On the assumption that Port Botany's capacity is 5 MTEUs per annum (56% higher than at present), it would reach capacity towards the end of our study period (around 2029). This is based a scenario of annual growth

tapering off from 8% to 5% over the forecast period. Should Port Botany's capacity be higher, this capacity constraint is deferred. NSW Department of Transport recently used a potential capacity of 8.664 MTEUs per annum in its submission to Infrastructure Australia[1]; this capacity would not be fully utilised until 2040 under ACIL Tasman's container growth forecasts.

If Port Botany runs out of capacity in 2029, then other ports would need to serve an additional 300,000 TEUs of container movements each year to keep pace with demand.

It is not certain that Port Kembla would be able to capture all of the overflow containers. The Port of Newcastle could also capture some of this overflow, although its links to Western Sydney (a key destination expected to receive more than 50% of import containers) are not as good as Port Kembla's would be if a Maldon-Dombarton rail line were available.

Overflow to Port Kembla is therefore judged to be unlikely until at least the end of the study period.

Alternatively, a major shipping company could be attracted to Port Kembla because it could then set up its own vertically integrated stevedore. We are not aware of any plans for that, and they would be announced only when the company was ready.

Overall demand

The demand forecasts are summarised in the Table 1 below. This summary is the central case for potential traffic on a Maldon-Dombarton rail line (but which could also go on other lines if there was sufficient capacity). The 2010 column covers those parts of current freight that might in future use a Maldon-Dombarton rail line, and does not include freight that is considered unlikely to use it (e.g. grain is expected to stay on the Moss Vale-Unanderra line).

[1] NSW Department of Transport, Container Freight Improvement Strategy, July 2010.

Table 1 **Demand relevant to the Maldon-Dombarton rail line (Base Case)**

		2010	2015	2020	2025	2030
Bulk Freight						
Coal						
Western Coalfield	Mtpa	6.75	11.65	10.00	10.00	8.70
Southern Coalfield	Mtpa	1.60	1.60	1.60	1.60	1.60
Newcastle/Hunter Coalfields	Mtpa	2.00	2.00	2.00	2.00	2.00
Other Ores						
Gold and Copper concentrates	Mtpa	0.35	0.65	0.65	0.65	0.65
Iron	Mtpa	-	-	-	-	-
Other bulk						
Scrap steel from Brisbane	Mtpa	0.09	0.09	0.10	0.10	0.10
Paper (IPMG)	Mtpa	-	-	-	-	-
Grain	Mtpa	-	-	-	-	-
Cement	Mtpa	0.30	0.60	0.60	0.60	0.60
Kaolin	Mtpa	0.50	1.10	1.50	1.50	1.50
Biodiesel	Mtpa	-	0.38	0.38	0.38	0.38
Total Bulk	**Mtpa**	**11.59**	**18.07**	**16.82**	**16.83**	**15.53**
Non-Bulk						
Automotive	Units	-	-	-	-	-
Containers	TEUs	17,352	56,626	118,067	169,401	478,180
Containerised steel	TEUs	6,944	7,131	7,363	7,596	7,828
All container movements	**TEUs**	**24,296**	**63,756**	**125,430**	**176,996**	**486,008**

Engineering assessment

A potential Maldon-Dombarton rail line would follow natural contours for about 70 per cent of its 35 km length, and most of this has already been constructed. It would also have Australia's longest and steepest tunnel (4 km; not yet constructed except for entrance portals), two major bridges (part of one has been constructed) and some minor structures.

The bridges, the adequacy of the tunnel design for freight locomotives (including ventilation) and the hydrological design have been assessed to identify any alignment enhancements options, provide a construction gaps analysis (from the original design to current standards), and redefine and update of the design of bridges, the Avon tunnel, and other rail and road infrastructure requirements.

Previous studies

Previous studies were reviewed for integrity, consistency with current standards and for any opportunities to reduce cost. After consideration of alternatives, the alignment and overall design in the previous study is supported as being cost effective. However it is proposed that the unconstructed bridge be of a different design (balanced cantilever instead of arch) which with current technology would be cheaper. Relatively minor road-over-rail bridges could be built more cost effectively as small tunnels. Other aspects can be improved - e.g. the design of the turnouts that join this line to the other lines at each end, and the provision of maintenance roads.

An issue identified in the previous study was the erodible nature of the soil and the line's passage through Sydney water catchment area, with consequences with drainage.

Performance specification

The engineering assessment worked to the current standards, guidelines, strategies and specifications used for a design of new railway lines that were developed by Australian Rail Track Corporation (ARTC) and Rail Corporation of NSW (RailCorp). These include track standards, civil design, drainage, total design and bridge design. In some cases these exceed or differ from the standards used in the previous study, e.g. shoulder width, vertical clearance, turnout speed and passing loop length.

The design and performance standards adopted for a potential Maldon-Dombarton rail line are summarised in the following table.

Design and performance standards

Requirements	Performance
Maximum freight train transit time from Maldon-Dombarton junction	55 min,
Maximum freight transit time from Wilton to Avon Passing loops	33 min
Desirable maximum operating speed	80kph for loaded, 100kph empty excluding speed at the junctions and tunnel
Maximum speed at junctions	60 kph
Maximum axle loads	30 tonnes
Gauge	1435 mm (standard gauge)
Minimum horizontal curve radius	800 m
Maximum gradient	1 in 30
Number of passing loops	2
Length of passing loops	1600-1800m
Maximum train length	2000m
Electrification	Non-electrified (assumed diesel)
Single / double track	Single track
Vertical clearance	7.1 m
Track structure on open track	Ballasted on concrete sleepers
Track structure in the tunnel	Reinforced concrete slab in parts depending on rock strength, , remainder ballast and sleepers
Maintenance access roads	Around the passing loops
Level crossings	At Fire Roads crossing the line and at both ends of the passing loops

Data source: Hyder Consulting

Engineering evaluation and risk assessment

The criteria adopted to identify successful options were defined in terms of:

- Cost
- Constructability
- Safety
- Environmental
- Performance

Risks were assessed using ARTC methodology. The process of the assessment comprised:

- Identify all inherent design /construction /maintenance risks
- Understand and mitigate the safety impacts
- Understand and mitigate inherent risks in operation, maintenance and disposal of assets.

Risks requiring mitigation measures include catchment area drainage, tunnel construction through varying rock strengths, tunnel ventilation and possible coal mining under the line. All the risks identified can be mitigated.

Route options

The route was reviewed on the basis of site inspections, an aerial survey, a digital terrain survey model, and a LiDAR survey.

The route previously chosen (and 70 per cent constructed) is viable from the track design point of view and alternatives would be more costly because so much of the rail line has already been constructed, with the exception of the junctions.

The tunnel is the most expensive component and the following options were considered:

- Original design option from 1982 with adjustment at the junctions
- Option to reduce the gradient of the tunnel on the same horizontal alignment by allowing deeper approach cuttings to the portals
- Option with no tunnel
- Option to reduce the gradient of the tunnel by slewing the tunnel alignment further south.

Using the criteria set out above, the first option is preferred. A variant of it with the grade reduced from 3.3% to 2.5% would lengthen the tunnel and increase capital costs. A no-tunnel option is not possible given the difference in innovation levels. The final option has environmental risks and would cost more.

Also examined was an option of increasing the gradient at a point near to Maldon to avoid having to relocate gas pipelines which were laid prior to commencement of works in the 1980s, but this would increase operational costs.

Besides the higher speed turnouts at each end, the proposed alignment would have two longer passing loops each of which is longer than the three proposed in the original design. More could be added later if demand warranted.

1 Introduction

1.1 Overview of feasibility study

The Commonwealth Government has commissioned a feasibility study of a potential rail link between Maldon (south-west of Sydney on the main southern rail line) and Dombarton (near Port Kembla). The rail link is a 35-kilometre standard gauge rail line connecting the Illawarra line from Wollongong to the Main Southern line running from Sydney via Campbelltown.

The study is being undertaken by economic consultants ACIL Tasman in conjunction with engineering consultants Hyder Consulting and with support from rail operations modellers Plateway.

The study involves a detailed analysis of existing structures, engineering requirements, demand for usage of the line, economic and financial modelling and land use and environmental planning issues.

The purpose of the study is to inform future Government decision-making about this project by:

a) carrying out a detailed investigation of the layout, design and cost of remaining works;

b) assessing the project's viability on environmental, social and economic criteria, including an economic cost benefit evaluation;

c) identifying any preconstruction requirements (such as the environmental impact assessment) to guide the construction of the project, should it proceed; and

d) examining and costing the implications of not pursuing the project.

1.2 Scope of this Working Paper

The Terms of Reference (ToR) for the feasibility study set out the tasks that define the scope of this Working Paper.

This paper reports the results of ACIL Tasman's analysis of potential demand and usage of the Maldon-Dombarton rail line and Hyder Consulting's engineering assessment of the line.

Demand for use of the line

According to the ToR, the feasibility study will expand and test the analyses of the current and future freight markets conducted in the pre-feasibility study, with particular regard to:

- assessing and 'stress testing' the accuracy of trade predictions and forecast growth and the assumptions made in developing these forecasts
- examining alternative freight routes to which future demand for freight services on this line might be concentrated in the event construction of the line does not proceed, and whether there is likely to be future capacity to absorb this demand on those routes
- examining and assessing the line's capacity to improve the connectivity of the freight rail network with existing and proposed intermodal terminals at Enfield, Eastern Creek, Moorebank, Minto, Ingleburn, Moss Vale and Wollondilly
- developing of train path modelling, with consideration of construction design updates and future demand on the intra and interstate networks of which Maldon-Dombarton would connect
- engaging with key stakeholders, and in particularly with relevant above rail operators and freight logistics organisations.

Engineering assessment

The ToR also specify that the study will assess the engineering requirements for the completion of the line. Tasks include the following.

- Identification of any alignment enhancements options and recommend an optimal alignment (if different from current alignment).
- A comprehensive construction gaps analysis from the original design to current standards.
- Refining and updating the design of bridges, tunnel, other rail infrastructure and associated signalling and road infrastructure to meet current legislative requirements and standards, with particular consideration to the following issues and the assumptions made about them in the pre-feasibility study.
  a) technical aspects, including:
  - hydrological design
  - the adequacy of the current tunnel design for diesel freight locomotives, including tunnel ventilation
  - locomotive capability to operate on a 1:30 gradient
  - land use management issues including the impact of designs on potential future industrial and residential developments in areas adjacent to the corridor.

  b) current and future operational requirements, including:
  - freight demand and supply developments in Illawarra, Sydney and other potential markets
  - train path modelling as undertaken under Scope 1 : Demand for the line
  - and social concerns.

1.3 Structure of this paper

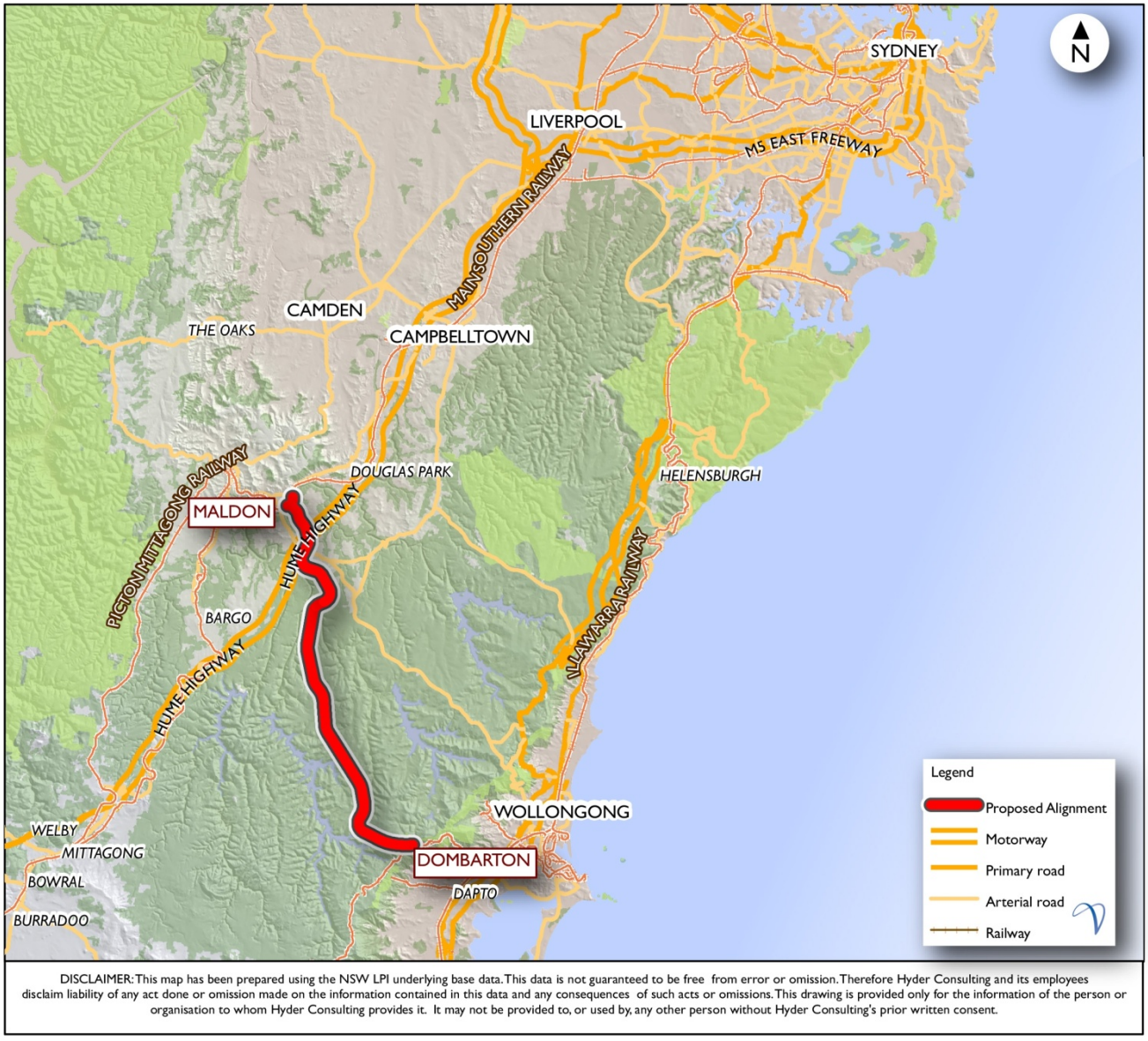
This Working Paper is organised as follows:

- Chapter 2 provides a brief description of the location and history of the potential Maldon-Dombarton rail line
- Chapter 3 presents an overview of the demand analysis undertaken by ACIL Tasman
- Chapter 4 analyses the potential use of the line for the haulage of coal from various parts of New South Wales
- Chapter 5 analyses the potential use of the line for the transportation of grain
- Chapter 6 analyses the potential use of the line for the transport of other bulk commodities such as cement, Kaolin, biofuels and metallic ores (including gold, copper and iron)
- Chapter 7 analyses the potential use of the line for the transport of steel, cars and containers
- Chapter 8 presents the engineering assessment of the line
- Chapter 9 examines the performance specifications of the line
- Chapter 10 discusses the value engineering and assessment of risks associated with the line
- Chapter 11 documents the routes options analysis used to determine the optimal alignment of the line
- Chapter 12 provides details on the design of the line, including drawings of key components of the line.

2 Location and history of the potential Maldon-Dombarton rail line

The potential 35 kilometre-long Maldon-Dombarton rail line provides a possible link between Maldon on ARTC's Main South line (near Picton in south-west Sydney) and Dombarton at the foothills of the Illawarra plateau, which is 15 km from Port Kembla along existing double track. The location of the line is shown in Figure 1.

Figure 1 **Location of Maldon-Dombarton rail line**



Source: Hyder Consulting

Heading west, the line from Dombarton would negotiate the steep Illawarra Escarpment, climbing at a 1-in-30 gradient through a 4 km-long tunnel and then descending at a 1-in-60 gradient. Beyond the tunnel, the line would enter the Sydney Catchment Authority Metropolitan Special Area in undulating country. Here, the line generally follows the ridge separating the Cordeaux and Avon rivers. It then crosses the Cordeaux River, leaves the Sydney Catchment Area, passes under a number of roads (including Picton Road), under the F5 Freeway passes and over the Nepean River, before joining the Main South line near Maldon.

A Maldon-Dombarton rail line was first conceived when the coal loader at Port Kembla was constructed in 1979. In October 1982, it was announced that the line had received concept approval, in preference to three other options for which detailed feasibility studies were also prepared.

Following the preparation of an Environmental Impact Statement, construction on the line commenced in 1983. During construction, many of the coal mines that were potential users of the line closed, and the project was cancelled in June 1988 following a change of NSW State government. The Maldon-Dombarton pre-feasibility study stated that a cost-benefit analysis of all State government capital works at the time indicated that the Maldon-Dombarton rail line had the lowest benefit-cost ratio.

When construction stopped, approximately two-thirds of earthworks had been completed, as well as the entry cuts to the tunnel portals and construction access roads to the tunnel and the catchment area. The two major structures on the line are the partially-complete bridge over the Nepean River near Maldon and the incomplete Avon Tunnel near Dombarton (see Figure 2). The bridge is missing the middle section. The 4 km-long Avon Tunnel would have been the longest in Australia, if completed.

In the years following the cancellation of the original project, there have been various task forces, inquiries and proposals to complete the line by the NSW and Commonwealth Governments.

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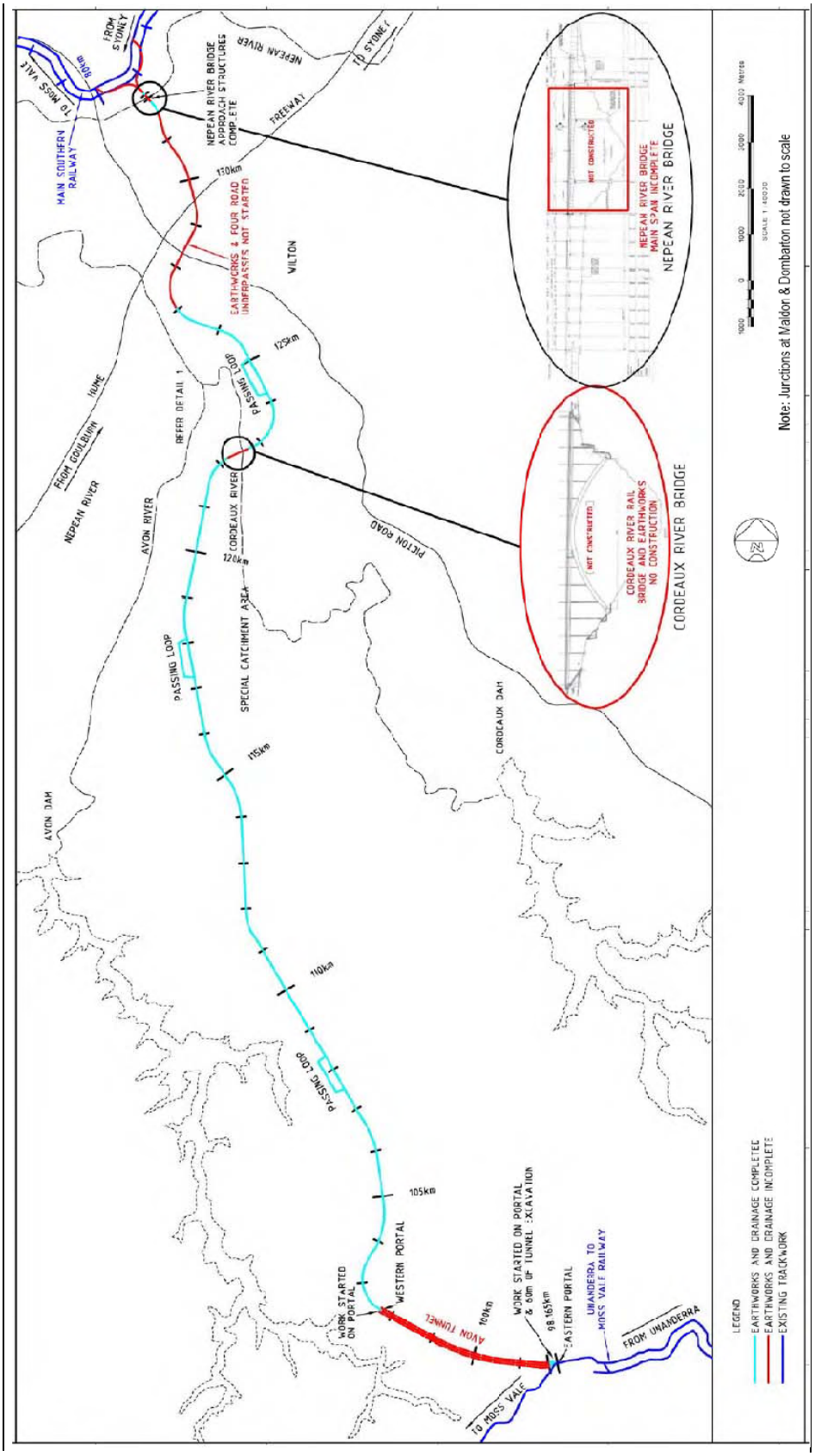
Figure 2 **Possible alignment of Maldon-Dombarton rail line**



Maldon-Dombarton rail line Pre-feasibility Study (2009)

3 Potential demand for the line

Potential demand for a Maldon-Dombarton rail line is part of the bigger picture of demand for freight[2] transport to and from Port Kembla. There are several main commodities and other types of freight to be considered, and several means of transport: a Maldon-Dombarton rail line, the existing Illawarra and Moss Vale-Unanderra lines, and road. There are some interactions to consider – e.g. the flatter Illawarra line is preferred for some freight but faces capacity constraints, and a new Maldon-Dombarton rail line could induce some new freight that otherwise would not move.

For the purpose of this study, the estimate of demand for the potential Maldon-Dombarton rail line therefore needs to consider the following:

- Current and future demand for freight to and from Port Kembla (irrespective of route or mode)
- New demand that would be induced by a potential Maldon-Dombarton rail line but would probably not otherwise move
- The preferred means of transport (road, or a particular rail route) for each component of demand
- Capacity limits or other constraints on road freight and on the existing rail lines
- Rail capacity issues elsewhere that could affect freight on a Maldon-Dombarton rail line
- Competition between ports, and developments at ports, that could result in diversion of sea freight to Port Kembla and to the rail lines and roads that serve it.

In this study, the approach to the demand analysis has been to consider total demand (with and without extra induced demand) and preferred route/mode, by commodity type by year.

In undertaking the demand analysis, ACIL Tasman consulted a wide range of stakeholders. These stakeholders are listed in Table 2.

The demand forecasts were converted into forecast road freight, and to forecast train numbers by route, after allowing for capacity constraints. The train numbers forecast for a potential Maldon-Dombarton rail line are a combination of trains serving demand that would naturally use that route, and trains that overflow from other routes when capacity on them is reached.

[2] The prefeasibility study concluded that a passenger services on a Maldon-Dombarton rail line would be unviable, and it is not included in the terms of reference for the current study.

Table 2 **Stakeholders consulted as part of demand analysis**

ARTC	FRID Resources	Pacific National
Autonexus	GrainCorp	Patrick Autocare
AWB	Hamburg Süd	Peabody
BHP Billiton	Hudson Resources	Port Kembla Coal Terminal
Blue Circle Southern	Independent Railways of Australia	Port Kembla Grain Terminal
BlueScope	K-line	Port Kembla Port Corporation
Boral (Timber)	Maersk	Prixcar
Cement Australia	Manildra	Qube Logistics
Centennial	Macarthur Intermodal ShippingTermina	RailCorp
CEVA	Newcrest	RTA
Coalpac	Newnes Kaolin Pty Ltd	Standard Iron
Coalworks	NRE Gujarat	Swire Shipping
Cosco	NSW Department of Industry and Inves	Sydney Ports Corporation
Eastern Iron	NSW Maritime	University of Wollongong
El Zorro	NYK line Shipping	VISY
	P&O Trans Australia	Xstrata

Source: ACIL Tasman

The following sections consider demand by freight type, starting with the most important commodity, coal. Coal accounts for more tonnes than all other freight combined, and would account for most of the track access revenue –in Australia coal typically pays an access price based on fully allocated "standalone" costs whereas some of the other types of freight typically pay a lower rate.

4 Potential coal haulage on a Maldon-Dombarton rail line

This chapter focuses on the prospects for coal traffic on the Maldon-Dombarton rail line. Coal would be the most important source of demand for the line, both because of the potential volumes and because in Australia coal trains typically pay access prices on a fully allocated cost basis ("standalone costs") that are much higher than those for grain or general freight trains.

4.1 Current output from NSW Southern and Western Coalfields

The mines from which coal will be transported to Port Kembla are principally those in its immediate hinterland (the Southern Coalfield) and the southern part of the Western Coalfield (around Lithgow) for which the rail link to Port Kembla is more direct than to the alternative Port of Newcastle.[3] The location of the Southern and Western Coalfields are shown in Figure 3.

In considering the haulage of coal from the Southern and Western Coalfields to Port Kembla, several points are noteworthy:

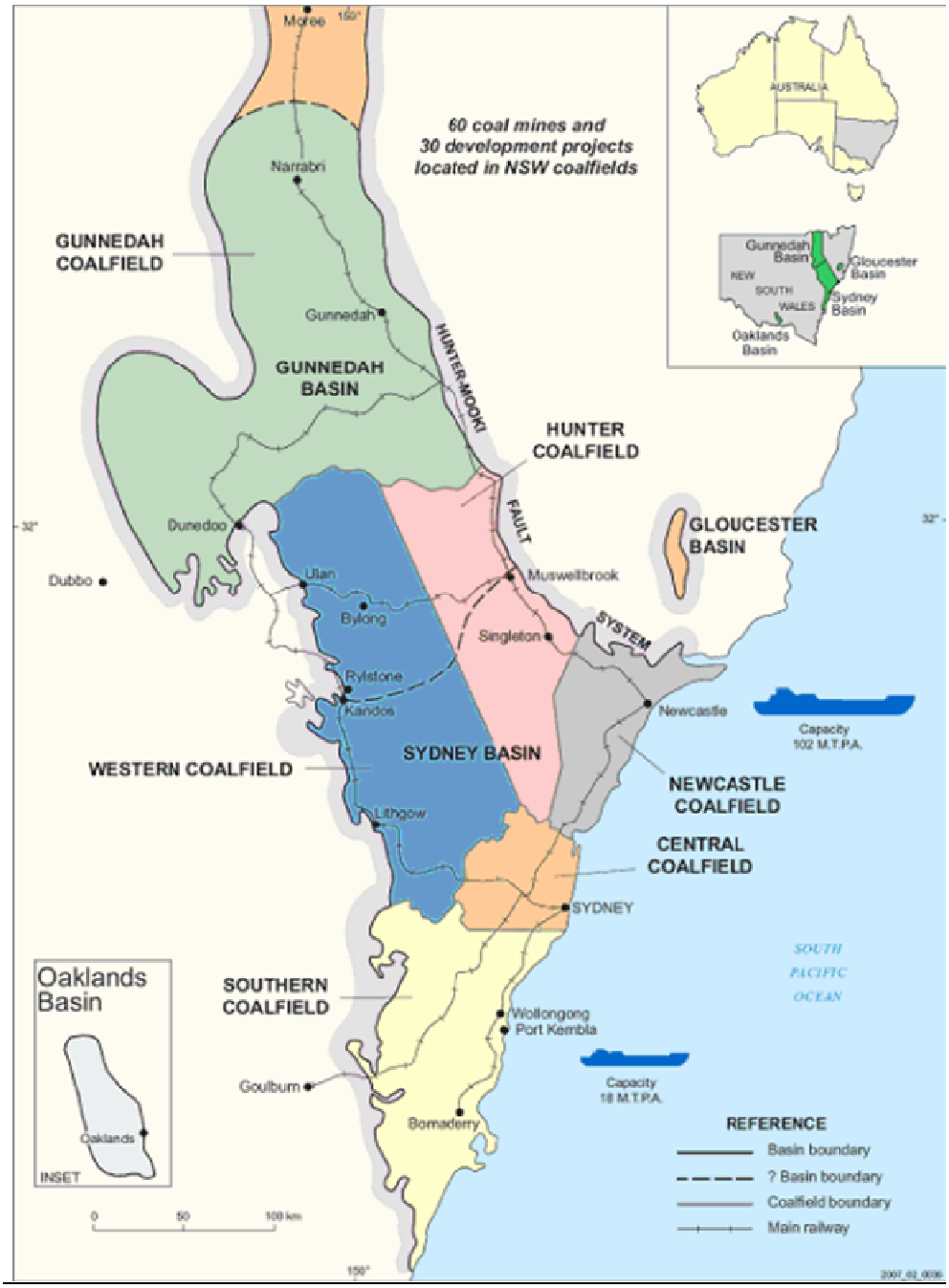
- Some mines have recently been re-opened through combination with other mines (e.g. reopening of the Elouera mine in combination with the Avondale mine under a new Wongawilli Colliery); and new operations have been proposed (e.g. the proposed Bulli Seam Colliery expansion that combines Appin with West Cliff).
- Proposals for expansion of existing mines and/or construction of new mines are subject to detailed environmental assessments and public consultations. These processes can create a degree of uncertainty about actual commencement of mining operations and the expected output.
- One potential source is the East Bargo deposit on the Maldon-Dombarton alignment itself.[4] The construction and operation of an East Bargo mine would, like any other proposed mines in any NSW Coalfields, depend on

[3] Relatively isolated pockets of mines in the central (between Airly Mountain and Rylstone) and northern (Ulan-Bylong area) parts of the Western Coalfield currently export through Newcastle because it is closer than Port Kembla. We are aware of the remote possibility that future output increases from these mines may exceed the current haulage capacity on the Ulan line. However the option for the tonnage overflow going to Port Kembla will require significant capital expenditures on the rail link between Lithgow and Gulgong

[4] NSW Department of Primary Industries, "East Bargo Expression of Interest Information" June 2009.

the Department of Planning's environmental assessments and public consultations.

Figure 3 **Location of NSW coalfields**



Source: 2008 NSW Coal Industry Report, NSW Department of Primary Industries

- Some mines close to Port Kembla would not make use of a Maldon-Dombarton rail line because their mining sites are on other lines (e.g. Metropolitan, Wongawilli). One mine (Tahmoor) is almost certain to use a

Maldon-Dombarton rail line because of savings to fuel, labour and capital costs, although there may be some locomotive power issues related to the long 1:60 gradient approaching the Avon tunnel.

- Output from marginal mines may be sensitive to international prices – production may be uneconomic at low prices but worthwhile at high prices. Most of the smaller mines in the Southern Coalfield (such as NRE No. 1 and Wongawilli) commenced operations between the mid- to late-2000s because of relatively high coal export prices. (NRE Wongawilli currently exports metallurgical coal to India for value-adding by other companies in its corporate group, which provides some buffer to international prices, but this output is not relevant to a Maldon-Dombarton rail line).
- There is a question of whether some mines that currently use road transport (namely Appin and West Cliff) could potentially use a potential Maldon-Dombarton rail line.

The analysis in this section is later considered alongside an assessment of wider rail network issues, as for some coal mines there are alternative rail routes – the Illawarra line and the Moss Vale-Unanderra line – that compete with a potential Maldon-Dombarton rail line. The coal tonnage on a Maldon-Dombarton rail line would depend on relevant mines that export their outputs, where they are, and whether one of the other lines (especially the Illawarra line) reaches capacity.

4.1.1 Existing and proposed mines in Southern Coalfield

The recent history of mine openings and closures in the Southern Coalfield (since January 2002) is summarised in Table 3.

Table 3 **Recent mine openings/closures in Southern Coalfield**

Bellami West	Closed January 2002
Tower	Closed December 2002
Gibsons	Closed May 2003
Dendrobium	Opened June 2003; on-going mine
Elouera	Closed June 2005
NRE No 1 (formerly Bellpac)	Opened March 2005; on-going mine
Appin (formerly Douglas)	Opened April 2005; on-going mine
Delta	Opened November 2005; closed March 2007
NRE Wongawilli	Opened February 2008; on-going mine

Source: DPI "2009 New South Wales Coal Industry Profile"

We note that the number of active mines has hovered between nine (in 2000 and 2006) and seven (in 2003). From 2007-08 onwards, eight mines have been in operation.

As shown in Table 4, about half of the total coal mined in the Southern Coalfield was exported through Port Kembla in 2004-05 while the other half was sold to domestic customers in the steel, coke, cement and other industries. The proportion of total output exported increased to 56 per cent in 2005-06 and 58 per cent in both 2006-07 and 2007-08.

Table 4 **Tonnages of coal sold by customer type – Southern Coalfield**

Customer	2004-05		2005-06		2006-07		2007-08	
	Mt	% total	Mt	% total	Mt	% total	Mt	% total
Overseas (exports)	4.93	50.2%	5.31	55.5%	6.41	57.9%	6.24	57.8%
Steel industry	4.22	42.9%	3.73	39.0%	4.19	37.8%	4.03	37.3%
Coke and cement works	0.51	5.2%	0.47	4.9%	0.43	3.9%	0.48	4.4%
Others	0.17	1.7%	0.05	0.5%	0.05	0.5%	0.05	0.5%
TOTAL	**9.83**	**100.0%**	**9.56**	**100.0%**	**11.08**	**100.0%**	**10.80**	**100.0%**

Source: NSW Department of Investment and Innovation (formerly Department of Industries), "2009 NSW Coal Industry Profile" and ACIL Tasman calculations of percentages

Details on each existing mine's output, principal market destination and haulage mode are summarised in Table 5.

The outputs from three mines, *viz.* Dendrobium, Tahmoor, and NRE Wongawilli, are all transported by rail to Port Kembla. Metropolitan also transports most of its output by rail. According to Peabody Energy, this applies to about 90 per cent of Metropolitan's total output that is exported through Port Kembla to meet existing supply contracts with overseas customers.[5] Taking this into account, ACIL Tasman estimated the total tonnage of coal transported by rail in 2007-08 to be about 5.04 Mt.

The mines that make use of road transport include Appin and West Cliff (which respectively supplied in 2007-08 an output of 2.53 Mt and 1.6 Mt to the steelworks at Port Kembla and Whyalla, South Australia), Berrima (which supplied 0.23 Mt to a nearby cement works) and NRE No. 1 (which exported 100 per cent of its coal to India). ACIL Tasman estimates the total tonnage from these mines transported on road in 2007-08, which includes 10 per cent of Metropolitan's output in the same year, to be about 5.3 Mt.

[5] http://www.peabodyenergy.com.au/nsw/metropolitan-mine.html

Table 5 **Southern Coalfield mines: output, principal market and mode of transport**

Coal mine	Location / Major shareholder	2006-07 Output (Mt)		2007-08 Output (Mt)		Principal market	Haulage
		Raw	Saleable	Raw	Saleable		
Dendrobium	Mt Kembla, 8 km W of Wollongong Illawarra Coal Holdings, 100% owned by BHP Billiton.	2.52	1.70	3.62	2.53	Steelworks at Port Kembla (BlueScope) and at Whyalla, South Australia (OneSteel)	By rail (7 km to Port Kembla)
Tahmoor	80 km SW of Sydney Xstrata 100%	2.36	1.67	1.84	1.38	Export	By rail - 122 km via Moss Vale (the main route used); 117 km to Port Kembla via Sydney
Metropolitan	Helensburgh (50 km S of Sydney) Peabody Energy 100%	1.63	1.40	1.48	1.22	Export (approximately 90% of output) and domestic coke works (approximately 10% of output)*	Coal transported to Port Kembla Coal Terminal on the Illawarra line; coal supplied to Corrima and Coalcliff coke works transported on road
NRE Wongawilli	15 km SW of Wollongong Gujarat NRE Coke 100%	n.a.	n.a.	0.04	0.04	Export to India.	By rail (15 km to Port Kembla Coal Terminal)
Total transported by rail *		**6.51**	**4.63**	**6.98**	**5.05**		
West Cliff	43 km NW of Wollongong Illawarra Coal Holdings, 100% BHP Billiton owned	2.34	1.84	3.37	2.88	Steelworks at Port Kembla (Bluescope), some export	By road. 43 km to Port Kembla Coal Terminal via Picton and Mt Ousley Roads
Appin	40 km NW of Wollongong Illawarra Coal Holdings; 100% BHP Billiton owned	3.09	2.49	1.95	1.60	Steelworks at Port Kembla (BlueScope) and at Whyalla, South Australia (OneSteel)	By road. 40 km to Port Kembla
NRE No 1**	8 km N of Wollongong Gujarat NRE 100%	0.46	0.46	0.55	0.55	Export	By road to Port Kembla through the Northern Distributor freeway via Figtree-Coniston Road
Berrima	6 km W of Berrima NW of Moss Vale Centennial Coal 100%	0.21	0.21	0.23	0.23	Berrima Cement Works (domestic)	By road to local cement works
Total transported on road *		**6.10**	**5.14**	**6.10**	**5.38**		

Note: * 90% of saleable output from the Metropolitan mine is transported by rail, 10% by road on trucks (see **http://www.peabodyenergy.com.au/nsw/metropolitan-mine.html)*
Source: ACIL Tasman

According to Industry and Investment NSW, even though "there are sufficient resources within existing mining leases and exploration areas to service the needs of the domestic steel industry well into this century, depletion of reserves within those collieries servicing the export market may result in mine closures over the next 19 years."[6] Based on the available public information on recent mining proposals (see Table 6), ACIL Tasman is of the view that the level of total output over the next 20 to 30 years may increase but only marginally due to extensions of the NRE No. 1 and Wongawilli mines, and integration of the Appin and West Cliff collieries into an expanded Bulli Seam mine.

Mine expansion and new mine proposals include the following:

- Gujarat NRE submitted a proposal in August 2009 to increase production at the NRE No. 1 mine to a maximum of 3 Mtpa over a period of up to 20 years.[7] Under this proposal, which is going through the NSW Department of Planning's approval process, unwashed coal is to be trucked to Port Kembla for export to India.
- Gujarat NRE has also submitted a proposal in August 2009 to combine the mining activities at Wongawilli and Avondale for an estimated output of up to 2 Mtpa over 20 years.[8] Under this proposal, which is going through the Department of Planning's approval process, unwashed coal is to be transported by rail to the Port Kembla Coal Terminal. We were informed by Gujarat NRE that output from the combined mines will be transported on trains that join the Illawarra line at Brownsville.
- In August 2008, Illawarra Coal and BHP Billiton submitted a Bulli Seam proposal to combine mining operations at the Appin and West Cliff collieries. This mining operation is located 13 Kms from the proposed Maldon-Dombarton rail line. The estimated (combined) saleable output from the new Bulli Seam operation will be up to 9.2 Mtpa over 30 years.[9] Illawarra Coal has proposed to continue with road transport of the ROM (run of mine) coal from the Appin colliery to the washery at West Cliff colliery. The washed coal would then be transported from the washery by

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6 NSW Industry and Investment NSW (formerly DPI), "2009 New South Wales Coal Industry Profile", p. 37.

7 http://majorprojects.planning.nsw.gov.au/page/project-sectors/mining--petroleum---extractive-industries/mining/?action=view_job&job_id=3448

8 http://majorprojects.planning.nsw.gov.au/page/project-sectors/mining--petroleum---extractive-industries/mining/?action=view_job&job_id=3111

9 http://majorprojects.planning.nsw.gov.au/page/project-sectors/mining--petroleum---extractive-industries/mining/?action=view_job&job_id=2673

road to BlueScope steelworks and the Port Kembla Coal Terminal.[10] This proposal has yet to be approved by NSW Department of Planning.

This product could be transported on rail via the Maldon-Dombarton rail line if a loading facility at Wilton was built (connected to the mine by a conveyor).. This would come with a significant capital cost and BHP Billiton has indicated that it is not likely to undertake this investment or divert its coal freight from road to the Maldon-Dombarton rail line.

- A new mine has been proposed at Sutton Forest located 15 km west of Moss Vale. The haulage of output to Port Kembla Coal Terminal can either be by road or by rail on the Moss Vale line.[11]. The coal from this mine is considered by Industry and Investment NSW to be low grade and expensive to mine – it is likely to come online only in upper case scenarios.
- The proposed new mine at Oaklands located 100 km west of Albury is considered a "feedstock" mine for base-load generators nearby. The transport of coal from this mine is more likely to be by road than rail.[12] It is low grade coal that, according to Industry and Investment NSW, of is not of export quality. This mine is not expected to come online within the forecast period.
- A new mine has been proposed at Oaklands north. According to the proponent, this could export between 3 and 6 Mtpa commencing 2014. The proponent, Coalworks, is also proposing a coal-to-liquids (CTL) plant which would consume some of the mine's output and would produce approximately 360 Mlpa of fuel. The mine's preferred transport option is rail to the Port of Geelong for the dry product and the Geelong (Shell) refinery for the fuel. However, coal terminal would need to be built at Geelong and the channel would need to be deepened for larger ships to berth there. The second best option identified by Coalworks is rail to Port Kembla via the Moss Vale line; this has higher operating costs but requires no new infrastructure at the port. However, according to Industry and Investment NSW the deposit the coal has high ash content and relatively low value, with exports are unlikely within the study period.
- In June 2009, Industry and Investment NSW (Now NSW Trade and Investment) called for Expressions of Interest in an exploration licence for the East Bargo coal exploration area. Located approximately 30 km northwest of Wollongong, in the area that would be traversed by the northern part of a Maldon-Dombarton line. The area is expected to contain more than 330 million tonnes of coal at depths from 360 metres to over

[10] The transport route from the washery to BlueScope Steelworks and Port Kembla Coal Terminal encompasses Appin Road, Princes Highway, F6 Southern Freeway, Mt Ousley Road, F6 Southern Freeway, Masters Road and Springhill Road.

[11] ABARE "Major projects – April 2010 listing", available at http://www.abare.gov.au/publications_html/energy/energy_10/energy_10.html

[12] ABARE, *ditto*.

500 metres. According to the Department these resources, which partly underlie the Avon, Nepean and Cordeaux rivers, require further studies to determine their potential mineability (and no significant interest was expressed in response to the EoI). This mine is unlikely to be developed within the study period, except as an extension of existing mines such as Tahmoor (and included in the output levels forecast for those mines).

These proposals are summarised in Table 6.

Table 6 **Recent mining proposals – Southern Coalfield**

Mining proposal	Location (Major shareholder	Estimated output	Proposed haulage mode
NRE No 1 (mine extension)	8 km N of Wollongong (Gujarat NRE 100%)	Up to 3 Mtpa over 20 years	By trucks along the existing haul route to Port Kembla Coal Terminal for export to India
NRE Wongawilli (mine extension)	15 km SW of Wollongong (Gujarat NRE Coke 100%)	Up to 2 Mtpa over 20 years	Rail transport to the Port Kembla Coal Terminal.
Bulli Seam (new mine)	40-43 km NW of Wollongong (Illawarra Coal Holding - 100% BHP Billiton owned)	Up to 9.2 Mtpa over 30 years	Haulage on public road network from the West Cliff Colliery Washery to BlueScope Steelworks and Port Kembla Coal Terminal.
Sutton Forrest (new mine)	15 km W of Moss Vale (Anglo Coal Holdings 100%)	Approximately 1.5 Mtpa over 30 years	Moss Vale line (70 km to Port Kembla Coal Terminal)
Oaklands North (new mine)	6 km N of Oaklands (Coalworks 100%)	3 Mtpa in first year, increasing to 6 Mtpa by year 4, then constant over 30 years.	Export of thermal coal from Port Kembla via Moss Vale line (590 Kms), or the preferred option south to Geelong (415 Kms). Also evaluating a CTL plant – output would be railed to the Geelong refinery (~360 Mlpa).
Oaklands (new mine)	100 km W of Albury (Coal and Allied Industries - Rio Tinto ultimate ownership75% per 2009 accounts)	Not known, 1.3 billion tonnes of measured and indicated reserves.	Coal mining prospect evaluated as "feedstock" for local base-load generators. By road and/or conveyors.
East Bargo	30km NW of Wollongong (Expression of Interest sought in June 2009)	Not known	Could potentially be transported to Port Kembla Coal Terminal via the Maldon-Dombarton rail line.

Source: Mining companies and ABARE See text above for Industry and Investment NSW *comments.*

4.1.2 Existing and proposed mines in the Western Coalfield

The recent history of mine openings and closures in the Western Coalfield (since January 2002) is summarised in Table 7.

Table 7 **Recent mine openings/closures in Western Coalfield**

Charbon O/C	Temporary closed December 2003, re-opened January 2004; on-going mine
Lambert's Gully	Opened January 2005; on-going mine
Baal Bone O/C	Opened February 2005; temporary closure August 2007; re-opened March 2008
Ivanhoe box cut	Reopened March/April 2005; on-going mine
Ivanhoe No 2	Opened June 2005; on-going mine
Enhanced Place	Closed June 2005
Pine Dale O/C	Opened March 2006; on-going mine
Wilpinjong O/C	Opened October 2006; on-going mine
Cullen Valley O/C	Temporary closed March 2007, re-opened February 2008; on-going mine
Invincible O/C	Opened December 2006; temporary closed February 2008, re-opened March 2008; on-going mine

Source: DII (formerly DPI), "2009 New South Wales Coal Industry Profile"

There are currently a total of 11 active mines across the Coalfield. The mined outputs are primarily exported or sold to local power stations (see Table 8). Between 2004-05 and 2007-08, the total tonnages exported have been (with the exception of 2006-07) more than 50 per cent of the total mined output. Since 2004-05, the tonnages exported out of Port Kembla have remained well above 4 Mtpa.

Table 8 **Tonnages of coal sold by customer type – Southern part of Western Coalfield**

Customer	2004-05		2005-06		2006-07		2007-08	
	Mt	% total	Mt	% total	Mt	% total	Mt	% total
Overseas								
- exported through Port Kembla	4.02	25.0%	4.32	26.4%	4.15	23.0%	4.79	21.5%
-exported through Port of Newcastle	4.27	26.6%	3.96	24.2%	4.82	26.7%	6.88	30.9%
Domestic								
Power stations	7.13	44.4%	7.45	45.6%	8.67	48.0%	10.07	45.2%
Steel industry	0.19	1.2%	0.16	1.0%	0.11	0.6%	0.07	0.3%
Cement works	0.11	0.7%	0.13	0.8%	0.10	0.6%	0.11	0.5%
Others	0.33	2.1%	0.33	2.0%	0.23	1.3%	0.35	1.6%
TOTAL	16.05	100.0%	16.35	100.0%	18.08	100.0%	22.27	100.0%

Source: NSW Department of Investment and Innovation (formerly Department of Industries), "2009 NSW Coal Industry Profile" and ACIL Tasman calculations of percentages

Mines of particular relevance to a potential Maldon-Dombarton rail line are those in the Coalfield's southern and central regions between Lithgow and

Kandos.[13] Details on the respective mines' output volume, principal market destination and haulage mode (which are only available for the years 2006-07 and 2007-08) are summarised in Table 9.

The collieries that exported all (or at least a portion) of their outputs include Angus Place/Springvale, Baal Bone, Clarence, Lambert's Gully and Charbon. Looking ahead, we note that:

- Mining at Lambert's Gully is to conclude in 2010
- Baal Bone submitted a proposal in August 2009 to continue extracting up to 2.8 Mt ROM per annum
- The approved reserves at Charbon are expected to be exhausted in 2013. A proposal to mine further reserves at a rate of up to 1.5 Mtpa over 15 years was submitted to the Department of Planning in November 2009[14]
- The Airly Colliery is to commence operation in the June quarter of 2010. According to Centennial Coal, the output of up to 1.8 Mtpa over 20 years is to be transported via the Mudgee-Sydney and the Illawarra line to the Port Kembla Coal Terminal.

[13] The Ulan and Wilpinjong collieries in the northern region (as well as the proposed Moolarben mine) can be expected to continue to transport their output on the Ulan line (via the Bylong tunnel) to the Port of Newcastle. Rail transport down south to Lithgow would require considerable capital expenditure on the Gulgong-Lithgow link.

[14] A Centennial proposal to extend the life of the Charbon Colliery for up to 15 years (dated November 2009) is still being assessed by DoP. According to Centennial, "In the event … this proposed Project does not receive approval, the currently approved coal resources will be exhausted between 2010 and 2013."

Table 9 **Mines in southern and central regions of Western Coalfield: Output, principal market and mode of transport**

Coal mine (major shareholder)	Location / Major shareholder	2006-07 Output (Mt)		2007-08 Output (Mt)		Principal market	Haulage
		Raw	Saleable	Raw	Saleable		
Southern region							
Angus Place / Springvale Joint Venture*	15-16 km NW of Lithgow Centennial Coal 50%	6.03	5.98	6.21	6.01	Long-term supply contracts with Wallerawang and Mt Piper power stations (totaling 5.1 Mtpa); some export	By conveyor belt to Mt Piper power station; new link being constructed to Wallerawang power station. Export tonnages by rail via Lidsdale Siding to Pork Kembla.
Baal Bone	24 km NW of Lithgow (underground) Xstrata 74.1%	2.40	1.81	1.98	1.49	Export (semi-coking; thermal). Domestic (thermal)	By rail (277 km to Port Kembla Coal Terminal)
Clarence**	16 km E of Lithgow (underground) Centennial Coal 85%	1.59	1.44	1.66	1.49	Predominantly export	By rail (221 km to Port Kembla Coal Terminal)
Lambert's Gully	16 km NW of Lithgow (open cut) Centennial Springvale 50%, a subsidiary of Centennial Coal	0.18	0.18	0.20	0.20	Export (thermal); and some domestic supply to Mt Piper power station. Mining to conclude in 2010 (Centennial Coal Annual Report 2009)	By rail to Port Kembla; overland conveyor to Mt Piper power station
Invincible	3 km SE of Cullen Bullen CET Resources 80%	0.55	0.55	0.45	0.42	Supply to Mt Piper power station	By road
Pine Dale	Blackmans Flat (open cut) Equal shares held by Borap, J KL Doherty and Tatama	0.19	0.19	0.24	0.24	Supply to Mt Piper power station.	By road

Cullen Valley	30 km NW of Lithgow (open cut) CET Resources 80%	0.19	0.19	0.35	0.34	Supply to Mt Piper power station	By road (approximately 5 km)
Central region							
Charbon	3 km S of Kandos (underground and open-cut) Centennial Coal 95%	1.12	0.86	1.23	0.94	Predominantly export	By rail to Port Kembla Coal Terminal (325 km); by road to cement works.
Airly	40 km NW of Lithgow (underground) Centennial Coal 100%	New mining operation. Estimated output of 1.6 – 1.8 Mt per annum for more than 20 years. Mining scheduled to commence in June 2010. *Source:* Centennial Coal website and Annual Report 2009.				Export	Rail loop and line to the Mudgee-Sydney railway line and port access through Port Kembla Coal Terminal.

Source: NSW DII (formerly DPI), "2009 NSW Coal Industry Profile", and ACIL Tasman

*Raw and saleable outputs (in Mt) derived by summing the respective Angus Place and Springvale figures reported in "2009 NSW Coal Industry Profile"

**We note that in a recent application to increase coal haulage by road from 0.2 to 0.5 Mtpa (dated April 2009), it was stated that "Centennial transports the primary coal product of Clarence Colliery (low sulphur, thermal coal) by rail to Port Newcastle from where it is shipped to export markets in Korea, Taiwan and Japan. There would be no change to the mining, processing or transport of this product." See "http://majorprojects.planning.nsw.gov.au/files/37538/02_72601_Summary.pdf

4.2 Coal export forecasts

4.2.1 Key assumptions

ACIL Tasman has forecast the annual export tonnages of mines in the NSW Southern and Western Coalfields (southern part) that are relevant to the Maldon-Dombarton rail line on the basis of the following key assumptions:

- The annual tonnage mined at each colliery will be up to (but not exceed) the Department of Planning's approved maximum production capacity.[15] Collieries can seek approval to expand their operations and production capacity, or to develop entirely new mines. We have not included these uncertain developments in our forecasts, but have allowed for them in upside scenarios.
- Although the average annual output growth rate in the Western Coalfield between 1996-97 and 2007-08 was 4.6 percent, this was largely in the northern part (which exports through Newcastle) and no growth has been assumed for the southern part that is relevant to a Maldon-Dombarton line. Industry and Investment NSW notes that the southern mines face physical constraints (e.g. only one or two seams, some difficult mining conditions), that output has been relatively steady, and that coal output growth in NSW is more likely in the less constrained Gunnedah basin (and Queensland).
- The remaining life of each mine is estimated by dividing its known reserves as at 30 June 2008 with the amount that is projected to be extracted each year.
- The average rate of annual output in the Southern Coalfield has been negative over the same time horizon (i.e. 1996-97 to 2007-08). We have assumed that the output from Tahmoor, which we consider to be the only mine in the Southern Coalfield for which the Maldon-Dombarton could be an option (unless BHP were to change its position on road freighting from Bulli Seam), will remain steady over the forecast period. We have also modeled Tahmoor growth scenario as there is a potential extension now undergoing pre-feasibility analysis.
- Output from the potential East Bargo mine is not separately included in the forecast but would be an extension of adjacent Tahmoor, included in the upside scenario just mentioned and transported to Port Kembla via rail

[15] Information on each mine's maximum production capacity is drawn from at least two sources: DII's "2009 New South Wales Coal Industry Profile" and various relevant proposals for coal mine construction, extension or expansion submitted to NSW Department of Planning (accessible at: http://majorprojects.planning.nsw.gov.au/page/project-sectors/mining--petroleum---extractive-industries/mining/)

(the Maldon-Dombarton rail line if built, otherwise the Moss Vale – Unanderra line.

- Output from the Bulli Seam colliery (an amalgamation of the existing West Cliff and Appin collieries) will continue to be transported by truck. As discussed previously, it could potentially be transported by rail via the Maldon-Dombarton rail line if a loading facility at Wilton were to be built, but BHP's intention is to continue to use trucks. There is uncertainty around this, however, as the NSW Minister of Planning has yet to approve BHP's application.
- Other assumptions regarding the current and future transport of the export coal are summarised in Table 10 below.

Table 10 **Forecast model – other assumptions**

Mine	Mine life	Current saleable output (Mtpa)	Saleable output exported		Current movement	Future movement (with Port Kembla)
			%	Mt		
Southern Coalfield						
Tahmoor	37	1.60	100%	1.60	Rail (Moss Vale line)	Rail (Maldon-Dombarton rail line)
Western Coalfield						
Airly (new mine)	20	1.80	100%	1.80	-	Rail (Maldon-Dombarton rail line)
Angus Place/Springvale	25	3.00	50%	3.00	Rail (Illawarra line)	Rail (Maldon-Dombarton rail line)
Baal Bone	5	1.65	100%	1.65	Rail (Illawarra line)	Rail (Maldon-Dombarton rail line)
Charbon	15	1.30	100%	1.30	Rail (Illawarra line)	Rail (Maldon-Dombarton rail line)
Clarence	35	2.00	100%	2.00	Rail (Illawarra line)	Rail (Maldon-Dombarton rail line)

Source: ACIL Tasman

4.2.2 Forecast results

We have forecast the tonnages that could potentially be transported to Port Kembla via a Maldon-Dombarton rail line by each relevant mine on an annual basis. The forecast results for the years 2015, 2020, 2025 and 2030 are summarised in Table 11. The projected annual output of these mines from 2011 to 2030 is shown in Figure 4. The forecasts assume that a Maldon-Dombarton line would be used in preference to the Illawarra line. It would be slightly longer (for coal from the Western Coalfield) but would have a ruling gradient that was not as steep and would not suffer from congestion.

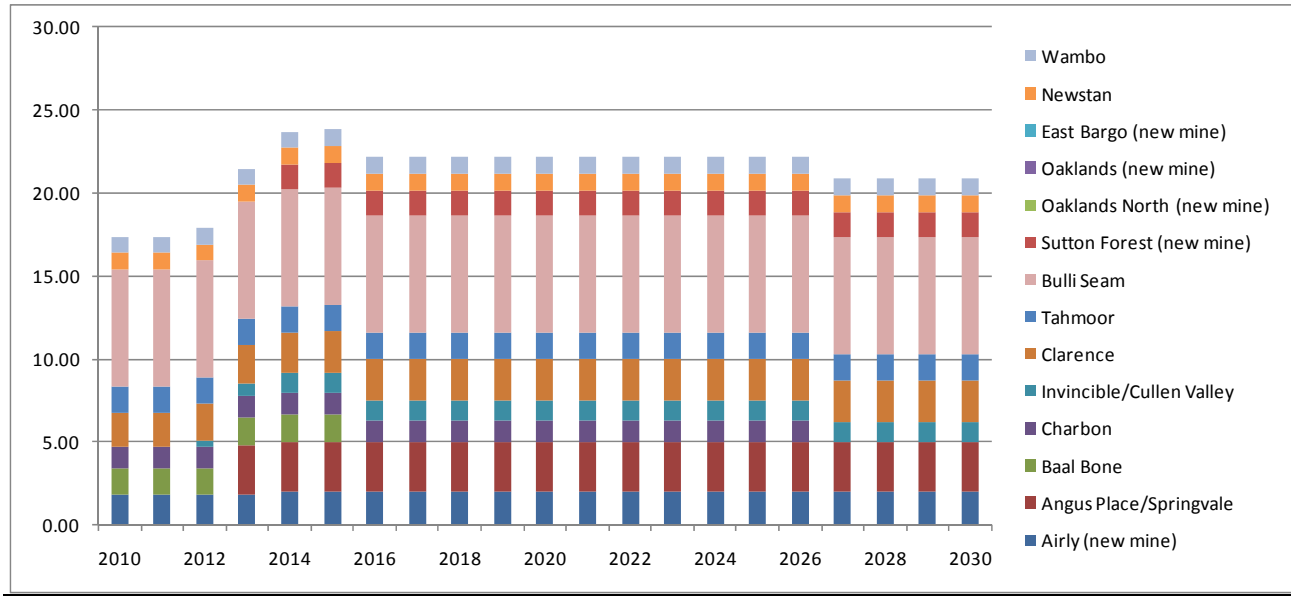
Table 11 **Projected output of mines relevant to the Maldon-Dombarton rail line**

Mine	Year			
	2015	2020	2025	2030
	Mtpa	Mtpa	Mtpa	Mtpa
Southern Coalfield				
Bulli Seam*	7.0	7.0	7.0	7.0
Tahmoor	1.6	1.6	1.6	1.6
Western Coalfield				
Airly (new mine)	2.0	2.0	2.0	2.0
Angus Place/Springvale	3.0	3.0	3.0	3.0
Baal Bone	1.7	0.0	0.0	0.0
Charbon	1.3	1.3	1.3	0.0
Invincible/Cullen Valley	1.2	1.2	1.2	1.2
Clarence	2.5	2.5	2.5	2.5
Newcastle/Hunter Coalfields				
Newstan	1.0	1.0	1.0	1.0
Wambo	1.0	1.0	1.0	1.0
TOTAL	**22.3**	**20.6**	**20.6**	**19.3**

* BHP Billiton has indicated that this coal will not use a Maldon-Dombarton rail line because of the cost of relocating its coal washery and coal wash emplacement facility.

Source: ACIL Tasman

Figure 4 **Projected annual output of mines relevant to the Maldon-Dombarton rail line, 2011 to 2030 (Mt)**



Note: Bulli Seam output is included throughout; even though it has indicated that it will not use a Maldon-Dombarton rail line.
Data source: ACIL Tasman

4.3 Additional coal movements

4.3.1 Coal from the Hunter Valley and Newcastle

There are approximately 2 million tonnes per annum which are rail freighted to Port Kembla from Newcastle (2009 figure). This coal is used for blending at the BlueScope steelworks at the port. ACIL Tasman expects this coal to continue at roughly the same level over the forecast period, and this is expected to switch to the Maldon-Dombarton rail line if it becomes available.

4.3.2 Summary

This chapter has considered expected future coal tonnages on a Maldon-Dombarton rail line. There are important caveats, mainly because existing mine operators have not publicly stated their desire to switch from road to rail transport.

- We have assumed that Tahmoor's coal output will stay steady over the forecast period. It is one of the existing mines in the Southern Coalfield for which the Maldon-Dombarton rail line could be an option. The coal transported would have a shorter journey to Port Kembla on a Maldon-Dombarton rail line, and could enter that line more easily, without the shunting movements required at present. But Tahmoor may continue to use the Moss Vale-Unanderra line for locomotive power reasons.
- The outputs from two other mines, namely Appin and West Cliff, are currently transported to Port Kembla by truck. Once the proposed Bulli

Seam project (which combines the mining at Appin and West Cliff) commences, the output could be carried on a Maldon-Dombarton (or Illawarra) rail line instead, although with substantial capital setup cost (BHP intends to continue using trucks).

- Some movement of coal from the Newcastle region for use in the steelworks is expected to continue throughout the forecast period.
- The main attraction of a Maldon-Dombarton rail line is its potential use by coal exporters not served by existing lines. It could lead to exploitation of a coal deposit on the line itself (East Bargo), and allow (at a cost) the new Bulli Seam colliery to switch from road to rail. That switch would have environmental benefits, and would help reduce the problem of heavy truck use of Appin Road and Mt Ousley, though BHP intends to continue with road transport.

The forecasts in this working paper are conservative, based on firm information. Upside scenarios, which are less certain, are examined in Working Paper 2. The broader question of coal output compared with capacity on existing rail lines is also explored in Working Paper 2.

5 Potential transport of grain on a Maldon-Dombarton rail line

The potential for grain to be transported on a potential Maldon-Dombarton rail line is dependent on several key variables:

- The amount and frequency of bulk grain (predominately wheat) exported from NSW annually
- Any capacity constraints on existing rail lines into Port Kembla, especially during the peak bulk grain export months of January February and March
- The relative cost of moving bulk grain via the Moss Vale line
- The relative cost of exporting bulk grain from other ports, particularly Newcastle.

5.1 Background

The Australian grain export terminals and the rail lines that support them were developed when storage, handling, railways and grain marketing (domestic and export) were regulated by a series of state and Australian government authorities.

In a regulated market, grain was generally drawn for each port from the 'port zone' with limited or no competition at the margin between port zones. As there was little competition between ports, transport linkages between port zones were generally not well developed. In addition, in regulated markets all grain is generally pooled when it enters the bulk handling system. When grain is pooled all costs are passed back to growers, diminishing incentives for the marketing authorities to reduce costs.

The domestic market for grain was deregulated in 1989 which, amongst other things, allowed grain to be sold by farmers across state boarders. In 2008 the export wheat market was deregulated. Over this period, the statutory marketing authorities in each state became publicly listed companies and there were a number of new entrants to the domestic and export markets.

While there have been significant changes to the grain market, there have not been any significant changes to the rail network, in particular the linkages between port zones.

The illustration of the rail NSW network in Figure 5 shows the orientation of the rail network towards particular ports.

Figure 5 **NSW grain rail network**

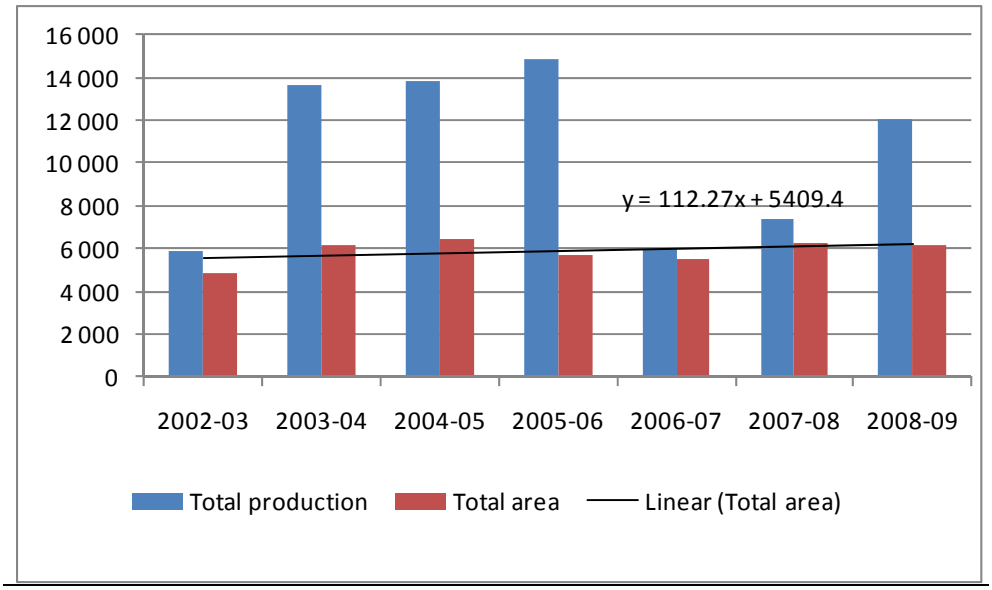
Data source: (Department of Infrastructure, Transport, Regional Development and Local Government, 2009)

In 2008 the Minister for Infrastructure, Transport, Regional Development and Local Government instructed his Department to conduct a major review into the grain freight task and the capacity of the railways to meet future demands (Department of Infrastructure, Transport, Regional Development and Local Government, 2009). The review recommended a series of improvements to the rail network, particularly the maintenance (with industry contributions) of the extensive NSW branch line network that services the bulk storage and handling system (which is predominately owned by GrainCorp).

5.2 Amount and frequency of grain exports from NSW

The production of grain in NSW is highly variable but the area sown to crops has been steadily increasing (see Figure 6). This is due to the relatively poorer financial performance of livestock enterprises compared with grain enterprises and the higher rate of productivity increases in cropping compared with livestock production.

Figure 6 **NSW grain production and area**

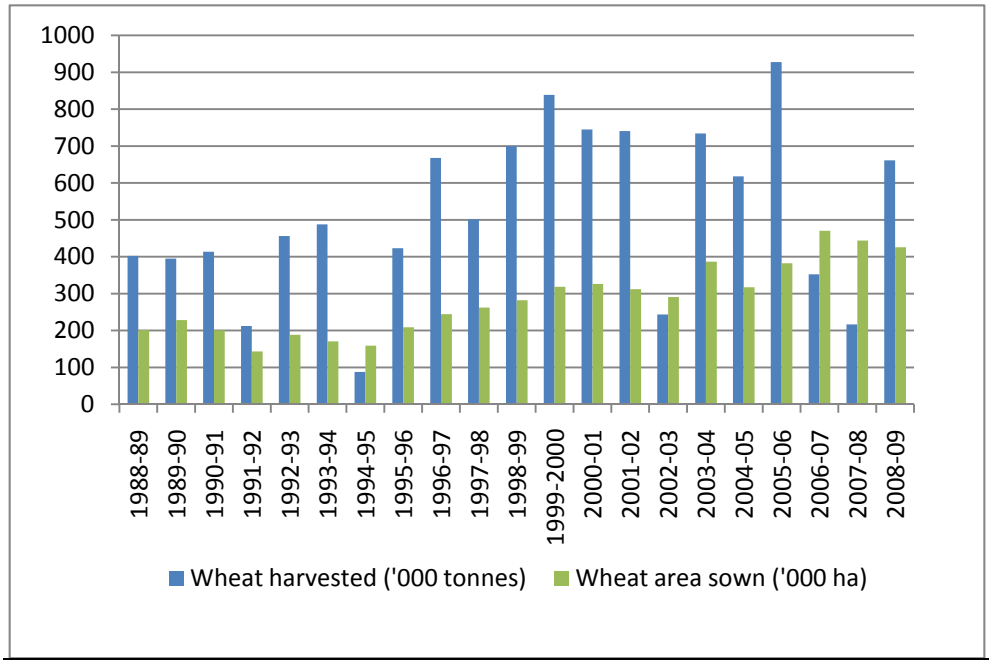


Data source: (ABARE, 2009)

Much of the increase in crop area is in the northern crop growing regions of NSW, which is primarily exported through Newcastle or Brisbane.

Wheat is the dominant crop grown in NSW (55 per cent of the total crop area) and shows similar area and production trends as crop production as a whole in NSW does (see Figure 7). Wheat is also the dominant export grain in NSW.

Figure 7 **NSW wheat areas sown and total production**

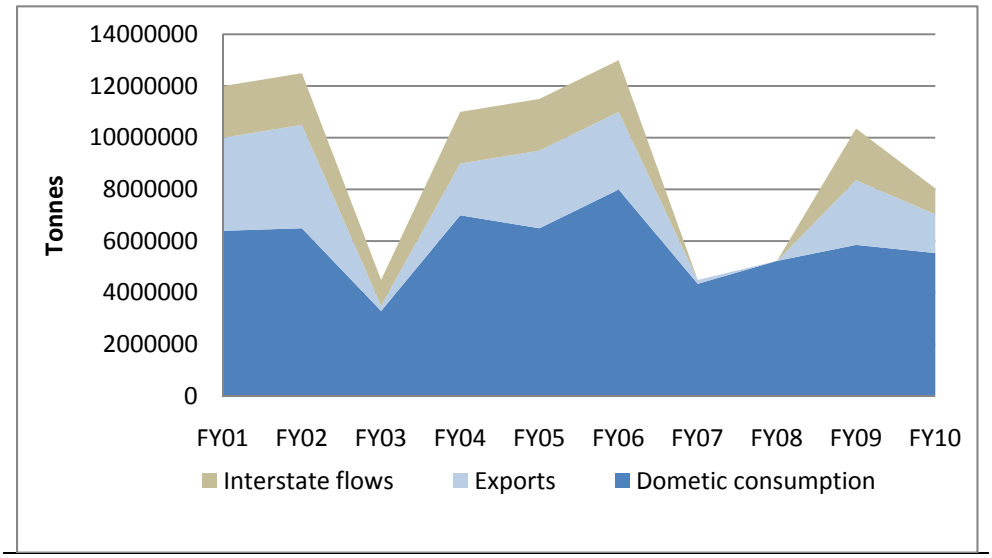


Data source: ABARE

In an average year, domestic consumption of grain in NSW accounts for approximately 40 per cent of total production while net interstate flows account for a further 18 per cent, leaving approximately 40 per cent for the export market.

The quantity of grain consumed domestically is trending slowly up with minimal year to year variation. With the expansion of ethanol production and intensive animal industries, domestic demand is rising at a slightly faster pace than production is increasing. The effect of a combination of variable production and a generally inelastic domestic demand on the volume of grain exported from NSW is shown in Figure 8.

Figure 8 **Indicative allocation of NSW grain production 2001-02 to 2007-08**



Data source: (Department of Infrastructure, Transport, Regional Development and Local Government, 2009)

GrainCorp estimates that the combined capacity of the two port terminals it operates in NSW is approximately 540kt per month. This equates to approximately 6.4 Mtpa (see Table 12). Therefore port capacity, given historical trends and a forecast increase in domestic demand, is unlikely to be a limiting factor in exporting grain from NSW in the foreseeable future.

Table 12 **Estimated GrainCorp elevation capacity per terminal in NSW**

	Monthly capacity (Kt)	Annual capacity (Mt)
Port Kembla	270	3.2
Newcastle (Carrington)	270	3.2
Total	540	6.4

Data source: (GrainCorp, 2010)

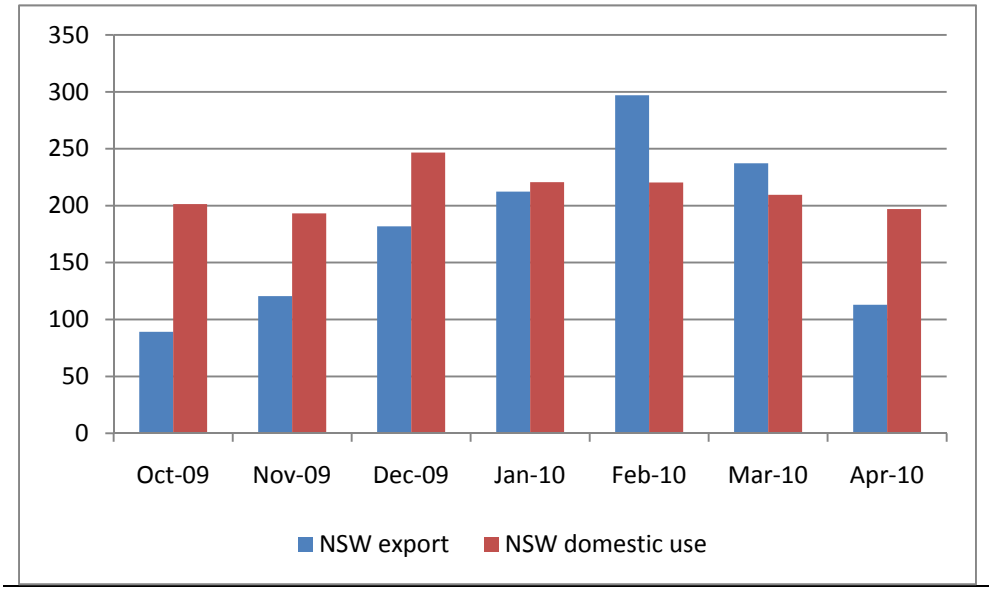
5.3 Capacity constraints and peak demand

Not only are annual export volumes highly variable, monthly exports vary considerably. The variability in monthly export volumes from NSW is illustrated in Figure 9. Grain, particularly wheat, is generally exported between the months of December and March.

This is because Australian exporters want to sell and ship as much grain as possible before the northern hemisphere wheat crops are harvested and exported between May and June each year. When facing imminent competition from the northern crop Australian grain prices tend to fall.

Even in a deregulated market, where export programs will be more responsive to market signals, the peak months for exporting grain are likely to remain from December to March.

Figure 9 **NSW monthly wheat exports**



Data source: (ABARE, 2010)

The combined effect of high variability of grain production and monthly exports means that peak port (and rail access demand) is likely to vary considerably from month to month.

5.4 Competition between ports

While export grain volumes will vary considerably month to month and year to year, there are several alternative paths for grain exports if rail capacity becomes a constraint at Port Kembla. The alternative grain export paths are containerisation of the grain and other ports.

An increasing trend in grain exports is the use of containers. GrainCorp estimates that an additional 1.0mt of grain could be exported by container from the east coast of Australian in the medium to short term (GrainCorp). However, containerised grain is generally exported through Sydney, not Port Kembla.

There are two ports that Port Kembla competes with for grain exports: Newcastle and Melbourne.

Port Kembla competes with Newcastle for grain in the northern areas of Central NSW, mostly from a branch line that extends from Dubbo to Coonamble. This is a highly productive grain producing region and is

approximately 482km from Newcastle and 600km from Port Kembla. However, due to the higher cost of exporting grain through the Newcastle port compared with Port Kembla, grain from this region is often transported through Port Kembla. It is estimated that there could be between 100,000 and 400,000 tonnes of grain that, while closer to Newcastle, is exported through Port Kembla from the Coonamble area.

The cost of exporting grain through Newcastle is higher due to congestion on the Hunter valley line, and inefficient rail/terminal facilities in Newcastle. The Newcastle terminal is older than Port Kembla and requires additional shunting of trains to unload as the terminal rail access is not long enough to handle full grain train configurations.

The Hunter Valley line that services Newcastle is heavily congested with coal trains, which means that grain trains have limited slots on the line.

An impediment to further switching of grain exports from Newcastle to Port Kembla is the nature of the rail line between the large grain growing area in northern New South Wales (north-west of Moree) and Parkes (on the way to Cootamundra and Moss Vale). Much of that line is not of high standard so the train journey is slow, with consequent expenses related to poor utilisation of crew and equipment.

Work on the recently completed Melbourne-Brisbane inland rail study, in which ACIL Tasman participated, identified potential improvements to that line involving upgrading of track standards and new sections to avoid indirect routing (such as the dogleg at Werris Creek). This, combined with potential improvements to the grain lines in northern New South Wales, would, according to the industry, make the connection to Port Kembla attractive. However the study concluded that it would not be economic to construct an inland line until at least 2030, too late to be relevant to this Maldon-Dombarton study.

This impediment to switch grain between Newcastle and Port Kembla works both ways. If one or more of the proposed new terminal investments in Newcastle proceeds, the costs of using the port could fall significantly. But the ability of Newcastle to significantly increase throughput by sourcing grain from southern NSW is constrained by the low standard of track linking the NSW port zones.

Grain produced in southern NSW can be exported either through Melbourne by transporting the grain down the main south line, or sent to Port Kembla via Cootamundra and onto Moss Vale. The boundary between the Melbourne and Port Kembla port zones generally falls somewhere south of Wagga Wagga. For example grain produced south of Wagga Wagga at The Rock is 422 km from

the port of Melbourne and 445 km from Port Kembla. By comparison, The Rock is 654 km from Newcastle.

When grain is exported from southern New South Wales, it is typically transported by train to Port Kembla via the Moss Vale-Unanderra line.

Based on the industry standard of approximately $0.095[16] per km per tonne to transport grain by rail, a change of $5.00 per tonne in port handling charges would alter the theoretical distance grain could be transported by rail to a port by 52 km to maintain the same total storage and handling charge. In other words, all else being equal, a $5.00 per tonne change in port handling costs could alter the boundary of a port zone by 52 km.

In addition to being able to physically move grain between ports, GrainCorp offers exporters the opportunity to swap exports between its export terminals. That is, if an exporter is unable to export grain out of one port, either due to limited grain availability or capacity constraints, the exporter can arrange to swap the slot they have booked at one port with an equivalent slot at another GrainCorp port where grain is available.

As a result of this arrangement, if an exporter were faced with congestion at Port Kembla due to rail constraints or other factors, some grain could be switched to either Newcastle or Melbourne (or vice versa) at relatively low cost.

5.5 Summary of key drivers for grain exports through Port Kembla

In summary the demand for additional grain to be exported through Port Kembla and thus take advantage of a potential Maldon-Dombarton line (should it proceed) is limited by increasing domestic demand for grain which is reducing the amount and frequency of grain exported through NSW ports

Although peak demand is likely to increase in variability between months and across years, were a constraint on the export of grain from Port Kembla to emerge, there are three relatively low cost alternative pathways for the grain:

[16] Grain Trade Australia (GTA) has established a series of location differentials based on a standard freight charge between the nearest port and individual receival points in the storage network. The standard freight charges are generally based on the rail freight cost of moving a tonne of grain between the receival point and the nearest port. They have been developed to allow a trader the option of quoting a standardized grain price at each receival point based on the 'natural'(nearest) port price less the cost of freight to the port. These prices are known as 'track prices' as they are based on the freight costs of the track that services each port. Location differentials do not reflect variations to freight rates during the year and between grain buyers which are likely to become more variable as the number of traders and freight options increase in the deregulated export wheat market.

- Newcastle
- Melbourne
- containerisation of the grain and exporting it through Sydney.

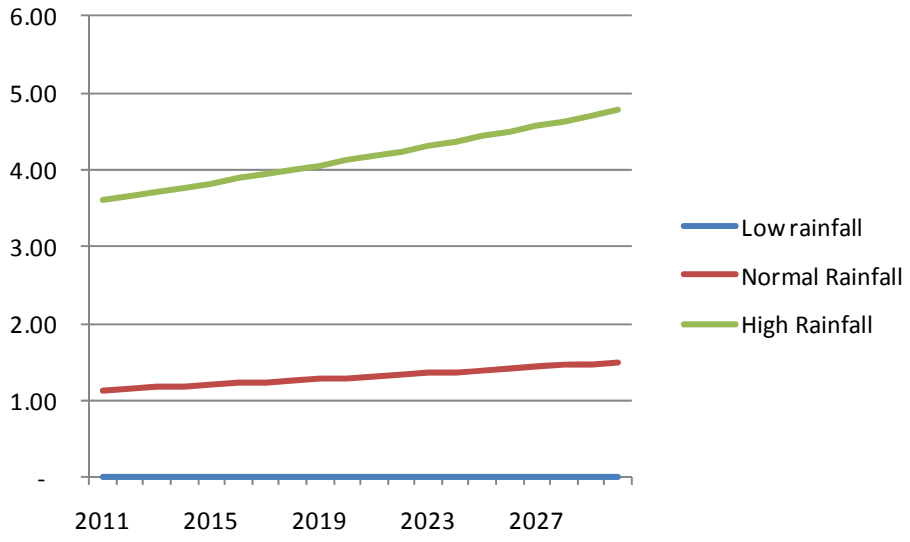
5.6 Projected grain exports via Port Kembla

Grain exports through Port Kembla are expected to remain steady at around 1.0-1.5 Mtpa in a typical year, or grow at a low rate, with weather-related fluctuations occurring from year to year. This reflects production trends and domestic demand, and assumes no improvement in the inland rail connection (via Parkes and Dubbo) to northern NSW.

These tonnages would increase if Port Kembla became more attractive compared with the Port of Newcastle due to improvements in the inland rail connection. Conversely, they would decrease if the Ports of Newcastle became more attractive due to upgraded grain facilities. They could also decrease if an increased proportion of grain was containerised and exported through Sydney.

ACIL Tasman's forecast of the tonnages of grain that would be transported by rail to Port Kembla for export is shown in Figure 10.

Figure 10 **Projected quantity of wheat exported through Port Kembla, 2011 to 2030**



Data source: ACIL Tasman

In the central case ("normal rainfall"), grain exported from Port Kembla is expected to rise from 1.13 Mt in 2011 to 1.50 Mt in 2030. Most of the grain (particularly those from southern NSW) will continue to travel to the port via the Moss Vale-Unanderra line. A portion of the grain from central NSW could potentially use ta potential Maldon-Dombarton rail line.

6 Other bulk commodities

This chapter analyses the potential use of the Maldon-Dombarton rail line for the transport of other bulk commodities, including metallic ores such as gold, copper and iron, as well as cement, Kaolin and biofuels.

6.1 Gold, copper and iron

A relatively low cost producer of gold, base metals and mineral Kaolins, NSW exports a significant quantity of minerals, much of which is concentrated in the central west region of the state near Orange and Parkes. Future mineral output in the state may be expanded considerably by a number of projects that are currently at various stages of feasibility.

Production growth of minerals in NSW has recently been dominated by gold and copper. Production of other base metals such as zinc, silver and lead has declined in the last two decades.

6.1.1 Current production and exports

In 2007-08, NSW produced 146,000 of Australia's 849,000 tonnes of copper and 34,000 kilograms of gold (see Table 13). They were valued at $1.26 billion and $1.00 billion respectively.

Table 13 **NSW copper and gold production, 1998-99 to 2007-08**

	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08
Copper (kt)	93	124	130	122	144	163	175	204	195	146
Copper ($m)	224	345	438	351	389	534	735	1,384	1,772	1,264
Gold (t)	19.1	20.2	18.6	18.8	26.5	28.0	29.0	29.0	32.0	34.0
Gold ($m)	280	293	303	332	482	493	525	659	843	1,000

Data source: NSW Minerals, http://www.nswmin.com.au/Media-Speeches-and-Info/Key-Statistics-and-Publications/default.aspx

The value of copper exports from NSW increased from $345 million in 2002-03 to $589 million in 2007-08, before declining to $488 million in 2008-09 (see Table 14).

Table 14 **Value of NSW copper exports, 2002-03 to 2008-09 ($mil)**

2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09 (p)
345	317	324	390	520	589	488

http://www.nswmin.com.au/Media-Speeches-and-Info/Key-Statistics-and-Publications/default.aspx

In 2008-09, 373,505 revenue tonnes of copper ore and concentrates was exported from Port Kembla (see Table 15).

Table 15 **Port Kembla copper ore exports/imports, 2000-01 to 2008-09**

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Exports	32	55	5	267	395	455		387	373

Source: Port Kembla Annual Reports and Port Kembla Freight Accessibility Strategy Study (2007), http://www.kemblaport.com.au/index.pl?page=53

6.1.2 Potential use of a Maldon-Dombarton rail line

Newcrest Cadia Hill

Newcrest's Cadia Hill mine near Orange, NSW is one of the largest open pit gold-copper mines in Australia. The Cadia Hill ore body is a large, low grade ore body. The gold-copper concentrates from both Cadia Hill and the adjacent Ridgeway treatment plants are combined and pumped as slurry to a filtration plant in the nearby town of Blayney. The concentrate is then de-watered before being transported by rail to Port Kembla for shipment.

Newcrest has two development projects underway in Cadia Valley. The Ridgeway Deeps project involves the development of the resource below the current Ridgeway mine, which will extend the life of this mine. Cadia East involves the development of one of the world's largest gold deposits. The mine will become the deepest panel cave in the world and Australia's largest underground mine.

Newcrest currently transports 0.35 Mtpa of (predominantly gold and copper) concentrates by rail from the Cadia Hill mine to Port Kembla via the Illawarra line. Due to the new development projects described above, the amount of concentrates that will be transported to Port Kembla for export is expected to increase considerably in the future. There is potential for Newcrest to use a potential Maldon-Dombarton rail line in place of the Illawarra line.

Rio Tinto Northparkes

Rio Tinto transports concentrates from its Northparkes copper and gold mine, located 27 kilometres northwest of Parkes in central west NSW, to Port Kembla for export. The concentrates are transported by rail on specialised containers via the southern route through Stockinbingal and then on the Moss Vale-Unanderra line.

In 2006, Northparkes commenced construction of its third major block cave mine, with full production expected to be achieved in late 2010. This extends the life of Northparkes' operations until 2024.

There is potential for Northparkes to use the Maldon-Dombarton rail line in place of the Illawarra line.

Tri Origin Woodlawn

Tri Origin Mineral's is considering reopening the old Woodlawn mine site located 30 kilometres south of Goulburn, NSW.

A pre-feasibility study for the Woodlawn Underground Project was undertaken during the March quarter 2007. A feasibility study has commenced, targeting an initial mine life of eight years and an ore production rate of 300,000 to 400,000 tonnes per annum producing approximately 80,000 to 100,000 tonnes per year of zinc, copper and lead concentrates. Metallurgical tests to determine plant design criteria have been undertaken but further work is required.

Initial estimates by Tri Origin are based on export volumes in excess of 100,000 tonnes per annum. While it is evaluating Port Botany as a likely export corridor, the product could potentially be transported to Port Kembla if rail capacity was available.

Eastern Iron

Eastern Iron has identified significant iron ore deposits in western NSW that stretch from north of Cobar through to Lake Cargelligo to the south (see Figure 11). As the ore body is located close to the surface, the operation is easily scalable, making rail capacity to port an important constraint in terms of potential export volumes. The deposits could access the existing rail network at various points via short distance road hauls. Trains could reach Port Kembla either via the Moss Vale-Unanderra line or a potential Maldon-Dombarton rail line.

Eastern Iron has indicated to ACIL Tasman that it is currently in the exploration stage of the project and that they have formed a joint venture which is currently investigating whether iron ore should be transported raw to China or be processed locally. It has indicated that Port Kembla is preferable to the Port of Newcastle because of problems with rail access to Newcastle due to competition with coal. If the Maldon-Dombarton rail line were to be used, the volume would be around 2 Mtpa.

Figure 11 **Eastern Iron ore deposits in western NSW**

Source: Eastern Iron

FRID Resources Lockhart

FRID Resources is currently drilling and exploring at Lockhart, located west-southwest of Wagga Wagga. They have acquired six tenements, totalling approximately 1,800 sq km.

FRID has entered into Memoranda of Understanding with Port Kembla and Pacific National. They say they would be likely to transport the iron ore to Port Kembla on rail via Cootamundra, Goulburn and Moss Vale. However, their understanding is that the Moss Vale-Unanderra line would need to be upgraded to take the weight of the heavy ores, so the Maldon-Dombarton rail line would be potentially useful. An alternative would be to rail the ore to Geelong, but this would require significant investment at the port. .

If the project went ahead (the current probability is said by the proponent to be approximately a 60-70 percent change of NOT proceeding) it says the the volumes would be 1 Mtpa in mid to late 2012, ramping up to 20 Mtpa two years after that. The availability of adequate rail infrastructure with sufficient capacity would an important requirement for this project to commence, and is considered further in Working Paper 2.

Industry and Investment NSW consider that substantial further research is needed on metallurgical and other quality aspects of the above iron ore, and that this will take some time. ACIL Tasman has not allowed for iron ore in its base case. The question of rail capacity for the ore, if it does prove worthwhile to export, will be addressed in Working Paper 2.

Table 16 **Forecast ore tonnages**

	2015	2020	2025	2030
	Mtpa	Mtpa	Mtpa	Mtpa
Northparkes	0.19	0.19	0.19	0.19
Ridgeway	0.00	0.00	0.00	0.00
Ridgeway deeps	0.21	0.00	0.00	0.00
Cadia East	0.25	0.46	0.46	0.46
Total	***0.65***	***0.65***	***0.65***	***0.65***

Data source: ACIL Tasman

6.2 Cement and limestone

Cement manufacturing involves extracting raw materials and refining them into cement. Cement is made from calcium carbonate, silica, aluminium and iron (generally limestone, shale, clay, Kaolin and iron ore). The raw materials are heated to transform them into clinker which is mixed with gypsum and ground to a fine powder to make cement. Raw materials may also include by-products such as fly ash from coal and slag from steel. Concrete product is then despatched by rail and road.

Box 1 **Mineral exploration, production and processing**

Private mineral exploration (broadly defined to include exploration and evaluation) comprises many sequential decisions, but it is useful to identify three key stages — the generative, primary exploration and evaluation stages:

- in the **generative stage** of private mineral exploration, companies identify areas that are considered to be prospective for target minerals using public geoscientific information and supplementary private reconnaissance work
- in the **primary exploration stage**, areas that have been identified as prospective for target minerals are acquired and tested in much greater detail by private explorers, the aim being to identify new zones of mineralisation that prove to be economic to mine
- where primary exploration activity has resulted in the discovery of a mineral deposit, the **evaluation stage** involves reserve delineation (to define more accurately the size, grade and physical characteristics of the mineral deposit), mine planning, metallurgical testing, feasibility studies and predevelopment planning including financing and government approvals and an assessment of the least cost method of mining.

Success in the exploration stage comprises the discovery of new mineral occurrences and in the later stages of the exploration stage these are further evaluated, generally by way of a drilling program, which, if successful, leads to the discovery of an economic deposit and defines the size, grade and geometry of the deposit.

Where the evaluation stage indicates an economic project, the development stage involves construction and development of the mine site and related mineral processing facilities. The requirements of the development stage will also be influenced by the availability and cost of other infrastructure services such as energy, transport and water.

In the production/processing stage, companies undertake mineral extraction, processing and marketing activities. Processing of minerals includes smelting, refining and chemical processes, which result in the production of a refined metal cathode, ingot or equivalent basic forms. Mineral processing at or close to the mine site reduces transport costs.

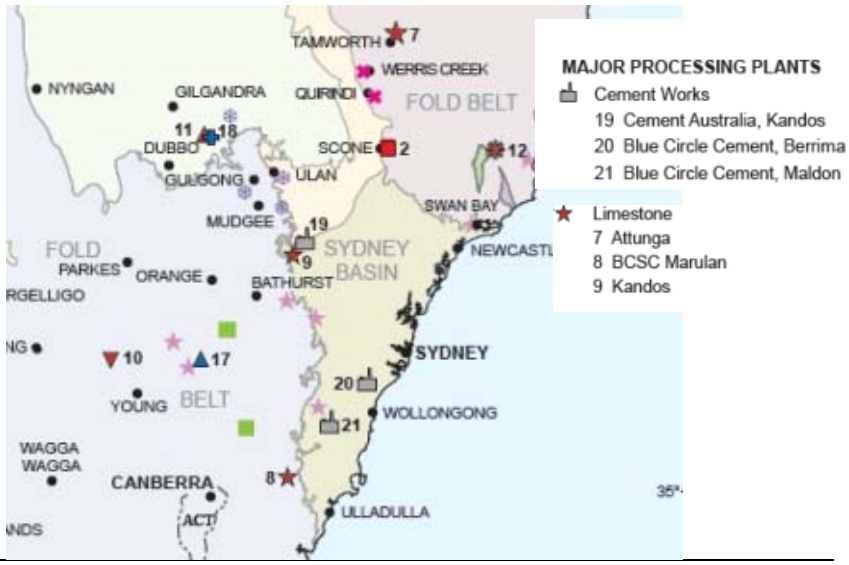
Mine site closure occurs with the economic depletion of mineral ore deposits from that location. Declining reserves at a particular mine site, however, may encourage further exploration around the existing deposit in order to extend the longevity of the mine and/or processing plant.

In the mine site rehabilitation stage, companies rehabilitate the mine site according to a strategy approved by government. This may require environmental restoration during as well as at the end of the mining operation depending mainly on the nature of the mining operation.

Source: ABARE, *Public Geological Surveys in Australia*, August 2003

Currently, there are limestone mines located in Attunga, Marulan and Kandos in NSW (see Figure 12). There are also cement processing plants including Cement Australia in Kandos, and Blue Circle Cement in Berrima and Maldon.

Figure 12 **Cement and limestone processing plants, NSW**



Source: Map adapted by ACIL Tasman from DPI (2010)

6.2.1 Production and imports

In the March 2010 quarter, Australia manufactured 1,904,000 tonnes of Portland cement and 5,268,000 cubic metres of pre-mixed concrete (ABS).

In 2006-07, NSW produced 4.5Mt of limestone worth around $32 million[17]. In 2005-06, NSW produced and used nearly 6.9 million cubic metres of pre-mixed concrete (CCAA)[18].

It appears national concrete production has been relatively steady over the past two years (see Table 17). Although there is not a time-series of data for production of concrete in NSW, we could assume that production in NSW would be relatively stable.

Table 17 **Concrete Production, Australia 2008-10**

	Mar-2008	Jun-2008	Sep-2008	Dec-2008	Mar-2009	Jun-2009	Sep-2009	Dec-2009	Mar-2010
Pre-mixed concrete									
Australia	5,839	7,032	6,924	6,419	5,146	5,407	5,969	5,905	5,268
Portland Cement									
Australia	2,183	2,558	2,612	2,373	1,963	2,160	2,325	2,273	1,904

Data source: NSW Minerals

[17] http://www.nswmin.com.au/Mining-in-NSW/About-the-Industry/What-we-mine/Industrial-Minerals/What-We-Mine---Industrial-Minerals/default.aspx

[18] http://www.concrete.net.au/industry/NSW_concrete.php

In 2008-09, Port Kembla imported 182,400 revenue tonnes of limestone and 77,000 tonnes of cement clinker (see Table 18).

Table 18 **Port Kembla cement imports, 2000/01 to 2008/09 ('000t)**

	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Limestone	258	331	311	-	273	182
Cement clinker	193	77	28	-	24	77

Source: Port Kembla Annual Reports

According to the 2007 Port Kembla Freight Accessibility Strategic Study, the port forecasts that imports of cement clinker will remain steady at 20,000 tonnes and 40,000 tonnes per annum, respectively, from 2006/07 to 2015/16.

6.2.2 Potential usage of a Maldon-Dombarton rail line

Cement Australia

Cement Australia currently has a clinker plant and cement distribution in Kandos (between Lithgow and Mudgee) in NSW as well as plants in Queensland and Tasmania where raw materials are extracted and refined into cement. Currently Cement Australia utilises rail, approximately 300,000 tonnes, to transport from the cement works in Kandos, North West of Lithgow, to Clyde in North West Sydney.

Cement Australia would use a potential Maldon-Dombarton rail line, if it was economical, for movement of cement out of Port Kembla to Sydney, and possibly the Canberra market. They would not use the line for transporting input commodities because they currently import all raw materials into Port Kembla.

It was stated that, if the line was to go ahead, initially they would start with approximately 300,000 tonnes to Sydney and around 50,000 to Canberra if it was economically viable. From 2013-2018, they estimate that their output would be approximately 800,000 tonnes, of which around 600,000 could potentially utilise the line. Some of this may be going to southern Sydney. If the line is not economical, road transport will be utilised.

Any service to Sydney would require a dedicated block train/dedicated cement wagons. Cement to Canberra could potentially use intermodal containers. There is also some potential for smaller volumes, around 20,000 tonnes to the Parkes area which may utilise intermodal containers on the line.

Blue Circle Southern

Blue Circle Southern is a producer of cement with processing plants in Maldon and Berrima. It has a distribution centre near Newcastle as well as a manufacturing centre and distribution in Victoria. Blue Circle Southern is also a primary supplier of limestone and coal by-products, with a limestone plant in Marulan. They stated that a potential Maldon-Dombarton rail line would increase their capacity to use the Illawarra line to transport concrete aggregate up to Sydney. They estimate their potential usage of the line at 500,000 tonnes. However, they would not utilise the line for southbound trips or to Port Kembla.

6.3 Kaolin

Sydney Construction Materials (SCM) currently has development approval for the Newnes Junction Kaolin Extraction and Kaolin Mining Project, a new Kaolin mining operation near Lithgow. The project will supply 1.3 Mtpa of construction Kaolin, and 0.12 Mtpa of kaolin clay to the Sydney market.

SCM is planning to export an initial volume of 0.5 Mtpa, growing to 1.5 Mtpa. This will involve running two trains a day from Lithgow to Port Kembla six days per week.

6.4 Biofuel

6.4.1 Ethanol

Manildra Group

The Manildra Group is expected to expand ethanol production at its Bomaderry plant; this increase will likely be accommodated initially through longer train lengths on existing rail services rather than requiring additional train paths. While the biofuel will be continue to be transported primarily on road by trucks, the animal feed by-product Dried Distillers Grain (DDG) may potentially be transported away by rail in the longer term.

6.4.2 Biodiesel

National Biofuels

National Biofuels Pty Ltd is developing a soybean biodiesel plant in Port Kembla. While the soybeans will initially be imported by ship, it will eventually be sourced domestically, thereby requiring rail services into Port Kembla.

The National Biodiesel Pty Ltd has proposed a soybean processing and biodiesel plant in the inner harbour of Port Kembla. It is expected that the new

plant would process soybeans to produce 1.1 million tonnes of soy protein meal (animal feedstock) a year and 288 million litres of biodiesel a year[19] (750 tonnes of biodiesel produced and 4,040 tonnes of soybeans prepared, each day).

It is estimated that project would generate up to 42 heavy vehicle, 4.3 rail, 0.34 ship and 230 car trips per day. It is estimated that the exiting road network has adequate capacity to accommodate this traffic.

The 2008 Environmental Assessment[20] stated that the plant would utilise the Southern Freeway and Illawarra rail line.

Inputs of soybeans and production materials would be received by ship, road and rail. The bulk of the soybeans will be received by shipment at the existing GrainCorp shipping terminal. Soybeans produced locally will be received mainly by a dedicated rail line to the site (one cargo carriage is estimated to hold 32-40 tonnes). Most chemical inputs will be received by trucks.

The main production outputs – soybean meal, biodiesel and glycerine – would be delivered to off-site locations by ship, road and rail. The bulk of the biodiesel and glycerine will be delivered by truck (one cargo truck is expected to carry 30-45 tonnes per truck). The capacity to move soybean meal by rail will be developed during the first few operational years of the proposed SPBP facility.

In terms of rail, the proposed plant is intended to utilise the rail system available to the site. It is envisaged that the operation will require up to 2 movements per day (17-21 outbound and 3-4 inbound carriages).

The Environmental Assessment examined three scenarios for the transportation of materials. Under the most likely "normal operation" scenario, transport by sea/rail comprises 99 percent of all incoming products and 77 percent of all outgoing products. The maximum and minimum number of movements by transport mode in this scenario is shown in Table 19.

[19] Director General's Assessment Report (2009), accessible at: http://majorprojects.planning.nsw.gov.au/files/34320/Director-General%27s%20Assessment%20Report.pdf

[20] http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=1427

Table 19 **Inbound and outbound movements – normal operation scenario**

Rate	Min ship	Max ship	Min rail	Max rail	Min truck	Max truck
Yearly	85	121	315	394	7,186	10,779
Daily	0.233	0.333	0.9	1.1	19.7	29.5
Hourly	0.011	0.015	0.039	0.0	0.895	1.3

Data source: 2008 Environmental Assessment Report, http://majorprojects.planning.nsw.gov.au/files/31446/3%20Chapter%207-5%20-%2010.pdf

The movements for each input and output under the "normal operation" scenario are shown in Table 20.

Table 20 **Inbound and outbound movements – normal operation scenario**

	Annual Quantity (tonnes)	Transport Method	Load per vessel (Min)	Load per vessel (Max)	Vessels per year (Min)	Vessels per year (Max)
Inbound – Raw Material						
Soybeans	1,273,600	Ship	35,000	40,000	31.84	36
	100,000	Train	960	1200	83	104
Hexane	816	Road truck	30	45	18	27
Methanol	24,000	Ship	1,500	1,500	16	16
Other substances	9,600	Road truck	30	45	213	320
Silica	750	Road truck	30	45	17	25
Bleaching earth	3,750	Road truck	30	45	83	125
Outbound - Product						
Soybean meal	180,000	Ship (NZ)	20,000	25,000	7	9
	600,000	Ship (AU)	10,000	20,000	30	60
	278,400	Train	960	1,200	232	290
	33,000	Road Truck	30	45	733	1,100
Biodiesel	250,000	Road Truck	30	45	5,556	8,333
Glycerine	25,450	Road Truck	30	45	566	848

Note: Other substances include Caustic Soda (50%) – 825mt, Sodium methylate (30%) – 5000mt, Sulphuric acid (98%) – 75mt, Hydrochloric acid (36%) – 3000mt, Phosphoric acid (80%) – 450mt, Activated carbon – 75mt, Citric Acid – 175mt.

Data source: 2008 Environmental Assessment Report, Appendix G (units amened by ACIL Tasman to correct for error in labelling) http://majorprojects.planning.nsw.gov.au/files/31449/Appendix%20F%20&%20G.pdf

In total, the biodiesel plant is expected to transport approximately 100,000 tonnes of Soybeans to the plant and 278,400 tonnes of Soybean meal from the plant annually (under the "normal operation" scenario).

According to the NSW Department of Primary Industries[21], in the North Cost of NSW, soybeans are mainly grown in the Clarence and Richmond Valleys,

[21] http://www.australianoilseeds.com/__data/assets/pdf_file/0008/1205/North_Coast_Soybean_Guide.pdf

and as far south as the Manning Valley. As these locations are all on the NSW North Coast, it is likely that they will use the Illawarra rail corridor.

National Biodiesel Ltd indicated to ACIL Tasman that they would definitely utilise a potential Maldon Dombarton link if it were to be constructed.

In the medium to long term, the plant would utilise approximately 1.3 million tonnes of soy beans, with 70 percent coming from the three regional hubs – northern coast of NSW, Narrabi and Riverina – of which some would use the Maldon-Dombarton rail line. The line also has the potential to be used for transporting soybean meal (a valuable waste product) in bulk between Brisbane and Melbourne, which would otherwise have to be shipped, and also to move biofuel (which will currently have to be moved by truck).

6.4.3 Paper

IPMG opened a large printing facility at Warwick Farm in 2008 and has applied to build railway sidings into its warehousing facility. The company would be importing 135,000 tonnes of paper packed on bolsters, using roll on roll off ships to bring in supply from local and overseas paper mills.

The intention is for paper to be railed from Port Kembla via the Illawarra line, Metropolitan freight network to Chullora and then using SSFL to the facility just south of Warwick Farm.

There would be a dedicated rail service 5 trains per week. The service would operate between IPMG and Port Kembla with no other stops detailed (although it could pick up and drop off goods between Chullora and Port Kembla).

This freight would seem to be ideally located as potential freight for the Maldon-Dombarton rail line. However, IPMG's planning application assesses the alternatives considered and road freight is considered to be the only alternative. IPMG's planning application states that the option of connecting the facility siding to the SSFL with a spur line to the south of the facility (which would be the direction of approach from a Maldon-Dombarton rail line) was examined and found to be unworkable because:

- It would require a lease to be taken out across the part of the rail corridor between the SSFL and the IPMG facility which would result in the IPMG Train potentially obstructing the maintenance access track of the SSFL
- There would be insufficient space for the train to enter the facility in one piece, the train would have to be broken into two segments and enter the facility in two parts via an entrance in the centre of the loading dock

- Trains would have to shunt on to the SSFL both when entering and leaving the factory, which would require a longer slot time for the train on the SSFL
- It would require a non-conventional turnout from the SSFL.

In light of these reasons, ACIL Tasman has determined that this freight would not utilise the Maldon-Dombarton rail line.

7 Steel, cars and containers

7.1 Steel

Steel

Bluescope Steel's plant at Port Kembla uses iron ore brought in by ship, limestone railed from Marulan, and coal railed from nearby and, for blending, from Newcastle. The steel from the plant is mainly transported by sea and rail.

Inputs

Bluescope Steel has long term contracts with Pacific National to transport coal from the Hunter Valley to its steelworks plant at Port Kembla (which has been increasing from 0.5 Mtpa to nearly 1.2 Mtpa – see Table 21). This relatively low grade coal is used to boost the blast furnace at the plant, and is brought in from the Hunter Valley as it is cheaper than local Illawarra coal. As Bluescope's inbound storage capacity is limited, it is striving for just-in-time deliveries.

Table 21 **Rail task for Bluescope Steel Port Kembla plant inputs**

Input	Origin	Annualised tonnes	Annualised number of trains	line that is likely to be used if Maldon-Dombarton rail line is built
Coal	Newcastle	1,100.0	330	Maldon-Dombarton or Illawarra
Limestone	Marulan	925.3	506	Moss Vale-Unanderra
Scrap steel	Brisbane	90.1	253	Maldon-Dombarton or Illawarra
Scrap steel	Adelaide / Melbourne	72.0	203	Any
BHP coal brought in for processing	Dendrobium	3,500	1,050	Private
Total inbound by rail		**2,187.4**	**1,292**	

Its other inputs include coal railed on a local line from Dendrobium or trucked from Appin/West Cliff and limestone railed from Marulan. The Dendrobium coal is not relevant to a potential Maldon-Dombarton rail line but the Appin/West Cliff coal that is currently transported by road could potentially be railed in the future. The limestone arrives from the southwest which suits

continued use of the Moss Vale-Unanderra line rather than a potential Maldon-Dombarton rail line.

Outputs

Bluescope's Port Kembla plant has a capacity of 5.3 Mtpa. About two-thirds of its output (approximately 3.5 Mtpa) is sent to Victoria, 0.5-1.5 Mtpa by rail and 2-2.5 Mtpa by sea.

About 150,000 tonnes of Bluescope's output is currently transported to Port Botany on two train services per day. Bluescope moves another 200,000 tonnes of outbound steel by road to Sydney for containerisation at Villawood, travelling along Mt Ousley Road. By the end of 2011 Bluescope intends to containerize this product at Port Kembla and move this product on rail. An additional 100,000 metric tonnes of output travels by road to Bluescope's Western Sydney plants for further processing.

Bluescope indicated that it is focused on rail options for moving inputs and outputs, using road only where there is no alternative. Rail capacity is therefore important to Bluescope.

Table 21 shows that some of the inputs to Bluescope's Port Kembla plant are likely to use the Maldon-Dombarton (or Illawarra) line. Some of the outputs could also potentially use the Maldon-Dombarton rail line, although the Illawarra line has the advantage of a ruling grade of 1:75 through Helensburgh, compared with 1:30 on the Maldon-Dombarton and Moss Vale-Unanderra lines. Because of the difference in ruling grades more freight can move northbound on the Illawarra line for a given amount of locomotive power, making it a more efficient service. Therefore Steellink services are expected to continue to move steel outputs on the Illawarra line, with the possibility that the Maldon-Dombarton rail line could compete for this freight.

Bluescope has considered using rail to take containerized steel products to Villawood and Port Botany for export. At this time, the cost of rail freight has made this uneconomic and the products currently move by road. This decision could be changed if some combination of carbon pricing, lower rail freight rates, mass-distance-location based pricing for heavy freight or increased inefficiencies in road haulage (such as increased road congestion) were to occur.

Pacific National has indicated that it would prefer to use the Illawarra line to haul steel and scrap steel (provided that there is sufficient capacity) because they can carry a heavier trailing load up the less steep grade, even for freight with a destination to the south west of Port Kembla. In the future, Illawarra

capacity constraints and modern locomotives that could allow a heavier trailing load could make the Maldon-Dombarton rail line more attractive.

However, as a consequence of the gradient to Sydney and pick up and delivery ("PUD") costs, it is expected that in the central case containerised steel will continue to be hauled by road freight. In the higher case scenario there are expected to be changes which see the movement of containerised products to BlueScope's Villawood terminal by rail, possibly using a potential Maldon-Dombarton rail line.

The forecast tonnages are shown in the table below. As there are no plans for substantial expansion at the steel plant, tonnage growth is expected to be minimal.

Table 22 **Contestable steel freight on the Maldon-Dombarton rail line**

	2015	2020	2025	2030
Summary of M-D train numbers per week				
Inbound	8	8	8	8
Outbound* (none in the central case)	2	2	2	2
Summary of potential M-D payload (Mt)				
Inbound	1.20	1.23	1.26	1.29
Outbound*	-	0.15	0.16	0.16
Total	**1.20**	**1.38**	**1.42**	**1.45**

** None in the central case. In the upper case the containerised steel from Pork Kembla could move on general freight/container services out of Port Kembla to Port Botany.*

Data source: ACIL Tasman analysis

7.2 Cars

ACIL Tasman has consulted with the major autologistics companies operating in Sydney – CEVA, Patricks Autocare, Prixcar and Autonexus – regarding potential use of a potential Maldon-Dombarton rail line for the transport of imported cars from Port Kembla to destinations throughout NSW.

All but one company suggested that the PUD cost makes it an unprofitable exercise. The remaining company, Prixcar, indicated that it was a marginal decision which could go either way.

7.2.1 Survey evidence

CEVA indicated that it was not interested in rail because of the PUD cost, although they might examine the issue in more detail once a Maldon-Dombarton rail line was built. Patricks concurred that the PUD cost renders the rail option uneconomic. Autonexus said they would not use it because they

are moving cars to their nearby Rosehill storage, and sometimes direct to dealers.

Prixcar provided mixed responses – our initial contact initially suggested that the PUD would be a barrier. However, we subsequently spoke to a logistics manager at P&O automotive and general stevedoring (P&O is a shareholder in Prixcar), who said that it was a marginal decision, which was dependent on attaining critical mass and new train equipment – one firm might not be able to make it work, but if a number cooperated then it could be profitable. The short run marginal costs of using rail would be cheaper, but there would need to be a capital investment which could prove to be a barrier to the use of rail.

The subject was also discussed with Qube logistics, who are also a shareholder of Prixcar and owner of the land in Minto upon which Prixcar is located. They discussed how some of that land is likely to be used for container storage and that dual-use trains with both cars and containers might be attractive to that facility. The Qube logistics contact indicated that the investment in rolling stock was not a major stumbling block to the decision, but that efficiency and cost questions needed to be addressed.

7.2.2 Analysis

Based on guidance from Prixcar, and using ABS data from the motor vehicle census, ACIL Tasman has projected the number of cars imported into Port Kembla that might potentially be transported on the Maldon-Dombarton rail line.

The following assumptions have been adopted:

- In the central case scenario no companies use rail for automotive logistics
- An upper case scenario with half of the relevant automotive market using rail was modelled
- Annual car import growth is determined by population growth[22] and an increase in the number of vehicles per capita from 645 to 777 per thousand. The effective rate of growth is 2 per cent in the short term declining to 1.3% by 2030 as population growth trends down and car ownership approaches saturation.
- The rail-capable proportion is 81 per cent of all new registrations (removing domestic manufacture and oversize imports)
- Destinations within southern Sydney will absorb 14.2 per cent of cars imported into Port Kembla – these will not be transported by rail because of the short distances involved.

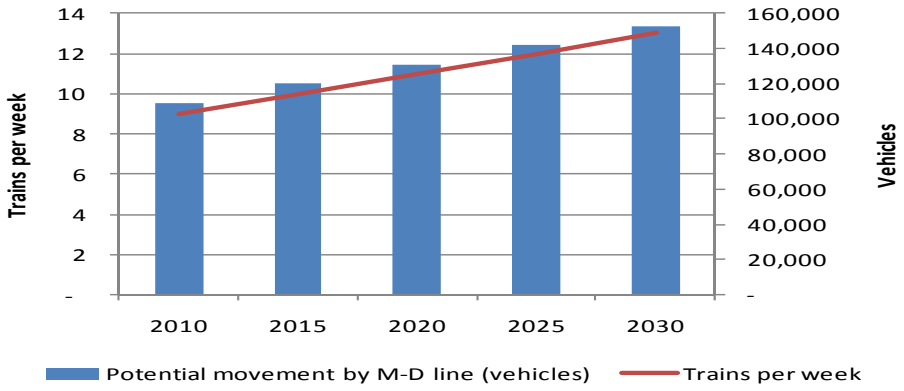
[22] NSW Department of Planning, April 2010. Annual growth rate for Sydney is forecast to be 1% per annum declining over time.

7.2.3 Conclusion

Prixcar indicated that the use of rail is a 50:50 decision, but that others would need to be involved in a cooperative effort to get critical mass. All other companies have determined that this is not profitable. On balance of opinion ACIL Tasman has determined that in the central case no cars would be transported by rail. This assumes that there are no actions taken by government to provide further incentives to move this freight on to rail.

For illustrative purposes, Figure 13 shows the number of cars that could be transported annually on rail should half of the relevant market decide to move its freight on to rail. Plateway has indicated to ACIL Tasman that the rail operation would be uneconomic at these volumes. It is more likely that the vehicles would move on a train carrying mixed freight.

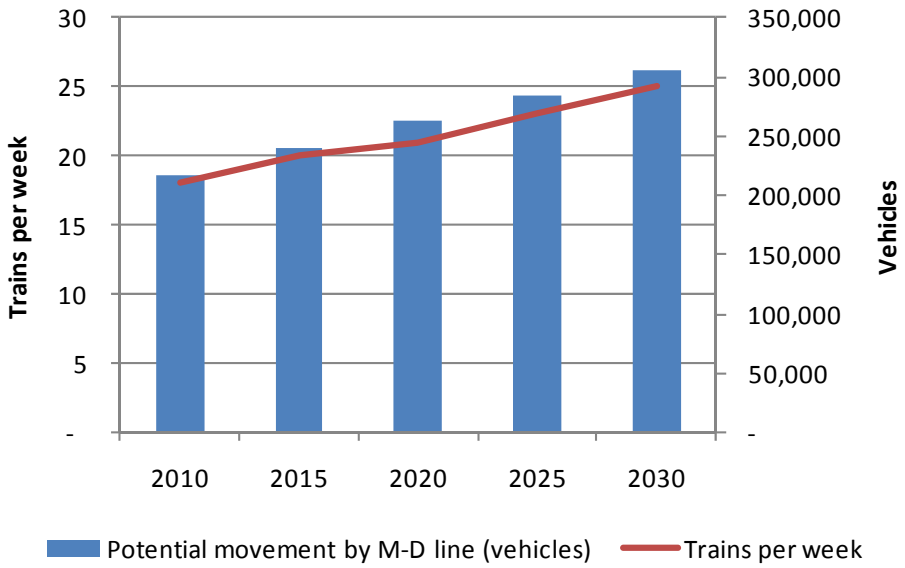
Figure 13 **Number of cars that might be transported on the Maldon-Dombarton line, 2010-2030**



Data source: ACIL Tasman

If all cars (excluding those with destinations south of Sydney) were to use a potential Maldon-Dombarton rail line, the number of required train paths is shown in Figure 14 below:

Figure 14 **Number of cars that might be transported on the Maldon-Dombarton line, potential market, 2010-2030**



Data source: ACIL Tasman

ACIL Tasman does not believe that rail could capture this amount, but it shows the estimated size of the total market as a reference point.

7.3 Containers

Nearly all containers moving in or out of NSW are handled through Port Botany; most of the containers are for imports. A small number of containers pass through Port Kembla. The Outer Harbour development at Port Kembla will make a substantial container operation possible there.

The question of whether containers are a potential type of freight on a potential Maldon-Dombarton rail line mainly comes down to:

1. whether there will be an overflow of containers from Port Botany
2. whether that overflow would go to Newcastle or Port Kembla
3. whether the landside journey for containers at Port Kembla would be by road or rail
4. whether the preferred rail link would be the Maldon-Dombarton rail line.

Another possibility is that of a shipping company choosing to move to Port Kembla for reasons other than Port Botany's capacity constraints. There is also a possibility of some export containers moving through Port Kembla. However, the last two bullet points 3 and 4 still apply in those cases.

7.3.1 Port Botany overflow

There would be an overflow of containers from Port Botany if demand exceeded its capacity. Capacity is whichever is the most constraining out of capacity at the port and capacity on the landside link (road and rail).

The current planning constraint on Port Botany's capacity is 3.2 million TEUs per annum (MTEUs). There are currently two stevedores (Patricks and DP World) with a third stevedore terminal (Hutchison) being developed which is assumed by ACIL Tasman to add an additional 50 percent capacity. Exact capacity estimates have not yet been announced.

From interviews with Port Botany and Maritime NSW , it is clear the planning constraint of 3.2 MTEUs is significantly below the capacity of three stevedores at Port Botany. The 3.2 MTEU reflects road and rail constraints, and the NSW Government has proposed investments that would ease them. ACIL Tasman has assumed that Port Botany's capacity is 5 MTEUs in the Study Period.

To keep pace with expansion, NSW Department of Transport has proposed landside infrastructure improvements. NSW Department of Transport believes that, should it receive funding for its investment priorities, there would be sufficient landside capacity to support up to 8.6 MTEUs movements at Port Botany per annum [23]. This is broadly consistent with the Port's view. It means that even at a high rate of growth[24] Port Botany would not exceed its expected capacity before around 2040.

Over the past 15 years, Port Botany's throughput has grown at average of rate of 7 per cent per annum. This has fluctuated with business cycles. In the Container Freight Improvement Strategy, NSW Department of Transport used the Port Corporation's 6.7 per cent growth rate projection to estimate the future TEU throughput at Port Botany.

ACIL Tasman does not favour projecting a container growth rate that is well above GDP growth for a prolonged period as it would lead to structural problems with the NSW economy. Without a slowing of import growth so that it converges to the growth of other components of GSP, the NSW economy would become dominated by imports, leading to movements in exchange rates which would cause imports to become more expensive. The Bureau of Infrastructure, Transport and Regional Economics also has a more conservative view.[25]

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[23] NSW Department of Transport, Container Freight Improvement Strategy, July 2010.

[24] 6.7% per annum in the NSW Department of Transport Container Freight Improvement Strategy, *op cit.*

[25] Australian Maritime Activity to 2029-30, BITRE2010,

For the purposes of its modelling, ACIL Tasman has assumed that the per annum growth rate in container movements is 8 per cent in 2009, declining to 5 per cent per annum by 2030. This reflects increasing containerisation, but at a decreasing rate. ACIL Tasman assumes that long run GSP growth of 2.4% per annum will continue in NSW.

These assumptions result in Port Botany not reaching capacity until 2028[26] if the cap is 5.0 MTEUs per annum, or later if the cap is higher.

7.3.2 Growth at Port Kembla

Port Kembla is pursuing its development plans for the Outer Harbour, which would see the port having four container berths each capable of handling approximately 300,000 TEUs per annum by the late 2020s.

The port already has contracts with small shipping companies to receive small container ships.

Port Kembla offers the possibility for a shipping company to establish its own (vertically integrated) stevedoring operation. This could attract a large shipping company to operate all of its Sydney business out of the port even if Port Botany is not at capacity. There has been a recent example of a smaller port in Asia capturing business off of a larger incumbent[27]. However, no shipping company has yet announced such a plan, so it is not assumed in the central forecasts.

Shipping companies have expressed a preference for Port Botany, mainly because of established operations there, its proximity to many of the destinations for containers and its good transport links. Therefore it is considered unlikely that a large share of the NSW market will be served by Port Kembla unless Port Botany is constrained, which is also considered unlikely.

7.3.3 Port Kembla or Newcastle?

Present NSW Government policy sees Newcastle as the preferred alternative. It is assumed that this policy will be relaxed and that the choice will be left to the market. The Port of Newcastle is further away from growing industrial areas in the West of Sydney and there are rail capacity issues on the North Sydney Freight Corridor.

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[26] With Port Botany assumed to have a planning constraint of 5.0 million TEUs.

[27] In 2000, Maersk Singapore moved its container operation to the Port of Tanjung Pelepas (PTP) in southern Malaysia.

7.3.4 Road or rail? Preferred rail line?

If significant container trade does develop at Port Kembla, perhaps because a large shipping company moves there, around 90 per cent of the landside link would have to be by rail as the outer harbour's physical configuration does not allow for much use of trucks.

These containers could move on the Moss Vale-Unanderra, Illawarra or potential Maldon-Dombarton rail lines.

The Moss Vale-Unanderra line might suit some export containers from regional NSW, e.g. Parkes, Narrabri and Griffith, and a Maldon-Dombarton rail line could compete for freight from some of these regions.

However, the number of TEU imports is double the number of full exports, with 24 per cent being of empty containers and 15 per cent being trans-shipments. Imports would therefore dominate the demand for rail services. Most imports are destined for the greater Sydney area, for which the Moss Vale-Unanderra line is the least suitable as the route is circuitous (around 85 per cent of imported goods are destined for consignees within 40 kilometres of Port Botany). Even of the 15% of imports not destined for the greater Sydney area, some will be destined for Wollongong and the south coast, and those destined for inland locations are likely to make their first move to intermodal operators in western Sydney.

For much of the Sydney area, the Illawarra line is suitable and provides a link to the Sydney freight network, including existing terminals such as Enfield and Chullora. However it suffers from capacity challenges, as will be discussed in Working Paper 2.

A potential Maldon-Dombarton rail line would provide a good link to west Sydney, a growing area in which logistics centres are important. More than 50% of import container destinations are likely to be located in and around Western Sydney by 2030. It would provide a good connection to a proposed major new freight terminal at Moorebank and to existing terminals such as M.I.S.T's[28] facility at Minto. In discussions M.I.S.T., whose subsidiary Independent Rail Australia already runs container shuttle trains to Port Botany, expressed interest in serving Port Kembla via a Maldon-Dombarton rail line. The alternative route via the Moss Vale-Unanderra line is deemed as being too long to be viable.

In its submission to the Port Kembla Outer Harbour Environmental Assessment RailCorp expressed concerns over Port Kembla's estimates of new rail demand resulting from container movements. Moving these additional

[28] Macarthur Intermodal Shipping Terminal

containers via the Illawarra line may not be possible, at least on regular daytime services.

The Maldon-Dombarton rail line would be needed for Port Kembla to be able to provide a fast and direct rail link for container (and automotive) freight to western Sydney and to offer sufficient capacity for scheduled port shuttle services throughout the day.

7.3.5 Survey evidence

In coming to its conclusions ACIL Tasman surveyed a number of intermodal operators, including:

- Qube Logistics (the owner of P&O Trans Australia, a rail shuttle to Port Botany, an investor in facilities at Moorebank , an investor in Prixcar including the ownership of the land that Prixcar's occupies in Minto)
- Pacific National (Owner of Patricks, which exited the port shuttle business in 2010)
- M.I.S.T. (Owner of Independent Rail Australia, which runs a port shuttle and regional rail business)

Some of the largest shipping companies serving Australia were also consulted. These companies included local executives from:

- Maersk
- Hamburg Sud
- Cosco
- K-line Shipping
- NYK line Shipping
- Swire Shipping.

In addition, ACIL Tasman also consulted the Port Kembla Port Corporation.

The views of shipping companies were fairly consistent. If Port Botany has landside capacity then it would be the favoured port for NSW. This is because of the proximity to the ultimate destination of most of the goods and the existing landside infrastructure (port shuttles, motorways and services). However, some considered that the performance of the stevedores at Port Botany lagged well behind most large ports in terms of productivity.

If capacity were limited at Port Botany (either at the port or on the road and rail links to and from it) some considered that Newcastle had a better port (one company mentioned physical factors such as swell) with sufficient land for development of container activities. PKPC mentioned that in 2009/10 Port of Newcastle was closed because of bad weather for 16 days whereas Port Kembla was closed for only one day. However, a number of companies

mentioned that the rail links in to Sydney were very congested and that this would need to be eased before Newcastle was viable[29]. Some also noted that a large and growing proportion of their consignments have a destination in west Sydney, travelling through an increasingly congested metropolitan freight network.

Many of the companies consulted were supportive of Port Kembla as an overflow port. They felt that there was a potential for significant expansion. Improved transport links to West Sydney were considered crucial for this to happen; many considered the Illawarra line to be at or near to capacity. Many felt that existing roads could serve much of the freight task, with some upgrades.

One large company noted that Port Kembla's natural catchment is not large (that is, goods going to south Sydney and Illawarra/Wollongong). This means that goods will likely be travelling further via Port Kembla, and that cost penalties would be suffered. This linked in to discussions about the adequacy of infrastructure to carry container freight into Sydney's southwest and west. All considered that improved rail links with Sydney would be needed if Port Kembla was to be the overflow port.

Some companies said that the distance for the movement of empty containers from the import destinations back to the port was further than to Port Botany, although Moorebank might alleviate these problems through significant additional storage capacity.

Most considered that Port Kembla would have better access than Newcastle to growing industrial areas, and most believed that the Maldon Dombarton line would be needed if Port Kembla was to have a significant role.

All shipping companies that have stevedoring operations thought that the opportunity to do their own stevedoring was attractive, particularly if the port was well configured and attractive rates could be offered. Some liked the notion that the port would be configured for rail (but only if Maldon-Dombarton was built), and that only a limited number of firms would be operating through Port Kembla to try to encourage efficient rail services. Some considered that the road links to Sydney were reasonably good.

7.3.6 Container freight on a potential Maldon-Dombarton rail line

In the central case, ACIL Tasman considers that Port Kembla will continue to attract additional services from second tier international shipping companies. With a capacity limit of 5.0 Mtpa Port Botany may exceed its capacity around

[29] This is analysed in NSW Department of Transport's 2010 submission to Infrastructure Australia (Part 2: North Sydney rail Freight Corridor).

2028, if the capacity is 8.6 Mtpa as the Container Freight Improvement Strategy indicates is achievable[30] then overflow container freight might be captured after around 2040.

In ACIL Tasman's central case, with the capacity at Port Botany considered to be 5.0 MTEUs per annum, this constraint is reached in 2028, with additional demand overflowing to Port Kembla and the Port of Newcastle equally and generating demand on a Maldon-Dombarton rail line (assuming there is no room on the Illawarra line). In the upper demand scenario the overflow container freight is not split with the Port of Newcastle. This generates the following demand scenarios as shown in Table 23 below.

Table 23 **Preliminary projections of Port Kembla container freight**

Million TEUs per annum	2010	2015	2020	2025	2030
Base case	0.02	0.06	0.13	0.19	0.53
Upper case	0.02	0.06	0.13	0.19	0.82

Note: Achieving any overflow within the reference period (to 2030) is dependent on the assumption that Port Botany is constrained to a capacity of 5.0 million TEUs. It is assumed that 90% of the overflow freight is moved by rail.

Data source: ACIL Tasman analysis

7.3.7 Summary

As shown in the final forecasts for container freight on a potential Maldon-Dombarton rail line, ACIL Tasman is assuming only modest growth for container freight from Port Kembla. That is not to say that the Port Kembla Port Corporation could not attract demand through a deal which makes it financially attractive to a shipping company, particularly one with a vertically integrated stevedoring capability. However, no such deal has been announced which would allow additional volumes to be assessed.

With sufficient capacity at Port Botany, we do not expect significant overflow container freight. However, we note that if there were such overflow, many shipping companies say they would find Port Kembla attractive if a Maldon-Dombarton rail line were built.

[30] *Op cit.*

8 Engineering assessment

8.1 Introduction

The route which a potential Maldon-Dombarton rail line would follow consists of sections that follow the natural habitat and environmental contour lines of the region. The route has largely been built, excepting that bridges are either partially constructed or still need to be constructed, and a long, steep tunnel known as 'Avon Tunnel' is also required.

In this and following chapters the engineering requirements are assessed in the context of facilitating completion of this rail line. Particular consideration is given to the technical aspects and the operational requirements of the railway line. For example, the assessment takes into account hydrological design, bridges, and the adequacy of the current tunnel design for freight locomotives, including ventilation and locomotive capability. As part of the analysis Hyder made assumptions relating to the condition of the constructed works including the stability of the existing embankments. The assumptions made were supported by visual inspection of the assets and deemed appropriate.

The following three tasks have also been undertaken:

- Identification of any alignment enhancement options and recommendation of optimal alignment
- Analysis of the construction gap between the original design to what is required by current standards
- Redefine and update the design of bridges, the Avon Tunnel, and other rail and road infrastructure requirements associated with the proposed rail line.

This chapter contains four sections:

- a review of previous studies
- the Avon Tunnel
- bridges
- the railway track.

Chapter 9 compares the performance specification used in the past with contemporary specifications and discusses the standards specifically identified for a Maldon-Dombarton rail line.

Chapter 10 provides a summary of the risk assessment.

In Chapter 11, a comprehensive review of route options is discussed and the final alignment for the proposed railway line is developed.

Chapter 12 provides a discussion of the designs, while Chapter 13 discusses work required in the future. Drawings and designs can be found in the appendix entitled, 'Conceptual Drawings'.

8.2 Review of previous studies

Hyder reviewed a number of prior studies, reports and designs undertaken by various consultants:

- State Rail Authority/ SKM alignment drawings produced in 1982
- bridge design drawings
- the Maldon-Dombarton Rail line Prefeasibility Study Report produced by Connell/ Hatch for Port Kembla Port Corporation in 2009
- the Project Position Report produced by SKM in January 1989
- The Avon Tunnel on the Maldon-Dombarton rail line by the State Rail Authority (SRA).

8.2.1 Rail alignment

Hyder has undertaken a comprehensive review of the rail alignment developed first by the SRA and subsequently by SKM, and concludes that this alignment (for which 70 per cent of the earthworks and drainage has already been constructed) is viable both in terms of track design and economic value.

The previously chosen route is an approximately 35km-long single track with three 800m passing loops, two major bridges (the Nepean River and Cordeaux River bridges), four overbridges and one tunnel approximately 4 km long.

The maximum gradient of 1 in 30 (or 3.33 per cent) on this alignment is within the Avon Tunnel, just west of Dombarton Junction.

Its connection with the Main South and Unanderra to Moss Vale lines is achieved via standard conventional turnouts.

The current engineering assessment focused on this particular alignment since it had already been adopted as the optimal option and was partially constructed. Alternative route options along the same corridor had previously been considered but deemed cost prohibitive because a significant scale of work on this rail line had already been constructed, with the exception of the junctions. Further discussion of alternative route options is provided in Section 11.2 and 11.3.

8.2.2 Track structure

The previous design of the track structure for the line specified concrete sleepers on ballast and 60 kg rail, and incorporating a resilient fastening system.

This is consistent with the requirements for a Class 1XC rail line. According to ARTC (2005), class 1XC lines are classified as 60kg/m standard or 60kg/m head hardened rail to accord with AS 1085. This further depends on the curvature of the line and the tonnage operating on it.

Hyder's review indicates that for nearly 70 per cent of the railway line, the bottom ballast is already in place and ready for laying of concrete sleepers and rails; no other ballast is required. The ballast already in place complies with current standards.

8.2.3 Civil design

During the review of drawings and reports, the following was noted in reference to specific infrastructure elements:

- **No maintenance access roads** were identified on the design alignment option.
- **12 level crossings** were identified on the section of line where the earthworks and drainage have been completed. There are no other level crossings on the section of track still awaiting construction.
- **Existing fire roads** were identified along the alignment (Fire Road No.6A, Fire Road No.6B and Fire Road No.11). No deviation on the fire roads has been identified in the design documentation that was available for the review.
- **Earthworks** have been completed between the end of the western portal of the Avon Tunnel (at 102.600km), to the western side of Cordeaux River (at 127.00km). From a total proposed rail line of 35 km, this represents around 70 percent of total required earthworks already completed.

8.2.4 Drainage

Previous studies found that soils within the project area are highly erodible, so an effective soil conservation management plan needs to be implemented to minimise erosion and maintain water quality. To achieve this, effective surface drainage, minimum vegetation clearing/site disturbance and vegetation stabilisation is required. Where the surface drainage is required, the ballast already in place will need to be reworked.

Review of previous studies also indicated that several locations in the cutting require final trim, erosion protection and catch drains at the top of the cutting. The addition of catch drains at the top of cuttings and protection of the cutting face is required to stop/prevent erosion and ensure the stability of these areas.

The proposed railway is located within the plateau divided by the Nepean River and its tributaries which have their headwaters in the Illawarra escarpment. The proposed rail alignment approximately follows the catchment

crest between Avon and Cordeaux rivers systems and crosses both the Cordeaux and Nepean rivers.

The section of the railway between 99.000 km and 126.500 km is located within land managed by the Sydney Catchment Authority (SCA). The rail line avoids the southern part of Lake Avon between 102.000 km and 111.500 km, crossing the headwaters of several small waterways that flow to Lake Avon. This is also under management by the SCA.

The SCA has a requirement that any developments located within the catchment must only produce neutral or beneficial effect on water quality. To comply with this requirement, the section of line located within SCA-managed land may require the integration of water quality treatment features. Existing drainage systems may further need modification to ensure that track runoff gets fed through the proposed water quality treatment features.

Most of the minor waterway crossings have already been constructed. Partially based on site inspection and assumptions drawn on the infrastructure already in place, it was estimated that 50 waterway crossings have been constructed and 19 waterway crossings still need to be constructed for the project to reach completion. Additionally, the existing cross drainage culverts located with the proposed passing loop and embankments require widening/extension.

A selection of existing cross drainage systems had their capacity checked and it was found that these complied with current ARTC standards, as well as engineering industry standards and practices. The new cross drainage systems were sized for locations where railway works have not been completed. The hydraulic assessment of these cross drainage systems determined that the existing and proposed cross drainage pipes have the required capacity.

8.2.5 Tunnel

A complete description and assessment of the Avon Tunnel is presented in the appendix 'Conceptual Drawings'. Technical information about the tunnel construction methodology and design parameters are included in the Appendix – Design Technical Report.

8.2.6 Bridges

A review of the existing drawings for the following bridges was carried out:

- Railway bridge over Nepean River (existing viaducts and proposed main bridge)
- F5 Freeway bridge over M-D railway
- Condell Park Road bridge over M-D railway
- Picton Road bridge over M-D railway

- Janderra Lane bridge over M-D railway
- Railway bridge over Cordeaux River.

The review considered issues such as applicability of previous bridge designs in relation to current design standards and whether the form of construction was still feasible and cost-effective.

With regard to the existing viaduct construction at the proposed Nepean River crossing, structural analysis work was carried out to check if the viaduct is theoretically adequate to support the current design loading.

With regards to the proposed bridge on the F5 freeway over the Maldon to Dobmarton Rail line it is recommended that a short tunnel is constructed under the freeway instead of construction of a bridge structure. This would reduce the traffic disruption on the freeway during the construction period and would reduce the construction cost. A concept design of the proposed tunnel has been provided in appendix 'conceptual drawings'.

Also, a basic review of culverts used to channel water and fauna underpasses (beneath the railroad) was carried out.

The listing of existing culverts and fauna underpasses is as follows:

- 2 concrete box culverts
- 21 concrete pipe culverts
- 27 corrugated steel pipe culverts
- 5 corrugated steel arch fauna underpasses.

It was concluded that the viaduct is theoretically adequate.

9 Performance specification

9.1 Introduction

In this chapter, a comparison of the performance specifications from previous studies against current specifications required specifically for the proposed Maldon-Dombarton rail line was undertaken and discussed.

This chapter is divided into these sections:

- Section 9.2 considers the general performance specification, as well as specific civil design standards and the standards for drainage, tunnels and bridge design standards
- Section 9.3 considers the specific track standards for the Maldon-Dombarton rail line
- Section 9.4 considers non-conformances of previous design compared with current standards.

9.2 Standards used today

The current standards, guidelines, strategies and specifications used for a design of new railway lines were developed by Australian Rail Transport Corporation (ARTC) and Rail Corporation of NSW (RailCorp).

The assessment and the design of the Maldon- Dombarton rail line has been based upon the most recent criteria and standards outlined within the documents listed below.

9.2.1 General track standards

The following general ARTC (2005; 2006; 2010) standards are applicable to the design and construction of new railway lines:

- TDS01 Prestressed Concrete Sleepers Design
- TDS09 Main line Track Geometry
- TDS10 Industrial Railway Design Standards
- TDS11 Standard Classification of lines
- BDS09 Transit Space Policy
- BDS10 Transit Space Handbook- Corridor Strategies
- BDS11 Transit Space Standards
- BDS12 Structure Gauge 1994
- BDS13 Application of Kinematic Envelope
- BDS19 Track Centre Clearance Signs for Yards

- TCS01 Track Standards Construction
- TPS01 Specification for the manufacture and supply of resilient rail fastenings assemblies
- TPS04 Specification for supply of aggregate for ballast
- LDS01 Catchpoint Design and clearance beyond catchpoints
- LDS02 Standard Turnouts
- LDS03 Turnouts- Component Definition

9.2.2 Civil design standards

The following general ARTC standards are applicable to the civil design of new railway lines

- TDS08 General Standards for Formation and Earthworks (14 March 2005);
- XDS01 Level Crossings-Configuration Standards (11 March 2005);
- XDS02 Level Crossings- Design and Installation (11 March 2005);
- RMP07 Standard Procedure for Embankment Widening (11 March 2005);
- RCP01 Earthworks Construction Procedures (11 March 2005);
- RDS01 Standard Fencing (11 March 2005);
- RDS03 Standard Trackside Warning Board Signs (11 March 2005);
- ETG-17-01 Installation of Utility Services and Pipelines within Railway Boundaries (26 April 2006).

9.2.3 Drainage standards

The assessment and design of the drainage systems has been based upon the criteria and standards outlined within the following documents:

- RailCorp Infrastructure Engineering Standard - Geotechnical Earthworks and Formation ESC 410 Version 1.1 Issue Date: October, 2007
- RailCorp Infrastructure Engineering Standard - Geotechnical Track Drainage ESC 420 Version 1.1 Issue Date: April 2007
- RailCorp Infrastructure Engineering Manual - Geotechnical Installation and Maintenance Manual TMC 421 Track Drainage Version 1.1 Issue Date: October 2007
- ARTC Engineering Practices Manual Civil Engineering Track Drainage - Inspection and Maintenance RTS 3432 Issue A, Revision 0 March 2006
- ARTC Engineering Practices Manual Civil Engineering Track Drainage - Design and Construction RTS 3433 Issue A, Revision 0 March 2006

- ARTC Engineering Standard - NSW Category Track Title General Standards for Formation and Earthworks Reference Number TDS 08 - (RIC Standard: TS 3421).

9.2.4 Tunnel design standards

The tunnel design standards (preliminary assessment) used for the potential Maldon-Dombarton rail line refer to ARTC Engineering (NSW standards and records) and are listed below:

- Work Cover Code of Practice Tunnels Under Construction 2006
- ARTC Structures - Design Standards, BDS 06 –(RIC Standard: TS 30 000 3 01 SP) issue 1 revision 2
- ARTC Mainline Track Geometry TDS 09 RIC Standard: C 2200 Version 3
- ARTC Standard Classification of lines TDS 11
- RailCorp Infrastructure Engineering Standard Tunnels ESC 340 Version: 2.1.

9.2.5 Bridge design standards

The bridge design standards used for the Maldon-Dombarton Rail Link refer to ARTC Engineering (NSW standards and records) and are listed below:

- ARTC Engineering Standard BDS 06 Structures
- Design Standards and BDS 04 Underbridge Walkways.

9.3 Specific track standards for the potential Maldon-Dombarton rail line

The design criteria and standards used for a Maldon-Dombarton rail line are summarised in Table 24.

Table 24 **Design and performance standards**

Requirements	Performance
Maximum freight train transit time from Maldon-Dombarton junction	55 min
Maximum freight transit time from Wilton to Avon Passing loops	33 min
Desirable maximum operating speed	80kph for loaded, 100kph empty excluded speed at the junctions and tunnel
Maximum speed at junctions	60 kph
Maximum axle loads	30 t
Gauge	1435 mm
Minimum horizontal curve radius	800 m
Maximum gradient	1 in 30
Number of passing loops	2
Length of passing loops	To accommodate 1,500 m train
Maximum train length	1,500 m
Electrification	Non-electrified (assumed diesel)
Single / double track	Single track
Vertical clearance	7.1 m double-stacking containers
Track structure on open track	Ballasted on concrete sleepers
Track structure in the tunnel	Non-ballasted (reinforced concrete slab)
Maintenance access roads	Around the passing loops
Level crossings	At Fire Roads crossing the line and at the both ends of the passing loops

Data source: Hyder Consulting

9.4 Non-conformance of the previous design with the current standards

In some instances, the previous design does not comply with the current ARTC and RailCorp standards and strategies. A summary of these differences is detailed in Table 25.

As mentioned above, Hyder's design is based on standards that are current as of 1 July 2010.

Table 25 **Summary of departures from current standards**

Standards	Original Design	New Design	Comments
TDS08	Shoulder width of formation 3.0m in cut, 4.0m in fill	Shoulder width of formation 4.25m	As required by the current ARTC Standard
TDS08	Shoulder width of formation 4.0m in passing loop where maintenance access road is required	Shoulder width of formation 6.50m in passing loop where access road is required	The requirements by the current ARTC Standard are 5.0m for non-electrified and 6.2m for electrified lines.
BDS12	Single stacking only, 5.00m vertical clearance	Structure gauge clearances to allow for double stacking of containers (7.1 m vertical clearance)	Double stacking is required with ARTC 2009 Network-wide Clearance Strategy
TDS09, TDS10 and TDS11	Design speed at Maldon Junction of 50 km/h	Design speed at Maldon Junction of 60 km/h	This is as a result of proposing new technology of turnouts.
TDS09, TDS10 and TDS11	Design speed at Dombarton Junction of 50 km/h	Design speed at Dombarton Junction of 60 km/h	This is as a result of proposing new technology of turnouts.
N/A	Passing loop 800m long	Passing loop 1800m long	ARTC Strategy for longer trains
N/A	Passing loop track centres of 4.0m	Passing loop track centres of 4.5m	ARTC Strategy for using wider locomotives in the future

Source: Hyder Consulting

It is important to note that for the BDS12 standard, the engineering assessment provided two options for the size of the tunnel (large and small), as well as their relative costs. However, the choice of a small versus large size tunnel (and vice versa) is subject to the final cost–benefit analysis of the overall project.

It is also important to note that the new design of the passing loop (specifically the 1800 m loop) is sufficient to support the proposed use of the rail line, however, an extension of the loop that might be required at a later stage would be possible to do achieve without significant additional costs.

10 Engineering evaluation and risk assessment

This chapter is divided into two sections. The first section presents a summary of the criteria adopted by Hyder to assess the potential Maldon-Dombarton rail line. The second section outlines the preliminary risk assessment and methodology.

10.1 Value Engineering

This section summarises the criteria that Hyder adopted to assess the Maldon-Dombarton rail line. The aims and assumptions for the project are in accordance with the 'success criteria', as deliberated in the initial Hyder workshop and in adherence with ARTC standards. The aim of the workshop was to consider, evaluate and rate engineering options for delivering the potential Maldon-Dombarton rail line. The following are the assumptions:

- The Maldon-Dombarton rail line will be used only for freight traffic with no provision for passenger rail
- It is considered that coal will be the predominant freight material being transferred in the southbound direction.
- The configuration of the line will be a single track with passing loops.

The criteria adopted to assess options and identify successful ones took into consideration:

- Cost
- Constructability
- Safety
- Environment
- Performance.

This criteria ('Success Criteria') was used to evaluate the engineering options in order to deliver cost effective solutions that also considers constructability and environmental impact.

10.2 Risk Assessment

This section is a summary of the preliminary Risk Assessment for the Maldon-Dombarton rail line. The methodology used for this assessment is set down by ARTC, as highlighted in its 2009 'Risk Management Procedure' document (RM-01).

The process of the assessment comprises three steps:

1. Identify all inherent design /construction /maintenance risks
2. Understand and mitigate the safety impacts
3. Understand and mitigate inherent risks in operation, maintenance and disposal of assets.

At this stage of the preliminary assessment, the risks were evaluated taking into account existing controls and good practices. The risks specified are those deemed relevant for the cost evaluation and estimation of the Maldon-Dombarton feasibility study. Other risks would be dealt with in the Safety in Design (SID) and construction Safe Work Method Statements (SWMS).

11 Route options analysis

This chapter presents the analysis used to determine the optimum route alignment from Maldon to Dombarton. The assumptions are based on the Value Management Engineering process, which is further discussed in the next chapter.

There are two sections in this chapter. In the first section, a comprehensive review and evaluation of route options is discussed. In the second section, the characteristics of the final alignment option selected are explained.

11.1 Preparations for route option development

An inspection of the rail line and associated infrastructure was undertaken on 30 April 2010 to familiarise with the site. The emphasis was on the section of the rail line where earthworks and drainage have not been constructed. Additional inspections were undertaken over two days (on 29 and 30 July 2010) to clarify issues on a constructed section of the track, the tunnel under Mt.Avon and a major bridge over the Cordeaux River.

Development of the route option could only begin after a digital terrain survey model had been produced, which in turn, required an aerial survey. This was undertaken by AAM and was conducted over the proposed railway corridor between Picton and Port Kembla on 29 June 2010.

The survey was performed on Integrated Survey Grid of Australia in zone 56/1 (ISG 56/1), which is based on Australian Geodetic datum 1966 (AGD66).

The marks used for the survey control and the levels on Australian Height Datum (AHD) over the site were obtained through the Department of Lands. A LiDAR survey was conducted with a vertical accuracy of +/-0.15m, and a horizontal accuracy of +/-0.32m.

11.2 Rail route options

A comprehensive review of the route options was undertaken. The review concluded that the route previously chosen and already 70 per cent constructed is viable. Alternative route options along the same corridor were deemed cost prohibitive because so much of the rail line had already been constructed, with the exception of the junctions.

Five options were considered and evaluated.

Option A: this was largely the original design option produced in 1982 with adjustments at the connections to the existing lines at Dombarton on the existing Unanderra to Moss Vale line and at Maldon on the existing Main South line.

Option B: this option offering no tunnel was investigated. It was determined that an alternative alignment along the south west side of the currently proposed tunnel could be achieved. The alternative alignment would run adjacent to Lake Avon.

Option C: a variation on Option A, except that by allowing for deeper approach cuttings to the portals, the tunnel gradient could be reduced on the same horizontal alignment.

Option D: a variation on Option A except that the reduced gradient of the tunnel is achieved through slewing the alignment 200 km further to the south.

Option E: a variation on Option A but with increased gradient at approximately 127.740 km to obviate the need to relocate an existing gas pipeline.

11.3 Evaluation of route options

All the options were evaluated according to the "Success Criteria" (as explained in Section 10.1) and Option A emerged as a strong contender.

Option B was considered in detail with vertical and horizontal design alignments shown in Appendix 'conceptual drawings'. This analysis showed that the alternative alignment would run adjacent to Lake Avon which would increase the environmental impact. The original Environmental Impact Assessment did not cover this area and this would be required to assess the environmental impact of the proposed alternative alignment.

The alternative alignement would connect to the Moss Vale-Unanderra line approximately 1.8km south of junction where the tunnel alignment would connect, increasing the route length by 1.8km. The geometrical constraints of this alignment, with a minimum curve radius of 300m, would limit the speed to 60kmh.

The construction of the line would also require significant earthworks with embankments of up to 30 to 40 meters. An alternative to construction of significant embankments would be introduction of bridges/viaducts and tunnels. A high level assessment showed that the cost of this alignment would be higher then the tunnel alternative and the environmental impact would be more significant. Therefore the original tunnel alignment has been considered a preferred option.

This left Options C and D, both of which are variations on Option A; however, it was the latter which presented the lowest capital expenditure since

the tunnel component in Option A presents the shortest out of the three options.

The gain of the grade reduction in Option C is significant—this is reduced from 3.3 per cent to 2.5 per cent—but the grade reduction would lengthen the tunnel by approximately 1.2 km from 4.4 km to 5.2 km, thereby increasing capital costs. It will also require a demolition of approximately 400m of previously constructed embankments.

Option D posed a greater environmental and capital risk than Option A as the tunnel comes close to the existing Cordeaux dam, thereby generating potential environmental issues and imposing additional cost since a longer alignment would be required.

The proposed grade of 2.50 per cent under Option D will require a tunnel of approximately 4.4 km length. It requires approx 1.5 km of deep cuttings (up to 30 m deep in isolated pockets). The proposed top of rail level is approximately 25 m below the major watercourse running to the existing Cordeaux Dam. The alignment ties in back to the Option A at the level crossing at approximately 104.0 km

While Option E does not increase capital costs, it increases operational costs (particularly for loaded trains) due to a steeper gradient of 2.2 per cent on a section around 520 m long. This steeper gradient is required for the top of the proposed rail level to be above the natural surface at the intersection with the existing gas pipeline. It would be cheaper to lower the gas pipeline to avoid the need for this option.

11.4 Developing the final alignment

Option A was adopted as a final alignment. This is based on the original design from 1982 with some adjustment at Maldon and Dombarton junctions.

Deviation from the original design alignment occurring at the junctions consists of new tangential turnouts with a higher turnout speed of 60 kph through the junctions, compared with the original design of 50 kph. The turnouts have a radius of 500m and a crossing turnout rate of 1 in 15.

The other deviation from the original alignment occurs at the passing loops. Originally, there were three passing loops, each around 800 m long. Option A incorporates two passing loops instead, each of which are longer than those in the original design.

11.5 Summary of proposed alignment

The kilometrage used for the railway line is that from Sydney via the Wollongong-Unanderra line, commencing at approximately 98.004 km near Dombarton and terminating at Maldon Junction North Fork at 133.126 km, where it joins the Main South line from Sydney at approximately 78.559 km.

The proposed alignment allows a maximum speed of 100 kph, except at the junctions where the maximum speed is 60 kph.

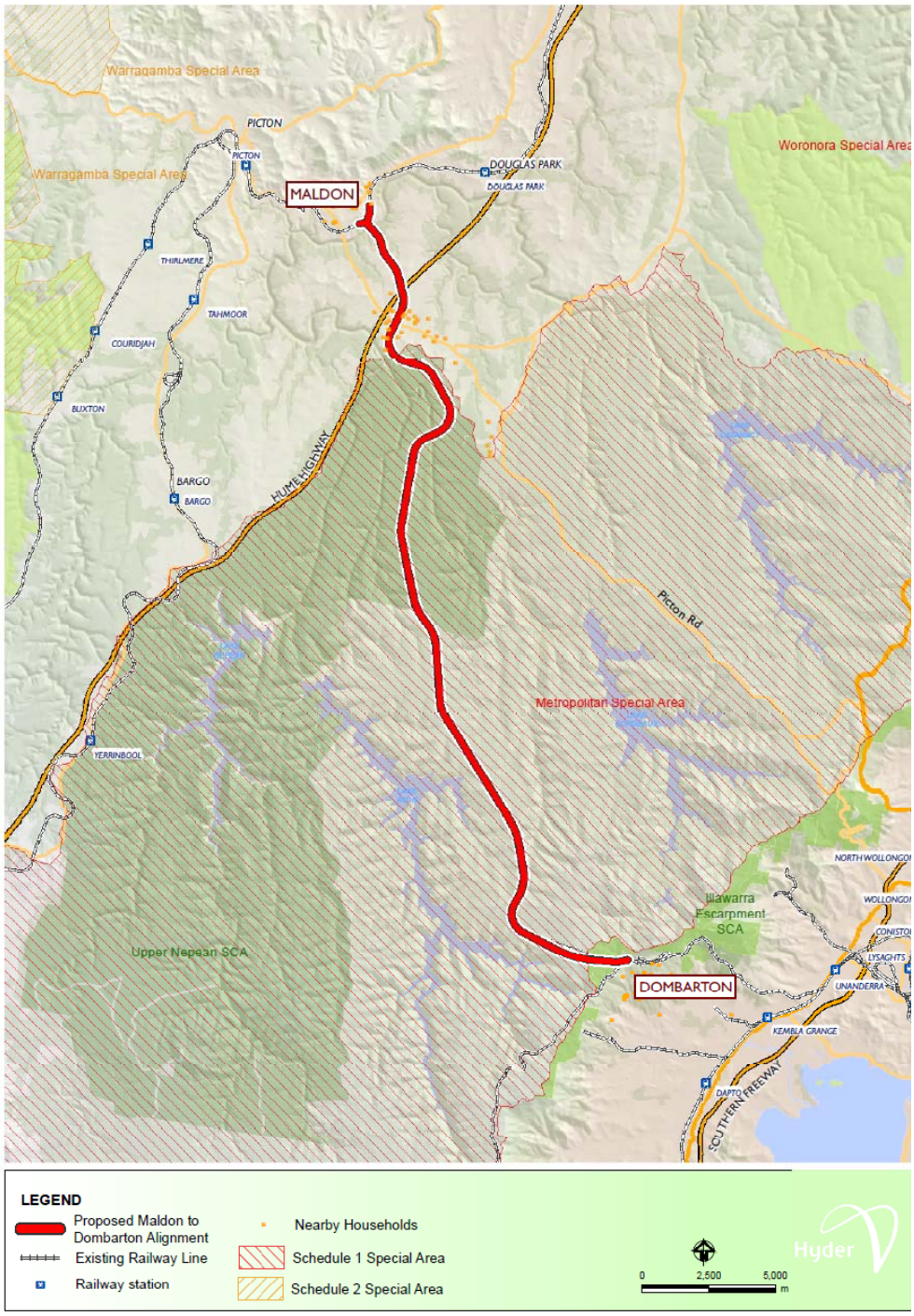
The alignment is approximately 35.026 km measured from Dombarton Junction along the North Fork at Maldon Junction plus the length of the South Fork of approximately 512 m.

There are two passing loops on the alignment of approximately 2.00 km each, namely Avon Passing loop from 110.150 km to 112.152 km and Wilton Passing loop, from 129.710km to 131.735km.

The minimum horizontal curve radius used on the section of the alignment where a maximum speed of 100 kph is allowed is 800 m. At the section west from the Nepean River Bridge towards Maldon Junction, the minimum horizontal curve radius is 300 m.

The maximum gradient of the alignment on the downward direction travelling to the west of Dombarton upwards is 1 in 30 through the 4 km proposed tunnel. In the opposite upward direction, the maximum gradient is approximately 1 in 60 or 1.67 per cent.

Figure 15 **Map of proposed alignment**



Source: Hyder Consulting