AUSTRALIAN RAIL TRACK CORPORATION LTD

Document Type:	**Project Proposal Report (PPR)**
Project Detail:	**Port Botany Rail Line (PBRL) Upgrade Stage 2** **Delivery Phase**
Location:	**Sydney Urban:** **Port Botany – Mascot – Marrickville – Campsie Enfield – Chullora – Flemington Sth / Sefton Park (rail line)**

April 2010

Project Context

Background

In September 2004, as part the overall suite of agreements dealing with ARTC's lease and management of the NSW interstate and Hunter railway network, ARTC and the NSW Rail Corporation (RailCorp) signed a *Deed of Agreement for Metropolitan Freight Network (MFN) Lease and License.* This Agreement provides for a lease by ARTC of the Port Botany Rail Line (PBRL), which includes a dedicated freight connection extending from Sefton Park Junction and Flemington through Chullora and Enfield to Port Botany.

The majority of the PBRL is located in its own corridor physically separate from the RailCorp passenger network. A 5.6km section of the PBRL between Campsie and Marrickville is located in a corridor shared with the RailCorp passenger network but the PBRL operates on separate dedicated freight tracks.

The PBRL makes an end-on connection at Sefton Park Junction to the Southern Sydney Freight Line (SSFL), which is currently under construction by ARTC. The SSFL will provide a dedicated freight connection from the PBRL to ARTC's Lease at Macarthur.

ARTC has developed a staged upgrading program for the PBRL to meet growing demand for container transport by rail and to achieve efficiencies in operating and maintenance practices, as a potential candidate for funding from the Nation Building Program.

Previous funding approvals

In December 2008, ARTC commenced its lease of the Port Botany Rail Yard, as the first phase of the lease of the Port Botany Rail Line, to permit detailed planning and preparatory work to proceed for the upgrading of Port Botany Rail Yard.

In June 2009 ARTC received advice from the Department of Infrastructure, Transport, Regional Development and Local Government of an allocation of $21.16m for the Port Botany Rail Line Upgrade Stage 1 (Port Botany Rail Yard upgrade). This was additional to an earlier $6m allocation to progress the Development Phase of the project (total allocation to date $27.16m).

The Stage 1 works at Port Botany Rail Yard are now well advanced with physical works expected to be complete by August 2010. The Delivery Phase of Stage 1 involves a major track reconfiguration and upgrade of the Port Botany Rail Yard, including associated lighting and access roadways. Stage 1 has also produced Signal Functional Specifications and Track & Civil designs in preparation for the Stage 2 projects.

Stage 2 Delivery Phase - funding sought under this PPR

This Project Proposal Report seeks approval of $147.0 million from the Nation Building Program, the full amount of funds available to the project, based on cost estimates of $145.4M (P50) to $156.3M (P90) inclusive of contingencies, escalation and company tax but exclusive of GST to allow the Stage 2 package of works to proceed.

Stage 2 Objectives

The Stage 2 PBRL upgrade program is a key component of ARTC's program to improve rail access to Port Botany. Key objectives are to deliver improved capacity and efficiency for rail, remove rail access bottlenecks and provide for reduced congestion for both rail and road to and from Port Botany.

The physical objectives of these Stage 2 works are to achieve separation of the PBRL from RailCorp and full control from the ARTC Network Control Centre South at Junee thus providing seamless control of trains from ARTC's southern interstate network to the Port of Botany. New and/or modified signalling and control will be required at various points along the PBRL as part of these works.

The program will also provide a rail staging facility at Enfield to hold and resequence trains away from the congested Port Botany Rail Yard This will allow Port Botany to operate efficiently as an arrival and departure facility linking the rail line to the port stevedores.

In addition, new signalling along with supporting track and civil works in the section from Cooks River to Mascot will upgrade existing siding tracks to achieve an effective mainline duplication in this segment.

Stage 2 Location

Geographically, the PBRL can be defined by the following areas:

- Marrickville – Port Botany Line (8.9km)
  - Marrickville Junction to Port Botany
  - Port Botany Rail Yard
- Shared Corridor (5.6km)
  - Campsie to Wardell Rd Junction
  - Wardell Rd Junction to Marrickville Junction
- Western Freight Corridors (11.8km)
  - Sefton Park Junction (Enfield West) to Chullora Junction
  - Flemington South to Chullora Junction
  - Chullora Junction to Enfield to Campsie

Stage 2 Scope of works

The Stage 2 project is defined by the following packages of works:

- Signal Control – Port Botany
- Signal Control Separation – Cooks River to Wardell Road including:
  - Additional signalling to effectively extend duplication from Cooks River to Mascot
  - Control separation of the Marrickville-Wardell Road segment of the shared corridor
- Signal Control Separation – Shared Corridor (Wardell Road – Campsie segment)
- Signal Control Separation – Enfield Control Area
- Enfield Staging Facility Construction

A map showing the scope and geographical location of the Stage 2 project packages is on Page 6.

Related Port Botany Rail Line Projects

Further stages of the PBRL Upgrade remain under development by ARTC, as follows:

Stage 3: Concrete sleepering and upgrading of the sub-standard sections of track to bring the PBRL to a consistent and reliable standard.

Stage 3 will be the subject of separate Project Proposal Report when planning work is sufficiently progressed.

Stages 3 will be complementary to Stages 1 and 2 and will provide additional incremental benefits that will serve to maximise the benefits accruing from Stages 1 and 2. However it should be stressed that Stage 2 is a separable project which is not contingent upon the subsequent progression of Stage 3.

A PROPONENT AND PROJECT DETAILS

Proponent Details

A1 Proponent Details

AUSTRALIAN RAIL TRACK CORPORATION LTD
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A2 Project Director

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Project Details

A3 Project ID

036644-09SA-NP

A4 Project Name

Port Botany Rail Line Upgrade Stage 2.

A5 Project Scope

This project involves Stage 2 of upgrading the PBRL to meet growing demand for container transport by rail and to achieve efficiencies in operating practices. The project includes the following key elements:

- **Signal Control - Port Botany**

  Stage 1 of the PBRL upgrade is providing a major reconfiguration of the track arrangement at Port Botany to better serve the rail linkages to the port stevedores. Stage 2 allows for the signalling of the new track configuration and provides remote train control centralised to ARTC's train control facility at Junee. The project also removes manual operation of track points from yard and therefore improves operational safety.

- **Signal Control Separation:**
  - *Cooks River to Wardell Road (including Marrickville to Wardell Rd segment of shared corridor)*
  - *Shared Corridor (Wardell Rd to Campsie segment)*
  - *Enfield Control Area*

  Separation from RailCorp of the train control & signalling interfaces to provide for centralised control of the PBRL from ARTC's train control facility in Junee. This will achieve control separation between the RailCorp passenger network and ARTC's PBRL, providing seamless ARTC control of trains from ARTC's southern interstate network into Port Botany.

- **Additional Signalling to Provide Mainline Duplication – Cooks River to Mascot**

  New signalling, along with supporting track and civil works, in the section from Cooks River to Mascot will upgrade existing siding tracks to achieve an effective mainline duplication of approximately two kilometres and therefore increased PBRL capacity. This scope reduces the PBRL single line track from 4.7km total to 2.7km between Mascot and Port Botany. This scope has been incorporated into the re-signalling required for Signal Control Separation – Cooks River to Wardell Road.

- **Enfield Staging Facility Construction**

  Establishment of train staging capacity at Enfield Yard to hold and resequence trains away from congested Port Botany area. This will provide 2 x 1,850m dedicated rail lines at Enfield. This will allow staging of trains away from Port Botany Rail Yard to reduce congestion in the port.

Additional detail is provided as follows:

- Maps and schematic diagrams are included in Figures A5.1 and A5.2 on pages 6-7.
- Table A5.3 on pages 8-10 contains details of the planned scopes of work for the various sub-packages.
- Detailed track diagrams for the Enfield Staging Facility are provided in Appendix G2.

Details of the scope of works are being finalised as part of the ongoing detailed design process and may be further refined during construction to account for local site conditions and the actual condition of existing assets (eg turnouts) that are planned to be reused.

Figure A5.1: Port Botany Rail Line Upgrade Stage 2 - Project Packages - Location Map

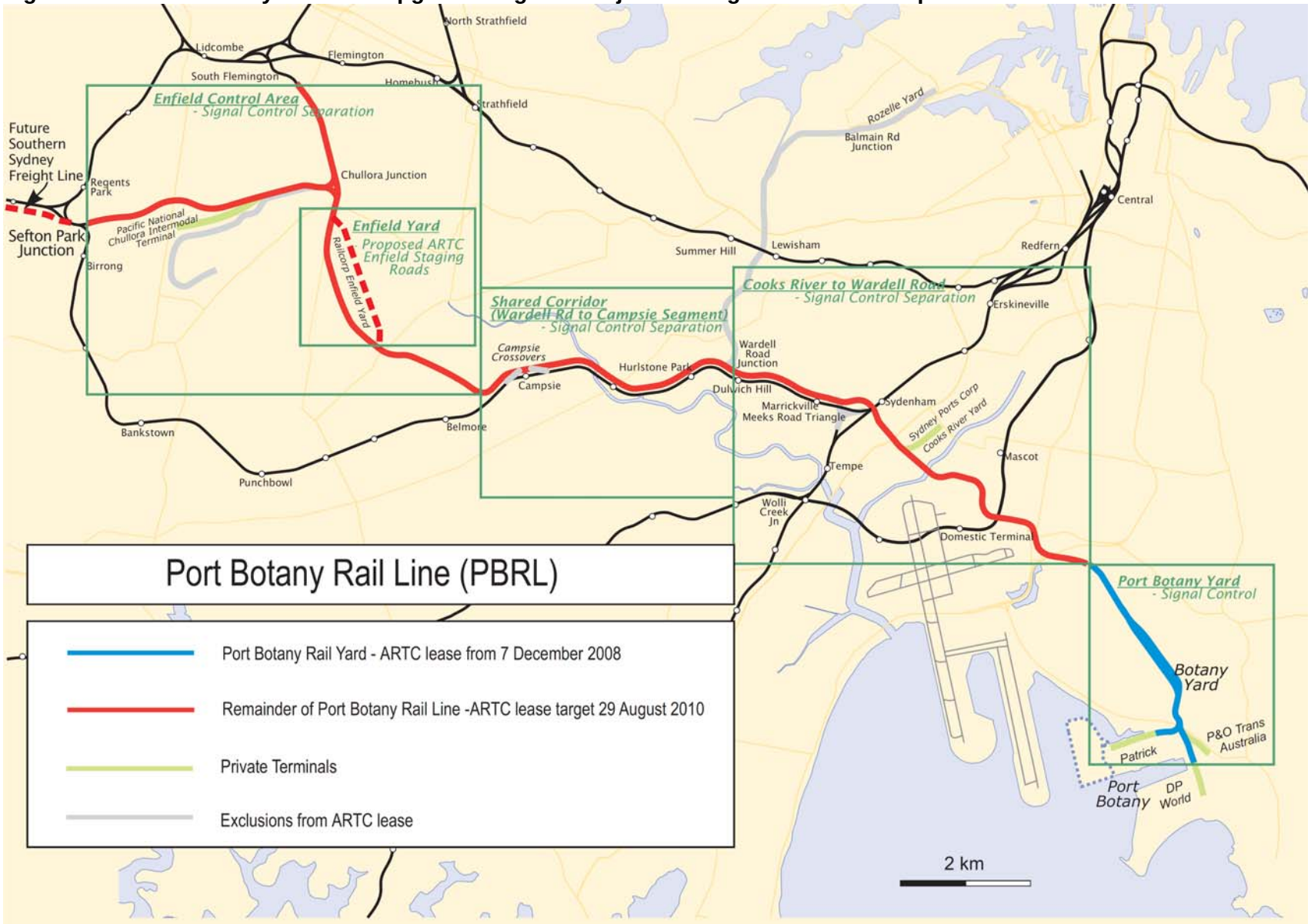


Figure A5.2: Enfield Staging Facility - Schematic Layout

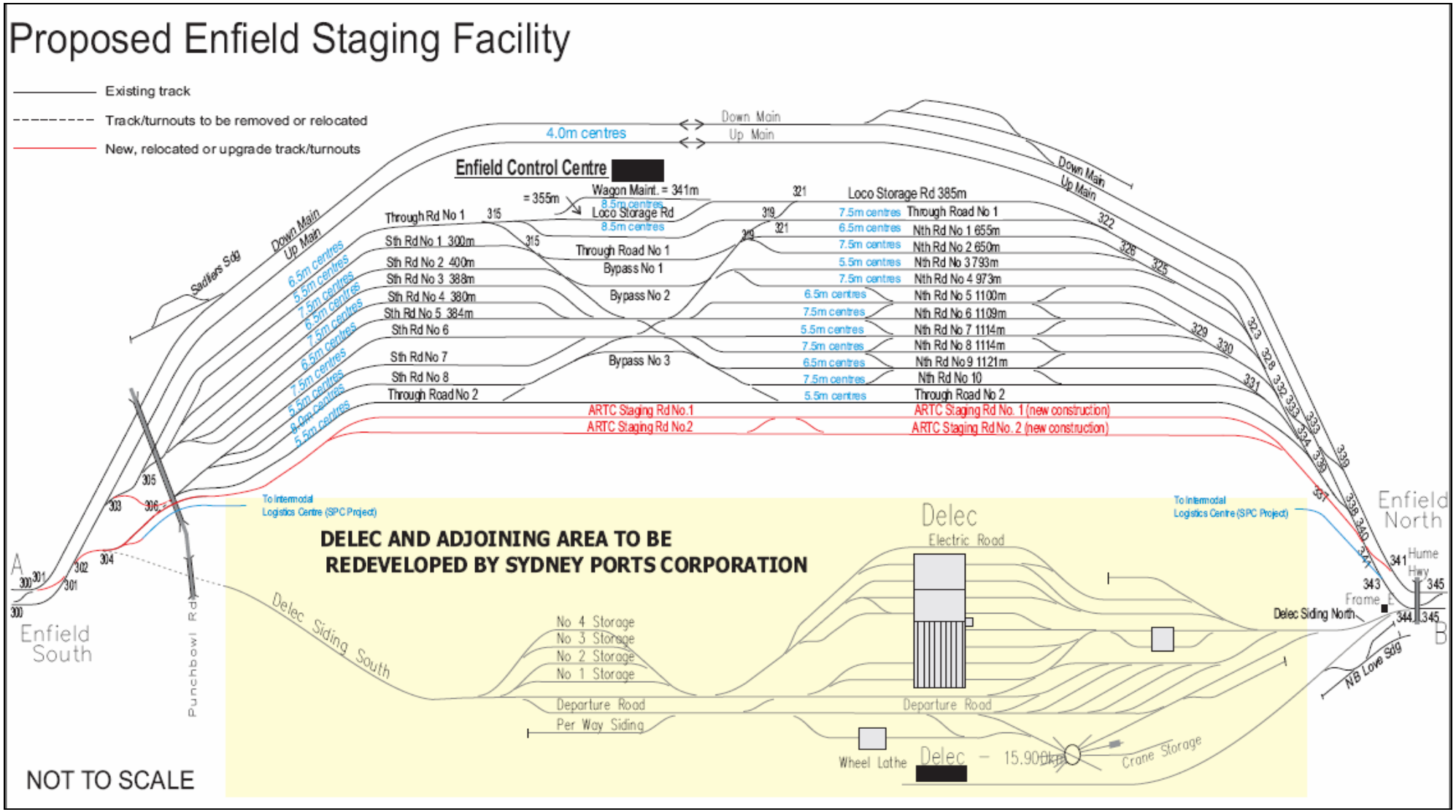


Table A5.3 Project Packages – Scopes of Work

Package	Scope of Work

Signal Control - Port Botany	• Four kilometres of new signalling.
	• Installation of new signalling equipment
	  - 38 signals
	  - 42 points machines
	  - 28 Emergency Operation Locks
	  - 57 track circuits
	  - 6 signalling equipment room/location cases
	  - Computer based interlocking
	• Construction of new cable route
	• Upgrade of existing power supply system to cater to the increased signalling in the area
	• Modification to Junee Control Centre to include control of Port Botany Rail Yard
	• Design and construct interface (communications) between the signalling interlocking and Junee Control Centre.
	• Infrastructure alteration to support signalling changes.

Signal Control Separation - Cooks River to Wardell Road
 	
includes
 	
- separation of signal control of the Marrickville-Wardell Road segment of the shared corridor
 	
- additional signalling on existing track to extend effective duplication from Cooks River to Mascot
	• Area for signal control separation spans four kilometres.
	• New computer based interlocking to separate Marrickville Junction to Cooks River from RailCorp network
	• Installation of new signalling equipment
	  - 17 signals
	  - 11 points machines
	  - 9 Emergency Operation Locks
	  - 32 track circuits
	  - 11 signalling equipment room/location cases
	  - New computer based interlocking (Microlok) for Wardell Rd Junction
	• Construction of new cable route
	• Circuit modifications to 18 existing signalling locations
	• Removal of 5 existing signals
	• Modify 18 existing signals and upgrade 3 existing signals with LED lights
	• Removal of signal phones from existing signals
	• Construct new power room
	• Modification to Junee Control Centre to include control of Cooks River to Wardell Rd
	• Design and construct interface (communications) between the signalling interlocking and Junee Control Centre.
	• Infrastructure alteration to support signalling changes.
	• Removal and recovery of redundant signalling equipment

Package	Scope of Work

Signal Control Separation - Shared Corridor
(Wardell Road – Campsie segment)
	• Modification to signalling for 3km of freight line between Canterbury and Campsie
	• New computer based interlocking to separate freight line between Canterbury to Campsie from RailCorp network
	• Installation of new signalling equipment
	  - 14 track circuits
	  - 5 signalling equipment room/location cases
	• Construction of new cable route
	• Recover 6 points machines from crossovers removed
	• Removal of signal phones from existing signals
	• Modification to RailCorp ATRICS control system
	• Modifications to 13 existing signals
	• Removal of 2 existing signals
	• Upgrade all existing signals with LED lights
	• Construct new power room
	• Modification to Junee Control Centre to include control of the freight line between Canterbury and Campsie
	• Design and construct interface (communications) between the signalling interlocking and Junee Control Centre.
	• Infrastructure alteration to support signalling changes.
	• Removal and recovery of redundant signalling equipment

Signal Control Separation – Enfield Control Area	• New computer based interlocking to control the Enfield Control Area including interfaces into Enfield Yard, Enfield Staging Facility and Chullora Junction. • Installation of new signalling equipment at interface into Enfield Yard • Construction of new cable route • Circuit modifications to existing signalling locations • Construction of new power room • Modification to Junee Control Centre to include control of the Enfield Control Area • Design and construct interface (communications) between the signalling interlocking and Junee Control Centre. • Infrastructure alteration to support signalling changes. • Removal and recovery of redundant signalling equipment • Update existing control panel at Enfield to reflect signalling and track changes to the staging facility

Package	Scope of Work
Enfield Staging Facility	• Construct two new 1,850M tracks ("staging roads" in railway terminology) with the capacity to hold 4 x 600M shuttle services. • Upgrade two crossovers and one turnout to increase crossover speed. • Construct 2 x centre crossovers between staging roads #1 & #2. • Construct turnout to reconnect staging road #2 into staging road #1. • Construct structural track formation (earthworks associated with the above). • Dispose/stockpile excess cut earth material. • Provide adequate yard lighting for the new configuration. • Provide adequate vehicular access roads. • Provide adequate yard walkways for rail operating and maintenance staff (access & inspections). • Fencing to separate ARTC & RailCorp tracks. • Associated service relocations • Install track drainage. • Incidental items required to support the above. • Temporary works as required to support the above including location & protection of existing services associated with rail activities and other 3rd parties with site access rights. • Relocate 5 existing signalling location cases/bungalows • Recable existing signalling equipment due to relocation of signalling location cases/bungalows • Modify 3 existing signals • Install 2 new points machines

A6 Geographical References

Figure A5.1 – Location Map on page 6 provides Geographical Reference.

A7 Project Summary

The Port Botany Rail Line (PBRL) Upgrade Stage 2 will achieve separation of the PBRL from the RailCorp passenger network and deliver full control of the PBRL to ARTC's Network Control Centre South at Junee. The separation will integrate ARTC's southern interstate network to the Port of Botany and improve connectivity of the port to the national freight network.

The project includes new and/or modified signalling and control at various points along the PBRL to achieve the network separation which will require both signalling and other infrastructure changes. The project will also provide capacity at Enfield to stage and resequence trains away from the congested Port Botany Rail Yard.

The PBRL Stage 2 project is defined by the following packages of works:

- Signal Control – Port Botany
- Signal Control Separation – Cooks River to Wardell Road
- Signal Control Separation – Shared Corridor (Wardell Road Junction – Campsie)
- Signal Control Separation – Enfield Control Area
- Enfield Staging Facility Construction

Stage 1 works to upgrade Port Botany Rail Yard are already well advanced and are forecast to be complete by August 2010. The Stage 1 works will deliver a major reconfiguration and upgrade of the Port Botany Rail Yard, which is the interface between the rail network and the stevedore port loading facilities. This will reduce congestion and increase capacity. It will also improve safety within the yard through improved lighting and physical access on site. Development works within Stage 1 have also produced essential long lead planning for Stage 2 delivery including Signal Functional Specifications and Track & Civil designs.

Stage 2 works are presently being planned to follow on from Stage 1 to provide continuity of construction (start mid 2010) and are currently forecast to be complete within 3 years (finish early 2013).

The Stage 2 works will be complementary to Stage 1, however it should be stressed that both Stage 1 and Stage 2 are justified as independent projects and each delivers benefits in its own right.

A8 Which corridor and section of the National Network is the project located on

The location of the proposed works is on the Sydney Metropolitan Freight Network between Sefton Park Junction and Port Botany Rail Yard.

A9 Under which category of the Act is the project eligible for approval

Part 3, Division 1, Section 10:(b). The construction of a proposed railway (including upgrade of existing railway) that is included in the National Land Transport Network.

A10 Phases seeking funding

This PPR seeks approval for funding of the **Project Delivery** phase which includes detailed design of signalling works and delivery of track, civil & signalling works.

B STRATEGIC FIT

B1 Has the Scoping Phase previously been approved

The initial Scoping Phase for the overall Port Botany Rail Line Upgrade program was funded by ARTC and the results where reported in the PPR which sought Development Phase funding as part of Stage 1 of the project. The PPR for the Development Phase was approved on 23 June 2008.

B2 Is the project identified in the MOU

The *National Partnership Agreement on Implementation of Major Infrastructure Projects in NSW, 2009-2014, Schedule A,* lists

"*Port Botany road and rail access and handling improvements package",* with the Commonwealth Government to provide $150m over the period 2009-2014*.*

B3 Has it been determined that the project has strategic merit through a formal Strategic Merit Test

The former AusLink Notes on Administration provided that project phases could be combined where necessary. Accordingly the strategic merit of the project was addressed in the PPR of the Development Phase, rather than through a separate strategic merit test. The PPR for the Development Phase was approved on 23 June 2008.

In brief, the earlier PPR considered the strategic fit of the project with:

- specific strategic issues within the Sydney metropolitan context, as identified in the Sydney Urban Corridor Strategy (previously undertaken with Australian Government funding)
- broader objectives for the National Land Transport Network
- other relevant strategic projects in the Sydney metropolitan area

More specifically:

- The Sydney Urban Corridor Strategy identified rapid growth of container traffic through Port Botany as a key challenge facing the Sydney urban corridors over the next 20 years. The Strategy identified improving rail links to and from Port Botany and enhancing landside port capability and freight distribution as short-term priorities for the Sydney urban corridors.

- The project is directly oriented to addressing these SUCS priorities and the key objectives of capacity, efficiency, productivity, reliability, safety and sustainability.

- Table B3.1 on the following page shows the intended project outcomes relative to these key objectives.

- In particular, the project is critical to:
  - meet growing demand for container transport by rail in the Port Botany corridor
  - reform the operation and management of the Port Botany Rail Line by integrating the PBRL with the ARTC network.

- The project is complementary to a number of other existing and prospective projects being undertaken by ARTC and other parties, as detailed in Table B3.2 on page 14.

Table B3.1 Project Outcomes vs Strategic Objectives

Strategic Objectives	Project Outcomes
Capacity	Improved capacity on the Port Botany Rail Line to meet growing demand for container transport by rail. Road congestion benefits flowing from diversion of freight from road to rail.
Efficiency	Operational efficiencies flowing from reduced congestion and increased capacity on the Port Botany Rail Line. Reductions in road maintenance expenditures flowing from diversion of freight from road to rail.
Productivity	Improved productivity of rolling stock, train crew and train control/signalling resources.
Reliability	Improved rail freight reliability contributing to improved rail market share and lower rail cost structures.
Safety	Reduced road accidents by facilitating increased rail market share and fewer road heavy vehicle safety incidents. Reduced rail safety risk flowing from extension of signalling systems at Botany Yard and Cooks River (reduced probability of safeworking incidents).
Sustainability	Reduced air pollution, greenhouse emissions, noise flowing from diversion of freight from road to rail.

Table B3.2 Strategic fit – relationship to other projects

Project	Description	Impact on Botany/MFN Project	Status	Proponent	Funding
Port Botany Expansion	Expansion of Port Botany to create five new shipping berths.	Essential to increase port container throughput. New rail connection to Port Botany line.	Under construction. Stevedore appointed.	Sydney Ports Corporation	Sydney Ports Corp & Private Sector
Enfield Intermodal Logistics Centre	New intermodal terminal to handle port container traffic with capacity of 300,000 TEU per annum.	Served by the PBRL. Essential to provide Intermodal Terminal capacity to meet NSW Government targets for rail-borne container traffic.	Base infrastructure under construction. Terminal operator selection underway	Sydney Ports Corporation	Sydney Ports Corp & Private Sector
Moorebank Intermodal Terminal	Potential intermodal terminal to handle longer term growth in both import/export and domestic markets	PBRL + SSFL provide freight-only connection between Port Botany and proposed Moorebank terminal. Would provide additional intermodal capacity to cater for longer term growth in rail borne container traffic	Under consideration by Australian Government.	To be determined.	To be determined.
Southern Sydney Freight Line	Freight only connection between PBRL at Sefton Park Junction and ARTC lease network at Macarthur.	Connects to Port Botany Rail Line. PBRL +SSFL provide freight-only connection between; - Port Botany and proposed Moorebank terminal. - Chullora terminal & main southern line. PBRL signalling and train control will be integrated with SSFL.	Under construction.	ARTC	ARTC
ARTC North-South Corridor Strategy	Package of works to capture increased rail market share in North-South Corridor (Melbourne-Sydney-Brisbane).	Sefton Park Junction-Chullora-Flemington section is part of the North-South corridor Chullora Intermodal Terminal is located on this segment.	Component projects being progressively implemented.	ARTC	ARTC and Australian Govt
Northern Sydney Freight Corridor	Package of works to provide additional freight capacity between Flemington and Broadmeadow	Additional freight volumes between North Flemington and Broadmeadow will feed into the PBRL.	Scoping phase.	To be determined.	Australian Government (Stage 1)

C PLANNED OUTCOMES AND OUTPUTS

C1 Describe the performance objectives and intended outcomes for this project. Are there any known risks to the project which will impact on project completion

The Stage 2 program of works will provide additional capacity improvements to the PBRL. The resulting train path and container movement capacities are shown in comparison with the capacity available after the Stage 1 works in Table C1.2 below.

Table C1.2: Port Botany Rail Line - Capacity Analysis

	2010 After Stage 1 PBRL Upgrade Port Botany Yard Upgrade	2012 After Stage 2 PBRL Upgrade This PPR's scope
Train path capacity		
Theoretical paths per day (both directions combined)	96	144
Practical train capacity per day (@70%)	67	101
Practical train capacity per annum	24,461	36,691
TEU capacity		
TEU slot capacity per annum (MTEU)	1.96	2.94
Practical TEU capacity per annum (MTEU)	**1.37**	**2.05**

TEU = Twenty-foot Equivalent Unit (Shipping Container)

Assumptions

Practical path utilisation	70%
TEU slots per train	80
Average slot utilsation	70%

The following benefits have been quantified in the benefit-cost analysis. Additional detail is provided in the Benefit Cost Analysis report in Appendix G3.

- *Train delay reductions*

  This captures the reduced delay to trains as a result of reduced train congestion in Port Botany Rail Yard. The estimated reduction in train delays in Port Botany Rail Yard is approximately 1.2 hours per train, generating delay reductions of 4000 train hours pa by 2012. See section 3.3.1 of the BCA.

- *Reduced maintenance costs*

  This relates to major periodic maintenance (MPM) expenditures which would be avoided in the Upgrade Case but which would be undertaken in the Base Case. The methodology is explained in section 3.3.3 of the BCA.

- *Externality benefits*

  Externality benefits arise from the transfer of freight movement from road to rail and the associated reductions in road accidents, noise, air pollution, road maintenance, congestion and other environmental issues.

  The forecast diversion of truck movements from road are shown below, for each demand scenario. The methodology adopted to quantify the externality benefits flowing from these diversions is explained in section 3.3.4 of the BCA.

  Table D21.2: Diversions of truck movements from road to rail

	Truck movements diverted ('000 pa)			
Scenario	**2012**	**2016**	**2021**	**2026**
Constant mode share	35	91	151	238
Increased mode share	40	118	218	372
Terminal driven	62	243	307	323

- *Benefits to rail freight customers*

  The project will generate benefits to rail freight customers through reductions in transport costs and improvements in service reliability and availability. The methodology adopted to quantify these benefits is explained is explained in section 3.3.5 of the BCA.

Risks to project completion are addressed in Section F1 of this PPR. Although certain cost and time risks have been identified, these are not considered likely to compromise the overall successful delivery of the project.

C2 Describe how achievement of these outcomes can be measured. What specific efficiency/safety/other metrics are proposed? What targets are proposed for these metrics?

Specific metrics that are proposed include:

- Number of early and late trains arriving at Port Botany Rail Yard.
- Average early / late arrivals at Port Botany Rail Yard.
- Number of freight containers arriving by rail at Port Botany.
- Trend information for on and / or off time train running (Port Botany train arrivals).

ARTC is compiling performance data dating from the implementation by ARTC of a monthly reporting system in March 2009 (see C3). This will allow specific targets to be set based on a reasonable time series of historic data.

C3 Identify what baseline data is available for metrics identified in C2 against which to compare data recorded post project completion

ARTC took up the lease of Port Botany Rail Yard from RailCorp in December 2008. From March 2009 it implemented a monthly reporting system using available data from ARTC's Daily Operating Plan for the yard.

This monthly report is an interim measure pending the Port Botany Rail Line being integrated into the ARTC network (this application) that provides base line data on train numbers and delays (at arrival and departure from Port Botany Rail Yard).

Post completion of this project the Daily Operating Plan reports will be replaced by ARTC's established automated reporting processes however information on train numbers and delays will be broadly comparable.

ARTC also has some historical data on train numbers and freight volumes prior to take up from RailCorp, the previous owner, and Sydney Ports Corporation who oversee the ports stevedore operation. There are also a number of studies and reports that provide additional data and information.

The baseline data available to ARTC for Port Botany Rail Yard currently includes daily / weekly / monthly reports presenting data on:

- Number of early trains each day / week / month
- How early the earliest train is each day / week / month
- How early on average each day / week / month are early trains
- Number of late trains each day / week / month
- How late the latest train is each day / week / month
- How late each day / week / month on average are late trains
- Number of freight containers arriving by rail
- Trend information for on and / or off time train running (train arrivals).

C4 Describe the planned outputs from this project

The outputs of these Stage 2 works are:

- Separation of control of the PBRL from RailCorp and full control from the ARTC Network Control Centre South at Junee.

- Provision of a staging facility at Enfield to allow trains to be held and resequenced away from the congested Port Botany Rail Yard, increasing capacity of the yard and the overall PBRL.

- New signalling in the section from Cooks River to Mascot to upgrade existing siding tracks to achieve an effective mainline duplication in this segment, with resulting capacity benefits for the PBRL

The scope of works provided in section A5 above also provides a detailed list of individual works elements.

D PROJECT APPROACH AND TIMING

D1 Has private financing been investigated

Private sector financing of this project is not considered feasible, as the works will not generate a revenue stream to attract private sector investment.

Current rail access prices do not cover maintenance costs on the Port Botany line, and it will be a considerable turnaround challenge to bring the line to breakeven. Current access prices do not provide a revenue stream to service the investment required to upgrade the line.

Increasing access prices to provide an incremental revenue stream to support private sector investment is not considered desirable or feasible. In the metropolitan and interstate markets, rail is a price taker – that is the charges that can be levied are effectively determined by the door-to-door prices charged by the road sector. Given the competitive dynamics between road and rail, seeking to increase access prices would serve to encourage a mode shift from rail to road, contrary to the established policy objective for the port logistics chain of increasing rail market share, and would diminish the economic benefits of the project.

D2 Describe the key milestones and the critical path for the complete project. What is the expected timing of these milestones? What is the current estimated completion date.

Activity	Target Date	Comments
1. Funding approval	May 2010	
2. Signal Control - Port Botany		
a. Project start date	May 2010	Dependent on funding approval.
b. Start on site	June 2010	
c. Project in service date	Sep 2011	
d. Project completion date	Oct 2011	
3. Signal Control Separation - Cooks River to Wardell Rd.		
a. Project start date	May 2010	Dependent on funding approval.
b. Start on site	Nov 2010	
c. Project in service date	Mar 2012	
d. Project completion date	Apr 2012	

Activity	Target Date	Comments
4. Signal Control Separation - Shared Corridor Project		
a. Project start date	May 2010	Dependent on funding approval.
b. Start on site	Mar 2011	
c. Project in service date	Sept 2012	
d. Project completion date	Oct 2012	
5. Signal Control Separation - Enfield Control Area		
a. Project start date	May 2010	Dependent on funding approval.
b. Start on site	May 2011	
c. Project in service date	Jan 2013	
6. Project completion date	Mar 2013	
7. Enfield Staging Facility		
a. Project start date	May 2010	Dependent on funding approval.
b. Start on site	Sep 2010	
c. Project in service date	July 2011	*Note: Project in service date is for the "un-signalled" staging roads. Signalling will be delivered with the Signal Control Separation for Enfield Control Area*
d. Project completion date	Aug 2011	
8. Completion of all works	**Mar 2013**	**Estimated to require 34 months from approval of funds.**

D3 What assumptions have been made in deriving the critical path set out under D2?

The key assumptions used in deriving the program are:

- Funding approval will be received during May 2010.
- ARTC's "take up" of the PBRL Network Lease to occur prior to commencement of physical construction activities.
- Provision by RailCorp of adequate resources to support design review, control system modifications and project commissioning of those elements of the project that have an interface with RailCorp.

A program has been developed (Appendix G4) including target timeframes for design, possessions and key works elements. This will be updated in the detailed design phase following funding approval to align available possessions to key elements of the project.

D4 Has the relevant Proponent representative approved the milestones and critical path?

The Project Director for ARTC has approved the milestones and critical path in the delivery program for the project.

E FINANCIAL ANALYSIS

Outturn Cost

E1 What is the anticipated Total Outturn Cost for the project

The estimate of the total outturn cost for the Port Botany Rail Line Upgrade Stage 2. – Delivery Phase is summarised below in Table E1.1.

Table E1.1 : PBRL Stage 2 - Outturn Cost Summary & Tax Provisions

Base Estimate Calculations	Total ($m)		Total ($m) Incl TAX	
Project Delivery Costs				
Signal Control Port Botany	14.6		20.9	
Enfield Staging Facility Construction	15.9		22.7	
Signal Control Separation, Cooks River to Wardell Rd	19.5		27.9	
Signal Control Separation, Shared Corridor	11.2		16.0	
Signal Control Separation, Enfield	8.4		12.0	
Possession Costs	3.0		4.3	
ARTC Project Management	4.0		5.7	
Insurances	0.4		0.6	
Contract Mobilisation	0.5		0.7	
Base Estimate	**77.5**		**110.7**	
Additional Costs				
Ralcorp Network Control Costs (ARTC Increment)	3.5	3.5	5	5
Track & Civil Support Works	1.8	1.8	2.6	2.6
Risk & Escalation Calculations	**P50**	**P90**	**P50**	**P90**
Contingency	13.8	21	19.7	30.0
Risk Based Project Estimate	**96.6**	**103.8**	**138.0**	**148.3**
Escalation	5.2	5.6	7.4	8.0
Total Outturn Cost	**101.8**	**109.4**	**145.4**	**156.3**

NB: All figures are in millions and have been rounded

Full details of the information supporting the above figures is attached in APPENDIX G1 – Evans & Peck report Metropolitan Freight Network, Botany Line Upgrade, 8 February 2010 (with the exception of RailCorp's network control costs and the track & civil support works which have been estimated separately and are shown in the above table).

The estimated expenditure timings for the P50 and P90 Total Outturn Cost estimates are summarised by financial year in Table E1.2.

Table E1.2: PBRL Stage 2 - Expenditure Timing

Financial Year	2009 / 10	2010 / 11	2011 / 12	2012 / 13
% of Expenditure	5%	56%	32%	7%
P50 Expenditure Incl. TAX	7.3	81.4	46.5	10.2
P90 Expenditure Incl. TAX	7.8	87.5	50.0	10.9

E2 What approach has been taken to cost escalation

Escalation has been calculated using monthly cash flow data which was generated from the costed Design and Construction Schedule.

Escalation has been applied to the monthly expenditure of the project, starting from the Base Date of Feb 2010 up until final completion. Contingency is included in the monthly figure which is escalated.

RailCorp's train management costs have been escalated over the period to which they apply.

E3 Provide details of the escalation rate(s) used and the source of those rates

An escalation factor of 5% pa (compounded annually) has been used, and is considered at the date the cost estimation was undertaken (February 2010) to be an appropriate indication of the expected change in construction cost from the Base Date.

E4 What elements of the Total Outturn Cost relate to ineligible costs

The RailCorp Network Control costs relate to the costs of RailCorp continuing to provide network control of the Port Botany Rail Line (incremental over the equivalent costs if ARTC were able to undertake network control) until the project is complete and has been commissioned. From ARTC's perspective these are an unavoidable cost associated with project implementation and accordingly they have been included in this project PPR.

Benefit Cost Analysis

This application is for Delivery Phase funding and therefore as noted in the *NOTES ON ADMINISTRATION for the NATION BUILDING PROGRAM* a Benefit Cost Analysis is not required.

However, for reference, a Benefit Cost Analysis report is attached at APPENDIX G3. The BCA indicates strong economic performance from the project, with Benefit Cost Ratios in the range 1.7 to 2.4 (based on the P90 cost estimates) and Internal Rates of Return in the range 12-16%.

F RISK AND GOVERNANCE

F1 Identify the major risks, and proposed mitigation strategies, to successful delivery of this phase and the overall project.

Safety & Business Risks

ARTC's approach to risk management is based on *AS / NZS ISO 31000:2009 (formerly AS / NZS 4360) Risk Management* and *AS4292.1 Rail Safety Risk Management.* All ARTC activities are subject to ARTC's established Risk Management Policy, Risk Management Procedure and relevant Work Instructions.

Project design has been carried forward to a level sufficient to allow works to be well articulated with programs and budgets identified. The design uses well known and proven technology being applied by an experienced and qualified design team. Developing detailed final designs is not expected to generate any significant unforseen risks.

The Project Delivery phase will involve changes to existing rail infrastructure and will require construction activities to be carried out within an operating rail corridor. ARTC recognises the risks associated with works of this nature and has significant experience in successfully carrying out work in similar environments. Information has been sought from RailCorp the long term previous owner of existing infrastructure and detailed site surveys and inspections have been carried out and will continue as a precondition of finalising designs.

ARTC will undertake the following risk management activities prior to and during construction:

- Risk assessment within the design development process (which is ongoing).
- Risk assessment ahead of construction activities to address both the activities themselves and their interaction with ongoing operations.
- Establish and manage a Project Risk Register for the upgrade works. This will be created as a local risk register within ARTC's Corporate Risk Register.
- Project risk assessments will be maintained until project completion when any residual risks will be transferred to the North South corridor risk register within the Corporate Risk Register.
- Ongoing consultation, briefings and workshops with RailCorp, operators, stevedores and Sydney Ports Corporation so that they are aware and informed on the type, extent and timings of works that are carried out.
- Other risk management activities that may be identified as necessary during the ongoing planning and execution of Port Botany Rail Line upgrade works (the subject of this PPR application).

The type of works proposed are being undertaken by ARTC elsewhere on the network on a regular basis. It is considered unlikely that major or unacceptable risks will be encountered.

Cost and time risks

The following key potential risks to final outturn costs and timing have been identified:

- RailCorp resources - design and design approvals by RailCorp has been identified as a critical item and RailCorp's resources are known to be constrained. In addition the availability of RailCorp resources to make necessary alterations to RailCorp infrastructure and systems (in particular RailCorp's ATRICS control system) and to participate in signalling commissioning processes will be critical. ARTC will be seeking to develop and agree with RailCorp the overall program and resource requirements as critical early activity.

- Contamination – appropriate allowances has been provided for in the project budget for treatment and if required off-site disposal of contaminated materials.

- Existing services – this is an existing rail corridor and records of existing services have been considered in design work carried out to date. Additional survey and services searches will be carried as the design and construction is carried out however there remains some risk that previously unidentified services will be found.

- Operational impacts – there may be a need to re-cast the delivery program if operational impacts prove unacceptable to train operators or other critical stakeholders in the port logistics chain. ARTC is currently in liaison with rail operators in the development of a possessions schedule that balances works implementation against operational impacts.

The program / timing risks have been considered during development of the delivery program and appropriate contingency time allowances have been included.

The cost risks arising from these issues have been considered in developing the P50 and P90 estimates presented in this PPR.

F2 Is a tender exemption being sought?

The provisions of Section 24 do not apply as the recipient of the funding is not a State or an authority of a State.

ARTC policy is to regularly test rates in the market place and given its significant works program it holds recent and proven information and knowledge on market rates. ARTC is presently assessing its procurement approach to these works which will either follow a tender process and / or an extension of existing contracts that have been market tested.

F3 If applying for Development or Delivery Phases, will this project trigger any environmental or cultural legislation

The requirements of relevant environmental and cultural legislation are summarised below.

NSW Planning Legislation

- The *State Environmental Planning Policy (Infrastructure) 2007* (Infrastructure SEPP) applies to the works.
- Under the Infrastructure SEPP development of rail infrastructure facilities does not require consent and the works are self-assessable by ARTC under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).
- ARTC has a *Code of Practice for Environmental Impact Assessment of Development Proposals in New South Wales* (ARTC Code of Practice) which applies to assessment of the project under Part 5 of the EP&A Act.
- The ARTC Code of Practice provides a process for determining the level of Environmental Impact Assessment that will be required for each sub-project.
- A draft Review of Environmental Factors has been prepared for the Enfield Staging Facility and is currently being assessed by ARTC.
- Additional assessments will be undertaken to address the other sub projects and assessed by ARTC before approvals are given for construction works to commence.

Commonwealth Legislation

- The works do not impact on matters of National Environmental Significance and accordingly a referral under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is not required.
- The site is not subject to any active native title claims and accordingly requirements of the Native Title Act 1993 are not applicable.

Other Relevant NSW Legislation

- ARTC's existing Environment Protection Licence (EPL) issued under the Protection of the Environment Operations Act 1997 covers railway systems activities. Concurrently with ARTC's Lease of the PBRL, an amendment to the EPL will be obtained to include the PBRL within the definition of ARTC's premises. A separate EPL for certain noise-emitting construction activities may also be required – this will be assessed in the environmental assessments for each sub project.
- No other requirements for NSW approvals have been identified, although ARTC has certain obligations in relation to the Noxious Weeds Act 1993, Water Management Act 2000 and Waste Avoidance and Resource Recovery Act 200 that it will need to adhere to during implementation of the works.

Other NSW State Environmental Planning Policies

- The project consists of a series of physically separable sub-projects which individually cost less than $30m and have stand alone benefits. Accordingly the *State Environmental Planning Policy (Major Projects) 2005* (Major Projects SEPP) does not apply
- The *State Environmental Planning Policy No. 55 – Remediation of Land* requires ARTC to consider whether the land is suitable (or can be made suitable) for the proposed development. Relevant contamination investigation will be undertaken as part of the environmental assessment for each sub-project.

F4 How will public and stakeholder participation be facilitated during this project

During the Project Delivery stage ARTC will maintain industry consultation with the previously identified stakeholders and appropriate stakeholder notifications will be given before works commence.

The project has a significant interface with other projects of broader community concern, in particular Sydney Ports Corporation's expansion of Port Botany and its proposed Enfield Intermodal Logistics Centre. ARTC is already cooperating closely with Sydney Ports Corporation and other relevant NSW Government Agencies to manage any issues that arise (e.g. any community concerns about increasing rail volumes).

ARTC maintains a fortnightly meeting with the operators and stevedores in relation to Port Botany Rail Yard operations and this will be utilised as a key communications forum with these stakeholders during construction. In addition, at a more strategic level, a Port Botany Rail Team (PBRT), facilitated by Sydney Ports Corporation, has en established with all rail and stevedore stakeholders to progress reform of the rail logistics chain. ARTC will keep the PBRT informed of progress on the PBRL upgrade works.

G Attachments

G1 Forecast Outturn Investment Costs

G2 Port Botany Rail Line Upgrade Stage 2 – Engineering Drawings

G3 Port Botany Rail Line Upgrade Stage 2 – Delivery Phase Benefit-Cost Analysis

G4 Project Gantt Chart

I acknowledge the information set out in this PPR is an accurate representation of available information.

Terry Bones

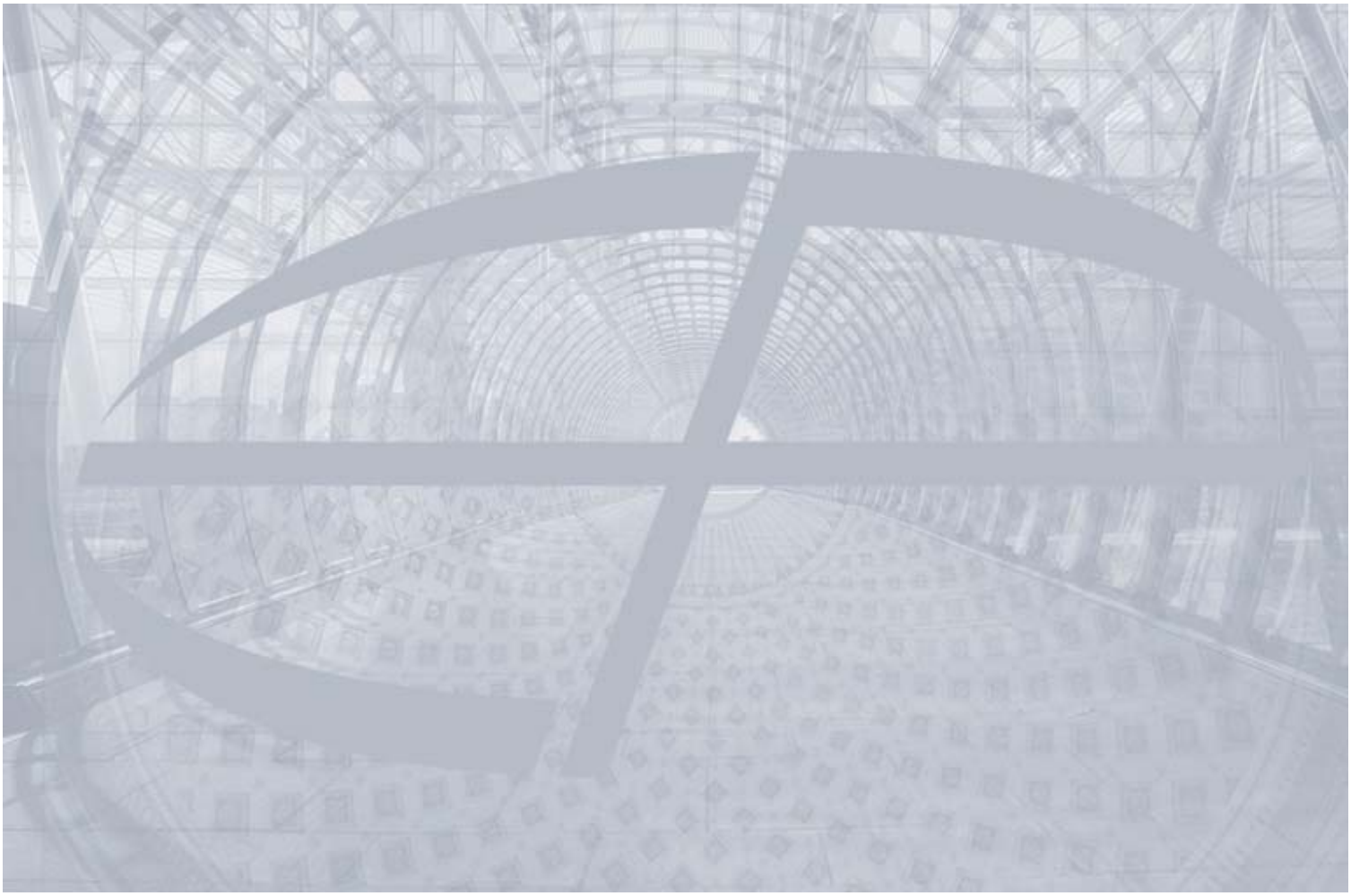
Project Director, ARTC

21 April 2010

G1 Forecast Outturn Investment Costs

Evans & Peck Report
Port Botany Line Upgrade (Stage 2) – Risk Model for Project Cost Estimates
8 February 2010

EVANS & PECK



Australian Rail Track Corporation (ARTC)

Metropolitan Freight Network, Port Botany Line Upgrade (Stage 2)

Risk Model for Project Cost Estimates

FINAL DRAFT 8 February 2010

COMMERCIAL IN CONFIDENCE

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1 EXECUTIVE SUMMARY

Evans & Peck (E&P) was requested by Australian Rail Track Corporation (ARTC) to conduct a P90 Quantitative Risk Analysis for the Port Botany Line Upgrade – Stage 2 (PBLU) project budgets. The risk analysis has been based on cost estimates which have been prepared by AECOM and Downer EDI Works (DEW). E&P has not conducted a review of the cost estimates.

The work, along with associated services, is required to support a Project Proposal Report (PPR) which is to be submitted to the Australian Government for funding, to a standard required by the Department of Infrastructure, Transport, Regional Development and Local Government (DITRDLG).

The scope of the work is predominantly signalling separation. A quantitative risk assessment was carried out involving ARTC, AECOM and DEW, with the workshop facilitated by Evans & Peck.

The Summary of the Total Out-turn Cost estimates at P50 ($96.5m) and P90 ($104.1m) are contained in the Estimate Summary in the table below.

Base Estimate Calculations	Total ($m)	
Construction Costs		
Direct Costs	40.2	
Indirect Costs	29.4	
Sub Total	**69.6**	
Client Costs		
Possession Costs	3.0	
ARTC Project Management	4.0	
Insurances	0.4	
Aliance setup	0.5	
Sub Total	**7.9**	
Base Estimate	**77.5**	
Risk & Escalation Calculations	**P50**	**P90**
Contingency	13.8	21.0
Risk Based Project Estimate	91.3	98.5
Escalation	5.2	5.6
Total Outturn Cost	**$ 96.5**	**$104.1**
NB: All figures are in millions and have been rounded		

2 BRIEF

Evans & Peck (E&P) was requested by Australian Rail Track Corporation (ARTC) to conduct a P90 Quantitative Risk Analysis for the Port Botany Line Upgrade – Stage 2 (PBLU) project budgets. The risk analysis has been based on cost estimates which have been prepared by AECOM and Downer EDI Works (DEW). E&P has not conducted a review of the cost estimates.

The work, along with associated services, is required to support a Project Proposal Report (PPR) which is to be submitted to the Australian Government for funding, to a standard required by the Department of Infrastructure, Transport, Regional Development and Local Government (DITRDLG).

As part of the engagement, E&P was also required to:

- Receive and collate various costs and associated data (estimates, assumptions, work scope) from AECOM, DEW and ARTC.
- Prepare the project work break down structures in a format suitable for risk assessment.
- Conduct a quantitative risk assessment in a joint workshop.
- Assist in the development of a design and construction program.
- Allocate project costs to appropriate activity level of the schedule.
- Following the risk workshop, determine the P90 value for the Works Program for inclusion in the PPR.
- Establish likely cash-flow and escalation allowances for the project, in order to calculate the outturn cost at P90.

3 INFORMATION PROVIDED

Throughout the process, E&P was supplied with project cost information from ARTC, AECOM and DEW.

The type of information includes:

- Work Scopes (Concept)
- Cost Estimates (Direct, Indirect and Client Costs)
- Assumptions and Qualifications
- Program Inputs
- Various correspondence (emails, etc).

A full list of information provided is outlined in Appendix 1.

4 METHOD

The cost estimates for MFN PBLU (Stage 2) works have been prepared by AECOM, DEW and ARTC. E&P has used these cost estimates to form the base estimate, which was then utilised to prepare a risk based estimate. The scope and assumptions of the base estimate are described in more detail in Section 5 – Base Estimate Summary, and includes discussion on:

- General estimate information
- Methodology
- Direct Costs
- Indirect Costs
- Client Costs, and
- Design and Construction Schedule.

A Quantitative Risk Assessment workshop was carried out on 2 December 2009 (with representatives from ARTC, DEW, AECOM and E&P), in order to test the assumptions, made by the estimators in the cost estimates and also to quantify the inherent and contingent risks associated with the project. This process is described in more detail in Section 7 – Quantitative Risk Assessment. Refer to Appendix 3 for a list of workshop attendees and Agenda.

A @Risk Simulation (Monte Carlo Analysis) was then carried out in order to produce the risk based cost estimate probability distributions. The input data and the @Risk model outputs are included in Appendices 7, 8 and 9.

5 BASE ESTIMATE SUMMARY

5.1 General

The contract delivery method assumed for the project is Alliance, as advised by ARTC.

The compilation of figures derived from all the signalling, communications, track and civil estimates amounts to a Total Construction Cost which includes:

- Direct Contractor Costs
- Indirect Contractor Costs
- Client Costs (as advised)
- Contingency allowances for Risk Cover to both Contractor and Client Costs
- Escalation from the base date of February 2010 until the date of expected project completion.

5.2 Methodology

In the process of compiling the estimates, the works for PBLU (Stage 2) were initially assessed in their five project groups:

- Botany Yard (BY)

- Cooks River – Wardell Road (CR-WR)
- Shared Corridor (SC)
- Enfield Yard (EY), and
- Enfield Staging Roads (ESR).

The groups were then rationalised and where necessary amalgamated in order to facilitate an efficient Risk Assessment.

The Direct Costs for BY were treated independently as this package is wholly ARTC owned, reasonably low risk work with minimal RailCorp interface. This project is deemed to be Priority 1.

ESR had a reasonably well defined scope, based primarily on Track and Civil Works (as opposed to Signals and Communications). This project is considered Priority 2.

The Direct Costs for CR-WR and SC were combined as they were considered to be similar in nature and status at the time (eg. more ARTC/RailCorp interface, more complexities, possibly optional stages of work). NB: These two projects were later shown separately in the Base Estimate Summary.

EY was treated as a separate package of Direct Costs. The attributes of this work are similar to CR-WR and SC.

Indirect Costs and Client Costs were assessed as global items i.e. Applicable to all Direct Construction Costs.

5.3 Direct Costs (DC's)

The DC's represent the cost of performing the work and include materials, plant, labour and sub-contract items. All the DC's for the project works were provided to E&P by others for review and compilation.

The DC's were first broken down to a suitable level. Then elements of the totals which belonged in other categories were stripped out (eg. overheads, safe-working, contingencies). Allowances for like items, such as comms, microloks and relays, were merged into a combined item.

The majority of the costs in each of the project DC's are related to Signalling Installation activities.

Other recurring elements in each of the projects are:

- Installation of Communications
- Train Control (Phoenix, ATRUS, T&D)
- Track Works
- RailCorp (including Installation and T&C)
- CountryNet Radio.

The DC's for the five packages amount to approximately $40m for the Program.

A compilation of the Direct Cost Estimates is provided in Appendix 2 – Base Estimate Summary.

5.4 Indirect Costs (IC's)

The IC's were categorised into one global grouping, applicable to all the works across the program.

The Main elements of the IC's are:

1. Design Costs (including RailCorp Review/Approval)
2. Project Management
3. Contingency (excluded from Risk Model)
4. Project overheads
5. Margins

All the IC's were provided to E&P by others. In some cases the figures have been determined by building up resourced rates and in other cases the IC's are % factors of other activities (eg. Construction Phase Service = 10% of Detailed Design).

As a percentage of the DC's, the combined IC's for the main items are as follows:

Item	$ m	% DC
Design	14.9	37%
Management & Overheads	10.1	25%
Margins	4.4	11%

Table 1 - Indirect Cost Percentages

The IC total for the Program of works equals approximately $29.4m, excluding contingencies. This figure represents 72% of the DC total, which can be expected from capital works which are heavily focussed around Signalling and Communications.

(Refer to Appendix 2).

A significant portion of the IC's is allocated to Design (50%). This is unusually high.

5.5 Client Costs (CC's)

Client Costs include those costs managed by the Client organisation, and which are not an integral part of the construction contractors scope or responsibility.

The CC's which have been advised to E&P, and which have been included in the Summary of Estimates are:

(1) Possession Costs

(2) ARTC Project Management

(3) Insurances

(4) Alliance Setup Costs

The CC's amount to approximately 20% of the total DC's, or $7.9m.

(Refer to Appendix 2).

5.6 Contingency and Escalation

The Base Estimate Summary does not allow for Contingency or Escalation. These items are addressed separately and are further described in subsequent sections of this report.

5.7 Design and Construction Schedule

E&P assisted with the development of a preliminary design and construction schedule which was used to plan and sequence the works, as well as the calculation of time related indirect costs associated with the project. The schedule was then used to forecast cash-flow, from which escalation allowances for the duration of the project were derived.

A copy of the construction schedule is included as Appendix 4.

The current preliminary construction schedule indicates construction duration of approximately 36 weeks. All time-based indirect costs are based on this duration.

The current schedule is a result of a workshop which was recently held by AECOM (27 Jan 2010. A set of Amendment Notes to the schedule was also produced by AECOM subsequent to the meeting. A copy of this is attached as Appendix 6.

(NB. A noteworthy outcome from the workshop is that the duration originally allocated to Commercial Mobilisation was set to zero).

A list of people and organisations which provided input to the schedule is attached as Appendix 5.

5.8 Base Estimate

The Base Estimate summary is made up of the components described above. The costs have been estimated at a Base Date of February 2010, and are subject to a quantitative risk assessment and cost escalation in accordance with the project program. The Base Estimate Summary, covering all five projects within the MFN program is contained in the table below:

A	Direct Costs		
1	**Botany Yard**		
(a)	Communications	$	232,890
(b)	Signalling	$	8,476,091
(c)	Train Control	$	220,000
(d)	Trackwork	$	260,055
(e)	RailCorp	$	66,000
	Botany Yard - Sub Total	**$**	**9,255,036**
2	**Cooks River-Wardell Rd**		
(a)	Communications	$	65,500
(b)	Signalling	$	7,171,791
(c)	Train Control	$	800,000
(d)	Trackwork	$	711,960
(e)	RailCorp	$	1,442,700
	Cooks River-Wardell Rd - Sub Total	**$**	**10,191,951**
3	**Shared Corridor**		
(a)	Communications	$	49,000
(b)	Signalling	$	2,849,399
(c)	Train Control	$	660,000
(d)	Trackwork	$	232,635
(e)	RailCorp	$	521,220
	Shared Corridor - Sub Total	**$**	**4,312,254**
4	**Enfield Yard**		
(a)	Communications	$	71,900
(b)	Signalling	$	3,294,664
(c)	Train Control	$	270,000
(d)	Trackwork	$	68,720
(e)	RailCorp	$	679,500
	Enfield Yard - Sub Total	**$**	**4,384,784**
5	**Enfield Staging Roads**		
(a)	Preliminaries	$	1,382,365
(b)	Construction	$	9,031,865
(c)	Communications	$	80,000
(d)	OHW and associated	$	918,400
(e)	Signalling	$	620,000
	Enfield Staging Roads - Sub Total	**$**	**12,032,630**
	DIRECT COSTS TOTAL	**$**	**40,176,656**

B	Indirect Costs		
1	Design	$	14,897,721
2	Project Management	$	2,290,755
3	Project Overheads	$	7,796,754
4	Margins	$	4,382,819
	INDIRECT COSTS TOTAL	**$**	**29,368,049**
	TOTAL CONSTRUCTION COST (exc Contingency)	**$**	**69,544,705**

C	Client Costs		
1	Possession Costs	$	3,000,000
2	ARTC Project Management	$	4,033,000
3	Insurances	$	360,000
4	Aliance setup	$	500,000
	CLIENT COSTS TOTAL	**$**	**7,893,000**
*	**Base Estimate (exc Contingency and Escalation)**	**$**	**77,437,705**

Table 2 - Base Estimate Summary

6 ASSUMPTIONS & QUALIFICATIONS

6.1 Base Estimate

- Lump sums for the following items have been split as follows against Design and Construction elements in the following proportions: (a) Phoenix 80/20%, (b) ATRICS 80/20%, (c) Communications at Enfield Staging Roads 20/80%.
- Lump sums have been apportioned as follows for the following items: (a) MISS Testing – PB 1/3, CR-WR 1/3 & SC 1/3, (b) CountryNet – BY 85%, CR-WR 5%, SC 5%, EY 5%.
- RailCorp cost estimates have been allocated into the relevant categories i.e. Direct Costs and indirect Costs and do not form part of the Client Cost Group.
- The number of possessions required has been assumed at 12No, at a cost of $250k each.
- The costs estimates produced by AECOM and DEW assumed that the projects would be delivered under an Alliance procurement method.

6.2 Design and Construction Schedule

6.2.1 General

- PB Civil works will be completed in a timeframe to support the signalling works in that yard as part of this program of works.
- The decision regarding the preferred ESR option, and whether to proceed with various detailed design, should be made in accordance with dates indicated in the program.
- The initial (un-signalled) ESR project is dependent on the use of the existing entry and exit turnouts into the area being used exclusively for the project.
- Possessions have been scheduled in accordance with the RailCorp Config 10 possessions program. Documents used and dates obtained are included in Appendix 7.
- Duration for long lead items has utilised the durations from the Signalling Specifications where appropriate.
- It is noted that RailCorp's technical input incorporated in the estimates is limited to the information from discussions with RailCorp's engineering staff. As yet a RailCorp project team has not been established.

6.2.2 Costs

- MISS testing has been allocated into Testing and Commissioning of Signals.
- WAE information for track and civil components has been assumed at 5% of design costs.
- Telemetry and data design costs have been placed into Train Control Design.
- Telemetry and data installation costs have been placed into Train Control Construction.
- RailCorp design approval has been split 20/80 against concept/detailed design phases.

- Margins have been spread across the projects at Program Level (L1).
- Overheads have been allocated at the Program Level (L1).
- RailCorp costs have been allocated at the Phase Level (L3) within each project.
- All other costs have been allocated to Engineering Discipline Level (L4) within the relevant projects.

6.3 Risk Model

- As part of the risk allocation, some of the ranges were assessed independently and others were aligned determined via a prorated base group i.e. base group +10%.
- Escalation has been excluded from the Risk Model.
- Common elements of work were merged for the purpose of running the model.

7 RISK AND CONTINGENCY

7.1 Introduction

The base estimate developed for the project does not contain any allowance for risk; it reflects the cost of the project based on the assumptions used to develop the estimate.

To assist in determining an appropriate contingency amount, the base estimate is used to develop a model to reflect uncertainty in terms of rate and quantity as well as making allowances for unplanned events that may occur. Using a Monte Carlo simulation, a range of possible project cost outcomes is determined.

7.2 Methodology

A probabilistic risk model has been used to develop a possible range of outcomes for the project cost. Uncertainty in the model can generally be grouped in two main areas:

1. **Inherent risk** – risk that relates to uncertainty with regards to the rates or quantities used in the original cost estimate; and
2. **Contingent risk** – risk where there is some uncertainty (% probability) regarding the occurrence of the risk, or where the quantum of the risk issue can vary based on the severity of the issue, when it eventuates.

The model considers the range of possible outcomes for inherent and contingent risks. To specify the range for key items in the estimate, three points are determined: a minimum value (best case scenario); most likely value and a maximum value (worst case scenario).

Given the assumptions made in the base estimate and current information available, ranges were assigned to relevant activity levels a required. These values were established in the Quantitative Risk Workshop (2 December 2009) and were further reviewed and finalised during a meeting held at E&P's Chatswood offices on Wednesday 9th February, 2010.

7.3 Risk model inputs

To compile the risk model, a range of values (best case, most likely and worst case) were determined for each element of the cost summary developed. The ranges used for the inherent risks were based on:

(a) The level of design information available at the time, and
(b) The collective past experiences and lessons with projects of a similar scale and scope of the workshop participants.

Where a greater amount of uncertainty exists with regards to a particular construction activity a wide risk range is used, and conversely where more certainty on a particular component exists, a narrower range is adopted. In general, the ranges used reflect the level of design information available at the current stage of the project.

The probability assigned and ranges used for each risk item of the contingent schedule reflect the outcome of the workshop discussions as well as subsequent consideration by E&P.

The inherent and contingent risk considerations used in the risk model are attached in Appendices 8 and 9.

7.4 Outcomes

The inputs of the model are used to perform a Monte Carlo simulation (using @Risk software) to generate a range of possible outcome values. These values are plotted to reflect the cumulative probability against the likely cost of that given probability. P-values denote the probability that the outcome values will be less than or equal to corresponding monetary value. For example, a P50 value represents a 50% likelihood that the outcome value will be less than or equal to the corresponding monetary value. For budgetary purposes, it is recommended that a P90 value be used. This represents a 90% probability that the outcome values will be less than or equal to the determined P90 monetary value. Appendix 10 contains an output summary from the model.

Figure 1 below depicts the cumulative distribution outcome from the model.

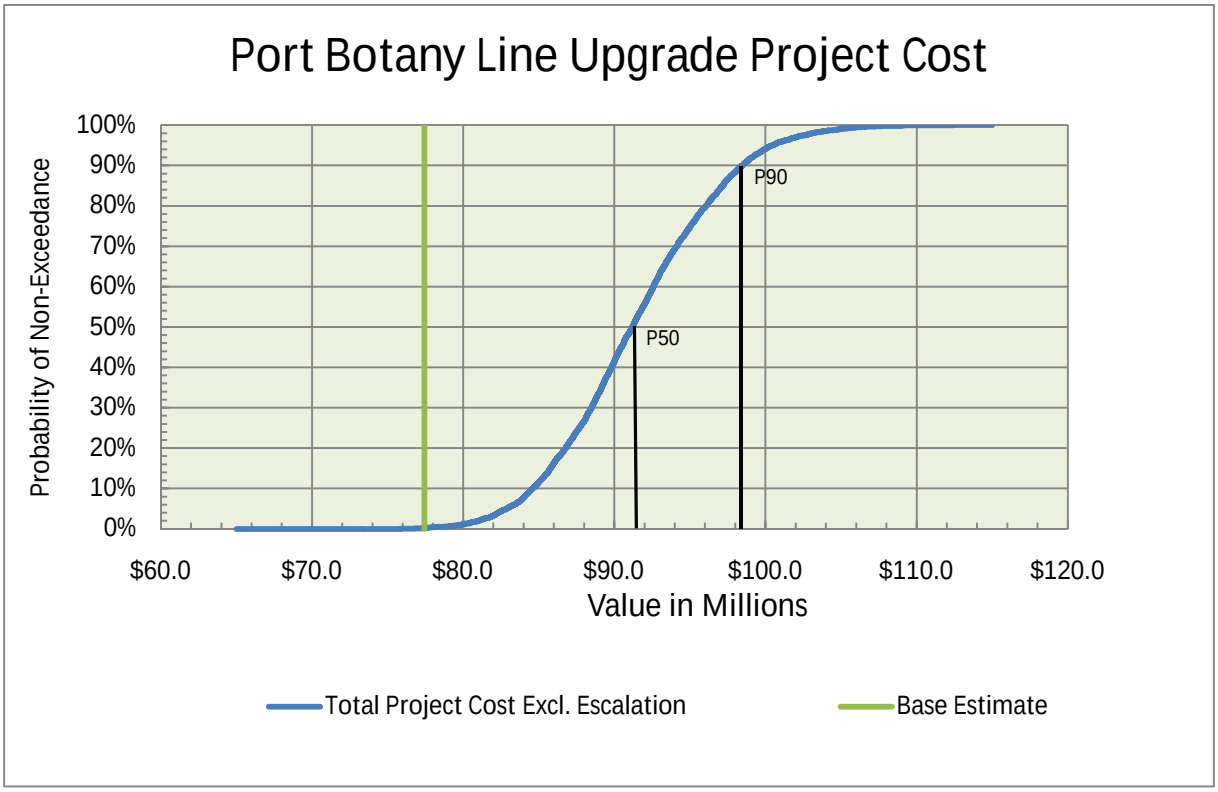


Figure 1 - Cumulative distribution outcome of model

The key values from the graph are tabulated below:

P-Value	$m
P10	84.6
P50	91.2
P90	98.5

Table 3 - Key P values

The P-value is selected as a basis for setting an appropriate budget and reflects an organisations commercial approach and willingness to accept risk.

The contingency for the project is measured by subtracting the base estimate value from the selected P-value.

Table 4 below summarizes some key P-values and the associated contingency amounts.

P-value	P-$ Value ($m)	Base estimate ($m)	Contingency ($m)
P10	84.6	77.5	7.1
P50	91.3	77.5	13.8
P90	98.5	77.5	21.0

Table 4 - Contingency Amounts

8 CASH-FLOW AND ESCALATION

Escalation has been calculated using monthly cash flow data which was generated from the costed Design and Construction Schedule (Appendix 4). Escalation has been applied to the monthly expenditure of the project, starting from the Base Date of Feb 2010 up until final completion. Contingency is included in the monthly figure which is escalated.

An escalation factor of 5%pa (compounded annually) has been used, and is considered at present to be an appropriate indication of the expected change in construction cost from the Base Date.

Figure 2 and 3 below indicate the following information for both P50 and P90 values:

- Monthly Cash Flow (Including contingency and escalation)
- Escalation Allowance
- Total Outturn Cost.

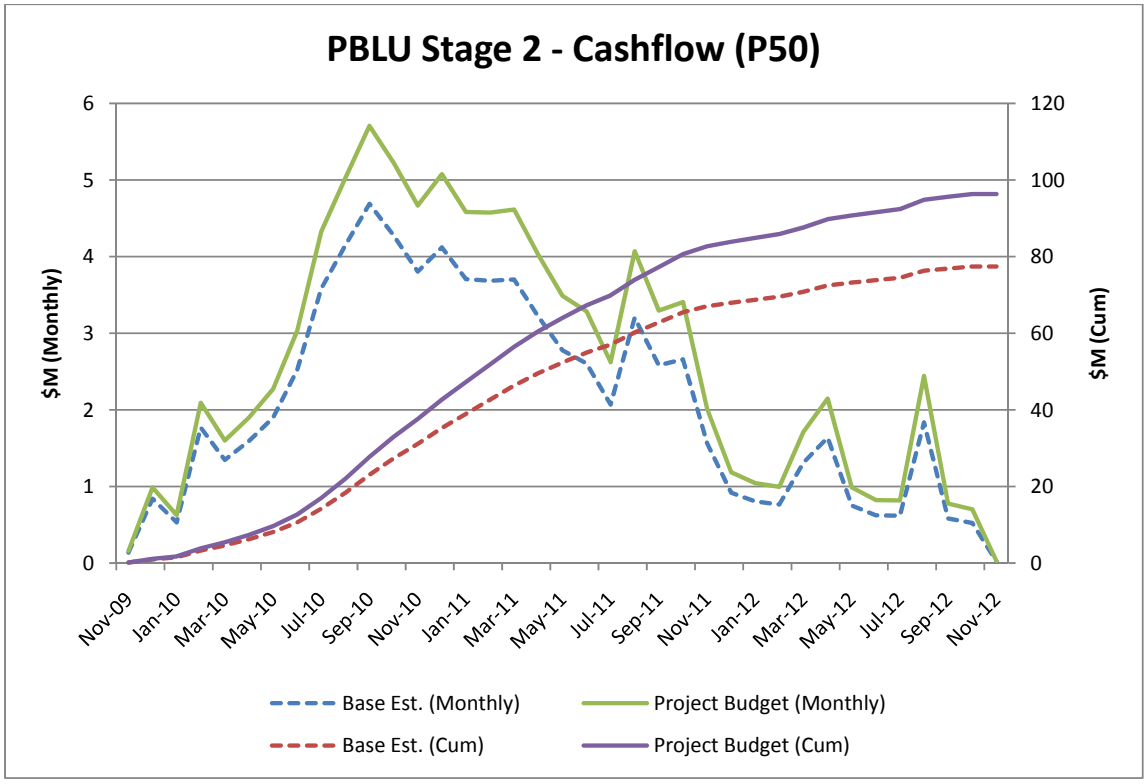


Figure 2 - P50 Cashflow

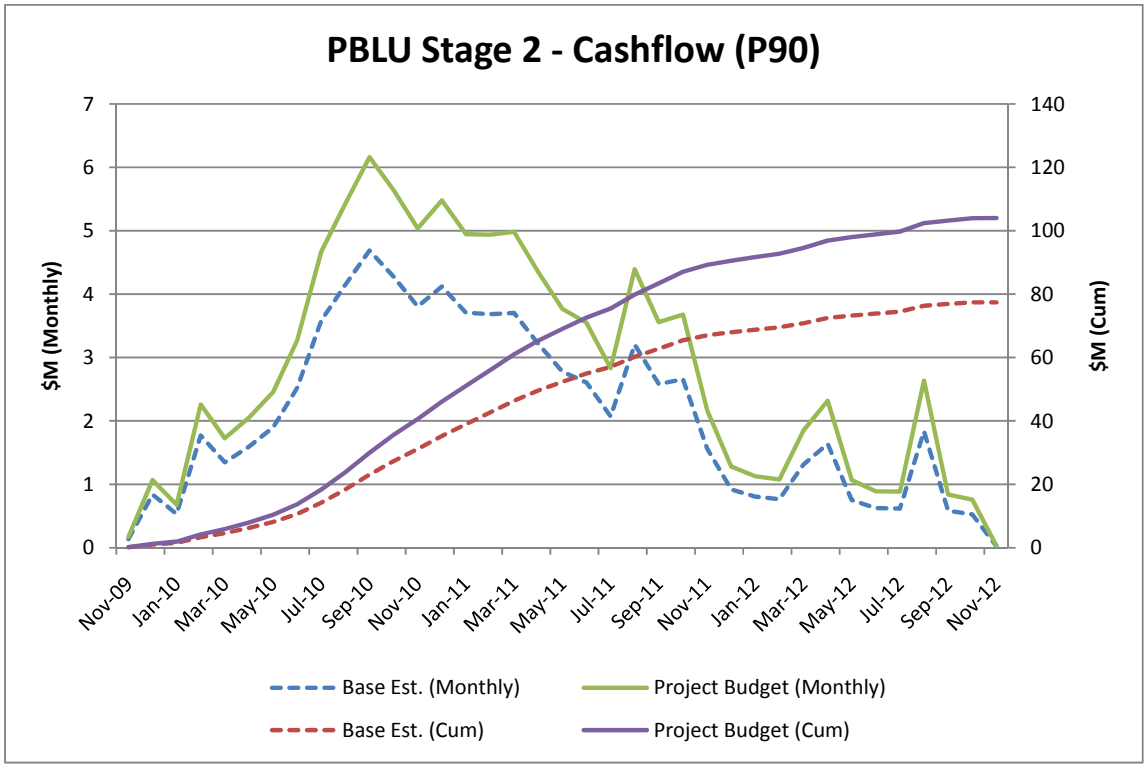


Figure 3 - P90 Cashflow

9 OUTTURN COST

The Total Outturn Cost is derived from the Base estimate with the addition of allowances for Contingency and Cost Escalation that are expected through to completion of the project.

The following components are described in separate section of this report:

- Contingency has been calculated separately and is further described in Section 7.
- Cost escalation has been calculated separately and is further described in Section 8.

The Total Outturn Cost is expressed in both P50 and P90 values, as shown in Table 5 below:

Base Estimate Calculations	Total ($m)	
Construction Costs		
Direct Costs	40.2	
Indirect Costs	29.4	
Sub Total	**69.6**	
Client Costs		
Possession Costs	3.0	
ARTC Project Management	4.0	
Insurances	0.4	
Aliance setup	0.5	
Sub Total	**7.9**	
Base Estimate	**77.5**	
Risk & Escalation Calculations	**P50**	**P90**
Contingency	13.8	21.0
Risk Based Project Estimate	91.3	98.5
Escalation	5.2	5.6
Total Outturn Cost	**$ 96.5**	**$104.1**
NB: All figures are in millions and have been rounded		

Table 5 - Total Outturn cost

The final outturn cost will be affected by the level of direct and indirect RailCorp interface throughout the design, installation and commissioning stages. Further definition of this interface is required to improve the certainty of this estimate.

It is assumed the cost estimates which have been provided to E&P adequately cover the work scope required to meet the current Signalling Function Specifications (SFS).

The Outturn Cost Estimate takes into account the uncertainty surrounding the assumptions made, but does not take into account changes or events of a functionality, scoping or timing nature that would fundamentally change the scope of the works.

Note: Only selected appendices are included in this document

Appendix 2 Base Estimate Summary

Port Botany Line Upgrade (Stage 2)

		Description	Amount	%DC
A1	**Direct Costs - Botany Yard**			
	1	**Construction: Communications**	$ 51,050	0.6%
	2	**Installation: Signalling**		
		Cabling	$ 1,732,671	18.7%
		Power supply	$ 306,077	3.3%
		Comms/Microlock & Relays	$ 438,438	4.7%
		Removals	$ 75,826	0.8%
		Bonding	$ 22,533	0.2%
		Asset Register	$ 16,444	0.2%
		Spares	$ 208,166	2.2%
		Commissioning	$ 352,438	3.8%
		Signalling Equipment installation	$ 5,290,165	57.2%
	3	**Installation: Phoenix ***	$ 190,000	2.1%
	4	**Installation: Telemetry & Data config ***	$ 30,000	0.3%
	5	**CountryNet Radio**	$ 181,840	2.0%
	6	**MISS Testing (Provisional Sum)**	$ 33,333	0.4%
	7	**Track Construction**	$ 260,055	2.8%
	8	**RailCorp (T&C)**	$ 66,000	0.7%
A2	**Direct Costs - Cooks River/Wardell Rd**			
	1	**Construction: Communications**	$ 55,500	0.5%
	2	**Installation: Signalling**		
		Cabling	$ 3,052,932	30.0%
		Power Supply	$ 206,594	2.0%
		Comms/Microlock & Relays	$ 292,220	2.9%
		Removals	$ 202,506	2.0%
		Bonding & Track Circuits & Points	$ 1,416,394	13.9%
		Asset Register	$ 34,292	0.3%
		Spares	$ 238,847	2.3%
		Commissioning	$ 564,488	5.5%
		Locations	$ 578,433	5.7%
		Signalling Equipment installation	$ 539,692	5.3%
		Signs	$ 12,060	0.1%
	3	**Installation: Phoenix ***	$ 270,000	2.6%
	4	**Installation: ATRICS ***	$ 500,000	4.9%
	5	**Installation: Telemetry & Data config ***	$ 30,000	0.3%
	6	**CountryNet Radio**	$ 10,000	0.1%
	7	**MISS Testing**	$ 33,333	0.3%
	8	**Track Construction**	$ 711,960	7.0%
	9	**RailCorp (Installation, T&C)**	$ 1,442,700	14.2%
A3	**Direct Costs - Shared Corridor**			
	1	**Construction: Communications**	$ 39,000	0.4%
	2	**Installation: Signalling**		
		Cabling	$ 509,869	5.0%
		Power Supply	$ 97,899	1.0%
		Comms/Microlock & Relays	$ 214,120	2.1%
		Removals	$ 188,600	1.9%
		Bonding & Track Circuits & Points	$ 7,800	0.1%
		Asset Register	$ 16,999	0.2%
		Spares	$ 198,936	2.0%
		Commissioning	$ 276,122	2.7%
		Locations		0.0%
		Signalling Equipment Installation	$ 1,305,721	12.8%
		Signs		0.0%
	3	**Installation: Phoenix ***	$ 130,000	1.3%
	4	**Installation: ATRICS ***	$ 500,000	4.9%
	5	**Installation: Telemetry & Data config ***	$ 30,000	0.3%
	6	**CountryNet Radio**	$ 10,000	0.1%
	7	**MISS Testing**	$ 33,333	0.3%
	8	**Track Construction**	$ 232,635	2.3%
	9	**RailCorp (Installation, T&C)**	$ 521,220	5.1%

A4	**Direct Costs - Enfield Yard**				
	1	**Construction: Communications**	$	61,900	1.4%
	2	**Installation: Signalling**			
		Cabling	$	1,126,902	25.7%
		Power Supply	$	27,999	
		Comms/Microlock & Relays	$	270,689	6.2%
		Removals	$	8,698	0.2%
		Bonding & Track Circuits & Points	$	508,126	11.6%
		Asset Register	$	16,999	0.4%
		Spares	$	187,158	4.3%
		Commissioning	$	646,201	14.7%
		Locations	$	166,192	3.8%
		Signalling Equipment installation	$	335,700	7.7%
	3	**Installation: Phoenix ***	$	240,000	5.5%
	4	**Installation: ATRICS ***	$	-	0.0%
	5	**Installation: Telemetry & Data config ***	$	30,000	0.7%
	6	**CountryNet Radio**	$	10,000	0.2%
	7	**MISS Testing**	$	-	0.0%
	8	**Track Construction**	$	68,720	1.6%
	9	**RailCorp**	$	679,500	15.5%
A5	**Direct Costs - Enfield Staging Roads**				
	1	**Preliminaries**			
		Establish site	$	145,315	1.2%
		Fence	$	59,800	0.5%
		Services relocation	$	250,000	2.1%
		Lighting	$	868,000	7.2%
		Survey	$	29,700	0.2%
		Environmental	$	29,550	0.2%
	1.1	**Design and Option Design and investigations**			
		Earthworks and gantries/OHW	$	1,300,000	
	2	**Construction Works**			
		Delivery of turnouts	$	320,000	2.7%
		Preassemble	$	39,500	0.3%
		Possession 1 - Install TO's & remove redundant	$	908,834	7.6%
	3	**Earthworks and Track Construction brown field site**			
		Sub-base, capping and drainage	$	1,874,623	15.6%
		Track works: Materials	$	3,010,000	25.0%
		Track works: Labour	$	546,000	4.5%
		Track works: Plant	$	787,880	6.5%
	4	**Sheet 1 & 10 Scope of Works**			
		Turnouts	$	1,230,000	10.2%
		Install crossover and new points	$	553,428	4.6%
	~~**5**~~	~~**OHW & Associated Elec Works #**~~	$	-	0.0%
	6	**Communications: Construction/Installation**	$	80,000	0.7%
	Total Direct Costs - A1, A2, A3, A4, A5				

B	**Indirect Costs**				
	1	**Design**			
	a	Signalling detailed design (PB, CRWR, SC, EY)	$	3,926,809	9.8%
	b	Communications detailed design (PB, CRWR, SC, EY)	$	41,490	0.1%
	c	Phoenix *	$	3,320,000	8.3%
	d	ATRICS *	$	4,000,000	10.0%
	e	Construction Phase Service (10% DD)	$	591,539	1.5%
	f	Telemetry & Data *	$	480,000	1.2%
	~~**g**~~	~~OHW & Associated Elec Design Works Enfield #~~	-		
	h	Design (OHW) work for ESR	$	50,000	0.1%
	i	Communications design for ESR	$	20,000	0.0%
	j	Signalling design for ESR	$	286,733	0.7%
	k	Track design (PB, CRWR, SC)	$	199,000	0.5%
	l	RailCorp (Review, Approval)	$	1,982,150	4.9%
	2	**Project Mgt**			
	a	Signalling Detailed Design	$	850,000	2.1%
	b	Communications	$	82,980	0.2%
	c	Enfield Staging Roads	$	1,223,747	3.0%
	d	Track Construction Mgt	$	134,028	0.3%
	3	**Contingency**			
	a	Communications	$	41,490	0.1%
	b	Signalling Detailed Design (15% DD Cost)	$	589,021	1.5%
	c	Enfield Staging Roads	$	1,079,747	2.7%
	d	Additional for RC risk cont. (ref Margin2 in estimates summary)	$	4,500,183	11.2%
	4	**Project OH**			
	a	Signalling I,T&C (safeworking, project running costs)	$	6,278,933	15.6%
	b	Safe working			
		PB	$	372,438	0.9%
		CRWR	$	496,584	1.2%
		SC	$	365,371	0.9%
		EY	$	181,676	0.5%
		ESR	$	34,840	0.1%
		Trackwork Extras (PB, CRWR, SC)	$	66,912	0.2%
	5	**Margins**			
		PB, CRWR, SC, EY	$	2,938,695	7.3%
		ESR	$	1,310,096	3.3%
		Track construction profit	$	134,028	0.3%
C	**Client Costs**				
	1	Railcorp - inc. Design review, Additional for Comm'n (**see B.3.d)**			
	2	Possession Costs	$	3,000,000	7.5%
	3	ARTC PMgt	$	4,033,000	10.0%
	4	Insurances	$	360,000	0.9%
	5	Alliance setup costs	$	500,000	1.2%
	6	Escalation	$	-	
					$ 77,437,705
	*	Split 80/20 against D/C			
	#	Enfield Staging Roads only			
	NB	Escalation not shown			
		NA - this item to be calculated from model			
		Taken from V2 of ESR estimate provided by T Pentland			
		Ranges aligned accounting for risk range difference i.e 10-15-20%			
		(MIN not adjusted)			
		Independently ranged/considered on workshop			
	abc	Ranges to be reviewed/revised. Default values assumed for model			
		Attention			

Appendix 8 Risk Assessment Inputs – Inherent Risk

INHERENT RISK RANGES FOR MODEL
Port Botany Line Upgrade (Stage 2)

		Description	Amount	%DC	Risk Allowances (%) MIN	ML	MAX		Risk Allowances ($) MIN	ML	MAX
A1	**Direct Costs - Botany Yard**		**$ 9,255,036**								
	1	**Construction: Communications**	$ 51,050	0.6%	90%	100%	115%	Ref 15	$ 45,945	$ 51,050	$ 58,707.50
	2	**Installation: Signalling**						Ref 7			
		Cabling	$ 1,732,671	18.7%	90%	100%	115%		$ 1,559,404	$ 1,732,671	$ 1,992,571.65
		Power supply	$ 306,077	3.3%	80%	100%	200%		$ 244,862	$ 306,077	$ 612,154.00
		Comms/Microlock & Relays	$ 438,438	4.7%	80%	100%	120%		$ 350,750	$ 438,438	$ 526,125.60
		Removals	$ 75,826	0.8%	90%	100%	115%		$ 68,243	$ 75,826	$ 87,199.90
		Bonding	$ 22,533	0.2%	80%	100%	120%		$ 18,026	$ 22,533	$ 27,039.60
		Asset Register	$ 16,444	0.2%	90%	100%	110%		$ 14,800	$ 16,444	$ 18,088.40
		Spares	$ 208,166	2.2%	90%	100%	120%		$ 187,349	$ 208,166	$ 249,799.20
		Commissioning	$ 352,438	3.8%	90%	100%	150%		$ 317,194	$ 352,438	$ 528,657.00
		Signalling Equipment installation	$ 5,290,165	57.2%	90%	100%	115%		$ 4,761,149	$ 5,290,165	$ 6,083,689.75
	3	**Installation: Phoenix ***	$ 190,000	2.1%	90%	100%	150%	Ref 3	$ 171,000	$ 190,000	$ 285,000.00
	4	**Installation: Telemetry & Data config ***	$ 30,000	0.3%	90%	100%	150%	Ref 3	$ 27,000	$ 30,000	$ 45,000.00
	5	**CountryNet Radio**	$ 181,840	2.0%	90%	100%	120%	Ref 3	$ 163,656	$ 181,840	$ 218,208.00
	6	**MISS Testing (Provisional Sum)**	$ 33,333	0.4%	90%	100%	150%	Ref 3	$ 30,000	$ 33,333	$ 50,000.00
	7	**Track Construction**	$ 260,055	2.8%	90%	100%	110%		$ 234,050	$ 260,055	$ 286,060.50
	8	**RailCorp (T&C)**	$ 66,000	0.7%	90%	100%	130%		$ 59,400	$ 66,000	$ 85,800.00
A2	**Direct Costs - Cooks River/Wardell Rd**		**$ 10,191,951**								
	1	**Construction: Communications**	$ 55,500	0.5%	90%	100%	150%	Ref 15	$ 49,950	$ 55,500	$ 83,250.00
	2	**Installation: Signalling**						Ref 7			
		Cabling	$ 3,052,932	30.0%	90%	100%	120%		$ 2,747,639	$ 3,052,932	$ 3,663,518.40
		Power Supply	$ 206,594	2.0%	80%	100%	205%		$ 165,275	$ 206,594	$ 423,517.70
		Comms/Microlock & Relays	$ 292,220	2.9%	80%	100%	125%		$ 233,776	$ 292,220	$ 365,275.00
		Removals	$ 202,506	2.0%	90%	100%	120%		$ 182,255	$ 202,506	$ 243,007.20
		Bonding & Track Circuits & Points	$ 1,416,394	13.9%	80%	100%	125%		$ 1,133,115	$ 1,416,394	$ 1,770,492.50
		Asset Register	$ 34,292	0.3%	90%	100%	115%		$ 30,863	$ 34,292	$ 39,435.80
		Spares	$ 238,847	2.3%	90%	100%	125%		$ 214,962	$ 238,847	$ 298,558.75
		Commissioning	$ 564,488	5.5%	90%	100%	166%		$ 508,039	$ 564,488	$ 937,050.08
		Locations	$ 578,433	5.7%	80%	100%	135%		$ 462,746	$ 578,433	$ 780,884.55
		Signalling Equipment installation	$ 539,692	5.3%	80%	100%	135%		$ 431,754	$ 539,692	$ 728,584.20
		Signs	$ 12,060	0.1%	80%	100%	135%		$ 9,648	$ 12,060	$ 16,281.00

	3	**Installation: Phoenix ***	$ 270,000	2.6%	90%	100%	155%	Ref 3	$ 243,000	$ 270,000	$ 418,500.00
	4	**Installation: ATRICS ***	$ 500,000	4.9%	60%	100%	155%	Ref 3	$ 300,000	$ 500,000	$ 775,000.00
	5	**Installation: Telemetry & Data config ***	$ 30,000	0.3%	90%	100%	155%	Ref 3	$ 27,000	$ 30,000	$ 46,500.00
	6	**CountryNet Radio**	$ 10,000	0.1%	90%	100%	125%	Ref 3	$ 9,000	$ 10,000	$ 12,500.00
	7	**MISS Testing**	$ 33,333	0.3%	90%	100%	155%	Ref 3	$ 30,000	$ 33,333	$ 51,666.67
	8	**Track Construction**	$ 711,960	7.0%	80%	100%	120%		$ 569,568	$ 711,960	$ 854,352.00
	9	**RailCorp (Installation, T&C)**	$ 1,442,700	14.2%	33%	100%	200%		$ 476,091	$ 1,442,700	$ 2,885,400.00
A3	**Direct Costs - Shared Corridor**		**$ 4,312,254**								
	1	**Construction: Communications**	$ 39,000	0.9%	90%	100%	150%	Ref 15	$ 35,100	$ 39,000	$ 58,500.00
	2	**Installation: Signalling**						Ref 7			
		Cabling	$ 509,869	11.8%	90%	100%	120%		$ 458,882	$ 509,869	$ 611,842.80
		Power Supply	$ 97,899	2.3%	80%	100%	205%		$ 78,319	$ 97,899	$ 200,692.95
		Comms/Microlock & Relays	$ 214,120	5.0%	80%	100%	125%		$ 171,296	$ 214,120	$ 267,650.00
		Removals	$ 188,600	4.4%	90%	100%	120%		$ 169,740	$ 188,600	$ 226,320.00
		Bonding & Track Circuits & Points	$ 7,800	0.2%	80%	100%	125%		$ 6,240	$ 7,800	$ 9,750.00
		Asset Register	$ 16,999	0.4%	90%	100%	115%		$ 15,299	$ 16,999	$ 19,548.85
		Spares	$ 198,936	4.6%	90%	100%	125%		$ 179,042	$ 198,936	$ 248,670.00
		Commissioning	$ 276,122	6.4%	90%	100%	166%		$ 248,510	$ 276,122	$ 458,362.52
		Signalling Equipment Installation	$ 1,305,721	30.3%	80%	100%	135%		$ 1,044,577	$ 1,305,721	$ 1,762,723.35
	3	**Installation: Phoenix ***	$ 130,000	3.0%	90%	100%	155%	Ref 3	$ 117,000	$ 130,000	$ 201,500.00
	4	**Installation: ATRICS ***	$ 500,000	11.6%	60%	100%	155%	Ref 3	$ 300,000	$ 500,000	$ 775,000.00
	5	**Installation: Telemetry & Data config ***	$ 30,000	0.7%	90%	100%	155%	Ref 3	$ 27,000	$ 30,000	$ 46,500.00
	6	**CountryNet Radio**	$ 10,000	0.2%	90%	100%	125%	Ref 3	$ 9,000	$ 10,000	$ 12,500.00
	7	**MISS Testing**	$ 33,333	0.8%	90%	100%	155%	Ref 3	$ 30,000	$ 33,333	$ 51,666.67
	8	**Track Construction**	$ 232,635	5.4%	80%	100%	120%		$ 186,108	$ 232,635	$ 279,162.00
	9	**RailCorp (Installation, T&C)**	$ 521,220	12.1%	**33%**	**100%**	**200%**		$ 172,003	$ 521,220	$ 1,042,440.00
A4	**Direct Costs - Enfield Yard**		**$ 4,384,784**								
	1	**Construction: Communications**	$ 61,900	1.4%	80%	100%	120%	Ref 15	$ 49,520	$ 61,900	$ 74,280.00
	2	**Installation: Signalling**						Ref 7			
		Cabling	$ 1,126,902	25.7%	90%	100%	125%		$ 1,014,212	$ 1,126,902	$ 1,408,627.50
		Power Supply	$ 27,999	0.6%	80%	100%	210%		$ 22,399	$ 27,999	$ 58,797.90
		Comms/Microlock & Relays	$ 270,689	6.2%	80%	100%	130%		$ 216,551	$ 270,689	$ 351,895.70
		Removals	$ 8,698	0.2%	90%	100%	125%		$ 7,828	$ 8,698	$ 10,872.50
		Bonding & Track Circuits & Points	$ 508,126	11.6%	80%	100%	130%		$ 406,501	$ 508,126	$ 660,563.80
		Asset Register	$ 16,999	0.4%	90%	100%	120%		$ 15,299	$ 16,999	$ 20,398.80
		Spares	$ 187,158	4.3%	90%	100%	130%		$ 168,442	$ 187,158	$ 243,305.40
		Commissioning	$ 646,201	14.7%	**90%**	**100%**	**166%**		$ 581,581	$ 646,201	$ 1,072,693.66
		Locations	$ 166,192	3.8%	80%	100%	135%		$ 132,954	$ 166,192	$ 224,359.20
		Signalling Equipment installation	$ 335,700	7.7%	80%	100%	135%		$ 268,560	$ 335,700	$ 453,195.00

	3	**Installation: Phoenix ***	$ 240,000	5.5%	90%	100%	160%	Ref 3	$ 216,000	$ 240,000	$ 384,000.00
	5	**Installation: Telemetry & Data config ***	$ 30,000	0.7%	90%	100%	160%	Ref 3	$ 27,000	$ 30,000	$ 48,000.00
	6	**CountryNet Radio**	$ 10,000	0.2%	90%	100%	130%	Ref 3	$ 9,000	$ 10,000	$ 13,000.00
	8	**Track Construction**	$ 68,720	1.6%	80%	100%	120%		$ 54,976	$ 68,720	$ 82,464.00
	9	**RailCorp**	$ 679,500	15.5%	**33%**	**100%**	**200%**		$ 224,235	$ 679,500	$ 1,359,000.00
A5	**Direct Costs - Enfield Staging Roads**		**$ 12,032,630**								
	1	**Preliminaries**									
		Establish site	$ 145,315	1.2%	80%	100%	120%		$ 116,252	$ 145,315	$ 174,378.00
		Fence	$ 59,800	0.5%	80%	100%	120%		$ 47,840	$ 59,800	$ 71,760.00
		Services relocation	$ 250,000	2.1%	80%	100%	150%		$ 200,000	$ 250,000	$ 375,000.00
		Lighting	$ 868,000	7.2%	50%	100%	120%		$ 434,000	$ 868,000	$ 1,041,600.00
		Survey	$ 29,700	0.2%	80%	100%	120%		$ 23,760	$ 29,700	$ 35,640.00
		Environmental	$ 29,550	0.2%	80%	100%	120%		$ 23,640	$ 29,550	$ 35,460.00
	1.1	**Design and Option Design and investigations**									
		Earthworks and gantries/OHW	$ 1,300,000	10.8%	80%	100%	150%		$ 1,040,000	$ 1,300,000	$ 1,950,000.00
	2	**Construction Works**									
		Delivery of turnouts	$ 320,000	2.7%	90%	100%	110%		$ 288,000	$ 320,000	$ 352,000.00
		Preassemble	$ 39,500	0.3%	80%	100%	120%		$ 31,600	$ 39,500	$ 47,400.00
		Possession 1 - Install TO's & remove redundant	$ 908,834	7.6%	90%	100%	120%		$ 817,951	$ 908,834	$ 1,090,601.15
	3	**Earthworks and Track Construction brown field site**									
		Sub-base, capping and drainage	$ 1,874,623	15.6%	60%	100%	120%		$ 1,124,774	$ 1,874,623	$ 2,249,547.60
		Track works: Materials	$ 3,010,000	25.0%	50%	100%	120%		$ 1,505,000	$ 3,010,000	$ 3,612,000.00
		Track works: Labour	$ 546,000	4.5%	90%	100%	120%		$ 491,400	$ 546,000	$ 655,200.00
		Track works: Plant	$ 787,880	6.5%	90%	100%	120%		$ 709,092	$ 787,880	$ 945,456.00
	4	**Sheet 1 & 10 Scope of Works**									
		Turnouts	$ 1,230,000	10.2%	90%	100%	110%		$ 1,107,000	$ 1,230,000	$ 1,353,000.00
		Install crossover and new points	$ 553,428	4.6%	80%	100%	120%		$ 442,742	$ 553,428	$ 664,113.60
	6	**Communications: Construction/Installation**	$ 80,000	0.7%	80%	100%	120%		$ 64,000	$ 80,000	$ 96,000.00
	Total Direct Costs - A1, A2, A3, A4, A5		**$ 40,176,656**								

B1	**Indirect Costs - Botany Yard**	**$ 6,555,816**										
	1	**Design**										
	a	Signalling detailed design (Stage 2 funding)	$ 565,226	6.1%	70%	100%	120%	Ref 16	$ 395,658	$ 565,226	$ 678,271.20	
	b	Communications detailed design	$ 10,210	0.1%	80%	100%	150%	Ref 15	$ 8,168	$ 10,210	$ 15,315.00	
	c	Phoenix *	$ 760,000	8.2%	80%	100%	120%	Ref 3	$ 608,000	$ 760,000	$ 912,000.00	
	e	Construction Phase Service (10% DD)	$ 135,989	1.5%	50%	100%	150%	Ref 3	$ 67,995	$ 135,989	$ 203,983.50	
	f	Telemetry & Data *	$ 120,000	1.3%	80%	100%	120%	Ref 3	$ 96,000	$ 120,000	$ 144,000.00	
	g	Track design	$ 16,000	0.2%	90%	100%	130%		$ 14,400	$ 16,000	$ 20,800.00	
	2	**Project Mgt**										
	a	Signalling Detailed Design	$ 212,500	2.3%	70%	100%	120%	Ref 3	$ 148,750	$ 212,500	$ 255,000.00	
	b	Communications	$ 20,420	0.2%	80%	100%	120%	Ref 15	$ 16,336	$ 20,420	$ 24,504.00	
	3	**Contingency**										
	a	Communications	$ 10,210	0.1%	80%	100%	120%	Ref 15	$ 8,168	$ 10,210	$ 12,252.00	
	b	Signalling Detailed Design (15% DD Cost)	$ 84,784	0.9%	80%	100%	120%	Ref 3	$ 67,827	$ 84,784	$ 101,740.68	
	c	Additional for RC risk cont. (ref Margin2 in estimates summary)	$ 1,185,539	12.8%	80%	100%	120%		$ 948,431	$ 1,185,539	$ 1,422,647.03	
	4	**Project OH**										
	a	Signalling I,T&C (safeworking, project running costs)	$ 1,962,433	21.2%	80%	100%	130%	Ref 7	$ 1,569,946	$ 1,962,433	$ 2,551,162.90	
	b	Safe working										
		PB	$ 372,438	4.0%	90%	100%	200%		$ 335,194	$ 372,438	$ 744,876.00	
		Trackwork Extras	$ 22,304	0.2%	80%	100%	120%		$ 17,843	$ 22,304	$ 26,764.80	
	5	**Margins**										
		PB	$ 1,077,763	11.6%	95%	100%	150%	Ref 7	$ 1,023,875	$ 1,077,763	$ 1,616,644.35	
B2	**Indirect Costs - Cooks River/Wardell Rd**	**$ 11,106,803**										
	1	**Design**										
	a	Signalling detailed design (Stage 2 funding)	$ 1,186,840	11.6%	70%	100%	150%	Ref 16	$ 830,788	$ 1,186,840	$ 1,780,260.00	
	b	Communications detailed design	$ 11,100	0.1%	80%	100%	150%	Ref 15	$ 8,880	$ 11,100	$ 16,650.00	
	c	Phoenix *	$ 1,080,000	10.6%	80%	100%	120%	Ref 3	$ 864,000	$ 1,080,000	$ 1,296,000.00	
	d	ATRICS *	$ 2,000,000	19.6%	60%	100%	120%	Ref 3	$ 1,200,000	$ 2,000,000	$ 2,400,000.00	
	e	Construction Phase Service (10% DD)	$ 160,076	1.6%	50%	100%	150%	Ref 3	$ 80,038	$ 160,076	$ 240,114.00	
	f	Telemetry & Data *	$ 120,000	1.2%	80%	100%	120%	Ref 3	$ 96,000	$ 120,000	$ 144,000.00	
	g	Track design	$ 153,000	1.5%	90%	100%	130%		$ 137,700	$ 153,000	$ 198,900.00	
	h	RailCorp (Review, Approval)	$ 476,950	4.7%	25%	100%	110%		$ 119,238	$ 476,950	$ 524,645.00	
	2	**Project Mgt**										
	a	Signalling Detailed Design	$ 212,500	2.1%	70%	100%	120%	Ref 3	$ 148,750	$ 212,500	$ 255,000.00	
	b	Communications	$ 22,200	0.2%	80%	100%	120%	Ref 15	$ 17,760	$ 22,200	$ 26,640.00	
	3	**Contingency**										
	a	Communications	$ 11,100	0.1%	80%	100%	120%	Ref 15	$ 8,880	$ 11,100	$ 13,320.00	
	b	Signalling Detailed Design (15% DD Cost)	$ 178,026	1.7%	80%	100%	120%	Ref 3	$ 142,421	$ 178,026	$ 213,631.20	
	c	Additional for RC risk cont. (ref Margin2 in estimates summary)	$ 1,644,935	16.1%	80%	100%	120%		$ 1,315,948	$ 1,644,935	$ 1,973,921.40	
	4	**Project OH**										
	a	Signalling I,T&C (exc SW, project running costs)	$ 2,334,258	22.9%	80%	100%	150%	Ref 7	$ 1,867,406	$ 2,334,258	$ 3,501,387.00	
	b	Safe working										
		CRWR	$ 496,584	4.9%	90%	100%	200%		$ 446,926	$ 496,584	$ 993,168.00	
		Trackwork Extras	$ 22,304	0.2%	80%	100%	120%		$ 17,843	$ 22,304	$ 26,764.80	
	5	**Margins**										
		CRWR	$ 996,930	9.8%	95%	100%	175%	Ref 7	$ 947,084	$ 996,930	$ 1,744,627.50	

B3	**Indirect Costs - Shared Corridor**	**$ 7,833,305**										
	1	**Design**										
	a	Signalling detailed design (Stage 2 funding)	$ 1,400,040	32.5%	70%	100%	150%	Ref 16	$ 980,028	$ 1,400,040	$ 2,100,060.00	
	b	Communications detailed design	$ 7,800	0.2%	80%	100%	150%	Ref 15	$ 6,240	$ 7,800	$ 11,700.00	
	c	Phoenix *	$ 520,000	12.1%	80%	100%	120%	Ref 3	$ 416,000	$ 520,000	$ 624,000.00	
	d	ATRICS *	$ 2,000,000	46.4%	60%	100%	120%	Ref 3	$ 1,200,000	$ 2,000,000	$ 2,400,000.00	
	e	Construction Phase Service (10% DD)	$ 176,196	4.1%	50%	100%	150%	Ref 3	$ 88,098	$ 176,196	$ 264,294.00	
	f	Telemetry & Data *	$ 120,000	2.8%	80%	100%	120%	Ref 3	$ 96,000	$ 120,000	$ 144,000.00	
	g	Track design	$ 30,000	0.7%	90%	100%	130%		$ 27,000	$ 30,000	$ 39,000.00	
	h	RailCorp (Review, Approval)	$ 611,950	14.2%	25%	100%	110%		$ 152,988	$ 611,950	$ 673,145.00	
	2	**Project Mgt**										
	a	Signalling Detailed Design	$ 212,500	4.9%	70%	100%	120%	Ref 3	$ 148,750	$ 212,500	$ 255,000.00	
	b	Communications	$ 15,600	0.4%	80%	100%	120%	Ref 15	$ 12,480	$ 15,600	$ 18,720.00	
	3	**Contingency**										
	a	Communications	$ 7,800	0.2%	80%	100%	120%	Ref 15	$ 6,240	$ 7,800	$ 9,360.00	
	b	Signalling Detailed Design (15% DD Cost)	$ 210,006	4.9%	80%	100%	120%	Ref 3	$ 168,005	$ 210,006	$ 252,007.20	
	c	Additional for RC risk cont. (ref Margin2 in estimates summary)	$ 693,284	16.1%	80%	100%	120%		$ 554,627	$ 693,284	$ 831,940.36	
	4	**Project OH**										
	a	Signalling I,T&C (exc SW, project running costs)	$ 1,020,282	23.7%	80%	100%	150%	Ref 7	$ 816,226	$ 1,020,282	$ 1,530,423.00	
	b	Safe working										
		SC	$ 365,371	8.5%	90%	100%	200%		$ 328,834	$ 365,371	$ 730,742.00	
		Trackwork Extras	$ 22,304	0.5%	80%	100%	120%		$ 17,843	$ 22,304	$ 26,764.80	
	5	**Margins**										
		SC	$ 420,172	9.7%	95%	100%	175%	Ref 7	$ 399,163	$ 420,172	$ 735,300.83	
B4	**Indirect Costs - Enfield Yard**	**$ 5,100,099**										
	1	**Design**										
	a	Signalling detailed design (Stage 2 funding)	$ 774,703	17.7%	70%	100%	150%	Ref 16	$ 542,292	$ 774,703	$ 1,162,054.50	
	b	Communications detailed design	$ 12,380	0.3%	80%	100%	150%	Ref 15	$ 9,904	$ 12,380	$ 18,570.00	
	c	Phoenix *	$ 960,000	21.9%	80%	100%	120%	Ref 3	$ 768,000	$ 960,000	$ 1,152,000.00	
	e	Construction Phase Service (10% DD)	$ 119,278	2.7%	50%	100%	150%	Ref 3	$ 59,639	$ 119,278	$ 178,917.45	
	f	Telemetry & Data *	$ 120,000	2.7%	80%	100%	120%	Ref 3	$ 96,000	$ 120,000	$ 144,000.00	
	h	RailCorp (Review, Approval)	$ 184,000	4.2%	25%	100%	110%		$ 46,000	$ 184,000	$ 202,400.00	
	2	**Project Mgt**										
	a	Signalling Detailed Design	$ 212,500	4.8%	70%	100%	120%	Ref 3	$ 148,750	$ 212,500	$ 255,000.00	
	b	Communications	$ 24,760	0.6%	80%	100%	120%	Ref 15	$ 19,808	$ 24,760	$ 29,712.00	
	3	**Contingency**										
	a	Communications	$ 12,380	0.3%	80%	100%	120%	Ref 15	$ 9,904	$ 12,380	$ 14,856.00	
	b	Signalling Detailed Design (15% DD Cost)	$ 116,205	2.7%	80%	100%	120%	Ref 3	$ 92,964	$ 116,205	$ 139,446.54	
	c	Additional for RC risk cont. (ref Margin2 in estimates summary)	$ 976,426	22.3%	80%	100%	120%		$ 781,141	$ 976,426	$ 1,171,711.20	
	4	**Project OH**										
	a	Signalling I,T&C (exc SW, project running costs)	$ 961,960	21.9%	80%	100%	150%	Ref 7	$ 769,568	$ 961,960	$ 1,442,940.00	
	b	Safe working										
		EY	$ 181,676	4.1%	90%	100%	200%		$ 163,508	$ 181,676	$ 363,352.00	
	5	**Margins**										
		EY	$ 443,830	10.1%	95%	100%	175%	Ref 7	$ 421,639	$ 443,830	$ 776,702.50	

B5	**Indirect Costs - Enfield Staging Roads**	**$**	**4,982,469**								
1	**Design**										
h	Design (OHW) work for ESR	$	50,000	0.4%	80%	100%	160%		$ 40,000	$ 50,000	$ 80,000.00
i	Communications design for ESR	$	20,000	0.2%	90%	100%	160%		$ 18,000	$ 20,000	$ 32,000.00
j	Signalling design for ESR	$	286,733	2.4%	90%	100%	130%		$ 258,060	$ 286,733	$ 372,752.90
l	RailCorp (Review, Approval)	$	709,250	5.9%	25%	100%	110%		$ 177,313	$ 709,250	$ 780,175.00
2	**Project Mgt**										
c	Enfield Staging Roads	$	1,223,747	10.2%	90%	100%	120%		$ 1,101,372	$ 1,223,747	$ 1,468,496.40
d	Track Construction Mgt	$	134,028	1.1%	80%	100%	120%		$ 107,222	$ 134,028	$ 160,833.60
3	**Contingency**										
c	Enfield Staging Roads	$	1,079,747	9.0%	80%	100%	120%	Ref 18	$ 863,798	$ 1,079,747	$ 1,295,696.40
4	**Project OH**										
b	Safe working										
	ESR	$	34,840	0.3%	90%	100%	200%		$ 31,356	$ 34,840	$ 69,680.00
5	**Margins**										
	ESR	$	1,310,096	10.9%	80%	100%	175%		$ 1,048,077	$ 1,310,096	$ 2,292,668.00
	Track construction profit	$	134,028	1.1%	80%	100%	175%		$ 107,222	$ 134,028	$ 234,549.00
	Total Indirect Costs - B1, B2, B3, B4, B5	**$**	**35,578,491**								
C	**Client Costs**	**$**	**7,893,000**								
1	~~Railcorp - inc. Design review, Additional for Comm'n (see B.3.d)~~										
2	Possession Costs	$	3,000,000	7.5%	90%	100%	130%		$ 2,700,000	$ 3,000,000	$ 3,900,000.00
3	ARTC PMgt	$	4,033,000	10.0%	80%	100%	130%	Ref 3	$ 3,226,400	$ 4,033,000	$ 5,242,900.00
4	Insurances	$	360,000	0.9%	80%	100%	120%		$ 288,000	$ 360,000	$ 432,000.00
5	Alliance setup costs	$	500,000	1.2%	70%	100%	120%		$ 350,000	$ 500,000	$ 600,000.00
6	Escalation	$	-	0							
	Total Client Costs	**$**	**7,893,000**								
A	**Base estimate with client contingency**	**$**	**83,648,147**								
B	**Base estimate excluding client contingency**	**$**	**77,437,705**								
C	**Clients contingency**	**$**	**6,210,442**								

Appendix 9 Risk Assessment Inputs – Contingent Risk

ARTC/AECOM/DEW														
Risks not included in WBS - Base Case		Port Botany Line Upgrade (Stage 2)												
			Risk Item					%				Values		
Description	Comment	Risk Covered in inherent?	QTY	UNIT	RATE	TOTAL	Like'd	Min	ML	Max	Min	ML	Max
General						**250,000**							
Force Majeure/insurance coverage	Amt for excess	N	1	Item	250,000	250,000	1%	50%	100%	200%	125,000	250,000	500,000
Delay in MFN takeup	Escalation exc from this analysis	N	1	Item	0	0	10%	50%	100%	150%			
Political						**225,000**							
Funding	possible 6mnth delay in app. Assume $450k pa	N	1	Item	225,000	225,000	10%	0%	100%	150%	0	225,000	337,500
Financial, Commercial, Market Forces						**6,580,000**							
Resources availability- human, financial, plant and equipment	Poss 2mnth delay. Assume $450k pa pre-construction running costs	N	1	Item	75,000	75,000	10%	0%	100%	150%	0	75,000	112,500
Contractor default		N	1	Item	2,000,000	2,000,000	2%	0%	100%	200%	0	2,000,000	4,000,000
Subcontractor default	estimated from largest S/C ie sigs	N	1	Item	200,000	200,000	2%	0%	100%	200%	0	200,000	400,000
Lead times for critical materials change resulting in a delay in construction program.	Assume $100k pw based on 20% OH on tot project costs; 1 mnth delay	N	1	Item	430,000	430,000	10%	50%	100%	300%	215,000	430,000	1,290,000
Under-purchase of signalling long lead equipment when design is not complete. Additional cost due to uncertainty in bill of MATS due to unapproved design.	Assume 5% of sigs contract	N	1	Item	375,000	375,000	15%	0%	100%	200%	0	375,000	750,000
Exchange rate fluctuation affecting foreign procurement	Assume 25% of sig costs are impacted. TBC	N	1	Item	1,850,000	1,850,000	100%	-10%	0%	30%	-185,000	0	555,000
Key supplier becomes insolvent		N	1	Item	1,000,000	1,000,000	5%	10%	100%	200%	100,000	1,000,000	2,000,000
Prices of steel/copper fall/rise from TCE	10% of cabling costs	N	1	Item	650,000	650,000	50%	-20%	0%	40%	-130,000	0	260,000
Latent Conditions						**1,600,000**							
Location of existing site services (any) is not known / inaccurate.		N	1	Item	500,000	500,000	100%	10%	100%	150%	50,000	500,000	750,000
Pre-existing defects in the RailCorp network (eg signalling) require additional work that is never-the-less necessary for commissioning.		N	1	Item	1,000,000	1,000,000	10%	10%	100%	300%	100,000	1,000,000	3,000,000
Contaminated material encountered	Minor allowance for remediation. Say, 500cum x $200	N	1	Item	100,000	100,000	50%	10%	100%	300%	10,000	100,000	300,000
Community/ stakeholders and approvals						**1,980,000**							
REF raises potential environmental or heritage issue requiring treatment	Additional specialist report required.	N	1	Item	30,000	30,000	10%	75%	100%	200%	22,500	30,000	60,000
Triggering an EIA	estimate	N	1	Item	200,000	200,000	10%	50%	100%	150%	100,000	200,000	300,000
Residential issues, noise	Perm and temp NW mitigation techniques		1	Item	250,000	250,000	50%	10%	100%	250%	25,000	250,000	625,000
Signalling functional spec not endorsed by RC at start of detailed design	add 10% of dgn cost	N	1	Item	1,500,000	1,500,000	50%	10%	100%	150%	150,000	1,500,000	2,250,000
Design Development						**5,066,250**							
Lack of RailCorp resources (design review)	additional mgt time/cost	N	1	Item	250,000	250,000	50%	50%	100%	200%	125,000	250,000	500,000
Impact on existing RailCorp infrastructure/equipment & operations as a result of new works	extra dgn cost	N	1	Item	250,000	250,000	10%	50%	100%	150%	125,000	250,000	375,000
Inadequate provision for access- easement required. Subsequent design change and delays	extra dgn cost	N	1	Item	250,000	250,000	5%	50%	100%	150%	125,000	250,000	375,000
Scope Changes - BY	2.5% of DC	N	1	Item	373,750	373,750	100%	50%	100%	200%	186,875	373,750	747,500
Scope Changes - CR/WR	5% of DC	N	1	Item	747,500	747,500	100%	50%	100%	300%	373,750	747,500	2,242,500
Scope Changes - SC	5% of DC	N	1	Item	373,750	373,750	100%	50%	100%	300%	186,875	373,750	1,121,250
Scope Changes - EY	5% of DC	N	1	Item	373,750	373,750	100%	50%	100%	200%	186,875	373,750	747,500
Scope Changes - ESR	5% of DC	N	1	Item	747,500	747,500	100%	50%	100%	200%	373,750	747,500	1,495,000
Non-acceptance from Stakeholders	more design	N	1	Item	250,000	250,000	10%	50%	100%	175%	125,000	250,000	437,500
Existing Condition of Infrastructure not considered in Scope and Design	included above	N	1	Item	0	0	10%	50%	100%	150%	0	0	0
Design does not account for future maintenance agreements	extra dgn, extra works	N	1	Item	1,000,000	1,000,000	80%	25%	100%	200%	250,000	1,000,000	2,000,000
Changes to Standards and procedures affecting design	re-design	N	1	Item	250,000	250,000	10%	20%	100%	200%	50,000	250,000	500,000
Design resources not sufficient	delay in design. Say $50k pmnth @ 2mnths	N	1	Item	100,000	100,000	20%	50%	100%	200%	50,000	100,000	200,000

ARTC/AECOM/DEW	Port Botany Line Upgrade (Stage 2)													
Risks not included in WBS - Base Case														
		Risk Covered	Risk Item					%				Values		
Description	Comment	in inherent?	QTY	UNIT	RATE	TOTAL		Like'd	Min	ML	Max	Min	ML	Max
Availability of accurate design records	Assume redo or survey	N	1	Item	100,000	100,000		80%	50%	100%	250%	50,000	100,000	250,000
Construction Delivery						3,260,000								
Operational incident	additional resources to rectify and mitigate incident	N	1	Item	100,000	100,000		10%	50%	100%	150%	50,000	100,000	150,000
Operations over-ride constn program eg. trk access	Loss of possession, 3mnth delay (430k x 3)	N	1	Item	1,300,000	1,300,000		60%	50%	100%	250%	650,000	1,300,000	3,250,000
Delay and disruption caused due to other party works being undertaken within the rail corridor	Interface conflict leads to reprogramming	N	1	Item	200,000	200,000		50%	50%	100%	150%	100,000	200,000	300,000
Resources availability- human, financial, plant and equipment	1 mnth delay	N	1	Item	430,000	430,000		15%	10%	100%	200%	43,000	430,000	860,000
Changes to conditions/compliance under license		N	1	Item	250,000	250,000		10%	30%	100%	200%	75,000	250,000	500,000
Contractor issues- accreditations, cash flow, human resources etc	no commercial impact	N	1	Item	0	0		10%	50%	100%	150%	0	0	0
Construction conflicting with operational and maintenance activities	reprogramming of some activities	N	1	Item	200,000	200,000		5%	50%	100%	150%	100,000	200,000	300,000
Damage to existing assets	repair costs	N	1	Item	100,000	100,000		20%	50%	100%	250%	50,000	100,000	250,000
Sabotage/Vandalism	allowances up to the value of the insurance excess	N	1	Item	250,000	250,000		5%	50%	100%	150%	125,000	250,000	375,000
Safety of Passengers, Workers and Contractors		Y												
Power supply		Y												
Rescheduling or cancellation of possession	included above	N	1	Item	0	0		10%	50%	100%	150%			
Industrial Delays (at average labour force)	1 mnth delay	N	1	Item	430,000	430,000		5%	50%	100%	200%	215,000	430,000	860,000
Interfaces, Compliance, Operational readiness						975,000								
ATRICS readiness	delay to completion of comm'n, %50k pw	N	1	Item	50,000	50,000		90%	100%	433%	866%	50,000	216,500	433,000
Lack of Co-ordination with other Utilities	additional mgt/interface etc	N	1	Item	150,000	150,000		10%	50%	100%	150%	75,000	150,000	225,000
Service relocation scope and requirements exceed that expected	say 50% of ESR reloc'n work	N	1	Item	125,000	125,000		60%	50%	100%	300%	62,500	125,000	375,000
Delayed or no access to the combined service route	redesign, reprogram	N	1	Item	500,000	500,000		30%	50%	100%	200%	250,000	500,000	1,000,000
RailCorp requiring addtional rework on safety assessment	more design	N	1	Item	50,000	50,000		70%	50%	100%	150%	25,000	50,000	75,000
Lack of user acceptance by train crews & signallers	improvements/changes req'd to end product	N	1	Item	100,000	100,000		5%	20%	100%	200%	20,000	100,000	200,000
Lead time for driver documentation and training		Y												
TOTAL CONTINGENT RISK COST							$ 19,936,250							

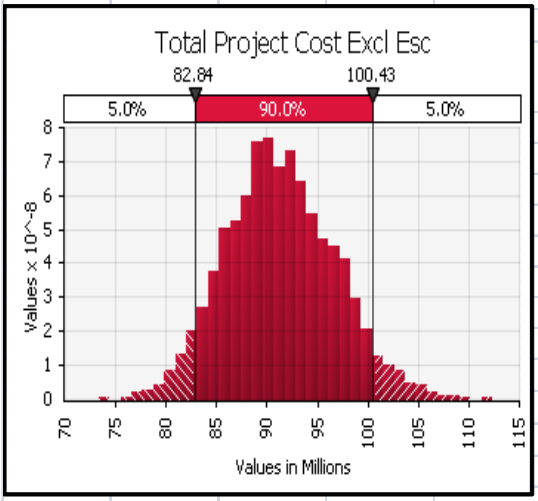
All risks considered to apply to all projects

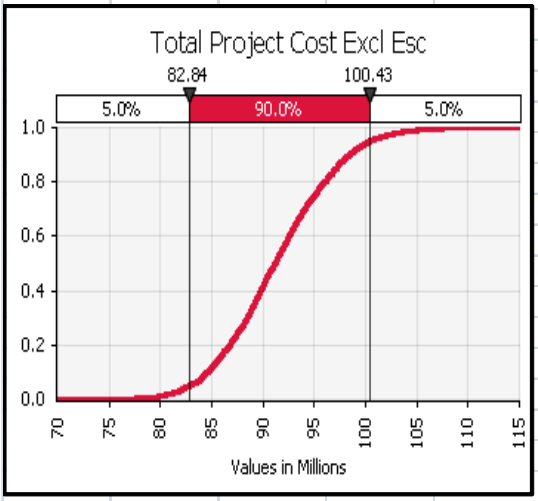
Appendix 10 Risk Output Report

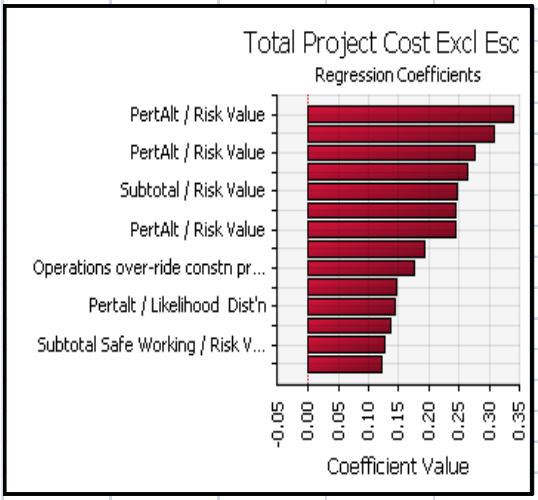
@RISK Output Report for Total Project Cost Excl Esc

Performed By: IJC

Date: Friday, 12 February 2010 9:42:25 AM







Simulation Summary Information	
Workbook Name	20100210 23592 Risk model on final base estimate summary-split out.xlsx
Number of Simulations	1
Number of Iterations	5000
Number of Inputs	173
Number of Outputs	9
Sampling Type	Latin Hypercube
Simulation Start Time	2/12/10 10:40:51
Simulation Duration	00:00:54
Random # Generator	Mersenne Twister
Random Seed	1096272182

Summary Statistics for Total Project Cost Excl Esc			
Statistics		Percentile	
Minimum	$ 73,331,656	5%	$ 82,843,703
Maximum	$ 112,399,634	10%	$ 84,562,407
Mean	$ 91,398,213	15%	$ 85,753,698
Std Dev	$ 5,418,823	20%	$ 86,759,788
Variance	2.93636E+13	25%	$ 87,670,570
Skewness	0.201930447	30%	$ 88,488,434
Kurtosis	3.017363731	35%	$ 89,154,448
Median	$ 91,189,822	40%	$ 89,806,600
Mode	$ 90,659,351	45%	$ 90,449,657
Left X	$ 82,843,703	50%	$ 91,189,822
Left P	5%	55%	$ 91,880,734
Right X	$ 100,426,545	60%	$ 92,577,205
Right P	95%	65%	$ 93,281,231
Diff X	$ 17,582,843	70%	$ 94,127,643
Diff P	90%	75%	$ 95,022,415
#Errors	0	80%	$ 96,058,319
Filter Min	Off	85%	$ 97,158,813
Filter Max	Off	90%	$ 98,450,442
#Filtered	0	95%	$ 100,426,545

Regression and Rank Information for Total Project Cos			
Rank	Name	Regr	Corr
1	PertAlt / Risk Val	0.339	0.514
2	Subtotal Signalli	0.308	0.295
3	PertAlt / Risk Val	0.276	0.259
4	% DC&IC exc desi	0.264	0.245
5	Subtotal / Risk Va	0.247	0.252
6	UniformAlt / Risk	0.245	0.235
7	PertAlt / Risk Val	0.243	0.247
8	PertAlt / Risk Val	0.193	0.432
9	Operations over-	0.175	0.195
10	PertAlt / Risk Val	0.147	0.131
11	Pertalt / Likeliho	0.145	0.131
12	UniformAlt / Risk	0.137	0.142
13	Subtotal Safe Wo	0.128	0.134
14	PertAlt / Risk Val	0.122	0.125

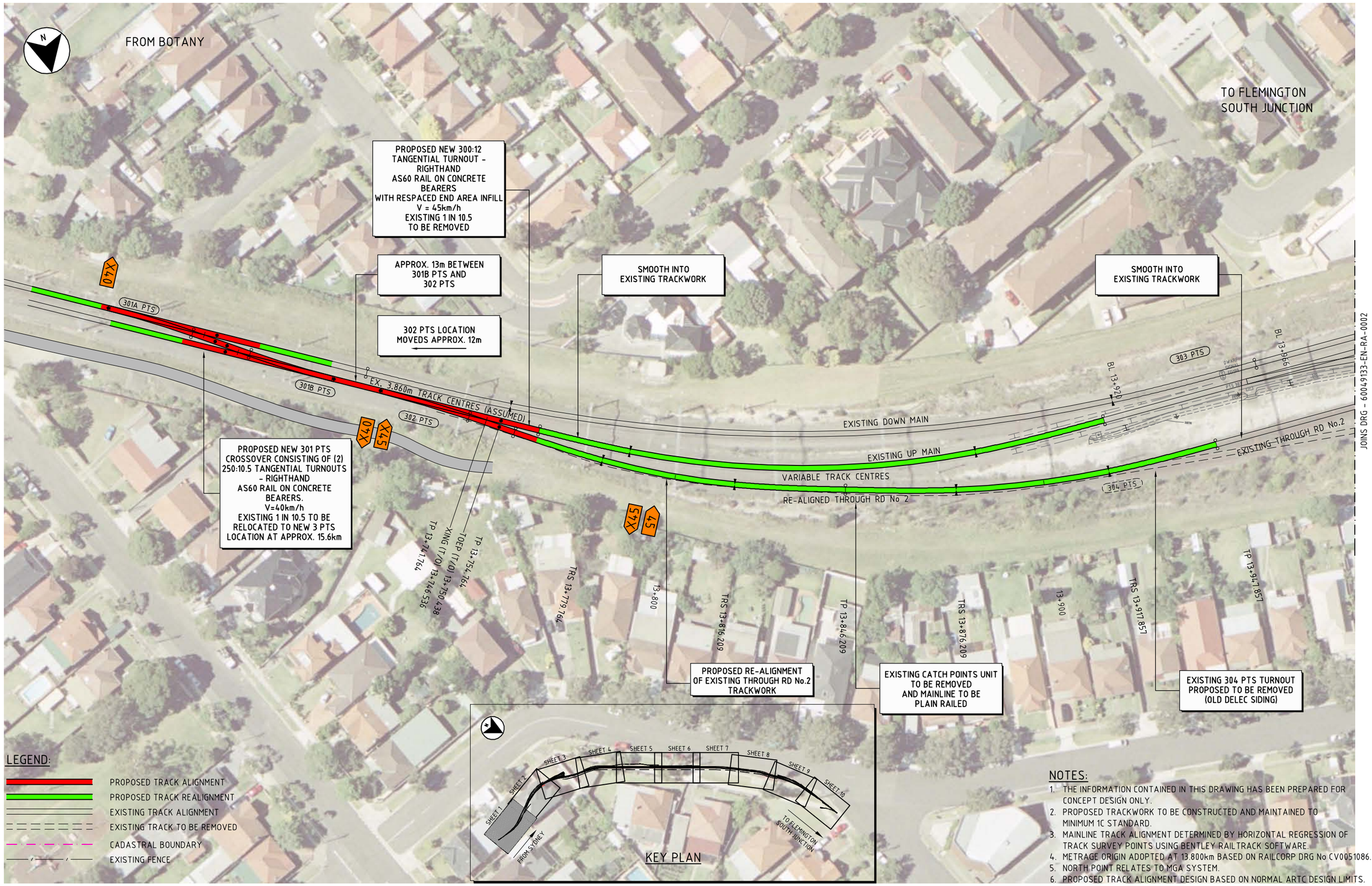
G2 Enfield Staging Facility – Engineering Drawings

The following drawings relating to the Enfield Staging Facility are attached:

60049133 – EN – RA – 0001

To

60049133 – EN – RA - 0010



NOTES:

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4. METRAGE ORIGIN ADOPTED AT 13.800km BASED ON RAILCORP DRG No CV0051086.
5. NORTH POINT RELATES TO MGA SYSTEM.
6. PROPOSED TRACK ALIGNMENT DESIGN BASED ON NORMAL ARTC DESIGN LIMITS.

NOT FOR CONSTRUCTION

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B	BK	19.08.09	RE-ISSUED FOR INFORMATION	
A	BK	15.07.09	ISSUED FOR INFORMATION	

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DESIGNED	DT	CHECKED	SON
DRAWN	BK	CHECKED	DT
APPROVED		DATE	

SCALES: 5 0 10 20m — 1 : 500 FULL SIZE A1

SUB-ALLIANCE PROVIDER: MAUNSELL AECOM

Maunsell Australia Pty Ltd A.B.N. 20 093 846 925

CLIENT: AUSTRALIAN RAIL TRACK CORPORATION LTD

ENFIELD STAGING

ENFIELD STAGING FACILITY 13.6km - 16.9km

TRACK LAYOUT

STAGING DESIGN

SHEET 1

DRAWING NUMBER:	REV:	STATUS:	ARTC REFERENCE NO:
60049133-EN-RA-0001	D	DETAILED DESIGN	

FROM BOTANY

TO FLEMINGTON SOUTH JUNCTION

EXISTING 303 PTS TURNOUT TO REMAIN UNALTERED

END OF PROPOSED ARTC ACCESS ROAD (CONSTRAINED BY EXISTING OHWS BL 14+055)

PROPOSED RE-ALIGNMENT OF EXISTING THROUGH RD No.2 ONTO NEW STAGING ROAD DESIGN ALIGNMENT. TO ACHIEVED DESIGN SPEED OF 45km/h

SMOOTH INTO EXISTING TRACKWORK

PROPOSED RELOCATION OF EXISTING SIGNAL EQUIPMENT

PROPOSED RE-USED 1 IN 8.25 TURNOUT TO BE INSTALLED (POTENTIAL FOR EXISTING 306T PTS TURNOUT TO BE RE-USED V = 15km/h

EXISTING 1 IN 8.25 TURNOUT TO BE REMOVED POTENTIALLY RELOCATED TO LOCATION (5)

PROPOSED NEW TRACK CONNECTION FROM EX. THRU RD No 1 TO No 2 TO BE CONSTRUCTED

PROPOSED RE-ALIGNMENT OF EXISTING TRACK ONTO NEW CONNECTION DESIGN, SMOOTH INTO EXISTING TRACKWORK

PROPOSED NEW STAGING ROAD TO BE CONSTRUCTED TO TRACK CLASS 1 (AS53 RAIL ON TIMBER SLEEPERS)

PROPOSED NEW 190:9 TANGENTIAL TURNOUT - RH AS60 RAIL ON CONCRETE BEARERS (RELOCATION OF EXISTING 306T PTS CONNECTION) V = 35km/h

PROPOSED RE-ALIGNMENT OF EXISTING TRACKWORK INTO NEW DESIGN ALIGNMENT

EXISTING DELEC TRACKWORK PROPOSED TO BE REMOVED

PENDING INTERLOCKING RECONFIGURATION FOR STAGING ROADS OPERATION. THE RELOCATION OF 306T PTS CAN BE ACCOMMODATED WITHOUT SIGNIFICANT ALTERATIONS TO THE EXISTING SIGNALLING SYSTEM ON A TEMPORARY BASIS

PROPOSED NEW INTERMODAL TRACKWORK TO BE CONSTRUCTED TO CONNECT INTO SPC INTERMODAL TRACK DESIGN

EARTHWORKS WIDENING THROUGH RE-ALIGNED SECTION OF TRACKWORK REQUIRED BASED ON 2:1 SLOPE BATTER

EXISTING SIGNAL LOC (ED123) PROPOSED TO BE RELOCATED

SECTION OF EXISTING TRACKWORK TO BE REMOVED/REALIGNED

PROPOSED 3m ARTC MAINTENANCE ACCESS ROAD TO BE CONSTRUCTED

EXISTING ABUTMENT

EX. UP MAIN

EX. THROUGH RD No.1

NEW STAGING ROAD No 1

VARIABLE TRACK CENTRES

NEW SPC INTERMODAL ROAD

RE-ALIGNED THROUGH RD No 2

THROUGH RD No.2

WIDENING TRACK CENTRES

PUNCHBOWL

306T PTS

POINTS

XING PT (T/O)

XING PT (M/L)

TOEP (M/L) 14+086.918

XING (M/L) 14+084.098

TP 14+094.751

TRS 14+124.751

TOE OF SWITCH (M/L) 14+060.620

TOTP (M/L) 14+061.110

TRS 14+243.450

TP 14+273.450

TP 14+303.450

TRS 14+333.450

JOINS DRG - 60049133-EN-RA-0001

JOINS DRG - 60049133-EN-RA-0003

LEGEND:

- PROPOSED TRACK ALIGNMENT
- PROPOSED TRACK REALIGNMENT
- EXISTING TRACK ALIGNMENT
- EXISTING TRACK TO BE REMOVED
- CADASTRAL BOUNDARY
- EXISTING FENCE

KEY PLAN

SHEET 1 SHEET 2 SHEET 3 SHEET 4 SHEET 5 SHEET 6 SHEET 7 SHEET 8 SHEET 9 SHEET 10

FROM SYDNEY

TO FLEMINGTON SOUTH JUNCTION

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B	BK	19.08.09	RE-ISSUED FOR INFORMATION	
A	BK	15.07.09	ISSUED FOR INFORMATION	

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DESIGNED	DT	CHECKED	SON
DRAWN	BK	CHECKED	DT
APPROVED		DATE	

SCALES: 5 0 10 20m — 1:500 FULL SIZE A1

SUB-ALLIANCE PROVIDER: MAUNSELL AECOM

Maunsell Australia Pty Ltd A.B.N. 20 093 846 925

CLIENT: ARTC Australian Rail Track Corporation Ltd

ENFIELD STAGING

ENFIELD STAGING FACILITY 13.6km - 16.9km

TRACK LAYOUT STAGING DESIGN

SHEET 2

DRAWING NUMBER: 60049133-EN-RA-0002 REV: D

STATUS: DETAILED DESIGN

ARTC REFERENCE NO:

Cad ref: K:\60049133_Botany Yrds\5_CADD\5.3 Working\Drg\2_Enfield-Staging\010_RA_Rail\60049133-EN-RA-0003.dwg Last modified: 29 Jan 10 - 16:15

JOINS DRG - 60049133-EN-RA-0002

JOINS DRG - 60049133-EN-RA-0004

FROM BOTANY

TO FLEMINGTON SOUTH JUNCTION

ARTC CONTROLLED

RAILCORP CONTROLLED

SPC CONTROLLED

PORTION OF LAND REQUIRED BY ARTC OF SPC (ARTC/SPC ARRANGEMENT

PROPOSED RELOCATION/REMOVAL OF EXISTING SIGNAL LOC ED 119 (DEPENDANT ON RAILCORP/ARTC AGREEMENT

PROPOSED RAILCORP/ARTC SEPARATION BOUNDARY APPROX. 3.5m OFFSET FROM NEW STAGING ROAD

PROPOSED 3m WIDE ARTC ACCESS MAINTENANCE ROAD TO BE CONSTRUCTED

PROPOSED NEW 300-12 STANDARD TANGENTIAL TURNOUT - RH A360 RAIL ON CONCRETE BEARS V = 45km/h

PROPOSED ACCESS GATE TO SPC INTERMODAL SITE

PORTION OF SPC LAND MAY BE REQUIRED BY ARTC

IMPACT ON EXISTING BRIDGE ABUTMENT. TREATMENT WORKS REQUIRED TO SURE UP BATTER

PROPOSED NEW STAGING RD No 1 TO BE CONSTRUCTED TO TRACK CLASS 1 STANDARD (AS53 RAIL ON TIMBER SLEEPERS)

ALTERED INTERMODAL TRACK DESIGN CONNECTS INTO CURRENT DESIGN ALIGNMENT HERE

PROPOSED RELOCATION OF EXISTING SIGNAL COM CABLE AND LV CABLE

PROPOSED APPROX. ARTC ACCESS TO SITE LOCATION LEVEL CROSSING REQUIRED OVER INTERMODAL TRACK, REQUIRES SAFETY PROTECTION (AGREEMENT BETWEEN SPC/ARTC)

SPC/ARTC CADASTRAL LAND BOUNDARY

EXISTING DOWN MAIN
EXISTING UP MAIN
EX. THROUGH RD No.1
EX. SOUTH RD No.1
EX. SOUTH RD No.2
EX. SOUTH RD No.3
EX. SOUTH RD No.4
EX. SOUTH RD No.5
EX. SOUTH RD No.6
EX. SOUTH RD No.7
EX. SOUTH RD No.8
NEW STAGING RD No.1
EXISTING THROUGH ROAD No.2
RE-ALIGNED THROUGH RD No 2
WIDENING TRACK CENTRES
RE-ALIGNED INTERMODAL ROAD
SPC CADASTRAL BOUNDARY
SPC INTERMODAL ROAD
PITT TOWN BOWL RD
D.P. 1007302
D.P. 1006861
TOE OF SWITCH (N/L) 14+617.738
(R/L) 14+617.248
X45

LEGEND:

- PROPOSED TRACK ALIGNMENT
- PROPOSED TRACK REALIGNMENT
- EXISTING TRACK ALIGNMENT
- EXISTING TRACK TO BE REMOVED
- CADASTRAL BOUNDARY
- EXISTING FENCE

KEY PLAN

SHEET 1 SHEET 2 SHEET 3 SHEET 4 SHEET 5 SHEET 6 SHEET 7 SHEET 8 SHEET 9 SHEET 10
FROM SYDNEY
TO FLEMINGTON SOUTH JUNCTION

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5. NORTH POINT RELATES TO MGA SYSTEM.
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A	BK	15.07.09	ISSUED FOR INFORMATION	

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DESIGNED	DT	CHECKED	SON
DRAWN	BK	CHECKED	DT
APPROVED		DATE	

SCALES: 1 : 500 (5 0 10 20m) FULL SIZE A1

SUB-ALLIANCE PROVIDER: MAUNSELL AECOM
Maunsell Australia Pty Ltd A.B.N. 20 093 846 925

CLIENT: ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

ENFIELD STAGING
ENFIELD STAGING FACILITY 13.6km - 16.9km
TRACK LAYOUT
STAGING DESIGN
SHEET 3

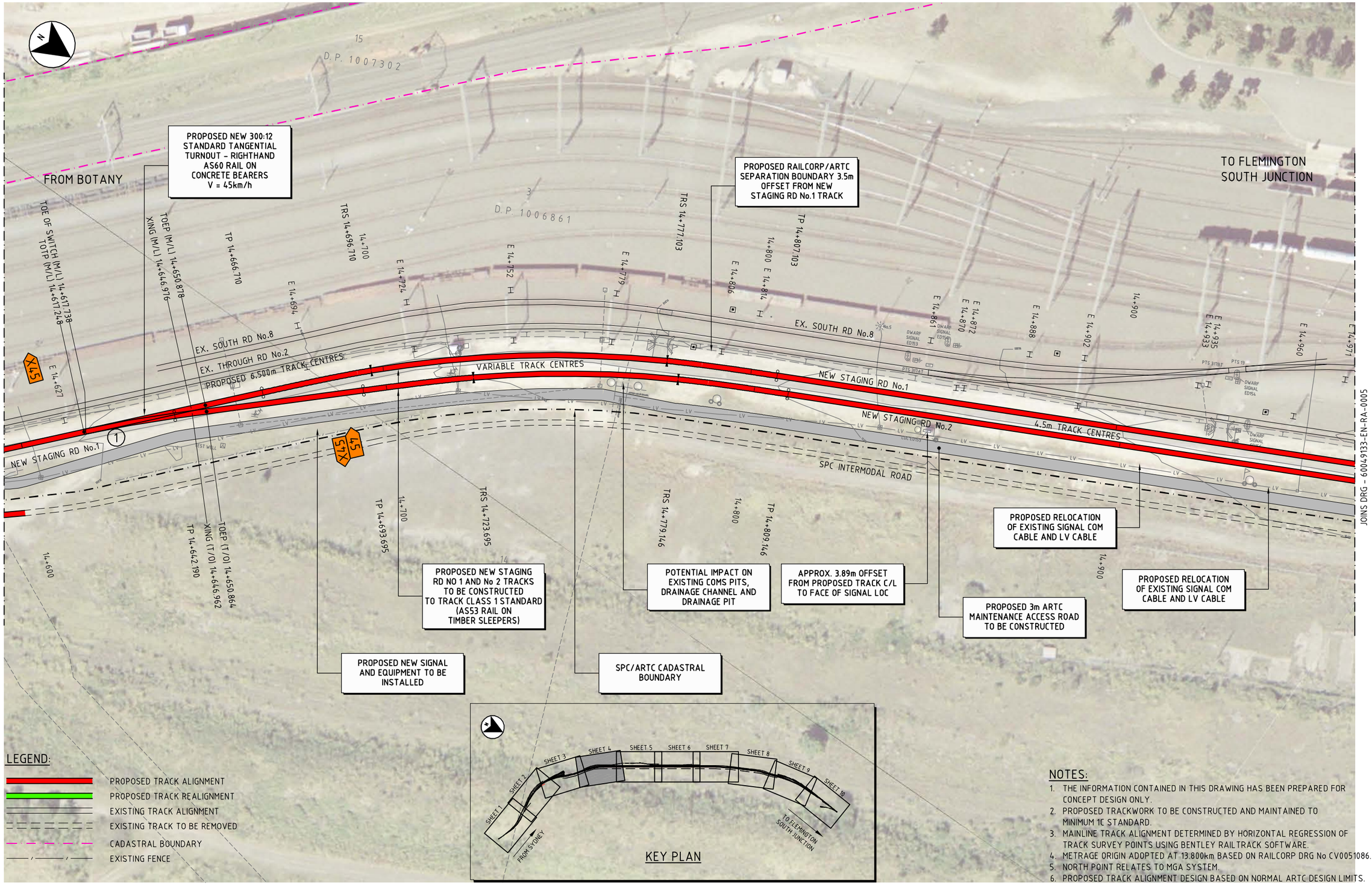
DRAWING NUMBER: 60049133-EN-RA-0003 REV: D
STATUS: DETAILED DESIGN
ARTC REFERENCE NO:

Last modified: 29 Jan 10 - 16:16

Cad ref: K:\60049133_Botany\rd15_CADD\5.3 Working\Dgn\2_Enfield-Staging\010_RA_Rail\60049133-EN-RA-0004.dwg

JOINS DRG - 60049133-EN-RA-0003

JOINS DRG - 60049133-EN-RA-0005



LEGEND:

- PROPOSED TRACK ALIGNMENT
- PROPOSED TRACK REALIGNMENT
- EXISTING TRACK ALIGNMENT
- EXISTING TRACK TO BE REMOVED
- CADASTRAL BOUNDARY
- EXISTING FENCE

KEY PLAN

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DESIGNED	DT	CHECKED	SON
DRAWN	BK	CHECKED	DT
APPROVED		DATE	

SCALES: 5 0 10 20m — 1 : 500 FULL SIZE A1

SUB-ALLIANCE PROVIDER: MAUNSELL AECOM

Maunsell Australia Pty Ltd A.B.N. 20 093 846 925

CLIENT: AUSTRALIAN RAIL TRACK CORPORATION LTD

ENFIELD STAGING

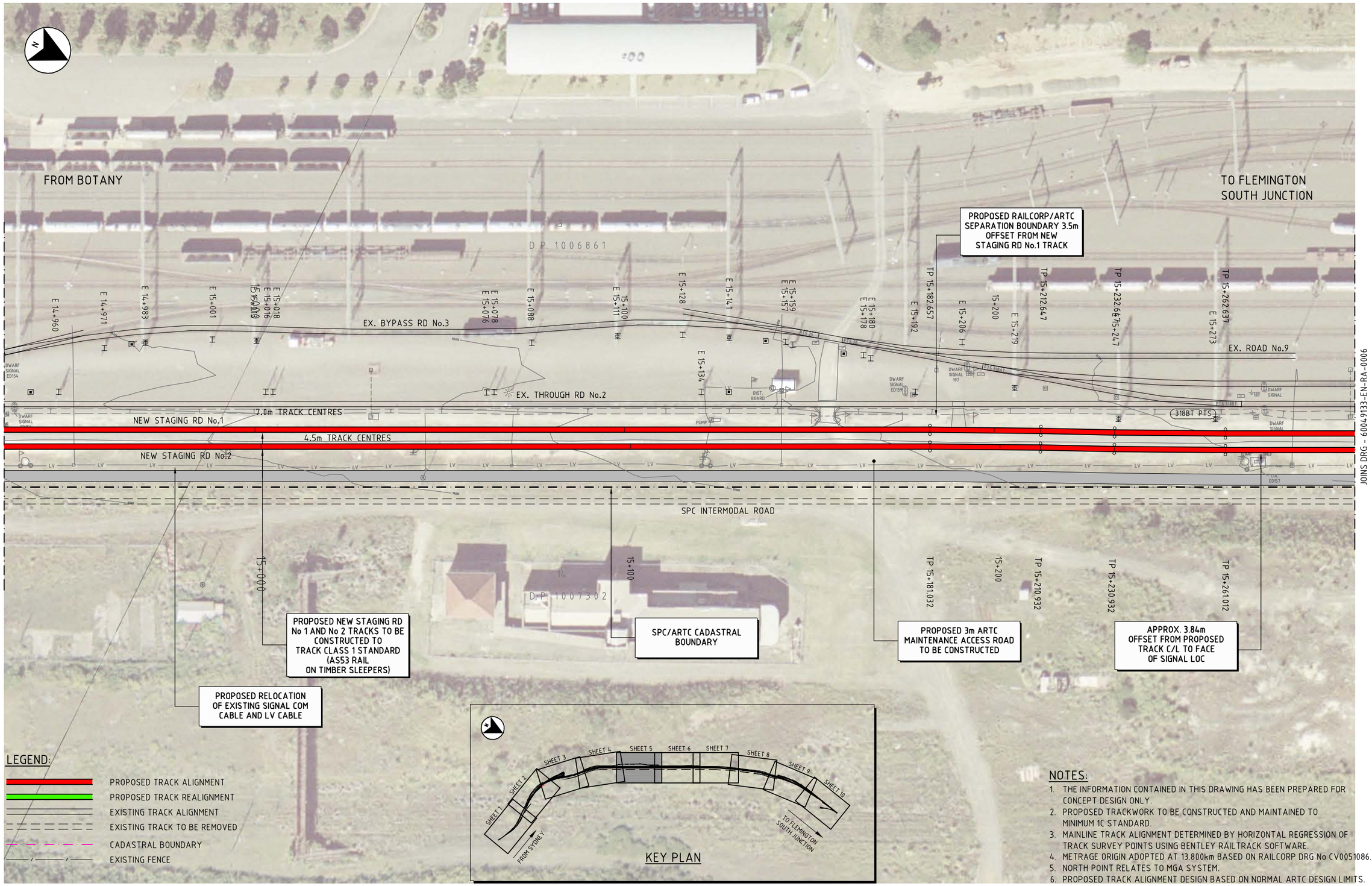
ENFIELD STAGING FACILITY 13.6km - 16.9km

TRACK LAYOUT STAGING DESIGN

SHEET 4

DRAWING NUMBER: 60049133-EN-RA-0004 | REV: D | STATUS: DETAILED DESIGN | ARTC REFERENCE NO:

Cad ref: K:\60049133_Botany\rdt5_CAD\5.3 Working\Drg\2_Enfield-Staging\010_RA_Rail\60049133-EN-RA-0005.dwg Last modified: 29 Jan 10 - 16:17



JOINS DRG - 60049133-EN-RA-0004

JOINS DRG - 60049133-EN-RA-0006

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DESIGNED	DT	CHECKED	SON
DRAWN	BK	CHECKED	DT
APPROVED		DATE	

SCALES: 1:500 — 5 0 10 20m — FULL SIZE A1

SUB-ALLIANCE PROVIDER:
MAUNSELL AECOM
Maunsell Australia Pty Ltd A.B.N. 20 093 846 925

CLIENT:
ARTC
AUSTRALIAN RAIL TRACK CORPORATION LTD

ENFIELD STAGING
ENFIELD STAGING FACILITY 13.6km - 16.9km
TRACK LAYOUT
STAGING DESIGN

SHEET 5

DRAWING NUMBER: 60049133-EN-RA-0005
REV: D
STATUS: DETAILED DESIGN
ARTC REFERENCE NO:

Cad ref: K:\60049133_Botany Yrds\S_CAD\S3 Working\Drg\2_Enfield-Staging\010_RA_Rail\60049133-EN-RA-0006.dwg Last modified: 29 Jan 10 - 16:18

JOINS DRG - 60049133-EN-RA-0005

JOINS DRG - 60049133-EN-RA-0007

FROM BOTANY

TO FLEMINGTON SOUTH JUNCTION

PROPOSED OVERBRIDGE TO BE CONSTRUCTED

POTENTIAL REDUCED CLEARANCE IMPACT WITH PROPOSED BRIDGE PIER

PROPOSED RAILCORP/ARTC SEPARATION BOUNDARY 3.5m OFFSET FROM NEW STAGING RD No.1 TRACK

PROPOSED NEW SIGNAL AND EQUIPMENT TO BE INSTALLED

PROPOSED CROSSOVER CONSISTING (2) RE-USED 1 IN 10.5 RIGHTHAND TURNOUT TO BE RELOCATED FROM EXISTING 301 PTS CROSSOVER LOCATION. INFILL PANEL MODIFICATION REQUIRED V = 25km/h

CLEARANCE IMPACT WITH PIER WILL REQUIRE MINOR REALIGNMENT OF STAGING ROADS

APPROX. 3.84m OFFSET FROM PROPOSED TRACK C/L TO FACE OF SIGNAL LOC

PROPOSED NEW STAGING RD No 1 AND No 2 TRACKS TO BE CONSTRUCTED TO TRACK CLASS 1 STANDARD (AS53 RAIL ON TIMBER SLEEPERS)

PROPOSED CROSSOVER CONSISTING (2) RE-USED 1 IN 10.5 LEFTHAND TURNOUT TO BE RELOCATED FROM EXISTING 341 PTS CROSSOVER LOCATION. INFILL PANEL MODIFICATION REQUIRED V = 25km/h

PROPOSED 3m ARTC MAINTENANCE ACCESS ROAD TO BE CONSTRUCTED

SPC/ARTC CADASTRAL BOUNDARY

SPC INTERMODAL ROAD

EX. ROAD No.9

EX. ROAD No.10

NEW STAGING RD No.1

NEW STAGING RD No.2

7.0m TRACK CENTRES

4.5m TRACK CENTRES

39 PTS

TP 15+262.637
E 15+273
15+300
TP 15+310.220
E 15+325
TP 15+340.210
TP 15+360.210
E 15+375
TP 15+390.200
15+400
E 15+436
TOEP (M/L) 15+491.124
XING (M/L) 15+495.026
E 15+482
15+500
TOE OF SWITCH (M/L) 15+524.754
TOTP (M/L) 15+524.264
S2X
X25
TOE OF SWITCH (M/L) 15+545.244
TOTP (M/L) 15+544.754
E 15+547
XING (M/L) 15+574.482
TOEP (M/L) 15+578.384
15+600
E 15+592

TP 15+261.012
15+300
TP 15+308.595
TP 15+338.675
TP 15+358.675
TP 15+388.575
15+400
TOE OF SWITCH (M/L) 15+444.172
TOTP (M/L) 15+444.662
TOEP (M/L) 15+473.900
XING (M/L) 15+477.802
TOEP (M/L) 15+588.456
XING (M/L) 15+592.358
15+600
TOE OF SWITCH (M/L) 15+621.596

D.P. 1006861

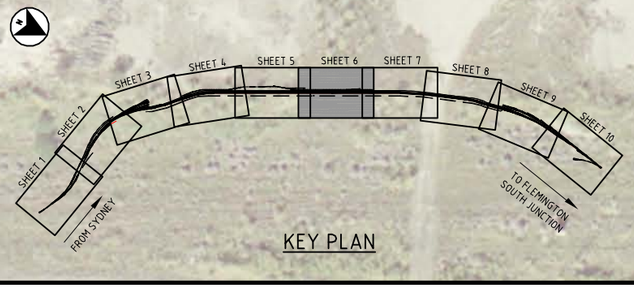
D.P. 1006902

2A 2B 3A 3B

LEGEND:

- PROPOSED TRACK ALIGNMENT
- PROPOSED TRACK REALIGNMENT
- EXISTING TRACK ALIGNMENT
- EXISTING TRACK TO BE REMOVED
- CADASTRAL BOUNDARY
- EXISTING FENCE

KEY PLAN



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6. PROPOSED TRACK ALIGNMENT DESIGN BASED ON NORMAL ARTC DESIGN LIMITS.

NOT FOR CONSTRUCTION

No.	BY	DATE	DESCRIPTION	APPD
D	JS	29.01.10	ISSUED FOR DETAILED DESIGN	
C	BK	25.09.09	RE-ISSUED FOR INFORMATION	
B	BK	19.08.09	RE-ISSUED FOR INFORMATION	
A	BK	15.07.09	ISSUED FOR INFORMATION	

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DRAWN	BK	CHECKED	DT
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SCALES: 5 0 10 20m — 1 : 500 FULL SIZE A1

SUB-ALLIANCE PROVIDER: MAUNSELL AECOM

Maunsell Australia Pty Ltd A.B.N. 20 093 846 925

CLIENT: AUSTRALIAN RAIL TRACK CORPORATION LTD

ENFIELD STAGING

ENFIELD STAGING FACILITY 13.6km - 16.9km

TRACK LAYOUT
STAGING DESIGN

SHEET 6

DRAWING NUMBER: 60049133-EN-RA-0006 | REV: D | STATUS: DETAILED DESIGN | ARTC REFERENCE NO:

FROM BOTANY

TO FLEMINGTON SOUTH JUNCTION

JOINS DRG - 60049133-EN-RA-0006

JOINS DRG - 60049133-EN-RA-0008

PROPOSED RAILCORP/ARTC SEPARATION BOUNDARY 3.5m OFFSET FROM NEW STAGING RD No.1 TRACK

PROPOSED NEW STAGING RD No 1 AND No 2 TRACKS TO BE CONSTRUCTED TO TRACK CLASS 1 STANDARD (AS53 RAIL ON TIMBER SLEEPERS)

EXISTING TOILET AND SEWER PIT PROPOSED TO BE RELOCATED/REMOVED

EX. ROAD No.10

EX. THROUGH RD No.2

7.0m TRACK CENTRES

4.5m TRACK CENTRES

NEW STAGING RD No.1

NEW STAGING RD No.2

SPC INTERMODAL ROAD

PROPOSED NEW SIGNAL AND EQUIPMENT TO BE INSTALLED

SPC/ARTC CADASTRAL BOUNDARY

PROPOSED RELOCATION OF EXISTING SIGNAL COM CABLE AND LV CABLE

PROPOSED 3m ARTC MAINTENANCE ACCESS ROAD TO BE CONSTRUCTED

APPROX 4.28m OFFSET FROM TRACK C/L TO SIGNAL LOC (CENTRE)

TOEP (M/L) 15+588.456

XING (M/L) 15+592.358

TOTP (M/L) 15+622.086

TOE OF SWITCH (M/L) 15+621.596

TP 15+766.881

TP 15+765.256

TP 15+889.377

TP 15+887.205

D.P. 1006861

LEGEND:

- PROPOSED TRACK ALIGNMENT
- PROPOSED TRACK REALIGNMENT
- EXISTING TRACK ALIGNMENT
- EXISTING TRACK TO BE REMOVED
- CADASTRAL BOUNDARY
- EXISTING FENCE

KEY PLAN

SHEET 1 SHEET 2 SHEET 3 SHEET 4 SHEET 5 SHEET 6 SHEET 7 SHEET 8 SHEET 9 SHEET 10

FROM SYDNEY

TO FLEMINGTON SOUTH JUNCTION

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3. MAINLINE TRACK ALIGNMENT DETERMINED BY HORIZONTAL REGRESSION OF TRACK SURVEY POINTS USING BENTLEY RAILTRACK SOFTWARE.
4. METRAGE ORIGIN ADOPTED AT 13.800km BASED ON RAILCORP DRG No CV0051086.
5. NORTH POINT RELATES TO MGA SYSTEM.
6. PROPOSED TRACK ALIGNMENT DESIGN BASED ON NORMAL ARTC DESIGN LIMITS.

NOT FOR CONSTRUCTION

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SCALES: 5 0 10 20m — 1 : 500 FULL SIZE A1

SUB-ALLIANCE PROVIDER: MAUNSELL AECOM

Maunsell Australia Pty Ltd A.B.N. 20 093 846 925

CLIENT: ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

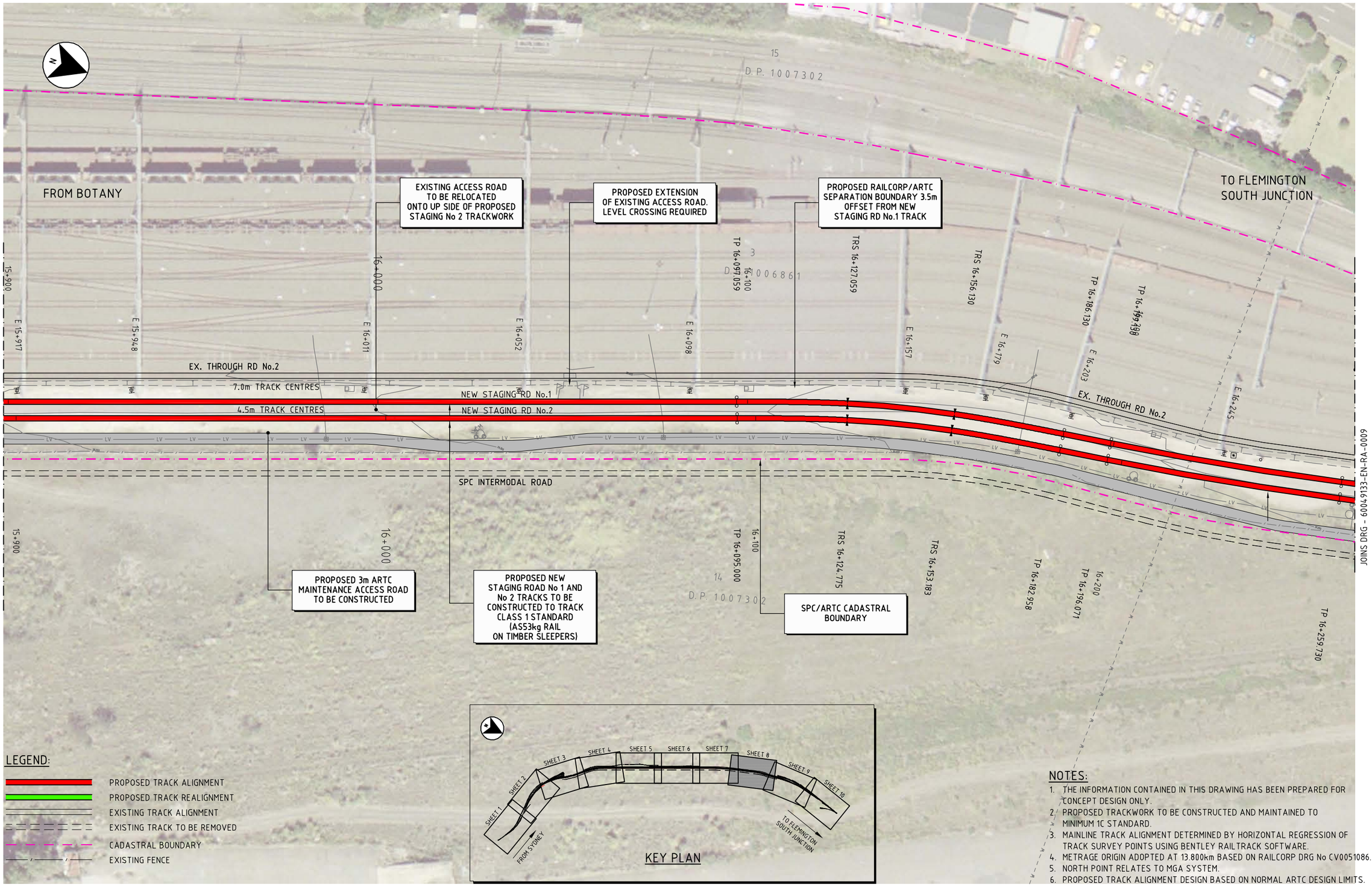
ENFIELD STAGING

ENFIELD STAGING FACILITY 13.6km - 16.9km

TRACK LAYOUT STAGING DESIGN

SHEET 7

DRAWING NUMBER:	REV:	STATUS:	ARTC REFERENCE NO:
60049133-EN-RA-0007	D	DETAILED DESIGN	



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DRAWN	BK	CHECKED	DT
APPROVED		DATE	

SCALES: 1 : 500 (5 0 10 20m) FULL SIZE A1

SUB-ALLIANCE PROVIDER: MAUNSELL AECOM
Maunsell Australia Pty Ltd A.B.N. 20 093 846 925

CLIENT: ARTC Australian Rail Track Corporation Ltd

ENFIELD STAGING
ENFIELD STAGING FACILITY 13.6km - 16.9km
TRACK LAYOUT STAGING DESIGN
SHEET 8

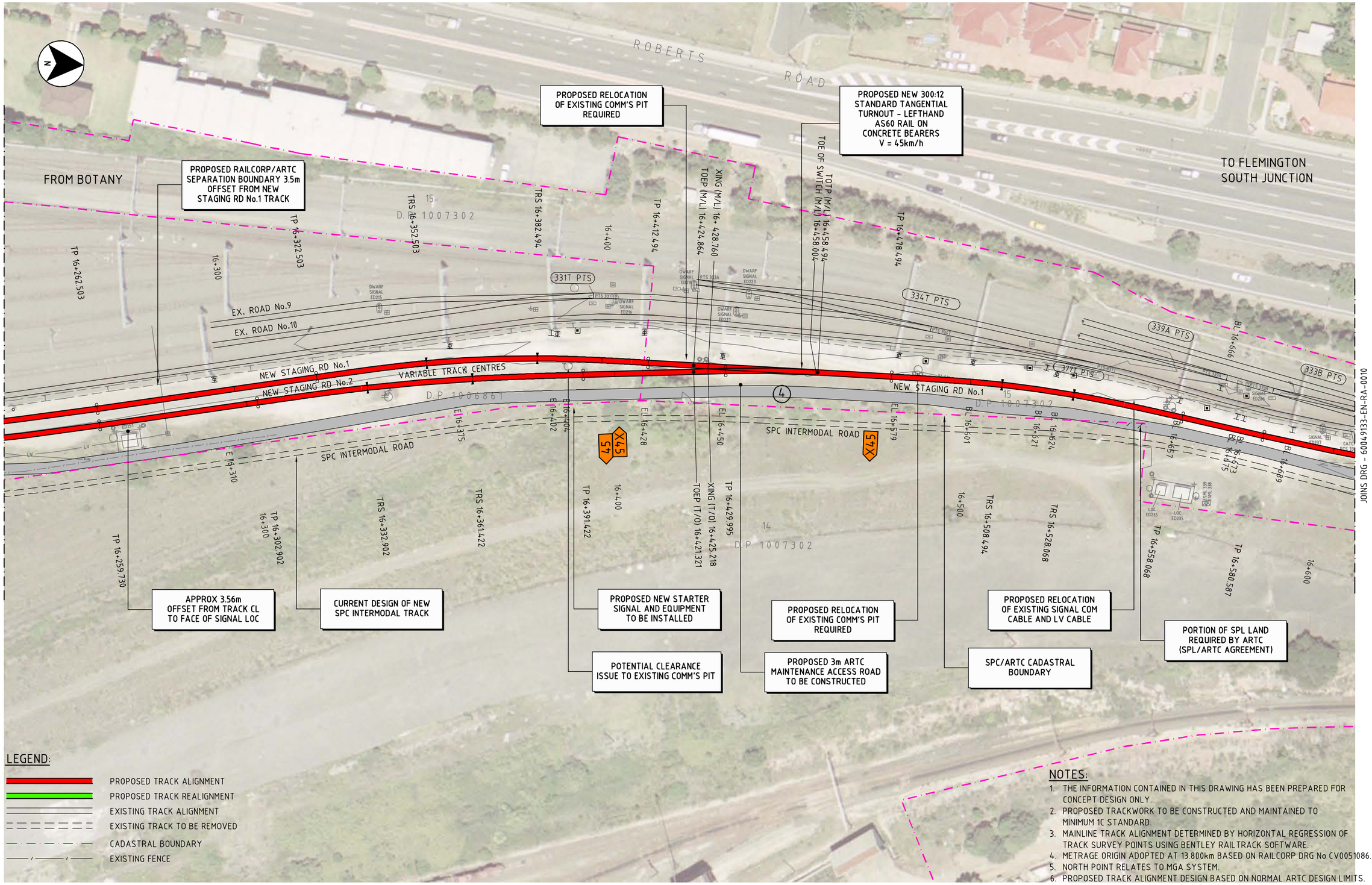
DRAWING NUMBER: 60049133-EN-RA-0008 | REV: D | STATUS: DETAILED DESIGN | ARTC REFERENCE NO:

Last modified: 29 Jan 10 - 16:21

Cad ref: K:\60049133_Botany Yrds\5_CADD\5.3 Working\Drg\2_Enfield-Staging\010_RA_Rail\60049133-EN-RA-0009.dwg

JOINS DRG - 60049133-EN-RA-0008

JOINS DRG - 60049133-EN-RA-0010



LEGEND:

- PROPOSED TRACK ALIGNMENT
- PROPOSED TRACK REALIGNMENT
- EXISTING TRACK ALIGNMENT
- EXISTING TRACK TO BE REMOVED
- CADASTRAL BOUNDARY
- EXISTING FENCE

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SCALES: 1 : 500 (5 0 10 20m) FULL SIZE A1

SUB-ALLIANCE PROVIDER:

MAUNSELL AECOM

Maunsell Australia Pty Ltd A.B.N. 20 093 846 925

CLIENT:

ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

ENFIELD STAGING

ENFIELD STAGING FACILITY 13.6km - 16.9km

TRACK LAYOUT STAGING DESIGN

SHEET 9

DRAWING NUMBER:	REV:	STATUS:	ARTC REFERENCE NO:
60049133-EN-RA-0009	D	DETAILED DESIGN	

JOINS DRG - 60049133-EN-RA-0009

FROM BOTANY

TO FLEMINGTON SOUTH JUNCTION

HUME HIGHWAY

PROPOSED RAILCORP/ARTC SEPARATION BOUNDARY 3.5m OFFSET FROM NEW STAGING RD No.1 TRACK

PROPOSED RELOCATION / REMOVAL OF 340A CATCHPOINT DEPANDANT ON SIGNAL FUNCTIONAL SPEC

PROPOSED NEW 340B PTS STANDARD 300:9 TANGENTIAL TURNOUT - LEFTHAND AS60 RAIL ON CONCRETE BEARERS V = 45km/h EXISTING 1 IN 10.5 TURNOUT TO BE REMOVED.

PROPOSED NEW 341 PTS CROSSOVER CONSISTING OF (2) TANGENTIAL 250:10.5 TURNOUTS - LEFTHAND AS60 ON CONCRETE BEARERS V = 40km/h EXISTING CROSSOVER TO BE REMOVED/RELOCATED TO NEW 2 PTS LOCATION AT APPROX. 15.500km

END OF EXISTING ACCESS ROAD

CURRENT DESIGN POSITION OF SPC INTERMODAL TRACK

SPC/ARTC CADASTRAL BOUNDARY

PROPOSED 3m ARTC MAINTENANCE ACCESS ROAD TO BE CONSTRUCTED

333B PTS
339B PTS
338B PTS
341A PTS
341B PTS
340B PTS
340A PTS
343 PTS
EX. 4.000m TRACK CENTRES
EX. DOWN MAIN
EX. UP MAIN
NEW STAGING RD No.1
SPC INTERMODAL ROAD
D.P. 1007302

BL 16+666
BL 16+747
BL 16+809
BL 16+851
BL 16+909
BL 16+673
BL 16+675
BL 16+689
TP 16+580.587
16+600
TP 16+654.484
TOEP (T/O) 16+678.856
XING (T/O) 16+688.287
16+700
TOTP 16+717.606 (STAGING RD 1)
L 16+857
L 16+889
L 16+891
L 16+912
L 16+935

X47
X46
X45
X44

LEGEND:

- PROPOSED TRACK ALIGNMENT
- PROPOSED TRACK REALIGNMENT
- EXISTING TRACK ALIGNMENT
- EXISTING TRACK TO BE REMOVED
- CADASTRAL BOUNDARY
- EXISTING FENCE

KEY PLAN

SHEET 1 SHEET 2 SHEET 3 SHEET 4 SHEET 5 SHEET 6 SHEET 7 SHEET 8 SHEET 9 SHEET 10
FROM SYDNEY
TO FLEMINGTON SOUTH JUNCTION

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DRAWN	BK	CHECKED	DT
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SCALES: 5 0 10 20m — 1 : 500 FULL SIZE A1

SUB-ALLIANCE PROVIDER: MAUNSELL AECOM — Maunsell Australia Pty Ltd A.B.N. 20 093 846 925

CLIENT: ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

ENFIELD STAGING

ENFIELD STAGING FACILITY 13.6km - 16.9km

TRACK LAYOUT STAGING DESIGN

SHEET 10

DRAWING NUMBER: 60049133-EN-RA-0010 | REV: D | STATUS: DETAILED DESIGN | ARTC REFERENCE NO:

G3 Port Botany Rail Line Upgrade Stage 2 Benefit Cost Analysis

AECOM Benefit-Cost Analysis of Stage 2 Works – Final report 23 March 2010.

Port Botany Rail Line Upgrade

Australian Rail Track Corporation Ltd

23 March 2010

Benefit-Cost Analysis of Stage 2 Works

Final Report

Benefit-Cost Analysis of Stage 2 Works

Final Report

Prepared for

Australian Rail Track Corporation Ltd

Prepared by

AECOM Australia Pty Ltd
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ABN 20 093 846 925

23 March 2010

60049399

Quality Information

Document Benefit-Cost Analysis of Stage 2 Works

Ref 60049399

Date 23 March 2010

Prepared by Lindsay Shepherd

Reviewed by

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
0	17-Jun-2009	Final Report for Stages 1, 2 & 3	Steve Kanowski Technical Director	Original signed
A	15-Mar-2010	Unverified Draft for Client Review		
B	23-Mar-2010	Incorporates comments from Client Review		

Table of Contents

1.0 Introduction

1.1 Project Background

The current configuration of Port Botany and the level of service provided by the Port Botany Rail Line impose a number of constraints on the increased use of rail to transport freight to and from the port.

ARTC has planned a series of works designed to relieve capacity constraints and improve efficiency of rail operations servicing Port Botany ("the Upgrade"). Due to funding constraints, it is anticipated that the Upgrade will be delivered in three stages. The Upgrade works and their proposed staging are:

- Reconfiguration of Botany Yard (Stage 1);
- Establishment of train staging capacity at Enfield (Stage 2);
- Separation of train control and signalling interfaces to provide for centralised control from ARTC's train control facility in Junee (Stage 2);
- Provision of signalling in Port Botany Yard to control train movements in and out of the stevedore terminals (Stage 2);
- Signalling at Cooks River Yard to streamline entry and exit from the yard (Stage 2); and
- Concrete sleepering and upgrading of the remaining timber-sleepered sections of the rail line to bring it to a consistent high standard (Stage 3).

1.2 Study Approach

Stages 1 & 2 of the Upgrade have been appraised earlier by ARTC and reported in the Project Proposal Report dated March 2008. The appraisal followed the standard economic benefit-cost analysis methodology used by ARTC and outlined in *ARTC North-South Strategy – Economic Analysis*, Draft, October 2005. The ARTC approach is consistent with that outlined in Australian Transport Council's *National Guidelines for Transport System Management in Australia*, 2006, Volume 3.

A previous AECOM study (dated 16 June 2009) reviewed the earlier ARTC appraisal and recommended a number of changes to the ARTC benefit-cost analysis of Stages 1 & 2. The recommended changes were agreed to by the ARTC Project Director and were incorporated in the AECOM report. The report also incorporated the benefit-cost analysis of Stage 3 of the Upgrade.

Stage 3 was undertaken as a separate benefit-cost analysis to that for Stages 1 & 2. Stages 1 & 2 were appraised together because it was difficult to separately estimate their benefits – the scope of the works in these stages jointly contributes to reducing constraints on the increased use of rail for freight transport to and from the port, with the majority of benefits accruing to freight customers. Stage 3, on the other hand, is to achieve efficiencies in operating and maintenance practices with the benefits accruing to train operators and ARTC.

The present study updates the capital cost estimates and capital expenditure profile of Stage 2. Although funding for Stage 1 has been approved and funds released, it is still necessary to appraise Stage 2 with Stage 1, because of the joint nature of their benefits. Although Stage 2 costs and timing have been updated from the previous report, Stage 1 costs and timing remain unchanged.

1.3 Report Structure

The remainder of the report comprises:

- Section 2.0 describing the benefit-cost analysis framework and the rail freight movement forecasts used in the analysis; and
- Section 3.0 sets out the updated economic appraisal of Stage 2 of the Upgrade, including description of the costs and benefits and the results of the main benefit-cost analysis and the sensitivity analysis.

2.0 Benefit-Cost Analysis Framework

2.1 Introduction

In the benefit-cost analysis methodology referred to in Section 1.2, an investment proposal is evaluated on an incremental basis from a base case, where the Base Case is defined as the situation without the investment proposal being implemented. Table 2.1 outlines the Base Case and the Upgrade Case for this benefit-cost analysis.

Table 2.1 shows that the rail infrastructure requirements are driven by movements of containers and trains. Container movements through Port Botany consist of import and export containers, both loaded and empty. These movements depend on a range of international and domestic macro-economic and trade factors. Growth in these movements is forecast by organisations such as Bureau of Infrastructure, Transport and Regional Economics and Sydney Ports Corporation. The current appraisal assumes that container movements through Port Botany will not be affected by the Port Botany Rail Line Upgrade, i.e. growth in container movements will be independent of the project (in transport modelling terms, there will be no induced demand).

Containers transported by rail and the resulting number of train movements depend on modal share factors, including the capacity of intermodal terminals serving Port Botany container traffic. Given the limitations of the information and data that are available on freight movements, forecasts of train movements are best prepared using a scenario approach.

For the current appraisal, the Base Case is defined as no additional rail investment - available capacity for increased rail freight is assumed to be 10% of current volumes based on information from ARTC. Three rail volume scenarios were considered for the Upgrade Case:

- Metropolitan rail freight grows at the same rate as overall Port Botany container growth (this implies rail maintains its market share);
- Metropolitan rail freight grows at 2% per year above overall Port Botany container growth (this would require an annual rail freight growth of around 7% per year which is consistent with achieving the NSW Government target of rail moving 40% of Port Botany containers); and
- Metropolitan rail freight growth is based on take-up capacity within new intermodal terminals (this implicitly assumes that there is latent demand which is currently constrained by a lack of intermodal terminal capacity).

It is considered that without any other substantial rail investments beyond Enfield, the Project is unlikely to lead to additional growth in regional rail volumes above the Base Case.[1] As such, regional rail freight volumes are the same for all scenarios.

Each rail volume scenario is discussed in the following sections.

[1] Port Botany rail freight comprises movements of import/export containers (loaded and empty) to/from metropolitan terminals and regional terminals. Container movements are conventionally measured in terms of twenty-foot equivalent units (TEUs). A TEU is an internationally recognised measure of shipping container volumes, where a 20ft container is equal to one TEU and a 40ft container is equal to two TEUs. ARTC estimates for 2007/08 are 200,000 metropolitan TEUs and 110,000 regional TEUs, with an overall rail mode share of 17% (total container movements through Port Botany were 1.8 million TEUs).

2.2 Base Case

The Base Case assumes that available capacity for increased rail freight is 10% of current volumes and that growth in freight volumes is at the same rate as overall Port Botany container growth until this capacity constraint is reached.

Table 2.1: Comparison of Base Case with Upgrade Case

Base Case Assumption	Description / Impact	
	Base Case	**Upgrade Case**
Infrastructure No change to configuration of Botany Yard, Cooks River Yard and Enfield Yard	**Botany Yard** • A mixture of siding lengths, ranging from 400 to 1500 metres • A lack of sufficient separating between arriving and departing trains • A significant 'pinch point' between the eastern and western halves of the yard • Restricted capacity between the yard and the stevedores (in particular, into DP World and P&O Trans Australia, which are only served by one track connection from Botany Yard) • The layout of the yard requires trains to propel (reverse) at low speed over distances of up to 2km into the stevedores • Trains need to be held within Botany Yard to await stevedore windows (inbound) or paths over the RailCorp network (outbound), due to impact of freight curfews over the RailCorp network and lack of staging capacity at other locations	**Botany Yard** • Construction of new track connections through the central part of the yard, in order to: • Create two arrival and two departure roads each with a length of approximately 1700m, and each with a holding capacity for two trains (on each track) • Remove the current pinch point. • Substantially reduce the distance for propelling movements • Construction of a third track between the yard and the stevedores with provision of separate arrival and departure roads into each stevedore (including the proposed new terminal) **Enfield** • Create staging capacity to relieve Botany Yard of trains awaiting stevedore windows (inbound) or paths over the RailCorp network (outbound)
Network Control No change to current network control and signalling arrangements for Metro Freight Network (MFN)	**MFN Network Control** • Train control and local signal control not integrated • Train control from RailCorp Rail Management Centre Central • Signal control from Enfield Signal Box, Sydenham Signal Box, Botany • Botany Yard movements controlled by ground staff at Botany • Excessive staffing, duplication of effort, multiple interfaces	**MFN Network Control** • Centralise and integrate train and signal network for MFN with future Southern Sydney Freight Line (SSFL) • Train control (direction of train movements) and signal control integrated under ARTC network controller • Remote control from ARTC's Junee Control Centre

Base Case Assumption	Description / Impact	
	Base Case	**Upgrade Case**
Rail Volumes	**Import / Export Rail Volumes** • Rail volumes through Port Botany are currently growing slowly and exhibiting indications of capacity constraint • Base Case assumes limited growth in import / export rail volumes for the first three years of the assessment period (until 2010/11) • Rail volume is assumed to be capacity constrained at 10% above 2007/08 volumes because of the rail infrastructure constraints described previously **Domestic Rail Volumes** • Assumed to be the same for Base Case and all Investment Case scenarios	**Import / Export Rail Volumes** • Unconstrained by Botany Yard capacity issues – resolved by infrastructure works described previously • Import / export rail volumes grow as per various Investment Case scenarios • Growth due to additional intermodal infrastructure (e.g. Moorebank) not included as assumed to require a further tranche of facilitating rail investment **Domestic Rail Volumes** • Assumed to be the same for Base Case and all Investment Case scenarios

Source: ARTC Project Proposal Report, March 2008, Table D19.1, modified by AECOM

2.3 Upgrade Case Rail Volume Scenarios

2.3.1 Constant percentage of total port throughput

The assumptions for this scenario are as follows:

- Metropolitan rail freight volume as a percentage of total Port Botany throughput remains constant at 11% (i.e. metropolitan containers grow at the same rate of increase as total Port Botany container movements);
- The proportional split of inner, middle and outer metropolitan freight remains constant;[2] and
- No change in regional freight volumes compared to the Base Case.

2.3.2 Increased percentage of total port throughput

The assumptions for this scenario are as follows:

- Metropolitan rail freight grows at 2% per year above the total Port Botany freight growth;
- The proportional split of inner, middle and outer metropolitan freight remains constant;[1] and
- No change in regional freight volumes compared to the Base Case.

2.3.3 Terminal-driven forecast of metropolitan rail containers

The assumptions for this scenario are as follows:

- The rail share of Port Botany freight increases as various intermodal terminals are expanded or developed, with linear growth assumed between forecast years. The proposed Moorebank and Eastern Creek intermodal terminals have not been included; and

[2] Inner and middle metropolitan freight refers to the existing terminals at Camellia, Yennora and Leightonfield plus a new terminal at Enfield (assumed to commence in 2011/12 with throughput of 200,000 TEUs reached in 2016 and 300,000 TEUs by 2021). Outer metropolitan freight refers to the existing terminal at Minto plus a new terminal at Ingleburn (assumed to commence in 2011/12).

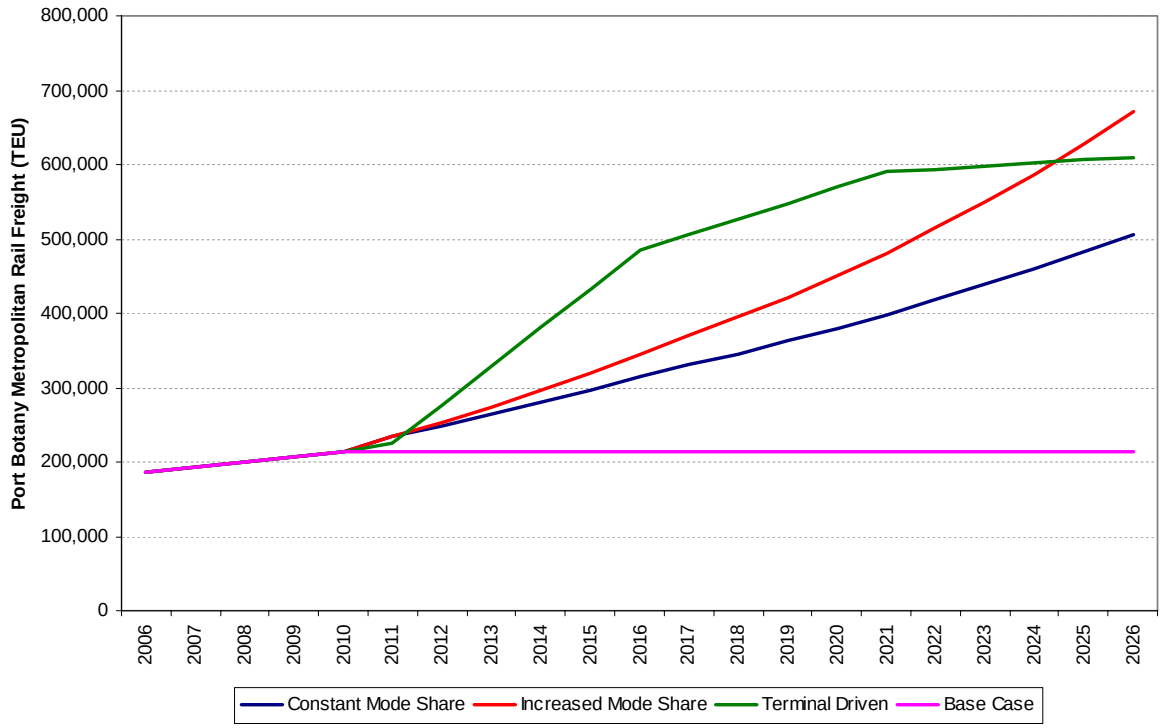
- No change in regional freight volumes compared to the Base Case.

2.4 Rail Freight Movements

Figure 2.1 shows the forecasts of rail freight movements (TEUs) for each rail volume scenario.

Metropolitan rail freight is currently about 11% of total port throughput (TEUs). With metropolitan rail freight growing at 2% per year above total Port Botany TEU growth, this percentage increases to 13% in 2016 and 16% in 2026. The terminal-driven forecasts (excluding Moorebank and Eastern Creek terminals) have metropolitan rail freight as 18% in 2016 and then falling to 14% in 2026, as all capacity is taken up when Enfield is fully developed in 2021.

Figure 2.1: Port Botany Metropolitan Rail Freight (TEUs)



Source: AECOM and ARTC Project Proposal Report, March 2008, attached Excel file

Table 2.2 sets out the forecasts of total container movements through Port Botany and existing and diverted rail metropolitan container movements in each rail volume scenario.

Table 2.2: Forecast Port Botany total container movements and metropolitan rail container movements (TEUs)

Year ending June	Total container movements	Metropolitan rail container movements [a/]			
		Existing	Movements diverted from road		
			Constant mode share	Increased mode share	Terminal driven
2008	1,778,000	200,000			
2011	1,968,000	213,000	22,000	22,000	12,000
2016	2,635,000	213,000	102,000	133,000	272,000
2026	4,234,000	213,000	293,000	458,000	397,000

Source: 2008 – Sydney Ports Corporation; forecast years - AECOM

Note: a/ There are also regional rail container movements in each forecast year and scenario of 118,000 TEU (2008 actual of 110,000 TEU).

3.0 Stage 2 Appraisal

3.1 Introduction

Stage 2 of the Upgrade (jointly with Stage 1) has been evaluated over a 17-year period from 2008/09 to 2025/26. The last year of the evaluation period was determined by the unavailability of container demand forecasts beyond this year. Residual values have been included for infrastructure with a useful economic life extending beyond 2025/26. Economic lives of 50 years were applied to capital works in Botany Yard and Enfield staging yard and 30 years to network control improvements, following discussions with ARTC staff.

A real discount rate of 7%, with alternative rates of 4% and 10%, has been used to calculate present values of annual cost and benefit streams. All costs and benefits are expressed in 2010 prices.

3.2 Upgrade Costs

Base cost estimates of $27 million for Stage 1 and $82 million for Stage 2 were utilised in the benefit-cost analysis. P50 and P90 cost estimates for Stage 2 added $14 million and $21 million in contingency.

Table 3.1 shows the cost of various project components and the costs attributed to each stage.

Table 3.1: Project Component Base Cost Estimates ($ million) – Stages 1 & 2

Project Component	Stage 1	Stage 2
Botany Yard	27	0
Enfield staging yard	0	34[a/]
Network control	0	48
Total	27	82[b/]

Source: ARTC

Note: a/ Includes complementary signal control at Port Botany.

b/ Excludes contingency allowances of $14 million (P50 cost estimate) and $21 million (P90 cost estimate).

Table 3.2 shows the indicative timing of project costs.

Table 3.2: Expenditure Timing – % of Expenditure

Year	Stage 1	Stage 2
2008/09	5%	-
2009/10	84%	5%
2010/11	11%	56%
2011/12	-	32%
2012/13	-	7%

Source: ARTC

3.3 Upgrade Benefits

Benefits quantified in the benefit-cost analysis of Stages 1 & 2 are summarised in Table 3.3. Each of these benefits is described in the following sub-sections.

Table 3.3: Undiscounted benefits by Upgrade rail volume scenario ($'000 in 2010 prices) – 2011, 2016 and 2026

	Constant mode share			Increased mode share			Terminal-driven		
Benefit	**2011**	**2016**	**2026**	**2011**	**2016**	**2026**	**2011**	**2016**	**2026**
Train delay reductions	327	1,031	1,031	327	1,031	1,031	327	1,031	1,031
Network control cost savings	-	2,015	2,015	-	2,015	2,015	-	2,015	2,015
Reduced maintenance costs	-	-	25,244	-	-	25,244	-	-	25,244
Externality benefits	80	1,028	2,956	80	1,339	4,621	109	2,782	3,983
Rail customer benefits									
Increased operating surplus	269	3,438	9,887	269	4,479	15,457	147	9,183	13,402
Improved service									
…existing customers	2,880	8,001	8,001	2,880	8,001	8,001	2,880	8,001	8,001
…new customers	97	1,235	3,551	97	1,609	5,552	53	3,299	4,814
Wider economic benefits	3	111	320	3	145	500	2	297	433
Total	3,656	16,859	53,005	3,656	18,619	62,421	3,518	26,608	58,923

Source: AECOM

3.3.1 Reductions in train delays

This benefit captures the reduced delay to trains as a result of reduced train congestion in Botany Yard and operational efficiencies from establishment of train staging capacity at Enfield. The relevant measure of benefits for container traffic through Port Botany is the reduction in train hours, as train hours are the main driver of operating costs and improvements in service reliability.[3]

[3] This is a different situation to coal movements through the Port of Newcastle, where shipping demurrage costs are determined by tonne hours of delay.

Table 3.4: Calculation of train delay reductions

	Constant mode share	Increased mode share	Terminal-driven
Value in 2016 [a/]	$1,031,000	$1,031,000	$1,031,000
Parameters	(i) $300 per hour of train delay (ii) Average train dwell time reduced to 5 hours (currently 5.6 hours) compared to 6.2 hours in the Base Case		
Source	ARTC Project Proposal Report Port Botany Rail Upgrade Stage 1 (March 2008) accompanying spreadsheet		
Formula	(Average train dwell time per train in Base Case - Average train dwell time per train in Upgrade Case) x No. of trains in Base Case x Delay cost per hour		

Source: AECOM

Note: a/ From Table 3.3

3.3.2 Network control cost savings

This benefit captures cost savings due to the replacement of the current labour-intensive practices with centralised control of the Botany Line and MFN from ARTC's Junee Control Centre. More effective train and signal control will contribute to improved rail operational efficiency.

Table 3.5: Calculation of network control cost savings

	Constant mode share	Increased mode share	Terminal-driven
Value in 2016 [a/]	$2,015,000	$2,015,000	$2,015,000
Parameters	(i) Annual labour cost (including overheads) of $130,000 per staff member (ii) No. of staff required reduced from 18 in Base Case (6 at Enfield Signal Box, 6 at Sydenham Signal Box, 6 at Botany Yard) to 5.5 in Upgrade Case		
Source	ARTC Project Proposal Report Port Botany Rail Upgrade Stage 1 (March 2008) accompanying spreadsheet		
Formula	(No. of staff required in Base Case – No. of staff required in Upgrade Case) x Annual labour cost		

Source: AECOM

Note: a/ From Table 3.3

3.3.3 Reduced maintenance costs

This benefit captures major periodic maintenance (MPM) costs in Botany Yard which would be avoided in the Upgrade Case but which would be undertaken in the Base Case (Stage 1), together with the costs of signalling replacement which would be required in about 15 years in the Base Case (Stage 2).[4]

The former is based on 50% of project cost being for replacement infrastructure and a saving of one-third when trackworks are undertaken as one job rather than spread out over a number of years as they would be in the Base Case. The latter is calculated by dividing the network control project cost by three in each of the last three years of the appraisal period.

[4] Existing signalling was installed in the early 1990s and is about half-way through its expected 30-year life.

Table 3.6: Calculation of reduced maintenance costs

	Constant mode share	Increased mode share	Terminal-driven
Value in 2026 [a/]	$25,244,000	$25,244,000	$25,244,000
Parameters	Resignalling would be required in the Base Case in about 15 years and works would be over three years		
Source	Discussions with ARTC staff		
Formula	Network control project cost / 3 in each of last three years of appraisal period		

Source: AECOM

Note: a/ From Table 3.3

3.3.4 Externality benefits

Externality benefits capture the benefits arising from the transfer of freight movement from road to rail and the associated reductions in road accidents, noise, air pollution, road maintenance, congestion and other environmental costs. These benefits are conventionally measured in terms of net tonne-kilometres which require assumptions on average trip length and average tonnes per container.

Table 3.7: Calculation of externality benefits

	Constant mode share	Increased mode share	Terminal-driven
Value in 2016 [a/]	$1,028,000	$1,339,000	$2,782,000
Parameters	(i) Incremental to rail in terms of cents per net tonne-kilometre: 1.26 for road maintenance, 0.23 for accidents, 0.11 for congestion, 0.29 for noise, 0.73 for air pollution, 0.06 for greenhouse gas emissions, 0.33 for nature and landscape, and 0.17 for urban separation. (ii) Average trip distances of 20 km for inner/middle distance terminals and 45 km for outer metropolitan terminals. (iii) Average tonnes per container of 12.1, which reflects the mix of import/export, full/empty carried by rail.		
Source	(i) Australian Transport Council, National Guidelines for Transport System Management in Australia, 2006, Volume 3 Appendix C (ii) Information from ARTC (iii) ARTC Submission to IPART Review (June 2007) and Sydney Ports Corporation, Trade Report 2007/08.		
Formula	[(TEUs x Trip distance in Upgrade Case for inner/middle distance terminals - TEUs x Trip distance in Base Case for inner/middle distance terminals) + (TEUs x Trip distance in Upgrade Case for outer metropolitan terminals - TEUs x Trip distance in Base Case for outer metropolitan terminals)] x Tonnes per TEU x Incremental externality cost (cents) per net tonne-kilometre		

Source: AECOM

Note: a/ From Table 3.3. Comprises road maintenance (40%), air pollution (23%), nature and landscape (10%), noise (9%), accidents (7%), urban separation (5%), congestion (4%) and greenhouse gas emissions (2%).

3.3.5 Rail freight customer benefits

The cost to a customer of using rail freight comprises price and service characteristics.[5] The latter are often referred to as non-price characteristics, the main ones being reliability and availability.[6] Both price and non-price characteristics will improve with rail investment programs and generate benefits to freight customers.

[5] This is similar to the generalised cost functions for passenger travel which include in-vehicle time, waiting time, access/egress time, amenity, etc.
[6] Reliability refers to the percentage frequency at which goods are available at their advertised availability time at the destination terminal – a major determinant of reliability is the capacity and flexibility provided by the track infrastructure. Availability refers to the ability for freight to be dispatched and received at times that meet supply chain needs – a major determinant of availability is

3.3.5.1 Price benefits

As rail networks improve (eg. the Southern Sydney Freight Line) and higher volumes improve rail economies of scale, rail costs and prices are likely to fall into the future (provided that train utilisation and daily cycles are improved). On the other hand, as road freight congestion and labour shortages for road transport operators increase, and fuel prices continue to increase, road freight rates are likely to increase.

It is likely that in the future rail freight rates will be lower than road freight rates. Customers who divert freight to rail will therefore receive a benefit, as they will gain an increase in gross operating surplus.

Analysis undertaken for the NSW Sea Freight Council shows that:[7]

- A nominal cost for a round trip by road between Port Botany and a customer's warehouse in Sydney (including return of the empty container to a container park at the port) is around $460-510 per container; and
- The nominal cost for a comparable intermodal service is around $290-410 per container (where the container park is integrated with the intermodal terminal and allows the opportunity for the empty container to be re-used for a loaded export movement).

Therefore, customers who divert freight from road to rail will receive an increase in operating surplus of about $100-170 per container for a round trip. However, this increase in operating surplus overestimates the benefits of tonnage attracted to rail – some customers will divert and attract almost all these benefits while others will divert and attract only a small marginal benefit. This reflects the conventional linear demand curve (with generalised cost on the vertical axis). This procedure is the 'rule of a half' employed to estimate benefits to diverted (and generated) traffic compared to existing traffic.

Benefits to customers diverting freight to rail will therefore receive an increase in gross operating surplus of $67.50 per container or $2.78 per tonne for a round trip.[8]

3.3.5.2 Non-price benefits

Service reliability and availability will improve with the Project. The main effect of these changes will be to offer the existing rail freight market, and diverting freight, additional market-related benefits. The values of these additional benefits have been estimated for each of the three interstate intermodal corridors. The resultant per tonne values of the service characteristics are shown in **Table 3.8**.

transit time. Refer Booz Allen & Hamilton, *Interstate Rail Network Audit – Evaluation Methodology*, prepared for ARTC, April 2001 and *ARTC North-South Strategy – Economic Analysis*, Draft, October 2005.

[7] Sea Freight Council of NSW, *Sydney's Intermodal System – Discussion Document*, Part 1 – Report, June 2007, p.24

[8] Derived as mid-point of range of $100-170 per container multiplied by 0.5 (for 'rule of half'). An average load of 12.1 tonnes per container movement has been assumed.

Table 3.8: Non-price customer benefits ($ per tonne)

Service characteristic	Sydney-Melbourne	Sydney-Brisbane	Melbourne-Brisbane
Reliability	$2.89	$3.90	$7.77
Availability	$2.57	$3.61	$3.87

Source: *ARTC North-South Strategy – Economic Analysis*, Draft, October 2005

In the absence of similar logit modelling of parameter performance and market share in the corridor, it is assumed existing customers place a value of $2 per tonne on these service improvements (and diverting customers $1 per tonne in line with the 'rule of a half'). This assumption represents a conservative increase in consumer surplus generated by the improved rail freight service.

Table 3.9: Calculation of rail freight customer benefits – increased operating surplus

	Constant mode share	Increased mode share	Terminal-driven
Value in 2016 [a/]	$3,438,000	$4,479,000	$9,183,000
Parameters	Increased operating surplus of $67.50 per container per round trip		
Source	Sea Freight Council of NSW, *Sydney's Intermodal System – Discussion Document*, Part 1 – Report, June 2007 (p.24)		
Formula	0.5 x (TEUs in Upgrade Case - TEUs in Base Case) x Increased operating surplus per container round trip		

Source: AECOM

Note: a/ From Table 3.3.

Table 3.10: Calculation of rail freight customer benefits – improved service benefits

	Constant mode share	Increased mode share	Terminal-driven
Value in 2016 [a/]	$8,001,000 (existing)	$8,001,000 (existing)	$8,001,000 (existing)
	$1,235,000 (new)	$1,609,000 (new)	$3,299,000 (new)
Parameters	(i) Consumer surplus of $2.00 per tonne from non-price benefits (ii) Average tonnes per container of 12.1		
Source	(i) Assumed from information in *ARTC North-South Strategy – Economic Analysis*, Draft, October 2005 (ii) ARTC Submission to IPART Review (June 2007) and Sydney Ports Corporation, *Trade Report 2007/08*		
Formula	(i) TEUs in Base Case x Tonnes per TEU x Consumer surplus from non-price benefits per tonne (ii) 0.5 x (TEUs in Upgrade Case - TEUs in Base Case) x Tonnes per TEU x Consumer surplus from non-price benefits per tonne		

Source: AECOM

Note: a/ From Table 3.3. Comprises approximately 50% from improved reliability and 50% from improved availability.

3.3.5.3 Wider economic benefits

Background

In addition to the economic effects identified in conventional benefit-cost analysis, recent research has established that transport investments can result in wider economic benefits (WEBs), which traditionally have not been counted.

Research by the UK Department for Transport (DfT) has led to the publication of methodologies for estimating these wider economic benefits arising from transport investments. These methodologies have now been incorporated into guidance on submissions to Infrastructure Australia.

The four main WEBs identified by the DfT are:

1. **Agglomeration benefits** - Transport investments may result a reduction in travel times, effectively bringing areas 'closer' together. Firms in these 'clusters' or those locating to them can gain productivity benefits through:
   - Access to a larger labour market
   - Access to a larger market of suppliers
   - Improved sharing of knowledge

   The fact of these benefits is demonstrated by the choice of many firms to locate in CBD areas despite additional costs.

   Agglomeration benefits refer to the net impact of these benefits on the economy.

2. **Increased competition** - Transport improvements may facilitate greater competition between firms by removing barriers preventing firms entering more distant markets, with consumers receiving the resulting benefits.

3. **Increased output from imperfectly competitive markets** - As markets are rarely perfectly competitive, firms are able to charge prices higher than their marginal costs. If transport costs are lowered, firms may lower their prices and increase output to satisfy demand. The additional benefit is the product of the difference between marginal cost and price and the increase in output due to reduced transport costs.

4. **Benefits from improved labour supply** - People may choose to enter the labour market or move to more productive jobs as a result of reduction in travel costs. Individuals make such choices based on the after tax income received, which is covered in traditional cost-benefit analysis. However, the full benefit is measured by the gross income paid by their employer including the additional tax revenue received by the state.

3.3.6 Application to the Upgrade

There has been little research as to whether rail freight projects are able to generate wider economic benefits. General applicability of the main areas of wider economic benefits is discussed below.

Agglomeration

Most, if not all, of the benefits associated with agglomeration will arise primarily as a result of improved transport for commuters.

Theoretically, the Port Botany Rail Line Upgrade may allow firms to have access to a larger market of suppliers by improving access to international supplier markets. However, there is no available evidence to suggest that this is likely to apply in practice. Firms will of course benefit from the reduction in costs but this is captured in conventional benefit-cost analysis.

Increased competition

Generally, for developed cities such as Sydney, capacity limitations in transport infrastructure do not present a barrier to competition and the entry of new suppliers into a market. Hence, capacity expansion is unlikely to result in increased competition in the wider economy.

Enabling rail freight to compete with road freight in new markets (for example, for time-sensitive goods) as a result of the reduced travel time will of course result in an increase in competition in the transport sector itself. However, this is likely to flow through to the markets of the transport-using sectors and hence the wider economy as a reduction in cost rather than an increase in competition. Again, this benefit is captured in conventional benefit-cost analysis.

Increased output

This particular wider economic benefit is likely to prove the most relevant to the case under study. As a result of the Port Botany Rail Line Upgrade, firms in the imperfectly competitive markets of the transport-using sectors are likely to increase output in response to the reduction in costs.

The UK DfT provides a methodology for calculating this benefit. A perfect calculation would require knowledge of the price/cost margin and elasticity of demand for each of the markets in question. As these parameters are difficult to generate, DfT provides values based on a review of research on the UK economy.

According to the best estimates available, prices across all sectors in the UK are, on average, 20% above marginal costs, or a price/cost margin of 0.2. The aggregate elasticity of demand is estimated at 0.5. The net effect of applying the DfT values is thus an 'uprate' factor of 0.1 – yielding an additional benefit of 10% of the conventionally appraised business user benefits.

Now available evidence suggests that there is a greater degree of market concentration in Australia than in the UK, with the firms in these imperfectly competitive markets possessing greater pricing power and the ability to charge a higher mark-up over marginal costs. Hence, it is likely that the additional benefit from increased output is higher in Australia than in the UK.

The best way to calculate the additional benefit from increased output as a result of the Port Botany Rail Line upgrade is to establish an uprate factor that reflects local conditions and which is likely to be higher than the UK figure. A factor of 0.3 has been derived, to be applied to the conventionally estimated reliability benefits for rail freight customers importing containers. The derivation of this factor and the rationale for the restricted application are described in Appendix A.

Improved labour supply

As the Port Botany Rail Line Upgrade will not affect commuter rail services and is unlikely to result in a significant reduction in road congestion during commuter travel periods, it is considered that there will not be any measurable additional benefits through improvements to the labour supply.

Table 3.11: Calculation of wider economic benefits

	Constant mode share	Increased mode share	Terminal-driven
Value in 2016 [a/]	$111,000	$145,000	$297,000
Parameters	(i) Uprate factor of 0.3 (ii) 30% of containers are import movements		
Source	(i) Appendix A (ii) ARTC Submission to IPART Review (June 2007) and Sydney Ports Corporation, *Trade Report 2007/08*		
Formula	Uprate factor x New customer non-price benefits x % import containers		

Source: AECOM

Note: a/ From Table 3.3. Increased output from transport-using industries.

3.4 Apportionment of Benefits

Table 3.12 shows the proportion of total benefits assigned to Stage 1 and Stage 2 for those benefit areas where it is not possible to separate the benefits. The basis for the assignment is the proportion of capital costs to be expended in each stage, assuming the benefit drivers and relevant investment component(s) shown in the second and third columns of **Table 3.12**.

Table 3.12: Proportion of Full Benefits Assigned to Stages 1 & 2

Benefit Area [a/]	Benefits Driver	Investment component(s) to achieve full benefits	Assignment of total benefits [b/]	
			Stage 1	Stage 2
Train delay reductions (above-rail operators)	Average turnaround time per train	All	36%	64%
Network control savings (ARTC)	Number of staff saved	Network control	0%	100%
Forward MPM reductions (ARTC)	Avoided MPM [c/]	Botany Yard	100%	0%
		Network control	0%	100%
Externalities (community)	TEUs/NTKs diverted from road	All	36%	64%
Rail freight customer benefits				
Wider economic benefits				

Source: AECOM

Notes: a/ Beneficiary indicated in brackets.

b/ Percentage of capital cost for investment required to achieve full benefits.

c/ Applies only to Botany Yard and network control, because Enfield Yard is a new facility.

3.5 Benefit-Cost Analysis Results

Table 3.13 shows the appraisal results incremental to the Base Case for Stage 2, for P50 and P90 cost estimates.

Table 3.13: Benefit-Cost Analysis Results – Stage 2

Measure	P50 Cost Estimate			P90 Cost Estimate		
	Constant Proportion	Increased Proportion	Terminal-Driven	Constant Proportion	Increased Proportion	Terminal-Driven
PV Costs ($000) [a/ b/]	67,603	67,603	67,603	72,700	72,700	72,700
PV Benefits ($000) [a/]	124,694	141,527	164,944	126,779	140,967	167,029
NPV ($000) [a/]	57,091	73,924	97,342	54,079	68,267	94,329
BCR	1.8	2.1	2.4	1.7	1.9	2.3
IRR	13%	14%	17%	12%	13%	16%

Source: AECOM

Notes: a/ In 2009/10 prices. Incremental to Base Case.

b/ Includes present value of residual value of the assets remaining at the end of the appraisal period. This reduces the present value of project costs.

There are three measures of economic return shown in **Table 3.13**.

- Net Present Value (NPV) measures the difference between benefits and costs, whilst accounting for the timing of benefits and costs. Net cash flows are discounted at the prescribed discount rate of 7%, reflecting the notion that future benefits and costs have less value compared to current benefits and costs. A project with a NPV greater than zero would be considered desirable in economic terms, with the project having the highest NPV providing the best economic return.
- Benefit-Cost Ratio (BCR) measures the economic return received per dollar of costs. The BCR is calculated by dividing the present value of all benefits by the present value of all costs. A project with a BCR greater than one would be considered desirable in economic terms, with the project having the highest BCR providing the highest return per dollar.
- Internal Rate of Return (IRR) provides a measure of how the particular investment compares with other investment opportunities, by comparing it with the opportunity cost of capital (as measured by the discount rate). The IRR also provides an indication of the margin for risk offered by a project, by the extent to which its value exceeds the opportunity cost of capital.

Table 3.14 shows that for both P50 and P90 cost estimates, Stage 2 of the Upgrade is economically viable in all three rail volume scenarios, with NPVs well in excess of zero, BCRs of 1.7 and above and IRRs considerably higher than the opportunity cost of capital.

3.6 Composition of Benefits

Table 3.14 shows a breakdown of benefit streams for Stage 2. Benefits (price and non-price) to both existing and new customers account for between 40% and 60% of total benefits. The next largest sources of benefit are forward reductions in major periodic maintenance costs in network control, network control labour cost savings and avoided externality costs.

Table 3.14: Composition of Economic Benefits ($000) – Stage 2 [a/]

Benefit	P50 Cost Estimate			P90 Cost Estimate		
	Constant Proportion	Increased Proportion	Terminal-Driven	Constant Proportion	Increased Proportion	Terminal-Driven
Train delay reductions	5,107	5,149	5,183	5,107	5,012	5,183
Network control savings	14,680	14,680	14,680	14,680	14,680	14,680
Forward MPM reductions	27,491	27,491	27,491	29,576	29,576	29,576
Externalities	6,795	9,708	13,763	6,795	9,450	13,763
Rail freight customer benefits						
Existing customers	*39,011*	*39,332*	*39,594*	*39,011*	*38,285*	*39,594*
New customers	*30,890*	*44,134*	*62,765*	*30,890*	*42,960*	*62,765*
Sub total	*69,901*	*83,466*	*102,359*	*69,901*	*81,244*	*102,359*
Wider economic benefits	721	1,034	1,469	721	1,006	1,469
Total	124,694	141,527	164,944	126,779	140,967	167,029

Source: AECOM

Note: a/ Present value in 2009/10 prices. Incremental to Base Case.

3.7 Sensitivity Analysis

Sensitivity analysis was undertaken to test the robustness of the economic results to variations in key parameter values. The following sensitivity tests were carried out, with the results presented in **Table 3.15**:

- alternative discount rates of 4% and 10%;
- 30% increase in capital costs; and
- 50% decrease in rail freight customer benefits.

Table 3.15: Sensitivity Analysis Results

Measure	P50 Cost Estimate			P90 Cost Estimate		
	Constant Proportion	Increased Proportion	Terminal-Driven	Constant Proportion	Increased Proportion	Terminal-Driven
Main Benefit-Cost Analysis [a/]						
NPV ($000) [b/]	57,091	73,924	97,342	54,079	68,267	94,329
BCR	1.8	2.1	2.4	1.7	1.9	2.3
4% discount rate						
NPV ($000) [b/]	110,113	133,472	162,202	108,812	129,290	160,900
BCR	2.8	3.2	3.7	2.7	3.0	3.5
10% discount rate						
NPV ($000) [b/]	22,176	34,535	53,795	18,163	28,089	49,783
BCR	1.3	1.5	1.8	1.2	1.4	1.6
30% increase in capital costs [a/]						
NPV ($000) [b/]	36,810	53,644	77,061	32,269	46,457	72,519
BCR	1.4	1.6	1.9	1.3	1.5	1.8
50% decrease in customer benefits [a/]						
NPV ($000) [b/]	21,825	31,730	45,463	18,812	27,037	42,450
BCR	1.3	1.5	1.7	1.3	1.4	1.6

Source: AECOM

Notes: a/ At 7% discount rate.
b/ In 2009/10 prices.

The results of the sensitivity analysis demonstrate the economic robustness of Stage 2. The BCR remains above 1.0 in all the sensitivity tests undertaken.

Appendix A

Application of Wider Economic Benefits

Appendix A Application of Wider Economic Benefits

Background

Section 3.3.5.3 concluded that only one of the four main wider economic benefits identified by the UK Department for Transport (DfT) for consideration in transport investment appraisals was relevant to appraising the Port Botany Rail Line Upgrade project – increased output from imperfectly competitive markets.

As markets are rarely perfectly competitive, firms are able to charge prices higher than their marginal costs. If transport costs are lowered as a result of a transport investment, firms in the imperfectly competitive markets of the transport-using sectors may lower their prices and increase output to satisfy demand. This response results in additional efficiency benefits (gains in welfare) compared to those captured in conventional benefit-cost analysis. The additional benefit is the product of the difference between marginal cost and price and the increase in output due to reduced transport costs.

It can be shown that this is equivalent to applying an uprate factor (V) to the conventionally appraised business user benefits (business time savings and reliability gains, BTS + RG) already included in the analysis.[9]

Equation 1: Economic benefit due to increased output in imperfectly competitive markets

$$Benefit = V \times (BTS + RG)$$

Source: DfT (2006)

The uprate factor is the ratio of the price-marginal cost gap to price, i.e. (P – MC)/P (referred to as the "price-cost margin") multiplied by the elasticity of demand (ED) for the imperfect market in question.

Equation 2: Uprate Factor

$$V = \frac{(P - MC)}{P} \times ED$$

Source: DfT (2006)

A perfect calculation would require knowledge of the price-cost margin and elasticity of demand for each of the markets in question. As these two parameters are difficult to generate, DfT provides values based on a review of research on the UK economy.

DfT reviewed a number of estimates of price-cost margins for the UK. According to the best estimates available, prices across all sectors in the UK are, on average, 25% above marginal costs, or a price-cost margin of 0.2.[10] DfT used an aggregate elasticity of demand estimate of 0.5. The net effect of applying the DfT values is thus an uprate factor of 0.1 (i.e. 0.2 x 0.5) – yielding an additional benefit of 10% of the conventionally appraised business user benefits.

Available evidence (refer Section 2.0) suggests that there is a greater degree of market concentration in Australia than in the UK, with the firms in these imperfectly competitive markets possessing greater pricing power and the ability to charge a higher mark-up over marginal costs. Hence, it is likely that the additional benefit from increased output is higher in Australia than in the UK.

[9] See UK Department for Transport (2006) pp. 45-46.
[10] Calculated by substituting P = 1.25MC in (P – MC)/P. That is:
(1.25MC – MC)/1.25MC = 0.25MC/1.25MC = 0.2

The best way to calculate the additional benefit from increased output as a result of the Port Botany Rail Line Upgrade project would be to establish an uprate factor that best reflects local conditions and which is likely to be higher than the UK figure. The results of preliminary research into this topic are outlined in the following sections.

Price-Cost Margin

Compared to the UK, there is considerably less research into price-cost margins in Australia from which to estimate an Australian specific uprate factor.

OECD (1996) provides an estimate of mark-up ratios[11] in manufacturing industries for 14 OECD countries, including the UK and Australia. It concludes (p 25) an average mark-up ratio in manufacturing industries of 1.15 for the UK (range of 1.03 to 1.67) and 1.20 for Australia (range of 1.10 to 1.61) between 1980 and 1992, implying that mark-up ratios in Australia are on average slightly higher than in the UK.

More recent work by Olive (2002) estimates the mark-up of eight manufacturing industries in Australia, concluding that the average mark-up rate is 26% (p 9). This result is supported in Olive (2004) where the average mark-up rate of eighteen manufacturing industries was found to be approximately 25% (p 10).[12] It is likely that the current mark-up rate is similar, given that the structure of the manufacturing industry (in terms of degree of concentration) has not changed significantly since the study was conducted.

One possible issue with the above studies is that none of them included the services sector. DfT (2006) notes that in the UK service industries typically have higher mark-up ratios than manufacturing industries, citing work by DTI and Small (1997). DfT (p 48) suggested a correction factor of about +0.1 to estimates of price-cost margins from studies that did not include service industries.[13] In the absence of any specific data on Australian service industries, the DfT correction factor has been adopted.[14] This is a conservative approach, as in reality the correction factor for Australia could be higher given the comparative mark-up ratios for Australia and UK in the manufacturing sector.

The suggested price-cost margin for Australia is then:

$$\frac{(1.25-1)}{1.25}+0.1=0.30$$

Aggregate Elasticity of Demand

The other variable needed to calculate the uprate factor is the aggregate elasticity of demand for final goods. As mentioned above, UK DfT uses 0.5. This compares to earlier studies in Australia that have assumed 1.0.[15]

[11] For the purpose of this report, the mark-up ratio is defined as P/MC.
[12] An earlier study by Martins et al (1996) found an average mark-up ratio for manufacturing industries of 1.24.
[13] Consideration may be needed as to the degree of increased output in the services sector as a result of the project improvements to Port Botany Rail Line. Service industries such as retail and wholesale (which rely heavily on imports) may increase output, whereas industries such as finance or business services may be unaffected. A services industry correction specific to rail freight transport-using industries may be required.
[14] Note that the economic contribution of the services sector is similar for Australia and UK – between 70-80% of GDP depending on definition.
[15] Refer Luk and Hepburn (1993).

There appears to be justification for the higher elasticity value, given that the elasticity of demand for a factor of production, such as transport (which is an input in the production process and has a derived demand), tends to be less price elastic than final goods.[16] This is based on the concept that freight transport demand elasticity (A) is a product of:

- the elasticity of demand for final goods (B);
- the proportion of the total cost of goods attributable to freight transport costs (C); and
- the elasticity of substitution between factors of production (influencing the likelihood of substitution between transport and other inputs) (D).

This relationship can be expressed as:

Equation 3: Freight transport demand elasticity

$$A = B \times C \times D$$

The elasticity of demand for final goods (B) can therefore be expressed as:

Equation 4: Elasticity of demand for final goods

$$B = A \times 1/C \times 1/D$$

This means that B generally will have a higher value (ie. be more elastic) than A because:

- 1/C will exceed 1 (freight transport costs are typically a small proportion of total costs); and
- 1/D will be 1 or above (supply changes are likely to be inelastic, particularly in the short to medium-term).

It is very difficult to estimate aggregate demand elasticities. However, using Equation 4, it is possible to infer from estimated elasticities of freight transport demand whether the value is likely to be closer to 0.5 or 1.0. There have been numerous overseas empirical studies of freight transport demand, but very few studies have examined the situation in Australia.

In a recent substantive review of transport demand elasticities from around the world conducted by Graham and Glaister (2004) for DfT, the average freight traffic elasticity with respect to price was found to be -1.07 (the majority of values lay between -0.5 and -1.3). These results are similar to a comprehensive study in 1990 for The World Bank.[17] It found the most likely range of rail freight price elasticities to be between -0.4 and -1.2, and the most likely range of road freight price elasticities to be between -0.7 and -1.1.

According to Starrs (2005), the corresponding ranges for Australia are -0.4 to -1.20 for rail freight price elasticities and -0.5 to -1.1 for road freight price elasticities. Meyrick and Associates (2006) arrived at a weighted range for Victorian rail price elasticities of between -0.7 and -0.9.

The elasticity values quoted in the two preceding paragraphs indicate that the aggregate elasticity of demand for final goods is likely to be closer to 1.0 than 0.5. The higher value has been adopted in the calculation of the uprate factor for Australia. This is consistent with the value of 1.0 assumed in earlier Australian studies.

[16] Also see Productivity Commission (2006) Appendix F.
[17] Reported in Oum et al (1992).

Conclusion

Considering the results of the research outlined in Section 2.0 and Section 3.0, and using Equation 2, an appropriate uprate factor to adopt for Australian conditions is 0.3 (i.e. a price-cost margin of 0.3 multiplied by an aggregate elasticity of demand of 1.0).

In the case of the Port Botany Rail Line Upgrade project, the uprate factor would be applied to the conventionally estimated reliability benefits for rail freight customers importing containers. The gains in welfare which are not captured by the conventional appraisal accrue to the buyers of the products of the transport-using industries (these industries receive the direct transport benefits not the welfare benefits associated with the increased production[18]). Therefore, the gains in welfare associated with export containers would not fall to domestic buyers and should not be included in the economic appraisal. In any case, with export products where Australia is largely a price-taker, a change in marginal cost may not be passed through a change in price.

The preliminary benefit-cost analysis of the Port Botany Rail Line Upgrade project estimates wider economic benefits from increased competition in the range of $1.2 million to $2.9 million (in present value terms for total Project), depending on the rail volume scenario. This is around 1% of the estimated value of total economic benefits.[19]

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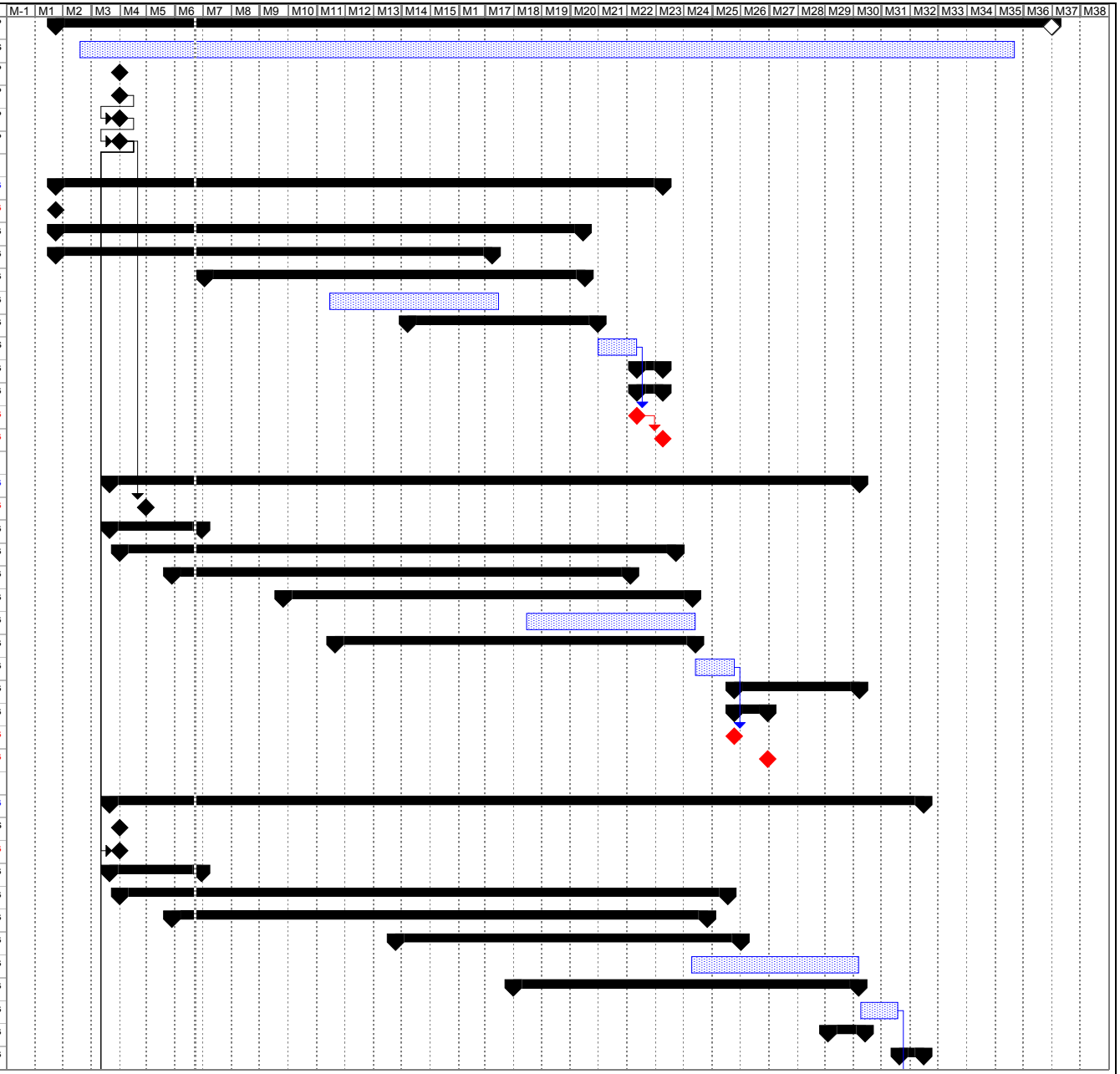
[18] Because price exceeds marginal cost where there is imperfect competition in a market, if improved transport induces transport-using firms to increase production, the gain in welfare is the value placed on the additional production less the cost of producing it. Consumers (households, firms, governments) are willing to pay more for additional products (as indicated by the product price) than it would cost to produce them. This is clearly not efficient as increased output would be valued higher by society than the cost of providing it.

[19] These estimates assume immediate supply response once the project is completed. In practice, there may be a phasing of these benefits due to time lags in transport-using firms adjusting supply.

G4 Project Gantt Chart

Consolidated design and construction program

ID	Task Name	Duration
1	**PBRL Stage 2 Project Management**	**768 days?**
2	Possessions	32 days
3	**Commercial Mobilisation**	**0 days?**
4	**Funding Application for balance of works**	**0 days?**
5	**Funding approval**	**0 days?**
6	**Procurement process for balance of works**	**0 days?**
7		
8	**BOTANY YARD PROJECT**	**468 days**
9	**Project Start Date**	**0 days**
10	**Design**	**406 days**
118	**Long Lead and Prefabrication**	**336 days**
131	**Construction**	**294 days**
179	**Operations Readiness**	**130 days**
180	**Commissioning**	**147 days**
190	**Project Contingency**	30 days
191	**Redundant Equipment Removal**	**20 days**
197	**Documentation**	**20 days**
208	**Project In Service Date**	**0 days**
209	**Project Completion Date**	**0 days**
210		
211	**COOKS RIVER TO WARDELL RD. PROJECT**	**577 days**
212	**Project Start Date**	**0 days**
213	**Concept Design**	**71 days**
223	**Detail Design**	**429 days**
390	**Long Lead and Prefabrication**	**354 days**
404	**Construction**	**315 days**
457	**Operational Readiness**	**130 days**
458	**Commissioning**	**278 days**
470	**Project contingency**	**30 days**
471	**Redundant Equipment Removal**	**96 days**
481	**Documentation**	**26 days**
499	**Project In Service Date**	**0 days**
500	**CRWR Project Completion Date**	**0 days**
501		
502	**SHARED CORRIDOR PROJECT**	**627 days**
503	ARTC advice to progress with SC SP detail design	0 days
504	**SC Project Start Date**	**0 days**
505	**Concept Design**	**71 days**
515	**Detail Design**	**469 days**
680	**Long Lead and Prefabrication**	**413 days**
694	**Construction**	**266 days**
739	**Operations Readiness**	**130 days**
740	**Commissioning**	**266 days**
752	**Project Contingency**	**30 days**
753	**Redundant Equipment Removal**	**30 days**
761	**Documentation**	**20 days**

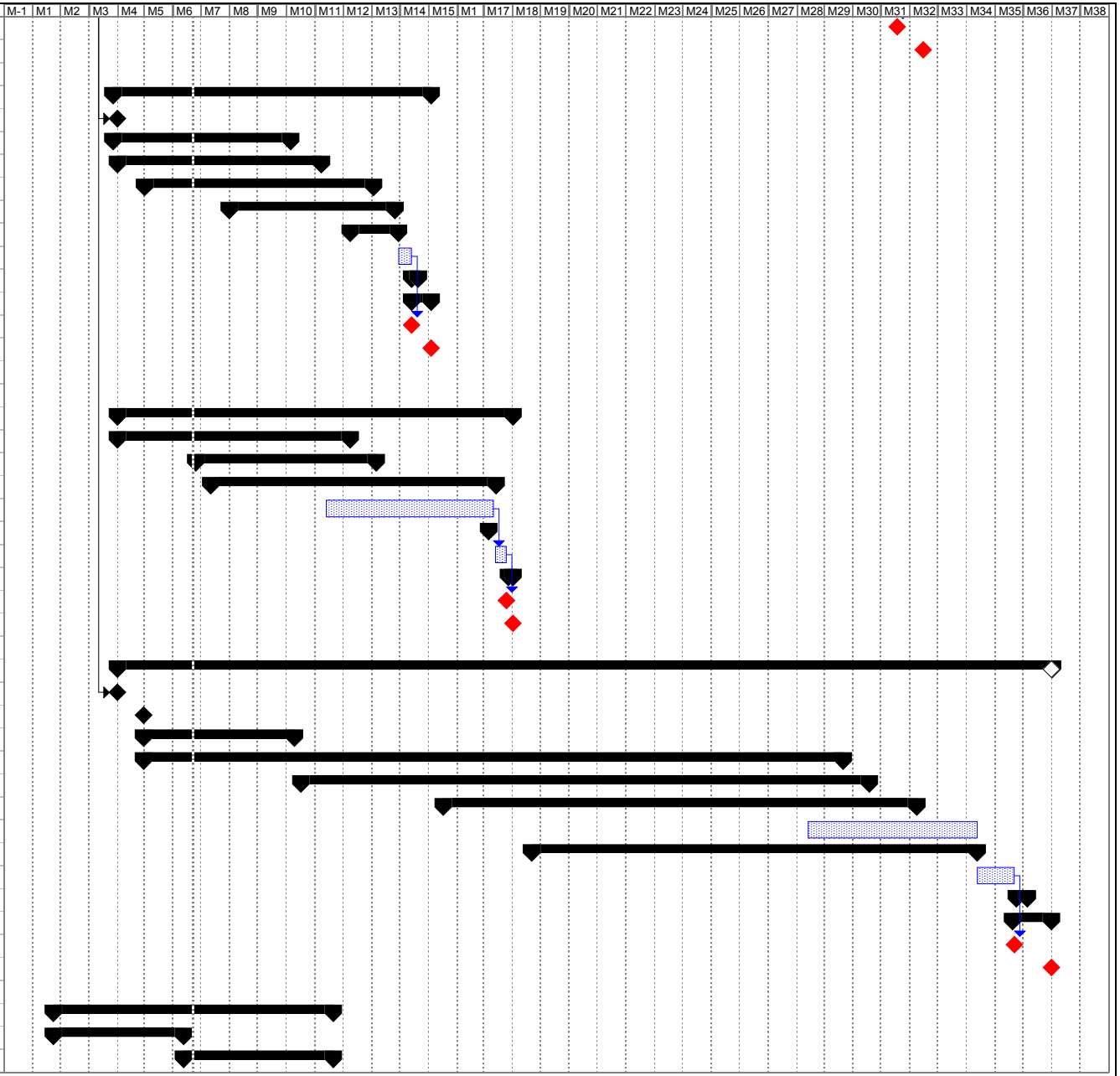


Project: MFN consolidated design and
Date: Thu 22/04/10

Task | Milestone | Rolled Up Task | Rolled Up Progress | External Tasks | Group By Summary

Progress | Summary | Rolled Up Milestone | Split | Project Summary | Deadline

ID	Task Name	Duration
780	Project In Service Date	0 days
781	SC Project Completion Date	0 days
782		
783	ENFIELD STAGING FACILITY PROJECT - ENABLING WORKS	244 days
784	Enfield Staging Roads Project - Enabling Works Phase Start Date	0 days
785	Concept Design	137 days
841	Detail Design	157 days
883	Long Lead and Prefabrication	176 days
892	Construction	128 days
911	Commissioning	36 days
916	Project Contingency	10 days
917	Redundant Equipment Removal	5 days
921	Documentation	15 days
930	Enabling Works Phase - in Service Date	0 days
931	Enabling Works Phase - Completion Date	0 days
932		
933		
934	ENFIELD STAGING FACILITY PROJECT - UNSIGNALLED STAGING ROADS CON	305 days
935	Detail design	180 days
969	Long Lead and Prefabrication	140 days
973	Construction	219 days
985	Operational Readiness	130 days
986	Commissioning	0 days
990	Project Contingency	10 days
991	Documentation	5 days
1000	Enfield Staging Roads (un-signalled) Operational	0 days
1001	Enfield Staging Roads Project Completion Date	0 days
1002		
1003	ENFIELD - REMOTE CONTROL PROJECT	719 days
1004	Enfield Project - Start Date	0 days
1005	ARTC preferred Enfield option confirmation/ approval to proceed with concept des	0 days
1006	Enfield - Concept Design	116 days
1044	Detail Design	538 days
1149	Long Lead and Prefabrication	437 days
1163	Construction	365 days
1206	Operational Readiness	130 days
1207	Commissioning	341 days
1216	Project Contingency	30 days
1217	Redundant Equipment Removal	10 days
1223	Documentation	30 days
1230	Project in Service date - signalled Enfield Staging Roads / split control	0 days
1231	Enfield Project Completion Date	1 day
1232		
1233	TRAIN RADIO PROJECT - ENABLING WORKS FOR ALL PROJECTS	215 days
1234	Generic design	100 days
1243	Construction	115 days



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Task
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