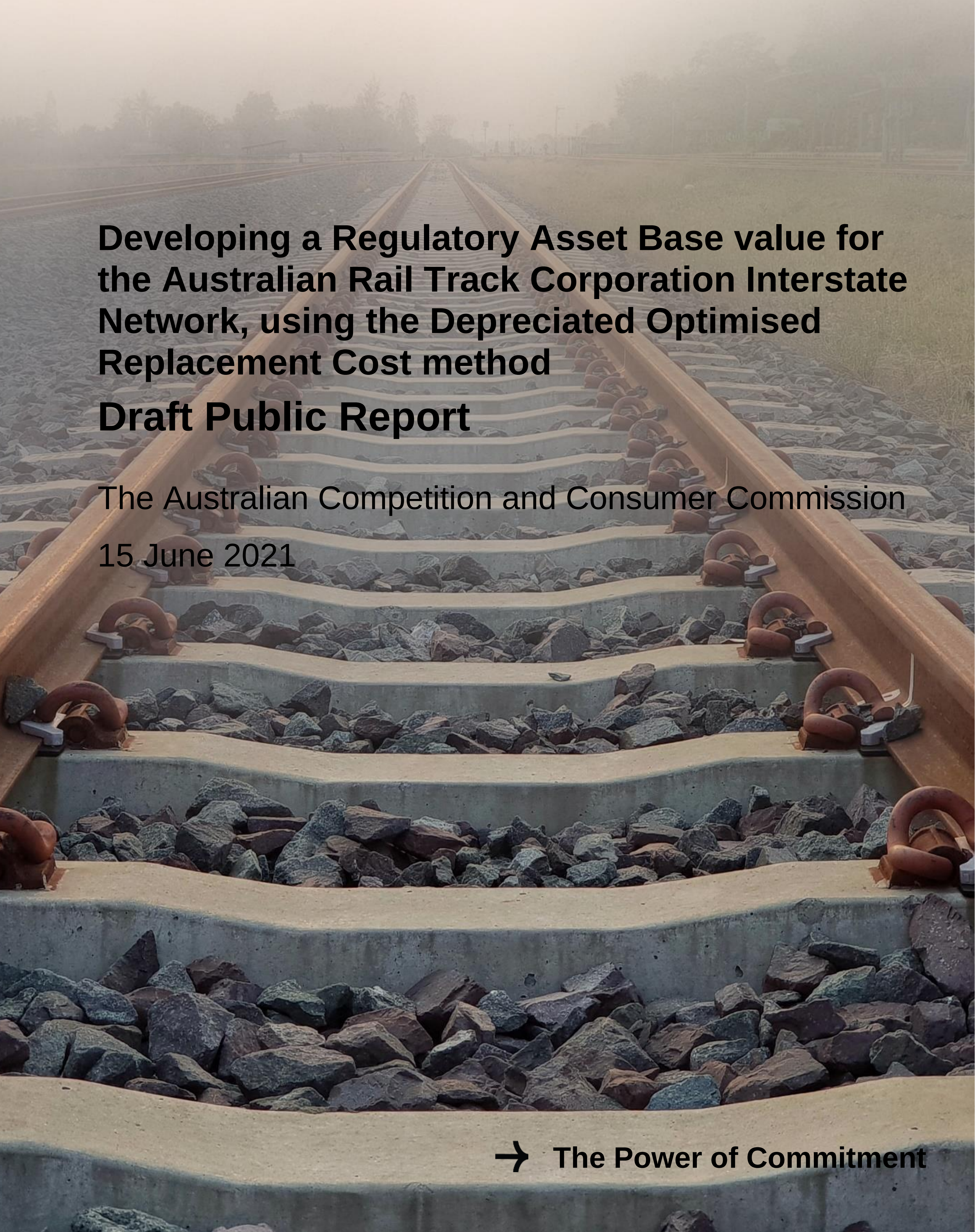

GHD Advisory

Developing a Regulatory Asset Base value for the Australian Rail Track Corporation Interstate Network, using the Depreciated Optimised Replacement Cost method

Draft Public Report

The Australian Competition and Consumer Commission

15 June 2021

→ The Power of Commitment

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.5 and the assumptions and qualifications contained throughout the Report.

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Executive Summary

The Australian Rail Track Corporation's (**ARTC**) Interstate Network is a system of rail track assets spanning over 8,500 km across New South Wales, Queensland, South Australia, Victoria and Western Australia.

ARTC's Interstate Access Undertaking (**IAU**) was approved on 30 July 2008 and is set to expire on 30 June 2021. ARTC's undertaking sets out the principles and processes under which ARTC, as an infrastructure provider of rail, will be obliged to provide access to businesses wishing to run trains on ARTC's interstate rail network. In March 2018, ARTC submitted its 2018 IAU to the Australian Competition and Consumer Commission (**ACCC**), which was intended to replace the 2008 IAU.

After the ACCC's draft decision in December 2018 to not accept ARTC's proposed 2018 IAU, ARTC withdrew its proposed IAU and proposed to revalue the Interstate Network using a Depreciated Optimised Replacement Cost (**DORC**) valuation method. After stakeholder consultation and consideration of the issues, the ACCC formed the view that a new DORC valuation was the most appropriate approach to setting the regulated asset base (**RAB**) for a replacement IAU.

In April 2020, the ACCC engaged GHD Advisory to determine the RAB for the Interstate Network, using a DORC valuation method, as of 1 July 2019 using a brownfields approach.

The ACCC has engaged us under an **Order for Services** that requires GHD Advisory to report on a:

– DORC estimate for the Interstate Network.
– Proposed RAB for the Interstate Network, including to account for assets funded by government grants.

Our approach

The DORC approach is an asset valuation method that determines the current cost required to replace the service of an existing asset. A DORC valuation reflects the market-based price a reasonable buyer would pay to construct a substitute asset of comparable utility, adjusted for condition, asset age and obsolescence that is designed to meet foreseeable regulated service requirements. The approach we have adopted to derive the DORC valuation is shown in Figure 1.

Figure 1: Overview of our approach

Within the DORC we have included allowances for:

– Pre-construction costs
– Interest during construction costs

And adjusted the DORC for operating expenditure savings resulting from the use of MEA.

On this basis, and on the direction of the ACCC, we then removed grant-funded assets from the DORC valuation to determine the RAB value.

Our DORC valuation is based on ARTC's information, evidence from recent construction contracts, our in-house database of rail sector projects and public domain information, where possible. We have also made several assumptions that may influence our overall valuation.

These include but are not limited to:

– **Replacement costs:** our replacement costs reflect both direct costs (labour, plant and materials) and indirect costs (site wide costs as well as project management, construction management and overheads). We consider these indirect costs values are typically applied in major construction projects and are therefore appropriate.
– **Optimisation:** we performed our optimisation analysis over a ten-year period, reflecting the surety of demand as well as the long-life nature of rail infrastructure. Our optimisation assessment adjusts the replacement cost of assets in accordance with infrastructure requirements from foreseeable demand, and still provides present-day service levels. Our analysis indicates that the:
    - Track capacity is greater than required, meaning that passing loops can be optimised. We consider that 39 passing loops can be removed from the overall Network.
    - There is some scope for optimising the track configuration. We consider that it is possible for some multi-track to be replaced with single track and passing loops as a lower cost solution.
– **Depreciation:** we were unable to obtain commissioning date information from ARTC for several of the assets that underpin our valuation. In these situations, we based the assessment of depreciation on other known data such as condition data, weighted average assessment of other similar assets or a nominal residual life for assets which are life-expired but still providing service. This is discussed in more detail in 8.1.
– **Interest during construction:** our interest during construction value is based on our assumed construction schedule. In accordance with DORC principles, our approach to minimise overall costs was to reduce the overall construction duration to a minimum, because this directly impacts the IDC cost. We consider that an efficient entrant would construct the Interstate Network as a single stage project, comprised of several individual projects that would occur concurrently. We determined the number of concurrent construction projects that could be implemented based on our understanding of the interest that such a project would generate from contractors of the size required for complex infrastructure of this scale. This approach is agnostic to segment and considers the network in its entirety. We considered, but did not adopt, a staged commissioning approach. This is discussed in more detail in 7.2.

Finally, to determine the RAB value, we calculated the value of grant-funded assets based on the proportion of original cost from grant funding and applied this to the replacement cost of the relevant assets. We then subtracted the difference from the DORC value to generate the RAB.

DORC and RAB estimate

We have estimated the DORC for the Interstate Network to be **$10.6 billion** ($10,574 million) as of 1 July 2019. Figure 2 summarises our DORC findings.

Table 1 presents more detail and shows the impact on the asset valuation of: optimisation; depreciation; and operating expenditure (**opex**) savings from the use of modern equivalent assets (**MEA**) compared with the existing assets comprising the Interstate Network.

The RAB for the ARTC Interstate Network is **$10.2 billion** ($10,249 million) as of 1 July 2019. The composition of the RAB by Track Segments is provided in Table 1. The RAB estimate is $325 million less than that of the DORC because the ACCC's Order for Services required that assets funded by government grants be excluded from the RAB.

Figure 2: Summary of results

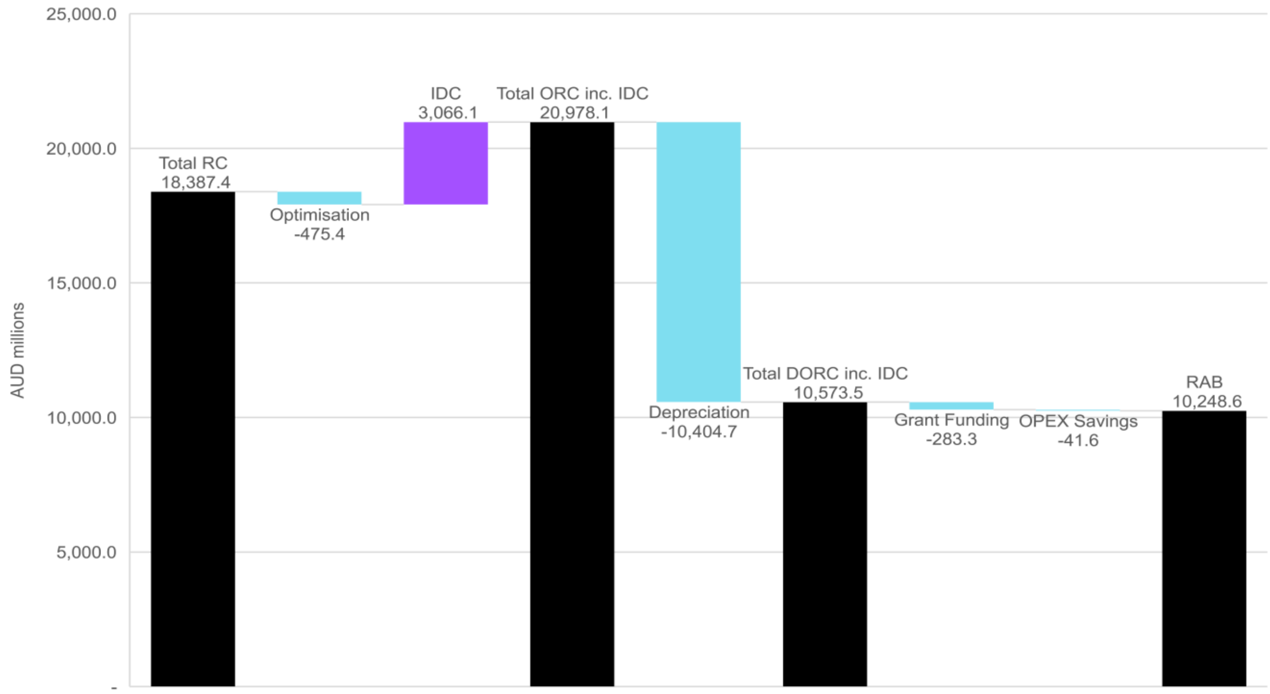

Table 1: Summary Depreciated Optimised Replacement (DORC) Cost including pre-development, indirect and IDC costs ($million)

Regulatory Segment	Total DORC including Pre-development, indirect and IDC ($million)	OPEX Savings Optimisaton ($million)	Grant Funding ($million)	RAB ($million)
Dry Creek to Parkeston	1,829.7	(7.9)	(6.2)	1,815.7
Tarcoola to Asia-Pacific Interface (API)	7.5	-	-	7.5
Port Augusta to Whyalla	101.6	(0.0)	-	101.6
Crystal Brook to Parkes	1,399.6	(4.4)	(7.0)	1,388.2
Cootamundra to Parkes	302.2	(1.2)	(1.8)	299.2
Dry Creek to Pelican Point	117.8	(0.2)	(0.2)	117.3
Dry Creek to Melbourne (Spencer Street)	962.5	(5.5)	(54.2)	902.8
Appleton Dock to Footscray	196.9	-	(46.7)	150.2
Melbourne (Tottenham) to Macarthur	2,968.5	(10.6)	(88.8)	2,869.1
Moss Vale to Unanderra	205.9	(2.0)	(0.4)	203.5
Southern Sydney Freight Line (SSFL)	316.6	(1.5)	-	315.1
Metropolitan Freight Network (MFN)	112.4	(0.6)	(72.2)	39.7
Newcastle to Acacia Ridge	2,052.2	(7.6)	(5.9)	2,038.7
TOTAL DORC	**10,573.5**	**(41.6)**	**(283.3)**	**10,248.6**

Note totals may not sum due to rounding

Glossary

Table 2: Glossary of terms used

Term	Definition
ACCC	Australian Competition and Consumer Commission
ACT	Australian Competition Tribunal
AER	Australian Energy Regulator
API	Asia-Pacific Interface
ARTC	Australian Rail Track Corporation
Asset class	The term 'asset class' is a superset of 'asset types'. 'Asset class' pertains to assets defined by their similar function and that render the similar capital service (such as track, right-of-way, structures etc.). '
Asset type	Asset type refers to discrete assets or components within each asset class that are defined by their purpose or characteristics such as materials technology, design and tolerances.
Capex	Capital expenditure
CCA	*Competition and Consumer Act 2010 (Cth)*
DEM	Digital Elevation Model
DRC	Depreciated Replacement Cost
DORC	The Depreciation Optimised Replacement Cost approach is an asset valuation method that determines the current cost required to replace the service of an existing asset. It involves valuing an asset at the cost of a modern equivalent asset (MEA) that is' optimised' to provide the required service in the most efficient way possible adjusted to reflect the remaining useful life of the asset[1]
EW	East-West
IAU	Interstate Access Undertaking
IDC	Interest During Construction
IPART	Independent Pricing and Regulatory Tribunal
Interstate Network	The Interstate Network covers the mainline standard gauge track linking Kalgoorlie in Western Australia, Adelaide, Wolseley and Crystal Brook in South Australia, Melbourne and Wodonga in Victoria and Broken Hill, Cootamundra, Albury, Macarthur, Moss Vale, Unanderra, Newcastle, Parkes and the Southern Sydney Freight Line in New South Wales, and the Queensland Border to Acacia Ridge in Queensland.
GIS	Geographical Information System
GRV	Gross Replacement Value
GTK	Gross Tonne Kilometre
MEA	Modern Equivalent Asset
MFN	Metropolitan Freight Network
MTP	ARTC's Master Train Plans for the Interstate Network

[1] P35 of Final Determination: Statement of Reasons, Access dispute between Glencore, Coal Assets Australia Pty Ltd and Port, of Newcastle Operations Pty Ltd, ACCC, September 2018, https://www.accc.gov.au/system/files/public-registers/other/Glencore%20PNO%20access%20dispute%20-%20Final%20Determination%20-%20Statement%20of%20Reasons%20-%2018%20September%202018%20%28Public%20version%29.pdf

Term	Definition
NS	North-South
NPV	Net Present Value
Opex	Operating Expenditure
ORC	Optimised Replacement Cost
PV	Present Value
QCA	Queensland Competition Authority
RAB	Regulatory Asset Base
RC	Replacement Cost
RFI	Request for Information
Segment	Any of the 13 Track Segments comprising the Interstate Network
SRT	Section Running Time
SSFL	Southern Sydney Freight Line
TMS	Top Moving Sum
TQI	Track Quality Index
TSR	Temporary Speed Restriction
WACC	Weighted Average Cost of Capital

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Appendices

1. Introduction

1.1 The Interstate Network

The Australian Rail Track Corporation's (**ARTC**) Interstate Network is a system of rail track assets spanning over 8,500 km across New South Wales, Queensland, South Australia, Victoria and Western Australia.

The Interstate Network covers the mainline standard gauge track linking Kalgoorlie in Western Australia, Adelaide, Wolseley and Crystal Brook in South Australia, Melbourne and Wodonga in Victoria and Broken Hill, Cootamundra, Albury, Macarthur, Moss Vale, Unanderra, Newcastle, Parkes and the Southern Sydney Freight Line in New South Wales, and the Queensland Border to Acacia Ridge in Queensland.

The Interstate Network corridors owned or leased by ARTC (13 Track Segments) are captured in Figure 3[2].

Figure 3: Interstate Network

[2] Note: the corridors owned or leased by ARTC include the corridors ARTC is proposing to include in its replacement Interstate Access Undertaking.

1.2 Background to the engagement

ARTC's current Interstate Access Undertaking (**IAU**) was approved on 30 July 2008 and is set to expire on 30 June 2021. ARTC's undertaking sets out the principles and processes under which ARTC, as an infrastructure provider of rail, will be obliged to provide access to businesses wishing to run trains on ARTC's interstate rail network.

In March 2018, ARTC submitted its 2018 IAU to the Australian Competition and Consumer Commission (**ACCC**), which was intended to replace the 2008 IAU. ARTC proposed to roll-forward its Regulated Asset Base (**RAB**) for the Interstate Network from the 2008 IAU opening value and incorporate the following (the New Segments):

– Southern Sydney Freight Line (i.e., SSFL)
– Metropolitan Freight Network (i.e., MFN)
– Queensland Border to Acacia Ridge Terminal.

ARTC's proposed roll-forward resulted in a proposed RAB increase from $3.7 billion to $10 billion.

In December 2018, the ACCC made a draft decision not to accept ARTC's 2018 IAU, due in part to the proposed RAB roll-forward. These concerns were:[3]

– ARTC's proposed RAB value of New Segments
– Prudency of capex
– Capex funded from government grants
– ARTC's treatment of replacement expenditure in its financial model
– ARTC's proposed allocation of capex to specific asset types
– Lack of asset disposals
– ARTC's proposed inclusion of capex from non-IAU sections
– ARTC's approach for indexing the RAB.

In January 2019, ARTC withdrew its proposed 2018 IAU[4]. In August 2019, ARTC proposed to revalue the Interstate Network using a Depreciated Optimised Replacement Cost (**DORC**) valuation method. After stakeholder consultation and consideration of the issues, the ACCC formed the view that a new DORC valuation of the Interstate Network was the most appropriate approach to setting the RAB for the replacement IAU.[5] The ACCC sought an independent consultant to undertake a DORC valuation of the Interstate Network and determine a RAB following the valuation.

[3] ACCC's Draft Decision on ARTC's proposed 2018 AU, available at: https://www.accc.gov.au/regulated-infrastructure/rail/artc-interstate-access-undertaking/interstate-rail-access-undertaking-2018/draft-decision
[4] ARTC's letter to the ACCC, available at: https://www.accc.gov.au/regulated-infrastructure/rail/artc-interstate-access-undertaking/interstate-rail-access-undertaking-2018/application-withdrawn
[5] ACCC's Statement of Approach, available at: https://www.accc.gov.au/regulated-infrastructure/rail/artc-interstate-access-undertaking/proposed-valuation-for-the-interstate-network/statement-of-approach

1.3 ACCC's appointment of an independent consultant

The ACCC engaged GHD Advisory on 23 April 2020 to develop a RAB for the Interstate Network using the DORC valuation method.

An independent DORC assessment would necessarily limit the nature of interactions between the ACCC's appointed consultant and ARTC, considering:

> *"…the ACCC also considers that to preserve the integrity of the valuation, it is critical that the terms of engagement of a consultant remain independent. Allowing ARTC to provide input into the request for quote would compromise the independence of this process, which could potentially have an impact on the economic efficiency of the outcome of the valuation process.*
>
> *However, once a consultant is engaged to undertake the valuation, the consultant will be required to work closely with ARTC staff to acquire the information necessary to carry out the valuation. This means that the ACCC will need ARTC to be engaged and involved throughout the valuation process.*
>
> *The ACCC considers that this balancing act of ensuring ARTC's involvement in the process, and preserving the independence of the process, represents the approach most consistent with the statutory criteria for assessing a Part IIIA access undertaking."*[6]

1.4 Scope of GHD Advisory's engagement

The ACCC requires the provision of independent written advice, in the form of a report, on the value of ARTC RAB for its Interstate Network, as described in the ACCC's Request for Quotation for this engagement, using the DORC method. The scope of our engagement reproduced from our Order for Services with the ACCC is set out below.

1.4.1 Method

GHD Advisory applied a DORC valuation method in valuing the RAB for the Interstate Network. In conducting the DORC valuation, the ACCC required GHD Advisory to:

- "base the valuation and optimisation on scrutinised contracted demand figures (for the avoidance of doubt, valuation and optimisation should be based on both existing and expected future demand figures)
- base the valuation on an optimised asset configuration as of 1 July 2019
- determine the 'optimised' Interstate network, within the brownfields constraints of the existing dimensions of the Interstate network:
  - determine the optimal configuration, size and scope of the Interstate Network to meet best estimates of forecast capacity demand for each segment
  - determine the optimal design of the system components and optimal modern technologies used to construct the system components. The system components are MEA
  - components not owned or leased by ARTC for the purposes of the IAU should not be included in the optimal network configuration

[6] ACCC's, Statement of Approach, Valuation of the Interstate network, available at: https://www.accc.gov.au/system/files/ACCC%20Statement%20of%20Approach%20-%20RAB%20valuation%20on%20Interstate%20network_0.pdf

- calculate the optimised replacement cost (**ORC**) of the Interstate Network. The form of optimisation applied is to be undertaken and identified both at the network/Segment level and for each asset type:
  - At the network/Segment level, the optimisation of configuration includes optimisation for over-design, over-capacity, redundancy and stranded assets.
  - At the level of the asset type, the MEA should reflect the minimum future cost of supplying the capital service. The MEA replacement should embody any improvements in materials and build technology, improvements in design and any improvements in the techniques and productivity of installing the MEA.
  - At the level of the asset type, GHD Advisory must exclude assets funded by government gifted expenditure that are discrete and separable assets from the RAB following the DORC calculation, except where there is evidence that assets funded by government expenditure required a commercial return
  - Any optimisation at the level of the network, segment and/or asset type identified by GHD Advisory.
- adjust the DORC for dynamic cost savings, since the optimal configuration of the MEA should minimise the Net Present Value (**NPV**) of future costs for a given best estimate of future capacity demand. These adjustments include:
  - any optimisation adjustments for the present value of operating expenditure savings arising from an optimally configured network and as a result of replacing existing assets with the MEA (for example, if passing loops or sidings are removed as part of the optimisation of configuration, maintenance and inspection costs may be saved and, calculated as a present value (**PV**)), must be deducted from the ORC value.
  - any further depreciation adjustment to DORC (or an adjustment or ORC if more economically appropriate) if the life or capacity of the MEA is different to the life or capacity of existing assets when new
  - any other future cost savings as a result of installing the optimally configured MEA identified by GHD Advisory.
- where indirect/overhead costs are included in the calculation of the ORC, GHD Advisory should clarify the following requirements are met:
  - the indirect/overhead costs correspond to the minimum costs necessary to support the commissioning of the MEA.
  - the indirect/overhead cost pools are clearly identified and itemised, including the activities contained within these pools, and the mark-up/cost estimates substantiated by industry benchmarks and/or relevant project costing evidence.
  - only those indirect/overhead costs that are directly attributable (avoidable cost) to the commissioning of the MEA are included. Where indirect/overhead costs are added to direct replacement costs, directly attributable cause-and-effect cost relationships need to be established.
- form a view on the optimal and cost minimising construction campaign and the construction period, and estimate the interest cost incurred during the construction period. The ACCC will advise GHD Advisory on the appropriate interest-during-construction (**IDC**) rate to be applied for this analysis.
- obtain the DORC from the ORC through an objective and verifiable best estimate of the remaining life for each asset type.
- In addition, apply any other ORC/DORC valuation approach that GHD Advisory considers relevant and important."

1.4.2 Other considerations

The DORC valuation does not include assets not owned or leased by ARTC for the purposes of the Interstate Access Undertaking (**IAU**). This is consistent with the Order for Services agreed with the ACCC

The DORC also does not include assets that are not in service at the valuation date (e.g. capital expenditure for assets that have not been commissioned by 1 July 2019). We confirmed with ARTC that the list of assets provided to us were in service on 1 July 2019, which it did. We have not sought to verify the accuracy of this information beyond that confirmation and have assumed that ARTC has provided a comprehensive list of assets in service as of 1 July 2019.

1.4.3 Structure of this report

We have structured our report to address the requirements set out in section 1.4 above. Our report is structured as follows:

- Section 2 – Principles for DORC valuations
- Section 3 – The data we have used in undertaking the DORC assessment
- Section 4 – Details of the broad assumptions and principles we have applied and the asset classes used
- Section 5 – Estimate of the Replacement Cost by Segment and by asset class
- Section 6 – Estimate of the Optimised Replacement Cost by Segment and asset class
- Section 7 – Assessment of the interest during construction (IDC) costs
- Section 8 – Estimate of the Depreciated Optimised Replacement Cost by Segment and asset class
- Section 9 – Summarises the DORC valuation
- Section 10 – Estimate of opex savings from using the modern equivalent of the existing asset compared with the existing asset itself
- Section 11 – Assessment of the effect of grant funded assets on the valuation
- Section 12 – Presents the value of the RAB for the Interstate Network
- Section 13 – Conclusion of the assessment

1.5 Disclaimer

This report has been prepared by GHD for the ACCC and is intended for use by the ACCC. This report has been prepared for the purpose agreed between GHD and the ACCC as set out in section 2.4 of this report.

GHD otherwise disclaims responsibility to any person other than the ACCC arising in connection with this report. GHD makes no representation concerning the appropriateness of this report for anyone other than the ACCC. If anyone other than the ACCC chooses to use or rely on this report, they do so at their own risk. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the contract between GHD and the ACCC.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer to sections 3 to 8, of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by the ACCC and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has prepared the Depreciated Optimised Replacement Cost (DORC) set out in section 12 of this report ("DORC Estimate") using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD.

The DORC Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the DORC Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the direct and indirect costs applying for the DORC Estimate will be the same as what would actually materialise if the Interstate Network were to be constructed today.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile. The DORC Estimate has been prepared for the purpose defined in the contract between the ACCC and GHD.

2. Overview of DORC principles

2.1 DORC valuations

The DORC approach is an asset valuation method that determines the current cost required to replace the service provided by an existing asset. The output of a DORC valuation reflects the market-based price a reasonable buyer would pay to construct a substitute asset of comparable utility, adjusted for condition that is designed to meet foreseeable regulated service requirements. Through considering the current cost of replacing service potential and including cost efficiencies because of using a Modern Equivalent Asset (**MEA**), it provides a valuation that seeks to be consistent with the long-run marginal cost of current service provision of existing assets[7].

DORC valuations are typically used to calculate value for an asset, typically a regulated asset, where the asset value is used, in part, to determine prices, and hence where a discounted net cash flow of future earnings cannot be used to assess fair value. This situation is often referred to as the 'circularity of asset valuation and asset service delivery pricing'.[8] DORC is also used for assets where there is no market data on sales of such 'specialized' assets because of their unique configuration[9].

2.2 Overview of the DORC valuation process

The high-level process used to undertake a DORC valuation is shown in Figure 4.

Figure 4: High-level process for undertaking a DORC valuation

A DORC is based on the assets that are identified as existing (in-use and delivering a service) or having been commissioned (i.e., achieving operational readiness) as of a certain valuation date.

MEAs refer to the standardised range of equipment that would be used if an asset owner were to replace its existing assets with modern equivalents. The replacement cost (**RC**) of each MEA is identified to determine the current cost of replacing the service potential of existing assets with modern equivalents. RCs are typically developed for each asset type that makes up an asset class. For example, there would be separate modern equivalent assets for bridges and tunnels, but both are part of the 'Structures' asset class. There may be several different types of modern equivalent assets within each asset type. Bridge assets for example vary as a function of span, height or form of construction. This is resolved by using an MEA which contains groupings of related asset types such as bridges of certain height ranges. This avoids the need to create an individual MEA for each asset in the asset base.

The set of MEA are then adjusted with reference to foreseeable usage of the asset, including for redundancy. For example, where demand is too low to support some assets being used, the cost of those assets are removed from the valuation as they are not needed to supply the service.

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[7] Australian Competition Tribunal's decision on an application by ElectraNet Pty Limited, available at: https://www.competitiontribunal.gov.au/decisions/year/2008/acompt-2008?sq_content_src=%2BdXJsPWh0dHBzJTNBJTJGJTJGd3d3Lmp1ZGdtZW50cy5mZWRjb3VydC5nb3YuYXUlMkZqdWRnbWVudHMlMkZKdWRnbWVudHMlMkZ0cmlidW5hbHMlMkZhY29tcHQlMkYyMDA4JTJGMjAwOGFjb21wdDAwMDMmYWxsPTE%3D

[8] Because the asset value is being used to determine pricing, referring to the net cash flow of future earnings cannot be used to determine the asset value. In these situations, an alternative means of valuing the asset must be used.

[9] International Valuation Guidance Note No. 8 Depreciated Replacement Cost International Valuation Standards 6th Edition, available at: http://www.romacor.ro/legislatie/22-gn8.pdf

Finally, to reflect that the asset has been operational for a time (i.e., it is not newly installed, as reflected by the RCs), the RCs for the MEA are then adjusted for age and/or deterioration (i.e., depreciated). The output of these steps creates the DORC valuation.

2.3 Greenfield vs brownfield approach

A DORC valuation can be undertaken using a greenfield or brownfield approach. The key difference between the two approaches is that a brownfields valuation assumes that the asset to be valued is at the same location as the existing asset and within the existing footprint. It also assumes that all supporting infrastructure (e.g., access roads, power supply, earthworks) exists.

The greenfields approach assumes that there are no limitations on asset location or footprint and that there is no relevant supporting infrastructure already in-situ. A greenfields approach therefore typically allows for greater optimisation than a brownfields approach because the ability to optimise the asset is unconstrained by existing location, footprint and infrastructure. This could mean that a different rail corridor to the one providing the service could be used as the basis for a greenfields valuation.

Table 3 sets out the regulatory precedent for the basis of various DORC valuations for rail assets. A brownfields approach is the most widely accepted form for DORC valuations, including for rail assets because it more appropriately reflects the assets which are delivering the service.

Table 3: Precedent for adopting a brownfield approach for a DORC valuation

Asset	Comments
ARTC Interstate Network, DORC valuation 2001	Brownfields approach adopted, but Booz Allan considered the impact of community development on replacement costs was irrelevant for most of the network.[10]
ARTC Interstate Network, DORC valuation 2007	Similarly, the 2001 DORC valuation, a brownfields approach was adopted.[11]
IPART, NSW Rail Access Regime	IPART considered that a greenfields valuation was less relevant to a potential entrant. It noted that a brownfields approach is more widely used for DORC valuations.[12]
Western Australia Freight Network	Greenfields approach is adopted to be consisted with the Costing Principles for the Railways Access Code 2000.[13]

2.4 Modern equivalent assets

A DORC valuation is based on the existing (in use) or commissioned (i.e., achieving operational readiness) assets, as of a certain valuation date. Determining the MEA involves considering the in-situ assets against improvements to those assets (such as technological improvements) or the construction method of those assets that have occurred since the asset was installed.

MEAs are selected to deliver the same service standard as existing assets (as of the valuation date) and are designed and constructed using the modern methods and materials and use proven technology as of the valuation date. They should be selected on the basis that they are not new technology that is unproven, as

[10] ARTC's Standard Gauge Rail Network DORC, available at: https://www.artc.com.au/uploads/news_160301a.pdf
[11] ARTC's Standard Gauge Rail Network DORC, available at: https://www.accc.gov.au/system/files/Booz%20Allen%20Hamilton%20DORC%20valuation%20report.pdf
[12] IPART's Aspects of the NSW Rail Access Regime, available at: https://www.ipart.nsw.gov.au/files/sharedassets/website/trimholdingbay/ipart_final_report_-_aspects_of_the_nsw_rail_access_regime_-_29_april_1999_pdf_version.pdf
[13] WestNetRail 2002, p. 8

this could reduce the viability of the MEA being able to provide identical service standards to the existing assets.

MEAs may differ from existing assets due to:

- There is likely to be variability in the actual assets because most infrastructure is developed in stages over time and may have been designed to provide a different level of service to that which is now required. The MEA is likely to be more consistent across assets that are required to provide a similar level of service.
- Changes in technology and/ or product development
- Changes dictated by legislation (e.g., health and safety legislation) and/ or current standards
- The asset is obsolete. This usually arises where technical advancements result in a type or style of in-situ asset is no longer being available. A typical example might be a SCADA system running on an old-style processor that is no longer available.

2.5 Replacement costs

The replacement cost (**RC**) is then the minimum that it would cost, in the normal course of business, to replace the existing asset with a technologically modern equivalent new asset with the same service potential, allowing for any differences in the quantity and quality of output and in operating costs."[14] RCs reflect the long-run sustainable competitive prices for assets constructed by a competitive provider using the most efficient means. For each asset, the RC is based on an MEA assuming average conditions for construction difficulty in a brownfield environment.

2.6 Optimisation

Optimisation of infrastructure is the step in a DORC valuation that addresses required changes in the asset specification resulting from forecast usage patterns. The objective is to remove any assets that are not required to deliver the required and foreseeable service from the asset base and to identify any assets that are capable of providing a greater level of service or functionality than is required. This results in the valuation reflecting an asset configuration that an efficient new entrant would provide to deliver the service.

2.6.1 Redundant assets

Redundant assets are existing assets that are no longer used to provide the reference service. These assets may still be in the asset register, though they no longer contribute to the immediate or planned service and are therefore excluded from the asset valuation. Redundant assets are different to spares, which are retained by an asset owner in the normal course of business to minimise any impact of an outage of the primary assets.

2.6.2 Technical optimisation

This relates to MEAs that have technical superiority over the existing asset. They may have performance capability or features that are not necessary for the services provided by existing assets. A technically superior MEA to the existing asset which it is replacing could include features (e.g., data-recording capabilities) that are not needed to deliver the reference service. For example, modern rail signalling equipment may record data that existing assets do not.

[14] NSW Treasury's Valuation of Electricity Networks - A Policy Guideline for NSW DNSPs, available at: https://www.treasury.nsw.gov.au/sites/default/files/pdf/TPP14-01_Accounting_Policy_-_Valuation_of_Physical_Non-Current_Assets_at_Fair_Value.pdf

2.6.3 Over-capacity assets

Over-capacity assets are assets with greater service capacity than required to meet service standard requirements, under existing and foreseeable planned demand. To determine any over-capacity of service, the service standard required for existing demand and that implied by foreseeable demand needs to be considered against the service standard provided by the asset.

2.6.4 Operating and maintenance cost optimisation

DORC values can be adjusted to account for any differences between the opex cost profiles of the optimised replacement asset and the existing asset. Cost optimisation is based on the principle that cost differences arise from the use of MEA compared to existing assets to provide the service.[15]

2.7 Depreciation

Depreciation represents the loss in asset service potential (e.g., via asset condition from wear-and-tear or elapsed time) and is applied to the replacement cost and optimised replacement cost. Assets are depreciated to recognise the reduction in the remaining service potential compared to a newly constructed asset to indicate a current value for the assets at the valuation date.

Depreciation is based on asset life. The asset life reflects the time-period an asset is expected to efficiently and reliably provide the service for which it was designed, assuming appropriate and industry good practice maintenance takes place. There are a number of different asset lives relevant for a DORC valuation, discussed in the following sections. The adjustments made to the MEA asset class life and the existing class asset life are identical on an asset-by-asset basis.

2.7.1 Selecting the asset life for the basis of depreciation

2.7.1.1 Economic life

An asset's economic life reflects the period of usefulness for its owner, or the period over which an asset owner intends to recover the investment. Consequently, economic life can be different to the actual physical or operating life of that asset, and some assets will have a life beyond the determined economic life. The economic life of an asset is an important part of business investment, as it dictates when the business can invest prudently in new equipment which assists in the planning and budgeting purposes. DORC valuations do not consider the economic life of the assets for the purposes of depreciation. However, the asset lives in the RAB should reflect the economic life of assets.

2.7.1.2 Design life (or Useful Life)

Useful life is the estimated life of an asset from its commissioning date to end of life, if only routine maintenance (i.e., maintenance that does not materially extend the asset's life) is undertaken

The design life of an asset is the typical anticipated life that is assumed during its design. It is the life expected from an asset designed to provide a given service, under nominal operating conditions and would typically be dictated by industry design standards, ISO standards or other design codes. Design life represents an expected life of the asset without premature failure. In practice, individual assets often cease to be required to provide the service before the end of their design life or, conversely continue to provide a service long after the design life has expired.

[15] The Allen Consulting Group's Review of asset values, costs and cost allocation of Western Australian urban water and wastewater service providers, available at:
https://www.erawa.com.au/cproot/2986/2/ACG%20Report%20on%20General%20Principles%20and%20Methodology.pdf

2.7.1.3 Residual Life (Remaining Life)

Residual life, also known as remaining life, is the expected life of an asset until it is replaced or until the next life-extending maintenance activity occurs. This considers the asset's current condition assuming that reasonable regular maintenance is carried out.

The residual life of an asset is defined in terms of the asset's ability to continue to deliver the service given its condition at the valuation date. In practice, the asset management policy of the asset owner may require disposal after a specified time, or after a proportion of the future economic benefits have been consumed. Therefore, the residual life of an asset may be shorter (or longer) than its economic life.

The estimation of the residual life of the asset is a matter of judgement based on the experience of the asset owner with similar assets (because this reflects the actual operating conditions) and typically involves the review of asset condition data.

2.7.1.4 Asset lives selected for depreciation in the DORC

A DORC valuation is associated with cost of replacing an asset that has the same service potential as the existing asset. A DORC is therefore based on assessments of Design (Useful) Life and Residual (Remaining Life). Economic Life is not used in a DORC valuation because this is entirely associated with the asset owner's capital recovery strategy.

2.7.2 Straight-line depreciation for DORC valuations

The depreciable amount of an asset is determined after deducting its residual value. The residual value of an asset is the estimated amount that an entity would currently obtain from disposing the asset, after deducting the estimated disposal cost. There are two methods that could be employed to allocate the depreciable amount of an asset on a systematic basis over its useful life. These methods include straight-line and diminishing value:

Straight-line depreciation assumes that the condition of an asset deteriorates linearly over time. This approach results in a constant annual reduction in asset value over the useful life.

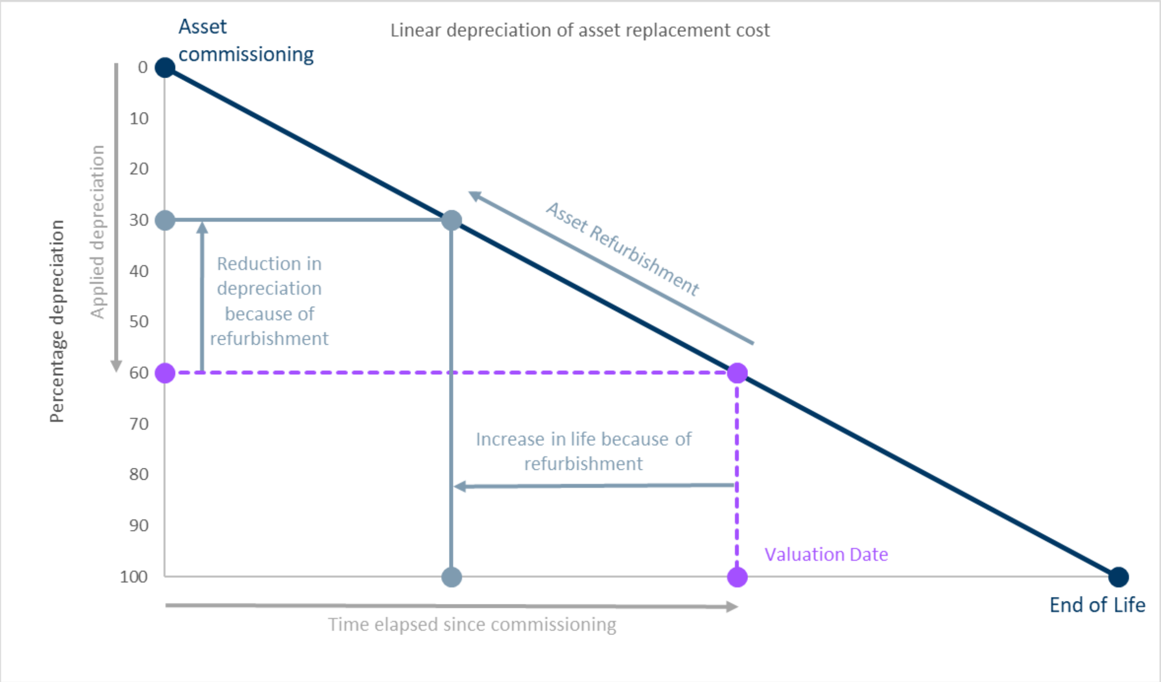
Figure 5 illustrates how the depreciated replacement cost is estimated using the proportion of residual life to useful life and illustrates how life extending maintenance increases the proportion of Useful Life that remains at the valuation date.

We were required to apply a **straight-line depreciation** method where an asset is assumed to deteriorate linearly from its commissioning date, to the end of its residual life. This is appropriate for assets where their ability to deliver the service degrades at a near-constant rate over time which is representative for many infrastructure assets, including rail infrastructure assets.

The depreciated replacement cost of the asset is evaluated by reducing the replacement cost of the asset, to the proportion of the asset's remaining life to its useful life. This is a standard and accepted approach when there is no data on temporal change in condition.

There are some assets that exhibit failure mechanisms that are not time-based and consequently their ability to deliver the level of service does not deteriorate over time. Consequently, it is not appropriate to depreciate these assets because, providing appropriate maintenance is undertaken, there is not material degradation in service level over time. These non-depreciating assets are also known as perpetual assets, reflecting that their value is constant into perpetuity. Perpetual assets typically include land, current assets such as cash-in-hand or receivables, and collectibles.

Figure 5: Straight line depreciation for refurbished assets



3. Data used in the DORC valuation

Our DORC valuation is largely based on information we received from ARTC.

We obtained this information from ARTC via a formal Request for Information (**RFI**) process as set out in the Order of Services. The RFI process was managed by the ACCC. We submitted RFI to the ACCC in a standard format. After discussing the RFI with the ACCC, we submitted it to the ACCC for issuance to ARTC, and ARTC responded with the required information.

We also received redacted documents prepared by [redacted], ARTC's consultant, as they relate to the DORC valuation we understand ARTC had commissioned. Over the course of the preparation of this report, we raised 15 RFIs with ARTC via the ACCC. We also received information from ARTC outside of the formal RFI process for us to begin our analysis. This information was provided to us on 13 May 2020, 14 May 2020, and 20 May 2020.

3.1 ARTC's data and information

The full list of documents provided to us by ARTC is provided in Appendix A. A summary of the information we received is set out in Table 4.

3.2 GHD's in-house data and information

We made use of our in-house confidential database of unit rates for capital expenditure relating to several below-rail service providers in Australia, as well as our engineering experience in working with below-rail service providers across the entire asset lifecycle. We have also relied on recent construction contracts and tenders.

3.3 Publicly available information

We made use of the following public information:

- ARTC's Master Train Plans (**MTPs**) for the Interstate Network
- ARTC's Network Information Books
- ARTC's Network Line Diagrams
- Evans & Peck DORC calculation for additional segments of the ARTC network (Queensland Border to Acacia Ridge Valuation Report)
- Evans & Peck Gap to Turrawan DORC calculation
- Booz Allen Hamilton, ARTC Standard Gauge Rail Network DORC
- GeoScience Australia Digital Elevation Model
- Applicable ARTC Standards

3.4 Asset register information

ARTC's financial and fixed asset registers and supporting information that was provided to us was not suitable for a DORC valuation. It was provided to us by ARTC from a previous DORC valuation that ARTC had commissioned and contained a number of assumptions that we were unable to verify.

There were also several gaps in the asset information provided to us by ARTC. Major gaps we identified included:

– Earthworks volumes, including lengths of cuttings and embankments
– Key information relating to the structural form of bridges
– Pipe lengths, sizes and types for drainage systems
– Sizes and construction material for building facilities
– Length and width of airstrips and the pavement types
– Size and construction material for communication towers
– Technical detail on ‘miscellaneous structures’ such as platforms, gantries, enclosures and yards
– Voltages, size of switchyards and the length of cable sections for distribution substations
– Sizes of equipment enclosures
– Technical detail for line routes and wayside devices

We sought further information from ARTC to fill these gaps and provide further supporting information to inform our assumptions. ARTC confirmed that it was unable to address most of the identified information gaps.

To address this deficiency, we prepared our own asset register using ARTC’s *Ellipse* asset management and equipment register where possible. [16] We used a GIS-based approach to derive the earthworks volumes and other approaches for key assets, such as signalling assets. These are set out in Section 5.

[16] We required a variation to the existing Order for Services with the ACCC to develop the asset register for the DORC valuation, as this task was beyond the scope of the contract.

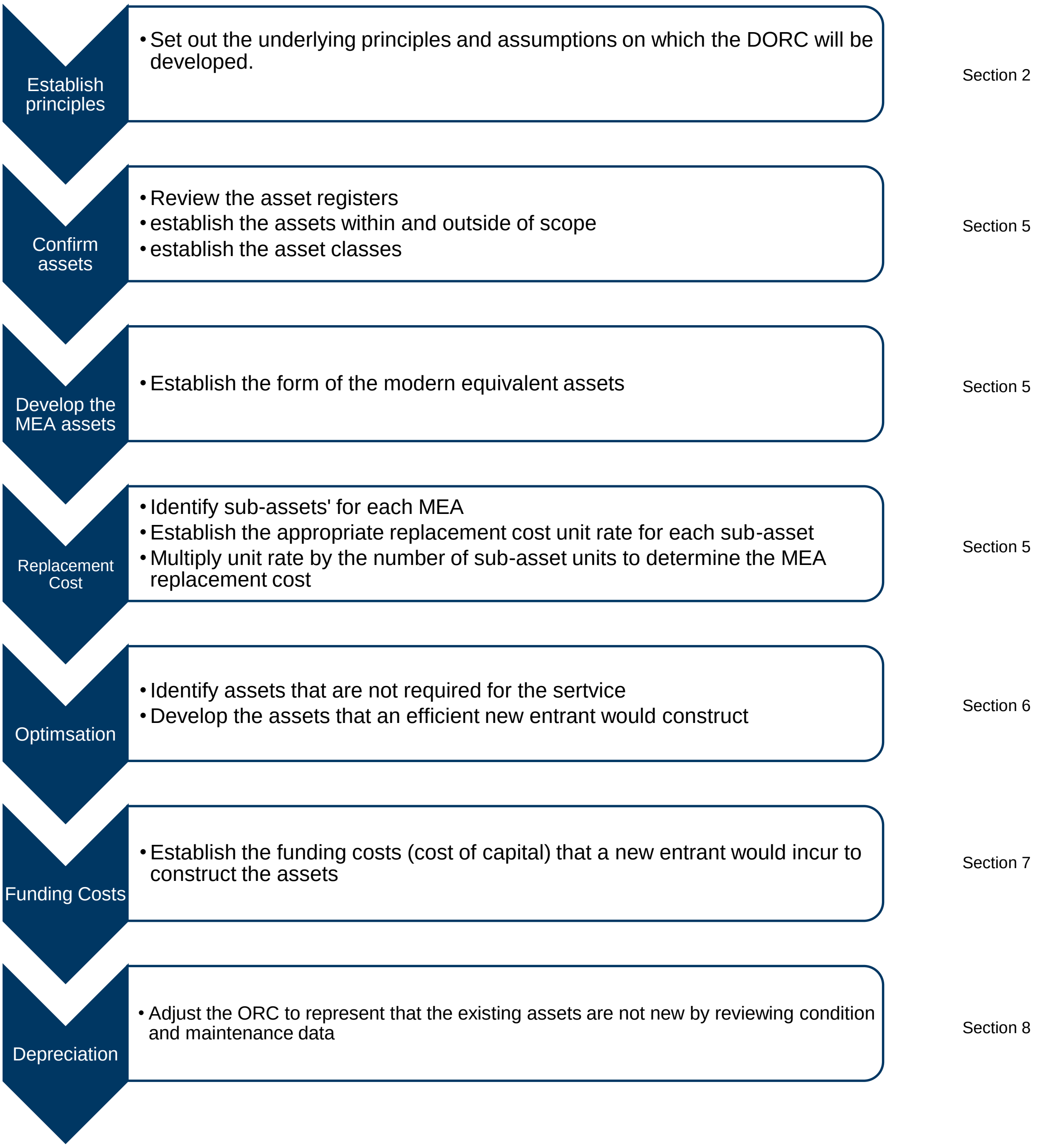
Table 4: Key information provided by ARTC

Financial & commercial	Asset specification information	Demand data	Survey data & drawings	Other
Fixed & financial asset register	*Ellipse* asset-management and *Nameplate* data for asset classes other than earthworks and track	Volume demand data, historical and forecast, inclusive of Inland Rail impact (FY2015 to FY2030)	ARTC Summary of Geotechnical Sites	[redacted] report section (redacted) for the approach used to derive earthworks volumes. This had all values, rates and optimisation percentages removed for the purposes of independence.
Lease agreements between ARTC and Queensland, New South Wales and Victorian governments	Track (rail, sleeper and ballast) asset data		Line diagrams	Earthworks risk register
Asset management document EGP 10-03	Asset specific information and manuals, such as IAU Comms Tower Information July 2020, ARTC Antenna Data, Specification documents for the RailBAM Bearing Acoustic Monitor			Account code listings and asset/network configuration mapping
CI Financials Asset Maintenance Plan – Actual and Forecast (FY2015 to FY2025)	TMS data extracts			
Further operating and maintenance cost data, over the period FY2015 to FY2025 (ACCC RFI 10 Submission 2020-10-23)	Interstate Rail Wear survey data			

4. Our approach

This section sets out the method that we have adopted to undertake a DORC valuation of the ARTC Interstate Network. This follows the flowchart in Figure 6 which includes references to the detailed discussion the following sections of the report.

Figure 6: DORC valuation flowchart



4.1 Overarching principles and considerations

4.1.1 Valuation date

The valuation date for our DORC is 1 July 2019.

4.1.2 Assets relevant for our DORC valuation

The assets we have valued are those assets that are used to provide the Interstate Network service. We consider these assets are those within the existing dimensions, routes and locations of the Interstate Network.

4.1.3 Brownfields approach

We have adopted a brownfields approach for the DORC valuation, consistent with the requirements in the Order for Services

4.1.4 Desktop review

Under the Order for Services, we were required to review and assess the relevant asset information provided to us by ARTC. Where we considered that information insufficient to form a justified view on the condition of some assets, or where ACCC required us to corroborate the information provided in relation to some assets, we would undertake a site visit.

We considered the information provided to us by ARTC sufficient to form a justified view on the condition of assets, and therefore did not consider that site visits were necessary. This is because we were provided with data from ARTC's railwear model which presents data on the track assets across the entire network. This is based on quantified measurements of the rail profile and can be directly correlated with remaining life because when the steel has worn away to predetermined limits, that section of rail is at the end of its life and needs to be replaced. Consequently, in our view, basing the remaining life assessment of this data results in a more rigorous and robust outcome than using a qualitative assessment based on condition reports or visual inspections, as would be typical for a DORC.

We also note that we were engaged by ACCC shortly before the COVID-19 pandemic in Australia. As a result, we were unable to undertake site visits while we were assessing ARTC's information due to the mitigation measures implemented by State and Federal governments, including border closures and lockdown(s).

4.2 Confirmation of Segments in the valuation

The Interstate Network covers 13 Segments located across Australia, all of which are standard gauge (also known as Stephenson gauge, 1,435 mm (4' 8 ½'')), tensioned welded track. The length and usage of these Segments is set out in Table 5.

4.3 Asset classes used in the valuation

The assets presented in the asset register have been grouped into a series of asset classes. This grouping is based on the physical function of the assets and is shown in Table 6.

***Table 5: The 13 Segments comprising the ARTC Interstate Network*[17]**

Segment	Track length (km)	Track configuration	Maximum train length (m)	Trains per week
Dry Creek to Parkeston	1993	Single	1800	[redacted]
Tarcoola to Asia-Pacific Interface (API)	6	Single	-	[redacted]
Port Augusta to Whyalla	71	Single	1500	[redacted]
Crystal Brook to Parkes	1101	Single	1800	[redacted]
Cootamundra to Parkes	198	Single	1800	[redacted]
Dry Creek to Pelican Point	32	Single	1200	[redacted]
Dry Creek to Melbourne (Spencer Street)	883	Single	1800	[redacted]
Appleton Dock to Footscray	30	Duplicated	1800	[redacted]
Melbourne (Tottenham) to Macarthur	1060	Duplicated	1800	[redacted]
Moss Vale to Unanderra	67	Single	-	[redacted]
Southern Sydney Freight Line (SSFL)	40	Duplicated	-	[redacted]
Metropolitan Freight Network (MFN)	36	Duplicated	1800	[redacted]
Newcastle to Acacia Ridge	848	Single	1500	[redacted]

[17] GHD's analysis from ARTC's Master Train Plans and other ARTC information

Table 6: Asset Classes used in the valuation

Asset Class	Sub-asset class
General Civil	– Culverts – Hard sub-surface drainage (RCP etc) – Level Crossings
Miscellaneous Assets	– Airstrips – Permanent Signs – Non-Safety-Critical Equipment – Stations
Right of Way	– Soft Drainage (piping) – Fencing – Earthworks
Signals and Comms	– Communications – Line Routes – Communications Towers – Signal Locations – Control Systems – Signals – Telemetry – Train Detections – Calibrated Equipment – Train Tokens – Enclosures – Level Crossing Signals – Insulated Joints – Interlockings
Structures	– Tunnels – Bridges
Track	– Rail Lubricators – Turnouts – Track – Points
Utilities	– Distribution Substations – Power Supply

The discussion in the subsequent sections is based on these asset classes.

5. Replacement costs (RC)

5.1 The approach used to determine the replacement cost

The Replacement Cost (**RC**) reflects the construction cost of replacing each asset with the MEA. We have determined this by establishing a unit cost rates for each MEA, which may be in dollars per square metre, or dollars per linear metre for example. These are then multiplied by the quantity of units in the MEA to estimate the replacement cost. An overview of how we have calculated the RC is shown in Figure 7.

Figure 7: Overview of approach to calculating the replacement cost

Our RCs seek to reflect the current cost of replacing the existing assets with MEAs and reflect the costs of assets constructed by a competitive industry service provider using the most efficient means.[18]

The RC is based on an MEA, which assumes average conditions for construction difficulty associated with installing the asset in a brownfield environment. We have used market and cost data drawn from several sources available to us, in the following order of hierarchy:

– Recent construction contracts and tenders
– Recent infrastructure cost information e.g., developed/procured by us from advising on refurbishments/upgrades or extensions
– In-house cost databases developed and updated by us through our previous infrastructure project work
– ARTC's financial asset register for some cost items such as:
  - Retaining Walls
  - Utilities
– Public domain information, where available.

The RC for each MEA within an asset class is then summed to give a Replacement Cost for each Asset Class.

[18] Note that the form of the existing asset could be the MEA, however, this has no impact on the selection or derivation of RC.

5.2 Modern equivalent assets

The MEA selection is based on two considerations, that is what:

– asset would be constructed today, given modern technology and construction methods, including prevalence of use of that item in industry (e.g. commercially available assets)
– the level of foreseeable demand is on each Segment, to determine if this influences MEA selection (e.g. use of concrete or timber sleepers).

The MEAs we have selected and the basis for selection are described by asset class in the following sections. Please note that the summation of each asset type's replacement cost may be different to the sum of the values in the tables for each MEA due to number rounding.

5.3 Development of unit rates

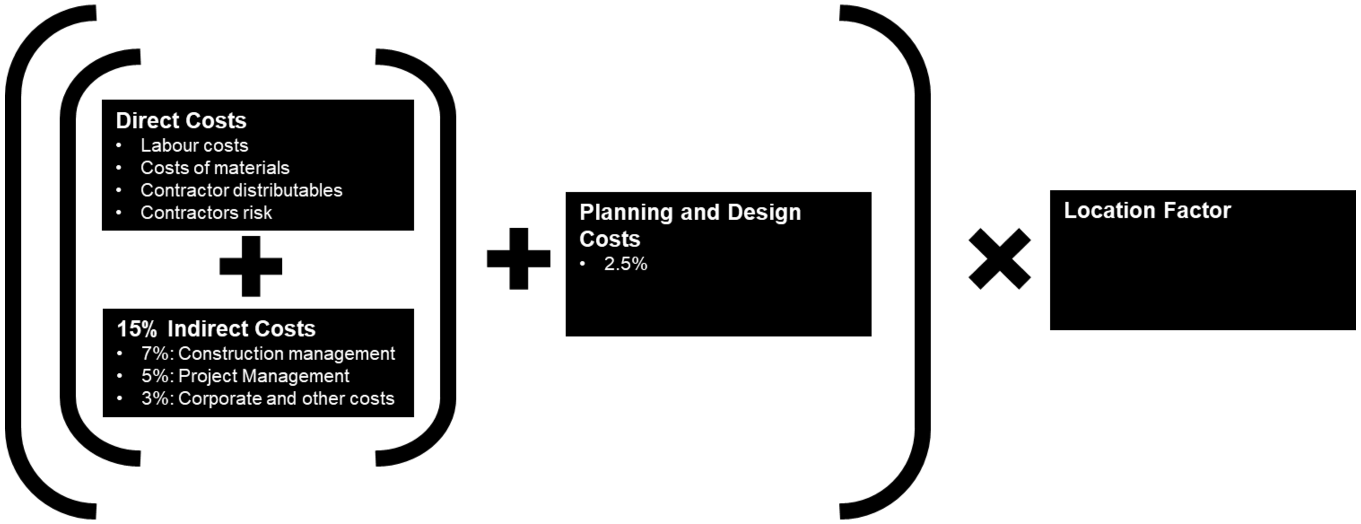
To establish the replacement cost of the MEAs in service at the valuation date, we developed a series of "units rates". Units rates were used to express common assets in terms of a cost per item, per unit length (e.g. $ per kilometre of track) or per unit area so that these could be extended by the quantity to determine the cost of each MEA.

The unit rates we developed are set out by asset class in the following sections.

The build-up of our unit rates is shown in Figure 8 and is structured to reflect the way the costs of a development like this would typically be determined.

The basis of each of these cost components in discussed in the following sections.

Figure 8: Build-up of unit rates



5.3.1 Direct costs

The direct cost is made up of four components. These are all based on our experience and knowledge of tendered rates for works of this type.

5.3.1.1 Cost of labour

This is the 'raw' salary costs to the employer which include payroll, burden[19] and taxes. Labour rates are based on average crew rates, with crews developed using typical mixes of trade skills per major trade discipline. Labour rates used in this DORC valuation are based on typical labour rates for Australia in the construction industry (e.g. via use of enterprise bargaining agreements).

5.3.1.2 Cost of materials

This is the cost of the bulk materials required for the construction. These are typically expressed in $/hour terms (plant and equipment) or in $\$/m^3$ or $/item terms (bulk materials).

5.3.1.3 Contractor distributable

These costs reflect the contractor's overheads, profits and preliminaries. These costs are typically expressed as a percentage of direct labour costs and represent the cost of doing business for the contractor, which is recovered in addition to the capital works. Contractor distributable include an allowance for supervision, maintenance and support; construction equipment and vehicles; cranage; temporary facilities; services and utilities; operating expenses; mobilisation and demobilisation; office-running costs; small tools; and overheads and fees.

5.3.1.4 Contractors Risk Allowance

The allowance is to cover the risk premium that an experienced contractor would include in developing their tender price, to allow for uncertainty in assumptions. This would typically be a percentage allowance that the contractor would apply based on their perceived risks associated with the works and the contract.

Contingency for scope risk is not included because the extent of the works is known.

5.3.2 Indirect costs

The indirect costs are set out below. These are typically a function of the direct costs and we have benchmarked the allowances proposed against recent tender submissions for similar construction works.

5.3.2.1 Construction management

This includes the temporary facilities and items that will be shared among multiple contractors at the project site including but not limited to the below. These are typically a function of the construction works, so are expressed as a percentage of the Direct Costs.

– Temporary laydown areas and access
– Temporary facilities
– Site Support Services
– Warehousing
– Security and Medical
– Site survey/set out

[19] Where burden refers to indirect costs that cannot be attributed to a specific member of staff. Such costs include leave allowances, super contributions, workers compensation insurance .

- Site labour, site safety induction costs
- Freight
- Construction accommodation costs

5.3.2.2 Project management

This covers the cost of managing the project development and construction works, including:

- Project management and Non-Technical support
- Project Controls
- Procurement and Contracts
- Inspection & Expediting
- Finance & Accounting
- Safety and Employment Relations
- Human Resources
- Document Control

5.3.2.3 Corporate and other costs

This includes other proponent overhead costs such as rental, office fit-out & furniture, information technology setup, hardware and software, other employee costs, such as, mobilisation / demobilisation, R&R, taxes and insurances.

5.3.3 Planning and design costs

Pre-construction costs include cost items such as planning, approvals, concept design, procurement, and detailed design. These costs are included in DORC valuations because a DORC value reflects the current replacement costs of the asset that would be incurred by an efficient entrant.

5.3.3.1 Feasibility, concept and detailed design

Feasibility studies consider the economic, technical, legal and scheduling considerations and are used to support the investment decision making process. Concept design refers to design studies that evaluate the potential design solutions for infrastructure. Concept design is the initial design that reflects the response to the feasibility studies. This phase typically outlines project specifications, planning strategies, programme and phasing strategies and construction logistics. Detailed design is the effort required to develop the concept designs to a level of detail sufficient for construction.

For the purposes of developing these costs, we have assumed that an efficient entrant would undertake feasibility and concept design studies for the entire Interstate Network at the planning phase, with the detailed design following shortly thereafter. Based on our experience in design studies for rail sector infrastructure, we consider that the costs for such a task would be of the order of 2-3% of the capital costs for the assets.

There would be further additional costs associated with the supervision of construction. These costs are incurred as the works are constructed and so these have been included in the 'indirect costs' discussed in 5.3.2.1.

5.3.3.2 Development and planning approval

The Interstate Network extends over five states: Western Australia, South Australia, Victoria, New South Wales and Queensland. If the Interstate Network were to be developed today, planning approval would be required under each state's legislature incorporating environmental impact assessment (**EIA**) of the construction and operation impacts of the network. Specific issues (such as nationally listed threatened species and communities and nationally listed heritage places) would also require assessment under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (**EPBC Act**).

To simplify assessment processes, most states and territories have set up bilateral agreements with the Australian Government that set out joint assessment processes. In most cases, the Commonwealth process is incorporated into the overall state assessment process. As ARTC is an Australian Government Business Enterprise, to simplify planning approval processes some states have enacted specific provisions to simplify approval processes. For example, in NSW, ARTC has the same status as a public authority for the purpose of environmental impact assessment of its activities under the NSW *Environmental Planning and Assessment Act 1979*. Key state legislation for planning approval of infrastructure is shown in Table 7

Table 7: Key state planning legislation

State	Legislation
Western Australia	Environmental Protection Act 1986
South Australia	Planning, Development and Infrastructure Act 2016
Victoria	Environmental Effects Act 1978
New South Wales	Environmental Planning and Assessment Act 1979
Queensland	Environmental Protection Act 1994 State Development and Public Works Organisation Act 1971

The key stages in the planning approval process for a project are as follows:

- **Scoping phase** – typically involving the preparation of a preliminary environmental assessment or scoping report to enable the lead approval authority to confirm the process to be followed and develop terms of reference for the environmental impact assessment.
- **Preparation of EIA** – the EIA documentation and supporting technical studies are prepared.
- **Public exhibition** – the EIA is made publicly available for review by stakeholders and submissions are sought by the lead approval authority.
- **Approval phase** – the lead planning approval authority considers the findings of the EIA and the stakeholder submissions and decides whether to grant approval for the project.
- **Conditions of approval** - should the project receive approval; conditions of approval are issued by the lead planning approval authority which set out the environmental compliance requirements that must be met during construction and operation.

Following approval of the project a construction environmental management plan (**CEMP**) is typically prepared based on the requirements of the EIA and conditions of approval. The CEMP sets out environmental mitigation and management measures, safeguards and monitoring that apply during construction of the project. Environmental advice is also commonly provided prior to the scoping phase to identify environmental risks and constraints and as an input into assessment of options and project alternatives.

There is limited available literature available on the costs of EIA processes. Legislation and requirements vary widely between different jurisdictions affecting cost of studies and timing.

A 20-year review of the European Union's EIA Directive (85/3337/EEC) conducted in 2007 undertook a literature review of the estimated costs of undertaking an EIA. Overall, the costs were found to be mostly less than 1% of the overall capital cost. The EIA component as a percentage of total cost was found to be smaller for larger projects. EIAs for linear infrastructure projects were found to be relatively more expensive.[20]

A study conducted by the European Union on the costs and benefits of EIA looked at 18 case studies over a six-month period based on project EIAs conducted in Greece, the Netherlands, Spain and United Kingdom. The study concluded that between 60% to 90% of the cost of a project EIA was incurred in undertaking the environmental studies and writing the Environmental Impact Statement. For 60% of the projects EIA costs were less than 0.5% of the overall capital cost. Costs exceeding 1% were the exception and were found to apply to controversial projects, projects in sensitive environments or where good EIA practice had not been followed.[21]

Based on our experience, the following direct cost percentages have been adopted in estimating the professional costs.

Table 8: Percentage costs for environmental planning and construction monitoring

Phase	Description	Percentage of ORC
Pre-construction planning and approvals	– Environmental constraints analysis – Options assessment – Environmental impact assessment preparation – Assessment and consideration of stakeholder submissions to EIA	0.40
Post approvals	– Preparation of construction environmental management plans and sub plan – Secondary approvals – Pre-construction activities	0.05
Construction monitoring	– Environmental monitoring and reporting during construction	0.15

The costs are based on a typical linear infrastructure project in an Australian rural setting with a capital cost in the range of $500 million to $1.5 billion. In an urban setting, the percentages would be lower due to significantly higher construction cost. Due to the small length of the ARTC network in urban settings the percentages in Table 8 have been applied across the entire network.

5.3.3.3 Summary pre-construction costs

A total of 2.5% has been added to the direct costs to allow for the combined design and development planning approval activities.

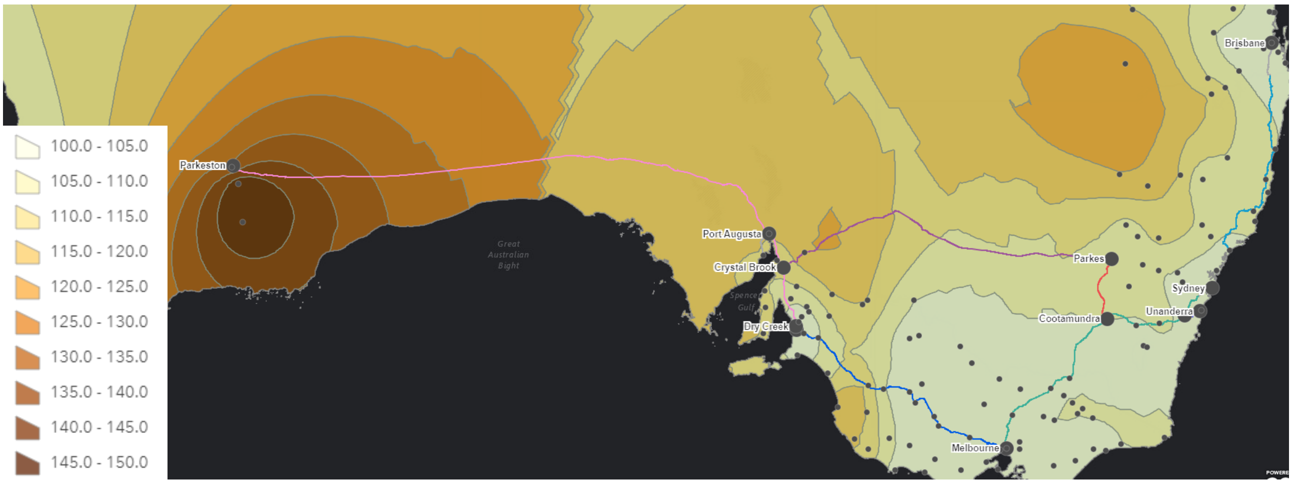
[20] Oosterhuis (2007). Costs and Benefits of the EIA Directive – Final report for DG Environment under specific agreement no 07010401/2006/447175/FRA/G1, available at: https://ec.europa.eu/environment/eia/pdf/Costs%20and%20benefits%20of%20the%20EIA%20Directive.pdf

[21] European Commission (EC) (1996). Environmental Impact Assessment in Europe. A Study on Costs and Benefits. Brussels, Netherlands: European Commission.

5.3.4 Location factor

Location factors were applied to the replacement cost of each asset to represent the increased cost required to mobilised materials, labour and plant to regional areas. To determine these factors, we digitised the regional uplift factors presented in industry estimating reference material[22] and plotted them in the GIS. This plot is shown in Figure 9 which illustrates how the factor varies by location.

Figure 9: Location Factor geographical distribution



We used GIS to determine the length of each segment that was proximal to each location factor to allow us to determine the appropriate weighted factor for each segment. For each location factor, we calculated the track length in a segment that was close to it and multiplied that by the location factor. We then summed these by segment to give the total factored track kilometres for each segment. We then divided the track length for each segment by the sum of the unfactored total track length in that segment to determine the weighted location factor. The resulting location factors are set out in Table 9.

Table 9: Location-related cost factors for the 13 Segments

Track Segment	Weighted location factor
Dry Creek to Parkeston	1.29
Tarcoola to API	1.20
Port Augusta to Whyalla	1.08
Crystal Brook to Parkes	1.09
Cootamundra to Parkes	1.05
Dry Creek to Pelican Point	1.00
Dry Creek to Melbourne (Spencer Street)	1.06
Appleton Dock to Footscray	1.00
Melbourne (Tottenham) to Macarthur	1.03
Moss Vale to Unanderra	1.05
SSFL	1.00
MFN	1.00
Newcastle to Acacia Ridge	1.07

[22] Rawlinsons Australian Construction Handbook 2021 - Edition 39, Regional Indices

5.3.5 Replacement cost calculation

The replacement cost for an asset was calculated as the product of the appropriate Unit Rate and the quantity of the asset, as shown below:

$$\text{Replacement Cost (Single asset)} = \text{Unit Rate} \times \text{Quantity}$$

Where:

– Unit rate is the unit rate for a given MEA
– Quantity is the number of assets in the MEA e.g. number of ‘spot’ assets (such as cabinets), length of linear assets (such as track), volume of cubic assets (such as earthworks)

5.4 General Civil Infrastructure

5.4.1 Modern Equivalent Asset selection

The MEAs used in our DORC valuation and the basis of their selection is shown in Table 10.

Table 10: General Civil Infrastructure MEAs

Asset	MEA for Asset Class	Reasoning for MEA selection
Culverts (reinforced concrete pipes)	Reinforced concrete pipes (RCPs)	Consistent with modern construction methods and drainage design
Culverts (corrugated metal pipes)	Corrugated Metal Pipes (CMPs)	Consistent with modern construction methods and drainage design
Culverts (reinforced concrete box culverts)	Reinforced Concrete Box Culverts (RCBCs)	Consistent with modern construction methods and drainage design
Level Crossings (Private Property)	Single track – passive control with signage only	Consistent with modern railway practice
Level Crossings (Public - Active)	Active control, as appropriate to the traffic conditions	Consistent with modern railway practice
Level Crossings (Public - Passive)	Passive control, as appropriate to the traffic conditions	Consistent with modern railway practice

5.4.2 Replacement Cost – General Civil Infrastructure

For general civil infrastructure, we identified a sub-asset for each MEA and then determined a unit replacement cost for each general civil structure MEA. We then determined the quantity of each sub-asset across the network and determined each MEA’s total replacement cost as shown in Table 11.

Table 11: Replacement Cost – General Civil Infrastructure

Asset	MEA	Unit	Quantity	Rate ($,000)	Replacement Cost ($million)
Culverts (reinforced concrete pipes)	Reinforced concrete pipes (RCPs)	ea	74	11.7	0.9
Culverts (corrugated metal pipes)	Corrugated Metal Pipes (CMPs)	ea	634	7.4	4.7
Culverts (reinforced concrete box culverts)	Reinforced Concrete Box Culverts (RCBCs)	ea	8089	21.4	173.1
Level Crossings (Private Property)	Single track – passive control with signage only	ea	21	73.6	1.5
Level Crossings (Public - Active)	Active control, as appropriate to the traffic conditions	ea	549	573.5	314.9
Level Crossings (Public - Passive)	Passive control, as appropriate to the traffic conditions	ea	1469	156.7	230.2
SUB-TOTAL					**725.2**

5.5 Miscellaneous assets

5.5.1 Modern Equivalent Asset selection

The MEA for miscellaneous assets and the basis of their selection is shown in Table 12.

Table 12: Miscellaneous assets MEAs

Asset	MEA	Reasoning for MEA selection
Airstrips	Unsealed with no buildings and battery-powered lighting	Matches minimum standard required for purpose for which the airstrips are used (e.g. light aircraft)
Stations (platforms)	Platform (concrete)	Consistent with modern railway platform standards
Non-safety critical equipment	Cattle grids	Consistent with practical, efficient, and cost-effective construction methods

5.5.2 Replacement Cost – Miscellaneous assets

For miscellaneous assets, we identified a sub-asset for each MEA and then determined a unit replacement cost for each miscellaneous asset MEA. We then determined the quantity of each sub-asset across the network and determined each MEA's total replacement cost as shown in Table 13

Table 13: Replacement Cost – Miscellaneous assets

Asset	MEA	Unit	Quantity	Rate ($,000)	Replacement Cost ($million)
Airstrips	Unsealed with no buildings and battery-powered lighting	ea	12	12,361.7	148.3
Stations (platforms)	Platform (concrete)	ea	23	82.6	1.9
Non-safety critical equipment	Cattle Grids	ea	20	60.8	1.2
SUB-TOTAL					**151.5**

5.6 Right of Way

5.6.1 Modern Equivalent Asset selection

The modern equivalent assets and the basis of their selection is shown in Table 14.

Table 14: Right of Way MEAs

Asset	MEA for Asset	Reasoning for MEA selection
Drainage	200 mm high density polyethylene (HDPE) pipe	Consistent with modern construction methods/drainage materials and drainage design
Earthworks - Cut to Stockpile	Designed to relevant State's extant standards and specifications for earthworks construction based on digital terrain data (see discussion below).	In accordance with existing ARTC standards
Earthworks - win to fill including placement and compaction	As above.	In accordance with existing ARTC standards
Earthworks - Cut to spoil	As above.	In accordance with existing ARTC standards
Earthworks - Imported fill	As above.	In accordance with existing ARTC standards
Fencing (rural), including right of way	Rural fencing (four-strand barbed wire with steel posts installed on both sides of the track)	Consistent with modern railway practice
Fencing (urban), including right of way	Urban fencing (steel palisade fencing)	Consistent with modern railway practice

5.6.2 Replacement Cost – Right of Way

In the data provided to us by ARTC, we also found that the earthworks volume information was insufficient for the purposes of undertaking a DORC, because it was focussed on geotechnical risk rather than asset extent and the information only extended over part of the Interstate Network. Previous DORC valuations undertaken by Booz-Allen and Evans and Peck indicate that earthworks comprise approximately 15% to 25% of the total DORC valuation. As such, we designed a modelling approach to develop estimates for these volumes.

To compensate for this lack of data, we used an authoritative national digital elevation model (**DEM**) from Geoscience Australia that captures elevation across the entire network to assess the order of earthworks effort to construct the ARTC network. The digital elevation model captures the full extent of the ARTC network at 30-metre resolution that has been smoothed to reduce noise and is the best representation of surface shape that supports the calculation of local terrain shape attributes such as slope, aspect and curvature at a national scale. We used Feature Manipulation Engine (**FME**) software to build a repeatable automated process for quantifying elevations along each ARTC rail segment.

The rail network data was obtained from State government datasets, which we consider to be the most up-to-date and spatially accurate data available. The State government data provides the horizontal alignment of the track infrastructure, which is effectively a plan of the rail network. The DEM provides elevation data at regular spaced grid across the country. By combining the two, we were able to approximate the elevation of the rail corridor and the adjacent topography. We did not rely on data provided to us by ARTC, as it provided schematic diagrams, but not a physical representation of the network that could be used as the basis for earthworks calculations.

Working systematically segment-by-segment, we overlayed the rail network data over the DEM, giving elevation data along the track alignment. The process extracts elevation data from the DEM at 100 m intervals along the centre of the rail corridor and offset 50 m either side to represent the surrounding terrain, across the entire ARTC network.

The variation in elevation between successive data points along the centre of the rail corridor was greater than could be realised (e.g. 2% would be a typical maximum vertical gradient for freight rail). This is because the elevation estimates are based on data resolved to a 30 m grid, rather than discrete data points located on the track. Further analysis of the data showed that smoothing the elevation data by using a moving average over 1 km of track resulted in a vertical track gradient of less than 2% between successive data points for over 90% of the track.

We took the elevation of the existing terrain as the average of the two elevations offset 50 m from the centreline. The earthworks volume was then calculated by assuming a formation width at the track bed level (typically 10 m) and embankment/cutting batter (1:1.5, i.e. a slope of 1 m horizontally for every 1.5 m vertically) at 100 m intervals across the entire network. We then calculated cut-and-fill volumes at each 100 m interval, to determine a material mass balance for each segment.

As is typical for constructing linear infrastructure (such as railway networks), we assumed that an efficient contractor would look to reuse material where possible. In this context, we built up costs on the basis that:

- all excavated material would be cut and placed in a stockpile within 1 km of the excavation
- stockpiled material would then be used for fill
- any surplus material would be carted to a stockpile, but any overall shortfall would be sourced from a land-based source.

The excavation mass balance is shown in Table 15.Rates for each activity were then applied to determine the replacement cost. This is shown for the earthworks in Table 15 and including corridor fencing in Table 16.

Table 15: Earthworks replacement cost breakdown by segment

Regulatory Segment	Cut to Stockpile (m^3)	Stockpile to fill including placement and compaction	Imported fill	Replacement Cost ($million)
Units	**Thousand m^3**	**Thousand m^3**	**Thousand m^3**	**$million**
Unit Rate (Inc. on-costs) ($million AUD / thousand m^3)	**8.3**	**12.2**	**79.5**	
Dry Creek to Parkeston	8,000	8,000	-	193.9
Tarcoola to Asia-Pacific Interface (API)	11	11	-	0.3
Port Augusta to Whyalla	516	516	-	10.5
Crystal Brook to Parkes	6,591	6,640	48	140.0
Cootamundra to Parkes	907	907	-	18.0
Dry Creek to Pelican Point	51	53	3	1.3
Dry Creek to Melbourne (Spencer Street)	7,187	7,303	116	154.3
Appleton Dock to Footscray	74	92	18	2.9
Melbourne (Tottenham) to Macarthur	12,527	12,527	-	243.3
Moss Vale to Unanderra	4,888	4,888	-	96.8
Southern Sydney Freight Line (SSFL)	519	519	-	9.8
Metropolitan Freight Network (MFN)	606	606	-	11.4
Newcastle to Acacia Ridge	19,246	19,246	-	388.4
TOTAL Volume of Earthworks	**61,122**	**61,307**	**184**	
TOTAL REPLACEMENT COST ($MILLION)	**509.5**	**746.8**	**14.7**	**1,270.9**

The replacement cost for right-of-way which includes the earthworks shown above plus an allowance for fencing is shown in Table 16.

*Table 16: Replacement Cost – Right of Way**

Asset	MEA	Unit	Quantity	Rate ($,000)	Replacement Cost ($million)
Earthworks - Cut to Stockpile	Designed to relevant State's extant standards and specifications for earthworks construction	,000m^3	61,122	0.008	509.4
Earthworks - Win to fill including placement and compaction	Designed to relevant State's extant standards and specifications for earthworks construction	,000m^3	61,307	0.012	746.7
Earthworks - Cut to spoil	Designed to relevant State's extant standards and specifications for earthworks construction	,000m^3	0	0.009	0.0[23]
Earthworks - Imported fill	Designed to relevant State's extant standards and specifications for earthworks construction	,000m^3	184	0.080	14.6
Fencing (rural), including right of way	Rural fencing (four-strand barbed wire with steel posts installed on both sides of the track)	m	6,400	0.032	0.2
Fencing (urban), including right of way	Urban fencing (steel palisade fencing)	m	63	0.071	0.0[24]
SUB-TOTAL					**1,270.9**

*Note: totals may not sum due to rounding

[23] Earthworks mass haul calculations have been developed to minimise cut to spoil
[24] Actual value is higher than $0 AUD but has been rounded to $0.0m AUD

5.7 Signalling and Communications

5.7.1 Review of current signalling and communications systems

In order to develop MEAs for the signalling and communication infrastructure, we completed a review of current available technology to understand the solution that a new entrant would implement to deliver present day service levels at least cost.

We also assessed the level of service offered by the signalling and communications infrastructure on the ARTC network. The ARTC train control network is made of four distinct elements of signalling and train control:

– Train order working
– Centralised train control
– Automatic block signalling
– Automatic train management system

These are shown in Figure 10 and described in more detail as follows.

5.7.1.1 Train Order Working

This is a system where the train is given limited authority to move, and this authority is updated frequently to keep the train moving. There is no train detection system. In practice this is a paper-based system where a train controller reads out the limit of the authority to the train driver. The driver records the information and reads it back to the train controller to confirm their authority, and then the train proceeds based on that authority. This system is used on the low volume, long range networks like the East-West (**EW**) line, the limit of authority is typically one length of single track, between two crossing loops.

Recently, ARTC's paper-based system has been replaced by a computer-based system called Train Management and Control System (**TMACS**). The current level of operation is TMCS level 1, which is still voice-based so the controller must contact the train to give him authority to move but the authorisations are computerised. Method of communication is by train radio, or cell phone.

5.7.1.2 Centralised Train Control (CTC)

CTC is a system where the train operates from lineside signals, and the driver reacts to the signal in front of him (as would a road user). The signals are controlled from a central train control centre (Junee, Parkes, or Newcastle depending on the route). The system can include rail vehicle detection (**RVD**), or not. If not, the system works purely on the signal lights being set by the train controller (pure CTC).
Train (or rail vehicle) detection is normally done by:

– Track circuit (literally the train completes an electric circuit – which is displayed on a screen at the CTC), or
– Axle counter (a device between tracks that counts each axle as it goes past, so can determine speed and position of the train and relay the information to the CTC).

In both systems, the communication system is via a fibre optic backbone that connects all the line side devices and provides communication, indication and control via the network.

Train Radio is only a backup communication method with the driver. Routes are set automatically by the central train control system by sending commands through to a small lineside location case, which controls all required local functionality through a system of interlocked equipment (the interlocking). Interlocking is a way of ensuring only safe routes can be set (i.e. options are interlocked to work together).

The interlocking can be computer based, through software such as Microlok, or relay / solid state based. Solid State Interlockings (**SS**I) are legacy and are being / have been replaced by computer based interlockings (**CBI**). CBI is fast becoming legacy technology as communication-based control systems such as European Train Control System (**ETCS**) or Advanced Train Management System (**ATMS**) are being introduced.

In complicated junction areas, often the interlocking is retained as it is a safer way to manage the many possible options for route setting.

5.7.1.3 Automatic block signalling (ABS).

ABS normally has rail vehicle detection which is assumed to be track circuits with relay interlocking given the age of the ABS system. A local train control panel in a signalling hut alongside the rail line collects the detection data and sets the route automatically. The drivers set their own routes into crossing loops, but other moves are automatically signalled from the local panel, using signals. There is no CTC to oversee the status of the network. This works in remote areas with few trains (Crystal Brooke to Parkes), and no junctions. Communication is via train radio only.

5.7.1.4 Automatic Train Management System (ATMS).

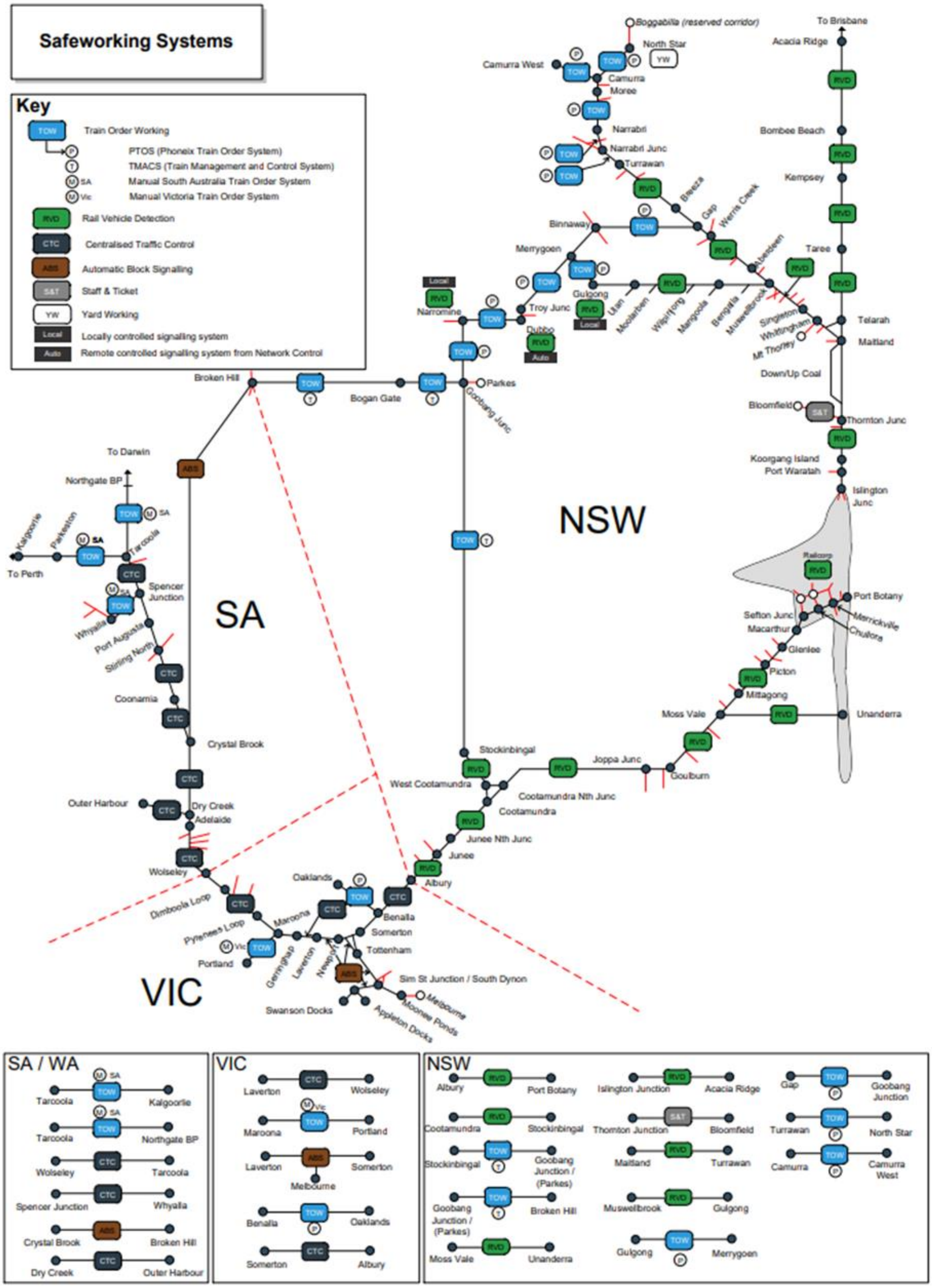
ATMS is a new communications-based train control system being type tested by ARTC at present. In effect, it is a train order working system, but the laborious paper and manual control system is replaced by a computer programme. The train has a box onboard with GPS and 4G mobile communication, as well as a satellite link for emergencies.

The GPS and the 4G chip are used to locate the train, and the Telstra 3G/4G network is used to relay information directly to the train. Movement authorities are still issued by section to the train, but this is done automatically without any required intervention by the train driver. This is through TMACS level 3. The train control sets the route via an onboard graphically based train control system, by clicking on the sections. This sends the authority to the train, and the driver acknowledges by pressing an acknowledgement button. In this arrangement there is little to no lineside equipment, other than at the beginning and end of sections, and instead there are radio towers for communicating with the driver. Voice Communication is via train radio and/or mobile networks, and data communication is via mobile networks.

The ARTC Communication network is made up of a plethora of radio-based communication systems that have recently been tied together by a common user interface called the National Train Communication System. This is a common user interface fitted in every train that operates on the ARTC network, and the unit automatically switches frequencies when required, to connect the driver with the relevant train controller.

The system is intended to form the backbone of the ATMS system once it goes live. The railway frequencies in use vary by line, though for ATMS ARTC has moved towards using the frequencies set aside by the ACMA for railway use – 400 Mhz and 1800 Mhz. These frequencies are also used in the urban rail networks in Sydney and Melbourne.

Figure 10: Signalling systems on the ARTC Network[25]



[25] ARTC, Network Configuration and Description, available at: https://www.artc.com.au/customers/access/access-interstate/network-configuration/

5.7.2 Modern Equivalent Asset selection

The strategy for selecting MEA assets was to assess the modern equivalent signalling system appropriate to each line, based on the minimum cost to achieve the current operational performance, but adjusted for the following factors, the:

– presence of passenger rail on the route – for the North Coast and South Coast Lines, the fact that passenger trains run on this line is assumed to not be an issue, and the trains can be fitted with whatever in-cab equipment is required to make them compatible with the new system. If this is not the case, then these routes are restricted to the current centralised train control system.

– need for Safety Integrity Level 3. Note that ATMS and similar systems (including ETCS) that do not have track side equipment rely on the local mobile network for their reliability. Mobile networks only provide SIL 2 level. Some aspects of train control require SIL 4 – such as public active level crossings.

– future use of the network to try and articulate possible future use. As an example, the north and south coast lines are likely to be overtaken by the Inland Rail therefore future growth is not required. Much of the traffic from Melbourne to Brisbane is currently delayed by the bottlenecks in Sydney. The coastal route via Sydney is also very slow. Inland rail will shorten that journey considerably, so all Melbourne to Brisbane traffic will reroute to the Inland Rail. A better example is Crystal Brook to Parkes – this route is likely to see an upturn in usage over time as paths become available. The MEA system will have the foundations to allow for easy expansion of services on this line, without actually installing anything over and above what is required for the short term.

The options for modern equivalent types of signalling system that we considered as suitably modern replacements for the above systems are as follows:

1. CTC based CBI to replace other CTC areas with passenger train interactions

   This is currently the most common form of train control system in the world. It is slowly heading to obsolescence as communication-based train control systems come online like the European Train Control System (**ETCS**). We consider that the DORC valuation should not be based on a system that would place an impost on passenger rolling stock. Consequently, we have considered adopting CTC because of its compatibility with today's passenger trains - as they run today. The current intercity, regional and interstate rolling stock using ARTC's Interstate Network are not fitted for ETCS.

   Nevertheless, in our view, a new entrant would be unlikely to adopt CTC based CBI for the interstate network because of the large volume of lineside infrastructure required. Modern communication-based systems can achieve the same outcome for a lower initial investment

2. Communications Based Train Control (**CBTC**) everywhere else

   Advances in mobile communications technology and the Internet of Things (**IoT**) has changed the landscape in terms of how challenging it is to create control networks with adequate levels of reliability and safety. Services are migrating from hard wired systems to mobile data systems as these communications networks proliferate. The location of the train and the method of communication of the train has moved to mobile networks and / or digital radio, with the mobile provider guaranteeing the Safety Integrity Level (**SIL**) of the communication system.

The CBTC options we have reviewed as appropriate MEAs are ATMS, and a cut down version of ETCS.

a. **Option 1: ATMS as rolled out on the test section** – rolled out everywhere but in the urban centres, where CTC based CBI would be installed. We have not considered changes to the ATMS offering, but selected it as is.

b. **Option 2: European Train Control System (ETCS) level 2** – rolled out everywhere. There are freight products for ETCS in use in Europe (Germany and Netherlands), which are very similar to ATMS. They do not have any lineside equipment and rely on 4G / GPS /Satellite in a similar fashion to ATMS. With a box installed in the train and using mobile phone and GPS for positioning / communications, the ETCS option would be very similar in cost to the ATMS option.

We have considered the following factors when considering which system to implement:

– **Scalability** – ETCS is proven to be able to scale infinitely. ATMS is not proven, but there are no obvious reasons why scalability of ATMS is not proven.

– **Interoperability** – the Sydney Network is implementing ETCS level 2 throughout (funded). Perth (Perth Transit Authority) and Brisbane (Transport and Main Roads) are planning for future implementation of ETCS level 2 throughout (business case prepared / being prepared, not funded yet). Melbourne is implementing a "High-capacity signalling system" but has not nominated ETCS specifically. We understand that ATMS in use in Australia has developed specifically for ARTC and is not in used anywhere other than ARTC's test track.

  ETCS products are fundamentally better at sharing information with other ETCS platforms.

– **Obsolescence** – technology always faces the risk of obsolescence – with the number of countries using ETCS this is not an issue for ETCS, but for ATMS, this is a real risk and is probably the single most important reason for proposing a change.

Overall, it is our view that an efficient entrant would choose the ETCS product over ATMS. Whilst the ATMS system is flexible, powerful and optimised for exactly this type of operation, it is also an orphan product. ETCS has since been developed and can do everything that ATMS can do. There is also a much larger body of knowledge, experience and availability to supply and implement it around the world.

Some ETCS Freight examples:

– Alstom Atlas 402 – solution based on GPS and Digital train radio. The train does its own detection and sends its position to the control centre. It can use any type of radio but base offer uses 4G and GSM-R. This base option can be enhanced by adding axle counters to improve the level of accuracy and safety.

– Siemens Control guide CTMobile – uses global navigation system satellites and GPRS radio, or GSM radio.

– Table 17 summarises our proposed MEA signalling and communications strategy across the network that forms the basis of this DORC.

Table 17: Signalling and Communications MEAs

Segment	Existing Asset Description	MEA Asset Description	Basis for MEA
Cook (exc) to West Kalgoorlie (exc) (via Parkeston)	Train Order Working	ETCS Freight	Remote, long distance low capacity line – optimise ability to use offsite assets
Tarcoola (exc) to Cook (inc)	Train Order Working	ETCS Freight	Remote, long distance low capacity line – optimise ability to use offsite assets
Tarcoola to Asia-Pacific Interface (API)	Train Order Working	ETCS Freight	Remote, long distance low capacity line – optimise ability to use offsite assets
Spencer Jct (exc) to Tarcoola (inc)	Centralised Train Control (CTC)	ETCS Freight	Reduction of assets on the ground. The reason for CTC in this area would appear to be the large number of level crossings that require active control and oversight. We have assumed that an acceptable SIL level can be achieved using ETCS. Option to overlay axle counters on approach to the level crossings – local control with remote indication
Spencer Jct (exc) to Whyalla (exc)	ATMS	ETCS freight	Reasons for selecting ETCS over ATMS given above this table.
Dry Creek North Junction (exc) to Spencer Junction (inc)	Centralised Train Control (CTC)	ETCS freight	Many signalled level crossings require active control We have assumed that an acceptable SIL level can be achieved using ETCS. Option to overlay axle counters on approach to the level crossings – local control with remote indication.
Crystal Brook (exc) to Broken Hill (exc)	Automatic Block Signalling (ABS)	ETCS freight	ABS systems are inherently not as safe a centralised control. The reason for the ABS is the remote operation and low number of trains, but given that the Telstra network reaches this area, the investment to set up ETCS freight would be like renewing a track circuited area.
Broken Hill (inclusive) to Stockinbingal (exclusive)	Train order system of safe working using the Train Management and Control System (TMACS)	ETCS freight	Remote, long distance low capacity line – optimise ability to use offsite assets
Cootamundra West to Stockinbingal	Rail Vehicle Detection	ETCS freight modules	Incorporate axle counter technology for more accurate rail detection, more traffic and higher speeds may require a higher level of SIL.
Dry Creek to Pelican Point	Centralised Train Control (CTC)	ETCS Freight	Low capacity line – optimise ability to use offsite assets
Dry Creek to Newport (exc)	Centralised Train Control (CTC)	ETCS freight modules	Incorporate axle counter technology for more accurate rail detection, more traffic and higher speeds may require a higher level of SIL.
Newport to Melbourne (Spencer Street)	Automatic Block Signalling (ABS)	ETCS freight	ABS systems are inherently not as safe a centralised control. The reason for the ABS is the operation and low number of trains, but given that the Telstra network reaches this area, the investment to set up ETCS freight would be like renewing a track circuited area

Segment	Existing Asset Description	MEA Asset Description	Basis for MEA
Appleton Dock to Footscray	Automatic Block Signalling (ABS)	ETCS freight	ABS systems are inherently not as safe a centralised control. The reason for the ABS is the remote operation and low number of trains, but given that the Telstra network reaches this area, the investment to set up ETCS freight would be like renewing a track circuited area
Newport (inc) to Somerton loop (exc)	Centralised Train Control (CTC)	ETCS freight modules	Incorporate axle counter technology for more accurate rail detection, more traffic and higher speeds may require a higher level of SIL.
Somerton to Albury	Centralised Train Control (CTC)	ETCS freight modules	Incorporate axle counter technology for more accurate rail detection, more traffic and higher speeds may require a higher level of SIL.
NW board - Maroona (exc) to Portland (exc)	Train Order Working	ETCS Freight	Low capacity line – optimise ability to use offsite assets
Albury to Macarthur (via Cootamundra)	Rail Vehicle Detection	ETCS freight modules	Incorporate axle counter technology for more accurate rail detection, more traffic and higher speeds may require a higher level of SIL.
Moss Vale to Unanderra	Rail Vehicle Detection	ETCS freight	Small section of route with light traffic.
Southern Sydney Freight Line (SSFL)	Rail Vehicle Detection	ETCS full	Urban area. Incorporate axle counter technology for more accurate rail detection, more traffic and higher speeds may require a higher level of SIL.
Metropolitan Freight Network (MFN)	Rail Vehicle Detection	ETCS full	Urban area. Incorporate axle counter technology for more accurate rail detection, more traffic and higher speeds may require a higher level of SIL.
Newcastle to Acacia Ridge	Rail Vehicle Detection	ETCS freight modules	Incorporate axle counter technology for more accurate rail detection, more traffic and higher speeds may require a higher level of SIL.

5.7.3 Replacement Cost – Signalling and Communications

We identified a signalling and communication sub-asset for each MEA and determined the unit replacement cost for each of those sub-assets. We then determined the total RC of the infrastructure captured in each sub-asset by multiplying the value of the sub-asset by the quantity of that MEA across the network as shown in Table 18.

Table 18: Replacement Cost – Signalling and Communications

Asset Class	MEA	Unit	Quantity	Rate ($000s)	Replacement Cost ($million)
Control Equipment	Level Crossing Boom and lights. Controller	Ea.	155	444.5	68.9
Control Equipment	Active Level crossing lights, controller	Ea.	185	1,024.6	189.6
Signals	3 Aspect	Ea.	4,144	56.5	234.2
Signals	Axle Counter System (1 Evaluator, 4 Heads)	Ea.	4,227	20.3	85.9
Signals	Track circuit	Ea.	1,228	10.9	13.4
Signage	Signs	Ea.	2,264	0.4	0.9
Signage	Speed Boards	Ea.	4,524	0.4	1.9
Signal Buildings & Enclosures	Signalling Location case	Ea.	2,452	14.0	34.4
Signal Buildings & Enclosures	Signalling Location Case Double Width	Ea.	332	21.4	7.1
Signal Buildings & Enclosures	Signalling Equipment Hut Including Interlocking (minor)	Ea.	776	214.2	166.2
Signal Buildings & Enclosures	Signalling Equipment Hut Including Interlocking	Ea.	36	430.1	15.5
Signal Buildings & Enclosures	Centralised train control centre building	Ea.	1	133,552.4	133.6
Communications	Optic Fibre	m	1,476,200	0.3	502.5
Communications	Router	Ea.	1,154	28.2	32.5
Communications	Radio Tower	Ea.	90	1,514.9	136.3
Communications	Radio Base Station	Ea.	90	75.7	6.8
SUB-TOTAL					**1,629.6**

5.8 Structures

5.8.1 Modern Equivalent Asset selection

The MEA for structures and the basis of their selection are shown in Table 19.

Table 19: Structures MEAs

Asset	MEA	Reasoning for MEA selection
Bridges Minor Crossing - Concrete	For spans up to 500 m (approximately), concrete bridges.	Consistent with modern bridge-building practices for railways in Australia
Bridges Major or Water Crossing - Concrete	For spans between 500m and 1,000 m (approximately), concrete bridges.	Consistent with modern bridge-building practices for railways in Australia
Buildings Facilities	Colourbond sheds	Consistent with practical, efficient and cost-effective construction methods
Tunnels	Single ballasted track, bored tunnel concrete lined.	Consistent with modern design for cut and cover, where otherwise the cutting would be too deep for geotechnical reasons
Dual Track Tunnel	Dual ballasted track, bored tunnel concrete lined.	Consistent with modern design for cut and cover, where otherwise the cutting would be too deep for geotechnical reasons
Misc. Structures	Assorted large structures i.e. retaining walls	Consistent with practical, efficient and cost-effective construction methods

5.8.2 Replacement Cost – Structures

We developed an MEA for each identified structures sub-asset and determined the unit replacement cost for each of those sub-assets. We then determined the total RC of the infrastructure captured in each sub-asset by multiplying the value of the MEA by the quantity of that sub-asset across the network as shown in Table 20.

*Table 20: Replacement Cost – Structures**

Asset	MEA	Unit	Quantity	Rate ($,000)	Replacement Cost ($million)
Bridges Minor - Concrete	Approximately, for spans up to 500 m, concrete bridges.	ea	1499	1,696.8	2,543.4
Bridges Major or Water Crossing - Concrete	Approximately, for spans up to 1,000 m, concrete bridges.	ea	179	10,417.1	1,864.7
Buildings Facilities	Colourbond sheds	ea	247	30.5	7.5
Single Track Tunnels	Single ballasted track, bored tunnel concrete lined.	ea	27	23,856.9	644.1
Dual Track Tunnels	Dual ballasted track, bored tunnel concrete lined	ea	5	54,806.5	274.0
Misc. Structures	Assorted large structures i.e. retaining walls, sheds	ea	710	311.9	157.2
SUB-TOTAL					**5,491.0**

5.9 Track

5.9.1 Modern Equivalent Asset selection

The modern equivalent assets and the basis of their selection is shown in Table 21.

Table 21: Track MEAs

Asset	MEA	Reasoning for MEA selection
Track (mainlines, crossings and passing loops)	60 kg/m rail on concrete sleepers with min 450 mm ballast depth	Track standard consistent with traffic tonnage, frequency and axle loads.
Track (sidings and yards)	53 kg/m rail on concrete sleepers with min 300 mm ballast depth	Track standard consistent with yard usage.
Turnouts (mainlines, crossing and passing loops)	1 in 08 turnout - 60 kg/m on concrete bearers	Consistent with modern railway design, considering operational requirements
Turnouts (mainlines, crossing and passing loops)	1 in 12 turnout - 60 kg/m on concrete bearers	Consistent with modern railway design, considering operational requirements
Turnouts (mainlines, crossing and passing loops)	1 in 18 turnout - 60 kg/m on concrete bearers	Consistent with modern railway design, considering operational requirements
Turnouts (yards and sidings)	1 in 08 turnout - 47 kg/m on timber bearers	Consistent with modern railway design, considering operational requirements
Turnouts (yards and sidings)	1 in 08 turnout - 53 kg/m on timber bearers	Consistent with modern railway design, considering operational requirements
Turnouts (yards and sidings)	1 in 12 turnout - 53 kg/m on timber bearers	Consistent with modern railway design, considering operational requirements
Turnouts (yards and sidings)	1 in 18 turnout - 53 kg/m on timber bearers	Consistent with modern railway design, considering operational requirements
Rail Lubricators	Train-actuated rail lubricator	Consistent with modern railway practice
Points	Standard electrical or manual points set	Consistent with modern railway design, considering operational requirements

5.9.2 Replacement Cost – Track

We identified a track sub-asset for each MEA and determined the unit replacement cost for each of those sub-assets. We then determined the total RC of the infrastructure captured in each MEA by multiplying the value of the sub-asset by the quantity of that sub-asset across the network as shown in Table 22.

*Table 22: Replacement Cost – Track**

Asset	MEA	Unit	Quantity	Rate ($,000)	Replacement Cost ($million)
Track (mainlines, crossings and passing loops)	60 kg/m rail on concrete sleepers with min 450 mm ballast depth	Per km	7,221	1,058.8	7,645.8
Track (sidings and yards)	53 kg/m rail on concrete sleepers with min 300 mm ballast depth	Per km	692	954.5	660.9
Turnouts (mainlines, crossing and passing loops)	1 in 08 turnout - 60 kg/m on concrete bearers	ea	139	254.9	35.4
Turnouts (mainlines, crossing and passing loops)	1 in 12 turnout - 60 kg/m on concrete bearers	ea	897	346.0	310.4
Turnouts (mainlines, crossing and passing loops)	1 in 18 turnout - 60 kg/m on concrete bearers	ea	108	346.3	37.4
Turnouts (yards and sidings)	1 in 08 turnout - 47 kg/m on timber bearers	ea	83	210.3	17.5
Turnouts (yards and sidings)	1 in 08 turnout - 53 kg/m on timber bearers	ea	165	213.7	35.3
Turnouts (yards and sidings)	1 in 12 turnout - 53 kg/m on timber bearers	ea	569	246.1	140.0
Turnouts (yards and sidings)	1 in 18 turnout - 53 kg/m on timber bearers	ea	26	325.2	8.5
Rail Lubricators	Train-actuated rail lubricator	ea	436	35.7	15.5
Points	Standard electrical or manual points set	ea	435	341.2	148.4
SUB-TOTAL					**9,055.1**

5.10 Utilities

5.10.1 Modern Equivalent Asset selection

The modern equivalent assets and the basis of their selection is shown in Table 23.

Table 23: Utilities MEAs

Asset	MEA	Reasoning for MEA selection
Power Supply	Modern power supply (i.e. modern switched-mode electronic power supply unit) for signalling and communications equipment	Consistent with modern applications for power supply
Distribution substations	Modern substations and control designs (e.g. pole- or plinth-mounted infrastructure)	Consistent with practical, efficient and cost-effective electrical equipment for substations

5.10.2 Replacement Cost – Utilities

We identified a utilities sub-asset for each MEA and determined the unit replacement cost for each of those sub-asset s. We then determined the total RC of the infrastructure captured in each sub-asset by multiplying the value of the sub-asset by the quantity of that sub-asset across the network as shown in Table 24

Table 24: Replacement Cost - Utilities

Asset	MEA	Unit	Quantity	Rate ($,000)	Replacement Cost ($million)
Power Supply	Modern power supply (i.e. modern switchmode electronic power supply unit) for signalling and communications equipment	ea	2522	25.0	63.2
Distribution substations	Modern substations and control designs (e.g. pole- or plinth-mounted infrastructure)	ea	13	73.1	0.9
SUB-TOTAL					**64.1**

5.11 Summary Replacement Cost

Table 25 presents the RC summarised by Asset Class and by Regulatory Segment. Costs per kilometre are presented in Table 26

.

Table 25: Summary Replacement Cost in $millions

Regulatory Segment	General Civil Infrastructure	Miscellaneous Assets	Right of Way	Signals and Comms	Structures	Track	Utilities	Total Replacement Cost ($million)
Dry Creek to Parkeston	117.2	148.3	193.9	252.6	270.4	2,729.1	8.9	**3,720.5**
Tarcoola to Asia-Pacific Interface (API)	1.3	-	0.3	-	2.4	10.6	0.1	**14.7**
Port Augusta to Whyalla	4.4	-	10.5	2.9	53.4	146.0	0.1	**217.3**
Crystal Brook to Parkes	87.1	1.3	140.1	91.2	277.2	1,346.2	4.5	**1,947.6**
Cootamundra to Parkes	28.8	-	18.0	31.3	47.2	257.7	1.2	**384.1**
Dry Creek to Pelican Point	13.5	-	1.2	27.2	77.3	44.5	1.9	**165.4**
Dry Creek to Melbourne (Spencer Street)	173.4	-	154.3	150.5	438.6	1,042.9	10.9	**1,970.6**
Appleton Dock to Footscray	10.2	-	2.9	33.7	213.7	131.6	0.3	**392.4**
Melbourne (Tottenham) to Macarthur	143.2	0.6	243.4	513.0	1,821.4	2,158.5	18.2	**4,898.4**
Moss Vale to Unanderra	15.0	-	96.8	29.9	90.2	78.5	1.0	**311.5**
Southern Sydney Freight Line (SSFL)	2.7	-	9.8	40.2	292.5	49.8	0.4	**395.4**
Metropolitan Freight Network (MFN)	1.7	-	11.4	24.3	41.9	79.2	0.7	**159.2**
Newcastle to Acacia Ridge	126.8	1.1	388.4	432.9	1,864.8	980.4	15.8	**3,810.2**
TOTAL RC ($MILLION)	725.2	151.5	1,270.9	1,629.6	5,491.0	9,055.1	64.1	18,387.4

Table 26: Summary Replacement Costs per kilometre in $millions

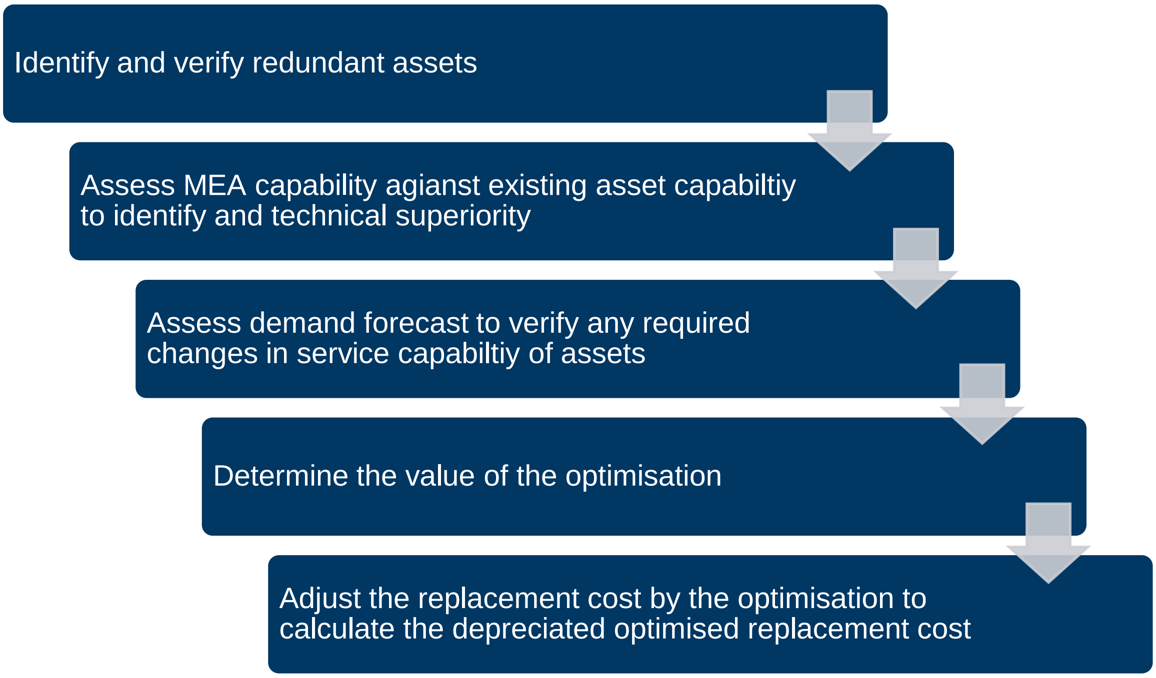
Regulatory Segment	Total Replacement Cost ($million)	Single Track Length	No. of Tracks (on average)	Sum Track Length	Cost per km Sum Length ($million)
Dry Creek to Parkeston	**3,720.5**	1993	1	1993	1.9
Tarcoola to Asia-Pacific Interface (API)	**14.7**	6	1	6	2.5
Port Augusta to Whyalla	**217.3**	71	1	71	3.1
Crystal Brook to Parkes	**1,947.6**	1101	1	1101	1.8
Cootamundra to Parkes	**384.1**	198	1	198	1.9
Dry Creek to Pelican Point	**165.4**	32	1	32	5.2
Dry Creek to Melbourne (Spencer Street)	**1,970.6**	883	1	883	2.2
Appleton Dock to Footscray	**392.4**	30	2	60	6.5
Melbourne (Tottenham) to Macarthur	**4,898.4**	1060	2	2120	2.3
Moss Vale to Unanderra	**311.5**	67	1	67	4.6
Southern Sydney Freight Line (SSFL)	**395.4**	40	2	80	4.9
Metropolitan Freight Network (MFN)	**159.2**	36	2	72	2.2
Newcastle to Acacia Ridge	**3,810.2**	848	1	848	4.5
TOTAL RC ($million)	18,387.4	**6365**		**7531**	
WEIGHTED AVERAGE ($MILLION)					**2.4**

6. Optimised Replacement Cost (ORC)

6.1 The approach used to determine the ORC

Optimisation adjusts the RC value for step changes in asset specification resulting from forecast usage patterns. It adjusts for any assets, asset capacity, or features of those assets, that are not required to deliver the required and foreseeable service. An overview of how we have applied this approach is shown in Figure 11.

Figure 11: Overview of approach to optimisation



Our optimised replacement cost (**ORC**) seeks to reflect the value of an asset configuration that an efficient new entrant would provide to deliver the Interstate Network service. For each asset, the ORC is based on an adjustment to the RC value reflecting optimisation and the approach is set out below. The optimisation adjustments are determined by removing the replacement cost of optimised assets by reducing the quantity of assets as we found no scope for technical optimisation.

6.2 Identifying assets relevant for optimisation

6.2.1 Redundant assets

To identify and verify the redundant assets in the asset information provided to us by ARTC, we sought to identify the assets that were not:

- Active, and therefore not used to provide the Interstate Network service
- Used to provide the Interstate Network service, or
- Owned by ARTC and used to provide the Interstate Network service.

We associated each asset contained in the asset information provided to us by ARTC with an ‘Active Flag’ that identified whether the asset was active or not. ARTC advised that assets with a ‘No’ flag had been disposed of. We have assumed that any assets flagged as inactive were not used to provide the Interstate Network service and were removed from the calculation of the replacement cost.

ARTC advised that overbridges were not used to provide the Interstate Network service and that they did not own platform structures. We therefore identified these assets in the asset register and marked them for exclusion from the replacement cost build upon the basis that these assets were not used to provide the Interstate Network service.

6.2.2 Technical optimisation

Over-designed assets (as described in Section 2.6.2), have features unnecessary for the goods or services the assets provide. Measuring the service potential embodied in these assets, based on modern equivalent assets, automatically excludes attributing any value to the overdesigned features".[26] These technical features of the MEA over the existing assets that are not required to deliver a regulated service are addressed via a reduction in the unit rate for any MEAs to remove the cost of the technically superior aspects of the MEA. Although there is difference in the services offered by the MEA signalling and communications system and that provided by the existing assets, we consider that on balance, the level of service offered is comparable. We did not identify any opportunities for technical optimisation.

6.2.3 Over-capacity assets

Over-capacity assets are those with the potential to provide a greater level of service than is required. This is likely to be presents as either:

- More available train paths per day than is required to meet demand, or
- Greater rail load capacity than is required

We discuss each of these issues separately as follows.

6.2.3.1 Review of demand data

We considered a ten-year period for optimisation to be appropriate. This reflects, in part, the long-life nature of several the significant assets in rail infrastructure.

For each Segment, ARTC provided historical gross tonne kilometre (**GTK**) data from 2015 to 2020 and forecast data from 2020 to 2030. These forecasts consider ARTC's forecast of the number of contracted train paths over 2020 to 2030. These forecasts are based on historical data and an assumed year-on-year growth rate. In these forecasts, demand remains constant or grows slowly over the forecast period.

The demand forecasts (million GTKs) for each year from 2020 to 2030, including the maximum figure for 2015 to 2029 was provided by ARTC on a Segment basis, with the exception of Tarcoola to API, as the forecast is embedded in those for the Dry Creek to Parkeston Segment. We converted these demand forecasts into the number of train paths per day to determine any overcapacity assets. Demand data for train services is typically reported in GTK terms; this refers to the product of the weight of the train, including its load, and the distance travelled. To convert the capacity of train paths to GTKs, the number of train paths were multiplied by the weighted average GTK of current train demand. This calculation was undertaken by reviewing the MTPs that ARTC issues for the Interstate Network.[27],

The MTPs set out weekly planned schedules for the times at which trains, including details of their lengths and payloads, depart their origin and arrive at their destination, allowing the derivation of the weighted average GTKs of current train demand. The supply-side data in GTK terms, weekly basis, is how we present

[26] NSW Treasury's Valuation of Electricity Networks - A Policy Guideline for NSW DNSPs, available at: https://www.treasury.nsw.gov.au/sites/default/files/pdf/TPP14-01_Accounting_Policy_-_Valuation_of_Physical_Non-Current_Assets_at_Fair_Value.pdf

[27] ARTC's Master Train Plan, available at: https://www.artc.com.au/customers/operations/mtp/

practical capacity for our demand-supply assessment for optimisation. [redacted]

Figure 12: ARTC's demand data FY2015 (actual) to FY2030 (forecast)[28]

[redacted]

6.2.3.2 Determining track capacity

Track capacity is determined by reference to the sectional running times (**SRTs**) along the Segment. This reflects the time taken (usually in minutes) for a train to get from one point to another on the track. This relates to single track sections where the track between those two points can be occupied by one train only. A section of a Segment with the longest SRT identifies the section that is likely to be most capacity constrained.

For single track sections, passing loops are typically provided. These are short sections of track that give trains the ability to:

- Pass on an otherwise single-track line, thereby increasing track capacity, and
- Be held off the main line for other operational reasons, such as loading or unloading.

We compared the number of passing loops required to support the peak demand between present day and 2030 and compared that to the number of passing loops on each section to identify scope for the optimisation of any over-capacity track.

The approach and analysis we undertook for identifying over-capacity assets is as follows:

- Divided each Segment into Stations, which contain several passing loops across the track sections between two Stations
- For the infrastructure between each Station, we estimated the number of available train paths per week by using the SRTs (derived by average line speeds) and an estimate of 80% track availability (i.e. to allow for outage as a result of planned/unplanned maintenance/renewals and day-of-operation losses).

[28] ARTC advised that it provided us with actual data for the years FY2014/15 to FY2018/19 and forecast data for the period FY2019/20 to FY2029/30

For example, if the SRTs indicated that 100 train paths were theoretically available per week between Stations, we assumed it was 80 train paths were practically available for usage between the Stations

- We identified the track section within a segment with the constraining number of train paths per day.
- We then calculated the number of passing loops that would be required to allow trains to operate at a separation that would support the peak number of train paths forecast between 2019 and 2030.

We compared this to the number of passing loops on the section to determine if there was scope for any infrastructure capacity to be optimised without compromising the networks' ability to meet the peak demand over the foreseeable period. The total number of loops required for each segment are shown in column (b) of Table 27:. The number of loops that could be optimised and still retain the number of train paths required are shown in column (c) of Table 27: as the difference between the number that exist, and the number that are required.

In addition, some passing loops are required to enable current service levels to be provided, that are not required for capacity. These may be stations, freight handling, bulk grain handling, maintenance, turning angles, junctions or cattle handling. We have completed a review of those loops that in our view are required to deliver these functions. The number of loops that are not required for these functions (and could be optimised) are shown column (d) of Table 27:.

We have combined the two assessments outlined above to assess the number of passing loops that can be removed as shown in column (e) of Table 27: as the minimum that could be removed for either demand or operational optimisation.

We used engineering judgement to identify which specific passing loops between Stations (and then at a Segment level) could be removed. When a passing loop is optimised, this includes the removal of associated assets in the following areas:

- Track
- Turnouts and points – both ends
- Signals – both ends and cabling
- Location boxes (signalling)
- Cross drainage – culverts under loop.

6.2.4 Multi-track sections

There are several sections of track within the network that are multi-track. We considered whether it was likely to be lower cost to replace these sections with single track rail with passing loops to provide for ARTC's demand. This reflects a reduction in track (from multi to single), and an increase in passing loops in the relevant sections. Our proposed approach to these sections is shown in Table 28.

Table 27: Demand Optimisation

Segment	Number of passing loops				
	Existing (a)	Required for peak demand (b)	Demand optimisation (c)	Operational optimisation (d)	Loops optimised (e = min(c,d))
Dry Creek to Parkeston	64	[redacted]	[redacted]	[redacted]	20
Tarcoola to API	-	[redacted]	[redacted]	[redacted]	0
Port Augusta to Whyalla	1	[redacted]	[redacted]	[redacted]	0
Crystal Brook to Parkes	27	[redacted]	[redacted]	[redacted]	0
Cootamundra to Parkes	5	[redacted]	[redacted]	[redacted]	0
Dry Creek to Pelican Point	2	[redacted]	[redacted]	[redacted]	0
Dry Creek to Melbourne (Spencer Street)	49	[redacted]	[redacted]	[redacted]	0
Appleton Dock to Footscray	0	[redacted]	[redacted]	[redacted]	0
Melbourne (Tottenham) to Macarthur	10	[redacted]	[redacted]	[redacted]	1
Moss Vale to Unanderra	4	[redacted]	[redacted]	[redacted]	2
SSFL (multi-track)	2	[redacted]	[redacted]	[redacted]	0
MFN (multi-track)	-	[redacted]	[redacted]	[redacted]	0
Newcastle to Acacia Ridge	40	[redacted]	[redacted]	[redacted]	16
TOTAL	204	[redacted]	[redacted]	[redacted]	39

Table 28: Optimisation of multi-track sections

Segment	Optimised provision
Tottenham to Benalla (Note 1)	Single track with 8 passing loops
Junee to Cootamundra (Note 1)	Single track with 2 passing loops
Cootamundra to Goulburn (Note 1)	Single track with 9 passing loops
MFN	Retain multi-track because this is lowest cost.
SSFL	Retain multi-track because of the operational requirements of this sector
Newport to Spencer St (Note 2)	Multitrack is appropriate because of the short length of this section.
Appleton to Footscray	Multitrack is appropriate because of the short length of this section.

Note 1 included in Melbourne (Tottenham) to Macarthur

Note 2: Included in Dry Creek to Melbourne (Spencer St)

Assets identified as requiring to be optimised from the application of our approach are set out in Section 7.3

The capacity of track is given in kg/m and relates to the wheel load that it is designed to accommodate. This is a function of the mass of the train and bogie configuration of the train and is not dependent on the number of train passes.

It is typical for 60kg/m rail to be used but 53kg/m rail could be used in areas that were to be used only unladen trains - sidings for example.

We reviewed the load ratings of the track is areas where only unladen trains would be required to pass and used 60kg/m rail for all main lines and 53kg/m rail for all sidings. This was included in the replacement cost so there was no further optimisation undertaken on rail capacity at this stage.

6.3 Assets to be optimised

This section details the impact of the optimisation described above on each asset class.

6.3.1 General Civil Infrastructure

The impact of this optimisation on general civil infrastructure is shown in Table 29.

Table 29: Optimised Replacement Cost – General Civil Infrastructure

Asset Class	MEA	Replacement Cost ($million)	Optimisation ($million)	Optimised Replacement Cost ($million)
Culverts (reinforced concrete pipes)	Reinforced concrete pipes (**RCPs**)	0.9	-	0.9
Culverts (corrugated metal pipes)	Corrugated Metal Pipes (**CMPs**)	4.7	-	4.7
Culverts (reinforced concrete box culverts)	Reinforced Concrete Box Culverts (**RCBCs**)	173.1	3.7	169.4
Level Crossings (Private Property)	Single track – passive control with signage only	1.5	-	1.5
Level Crossings (Public - Active)	Active control, as appropriate to the traffic conditions	314.9	-	314.9
Level Crossings (Public - Passive)	Passive control, as appropriate to the traffic conditions	230.2	-	230.2
SUB-TOTAL		**725.2**	**3.7**	**721.5**

6.3.2 Right of Way

The impact of this optimisation on right of way assets is shown in Table 30.

Table 30: Optimised Replacement Cost – Right of Way

Asset Class	MEA	Replacement Cost ($million)	Optimisation ($million)	Optimised Replacement Cost ($million)
Drainage	200 mm high density polyethylene (HDPE) pipe	-	-	-
Earthworks - Cut to fill	Designed to relevant State's extant standards and specifications for earthworks construction	509.4	-	509.4
Earthworks - Win to fill including placement and compaction	Designed to relevant State's extant standards and specifications for earthworks construction	746.7	-	746.7
Earthworks - Cut to spoil	Designed to relevant State's extant standards and specifications for earthworks construction	0.0	-	0.0
Earthworks - Imported fill	Designed to relevant State's extant standards and specifications for earthworks construction	14.6	-	14.6
Fencing (rural), including right of way	Rural fencing (four-strand barbed wire with steel posts installed on both sides of the track)	0.2	0.0	0.2
Fencing (urban), including right of way	Urban fencing (steel palisade fencing)	0.0	0.0	0.0
SUB-TOTAL		**1,270.9**	**0.0[29]**	**1,270.9**

[29]Rounded down to $0.0 in AUD millions.

6.3.3 Signalling and Communications

The results of combination of the technical optimisation (increased functionality) and the passing loop optimisation is shown in Table 31.

Table 31: Optimised Replacement Cost – Signalling and Communications

Asset Class	MEA	Replacement Cost ($million)	Optimisation ($million)	Optimised Replacement Cost ($million)
Control Equipment	Level Crossing Boom and lights. Controller	68.9	1.0	67.9
Control Equipment	Active Level crossing lights, controller	189.6	2.8	186.8
Signals	3 Aspect	234.2	3.4	230.7
Signals	Axle Counter System (1 Evaluator, 4 Heads)	85.9	1.3	84.6
Signals	Track Circuit	13.4	0.2	13.2
Signage	Signs	0.9	0.0	0.9
Signage	Speed Boards	1.9	0.0	1.9
Signal Buildings & Enclosures	Signalling Location case	34.4	0.5	33.9
Signal Buildings & Enclosures	Signalling Location Case Double Width	7.1	0.1	7.0
Signal Buildings & Enclosures	Signalling Equipment Hut Including Interlocking (minor)	166.2	2.4	163.8
Signal Buildings & Enclosures	Signalling Equipment Hut Including Interlocking	15.5	0.2	15.3
Signal Buildings & Enclosures	Centralised Train Control Centre	133.6	1.9	131.6
Communications	Optic Fibre	502.5	7.3	495.2
Communications	Router	32.5	0.5	32.0
Communications	Radio Tower	136.3	2.0	134.4
Communications	Radio Base station	6.8	0.1	6.7
SUB-TOTAL		**1,629.6**	**23.7**	**1,605.9**

6.3.4 Track

The impact of this optimisation on track assets is shown in Table 32

Table 32: Optimised Replacement Cost – Track

Asset Class	MEA	Replacement Cost ($million)	Optimisation ($million)	Optimised Replacement Cost ($million)
Track (mainlines, crossings and passing loops)	60 kg/m rail on concrete sleepers with min 450 mm ballast depth	7,645.8	368.6	7,277.2
Track (sidings and yards)	53 kg/m rail on concrete sleepers with min 300 mm ballast depth	660.9	3.6	657.3
Turnouts (mainlines, crossing and passing loops)	1 in 08 turnout - 60 kg/m on concrete bearers	35.4	3.6	31.8
Turnouts (mainlines, crossing and passing loops)	1 in 12 turnout - 60 kg/m on concrete bearers	310.4	31.8	278.6
Turnouts (mainlines, crossing and passing loops)	1 in 18 turnout - 60 kg/m on concrete bearers	37.4	3.8	33.6
Turnouts (yards and sidings)	1 in 08 turnout - 47 kg/m on timber bearers	17.5	1.8	15.7
Turnouts (yards and sidings)	1 in 08 turnout - 53 kg/m on timber bearers	35.3	3.6	31.7
Turnouts (yards and sidings)	1 in 12 turnout - 53 kg/m on timber bearers	140.0	14.3	125.7
Turnouts (yards and sidings)	1 in 18 turnout - 53 kg/m on timber bearers	8.5	0.9	7.6
Rail Lubricators	Train-actuated rail lubricator	15.5	-	15.5
Points	Standard electrical or manual points set	148.4	15.9	132.5
SUB-TOTAL		**9,055.1**	**447.9**	**8,607.1**

6.3.5 Utilities

The impact of this optimisation on Utilities assets is shown in Table 33.

Table 33: Optimised Replacement Cost – Utilities

Asset Class	MEA	Replacement Cost ($million)	Optimisation ($million)	Optimised Replacement Cost ($million)
Power Supply	Modern power supply (i.e. modern switchmode electronic power supply unit) for signalling and communications equipment	63.2	-	63.2
Distribution substations	Modern substations and control designs (e.g. pole- or plinth-mounted infrastructure)	0.9	-	0.9
SUB-TOTAL		**64.1**	**-**	**64.1**

6.4 The impact on Inland Rail on the scope for optimisation

The proposed 1,700 km Inland Rail route will link Melbourne and Brisbane via regional Victoria, New South Wales and Queensland. The route will use the existing Interstate Network from Melbourne, Victoria to Illabo, New South Wales. It will be enhanced to accommodate double-stacked trains. A combination of new and upgraded tracks will then be used via Parkes, Moree, Toowoomba and Calvert, to reach the existing Interstate Network at Kagaru, and then to Acacia Ridge and Bromelton, south of Brisbane. The Inland Rail project will impact the demand that has historically been for the Interstate Network. These following Interstate Network Segments are those most likely to experience a fall in demand as a result of Inland Rail:

- Melbourne (Tottenham) to Macarthur. This covers Melbourne to Cootamundra.
- Newcastle to Acacia Ridge. This covers Kagaru to Acacia Ridge.
- Cootamundra to Parkes

ARTC advised that the demand reduction on the Interstate Network resulting from Inland Rail was reflected in the demand forecast data provided to us as from July 2027 (FY2028).

Where the demand levels reduce to the point that optimisation is required because of a construction project, we consider that this requires a more detailed investigation of the specific assets. Where the demand levels reduce to the point that assets are no longer required and is below the level required to service present day demand levels, we consider that this represents asset stranding risk.

In our view, a stranded asset represents an investment risk to a new entrant and may therefore affect the efficient assets that a new entrant would construct. From a DORC valuation perspective, we consider that the stranding risk of assets does not impact the valuation of specific assets. This is because the assets will need to be constructed to provide the present-day service standard together with foreseeable service requirements. Therefore, we consider any assets at risk of stranding because of Inland Rail to be a matter for a future RAB adjustment and not a matter for optimisation in this DORC valuation.

6.5 Summary Optimised Fixed Asset Replacement Cost

Table 34 summarises the optimised fixed asset replacement cost.

Table 34: Summary of optimised fixed asset replacement cost

Regulatory Segment	RC ($million)	General Civil Infrastructure	Misc. Assets	Right of Way	Signals and Comms	Structures	Track	Utilities	Subtotal ($million)	Total ORC ($million)	Cost per track km ($million)
RC ($million)	18,387.4	725.2	151.5	1,270.9	1,629.6	5,491.0	9,055.1	64.1			
Optimisation by segment											
Dry Creek to Parkeston	3,720.5	0.6	-	-	3.7	-	28.3	-	32.6	**3,688.0**	**1.9**
Tarcoola to Asia-Pacific Interface (API)	14.7	0.0	-	-	-	-	0.6	-	0.6	**14.2**	**2.4**
Port Augusta to Whyalla	217.3	0.0	-	-	0.0	-	0.9	-	1.0	**216.3**	**3.0**
Crystal Brook to Parkes	1,947.6	0.4	-	-	1.3	-	16.5	-	18.2	**1,929.4**	**1.8**
Cootamundra to Parkes	384.1	0.1	-	-	0.5	-	3.6	-	4.2	**379.9**	**1.9**
Dry Creek to Pelican Point	165.4	0.0	-	-	0.4	-	1.0	-	1.4	**163.9**	**5.1**
Dry Creek to Melbourne (Spencer Street)	1,970.6	0.4	-	-	2.2	-	15.0	-	17.6	**1,953.0**	**2.2**
Appleton Dock to Footscray	392.4	0.1	-	-	0.5	-	4.1	-	4.6	**387.7**	**6.5**
Melbourne (Tottenham) to Macarthur	4,898.4	1.0	-	-	7.5	-	345.9	-	354.4	**4,544.0**	**2.1**
Moss Vale to Unanderra	311.5	0.1	-	-	0.4	-	1.0	-	1.6	**310.0**	**4.6**
Southern Sydney Freight Line (SSFL)	395.4	0.0	-	-	0.6	-	0.9	-	1.5	**393.9**	**4.9**
Metropolitan Freight Network (MFN)	159.2	0.0	-	-	0.4	-	15.8	-	16.2	**143.1**	**2.0**
Newcastle to Acacia Ridge	3,810.2	0.9	-	-	6.3	-	14.3	-	21.5	**3,788.7**	**4.5**
Subtotal optimisations ($million)		**3.7**	**-**	**-**	**23.7**	**-**	**447.9**	**-**	**475.4**		
TOTAL Optimised Replacement Cost ($million)	**18,387.4**	**721.5**	**151.5**	**1,270.9**	**1,605.9**	**5,491.0**	**8,607.1**	**64.1**		**17,912.0**	
WEIGHTED AVERAGE ($MILLION)											**2.4**

7. Interest during construction

7.1 Including interest during construction (IDC) in a DORC valuation

IDC is included in DORC valuations because a DORC value reflects the costs incurred by an efficient entrant to replace the asset, inclusive of direct labour and materials costs, pre-construction costs and costs associated with project management.

IDC reflects the funding costs (essentially the opportunity cost of capital) incurred during the construction of the assets to which the DORC valuation relates. Because infrastructure investments are 'lumpy' and have a long lead time relative to commissioning, IDC is calculated over the entire project development and construction period until commissioning, when the assets begin to generate revenue.

To calculate IDC value, we have made assessments of the following:

- construction schedule, capturing both the time taken for construction as well as the scheduling of construction tasks
- availability of plant, labour and materials that may influence the construction schedule
- service provided by the infrastructure and the extent to which that service can be separable

7.2 Determining the construction schedule

The basis of the IDC calculation is the construction schedule built up from the scheduling dependencies and durations of construction tasks (e.g. undertaking bulk earthworks prior to installing track). The construction schedule is assumed to be neither unduly rushed or unduly delayed[30] but is intended to represent the minimum (and therefore least overall cost) duration that we anticipate consortia of experienced contractors would require to complete the construction.

The construction schedule also reflects the period that the new entrant is exposed to increasing opportunity cost of capital, as it reflects the period where the efficient entrant is unable to earn revenue, despite outlaying cost. In accordance with DORC principles, our approach to minimise overall costs was to reduce the overall construction duration to a minimum, because this directly impacts the IDC cost. We consider that an efficient entrant would construct the Interstate Network as a single stage project, comprised of several individual projects that would occur concurrently.

We determined the number of concurrent construction projects that could be implemented based on our understanding of the interest that such a project would generate from contractors of the size required for complex infrastructure of this scale. Because this approach considers that the shortest realistic time required to complete the network as a whole is likely to result in the minimum overall cost, it is based on a single stage commissioning and is agnostic to segment.

Notwithstanding, we recognise that an efficient entrant may seek to complete the construction and commissioning of some sections of the asset sooner than others to enable the commissioned sections to generate revenue and minimise exposure to interest costs on debt and opportunity cost for equity.

[30] ACCC's final determination: statement of reasons – access dispute between Glencore Coal Assets Australia Pty Ltd and Port of Newcastle Operations Pty Ltd, available at: https://www.accc.gov.au/system/files/public-registers/other/Glencore%20PNO%20access%20dispute%20-%20Final%20Determination%20-%20Statement%20of%20Reasons%20-%2018%20September%202018%20%28Public%20version%29.pdf

The IDC assessment typically undertaken for a DORC valuation is not a cashflow assessment used to support or confirm financial viability of the project, but rather an estimation of the minimum reasonable amount of compensation for the opportunity cost of capital involved with constructing the asset. Determining the revenue generated from the constructed parts of the asset is complex and outside the DORC setting. The review of staging and the impacts of interim revenue on cash flow is for a prospective new entrant to consider as part of their business cases and outside the requirements for the DORC.

7.2.1 Principles and assumptions used in developing the construction schedule

The construction schedule we prepared for the development of the Interstate Network assets is based on the following principles:

- Development approvals would be secured for the entire network, and not on a Segment-by-Segment basis
- The construction project would be a single-phase project comprised of numerous individual projects. That is, the entire Interstate Network would be constructed so that it could all be commissioned at once, rather than a series of separate, staged sections with the express purpose of generating revenue sooner.
- Construction of the network would be undertaken in a series of ‘projects’ of a scale typical of major rail infrastructure developments. Recent precedent indicates that the line length of a typical major rail infrastructure project is around 200-300 km.
- Our experience with rail construction projects is that a typical 200 – 300 km project takes around two-years to construct but this duration would increase or decrease as a function of terrain and remoteness of the site.
- The durations presented are neither unduly rushed nor unduly delayed, and are those that an experienced contractor would require to complete the works to appropriate standards
- The works would be completed by an experienced contractor who would make a reasonable assessment of the effort and risks
- Appropriate plant and resources would be deployed, with due regard for the limited availability of rail-construction equipment.

Applying these principles, we determined that 30 ‘projects’ would be required to construct the Interstate Network, as shown in Table 35

Our assessment of the minimum realistic duration that would be required for construct the entire network is based on the number of contractors that could deliver projects of this scale and complexity.

Each of the larger ‘projects’ would be a major rail infrastructure development and consequently would need to be undertaken by a Tier 1 Contractor[31] We have assumed that there will be in the order of five contractors of the size and capability required to undertake projects of this magnitude. These Tier 1 contractors would also draw on international and Tier 2 contractors to complete their consortia.

We’ve assumed there may then be a further four Tier 2 contractors able to construct some of the lower value sections. That means that with a total of nine contractors working concurrently, the construction task would take 6 to 7 years. Table 35 shows the projects and construction duration by Segment.

[31] Tier 1 Contractors are widely considered the largest and most experienced in the construction industry. Tier 1 contracting firms work on the most significant and largest infrastructure projects, and are generally used where there is significant risk associated with construction.

Table 35: Interstate Network Construction Project Breakdown

Segment	Line Length (km)	Terran Type	Number of projects	Project Construction Duration (year)	Total Duration (project years)
Cootamundra – Parkes	198	Rural	1	1.5	1.5
Crystal Brook - Parkes	1,101	Rural	5	1.5	7.5
Dry Creek – Parkeston	1,993	Remote Rural	8	3.0	24.0
Dry Creek – Pelican Point	32	Metropolitan	Note 1		
Dry Creek – Spencer St (Melbourne)	883	Rural	4	2.0	8.0
Appleton Dock Jct – Footscray Rd	30	Metropolitan	Note 2		
Melbourne (Tottenham – Macarthur)	50	Metropolitan	1	0.7	0.7
Melbourne (Tottenham – Macarthur)	1,010	Rural	4	2.0	8.0
Moss Vale - Unanderra	67	Rural	1	1.0	1.0
Newcastle – Acacia Ridge	776	Rural/Metropolitan	3	2.0	6.0
Port Augusta - Whyalla	71	Rural	1	1.0	1.0
South Sydney Freight Line	40	Metropolitan	2	1.0	2.0
MFN Chullora Jct – Port Botany	36	Metropolitan	Note 3		
Total	**6,287**		**30**		**59.7**

Notes:
1: Combined with Dry Creek to Spencer Street
2: Combined with Melbourne Metropolitan
3: Included in Southern Sydney Freight Line

In our approach we have assumed that:

– There is sufficient plant and labour across the contractors to enable nine projects to run concurrently
– There is sufficient temporary infrastructure to support the construction of the necessary labour camps and support the movement of labour around the country over the period to enable construction
– Materials and products (e.g. ballast, sleepers, track, services and comms cabling etc.) could be sourced, manufactured and delivered to site at a rate to support the construction of about 1,200 km of line length annually.

Schedule for pre-development activities

Prior to construction, there are several activities that need to be undertaken. These include the design, approvals and contractor engagement. There is likely to be considerable uncertainty over the duration that a project of this scale would require to secure the necessary approvals and progress the design to a level suitable for construction.

Our assessment is based on our experience of linear infrastructure projects of a similar size and is summarised in Table 36, which indicates approximately five years would be required between identifying the project need and awarding the construction contracts.

This is shown in the context of the overall development duration in Figure 13

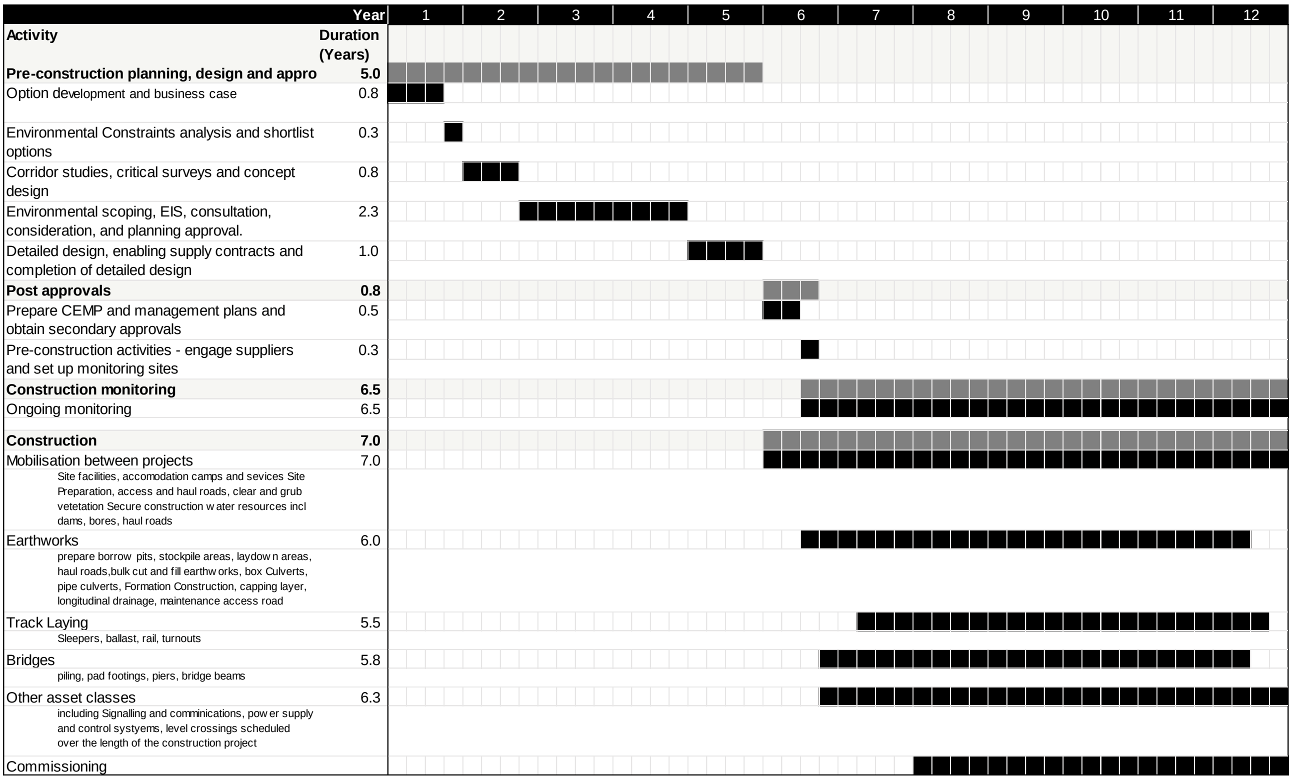
Table 36: Predevelopment and design duration

Activity	Duration (years)	Complete at year
Option development and business case	0.75	0.75
Environmental Constraints analysis and shortlist options	0.25	1.0
Corridor studies, critical surveys and concept design	0.75	1.75
Environmental scoping, EIS, consultation, consideration, and planning approval. Preparation of reference design.	2.25	4.00
Detailed design, enabling supply contracts and completion of detailed design	1.00	5.00

7.2.2 Summary construction schedule

The construction programme is shown in Figure 13

Figure 13: Summary construction schedule



7.3 Calculation of interest during construction

The ACCC has instructed us to use a real, pre-tax WACC rate of 4.37% to determine IDC.[32] As IDC is typically calculated monthly, we have mapped the expenditure profile into monthly terms.

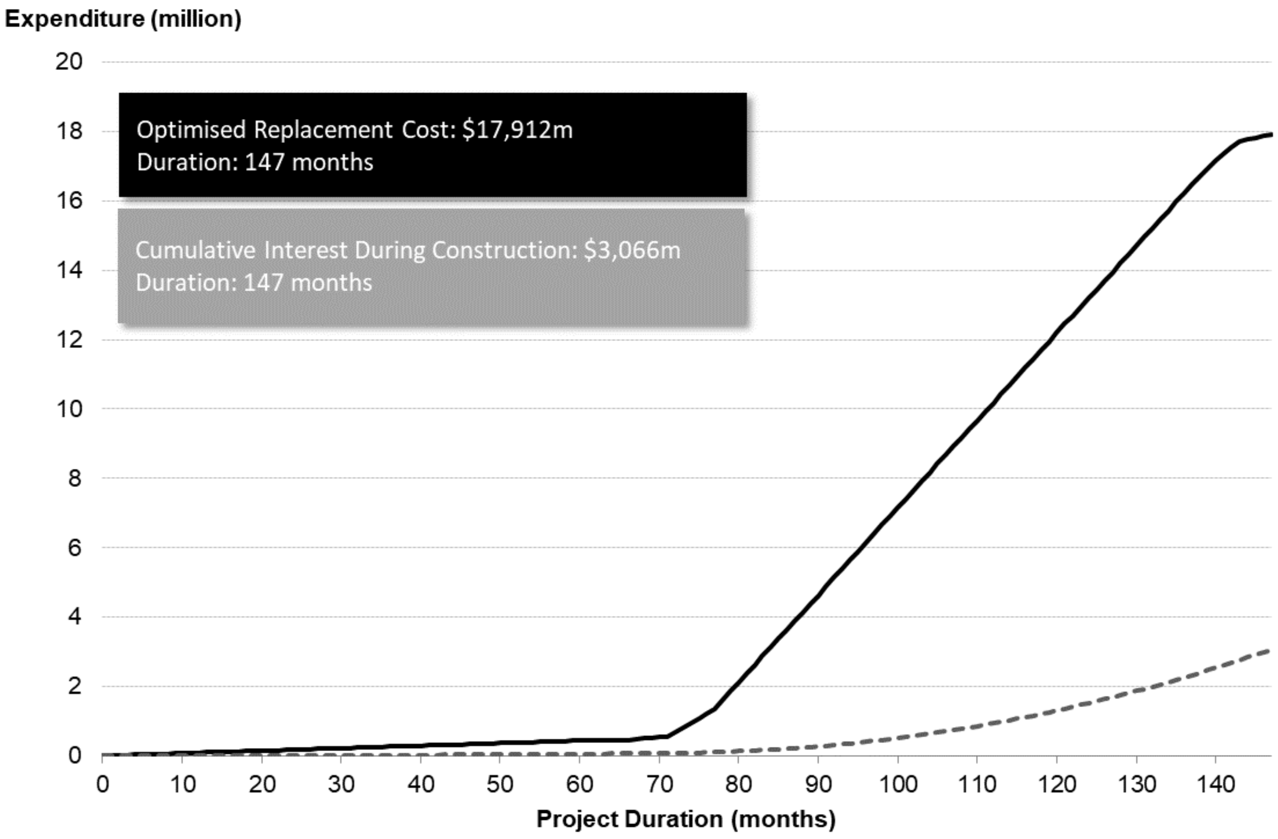
We determined a preliminary expenditure profile (using the ORC value) that is mapped against the construction period for the Interstate Network.

The IDC principal amount was based on both the pre-construction cost (planning and approvals) and the construction cost for the network. It does not include any post-construction costs because these would be incurred during operation of the asset, when the service is generating revenue.

This results in the project expenditure profile show in Figure 14. This shows a low rate of expenditure during the initial five years when the planning tasks are being completed. The expenditure proceeds at a near constant rate during construction because of the close sequencing of construction activities, and levels off toward the end as construction completes.

Table 37 shows the allocation of IDC to segment in proportion to ORC, which is appropriate because to do otherwise would pre-suppose a construction sequence. The temporal growth of IDC is shown in Figure 14.

Figure 14: Second order curve expenditure profile



[32] The ACCC has not provided an explanation for the derivation of the WACC nor explained why a pre-tax figure is required. These considerations are beyond the scope of our engagement with the ACCC.

Table 37: IDC by Segment (ORC)

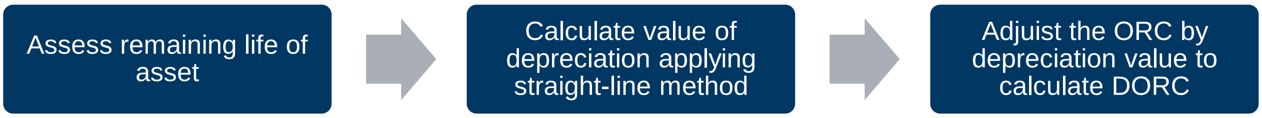
Regulatory Segment	Optimised Replacement Cost ($million)	IDC ($million)	Proportion of ORC (%)	TOTAL ORC Including IDC ($million)
Dry Creek to Parkeston	3,688.0	631.3	21%	4,319.3
Tarcoola to API	14.2	2.4	0%	16.6
Port Augusta to Whyalla	216.3	37.0	1%	253.3
Crystal Brook to Parkes	1,929.4	330.3	11%	2,259.7
Cootamundra to Parkes	379.9	65.0	2%	444.9
Dry Creek to Pelican Point	163.9	28.1	1%	192.0
Dry Creek to Melbourne (Spencer Street)	1,953.0	334.3	11%	2,287.3
Appleton Dock to Footscray	387.7	66.4	2%	454.1
Melbourne (Tottenham) to Macarthur	4,544.0	777.8	25%	5,321.8
Moss Vale to Unanderra	310.0	53.1	2%	363.0
SSFL	393.9	67.4	2%	461.4
MFN	143.1	24.5	1%	167.6
Newcastle to Acacia Ridge	3,788.7	648.5	21%	4,437.2
TOTAL	**17,912.0**	**3,066.1**	**100%**	**20,978.1**

8. Depreciated Optimised Replacement Cost (DORC)

8.1 Our approach used to determine the DORC

Our approach to deriving the DORC from the ORC is shown in Figure 15.

Figure 15: Overview of approach to calculating the DORC



As set out in Section 2.7, in undertaking the depreciation of the MEA, the useful life and remaining life of the existing asset is applied to its MEA and the ORC depreciated accordingly.

8.1.1 Information gaps relevant for depreciation assessment

Of the asset information we received from ARTC, the majority did not have commissioning date information. We sought further information from ARTC regarding the commissioning date of assets, and ARTC advised that all available data related to in-service or commissioning date had been provided to GHD. We therefore developed an alternative approach for calculating depreciation for those assets.

We considered that, where condition information was provided to us by ARTC and we could identify relevant assets within a Segment, that we could estimate the residual life of assets based on the outcomes of the condition assessment. We also used the condition information to verify the extent to which assets may have performed differently to expected, relative to forecast design life performance. That is, while an asset may have a design life of 50 years, it may deteriorate at a faster rate, which would mean that it becomes life expired before its design life. Where commissioning date data did exist, we reviewed the condition data against the commissioning date to verify whether any further adjustments to residual life were warranted.

We issued an RFI to ARTC and had a subsequent discussion with ARTC on 15 October 2020 to determine the appropriateness of using AK-Car data for our condition assessment verification.

We understand that the primary purpose of AK-Car is to assess track geometry and the state of the track. AK-Car provides inputs into other data we received from ARTC (such as the RailWear model).

From our discussion with ARTC, we understand that AK-Car does not provide a complete set of information for the entire Interstate Network. Through our discussion with ARTC, we also understood that AK-Car data provides an input to TMS data, which ARTC uses to identify areas where specific work activities (such as undercutting, tamping and ballasting) may occur. We understand that ARTC uses TMS for both reactive and planned maintenance activities and is used to prioritise expenditure on items in specific locations (rather than determine the programme of works).

ARTC advised that TMS data is not used to inform the RailWear model, and that these are two independent data sets. The RailWear model assesses the rate of rail wear per year to estimate the remaining life of each rail, based on measurements of rail remaining head height and width profile data. Conversely, TMS data measures track condition based on track geometry. We understand that ARTC uses it to inform condition assessments by assigning a key performance indicator (**KPI**) to the track in an area. Areas that are below the KPI are prioritised for remedial action, which could include activities such as undercutting, tamping, and ballasting. TMS data was provided to us in a raw extract, and we were unable to use this information to verify track condition.

We received ARTC's maintenance data as input to our opex savings calculation (refer Section 10). This data was presented on an activity level basis and contained some activities relating to asset life extension, though, we understand, it did not contain forecast major capital works forecast. We considered if we could verify our assessment of condition data with reference to the maintenance data we received, as the maintenance data would indicate whether any significant costs are forecast to be incurred on particular activities over the period to FY2029. ARTC advised that its maintenance cost information is not available at an asset class, or asset, level. We therefore did not rely on the maintenance data to verify our assessment.

We considered whether we would be able to estimate the commissioning date of assets with reference to the commissioning or refurbishment date of any co-located or dependent assets. For example, we considered if we could estimate the commissioning date of sleepers by considering the commissioning dates of the associated track and ballast assets. We have applied this approach for assets that we lacked in-service or condition data to estimate the residual life.

We applied a network-wide average depreciation asset for which insufficient condition data existed to conduct a depreciation assessment. The network-wide average depreciation amount was calculated by averaging the residual life of all assets: by summing the ORC value of all assets with known commissioning data and dividing this value by the corresponding DORC value of all assets with known commissioning data. Figure 16 details the proportion by ORC value used in this approach. We consider this an appropriate assumption because we have seen no evidence to suggest that ARTC prioritises the management of its assets in such a way that would lead to a systemic difference in asset condition between groups.

For any assets that were life expired but still providing a service, we applied a nominal 10% residual life of the MEA. This is to reflect that the asset is still in-service but is likely to require replacement or refurbishment in the near-term.

We selected 10% of the residual life of MEA for life expired assets that are still providing a service because of the range of asset lives associated with rail infrastructure. For example, bridges, culverts and other major civil infrastructure are long-lived assets and, in some cases, have asset class lives over 100 years, while other rail infrastructure (such as SCADA, computer and communication systems) often have an asset class life of only five years. This approach is also consistent with an Energy Australia submission to the AER developed by Sinclair Knight Merz in June 2004:[33]

> *The asset class life is designed to reflect the average service life that may be expected from each set of assets. As with all averages, some equipment will fall short of the average, while some equipment will remain in service well beyond the asset class life. For assets that exceed the average class life, a reasonable residual life must be assigned to the asset to reflect its continued serviceability.*
>
> *The NSW Treasury Guidelines suggest that "… ENB's (Electricity Network Business) should allow a minimum remaining life of three years for all assets still in use".[34]*
>
> *Adequate and effective maintenance over the life of an asset does however contribute to the overall extension of power system asset lives and the normal period required to implement planning and project works to effect the replacement of ageing assets may be longer than three years, on average. Given the general history of power system asset lives in Australia and overseas, Sinclair Knight Merz is of the view that a residual life of 5 years is appropriate for this valuation.*

On this basis, residual life equivalent to 10% of the asset class life of a given asset for power network assets that typically have an asset life of circa 50 years results in a five-year residual life.[35]

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[33] SKM's review of draft ACCC determination re Energy Australia transmission projects, available at: https://www.aer.gov.au/system/files/EnergyAustralia%20attach%202%20%20-%20SKM%20report%20%20-%202%20July%202004.pdf
[34] Clause 2.5.4
[35] Some commentators suggest that the five-year residual life for power network assets is linked to the five year regulatory cycle for that industry. However, and again, we consider it more sensible to link residual life to a proportion of standard asset class life.

However, where no commissioning date data or condition reports exist, we applied the weighted average depreciation determined from the above approaches on the basis that this was representative of the typical assert condition across the network.

Our approach is summarised as follows and shown in Figure 16:

- Quantified data on condition and/or in-service date was used to depreciate 51% of the ORC
- In-service date for 8% of assets demonstrated that these assets were beyond their useful lives but are still in service. These assets were depreciated to 90%, providing a residual life of 10% of the asset class life.
- The depreciation from the above assets was extrapolated to those assets where we had no other data on the assumption that these assets are maintained to a similar standard. This amounts to 25% of the ORC.
- An alternative approach was used for signalling and communications because although these assets do deteriorate over time, they are typically replaced because of technical obsolescence. This is discussed further in 9.5.
- We consider earthworks assets to be perpetual because their service potential does not deteriorate with the passage of time or trains. This is discussed further in 8.4.
- Timber turnouts are typically not constructed new and tend to deteriorate at a quicker rate than concrete turnouts. Subsequently, we considered that any existing timber turnouts would likely be approaching the end of their useful life and due for replacement or in other words; are life expired.

Figure 16: Methods used to estimate depreciation

Asset Condition Data or in-service date	• All track assets • Structures	51% of ORC
Extrapolation of data	• Average network wide residual life	25% of ORC
Experienced-based judgement	• Signalling • Communications	9% of ORC
Life Expired assets	• 10% adopted	8% of ORC
Perpetual assets	• Earthworks	7% of ORC

8.1.2 Application of straight-line depreciation

For the purposes of summarising and presenting depreciation for an asset class, we present the 'weighted depreciation'. This is based on a weighted average residual life for the asset class which is derived from the residual life assessments at the more granular level sub-asset class level, by weighting the residual life in proportion to the replacement cost of the sub-asset class. This is shown in Figure 17 where *i* is the number of sub-asset classes.

Figure 17: Weighted Average Residual Life Calculation

$$Asset\ Class\ Weighted\ Average\ Residual\ Life = \frac{\sum_{i=1}^{n}(Replacement\ Cost\ \times Residual\ Life)}{\sum_{i=1}^{n} Replacement\ Cost}$$

We have then applied straight-line depreciation as set out in Section 2.7.2.

8.1.3 Determining useful life of MEA

Our assessment of the useful life of MEA is shown in the sections below. Where necessary, we applied engineering judgement in developing these MEA asset lives, which is based on AS/NZ Standards (which specify the design, selection, construction and installation of specific assets; and also nominate a typical design life), as well as our experience working in the rail sector.

8.2 General Civil Infrastructure

8.2.1 Approach taken

Table 38 summarises the approach taken to assess the remaining life of each asset.

Table 38: Depreciation Approach - General Civil Infrastructure

Asset	Depreciation Approach
Culverts (reinforced concrete pipes)	Elapsed time since commissioning. Segment install year taken as in-service date Where the Asset is identified as life expired, 10% life remaining adopted Where no in-service date exists, the average weighted depreciation of the network has been taken. Approximately 52%
Culverts (corrugated metal pipes)	As above
Culverts (reinforced concrete box culverts)	As above
Level Crossings (Private Property)	As above
Level Crossings (Public - Active)	As above
Level Crossings (Public - Passive)	As above

8.2.2 Depreciation assessment

The assessment of the percentage depreciation is shown in Table 39:

Table 39: Depreciation - General Civil Infrastructure

Asset	Asset Useful Life (years)	Weighted average Remaining Life (years)	Weighted average Depreciation (%)
Culverts (reinforced concrete pipes)	100	50	50%
Culverts (corrugated metal pipes)	35	9	73%
Culverts (reinforced concrete box culverts)	100	19	81%
Level Crossings (Private Property)	50	5	90%
Level Crossings (Public - Active)	50	10	80%
Level Crossings (Public - Passive)	50	12	76%
ASSET CLASS TOTAL DEPRECIATION (%)			**79%**

8.3 Miscellaneous assets

8.3.1 Approach taken

Table 40 summarises the approach taken to assess the remaining life of each asset.

Table 40: Depreciation Approach – Miscellaneous assets

Asset	Approach
Airstrips	No in-service date exists, the average weighted depreciation of the network has been taken as a proxy of in-service life to determine the remaining life of these assets. Approximately 52%
Stations (platforms)	Elapsed time since commissioning. Where the Asset is identified as life expired, a residual life of 10% of asset class life has been adopted Where no in-service date exists, the average weighted depreciation of the network has been taken as a proxy for the depreciation of these assets on the basis that they will have been commissioned at the same time as the track. Approximately 52%
Non-Safety Critical Equipment	As above – Stations (platforms)

8.3.2 Depreciation assessment

The assessment of the percentage depreciation is shown in Table 41:

Table 41: Depreciation – Miscellaneous assets

Asset	Asset Useful Life (years)	Weighted average Remaining Life (years)	Weighted average Depreciation (%)
Airstrips	50	24	52%
Stations (platforms)	50	14	72%
Non-Safety Critical Equipment	40	19	52%
ASSET CLASS TOTAL DEPRECIATION (%)			**53%**

8.4 Right of Way

8.4.1 Approach taken

Table 42 summarises the approach taken to assess the remaining life of each asset.

Table 42: Depreciation Approach – Right of Way

Asset Class	Approach taken
Drainage	No material quantity identified
Earthworks - Cut to fill	See discussion below.
Earthworks - Win to fill including placement and compaction	See discussion below.
Earthworks - Cut to spoil	See discussion below.
Earthworks - Imported fill	See discussion below.
Fencing (rural), including right of way	No in-service date exists, the average weighted depreciation of the network has been taken as a proxy for the depreciation of these assets given that they will have been constructed at the same time as the track. Approximately 52%
Fencing (urban), including right of way	No in-service date exists, the average weighted depreciation of the network has been taken as a proxy for the depreciation of these assets given that they will have been constructed at the same time as the track. Approximately 52%

Earthworks for a rail development consist of similar activities to that required to construct a road, which the AASB defines as typically including, "*clearing the land and reshaping and aligning the land surface through cutting, filling, grading and compacting soil and rock to suit the type of road to be constructed*". [36]

The DORC valuations completed for ARTC in 2001[37] and 2007[38] note that, "earthworks are assumed to be a perpetual asset in that given appropriate maintenance they do not "wear out" due to the passage of trains or time". Contrary to this definition, both these DORC reports then depreciate earthworks assets based on age

[36] Accounting for Road Earthworks, Interpretation 1055, paragraph 1, Australian Accounting Standards Board
[37] Booz Allen & Hamilton's ARTC standard gauge rail network DORC, available at: https://www.artc.com.au/uploads/news_160301a.pdf
[38] Booz Allen & Hamilton's ARTC standard gauge rail network DORC, available at: https://www.accc.gov.au/system/files/Booz%20Allen%20Hamilton%20DORC%20valuation%20report.pdf

relative to a nominal life of 100 years, with earthworks over 50 years old depreciated to 50% of their replacement value.[39] The reason for this contradiction in approach is unclear and neither report provides a basis for the assumed 50% depreciation extent.

The more recent DORC report for the Queensland Border to Acacia Ridge segment inherently assumes that earthworks are not perpetual by assigning them an economic life of 100 years and depreciating these assets based on the time remaining to the end of ARTC's lease over the segment (from 2014 to 2064). This also resulted in 50% depreciation. This assessment appears to be based on an economic depreciation, rather than condition and asset life based depreciation, driven by the remaining time that ARTC have in their lease to recover the capital – as opposed to depreciation based on the ability of the asset to perform the service.[40]

Different approaches have been taken to depreciate earthworks, as echoed by commentary in relation the depreciation of earthworks component of road assets:[41]

> *'There are different views concerning whether the earthworks component of road assets should be depreciated, with some entities taking the view that it is not feasible to reliably estimate a useful life for earthworks, and other entities determining depreciation on the basis of an estimated average useful life.'*

The AASB notes that some Earthworks are like Land, in that that earthworks represent, in some circumstances:

> *'another exception to the expectation that all tangible assets have limited useful lives because the service potential of the earthworks is expected to be retained due to the absence of any events that cause physical deterioration, such as excessive usage, flooding or land movement, of the earthworks'.*[42]

And that:

'earthwork assets that are assessed as not having a limited useful life shall not be depreciated'[43].

AASB 116 further notes that:

> *'with some exceptions, such as quarries and sites used for landfill, land [which is similar to earthworks] has an unlimited useful life and therefore is not depreciated.*[44]

As noted by the AASB with respect to road corridors, provided earthworks and drainage infrastructure is adequately maintained, earthworks may not be subject to material physical deterioration[45]. Notwithstanding, maintenance is undertaken by ARTC to maintain earthworks in response to discrete events which result in a loss of service, because of storms and flooding causing washout, for example, and other similar events.

Regardless of the physical condition, earthworks could have a finite life as a consequence of obsolescence, which in this application would most likely result from the asset becoming redundant through a fall in demand for its services and a section of track decommissioned.[46] While demand on some of ARTC's network may fall over time, such as when Inland Rail is operational, we see no evidence to suggest that Segments will become redundant.

Should Segments become redundant, this should be addressed as an asset stranding risk in the RAB, and not within this DORC valuation. Similarly, where there is limited time for the asset owner to recover the

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[3939] Booz Allen & Hamilton's ARTC standard gauge rail network DORC, available at: https://www.accc.gov.au/system/files/Booz%20Allen%20Hamilton%20DORC%20valuation%20report.pdf
[40] Depreciated Optimised Replacement Cost Calculation for additional segments of the ARTC network, Evans and Peck, July 2014
[41] Accounting for Road Earthworks, Interpretation 1055, paragraph 3 Australian Accounting Standards Board
[42] Accounting for Road Earthworks, Interpretation 1055, paragraph 16 Australian Accounting Standards Board
[43] Accounting for Road Earthworks, Interpretation 1055, paragraph 7 Australian Accounting Standards Board
[44] AASB 116 property, plant and equipment, available at: https://www.aasb.gov.au/admin/file/content105/c9/AASB116_08-15_COMPmay19_01-20.pdf0
[45] Accounting for Road Earthworks, Interpretation 1055, paragraph 18 Australian Accounting Standards Board
[46] Accounting for Road Earthworks, Interpretation 1055, paragraph 20 Australian Accounting Standards Board

investment, as noted in the 2017 DORC[47], we consider that this also presents a risk of asset stranding that is more appropriately managed in the RAB.

We consider that depreciation within the DORC should be based on the ability of the asset to provide the service over time. We share the view of Booz Allen Hamilton that earthworks are perpetual assets[48] because they will continue to provide the level of service indefinitely (provided routine maintenance is undertaken). Consequently, we see no credible basis to depreciate earthworks assets within the DORC valuation.

8.4.2 Depreciation assessment

The assessment of the percentage depreciation is shown in Table 43:

Table 43: Depreciation – Right of Way

Asset	Asset Useful Life (years)	Weighted average Remaining Life (years)	Weighted average Depreciation (%)
Drainage	25	No material quantity identified	No material quantity identified
Earthworks - Cut to fill	∞	∞	0
Earthworks - Win to fill including placement and compaction	∞	∞	0
Earthworks - Cut to spoil	∞	∞	0
Earthworks - Imported fill	∞	∞	0
Fencing (rural), including right of way	10	5	52%
Fencing (urban), including right of way	20	10	52%
ASSET CLASS TOTAL DEPRECIATION (%) OF DEPRECIABLE ASSETS			**52%**

Worley Parsons' and Evans & Peck's Depreciated optimised replacement cost calculation for additional segments of the ARTC network, available at: https://www.accc.gov.au/system/files/Evans%20%26%20Peck%20-%20Queensland%20Border%20to%20Acacia%20Ridge%20DORC%20Valuation%20Report%20-%20July%202014.pdf

[48] Booz Allen & Hamilton's ARTC standard gauge rail network DORC, available at: https://www.artc.com.au/uploads/news_160301a.pdf

8.5 Signalling and Communications

8.5.1 Approach taken

We have assumed that the assets that make up the signalling and communications network have a useful life of about 30 years. Whilst they do deteriorate over time, in practice replacement is typically due to obsolescence due to improvements in technology.

We have therefore assessed depreciation on a segment basis, using our understanding of when the signalling system was most recently replaced (or scheduled to be replaced) as a basis for remaining life.

8.5.2 Depreciation assessment

Table 44 summarises the approach taken to assess the remaining life of each segment.

Table 44: Depreciation – Signalling and Communications

Track Segment	Useful Life	Remaining Life		Basis
	Years	**Years**	**%**	
Dry Creek to Parkeston	30	-	10%	ATMS is currently being installed from Port Augusta to Parkeston. Therefore, existing signalling assets assumed to be at the end of their lives, and extrapolated this assessment across the remainder of the segment.
Tarcoola to API	30	-	10%	As Dry Creek to Parkeston
Port Augusta to Whyalla	30	30	100%	ATMS recently installed and operating.
Crystal Brook to Parkes	30		10%	As Dry Creek to Parkeston.
Cootamundra to Parkes	30	10	33%	We have assumed that on average, 70% of the assets are between 20-30 years old, and 30% are less than 20 years old. Gives an average asset age of about 20 years.
Dry Creek to Pelican Point	30	10	33%	
Dry Creek to Melbourne (Spencer Street)	30	10	33%	
Appleton Dock to Footscray	30	10	33%	
Melbourne (Tottenham) to Macarthur	30	10	33%	
Moss Vale to Unanderra	30	10	33%	
SSFL	30	25	83%	Assets typically 5 years old.
MFN	30	15	50%	We have assumed that on average, 30% of the assets are over 20 years old, and 70% are less than 20 years old. Average asset age therefore about 15 years
Newcastle to Acacia Ridge	30	17	55%	28% of 30 year life consumed in July 2014 (E&P Report). Equates to 8.5 years. Assuming linear depreciation since then, amounts to 13 years life consumed – 17years remaining.
ASSET CLASS TOTAL DEPRECIATION (%)			**64%**	

8.6 Structures

8.6.1 Approach taken

Table 45 summarises the approach taken to assess the remaining life of each asset.

Table 45: Depreciation Approach – Structures

Asset	Approach
Bridges Minor Crossing - Concrete	Elapsed time since commissioning. Where the Asset is identified as life expired, a residual life of 10% of the asset class life has been adopted Where no in-service date exists, the average weighted depreciation of the network has been taken as a proxy for the depreciation of these assets given that they will have been constructed at the same time as the track. Approximately 52%
Bridges Major or Water Crossing – Concrete	As above
Bridges (steel)	No material quantity identified
Buildings Facilities	As above
Tunnels	Elapsed time since commissioning.
Misc. Structures	No in-service date exists, the average weighted depreciation of the network has been taken as a proxy for the depreciation of these assets given that they will have been constructed at the same time as the track. Approximately 52%

8.6.2 Depreciation assessment

The assessment of the percentage depreciation is shown in Table 46.

Table 46: Depreciation – Structures

Asset	Asset Useful Life (years)	Weighted average Remaining Life (years)	Weighted average Depreciation (%)
Bridges Minor Crossing - Concrete	100	43	57%
Bridges Major or Water Crossing - Concrete	100	46	54%
Buildings Facilities	20	10	52%
Tunnels	100	15	85%
Misc. Structures	50	24	52%
ASSET CLASS TOTAL DEPRECIATION (%)			**61%**

8.7 Track

8.7.1 Approach taken

Table 47 summarises the approach taken to assess the remaining life of each asset.

Table 47: Depreciation Approach – Track

Asset	Approach Taken
Track (mainlines, crossings and passing loops)	RailWear Model ARTC Sleeper and ballast condition data
Track (sidings and yards)	As above
Turnouts (mainlines, crossing and passing loops)	As above
Turnouts (yards and sidings)	As above
Rail Lubricators	No in-service data. Depreciation based on RailWear RL by account code.
Points	Same as Track asset class

8.7.2 Depreciation assessment

The assessment of the percentage depreciation is shown in Table 48:

Table 48: Depreciation – Track

Asset	Asset Useful Life (years)	Weighted average Remaining Life (years)	Weighted average Depreciation (%)
Track (mainlines, crossings and passing loops)	53[49]	29	55%
Track (sidings and yards)	44[50]	29	64%
Turnouts (mainlines, crossing and passing loops)	25	12	51%
Turnouts (yards and sidings)	25	12	51%
Rail Lubricators	5	4	23%
Points	20	16	21%
ASSET CLASS TOTAL DEPRECIATION (%)			**56%**

[49] Weighted average nominal life of rail, ballast and sleeper using 30-year, 50-year, and 75-year nominal design life respectively
[50] Weighted average nominal life of rail, ballast and sleeper using 30-year, 50-year, and 50-year nominal design life respectively

8.8 Utilities

8.8.1 Approach taken

Table 49 summarises the approach taken to assess the remaining life of each asset.

Table 49: Depreciation Approach - Utilities

Asset	Approach
Power Supply	No in-service date. Network Average depreciation used as a proxy for the depreciation of these assets given that they will have been constructed at the same time as the track. Approximately 52% depreciation.
Distribution substations	As above.

8.8.2 Depreciation assessment

The assessment of the percentage depreciation is shown in Table 50:

Table 50: Depreciation - Utilities

Asset	Asset Useful Life (years)	Weighted average Remaining Life (years)	Weighted average Depreciation (%)
Power Supply	5	2[51]	52%
Distribution substations	40	19	52%
ASSET CLASS TOTAL DEPRECIATION (%)			**52%**

[51] Rounded to nearest whole number, actual number is 2.38 years

8.9 Summarising the DORC valuation

Table 51 presents the effect of depreciation by asset class and segment

Table 51: Summary Depreciated Optimised Replacement Cost

Regulatory Segment	Replacement Cost ($million)	Optimised Replacement Cost ($million)	Optimised Replacement Cost + IDC ($million)	General Civil Infrastructure	Miscellaneous Assets	Right of Way	Signals and Comms	Structures	Track	Utilities	Subtotal Depreciation by segment ($million)	Subtotal Depreciation by segment (%)	Total Depreciated Optimised Replacement Cost ($million)	Cost per track km ($million)
Replacement Cost	18,387.4			725.2	151.5	1,270.9	1,629.6	5,491.0	9,055.1	64.1				2.43
Optimised Replacement Cost		17,912.0		721.5	151.5	1,270.9	1,605.9	5,491.0	8,607.1	64.1				2.38
Optimised Replacement Cost + IDC			20,978.1	845.0	177.4	1,488.5	1,880.8	6,431.0	10,080.5	75.1				2.79
Depreciation by segment														
Dry Creek to Parkeston	3,720.5	3,688.0	4,319.3	47.4	91.1	0.0	262.4	166.2	1,916.9	5.5	2,489.5	58	1,829.7	**0.9**
Tarcoola to Asia-Pacific Interface (API)	14.7	14.2	16.6	1.4	-	-	-	1.5	6.1	0.1	9.0	55	7.5	**1.3**
Port Augusta to Whyalla	217.3	216.3	253.3	4.3	-	0.0	-	32.8	114.5	0.1	151.7	60	101.6	**1.4**
Crystal Brook to Parkes	1,947.6	1,929.4	2,259.7	90.2	1.0	0.0	94.8	176.8	494.5	2.8	860.1	38	1,399.6	**1.3**
Cootamundra to Parkes	384.1	379.9	444.9	28.5	-	0.0	24.1	25.7	63.7	0.7	142.7	32	302.2	**1.5**
Dry Creek to Pelican Point	165.4	163.9	192.0	14.2	-	0.0	20.9	12.7	25.4	1.1	74.2	39	117.8	**3.7**
Dry Creek to Melbourne (Spencer Street)	1,970.6	1,953.0	2,287.3	178.3	-	0.0	115.8	404.6	619.5	6.7	1,324.8	58	962.5	**1.1**
Appleton Dock to Footscray	392.4	387.7	454.1	9.7	-	0.0	25.9	180.5	41.0	0.2	257.2	57	196.9	**3.3**
Melbourne (Tottenham) to Macarthur	4,898.4	4,544.0	5,321.8	146.8	0.3	0.0	394.7	1,152.7	647.6	11.2	2,353.3	44	2,968.5	**1.4**
Moss Vale to Unanderra	311.5	310.0	363.0	15.4	-	0.0	23.0	85.2	32.8	0.6	157.1	43	205.9	**3.1**
Southern Sydney Freight Line (SSFL)	395.4	393.9	461.4	1.1	-	0.0	7.7	99.8	35.9	0.3	144.8	31	316.6	**4.0**
Metropolitan Freight Network (MFN)	159.2	143.1	167.6	1.5	-	0.0	14.0	25.5	13.7	0.5	55.1	33	112.4	**1.6**
Newcastle to Acacia Ridge	3,810.2	3,788.7	4,437.2	126.5	1.1	0.0	224.8	1,588.7	434.2	9.7	2,385.1	54	2,052.2	**2.4**
Total depreciation				**665.3**	**93.5**	**0.1**	**1,208.1**	**3,952.6**	**4,445.6**	**39.4**	**10,404.7**	**50**		
TOTAL ($MILLION)	18,387.4	17,912.0	20,978.1	179.7	83.9	1,488.3	672.7	2,478.4	5,634.8	35.7	10,404.7		10,573.5	1.38

9. Summary of DORC estimate

The DORC values, inclusive of preconstruction costs and the IDC associated with this infrastructure, are summarised in Table 52 and Figure 18.

Figure 18: DORC Summary Build Up

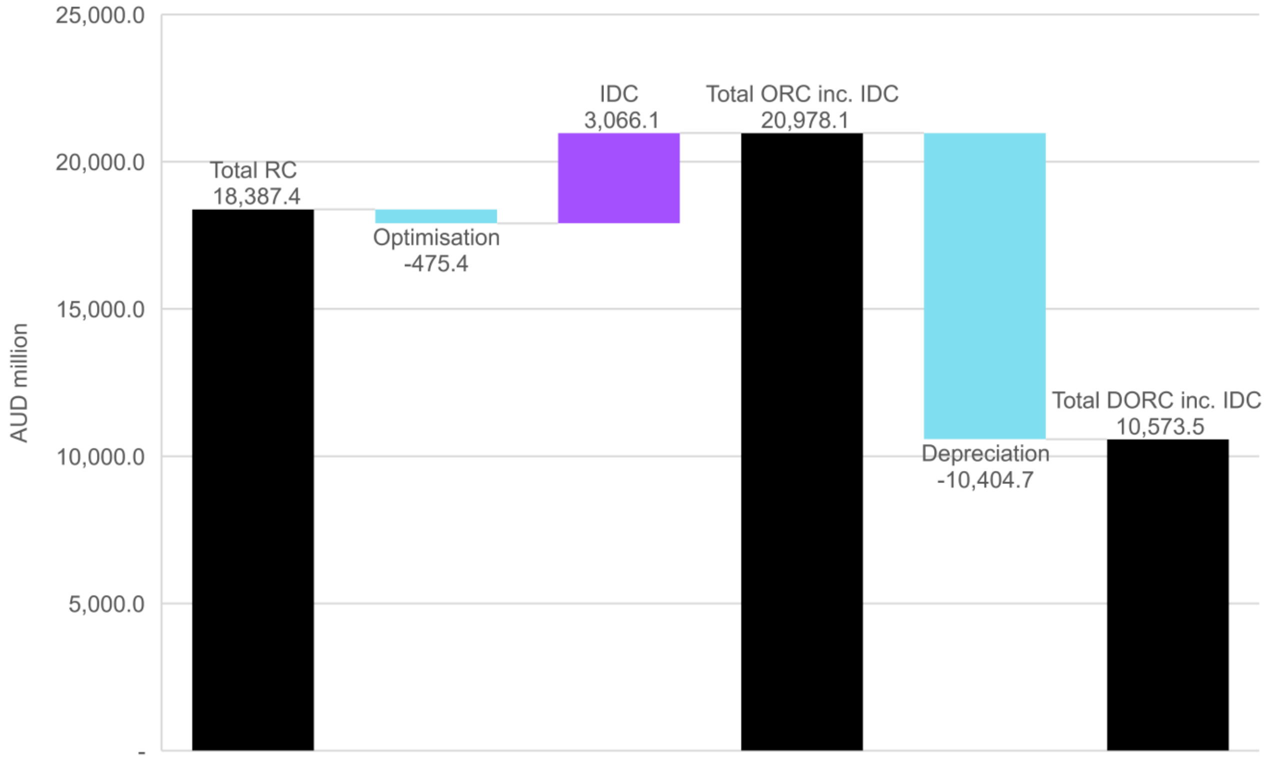


Table 52: Summary Depreciated Optimised Replacement Cost

Regulatory Segment	General Civil	Misc. Assets	Right of Way	Signals and Comms	Structures	Track	Utilities	DORC($million)	DORC ($million) per km
Dry Creek to Parkeston	89.1	82.6	227.1	29.2	150.5	1,246.3	5.0	1,829.7	0.9
Tarcoola to Asia-Pacific Interface (API)	0.2	-	0.3	-	1.3	5.7	0.1	7.5	1.3
Port Augusta to Whyalla	0.8	-	12.3	3.3	29.7	55.4	0.1	101.6	1.4
Crystal Brook to Parkes	11.3	0.6	164.0	10.5	147.8	1,062.8	2.5	1,399.6	1.3
Cootamundra to Parkes	5.0	-	21.0	12.1	29.6	233.9	0.6	302.2	1.5
Dry Creek to Pelican Point	1.6	-	1.4	10.4	77.8	25.5	1.0	117.8	3.7
Dry Creek to Melbourne (Spencer Street)	24.3	-	180.7	57.9	109.1	584.3	6.1	962.5	1.1
Appleton Dock to Footscray	2.2	-	3.4	13.0	69.8	108.4	0.2	196.9	3.3
Melbourne (Tottenham) to Macarthur	19.8	0.5	285.0	197.4	980.5	1,475.3	10.1	2,968.5	1.4
Moss Vale to Unanderra	2.0	-	113.4	11.5	20.5	58.0	0.6	205.9	3.1
Southern Sydney Freight Line (SSFL)	2.1	-	11.5	38.6	242.8	21.4	0.2	316.6	4.0
Metropolitan Freight Network (MFN)	0.4	-	13.4	14.0	23.7	60.6	0.4	112.4	1.6
Newcastle to Acacia Ridge	20.9	0.2	454.9	274.8	595.3	697.3	8.8	2,052.2	2.4
Total DORC	**179.7**	**83.9**	**1,488.3**	**672.7**	**2,478.4**	**5,634.8**	**35.7**	**10,573.5**	
WEIGHTED AVERAGE									**1.38**

10. Operating expenditure savings

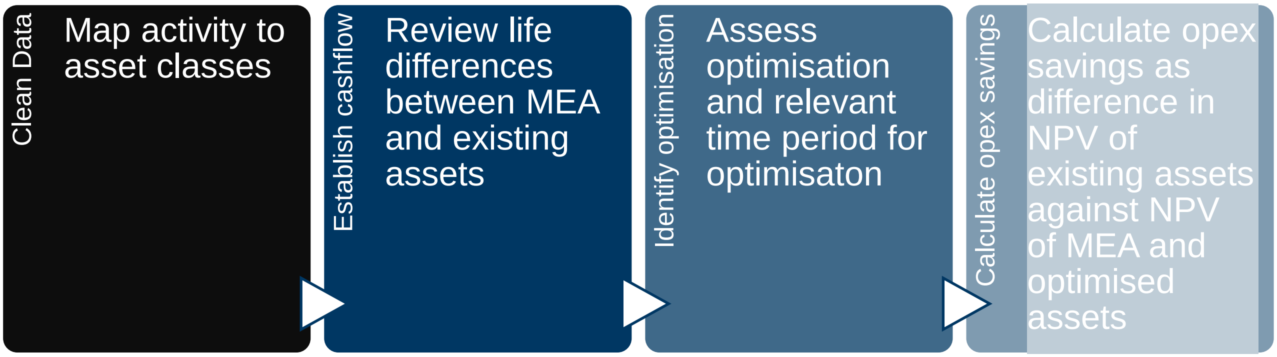
10.1 Including operating expenditure savings in our DORC

Under the Order of Services, we are required to calculate the net present value (**NPV**) of operating expenditure (**opex**) savings for each Segment. Opex savings arise from: using the MEA instead of the existing asset; and when assets (e.g. passing loops) are optimised out following the optimisation assessment.

10.2 Our approach to calculating opex savings

An overview of our approach is shown in Figure 19.

Figure 19: Overview of opex savings calculation approach



10.2.1 Opportunities for opex savings

We have considered two opportunities for opex savings, being from:

- Using MEA instead of the existing asset
- Optimisation, where assets are no longer required to provide the service under an optimised network configuration.

10.2.2 Discount rate applied in our NPV analysis

ACCC instructed us to use a real, pre-tax WACC rate of 4.37% to determine opex savings.

10.2.3 Asset life relevant for our assessment

We have performed our opex savings calculation using the remaining life of existing assets. We consider this appropriate because opex savings are only possible over the period the asset remains in-service to when it is either disposed of or renewed. We also expect that at the time of renewal, an efficient operator would replace the existing assets with MEA. For consistency across all asset classes, we adopted the weighted average life of each existing asset class as the basis for our NPV analysis.

Some MEAs have a different useful life to existing assets. For calculating the opex savings, we have not considered the cost savings that are possible due to life differences. Where an existing asset has a shorter useful life than the MEA, the cost savings are only possible over the life of the existing asset.

For MEA that have a shorter life than that of the existing asset, we would have to make assumptions regarding ARTC's disposal, renewals and capex profiles, which is divorced from the opex requirements to maintain assets in good working order for operations: the purpose of the opex savings.

10.2.4 Fixed and variable opex costs

We acknowledge that opex and maintenance costs can be either fixed or variable in nature. Variable maintenance costs in the rail sector are typically demand driven. We have not considered any differences in fixed or variable costs that may be achievable due to the installation of MEA or optimisation. ARTC advised that it had not adjusted its cost forecasts by any specific demand parameter, and we therefore consider the scope for undertaking this kind of analysis is limited.

10.2.5 ARTC's maintenance practices

We have not assessed whether ARTC's maintenance practices reflect prudent or efficient outcomes, nor whether it uses leading practice asset maintenance techniques.

10.2.6 Mapping ARTC cost information to asset classes

ARTC provided its actual cost information for the period FY2015/16 to FY2019/20 and forecast cost information for the period FY2020/21 to FY2024/25. It also provided its Asset Management Plan Development document (EGP-10-103) and supporting explanatory information.

ARTC advised that it had applied a cost escalation factor of 2% per annum to forecast data. Upon review of the data, we identified that some costs were increasing at a constant 2.5% rate year-on-year. We sought clarification from ARTC on this matter but did not receive a response. We therefore have adopted 2.5% as the basis for de-escalating the data to be in real, 2019 terms.

ARTC provided its data on an activity level, not on an asset or asset class level. ARTC advised that it was unable to provide the data at an asset class level. We have therefore mapped the activity data to relevant asset classes, based on the type of activity and applying engineering judgement. Mapping outcomes are presented in Appendix C.

10.2.7 Impact of Inland Rail in cost forecasts

ARTC advised us that the maintenance impact of Inland Rail on the Interstate Network was not included in the data provided, as the anticipated impacts will occur after the period, we requested data for. ARTC also advised us that where existing track forms part of the eventual Inland Rail route, the impact of enhancements was embedded into the current Instate Corporate plan. It also advised that maintenance costs attributable to the North East Rail Line (**NERL**) are included in the forecasts for certain Segments.

We have taken this to mean that the anticipated Inland Rail and NERL impacts on the existing footprint of the Interstate Network are included in the opex forecasts, however, the broader impacts of Inland Rail have been excluded. We have therefore not made any further adjustments for Inland Rail costs.

10.3 Effect of MEA selection on Opex

Using the mapped activities to asset classes, we identified which asset classes had an MEA form that was different to the existing asset. Our evaluation is set out in the following sections. The assets we have identified as being relevant for a cost saving are:

- Level crossings
- Signalling assets
- Poles and lines that support signalling assets
- Equipment enclosures, and
- Track circuits.

All other assets were excluded from our opex calculations on the basis that there was no material cost difference between the MEA and existing assets, or the MEA was the existing asset and therefore no cost saving could be realised. Our reasoning is shown in Appendix C.

To calculate the opex savings resulting from MEA, we considered ARTC's activity data with reference to the typical maintenance requirements for the MEA. Specifically, we considered differences in activities driven by particular features of assets, such as the MEA signalling assets having self-test functionality which significantly reduces the need for inspections, testing and minor repairs. We also considered where the activities performed on existing assets were no longer required, such as where in-ground cabling and services are no longer required as the asset now relies on the 5G or wireless networks.

We identified the relevant activity codes that correlated with the activities we had identified as no longer being required or not being required to the same extent for MEA. We then calculated the total cost for each activity over our assumed weighted average asset class life for each activity. We then applied a set of cost reductions in percentage terms based on our experience working to construct and maintain assets in the Australian rail sector. These ranged from between 50% and 80%. The opex savings from this analysis is set out in Table 53.

Table 53: Opex savings due to MEA

Regulatory Segment	Signals and Comms ($million)	Total opex saving ($million)
Dry Creek to Parkeston	5.0	5.0
Tarcoola to Asia-Pacific Interface (API)	-	-
Port Augusta to Whyalla	0.0	0.0
Crystal Brook to Parkes	3.6	3.6
Cootamundra to Parkes	1.2	1.2
Dry Creek to Pelican Point	0.2	0.2
Dry Creek to Melbourne (Spencer Street)	5.5	5.5
Appleton Dock to Footscray	-	-
Melbourne (Tottenham) to Macarthur	9.7	9.7
Moss Vale to Unanderra	1.6	1.6
Southern Sydney Freight Line (SSFL)	1.5	1.5
Metropolitan Freight Network (MFN)	0.6	0.6
Newcastle to Acacia Ridge	3.5	3.5
TOTAL SAVINGS	**32.4**	**32.4**

Note: figures may not sum due to rounding.

10.4 Opex savings from the optimisation assessment

Like our approach for opex savings resulting from MEA, we used the mapped activities to asset classes, and identified those assets that we had optimised. This involved assessing the optimisation we had performed and identifying the assets that would be associated with the optimisation. These included:

- Rail
- Turnouts
- Ballast
- Sleepers
- Earthworks
- Signals
- Comms

For assets involved in the multi-track optimisation, we did not identify any material cost savings that could be realised through the optimised network. Our opex savings from optimisation therefore only reflects the opex savings resulting from the removal of passing loops to service ARTC's demand.

The cost saving that can be realised through optimisation results from the assets becoming redundant based on the optimised configuration. That is, there are no ongoing operating and maintenance costs associated with assets that are not required to provide the Interstate Network service when these assets have been optimised out of the asset base.

Therefore, to calculate the opex savings associated with optimisation, we calculated the activity cost on a per asset basis, by taking an average of the total cost divided by the total number of the relevant asset.

We undertook the following:

- Identified the mode of the passing-loop length for each Segment for which optimisation occurred, and then multiplied it by the number of passing loops to be optimised
- Determined average $/km expenditure (FY2020 to FY2025) of rail, ballast, sleeper and signalling expenditure (based on activity codes for ARTC's maintenance activities)
- Determined average $/turnout expenditure (FY2020 to FY2025) for turnout maintenance (based on activity codes for ARTC's maintenance activities)
- Determine the mode of each of the remaining life for rail, ballast and sleepers for the passing loops, based on the data in the asset register we derived
- Assumed the remaining life of signalling assets was five years
- Determined the annual avoided maintenance expenditure for the distance and number of turnouts covering the passing-loop distance in question
- Ascertained the PV of avoided maintenance expenditure from 2020 to the year at which the existing assets life expire.

We included the incremental cost relating to the relevant assets by multiplying the cost per asset by the number of assets subject to optimisation for the "without optimisation" calculation. For with "with optimisation" calculation, we set these costs to zero. The period over which we performed our analysis was the existing-asset remaining life. We then determined the NPV difference for those assets. Our findings are presented in Table 54.

Table 54: Opex savings due to optimisation

Regulatory Segment	Track ($million)	Turnouts ($million)	Earthworks ($million)	Signals and Comms ($million)	Total opex saving ($million)
Dry Creek to Parkeston	2.6	0.1	-	0.2	**2.9**
Tarcoola to Asia-Pacific Interface (API)	-	-	-	-	**-**
Port Augusta to Whyalla	-	-	-	-	**-**
Crystal Brook to Parkes	0.8	0.0	0.0	0.1	**0.9**
Cootamundra to Parkes	-	-	-	-	**-**
Dry Creek to Pelican Point	-	-	-	-	**-**
Dry Creek to Melbourne (Spencer Street)	-	-	-	-	**-**
Appleton Dock to Footscray	-	-	-	-	**-**
Melbourne (Tottenham) to Macarthur	0.8	0.0	0.0	0.0	**0.9**
Moss Vale to Unanderra	0.3	0.0	-	0.1	**0.4**
Southern Sydney Freight Line (SSFL)	-	-	-	-	**-**
Metropolitan Freight Network (MFN)	-	-	-	-	**-**
Newcastle to Acacia Ridge	3.7	0.1	0.0	0.2	**4.1**
TOTAL SAVINGS	**8.3**	**0.3**	**0.0**	**0.6**	**9.2**

*Note: figures may not sum due to rounding

10.5 Our estimate of opex savings

A summary of our opex savings by Segment is presented Table 55.

Table 55: Summary of opex savings

Regulatory Segment	MEA Optimisation OPEX savings	Optimisation OPEX savings	Total opex saving ($million)	DORC ($million)	Adjusted DORC ($million)
Dry Creek to Parkeston	5.0	**2.9**	7.9	1,829.7	1,821.8
Tarcoola to Asia-Pacific Interface (API)	-	**-**	-	7.5	7.5
Port Augusta to Whyalla	0.0	**-**	0.0	101.6	101.6
Crystal Brook to Parkes	3.6	**0.9**	4.4	1,399.6	1,395.2
Cootamundra to Parkes	1.2	**-**	1.2	302.2	301.0
Dry Creek to Pelican Point	0.2	**-**	0.2	117.8	117.6
Dry Creek to Melbourne (Spencer Street)	5.5	**-**	5.5	962.5	956.9
Appleton Dock to Footscray	-	**-**	-	196.9	196.9
Melbourne (Tottenham) to Macarthur	9.7	**0.9**	10.6	2,968.5	2,957.9
Moss Vale to Unanderra	1.6	**0.4**	2.0	205.9	204.0
Southern Sydney Freight Line (SSFL)	1.5	**-**	1.5	316.6	315.1
Metropolitan Freight Network (MFN)	0.6	**-**	0.6	112.4	111.9
Newcastle to Acacia Ridge	3.5	**4.1**	7.6	2,052.2	2,044.6
TOTAL SAVINGS	**32.4**	**9.2**	**41.6**	**10,573.5**	**10,531.8**

*Note: figures may not sum due to rounding

11. Assets funded by government grants

11.1 Excluding grant-funded assets for the RAB

Pursuant to the Order for Services with the ACCC, assets that have been funded by government grants are to be deducted from our DORC estimate to calculate the RAB.

11.2 Process for identifying assets funded by government grants

To identify the assets funded by government grants, we assessed a set of assets provided to us by ARTC via ACCC (**the Grant Funding Data**).[52] We understand that these had been identified by ARTC as having been fully or partly funded by project grants over the period 1 July 2008 to 31 June 2019. The spreadsheet included the following data:

- List of 13 projects that had obtained grant funding
- A high-level description of each project.
- Actual capital expenditure on each project
- Grant funding for each project
- Project numbers for each of the 13 projects
- Asset numbers for each item comprising each project
- A description of what each asset item was
- Actual capital expenditure on each asset item comprising each project
- Grant funding on each asset item comprising each project.

This information enabled us to provide an overview of the assets for which grant funding has been received by ARTC (see Table 56). The total grant-funding received by ARTC totals $448.0 million in the data provided to us. The three projects that obtained the most grant funding are: Wodonga Bypass ($102.5 million); Stage 2 of Port Botany ($98.6 million) and the Geelong Upgrade ($49.9 million).

[52] ARTC – IAU – DORC – ARTC Grant Asset Register for exclusion from the RAB, following the DORC – 29 October 2020 (11656788.1).xlsx

Table 56: Summary of grant funding by Interstate Network project

Projects funded by government grants	Assumed asset class[53]	Capital cost ($million)	Grant funding ($million)	Segment
Altona Loop	Track	20.1	20.1	Adelaide (Dry Creek) to Melbourne (Spencer St)
Geelong Upgrade	Track	49.9	49.9	Adelaide (Dry Creek) to Melbourne (Spencer St)
Hexham Loop[54]	Excluded	15.3	15.3	N/A
EW level crossings	Level crossings	5.3 (Crystal Brook – Parkes) 2.4 (Cootamundra – Parkes) 2.7 (Adelaide (Dry Creek) – Melbourne)	15.1	Crystal Brook – Parkes ($5.3 million) Cootamunda – Parkes ($2.4 million) Adelaide (Dry Creek) – Parkeston ($5.1 million) Adelaide (Dry Creek) – Melbourne ($2.7 million)
NS level crossings	Level crossings	0.7 (Moss Vale – Unanderra) 10.0 (Melbourne (Tottenham) - Macarthur) 9.7 (Newcastle - Queensland Border)	20.2	Moss Vale – Unanderra ($0.7 million) Melbourne (Tottenham – Macarthur ($9.9 million) Newcastle – Queensland Border ($9.6 million)
Missing link	Track	33.6	33.4	Adelaide (Dry Creek) – Melbourne
Stage 1 of Port Botany	Track	27.2	27.2	Port Botany Yard[55]
Stage 2 of Port Botany	Signalling Equipment, Communications Equipment	11.5 (Port Botany Yard) 87.1 (MFN)	98.6	Port Botany Yard ($11.5 million) MFN ($87.1 million)
Stage 3 of Port Botany	Track	7.7	7.7	MFN
Regional Rail	Track	1.6	1.6	Adelaide (Dry Creek) – Melbourne
Tottenham to West Footscray Rail Link	Mix of Earthworks, Track, Turnouts, Points and Signalling	45.1	45.0	Adelaide (Dry Creek) – Melbourne
Urban Superway	Level Crossing	0.3	0.3	Adelaide (Dry Creek) – Pelican Point
NS Wodonga Bypass	Track	103.0	102.5	Melbourne (Tottenham) – Macarthur

[53] Inferred by the asset description in the data provided to us
[54] We were not provided Hexham Loop assets to value as part of our DORC valuation. We have therefore not included the Hexham Loop grant-funded assets to derive the RAB.
[55] We were advised by ARTC that Port Botany Yard assets were not included in the Interstate Network. We therefore did not value these assets, and therefore the grant-funded assets are not included in our estimate of the RAB.

Projects funded by government grants	Assumed asset class[53]	Capital cost ($million)	Grant funding ($million)	Segment
Crossing extensions from Broken Hill to Parkes	Track	5.6	5.6	Crystal Brook – Parkes
Crossing Loops from Port Augusta to Broken Hill	Mix of Earthworks, Track, Turnouts, Points and Signalling	1.5	1.5	Crystal Brook – Parkes ($1.0 million) Adelaide (Dry Creek) – Parkeston ($0.5 million)
Crossing Loop from Port Augusta to Parkeston	Mix of Earthworks, Track, Turnouts, Points and Signalling	3.8	3.8	Adelaide (Dry Creek) – Parkeston
TOTAL	**N/A**		**448.0**	**N/A**

*Note: figures may not sum due to rounding

11.3 Treatment of grant-funded assets grants

There are 13 projects in the Grant Funding data provided to us by ACCC comprising 1,382 assets. Our initial approach was to map the *Ellipse* numbers contained in the Grant Funding Data against the *Ellipse* numbers of the assets that underpin our valuation to identify the grant-funded assets on a line-by-line basis in our DORC value, to exclude the applicable DORC value for those assets on an individual asset basis. However, we were unable to reconcile 1,318 assets and hence were unable to use this approach.

We were able to identify the assets in the Grant Funding Data by using the asset numbers contained in the Grant Funding Data in the financial asset register data provided to us by ARTC on 26 May 2020. This means that we have been able to calculate the depreciation using the commissioning date data contained in the financial asset register to determine the depreciated value of the grant-funded assets on an individual asset basis. Upon review of the commissioning date information, the Grant Funding Data provided to us contains assets that were commissioned as early as 2006. We have not sought to alter the commissioning date information supplied to us, meaning that the depreciated value of grant-funded assets reflects the depreciation profile supplied in the financial asset register information.

We were able to reconcile all asset numbers except for assets in the Hexham Loop project. We did not receive further supporting information from ACCC for the inclusion of these assets prior to the publication of our Draft Report, and therefore, our calculation is presented net of the Hexham Loop assets.

The approach we have applied to determine the value of grant-fund assets is as follows:

- Using the asset number reconciled to the ARTC financial asset register, determine the commissioning date of each asset
- Using the commissioning date of each asset from the ARTC financial asset register, calculate the depreciated value using straight-line depreciation
- Subtract the above value for each project from the DORC valuation.

12. RAB for Interstate Network

The ACCC's Order for Services requested that assets funded by government grants be deducted from the DORC valuation to derive the RAB for the Interstate Network. Based on our analysis articulated in Section 11, Table 57 presents our DORC estimate of the assets funded by government grants, on an asset class and Segment basis. The DORC value of these amounts to $283.3 million.

The RAB for each of the 13 Segments of which the ARTC Interstate Network is comprised. The estimate of the RAB is $10.2 billion ($10,249 million) as at 1 July 2019.

Table 57: DORC value of grant-funded assets to be removed from the RAB

Regulatory Segment	DORC adjusted for opex savings ($million)	Grant funding reduction ($million)	RAB estimate ($million)
Dry Creek to Parkeston	1,821.8	6.2	1,815.7
Tarcoola to Asia-Pacific Interface (API)	7.5	-	7.5
Port Augusta to Whyalla	101.6	-	101.6
Crystal Brook to Parkes	1,395.2	7.0	1,388.2
Cootamundra to Parkes	301.0	1.8	299.2
Dry Creek to Pelican Point	117.6	0.2	117.3
Dry Creek to Melbourne (Spencer Street)	956.9	54.2	902.8
Appleton Dock to Footscray	196.9	46.7	150.2
Melbourne (Tottenham) to Macarthur	2,957.9	88.8	2,869.1
Moss Vale to Unanderra	204.0	0.4	203.5
Southern Sydney Freight Line (SSFL)	315.1	-	315.1
Metropolitan Freight Network (MFN)	111.9	72.2	39.7
Newcastle to Acacia Ridge	2,044.6	5.9	2,038.7
TOTAL DORC	**10,531.8**	**283.3**	**10,248.6**

*Note: figures may not sum due to rounding

13. Conclusion

Our results for the DORC and the RAB for the Interstate Network are summarised for Interstate Network in Table 58 and Figure 20.

Table 58: DORC valuation of the ARTC Interstate Network by Asset Classes

Regulatory Segment	DORC($million)	DORC ($million) per km	RAB ($million)	RAB ($million) per km
Dry Creek to Parkeston	1,829.7	0.9	1,815.7	0.9
Tarcoola to Asia-Pacific Interface (API)	7.5	1.3	7.5	1.3
Port Augusta to Whyalla	101.6	1.4	101.6	1.4
Crystal Brook to Parkes	1,399.6	1.3	1,388.2	1.3
Cootamundra to Parkes	302.2	1.5	299.2	1.5
Dry Creek to Pelican Point	117.8	3.7	117.3	3.7
Dry Creek to Melbourne (Spencer Street)	962.5	1.1	902.8	1.0
Appleton Dock to Footscray	196.9	3.3	150.2	2.5
Melbourne (Tottenham) to Macarthur	2,968.5	1.4	2,869.1	1.4
Moss Vale to Unanderra	205.9	3.1	203.5	3.0
Southern Sydney Freight Line (SSFL)	316.6	4.0	315.1	3.9
Metropolitan Freight Network (MFN)	112.4	1.6	39.7	0.6
Newcastle to Acacia Ridge	2,052.2	2.4	2,038.7	2.4
TOTAL	**10,573.5**		**10,248.6**	
WEIGHTED AVERAGE ($MILLION/KM)	**1.38**			**1.36**

Figure 20: Depreciated Optimised Replacement Cost build up including interest during construction ($million)


12,000.0
10,000.0
8,000.0
6,000.0
4,000.0
2,000.0
-
AUD million
Total DORC inc. IDC
10,573.5
Grant Funding
-283.3
OPEX Savings
-41.6
RAB
10,248.6

Appendices

Appendix A

Information provided to us by ARTC

A-1 Information provided to us by ARTC

The documents we received form ARTC are as follows:

1. Fixed and financial asset registers for the Interstate Network
2. *Ellipse* asset-management and *Nameplate* data for asset classes other than earthworks and track
3. Earthworks risk register
4. Track (rail, sleeper and ballast) asset data
5. Average remaining life of rail per account code data
6. Technical proposal for the supply and installation of wheel profile measurement equipment
7. ARTC fixed assets policy with respect to accounting and taxation treatment for Fixed Assets
8. Tripartite agreement in relation to the Lease of the NSW Interstate and Hunter Valley rail assets
9. Queensland sublease agreement
10. Amendment and restatement deed – Interstate infrastructure lease between Public Transport Victoria and ARTC
11. [redacted] ARTC Interstate Network: 2019 asset valuation
12. [redacted] earthworks register and matrix
13. ARTC asset management plan development
14. CI financials asset maintenance plan – actual and forecast
15. ARTC AK Car recording log June to September 2019 – Interstate Network
16. Interstate TMS data June – September 2019
17. Account code listings and asset/network configuration mapping
18. Line diagrams
19. Interstate Rail Wear survey data
20. Volume demand data, historical and forecast, inclusive of Inland Rail impact (FY2015 to FY2030)
21. Asset specific information and manuals, such as IAU Comms Tower Information July 2020 and ARTC Antenna Data July 2020
22. Drawings, including DR 195/15 Pocket Sections T.A.R
23. IAU ALCAM Level Crossing Data September 2019
24. ARTC Building Facilities Listing Nov 2019 and supplementary information
25. Interstate Equipment data
26. Wheel Condition Monitor (WCM) Specification
27. RailBAM Bearing Acoustic Monitor – Specification
28. Voestalpine Efficient Detection of Dragging Equipment document

Appendix B

Demand data received from ARTC

[Redacted]

Table B.1 Demand data by segment provided to us by ARTC

Track Segment	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Appleton Dock Jct – Footscray Rd	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Cootamundra - Parkes	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Crystal Brook – Parkes	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Dry Creek – Parkeston	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Dry Creek – Pelican Point	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Dry Creek – Spencer St (Melbourne)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Melbourne (Tottenham) – Macarthur	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Metropolitan Freight Network Chullora Junction – Port Botany	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Moss Vale – Unanderra	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Newcastle – Acacia Ridge	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Port Augusta – Whyalla	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Southern Sydney Freight Line incl Sefton Park Junction – Flemington South	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Track Segment	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Border to Acacia Ridge	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Appendix C

Activity to asset mapping

C-1 Exclusions for opex savings calculations

Table C.2 GHD's mapping of ARTC's activity codes to asset classes for opex savings calculation

	Activity	Activity Description	Asset	Asset class
4	Internal Plant & Equip E/W (RCRM)	General	General	Assumed typical cost of business.
6	Consumables E/W (RCRM)	General	General	Assumed typical cost of business.
100	Routine Inspections - Track (RCRM)	Track	Track	Assumed that inspection costs would be unchanged under MEA or existing asset.
109	Routine Inspections - Turnouts	Turnouts	Track	Assumed that inspection costs would be unchanged under MEA or existing asset.
111	Routine Inspections - Right of Way(RCRM)	Fencing, drainage, vegetation	Rail corridor	Assumed that inspection costs would be unchanged under MEA or existing asset.
121	Callouts Track & Structures RCRM	Track and structures	Track	Assumed that inspection costs would be unchanged under MEA or existing asset.
142	Facilities, Housekeeping and Stores Mana	General	General	Assumed typical cost of business.
144	Vegetation Control - Reactive (RCRM)	General	General	Assumed typical cost of business.
146	Right of Way Maintenance (RCRM)	Fencing, drainage, vegetation	Rail corridor	
160	Ultrasonic Rail Examination(RCRM)	Track	Track	
161	Rail Lubrication RCRM	Track	Track	
163	Rail Defect Removal(RCRM)	Track	Track	
165	Insulated Rail Joints RCRM	Track	Track	
166	Welded Track Stability RCRM	Track	Track	
174	Ultrasonic Test Car (RCRM)	Track	Track	
180	V Crossing Maintenance(RCRM)	Turnout	Track	
181	Turnout Maintenance - Reactive RCRM	Turnout	Track	
201	Reactive Track Geometry Correction RCRM	Track	Track	
209	Track Geometry Recording(RCRM)	Track	Track	
225	Fastening Maintenance(RCRM)	Sleepers	Track	
260	Level Crossing Reactive Maintenance - ci	Level crossings	Level crossings	
301	Track & Civil - Reactive Repairs (RCRM)	Track	Track	
302	Third Party Support RCRM	General	General	Assumed typical cost of business.
323	Training RCRM	General	General	Assumed typical cost of business.
327	Wayside Detection Systems -(RCRM)	Wayside devices	Comms	
700	Lxings (Signals) - Inspect, Test & Minor Repairs (RCRM)	Level crossings	Signals	
701	InspectTesting&MinorRepairs-Signals RCRM	Signals	Signals	
702	InspectTesting&MinorRepairs-PointsInterl	Points	Signals	
703	Cable & Pole Lines - Inspect, Test & Minor Repairs (RCRM)	Power	Power	Assumed to be power only.
706	Comms - Inspect, Test & Minor Repairs (RCRM)	Comms	Comms	

	Activity	Activity Description	Asset	Asset class
710	Callouts Signalling RCRM	Signals	Signals	Assumed callouts relates to inspection costs. Therefore assumed that these costs would not change under existing and MEA asset.
776	InspectTesting&MinorRepairs-ControlandIn	Control systems	Comms	
777	InspectTesting&MinorRepairs-TrackCircuit	Track	Signals	
778	Inspect&MinorRepairs-Enclosures/Location	Enclosures	Signals	Assumed that inspection costs would be unchanged under MEA or existing asset.
779	InspectTesting&Minor Repairs -SigsPowerS	Power	Signals	Assumed that inspection costs would be unchanged under MEA or existing asset.
712	Inspections - Signals & Comms(RCRM)	Signals and comms	Signals and comms	
101	Detailed Inspections - Structures(RCRM)	Misc structures	Misc structures	Assumed that inspection costs would be unchanged under MEA or existing asset.
106	Routine Inspect - Underbridges (RCRM)	Bridges	Bridges	
107	Routine Inspect - Culverts & Misc(RCRM)	Culverts	Culverts	
150	Access Road Maintenance(RCRM)	Rail Maintenance Access Road	Roads	Assumed that inspection costs would be unchanged under MEA or existing asset.
248	Underbridge: Reactive Repairs RCRM	Bridges	Bridges	
720	Third Party Support - Signals & Comms (RCRM)	Signals	Signals	
140	Airstrip Maintenance (RCRM)	Airstrips	Misc structures	
143	Fire Prevention(RCRM)	General	General	Assumed typical cost of business.
164	Wheel Burn Removal(RCRM)	Track	Track	
240	Structures - Minor Repairs(RCRM)	Misc structures	Misc structures	
266	Culvert Reactive Corrective Maint(RCRM)	Culverts	Culverts	
320	Rest House Maintenance(RCRM)	Buildling facilities	Misc structures	
820	Signage Maintenance(RCRM)	Signs	Misc structures	
704	Voice Radio Maintenance(RCRM)	Comms	Comms	
711	Reactive Maintenance - Callouts Comms(RC	Comms	General	Assumed callouts relates to inspection costs. Therefore, assumed that these costs would not change under existing and MEA asset.
284	Mud hole Rectification - Dig outs RCRM	Earthworks	Rail corridor	
769	Lightning Arrestor Testing(RCRM)	Building and facilities	Misc structures	
705	SCADA Telemetry Maintenance(RCRM)	Telemetry	Comms	
725	2rd Party Support Sigs Elec & Comms(RCRM	Exclude	Exclude	
325	Facilities Maintenance(RCRM)	Building facilities	Misc structures	
162	Ultrasonic Testing - Ongoing(RCRM)	Rail	Track	
216	Survey Monument Maintenance(RCRM)	General	General	Assumed typical cost of business.
733	Training - Signals & Comms(RCRM)	Signals and comms	Signals and comms	Assumed typical cost of business.
707	Signals High Voltage Power Supply - Inspect, Test & Repairs	Signals	Power	
721	Westnet Level Crossing Maintenance(RCRM)	Level crossings	Level crossings	
3	Management Fee - Site Overheads(RCRM)	General	General	Assumed typical cost of business.
911	RCRM - Forecast – Civil Infrastructure	General	General	Assumed typical cost of business.

	Activity	Activity Description	Asset	Asset class
249	Overbridge: - Reactive Repairs RCRM	Bridges	Bridges	Assumed typical cost of business.
918	Timefiler Labour Accruals	General	General	Assumed typical cost of business.
104	Routine Inspections - Overbridges RCRM	Bridges	Bridges	
141	Pest Control (RCRM)	General	General	Assumed typical cost of business.
200	Track Geometry Fault Repairs(RCRM)	Track	Track	
326	Signal Equipment Building Maintenance(RC	Signal	Signal	
244	Culvert Cleaning(RCRM)	Culverts	Culverts	
269	Drainage Maintenance/Installation (RCRM)	Drainage	Drainage	
145	Vegetation Control - Planned(MPM)	General	General	Assumed typical cost of business.
183	Turnout Retimbering(MPM)	Turnouts	Track	
187	Turnout Steel Component Replacement(MPM)	Turnouts	Track	
203	Maintenance Resurfacing MPM	Station	Misc structures	
230	Yard & Siding - Track Rehabilitation(MPM	Track	Track	
766	Power Supply (MPM)	Power	Power	
210	Rectify Line & Top faults Initiators(MPM	Power	Power	
171	Rail Grinding(MPM)	Rail	Track	
168	Rerailing - Minor(MPM)	Rail	Track	
261	Track & Civil - Level Crossing Maintenance (MPM)	Level crossings	Level crossings	
172	Turnout Grinding(MPM)	Turnout	Track	
205	Turnout Resurfacing MPM	Turnout	Track	
242	Bridge Transoms(MPM)	Bridges	Track	
743	Cable Replacement(MPM)	Power	Power	Assumed to be power
749	Level Crossing Equipment Replacement(MPM	Level crossings	Level crossings	
794	Signals(MPM)	Signals	Signals	
814	Plan & Document Maintenance-Signals(MPM)	Signals	Signals	
294	Ballast Undercutting(MPM)	Ballast	Track	
281	Cess & Top Drain Maintenance(MPM)	Drainage	Rail corridor	
335	Removal Redundant of Infrast Not to be Replace(MPM)	General	General	
206	Ballasting(MPM)	Ballast	Track	
252	Culvert Structural Repairs or Cleaning M	Culverts	Culverts	
258	Steel Underbridge Repairs(MPM)	Bridges	Bridges	
807	Comms Systems Modif (MPM)	Comms	Comms	
152	Right of Way Maintenance (MPM)	Right of Way	Rail Corridor	
259	Concrete/Masonry Underbridge Repairs(MPM	Bridges	Bridges	
285	Shoulder Ballast Cleaning(MPM)	Ballast	Track	
324	Unscoped Works - Track & Civil(MPM)	Track	Track	General
321	Rest House Upgrade(MPM)	Buildling facilities	Misc structures	

	Activity	Activity Description	Asset	Asset class
222	Resleepering - Concrete (MPM)	Sleepers	Track	
730	Unscoped Works - Signals(MPM)	Signals	Signals	
220	Resleepering - Timber(MPM)	Sleepers	Track	
247	Tunnel Maintenance(MPM)	Tunnels	Tunnels	
280	Cutting, Embankment Maintenance & Geotec	Earthworks	Rail corridor	
295	Fouled Ballast Removal (MPM)	Ballast	Track	
770	Track Circuit (MPM)	Track	Signals, Comms	
293	Track Formation Reconstruction (MPM)	Track	Earthworks	
110	Engineering Investigations MPM	General	General	Assumed typical cost of doing business.
754	Pole Line(MPM)	Power	Power	
149	Urban Fencing - Replacement(MPM)	Fencing	Rail Corridor	
745	Point Machine Renewal(MPM)	Points	Signals	
188	Corrective Rail Grinding (MPM)	Rail	Track	
214	Survey Monument Restoration(MPM)	Monuments	Track	
255	Overbridge Refurbishment(MPM)	Bridges	Bridges	
245	Formation & Scour Protection(MPM)	Earthworks	Rail corridor	
915	Expense Recovery MPM	General	General	Assumed typical cost of business.
916	Third Party Revenue	General	General	Assumed typical cost of business.
173	Rail Straightening(MPM)	Track	Track	
226	Pad Replacement(MPM)	Sleepers	Track	
755	General Signal Equipment(MPM)	Signals	Signals	
292	Subsurface Drainage Maintenance(MPM)	Drainage	Rail Corridor	
246	Ballast Wall Extension(MPM)	Ballast	Tracks	
910	MPM - Forecast	General	General	Assumed typical cost of business.
478	BRP:Major Drainage - Cess	Drainage	Rail corridor	
492	BRP:Shoulder Ballast Cleaning	Ballast	Track	
113	Environmental Programs (MPM)	General	General	Assumed typical cost of business.

Appendix D

Exclusions from opex savings

D-1 Exclusions for opex savings calculations

Table D.3 Exclusions for opex savings calculation, asset level

Asset Class	Quantity	Basis of exclusion
Drainage	0	No assets identified
Earthworks - Cut to fill	52,543,883m^3	No material cost difference between MEA and existing assets
Earthworks - Win to fill including placement and compaction	64,982,530	No material cost difference between MEA and existing assets
Earthworks - Cut to spoil	33,713,893	No material cost difference between MEA and existing assets
Earthworks - Imported fill	13,969	No material cost difference between MEA and existing assets
Fencing (rural), including right of way	6,400	Immaterial cost item and non-critical asset for providing Interstate Network service.
Fencing (urban), including right of way	63	Immaterial cost item and non-critical asset for providing Interstate Network service.
Airstrips (unsealed)	12	Immaterial cost item and non-critical asset for providing Interstate Network service.
Permanent Signs (steel post and aluminium signs)	0	Immaterial cost item.
Stations (platforms - concrete)	23	No material cost difference between MEA and existing assets
Stations (buildings - Colourbond)	0	No material cost difference between MEA and existing assets
Non-safety critical equipment (cattle grids)	20	Non-critical asset for providing the Interstate Network service and immaterial cost item.
Signage – Signs	2,264	No material cost difference between MEA and existing assets
Signage – Speed Boards	4,524	No material cost difference between MEA and existing assets
Signal Buildings & Enclosures – Signalling Location Case	2,452	No material cost difference between MEA and existing assets
Signal Buildings & Enclosures – Signalling Location Case Double Width	332	No material cost difference between MEA and existing assets
Signal Buildings & Enclosures – Signalling Equipment Hut Including Interlocking (minor)	776	No material cost difference between MEA and existing assets
Signal Buildings & Enclosures – Signalling Equipment Hut Including Interlocking (minor)	36	No material cost difference between MEA and existing assets
Communications – Optic Fibre	1,476,200 m	No material cost difference between MEA and existing assets
Communications – Router	1,154	No material cost difference between MEA and existing assets
Communications – Radio Tower	90	No material cost difference between MEA and existing assets
Communications – Radio Base Station	90	No material cost difference between MEA and existing assets

Asset Class	Quantity	Basis of exclusion
Bridges Minor Crossing (Concrete)	1,499	Existing asset is MEA, therefore no cost difference
Bridges Major or Water Crossing (Concrete)	179	Existing asset is MEA, therefore no cost difference
Building Facilities	247	No material cost difference between MEA and existing assets
Tunnels	32	No material cost difference between MEA and existing assets
Miscellaneous Structures	710	No material cost difference between MEA and existing assets

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