FINAL REPORT

ARTC Standard Gauge Rail Network DORC

Australian Rail Track Corporation

Sydney

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1. Introduction

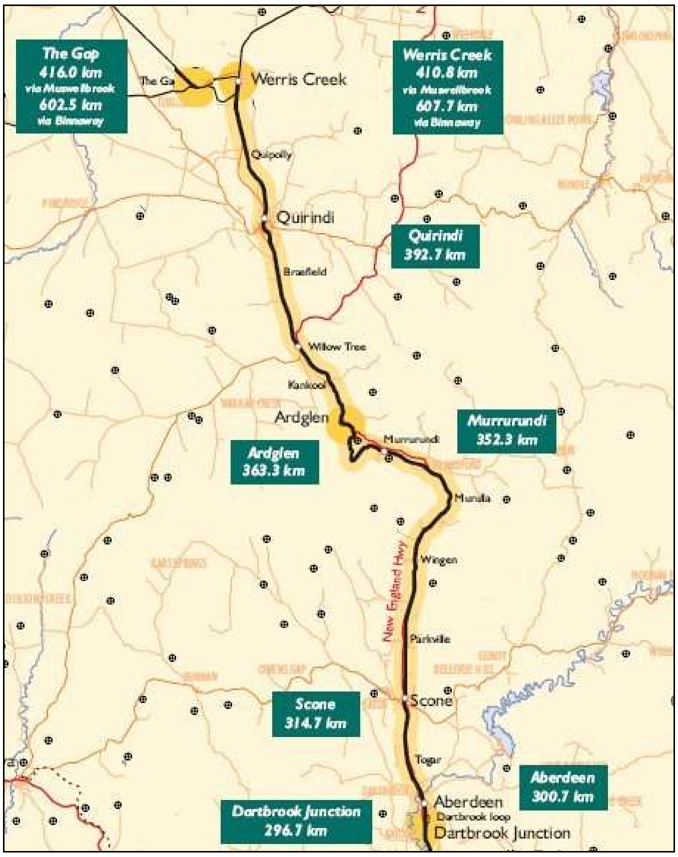
1.1 Background

Booz & Company has been retained by the Australian Rail Track Corporation (ARTC) to assist development of a Depreciated Optimised Replacement Cost (DORC) methodology for ARTC's Dartbrook to The Gap line in the upper Hunter region of New South Wales. The valuation is to be prepared in a form acceptable to the Australian Competition and Consumer Commission (ACCC).

ARTC previously engaged Booz Allen Hamilton (now Booz & Company) in 2006 to undertake a DORC valuation of the ARTC rail network South Australia (SA), Victoria (VIC) and New South Wales (NSW). Booz Allen’s reports dated February 2001 (“the 2001 DORC”) and dated January 2007 (“the 2006 DORC”) provide the basis from which the current work has been developed. The current work has also been informed by a DORC valuation of the Hunter Valley coal network undertaken by Booz Allen in 2000 for the Independent Pricing and Regulatory Tribunal of NSW (IPART), which valuation extended to the Dartbrook Mine.

This report describes the scope, approach and results of the 2008 Dartbrook Mine to The Gap DORC analysis. Figure 1 provides a generalised view of the extent of ARTC’s network subject to this DORC evaluation.

Figure 1 – ARTC’s network (source – RAC)



The sections of the ARTC network included in the study are:

Table 1 – ARTC Track Sections, Dartbrook Mine to The Gap

ARTC Track Sections	
11.1	Dartbrook Mine - Werris Creek
11.2	Werris Creek - The Gap

Source: ARTC

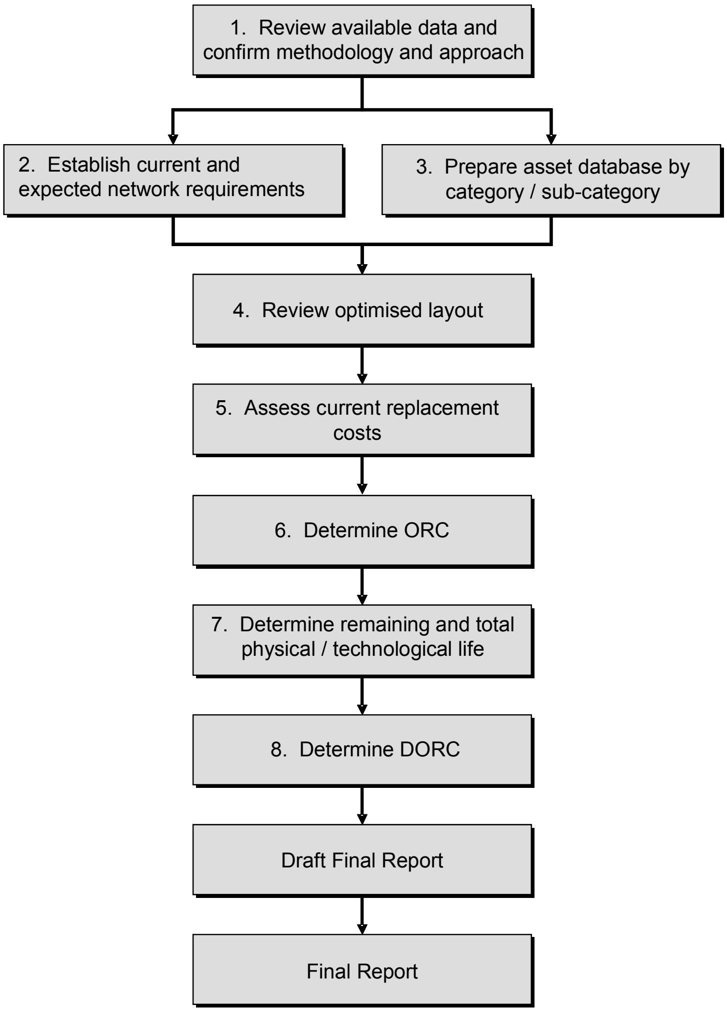
1.2 Establishing the DORC value

The approach used in establishing the DORC value is illustrated in Figure 2 below.

The ARTC network under study was divided into pricing segments matching those adopted by the ARTC, as listed in section 1.1 above.

This DORC valuation considers infrastructure currently in place and does not forecast changes over the following five years, as was the case in the 2001 DORC, for example.

Figure 2 – Approach



The brief was to determine the DORC by way of a desktop study using information provided by ARTC. No field inspection was done to verify the accuracy or otherwise of this information.

1.3 Structure of the Report

The Report is structured to reflect the key work steps in the assignment. There are five further sections:

- Section 1 Introduction (this section)
- Section 2 Existing and expected rail network requirements
- Section 3 Optimised rail network
- Section 4 Replacement costs
- Section 5 Condition Assessment
- Section 6 Final ORC and DORC values.

2. Existing and expected rail network requirements

2.1 Rail Task

Table 2 provides details of ARTC's train task in generalised terms as, for historical reasons, specific details of train type and speed vary somewhat. Also the 2008 DORC evaluation applies to track with variable technical standards. While in theory these issues should impact upon the DORC evaluation, the pragmatic approach taken here is that the same or very similar trains travel across ARTC's network and all infrastructure and train operations are taken as being essentially equal.

Table 2 – Train Characteristics

ARTC Business Segment	Max. train speed (km/h)[1]	max. axle load (T)
Passenger Super Premium	130	20
Freight or Passenger Premium	115	20
Freight High	110	21
Freight Standard	80	25

2.2 Historical Rail Task

Many asset types have lives which can be measured in gross tonnes. For example, a certain rail size may be quoted as having a life of 600 million gross tonnes (MGT), meaning that the rail is considered to require replacement when it has carried 600 MGT of traffic.

Calculating remaining asset life in years for such assets requires knowledge of the asset life, the asset life already consumed, and the expected usage over future years. Unfortunately, there is no reliable data available on the gross tonnes already carried by the ARTC network from initial construction of the network to now. ARTC did however provide volume information on this part of the network for the period 1997 to 2007 (see Table 3), which data was in part ARTC's record (for 2004 to date) and in part the record from the previous track owner, Rail Infrastructure Corporation and predecessor organisations. Based upon this information, the assumption has been made that the historical level of traffic reflects the average over the nine year period of available data, that is, approximately 6.5 MGT per annum.

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[1] *Subject to permanent and temporary speed restrictions*

Table 3 – Dartbrook Mine to The Gap Volume History, Million Gross Tonnes Per Annum

	Dartbrook to Ardglen	Ardglen to Werris Creek	Werris Creek to The Gap
1997/98	8.7	8.5	7.8
1998/99	5.3	5.2	5.1
1999/00	5.5	5.3	5.3
2000/01	6.2	6.1	5.4
2001/02	6.0	5.8	5.8
2002/03	5.1	5.1	4.8
2004/05	5.9	5.9	5.5
2005/06	7.6	7.6	6.2
2006/07	8.8	8.0	6.4
Average	**6.6**	**6.5**	**5.8**

3. Optimised rail network

3.1 Approach to Optimisation

Producing a fully optimised network layout normally requires extensive analysis of traffic requirements and detailed computer simulation of the network operation. Such a rigorous approach has not been possible within the timeframe available to carry out this DORC, and is unlikely to be warranted under the circumstances. Given the relatively simple nature of the Dartbrook to The Gap line, the optimisation process was essentially limited to reviewing the number and placement of crossing loops and associated train control systems, plus reviewing the track structure required for present and future traffic.

3.2 Maximum Capacity Considerations

It is understood that ARTC currently meets stipulated performance criteria for the percentage of "Healthy" trains which achieve their timetabled transit time. There is also a requirement to make capacity available for moderate but growing demand on this line for coal throughput where train cycle times and train sequencing requirements drive train performance. When extra capacity is requested by operators, it is becoming increasingly difficult for ARTC to reliably provide same. This implies that the current network configuration is reasonably well matched to the demand (for the purposes of this DORC valuation).

3.3 Optimised Network

The scope of the 2008 DORC precludes detailed assessment of full optimised network requirements and consequently precise location and length of loops has not been calculated. Instead, the existing network loops have been adopted for valuation purposes including some new loops constructed to reflect increasing traffic.

In optimising infrastructure it is assumed that the only track infrastructure required for ARTC's operations is mainline and crossing loops. Where there are additional tracks and sidings coming off the mainline or crossing loops in the current network configuration generally ARTC own the turnout connecting the additional tracks to the mainline or crossing loop and connecting track (and subsequent turnouts) are owned by another party. An exception is an allowance for a small yard at Werris Creek, necessary for train management.

3.4 Optimised Infrastructure

In developing replacement costs, "modern equivalent form" (MEF) configuration applies. However, rail sizes vary, sleeper types and spacings vary, bridge designs vary, topography is highly variable, train control and communication systems are mixed, and there is some uncertainty regarding actual configuration.

Furthermore, there has been a significant change in some key infrastructure supply items. Notably signals and communications are changing relatively radically, and timber sleepers now cost (slightly) more than concrete sleepers (while concrete sleepers provide a much longer and more reliable service life). As the outcome of signals and communications changes are not clearly definable, it is assumed that prior generation installations together with some recent renewals represent assets to be valued.

Nevertheless, infrastructure configuration is taken as constant over the line – see ARTC Standard Gauge Rail Network DORC, Booz Allen Hamilton, January 2007 for commentary – and MEF is applied, notably including 60 kg rail, concrete sleepers and 200 mm of ballast depth.

4. Replacement Costs

Replacement costs were calculated in detail for the 2001 DORC using asset configuration information and unit rates developed for each type of asset. Some unit rates were developed from first principles by Booz Allen Hamilton and some unit rates were developed by Connell Wagner and others in previous work for the ARTC.

While the rates used in the 2001 DORC were reasonable at the time (and subsequently matched reasonably other DORC work such as Tarcoola – Alice Springs, allowing for inflation, in 2003), there has been a very large increase in costs recently.

For the 2006 DORC, detailed cost estimates were obtained from ARTC's Southern Alliance for several proposed passing lanes, a total scope approaching 100 km of new track. (The estimates were provided at a very aggregated level, leading to considerable interpretation being required.) The estimates covered several 6.8 km sections of track, including all associated works, (including some works that would not apply to a greenfields site, the costs for which have been stripped out where identifiable). As Southern Alliance includes commercially selected contractors and designers, it can be reasonably assumed that their estimates would represent efficient costs. While not directly comparable to large scale greenfield site assumptions applicable to a DORC, the ARTC estimate covers a not inconsiderable scope of work.

However, in unit rate terms, the comparison between the 2001 DORC (plus CPI inflation) and ARTC's Southern Alliance estimates (as assessed in the 2006 DORC) was stark. This supports considerable anecdotal (and some objectively reported) evidence that infrastructure construction costs have recently increased significantly beyond CPI, an example being recently completed loop works on the Dartbrook Mine to Werris Creek line, having construction rates more than two times the costs determined for this DORC.

While construction costs have increased, better management by ARTC of materials purchasing has contained costs well. It may be deduced it is the actual installation that has increased greatly in cost.

Booz & Company has attempted to reconcile these matters by analysing:

- rates used in the 2001 DORC;
- construction rates achieved on the Alice Springs to Darwin line works;
- ARTC's Southern Alliance estimate;
- construction and installation estimates prepared by Hyder Consulting in the recent *North-South Corridor Study* undertaken for the Australian Government and made available by ARTC for this assessment on a confidential basis;
- resulting rates as discussed in the 2006 DORC;
- review of same with reference to ERA WA's report, "WestNet Rail's Floor and Ceiling Costs Review", July 2007;

- detailed reconsideration of earthworks costs.

The, *a priori*, generalised result is that the base installation element of the cost of works should have:

- a 38.4% loading, applied in lieu of an 18% mark-up previously used in the 2001 DORC[2]; and
- an 18% loading applied to the ARTC purchase price for materials (where readily identifiable)

These adjustments would collectively produce approximately the same estimated cost as the known current cost of an ARTC Southern Alliance passing lane of seven kilometres in length, (though would be less than current passing loop extension costs on the Dartbrook Mine to The Gap line).

As this mark-up would presumably decrease considerably where a project of the scale of replacement of the Dartbrook Mine to The Gap line was involved, some reduction from the 38.4% loading should apply.

There is no ready point of reference to apply in this situation. Therefore, the following approach has been adopted:

- the 18% loading used in the 2001 DORC has been increased to 28%[3] for *installation costs*, while an 18% loading has been retained for *materials supply costs;*
- where materials are not readily separable (e.g. structures), the 28% figure has substituted for the previous 18% loading

This results in a loaded "optimised" track (i.e. rail, sleepers and ballast) installed replacement cost of **$605,182 per km** (after allowing for inflation from previous estimates to 2008).

Each of the following sections clarifies which loading has been applied.

As noted above, the 2008 DORC track construction rate benefits from ARTC's bulk materials purchasing policies, offsetting the higher installation costs to some extent.

The 2001 DORC allowed for a "location factor" that varied from 0% to 8% to account for the distance from major population centres. Given the previous discussion about rates and the uncertainty associated with construction costs, it seems unreasonable to load uncertainty

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[2] *The 38.4% loading was calculated as follows: ARTC's current materials prices were allowed for, plus installation costs sourced from Booz Allen Hamilton's 2003 Tarcoola to Darwin DORC estimate (which, in turn, partly reflected the results of the 2001 ARTC DORC). An inflation rate of 3.1% p.a. was then applied to the 2001 DORC installation costs so as to equate them to 2008 dollars. The 18% loading allowed for in the 2001 ARTC DORC was then deducted. A loading of 38.4% was then added back so as to produce a match for ARTC's current Southern Alliance estimate of per kilometre costs for a 7 kilometre passing lane.*

*Note that the CPI estimate of 3.1% p.a. was based on the annual average of the change in Australian (All Groups) CPI between 30 June 2003 and 30 June 2006. That is,(((154.3/141.1)-1)/3)*100 = 3.1 an average inflation rate of 3.1% per annum (p.a.).*

[3] *A 28% loading has been selected as this is the rounded average of the earlier 18% loading (too low) and the 38.4% loading estimated above (probably too high). As indicated, above there is a need for a more conservative loading then 38.4% given that the comparator is a 7 kilometre stretch of track with no "economies of scale" effects. Also note that the 28% loading is used only for construction costs, not materials costs (where the 18% loading is retained).*

with additional factors. It should also be noted that track costs on a relatively wet, topographically challenging east coast would also need some sort of weighting by comparison with the simple (though remote) access to desert construction sites, (benchmark costs for which weigh upon previous DORC estimates, which in turn impact upon this DORC).

Consequently the location factor approach has not been repeated and it is assumed that the rates discussed here would average out across the line for differing reasons (such as access, topography and climactic and geological conditions)

As indicated, a consistency check was also conducted, comparing unit rates for construction and installation, reported by Hyder Consulting in the recent *North-South Rail Corridor Study* with those estimated by Booz Allen Hamilton (for the 2006 DORC).

Booz Allen Hamilton's 2006 DORC estimated unit costs for construction and installation, including ballast, concrete sleepers and rail equated to $496,000 per kilometre, while Hyder Consulting's equated to $490,000 per kilometre – a difference of only 1.2%. While signalling and earthworks unit costs estimates could not be compared, Booz Allen Hamilton and Hyder unit costs per kilometres for bridges, turnouts, tunnels, level crossings and crossing loops were similar in magnitude.

The previously referenced ERA WA July 2007 review of WestNet's costs should be considered, including a typical earthworks rate of approximately $220,000 / km (see Table 1 in that report).

ARTC has undertaken a detailed but generalised earthworks assessment for 'flat', 'undulating', 'hilly' and 'mountainous' terrain (ref. internal ARTC memo by Wayne Potter, "Depreciation of Earthworks", Oct.'05). Respectively the rates were $328,640, $461,360 and $1,485,460 per kilometre when inflated to 2008.

As a check, the cost of current railway formation works in the Upper Hunter Valley reveal pricing for earthworks is in excess of $2 million per kilometre for a 7 km section of track. This example illustrates vividly that current DORC estimates undertaken for regulatory purposes, typically benchmarked against historic costs across Australia, with standard inflation indices applied, seem well below real current construction costs.

4.1 Track

A standard track cross-section with the following attributes has been considered:

- Rail size: 60 kg/m
- Sleeper type: Concrete, with resilient fasteners
- Sleeper spacing: 600 mm average
- Ballast depth: 200 mm under the sleeper
- Ballast shoulder: 250 mm

The unit rate for track replacement is $605,182 per kilometre as discussed above, including an 18% loading on materials used and a 28% loading on installation.

Track quantities in single track kilometres (STKs) are listed in Table 4, where STKs in any segment are equal to route kilometres times the number of tracks and allowing for any loops and yards.

Table 4 – Track STKs

Segment Number	Segment	STK
11.1	Dartbrook Mine – Werris Creek	133
11.2	Werris Creek – The Gap	6
Total		139

4.2 Turnouts

Turnouts may be classified into primary and secondary turnouts. Primary turnouts are those that connect directly to the ARTC mainline, for example turnouts at each end of a crossing loop or turnouts connecting private sidings to the mainline. Secondary turnouts are those that connect to non mainline track, for example turnouts to sidings and yards from crossing loops. 60 km per hour turnouts are assessed on this line as adequate for Primary use.

Table 5 lists Booz Allen's interpretation of turnouts numbers obtained from information provided by ARTC, listed as Primary and Secondary turnouts located in each DORC segment.

Table 5 – Primary and Secondary Turnouts

Segment Number	Segment	Primary	Secondary
11.1	Dartbrook Mine – Werris Creek	37	18
11.2	Werris Creek – The Gap	3	2

Two standard turnout configurations have been adopted for the line, based upon existing configuration[4].

- Primary turnouts with rail bound manganese crossings and concrete bearers, cost $251,326 per unit for supply and installation
- Secondary turnouts with timber bearers, cost $230,157 per unit for supply and installation.

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[4] *An optimised loop is considered to include two primary turnouts and one secondary turnout.*

These costs exclude switch motors, which are included in the signalling costs. Costs include the loading discussed above. That is, an 18% loading has been applied to materials costs and a 28% loading has been applied to installation costs.

4.3 Structures

Structures include underbridges, overbridges, footbridges and culverts.

In previous asset valuation work for ARTC, Connell Wagner developed unit rates for replacement of structures within South Australia and Western Australia. These have been used in the 2001 and 2006 DORCs and checked in the Tarcoola to Alice Springs DORC. These rates were increased by the loading of 28%, applied to the combined materials and installation rate in this case (in lieu of the 2001 DORC 18% loading), as discussed above. The resulting underbridge rate is $18,509/m.

However, data from the ARTC's Structures Manager in 2006, indicated that the then current underbridge projects were found to average about $35,000/m. While this figure represented relatively isolated projects, ARTC's Structures Manager demonstrated that widely spread underbridges of a variety of sizes and configurations were costing between $30,000 and $80,000 per m length to construct, though the higher end of the range tended to be special situations.

A rate of $27,337 has been adopted for the 2008 DORC, being an average of previous DORC estimates and the ARTC Structures Manager's advice (see the ARTC 2006 DORC for discussion) plus inflation to 2008.

Bridge type and length data was obtained from ARTC asset register information to enable up-to-date data to be used where possible

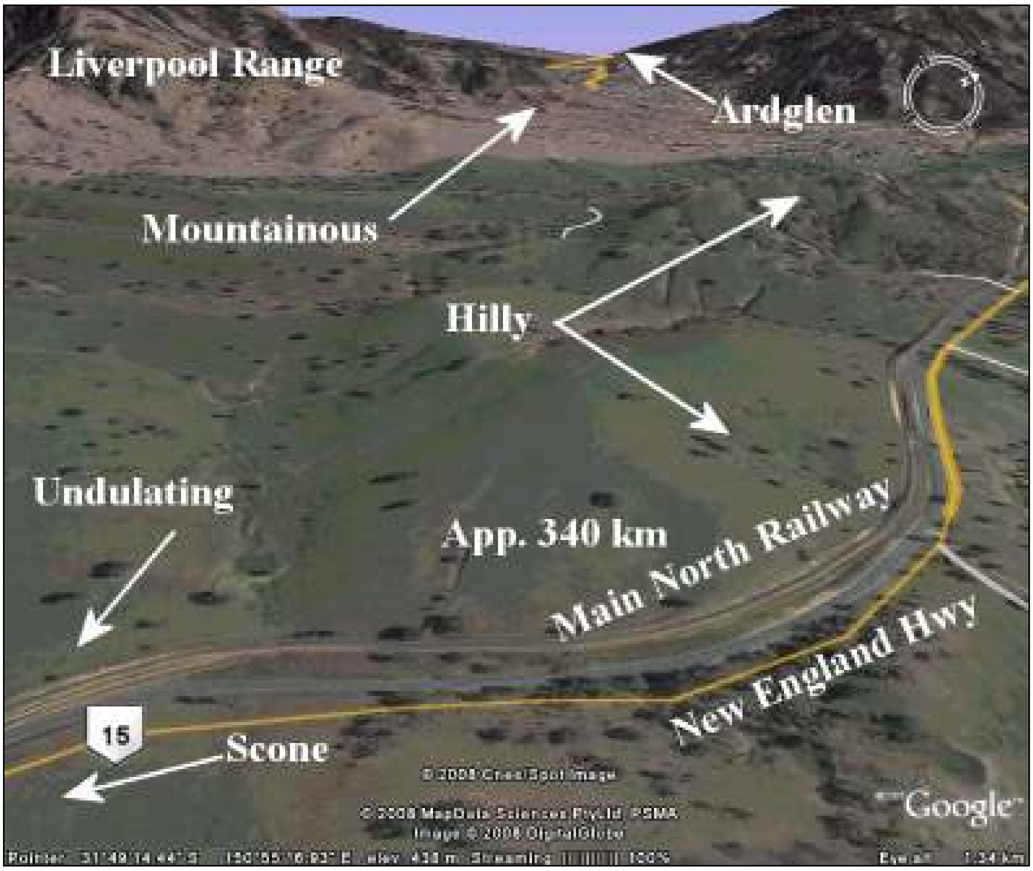
Culvert details were obtained from the same sources.

4.4 Earthworks

As discussed in the introduction to section 4. above, earthworks have been divided into "undulating", "hilly" and "mountainous" terrain terms, and the previously identified rates were applied. Booz & Company consider little if any of the Dartbrook to The Gap line is 'flat', and consequently has assessed earthworks for this line in terms of 'undulating' , 'hilly' and 'mountainous' terrain. As the ARTC analysis considered "undulating" terrain to involve cuttings and embankments to be between 1 m and 2 m in depth and height, "hilly" to be between 2 m and 5 m, and "mountainous" to be in excess of 5 m, then a reasonable method of assessment of the Dartbrook Mine to The Gap line was needed.

Figure 3 shows a Google Earth perspective of terrain south of Scone on the Dartbrook Mine to The Gap line.

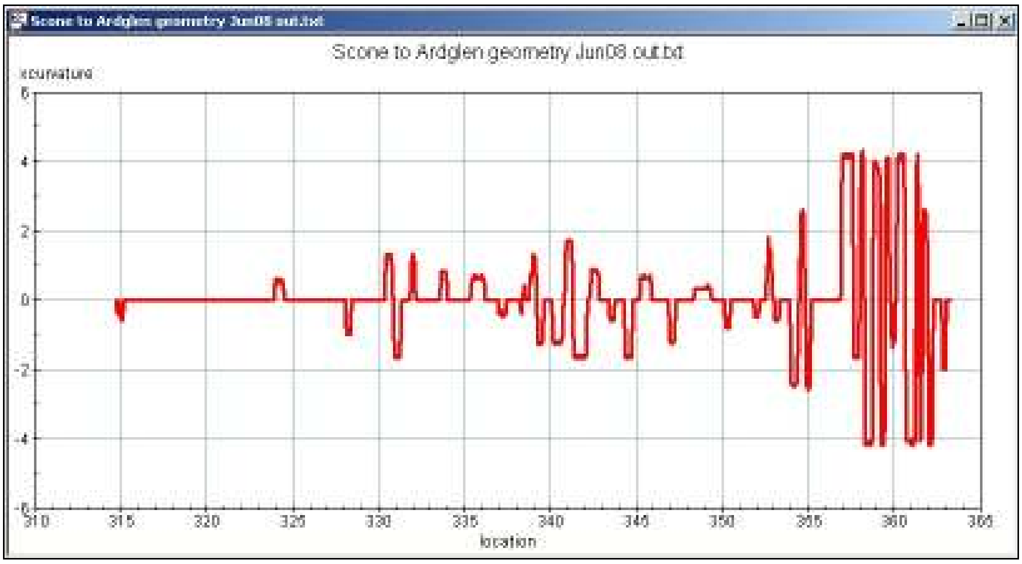
Figure 3 – Terrain between Scone and Ardglen (source – Google Earth)



As ARTC's generalised approach requires a reasonable categorisation of terrain, a combination of general knowledge of the area plus consideration of maps and Google Earth lead to use of AK Car xCurvature data as a proxy for terrain, on the principle that the steeper the terrain, the more curved the track. Curvature from Scone to Arglen through the Liverpool Ranges track section was used to "calibrate" the procedure. Comparing Figure 3 above (terrain) and Figure 4 below, (xCurvature between Scone and Ardglen, where xCurvature of 4 equals 250 m radius), then, for earthworks valuation puproses, xCurvature of less than or equal to 0.5 was selected as representative of "undulating" terrain, more than 0.5 and less than 1.5 was taken as "hilly", and equal to or more than 1.5 was taken as "mountainous".

This procedure enabled reasonably objective assessment of the extent and distribution of terrain type for earthworks evaluation purposes, as the AK Car xCurvature data could be readily evaluated in Excel. For example, the Scone to Ardglen section of the Dartbrook Mine to The Gap line was assessed has having 70.5% undulating terrain (1-2 m land profile), 15.5% hilly terrain (2-5 m land profile) and 15.0% mountainous (5 m or more land profile) terrain.

Figure 4 – AK Car xCurvature between Scone and Ardglen



Tunnels were estimated at $40,000/m using current ARTC Liverpool Range estimates, though this figure is still well below Ernst & Young's Inland Rail study estimate.

4.5 Signalling, Train Control, Safeworking and Communications

In recognition of the lack of detailed data, cost information was obtained for recent projects being undertaken in NSW. The Ulan to Muswellbrook resignalling project was investigated as being relevant to the Dartbrook Mine to The Gap line. This allowed a cost per km figure for signalling and communications to be calculated for the 2008 DORC.

In addition to the signalling and communications rate, an additional 4% was added to allow for the ORC of an associated train control centre. This rate was determined by considering the proportion of train km in any year on the Dartbrook Mine to The Gap line versus the ARTC network excluding the Hunter Valley, applied to a Train Control Centre value of $20 M in the 2006 DORC. The result is that $340,000 is included in the ORC for an appropriate proportion of Train Control Centre costs.

4.6 Fences and Level Crossings

It is normal practice to provide fencing along a railway to prevent animals and unauthorised persons gaining access to the infrastructure. For the purposes of this evaluation, it is assumed that fences are provided on both sides of the track.

A 28% loading was applied to level crossing fencing cost estimates, consistent with the discussion at the beginning of this chapter. The resulting rate per single fence kilometre is $19,430.

The 28% cost loading was also applied to level crossings. Level crossings may be across main roads with boom gates and signalling (estimated at $252,727 per track) or public level crossings with no lights or booms (estimated at $35,255 per track) or farm access type crossings (estimated at $17,059) per track. ARTC provided a listing of level crossing assets, split into public (signalled and not) and private. A composite rate of $159,214 was applied to the public level crossings, accounting for the mix of 57% of signalled crossings and 43% of unsignalled crossings.

5. Condition Assessment

5.1 General sources of information

ARTC had an asset condition investigation undertaken for DIRN track in NSW in mid 2005 that sought to document infrastructure condition at ARTC take-over in September 2004. A series of reports by WorleyParsons and sub consultants, (URS has been previously referenced regarding bridges, for example), provide a fairly complete description of infrastructure condition. WorleyParsons provided a number of spreadsheets listing details such as rail type and age. ARTC's project manager for the NSW asset condition investigation produced a comprehensive Executive Summary for the project as a whole.

All these documents were referenced for the 2006 DORC and form an on-going base of condition assessment for the 2008 DORC. A common source of data for these reports appears to be the TrackData on-line infrastructure database. The TrackData database was largely inherited from Rail Infrastructure Corporation, and has been updated over time to a somewhat varying degree to both improve information quality and to reflect on-going renewals. In practice there are some limitations to applicability of all this data for the DORC project.

Booz & Company has consequently used a range of data sources, including the WorleyParsons reports and spreadsheets and ARTC's Executive Summaries, direct communications with Corridor Management personnel, ARTC data and Booz & Company's own knowledge. Inevitably there is some inconsistency between these sources, and detailed knowledge of asset condition is limited. Furthermore, each source has a different data structure, none matching precisely ARTC's DORC segments, with the result that there will inevitably be errors in Booz & Company's asset register and asset condition data.

The most recent AK Car track geometry data set (June 2008) for the Dartbrook Mine to The Gap has also been analysed. This has contributed to understanding of rail wear and ballast condition.

A range of asset configuration and condition spreadsheets and commentaries were also provided by ARTC following a visit by a member of ARTC's Performance team to gather data for this project.

Booz & Company's spreadsheets are extensively commented to identify data sources, and assumptions applied. The following comments upon specific asset types should be regarded as a brief overview to aid understanding of the ORC and DORC evaluations.

5.2 Track

5.2.1 Rail

The assessment of life consumed is based upon two factors: tonnage carried and, where available, specific observations or data regarding condition.

Tonnage was calculated using MGT figures provided by ARTC, and the resulting life consumption by comparison with a nominal 600 MGT total life was determined. (This reflects the assumed life for 53kg rail, which represents by far the largest proportion of rail installed in track). A great deal of this 53kg rail is very old (dating to the 1930s). As there is also some relatively new 60kg rail in track, the 600 MGT figure is assessed as a compromise rail life for valuation purposes. 100lb and 103lb rail has been assessed as having a nominal 450 MGT total life.

As rail life is affected by curvature, this was calculated for each segment in the following bands: straight track plus curves greater than 600 m radius, curves between 600 m radius and 350 m radius, and curves less than 350 m radius. Curves between 600 m and 350 m radius are assumed to consume rail life at twice the rate of rail on straight track, and curves less than 350 m are assumed to consume rail life at three times the rate of rail on straight track. The evaluation then attributes a proportion of life consumed for each segment corresponding to the proportion of curves, while achieving the overall average of 600 MGT.

(It should be recognised that ARTC's rail management strategy, including works for straightening and grinding rail, for sleeper and fastener improvement, and for ballast and formation strengthening, will achieve improved rail life over time. Consequently future DORC evaluations may include longer rail lives.)

AK Car rail wear data and ultrasonic rail flaw data were checked to ensure no added life consumption should apply. Other than a limited extent of high curve worn rail (evaluation of which would have little effect upon the high level consumed life analysis used here), no extra life consumption was warranted.

5.2.2 Sleepers

Assessment of sleeper life consumed is based upon age, using concrete sleepers as a MEF. Where concrete sleepers are presently in place, the age is simply compared with a presumed total life of 50 years.

Where timber are installed, an equivalent life consumed figure is calculated for the MEF concrete sleeper. For example a timber sleeper may be assessed as having 5 years' life remaining. Comparing this with an assumed 20 year total life, then the timber sleeper is considered to be 75% life consumed. However, to have 5 years' remaining life, the MEF sleeper would need to be 90% life consumed.

In many cases WorleyParsons reported timber sleeper condition as being, for example, "40% of sleepers having less than 5 years' life". The procedure used to calculate life consumed in this instance is as follows. Take 40%<5yrs as being a sleeper count, needing reasonably prompt renewal, hence 100% life expired, then determine remaining sleeper contribution to life consumed assuming they are 50% life consumed on average. E.g. 40% + (100-40)x50% = 70% overall life consumed.

5.2.3 Ballast

ARTC have provided a ballast assessment in terms of Good, Fair and Poor. These assessments have been taken together with a detailed analysis of AK Car Surface parameters to identify the proportion of track affected by poor track support – generally taken as consequent upon poor ballast.

5.2.4 Turnouts

ARTC provided a general description in terms of Good, Fair and Poor, assessed as 25%, 50% and 75% life consumed respectively.

5.3 Structures

In NSW a reasonably detailed condition assessment was undertaken by URS, sub consultant to WorleyParsons, in 2005. This data has been utilised for this valuation. (See the 2006 DORC report for more detail.)

5.4 Earthworks

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. For the purposes of this analysis, earthworks are assigned a depreciated value of 50% of their replacement value. The same approach has been taken for tunnels.

5.5 Signalling, Train Control and Communications

With reference to ARTC document "Asset Condition Survey - SIGNALLING.doc", the signalling and communications assets are recorded as mostly average, some poor and limited amounts of assets are reported to be in good condition. ARTC updated the information on 25Jun08, resulting in some reassessment as Werris Creek to The Gap has effectively been renewed as part of the recently completed train control consolidation project, and considerable upgrade work has also recently been completed on the Dartbrook Mine to Werris Creek section also. Life consumed on the Werris Creek to The Gap section is accordingly assessed as 5%, and on the Dartbrook Mine to Werris Creek section as 50%.

5.6 Fences and Level Crossings

Fences and level crossings are assumed to be 50% life consumed.

6. Final ORC & DORC values

6.1 Dartbrook Mine to The Gap ORC and DORC

Two sets of ORC and DORC values are provided below. This reflects the exclusion (first tabulation) and inclusion (second tabulation) of newly completed loop extension works. As real new construction rates exceed the nominal ORC rates outlined in this report by a significant margin (see for example the comments on new earthworks in Section 4), these new assets with their new costs significantly distort the conventional DORC valuation approach, even after allowing higher earthworks rates as discussed above.

6.2 ORC and DORC excluding new capital works

The final replacement cost (ORC) and depreciated, optimised replacement cost (DORC) values for the Dartbrook Mine to The Gap line, excluding new capital works, are presented in Table 5.

The following highlight points are worth noting with respect to this estimate.

- The Dartbrook Mine to The Gap line 2008 DORC is approximately $109 million, derived from an ORC of approximately $229 million.
- The Dartbrook Mine to The Gap line 2008 DORC rate is approximately $783,000 per km and ORC rate is approximately $1.65 million per km.
- This 2008 ORC rate is approximately $147,000 per km higher than the ERA WA rate for Forrestfield to West Kalgoorlie (inflated to 2008), consequent largely upon the increased earthworks rate.
- Checking current (2008) new works costs, the 2008 ORC rate is arguably between 25% and 50% low.
- The average life consumed of the network infrastructure is approximately 52.5%.

Table 6 – 2008 Dartbrook Mine to The Gap – DORC and ORC, excluding new capital works

Item	Item
Line Results: 2008	
ORC ($)	**229,344,191**
DORC ($)	**109,043,338**
Per cent life consumed (%)	52.5
STK including yards	139
STK excluding yards	133
ORC average per kilometre ($)	1,647,647
DORC average per kilometre ($)	783,385

Table 6 provides a more detailed view of unit costs, again excluding new capital works. ("Track" includes track, turnouts, level crossings and fences; "Structures" includes bridges, culverts and tunnels.)

Table 7 – Details by asset type, $/km

Track		Earthworks		Structures		Sigs		Comms		Total	
ORC	**DORC**	**ORC**	**DORC**	**ORC**	**DORC**	**ORC**	**DORC**	**ORC**	**DORC**	**ORC**	**DORC**
$784.424	$343,981	$591,714	$255,857	$207,827	$110,567	$52,219	$27,077	$11,463	$5,936	$1,647,647	$783,386
per km	per km	per km	per km	per km	per km	per km	per km	per km	per km	per km	per km

6.3 ORC and DORC including new capital works

The final replacement cost (ORC) and depreciated, optimised replacement cost (DORC) values for the Dartbrook Mine to The Gap line, including new capital works, are presented in Table 8.

Table 8 – 2008 Dartbrook Mine to The Gap – DORC and ORC, including new capital works

Item	Item
Line Results: 2008	
ORC ($)	**259,631,191**
DORC ($)	**139,330,338**
Per cent life consumed (%)	46.3
STK including yards	144
STK excluding yards	138
ORC average per kilometre ($)	1,806,689
DORC average per kilometre ($)	969,555