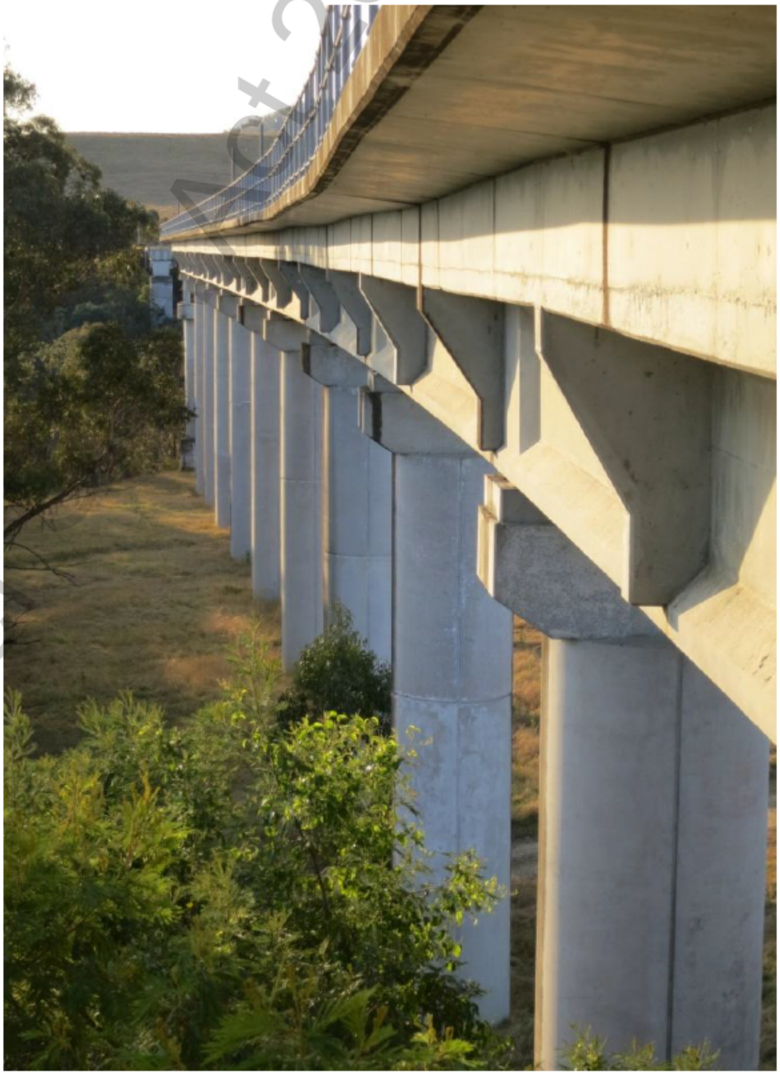
MALDON TO DOMBARTON RAIL LINK

Final Business Case



Transport for NSW

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Document Information

This template provides the format required for any business case requesting capital funding within Transport for NSW.

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Proponent and Project Information	
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Project Details	
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Project Name:	*Maldon to Dombarton Rail Line*
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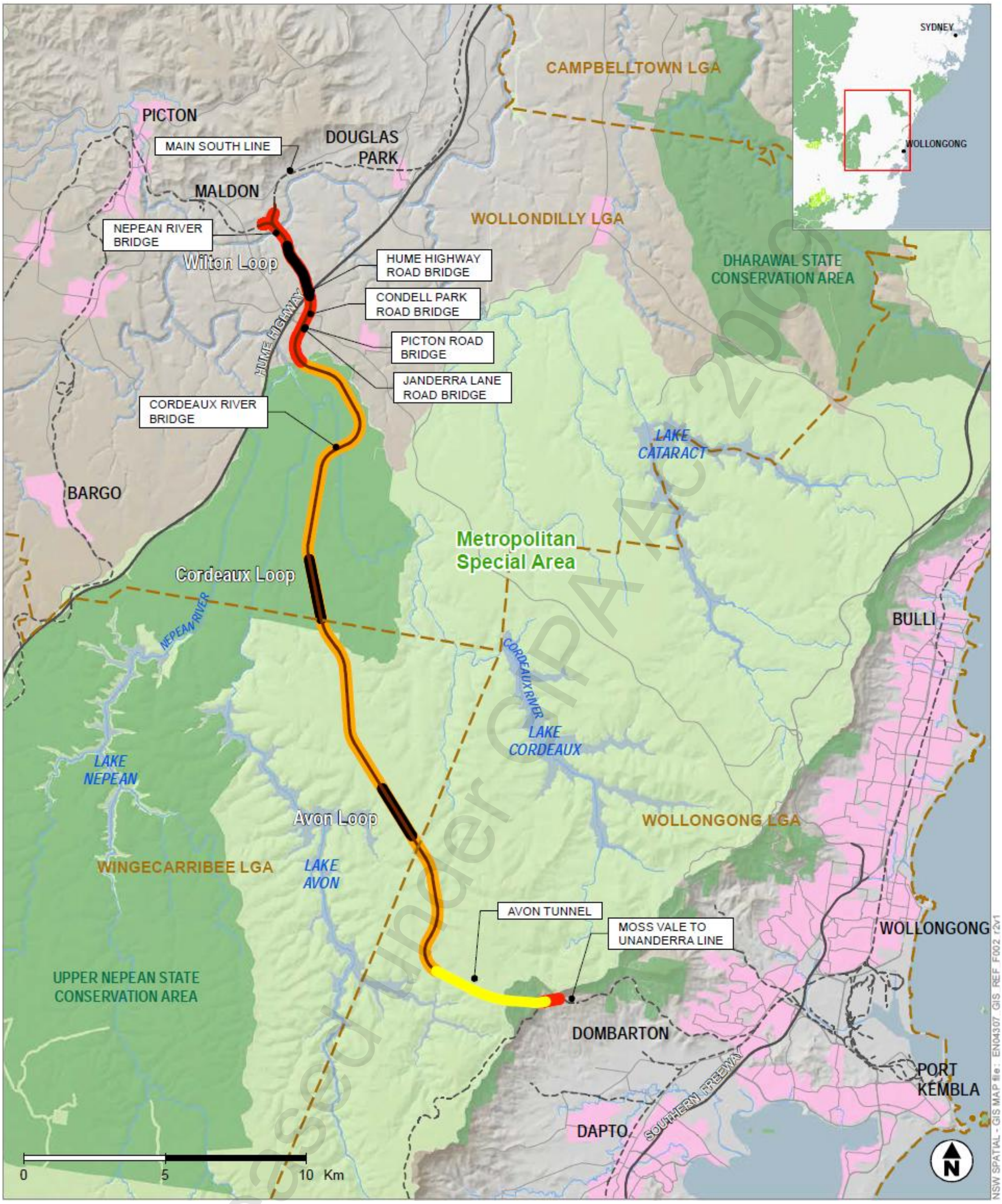
Project Summary:	The proposed Maldon to Dombarton Rail Link (MDRL) is a 34.5 kilometre single track freight only line from the Main South Line at Maldon to the Moss Vale to Unanderra Line at Dombarton. The MDRL would provide improved linkages for freight between Port Kembla, Hunter Valley, the southern and western coalfields and Sydney. The project has had a history spanning over 30 years. The Maldon to Dombarton Rail Link was first considered during construction of the Port Kembla coal loader in 1979. In the early 1980's a decision was made to proceed with the rail link and the NSW Government enacted the *Railway Construction (Maldon to Port Kembla) Act 1983* (Maldon Act), prepared and determined an Environmental Impact Statement, followed by the construction of a substantial portion of the rail link. The works that were completed in 1988 were earthworks and trackwork for key junctions, 25 kms of rail formation, approach spans and abutments for Nepean River Bridge, and a tunnel portal at Dombarton. Construction of the rail link was suspended in 1988 due to poor economic conditions. In October 2012, the Commonwealth Government provided funding for TfNSW to undertake further detailed demand assessment, operational analysis design and environmental investigations for the future construction of the Proposal. The operational and demand modelling undertaken has shown that the line is not required for current operations, but would be required if a number of likely trigger events occur in the foreseeable future. Then the link would be necessary in order to maintain the longer term visibility of Port Kembla. The current foreseen triggers either planned or projected are; 1. Increased frequency of Illawarra line passenger services 2. Conversion of the Illawarra line to new single deck passengers as per Sydney Rail Futures policy. 3. Expansion of demand for coal haulage, 4. Outer Harbor development including development of Port Kembla as a 2nd container terminal and Moorebank development. 5. Change in demand for any other major commodity The capex for the project has been estimated to be $701 million for MDRL and $105 million for Coniston upgrade. During operation the link would have a capacity to carry up to 36 train movements per day (generally consisting of 18 train movements in each direction). The trains would be powered by diesel locomotives and used predominantly for the haulage of coal. As the line would take approximately five years to construct from the confirmation of the availability of construction funding, this Final Business Case has been prepared with a view to confirming that all required planning activities have been undertaken, and that even in the event of a hiatus, that upon confirmation of funding, that the project will be ready to be progressed.



Legend

The Proposal
Passing loops
Avon Tunnel
Earthworks and drainage complete
New track earthworks and drainage
Railways
Motorway
Roads
Waterways
LGA Boundaries
Waterbodies
Built Up Areas
NPWS reserves
Other reserves (SCA)

Figure E-1 Overview Map

MALDON TO DOMBARTON RAIL LINK

CONTENTS

APPROVAL REQUEST

The signatures below endorse that all necessary areas have been consulted, the details of the investment as described in this document and supporting documents are accurate

Proposed

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1 EXECUTIVE SUMMARY

1.1 Background

In the mid to late 1980s, the NSW Government partially constructed a 35 km freight rail line south of Sydney within the Port Kembla region from Maldon in the Southern Highlands to Dombarton, 10 km west of Unanderra on the Unanderra to Moss Vale line.

This rail link was first considered in the late 1970's to complement the developments at Port Kembla and to primarily transport coal from pit to port. The line was operationally developed as an electrified route to support AC powered locomotives. Such locomotives were becoming more economical to purchase and operate at that time, but due to changes in global supply and commodity process over the years operators have not invested in these. Currently (2013) diesel locomotive power is almost universally used in NSW and predicates the current design, specifically the tunnel design.

It is pertinent to note that the nature of the rail industry has also changed over the intervening years due to competition policy and reforms in the 1990's. The original project was designed and delivered for a vertically integrated owner, the former State Rail Authority.

The design of the rail link was completed and significant construction had commenced prior to the decision to cease the works.

In September 2011 the Commonwealth Government completed a feasibility study into the completion of the Maldon to Dombarton Rail Link and in 2012 the Commonwealth Government committed funds to TfNSW to bring the project up to construction readiness.

The Maldon to Dombarton Rail Link (MDRL) would provide a freight rail link between south western Sydney and Port Kembla and the Illawarra. It will provide additional rail capacity to Port Kembla and the Illawarra line by providing a direct connection between Dombarton on the Unanderra line to the main southern rail line at Maldon. It will also decrease journey times from south west Sydney to Port Kembla.

At the time of the cessation of Works in 1988 a significant portion of the Works had been completed, including the bulk civil platform of embankments and cuttings and minor civil structures of drainage culverts and approaches to the Nepean Bridge. However, the primary assets including the Avon Tunnel, Cordeaux River Bridge and the main span of the Nepean River Bridge had not commenced.

1.2 Need for the Investment

Existing Issue

Port Kembla is a key international gateway for both NSW and Australia servicing both the local steel industry in Wollongong as well as broader supply chains in Sydney (cars), regional NSW (coal, grain and other bulks) as well as other regions in Australia (steel and other bulks). Consequently, increasing the efficiency and capacity of the landside transport links to the Port are of significance to NSW and the nation.

Currently, a significant proportion of freight to and from Port Kembla is transported by rail, either via the Illawarra Line (Western Coalfields and Hunter Valley coal, steel, ballast, aggregates and ores) and the UMVL (Tahmoor coal, grain, ores and limestone). However, there are a number of constraints on each or both of these lines including:

- *Shared use of rail infrastructure with passenger trains* on the Illawarra Line with priority in the use of train paths given to passenger services. This means that there are no paths in the peaks and limited paths for freight in the off-peak. In addition, rail freight services can impact the reliability of passenger services.
- *Growing train patronage on the Sydney rail network* is likely to lead to conflicts with passenger services increasing in the future. To meet anticipated demand for train services, there exists a growing need to increase train frequencies, which may result in additional off-peak services. For instance, current government policy includes the intention to enhance off-peak passenger service frequencies on the Illawarra Line which could result in capacity for freight services being very significantly reduced.
- *Steep gradients and tight curvatures* that restrict train lengths, operating speeds and in some cases the type of cargo that can be carried into and out of the Illawarra. For instance, on the Illawarra Line, ruling grades reach 1:40[1] in parts, specifically between the Georges River and Engadine and between Oaks Flats and Dunmore. On the UMVL, the ruling grade towards Moss Vale is 1:30 between Dombarton and Summit Tank and towards Port Kembla, the ruling grade is 1:75 between Moss Vale and Summit Tank.
- *Lack of capacity* impacting rail freight reliability and availability, which are key metrics in determining shipper freight mode choice.

The Sydney Rail Futures policy will result in a single decker rail network being built progressively to complement the double decker network. The Hurstville line is proposed to be converted to Rapid Transit single decker network with limited freight paths available by about 2031. Growing train patronage on the Sydney rail network is likely to lead to conflicts with freight services increasing in the future. To meet anticipated demand for passenger train services, there exists a growing need to increase train frequencies, which may result in additional off-peak services.

Further, as part of *Sydney Rail Futures*[2], there is a policy to enhance off-peak passenger service frequencies on the Illawarra Line which could result in capacity for freight services being very significantly reduced.

A key driver of when MDRL project should be built is the Sydney Rail Futures conversion of Hurstville Line and an allowance of 5 years prior to this to begin construction.

Further, the current foreseeable triggers that would bring forward the project are;

1. Conversion of the Illawarra line to new single deck passengers between Sydenham to Sutherland as per Sydney Rail Futures policy.
2. Increased frequency of Illawarra line passenger services. Passenger services have priority over freight with shared infrastructure
3. Expansion of coal demand for coal haulage, either through port expansion or increased mine output.
4. Outer Harbor development including development of Port Kembla as a 2nd container terminal and Moorebank development.
5. Change in demand for any other major commodity

These changes would lead to a situation where the requirement for freight train paths to Port Kembla and the Illawarra region can no longer be met by the currently available infrastructure. This may constrain the long term sustainability of Port Kembla to expand.

The construction of the MDRL would reduce pressure to expand capacity and introduce safety measures on a number of key roads accessing Port Kembla including Mount Ousley Road, Picton Road and Appin Roads. These routes have experienced increasing traffic volumes in recent years

[1] RailCorp (2012), Driver Route Knowledge Diagrams, p. 240
[2] Transport for NSW (2012), Sydney's Rail Future

(both passenger and freight)[3], which combined with the steep gradients and tight curvatures on these roads, have increased the potential for crashes on these routes. In the event one or more if the triggers occur, given the challenging topography through which these roads pass, any upgrade to the existing infrastructure is likely to entail significant capital expenditure.

Strategic Alignment

The Proposal would address strategic transport objectives as outlined in:

- Illawarra Regional Transport Plan (April 2014) – Which identifies short, medium and long term actions to deliver key transport and infrastructure projects to the Illawarra region
- NSW Freight and Ports Strategy (November 2013) – which seeks to improve efficiency of freight movement and to separate passenger and freight movements through network enhancements and rail alignments
- NSW Long Term Transport Master Plan (December 2012) – which identifies the Proposal as a corridor which should be protected and states that the completion of the planning phase for the MDRL should be undertaken
- NSW 2021: A plan to make NSW Number One (September 2011) – which aims to improve the performance of the NSW economy and reduce travel times
- National Freight Strategy (June 2011) – which predicts significant increases in rail freight and seeks to ensure that capacity is not constrained or encroached by urban expansion

1.3 Proposed Strategy

The main objective of the Proposal is to maintain the capacity of the rail links to and from Port Kembla and reduce congestion on the local passenger and freight transport network.

The Proposal also seeks to:

- Separate freight and passenger movements to reduce the competition for freight capacity and allow for growth
- Support economic growth through provision of effective rail and road transport
- Adapt to changes to the scope and nature of operations of Port Botany and Port Kembla
- Support the rapidly expanding resource demand in NSW, by providing alternate access to Port Kembla
- Maintain or improve the level of safety risks to the rail network

Any corridor which traverses 20km of Sydney's second catchment area will also need to:

- Achieve a neutral or beneficial impact on water quality and maintain ecological integrity within Sydney's drinking water catchment
- Minimise impacts on the environment, surrounding land users and the community
- Achieve a minimum 'Silver' rating under TfNSW's NSW Sustainable Design Guidelines v3.0

1.4 Options Considered

A number of alternatives have been investigated to meet the freight task. These include:

- '**Do nothing' option**. This consists of the existing Illawarra Line and UMVL. If the Proposal was not to proceed and there was a high growth rate in freight demand, there would be congestion on the existing rail freight network under some scenarios. This would lead to increased costs, delays to freight and passenger trains, and additional pressure on the road

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3 RTA (2011), Picton Road Corridor Strategy

network. Investment would be required on alternative lines and increased use would lead to noise and air quality impacts. The ‘do nothing‘ option was not considered a feasible alternative as it is inconsistent with the objective of maintaining the viability of Port Kembla.

- **Wider network operating scenarios -** for example upgrades to alternative lines like UMVL or Hurstville to Sutherland line additional track, and limiting the Proposal to a single (north to south) unidirectional operation in conjunction with the UMVL were considered. These options were discounted on cost and / or operational capability.
- **Twelve alternative tunnel alignment options** and portal locations were considered to avoid land use issues and environmental impacts, and reduce capital works costs. The alignment grade, mine subsidence impact and overall route length was also considered. The conclusion of the feasibility study was to retain the original portals and route.
- **Alternative surface alignment** to avoid building the tunnel was considered. However, this was discarded due to proximity to water catchment area and difficulty in building through steep terrain resulting in extremely high costs. During the Final Business Case phase, two short-listed alignment options were assessed – the original alignment (yellow) and a revised flatter alignment (salmon option). A range of criteria like construction cost, constructability, corridor capacity, operations costs, length of tunnel, environmental issues, etc were applied to the options. The Yellow option has the benefits of lower construction costs, compliance with Maldon to Dombarton Act (which enables use of REF), less environmental damage and greater use of the existing works. The disbenefits are steeper grade, higher ventilation and operating cost. It should be noted that ventilation and operating cost are not a key driver.

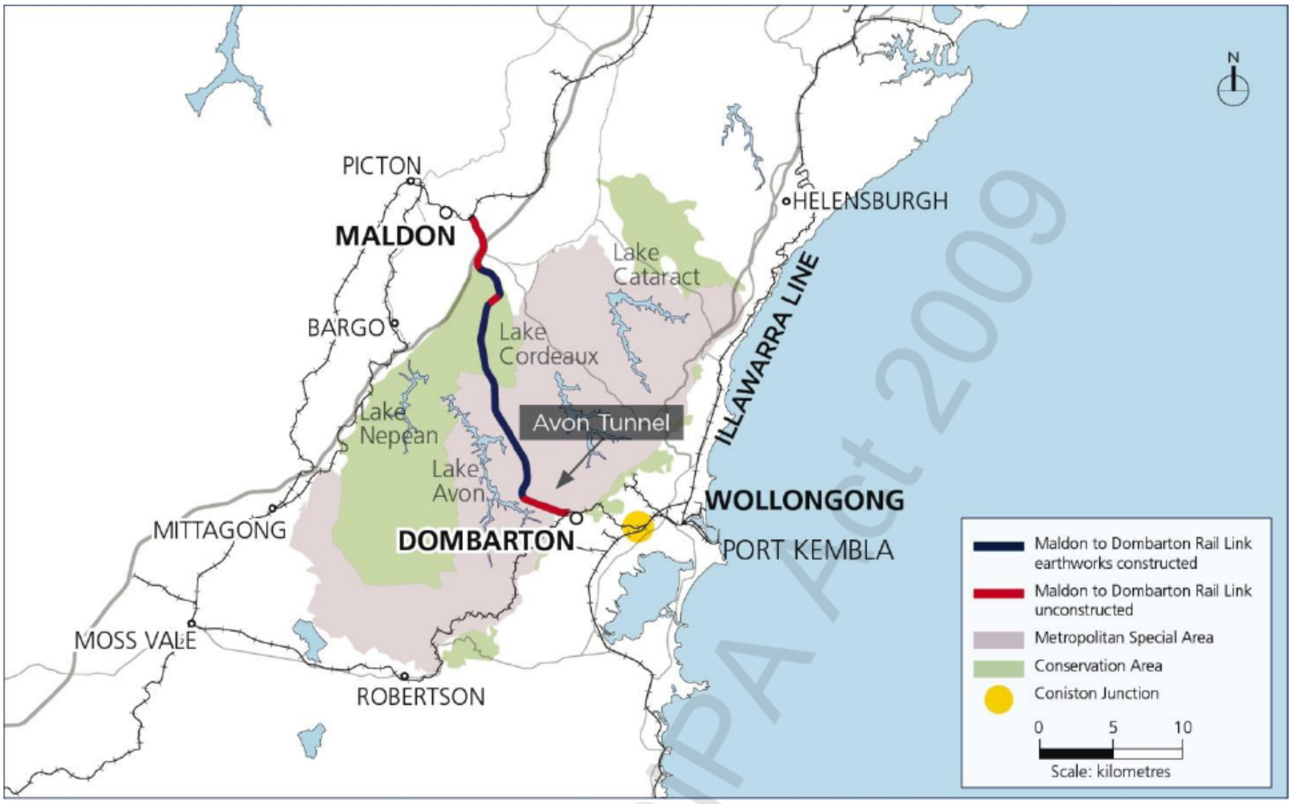
1.5 Recommended Option

The scope of remaining works under this option includes:

- Connections with the Main South Line and UMVL
- Upgrade of Coniston Junction
- A 250m long bridge over the Cordeaux River
- A 190m long bridge over the Nepean River
- A crossing over the Hume Highway
- Three additional road bridges
- Avon Tunnel (as shown in Figure 1.1)
- New line side signalling and train control equipment and other auxiliary infrastructure including power supply.

In addition to the works required between Maldon and Dombarton, the increasing use of the South Coast line between Coniston and Unanderra junction would require a reconfiguration of the rail junctions. A concept design for their works has been completed and a pre-construction cost estimate finalised with an estimated cost of $105million.

Figure 1.1: Option 2A Reference Project Route Alignment



Source: TfNSW

1.5.1 Overall project cost

Capital cost estimates were prepared by Aquenta based on the engineering works undertaken by PB. For the purposes of the economic assessment, outturn costs were converted to economic costs to remove nominal cost escalation and corporate overhead. The estimated upfront capital costs are shown in Table 1.1.

Construction Cost Estimates under the 'With Project' Case - Undiscounted

Item	MDRL	Coniston Junction	Total
Outturn cost	$701.4 m	$104.6m	**$805.9 m**
Economic cost	[redacted]	[redacted]	[redacted]

Source: Deloitte analysis based on Aquenta cost information. Values in 2013-14 prices

Table1.1: Construction Cost Estimates for the MDRL

	Cost ($m)
(A) Contractors direct cost	[redacted]
(B) Indirect cost	
(C) Total construction cost (A+B)	
(D) Owners cost	
(E) Base estimate (C+D)	
(F) Contingency and risk allowance	
Inherent and contingent risks (P50)	
Contractors escalation	
Sub total (F)	

	Cost ($m)
(G) Project estimate (E+F)	[redacted]
(H) Client escalation (construction)	[redacted]
(I) Program contingency recover (P90)	[redacted]
(J) Corporate overhead recovery	[redacted]
Total Outturn cost	**701.4**

Source: Aquenta, June 2014.

Direct costs account for $315 million and are the biggest part of all outturn costs.

[redacted]

An allowance for owners or government costs, risk and escalation and project contingency recover and corporate overhead recovery has also been included. Owner costs include the costs involved for the Tf NSW to manage the project through environmental approval, procurement and tendering and management during the construction phase. [redacted]

An estimate for Coniston Junction – Unanderra Upgrade is provided below.

Construction Cost Estimates for Coniston Junction – Unanderra Upgrade

Item Code	Item	Coniston Junction Works	Unanderra Works	Total	%
	Contractors direct cost				
	Civil works	[redacted]	[redacted]	[redacted]	[redacted]
	Structures	[redacted]	[redacted]	[redacted]	[redacted]
	Trackwork	[redacted]	[redacted]	[redacted]	[redacted]
	Systems	[redacted]	[redacted]	[redacted]	[redacted]
A	**Total direct costs**	[redacted]	[redacted]	[redacted]	[redacted]
	Indirect cost	[redacted]	[redacted]	[redacted]	[redacted]
	Contractors design costs	[redacted]	[redacted]	[redacted]	[redacted]
	Preliminaries	[redacted]	[redacted]	[redacted]	[redacted]
	Contractors overhead and profit	[redacted]	[redacted]	[redacted]	[redacted]
B	**Total indirect costs**	[redacted]	[redacted]	[redacted]	[redacted]
C	**Total construction cost (A+B)**	[redacted]	[redacted]	[redacted]	[redacted]
D	**Owners cost**	[redacted]	[redacted]	[redacted]	[redacted]
E	**Base estimate (C+D)**	[redacted]	[redacted]	[redacted]	[redacted]
	Contingency and risk allowance	[redacted]	[redacted]	[redacted]	[redacted]
	Inherent and contingent risks (P50)	[redacted]	[redacted]	[redacted]	[redacted]
	Contractors escalation	[redacted]	[redacted]	[redacted]	[redacted]
F	**Total contingency and risk allowance**	[redacted]	[redacted]	[redacted]	[redacted]
G	**Project cost estimate (E+F)**	[redacted]	[redacted]	[redacted]	[redacted]
H	**Client escalation**	[redacted]	[redacted]	[redacted]	[redacted]
I	**Program contingency recovery(P90)**	[redacted]	[redacted]	[redacted]	[redacted]
J	**Corporate overhead recovery**	[redacted]	[redacted]	[redacted]	[redacted]
K	**Total outturn costs (G+H+I+J)**	[redacted]	[redacted]	**$104.6m**	**100.00%**

Source: Aquenta. All monetary values in 2013-14 prices

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10 22/23
Maldon to Dombarton			*$36m*	*$148m*	*$181m*	*$138m*	*$110m*	*$89m*		
Coniston					*$52m*	*$52m*				
Total cashflow estimate			*$36m*	*$148m*	*$233m*	*$190m*	*$110m*	*$89m*		

1.5.2 Ongoing operating and maintenance costs (whole of life)

The operating and maintenance costs for the MDRL were developed by Aquenta who developed a bottom up estimation of incremental operating and maintenance costs as a result of the scheme. The analysis was discussed with PB and TfNSW to ensure that the analysis was robust and used similar operating assumptions from these agencies currently being incurred on the rail network. The analysis assessed the following items:

- Tunnel: periodic capital maintenance cost
- Structures: including periodic capital replacement costs of the noise walls
- Systems: this includes tunnel lighting and power, mechanical ductwork and systems, ventilation fans and water piping.
- Water treatment plant: Monthly inspections will be required as well as minor ongoing maintenance
- Signalling: this includes regular inspections and the periodic replacement of 27 signal locations
- Civils: this includes inspections and minor repairs of cuttings, embankments and structural fill etc.
- Bridges: includes annual inspections and periodic replacement and corrections to joints and cracks
- Trackwork: this includes tamping and re-ballasting, rail grinding, sleeper replacement and new rail replacement.

The whole of life costs are summarised in Table 1.2 and Figure 1.2.

Table 1.2: Summary of MDRL Whole of Life Costs ($m) 2021 to 2070

Item	Capital Replacement	Operating Costs	Maintenance
Civil works	[redacted]	[redacted]	[redacted]
CSR	[redacted]	[redacted]	[redacted]
Tunnels	[redacted]	[redacted]	[redacted]
Structures	[redacted]	[redacted]	[redacted]
Track	[redacted]	[redacted]	[redacted]
Systems	[redacted]	[redacted]	[redacted]
Road and Transport Hub	[redacted]	[redacted]	[redacted]
Miscellaneous	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]

Source: Aquenta

Beyond 2049, the whole of life costs were assumed to remain at 2049 levels.

[redacted]

1.6 Final Economic and Financial Assessment

The Final Economic and Financial Assessment has evaluated the economic and financial merits of the Project against a do minimum base case.

Base Case

The Base Case is based on a 'do-minimum' scenario. Under the base case, no major rail or road infrastructure improvements were assumed.

Rail freight capacity on the Illawarra Line would remain at current levels at up to 60 paths per day until 2031(although in practice there may be some reduction prior to 2031 due to growth in passenger service frequencies during the day). Post 2031, a significant enhancement in passenger train service frequencies is proposed on the Illawarra Line, most notably between Hurstville and the city. Assumptions made by TfNSW have assessed the impact of these additional services would reduce future rail freight capacity to 8 paths per day[4] with freight operations confined to night times only when passenger services are assumed not to be in operation. This would apply under the base case as well as the 'with project' case. A zero path scenario was also tested for sensitivity purposes should passenger train infrastructure changes preclude any night time freight movements.

'With Project' Case

Under the 'with Project' case, the development of the following key infrastructures would be progressed:

- The Maldon to Dombarton Rail Link
- Capacity enhancements between Coniston Junction and Unanderra.

Works between Coniston Junction and Unanderra have been identified to increase capacity to support the increase in movements anticipated on the MDRL, ensuring that the MDRL is not constrained by current capacity issues at Coniston Junction.

Operating Scenarios

Two scenarios were assessed against a 'Base Case', which assumes that passenger service frequencies on the Illawarra Line will be significantly enhanced from 2031. The increase in passenger service frequencies would see capacity available on the Illawarra Line for freight trains reduce from 60 paths per day to 8 paths per day under Scenario 1, and 0 paths per day under Scenario 2. These two scenarios were modelled to compare and assess the impact of commissioning the MDRL in 2021 or 2031.

The operating scenarios considered are listed in Table 1.3

Table 1.3: Operating Scenarios Considered

Scenario	Capacity Available for Freight on the Illawarra Line from 2031	First Year of MDRL Operations
Scenario 1 **(Core Scenario)**	8 paths	2021
Scenario 1a		2031
Scenario 2	0 paths	2021
Scenario 2a		2031

Scenario 1 has been adopted as the core scenario for the Economic and Financial Assessment. The other scenarios have been considered in the sensitivity analysis.

Demand Forecasts and Capacity

Commodities that are considered to be potential candidates for the MDRL, or could be displaced on to road without the MDRL, were considered in the preparation of the demand projections. These commodities include:

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[4] Based on advice from Transport for NSW and assuming that freight services would be limited to between 1am and 5am.

- Cement
- Ores (Western, South Western)
- Coal (Western, Hunter, Tahmoor)
- Grain (Western, South Western)
- Limestone
- Steel products
- Ballast and aggregates
- Manildra (inputs and outputs).

This assumes no new freight from Outer Harbour development.

Candidate tonnages are anticipated to increase from 16.5Mtpa in 2014 to 22.5Mtpa in 2021. These tonnages are projected to remain constant until 2031 when the aggregate and ballast trades are assumed to cease[5], reducing tonnages to 19.5Mtpa. Accordingly, an increase in the number of paths is required from 64 paths currently to 72 paths by 2021 and then to 64 paths by 2031. Despite the fall in paths projected by 2031, the decrease in available freight capacity on the Illawarra Line would result in unmet demand without the MDRL.

Based on available line capacity, preferred routes and the relative propensity to use rail (which varies by commodity), the commodities were routed through the Illawarra Line, UMVL or MDRL. Where capacity is not available, commodities were routed to an alternate port or were assumed to travel by road (or sea in the case of steel).

1.7 Justification

1.7.1 Economic appraisal

The project options were compared with the do nothing Base Case using a discounted cash flow technique on the basis of a real discount rate of 4.4% in accordance with the Commonwealth Department of Infrastructure and Regional Developments appraisal guidelines. The benefits of the project were assessed over a 50 year evaluation period.

The economic results from the core scenario are summarised in Table 1.4. These show the costs and benefits of the project options incremental to the project base case. Assuming rail freight capacity on the Illawarra Lines reduces to 8 paths per day, the economic merit of developing the MDRL is estimated to be positive with a BCR of 1.47 and a Net Present Value of $353m.

[5] This is a result of the life expiry of the quarries on the South Coast.

Table 1.4: Headline Results for Core Scenario

Key Stream	Undiscounted Values	Discounted Values	Breakdown
Initial capital costs	[redacted]	[redacted]	[redacted]
Recurrent costs (capital, maintenance and operating)	[redacted]	[redacted]	[redacted]
Total costs	[redacted]	[redacted]	[redacted]
Time savings	[redacted]	[redacted]	[redacted]
Transport cost savings	[redacted]	[redacted]	[redacted]
Avoided environmental externalities	[redacted]	[redacted]	[redacted]
Avoided crash costs	[redacted]	[redacted]	[redacted]
Road decongestion	[redacted]	[redacted]	[redacted]
Avoided road damage	[redacted]	[redacted]	[redacted]
Residual value	[redacted]	[redacted]	[redacted]
Total benefits	[redacted]	[redacted]	[redacted]
NPV		**$352.9m**	
BCR		**1.47**	
NPVI		**0.59**	
IRR		**6.2%**	

All values are in 2013-14 prices and are discounted at a real discount of 4.4% per annum over a 50 year evaluation period

The projected economic benefits of the Project can be largely attributed to the avoided transfer of freight from rail to road under the 'with Project' case. The key benefit stream arising from the Project is the value of transport operating cost savings which account for half of the Project's benefits, attributable to the lower unit cost of rail relative to road. A quarter of the Project's benefits can be attributable to avoided externalities, which arise from avoided environmental externalities, crash costs, decongestion and road damage. These costs are significantly higher for road transport compared to rail transport.

Scenario testing was undertaken on three alternative operating scenarios to test how the merits of the Project alter if no paths are available on the Illawarra Line from 2031 and/or if MDRL opens from 2031. Table 1.5 outlines the impact of these variations on the projected economic outcomes.

Table 1.5: Economic Outcomes under Different Operating Scenarios (Discounted)

Variable	Scenario 1 (Core)	Scenario 1a	Scenario 2	Scenario 2a
Paths on the Illawarra Line from 2031	*8*	*8*	*-*	*-*
First year of MDRL Operations	*2021*	*2031*	*2021*	*2031*
Total costs	[redacted]	[redacted]	[redacted]	[redacted]
Total benefits	[redacted]	[redacted]	[redacted]	[redacted]
NPV	**$352.9m**	**$681.9m**	**$229.1m**	**$548.8m**
BCR	**1.47**	**2.40**	**1.30**	**2.12**

All values are in 2013-14 prices and are discounted at a real discount of 4.4% per annum over a 50 year evaluation period

Of note is the increased BCR when delaying the opening of the MDRL until 2031, as modelled within Scenario 1a and Scenario 2a. The delay in construction discounts the cost of construction as well as avoids some transport cost increases associated with the assumed rerouting of Western

Coalfields, Hunter Valley coal and cement trains from the Illawarra Line to MDRL between 2021 and 2031.

The benefits under Scenario 2, which measures the impact of zero paths on the Illawarra Line from 2031, are projected to be lower than Scenario 1 as four fewer return paths can be diverted from the Base Case (where significant volume of commodities are forced onto road due to Illawarra Line constraints). The commodities then have to use alternative routes, road / rail or other ports.

A preliminary financial assessment has been undertaken which assesses the cash flows accrued by the owner of the MDRL, which are likely to be confined to track access charges. These have been based on the prevailing ARTC track access charges rates. The analysis only considers track access charges accrued on the MDRL and does not consider changes in track access charges on other parts of the rail network as these charges may not accrue to the owner of the MDRL.

The financial assessment indicates that track revenues are insufficient to cover the costs of developing, maintaining and operating the MDRL. When the upfront capex and the operations and maintenance costs are valued against the track access charge revenue, the NPV for all MDRL options is negative with losses estimated at -$501m. Should the development of the MDRL be deferred, the NPV improves to -$255m, however with no change in the BCR, the apparent decrease in losses is a reflection of discounting rather than a change in the gap between the MDRL's financial costs and revenues. Further, track charges are projected to be insufficient to cover all recurrent costs. Accordingly, a contribution from government, other track managers or other beneficiaries would be required to financially support the development and operation of the MDRL.

Table 1.6 Projected Discounted Financial Outcomes ($m)

Financial Indicator	Scenario 1 (Core)	Scenario 1a	Scenario 2	Scenario 2a
Capital costs	[redacted]			
Recurrent costs				
Total costs				
MDRL charges				
Residual value				
Total benefits				
NPV	**-$500.9m**	**-$254.6m**	**-$501.9m**	**-$255.7m**
BCR	**0.09**	**0.09**	**0.09**	**0.09**
NPVI	**-1.04**	**-1.04**	**-1.05**	**-1.05**
IRR	**No real or positive solution**			

All estimates are based on a 7% real discount rate with benefits and costs evaluated over 50 years. Prices are expressed in 2013-14 dollars

[redacted]

[redacted]

[redacted]

[redacted]

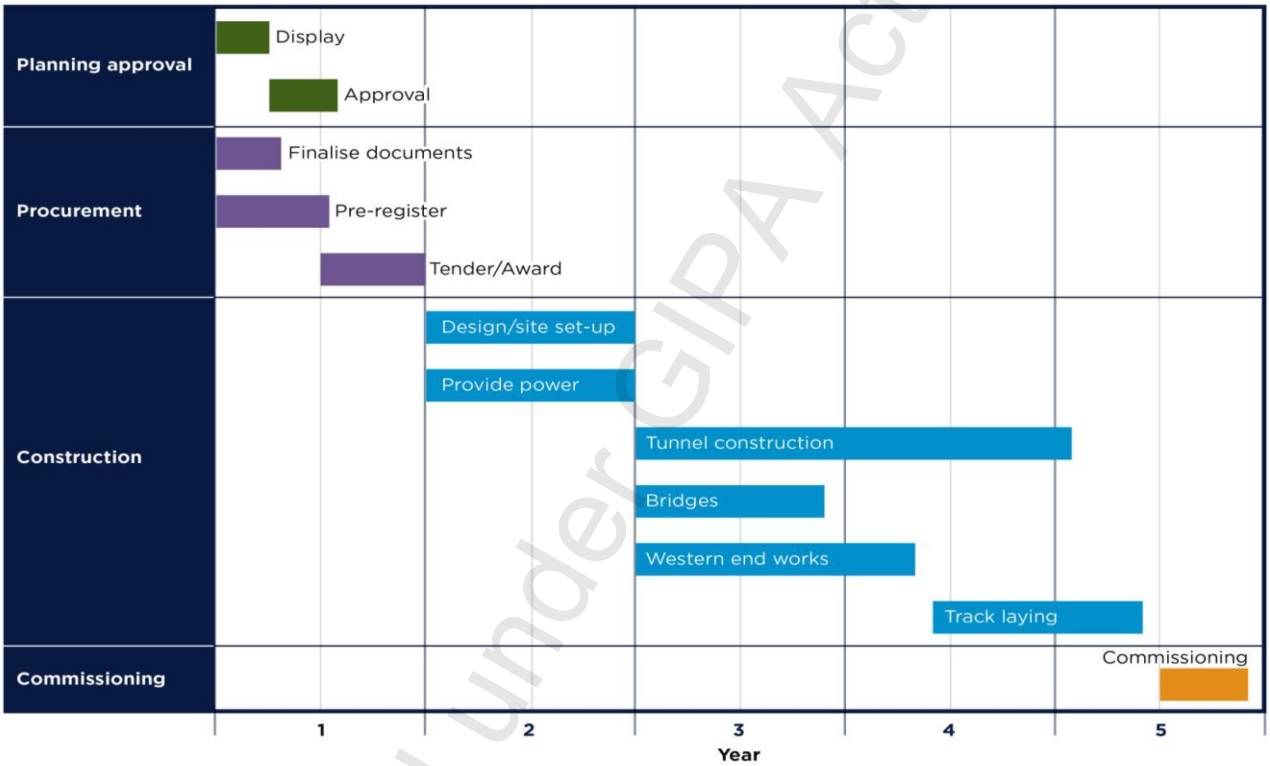
[redacted]

1.8 Delivery

The most likely delivery method would be a conventional design and construct contract with TfNSW undertaking, in conjunction with a specialist project management team, the overall project management of the link. The following timelines are shown from the time that funding is made available.

Key Milestones & Expected Timing – Implementation Phase

Table 1.7 - Milestones for Delivery Stage – Implementation Phase



2 NEED FOR THE INVESTMENT / REASON FOR EXPENDITURE

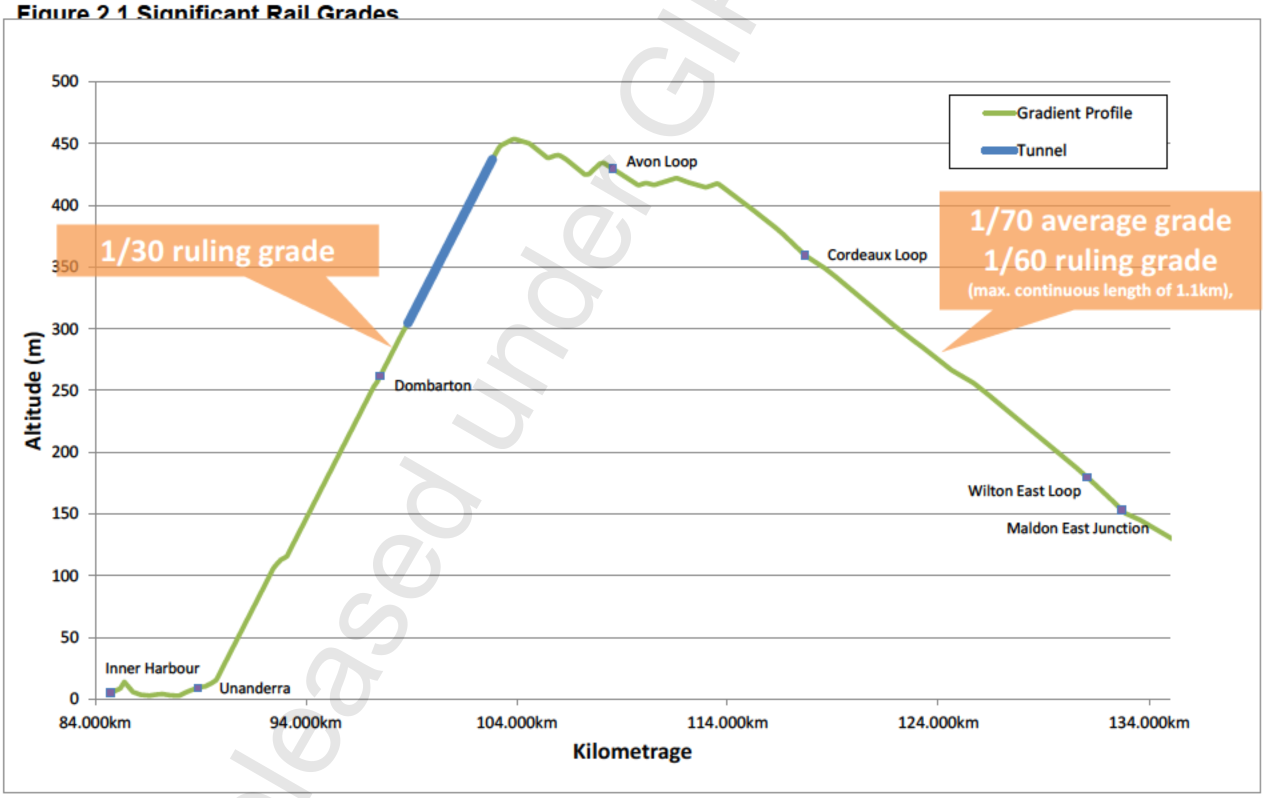
A comprehensive response is provided below (project description, key issues, problems, condition of assets, proposed solution and description of project elements).

2.1 PROJECT OVERVIEW

The project is a 35 km route south of Sydney generally from the region of Dombarton at the eastern end with an interface with the Unanderra to Moss Vale Line heading in a westerly direction through the National Park and Sydney Water Catchment to interface with the Main South Line at the western end near Maldon. See figures in Project Overview and Executive Summary.

The schematic below highlights the significant rail grades at each end of the route.

Figure 2.1 Significant Rail Grades



The line joins the eastern section of the Unanderra to Moss Vale line at a point some 15km west of Port Kembla. At the junction, trains have been powering at a maximum 1:30 grade before continuing as the MDRL for a further 4km at the same steep 1:30 grade through the Avon Tunnel. Locomotives are at full power on the upgrade here and expunge significant heat and emissions, which has particular significance for the tunnel design. Further west the route is categorized as a long 1:60 down grade toward Wilton. Depending on the train consist and modal type, the grades in each direction pose their own issues.

Beyond the western portal of the Avon Tunnel the route traverses undeveloped areas of National Park, including areas serving the Sydney Water Catchment, through sections at grade, cuttings or

embankments. A series of concrete and steel culverts have been constructed together with most of the civil earthworks. Significant sections of the route have had the bottom ballast laid, but no rail or rail systems have been installed.

Two major bridges traverse the Cordeaux River and Nepean River and three road bridges span local roads with a major overbridge proposed at the Hume Highway (6 bridges in total). Only the approach viaduct structures have been constructed either side of the Nepean River. No other bridge structure construction has commenced.

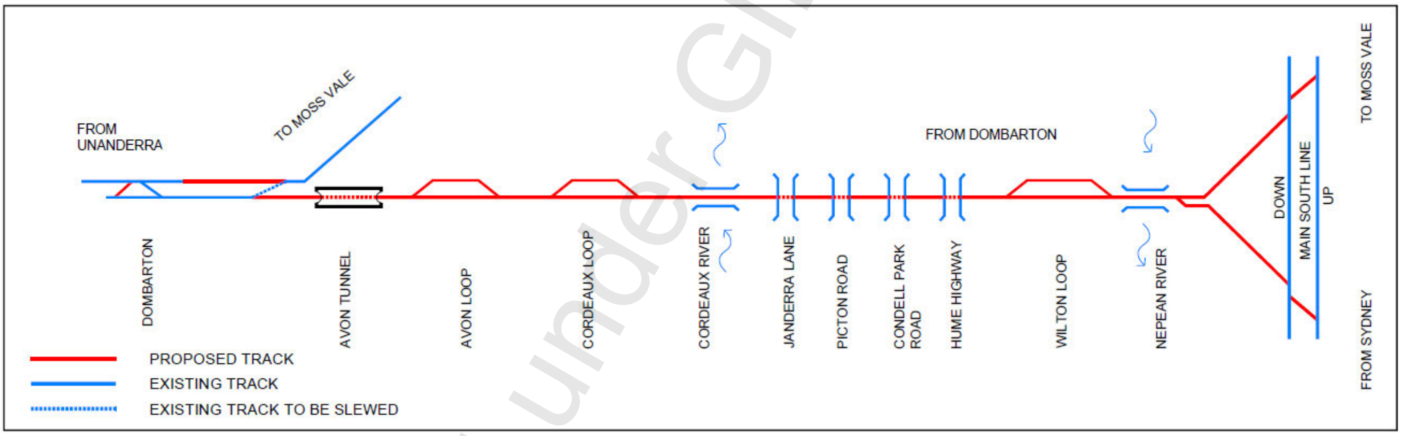
The general route area either has been subject to long wall coal mining at significant depth or is planned for future long wall mines. In particular the area to the east near Dombarton has been heavily mined to date and evidence of mine subsidence is evident along the tunnel route and in the vicinity immediately west of the tunnel. Further mining is planned west of the proposed tunnel and also near the Wilton area.

An engineering assessment of the past and future mining activities has been undertaken by a specialist subsidence engineer, Mine Subsidence Engineering Consultants.

The *General Overview* figure attached provides the geography and general site features for the route and identify all the primary structures and civil works necessary to complete the link.

A rail line schematic is also shown below outlining the functional requirements of the rail link;

Figure 2.2 Track diagram schematic



The land for the corridor has been acquired through the Wilton area, with the remainder owned by the state. Land acquisition survey work will be required over this remaining section.

In more detail, much of the civil platform was constructed including some laying of track, the latter which was subsequently removed. In order to integrate and commission the MDRL into the network.

The following major works are required to be undertaken;

1. **Avon Tunnel**: provision of a **4km** (approximately) tunnel, including services
2. **Cordeaux River Bridge**: provision of a **250m** single span arch bridge over the Cordeaux River
3. **Nepean River Bridge**: completion of the **190m** central span over the Nepean River
4. **Hume Highway Overbridge**: crossing under the Hume Highway.
5. **3 new overbridges** across local roads at:
   - Picton Rd

- Janderra Lane
- Condell Park Rd.

6. **Civil Works**: approximately **5km** of new formation at the Maldon end (not previously constructed).
7. **Rail Infrastructure**: provision of **35km** of top ballast and new track for the complete railway; and ancillary infrastructure including power supply and fencing, including the ARTC rail interfaces and tie-in either end.
8. **Rail Systems**: all associated signalling and control systems, including a link to the ARTC Junee Train Control Centre
9. **Access Roads**: internal road access upgrades and corridor improvements as required

Photographs of the current corridor are provided below:

Figure 2.3 Original Construction Photo

CHAINAGE 103.5 to 107 An aerial view of completed earthworks through steep terrain near the Avon Dam.

Figure 2.4 Existing Cutting

Figure 2.5 Existing Embankment

In addition to the above, the project originally included planned external enabling works enhancements to the existing rail network outside of the notional project boundary. The notional project boundary can be thought of as the immediate route connections to the Main South line at Maldon to the West and the Moss Vale - Unanderra Line at Dombarton to the East. The external enabling works, some of which were constructed or partially constructed or planned included:

- Installation of 25KV overhead wiring masts to Unanderra/Port Kembla.

- Electrification to Macarthur
- Works at Port Kembla Yard
- Reconfiguration of Unanderra station and other trackwork
- Coniston Junction trackwork
- New line from St Marys to Glenlee
- Grade separation of the Princes Highway to the east.
- 2nd Track to Dombarton from Unanderra.

2.2 Current situation and proposed solution

Port Kembla is a key international gateway for both NSW and Australia servicing both the local steel industry in Wollongong as well as broader supply chains in Sydney (cars), regional NSW (coal, grain and other bulks) as well as other regions in Australia (steel and other bulks). Consequently, increasing the efficiency and capacity of the landside transport links to the Port are of significance to NSW and the nation.

Currently, a significant proportion of freight to and from Port Kembla is transported by rail, either via the Illawarra Line (Western Coalfields and Hunter Valley coal, steel, ballast, aggregates and ores) and the UMVL (Tahmoor coal, grain, ores and limestone). However, there are a number of constraints on each or both of these lines including:

- *Shared use of rail infrastructure with passenger trains* on the Illawarra Line with priority in the use of train paths given to passenger services. This means that there are no paths in the peaks and limited paths for freight in the off-peak. In addition, rail freight services can impact the reliability of passenger services.
- *Growing train patronage on the Sydney rail network* is likely to lead to conflicts with passenger services increasing in the future. To meet anticipated demand for train services, there exists a growing need to increase train frequencies, which may result in additional off-peak services. For instance, current government policy includes the intention to enhance off-peak passenger service frequencies on the Illawarra Line which could result in capacity for freight services being very significantly reduced.
- *Steep gradients and tight curvatures* that restrict train lengths, operating speeds and in some cases the type of cargo that can be carried into and out of the Illawarra. For instance, on the Illawarra Line, ruling grades reach 1:40[6] in parts, specifically between the Georges River and Engadine and between Oaks Flats and Dunmore. On the UMVL, the ruling grade towards Moss Vale is 1:30 between Dombarton and Summit Tank and towards Port Kembla, the ruling grade is 1:75 between Moss Vale and Summit Tank.
- *Lack of capacity* impacting rail freight reliability and availability, which are key metrics in determining shipper freight mode choice.

Growing train patronage on the Sydney rail network is likely to lead to conflicts with passenger services increasing in the future. To meet anticipated demand for passenger train services, there exists a growing need to increase train frequencies, which may result in additional off-peak services. For instance, as part of *Sydney Rail Futures*[7], there is a policy to enhance off-peak passenger service frequencies on the Illawarra Line which could result in capacity for freight services being very significantly reduced.

These emerging constraints will progressively lead to a situation where the net requirement for train paths to Port Kembla and the Illawarra region can no longer be met by the currently available infrastructure.

[6] RailCorp (2012), Driver Route Knowledge Diagrams, p. 240
[7] Transport for NSW (2012), Sydney's Rail Future

This will severely constrain the long term viability of Port Kembla.

These emerging constraints will increase the need to provide separate freight operations from passenger services, provide additional track or provide alternative routes for freight through the Sydney metropolitan area in the future.

The construction and operation of the MDRL could also reduce pressure to expand capacity and introduce safety measures on a number of key roads accessing Port Kembla including Mount Ousley Road, Picton Road and Appin Roads. These routes have experienced increasing traffic volumes in recent years (both passenger and freight), which combined with the steep gradients and tight curvatures on these roads, have increased the potential for crashes on these routes. Given the challenging topography through which these roads pass, any upgrade to the existing infrastructure is likely to entail significant capital expenditure.

Table 2.1 Recent Developments Affecting MDRL

Item	Impact
Long term leasing of Port Kembla and Port Botany in 2013	In May 2013, the NSW Government announced that an offer for a long term lease of both Port Botany and Port Kembla was accepted. Given the transfer of the operations on a 99 year lease sale of both ports to one private operator, combined with the removal of the 3.2m TEU per annum planning cap at Port Botany, it is possible that in the short term increasing focus will occur in container operations in Sydney with bulk operations continuing at Port Kembla. However, in the medium to long term, it is possible that the private operator of Port Kembla would have interest in developing container operations at Port Kembla, especially if container handling capacity at Port Botany becomes capacity constrained. However, it is uncertain of the time of such a development.
NSW Freight and Port Strategy	The Strategy outlines the NSW Government's plans to meet freight challenges over the next 20 years. Of particular relevance to the MDRL study is Task 2C-1 of the Strategy which aims to separate passenger and freight movements through network enhancements and rail alignments. The MDRL is identified as an important upgrade as it would support the rapidly expanding resources sector in NSW and provide alternative means of access to Port Kembla away from the Illawarra Line, heavily used by both passenger and freight services. Additionally, the rail link may allow Port Kembla to provide additional container handling capacity to supplement Port Botany's container business, and provide a more reliable link between the south-west and western coalfields and the rest of the eastern seaboard.
NSW Long Term Transport Master Plan and Sydney's Rail Future	These plans include the potential for introducing a rapid transit network that will incorporate the: • Planned North West Rail Line • Conversion of the existing Epping Chatswood Rail Link • Proposed CrossLink (Second Harbour Crossing) • Service frequency enhancements on parts of the Bankstown and Illawarra Lines from 2031. Service frequency enhancements on the Illawarra Line are projected to result in capacity available for freight movements on the Illawarra Line fall from 60 paths to 8 paths and possibly 0 paths.
Resource Market Cooling	In the past 12 months there has been a noticeable cooling in the resource export market as the economic growth rates of major export receiving countries such as China have moderated, which in turn may have an impact future resource export volumes, at least in the short term.
Southern Sydney Freight Line (SSFL)	Commissioned in January 2013, in combination with the MDRL or the UMVL, the Southern Sydney Freight Line provides an alternative route for freight trains seeking to access Port Kembla.
Intermodal terminals at Moorebank	Two intermodal freight terminal concepts are currently being developed for the Moorebank area. Following responses to the Expressions of Interest, the Moorebank Intermodal Company has proposed to begin negotiations with QUBE and Aurizon. Should either or both terminals be developed, this would lead to other rail services competing for rail path capacity on the SSFL and the Metropolitan Freight Network (MFN).

Key Issues

The option development process for the project needed to consider a range of issues in designing the 'without project' and 'with project' options. These issues include:

- Levels of freight handled through Port Kembla
- Future capacity and demand for freight paths on the Sydney network
- Potential increase in passenger service frequencies on the Illawarra Line
- State of road links into and out of Port Kembla and the Illawarra.

Each of these issues is discussed in turn:

Port Kembla Infrastructure and Growth

The port currently handles approximately 32Mt[8] of cargo annually in the Inner Harbour including coal, iron ore, grain, steel, cars, other bulks and general cargo.

Currently, the scope for expansion to attract new trades is limited by the availability of land, the occupation rates for the existing berths and then the capacity of the landside and rail network. To address emerging capacity constraints at the port, the then Port Kembla Port Corporation[9] has developed plans for the expansion of berth capacity with the development of the Outer Harbour. Approval was granted by the NSW Department of Planning and Infrastructure for the progression of Stage 1 in 2011, with a multi-purpose berth to be operated as a common user facility. The works will continue into the near future to complete reclamation and to provide rail access for bulk traffic. Concept Plan Approval for Stages 2 and 3 has also been granted with additional infrastructure for rail and road and two multi-purpose berths and four container berths to be constructed.

The NSW Government has also identified Port Kembla as a candidate for development as a second container terminal to supplement Port Botany in the medium to long term once Port Botany becomes capacity constrained as per NSW Freight and Ports Strategy. If realised, the container berths at Port Kembla could provide capacity of up to 1.2M TEUs per annum.

In order to minimise the impact of this potential cargo volume on the local road network and the community, the Outer Harbour concept approval limits the TEU volumes on road to 120,000 per annum, with the remainder expected to utilise rail[10] (subject to available capacity on the rail network). Given the current rail path availability this additional trade volume would require investment in additional rail infrastructure between Wollongong and Sydney[11].

Given the uncertain nature and timing of the Outer Harbour development and the potential trades it might attract, the Base Case scenario assumes that Port Kembla operations are maintained within the current Inner Harbour footprint and do not include any expansion of the Outer Harbour. Whilst this allows growth in existing trades such as coal, grain, steel and other bulks, it does not allow for a the provision of significant new trades such as a container terminal which would represent an over-flow facility to Port Botany.

Indeed, given the current growth of container volumes through Port Botany and the capacity of the three stevedore terminals in Sydney, it is not likely that a second container port would be required until the late 2020s at the earliest.

As both the ports have been sold to NSW Ports; the new owner has to make an investment decision on the timing of development of a new container terminal at Port Kembla. The

[8] http://www.portkembla.com.au/page/port-operations/trade---cargo/, accessed 1 July 2013.
[9] Recently renamed NSW Ports as part of the long term lease of the facility
[10] http://www.nswportskembla.com.au/projects/outer-harbour/, accessed 1 July 2013.
[11] Origin –destination data suggests that the majority of imports containers would likely have a destination in metropolitan Sydney.

development of large scale container handling facilities is not considered within the base demand scenario.

2.3 Rail Freight Infrastructure

Understanding changes in the nature of demand as well as the level of demand and capacity on rail links between the Port and its customers is imperative in understanding the take-up of paths on the proposed MDRL. It has been identified that trains seeking to access the Port will be impacted by the following three issues:

- The proposed implementation of Sydney Rail Futures with introduction of higher frequency single decker passenger services
- Operation of freight trains through the Sydney metropolitan area with impacts on MFN and SSFL
- Emerging constraints at Coniston Junction, the point at which trains access Port Kembla.

These issues are discussed in turn below and Coniston Junction upgrade is discussed in section 3.5.4.

2.4 Sydney's Rail Future

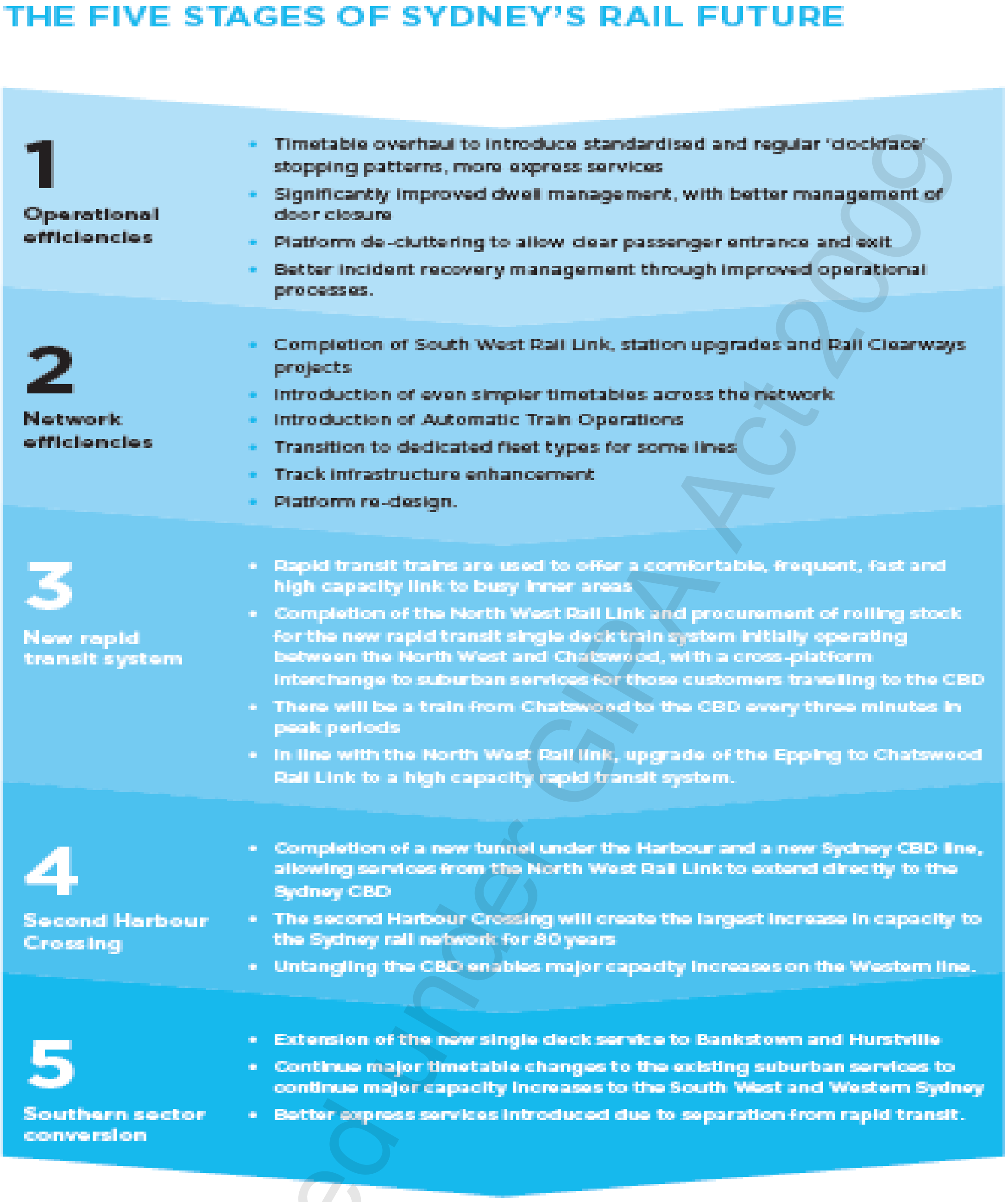
The NSW Government's development of *Sydney's Rail Future* anticipates a need to significantly increase passenger services on the Illawarra Line by 2031. In accordance with the Long Term Transport Master Plan, it is proposed that the higher capacity services would be achieved by connecting the Illawarra Line to Hurstville (and the Bankstown Line) to a rapid transit system which would include the North West Rail Line (Stage 3) and the Second Harbour Crossing (Stage 4). This would happen under Stage 5 called Southern Sector conversion as per *Sydney Rail Futures*. The funding and implementation of these initiatives is dependent on a variety of factors including NSW Budget, sale of assets like electricity network, ports and political factors, etc.

This would mean that rail capacity on the Illawarra Line north of Hurstville would be increasingly used by passenger services, reducing the capacity available for freight services. The comparative reduction would be greatest in the off-peak, which is currently used for freight movements.

The NSW Government plans for the development of *Sydney's Rail Future* are ongoing and still to be finalised. Consequently, it is uncertain as to the timing, staging and routing of such plans for increased passenger services. However, the impact of this increase in passenger services on the Illawarra Line has been included in the economic and financial evaluation based on a likely future scenario of 8 trains per day (combined directions) by 2031 with freight operations confined to night times only when passenger services are assumed not to be in operation[12].

[12] Based on advice from TfNSW and assuming that freight services would be limited to between 1am and 5am.

Figure 2.6 Sydney's Rail Future



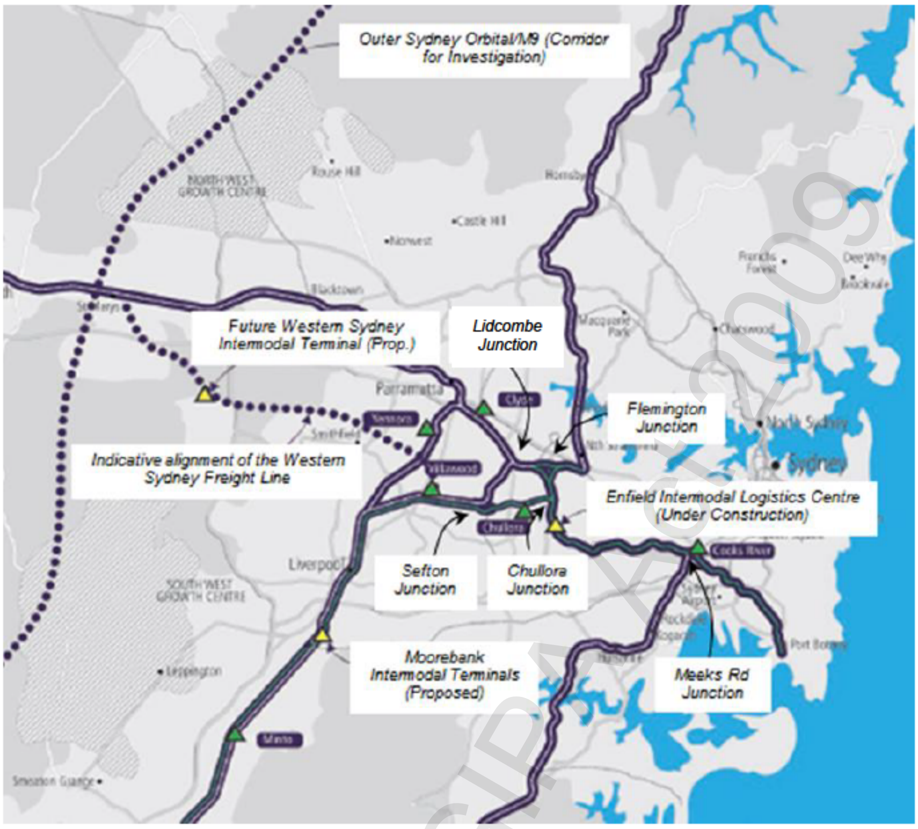
Source: Sydney Rail Future, June 2012

Freight routing under *Sydney's Rail Future* is assessed in Section 4 with an economic assessment under *Sydney's Rail Future* shown in Section 4.

Metropolitan Freight Network and Southern Sydney Freight Line

Rail freight operations through the Sydney metropolitan area are undertaken on a collection of lines. A dedicated rail freight network known as the Metropolitan Freight Network (MFN) runs from Port Botany to Flemington Junction and Chullora to Sefton and is augmented by the Southern Sydney Freight Line (SSFL). In addition, freight services and passenger services share track on parts of the Illawarra, Western, Northern and South Lines. The rail freight network is summarised in Figure 2.6.

Figure 2.7 Sydney's Rail Freight Network

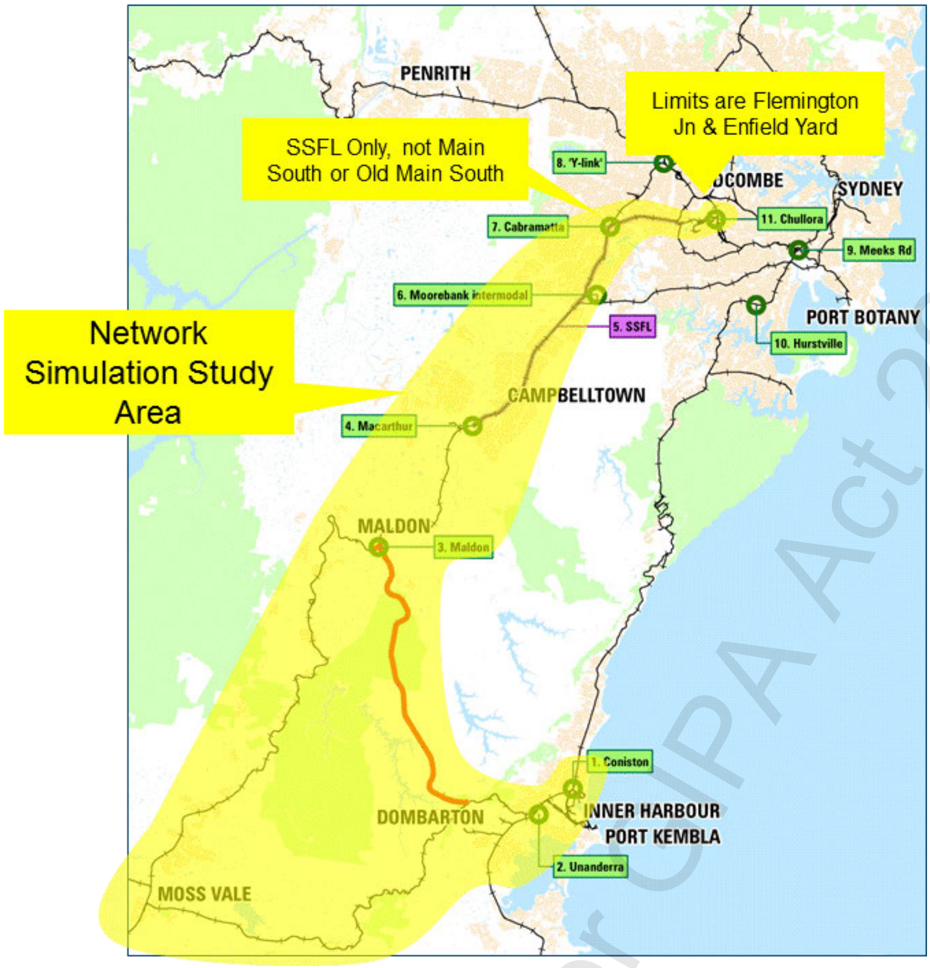


Source: Deloitte adapted from Long Term Transport Master Plan

The extent to which MDRL can be utilised is dependent on capacity on the MFN and SSFL and also at the Coniston-Unanderra Junction and future developments at Moorebank. In order to assess this, Parsons Brinkerhoff (PB)[13] assessed the network and operational impacts by preparing a comprehensive model of the corridor covering Port Kembla – Moss Vale – Maldon – up to Chullora as shown in figure 2.8

[13] Parsons Brinckerhoff, Technical Memo – Rail Operations, 12 June 2014

Figure 2.8 Network issues and study area



Source: Parsons Brinckerhoff

Freight train services accessing Port Kembla currently traverse the MFN, which is used by other freight trains including metropolitan container shuttles, interstate and regional freight traffics. Access to Port Kembla from the north, west and east is via the MFN and then onto the Illawarra Line via the Meeks Road Junction. It should be noted that Illawarra Line passenger services also pass through this junction, requiring careful management of train operations to avoid conflicts. Rail access to Port Kembla from the south and south-west is currently via the South Coast Line and the UMVL.

A number of commodities are forecast to experience volume growth on rail in the next two decades especially metropolitan container traffic with the planned opening of an intermodal freight terminal in Moorebank before 2020, as well as a number of regional traffics including coal, grain, aggregates and a number of other bulk commodities. In addition, interstate rail container traffic along the east coast is anticipated to grow at rates between 2% and 3% per annum.

The combined impact of this growth will place increasing demands on rail capacity through the MFN, which will mean that rail traffic to and from Port Kembla will need to compete with other traffic in terms of securing paths, especially through the MFN.

The study of network linkages is based on four demand scenarios, which are related to construction of MDRL and growth in traffic from Moorebank as shown in table 2.2:

Table 2.2 Growth in traffic from Moorebank

Scenario	Key freight impacts	Freight Trains to and from Port Kembla & South Coast per day	Freight Trains on SSFL per day	Passenger Sydney Trains	Passenger South Coast
2014	Current capacity	64	20	2014 timetable	2014 timetable
2021 without MtDRL	Moorebank IMT	64	62	2014 timetable	Two options: A. 2014 timetable B. Increase of services to Dapto
2021 with MtDRL	Opening of MtDRL with relocation of coal traffic	72	90	2014 timetable	
2031 with MtDRL	Demand growth to Moorebank and interstate Reduction in traffic to South Coast	64	124	Increase in services on Illawarra Southern Highlands as per 2014 timetable	Two options: A. 2014 timetable B. Increase of services to Dapto

Source: Parsons Brinckerhoff

Infrastructure requirements on SSFL and MFN

The infrastructure requirements and their capacity triggers for the SSFL and MFN are shown below. This shows the infrastructure requirements on the SSFL and between Chullora and Flemington. While these improvements are needed to fully utilise the MDRL, they are outside the MDRL project scope. *For the purposes of this economic assessment, it has been assumed that capacity on the MFN is available to allow Port Kembla bound trains that need to traverse the MFN*.

Table 2.3 Infrastructure requirements on SSFL and MFN

Scenario	Daily Trains on SSFL	SSFL (incremental projects)	Chullora to Flemington (incremental projects)
2014	**20**	-	-
2021 pre Moorebank	**32**	New Macarthur Loop Glenfield Loop extension for simultaneous entry	-
2021 with Moorebank	**62**	New Carramar Loop	-
2021 with MtDRL	**90**	New Minto Loop Glenfield to Liverpool Duplication Carramar to Enfield West Duplication Headway reduction Liverpool – Carramar (single track)	Loop between Chullora and Flemington South junction for westbound coal trains
2031	**124**	Liverpool to Carramar duplication	As above

Source: Parsons Brinckerhoff

The future operation of freight trains to and from Port Kembla and the South Coast depends on other projects across the wider metropolitan rail network, both freight and passenger. For example the planned intermodal terminal at Moorebank will increase freight traffic on the SSFL, while the NSW Government's Sydney Rail Future strategy proposes an increase in passenger services on the Illawarra.

2.5 Road Infrastructure

The main freight access roads serving Port Kembla include a number of key State routes including Springhill, Five Islands and Masters Roads. These routes provide direct access to the Inner and Outer Harbours from the regional access routes to Wollongong.

Regional road routes accessing Wollongong from the wider area can be categorised into those providing north – south connections and providing east – west connections.

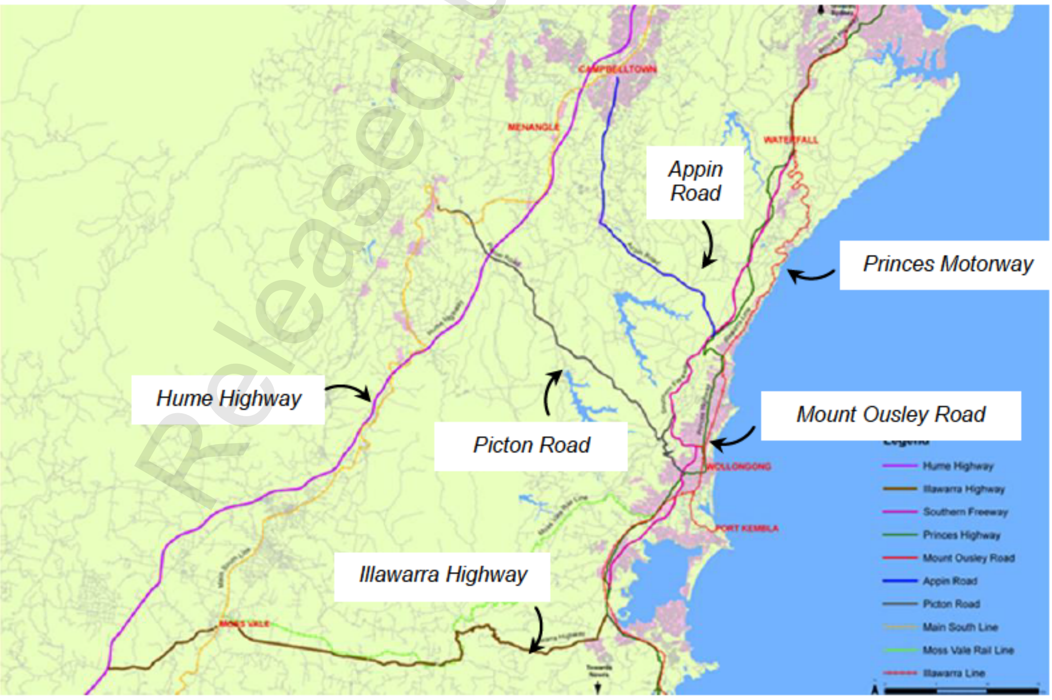
The principal north – south link between Sydney and Wollongong is through the M1 (Princes Motorway and Mount Ousley Road) with the M31 (Hume Highway) providing alternative access to the Illawarra through Picton and Appin Roads.

In addition, there are two key routes for freight movements traversing the Illawarra Escarpment including Appin Road and Picton Road. In terms of freight activity, Appin Road acts as the main route for transporting coal for a number of coal mines in the Appin area, whilst Picton Road is the main road freight route between Wollongong and south west Sydney. Both routes rely on Mount Ousley Road which provides road access to and from Port Kembla from the north. A number of elements create a high safety risk along the road including its steep gradients as it descends the Escarpment to Wollongong, tight curvature at Mount Pleasant, an at-grade junction with the Princes Motorway at the University of Wollongong, high traffic volumes and a high proportion of commercial vehicles.

The Illawarra Highway, which connects the M31 with the M1 to the south of Port Kembla, has a number of tight curves making it unsuitable for some truck configurations. The key issues with this route is that it is not an authorised B-double route, although it is used by truck operators in daylight hours as it provides a shortcut for Melbourne-Wollongong freight including semi-trailers which are permitted to use the route. However, due to tight curvatures and gradients, anecdotal evidence is that the route is not used by freight traffic after dark due to safety reasons.

The main road routes serving Port Kembla are shown in Figure 2.10.

Figure 2.10: Key Road Links



The NSW Roads and Maritime Services have an ongoing program of road improvements in the study area. These are largely focussed around safety improvements and local pinch-point mitigation and currently, there are no committed plans to significantly augment road capacity in the study area. Any proposals to improve road freight access to Port Kembla are likely to require significant capital expenditure given the local topography, particularly on Mount Ousley Road, which is currently the main access point to the Port.

Consequently, in the Base Case, outside of planned safety and pinch-point improvements, no capacity upgrades to the strategic road network have been assumed.

2.6 Customer Outcomes / Benefits of the Investment

2.6.1 Corporate Plan Result Areas

Result Area	Result	What it means	Driver
Customer	The customer is at the centre of everything we do.	MDRL Project is aimed at reducing freight congestion in Sydney and Illawarra region, increasing freight throughput by creating alternate freight paths and potentially increase passenger services capacity on Illawarra Line and reduce bottlenecks at Coniston	**Primary**
Travel	The door-to-door movement of people and goods is efficient and reliable.	MDRL project will enable more reliable movement of freight and goods and indirectly improve passenger capacity and throughput and reliability on Illawarra Line	**Primary**
Asset	Transport infrastructure meets acceptable standards.	MDRL project is being designed to the relevant environmental, construction and sustainability standards and guidelines. Whole of life, maintainability and asset refurbishment issues have been carefully considered	**Primary**
Accessibility	The accessibility of transport is aligned to the needs of the community and the economy.	N/A MDRL is primarily a freight project and thus access to all users is restricted to freight only. The route connects Port Kembla / Illawarra region with Sydney	**Secondary**
Environment	The impact of transport on the environment is minimised.	MDRL project complies with all aspects of environment with significant mitigation measures to conserve and protect biodiversity, air quality, noise, heritage, landscape and visual amenity, water quality / groundwater and land use. Project is designed for 'Silver' rating for NSW Sustainable Design Guidelines and 'Excellent' rating for Design and As Built stages	**Secondary**
Safety	The safety and security of the transport system is maximised.	MDRL Project will comply with the Safety Requirements during Construction and Operations including Safety in Design, WHS Act compliance, ONRSR requirements, National and State legislation	**Secondary**

Result Area	Result	What it means	Driver
✔ Business	Effective governance is in place to deliver our Results.	MDRL Project will deploy existing practices for Governance, Project Management and Delivery	**Secondary**

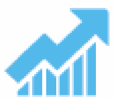
2.6.2 Customer Benefits

Note: As the project is awaiting budget and funding approval, this section has not been completed fully as the Owner / Operator / Maintainer cannot be identified at this stage

Strategic themes	Benefits realisation	KPI target	Benefit Owner
Planning and financing the transport system of the future	Corridors are reserved for potential future transport links	TBD	Commonwealth / ARTC / TfNSW to preserve and maintain rail corridors
	Accessibility (now and future)	TBD	Commonwealth / ARTC / TfNSW to preserve and maintain rail corridors
Maintaining transport assets	Value of assets	TBD	Commonwealth / ARTC / TfNSW to preserve and maintain rail assets
	Renewal cycle for assets (whole-of-life costs)	TBD	Commonwealth / ARTC / TfNSW to preserve and maintain rail assets
	Quality of road network	TBD	RMS to maintain highways
	Quality of track network (passenger/freight)	TBD	Commonwealth / ARTC / TfNSW to preserve and maintain rail assets
	Asset availability of public transport services	N/A	N/A – no passenger services
	Efficiency of maintenance	TBD	Commonwealth / ARTC / TfNSW to preserve and maintain rail assets
Improving transport services and operations	Mode shift to public transport	N/A	N/A – no passenger services
	Customer satisfaction/loyalty/advocacy across all forms of transport	N/A	Applies to freight owners and users as per demand forecasts
	In-vehicle amenity	N/A	N/A – no passenger services
	Customer comfort when using the transport system	N/A	N/A – no passenger services
	Freight efficiency in NSW	TBD	ARTC
	Load on public transport services	N/A	N/A – no passenger services
	Public transport patronage	N/A	N/A – no passenger services

Strategic themes	Benefits realisation	KPI target	Benefit Owner
	Journey times (public transport/roads)	N/A	N/A – no passenger services
	Reliability of public transport	N/A	N/A – no passenger services
	Accessibility of (and disability access to) public transport	N/A	N/A – no passenger services
	Stations, shops and interchanges are functional, easy to find and easy to get to	N/A	N/A – no passenger services
	Road user crashes, fatalities and serious injuries	N/A	RMS (road) and ARTC (rail freight)
	Waterway user accidents/fatalities	N/A	N/A – no passenger services
	Public transport people incidents (safety/security)	N/A	N/A – no passenger services
	Efficiency of transport operations	TBD	ARTC if operator when MDRL is operational
	Mode share of sustainable transport (walking/cycling)	N/A	N/A – no passenger services
	Carbon emissions from transport	TBD	ARTC
	Energy use by the transport system	TBD	ARTC
	Noise impact from transport	TBD	TfNSW Transport Projects Division during construction, ARTC during Operations
Growing the transport system	Network capacity of public transport services	TBD	Sydney Trains / NSW Trains – more passenger service capacity available
	Frequency of public transport services	N/A	N/A – no passenger services
	Total freight movement and freight shift to rail	TBD	Various mining and other freight operators
	Delivery of transport projects on time, on budget	TBD	TfNSW Transport Projects Division during construction
	Community and customer consultation	TBD	TfNSW Transport Projects Division during construction
Developing the transport businesses of the future	Heritage items are preserved	TBD	TfNSW Transport Projects Division during construction
	Value for money – services and infrastructure	TBD	TfNSW Transport Projects Division during construction, ARTC during Operations
	Lost Time Injury Frequency Rate	TBD	TfNSW Transport Projects Division during construction, ARTC during Operations

2.6.3 Strategic Alignment

Themes	Strategies	Alignment	Comment to support degree of alignment
1. Improve quality of service 	Improve travel time and reliability of transport services	***Medium***	MDRL will deliver freight services and add extra capacity for freight, which can indirectly enable increased passenger services throughput on Illawarra Line. This can also improve travel times and reliability of transport services
	Improve customers travel experience and freight experience	***Medium***	MDRL will not directly improve customer travel experience other than to provide capacity for freight and improve freight customer experience, which can indirectly enable increased passenger services throughput on Illawarra Line. Separation of freight and passenger services can also improve passenger and freight experience
	Improve customers travel options	***Low***	MDRL will not directly improve customer travel options for improving passenger services throughput on Illawarra Line
	Provide integrated services that meet our travel requirements	***None***	MDRL does not provide passenger service
2. Improve liveability 	Providing transport services that support job growth in centres close to residential precincts	***None***	N/A. MDRL will provide during construction opportunities for jobs. MDRL does not provide service that supports jobs growth in regional centres or near residential precincts except indirectly
	Facilitating ease of movement to activity centres	***Low***	N/A. MDRL does not provide service that facilitates ease of movement to activity centres except indirectly
	Supporting urban design and liveable cities	***None***	N/A. MDRL does not provide service that supports urban design and liveable cities except indirectly
3. Support economic growth and productivity 	Improving efficient travel practices such as trunk and feeder systems	***Low***	N/A. MDRL does not provide service that improves efficient travel practices except indirectly
	Improving freight productivity by providing more efficient modes and routes	***High***	Primary aim of MDRL is to provide freight capacity and an alternative route between Port Kembla and Sydney
	Reduce congestion on major freight routes	***High***	Primary aim of MDRL is to provide freight capacity and an alternative route between Port Kembla and Sydney and thus reduce congestion
4. Support regional	Improve connectivity to jobs and services	***Low***	MDRL line can indirectly be catalyst for additional services on Illawarra Line and improve connectivity to jobs and services

Themes	Strategies	Alignment	Comment to support degree of alignment
development 	Improve services to major regional centres including the availability of community transport	***High***	Primary aim of MDRL is to provide freight capacity and an alternative route / additional services between Port Kembla and Sydney
5. Improve safety and security 	Improve road safety	***Low***	By avoiding the shifting of some commodities from road to rail, there will be some improvement in road safety. This is rated low as currently there is only minimal diversion of road to rail freight
	Ensure that passengers feels safe and secure on public transport	***None***	This does not directly apply to MDRL
	Improve the security of our assets	***None***	This does not directly apply to MDRL
6. Reduce social disadvantage 	Ensure that all areas of the state have access to services, jobs and education supported by adequate transport opportunities	***Low***	MDRL does not directly improve social disadvantage but will benefit by providing employment opportunities, improved access for freight between Port Kembla and Sydney and indirectly enable increased passenger capacity on Illawarra Line
7. Improve sustainability 	Maximise the efficient use of the existing transport system	***Low***	MDRL does not directly maximise use of existing transport system but indirectly enable increased passenger capacity between Port Kembla and Sydney
	Reduce congestion	***Medium***	In future there may be increased congestion on Illawarra Line, which will be alleviated by MDRL
	Grow the proportion of travel by sustainable modes such as public and active transport	***Low***	MDRL does not directly maximise use of existing transport system but indirectly enable increased passenger capacity between Port Kembla and Sydney
	Improve the energy efficiency of transport	***Low***	MDRL avoids a major shift of freight from road to rail however, future growth may be accommodated on rail. Newer generation AC locos can be more energy efficient and their introduction will happen across the network

2.6.4 Relevant transport goals, strategies or policies

This proposal supports the following initiatives

- Illawarra Regional Transport Plan (April 2014) – Which identifies short, medium and long term actions to deliver key transport and infrastructure projects to the Illawarra region
- NSW Freight and Ports Strategy (November 2013) – which seeks to improve efficiency of freight movement and to separate passenger and freight movements through network enhancements and rail alignments
- NSW Long Term Transport Master Plan (December 2012) – which identifies the Proposal as a corridor which should be protected and states that the completion of the planning phase for the MDRL should be undertaken
- NSW 2021: A plan to make NSW Number One (September 2011) – which aims to improve the performance of the NSW economy and reduce travel times
- National Freight Strategy (June 2011) – which predicts significant increases in rail freight and seeks to ensure that capacity is not constrained or encroached by urban expansion

2.6.5 External requirements

In order to fully secure land tenure through the eastern section of the tunnel, an Act of Parliament is required. The amendment, under section 47L of the National Parks and Wildlife (NPW) Act would be required as the land is classed as National Park, and hence cannot be either revoked or compulsorily required.

Section 47H provides, in effect, that existing interests (i.e. interests existing at the date of reservation) continue to apply. However, TfNSW did not relevantly hold an interest in the relevant land at the date of declaration. The identification of land under the *Railway Construction (Maldon to Port Kembla) Act 1983 (Maldon Act)* does not amount to an existing interest

Amendment acts such as would be required in this instance, to alienate a sub-stratum beneath a National Park, are not uncommon, and would take approximately 12 months from funds becoming available.

3 PROPOSED STRATEGY / RECOMMENDED OPTION

3.1 Options Considered

Strategic Project Options

Overview

A number of alignment upgrade alternatives were considered as part of option development.

The starting point is Base Case or Do Nothing Case or 'do-minimum' philosophy[15]. No capacity improvements to the passenger or freight rail network or road network are assumed, including the implementation of *Sydney's Rail Future*. Accordingly, this implies the following capacities under all project options:

- 60 paths per day on the Illawarra Line in both directions (north of Waterfall) until 2031 when *Sydney's Rail Future* is implemented resulting in 8 paths from 2031 onwards and a sensitivity test with 0 paths.
- 24 paths per day on the UMVL in both directions.

The Base Case has been compared with a range of route alignment (tunnel / surface) and route alternatives during the Preliminary Business case stage. This also considered variants on earlier MDRL corridor alignments as well as potential capacity upgrades in the other rail freight corridors linking Sydney to Port Kembla including both the Illawarra Line and the UMVL.

Base Case

The economic merits of projects are assessed by comparing 'with project' options against a 'without project' base case.

For the purposes of the economic assessment, a base case needs to be developed to allow an assessment of benefits and costs. Economic assessments are undertaken by comparing the differences between a base case and a 'with project' case, from which changes in the incremental costs and benefits can then be assessed.

Whilst the existing rail freight capacity on the Illawarra Line is 60 paths per day, assessment undertaken by TfNSW as part of the Sydney's Rail Future has assessed the impact of increasing passenger service frequencies on the Illawarra Line and estimated that the likely future rail freight capacity in this corridor would be limited to as little as 8 paths per day. This updated analysis has been incorporated into the revised economic evaluation of the MDRL option, and is the base case assumed, for all assessment.

No significant improvements to the road network have been assumed.

[15] Other required capacity upgrades on the MFN would need to identify their relative costs and benefits as part of a separate Business Case.

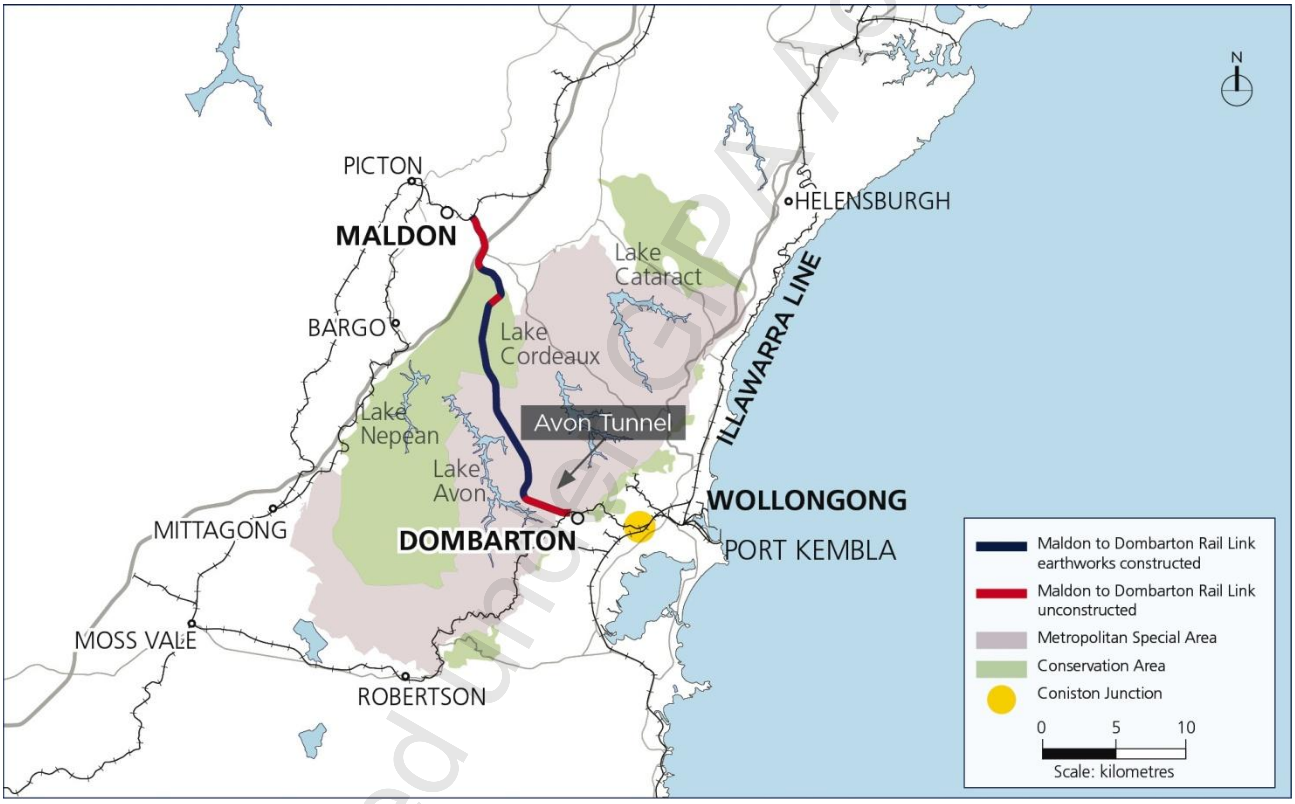
Maldon-Dombarton Rail Link (Reference Case Option)

Core Option

Based on the engineering and operations analysis undertaken by Parsons Brinckerhoff, TfNSW has held a number of internal reviews, to identify and clarify which options should be considered for the project. The primary focus of the work to date has focussed on the Reference Project Case MDRL Alignment which is the main project reference case as progressed in the 1980s and as assessed in the 2011 Hyder/ ACIL Tasman Study. The route alignment is shown in Figure 3.1.

In addition, based on the capacity initiatives identified by the modelling, TfNSW have included an upgrade to Coniston Junction as part of the proposed works.

Figure 3.1: Option 2A Reference Project Route Alignment



Source: TfNSW

Previous construction work on the alignment focused on surface earthworks and drainage as well as a half completed bridge over the Nepean River. Sections where earthworks are complete are shown in blue in Figure 3.1. The scope of works under this option includes:

- Connections with the Main South Line and UMVL
- Upgrade of Coniston Junction
- A 250m long bridge over the Cordeaux River
- A 190m long bridge over the Nepean River
- A crossing over the Hume Highway
- Three additional road bridges and accommodation bridge
- Avon Tunnel (as shown in Figure 3.1)

- New line side signalling and train control equipment and other auxiliary infrastructure including power supply

Alternative Route Options

As discussed above, during the Preliminary Business Case, multiple route options and operating scenarios were considered and discarded.

The project components for which alternative options were investigated and assessed included wider network operating scenarios and tunnel alignment and portal locations. These were;

- **Option 1 – Base Case / Do Nothing**
- **Option 2 – MDRL Reference Project Case –** this option looked at many sub-options such as Tunnel alignment and portal locations – These compared and assessed for key factors like
  - **Alignment Grade**
  - **Mine Subsidence Im**pact
  - Avoidance of Illawarra Escarpment State Conservation Area (IESCA)
  - Overall Route Length
  - Construction Methodology
- **Option 3 - Moss Vale to Unanderra Line enhancement -** Extension of four existing passing loops to increase capacity from 24 paths to 28 paths per day
- **Option 4: Uni-directional Option – Clockwise Operation of the MDRL and UMVL -** Development of MDRL and UMVL with trains operating towards the coast on MDRL and UMVL away from the coast, aimed at increasing network capacity by avoiding bidirectional operations on single track.
- **Option 5: MDRL with UMVL (bi-directional operation of the MDRL) -** As above but with coal trains permitted to operate on the MDRL in both directions
- **Option 6: Electric Banking of MDRL -** Provision of traction supply on the MDRL, with freight trains using the MtDRL being hauled by electric locomotives between Port Kembla and Wilton only
- **Option 7: Electrification of MDRL -** Provision of traction supply on the MDRL, with freight trains using the MtDRL being hauled by electric locomotives from each origin to each destination
- **Option 8: Hurstville to Sutherland Third Track -** Development of an additional track on the Illawarra Line between Hurstville and Sutherland to add capacity for freight movements between Port Kembla and Sydney region

During the Preliminary Business Case stage, the core MDRL option was considered for further detailed analysis including detailed evaluation of alternative tunnel and surface alignment options. Options 3 to 8 were discarded due to lack of capacity (Option 3 to 5), high cost (Option 8) or complex operational implications (Options 4 and 5). Options 6 and 7 assume use of electrical locomotives which is not commonly used on the NSW rail network.

The engineering team also undertook an assessment of a range of alternative tunnel alignments for the Project. This included an assessment of seven route sub-options identified near the

eastern end of the MDRL as well as an additional Cordeaux River option near Wilton. These sub-options were aimed at assessing the potential of reducing the gradient of the MDRL alignment or reducing its distance, which in all cases was offset by an increase in tunnelling required and accordingly additional capital costs. Figure 3.2 illustrates the alignment of the seven sub-options considered.

Avon Tunnel Route/Cross Section Options

A significant amount of analysis and assessment was undertaken both during the Scoping Stage as well as the Concept Design Stage to identify the most efficient alignment to adopt. Horizontal alignment considerations are primarily based on geographic and land issues. The vertical alignments are almost wholly a function of rail operations functionality (with grade) and the symbiotic relationship with the type and size of ventilation system.

It has been definitively concluded that the flatter grades resulted in superior whole of life and safety outcomes. However, this must be tempered by the fact that a significant amount of civil works has been constructed from the 1980's period. Alternative alignments and subsequent effects on the environmental assessment and legislative approvals strongly influence any desire for change.

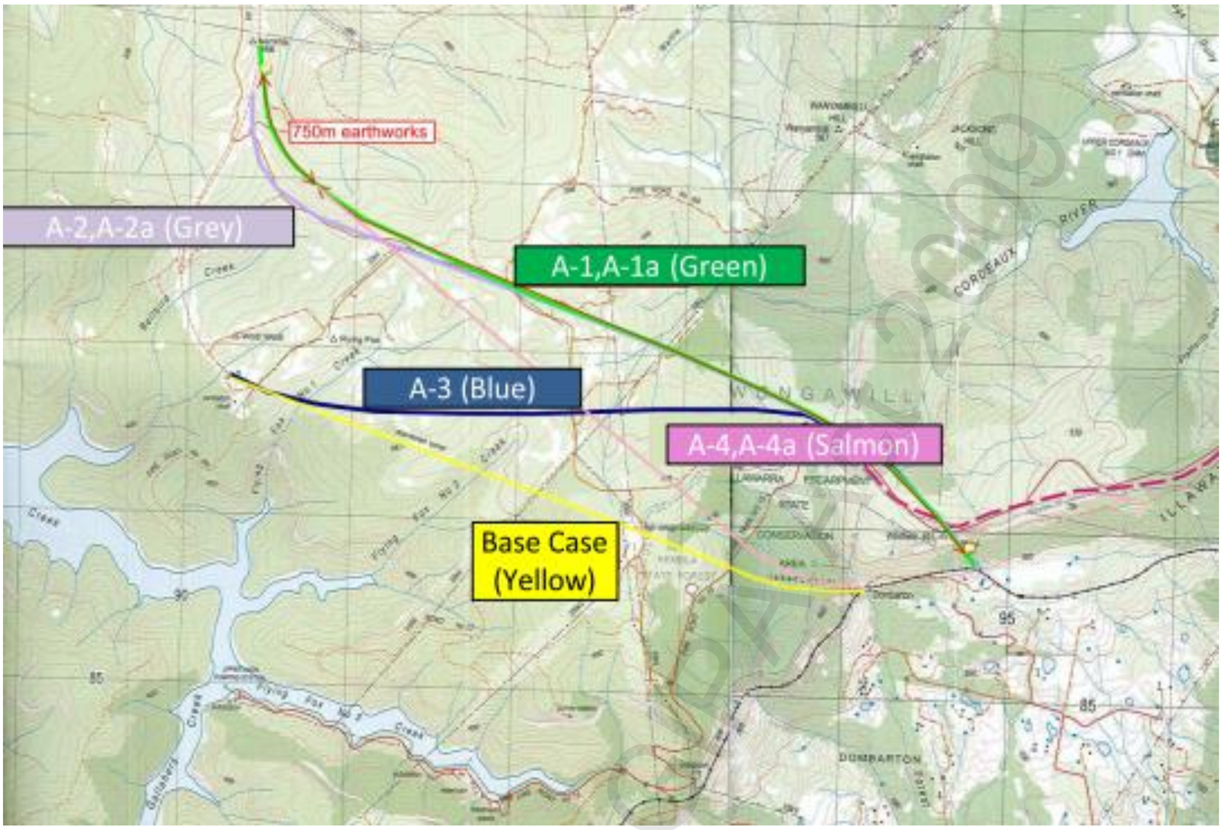
Design investigation and development of the Avon Tunnel overall alignment and associated cross section has found a complex relationship between the tunnel characteristics of length, grade and sectional area with the train characteristics of power, gross mass and trailing length and further influenced by environmental parameters such as ambient temperature and ventilation requirements. All these parameters form an intertwined mix that need to be considered in order to arrive at a solution.

Further, an optimal solution will be a function of proposed train operations coupled with a cost effective infrastructure in terms of civil elements and mechanical operations.

Short and long term operational requirements and current and future requirements need to be considered in developing the optimum solution.

Preliminary work was undertaken during the previous Scoping Stage and augmented by an additional study at the commencement of this Concept Design stage. The results of both studies were taken to a Value Management workshop held on February 14th 2014. The outcome of the Value Management Workshop concluded that of all the options considered that a remaining two separate alignments and associated sections were worthy of a more detailed assessment in order to arrive at a preferred alignment and cross section for Project Definition.

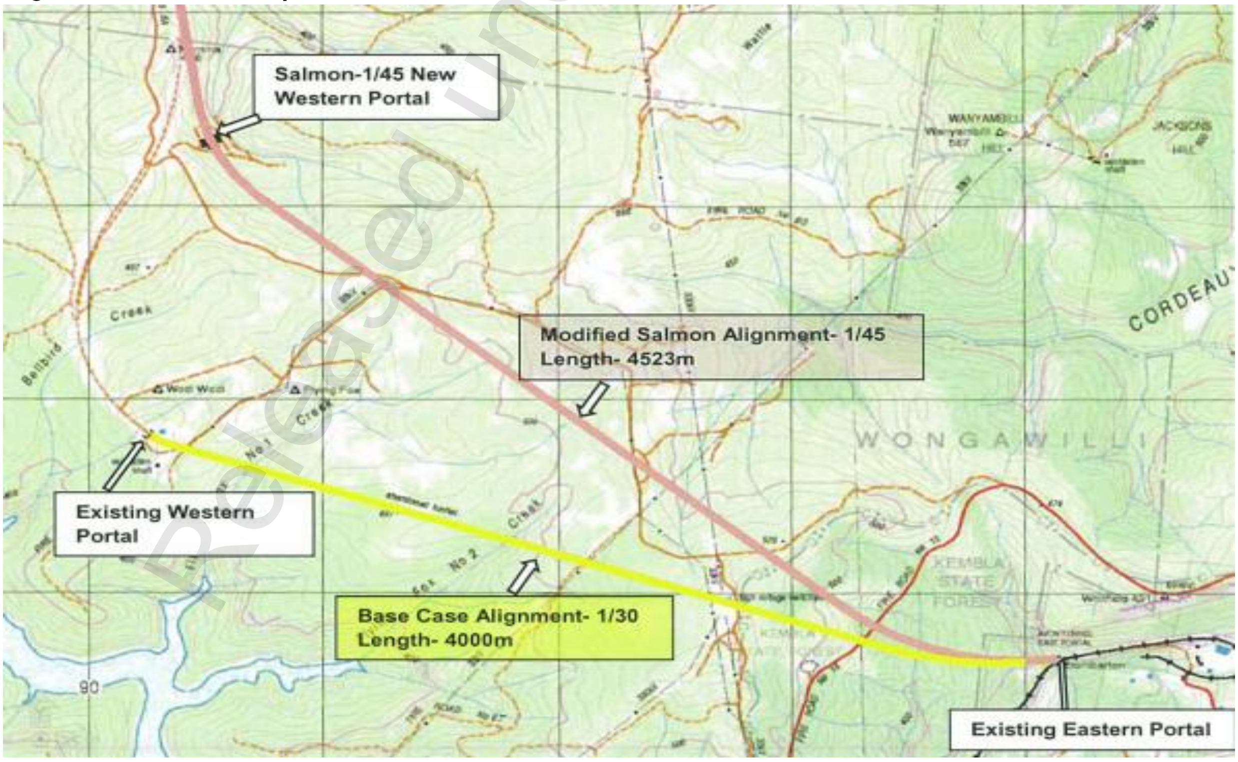
Figure 3.3 Avon Tunnel Alignment Options for the Value Management Workshop



The two preferred options from the above are;

- **Base Case** (Yellow): Original 1980's alignment 1:30 Grade of 50m^2 over a 4000m length.
- **Alternative** (Salmon): **Option A-4a** alignment 1:40 Grade of 44m^2 over a 4523m length.

Figure 3.4 Short listed options for Final Business Case



Tunnel Diameter and Ventilation Cost Optimisation

One of the key components of the MDRL is the construction of the 4km long Avon Tunnel with a 1:30 maximum grade. As part of the current scope of works, an engineering assessment was undertaken to assess the compliance of the previous MDRL design with the current safety and engineering standards and ventilation requirements for current diesel locomotives. Based on this work, it was recommended to revise the original tunnel design to incorporate the current rolling stock operational envelope, increased ventilation area requirements and providing for all current fire and safety considerations.

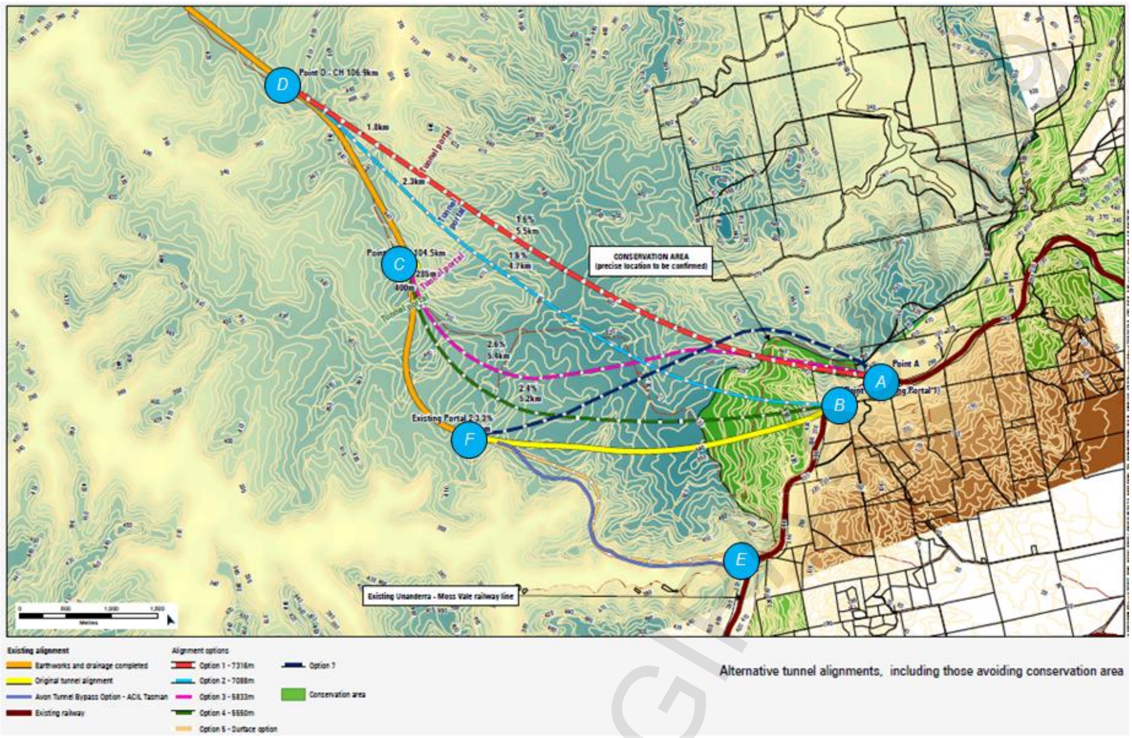
Diesel trains are generally designed to operate in an open environment where heat exchange and diesel fume discharge do not impact locomotive performance. However, when diesel trains operate in a closed environment, such as in a tunnel, the heat exchange and diesel fume discharge can be compromised which leads to a depletion of oxygen and increase in temperature in the tunnel which affects subsequent rolling stock performance, or in the case where a train consist includes more than one locomotive, current performance.

In order to mitigate the build-up of heat and gases in the tunnel, ventilation systems are required to maintain a safe operating environment and reduce purge times (the time taken to restore the air quality in the tunnel to a safe level to allow ongoing service operation). Given that the Avon Tunnel is planned to be 4km long, a ventilation building housing a series of ventilation fans will be required. In addition, a further set of tunnel design dimensions were assessed including:

- The trade-off between larger dimension tunnels which allow the operation of longer trains with more locomotives due to a reduced impact of heat build-up, and increased capital cost of tunnel construction as well as the higher operating costs from increased usage of tunnel ventilation systems
- The trade-off between reduced tunnel grade resulting in locomotive lower operating costs and reduced ventilation operating costs and increased capital cost.

Grade and route alignment are a major driver of capital cost, but were found to only have a relatively minor impact on tunnel ventilation operational costs. Preliminary costing work by Aquenta compared tunnel capital costs against annual tunnel ventilation operating costs. Over a 50 year operating period, the reduced operating costs from providing a narrower tunnel and a reduced grade were not sufficient to offset the increased capital construction costs.

Figure 3.2 MDRL Route Sub-Options Assessed



Strategic Options Assessed – Preliminary Business Case Stage

Based on the analysis undertaken to date, four options were taken forward for further quantitative analysis for the project whilst a number of others have been excluded from more detailed assessment based on engineering, operational or costing criteria. Based on the above, the following options were considered in further detail:

- **Option 1:** Base Case (existing capacity of 60 freight paths per day on the Illawarra Line)
- **Option 2A:** The MDRL Reference Project Case – Base Demand
- **Option 3:** UMVL Upgrade
- **Option 4:** Unidirectional Loop on MDRL and UMVL.

Based on the above assessment of options, the economic assessment indicated that none of the options produced a positive result with incremental project costs higher than incremental project benefits.

However, the analysis indicated that Option 2A (MDRL) produced the highest economic returns and was the subject of further analysis based on the updated base case assumptions relating to reduced freight capacity on the Illawarra Line (8 freight paths per day). The remaining options were not considered further.

3.2 Proposed Strategy / Recommended Option Description

Project Staging and Concept Design Development – Final Business Case Stage

Final Business Case Options

The Preliminary Business Case found that alternative options performed poorly relative to developing the MDRL. The scope of the Final Business Case was limited to assessing future short-listed options.

Business User Requirements

A key criterion used to assess the options and tunnel diameter was the required. The tunnel is designed to carry the following rolling stock shown in figure 3.5. It is noted that the limiting train types, being the heaviest and putting the greatest load on the ventilation system are;

- steel trains (1200 metres length, C44ACi locos, gross trailing mass 3900 toms laden and 2700 tons empty) and
- intermodal container trains (1500 metres length, NR Class locos, gross trailing mass 3900 toms laden and 2700 tons empty)

In order to accommodate steel and intermodal trains and the ventilation / air resistance requirements (described below), a tunnel cross sectional area of $65m^2$ may be required. The requirements below have been converted into a train operations specification.

Figure 3.5 Train path requirements and types of Rolling Stock for Expected Commodities – 2031 MDRL

Commodity	Illawarra	Moss Vale	MtDRL	Train Consist Loco, empty/laden, length	Paths to Port Kembla Time at Wollongong / Unanderra	Paths from Port Kembla Time at Wollongong / Unanderra
Containers	[redacted]					
Cement	[redacted]					
Western Ores (Orange)	[redacted]					
SW Ores (Parkes/Tottenham)	[redacted]					
Coal – Western (Lithgow)	[redacted]					
Coal – Hunter Valley	[redacted]					
Coal – Tahmoor	[redacted]					
Coal – Appin	[redacted]					
Grain – Western (Parkes)	[redacted]					
Grain – South Western (Temora)	[redacted]					
Cars (Sydney)	[redacted]					
Limestone (Marulan)	[redacted]					
Steel products (Mel/Brisbane)	[redacted]					
Aggregates / Ballast	[redacted]					
Manildra (Various)	[redacted]					
Total 64 paths	8	20	36			

Source: Parsons Brinckerhoff

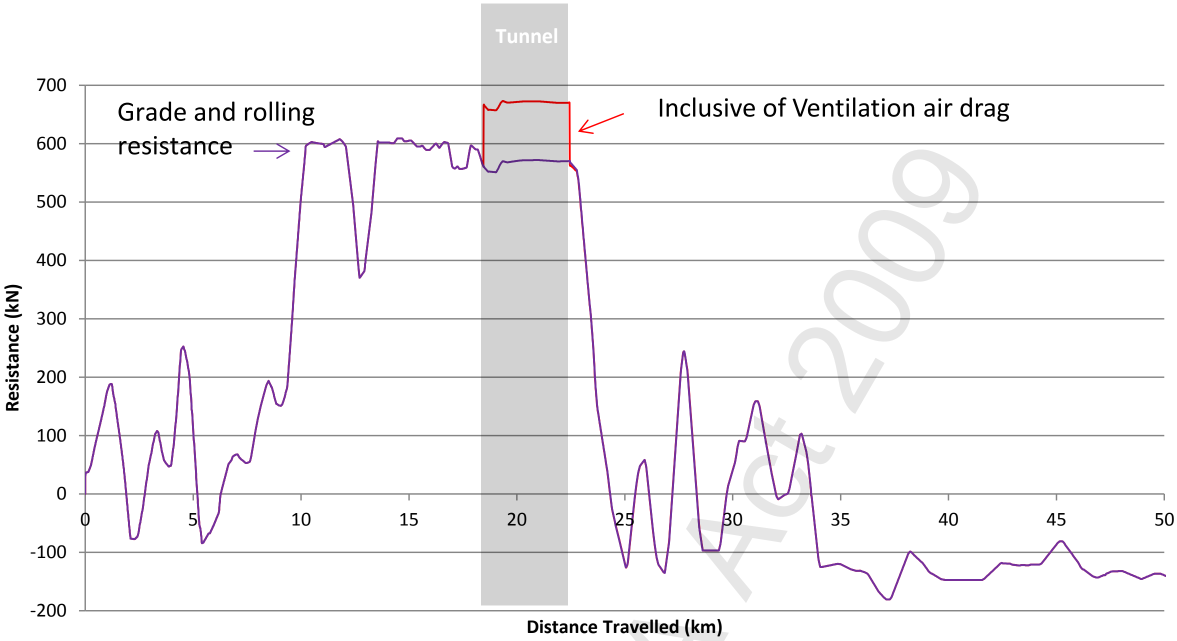
Operational Impacts of the tunnel and ventilation strategy

The resistance acting against the train, including both the grade and rolling resistance and additional ventilation resistance, is a key operational constraint on the MDRL. Resistance experienced by an empty western coal train on the reference alignment (as originally conceived in the 1980s) is shown in figure below. Here approximately 600kN resistance experienced by the train climbing the 1/30 Unanderra- Moss Vale line can be seen to step up to approximately 670kN at the Dombarton tunnel portal due to the headwind required to ventilate and cool the locomotives.

The resistance could be reduced by;

- increasing the tunnel cross-section (and therefore reducing the air speed and drag force for the same mass flow)
- reducing the grade to compensate for air resistance. This also reduces brake control related risks in the tunnel

Figure 3.6 Resistance against empty western coal train climbing 1/30 tunnel (metrage from Inner Harbour)



Source: Parsons Brinkerhoff

Table 3.1 Tunnel characteristics

Characteristic		Original Yellow
Grade in tunnel		1:30
Grade outside tunnel		1:30
Tunnel cross section		50m^2
Tunnel length		4.000km
Route length		36.061km
Climb from port to summit		453.4m
Provisional cost estimate		[redacted]
Maximum ambient temperature	Coal	38°C
before restrictions apply	Intermodal & steel	30°C

Source: Parsons Brinkerhoff (2014b)[16], Table 2.2, 4.4 and p. 20

The above studies also required train operational controls or limits in order to achieve a reasonable tunnel sectional size. At the conclusion of the Scoping Stage it had been determined that an upper limiting ambient temperature of less than 38^0 C was required to maintain locomotive operability within a 50m^2 internal tunnel section at a 1:30 rail grade with the diesel locomotives considered. It was recognised that if further efficiencies in tunnel CapEx and OpEx were to be achieved that further limitations on specific train consists in terms of gross mass and trailing length would be required. These were not deemed acceptable in the context of broader network operations.

As a result of the more detailed assessment, both in terms of rail operational modelling and engineering assessment a greater level of understanding was gained regarding the inter-relation of the above tunnel parameters. The combined effect of train movement against the forced mechanical ventilation was found to be of greater influence than estimated at the Scoping Stage. This effect combined with the need to allow all train configurations has resulted in a revised sectional area.

[16] Parsons Brinkerhoff (2014b), *Maldon to Dombarton Rail Link Technical Memo Avon Tunnel Project Definition*, issued 11 April 2014

Conclusion on Option Selection

The choice of a route option is also dependent on,

- **Cost effectiveness**
- **Constructability**
- **Future proofing**
- **Rolling stock requirements**
- **Purge times**
- **Operational requirements (speed, energy usage)**
- **the overall network configuration**

These studies have adopted the (Base Case: Original 1980's alignment. 1:30 Grade of 4000m length) with an associated internal tunnel cross section of $65m^2$. This larger cross section as shown in the figure above would allow the TfNSW proposed train configurations including heavier intermodal trains (as referenced in the Rail Operations report) to operate up to a working ambient temperature of 35^0C. The tunnel would be excavated using Road Header methods in order to form a bespoke horse-shoe shape efficient profile.

Options to increase the line capacity in the future

Single tunnel track limitation

Any single-track railway's capacity is limited by the longest sectional running time of a component section. In the case of MDRL this limiting section is, for several train configurations, the section between Dombarton and Avon, which include the 4km Avon tunnel. The section between Wilton and Cordeaux has the next highest sectional running time.

Tunnel air quality / ventilation limitation

When a diesel-hauled train enters the tunnel, no other train can enter until

1. The tunnel is no longer occupied by a proceeding train (transit time between 8 and 20 minutes), and
2. The portal door has shut and the purge process has completed (approximately 7 minutes)

Therefore, from the moment any train enters the tunnel in either direction, there is exclusion for approximately 15 to 27 minutes.

This also precludes dividing the block for fleeting moves, which would under normal circumstances be an opportunity for increasing capacity.

Importantly, while internal combustion traction is used, this constraint continues to apply even if double-track is available in the single-bore tunnel. That is, there is no capacity gain from double-tracking the tunnel while diesel trains are used.

Opportunities to increase capacity

A range of operational measures were considered:

External infrastructure changes - There is an opportunity to increase utilisation of the MDRL if trains can be optimally timed to enter the corridor in both directions. With current network infrastructure, there are very few opportunities to hold trains that do not involve blocking a mainline or a loop, both of which have adverse capacity consequences. It may be possible to build staging roads at greater cost on approach to Maldon and at Port Kembla and Inner Harbour. This may provide 4 additional paths. However, this may result in increased cycle times and labour costs

Minor infrastructure changes - There are opportunities to duplicate eastward from Wilton loop towards Cordeaux and from Avon loop towards western tunnel portal. This may provide **2 additional paths**. Additional ventilation plant and additional duplication outside tunnel may result in **4 additional train paths**.

Duplicate corridor end-to-end including duplicated track in single tunnel - Duplicating the corridor end-to-end provides additional ability to accommodate irregular running, and eliminates single-track constraints. However, the tunnel constraints, in terms of limitations on when a following train can enter the tunnel, continue to apply to both tracks. While diesel trains continue to operate, there is no operational capacity benefit from duplicating the track through the tunnel.

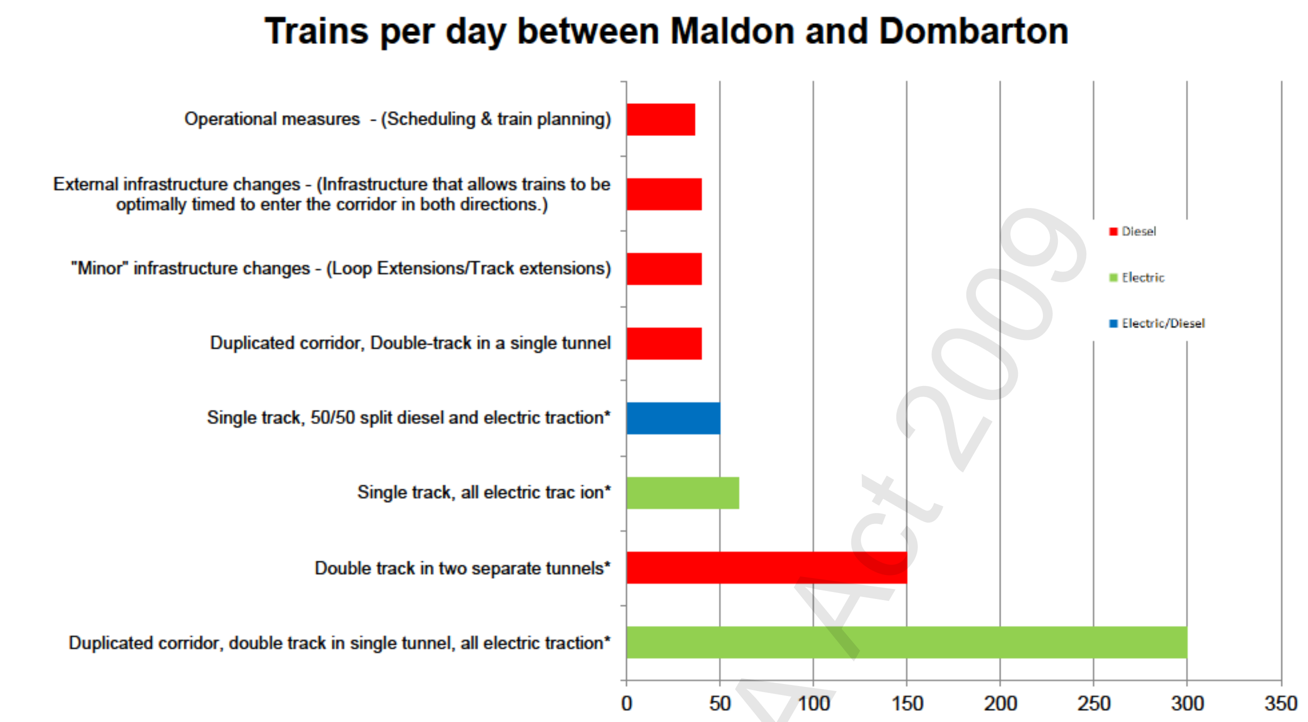
Single track, all electric traction - By virtue of eliminating tunnel ventilation, including both purge time and additional drag, and as a consequence of higher performance, line capacity is increased with no below-rail enhancements. This was reported to support up to **70 theoretical train paths** per day, which corresponds with **approximately 60 practical operable paths**.

Single track, mixed diesel and electric traction – A mix of electrically powered trains offers an intermediate level of capacity improvement. Whenever an electric train operates, it occupies the limiting section for a shorter time, and requires no following purge time. As such, the next train move (be it diesel or electrically hauled) can occur earlier. At a 50/50 mix of electric and diesel hauled traffic, a mid-point capacity half-way between **36 and 60 trains per day should be expected.**

Double track in two separate tunnels - This would enable trains to climb and descend in independent tunnels simultaneously. The constraint however remains the tunnel. For a conservative representative train, of 1000m length and 25km/hr climbing speed through the tunnel, the tunnel remains occupied for 12 minutes. In addition the tunnel must purge for 7 minutes before the following move can enter (excluding equipment operation time). This means that the headway cannot be less than 19 minutes, amounting to 75 trains per day in the climbing direction. Therefore, if the opposite direction of traffic is operated through an independent tunnel, the capacity could be increased to approximately **150 trains per day.**

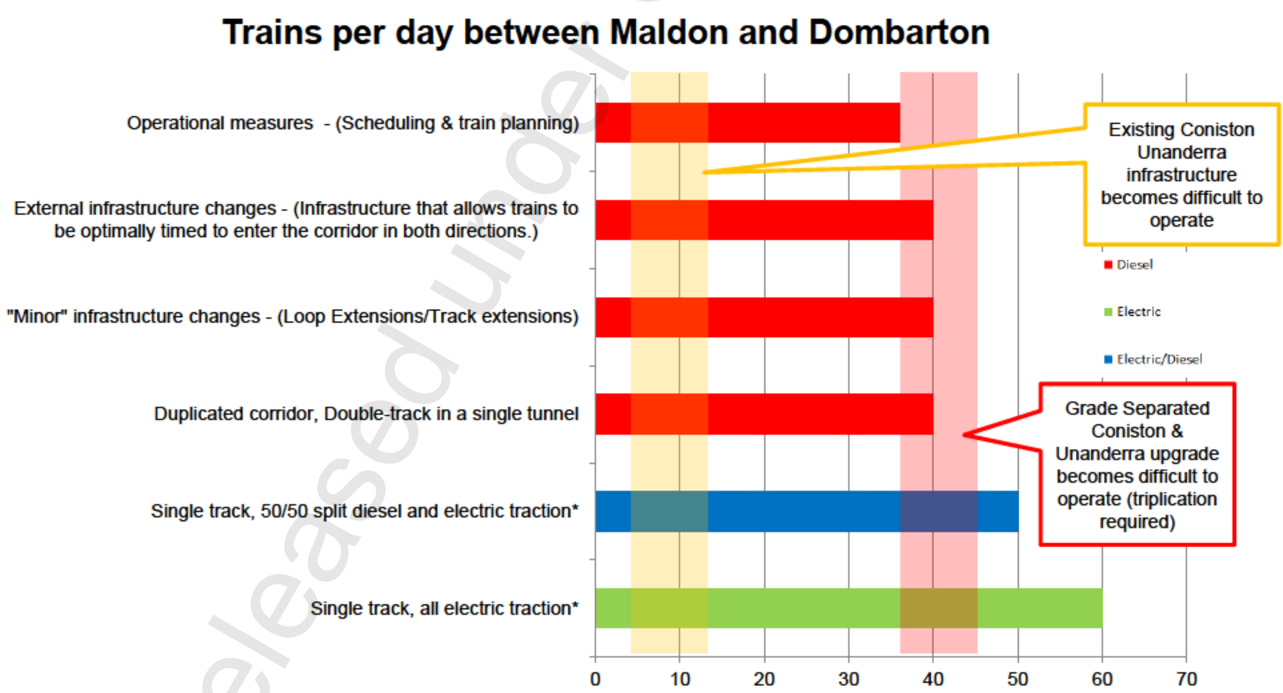
Duplicate corridor end-to-end, including double-track single tunnel or double-track in two separate tunnels, all electric traction - If the line is operated by electrically hauled trains, and is duplicated end-to-end, the only limitation on headway is that imposed by signalling. Under this scenario, at 10-minutes between train, line capacity would be around 300 trains per day. This applies in both the case of a double-track single-bore tunnel, and independent tunnels.

The comparative capacity performance of all of the above options are shown below



Capacity outcome from alternative infrastructure and operations configurations

Excluding a second independent tunnel, and complete double-track electrification, the same capacity scenarios are illustrated, with the triggers for Coniston- Unanderra improvements also shown in coloured bands.



Capacity outcome from alternative infrastructure and operations configurations (excluding 2nd tunnel and double-track electrification)

Civil Works

Existing Works

As noted throughout this report, a substantial amount of the corridor route civil works, including earthworks for cuttings, embankments and at grade platform has been completed as well as drainage and culvert structures have already been constructed. The only major built structure is the approach viaducts either side of the Nepean River and tunnel portals.

Figure 3.9 Incomplete Nepean River brdige

All of the existing corridor works have been inspected, categorised and evaluated for future use.

All earthworks for cuttings and embankments were inspected, and a risk based approach including engineering analysis was used to evaluate either;

- Compliance with current Standards,
- Suitability for current and future use,
- Suitability for use with remedial work required to be undertaken, or
- Modification required ensuring suitability.

Figure 3.10 Typical cutting example with mining subsidence at bottom right

The results of all investigations and analysis can be found in the wider report, however, the general conclusion is that although Standards have changed through time and the existing works does not always comply, most if not all works can be justified for use with some remedial work to address the effects of weathering over time.

For the steel and concrete built structures, their condition can generally be categorised in two parts;

1) Concrete structures, including the Nepean River Approaches, as in good condition.

2) Steel arches for culverts and fauna crossings, as in poor condition, however, simple remedial works could preserve their design life until a decision is made for the project to proceed.

Some intrusive testing has been identified for the concrete structures to validate the condition assessment and conclude the life span of the existing structures. Dynamic testing is also being undertaken to validate the integrity of the Nepean Bridge approach spurs.

Figure 3.11 Fauna crossing example

An assessment of the rail formation capping layer and bottom ballast to most of the corridor was inspected and found to be in good condition. With the passage of time and road vehicles using the corridor for maintenance or access, there has been a tendency for the ballast to push into the top of the capping layer. This is not considered a significant issue, however, it was concluded that the bottom ballast would be discarded, but minimal remedial works were likely to the remaining formation.

Figure 3.12 At grade rail formation example

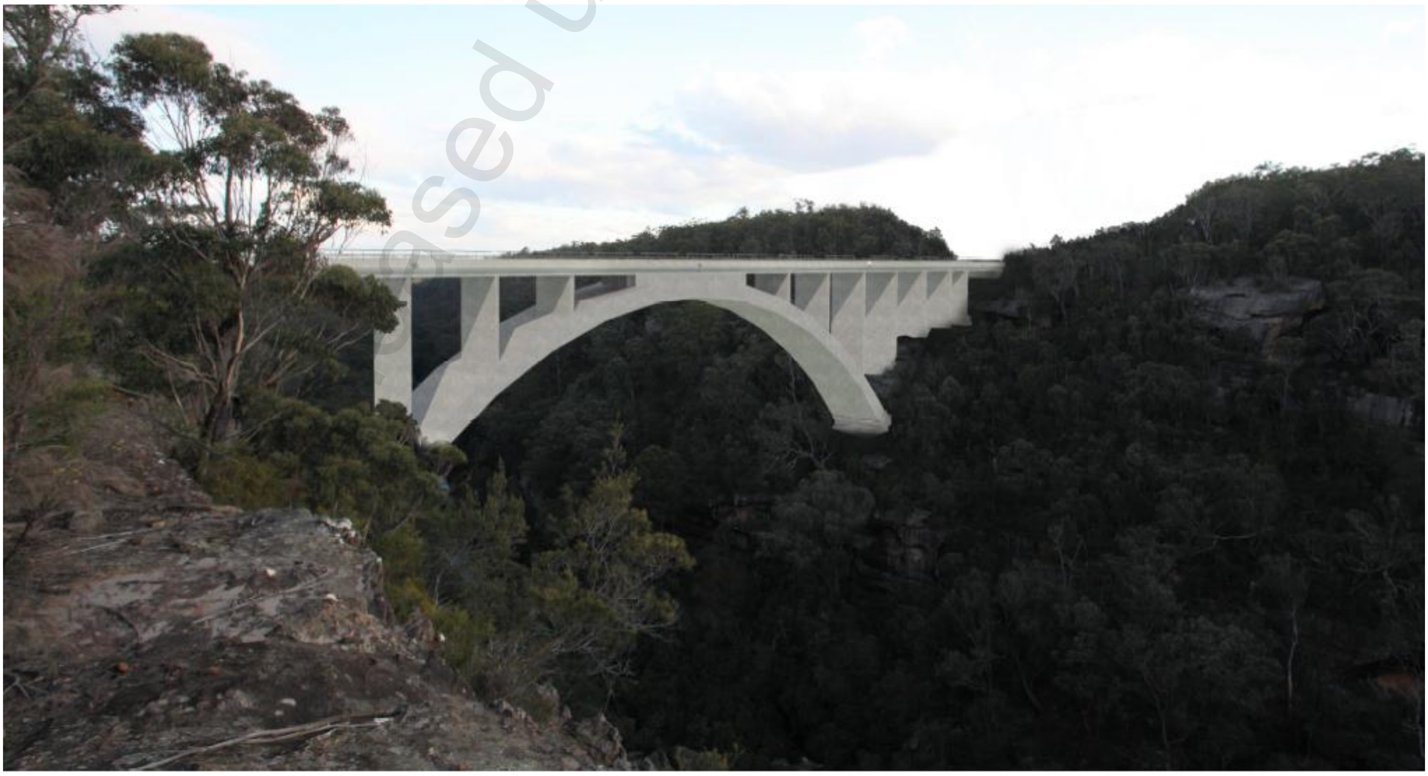
Bridge Works

At the western end of the route corridor there are eight new bridges;

Major River Bridges;

- Cordeaux River Bridge – a 290m arch bridge with concrete approach structures spanning of the Cordeaux River gorge.

Figure 3.13 Proposed Cordeaux River Bridge (photomontage)



- Completion of the 190m balanced cantilever bridge over the Nepean river to complete the entire crossing and marry with the existing approach structures.

Figure 3.14 Proposed Nepean River Bridge (photomontage)

Road Overbridges (Roadway traverses "over" the rail corridor). These bridges essentially replicate the existing road requirements, including the potential for future expansion as per council and government planning. These are;

- Hume Highway crossing – a traditional RMS bridge structure, however, to a major arterial highway.
- Picton Road
- Janderra Lane, and
- Condell Park Road.

Figure 3.15 Proposed Hume Highway overbridge (photomontage)

Two additional bridges have been introduced to the overall bridge structures to accommodate adjacent developments;

- An "Accommodation Crossing" – essentially a twin lane road bridge west of the Nepean Bridge to allow a crossing over the rail corridor either side of planned housing developments.

Rail Infrastructure & Systems

The rail infrastructure design has been progressed for the route from the Dombarton Junction on the Unanderra to Moss Vale Line through to Maldon Junction on the Main South Line. This alignment closely follows the 1980's alignment with variations in the Dombarton Junction area comprising an additional crossover, the loop lengths and locations which have been set to accommodate the current requirements of longer trains, and some adjustment to Maldon Junction including having both forks as single tracks and widening track centres at the turnout installation areas.

Alternative alignment in the vicinity of the Cordeaux River crossing was examined in the Value Management session, with the selection of the original alignment as the best solution. This is documented in the Value Management report.

Other options considered resulted in a minor lowering of the design height through sections of the route following the delivery of the survey data. Much of this lowering has been the result of mining settlement since the original construction.

A new maintenance access road was added to requirements for bridges to suit maintenance and access by 3rd parties. A particular example is the additional vehicular access for Cordeaux Bridge, which provides substantial improvements over existing arrangements.

3.3 Program / Project Objectives

In order to guide the current development of the project, a Project Control Group (PCG) has been established. This comprises representatives from both the NSW and Federal Governments.

As part of their early activities, the PCG has established a series of objectives for the project. These objectives are summarised in the following table and show how they relate to objectives identified in the Commonwealth Government's Nation Building Program and the NSW Freight and Port Strategy.

Table 3.2 Project Objectives Summary

Nation Building Program Objectives	TfNSW Objectives and Challenges (Freight and Port Strategy)	Maldon to Dombarton Project Specific Objectives
Improve national and inter-regional connectivity for people, communities, regions and industry	Delivery of freight network that efficiently supports the projected growth of the NSW economy: • Fixing bottlenecks on road and rail networks	Meet capacity for rail freight to/from Port Kembla for the long term Reduce the effect of Illawarra Line constraints on freight to the Port Kembla and Illawarra region.
Improve national, inter-regional and international logistics and trade	Delivery of a freight network that efficiently supports the projected growth of the NSW economy: • Identifying, protecting and developing strategic corridors • Creating opportunities for intermodal terminal development	Improve efficiency of the rail freight supply chain to and from Port Kembla by providing: • Greater flex bility in train arrival and departure times • Improved reliability • Shorter cycle times from origin to Port Kembla Support progressive separation of freight and passenger services. Support future intermodal movement by rail
Enhance health, safety and security	Balancing of freight needs with those of broader community and the environment: • Improve safety of freight transport	Maintain or improve the level of safety risks to the rail network
Is consistent with the obligation to current and future generations to sustain the environment	Balancing of freight needs with those of broader community and the environment: • Integrating requirements of freight transport and other land uses	Achieve a neutral or beneficial impact water quality within Sydney's drinking water catchment Minimise impacts on the environment, surrounding land users, and the community Achieve a 'Silver' rating under the TfNSW Sustainable Design Guidelines for Rail V 2.0
In consistent with viable, long-term economic and social outcomes	Delivery of a freight network that efficiently supports the projected growth of the NSW economy: • Supporting regional network development	Support economic development of Port Kembla and the Illawarra region and regions served by the port
Is linked effectively to the broader transport network	Delivery of a freight network that efficiently supports the projected growth of the NSW economy: • Supporting regional network development	Optimises overall rail network investment for the NSW freight task

Source: TfNSW

3.4 Scope of Work

3.4.1 Scope

The scope of the current project is based on the partially completed 35km rail line from Maldon in the Southern Highlands to Dombarton, 10km west of Unanderra on the Moss Vale to Unanderra Line. See Figure 1 in Project Overview and Executive Summary for the context of the proposed alignment.

Based on the Reference Project Case, the main remaining physical works for completion are:

- A triangle junction connection at Maldon to the existing Sydney to Melbourne line
- A 250m-long single track rail bridge over the Cordeaux River
- A 190m-long single track rail bridge over the Nepean River
- A 120m-long double track crossing under the Hume Highway due to the Wilton Loop
- Three road overbridges
- A 4km single track tunnel at a 1:30 grade
- Re-clearing of a 20m-wide by 20km-long corridor through regenerated and native vegetation
- Installation of 5km of complete earthwork formation
- Cleaning and re-installation of 10km of bottom ballast
- A new lineside signalling system
- Installation of new signal interlocking at Maldon and Dombarton, and for three intermediate loops
- Potentially a new communications link to the train control system at the ARTC Junee Train Control Centre
- Supply and emplacement of 35km of top ballast
- Installation of 35km of new sleepers and rail, including for three new loops
- Improvements to the existing drainage and detention systems
- Installations of tunnel and signalling system power supply (including construction power)
- Spoil mound

It is also noted that a significant upgrade at Coniston Junction will be required. The line was originally intended to be operated with 25kV AC traction locomotives (locos). However due to the current characteristics of the rail freight industry in NSW the line, at least initially, will need to be capable of accommodating the existing various types of diesel locos. The current design of the line will not preclude installation of 25kV AC overhead traction supply in the future.

Section 6 describes the work program, key milestones, governance, delivery method / procurement strategy, stakeholder management, environment and costing issues.

3.5 Funding Requirements

3.5.1 Overall Project Funding

Table 3.3 Description of Summary Cash Flows and Funding

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Project Costs (1)	$0m	$0m	$36m	$148m	$233m	$191m	$109m	$89m	$0m	$0m
Savings/Benefits (2)	$0m	$0m	$0m	$0m	$0m	$0m	$0m	$0m	$0m	$0m
Net cashflow (3)	**$0m**	**$0m**	**$36m**	**$148m**	**$233m**	**$191m**	**$109m**	**$89m**	**$0m**	**$0m**
Alternate	To be determined									

funding [4]										
State funding requirement [5]	To be determined									
Existing provisions [6]	To be determined									
Difference [7]	$XXm	$XXm	$XXm	$XXm	$XXm	$XXm	$XXm	$XXm	$XXm	$XXm

Notes:

(1)	Project Costs	Equals the sum of the all project related costs and contingency per the cashflow line in the Cost Plan
(2)	Savings / Benefits	Equals the sum of the proceeds from the sale of assets or delivery of benefits during the life of the project
(3)	Net cashflow	Sub-total equals (1) minus (3)
(4)	Alternate funding	Equals the sum of funding available from sources other than NSW Treasury (e.g. Federal funding). Where alternate (e.g. federal) funding is deemed l kely, indicate why this is considered eligible. Where no alternative funding is indicated, explain in this note why alternative funding has been deemed unavailable.
(5)	State funding requirement	Sub-total equals (3) minus (4)
(6)	Existing provisions	Equals the existing unused provisions per most recent submission (e.g. TAM) to NSW Treasury
(7)	Difference	Sub-total equals (5) minus (6). Indicates to Investment Programs changes being requested to capital budget.

At this stage, the funding arrangements have not been assessed or estimated except for the initial funding grant of $25.5 m from the Commonwealth.

3.5.2 Budget request

Since this is the Final Business Case, the Budget Request would be for the amount of project capex as shown in table 3.3 $701 m for MDRL and $105m for Coniston upgrades.

3.5.3 Related projects or decisions

Any decisions to progress the MDRL needs to note progress on the following projects which are currently in the pipeline:

- Coniston Unanderra Junction Upgrade – see below
- Upgrades of Unanderra Moss Vale Line – it should be noted that Preliminary Business case evaluated the costs and schematic layout for building 4 passing loops for a cost of $100 m in total
- Freight Network initiatives like SSFL and MFN and the triggers for upgrades as explained in section 2.3 above
- Timing of Sydney Rail Futures initiatives including Hurstville line conversion, which will reduce capacity on IRL – see section 2.3 above
- Any changes to Illawarra Rail Line capacity including deployment of extra passenger services

3.5.4 Other impacts

Coniston Junction Upgrade

Lying to the immediate south of Coniston Station, Coniston Junction is a key pinch point for rail operations in the Illawarra. Currently, the predominant flow of freight to/from Port Kembla is towards the north with freight services to the Inner Harbour at Port Kembla and servicing the mines along Illawarra escarpment, Bombo and Dunmore Quarry and Manildra's Bomaderry plant. As such, the junction with the South Coast Line and the layout of the track between Coniston and Unanderra is primarily configured for this operation. The flat junction at Coniston/ Unanderra services both freight and passenger services, which results in multiple conflicting train paths.

In addition, with no ‘triangle’ line connecting the UMVL and the South Coast Line south of Unanderra, freight trains moving between the UMVL and the South Coast Line south of Unanderra need to shunt at Unanderra to change direction.

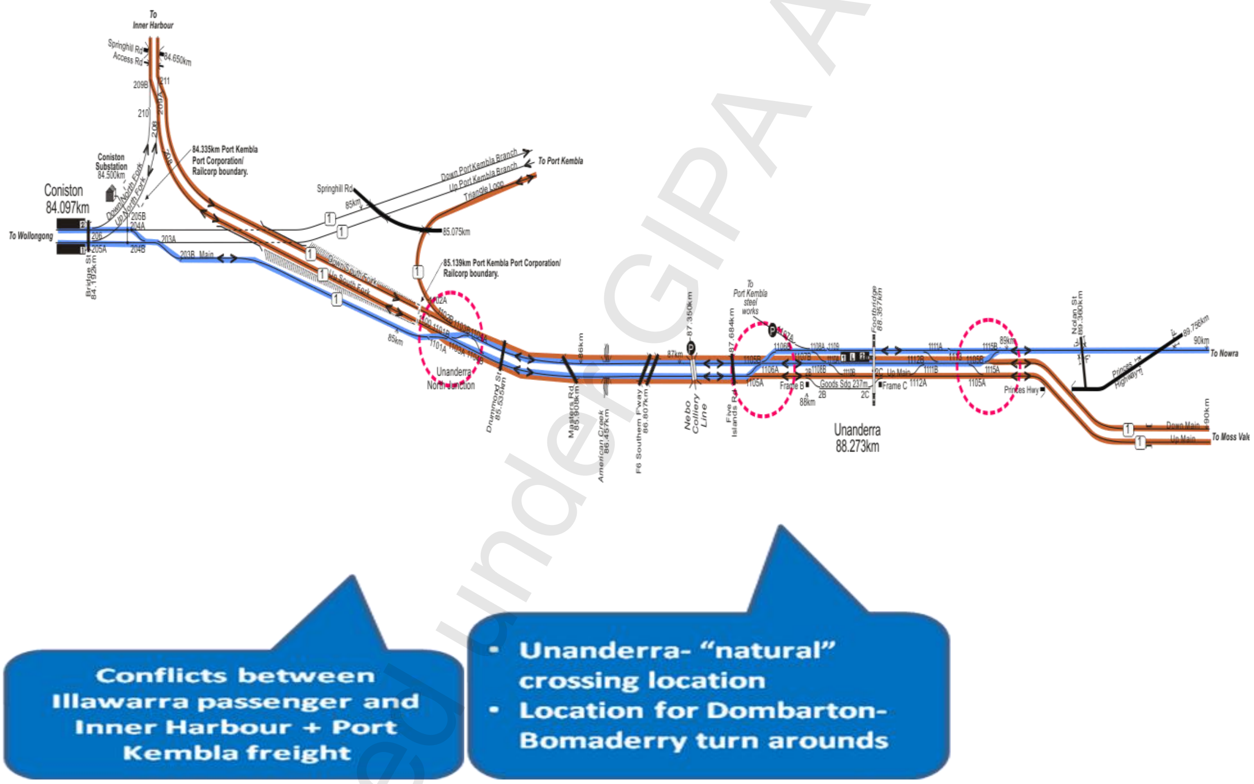
Due to these factors, between 2 and 10 more trains per day on MDRL can be added before capacity is reached.

The development of the MDRL would result in rail traffic patterns approaching Port Kembla changing considerably, with additional rail freight movements from south of the junction feeding into Port Kembla. Combined with increases in rail freight volumes, the change in rail movements is likely to give rise to conflicts between different rail services including:

- South Coast inter city passenger movements and freight services near Unanderra Station
- All South Coast movements and rail services seeking to access the Outer Harbour.

The location of these potential conflicts is shown in Figure 3.16.

Figure 3.16: Conflicts at Unanderra between Illawarra Passenger Services and Dombarton Freight Services



Source: Parsons Brinckerhoff

Operations around Coniston – key issues

The network in the vicinity of Coniston known as “Unanderra North Junction” suffers from a number of challenging facing conflicts, as identified in the occupancy analysis in the previous reports cited above. The demands for train routes through Coniston post MtDRL are:

- Coal and grain moves running between Unanderra and Inner Harbour on the main route, which is known as the “Illawarra Main” between Unanderra and North Unanderra, and the “South Fork” between North Unanderra and Inner Harbour.
- Illawarra passenger and freight trains (including ballast and aggregate) run between Coniston and Unanderra on the Illawarra main, including a single-track section between Coniston Station and Unanderra North Junction.

- Steel, minerals, coking coal and other Port Kembla (or Outer Harbour) traffic operates between Unanderra and North Unanderra on the Main route, turning out on the Triangle Loop (also called Allens Creek Triangle or Loop).

Operations around Unanderra – key issues

Conflicts at Coniston and Unanderra, though geographically separate, become constraining elements simultaneously as demand increases. It is for this reason that they are considered concurrently. The operations around Unanderra are in themselves quite complex, and explained in more detail

- Up / Down Illawarra passenger
- Up / Down Illawarra freight
- Up Port Kembla and up Inner Harbour freight
- Down Port Kembla and down Inner Harbour freight
- Dombarton to South Coast freight
- South Coast to Dombarton freight

Also, the current terminal design at Port Kembla Coal Terminal, the grain loader and within the BlueScope Steelworks does not guarantee prompt acceptance of trains into the terminals. This may serve to compound any reduction in the reliability of rail freight services in the future.

Consequently, the development of the MDRL could see decreases in network reliability for both passenger and freight services.

Rail operations modelling indicate that current infrastructure has sufficient capacity for the passenger services as per the 2013 timetable. Although capacity may be sufficient to cater for projected increases in rail freight levels, it is anticipated that rail freight services will be subject to an increased risk of delay.

In addition, holding trains on the 1:30 grade on the UMVL to the west of Unanderra for extended periods would have safety implications, which would also need to be addressed.

To resolve potential concerns regarding delays and safety, a number of potential infrastructure upgrade solutions were assessed for the Coniston Junction. These options broadly assessed the benefits and costs of:

- Mixed running of passenger and freight services on left hand or right road moves
- Segregated passenger and freight services with flyover and dedicated single track between Coniston and Unanderra
- Segregated passenger and freight services on triplicated track with single track to passenger and double track to freight and vice versa
- Segregated passenger and freight services on quadruplicated track

There are several upgrade scenarios depending on traffic volumes from MDRL and UMV and on Illawarra Line (due to passenger growth) that are shown in the figure below.

The following infrastructure requirements were identified for Coniston – Unanderra:

Table 3.3 Infrastructure Requirements identified for Coniston - Unanderra

Scenario	Trains to & from Port Kembla & South Coast	Passenger services to Port Kembla & Dapto infrastructure works	All Passenger services to Dapto infrastructure works
Freight 2014	**64**	-	(not analysed)
Freight 2021 via MtDRL	**72**	Coniston Grade separation and Unanderra Freight- Passenger Segregation	Coniston Grade separation and Unanderra Freight- Passenger Segregation
Freight 2031 via MtDRL	**64**	Coniston Grade separation and Unanderra Freight- Passenger Segregation	Coniston Grade separation and Unanderra Freight- Passenger Segregation

Source: Parsons Brinckerhoff

The following table shows the trigger points at which enabling works have to be carried out.

Table 3.4 Coniston Junction Upgrade Scenarios

Infrastructure Step	Triggered by number of freight trains per day to/from Dombarton	Available capacity Freight trains per day to/from Dombarton	Service plan structure
Current Infrastructure		28-36	Current (2014) timetable
Construct Down Illawarra grade separation and Unanderra passenger/ freight segregation	Demand exceeds 28-36 freight paths Unanderra - Dombarton	61-70	Current (2014) passenger timetable. Coal removed from Illawarra. MtDRL paths added until unsustainable
Triplication between Coniston triangle and Unanderra	Demand exceeds 61-70 freight paths Unanderra - Dombarton	Available capacity not identified	2014 passenger timetable with Port Kembla services re-routed to Dapto. 2021 freight demand. Theoretical extra paths added until unsustainable
Quadruplication between Coniston and Unanderra	Trigger too high to identify		Complete segregation of passenger and freight services

Source: Parsons Brinckerhoff

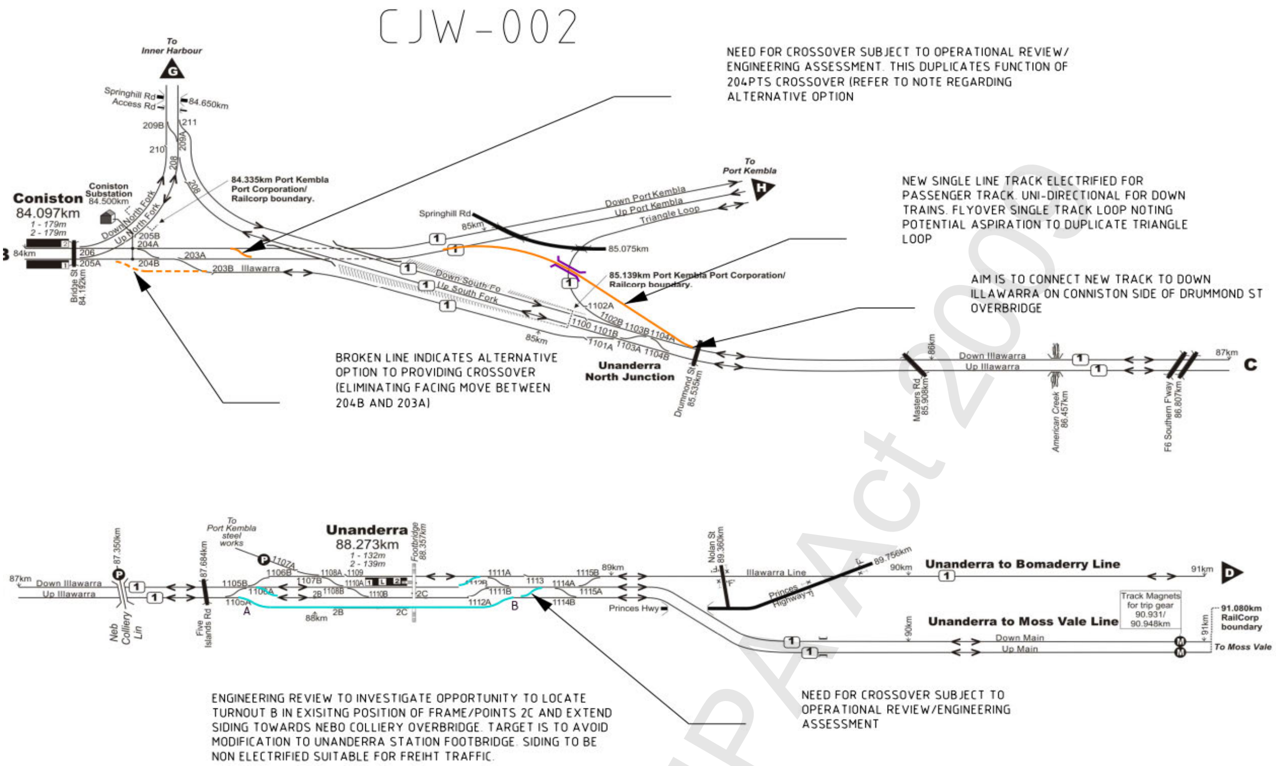
Coniston Unanderra Conclusion

The Coniston to Unanderra section of the Illawarra line is a key constraining element of the route for trains operating between Dombarton and Port Kembla or Inner Harbour.

It was identified that the Down Illawarra grade separation and Unanderra station passenger and freight separation is required for all scenarios (2021 and 2031). The re-direction of all Port Kembla services to Dapto, as a proxy for increased passenger services to the South Coast, had little impact on the requirements, but it should be noted that it assumed duplication between Unanderra and Dapto. Once the freight demand between Unanderra and Dombarton exceeds 61-70 freight paths per day, triplication between Coniston and Unanderra will be required.

No trigger was identified for the quadruplication, but the benefit of this option is to enable an almost complete segregation of freight and passenger traffic.

Figure 3.17 Potential Infrastructure Upgrade to Mitigate Coniston – Unanderra Conflict



Source: Parsons Brinckerhoff

Third Party Agreements

A wide range of Third Party Agreements are required for the project to proceed. These have been progressed to the point where either the Project or the construction contractor have clearly identified actions to complete with each third party stakeholder once the project is approved for construction. These include:

- **Natural gas and Ethane pipelines:** Project liaison with APA on the form of agreement and indicative cost to carry out a design study to relocate/protect pipelines in the MDRL corridor.
- **Hume Highway and Picton Rd overbridges**: Process for the establishment of Works Authorisation Deed(s) with RMS for construction of overbridges.
- **Four overbridges within Wilton Junction**: Wollondilly Shire Council's design requirements and approvals process obtained for construction of overbridges.
- **Road access within SCA and NPWS lands**: Actions identified for construction contractor to liaise with SCA for construction access consents. Project will need to liaise with SCA to develop Operations access consent.
- **Road access in Crown Lands**: No issues foreseen with obtaining consent to use Crown roads.
- **Temporary Construction Road Access:** Actions identified for construction contractor to liaise with RMS.
- **Mine subsidence**: Project has advised DTIRIS (Department of Trade and Investment, Regional Infrastructure and Services), MSB (Mine Subsidence Board) on principles and assumptions for design of coal mining induced settlement on rail structures.
- **Access to Avon Tunnel through mine lease areas**: Project liaison with DTIRIS to cancel part of mining lease ML 1596.

- **Energy Supply – Construction and Operations**: Process identified for contracting arrangements to obtain power for construction and operations.
- **Sydney Water Supply Tunnel**: Rail cutting completed over water supply tunnel; no action required.
- **Sydney-Melbourne Coaxial Cable**: Rail cutting completed over coaxial cable; construction contractor to pot hole and survey to identify encasement.
- **Bingara Gorge services/access adjacent to Hume Highway in Lend Lease easement**: Lend Lease submitted licence application for installation of rising mains.
- **Endeavour Energy, Nextgen, Telstra, Powertel and Optus services**: **P**rocesses identified for construction contractor (including contacts, stakeholder documents and timing) to liaise with asset owners to relocate services.

3.5.5 Consequences of deferral

At this stage, due to adequate spare capacity on the Illawarra Line; there are no major consequences of deferral.

The consequences of deferral over the long-term are:

- Potential lack of capacity on Illawarra Line due to deployment of Sydney Rail Futures and Hurstville line conversion to Rapid Transit
- Potential congestion in Unanderra-Coniston Junction
- Potential impact on passenger services due to lack of capacity
- Potential increase in construction costs
- Over time, existing corridor and MDRL line built in 1980s will continue to become less viable and will require more refurbishment work and also become more environmentally sensitive.
- There may be changing environmental, legislation, land use and environmental issues that may make the project costlier or less viable in the future.
- Dilapidation of existing assets (e.g. bridges, cuttings, embankments, and civil structures)
- Wilton Junction development may result in additional scope increase

3.6 Cost Planning

3.6.1 Base Cost Plan

TfNSW engaged Aquenta to undertake the estimates for the reference case, capital costs, operating costs and options cost for the project.

The P90 estimates are based on the Project Definition Design.

The key assumptions of the Construction Estimate are that the Project will be delivered as a Design and Cost contract and that the Project will be awarded in early 2016.

3.6.2 Cost Planning Management

The key methodology to estimate the costs involved:

- **Direct Costs -** The direct costs have been calculated using first principle's estimating techniques as required for Reference Level Design Estimates and in accordance with the TfNSW Draft Project Cost Estimating Standard document. The Estimate was developed

with a full understanding of the constructability issues and the methodology required to construct the works. [redacted]

- **Indirect Costs** – these have been calculated in same way as direct costs including design, contractors profit and overhead represents [redacted] of TCC.

- **Design costs** have been estimated using deterministic percentages and ratios of Direct Costs. The design estimate includes all design effort to bring the design from concept to AFC. The total design estimate of [redacted] includes construction phase design support.

- **Overhead and Profit -** Contractor's profit is calculated as [redacted] of the total Construction cost (TCC) plus contractors contingency (P50 contingency amount has been allowed as contractors' contingency for the purposes of valuing the Overhead and Profit.)

- **TPD project and program costs** have been developed against a list of typical Owners costs with percentage factors provided by TfNSW. The percentage factors were applied to the Total Construction Cost (TCC), plus contractors P50 contingency amount derived from the probabilistic risk assessment and escalation. [redacted]

- **Risk Contingency –** Risk workshops were undertaken and probabilistic risk modelling undertaken. [redacted]

- **Escalation -** Escalation has been calculated annually on the contractors and owners costs based on the program cashflow. An annual inflation rate of 2.5% has been applied to both the Contractors and the Owners costs including contingency over the duration of the project. [redacted]

The Total Outturn Cost (TOC) summary is shown below

[redacted]

Full breakdown of the key components of the construction costs are shown below in Table 3.5

Table 3.5 MDRL Construction Cost Estimates (Undiscounted)

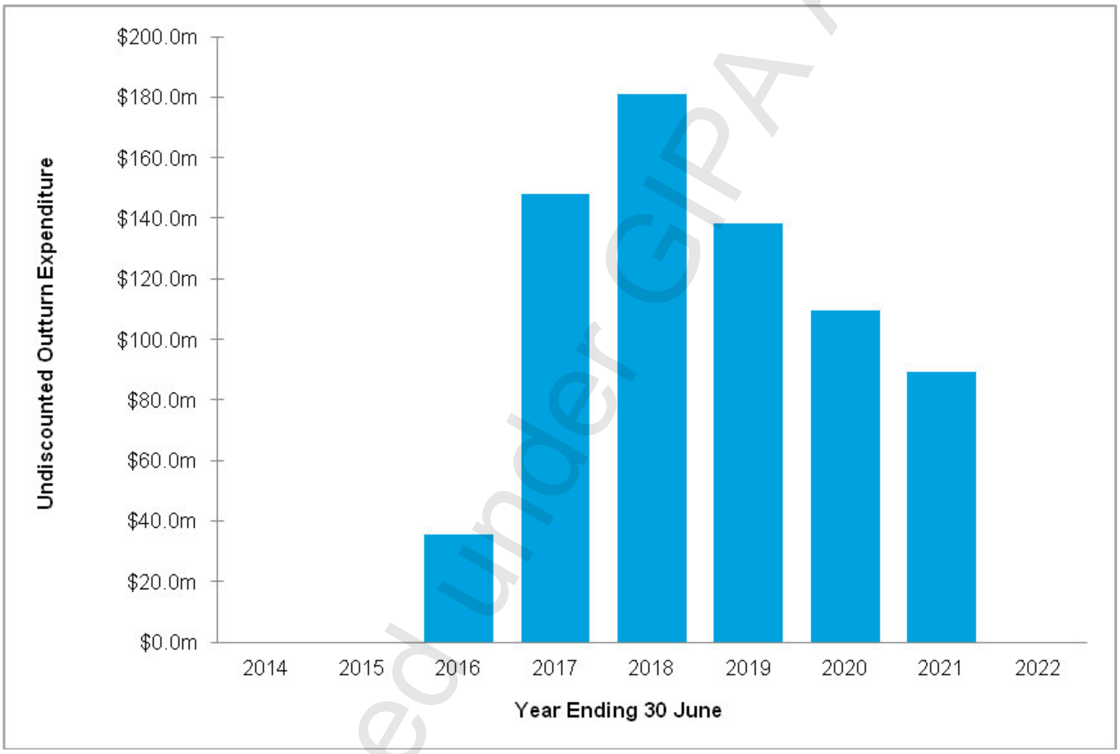
Item Code	Item	Cost
	Contractors direct cost	[redacted]
	Civil works	
	Tunnels	
	Structures	
	Trackwork	
	Systems	
	Utilities	
	Roads and transport hub	
	Miscellaneous	
A	**Total direct costs**	
	Indirect cost	
	Contractors design costs	
	Staff and supervision	
	Site buildings and offices	
	Contractors overhead and profit	
	Other indirect costs	
B	**Total indirect costs**	
C	**Total construction cost (A+B)**	
D	**Owners cost**	

E	Base estimate (C+D)	[redacted]
	Contingency and risk allowance	[redacted]
	Inherent and contingent risks (P50)	[redacted]
	Contractors escalation	[redacted]
F	**Total contingency and risk allowance**	[redacted]
G	Project cost estimate (E+F)	[redacted]
H	**Client escalation**	[redacted]
I	**Program contingency recovery(P90)**	[redacted]
J	**Corporate overhead recovery**	[redacted]
K	***Total outturn costs (G+H+I+J)***	***$701.4m***

Source: Aquenta cost data. All values in 2013-14 prices [17]

The assumed capital expenditure profile for the project is shown in Figure 3.18. The construction period is assumed to be incurred over six financial years from 2015/16 to 2020/21.

Figure 3.18 MDRL Capital Cost Expenditure Profile (based on Outturn Cost Estimates)



Source: Aquenta cost data. All values in 2013-14 prices

An adjustment to the Project costs was undertaken in order to convert outturn estimates to economic costs for application in the economic assessment. These adjustments include[18]:

- Adjustment of escalation estimates (contractor and client escalation) to remove the general increase in prices and maintain valuations at 2013-14 prices. Although guidance provides scope for real escalation, no real escalation was assumed by Aquenta

[17] Aquenta (2014), Maldon to Dombarton Rail Link (M2DRL) – Volume 1 Cost Report, May 2014

[18] Removal of contractor profit was previously undertaken during the Preliminary Business Case phase as it was Deloitte's view that is considered a transfer payment (a transfer of producer surplus) between the government and the private sector and does not reflect a resource cost and consequently does not affect economic welfare. An alternative view is provided by Transport for NSW (2013), which suggests that contractor profit is a payment for the opportunity cost of capital and accordingly is a resource cost. Accordingly, Deloitte has adopted the conservative approach of including contractor profit as part of the resource cost of the project.

- Client corporate overheads as these costs represent a sunk cost and are incurred by the client regardless of whether the Project proceeds or not.

[redacted]

Table 3.6 MDRL Construction Cost Estimates (Economic Costs)

Item	$m
Total outturn cost	[redacted]
Less contractor escalation	[redacted]
Less client escalation	[redacted]
Less client overhead recovery	[redacted]
Economic cost (undiscounted)	[redacted]
Economic cost (discounted)	[redacted]

Source: Deloitte analysis based on Aquenta cost information. Where discounted, values are discounted using a real discount rate of 4.4% p.a. All monetary values in 2013-14 prices

Coniston Junction – Unanderra Upgrade Costs

In order to provide an increase in capacity to enable the full functionality of the MDRL, upgrade works are required between Coniston and Unanderra.

These include track slewing and new turnout / crossovers and platform at Unanderra, a grade separated connection on the Down Main over the Port Kembla branch line and section of triplication of track between Coniston Junction and Unanderra. The outturn cost of these works was assessed by Aquenta to be $105m and are assumed to be incurred evenly between 2017/18 and 2018/190. The capital costs for upgrading Coniston Junction to Unanderra are summarised in Table 3.7.

Table 3.7 Construction Cost Estimates for Coniston Junction – Unanderra Upgrade

Item Code	Item	Coniston Junction Works	Unanderra Works	Total	%
	Contractors direct cost				
	Civil works	[redacted]	[redacted]	[redacted]	[redacted]
	Structures	[redacted]	[redacted]	[redacted]	[redacted]
	Trackwork	[redacted]	[redacted]	[redacted]	[redacted]
	Systems	[redacted]	[redacted]	[redacted]	[redacted]
A	**Total direct costs**	[redacted]	[redacted]	[redacted]	[redacted]
	Indirect cost	[redacted]	[redacted]	[redacted]	[redacted]
	Contractors design costs	[redacted]	[redacted]	[redacted]	[redacted]
	Preliminaries	[redacted]	[redacted]	[redacted]	[redacted]
	Contractors overhead and profit	[redacted]	[redacted]	[redacted]	[redacted]
B	**Total indirect costs**	[redacted]	[redacted]	[redacted]	[redacted]
C	**Total construction cost (A+B)**	[redacted]	[redacted]	[redacted]	[redacted]
D	**Owners cost**	[redacted]	[redacted]	[redacted]	[redacted]
E	**Base estimate (C+D)**	[redacted]	[redacted]	[redacted]	[redacted]
	Contingency and risk allowance				

	Inherent and contingent risks (P50)	[redacted]			
	Contractors escalation				
F	**Total contingency and risk allowance**				
G	**Project cost estimate (E+F)**				
H	**Client escalation**				
I	**Program contingency recovery(P90)**				
J	**Corporate overhead recovery**				
K	**Total outturn costs (G+H+I+J)**	[redacted]	[redacted]	**$104.6m**	**100.00%**

Source: Aquenta. All monetary values in 2013-14 prices

The conversion of outturn costs into economic costs is outlined in Table 3.8. The undiscounted economic cost is estimated to be [redacted].

Table 3.8 Coniston Jct – Unanderra Upgrade Construction Costs (Economic Costs)

Item	$m
Total outturn cost	[redacted]
Less contractor escalation	
Less client escalation	
Less client overhead recovery	
Economic cost (undiscounted)	
Economic cost (discounted)	

Source: Deloitte analysis based on Aquenta cost information. Where discounted, values are discounted using a real discount rate of 4.4% p.a. All monetary values in 2013-14 prices

3.6.3 Contingency Management

The net risk allowance, to be controlled by the Project Control Group is;

Table 3.9 Contingency Allowances

Contingency Item	Value ($ m)
Inherent and Contingent risks (P50)	[redacted]
Project Contingency recovery (P90)	[redacted]
Total Contingency	[redacted]

A probabilistic risk assessment based on both 50% and 90% confidence levels has been undertaken and added to the reference design base estimate. These P50 and P90 financial risk contingencies considered in this risk assessment were based on both the inherent and contingent risks to the project.

The inherent risks within the Work Breakdown Structure (WBS) were ranged during the risk workshop from a best case, most likely and worst case costs with separate percentage likelihoods assigned to each of the best and worst case scenarios.

Contingent or event risks to the project were identified as additional separate to the WBS as most likely cost items (should they ever eventuate) and then ranged and provided likelihoods in the same manner as the inherent risks.

Further the estimate also included a contingency for contractors allowance for wet weather delays.

The ownership of the P50 and P90 contingencies would be subject to the future decision of TfNSW. However, a likely scenario is that the P50 contingency amount would be included in the D&C Contractor's proposal and the P90 contingency amount would be managed by TPD during construction delivery.

3.6.4 Ongoing Maintenance, Operating and Service costs

Whole of Life Costs

MDRL Option

The operating and maintenance costs for the MDRL were developed by Aquenta who developed a bottom up estimation of incremental operating and maintenance costs as a result of the scheme. The analysis was discussed with PB and TfNSW to ensure that the analysis was robust and used similar operating assumptions from these agencies currently being incurred on the rail network. The analysis assessed the following items:

- Tunnel: periodic capital maintenance cost
- Structures: including periodic capital replacement costs of the noise walls
- Systems: this includes tunnel lighting and power, mechanical ductwork and systems, ventilation fans and water piping.
- Water treatment plant: Monthly inspections will be required as well as minor ongoing maintenance
- Signalling: this includes regular inspections and the periodic replacement of 27 signal locations
- Civils: this includes inspections and minor repairs of cuttings, embankments and structural fill etc.
- Bridges: includes annual inspections and periodic replacement and corrections to joints and cracks
- Trackwork: this includes tamping and re-ballasting, rail grinding, sleeper replacement and new rail replacement.

The whole of life costs are summarised in Figure 3.19.

Beyond 2049, the whole of life costs were assumed to remain at 2049 levels.

[redacted]

3.6.5 Exclusions

The following exclusions for this project are assumed:

- SSFL / MFN upgrades are not included in scope of the MDRL project scope
- 25 KV AC electrification can be implemented in future and has been assessed but not included in cost forecasts
- Future capacity upgrades can be implemented in future and has been assessed but not included in cost forecasts
- Run off road subject to further risk assessment and cost review
- UMVL upgrades are excluded from MDRL project scope
- Wilton developments are assumed to have uncertainty and proposed bridges reflect existing road condition

4 JUSTIFICATION

4.1 The Economic Appraisal

4.1.1 Demand Assessment

Background

This Demand Forecast Working Paper (the 'Working Paper') outlines the key demand projections used as the basis for the likely usage within the Final Business Case.

This Working Paper outlines the range of candidate or contestable commodities that may be handled by rail on the MDRL. For completeness, this Working Paper also covers commodities that may not necessarily be handled by rail on the MDRL, but may be displaced on to another line or on to road if the MDRL was not developed.

A Preliminary Business Case was prepared and submitted into the Transport for NSW Gateway Assurance process in September 2013 and was approved. At that time, the feasibility of developing the MDRL was tested with and without the full rollout of the *Sydney's Rail Future*[19]. Should it be implemented available rail freight capacity on the Illawarra Line, the main rail route into the South Coast, will significantly reduce with a growth in off-peak passenger services and other initiatives. Some of the Illawarra Line passenger service growth initiatives may be implemented in response to population growth in the region independently of Sydney Rail Future.

Based on further policy developments, it was advised in late 2013 that the MDRL Final Business Case should assume a full rollout of *Sydney's Rail Future*. Accordingly, this Working Paper outlines the range of commodities and the train paths to convey these commodities to reflect the reduced capacity available to rail freight on the Illawarra Line from 2031.

This section provides an overview of the current and future growth in a number of freight markets as well as providing an indicative assessment of the anticipated freight transport task, the likely propensity to use the MDRL and its implication for demand for freight paths into and out of the Illawarra. The analysis is based on the freight demand assessment work undertaken by Worley Parsons[20].

Factors influencing demand

The potential of MDRL to attract freight has been based on a range of factors. Commodities that could potentially be attracted to use MDRL must be commodities that can be moved by rail. Certain freight cannot economically be transported by rail due to its time sensitivity, the absence of a direct rail link or limited scale.

Future demand on the MDRL will also be shaped by:

- The propensity of existing commodities currently transported by rail into and out of the Illawarra to shift on to the MDRL – e.g. Western Coal or from UMVL to MDRL – e.g. Tahmoor Coal

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[19] *Sydney's Rail Future* is the NSW Government's current plan to improve the capacity and efficiency of Sydney's rail network for passenger operations.

[20] Maldon to Dombarton Rail Link Freight Access Plan, Worley Parsons, 30 August 2013.

- The propensity of existing commodities currently transported by road to switch to rail and on to the MDRL – this is considered unlikely at this stage
- Growth in volumes of existing commodities moved either by road (unlikely) or rail e.g. Western Coal
- The emergence of new trades due to development of Outer Harbour at Port Kembla or development within the Illawarra region – this is not factored in the demand forecasts.

This section outlines the prospects of a range of commodities that may be candidates for haulage on the MDRL.

Future demand on the MDRL will also be shaped by:
- Capacity constraints on other rail corridors
- Capacity constraints on the MDRL.

These factors will be reflected in the allocation of paths by route, discussed in the next section.

Demand for the link

As mentioned in the previous section, Port Kembla is a key generator and attractor of freight, predominantly handled through the Port for import and export. Activities at the Port are anticipated to increase with time in terms of volumes and the range of commodities handled. Key commodities handled at the Port that were considered as part of the project business case include:

- Coal
- Grain
- Steel
- Other metals and ores
- Motor vehicles – not feasible for rail transport currently
- Containers – not feasible for rail transport currently

In addition, there exist a few relatively minor freight generators in the Illawarra including:

- Manildra's activities at Bomaderry
- Aggregates and ballast extracted from Dunmore and Bombo quarries.

Activities at Port Kembla are anticipated to increase initially in terms of volumes although tonnages decrease slightly with the assumed cessation of ballast and aggregate extraction from 2031. Table 1 outlines the assumed annual throughputs by commodity by model year. For reference, tonnages projected in previous studies are outlined in Appendix A.

Table 4.1 Assumed Annual Throughputs by Commodity and by Model Year

Commodity	2014	2021	2031	Notes and Sources
[redacted]	0.00Mtpa	0.62Mtpa	0.62Mtpa	[redacted]
	0.35Mtpa	0.50Mtpa	0.50Mtpa	
	0.10Mtpa	1.70Mtpa	1.70Mtpa	
	4.00Mtpa	5.70Mtpa	5.70Mtpa	
	2.00Mtpa	2.00Mtpa	2.00Mtpa	
	2.00Mtpa	3.00Mtpa	3.00Mtpa	
	0.40Mtpa	0.40Mtpa	0.40Mtpa	

[21] EIG (2014), *Rolling Stock Operational Cost Model*

[redacted]	1.60Mtpa	1.60Mtpa	1.60Mtpa	[redacted]
	0.50Mtpa	0.50Mtpa	0.50Mtpa	
	1.35Mtpa	2.35Mtpa	2.35Mtpa	
	1.50Mtpa	1.50Mtpa	-	
	1.50Mtpa	1.50Mtpa	-	
	1.00Mtpa	1.00Mtpa	1.00Mtpa	
	0.15Mtpa	0.15Mtpa	0.15Mtpa	
Total	**16.45Mtpa**	**22.52Mtpa**	**19.52Mtpa**	

[redacted]

Each of these commodities is considered in turn in the following sections.

Coal

The Port Kembla Coal Terminal is the fourth largest coal export terminal in Australia and receives coal from the Western and Southern Coalfields of NSW. These coalfields produce steaming (thermal) coal and coking coal (metallurgical) respectively.

Coal is the largest export product through Port Kembla amounting to 13.4 Mt in 2012-13[24]. 50% is by road from Appin and is non contestable. This represented 72% of all export tonnages through the Port. In response to demand from Asia, export volumes have grown over the past four years but declined in the last year. Export volumes actually fell in 12/13 due to a slowdown in China's economy.

- 08/09=13.2 Mtpa,
- 09/10=13.7 Mtpa,
- 10/11=14.0 Mtpa,
- 11/12=14.6 Mtpa and
- 12/13=13.5 Mtpa.

In addition to these export volumes, the BlueScope Steelworks receives approximately 2 Mtpa of coal from the Hunter Valley by rail.

The prospects of key Western and Southern coal mines are outlined briefly as follows:

Western Coalfields

Export Western Coalfields coal is sourced from a number of sources near Lithgow including:

- **Airly** is an underground steaming coal mine north west of Lithgow. The mine was acquired in 1997 by Centennial Coal. Although the mine moved to 'care and maintenance' in 2013, Airly reopened in March 2014. Projected coal reserves are estimated to be 33.7Mt, equivalent to 18-20 years of production.
- **Clarence** is an underground steaming coal mine located near Lithgow jointly owned by Centennial Coal and SK Energy Australia Pty Ltd. The mine has a production capacity of 2.5Mtpa. Projected coal reserves are estimated to be 46.7Mt, equivalent to 20 years of production.

[22] DIPNR (2004), *Proposed Boral Dunmore Quarry Production Increase – Assessment Report*

[23] Cowman Stoddart (2012), *Shoalhaven Starches Expansion Project Proposed Operational and Process Improvements Relating to Project Approval MP06_0228 Environmental Assessment*. Based on 20,000 tonnes of flour per week processed at Manildra's plant.

[24] NSW Ports (2013), *Trade Report 2012-13, p. 7*

- **Springvale** is an underground steaming coal mine located near Lithgow, jointly owned by Centennial Coal and SK Energy Australia Pty Ltd. Springvale primarily supplies coal to power stations at Wallerawang and Mt Piper. The mine has a capacity of 3.5Mtpa, with 3Mtpa mined in 2011. Projected coal reserves are estimated to be 61.1Mt, equivalent to 18 years of production. The mine has been operational since 1992.
- **Charbon** is an underground and open cut steaming coal mine located near Kandos, majority owned by Centennial Coal. Production capacity is 1.3Mtpa although underground operations have recently ceased. Open cut operations are due to cease by 2015.

Currently, these mines collectively produce an average of 4Mtpa, primarily for exports and this volume is expected to increase to up to an average of 5.7Mtpa. Most of this product is currently transported through Port Kembla via the Illawarra Line. These volumes are candidates for transfer to the MDRL.

Hunter Valley Coal

Hunter Valley coal is largely exported out of the Port of Newcastle. However, a small quantity is transported by rail from Mt Thorley to the BlueScope Steelworks at Port Kembla as an input to the steel manufacturing process. This traffic is currently around 2Mtpa and is expected to remain constant in the future. Hunter Valley coal is a potential MDRL candidate.

Tahmoor Coal

Tahmoor Colliery is an underground coal mining operation situated in the Southern Highlands, some 75km south west of Sydney. The mine currently generates 3Mtpa of predominantly hard coking coal which is exported by rail via the Unanderra to Moss Vale Line (UMVL) out of Port Kembla. [redacted]

These volumes could divert onto the MDRL as the MDRL offers a shorter route compared to the UMVL.

Western and South Western ores

Western Ores: Gold and copper concentrate from Newcrest Mining's Cadia Mine near Orange are projected to increase from 0.35Mtpa per annum currently to about 0.5Mtpa with an expansion of operations. These commodities are currently transported via the Illawarra Line but could be transported via the MDRL.

South Western Ores: A further 0.1Mtpa to 0.2 Mtpa of gold and copper concentrate is moved from Rio Tinto's Northparkes mine via Moss Vale.

In addition, iron ore reserves near Tottenham and bauxite reserves near Taralga may generate additional ore volumes from the south west. If economic, iron ore deposits near Tottenham may realise up to 3Mtpa. Bauxite reserves in Taralga North and South may generate between 1-2Mtpa and 2-3Mtpa respectively. If developed, these commodities would travel via UMVL. The demand forecasts assume a partial realisation of 1.5Mtpa from one of these reserves.

Grain

Port Kembla is the main export gateway for NSW grain with 2.6 Mt exported from the Port in 2012-13[25]. This accounts for 61% of total NSW bulk grain exports, with Port of Newcastle being the other major export outlet. Year to year, grain volumes can vary significantly depending on crop yields. Different regions can have good/bad years which will affect the port of export.

Projections prepared by [redacted] assume that average NSW grain harvest would be steady at [redacted]. Approximately half of this volume would be exported through either Newcastle or Port

[25] Ibid **Error! Bookmark not defined.**

Kembla with historically slightly higher share of 60% of exported grain going through Port Kembla.

The main grain growing areas using Port Kembla are south-west and western areas of NSW and exports through Port Kembla are currently transported by rail using the UMVL. Relative to the MtDRL, the UMVL offers a shorter route to Port Kembla for traffic operating through Cootamundra, and hence it is assumed that grain would not use the MtDRL

Steel

Steel is produced by BlueScope at Port Kembla. Coal and limestone, key inputs into the steel manufacturing process, are transported by rail. The BlueScope steelmaking operation at Port Kembla is the largest manufacturer and supplier of flat steel in Australia by volume and manufactures slab, hot rolled coil and plate products.

Of the steel produced at Port Kembla, approximately 2Mtpa is transported to a variety of destinations including Newcastle, Brisbane, Whyalla and Hastings (via the Melbourne Steel Terminal). These volumes are generally handled by rail on the Illawarra Line to Sydney in preference to UMVL due to steep grades on UMVL. This could be accommodated on the MDRL with certain changes to the motive power of the train, given the steep gradients the heavily loaded trains must transverse.

Limestone

Limestone from Marulan is transported to the BlueScope Steelworks at Port Kembla for input into the steel making process. Current volumes are at 0.5Mtpa and are moved via the UMVL and unlikely to divert to MDRL given the longer route.

Cement

A new cement terminal at Port Kembla is currently being planned. If developed to its full potential, it would be used to move up to 0.8 Mtpa of cement produced in Tasmania, destined for the Sydney market. The demand forecasts assume 0.6Mtpa would be realised, with the balance used locally in the Illawarra..

The MDRL would be a potential route for cement trains to move product from Port Kembla to a cement terminal in the Sydney metropolitan area.

Ballast and aggregate

Ballast and aggregates is quarried from Bombo and Dunmore respectively on the NSW South Coast. Boral operates the Dunmore Quarry, producing approximately 1-2Mtpa of aggregate. Boral's planning approvals largely restrict the movement of outputs at the quarry to rail, aggregates are then transferred to truck at St Peters and Enfield for delivery throughout the Sydney metropolitan area.

RailCorp operates the Bombo Quarry, which supplies ballast for rail construction and infrastructure maintenance works. The quarries are assumed to reach end of life by 2031 or revert to local production with road distribution.

Manildra products

The Manildra Group plant at Bomaderry produces starch, gluten, flour, glucose and by-products including ethanol. The main inputs to this process include:

- Grains and flour from regional NSW (Manildra, Gunnedah and Narranderra)
- Coal from Wallerawang ([redacted] per day by road)
- Acid and caustic products ([redacted] per week)

Flour and grain are transported by rail from Manildra's flour mills at Manildra, Gunnedah and Narrandera. Manildra recently constructed a flour mill to enable the milling of grain to flour. The remainder of the Manildra's flour requirement will continue to be sourced from the Manildra's off-site

flour mills. The plant has the capability of handling up to 20,000 tonnes of flour each week either by processing grain on site or using flour transported directly to the site.

- [redacted] of containerised exports by rail to Port Botany
- Various starch and glucose products by road to various industrial consumers
- Ethanol by road to Sydney for fuel blending and industrial uses.

The UMVL and Illawarra Line are preferred routes for the movement of goods into and out of Manildra's plant. However, the MDRL may be an alternative route should capacity on the Illawarra Line become constrained.

4.1.3 Excluded commodities

A range of other commodities were also considered but were not included in the scope of the Final Business Case. These commodities include:

Helensburgh Coalfield (Metropolitan Coal)

Helensburgh Coal is sourced within the Illawarra to the north of Port Kembla. The majority of this coal (1.5 Mtpa) is transported by rail to Port Kembla via the South Coast Line, with small volumes (0.14 Mtpa) transported by road. A further 0.22 Mtpa of reject coal is transported by road to the Glenlee Washery for disposal. Given that the coalfields are located adjacent to South Coast Line, no coal volumes from Helensburgh are expected to be carried using the MDRL.

Illawarra Coal

Illawarra Coal (part of BHP Billiton) operates two underground coal mines, generally beneath the route of the MtDRL with pit tops at Appin, West Cliff and Dendrobium. Output from the Appin and West Cliff mines is planned to increase from 7.5 Mtpa to 10.5 Mtpa. Both mines transport product by road to the West Cliff Washery, after which it is transported by road to the Port Kembla Coal Terminal for export, or to the BlueScope Steelworks. The mine has planning consent for road only operation.

The future road task from Appin and West Cliff to the port and the steelworks could amount to 9 Mtpa. This could generate 247,000 round trip truck movements per annum.

Currently, the mines' operations are set-up for road and if a switch to rail were to occur there would be a need for infrastructure investment to enable a switch. Consultation with Illawarra Coal has indicated that at present there are no plans for such a switch.

Illawarra coal also operates Dendrobium, which is 8 kilometres from Wollongong. The mine is approved to produce 5.2 Mtpa with an expected mine life of 20 years. The main customers for this product are BlueScope Steel in Port Kembla and OneSteel in Whyalla in South Australia, as well as some export coal out of Port Kembla. Currently, coal is transported by conveyor to the Kemira Valley coal loading facility and then by rail to the Dendrobium Coal Preparation Plant at Port Kembla via BHP Billiton's private railway. Given this existing supply chain, the Dendrobium coal is not a candidate for MDRL or the UMVL and has not been considered.

Wollongong Coal

Formerly owned by Gujarat NRE, Wollongong Coal owns two mines at Russell Vale and at Wongawilli, which have a projected mine life of 30 years. Recent capital investment at the mines has the potential to increase production from 1.1 Mtpa to 5 Mtpa by 2016.

Although Wongawilli coal is moved by rail, its proximity to the South Coast Line and Port Kembla mean that Wollongong Coal is not a candidate for MDRL. It was recently announced mine was going to care and maintenance.

Motor Vehicles

Port Kembla is the primary location for the import of motor vehicles in NSW with a throughput of 300,000 units per annum. NSW Ports, the current operators of Port Kembla, projects that motor vehicle import volumes will grow to between 0.8 million and 1.2 million units by 2043.

Currently, motor vehicle processing and storage occurs in West Dapto, Ingleburn and Leumeah and all transport occurs by road trailer. The truck movement to south west Sydney from Port Kembla occurs via Mt Ousley Road and Picton Road.

There have been previous investigations of transporting cars by rail to Enfield but this concept is currently not seen as economic. The major impediment to transporting motor vehicles by rail to Sydney is the lack of a suitable large receival location and tunnels which restrict rolling stock profiles. The WorleyParsons analysis concluded that the transporting of motor vehicles would likely continue by road.

Containers

Port Kembla does not currently handle any significant container trade as NSW's main container port is located at Port Botany in Sydney. Until recently, container throughput at Port Botany was limited to 3.2M TEU per annum, however, as part of the recent long term lease of the port this cap was lifted. The current status is:

- 3.2Mteu cap was lifted at Port Botany with no cap on container traffic. Some studies estimate that land side / rail constraints may limit container traffic to 5 to 7 Mteu
- New 3rd stevedore - Hutchison now operating at Port Botany
- The State's current policy position is that Port Kembla will be second container terminal in NSW, but NSW Portshas no forecast for commencement of container terminal at Port Kembla
- Port Kembla will continue to handle break-bulk in long term

While current Government policy (as outlined in NSW Freight and Ports Strategy) is to develop an alternative port at Port Kembla; the actual timing and implementation is dependent on the new private owner (NSW Ports). A possible trigger may be once capacity is reached at Port Botany,. The development of a container terminal at Port Kembla with the capacity of up to 1M TEU per annum has been included as part of the Outer Harbour development.

Another trigger may be the planning constraint limiting the use of road for the landside transport of containers (most of which will be destined for Sydney), there is significant potential to use MDRL to connect to container processing locations, such as the potential Moorebank precinct, in south west Sydney.

Given the uncertain timing of the Outer Harbour expansion, no container volumes have been assumed on MDRL within the assessment period of the Business Case.

4.1.4 Capacity by line

This section details how the demand tonnages identified in earlier Section are translated into train paths and how the demand for train paths would be met by the rail network proposed for 2031.

Table 4.2 outlines the assumed daily capacity available to rail freight for each rail line leading to Port Kembla from Sydney line up to 2031 and from 2031. The table assumes a growth in passenger operations on the Illawarra line and that the full implementation of *Sydney's Rail Future* has been completed and hence only either zero or eight paths are available:

Table 4.2 Assumed Daily Rail Capacity by Line#

Line	Up to 2031	2031 Onwards
Illawarra Line	60 paths	0/8 paths[26]
UMVL	24 paths	24 paths
MDRL (with Coniston Junction upgrade)	36 paths	36 paths

Capacity represents the total number of paths in both directions.

Background information used to inform these capacity assumptions is provided as follows:

Illawarra Line

The Illawarra Line is currently the primary rail conduit into the Illawarra. Capacity currently available for freight on the Illawarra Line, as measured at Waterfall, is estimated to be up to 60 paths per day (up to 30 in each direction). Up until 2031 there may be some reduction due to growth in passenger trains during the day.

Post 2031, it is anticipated that available capacity will be restricted due to the planned increase in passenger service frequencies on the Illawarra Line. The NSW Government's *Sydney's Rail Future* policy anticipates a need to increase passenger services on the Illawarra Line. This would result in rail capacity on the Illawarra Line being increasingly used by passenger services, reducing the capacity available for freight services.

Assumptions made by Transport for NSW as part of the *Sydney's Rail Future* has assessed the impact of increasing passenger service frequencies on the Illawarra Line and estimated that the likely future rail freight capacity in this corridor could be limited to 8 paths per day by 2031, with freight confined to night/early morning movements. An additional scenario with 0 paths per day has also been tested should passenger train infrastructure changes preclude any night time freight movements.

Maldon-Dombarton Line

The nominal design capacity of the MDRL has been assessed to be 36 paths per day, on a single line track with 3 passing loops.

To ensure the capacity of the MDRL is not constrained, upgrades between Coniston Junction and Unanderra would also need to be undertaken. Located to the south of Coniston Station, this section of track is a key pinch point for rail operations in the Illawarra. Rail movements to and from Port Kembla enter the rail network at this junction, mixing in with passenger and other freight movements on the South Coast Line. Various tracks cross at grade, which requires passenger services to cross paths with freight trains. Without an upgrade, the combined capacity of the MDRL and UMVL would be restricted to about 32 paths per day because of the Coniston to Unanderra section.

Moss Vale to Unanderra Line

The UMVL's capacity is assumed to remain at the current levels of 24 paths per day.

4.2 Network response to demand

Table 4.3 outlines the current and projected allocation of train paths by commodity and by model year. To guide route allocation, each commodity has been assigned an indicative origin and

[26] Two scenarios are to be tested as part of the Final Business Case. Scenario 1 is based on a capacity of 8 paths per day. Scenario 2 is based on a capacity of 0 paths per day.

destination. Where a commodity may be delivered from or to multiple locations, a common origin or destination has been assumed for each commodity.

Table 4.3 Projected Daily Train Paths Required by Demand Scenario

Freight Type	Indicative Origin	Indicative Destination	2014	2021	2031
Cement	Port Kembla	Chullora	[redacted]	[redacted]	[redacted]
Western Ores	Blayney	Port Kembla	[redacted]	[redacted]	[redacted]
South Western Ores	Tottenham / North Parkes	Port Kembla	[redacted]	[redacted]	[redacted]
Coal - Western	Charbon Colliery	Port Kembla	[redacted]	[redacted]	[redacted]
Coal - Hunter	Mount Thorley Mine	Port Kembla	[redacted]	[redacted]	[redacted]
Coal - Tahmoor	Tahmoor	Port Kembla	[redacted]	[redacted]	[redacted]
Grain - Western	Parkes	Port Kembla	[redacted]	[redacted]	[redacted]
Grain - South Western	Cootamundra	Port Kembla	[redacted]	[redacted]	[redacted]
Limestone	Marulan	Port Kembla	[redacted]	[redacted]	[redacted]
Steel products	Port Kembla	Sydney (then Melb / Brisbane)	[redacted]	[redacted]	[redacted]
Ballast	Bombo	Chullora	[redacted]	[redacted]	[redacted]
Aggregates	Dunmore	Enfield	[redacted]	[redacted]	[redacted]
Manildra - Grain	Cootamundra	Bomaderry	[redacted]	[redacted]	[redacted]
Manildra - Containers	Cooks River Goods	Bomaderry	[redacted]	[redacted]	[redacted]
Total			64	72	64

Current train path requirements have been based on the prevailing standard working timetable with a Wednesday base. The number of train paths assumed for each commodity reflects the number of paths required to securitise the flow of the commodity to its destination. This in turn reflects allowances made to provide service flexibility in response to production variations (volume and timing variations) as well as the need for flexible paths to maintain service reliability for both freight and passenger movements.

In some cases, train lengths may be extended in the future to cater for future growth. However, an increase in paths has been projected to be required to allow for growth in the following trades:

- Cement
- South Western Ores
- Western Coalfields
- Steel.

The core demand projections assume that ballast and aggregates do not continue to be produced and transported by rail from 2031. A summary of key changes are outlined in Table 4.4

Comparison of Demand against Capacity

Based on the capacity assumptions outlined in Section 4.3 and the train path allocations outlined in Table 4.3, Figure 4.1 and Figure 4.2 provide a comparison of the demand for paths relative to supply.

Figure 4.1: Comparison of Demand versus Capacity under Scenario 1

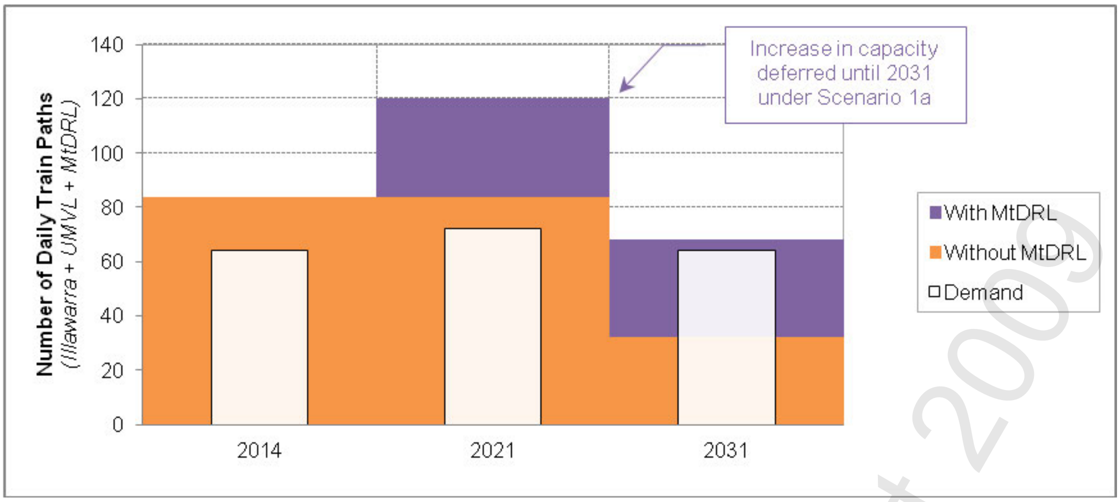
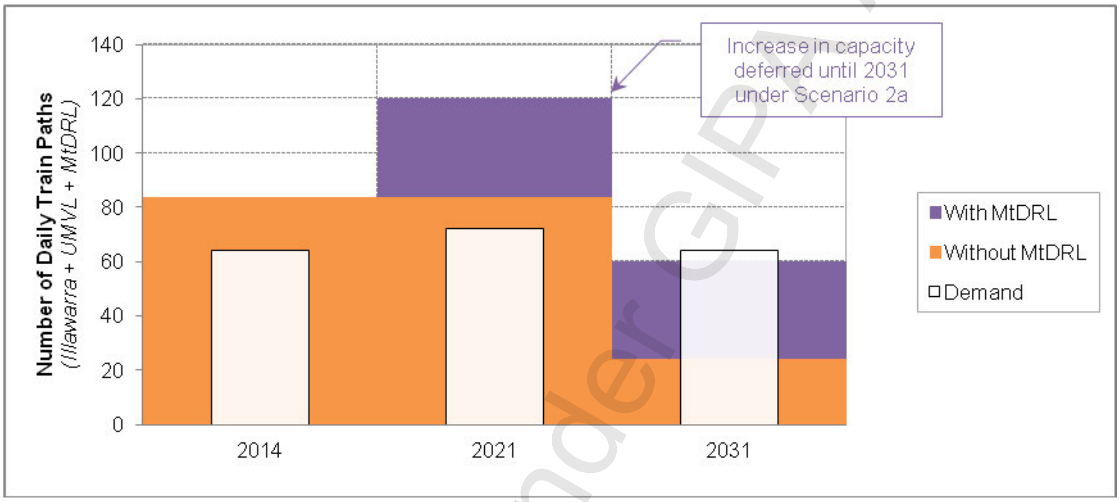


Figure 4.2: Comparison of Demand versus Capacity under Scenario 2



Across all lines feeding into the Illawarra region, current network capacity may be sufficient to meet the increase in demand up to the 2020s.

However post 2031, the anticipated fall in capacity available for freight on the Illawarra Line results in total capacity falling close to anticipated demand. Without the MDRL, network capacity is likely to fall well short of anticipated demand for paths.

Table 4.4 Summary of Key Changes over Time

Freight Type	Changes between 2014 and 2021	Changes between 2021 and 2031
Total paths demand	Increase from 64 paths per day to 72 paths per day	After increasing to 72 paths from 2021, the number of paths allocated decreases to 64 paths from 2031
Total capacity	Illawarra Line: </=60 paths UMVL: 24 paths MDRL: 36 paths after construction (first year of operations in 2021)	Illawarra Line: 0 - 8 paths after the full implementation of *Sydney's Rail Future* in 2031. UMVL: 24 paths MDRL: 36 paths
Cement	[redacted]	
Western Ores		
South Western Ores		
Coal - Western		
Coal - Hunter		
Coal - Tahmoor		
Grain - Western		
Grain - South Western		
Limestone		
Steel products		
Ballast		
Aggregates		
Manildra - Grain		
Manildra - Containers		

4.3 Demand Allocation

This section relates to prioritisation if MDRL is not built and there is no freight capacity on the Illawarra line. The assumptions stated are not true for all scenarios.

Subject to available capacity, train paths were allocated between three lines – the Illawarra Line, the UMVL and the MDRL. Generally, trains were allocated on the route that is shortest in length from origin to destination. However, some exceptions have been applied to reflect route choices currently made by shippers and operational restrictions.

Where insufficient capacity is available to cater for all commodities, certain commodities were assumed to either be redirected to other ports or on to road.

Table 4.3 outlines the general priority and alternative mode or destination assigned to different commodities, with commodities at the bottom of the following list assumed to switch to road more readily if capacity is not available.

Table 1.5 Alternative Mode/Destination

Commodity	Next Best Alternative
Coal - Western	No alternative – assigned highest priority due to large volume and distance
Coal - Hunter	No alternative – assigned highest priority due to large volume and distance
Manildra freight	No alternative – assigned highest priority due to low margins
Western Ores	Rerouting to the Port of Newcastle
SW Ores	Rerouting to the Port of Newcastle
Grain – Western	Rerouting to the Port of Newcastle
Grain – South Western	Rerouting to the Port of Melbourne
Coal – Tahmoor	Road
Steel	Sea
Limestone	Road
Aggregates	Road
Ballast	Road
Cement	Road

[redacted]

Generally, the prioritisation reflects:

- The physical limitations of moving bulk commodities using road
- The potential unviability of industries if road is used
- The potential to divert trades to other ports.

Should rail capacity be unavailable for grain and ores, alternative port destinations were identified that could readily accept these trades and where a rail route to the port may be available. For steel, coastal shipping has been identified as a cheaper alternative to road. All other commodities are assumed to be moved by road if sufficient rail capacity is not available.

Path allocation for 2014, 2021 and 2031 is outlined under the base case and with MDRL on the following pages. For reference, WorleyParsons path allocations are shown in Demand Assumptions Report (Deloitte) Appendix B. It should be noted that WorleyParsons' allocations are not constrained by an assumed restriction in capacity on the Illawarra Line post 2031.

2014 Routing

Table 4.6 outlines the current routes used by freight trains travelling to and from Port Kembla.

Table 4.6 2014 Path Allocation under the Base Case (no MDRL)

Commodity	Rail via Illawarra	Rail via UMVL	Rail via MDRL	Rail to Melbourne	Rail to Newcastle	Road	Total	Comments/Assumptions
Cement							-	
Western Ores	2						2	Potential candidate for MDRL
South Western Ores		2					2	Preference for UMVL due to its shorter distance
Coal - Western	18						18	Potential candidate for MDRL
Coal - Hunter	4						4	Potential candidate for MDRL
Coal - Tahmoor		8					8	Potential candidate for MDRL as UMVL is a longer route
Grain - Western		2					2	Total grain exports range between 1.5 to 3.0 Mtpa depending on yields. Preference for UMVL due to its shorter distance
Grain - South Western		8					8	
Limestone		2					2	Preference for UMVL due to its shorter distance
Steel products	4						4	Preference for the Illawarra Line due to its heavy trains
Ballast	4						4	Preference for the Illawarra Line due to its location on the South Coast Line
Aggregates	4						4	Preference for the Illawarra Line due to its location on the South Coast Line
Manildra - Grain	2	2					4	Mixture of preferences based on where Manildra sources its grain and flour. All containers have preference via the Illawarra to Port Botany.
Manildra - Containers	2						2	
Total Demand	40	24					64	
Capacity	60	24					84	

Source: Project assumptions

2021 Routing

By 2021, it is projected that the demand for train paths would increase from 64 paths per day to 72 paths per day. The increase of 8 paths is assumed to be due to:

- Two new cement train paths between Sydney and Port Kembla
- Two new coal paths between Lithgow and Port Kembla
- Two new steel paths between Port Kembla and various destinations
- Two new South Western ore trains between the south west and Port Kembla.

Table 4.5 & 4.6 outline the assumed routes used by freight trains travelling to and from Port Kembla in 2021 under the base case and with Project case in 2021.

Table 4.7 2021 Daily Path Allocation under the Base Case (unconstrained capacity on Illawarra Line)

Commodity	*Rail via Illawarra*	*Rail via UMVL*	*Rail via MDRL*	*Rail to Melbourne*	*Rail to Newcastle*	*Road*	*Total*	Assumed Changes Relative to 2014
Cement	[redacted]							
Western Ores	[redacted]							
South Western Ores	[redacted]							
Coal - Western	[redacted]							
Coal - Hunter	[redacted]							
Coal - Tahmoor	[redacted]							
Grain - Western	[redacted]							
Grain - South Western	[redacted]							
Limestone	[redacted]							
Steel products	[redacted]							
Ballast	[redacted]							
Aggregates	[redacted]							
Manildra - Grain	[redacted]							
Manildra - Containers	[redacted]							
Total Demand	**48**	**24**					**72**	
Capacity	**60**	**24**					**84**	

Source: Project assumptions

Table 4.8 2021 Daily Path Allocation with MDRL (unconstrained capacity on Illawarra Line)

Commodity	*Rail via Illawarra*	*Rail via UMVL*	*Rail via MDRL*	*Rail to Melbourne*	*Rail to Newcastle*	*Road*	*Total*	Assumed Changes Relative to 2014
Cement	[redacted]							
Western Ores	[redacted]							
South Western Ores	[redacted]							
Coal - Western	[redacted]							
Coal - Hunter	[redacted]							
Coal - Tahmoor	[redacted]							
Grain - Western	[redacted]							
Grain - South Western	[redacted]							
Limestone	[redacted]							
Steel products	[redacted]							
Ballast	[redacted]							
Aggregates	[redacted]							
Manildra - Grain	[redacted]							
Manildra - Containers	[redacted]							
Total Demand	16	20	36				72	
Capacity	60	24	36				120	

Source: Project assumptions

Notes: Additional traffic through UMVL and MDRL will result in essential upgrades at Coniston Junction with higher volumes requiring grade separation as noted in section 3.1.2. Upgrades for Southern Sydeny Freight Line and Main Freight Network may be required in line with increased freight as outlined in the PB Operations Modelling Report

2031 Routing under Scenario 1 (8 Paths on the Illawarra Line)

From 2031, demand for paths is assumed to fall from 72 paths to 64 paths following the cessation of the aggregate and ballast trades. To accommodate the movement of coal from the Western Coalfields and Hunter Valley, all previous movements on the UMVL have been reallocated to alternative rail routes or on to road under the base case.

As mentioned previously, the full implementation of *Sydney's Rail Future* in response to increasing passenger demand is likely to result in the capacity available for freight movements being reduced from the current up to 60 paths on the Illawarra Line to 8 paths (Scenario 1) and potentially zero paths (Scenario 2) from 2031.

To assess the impact of *Sydney's Rail Future*, capacity available to freight on the Illawarra Line was assessed for the above two scenarios from 2031. The reduction in train paths available on the Illawarra Line would have a profound impact on the distribution and level of freight that can be handled by rail.

Table 4.7 & 4.8 outline the assumed distribution of train paths under the base case and with Project case respectively if capacity were restricted to 8 paths per day on the Illawarra Line in 2031.

Table 4.9 2031 Daily Path Allocation under the Base Case for Scenario 1 (no MDRL)

Commodity	Rail via Illawarra	Rail via UMVL	Rail via MDRL	Rail to Melbourne	Rail to Newcastle	Road	Total	Assumed Changes Relative to 2021 Base Case
Cement	[redacted]							
Western Ores								
South Western Ores								
Coal - Western								
Coal - Hunter								
Coal - Tahmoor								
Grain - Western								
Grain - South Western								
Limestone								
Steel products								
Ballast								
Aggregates								
Manildra - Grain								
Manildra - Containers								
Total Demand	8	24	-	8	8	16	64	
Capacity	8	24	-				32	

Source: Project assumptions

Table 4.10 2031 Daily Path Allocation with MDRL for Scenario 1 (8 paths capacity on Illawarra Line)

Commodity	Rail via Illawarra	Rail via UMVL	Rail via MDRL	Rail to Melbourne	Rail to Newcastle	Road	Total	Assumed Changes Relative to 2021 with MDRL Case
Cement	[redacted]							
Western Ores	[redacted]							
South Western Ores	[redacted]							
Coal - Western	[redacted]							
Coal - Hunter	[redacted]							
Coal - Tahmoor	[redacted]							
Grain - Western	[redacted]							
Grain - South Western	[redacted]							
Limestone	[redacted]							
Steel products	[redacted]							
Ballast	[redacted]							
Aggregates	[redacted]							
Manildra - Grain	[redacted]							
Manildra - Containers	[redacted]							
Total Demand	8	20	36				64	
Capacity	8	24	36				68	

Source: Project assumptions

2031 Routing under Scenario 2 (0 Paths on the Illawarra Line)

4.9 & 4.10 outline the distribution of train paths under the base case and with Project case respectively if capacity were restricted to 0 paths per day on the Illawarra Line from 2031.

Table 4.11 2031 Daily Path Allocation under the Base Case for Scenario 2 (0 paths capacity on Illawarra Line)

Commodity	*Rail via Illawarra*	*Rail via UMVL*	*Rail via MDRL*	*Rail to Melbourne*	*Rail to Newcastle*	*Road /Sea*	*Total*	Assumed Changes Since 2021 Base Case
Cement	[redacted]							
Western Ores	[redacted]							
South Western Ores	[redacted]							
Coal - Western	[redacted]							
Coal - Hunter	[redacted]							
Coal - Tahmoor	[redacted]							
Grain - Western	[redacted]							
Grain - South Western	[redacted]							
Limestone	[redacted]							
Steel products	[redacted]							
Ballast	[redacted]							
Aggregates	[redacted]							
Manildra - Grain	[redacted]							
Manildra - Containers	[redacted]							
Total Demand	**-**	**24**	**-**	**8**	**8**	**24**	**64**	
Capacity	**-**	**24**	**-**				**24 Rail**	

Source: Project assumptions

Table 4.12 2031 Daily Path Allocation with MDRL Case for Scenario 2

Commodity	*Rail via Illawarra*	*Rail via UMVL*	*Rail via MDRL*	*Rail to Melbourne*	*Rail to Newcastle*	*Road*	*Total*	Assumed Changes Since 2021 with MDRL Case
Cement	[redacted]							
Western Ores	[redacted]							
South Western Ores	[redacted]							
Coal - Western	[redacted]							
Coal - Hunter	[redacted]							
Coal - Tahmoor	[redacted]							
Grain - Western	[redacted]							
Grain - South Western	[redacted]							
Limestone	[redacted]							
Steel products	[redacted]							
Ballast	[redacted]							
Aggregates	[redacted]							
Manildra - Grain	[redacted]							
Manildra - Containers	[redacted]							
Total Demand	**-**	**24**	**36**		**2**	**2**	**64**	
Capacity	**-**	**24**	**36**				**60**	

Source: Project assumptions

4.3.4 Project Costs

Capital Costs

MDRL Costs

During the Procurement and Delivery Strategy work conducted by Evans and Peck and TPD (see section 6.4); it was decided that a Design and Construction contract was the only feasible option. A PPP option was assessed by Deloitte but not considered feasible except for an availability based payment model to be explored further.

The direct costs of the MDRL project have been provided by the project team cost estimator, Aquenta. The breakdown of these costs is detailed in Table 3.5. The total outturn cost is estimated to be $701 million in 2013-14 prices. Full details are provided earlier in section 3.6.2

[redacted]

An allowance for owners or government costs, risk and escalation and project contingency recover and corporate overhead recovery has also been included. Owner costs include the costs involved for the TfNSW to manage the project through environmental approval, procurement and tendering and management during the construction phase.

[redacted] The assumed capital expenditure profile for the project is shown in section 3.6.2. The construction period is assumed to be incurred over 5 years from 2016 to 2020. The pre-construction works program is expected to be as follows:

- 2014 – Planning Approvals, Environmental Impact Statement, Project Development in Stages 2 and 3, Funding Approval
- 2015 – Procurement and tendering, contract award (including Expression of Interest to RFT stage)
- 2016 – Start of construction.

The direct costs of the Coniston project have been provided by the project team cost estimator, Aquenta. The total outturn cost is estimated to be $105 million.

A number of adjustments have been made to the project costs in order to convert outturn estimates to economic costs for application in the economic evaluation. These adjustments include:

- Removal of contractor profit, as this is considered a transfer payment between the government and the private sector and does not reflect a resource cost and consequently does not affect economic welfare
- Extra project scope client contingency usually reflects an augmentation of the project for which benefits should normally accrue. Given that these benefits are not quantified, the additional cost to allow for scope change has also been removed from the economic costs
- Adjustment of escalation estimates (contractor and client escalation) to remove the general increase in prices and reflect only real escalation increases over time.

[redacted] These resulting economic costs are summarised in section 3.6.2.

Key risks for Costs

Table 4.13 Key risks for Costs

RISK DESCRIPTION	P50 'true expected' VALUE
Cordeaux river rail bridge	[redacted]
Contractors Indirect Costs	
Design	
Tunnel Works	
Ballasted Track	
Nepean River Rail Bridge	
Systems	
May need to replace the existing capping (Event Risk)	
Drainage	
Embankment construction	
Wilton Earthworks 126km980 to 132km400	
Hume Highway Overbridge	
Portal Door supply and manufacturing (Event Risk)	
Unsuitability of cutting treatments to existing cuttings/embankments (Event Risk)	

Source: Aquenta, June 2014

Coniston Junction Upgrade Costs

In order to provide an increase in capacity to enable the full functionality of the MDRL, upgrade works are required between Coniston and Unanderra.

These include an additional siding and platform at Unanderra, a grade separated connection on the Down Main over the Port Kembla branch line and triplication of track between Coniston Junction and Unanderra. The outturn cost of these works was assessed by Aquenta to be $105m and are assumed to be incurred between 2017/18 and 2018/19 . The capital costs for upgrading Coniston Junction to Unanderra are summarised in section 3.5.4.

These costs are assumed to be incurred equally between 2019 and 2020.

[redacted]

Residual Value

The project infrastructure has been assigned a residual life to the key components of fixed infrastructure with economic lives that extend beyond the evaluation period. For the purposes of the analysis it is assumed that rail capital assets are considered to have the following economic lives[27] outlined in Table 4.14 for initial capital expenditure items and Table 4.15 for recurrent capital expenditure items. Shorter economic lives have been assumed for recurrent capital expenditure items to reflect the more frequent replacement of these assets.

Table 4.14 Assumed Economic Lives (Initial Capital Expenditure Items)

Major Asset Category	Life (Years)
Civil works (earthworks)	60
Tunnels	125
Structures (bridges)	120

[27] Assumptions based on similar projects and ATC guidelines.

Track	30
Systems (signalling, communications, electrical bulk supply, ventilation)	20
Utilities (existing services)	30
Roads (fire roads, access roads)	40
Miscellaneous (fencing)	30

Source: Deloitte assumptions based on ATC (2006d) and ATO (2013)[28]

Table 4.15 Assumed Economic Lives (Recurrent Capital Expenditure Items)

Major Asset Category	Life (Years)
Civil works (earthworks)	15
Tunnels	15
Structures (bridges)	10
Track	25
Systems (signalling, communications, electrical bulk supply, ventilation)	25
Utilities (existing services)	0
Roads (fire roads, access roads)	20
Miscellaneous (fencing)	10

Source: Deloitte assumptions based on Aquenta cost information

The residual value is derived from the application of the following formula:

$$\text{Residual value} = \text{Capital Cost} * \left(\frac{Ec_{life} - Ev_{period}}{Ec_{life}} \right)$$

Where:

- Ec_{life} = economic life of the asset; and
- Ev_{period} = evaluation period.

Based on a 50 year evaluation period, the above asset life assumptions, the undiscounted residual values are summarised by option in Table 4.15.

Table 4.16 Residual Value Estimates (Undiscounted)

Project Component	Initial Capital Base	Recurrent Capital Base	Total
MDRL	[redacted]		
Coniston Junction Upgrade			
Total			

Source: Deloitte calculations

All the options and cost comparison have been described earlier including section 2.6 Cost Comparison.

[28] ATO (2013), *TR 2013/4 - Income tax: effective life of depreciating assets (applicable from 1 July 2013)*

4.3.5 Value of Benefits

Introduction

The economic evaluation seeks to quantify the benefits arising from a change in system transport costs as a result of a transfer of freight commodities to the MDRL or the upgraded UMVL. These result in a number of potential benefits or cost savings as follows:

- Freight transit time benefits
- Savings in road and rail operating costs
- Externality cost reductions
- Crash cost savings
- Decongestion benefits as a result of reduced road congestion
- Reduced road damage costs.

Values for key parameters have been derived from several sources, including TfNSW (2013), Austroads, the ATC National Guidelines (ATC 2006) and the Infrastructure Australia Guidelines (Australian Government 2008).

The quantification of project benefits is based on the evaluation on the freight demand forecasts with sensitivity analysis undertaken to assess the impact of alternatives. In the evaluation, distinction is made between rail freight demand with the project upgrade option which is compared to the Base Case or without project option. Under the 'with project' case, there is also potential for mode shift (under some demand scenarios) of freight to rail from road arising from improvements in service and rail becoming more competitive with road transport due to increased capacity. The approach to quantifying each of the benefit categories is included in the following sections.

Key Parameters & Assumptions

The economic assessment of all 'with project' options has been undertaken against the base case. All economic estimates are based on the key parameters shown in Table 4.17:

Table 4.17 Key Parameters and Assumptions

Key Parameter	Value
Base year	2013-14
Real discount rate	4.4% per annum
Price year	2013-14
Commencement of operations	2021-22
Evaluation period	50 years from the first year of operations[29]
Valuation	In real terms. Valuations are in resource cost terms and exclude taxes
Stakeholder coverage	NSW Government, rail and road transport operators and the broader community
Indexation	No real indexation applied on other costs or benefits
Annualisation factor	320

[29] A 50 year evaluation period has been assumed which is in accordance with the Nation Building Notes on Administration guidelines. A sensitivity test has also been undertaken using a 30 year evaluation period, in line with ATC and Infrastructure Australia guidelines.

Vehicle Configurations

A range of economic and financial streams including externalities and track access charges are based on either net tonne kilometres or gross tonne kilometres. To inform the valuation of these streams, a series of assumptions specifying the configuration of trucks and trains are required.

Payloads

Table 4.18 outlines the assumed train payloads by commodity. These payloads were used as part of rail simulation work undertaken by Parsons Brinkerhoff to inform EIG's rail costing analysis, which features within this economic assessment. Assuming the use of wagons with the capacity to handle up to 76 tonnes, Table 4.18 also outlines the number of wagons required.

Table 4.18 Train Payloads

Commodity	Payload per Train	Wagons per Train
Cement	[redacted]	[redacted]
Western Ores	[redacted]	[redacted]
South Western Ores	[redacted]	[redacted]
Coal - Western	[redacted]	[redacted]
Coal - Hunter	[redacted]	[redacted]
Coal - Tahmoor	[redacted]	[redacted]
Grain - Western	[redacted]	[redacted]
Grain - South Western	[redacted]	[redacted]
Limestone	[redacted]	[redacted]
Steel products	[redacted]	[redacted]
Ballast	[redacted]	[redacted]
Aggregates	[redacted]	[redacted]
Manildra - Grain	[redacted]	[redacted]
Manildra - Containers	[redacted]	[redacted]

Source: EIG (2014)

To ensure that the economic assessment does not overestimate transport costs, imputed utilisation rates, which vary by year and commodity, were used to ensure the product of train payloads and train paths reflects the projected tonnages assumed in Table 4.18 above.

Should spare capacity be unavailable on the rail network, a number of commodities are assumed to be transported by road. Table 4.19 outlines assumptions regarding what type of truck would be used to move a given commodity by road, its payload and the number of trucks required to match the payload of one train.

Table 4.19 Truck Payloads and Number of Trucks per Train

Commodity	Truck Type	Assumed Payload per Truck (t)	Trucks Required per Train
Cement	[redacted]		
Western Ores	[redacted]		
South Western Ores	[redacted]		
Coal - Western	[redacted]		
Coal - Hunter	[redacted]		
Coal - Tahmoor	[redacted]		
Grain - Western	[redacted]		
Grain - South Western	[redacted]		
Limestone	[redacted]		
Steel products	[redacted]		
Ballast	[redacted]		
Aggregates	[redacted]		
Manildra - Grain	[redacted]		
Manildra - Containers	[redacted]		

Source: Deloitte assumptions

Train Configurations

Train configurations vary depending on the payload, gross mass of a train set and the operating conditions such as grades and braking en-route. Table 4.21 outlines EIG's assumptions regarding the number of locomotives required per train set by commodity. Table 4.18 outlined the number of wagons per train set by commodity.

For Western and Hunter coal trains, DC locomotives are predominantly used presently to haul coal towards Port Kembla. It is anticipated that a transition from DC to AC locomotives would occur sometime in the future. The higher power rating of AC locomotives is sufficient to reduce the number of locomotives required from 4 to 3 locomotives, reducing operating costs.

Table 4.21 Number of Locomotives

Commodity	Rail via Illawarra	Rail via UMVL	Rail via MDRL	Rail to Melbourne	Rail to Newcastle
Cement	[redacted]				
Western Ores	[redacted]				
South Western Ores	[redacted]				
Coal - Western	[redacted]				
Coal - Hunter	[redacted]				
Coal - Tahmoor	[redacted]				
Grain - Western	[redacted]				
Grain - South Western	[redacted]				
Limestone	[redacted]				
Steel products	[redacted]				
Ballast	[redacted]				
Aggregates	[redacted]				
Manildra - Grain	[redacted]				
Manildra - Containers	[redacted]				

Source: EIG (2014)

Transport Operating Cost Savings

In commercial freight markets, prices charged for transport services are generally based on the costs of provision. Thus, reductions in transport costs are likely to be shared between transport users (by way of lower prices) and transport providers (by way of higher profits). From an economic efficiency viewpoint, the appraisal is indifferent as to how the benefit falls and it is likely that in practice it will be shared depending on the level of contestability in the different markets.

For the purposes of this evaluation, this benefit has been identified as operating cost reductions, thereby occurring as increases in operator producer surplus. As a result of a more direct route or a switch of freight from road (or sea) to rail there will be cost impacts on all transport operators.

Rail Operating Costs

For the purposes of this evaluation, this benefit has also been identified as operating cost reductions, thereby occurring as increases in operator producer surplus. As a result of a more direct route or a switch of freight from road to rail there will be cost impacts on road and rail operators. To determine the cost impact of this effect, specialist train simulations were undertaken by Parsons Brinckerhoff were used to inform costing work undertaken by Everything Infrastructure Group (EIG)[30]. These simulations were undertaken to precisely reflect the differences in operating conditions on different routes into and out of the Illawarra.

The costing model incorporates the following costs:

- Fuel consumption costs
- Crewing costs
- Wagon and locomotive capital costs
- Maintenance costs
- Mid-life refurbishment costs.

These costs vary by:

- Level and cost of crewing
- Payload
- Distance
- Track curvature, gradients and operating condition
- Dwell times
- Locomotive type
- Train configuration
- Spares.

Costs estimates as provided by EIG are shown in Deloitte Report.

Three adjustments were made by Deloitte to convert the EIG data for use within the economic assessment:

- Removal of fuel excise to convert fuel market price costs into resource costs
- Conversion of capital and refurbishment costs in an annuity with costs evenly spread over a 30 year period using a cost of capital rate of 10% p.a.

[30] EIG (2014), *Rolling Stock Operational Cost Model*

- Conversion of annual cost rates into a per path rate.

The result of these adjustments is shown in Deloitte Business Case

It is assumed that a transition to AC locomotives for Western and Hunter coal trains (and accordingly lower cost rates) would occur from 2031.

Road Operating Costs

Unit road operating costs were determined by using the rates quoted in TfNSW's Guidelines based on a weighted average of urban and regional road vehicle operating cost rates. These costs are inclusive of:

- Fuel and lubricants
- Tyres
- Vehicle capital costs
- Repairs and maintenance.

The vehicle operating costs are valued on a resource cost basis and accordingly exclude taxes, fuel excise and GST.

Assuming that 7.5% of vehicle kilometres are travelled within urban areas, the following weighted average vehicle operating cost rates were derived.

Table 4.22 Road Operating Costs – Resource Costs (c/km)

Vehicle Type	Urban	Regional	Weighted
6-axle	198.0	127.7	**133.0**
B-double	232.5	165.5	**170.5**

Source: TfNSW (2013)[31] and Deloitte analysis. Prices in 2013-14 dollars

Coastal Shipping Operating Costs

Under demand scenarios where no capacity is assumed to be available for freight on the Illawarra Line, steel movements are assumed to travel by sea between Brisbane and Port Kembla.

To ensure that the economic assessment captures these costs, a shipping cost model was incorporated into the economic assessment. The shipping cost model is based on a shipping cost model presented in Stopford (2009)[32] and draws upon parameters presented within NZSC (2010)[33]. The shipping cost model encompasses the following key costs. Full details are provided in the Deloitte Report:

- Fuel costs
- Shipping capital costs
- General operating costs, including crewing, insurance and administration
- Port charges.

Table 4.23 Shipping Cost Model Outputs

Variable	Value

[31] Transport for NSW (2013), *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*

[32] Stopford, M. (2009), *Maritime Economics*, 3rd Edition

[33] NZSC (2010), *The Question of Bigger Ships: Securing NZ's International Supply Chain*

	[redacted]
Bunker costs	
Capital costs	
Operating costs	
Port costs	
Total costs	
with profit margin	
Transport costs per tonne	
Total cycle time (days)	
Freight - time in transit	

[redacted] *Prices are in 2013-14 Australian dollars*

Freight Transit Time Benefits

For existing freight, travel time benefits are derived by the average time saving provided by the upgrade option multiplied by an average value of time for freight. Travel time benefits may be incurred where freight trains use a shorter or faster route or where freight is shifted from a slower to a faster mode of transport.

In addition, given the different topography through which the different rail links pass, the analysis assumes different train operating speeds by route. Train travel times were based on EIG modelling based on estimated cycle times less dwell times (which reflect train time spent out of service).

Truck travel times were based on guidance provided within TfNSW (2013), which adopts 70km/h and 30km/h as default truck speeds in regional and urban areas respectively. In deriving an overall speed, it was assumed that 5% of all truck VKTs accrue within Sydney and 2.5% of truck VKTs in Wollongong and 45 minutes is spent waiting, loading and unloading.

To maintain mode neutrality, a generic freight value of time unit rate has been used to estimate the value of changes in travel time for freight. Drawing upon research undertaken by Wigan et al (1998)[34], the value of a one hour time savings per tonne of inter-capital freight was originally valued at $0.66 per tonne hour in 1998. This has been indexed with movements in PPI (Preliminary Demand)[35] to derive a contemporary value of freight time. Original and updated values of freight time are shown in Table 4.24.

Table 4.24 Value of Freight Time

Variable	Value
Value of freight time in 1998 prices	$0.66/tonne hour
Updated value of freight time	$1.08/tonne hour

Based on Wigan et al (1998). Updated value of time in 2013-14 prices

Value of Occupant / Crew Time

The value of occupant (crew) time was incorporated in the train costing rates (discussed in Section 6.4) and hence no additional allowance has been made for savings in train occupant time to avoid double counting.

However, this is not the case for road freight transport and an additional calculation is required to assess the value of changes in road driver hours. Should road transport be assumed, the 6-axle rate has been used to value all road time spent for all freight with the exception of containers

[34] Wigan, M., Rockliffe, N., Thoresen, T. & Tsolakis, D. (1998), *Valuing Long-Haul and Metropolitan Freight Travel Time and Reliability*

[35] The PPI Preliminary Demand series measures movements in prices for goods that may be used for intermediate production (e.g. manufacturing)

(Manildra) and grain, whereby a B-double rate has been assumed. Assumed occupant value of time for road movements are shown in Table 4.25.

Table 4.25 Occupant Value of Time for Road Movements

Variable	6-axle Occupant Time ($/vehicle hr)	B-double Occupant Time ($/vehicle hr)
Value of time in urban areas (2011 prices)	$25.77	$26.94
Value of time in rural areas (2011 prices)	$25.77	$25.77
Weighted average (2011 prices)	$25.77	$25.86
Updated value of time	**$27.31**	**$27.41**

Source: Transport for NSW (2013) and Deloitte analysis. Prices in 2013-14 dollars

The value of occupant time is based on a blended value of urban and rural time, whereby the weighted average assumes that 7.5% of time is spent within urban areas (Sydney & Wollongong).

Environmental Externalities

Changes in both road and rail kilometres are associated with changes in environmental externalities including pollution and greenhouse gas emissions.

Externality values are based on Transport for NSW Guidelines, with the assumption of 7.5% of the traffic being in urban areas. Table 4.26 outlines the value of key externality categories assessed in the appraisal. The total externality value was updated to 2013-14 prices using CPI data.

Table 4.26 Environmental Externality Values ($ per thousand tonne km)

Externality Type	Rail Freight	Road Freight
Air pollution	$0.2925	$2.0355
GHG	$0.4000	$5.3800
Noise pollution	$0.1275	$0.6815
Water pollution	$0.1000	$1.6128
Nature and landscape	$1.0000	$3.7670
Urban separation	$0.0750	$0.2018
Upstream and downstream costs	$0.0000	$0.0000
Total – 2011 prices	**$1.9950**	**$13.6785**
Updated environmental externality costs	**$2.0950**	**$14.3638**

Source: Transport for NSW (2013) and Deloitte analysis. Prices in 2013-14 dollars

Crash Costs

The reduction in road freight will reduce the number of vehicle kilometres travelled by trucks and one consequence of this will be a reduction in the road crashes. Estimates prepared by the then Bureau of Transport Economics estimated crash costs for both road and rail freight. These values were indexed to 2013-14 prices using movements in NSW AWE and are shown in Table 4.27.

Table 4.27 Crash Costs by Mode

Mode	Value
Road	0.616 c/tonne km
Rail	0.058 c/tonne km

Source: BTE (1999), updated to 2013-14 prices

Road Damage Costs

Heavy road vehicles are the major contributor to road pavement deterioration. Consequently, savings in expenditures on road maintenance will occur with a reduction in heavy truck traffic following a switch to rail freight in the 'with project' case. The following road damage cost rates have been assumed, based on road damage cost rates for combination and articulated vehicles.

Table 4.28 Road Damage by Vehicle Type

Vehicle	Value
6-axle artic	$0.1650 per VKT
B-double	$0.2193 per VKT

Source: Transport for NSW (2013) and Deloitte analysis. Prices in 2013-14 dollars

Road Congestion Costs

The diversion of freight from road to rail under some demand scenarios, as a result of project will lead to a reduction in truck kilometres. This reduction will lead to a benefit to the remaining road users by relieving congestion in peak times and speeding up traffic. In the analysis it was assumed that the decongestion effect would apply only in urban areas where roads are more likely to be operating close to capacity.

The value of decongestion was calculated by applying Transport for NSW Guideline rates shown in Table 4.29 and assuming 5% of all truck VKTs accrue within Sydney and 2.5% of truck VKTs in Wollongong.

Table 4.29 Road Congestion Costs by Vehicle Type

Vehicle	Value
6-axle artic	$1.84 per VKT
B-double	$2.46 per VKT

Source: Transport for NSW (2013) and Deloitte analysis. Prices in 2013-14 dollars

Track Access Charges

In order to assess the financial impact of the Project, change in track access charges require consideration of the charges applied by each track manager and changes in demand by track manager and track section.

Currently, rail freight services that could potentially use the MDRL operate on a network which is operated and maintained by a number of different organisations. These include:

- The Australian Rail Track Corporation (ARTC) which manages below rail infrastructure on the Interstate network as well as the MFN in Sydney
- Regional rail lines which were previously managed by the Country Rail Infrastructure Authority and which have been transferred to Transport for NSW and are currently operated by John Holland
- Transport for NSW, through Sydney Trains, which manages the Metropolitan Rail Network (MRN) including the Illawarra Line, the Main West and the Short North.

In addition to these organisations, the operator of the newly constructed MDRL would also need to be considered in the assessment of track access revenue impacts.

Full details are provided in Deloitte Report.

4.5.2 Cost Benefit Results

The economic assessment of all 'with project' options has been undertaken against the base case. All economic estimates are based on the following key economic parameters:

Table 4.30 Key Parameters and Assumptions

Key Parameter	Value
Base year	2013-14
Real discount rate	4.4% per annum
Price year	2013
Commencement of operations	2021
Evaluation period	50 years from the first year of operations[36]
Valuation	In real terms. Valuations are in resource cost terms and exclude taxes
Stakeholder coverage	NSW Government, rail and road transport operators and the broader community
Indexation	No real indexation applied on other costs or benefits

The valuation of costs and benefits is based on a discounted cash flow technique, with benefits and costs valued in line with TfNSW, ATC and Infrastructure Australia appraisal guidelines.

It should be noted that the economic assessment results have been prepared for the purposes of the Nation Building Program, which requires funding submissions to be based on a 4.4% discount rate and a 50 year evaluation period.

Headline Results

This section outlines the economic assessment results for the core scenario, which compares the ‘with Project’ case against the base case under a restriction of 8 paths on the Illawarra Line with 2021 being the first year of operations on the MDRL.

Under the assumed economic parameters, the ‘with Project’ case is projected to be economically viable. At the assumed discount rate of 4.4% p.a. over an evaluation period of 50 years, the net present value is projected to be $353m with a corresponding benefit cost ratio of 1.47.

Headline Economic Results

Table 4.31 Headline Economic Results

Key Stream	Undiscounted Values	Discounted Values	Breakdown
Initial capital costs	[redacted]		
Recurrent costs (capital, maintenance and operating)			
Total costs			
Time savings			
Transport cost savings			
Avoided environmental externalities			
Avoided crash costs			
Road decongestion			
Avoided road damage			
Residual value			
Total benefits			

[36] A 50 year evaluation period has been assumed which is in accordance with the Nation Building Notes on Administration guidelines. A sensitivity test has also been undertaken using a 30 year evaluation period, in line with ATC and Infrastructure Australia guidelines.

NPV	**$352.9m**
BCR	**1.47**
NPVI	**0.59**
IRR	**6.2%**

All values are in 2013-14 prices and are discounted at a real discount of 4.4% per annum over a 50 year evaluation period

In discounted terms, initial capital costs account for [redacted] or approximately [redacted] of the Project's cost. The cost of implementing upgrades between Coniston Junction and Unanderra are included within the economic assessment, with the costs of these upgrades accounting for approximately [redacted] of total discounted initial capital costs. The discounted cost of maintaining and operating the MDRL as well as upgrades between Coniston Junction and Unanderra accounted for [redacted] or approximately [redacted] of all costs.

The projected economic benefits of the Project can be traced to the avoided transfer of freight from rail to road under the 'with Project' case.

The key benefit stream arising from the Project is the value of transport operating cost savings, attributable to the lower unit cost of rail relative to road. Transport cost savings are projected to generate [redacted] of discounted benefits, or [redacted] of the Project's benefits.

Travel time savings account for [redacted] of discounted benefits or approximately [redacted] of all benefits.

The relatively large proportion of benefits attributed to avoided externalities provides another indication of the significant contribution of mode shift from road to rail to the economic benefits of the Project. Avoided externalities including environmental externalities, crash costs, decongestion and road damage collectively account for [redacted] of discounted benefits or a little over [redacted] of benefits.

Benefit Decomposition

A benefit decomposition was undertaken to further highlight the contribution of mode shift from road to rail within the economic assessment. The decomposition disaggregates the projected benefits of the Project by both benefit stream and commodity. This decomposition is shown in Table 4.32

Table 4.32 Benefit Decomposition under Scenario 1 (Discounted)

Commodity	Time savings	Transport Cost Savings	Avoided Externalities	Residual value	Total
Cement	[redacted]				
Western Ores					
South Western Ores					
Coal - Western					
Coal - Hunter					
Coal - Tahmoor					
Grain - Western					
Grain - South Western					
Limestone					
Steel products					
Ballast					
Aggregates					
Manildra - Grain					
Manildra - Containers					
Economic benefit					

All values are in 2013-14 prices and are discounted at a real discount of 4.4% per annum over a 50 year evaluation period

The projected economic benefits of the Project are not evenly spread across all commodities. The bulk of the projected benefits are attributable to the following trades:

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted] Intuitively, the economic benefits associated with these trades are larger than for other trades as:

- Unit transport costs are higher for road than rail and accordingly, transport cost savings would be accrued for any avoided road travel
- In addition, road transport generates a range of negative externalities, which can be largely avoided with the use of rail transport.

Savings accrue under the 'with Project' case for [redacted] relative to the base case as these volumes are assumed to shift from the UMVL (under the base case) to the MDRL (with Project) from 2031. This shift results in shorter distances and lower operating costs. However, these benefits are slightly offset by higher transport costs incurred by [redacted] trains under the 'with Project' case between 2021 and 2031, with the estimated costs of transport higher using the MDRL relative to the Illawarra Line, which would be used under the base case.

Other commodities do not contribute significantly to the economic assessment as they remain on rail. No economic savings are attributable to [redacted] or [redacted] as these remain on rail on the same route. Small changes in economic costs are projected for:

- [redacted]
- [redacted]
- [redacted]
- [redacted]

These trades are assumed to be redirected from Port Kembla under the base case due to the lack of rail capacity. The journeys to alternative ports are slightly longer in distance for these trips, although in some cases, faster. Overall, the additional capacity provided under the 'with Project' case results in economic cost savings, albeit that these savings are relatively small as no mode shift is assumed.

Scenario Tests

The core results of the economic assessment are based on the Scenario 1 operating scenario. This scenario is based on MDRL opening by 2021 and assumes 8 paths remain available on the Illawarra Line from 2031.

Scenario testing was undertaken on three alternative operating scenarios that assume no paths are available on the Illawarra Line from 2031 and/or assume that MDRL opens from 2031.

The economic assessment projects that all alternative operating scenarios are economically viable at a 4.4% discount rate and over a 50 year evaluation period. The results of the economic assessment under the four operating scenarios considered are shown in Table 4.33.

Of note is the benefit of delaying the opening of the MDRL until 2031. The delay in construction further discounts the cost of construction, decreasing the present value of costs from [redacted] under Scenario 1 to [redacted] under Scenario 2. The impact of the benefit stream commencing 10 years later under Scenario 2 is not as significant relative to costs as the discounting impact is weakest at the end of what is a relatively long 50 year evaluation period. Furthermore, Scenario 2 avoids the projected increase in transport costs with the Project between 2021 and 2031, whereby the assumed diversion of Western coal, Hunter Valley coal and cement trains from the Illawarra Line to the MDRL increases transport costs. The resultant decrease in costs and (slight) increase in benefits results in the projected economic benefits being higher with deferral, with BCRs of 2.4 under Scenario 1a (8 paths) and 2.1 under Scenario 2a (0 paths).

Table 4.33 Projected Economic Outcomes under Different Operating Scenarios (Discounted)

Variable	Scenario 1 (Core)	Scenario 1a	Scenario 2	Scenario 2a
Paths on the Illawarra Line	*8*	*8*	-	-
First year of MDRL Operations	*2021*	*2031*	*2021*	*2031*
Initial capital costs	[redacted]			
Recurrent costs				
Total costs				
Time savings				
Transport cost savings				
Avoided environmental externalities				
Avoided crash costs				
Road decongestion				
Avoided road damage				
Residual value				
Total benefits				
NPV	**$352.9m**	**$681.9m**	**$229.1m**	**$548.8m**
BCR	**1.47**	**2.40**	**1.30**	**2.12**
NPVI	**0.59**	**1.75**	**0.38**	**1.41**
IRR	**6.2%**	**12.3%**	**5.7%**	**11.0%**

All values are in 2013-14 prices and are discounted at a real discount of 4.4% per annum over a 50 year evaluation period

In comparison to Scenario 1, the economic benefits in Scenario 2 are slightly lower. Scenario 2, which constrains the number of paths available for freight on the Illawarra Line to zero paths, is projected to generate discounted benefits worth [redacted] over the course of the evaluation period, [redacted] than Scenario 1. A comparison of benefits by commodity, as shown in Table 4.34 indicates that the benefits accrued by commodity are equivalent to what is projected under Scenario 1 with the exception for:

- [redacted]
- [redacted]

- [redacted]

Under Scenario 2, paths on the Illawarra Line that would otherwise be used under Scenario 1 need to be reallocated. Under the base case, steel is assumed to move by sea. The 'with Project' case results in an additional [redacted] of economic costs being incurred over the evaluation period, due to additional externalities generated by rail relative to sea. The higher cost of rail relative to sea transport is projected to just offset the value of travel time savings, with rail being faster than sea. As an aside, the changes in sea transport costs (circa [redacted]) and the value of sea travel time are sufficient large to change the composition of Scenario 2's projected economic benefits such that travel time saving benefits are the largest economic benefit stream under Scenario 2.

With demand for paths exceeding the supply for paths under Scenario 2 even with the Project, two trades are assumed to be displaced. Cement, which would otherwise use rail if capacity is available, as it does between 2021 and 2031, is assumed to continue to use road under the 'with Project' case under Scenario 2. This means the mode shift economic benefits associated with cement under Scenario 1 are no longer accrued.

Similarly with no spare capacity, [redacted] is assumed to be handled through the [redacted] under both the base case and 'with Project' case post 2031. Again, the economic benefits of a shorter trip to Port Kembla accrued under Scenario 1 are not available under Scenario 2.

Table 4.34 Comparison of Discounted Benefits between Scenario 1 and 2

Commodity	Scenario 1	Scenario 2	Scenario 2 less 1
Cement	[redacted]		
Western Ores			
South Western Ores			
Coal - Western			
Coal - Hunter			
Coal - Tahmoor			
Grain - Western			
Grain - South Western			
Limestone			
Steel products			
Ballast			
Aggregates			
Manildra - Grain			
Manildra - Containers			
Economic benefit			

All values are in 2013-14 prices and are discounted at a real discount of 4.4% per annum over a 50 year evaluation period

Sensitivity Tests

A range of high level sensitivity tests have been undertaken to assess the sensitivity of the projected economic outcomes. Table 4.35 outlines the tests that have been undertaken:

Table 4.35 Description of Sensitivity Tests

Test	Description
Discount rates	The core economic assessment results are based on a discount rate of 4.4%. The discount rate for all options has been varied using rates recommended by Infrastructure Australia and NSW Treasury, at 4%, 7% and 10%.

P50 Costs	The core results are based on P90 costs. This test uses P50 cost rates where they have been provided for MDRL costs, Coniston Junction upgrade costs and car handling facilities under the upside case.
Variation in Upfront Construction Costs	This test measures the impact of larger variations in upfront construction costs across all upfront cost items. A ±20% variation has been applied on all upfront construction costs under this test
30 year evaluation period	A shorter evaluation period of 30 years is tested under this test.
NSW Treasury parameters	This test uses parameters recommended by NSW Treasury, setting the real discount rate to 7% per annum and the evaluation period to 30 years.

The results of the sensitivity tests are shown in Table 4.36:

Table 4.36 Sensitivity Test Results (BCRs)

Test	Scenario 1	Scenario 1a	Scenario 2	Scenario 2a
Core results	**1.47**	**2.40**	**1.30**	**2.12**
4% discount rate	1.59	2.53	1.42	2.24
7% discount rate	0.86	1.72	0.76	1.52
10% discount rate	0.48	1.24	0.43	1.10
P50 costs	1.51	2.47	1.34	2.19
+20% construction costs	1.73	2.85	1.54	2.52
- 20% construction costs	1.27	2.07	1.13	1.84
30 year evaluation period	1.23	2.17	1.11	1.94
NSW Treasury parameters	0.77	1.64	0.69	1.45

Unless otherwise specified, BCRs reflect a 4.4% p.a. discount rate with an evaluation period of 50 years

Sensitivity analysis suggests that developing the MDRL would have economic merit under most scenarios tested.

For Scenario 1a and Scenario 2a, where the opening of the MDRL is delayed to 2031, the development of the MDRL has economic merit under all scenarios tested. Of note, if the Project were assessed under conventional NSW Treasury parameters, the Project would be viable, with BCRs of 1.64 (8 paths) and 1.45 (0 paths).

Should the Project be opened in 2021, the economic viability of the Project would be sensitive to higher discount rates. If standard NSW Treasury parameters were used, the projected benefits of developing the MDRL are less than its costs in present value terms.

Potential Other Benefits and Costs

The economic assessment was undertaken using conventional approaches to evaluate conventional economic benefit streams as recognised by current guidance. However, a range of potential other economic benefits and costs have not been monetised within the economic assessment due to the limitations of the Project scope but are no less important. These benefits and costs are outlined as follows:

Passenger Train Benefits

The development of the MDRL provides opportunities to reroute freight trains away from routes that are shared currently with passenger trains. For instance, the routing of Western Coalfield trains via the MDRL would require these trains to divert from the Western Line at Flemington and travel via the MFN (including the SSFL). In doing so, there would be fewer interactions with passenger trains on other parts of the MRN including the Illawarra and South Coast Lines, improving separation and reliability for both freight and passenger services.

Furthermore, the diversion of additional freight trains on to the MFN may free up capacity on parts of the MRN. This would open up opportunities to enhance service frequencies for passenger trains, most notably on the Illawarra Line.

Additional Road Supply Chain Costs

With few exceptions, the commodities analysed in the economic assessment are existing commodities with well-established supply chains and supporting infrastructure. Most of these commodities have a clear preference for rail and accordingly have infrastructure to support their rail operations.

The economic assessment assumes a number of these trades may need to shift to road should network rail capacity not be sufficient. Whilst the economic assessment accounts for the (additional) costs of road transport between nodes, no account for additional terminal costs have been included under the base case, which would continue to be avoided under the 'with Project' case.

These costs may include the development of additional loading bins and dumping bins to handle trucks handling bulk materials. Bulk materials including coal, ballast and aggregates may require loading bins that load trucks from above and dumping bins that collect material upon unloading. Alternatively, trucks may be loaded through more labour intensive means by loading trucks using hydraulic loaders and shovels.

Rail Network Expansion Costs

With a projected diversion of freight traffic from the Illawarra Line and background growth in rail freight volumes, capacity enhancements are likely to be required across the MFN and MRN. Modelling undertaken by Parsons Brinkerhoff highlights the impact of projected growth in rail freight volumes on infrastructure requirements on the SSFL. Logically, increased volumes on the SSFL would also lead to increasing congestion at certain key points on the network feeding into the SSFL and beyond. These pressures are particularly evident if the development of the Moorebank Intermodal Terminal were to proceed.

Given the broader significance of these works in a network context, the development of a program business case with associated analysis is highly recommended. However, with limited clarity on the scope of these works required across the MFN and MRN and the challenges in appropriately allocating these costs between MDRL, other freight and passenger traffic, these costs have been excluded from this economic assessment.

Broader Economic Impacts

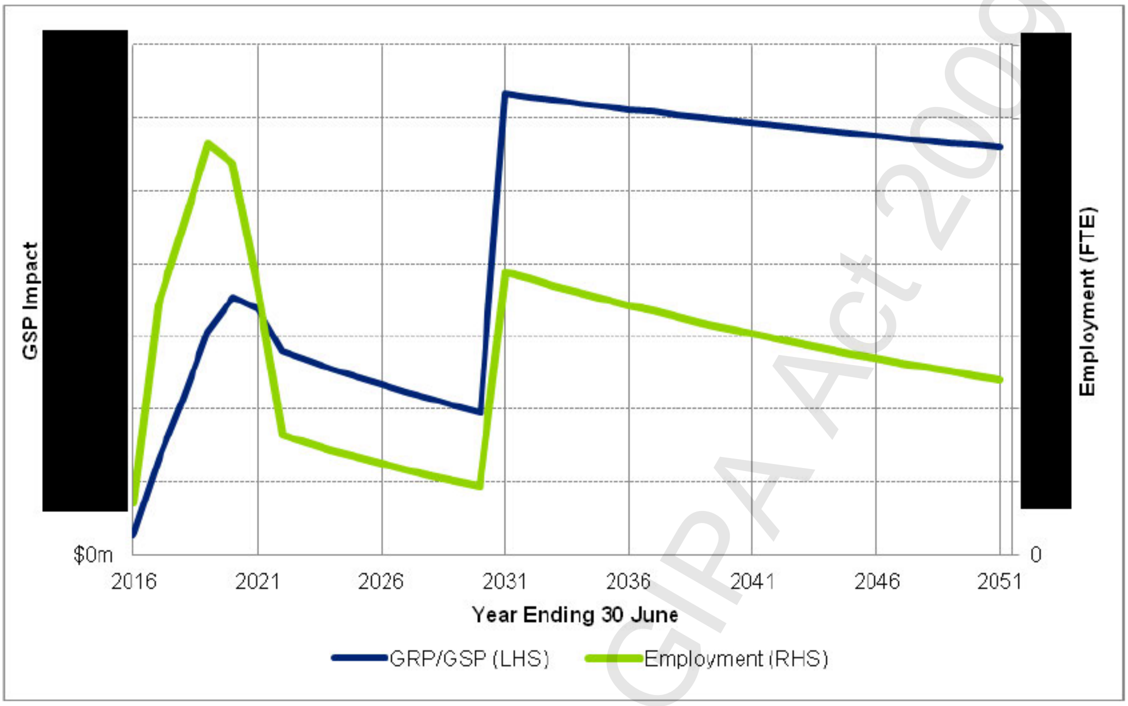
CGE modelling was undertaken to assess the relative economic impact of the 'with Project' case compared to the base case using Deloitte Access Economics' in-house CGE model. These impacts have been assessed in economic activity and employment terms. The model used has been based on recent work undertaken by Deloitte Access Economics for Infrastructure NSW in the Illawarra.

CGE modelling can be used to assess the impacts of a much broader range of actions than other modelling approaches, including input-output models. CGE models incorporate a much more detailed representation of the economy, including the multiplicity of flow on interactions between different sectors, and impacts of changes in prices and wages in one sector of the on the equilibrium in other sectors of the economy - hence the descriptive term "general" equilibrium. A CGE model can provide very detailed estimates of the flow on economic impacts from an action originating in a particular industry sector.

It should be noted that given the nature of the Project where the Project is replacing existing capacity which would otherwise not be replaced post 2031, **economic impacts assessed after 2031 are best interpreted as "avoided losses".**

CGE modelling was undertaken for the core scenario with economic impacts assessed at a state level and for the Illawarra region between 2016 and 2051. This approach ensures that the spillover impact of the Project on say export activities including ores, grain and coal that originate well outside the Illawarra can be captured. The modelled impact of the Project on NSW Gross State Product and NSW employment levels is illustrated in Figure 4.3.

Figure 4.3: NSW Gross State Product and Employment Impacts



Source: Deloitte Access Economics. Estimates are presented in 2013-14 prices and are undiscounted

The initial construction impact is evident within the first five years with net employment increasing by up to [redacted] FTEs by 2018 during the construction phase, broadly reflecting the pattern of construction spend.

As an aside, the net economic and employment impact projected by the CGE model is lower than what might be predicted using alternative multiplier based approaches as CGE modelling results reflect the *net impact on the economy* arising from an intervention. As an illustration, whilst the Project could employ say [redacted] people[37] during the course of its construction, a large proportion of these people would be diverted from working in other industries, an effect which is modelled within the CGE model.

The broader economic impacts of construction are slightly lagged, with the largest impact during construction estimated to occur in 2020, with a [redacted] impact. Like the employment impact, CGE modelling captures the net impact from the Project.

After the MDRL becomes operational, the initial economic impact is projected to be [redacted] in 2021. After declining between 2021 and 2030, the impact again increases to around [redacted] in 2031. The shift in economic impact reflects the projected increases in travel times and travel costs incurred under the base case relative to the 'with Project' case. As an aside, declines in the level of economic and employment impacts over time reflect the workings within the CGE model, which allows productivity shocks to dissipate with time, allowing wages and prices in other parts of the economy to adjust, with equilibrium achieved over a number of years.

Approximately 20% of the incremental economic impact is projected to be accrued within the Illawarra region. The low proportion reflects the bulk of the freight task being simply transported

[37] Based on an employment multiplier of 4 for every million dollars spend (Table 3.1 in NSW Treasury (2009), *Guidelines for estimating employment supported by the actions, programs and policies of the NSW Government*, TPP09-07)

and unprocessed within the region, passing through the region as exports or imports e.g. Western coal, grain, cement. Nevertheless, a number of existing local industries are likely to rely on the provision of rail capacity that would otherwise be foregone without the Project including Bluescope and Manildra's operations within the Illawarra and the Shoalhaven respectively.

5 The Financial Appraisal

Financial Assessment

Key Financial Parameters

The financial assessment of all with project case has been undertaken against the base case. Financial projections are based on the key financial parameters summarised in Table 5.1

Table 5.1: Key Parameters and Assumptions

Key Parameter	Value
Base year	2013-14
Real discount rate	7% per annum
Price year	2013-14
Commencement of operations	2020-21
Evaluation period	50 years from the first year of operations
Valuation	In real terms
Stakeholder coverage	MDRL owner only
Indexation	No real indexation applied on other costs or benefits

The valuation of costs and benefits is based on a discounted cash flow technique.

It should be noted that the financial assessment differs from the economic assessment in that a higher real discount rate of 7% is used to better reflect the cost of capital.

Furthermore, the financial assessment includes cash flows accrued by the owner of the MDRL, likely to be confined to track access charges. In lieu of a pricing structure for the usage of the MDRL, the rail operating cost modelling adopts the assumed track access charge rates for the MDRL, which mirrors the rates used by the ARTC on the UMVL.

The financial assessment considers only track access charges accrued on the MDRL and does not consider changes in track access charges on other parts of the rail network as these charges may not accrue to the owner of the MDRL.

In addition, only the upfront and ongoing costs of developing the MDRL are included. These costs were assessed on a financial basis i.e. based on the economic costs *plus* corporate overheads. Escalation continues to be excluded as the valuations for the financial assessment were assessed in real terms. The costs of developing and maintaining upgrades between Coniston Junction and Unanderra were excluded as these are assumed to be within the domain of the current track manager of the MRN, Sydney Trains.

Headline Financial Results

Table 5.2 provides a breakdown of key revenues and costs attributable to MDRL operations by operating scenario:

Table 5.2: Projected Discounted Financial Outcomes ($m)

Financial Indicator	Scenario 1 (Core)	Scenario 1a	Scenario 2	Scenario 2a
Capital costs	[redacted]			
Recurrent costs				
Total costs				
MDRL charges				
Residual value				
Total benefits				
NPV	**- $500.9m**	**- $254.6m**	**- $501.9m**	**- $255.7m**
BCR	**0.09**	**0.09**	**0.09**	**0.09**
NPVI	**-1.04**	**-1.04**	**-1.05**	**-1.05**
IRR	No real or positive solution			

All estimates are based on a 7% real discount rate with benefits and costs evaluated over 50 years. Prices are expressed in 2013-14 dollars

The financial assessment indicates that track revenues are insufficient to cover the costs of developing, maintaining and operating the MDRL. When the upfront and ongoing costs of developing and operating the MDRL are valued against projected MDRL track access charge revenue, the NPV of developing and operating the MDRL is projected to be approximately negative $500m under the core scenario. Should the development of the MDRL be deferred, the NPV improves to -$255m, however with no change in the BCR, the apparent decrease in losses is a reflection of discounting rather than a change in the gap between the MDRL's financial costs and revenues.

Based on the difference between recurrent costs and MDRL charges, track charges are projected to be insufficient to cover all recurrent costs.

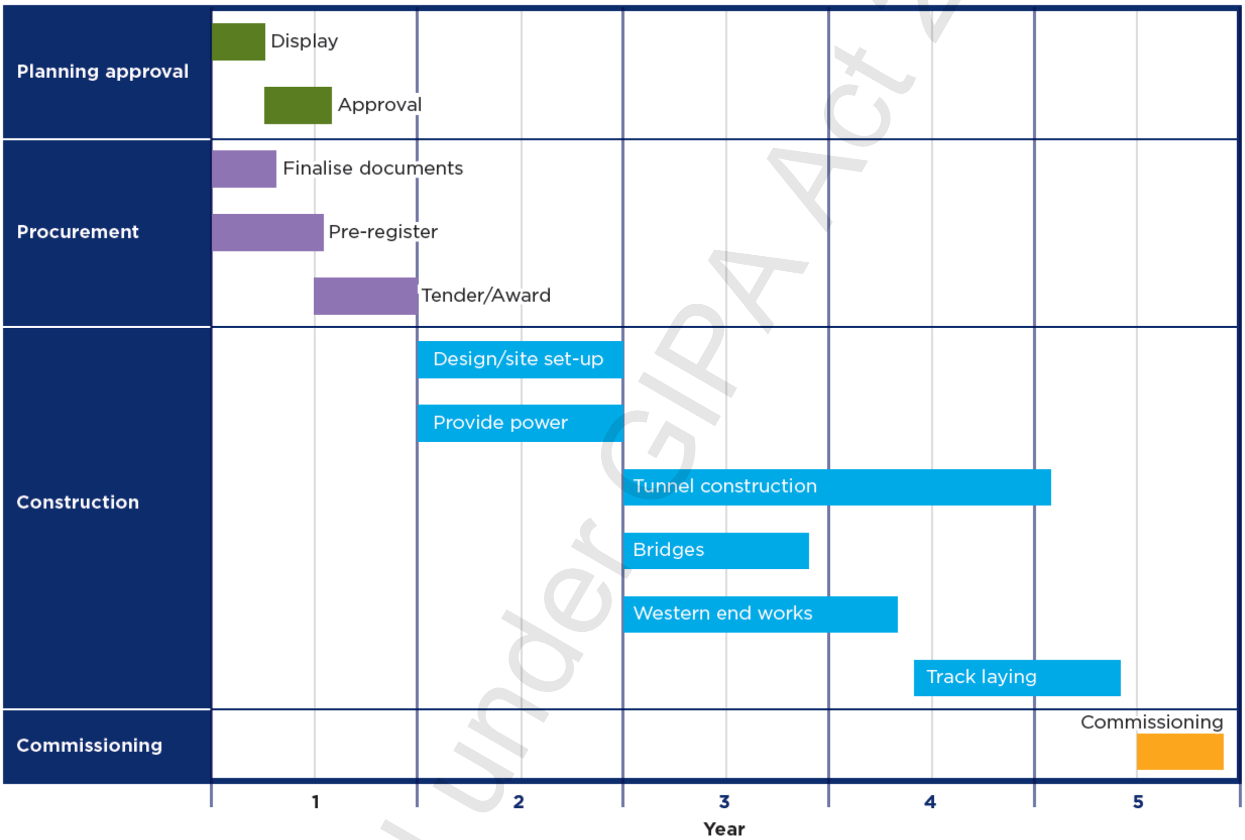
Accordingly, a contribution from government, other track managers or other beneficiaries would be required to financially support the development and ongoing operation of the MDRL.

6 PROGRAM / PROJECT MANAGEMENT

6.1 Project Management, Program and Milestones

The Project Timeline during the Construction Preparedness, Funding Submission and Project Proposal report is shown in Figure 6.1 below. These timings depend on when project funding is approved.

Figure 6.1 Key Project Milestones



Resourcing is described in section 6.2. Full details will be developed once funding for the project is approved. The core MDRL project team is likely to provide the nucleus of the Project Implementation team with additional resources brought in for design, engineering, operations, stakeholder and community management, commercials / tendering and procurement.

A works Brief for tender Documentation is currently being prepared and will be ready by end June 2014.

Should the project proceed to the next stage of approvals, Tender documentation will need to be finalised and the MDRL Project team anticipates 9 to 12 months to prepare EOI and RFT tender documentation, issue and evaluate, negotiate contracts and award.

Below shows the high level construction programme which indicates that the completion of the works will take approximately 4 years for the current tunnel alignment.

This programme is based on:

1. The current concept design. *(Project Definition design at this stage)*
2. The project being delivered under a Design and Construct Contract.

3. The programme and construction methodology for the Nepean and Cordeaux River Bridges as developed by the original project. The concept designs adopted are similar and whilst there have been advances in the technical expertise in constructing these types of bridges, the potential time savings are not significant in the total scheme of the project.
4. The tunnel is to be driven from the eastern portal using a road header. *(Refer to the Tunnel Report for the discussion regarding the tunnel section and construction methodology)*
5. Time is not critical.
6. Coniston Upgrade is required prior to commissioning of MDRL in last 2 years

Given the above, the construction *critical path* is through the tunnel drive.

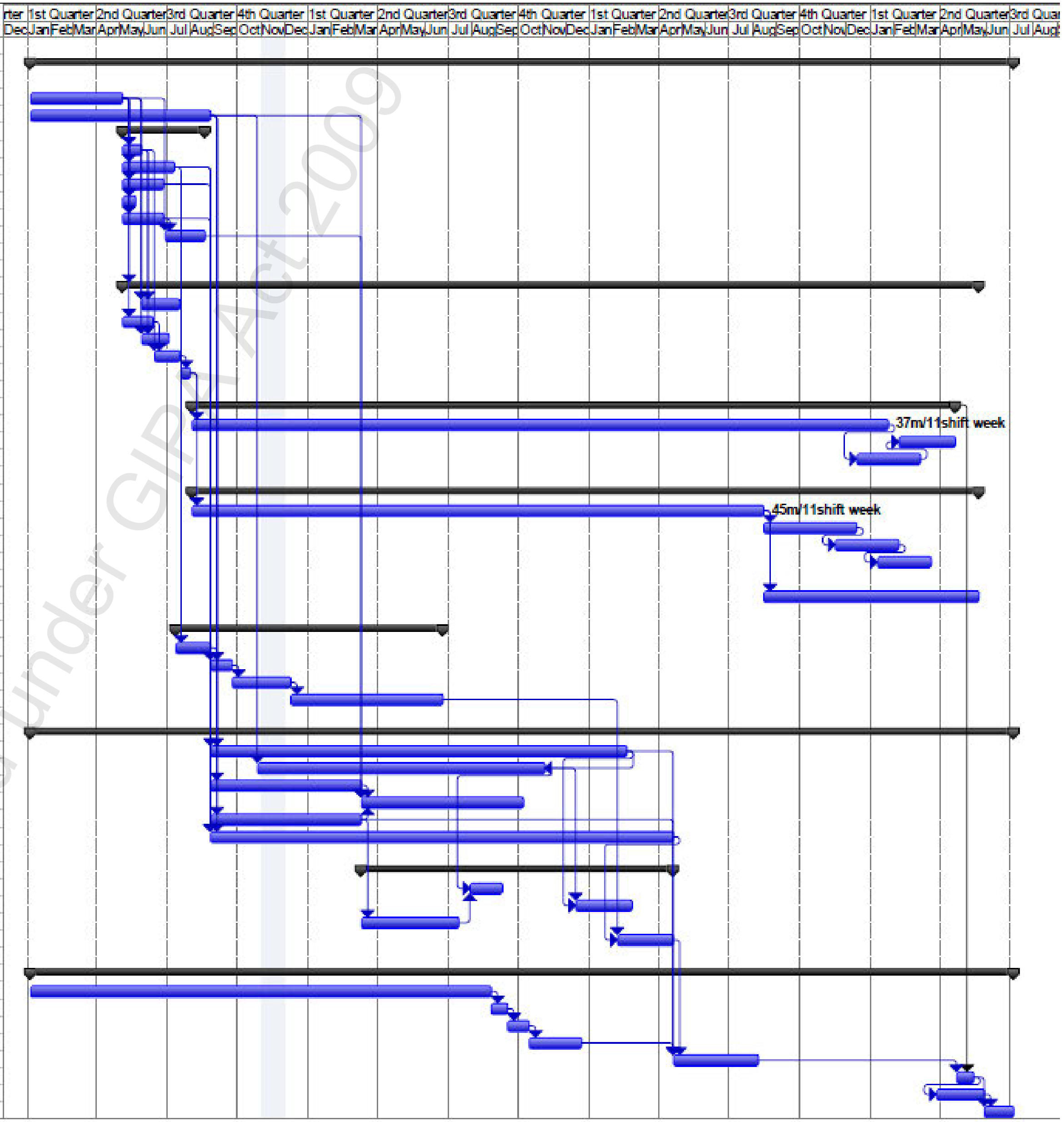
The drive could be completed more quickly if a tunnel boring machine (TBM) is used. However, there are severe access and work area constraints in order to build and commission a TBM in the limited space between the existing Unanderra and Moss Vale Rail Line.

The program indicates that the critical path of the project passes through the tunnelling, tunnel services and the rail laying activities. The major constraints for the program are the completion of the Nepean and Cordeaux River Bridges and the tunnel construction. It has been assumed that rail will be brought to site in 110m lengths using trains from the Maldon end of the works however the rail cannot be delivered south of the Nepean River until the bridge is completed. Rail is not being brought from the Dombarton end, as the rail trains cannot utilise the tunnel until the ventilation systems have been completed and commissioned. The completion of the tunnel and its systems is the driving predecessor for the rail laying activity and hence construction completion.

Tunnelling has been considered from the eastern portal only. The spoil will be emplaced into the permanent stockpile located near the eastern portal on TfNSW land. 420,000 m^3 of.spoil will be transported by conveyor belt from the tunnel into the permanent stockpile. There is an opportunity for 200,000 m^3 of spoil to be used as permanent landscaping features at the Maldon end.

There is approximately a 10 month float between the completion of all the other works and the completion of the tunnel which provides opportunities for resource balancing and provides time protection against delays including wet weather and times of extreme heat and fire danger. This could be between 25 and 30 days per year; however, the fire danger will primarily affect the works within SCA area. This float provides TfNSW in association with third parties to set dates for the completion of sections of the works or providing delayed access.

ID		Task Name	Duration	Start	Finish	Predecessors
1						
2		**Award contract**	**790 days**	**Mon 5/01/15**	**Thu 5/07/18**	
3						
4		CEMPS	80 days	Mon 5/01/15	Mon 4/05/15	
5		Design	150 days	Mon 5/01/15	Wed 26/08/15	
6		**Access Roads**	**65 days**	**Tue 5/05/15**	**Wed 19/08/15**	
7		Eastern portal	15 days	Tue 5/05/15	Thu 28/05/15	4
8		Fire Trails inc turn off\	40 days	Tue 5/05/15	Fri 10/07/15	4
9		Alignment Picton RD to exisiting incl turn off	30 days	Tue 5/05/15	Fri 26/06/15	4
10		Wilton Road	10 days	Tue 5/05/15	Thu 21/05/15	4
11		Nepean Br West incl Turn off	30 days	Tue 5/05/15	Fri 26/06/15	4
12		Picton Road diversion	35 days	Mon 29/06/15	Wed 19/08/15	4,11
13						
14						
15		**Tunnel**	**685 days**	**Tue 5/05/15**	**Mon 21/05/18**	4
16		Site establlishment	30 days	Fri 29/05/15	Fri 17/07/15	4,7
17		Environmental controlds	20 days	Tue 5/05/15	Fri 12/06/15	4
18		Prepare spoil area	20 days	Fri 29/05/15	Fri 3/07/15	4,7
19		Prepare portal	25 days	Mon 15/06/15	Fri 17/07/15	17,7
20		Set up Roadheader	10 days	Mon 20/07/15	Fri 31/07/15	19
21						
22		**alignment 4000m S300**	**610 days**	**Mon 3/08/15**	**Fri 20/04/18**	
23		S300 Road header 45m/week	550 days	Mon 3/08/15	Tue 23/01/18	20
24		Access paths	50 days	Wed 7/02/18	Fri 20/04/18	25FS-20 days
25		Cabling ducts	50 days	Thu 14/12/17	Tue 6/03/18	23FS-20 days
26						
27		**Alternative Drive S200**	**630 days**	**Mon 3/08/15**	**Mon 21/05/18**	
28		S200 top headings	450 days	Mon 3/08/15	Mon 14/08/17	20
29		Bench cut drill and blast bench	80 days	Tue 15/08/17	Wed 13/12/17	28
30		Cabling ducts	50 days	Thu 16/11/17	Tue 6/02/18	29FS-20 days
31		Access paths	50 days	Wed 10/01/18	Tue 20/03/18	30FS-20 days
32						
33		S200 bench cut	180 days	Tue 15/08/17	Mon 21/05/18	28
34						
35		**Western Portal**	**195 days**	**Mon 13/07/15**	**Thu 23/06/16**	
36		Prepare environmnetal controls	30 days	Mon 13/07/15	Wed 26/08/15	8
37		Site Establishment	20 days	Thu 27/08/15	Wed 23/09/15	8,36
38		pump out and clean up	25 days	Thu 24/09/15	Tue 8/12/15	37
39		Ventilation Building	120 days	Wed 9/12/15	Thu 23/06/16	38
40						
41		**Bridges**	**790 days**	**Mon 5/01/15**	**Thu 5/07/18**	
42		Napean River	320 days	Thu 27/08/15	Fri 17/02/17	5,11
43		Hume Highway	220 days	Tue 27/10/15	Thu 3/11/16	5,42FF-60 days
44		Condell Park Road	100 days	Thu 27/08/15	Wed 9/03/16	5
45		Picton Road	140 days	Thu 10/03/16	Thu 6/10/16	5,12,44,46
46		Jinderra Lane	100 days	Thu 27/08/15	Wed 9/03/16	5
47		Cordeaux Bridge	360 days	Thu 27/08/15	Wed 19/04/17	5,8,9
48						
49		**Earthworks**	**260 days**	**Thu 10/03/16**	**Wed 19/04/17**	
50		Hume to Picton Road	30 days	Fri 29/07/16	Thu 8/09/16	43FS-70 days,52
51		Napean to Hume	45 days	Wed 14/12/16	Fri 24/02/17	42FS-40 days,43
52		Picton to Exisitng	80 days	Thu 10/03/16	Thu 14/07/16	46
53		Upgrade drainage and existing aligment	50 days	Mon 6/02/17	Wed 19/04/17	39,47FS-50 days
54						
55		**Rail from Maldon**	**790 days**	**Mon 5/01/15**	**Thu 5/07/18**	
56		Agreement with ARTC	360 days	Mon 5/01/15	Thu 25/08/16	
57		Turn outs	15 days	Fri 26/08/16	Thu 15/09/16	56
58		Initial 200m	20 days	Fri 16/09/16	Thu 13/10/16	57
59		Bottom Ballast alignment	40 days	Fri 14/10/16	Tue 20/12/16	58
60		Top Ballast and rail	70 days	Thu 20/04/17	Mon 7/08/17	59,42,46,53
61		Rail in tunnel	15 days	Mon 23/04/18	Mon 14/05/18	22,60
62		Signalling and Controls	40 days	Wed 28/03/18	Mon 28/05/18	61FS-30 days
63		Commissioing	20 days	Tue 29/05/18	Thu 5/07/18	61,62



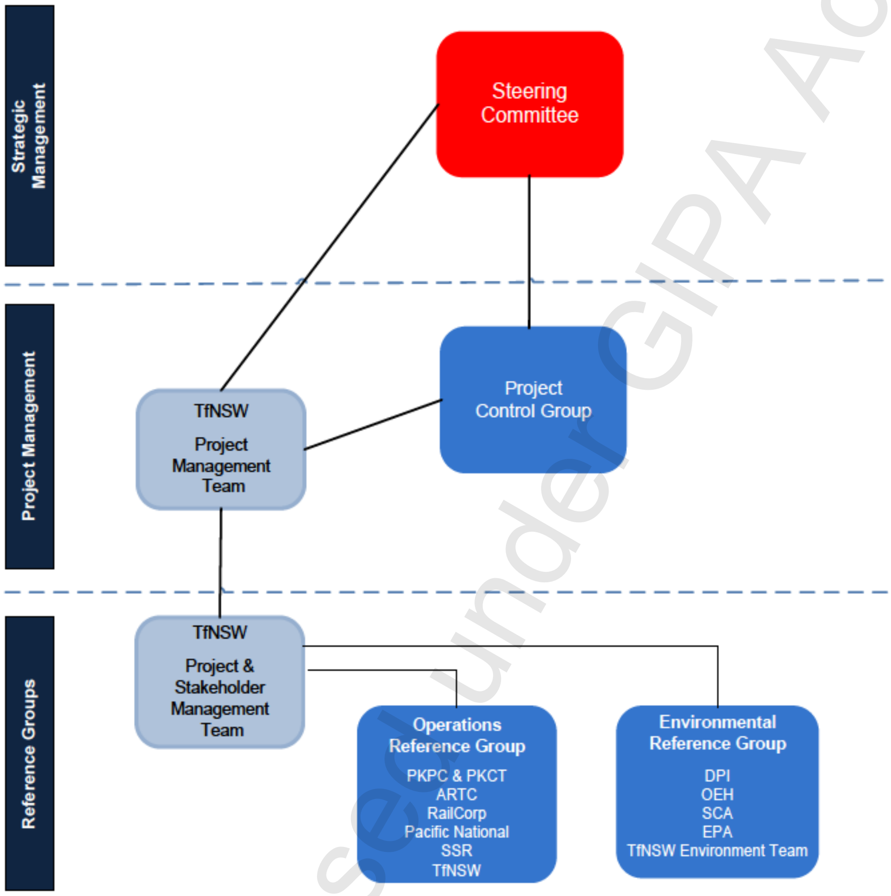
6.2 Governance

As a result of the complex interrelationship between the Commonwealth, NSW Government and the operating agencies, a key activity at the commencement of the project was the establishment of a governance structure.

The project governance structure outlined in Figure 6.2 shows the relationships between the projects strategic and operational levels, as well as its reference groups. The TfNSW project management team is the main liaison point with and between the Steering Committee, Project Control Group (PCG), Operations Reference Group (ORG), and Environmental Reference Group (ERG).

Each group has an agreed Terms of Reference endorsed by the group members and the steering committee.

Figure 6.2 Project Governance Structure



The key reporting requirements for the MtDRL project are highlighted below.

Project Governance - Meetings & Reports

The following meetings shall be attended and reported on as detailed:

Table 6.1 – Project Governance - Recurring Meetings & Report

Meeting	Frequency	Team Attendees	Minutes Responsibility
Steering Committee	Quarterly (t.b.a)	• DDG F&RD (Chair) • DDG TPD • General Manager, Rail and Intermodal DoIT	Project Manager

Meeting	Frequency	Team Attendees	Minutes Responsibility
Project Control Group	Bi-monthly	As detailed within Attachment 3.	Project Manager
Operations and Commissioning Reference Group	As determined by the Chair	As detailed within Attachment 4.	Project Manager
Project Team Meeting	Fortnightly	As required.	Project Secretary

Project Progress Reports

In accordance with TfNSW's Assurance System, progress reports will be provided at the Gate 4 hold point, as outlined in Section 5 of the PMP. The additional progress reports that will also be prepared are outlined in Table below.

Table 6.2 Progress Reports

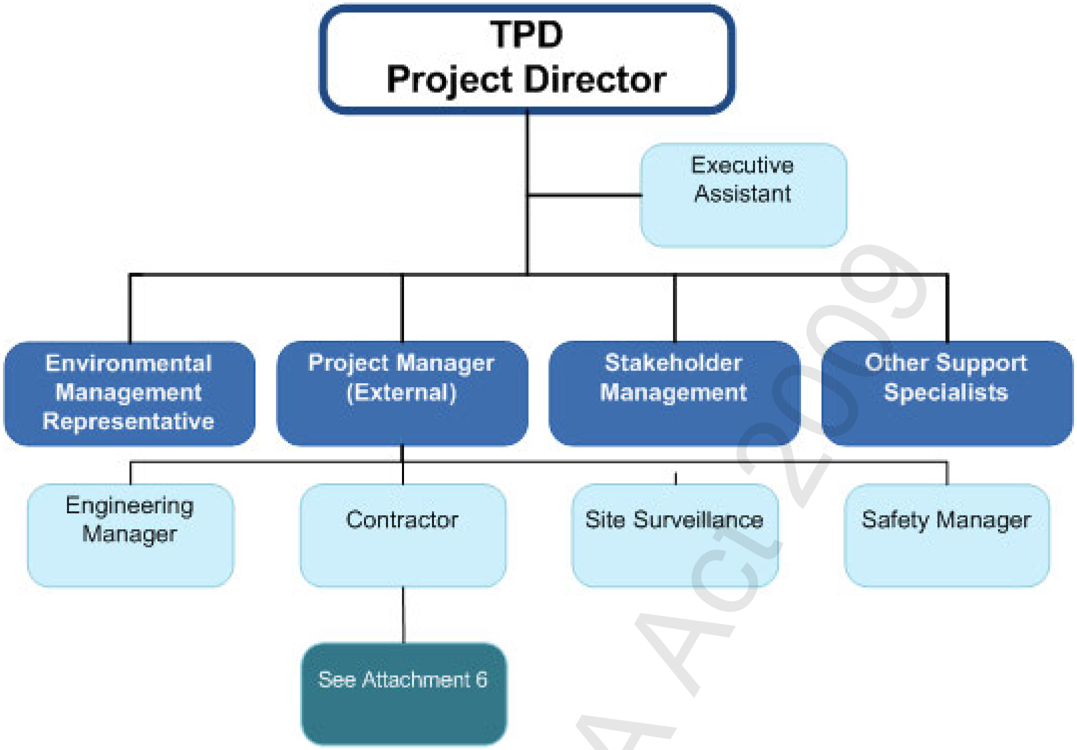
Report Description	Prepared by	Audience	Frequency
Executive Status Report	Sponsor FRD DDG	Steering Committee	As per meeting frequency
	Delivery TPD Project Manager		
Project Status Report	Delivery TPD Project Manager	Project Control Group, & Reference Groups	As per meeting frequency
Project Invoices	Transport Projects Division	Commonwealth DoIT	In accordance with the *Notes On Administration for the Nation Building Program*
Project Accruals & Forecasting	Transport Projects Division	Finance Manager / Accountant Federal Programs Unit, P&PD	2 days prior to last working day of month

The Governance arrangements during implementation of the project have yet to be determined as the Owner / Operator / Maintainer has not been identified subject to funding approval. It is likely that if the project is delivered it would be implemented by using standard Transport Projects Division approach of using:

- Program Control Group or Steering Committee – oversight of project
- Integrated Project Team – day to day management of project with multi-disciplinary team
- Contract Management Group
- Working Group for each discipline – e.g. design, civils, tunnels, etc

The indicative structure of the team that will undertake the Implementation Phase of the project is shown in the chart below. This team provides specialised management and supervision capabilities in the areas of civil engineering, rail systems, signalling, safety, planning, commercial and project administration and reporting. The team structure is consistent with the Stage 4 TOC Report.

Figure 6.3 Project Management team



The Project Director will provide;

- Commissioning management
- Safety supervision
- Site recording
- Contract Management
- Site surveillance
- Design Management
- Stakeholder Interface
- Construction Management

Should funding be made available for the project, a detailed Project Resourcing and Implementation Plan will be prepared.

6.3 Implementation Strategy

The following high level summary of the key project milestones and documents produced to date provides an overview for the Project Review team of the available information, scope and direction of the existing TfNSW works.

Over the period Feb 2013 to September 2013, the project team have:

- Identified the key engineering and environmental issues in detail
- Documented the demand for a range of commodities and a range of potential growth scenarios, and the capacity of the line and the surrounding network has been calculated
- Considered a range of infrastructure and non infrastructure solutions to meet the freight task
- Costed the reference project case and other feasible options
- Drawn together the results in a Preliminary Business Case

Over the period Oct 2013 to June 2014, the project has engaged consultants to:

1. Prepare the concept design
2. Prepared detailed engineering and operations reports
3. Prepare all information for REF and obtaining planning approval
4. Prepared more accurate cost estimates based on detailed Project Definition Design and engineering
5. Prepared Third Party Framework agreements
6. Prepared Final Business Case
7. Prepare works brief for a design and construct tender

The project is currently at the completion of the Final Business Case stage prior to start of Procurement. This aligns with TfNSW Assurance Stage 3 Final Business Case Review.

Should funding approval be provided, the project will move into a Procurement Phase along with REF display and community consultation activities. The project will be delivered as per Standard TPD process and project management, procurement and delivery standards / templates / resourcing will apply. This has not been fully developed until Funding is approved for the project. This has been described in section 6.2 (Governance), 6.4 (Procurement), 6.8 (Stakeholder), 6.9 (Communications). A focus area would be to identify in further detail the key risks during Design and construction and develop detailed mitigation strategies. A live risk register will be maintained in CURA database.

6.4 Procurement Strategy

6.4.1 Procurement options

[redacted]

Workshop was held in June 2013, to agree the preferred delivery strategy and the associated strategy to complete the stage 2 and 3 investigation for the Maldon to Dombarton Rail Link. The workshop attendees reviewed the available project information including scope, risks and program and assessed a number of packaging and contracting options to arrive at the preferred delivery strategy. The approach taken by the delivery strategy workshop assumed the project will be Government funded.

A series of criteria were used to evaluate the options with Non-cost Outcomes (quality, safety and environment), Cost and Operational / Whole of Life being the key criteria.

PACKAGING STRATEGY

The workshop assessed 3 options for packaging. The options included whether to split into 1 / 2 or 3 packages. [redacted]

CONTRACTUAL RISKS

The key performance requirements and contractual risks were identified as follows in the Procurement Strategy workshops.

[redacted]

DESIGN DELIVERY STRATEGY

The workshop also recommended that the team engage Professional Services Contractors to undertake the following packages of work as part of Stage 2 (Project Definition Phase). These packages will need to be progressed to a stage where there is an acceptable level of remaining design risk at the time of going to tender:

- Engineering Project Definition and Concept Design
- Environmental and Planning Approvals

FUNDING AND PROJECT FINANCING STRATEGY

Deloitte was hired and engaged to identify and assess feasible PPP options.

[redacted]

- [redacted]
- [redacted]
- [redacted]

[redacted]

6.4.1 Preferred Strategy

[redacted]

6.5 Benefits Realisation

The Benefits Realisation Plan has not been completed as the project has not received committed funding and the Owner / Operator / Maintainer has not yet been identified. Thus, a phased achievement of targets is not possible at the current time. It is likely that when the project proceeds, the metrics to be measured are likely to be:

- Safety during Construction - LTIFR, MTIFR and any other safety data
- Safety during Operations - LTIFR, MTIFR and any other safety data
- Project completion within budget / on time metrics as defined by TPD and FRD
- Train path availability / network performance metrics or other metrics as defined by ARTC / future owner / operator / maintainer
- Tunnel performance metrics or other metrics as defined by ARTC / future owner / operator / maintainer
- Environmental metrics – e.g. air quality, water quality, noise
- Network journey time reductions compared to previous years
- Any other metrics as identified in the BRS (Business Requirements Specification) document
- It should be noted that the metrics as defined in the template are not all relevant for this project

6.6 Asset Management

6.6.1 Asset Management Strategy

Note: at this stage of submission, the Owner / Operator and Maintainer have not been identified until funding is approved. ARTC is assumed as Owner / Operator and Maintainer for purposes of this document.

Implementation of an effective asset management system is critical to the delivery of required standards of reliability, availability, maintainability and safety throughout the assets and systems, in accordance with the SRS. This asset management strategy shall ensure that physical assets employed in the delivery of MDRL operations have specified maintenance regimes to help ensure that:

- assets operate safely over their design life
- assets achieve their expected life taking account of their duty cycle(s) and operating environment(s)
- assets meet the required performance targets.

TfNSW requires that the D & C contractor adopt a whole-of-life approach to the management and maintenance of MDRL assets and this would typically be demonstrated by:

- the Asset Management Plan

- the Maintenance Manuals
- Engineering and Competency Management Plans
- safety and environmental documentation

Asset Management Lifecycle	Description of Activities	Timeframe	Roles and Responsibilities
Plan	Business Case, Engineering, Design, Cost Estimates, Environmental Impact statement,	2 years	TfNSW
Design and Build	Procurement (EOI and RFT), Contract Award, Final Design, Construction, Testing and Commissioning, Handover	5 years	TfNSW
Operate and Maintain	Operations of line, Regular / Periodic / Maintenance	30 + years	ARTC
Improve and Dispose	Refurbishment / Major Maintenance	Regular intervals	ARTC

A preliminary Asset Management Plan has been prepared with key components including:

- **Maintenance Philosophy** with a core philosophy of preventative (condition monitoring, replacement of components and functional testing) and corrective maintenance (planned and emergency repairs)

- Consideration not just of the different asset types but of asset systems and sub-systems and their associated interfaces.
- The use of recognised and proven maintenance and risk techniques to ensure maintenance is optimised and risks are eliminated / mitigated against over the assets' lifecycles.
- The performance targets the assets are expected to achieve.
- Consideration of the criticality of the assets to the safe operation of MDRL and the implications on performance should these asset(s) fail / degrade.
- Consideration of the local environment in which the assets will be operating.
- Incorporation of any 'lessons learnt' from operating identical / similar assets in NSW and other environments, as appropriate.
- Consideration of the maintenance facilities, locations and resources available (including staff competency requirements) to maintain the assets.
- Consideration of the track access time allotted to carry out maintenance, given the operational requirements.
- If applicable, how any out-sourced / sub-contracted activities will be managed and controlled to ensure the safety and quality of deliverables.
- Consideration of 'what if' scenarios should unforeseen events occur (e.g. unavailability of spares, logistical failures).
- Consideration of the computer-based systems, including the asset register, and information required.
- Consideration and incorporation of legislative requirements.

Asset Management System

- Develop and maintain an Asset Register
- Maintenance Works Plan with procedures for installation, inspection and routine maintenance and thresholds for carrying out maintenance activity
- Asset management system with Spares and Inventory management plan, records management plan, handback condition and specified performance standards system,

Infrastructure Maintenance Plan

This will require:

- **Track maintenance** – bi-weekly visual, periodic and regular maintenance
- **Maintenance of cuttings and embankments** – apart from regular inspection, increased inspection / monitoring required with steep slopes, embankments and cuttings
- **Signalling maintenance** – periodic inspection, certification, signalling adjustment
- **Maintenance of power, comms and control systems** – periodic maintenance, replacement of batteries, checking for earthing and bonding
- **Maintenance of tunnel civil structure** – periodic inspection of permanent support, walkway and drainage, maintain monitoring instruments
- **Maintenance of tunnel system, portal door, ventilation fans and buildings** – periodic inspection, maintenance and repair and regular servicing will be required
- **Bridges and civil structure maintenance** – periodic and routine inspection including specific inspection and maintenance for structures built in 1980s
- **Corridor, vegetation and access road maintenance** – this includes maintenance, upgrading, road resurfacing, weed removal / pruning, re-vegetation, lighting maintenance, graffiti removal, fence repair, landscaping, etc

Rolling stock would be maintained, refurbished and operated by private operators and is not part of the scope of this project.

6.6.2 Asset Ownership Matrix

Asset Category	Asset Category Description	Asset Owner	Asset Operator	Asset Maintainer
Rail Corridor	Property	TfNSW		ARTC
Civil structures,	This will include culverts, bridges, tunnels, signalling, overhead wires, retaining walls and related infrastructure	ARTC	ARTC	ARTC
Tunnel	Tunnel Structures and tunnel Systems, Ventilation building	ARTC	ARTC	ARTC
Below rail	Track, ballast, turnouts, crossovers	ARTC	ARTC	ARTC
Water treatment plant		ARTC	ARTC	ARTC
Roads	Local and major roads	Local – Councils; major highway - RMS	Local – Councils; major highway - RMS	Local – Councils; major highway - RMS
Roads	Roads in catchment area	SCA	SCA	SCA
Rail	Main Freight Network,	ARTC	ARTC	ARTC
Rail networks connecting to MDRL	Coniston Junction, Illawarra Line	Sydney Trains / ARTC for parts	NSW Trains / ARTC for parts	Sydney Trains / ARTC for parts
Utilities	Gas, electricity, water mains	Respective owner	Respective owner	Respective owner
Rolling stock	Locomotives, wagons and above rail staff for rolling stock operations and maintenance	Each mining company / freight provider	Each mining company / freight provider	Each mining company / freight provider

6.6.3 Impact Assessment on Current Assets

At this stage, no changes to services or service levels or for any assets are planned or for disposal or retirement of assets.

The current assets are the incomplete works on the MDRL Line such as 35 kms of rail track, incomplete bridges on Cordeaux River and Nepean River. These assets are likely to continue to deteriorate in the absence of any remedial work or new projects.

Should MDRL be built, the impacts on nearby assets are mainly

- **Upgrades to Coniston Unanderra Junction** will be required – Due to capacity constraints at Coniston junction, additional throughput from MDRL will require additional works. This is discussed in section 3.5.4. Full analysis of these impacts is provided in the PB Technical Memo – Coniston – Unanderra Rail Operations Report.

- MDRL will trigger additional capacity requirements on SSFL and MFN this is discussed in section 2.3.1 and 2.3.2. Full analysis of these impacts is provided in the PB Technical Memo – Rail Operations Report.

- Remedial repair works for culverts have been identified as preventive maintenance and this will be supplied to Country rail Network / John Holland as part of the current documentation

6.7 Risk Management

6.7.1 Risk Management Strategy

Risk management within TfNSW in general and MDRL project in specific comply with AS/NZS ISO 31000:2009 Standard with orientation to other good practices and TfNSW's references including below:

- TfNSW Project Cost Estimating Standard, 4TP-ST-173

- TfNSW Enterprise Risk Management Standard, 30-ST-164/3.0

- Risk Management Procedure, 30-PR-437/1.0

- Risk-based Cost Contingency, 3TP-PR-157/1.0

- TfNSW Standard Requirements TSR Prelude, 5TP-FT-300/2.0

In addition safety, quality, environmental and business risks, the aim is to achieve the best possible balance between project cost, time and uncertainties; to analyse and manage the project's risks and uncertainties.

Generally, there are two main types of risk that need to be assessed and managed: Project Uncertainties (i.e. Inherent Risks or Planned Risks) and Project Risk Events (i.e. Contingent Risks or Un-Planned Risks).

The project risks and uncertainties (both positive and negative) arise from the project components and their interactions with each other, from technical complexity, schedule and/or cost constraints, and with the broader environment in which the project is managed.

MDRL's approach to project risk categories includes:

- Environment-level risks & uncertainties
- Program-level risks & uncertainties
- Project-level risks & uncertainties
- Operational-level risks & uncertainties
- Portfolio-level risks & uncertainties
- Benefit-related risks and uncertainties

Accordingly a detailed Risk Management Plan has been developed to plan and manage all project risk management requirements. The key elements of MDRL's Risk Management Plan are, Approach (which defines the methodology, tools, and data sources and also describes how the components and their outputs are linked to the project risk management process), Roles & Responsibilities, Budgeting, Timing, Risk Categories, Probability and Impact Matrix, Revised Stakeholders' Tolerances, Reporting Formats, Tracking, Approvals, and Input to Enterprise PRM Process.

MDRL's approach to identification and review of possible risks, opportunities and uncertainties includes:

- Documentation Reviews
- Information Gathering Techniques including Brainstorming (R&O Workshop, Delphi Technique, Interviewing (internal and external), Root Cause Identification, and Business Case Analysis
- Benchmarking and Lessons Learned Reviews
- Diagramming Techniques including Cause-and-effect Diagram, Program Dependency Analysis
- Scenario Analysis

The outputs of the risk identification process have been systematically captured and documented within the Project Risk Register (TfNSW's CURA Enterprise Risk Management System) for further quantification and program confidence level assessment.

For a complete project risk management, the level of risk and uncertainty included in each project's cost estimate and schedule has also been assessed by project team. Through the consolidation of possible schedule and cost consequences of residual risks, the team will have assessed the overall project confidence level that the P90 cost will have 90% probability of being equal or less than the current approved budget and schedule (including all its interim milestones) will be equal or less than the current approved contractual completion date/s.

This approach will help to inform TfNSW management the likelihood of the project's delivery success through combining the project's cost, schedule and risk data into a complete picture.

TfNSW TPD have used its proprietary risk based program CURA to manage the development and reporting of risks. This framework is part of the TfNSW management process which will be applied throughout the MDRL project.

6.7.2 Risk Profile

Risk Matrix

Risk Ratings:			Consequence					
			Insignificant	Minor	Moderate	Major	Severe	Catastrophic
			C6	C5	C4	C3	C2	C1
Likelihood	Almost Certain	L6						
	Very Likely/ Probable	L5	1			2		
	Likely	L4						
	Unlikely	L3				3		
	Very Unlikely/ Improbable	L2						
	Almost Unprecedented	L1						

Note: 1,2,3 - Refers to the risk id.

Key

Risk Exposure: Severe High Moderate Low

TfNSW engaged Aquenta to provide a risk management plan. The plan was based on the engineering, operational and safety risks as identified and assessed by PB during Concept Design Investigations and the environmental risks as identified and assessed by SKM during the REF.

The project financial event risks are based on the risks identified by TfNSW and its PSC - PB and GHD. The financial inherent and event risks were assigned lower bound and upper bound cost ranging and likelihoods determined in a workshop environment hosted by Aquenta which included TPD and PB personnel. The costs assigned to project event and inherent financial risks were assessed using risk analysis (Monte Carlo) software and included in the P50 and P90 estimates for the project.

The project financial event risks are based on the risks identified by PB, GHD and SKM. The financial inherent and event risks were assigned lower bound and upper bound cost ranging and likelihoods determined in a workshop environment hosted by Aquenta which included TPD and PB personnel. The costs assigned to project event and inherent financial risks were assessed using risk analysis (Monte Carlo) software and included in the P50 and P90 estimates for the project.

TPD consolidated the key non-financial project completion risks sourced from GHD, PB and internal inputs. These risks were reassessed using the TPD Project Risk Management Procedure (3TP-PR-086/1.0). The overall thirty highest risks have been included within the separate TPD Delivery and Operations and Development Risk Registers as loaded into the TPD CURA system. The remaining lower level, risks are also included into the risk management plan within the PB Project Risk Register for reference and periodic review during the Detail Design and Construction phase of the project.

<u>See Risks Spreadsheet for Key Risks</u>
The following table details the key projects risks identified by the project team during the scoping stage.

The risk registers have been updated and a finalized risk management plan produced.

Risk Summary

[redacted]

[redacted]

[redacted]

Top 10 risks for Costs are described under Cost Management section. The key risks for construction of the project are described below.

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

- [redacted]

6.8 Stakeholder Management

Taking into account the key stakeholders, their views and community issues as well as the project objectives and deliverables, a Stakeholder Engagement and Communications Strategy[38] was prepared, which identified the most appropriate forms of communication and engagement.

The overall objective was to prepare a structured and coordinated approach to communications with stakeholder engagement in order to:

- Identify all key stakeholders
- Plan and coordinate engagement activities for key stakeholders particularly during preparation of the environmental assessments
- Identify key messages
- Establish workable protocols for stakeholder engagement
- Ensure key stakeholders were adequately informed and consulted about the status and phase of the project (the key timelines and deliverables)
- Develop and implement workable mechanisms that allowed stakeholders to provide feedback
- Identify and manage stakeholder engagement risks
- Help manage expectations
- Ensure equitable access to information for stakeholders
- Ensure development of an appropriate data base of stakeholders to allow for ongoing contact during further phases
- Ensure key decision makers were aware of stakeholder interest and feedback; and
- Identify appropriate timelines and opportunities for stakeholder engagement.

The interests of each stakeholder were identified by undertaking Stakeholder Analysis and Situational Analysis. These are described in figure below.

Stakeholder	Interest in the Project
Sydney Catchment Authority	Environment
Australian Rail Track Corporation (including John Holland to Signalling Interface at Junee as part of the Country Rail Network)	Operational, Interfaces, Potential end owner
Port Kembla Port Corporation	Operational, Interfaces
Pacific National and Southern Shorthaul Railroad	Operational
NSW Office of Environment and Heritage	Environment, Compliance
NSW Environment Protection Authority	Environment, Compliance
National Parks and Wildlife	Environment
NSW Department of Planning and Infrastructure	Planning, Environment
5 Local Councils	Political, Advocates
Additional Key Stakeholders identified during the workshop	
Roads and Maritime Services (Hume Highway)	Interfaces
Jemena (Ethane Gas pipeline)	Interfaces
Commonwealth Department of Infrastructure and Transport	Political, Funding

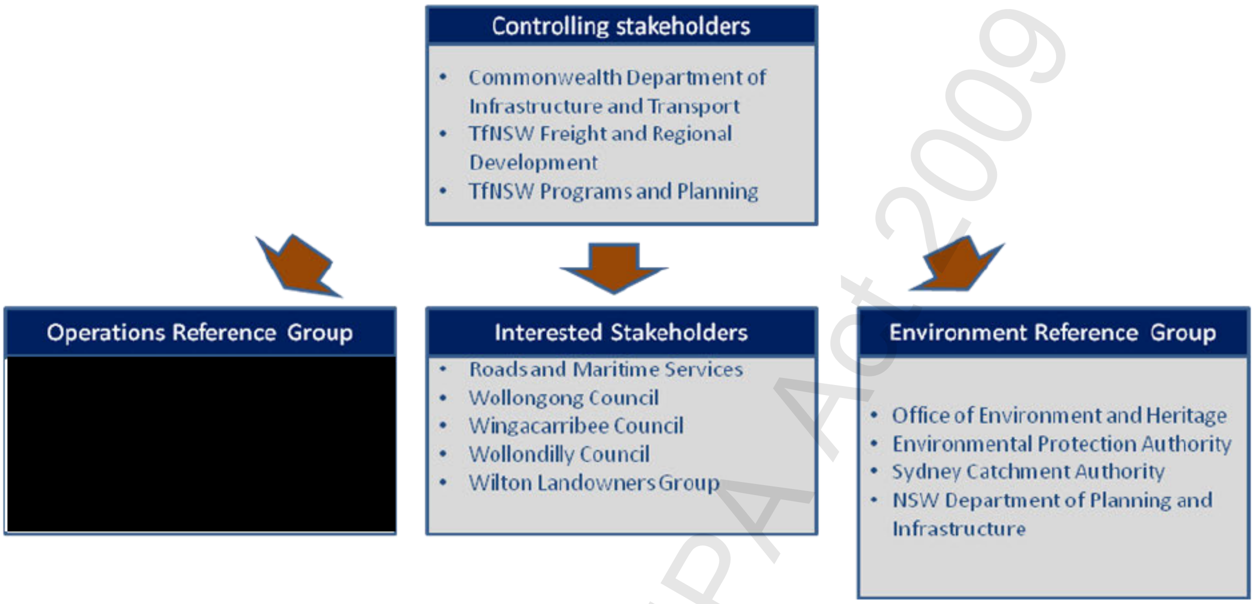
6.8.1 Stakeholder Management to date

The stakeholder management for the project has been split into three main groupings

[38] Stakeholder Engagement and Communications Activities Status report – June 2014 and SKM Stakeholder Communications Plan – February 2014

CONTROLLING STAKEHOLDERS

The main government agencies responsible for the strategic and operational management of the project are:



Commonwealth Department of Infrastructure and Transport

- Responsible for funding
- Ensuring integration within an Australia-wide port and transport context, and
- A member of the Steering Committee and PCG.

TfNSW Freight and Regional Development:

- The DDG FRD is the Project Sponsor and Chair of the Steering Committee,
- F & RD also sit on the PCG
- Responsible for the integration with NSW rail planning,
- main interface with rail parties, and
- Chair of the Operations Reference Groups.

TfNSW Programs and Planning

- Responsible for interfacing the project within the overall framework of Commonwealth funding
- Attendance at PCG's

REFERENCE GROUPS

Operations Reference Group The reference group responsible for owner/operators and end users. It includes:

- [redacted]
- [redacted]
- [redacted]
- [redacted]

Environmental Reference Group All the main NSW Government agencies with an interest in maintaining the quality of the environment, including:

- The Office of Environment and Heritage
- The Environmental Protection Authority
- The Sydney Catchment Authority, and

- The Department of Planning and Infrastructure

INTERESTED STAKEHOLDERS

Presentations were given to
- Wollongong Council
- Wingecarribee Council
- Wollondilly Council
- NSW Trade and Investment; Division of Resources and Energy

Interface meetings were held with BradCorp, representing the Wilton Landowners Rezoning Group to consider the interaction of the rail line with the large housing and employment development proposed for the Wilton Area.

6.8.2 Proposed Stakeholder Management

It is currently envisaged that the Stakeholder Management during EIS, Design and Construction will be a continuation of the dialogue with the above key parties. During EIS there will be a greater focus on Community Consultation.

6.9 Communications Management

Communications activities were designed to support the engagement program (see TfNSW and SKM Stakeholder and Communications Plans). The project attracted considerable media attention (especially in the Illawarra and industry media) and it was important to provide information about the progress of work through news outlets and other accessible channels.

Using the IAP approach, a clear framework was developed and responsibilities allocated between SKM and TfNSW staff. The key issues were identified for the project, risk identified and specific mitigation measures developed and the suitable tool / channel. For example, to avoid negative publicity, relevant media releases were issued. Further, to ensure that key stakeholders were informed, early engagement was undertaken and similarly key messages identified and conveyed.

There was extensive consultation with community and property owners and ensure the rationale of using REF as compared to EIS.

INCREASING LEVEL OF PUBLIC IMPACT

INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
Objective	Objective	Objective	Objective	Objective
To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, or solutions	To obtain public feedback on analysis, alternatives, or decisions	To work directly with the public throughout the process to ensure that public and private concerns are consistently understood and considered	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution	To place final decision making in the hands of the public

Source: IAP2 International Association for Public Participation.

Figure 6.5 IAP2 Public Participation Spectrum

These channels and tools were developed and utilised throughout the project:

- Compilation of a database of stakeholders and interested parties which could also record any contact with these stakeholders
- Establishment of a dedicated project webpage on the Transport for NSW website www.transport.nsw.gov.au/projects-maldon-dombarton-rail-link
- A 1800 phone number for project enquiries
- A project email address
- A project business card
- Key project messages
- A question and answer document
- Maps
- Photography.

Communications activity focussed on:

- Aerial filming
- Media releases
- Media monitoring
- Presentations and workshops
- Website updates with media releases, images and links to key documents.

Key messages were determined and underpinned the external information and conversations.

- Transport for NSW is conducting a range of investigations into the proposed Maldon to Dombarton Rail Link. These investigations include environmental and engineering assessments.
- The Federal Government has allocated funds for Transport for NSW to conduct these studies with the aim of having the project "shovel ready" stage by mid 2014 for possible approval to construct.
- When this work is complete, funding for construction could be considered by the state, federal and private sectors.
- A feasibility study conducted in 2011 showed the Maldon to Dombarton Rail Link may have long-term strategic merit. The current studies are in accord with work undertaken including the Long Term Transport Master Plan, the Infrastructure NSW Plan and the NSW Freight and Ports Strategy.
- The Project Team is investigating the cost of the project, its impacts and benefits.
- No major works will be undertaken until an environmental impact assessment has been developed and exhibited and the views of all stakeholders considered.
- Stakeholder input and feedback are important.
- The project is unique in NSW because it was started and partially completed in the mid 1980's - it therefore could be completed relatively quickly.
- It will be somewhat different to the originally envisaged rail link because of changes in technology, safety and environmental standards.

The ongoing messages about work undertaken by TfNSW and the future of the Maldon to Dombarton Rail link will be:

- As scheduled, TfNSW completed its investigations and engineering design work in mid 2014 and the Maldon to Dombarton Rail Link is 'shovel ready'
- The TfNSW work ensures that construction would meet current environmental, engineering and operational safety standards
- Economic feasibility modelling indicates the Link is not required to meet freight logistics needs in the short to medium term.
- On the basis of the expansion of Port Kembla and the reduction of freight paths on the Illawarra Line (to provide for passenger rapid transit services), the Maldon to Dombarton Rail Link will be required for commissioning in the longer term (2028)
- Funding for further work was not provided in the 2014/15 Federal Budget.

Media releases were prepared by Transport for NSW and provided to the Commonwealth to issue. Between 17 August 2012 and 22 July 2013, six media releases were issued, largely focussing on building an expert team to undertake the investigations.

They received coverage in local news outlets and are available on the Transport for NSW website and the (then) Federal Minister for Transport and Infrastructure's website. No media releases were issued after the change of Federal Government in September 2013.

6.10 Change Management

As the owner for the line is yet to be determined, and hence any impact on the owners business is yet to be defined, the Change Management activities during this phase of the Pre-construction activities have been limited to;

- **Configuration Change Management**

TfNSW have prepared al relevant documentation for submission to as a Stage 1 project to the TfNSW Configuration Change Management Board. The documentation includes all relevant engineering design

- **Asset Management Plans**

TfNSW have prepared Asset Management Plans to guide future maintainers in the overall management of the line. The contractor will be required to progressively populate the Asset Management Framework prior to commissioning and handover.

- **Safety Management**

TfNSW have prepared a detailed Safety Change Plan. Following award of the tender, the Contractor will be expected to complete the design and safety assurance in accordance with the Safety Change Management system adopted by TfNSW to date.

TfNSW have therefore been unable to forecast the impact of the new line on such things within the owners business as

- Maintenance crews size and skill sets
- Property maintenance functions
- Above Rail Operator interfacing including line costing details
- Driver training
- Integration within the ARTC network operating subsystem
- Timetabling
- Provision of Maintenance Specifications
- Remote area working
- Accreditation and training to work within National Parks
- Crew Scheduling

TPD standard process for Change Management and Operational Readiness will apply.

6.11 Sustainability and Environment

Energy management

To use Transport's energy sources more efficiently and reduce its greenhouse gas emissions

- Reduced energy consumption
- Reduced greenhouse gas emissions

Pollution control

To minimise air, noise, water and pollution from Transport's operations and construction

- Reduced pollution (air, noise, land and water)

Climate change resilience

To plan and deliver transport infrastructure and operations that are resilient to the effects of climate change

- Transport infrastructure and operation that is resilient to the effects of climate change

Resource management

To reduce water consumption in Transport's operations, maintenance, construction and management

- Reduced waste generation
- Reduced resource consumption

Biodiversity

To mitigate transport impacts on biodiversity

- Transport which conserves and enhances biodiversity

Heritage

To mitigate transport impacts on heritage

- Transport which conserves and enhances heritage

Liveable communities

To improve community experience through the delivery of transport which is integrated with surrounding land use activities

- Transport which is integrated with surrounding land-use activities
- Improved community experience with transport

Corporate sustainability

To establish governance arrangements for Transport which support resources efficiency and continuous improvement in environment and sustainability performance

- Governance arrangements that support continuous improvement of sustainability performance

Summary of the key findings of the Review of Environmental Factors

Air quality

Potential impacts on air quality during construction would be as a result of the material handling and earthworks, as well as wind erosion of exposed areas. The potential emissions of particulate

matter may cause nuisance impacts. There would also be emissions to air from products of combustion (such as engine exhausts) but in practice these emissions would be minor.

Results from the dispersion modelling indicate that the construction activities are unlikely to cause exceedance of the Environment Protection Authority (EPA) air quality criteria. A Construction Dust Management Plan would be prepared to further minimise the impact of construction activities on air quality.

Operational activities would include train movements along the Proposal. Emissions to air would be from the train exhausts and would comprise mainly carbon monoxide (CO), oxides of nitrogen (NO_x) including nitrogen dioxide (NO_2), particulate matter and other pollutants such as benzene and formaldehyde. Exhaust from moving trains would rapidly disperse, however pollutants could become more concentrated around the tunnel portals as emissions are purged by the tunnel ventilation system. The design of tunnel and ventilation system has been further developed to minimise air quality impacts and concentrations of key air pollutants would be within acceptable limits.

Dispersion model predictions show that the Proposal would not cause exceedances of the air quality criteria for all air pollutants at the closest sensitive receptors to the Proposal during operation.

Avon tunnel eastern portal

Noise and Vibration

The Proposal passes through a wide variety of land uses, including farming, mining, rural and suburban residential areas at the southern and northern ends of the Proposal with extensive bushland / water catchment areas throughout the centre of the alignment.

Existing sensitive receivers in the north are located in the townships of Maldon and Wilton. Residential development of Bingara Gorge, to the west of Wilton has commenced. Receivers in this area are generally impacted by noise from road traffic on Picton Road, Menangle Road and the Hume Highway. Rail traffic on the existing Main South Rail Line would also be audible in this area.

Receivers in the vicinity of the Proposal in the south are located in Dombarton. These receivers are generally located in quiet rural areas; however the existing Unanderra to Moss Vale rail line and several small mines generate some background noise. In addition, traffic on the Princes Highway would be audible in eastern areas of Dombarton.

The Proposal would result in construction noise and vibration impacts at some properties during specific activities. Exceedances of the construction noise criteria during standard hours would generally be minor according to conservative (worst case) modelling. Exceedances of noise criteria would also occur during out of hours construction, however exceedances would be short term in duration as the amount of out of hours construction work would be minor.

A Construction Noise and Vibration Management Plan (CNVMP) would be prepared and would reference the standard construction noise mitigation measures outlined in TfNSW's construction noise guidelines.

During operation of the Proposal exceedances of the Rail Infrastructure Noise Guideline (RING) trigger levels have been predicted for four existing sensitive receivers. Noise contours have also been generated to assist in identifying the likely impact on the Wilton Junction and Bingara Gorge developments. These predict exceedances of operational noise trigger levels in some areas of the Wilton Junction and Bingara Gorge developments immediately adjacent to the Proposal.

The developers of these properties would be responsible for mitigation of operational noise from the Proposal in accordance with current state policies. Notwithstanding, TfNSW would consult with the Wilton Junction developers to determine additional noise mitigation measures which may be provided by TfNSW subject to cost-effectiveness.

Traffic and Transport

During construction, impacts of the Proposal caused by light and heavy traffic movements would include some congestion on roads, short-term and temporary impacts on access to roads and private property, and potential damage to road infrastructure.

The majority of inbound and outbound trips of up to 350 construction personnel would occur outside the commuter peak periods (7am to 9am in the morning and 3pm to 6pm in the evening) and would result in minimal impact on the road network.

Major construction compounds may generate around 40 heavy vehicle movements a day. These movements are not likely to cause any substantial loss of capacity to the wider road network and not likely to cause any damage to roads and associated infrastructure.

Measures for managing heavy vehicles would include managing spoil within the rail corridor as much as possible; off peak movement of plant and equipment on and off the site; storage of plant and equipment on site to avoid multiple trips; mandating the use of major arterial roads; timely notification of any lane closures and detours; and ensuring access to private land is maintained.

The Proposal crosses the Hume Highway, Picton Road, Janderra Lane and Condell Park Road near Wilton. At these locations road bridges would be constructed which would lead to full and/or partial closure of road lanes during construction. Temporary pavements would be provided adjacent to the existing roads to maintain access.

A Construction Traffic Management Plan will be developed in consultation with relevant local government and transport authorities to minimise impacts caused by light and heavy vehicle movements as much as possible.

Landscape and visual amenity

Construction activities would have some implications on landscape and visual amenity due to vegetation clearing, tunnelling and spoil disposal, bridge construction, site compounds, and work areas, and night works.

Visual impacts from bridge construction would arise from views of cranes and other construction machinery and views of the partially completed bridge itself. Although cranes would appear higher and be visible from much further than the bridge, any impact would be temporary in nature (approximately two years) until construction is complete.

A large spoil mound would be created to store the spoil from the construction of the Avon tunnel. The spoil mound would be shielded from direct views from nearby properties by existing trees. At the completion of tunnelling the mound would be landscaped and vegetated to minimise its visual impact.

Visual impacts during operation of the Proposal would result from operation of freight trains on the Proposal and maintenance activities.

Views from Picton Road would allow a more elevated view toward the Proposal and more of the cutting would be potentially visible. Once mitigation planting along the rail link is established, the visual impact of the Proposal would be reduced to negligible or nil in most cases with the potential exception of the north west view from Picton Road, which is almost directly above the Proposal. This landscape is already modified and therefore the impacts would be considered low. Measures to reduce the visual impact of the construction have been proposed.

The Coastal Escarpment looking south from above the southeast end of the Proposal

Biodiversity

The majority of the Proposal would be located in the heavily vegetated Metropolitan Special Area and Upper Nepean State Conservation Area. The rail formation in these areas was constructed during the works in the 1980's and consequently further vegetation clearing would be limited to removing regrowth from the rail corridor and clearing for the construction of passing loops and the Cordeaux River bridge. In the unconstructed northern extent of the Proposal around Wilton, most of the vegetation has already been cleared in the past for agriculture and other development, however some patches of important remnant vegetation remain.

Overall approximately 14.8 hectares of vegetation would be cleared, of which 4.3 hectares would be a threatened ecological community listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and/or the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The threatened ecological communities cleared would not result in a significant impact on the extent or distribution of any of the threatened ecological communities. A suitable biodiversity offset would be provided by TfNSW to account for the loss of the threatened ecological communities due to clearing for the Proposal.

Populations of 5 threatened flora species were recorded in or adjacent to the Proposal. One of these species, *Epacris purpurascens var. purpurascens* (Common name: Port Jackson Heath) was identified as being potentially impacted by the Proposal. Large numbers of plants were found in drainage swales of the already constructed rail formation on both sides of the proposed Cordeaux River bridge. The cuttings associated with the rail formation in this location had protected the populations of *Epacris purpurascens var. purpurascens* in the drainage swales from an intense bush fire in October 2013. Because of the impacts of the bush fire, it was difficult to determine whether there was a larger population of *Epacris purpurascens var. purpurascens* outside the rail corridor. Additional surveys undertaken in March 2014, identified additional populations of *Epacris purpurascens var. purpurascens* in the upper reaches of drainage lines on both sides of the proposed Cordeaux River bridge. Also the drainage of the rail formation in these areas was redesigned to avoid direct impacts on populations in the drainage swales. Overall, the Proposal would impact less than 10% of individual plants in any of the identified populations of *Epacris purpurascens var. purpurascens* and consequently would not have a significant impact.

A large number of both threatened and non-threatened fauna species were identified in the study area for the Proposal. Threatened species such as the Red-crowned toadlet and the Giant Burrowing Frog were found in already completed areas of the Proposal. Other threatened microbat species and bird species are likely to forage in vegetated areas adjacent to the Proposal. However, while the Proposal would have some indirect impacts on habitat, connectivity and foraging resources, these impacts would not be significant.

Epacris purpurascens var. purpurascens *Giant Burrowing Frog*

Image courtesy the Australian Museum

Aboriginal Heritage

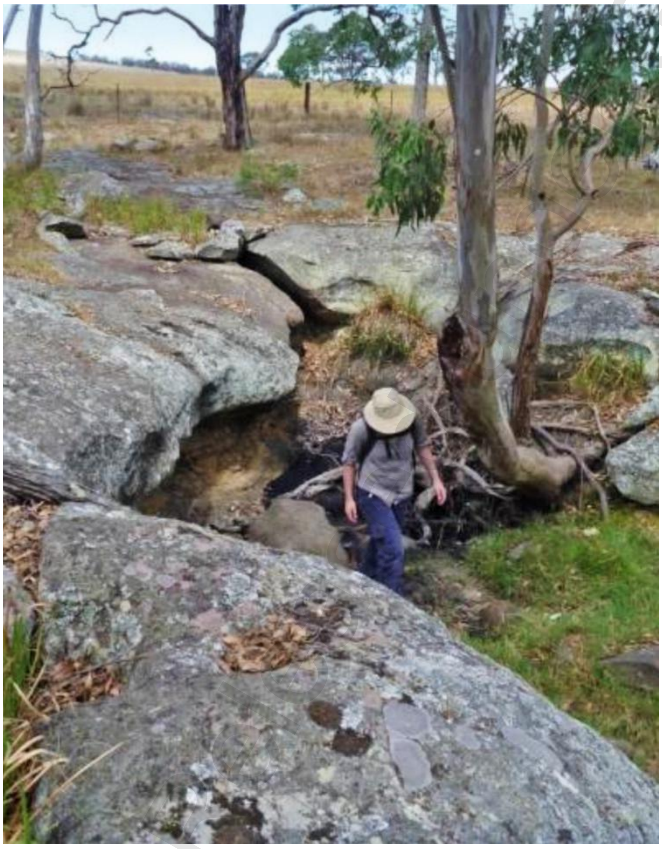
Direct impacts on Aboriginal heritage may result from new construction activities associated with bridges, tunnels, signals, rail track, passing loops, ancillary infrastructure, the addition of top ballast as well as dust and vibration during construction. This may result in partial or complete destruction of sites.

An Aboriginal Heritage Information Management System (AHIMS) search indicates that 282 registered Aboriginal sites are located within 200 metres of the Proposal. A survey of the Proposal was also undertaken with registered Aboriginal groups. No previously unknown heritage items or areas of archaeological potential were identified in the study area during the survey. The areas where excavation is to take place for the Proposal have previously been heavily disturbed by prior rail works associated with the original Maldon to Dombarton railway line and ancillary works, including slope embankment cutting and vehicular access areas. This supports the extremely low likelihood of the presence of historical deposits in any areas to be excavated as part of the Proposal.

Five AHIMS recorded sites and Potential Archaeological Deposits (PAD) have been identified as directly or potentially indirectly impacted by the Proposal. One site, a PAD, would be directly impacted from the construction of the Proposal.

A range of mitigation measures would be employed to reduce potential impacts to Aboriginal sites, including undertaking salvage activities to preserve the PAD site where possible.

Potential indirect impacts from dust and vibration due to the operation of the Proposal were identified for two sites containing rock art. Appropriate mitigation measures would be implemented to avoid these impacts.



Rocky creek bed at north-eastern end of M2DPAD1

Non-Aboriginal Heritage

Three listed non-Aboriginal heritage items are situated within or immediately adjacent to the Proposal. Of these, the Escarpment Core Area/Illawarra Escarpment and the Upper Nepean

Catchment conservation areas are outside of the construction boundary and would not be impacted by the Proposal.

One heritage item would potentially be impacted by the Proposal, the Upper Nepean Scheme-Canal System (Pheasants Nest Weir to Prospect Reservoir). While the proposed works are located 750 metres to the west of the listed heritage curtilage for this item, the canal system itself continues subsurface as a tunnel. This tunnel is underneath the proposed works area. Potential construction impacts may occur due to vibration and direct contact with construction plant and vehicles during earthworks and track formation.

The Upper Nepean Scheme-Canal System appears to be in a stable condition and damage due to vibration impacts is unlikely due to the distance from the works and the stability and fabric of the construction.

Direct damage by construction machinery or materials would be mitigated and monitored in consultation with the Sydney Catchment Authority (SCA). General mitigation measures such as construction worker training and protocols would be implemented to reduce the risk of impacts

No potential impacts have been identified during operation.

Land use and property

The majority of the Proposal would traverse dense bushland, although areas of rural and residential uses are located at the northern and southern ends of the proposal.

Cumulative impacts may occur as a result of the construction of the Proposal in conjunction with further construction development works at the Wilton Junction and Bingara Gorge developments. The construction period for Wilton Junction is unknown as the re-zoning proposed within the Wilton Junction Master Plan has not been determined by Planning and Environment.

Operation of the Proposal would not impact the use of the drinking water catchment as it would not inhibit the collection of drinking water.

Mine subsidence has the potential to impact upon the Proposal during operation, causing temporary delays. These impacts would be manageable and be addressed in further detail during the detailed design.

Socio-economic

Communities in the study area value the rural character, amenity and natural setting of the locality. The importance of the area's rural character is recognised in the Wollondilly and Wingecaribee Community Plans, where retainment and enhancement of a rural lifestyle was considered to be a key outcome for residents in both local government areas.

Potential impacts to amenity may include noise and dust generated from the construction activities. These impacts would be monitored and management plans would be in place to minimise impacts.

The construction of the Proposal would result in the loss of some grazing land with sections of the existing rail corridor being fenced off from neighbouring properties. Local business and industry in the study area are mainly concentrated within or near to the localities of Picton, Maldon and Wilton. There are no businesses located in Dombarton. Expenditure relating to construction may result in direct and indirect benefits to local businesses in the area.

The Proposal would improve access for freight between Port Kembla and Sydney, reducing freight rail traffic on the existing Illawarra Railway Line. During operation, noise and dust generated by freight trains may impact on the rural character and amenity of the study area. As a whole it is expected that the proposal would support regional economic development by improving efficiencies in the transportation of freight.

Community consultation would continue throughout the detailed design and construction phases to ensure concerns are identified and considered for the Proposal. Project information and contact details are available to enable feedback mechanisms and early identification of issues.

Hydrology and water quality

Construction would involve earthworks and construction of bridges across the Nepean and Cordeaux rivers as well as the transport and usage of a range of materials. These activities could result in the release of pollutants such as sediments, hydrocarbons and other contaminants into the surrounding environment. These contaminants have the potential to pollute downstream waterways by causing increased sedimentation, excess nutrients, and high levels of chemical and heavy metal concentrations. A range of mitigation measures, including a Soil and Water Management Plan would be implemented to ensure that surface waters are not impacted by the construction of the Proposal.

During operation water quality impacts could arise from contaminated runoff from the rail formation, major spills of dangerous goods along the rail line and water discharge from the Avon tunnel. Measures to treat runoff from the Proposal in the Metropolitan Special Area and the Upper Nepean State Conservation Area have been developed to meet the Neutral or Beneficial (NorBE) water quality requirements mandated by the Sydney Catchment Authority. Spill containment would be provided at key waterway crossings and detailed emergency response plans would be developed in conjunction with relevant agencies. A water treatment plant would be provided to treat water from the Avon tunnel to meet relevant criteria for discharge.

Potential hydrological impacts from the operation of the Proposal include increases in flood levels adjacent to the rail corridor and changes in waterway hydrology and natural drainage patterns. However, these impacts would be minor and can be addressed during the detailed design of the Proposal.

Groundwater and geology

The alignment of the Avon tunnel would traverse Bulgo and Hawkesbury sandstone strata in the Illawarra Escarpment and Woronora Plateau. Hawkesbury sandstone typically contains perched groundwater aquifers that provide baseflow to surface waterways and water to groundwater

dependent ecosystems. While the construction of the Avon tunnel would result in an initial lowering of local groundwater levels, this impact is expected to be temporary until measures to reduce groundwater inflow into the tunnel are implemented. Further assessment of the impact of the Avon tunnel on groundwater would be undertaken.

Contamination and waste

Construction would not result in the disturbance of existing known contaminated sites or cause contamination of soils or water.

Construction waste generated would be managed in accordance with waste classification guidelines, waste policies and a Waste Management Plan. Spoil generated as a result of tunnel excavation and earthworks would be stored on site or beneficially reused where possible.

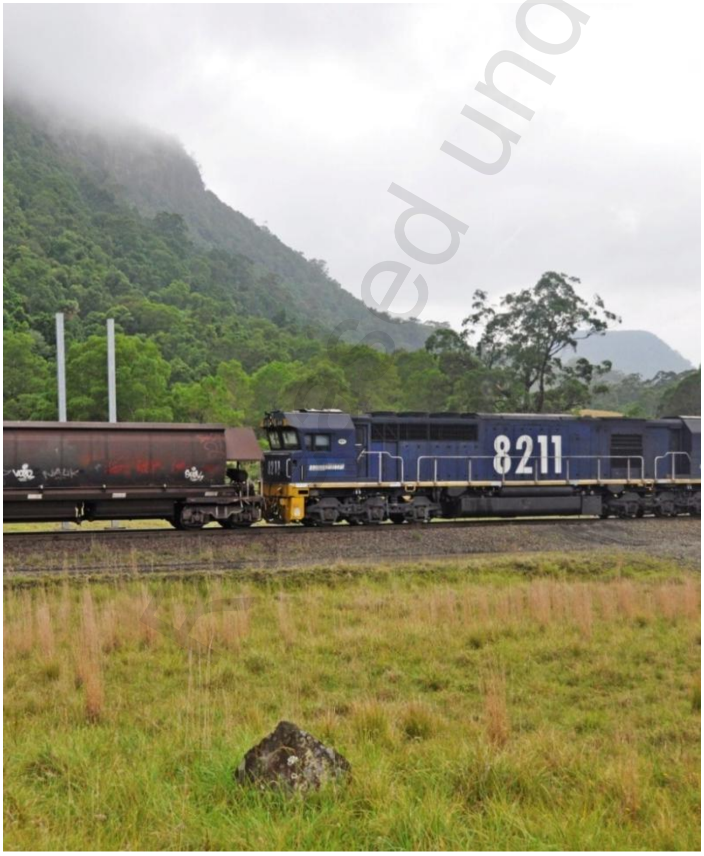
Hazard and risk

Construction activities would involve the movement of construction vehicles, work over a high pressure gas pipeline, explosive handling as well as the use of oil, fuel and chemicals.

During the operation of the Proposal the potential hazards and risks include rail collisions, train derailment, bushfires and flooding, and the transportation of dangerous goods. A range of hazard and risk prevention, detection and protection measures would be implemented throughout all stages of the proposal to reduce the likelihood of hazardous events occurring.

Freight transport guidelines and regulations would be adhered to as part of normal operations for the Proposal.

As the majority of identified hazards would have no significant offsite impact, and the risk levels associated with identified hazards would be low to medium, the Proposal would achieve the objective of minimising hazards and risks on people and property.



Climate change and greenhouse gas emissions

A climate change impact assessment identifies sixteen climate change risks across a range of Proposal receptors. Of these, 11 were classified as low, five were classified as moderate and no risks were classified as either high or severe. Moderate risks related to increased heat intensity potentially impacting workers during operation and maintenance of the line, corrosion of concrete and steel due to atmospheric carbon increase as well as increased rainfall intensity potentially affecting drainage systems, track and bridge infrastructure. The assessment would be used to inform the design of the Proposal to increase its resilience to climate change.

An initial quantitative estimate of the greenhouse gas (GHG) emissions associated with the construction and operation of the Proposal has been calculated. Measures to reduce emissions have been proposed including reduction or replacement of materials and fuel as well as construction and procurements strategies. The GHG inventory would be monitored and refined at subsequent stages of design.

Sustainability

The design of the Proposal has been undertaken in accordance with the project targets identified in TfNSW's Environmental Management System (EMS) and the NSW Sustainable Design Guidelines (SDG) Version 3.0 (TfNSW2013a) which groups sustainability into seven themes:

- Energy and greenhouse gases
- Climate resilience
- Materials and waste
- Biodiversity and heritage
- Water
- Pollution control
- Community benefit

Within each theme, potential initiatives are prioritised into two categories of requirements:

- **Compulsory** – the initiative is required to be implemented when applicable to the project as they refer to a corporate target, or are fundamental to the delivery of sustainable assets. All applicable compulsory initiatives must be achieved to award a sustainability rating.
- **Discretionary** – the initiative has benefits to be implemented, however may not be the most appropriate. Where discretionary credits are adopted these contribute to a percentage score which determine the sustainability rating as shown in Table x below.

Table 6.3 Project rating scores

Score	<50%	50%	60%	70%	80%	90%
Rating	Non-compliance	Compliance	Bronze	Silver	Gold	Platinum

A minimum 'Silver' rating is targeted for the Proposal. A selection of the sustainable design initiatives proposed in the concept design to achieve this rating is listed in the Sustainability Report. These sustainable design initiatives would be considered further during detailed design.

As per the TfNSW sustainability policy, TfNSW also intends to certify the Proposal under the Infrastructure Sustainability Council of Australia's Infrastructure Sustainability (IS) rating scheme. The MDRL project will target an Excellent rating, with a minimum score of 65, for both 'Design' and 'As Built' stages. This rating is equivalent to a best practice outcome for sustainability performance and would be pursued as the design progresses.

Table 6.4 Sustainable design initiatives to be considered during detailed design

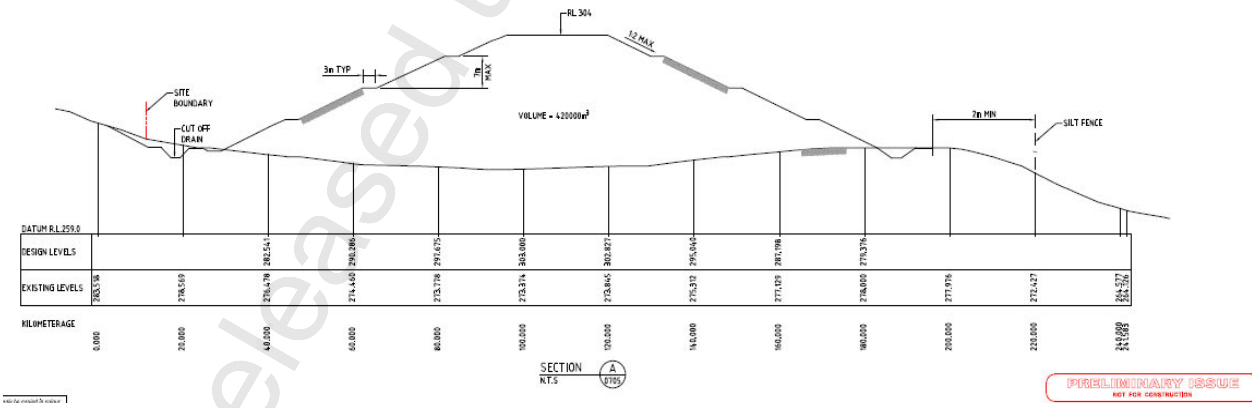
Ref	Name	Description	Applicability

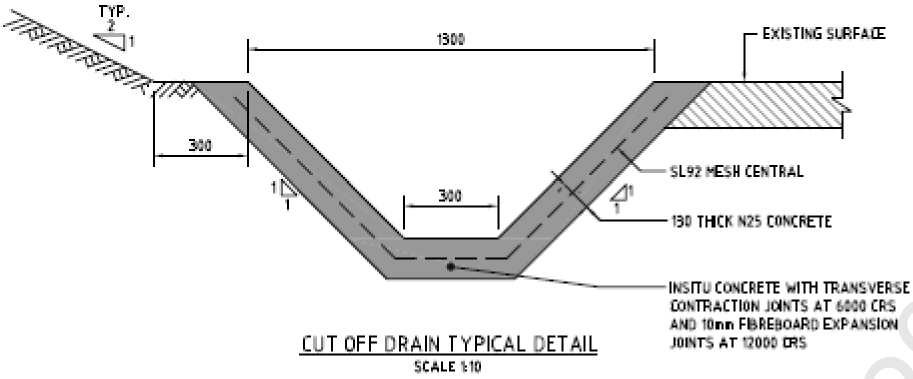
Ref	Name	Description	Applicability
Compulsory initiatives			
C.7	Decrease climate vulnerability	All projects with a capital investment value over $10 million to design out extreme, high and medium risks as identified in the climate change impact assessment where practicable	Civils and Tunnels
C.8	Whole of life costing	Use whole of life costing methodologies (e.g. Life-Cycle Cost Analysis Method) in line with ISO 15686-5 to inform decision-making on significant issues pertaining to project scope options (e.g. route selection) and material/technology selection (e.g. steel versus concrete bridge). Significant issues can be determined using qualitative criteria such as likely scale of environmental impact	Civils and Tunnels
C.10	Reuse spoil	For all projects generating >300 cubic metres of spoil, ensure that 100 per cent of usable spoil (by weight) is beneficially reused, onsite or nearby offsite. Usable spoil is not to be sent to landfill. A spoil mound has been proposed as described in enclosed figure with extensive revegetation	Civils and Tunnels
C.11	Reduce cement	Reduce the absolute quantity of Portland cement by at least 30 per cent, as an average across all concrete mixes, by substituting it with supplementary cementitious materials (such as a fly ash, ground granulated blast furnace slag or alkali activated cements) subject to meeting strength and durability requirements	Civils and Tunnels
Discretionary initiatives			
1.2	Quantity surveyor	Quantity surveyor reports to include mass quantities of building materials. This would enable the carbon footprinting to be more accurate and more cost effective. Quantity surveyor reports would also include costing for capital and ongoing maintenance of sustainability initiatives that involve onsite energy generation	Civils and Tunnels
3.22	Services corridor	Provide services corridor for energy, water or other buried infrastructure	Civils and Tunnels
3.26	On-site spoil reuse	Reuse any excess spoil as a landform feature, visual screen, in concrete and/or for noise attenuation	Civils and Tunnels
3.36	Prefabrication	Use prefabricated building and civil components (for bridges, walls (retaining, deflection, noise), culverts, platforms, level crossings and tunnel lining etc.) to reduce construction waste material usage, pollution risks and travel	Civils and Tunnels
3.39	Member spacing	Optimise the spacing of structural members in beam and post type designs	Civils only
3.41	Coordinate dimensions	Design for standard material sizes and components to reduce waste and improve ease of assembly and disassembly	Civils and Tunnels
3.42	Design for disassembly	Design for disassembly of new structures to maximise opportunities for recycling materials. Develop a deconstruction plan supported by disassembly	Civils only

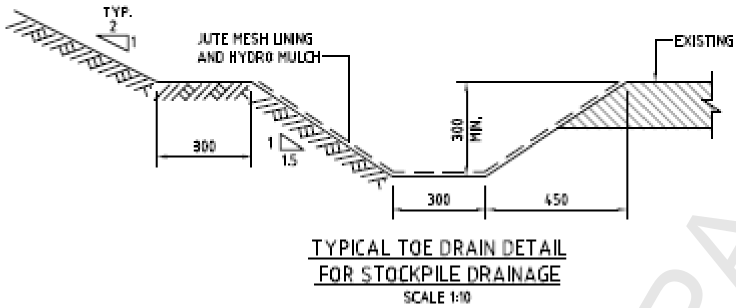
Ref	Name	Description	Applicability
		principles	
3.45	Heavy-duty geotextile for foundation	Use heavy-duty geotextile instead of oversize stone, to prevent capillary action at the base of the embankment	Civils only
5.6	Water efficient systems	Review alternate solutions that increase water use efficiency (e.g. avoid deluge systems)	Civils and Tunnels
6.8	Avoid noise sensitive areas	Locate noise generating infrastructure away from sensitive areas (maintenance facilities, turnouts, crossings, signals, crossing loops, storage road etc.) and locally enclose noisy activities	Civils only
7.11	Avoid future possessions	Consider maintenance and construction solutions that eliminate or minimise need for future possessions (e.g. power isolation). This will be done by providing road access	Civils and Tunnels
7.12	Future community disruption	Consider concurrent staging and provision for planned and potential future projects to minimise community disruption	Civils and Tunnels
7.35	Asset protection zones	Provide an asset protection zone (APZ) fire buffer around buildings and infrastructure. Refer to Standards for Asset Protection Zones (NSW Rural Fire Service)	Civils only
7.44	Fibre optic backbone	Provide fibre optic backbone including micro/pico cell access to mobile phone operators. This would enhance train and construction radio, provide GSM service and allow a wireless internet service on the train line	Civils and Tunnels
7.45	Utility services	Co-location of utility services (e.g. Wi-Fi, 4G, and radio)	Civils and Tunnels

Proposed Spoil Disposal Mound

As the tunnel will generate large volumes of spoil, this is proposed to be developed as a spoil mound with extensive vegetation planned.







6.12 Assurance results

The results of the previous TfNSW Assurance process completed in September 2013 are provided separately.

Further, the following have been completed:

- TfNSW Assurance in September 2013 and June 2014
- AEO process and application
- Audit results