Determination on the 2017 Weighted Average Cost of Capital for the Freight and Urban Railway Networks, and for Pilbara railways

6 October 2017

Economic Regulation Authority
WESTERN AUSTRALIA

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Introduction

1. The Economic Regulation Authority (**Authority**) administers the Western Australian railways access regime. The regime consists of the *Railways (Access) Act 1998* (**Act**) and the *Railways (Access) Code 2000* (**Code**). The rail network and types of infrastructure subject to the regime are defined in this legislation. The Authority's role is to administer the Act and the Code.

Requirements of the Code

2. Schedule 4, clause 3(1) of the Code requires the Authority to make an annual calculation, as at 30 June, of the Weighted Average Cost of Capital (**WACC**) to be applied in determining the costs for each of the rail networks covered under Schedule 1 of the Code.[1] The Authority must then publish its determination of the WACC for each rail network in the Government Gazette as soon as practicable after it is made (Schedule 4, clause 3(1)(b)).

3. The Code also requires the Authority to undertake public consultation every fifth year, commencing 2003, before determining the WACC values for that year (Schedule 4, clause 3(2)). Consequently, the Authority was required to undertake a public consultation process prior to making its WACC determination for 30 June 2013.

4. This 2017 determination updates the annual calculation, as at 30 June 2017, of the WACC to be applied in determining the costs for each of the rail networks covered under Schedule 1 of the Code for the 2017-18 period. The update follows the revised method set out in the 2013 rail WACC review.

The 2013 rail WACC review

5. The Authority undertook a public consultation program prior to making its annual WACC determination for the regulatory year commencing 1 July 2013.

6. The Authority released the Final Report in relation to the rail WACC method review on 18 September 2015.[2] The Final Report set out the method for the following regulated rail networks:

   - Public Transport Authority;
   - Brookfield Rail (now Arc Infrastructure); and
   - The Pilbara Infrastructure (TPI).

Roy Hill Infrastructure railway

7. The Roy Hill Infrastructure (**RHI**) railway became a regulated railway in August 2015 when the Code was applied with the modifications set out in Part 3 of the *Railway (Roy Hill Infrastructure Pty Ltd) Agreement Act 2010*. The RHI railway is a 344 km standard gauge, single line heavy haulage railway. It transports iron ore from the

[1] *Railways (Access) Code 2000*, Schedule 4.

[2] Economic Regulation Authority, *Review of the method for estimating the Weighted Average Cost of Capital for the Regulated Railway Networks: Final Decision*, 18 September 2015.

Roy Hill mine in the Chichester Ranges to port facilities at Port Hedland. The railway currently has a capacity of 55 million tonnes per annum.

8. In its revised 2015 rail WACC method, the Authority set out the following qualitative theoretical determinants of systematic risk which are used to inform the construction of the benchmark samples for the regulated rail entities:

- economic conditions;
- political and social considerations;
- market structure; and
- a firm's competitive position.

9. The Authority utilised these determinants to establish the benchmark sample for the three existing regulated rail networks.

10. The Authority's view is that, based on these determinants, the benchmark sample for RHI should be the same as that for TPI. RHI, like TPI:

- is 100 per cent dedicated to the bulk transport of iron ore, across one intermediate distance in the remote Pilbara;[3]
- is significantly exposed to cyclical international commodity markets;
- is new infrastructure which is in the early years of its life;
- has a new, undiversified customer base, with exposure to only a limited number of potential users in the mining industry;
- has, or is likely to have, contractual arrangements which smooth the volatility of revenue;
- benefits from sound underlying economics, given the strong position of the Pilbara iron ore producers in the global cost curve.

11. The Authority does not consider that there are any material distinguishing features between TPI and the RHI for the purpose of establishing the benchmark sample or the relevant WACC parameters.

12. Accordingly, the Authority has determined that the WACC for RHI should be the same as for TPI, informed by the analysis for TPI which was set out in the 2015 rail WACC method.[4] Therefore, both TPI and RHI will be referred to as 'the Pilbara railways (TPI and RHI)', and treated identically.

The 2017 rail WACC

13. The Authority has determined the following real pre-tax 2017 rail WACC values, to apply for the 2017 regulatory year, from 1 July 2017 to 30 June 2018:

[3] RHI is therefore typical of a United States 'class II/III type railroad' industry, which provides a better comparator than a large long distance (Class I) trans-national railroad network. The US company Genesee & Wyoming is an operator of Class II/III railroads, predominantly comprising short spur networks which connect to the major US interstate trunk lines. The Authority concluded that Genesee & Wyoming is the best, (albeit an imperfect) comparator for TPI (Economic Regulation Authority, *Review of the method for estimating the Weighted Average Cost of Capital for the Regulated Railway Networks: Final Decision*, 18 September 2015, p. 168).

[4] Economic Regulation Authority, *Review of the method for estimating the Weighted Average Cost of Capital for the Regulated Railway Networks: Final Decision*, 18 September 2015.

- Public Transport Authority: 4.35 per cent
- Arc Infrastructure: 7.52 per cent
- the Pilbara railways (TPI and RHI): 10.56 per cent

14. The complete set of parameter inputs contributing to these real pre-tax estimates is shown in Table 1.

Table 1 Determination on 2017 WACC values

Determination	Public Transport Authority	Arc Infrastructure	Pilbara railways
Nominal Risk Free Rate (10 year term)	2.49%	2.49%	2.49%
Real Risk Free Rate	0.57%	0.57%	0.57%
Inflation Rate[5]	1.91%	1.91%	1.91%
Gearing	50%	25%	20%
Debt Risk Premium	1.771%	1.992%	2.512%
Debt Issuing Cost	0.125%	0.125%	0.125%
Australian Market Risk Premium	7.20%	7.20%	7.20%
Equity Beta	0.6	0.9	1.3
Asset Beta	0.30	0.70	1.05
Corporate Tax Rate	30%	30%	30%
Franking Credit	40%	40%	40%
Nominal Cost of Debt	4.389%	4.610%	5.130%
Real Cost of Debt	2.430%	2.647%	3.157%
Real After Tax Cost of Equity	4.81%	7.16%	9.84%
Nominal Pre Tax Cost of Equity	8.31%	11.24%	14.56%
Real Pre Tax Cost of Equity	6.28%	9.15%	12.41%
Nominal Pre Tax WACC	6.35%	9.58%	12.68%
Real Pre Tax WACC	**4.35%**	**7.52%**	**10.56%**
Nominal After Tax WACC	5.60%	8.06%	10.58%
Real After Tax WACC	3.62%	6.03%	8.51%

Source: Economic Regulation Authority analysis

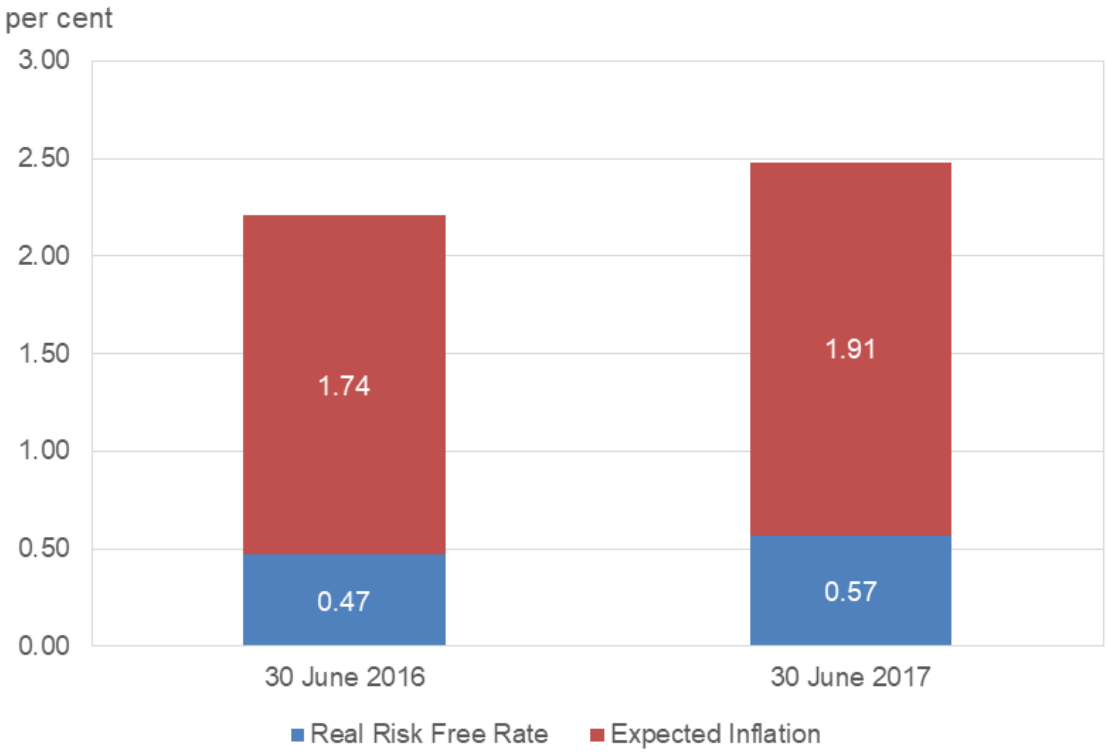
[5] This is a forecast implied from Treasury Indexed Bonds instead of the mid-point of the RBA's target inflation range.

Explanation of updated parameter estimates

Nominal Risk Free Rate

15. The 10 year nominal risk free rate has risen by 27 basis points from 2.22 to 2.49 per cent since the 2016 determination. This is mainly a result of inflation implied in the nominal risk free rate increasing to 1.91 per cent (Figure 1).[6] The real 10 year risk free rate has increased by 10 basis points based on Treasury Indexed Bond yields.

Figure 1 Nominal 10 year Risk Free Rate Composition – June 2016 and 2017



Source: ERA Analysis, Reserve Bank of Australia

Debt Risk Premium

16. The debt risk premium across the three relevant credit ratings have decreased from:
    - 2.111 to **1.771 per cent** for PTA;
    - 2.450 to **1.992 per cent** for Arc Infrastructure; and from
    - 3.578 to **2.512 per cent** for the Pilbara railways since 2016.

17. These premiums were estimated using the Authority's bond yield approach set out in the 2013 rail WACC review.[7] The sample of bonds used and the resulting estimates are shown in Appendix 1 and 2.

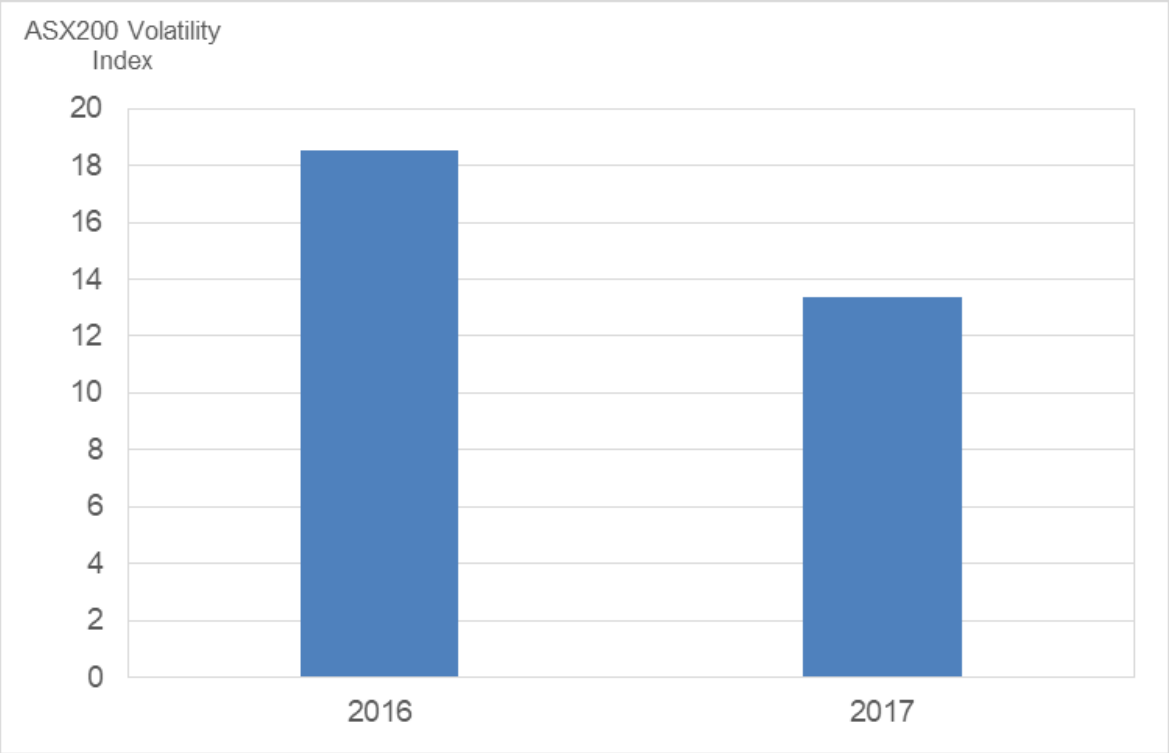
[6] Implied inflationary expectations are derived by discounting the real yield on Treasury inflation indexed bonds out of the nominal yield on conventional Treasury bonds. The real risk free rate and implied inflation figures graphed must be compounded to arrive at the nominal risk free rate – not added.

[7] The Authority determined these credit ratings for each of the rail networks based on the analysis in the 2013 rail WACC review.

18. In an attempt to verify and understand these decreases the Authority examined indicators of risk specifically in financial markets in which debt is traded and indicators of risk among corporates who issue debt. The implied volatility index on the ASX 200 is a measure of risk in the Australian equity market. This can be considered a proxy for risk in the Australian corporate sector more broadly as the ASX 200 is mainly comprised of equity in large Australian corporations. For consistency with the rail averaging period the *40 day* trailing averages of this measure are shown in Figure 2.

19. The average volatility has moved from 18.5 at 30 June 2016 to 13.4 at 30 June 2017 indicating that risk in the equity market has decreased substantially. The factors driving lower risk for equity returns in the corporate sector may be contributing to the observed declines in the debt risk premium.

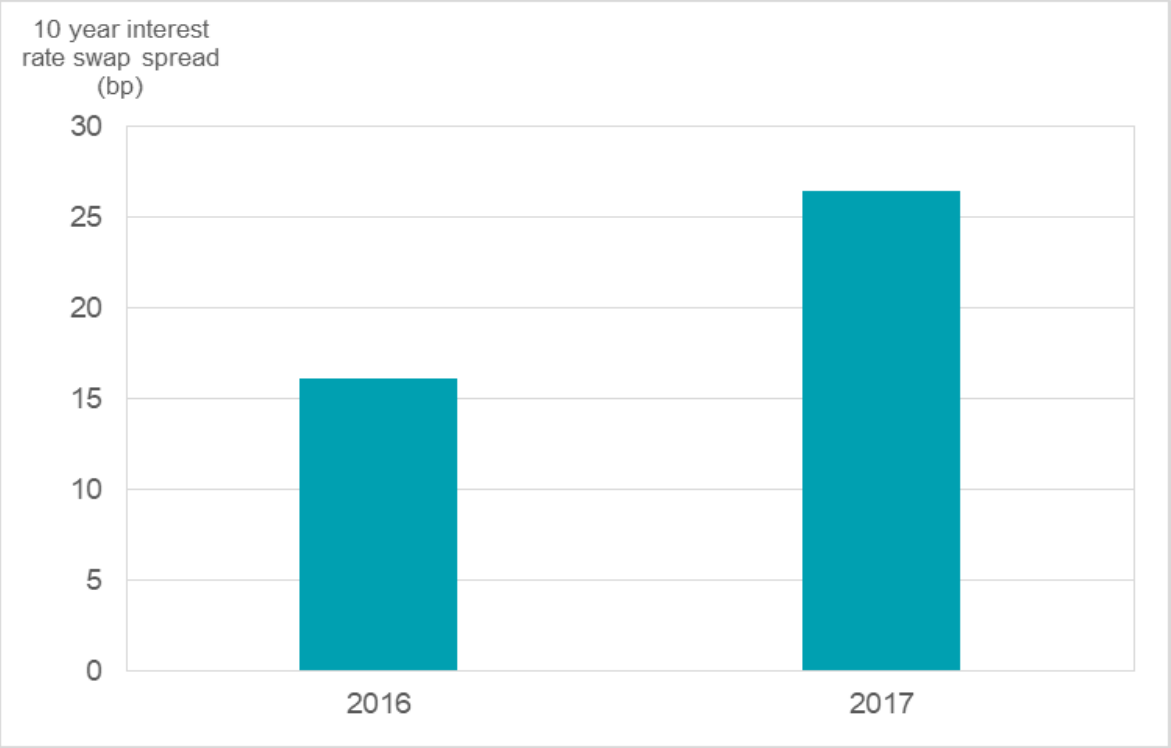
Figure 2 Australian Stock Exchange (ASX) 200 Volatility Index: 40 day trailing June 2016 versus June 2017



Source: ERA Analysis, Bloomberg

20. The Authority also examined the 40 day trailing average of the 10 year interest rate swap spread over the risk free rate on 30 June 2016 and 30 June 2017 (Figure 3).

Figure 3 10 year interest rate swap spread: 40 day trailing June 2016 versus June 2017



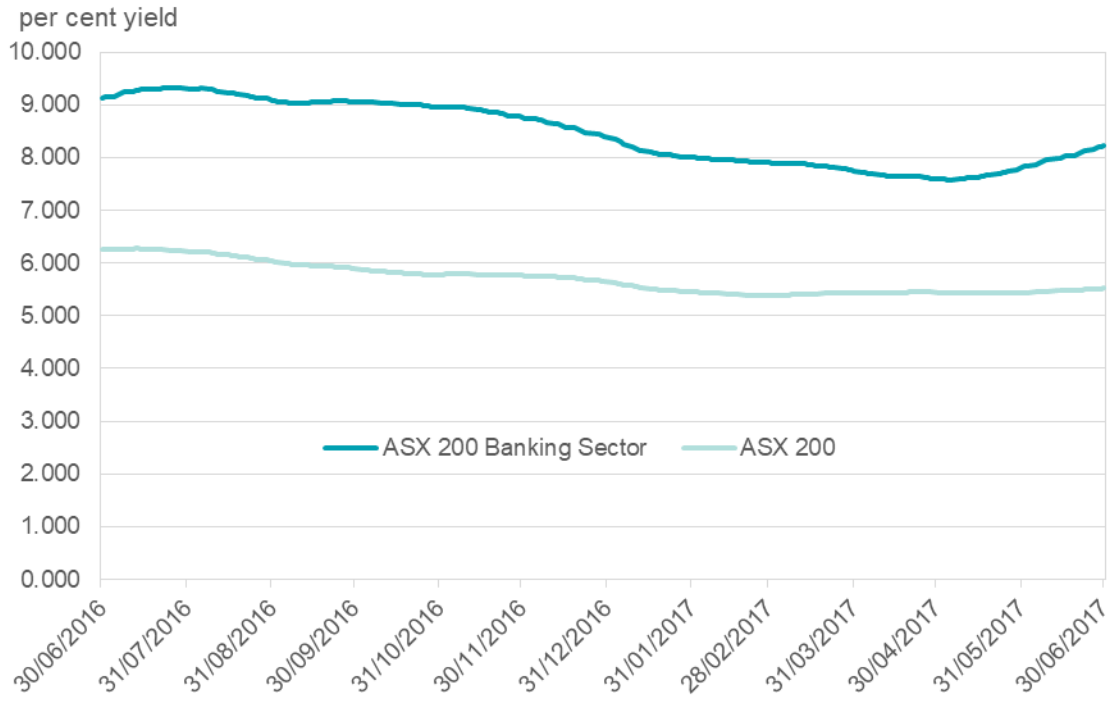
Source: ERA Analysis, Bloomberg

21. The 2017 outcome (26 basis points) was higher than the 2016 outcome (16 basis points) indicating increased financial system risk in 2017. This runs counter to the decline in the DRPs for this year. However, despite these increased swap spreads, the decline in the implied volatility index suggests that the observed decreases in the DRPs stem from decreased risk for the broader Australian corporate sector, outside of banking.

22. A comparison of banking sector dividend yields to those of the broader ASX200 market index tends to confirm the view that banking sector risk has increased while risk in the broader corporate sector has not.[8] Figure 4 shows that leading up to 30 June 2017 dividend yields have increased for the banking sector while yields for the ASX 200 (which includes the banking sector) have remained relatively flat.

[8] Dividend yields can be thought of as a forward looking indicator of risk. Higher dividend yields can signal an increase in risk premium required to hold the asset. This tends to materialise through a decrease in stock price relative to dividends paid.

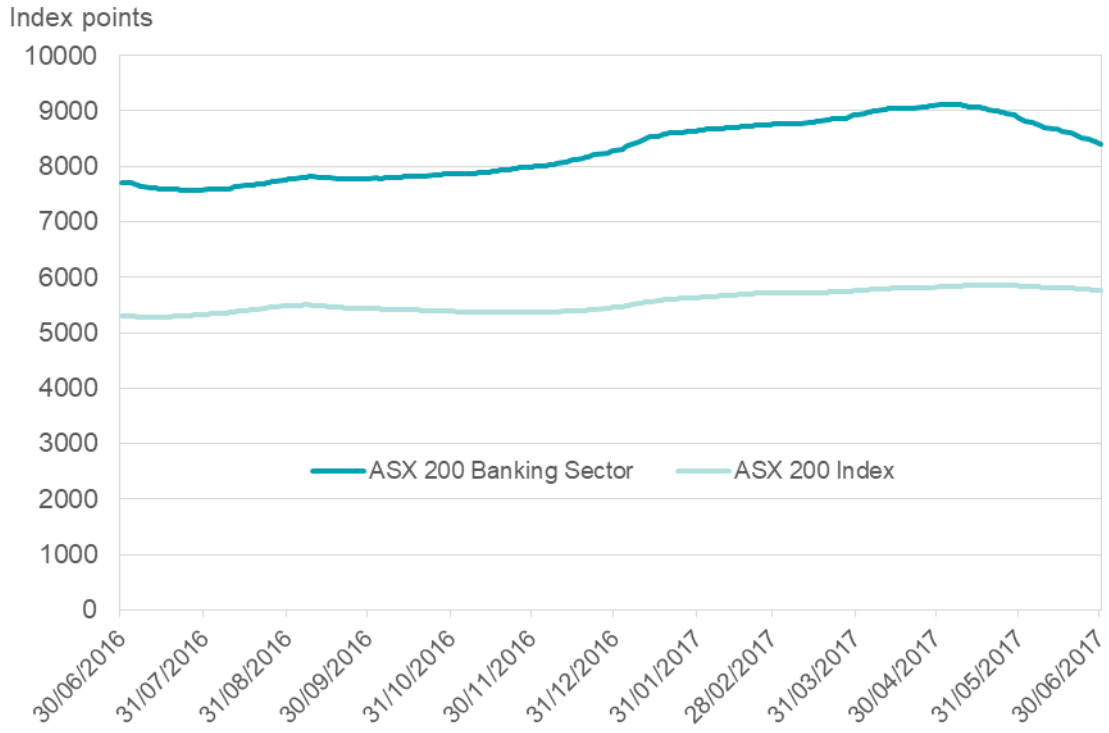
Figure 4 Banking sector versus ASX 200 gross dividend yields: 40 day trailing June 2016 to June 2017



Source: ERA Analysis, Bloomberg

23. Figure 5 compares the price indices for the broader ASX 200 and ASX 200 banking sector.

Figure 5 Banking sector versus ASX 200 price index: 40 day trailing June 2016 to June 2017



Source: ERA Analysis, Bloomberg

24. Figure 5 indicates that price falls rather than dividend increases have driven the increase in dividend yields for the banking sector shown in Figure 4. Pricing for the broader ASX 200 index has remained relatively flat. This is consistent with the view that while the banking sector has seen an increase in risk, the broader market has not.

25. The RBA's May 2017 Statement on Monetary Policy states:

> In line with developments in global markets, Australian government bond yields have declined over recent months, partly reversing the increase observed during 2016.[9]

26. Again, this supports the view that risk factors for the corporate sector, excluding the Australian banking sector, are driving decreases in the debt risk premium. This inference applies to all three credit ratings in the latest estimates.

Market Risk Premium

27. The estimate of the forward looking market risk premium (**MRP**) has decreased by 20 basis points from 7.40 to 7.20 per cent since the 2016 determination. Estimating the MRP requires considerable judgment as:

- the forward looking MRP is unobservable in financial markets before it is realised; and
- while there are various well-accepted estimation approaches, they tend to produce significantly different forecasts.

[9] Reserve Bank of Australia, *Statement on Monetary Policy*, May 2017, p. 39.

28. The MRP has two components; the nominal risk free rate (outlined above) and the market return on equity. The MRP is generally calculated as follows:

$$MRP = E(R_M) - R_f$$

where:

$E(R_M)$ is the expected market return on equity observed in the Australian stock market; and

R_f is the 10 year risk free rate of return.

29. Estimation of these two components of the MRP is discussed below.

Estimating the expected market return on equity

30. One view is that – given a sufficient period of time – the market return on equity will revert to a long run historical average. This outcome is observed in Australian equity market data. This implies that the long run historical average is a good forecast of the market return on equity, despite the short term fluctuations around the average.[10] This is because historical data indicates that over a long preiod of time the long run historical mean will tend to be realised *on average*.

31. Other methods attempt to account for the shorter term fluctuations observed in the market return on equity by using forward looking as opposed to historical data. The most common example is the Dividend Growth Model (**DGM**) which uses forecast cash flows (dividends) based on growth expectations and solves for a discount rate which equates this stream of cash flows to the current stock price. This forward-looking discount rate is the implied market return on equity.

Estimating the risk free rate of return

32. The risk free rate of return that will be realised for the next 10 years is observable.[11] This is because the price paid for a 10 year bond and the associated coupons are defined in advance which allows a return to be calculated assuming the bond is held to maturity. However, the 10 year risk free rates of return prevailing from the outset of future years are unobservable and so must be forecast. There is no apparent consensus as to whether historical risk free rates or the on-the-day (current) risk free rate should be used to forecast the risk free rate in the MRP calculation.

33. Australian Government bond yield data used as the measure of the risk free rate of return does not exhibit a tendency to return to a long run average.[12] Given that evidence, the Authority's view is that the on-the-day rate is a better forecast of the

[10] Economic Regulation Authority, *Appendices to the Explanatory Statement for the Rate of Return Guidelines: Meeting the requirements of the National Gas Rules*, 16 December 2013, p. 141.

[11] Specifically, prevailing on-the-day yields on Australian Treasury bonds may be used as a proxy for the risk free rate of return. These yields are observable because a Treasury bond's current market price, coupon interest rate and principal payable upon maturity are observable prior to maturity. The discount rate that equates a bond's remaining coupon payments and principal with the current price is the current yield to maturity.

[12] Economic Regulation Authority, *Appendices to the Explanatory Statement for the Rate of Return Guidelines: Meeting the requirements of the National Gas Rules*, 16 December 2013, p. 140.

risk free rate than the long run average. Hence the current on-the-day observed risk free rate for the next 10 years is used for this WACC decision.

Specific methods for calculating the MRP

34. The MRP equation shown above provides a general mathematical construct for the MRP. However, it does not specify how the equation parameters and thus MRP itself should be estimated.

35. In its 2015 revised rail WACC methodology, the Authority set out a specific method for estimating the MRP, that accounts for practitioners' use of both historical and forward looking data. Specifically, two well accepted methods for calculating the MRP using *historical* data are those of Ibbotson and Wright. An accepted *forward looking* method is provided by the DGM.

36. These two historical methods produce very different results. The Authority therefore takes both the Ibbotson and Wright methods into consideration.

37. The Ibbotson method calculates the average of a series of annual *MRP observations*. The MRP is calculated for each calendar year over the longest period of time for which data is available. There are currently 134 annual Australian MRP observations dating back to 1883. These observations are derived by deducting the risk free rate in each calendar year from the realised market return on equity in that year. The arithmetic average of these observations is typically employed, but the geometric average is also often quoted. If one believes the risk free rate and market return on equity are related, such that they will not drift too far apart, the Ibbotson method would be emphasised. This is because it is reliant on reversion of the *MRP,* as opposed to market return on equity, to a long run average.

38. The Wright method uses the 134 years long run average of a series of annual *real market return on equity* observations. This average market return on equity is indexed with a 10 year inflation forecast. The inflation forecast used by the Authority is that implied from the difference between the on-the-day nominal and real 10 year risk free rate of return. To arrive at the Wright MRP estimate the on-the-day risk free rate is then subtracted from the indexed average market return on equity.[13] If one believes that the market *return on equity* will revert to a long run average rate – regardless of the behavior of the risk free rate – more emphasis would be placed on the Wright method. This is because the Wright method reflects a perpetual outlook on the real market return on equity.

39. The DGM based approach to estimating the MRP also deducts the 10 year on-the-day risk free rate of return from the DGM based estimate of the market return on equity. While the DGM based method has the benefit of being forward looking, and taking the current economic outlook into account – through dividend growth expectations – it is known to produce upwardly biased estimates. As noted by McKenzie and Partington in their report to the Australian Energy Regulator, the shortcomings of the DGM are:

    - analyst forecasts have a tendency to be upwardly biased, as they are often based on over-optimistic expectations for target prices and earnings;

[13] Despite the naming convention the on-the-day rate is usually an average over some short period of time such as 20 or 40 trading days prior to the day of the cost of capital determination date to reduce the risk of idiosyncratic events unduly influencing the risk free rate forecast.

- DGMs may not fully reflect market conditions if firms follow a stable dividend policy; and
- DGMs do not capture non-dividend cash flows, such as share repurchases or dividend re-investment plans.[14]

40. The treatment of data under the three methods is outlined in Table 2.

Table 2 Data treatment in various market risk premium calculation methods

Approach	Market return on equity	Risk free rate
Ibbotson	Historical	Historical
Wright	Historical	On-the-day
DGM based	Forward looking	On-the-day

Application of methods to calculate the MRP

Historical data approaches

41. Brailsford, Handley and Maheswaran (**BHM**) produce the furthest backdated source of historical equity risk premium data for Australia.[15] However, in 2013 NERA Consulting raised concerns over potential downward bias in some of the older data observations and produced an adjusted version of the BHM data.[16] Professor Handley responded to these concerns highlighting shortcomings in NERA's adjusted series.[17] The Authority is not aware of any data that rectifies these issues or new information that favours the use of one data source over the other. To minimise the potential error from incorrectly favouring one source, the Authority uses the average of the NERA and BHM data.

42. Both of the historical equity return series are also adjusted for the value of imputation credits before being used in the MRP estimation process. The details of this process are given in Appendix 3.

43. The results of applying the Ibbotson method are shown in Table 3. There are four sub-periods that correspond to improvements in data quality prior to the sub-period from 1988 which corresponds to the introduction of the dividend imputation regime.[18]

[14] M. McKenzie and G. Partington, *Report to the AER, Part A: Return on equity*, October 2014, pp. 26-31.

[15] T. Brailsford, J. Handley and K. Maheswaran, 'The historical equity risk premium in Australia: post-GFC and 128 years of data', *Accounting and Finance*, vol.52, no.1, 2012, pp.237-247.

[16] NERA Economic Consulting, *Historical Estimates of the Market Risk Premium*, February 2015, pp.47-51.

[17] J. Handley, *Advice on the Return on Equity:, Report prepared for the Australian Energy Regulator*, 16 October 2014, pp. 19-20.

[18] T. Brailsford, J. Handley and K. Maheswaran, 'The historical equity risk premium in Australia: post-GFC and 128 years of data', *Accounting and Finance*, vol.52, no.1, 2012, p. 240.

Table 3 MRP results from Ibbotson method classified by sub-periods of improving data quality

	Arithmetic mean			Geometric mean		
Period	**BHM**	**NERA**	**Average**	**BHM**	**NERA**	**Average**
1883-2016	6.59%	6.23%	6.41%	5.23%	4.88%	**5.06%**
1937-2016	5.86%	5.91%	5.88%	4.01%	4.06%	4.04%
1958-2016	6.37%	6.37%	6.37%	4.03%	4.03%	4.03%
1980-2016	6.22%	6.22%	6.22%	3.96%	3.96%	3.96%
1988-2016	5.72%	5.72%	**5.72%**	4.12%	4.12%	4.12%

Source: Brailsford, Handley, Maheswaran (2012), NERA (2013) and ERA Analysis.

44. There are mixed views on the appropriate averaging process for historic returns. McKenzie and Partington state it is well understood that geometric average returns will tend to understate returns.[19] In the same report they also highlight Blume's 1974 study which shows that the arithmetic average will tend to overstate returns when it is compounded over more than one period. This is due to compounding the sampling error inherent in the data. Therefore the Authority's view is that an unbiased estimator is likely to lie somewhere between the two types of averages. In lieu of any other information, the Authority seeks to minimise any error associated with over-reliance on one of the two types of averages by using the simple average of the lowest arithmetic mean and highest geometric mean in Table 3.

45. The Authority considers that the average of the lowest arithmetic mean estimate of 5.72 per cent and highest geometric mean estimate of 5.06 per cent provides a reasonable Ibbotson based MRP estimate of 5.39 per cent.

46. The results of applying the Wright method to the historical data are shown in Table 4.

Table 4 MRP result from Wright method

	NERA	BHM	Average
Nominal market return on equity including realised inflation	12.14%	11.78%	11.96%
Real market return on equity excluding realised inflation	8.91%	8.56%	8.74%
Expected Inflation	1.91%	1.91%	1.91%
Nominal market return on equity including expected inflation	10.99%	10.63%	10.81%
10 year Risk Free Rate of Return	2.49%	2.49%	2.49%
Market Risk Premium	**8.50%**	**8.14%**	**8.32%**

Source: ERA Analysis December 2015, NERA (2013), Brailsford, Handley and Maheswaran (2012).

47. The historical nominal market return on equity series is adjusted for realised inflation to create a real market return on equity series. The average of this series is 8.91 per cent using NERA's data and 8.56 per cent using the BHM data. These averages are then indexed for expected inflation of 1.91 per cent. The average of the resultant nominal market return on equity estimates is 10.81 per cent. Deducting the 10-year risk free rate of 2.49 per cent from this figure results in an MRP of 8.32 per cent.

[19] M. McKenzie and G. Partington, *Supplementary report on the equity MRP*, 22 February 2012, p. 5.

Forward looking data approach (DGM)

48. In the 2015 determination various DGM estimates were considered in addition to the Authority's estimate to assist in developing a range. Dividend growth expectations are extremely variable due to the continuous arrival of new information in the market. The latest information is therefore the most relevant to the expected return. Accordingly, the Authority has included estimates that are less than two years old. The updated table of DGM estimates from a range of DGM models is shown in Table 5.

Table 5 Recent estimates of the MRP using the DGM

Study/Author	Date	Dividend yield source	Theta	Risk free rate (%)	Implied MRP (%)
Bloomberg	June 2017	Bloomberg	-	2.6	6.97
Frontier Economics	December 2016	-	0.25	2.8	6.58 - 7.84
AER	April 2017	Bloomberg	0.6	2.6	6.53 – 7.80
ERA	March 2017	Bloomberg	0.53	2.25	7.51
Estimated range of the MRP					**6.53 – 7.84**

Source:

Bloomberg CRP AU <GO> 30 June 2017

Frontier Economics, *The market risk premium*, Report prepared for Icon Water, June 2017, p. 32.

Australian Energy Regulator, *Draft decision: AusNet Services Gas access arrangement 2018 to 2022*, Attachment 3: Rate of return, July 2017, p. 232.

Economic Regulation Authority, *The Efficient Costs and Tariffs of the Water Corporation, Aqwest and Busselton Water: Draft Report*, 21 August 2017, p. 377.

49. The Authority has also updated its two stage DGM estimate. The data input into the DGM are also augmented with imputation credit yields using the process outlined in Appendix 3. The DGM estimate is based on a two-stage approach outlined below:

$$P_0 = \frac{m \text{ x } E(D_0)}{(1+k)^{m/2}} + \sum_{t=1}^{N} \frac{E(D_t)}{(1+k)^{m+t-0.5}} + \frac{\frac{E(D_N)(1+g)}{k-g}}{(1+k)^{m+N-0.5}}$$

where:

P_0 is current price the of the equity index;

m is the fraction of the current year remaining;

$E(D_0)$ is the dividend inclusive of imputation credit value per share expected in the current year;

$E(D_t)$ is the dividend inclusive of imputation credit value per share expected t years into the future;

k is the market return on equity implied by the model;

N is the year of the furthest out dividend forecast; and

g is the long run dividend growth rate.

50. Monthly cash (or net) dividend per share forecasts for the All Ordinaries Index are sourced from Bloomberg for the current year, the next year and the year after. The monthly closing price for the All Ordinaries index is also sourced from Bloomberg.

51. The assumption for the long run dividend growth rate g is 4.6 per cent. This is based on Professor Lally's 2013 study which equates g to the estimated long run nominal GDP growth of 5.6 per cent less 1.0 per cent to account for new share issues and new companies.[20]

52. The Authority's DGM based MRP estimate is 7.52 per cent. This is a result of subtracting the risk free rate of 2.49 per cent from the solution for the market return on equity k of 10.01 per cent. This estimate falls within the range of DGM estimates in Table 5.

53. Table 6 shows the MRPs calculated using the Ibbotson, Wright and DGM methods as well as the DGM range observed from other decisions.

Table 6 MRP calculation results from the three methods

	Ibbotson	Wright	DGM	DGM Range
MRP	5.39%	8.32%	7.52%	6.53 – 7.84%

[20] M. Lally, *The Dividend Growth Model*, 4 March, 2013, p. 17.

Determining the final estimate of the MRP

54. Where possible, the Authority has sought to replicate the rationale applied to arrive at the final MRP estimate in the 2015 rail WACC determination.

55. The final MRP estimate in the 2016 determination (7.40 per cent) was derived from a range based on historical information, with the Wright based calculation forming the upper bound (8.4 per cent) and Ibbotson based calculation (5.4 per cent) forming the lower bound.

Historical data

56. The rounded Ibbotson lower bound of 5.4 per cent for 2017 is the same as that of 2016. A comparison of the rounded estimates are shown in Table 7.

Table 7 Ibbotson MRP- 30 June 2016 versus 2017 estimate

Ibbotson Method	2016	2017
Market Risk Premium	5.4%	5.4%

Source: ERA Analysis

57. The 2017 upper bound of 8.3 per cent based on the rounded Wright estimate is around 10 basis points lower than in 2016 (see Table 8).

Table 8 Wright MRP- 30 June 2016 versus 2017 estimate

Wright Method	2016	2017
Market Risk Premium	8.4%	8.3%

Source: ERA Analysis

58. The MRP using the Ibbotson and Wright estimation methods based on historical data ranges from 5.4 to 8.3 per cent. The mid-point rounded to one decimal place is 6.9 per cent.

59. In the 2015 review the Wright MRP was given most weight according to the following rationale:

> …the Authority considers that the Wright estimate provides a strong indicator for the likely market return on equity for the next 50 years, given the statistical evidence for the mean reversion of the market return on equity…
>
> … the Authority is inclined somewhat more toward the Wright view of the world, given the long term nature of the estimate...

Forward looking (DGM) data

60. The DGM estimates in Table 5, however, support an MRP estimate between 6.5 per cent and 7.8 per cent. The mid-point is 7.2 per cent rounded to 1 decimal place.

61. In the 2015 determination the Authority noted:

> … that the DGM approach tends to provide upwardly biased estimates. Therefore, the Authority is inclined to give more weight to those estimates which are in the lower half of the recent range.

62. This indicates that the final MRP estimate should reflect more weight being given to the lower half of the DGM based range. The lower half of the externally observed DGM based range is 6.5 and 7.2 per cent. The Authority's updated DGM estimate of 7.5 per cent falls outside the upper bound of the lower half of this range. Thus it should be afforded less weight. As discussed above, DGM estimates tend to be

upwardly biased. The Authority therefore considers its DGM estimate of 7.2 per cent to be a reasonable upper bound for the *DGM* MRP range.

63. The Authority will establish an MRP range with:

- an upper bound based on the DGM upper bound estimate, of 7.2 per cent;
- a lower bound based on the mid-point of the historical data, of 6.9 per cent.

64. This range will be used to establish the point estimate of the MRP.

65. The Authority's 2017 DGM estimate is substantially lower than the 2016 estimate (33 basis points) as shown in Table 9.

Table 9 Two stage DGM MRP- 30 June 2016 versus 2017 estimate

Two Stage DGM Method	2016	2017
Market Risk Premium	7.85%	7.52%

66. The key driver of this decrease in the DGM estimate is the increase in the risk free rate from 2.22 to 2.49 per cent, accounting for 27 basis points of the decrease. The other 6 basis points of the 33 basis point change results from a decrease in the implied return on equity from 10.07 per cent to 10.01 per cent. This tends to support a decrease in the MRP of around 30 basis points, as compared to 2016.

67. In line with previous years, the Wright MRP is given most weight. While the Ibbotson method is constant, the Wright MRP has decreased since the last determination. The historical data therefore suggests that the MRP should have decreased since last year. The 10 basis point reduction in the Wright estimate supports a similar downward adjustment to last year's MRP estimate of 7.4 per cent. The MRP is conventionally changed in increments of 10 basis points. Accordingly, the *information on the direction of change* from the Wright approach supports a reduction of 10 basis points in the MRP estimate.

68. The range for the MRP established in paragraph 63 is 6.9 to 7.2 per cent. In light of the increase in the risk free rate, and the reductions in the Wright and DGM estimates, the Authority determines that an estimate of 7.2 per cent for the forward looking MRP, or a reduction of 20 basis points from last year's MRP, adequately reflects all of the considerations outlined above.

69. To summarise the rationale applied:

- The historic MRP mid-point estimate is 6.9 per cent. The Ibbotson estimate of 5.4 per forms the lower bound for the historic data and is unchanged from the 2016 estimate. The Wright estimate of 8.3 per cent forms the upper bound and is given the most weight, in line with the 2015 approach. The Wright estimate for 2017 is 10 basis points lower than the Wright estimate for 2016. This indicates that the final MRP determination for 2017 should be marginally lower than last year's final estimate of 7.4 per cent.
- The Authority accounts for the DGM estimate of the MRP. In the 2015 determination the Authority placed more weight on the lower half of the range of externally observed DGM estimates than the upper half, in recognition of DGM estimates' inherent upward bias.
- The Authority's most recent two stage DGM based MRP estimate is 7.52 per cent. This estimate falls outside the lower half of the range of observed DGM estimates, thus is given less weight. However, this estimate has decreased by 33 basis points since 2016. The main driver of this is a 27 basis point decrease

in the risk free rate which suggests a decrease in the MRP of around 30 basis points is appropriate.

- Based on the evidence, a reasonable range for the MRP is 6.9 - 7.2 per cent. The upper bound is based on the DGM while the lower bound is based on the mid-point of the historic estimates.
- In light of the increase in the risk free rate, the reductions in the Wright and DGM estimates, and the greater weight afforded to the Wright estimate, the Authority determines that the upper end of the 6.9 to 7.2 per cent range adequately reflects all of the considerations outlined above. An MRP estimate of 7.2 per cent is therefore adopted for this rail WACC decision.

Appendix 1 International bond sample

Figure 6 Public Transport Authority Sample

Ticker	Issuer (Short name)
EI6011817 Corp	ETSA UTILITIES FINANCE
EI0055331 Corp	OPTUS FINANCE PTY LTD
EJ5424159 Corp	AUSNET SERVICES HOLDINGS
EJ5681071 Corp	AUSNET SERVICES HOLDINGS
EJ5679471 Corp	WESFARMERS LTD
EI1892617 Corp	TELSTRA CORP LTD
EJ5984160 Corp	SGSP AUSTRALIA ASSETS
EK8757206 Corp	BHP BILLITON FINANCE LTD
EJ6958775 Corp	AUSTRALIA PACIFIC AIRPOR
EI2917587 Corp	TELSTRA CORP LTD
EJ7525219 Corp	AUSNET SERVICES HOLDINGS
EI4007098 Corp	OPTUS FINANCE PTY LTD
EJ3721366 Corp	BHP BILLITON FINANCE LTD
EK9024770 Corp	WESFARMERS LTD
EK8989288 Corp	WESFARMERS LTD
EI5615311 Corp	SGSP AUSTRALIA ASSETS
EK1048710 Corp	SGSP AUSTRALIA ASSETS
EI4432049 Corp	TELSTRA CORP LTD
EI6263145 Corp	AUSNET SERVICES HOLDINGS
AN1491306 Corp	TELSTRA CORP LTD
AN1290245 Corp	TELSTRA CORP LTD
EI6010694 Corp	VICTORIA POWER NETWORKS
EK5233391 Corp	WESFARMERS LTD
EI6383935 Corp	TELSTRA CORP LTD
EI8810216 Corp	BHP BILLITON FIN USA LTD
EI6011379 Corp	VICTORIA POWER NETWORKS
EJ0387146 Corp	BHP BILLITON FIN USA LTD
EI8731610 Corp	TELSTRA CORP LTD
EJ2023566 Corp	NEW ZEALAND MILK PTY LTD
EK9698532 Corp	OPTUS FINANCE PTY LTD
EK9664815 Corp	OPTUS FINANCE PTY LTD
EJ2512352 Corp	AUSNET SERVICES HOLDINGS
EJ2514606 Corp	AUSNET SERVICES HOLDINGS
EK3157451 Corp	SGSP AUSTRALIA ASSETS
EJ2973612 Corp	WESFARMERS LTD
UV8008012 Corp	AUSTRALIA PACIFIC AIRPOR
UV8270729 Corp	TELSTRA CORP LTD
EJ0952857 Corp	TELSTRA CORP LTD

Ticker	Issuer (Short name)
EK8757560 Corp	BHP BILLITON FINANCE LTD
EJ3849779 Corp	SGSP AUSTRALIA ASSETS
LW4748379 Corp	SGSP AUSTRALIA ASSETS
EJ5831940 Corp	TELSTRA CORP LTD
EJ8457800 Corp	AUSTRALIA PACIFIC AIRPOR
EJ8553962 Corp	BHP BILLITON FIN USA LTD
EI9022241 Corp	TELSTRA CORP LTD
EI9023967 Corp	TELSTRA CORP LTD
EK0554445 Corp	AUSNET SERVICES HOLDINGS
EJ2120461 Corp	BHP BILLITON FINANCE LTD
EK3489227 Corp	AUSNET SERVICES HOLDINGS
EJ3722562 Corp	BHP BILLITON FINANCE LTD
EK5369849 Corp	AUSTRALIA PACIFIC AIRPOR
EK8353493 Corp	TELSTRA CORP LTD
QJ5397360 Corp	AUSTRALIA PACIFIC AIRPOR
DD1056769 Corp	BHP BILLITON FINANCE
JK7301761 Corp	TELSTRA CORP LTD
LW9385011 Corp	SGSP AUSTRALIA ASSETS
QZ9328522 Corp	AUSTRALIA PACIFIC AIRPOR
DD1091428 Corp	WMC FINANCE USA LTD
EK7552160 Corp	AUSNET SERVICES HOLDINGS
AN1290252 Corp	TELSTRA CORP LTD
AO1476404 Corp	SGSP AUSTRALIA ASSETS
AM4028255 Corp	AUSNET SERVICES HOLDINGS
EJ3721465 Corp	BHP BILLITON FINANCE LTD
EK8757685 Corp	BHP BILLITON FINANCE LTD
EJ6510642 Corp	BHP BILLITON FINANCE LTD
ED1042677 Corp	WMC FINANCE USA LTD
EJ0387187 Corp	BHP BILLITON FIN USA LTD
EJ3722414 Corp	BHP BILLITON FINANCE LTD
EJ8554085 Corp	BHP BILLITON FIN USA LTD

Figure 7 Arc Infrastructure Sample

Ticker	Issuer (Short name)
EJ4265850 Corp	DBNGP FINANCE CO PTY LTD
EJ4333419 Corp	COCA-COLA AMATIL LTD
EK5876389 Corp	CROWN GROUP FINANCE LTD
EI0704078 Corp	INCITEC PIVOT FIN LLC
EI1608021 Corp	TRANSURBAN FINANCE CO PT
EI1592092 Corp	TRANSURBAN FINANCE CO PT

Ticker	Issuer (Short name)
EI2000491 Corp	BRAMBLES USA INC
EJ6899243 Corp	COCA-COLA AMATIL LTD
EK9545295 Corp	ENERGY PARTNERSHIP GAS
EK9580078 Corp	ENERGY PARTNERSHIP GAS
EI7021476 Corp	CIMIC FINANCE USA PTY LT
EI3253362 Corp	APT PIPELINES LTD
EJ7588209 Corp	PERTH AIRPORT PTY LTD
EJ7646361 Corp	QPH FINANCE CO PTY LTD
EI4044356 Corp	WOOLWORTHS LIMITED
EK5107249 Corp	DBNGP FINANCE CO PTY LTD
EJ8616397 Corp	TRANSURBAN FINANCE CO
EJ8798880 Corp	BRISBANE AIRPORT CORP LT
EJ8893137 Corp	AURIZON NETWORK PTY LTD
EJ9225768 Corp	COCA-COLA AMATIL LTD
EJ9637749 Corp	AQUASURE FINANCE PTY LTD
EI4214900 Corp	SYDNEY AIRPORT FINANCE
EK1306886 Corp	PERTH AIRPORT PTY LTD
EI6348474 Corp	WOOLWORTHS LIMITED
EI6641167 Corp	WOODSIDE FINANCE LTD
EK2622026 Corp	COCA-COLA AMATIL LTD
EK3554137 Corp	QPH FINANCE CO PTY LTD
EI7486208 Corp	COCA-COLA AMATIL NZ LTD
EK4152378 Corp	COCA-COLA AMATIL LTD
EI8144731 Corp	COCA-COLA AMATIL LTD
EG0640763 Corp	SYDNEY AIRPORT FINANCE
EK6279310 Corp	SUN GROUP FINANCE
AM6765136 Corp	COCA-COLA AMATIL LTD
EK8055148 Corp	APT PIPELINES LTD
EJ2714362 Corp	COCA-COLA AMATIL LTD
LW8323849 Corp	COCA-COLA AMATIL LTD
EJ3906165 Corp	APT PIPELINES LTD
EG0219857 Corp	SYDNEY AIRPORT FINANCE
EJ4317107 Corp	CIMIC FINANCE USA PTY LT
EJ4068577 Corp	SYDNEY AIRPORT FINANCE
EJ5962760 Corp	AMCOR LTD
LW2393780 Corp	QPH FINANCE CO PTY LTD
QZ4475534 Corp	UNITED ENERGY DISTRIBUTI
UV3027009 Corp	DBNGP FINANCE CO PTY LTD
QZ7667723 Corp	TRANSURBAN QLD FINANCE
QZ8701372 Corp	APT PIPELINES LTD
EK1561159 Corp	SYDNEY AIRPORT FINANCE

Ticker	Issuer (Short name)
AN2611019 Corp	COCA-COLA AMATIL LTD
EK3156859 Corp	BRAMBLES FINANCE LIMITED
EK4655081 Corp	TRANSURBAN FINANCE CO
EK4685294 Corp	AURIZON NETWORK PTY LTD
EJ4508010 Corp	APT PIPELINES LTD
EK6424791 Corp	SUN GROUP FINANCE
EK7758478 Corp	WOODSIDE FINANCE LTD
EK8078215 Corp	APT PIPELINES LTD
EK8787450 Corp	SYDNEY AIRPORT FINANCE
EK9118226 Corp	TRANSURBAN FINANCE CO
UV8551672 Corp	COCA-COLA AMATIL LTD
QJ2217868 Corp	BRAMBLES USA INC
JV3204296 Corp	COCA-COLA AMATIL LTD
QJ4132016 Corp	TRANSURBAN FINANCE CO
JK8763837 Corp	SYDNEY AIRPORT FINANCE
JK8498749 Corp	AMCOR FINANCE USA INC
JK9360021 Corp	COCA-COLA AMATIL LTD
LW0777554 Corp	AURIZON NETWORK PTY LTD
QZ3723793 Corp	WOODSIDE FINANCE LTD
EK8055387 Corp	APT PIPELINES LTD
QZ4183500 Corp	TRANSURBAN FINANCE CO
AM7968663 Corp	APT PIPELINES LTD
EK8055262 Corp	APT PIPELINES LTD
EK8078397 Corp	APT PIPELINES LTD
QJ1896811 Corp	BHP BILLITON FIN USA LTD
QJ1928531 Corp	BHP BILLITON FIN USA LTD
JV5237112 Corp	AUSNET SERVICES HOLDINGS
QJ1906909 Corp	BHP BILLITON FINANCE LTD
QJ1910778 Corp	BHP BILLITON FINANCE LTD
QJ1908806 Corp	BHP BILLITON FINANCE LTD

Figure 8 The Pilbara railways Sample

Ticker	Issuer (Short name)
EJ4265850 Corp	DBNGP FINANCE CO PTY LTD
EJ3879651 Corp	ORIGIN ENERGY FINANCE
EK5876389 Corp	CROWN GROUP FINANCE LTD
EI0704078 Corp	INCITEC PIVOT FIN LLC
EJ6468916 Corp	QANTAS AIRWAYS LTD
EK2849330 Corp	ADANI ABBOT POINT TERMIN
EK9545295 Corp	ENERGY PARTNERSHIP GAS

Ticker	Issuer (Short name)
EK9580078 Corp	ENERGY PARTNERSHIP GAS
EI7021476 Corp	CIMIC FINANCE USA PTY LT
EI3253362 Corp	APT PIPELINES LTD
EJ7588209 Corp	PERTH AIRPORT PTY LTD
EJ7646361 Corp	QPH FINANCE CO PTY LTD
EI4044356 Corp	WOOLWORTHS LIMITED
EI4098048 Corp	ASCIANO FINANCE LTD
EK5107249 Corp	DBNGP FINANCE CO PTY LTD
EJ8798880 Corp	BRISBANE AIRPORT CORP LT
EJ6371623 Corp	ORIGIN ENERGY FINANCE
EI4214900 Corp	SYDNEY AIRPORT FINANCE
EK1306886 Corp	PERTH AIRPORT PTY LTD
EI6348474 Corp	WOOLWORTHS LIMITED
EK3117976 Corp	QANTAS AIRWAYS LTD
EK3554137 Corp	QPH FINANCE CO PTY LTD
EJ8598074 Corp	ORIGIN ENERGY FINANCE
EI8364461 Corp	ORIGIN ENERGY FINANCE LT
EI8703494 Corp	NEWCREST FINANCE PTY LTD
EG0640763 Corp	SYDNEY AIRPORT FINANCE
EK6279310 Corp	SUN GROUP FINANCE
EK8777964 Corp	FMG RESOURCES AUG 2006
EK8055148 Corp	APT PIPELINES LTD
EK2690916 Corp	QANTAS AIRWAYS LTD
EJ3784331 Corp	NEWCREST FINANCE PTY LTD
EJ3906165 Corp	APT PIPELINES LTD
EG0219857 Corp	SYDNEY AIRPORT FINANCE
EJ4317107 Corp	CIMIC FINANCE USA PTY LT
EJ4068577 Corp	SYDNEY AIRPORT FINANCE
EJ5962760 Corp	AMCOR LTD
EJ6105286 Corp	ORIGIN ENERGY FINANCE
EI6307918 Corp	ASCIANO FINANCE LTD
LW2393780 Corp	QPH FINANCE CO PTY LTD
EJ8324406 Corp	ASCIANO FINANCE LTD
UV3027009 Corp	DBNGP FINANCE CO PTY LTD
QZ5121780 Corp	QANTAS AIRWAYS LTD
QZ7667723 Corp	TRANSURBAN QLD FINANCE
QZ8701372 Corp	APT PIPELINES LTD
EK1561159 Corp	SYDNEY AIRPORT FINANCE
EJ4508010 Corp	APT PIPELINES LTD
EK6424791 Corp	SUN GROUP FINANCE
EK8078215 Corp	APT PIPELINES LTD

Ticker	Issuer (Short name)
EK8787450 Corp	SYDNEY AIRPORT FINANCE
EK9072910 Corp	ASCIANO FINANCE LTD
JK8763837 Corp	SYDNEY AIRPORT FINANCE
JK8498749 Corp	AMCOR FINANCE USA INC
QZ7279925 Corp	QANTAS AIRWAYS LTD
EK8055387 Corp	APT PIPELINES LTD
AN1919132 Corp	ASCIANO FINANCE LTD
AN4412705 Corp	ASCIANO FINANCE LTD
AM7968663 Corp	APT PIPELINES LTD
EK8055262 Corp	APT PIPELINES LTD
EK8078397 Corp	APT PIPELINES LTD
EJ3049461 Corp	CALTEX AUSTRALIA LTD
EI8704930 Corp	NEWCREST FINANCE PTY LTD
JV5237112 Corp	AUSNET SERVICES HOLDINGS

Appendix 2 Debt Risk Premium estimates

70. In the 2013 rail WACC review the Authority acknowledged stakeholder concerns relating to insufficient bond sample sizes to produce robust estimates. This led the Authority to expand the samples for each benchmark credit rating by including additional credit rating steps within the broader rating band. Additional DRP estimates based on these augmented samples were then used as a robust reference point for evaluation and adjustment of the DRP estimates based on the pure benchmark credit ratings.

71. The 2017 bond sample sizes for each of the benchmark credit ratings were:

- 36 bonds for the PTA A rated sample;
- 37 bonds for the Arc Infrastructure BBB+ rated sample; and
- 22 bonds for the Pilbara railways (TPI and RHI) BBB- rated sample.

72. These small sample sizes warrant applying the same sample augmentation process carried out in 2016. The samples are augmented as follows:

- PTA sample extended from the A benchmark to A+/A/A- increasing the sample from 36 to 68 bonds;
- Arc Infrastructure sample extended from the BBB+ benchmark to BBB+/BBB increasing the sample from 36 to 78 bonds; and
- the Pilbara railways sample extended from the BBB- benchmark to BBB/BBB- increasing the sample from 22 to 63 bonds.

73. The DRPs based on the augmented samples benefit from a reduced estimation error around the point estimate. However, introducing a sample of bonds with a credit rating that differs from the target benchmark rating will tend to bias the DRP estimate upward - as lower rated bonds are added - or downward, as higher rated bonds are added. To mitigate this bias, the Authority firstly establishes the direction of the bias. The Authority's bond yield approach used to estimate the DRP applies three estimation methods (Nelson Siegel, Nelson Siegel Svensson and Gaussian kernel).[21] If the bias in an augmented sample based estimate is likely to be downward, the Authority uses the highest augmented sample estimate coming from these three methods. This estimate is then averaged with the highest estimate from the original benchmark rated sample.[22] The symmetrically opposed approach is conducted if the bias is likely to be upward. The Authority considers that this sample augmentation/averaging approach balances bias and estimation error. It mitigates the errors that may arise given the data limitations.

74. The results of this process applied to each of the rail networks are outlined below.

75. The augmented PTA sample was expanded to allow the inclusion of A+ and A- rated bonds, however, no A+ rated bond yield data was available on Bloomberg over the period in question. As a result the PTA A rated sample was only

[21] For further technical details on how the bond yield approach is applied see Economic Regulation Authority, *Review of the method for estimating the Weighted Average Cost of Capital for the Regulated Railway Networks: Final Decision*, 18 September 2015, pp. 78-83.

[22] The highest augmented sample estimate is still likely to be downwardly biased. To offset this bias it is averaged with the highest of the original benchmark sample estimates. This provides for a conservative approach which is intended to limit the bias inherent in expanding the sample away from the target credit rating band. Similar rationale is applied to augmented sample estimates considered upwardly biased - the *lower* of the augmented sample and original benchmark sample estimates are averaged.

augmented with A- bonds. The addition of bonds with a lower credit rating will tend to bias the estimates upward. For this reason the lowest of the augmented sample based estimates (1.652 per cent) is averaged with the lowest A rated sample based estimate (1.889 per cent) to produce an estimate of 1.771 per cent (see Table 10).

Table 10 Public Transport Authority - Augmented and original benchmark sample DRP estimates (per cent)

Approach	High	Mid	Low
A	2.064	1.956	**1.889**
A+/A/A-	1.787	1.784	**1.652**
Average of two lowest estimates			**1.771**

Source: ERA Analysis, Bloomberg

76. The augmented Arc Infrastructure BBB+ sample was expanded to allow the inclusion of BBB rated bonds. The addition of bonds with a lower credit rating will tend bias the estimates upward. For this reason the lowest of the augmented sample based estimates (2.044) is averaged with the lowest BBB+ rated sample based estimate (1.940) to produce an estimate of 1.992 per cent (see Table 11).

Table 11 Arc Infrastructure - Augmented and original benchmark sample DRP estimates (per cent)

Approach	High	Mid	Low
BBB+	2.211	1.940	**1.940**
BBB+/BBB	2.197	2.044	**2.044**
Average of two lowest estimates			**1.992**

Source: ERA Analysis, Bloomberg

77. The augmented Pilbara railways BBB- sample was expanded to allow the inclusion of BBB rated bonds. The addition of bonds with a higher credit rating will tend to bias the estimates downward. For this reason the highest of the augmented sample based DRP estimates (2.651) is averaged with the highest BBB- rated sample based estimate (2.373) to produce an estimate of 2.512 per cent (see Table 12).

Table 12 The Pilbara railways – Augmented and original benchmark sample DRP estimates (per cent)

Approach	High	Mid	Low
BBB-	**2.651**	2.639	2.483
BBB/BBB-	**2.373**	2.363	2.176
Average of two lowest estimates	**2.512**		

Source: ERA Analysis, Bloomberg

Appendix 3 Adjustment for imputation credit yield

78. The historical and DGM based market return on equity applied in the MRP estimates above are augmented with imputation credit yields. This is so that the return reflects the *total* market return on investing in equity. The imputation credit yield reflects the part of the total return that is gained through receiving imputation credits for taxes paid on dividends that can be rebated upon submission of an Australian taxation return. This idea is outlined in the stylised equation below.

Total Market Return on Equity = Capital Gain + Dividend Yield + Imputation Credit Yield

79. Capital gains are the source of return that come from appreciation in price. Dividend yields and imputation credit yield are the cash dividend (net of tax) and the imputation credit expressed as a proportion of the price paid for the investment. The total market return on equity estimated from the approaches outlined in this determination is interpreted as the investor's 'required rate of return' on equity. The required rate of return in turn is the *minimum* annual return that induces investment in an asset. It is necessary to include the imputation credit yield to ensure this minimum return estimate in not underestimated.

80. Prior to 1988 total market returns on equity were only comprised of capital gains and dividend yield. Dividend imputation was introduced in Australia from 1 July 1987.

81. The implications of this for historical equity risk premium data series, such as BHM and NERA, is that from 1988 some part of the required return on equity is received via imputation credits. Unlike capital gains and dividend yields, the value gained from these imputation credits is not observable in financial markets and so must be estimated and then incorporated into the return on equity.

82. To calculate the value of imputation credit yields in each year from 1988 (inclusive) onwards the equation below is used:[23]

$$c_t = \rho\theta \; x \left(\frac{T_t}{1-T_t} \right) x \; d_t$$

where:

θ is the value of distributed imputation credits consistent with the Authority's estimate of gamma[24];

d_t is the dividend yield in year t;

ρ is the proportion of dividends which are franked; and

[23] This equation is based on that in T.Brailsford, J.Handley and K.Maheswaran, *Re-examination of the Historical Equity Risk Premium in Australia*, Accounting and Finance, vol. 48, 2008, p. 85. The ρ in this equation is taken to be 0.75, hence a value for theta of 0.53 corresponds to an estimate of gamma of 0.4.

[24] Gamma is defined as the value *that investors* attach to distributed imputation credits. It incorporates an estimate of the distribution rate such that gamma equals the product of the distribution rate and θ.

T_t is the corporate tax prevailing in that year.

83. The yield c_t is then added on to the capital gain and dividend based return in each year of the NERA and BHM series from 1988 through to 2015. The resultant series represents total market return on equity for each calendar year.

84. The implications for the DGM model are that each of the cash (or net) dividend forecasts need to be adjusted upward to incorporate the estimated value of imputation credits. The following formula is used:

$$\text{Imputation Value Adjusted Dividend Forecast} = \text{Dividend Forecast}\left[1+\rho\theta\left(\frac{T_t}{1-T_t}\right)\right]$$

85. This ensures the solution for the market return on equity in the DGM model (k) set out below reflects the estimated value of imputation credits.

Appendix 4 Annual updates of expected inflation

86. In the 2013 Rail WACC review the Authority determined that the long-run forward looking estimate of inflation was 2.5 per cent. The rationale for this was as follows:

> Given the long term of the asset classes to which the rail WACC estimates apply – approaching 50 years – the Authority considers that the appropriate estimate for inflation going forward is the mid-point of the Reserve Bank of Australia's inflation target, which is 2 to 3 per cent.[25]

87. It was also determined that the nominal risk free rate estimated over a term of 10 years would be used as a proxy for the long term risk free rate. As of 30 June 2016 the nominal risk free rate estimate was 2.22 per cent. As of 30 June 2017 the nominal risk free rate was 2.49 per cent. Discounting the 2.5 per cent inflation assumption out of this risk free rate estimate implies a real interest rate of -0.27 per cent and -0.01 per cent respectively for these dates.

88. As in the 2013 Rail WACC review, the fixed 2.5 per cent inflation estimate was also used to inflate the long run average market return on equity used in the calculation of the Wright MRP.

89. The 2016 Rail WACC Determination found that inflating the average market return on equity using the 2.5 per cent estimate overstated the MRP. This is because the on-the-day Wright MRP deducts the on-the-day nominal risk free rate which recently has had an implicit rate of inflation *lower* than 2.5 per cent. Deducting a lower rate of inflation from the return on equity than that used to index it results in an MRP that incorrectly includes inflation. The MRP is a premium for risk - not inflation and so inclusion of inflation results in an overestimate of the MRP.

90. For these reasons, the Authority replaces the fixed 2.5 per cent inflation estimate used in the calculation of the rail WACC with an annually updated estimate (π_e) implied from Treasury Bonds and TIBs using the Fisher equation below:

$$\pi_e = \frac{1+R_f}{1+R_f^R} - 1$$

where:

R_f is the 10 year risk free rate of return estimated on Treasury Bonds; and

R_f^R is the 10 year real risk free rate of return estimated on Treasury Indexed Bonds.

91. This method has been applied to this determination.

[25] Economic Regulation Authority, *Review of the method for estimating the Weighted Average Cost of Capital for the Regulated Railway Networks: Final Decision*, 18 September 2015, p. 209.