THE ESTIMATED WACC FOR THE SEQ INTERIM PRICE MONITORING

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EXECUTIVE SUMMARY

The Queensland Government has recently imposed a price monitoring regime on the water activities of three entities in the South East Queensland (SEQ) area, and the responsibility for implementing this lies with the QCA. These water entities set prices annually from 1 July and the QCA is required to compare the entities' revenues with their Maximum Allowable Revenue for the year commencing 1 July 2010 and the following two years. As part of this process, the QCA must estimate the WACC for each entity for each of these years. This paper seeks to estimate the WACC for the first year, consistent with the approach adopted by the QCA in its recent decisions relating to QR Network and GAWB. The conclusions are as follows.

Firstly, since the SEQ entities are resetting prices annually, the QCA should reset WACC annually using the prevailing risk free rate and the debt premium. The risk free rate used for the cost of equity should then be the prevailing one year rate. The risk free rate used within the cost of debt should also be the prevailing one year rate if relevant comparator businesses engage in approximately annual debt refinancing or interest rate swaps are available to convert the risk free rate component of their cost of debt into the one year rate. Notwithstanding these points, the QCA has also requested an analysis predicated on triennial resetting of WACC to match the period for which interim price monitoring is required, and this leads to use of the three rather than the one year risk free rate.

In addition, I favour continued use of the QCA's estimate of 6.0% for the market risk premium (based upon the ten year risk free rate) despite the use of the one or three year risk free rate within the first term of the cost of equity. In addition, I favour a 20 day averaging period to estimate the risk free rate and the debt premium, as a compromise between relevance (which favours the observed rate immediately preceding the commencement of the regulatory period) and minimizing exposure to "freak" transactions (which favours averaging over some period). In addition, I favour an ending date for the 20 trading days just referred to of 30 June 2010 because price monitoring operates from 1 July 2010. However, since CEG on behalf of the regulated entities uses the period ending with 3 June 2010 and other regulatory situations have involved a

WACC set over a term prior to the commencement of the regulatory period, I have also provided results based upon this ending date.

In addition, I estimate the appropriate leverage ratio at 60%, based upon an examination of the current market leverages of Australian energy network businesses. In addition, I estimate the appropriate credit rating at BBB based upon the current and recent credit ratings of privately-owned Australian energy network businesses. In addition, I favour a debt term of ten years based upon a recent PwC examination of four private-sector energy network businesses without significant unregulated activities. In addition, I consider that credit default swaps (to convert the credit spread on ten year debt into one or three year debt) are effectively unavailable, based upon recent analysis by Evans and Peck. The last two conclusions then imply the need to use the ten year debt premium.

In addition, based again on recent analysis by Evans and Peck, the transaction costs on interest rate swaps are estimated at 0.148% for swapping ten-to-one year debt and 0.174% for swapping ten-to-three year debt, at both 3 June 2010 and 30 June 2010. In addition, I estimate the risk free rates for one and three years as 4.31% and 4.91% respectively for the 20 trading days ending on 3 June 2010, and 4.50% and 4.76% respectively for the 20 trading days ending on 30 June 2010. In addition, I estimate the debt premium on ten year BBB bonds as 4.48% for the 20 trading days ending on 3 June 2010 and 4.53% for the 20 trading days ending on 30 June 2010.

In addition, I favour an estimated debt beta of zero but an alternative estimate of 0.11 consistent with QCA's GAWB decision is also considered. In addition, I favour an estimate for the asset beta of 0.30 if the debt beta is estimated at zero and 0.35 if the debt beta is estimated at 0.11. Finally, the QCA's prevailing estimate of 0.125% per year for the debt refinancing costs of ten year debt is adopted here.

Since there are two possible values for the equity beta, depending upon the estimate for the debt beta (0 or 0.11), and two possible R_f terms (one or three years) with their associated transaction costs on the interest rate swaps, and two possible averaging periods (ending 3 June or 30 June), there are eight possible WACC values for the SEQ entities. These values range from 8.74% to

9.42%. Consistent with my preference for a debt beta of zero, a one year risk free rate, and an averaging period that ends on 30 June 2010, my preferred estimate of WACC is 9.02%. However, if the three year risk free rate were used, the WACC value would rise to 9.30%. Using an averaging period that ends on 3 June 2010 would further raise this figure to 9.42% and using a debt beta of 0.11 would lower it to 9.35%.

By contrast, CEG favours a mid-point WACC estimate of 9.88% and is therefore higher than my estimate by 0.86%, due to a higher cost of equity (due to both a higher market risk premium and equity beta) outweighing a lower cost of debt (due to a lower debt premium and the absence of both swap costs and debt issue costs outweighing a higher risk free rate). Both Allconnex Water and Unity Water favour CEG's mid-point estimate whilst QUU favours the even higher figure of 10.25%.

1. Introduction

The Queensland Government has recently imposed a price monitoring regime on the water activities of three entities in the South East Queensland (SEQ) area, and the responsibility for implementing this lies with the QCA. These water entities set prices annually from 1 July and the QCA is required to compare the entities' revenues with their Maximum Allowable Revenue (MAR) for the year commencing 1 July 2010 and the following two years (QCA, 2010a). As part of this process, the QCA must estimate the WACC for each entity for each of these years. This paper seeks to estimate the WACC for the first year, consistent with the approach adopted by the QCA in its recent decisions relating to QR Network (QCA, 2010b) and GAWB (QCA, 2010c).

We start by summarizing the QCA's approach in these recent decisions, followed by considering their implications for the present situation. This is followed by estimating the WACC for the SEQ entities under price monitoring, starting with relevant parameter values: leverage, the risk free rate, asset beta, market risk premium, debt margin, the transaction costs of swap contracts, and debt refinancing costs. This is followed by a review of the entities' submissions, including comparison with the QCA's approach and the parameter values proposed in this paper.

2. The QCA's Approach

The QCA's approach (QCA, 2010b, 2010c) invokes a cost of capital equal to the value-weighted average of the cost of equity (k_e) and the cost of debt (k_d):

$$WACC = k_e(1-L) + k_d L \tag{1}$$

where L is the leverage ratio. The cost of equity is determined using the Officer (1994) version of the CAPM:

$$k_e = R_{fR} + \phi\beta_e \tag{2}$$

where R_{fR} is the risk free rate corresponding to the regulatory period (R), ϕ is the market risk premium, and β_e is the equity beta. The equity beta is determined using the Conine (1980) gearing model with the company tax rate adjusted for the proportion of corporate tax that is effectively personal tax:

$$\beta_e = \beta_a \left[1 + \frac{B}{S}[1 - T_c(1-\gamma)] \right] - \beta_d \frac{B}{S}[1 - T_c(1-\gamma)] \tag{3}$$

where β_a is the asset beta, β_d is the debt beta, B is the debt value, S is the equity value, T_c is the statutory corporate tax rate, and γ ("gamma") is the proportion of corporate tax that is effectively personal tax. Finally, the cost of debt is the sum of R_{fR}, the debt premium for bonds with a term equal to the regulatory period (p_R), the transaction costs of the interest rate swaps to convert the risk free rate component of the (generally employed) ten year bonds into that for R year bonds(t_I) , the transaction costs of the credit default swaps to convert the debt premium component of the (generally employed) ten year bonds into that for R year bonds(t_C), and the annualized refinancing costs associated with the (generally employed) ten year bonds (f):

$$k_d = R_{fR} + p_R + t_I + t_C + f \tag{4}$$

Some of these parameter values or approaches to estimation are or should be applied generally by the QCA rather than being specific to a particular regulatory situation. The first of these is the market risk premium, which is estimated at 6.0% relative to both five and ten year bonds. In addition, gamma has been estimated at 0.50. In addition, the risk free rate is estimated from Commonwealth government bonds over a period of 20 trading days shortly before the commencement of the regulatory period. In addition, the debt premium is estimated for the relevant credit rating and with the use of Bloomberg data over a period of 20 trading days shortly before the commencement of the regulatory period. In addition, the QCA has estimated the annualized refinancing costs (f) at 0.125% if the regulated entities are deemed to be using ten year debt. Finally, the transactions costs of the credit default swaps to convert the debt premium component of the (generally employed) ten year bonds into that for R year bonds is estimated from the excess of the debt premium for ten year bonds over that of *R* year bonds. The effect of this is that the last equation reduces to

$$k_d = R_{fR} + p_{10} + t_I + f \tag{5}$$

This equation would also arise if firms borrowed for ten years and used interest rate swaps to convert the risk free rate component of ten year bonds into that for *R* year bonds but did *not* use credit default swaps to convert the debt premium component of ten year bonds into that for *R* year bonds. In relation to the use of the debt premium differential between *R* and ten year bonds as a proxy for the transaction costs of credit default swaps, the debt premium differential is driven by differential default risk and liquidity on the *R* and ten year bonds, whilst the transaction costs on credit default swaps reflect the degree of competition in the CDS market and the risk of the counter-party defaulting. Accordingly I do not consider that the debt premium differential would be a good proxy for the transaction costs of the credit default swaps. So, if the use of credit default swaps is feasible, equation (4) is appropriate and t_C should be estimated in the normal way (by enquiries directed at banks). Alternatively, if the use of credit default swaps is not feasible, equation (5) is appropriate but it should be interpreted as arising from firms borrowing for ten years and using interest rate swaps to convert the risk free rate component of ten year bonds into that for *R* year bonds but *not* using credit default swaps to convert the debt premium component of ten year bonds into that for *R* year bonds.

In summary, the QCA's approach to WACC as reflected in recent decisions corresponds to equations (1), (2) and (3) in conjunction with either equation (4) or (5), a market risk premium of 6.0%, gamma of 0.50, the use of Bloomberg data to estimate the debt premium, estimation of the risk free rate and the debt premium over 20 trading days shortly before the commencement of the regulatory cycle, and debt refinancing costs of 0.125% per year.

3. Implications for the SEQ Entities

We now turn to the implications of the QCA's approach for the present situation, and this gives rise to four issues. The first issue relates to the nature of the regulation. The situations discussed in the previous section (QCA, 2010b, 2010c) involve price regulation with a five year cycle whilst the present situation involves only price monitoring. However, as discussed in Lally (2010b), a regulator engaged in a monitoring process should set WACC in such a way as to mirror the actions of an efficient firm that sets prices so as to just cover costs. Since the SEQ entities are resetting prices annually, the QCA should reset WACC annually using the prevailing risk free rate and the debt premium. The risk free rate used for the cost of equity should then be the prevailing one year rate. The risk free rate used for the cost of debt should also be the prevailing one year rate if relevant comparator businesses engage in approximately annual debt refinancing or interest rate swaps are available to convert the risk free rate component of their cost of debt into the one year rate; otherwise, the prevailing risk free rate used for the cost of debt should correspond to the average debt term of relevant comparator businesses. Finally, the debt premium used for the cost of debt should be the prevailing one year rate if comparator firms engage in approximately annual debt refinancing or credit default swaps are available to convert the debt premium component of their cost of debt into the one year rate; otherwise, the debt premium used for the cost of debt should correspond to the average debt term of relevant comparator businesses.

Notwithstanding these points, the QCA has also requested an analysis predicated on triennial resetting of WACC to match the period for which interim price monitoring is required. In this case, the risk free rate used for the cost of equity should be the prevailing three year rate. The risk free rate used for the cost of debt should also be the prevailing three year rate if relevant comparator businesses engage in approximately triennial debt refinancing or interest rate swaps are available to convert the risk free rate component of their cost of debt into the three year rate; otherwise, the prevailing risk free rate used for the cost of debt should correspond to the average debt term of relevant comparator businesses. Finally, the debt premium used for the cost of debt should be the prevailing three year rate if comparator firms engage in approximately triennial debt refinancing or credit default swaps are available to convert the debt premium component of their cost of debt into the one year rate; otherwise, the prevailing debt premium used for the cost of debt should correspond to the average debt term of relevant comparator businesses.

The second issue relates to the risk free rate used in estimating the market risk premium and the possible inconsistency between the rate used here and that rate used in the first term of the CAPM. The QCA has estimated the market risk premium at 6.0% using ten year government bond yields (and judged that this would also apply if five year bonds had been used) whereas the risk free rate used within the first term of the CAPM in respect of the SEQ entities would be either the one or three year rate as discussed in the previous two paragraphs. As discussed in Lally (2010a), I do not consider that these rates need to match. The risk free rate within the first term of the CAPM should reflect the price resetting cycle whilst that used in estimating the market risk premium should reflect the across-investor average period between successive portfolio reassessments. Plausible values for the latter period range from one to ten years. Furthermore, even with a period of five years, the resulting estimate of the market risk premium would not differ from that applicable in the event of ten years being the appropriate period (6.0%). To justify a different estimate of the market risk premium to the 6.0% used by the QCA, the across-investor average period between successive portfolio reassessments would have to be judged to be significantly below five years. For example, if it were considered to be one year, this would warrant an increase in the QCA's estimate of the market risk premium by about 0.5% (Lally, 2010a). However, there are estimation difficulties surrounding such an adjustment. I favour no adjustment because of the estimation difficulties in doing so and the lack of clear evidence in support of the need to make such an adjustment.

The third issue relates to the averaging period for the risk free rate and the debt premium, with the QCA favouring a period of 20 trading days shortly before the commencement of the regulatory period (in the context of price control). This period represents a trade-off between relevance (which favours the observed rate immediately preceding the commencement of the regulatory period) and minimizing exposure to "freak" transactions (which favours averaging over some period). The use of 20 business days in the context of price control regulation represents a compromise between these two opposing considerations. The same considerations apply to price monitoring, and therefore warrant the same decision. Accordingly, the risk free rate and the debt premium should be averaged over 20 trading days shortly before 30 June 2010.

The fourth issue relates to the ending date for the 20 trading days just referred to. Since price monitoring operates from 1 July 2010, the natural end date for the 20 trading days is 30 June 2010. However, CEG (2010) on behalf of the regulated entities uses the period ending with 3 June 2010. Taking account of this and the fact that other regulatory situations have involved a WACC set over a term prior to the commencement of the regulatory period, the QCA has requested results also based upon this ending date. So, estimates will be presented using both dates.

The parameters that require estimation in the present situation are then as follows: the leverage ratio, the credit rating (which depends upon leverage), the debt beta, the asset beta, the one and three year risk free rates (for the cost of equity), the average debt term for relevant comparator firms (denoted T years), the T year risk free rate for the cost of debt if T differs materially from one or three years and interest rate swaps are not available to convert the risk free rate component of the cost of debt into the one or three year rate, the one and three year debt premiums for the specified credit rating if T corresponds to one or three years, and the T year debt premium for the specified credit rating if T differs materially from one or three years and credit default swaps are not available to convert the risk premium component of the cost of debt into the one or three premium. In addition, the risk free rates and debt premiums should be averaged over the 20 trading days ending on both 3 June 2010 and 30 June 2010. Finally, Bloomberg data should be used for the debt premiums and therefore also for the risk free rates.

4. Parameter Estimates

4.1 Leverage

In a recent decision relating to the GAWB, the QCA (2010c) favoured leverage of 50% based upon a report commissioned from PwC (2009). PwC (2009, Table 3.2) noted that there were no listed Australian water businesses and therefore identified a number of listed water businesses in the US and the UK with average market leverages in 2009 of 41% and 59% respectively. PwC (2009, section 3.3) also noted that most regulatory decisions on Australian water businesses have prescribed a leverage of 60%, that GAWB faces greater demand and weather-related risks than these metropolitan water businesses, and therefore favoured lower leverage of 50% for the GAWB. In another recent (draft) decision, relating to QR Network, the QCA (2010b) favoured leverage of 55% based upon a report commissioned from ACG (2009). ACG (2009, Table 3.4) provided market leverage data on eight Australian transport businesses that were considered to be the best available comparators for QR Network, over the period 2004-2008, with a median leverage of 47%. ACG also noted that these businesses had greater volatility in their cash flows than QR Network, leading to their conclusion that leverage of 55% was appropriate for QR Network. Amongst other recent regulatory reports, with empirical leverage data, the most comprehensive seems to be that of the AER (2009), who examined average market leverage levels amongst Australian gas and electricity network businesses over the period 2002-2007. The figure for 2007 was 59% and the average over the six year period was 62% (ibid, Table 5.3).

The appropriate leverage for the present purposes is the market value leverage of relevant comparator entities, i.e., stand-alone efficient private sector firms in the water business or other monopoly providers of essential services, who must also be listed in order to obtain market value leverages. In respect of PwC's (2009) report, which identified a number of listed water businesses in the US and the UK, the relevance of these foreign firms is undercut by cross-country differences in the factors underlying leverage decisions, such as differences in the bankruptcy regimes (the US Chapter 11 regime seems less protective of creditor rights than the Australian regime); the difference in the US and UK averages reported by PwC (41% and 59%) simply confirms this problem. In respect of PwC's (2009, Table 3.3) reference to regulatory decisions on Australian water businesses, which have generally prescribed a leverage of 60%, these decisions are generally lacking in reference to market data and therefore lack persuasive value. For example, the two most recent regulatory decisions cited by PwC are those of the ESC (2009) and IPART (2009). The first of these reports favours 60% and cites an earlier decision (ESC, 2008) in support of this. In turn, this 2008 decision refers to an unreferenced previous price review (ESC, 2008, p 88). In respect of IPART (2009), this report also favours 60% but no explanation whatsoever is offered. In respect of ACG's (2009, Table 3.4) reference to eight Australian transport businesses that were considered to be the best available comparators for QR Network, these transport businesses are typically not monopoly providers of essential services and are therefore not suitable comparators for the SEQ entities. Finally, in respect of the AER's 2002-2007 figures relating to six Australian gas and electricity network businesses, these appear to be suitable comparators; the average leverage for 2007 was 59% and the average over the six year period was 62% (AER, 2009, Table 5.3). However, these figures require updating. Accordingly, I have sought current market leverage data for the six firms: APA Group, DUET, Envestra, Gasnet, SP Ausnet, and Spark Infrastructure. Of these firms, Gasnet has since been absorbed into APA Group, leaving five firms with current market leverages of 57%, 79%, 73%, 65% and 61% respectively with an average of 67%.[1] Mindful that firms experience short-term fluctuations around their optimal leverage, this data points to an optimal leverage for these firms of about 60%.

In extrapolating this figure to the SEQ entities, two issues arise. The first issue is whether there are unusual features of the SEQ entities that would warrant departure from the results for these comparators. For example, PwC (2009) favoured a lower leverage of 50% for the GAWB than the regulatory norm of 60%, due to GAWB's exposure to greater demand and weather related risks than those faced by metropolitan water businesses. However, the SEQ entities are metropolitan water businesses and therefore this concern does not arise. The second issue is that some of these comparator firms have features that undercut their suitability. In particular, some of them contain non-regulated activities and others have parents that might support them; the first effect would drive their leverage down whilst the second would drive it up. All of this suggests that a suitable estimate for the market value leverage for the SEQ entities is about 60%.

In view of the uncertainty about this estimate, the impact of errors in the regulatory judgement should be considered. This constitutes the impact on WACC inclusive of the tax deduction on interest, which is not included in equation (1). So, allowing for the tax deduction in interest in equation (1) at the imputation-adjusted corporate tax rate T_e shown in (3), and substituting equations (2) and (3) into (1), it follows that:

$$WACC = k_u + L\left[(p - \beta_d \phi)(1 - T_e) - k_u T_e\right] \qquad (6)$$

where k_u is the unlevered cost of equity and p is the debt premium inclusive of refinancing and swap costs. Thus, a regulatory overestimate of optimal leverage will induce an overestimate of

[1] This 2010 Bloomberg data was supplied by the QTC.

WACC if the term [ ] is positive, and an underestimate of WACC if [ ] is negative. Using the parameters in the GAWB decision (QCA, 2010c, p 137), p = 4.68%, β_d = 0.11, ϕ = 6.0%, T_e = .15, and k_u = 7.58%. It follows that [ ] = 2.28%. Thus, if optimal leverage for the SEQ entities were 50% and the regulatory estimate were 60%, then WACC would be overstated by 0.23%. This is not a large sum and it would be considerably smaller and possibly zero if the debt premium was at a historically more typical (lower) level. For example, if the debt premium were 2.0%, [ ] would be zero and WACC would then be invariant to errors in estimating optimal leverage. Alternatively, if the debt premium were 2.50%, [ ] would be 0.86% and therefore overestimating optimal leverage by 10% (60% rather than 50%) would induce an overestimate in WACC of only 0.04%.

In summary, an appropriate estimate for the market value leverage of the SEQ entities is about 60%. Furthermore, errors in estimating the optimal leverage level are unlikely to have a significant impact on WACC and any such impact will tend to zero in the future as debt premiums revert back towards the historically lower levels.

4.2 Credit Rating

In a recent decision relating to the GAWB, the QCA (2010c) favoured a credit rating of BBB coupled with leverage of 50%, based upon a report commissioned from PwC (2009). PwC (2009, sections 4.2 and 4.3) considered a number of financial ratios that are significant to rating agencies, and compared GAWB's values for these ratios (if leverage were 50%) with those of four Australian energy network companies, whose credit ratings ranged from BBB- to BBB+. Accordingly, PwC favoured a credit rating for GAWB of BBB with leverage of 50%. In another recent (draft) decision, relating to QR Network, the QCA (2010b) favoured a credit rating of BBB+ coupled with leverage of 55% based upon a report commissioned from ACG (2009). ACG (2009, section 3.6) appeared to favour energy network companies as comparators and therefore favoured a rating for QR Network of BBB+. Amongst other recent regulatory reports, with empirical data on credit ratings, the most comprehensive seems to be that of the AER (2009), who report median credit ratings for both government and privately-owned Australian energy network businesses over the period 2002-2008 and favoured a credit rating for an efficient energy network business of BBB+. The AER data (ibid, Figure 9.2) shows that the ratings vary with ownership (government versus private), the nature of the business (gas versus electricity) and whether a parent company exists.

For any given type of business, credit ratings depend (inter alia) on leverage, and the previous section has concluded that leverage of about 60% is appropriate. Consequently the appropriate credit rating for the SEQ entities is that of stand-alone efficient private sector firms in the water business or other monopoly providers of essential services, with market value leverage of 60%. In respect of PwC's (2009) report, which favoured a credit rating of BBB at leverage of 50% based upon an analysis of financial ratios for the GAWB that are significant to rating agencies, this constitutes an estimate of the credit rating that the GAWB would face if it were rated rather than an estimate of the credit rating of an efficient private sector water business. The distinction here is fundamental to regulation. For example, if the GAWB were burdened with an inefficient cost structure, its credit rating at any leverage level would be reduced but this would not constitute grounds for reducing the credit rating (and therefore raising the cost of debt) used for regulatory purposes; doing so would encourage rather than discourage inefficiency. In respect of PwC's (2009, Table 4.1) credit ratings for four regulated Australian network businesses, ranging from BBB- to BBB+, these ratings are not current and PwC does not provide market leverage values. In respect of the AER's (2009, Figure 9.2) median credit ratings data for government and privately-owned energy networks, the relevant set of firms for the present purposes is privately-owned energy networks, with a median 2008 credit rating of BBB. However, these ratings are not current. Furthermore, the market leverage values of these firms are not disclosed and the set of firms differs significantly from the six firms for which AER does provide market leverage values (ibid, Table 5.3). So, for the six firms just referred to, current credit ratings are sought. These are available for three firms (SP Ausnet, Envestra, and DUET Group) with credit ratings of A-, BBB-, and BBB- respectively and current market value leverages of 65%, 73% and 79% respectively.[2] All of this suggests that the average current credit rating for these privately-owned firms with market value leverage of 60% would be about BBB.

In extrapolating this credit rating to the SEQ entities, two issues arise. The first issue is whether there are unusual features of the SEQ entities that would warrant departure from the results for

[2] This Bloomberg data was supplied by the QTC.

these comparators. As discussed in the previous section, this does not seem to be the case. The second issue is that some of these comparator firms have features that undercut their suitability. In particular, some of them contain non-regulated activities and others have parents that might support them; the first effect would drive their credit rating down whilst the second would drive it up. All of this suggests that the appropriate credit rating for the SEQ entities with market value leverage of 60% would be approximately BBB.

4.3 Average Debt Term of Comparator Businesses

The relevant comparators here are efficient stand-alone privately-owned water businesses or other monopoly providers of essential services. In a recent report for the QCA, PwC (2010) sought to determine the average debt term (from issuance to maturity) of regulated private-sector businesses and focused upon four energy network businesses because they are the only such businesses without significant unregulated activities (ibid, Table 1). PwC concluded that the average debt term is about ten years, and that it had not materially changed during the GFC. This conclusion can reasonably be extrapolated to the SEQ entities.

4.4 Swap Costs

Based inter alia on the leverage, credit rating and debt term referred to in the previous three sections, Evans and Peck (2010) have examined the viability (and cost) of interest rate and credit default swaps to convert ten year debt into either one or three year debt, and their conclusions are twofold. Firstly, the Australian credit default swap market is relatively illiquid for contracts greater than five years (ibid, page 3). Consequently, the transactions cost of converting the credit spread on ten year bonds into that for either one or three year bonds are not objectively determinable; I therefore proceed as if these swap contracts are not available. Secondly, the Australian market for interest rate swaps to convert the risk-free rate element of ten year debt into either one or three year debt is relatively liquid and the transaction costs are estimated at 0.148% for swapping ten-to-one year debt and 0.174% for swapping ten-to-three year debt, at both 3 June 2010 and 30 June 2010 (ibid, page 4).

4.5 Risk Free Rate

Following section 3, for purposes of estimating the cost of equity and the cost of debt, we require the one and three year risk free rates averaged over the 20 trading days ending on both 3 June 2010 and 30 June 2010. Using Bloomberg data supplied by the QTC, the one and three year rates averaged over the 20 trading days ending on 3 June 2010 are 4.31% and 4.91% respectively, and those averaged over the 20 trading days ending on 30 June 2010 are 4.50% and 4.76%.[3]

4.6 Debt Premium

The average debt term for comparator businesses has been judged to be ten years as discussed in section 4.3, and the credit rating for comparator businesses has been judged to be BBB as discussed in section 4.2, and credit default swaps are (effectively) unavailable to convert the debt premium component of their cost of debt into the one or three year premiums. So, following section 3, we require the debt premium for ten year BBB bonds and this should be averaged over the 20 trading days ending on both 3 June 2010 and 30 June 2010 using Bloomberg data. However, Bloomberg no longer reports the ten year BBB yields. One solution to this problem would be to estimate the ten year BBB debt premium by adding the seven year BBB debt premium and the excess of the ten over the seven year AAA debt premium (as with QCA, 2010c, p 133). However, such an approach assumes that the increment to the debt premium as debt term rises is invariant to the credit rating, and this assumption does not seem to be supported by the data. In particular, using the Bloomberg debt premiums for AAA, A and BBB bonds (averaged over the period 7 May to 30 June 2010), the excess of the seven over the one year debt premium rises as the credit rating declines: 0.20% for AAA bonds, 0.69% for A bonds, and 1.43% for BBB bonds. This implies that the QCA's approach would underestimate the ten year BBB debt premium. An alternative approach would be to linearly extrapolate the BBB debt premiums for one and seven year bonds out to ten years. However, the relationship is likely to be concave rather than linear and such an approach would therefore overestimate the ten year BBB premium. A third approach would be to linearly extrapolate the BBB debt premiums for five and seven year bonds out to ten years. Such an approach will also overestimate the ten year BBB premium but by less than the second approach. Using the Bloomberg data from 7 May to 30 June 2010,

[3] All rates are corrected so as to reflect semi-annual compounding.

the first approach would add an average of 0.47% to the seven year BBB debt premium, the second approach would add 0.71%, and the third would add 0.63%.

All three approaches are subject to considerable imperfections in the data, because it contains a number of implausible features. For example, the average AAA debt premium for three year bonds is *lower* than for one year bonds, and the average A debt premium for seven year bonds is *lower* than for five years bonds. However, the results from the three approaches canvassed are not significantly different. Furthermore, although the first approach is inherently biased down as an estimator of the ten year BBB debt premium, the average excess for the ten over the seven year AAA debt premium within this data (0.47%) is likely to be too high because it is over twice as large as the average excess of the seven over the one year AAA debt premium (0.20%). In view of these potentially offsetting features of the first approach, I favor its use here.

A further complication here is that the seven and ten year AAA bond yields are not reported after 22 June 2010 whilst the seven year BBB yields are, which presents difficulties when estimating results using data for the 20 trading days ending on 30 June 2010. Consequently, the excess of the ten over the seven year AAA premium for the period 23 June to 30 June 2010 is estimated from the average such value over the period 3 June to 22 June 2010.

Following this process, the ten year BBB debt premium is estimated at 4.48% when averaged over the 20 trading days ending on 3 June 2010 and 4.53% when averaged over the 20 trading days ending on 30 June 2010.[4]

4.7 Debt Beta

In its recent decision relating to the GAWB, the QCA (2010c) favoured a debt beta of 0.11, based upon its 2005 review. In turn, this estimate was half of the debt margin-MRP ratio on the grounds that this ratio was an upper bound on beta whilst zero was a lower bound. Since 2005 the debt margin, and hence the debt margin-MRP ratio, has significantly increased but the QCA

[4] By way of comparison, the one and three year BBB debt premiums are 2.61% and 2.74% respectively when averaged over the 20 trading days ending on 3 June 2010, and 2.58% and 2.80% respectively when averaging over the 20 trading days ending on 30 June 2010. These figures are free of the problem arising from the missing data described above.

has elected to retain the earlier estimate of 0.11 (presumably on the grounds that the increase in the debt margin since 2005 is largely attributable to non-beta components). Similar comments apply to the QCA's recent draft decision on QR Network, in which the debt beta is estimated at 0.12 (QCA, 2010b).

The QCA's approach is a special case of the following methodology. The cost of debt (the promised yield) comprises the expected return that compensates for the time value of money and systematic risk, an allowance for inferior liquidity relative to government bonds (*LIQ*), and an allowance for expected default losses (*DEF*). In addition, the compensation for the time value of money and systematic risk is given by the CAPM. The cost of debt is then as follows.

$$k_d = R_f + \beta_d MRP + LIQ + DEF$$

The debt risk premium, being k_d net of R_f, is then as follows.

$$p = \beta_d MRP + LIQ + DEF \qquad (7)$$

If the last two terms can be estimated, then the debt beta can be estimated. Estimates of *DEF* have been offered (for example, Elton et al, 2001, Table VI) but the use of historical data presumes that *DEF* is at a historically typical level, which is clearly not the case at the present time. Furthermore, estimates of *LIQ* are very problematic; Elton et al (2001) do not even attempt to estimate the liquidity premium presumably due to the difficulties in doing so (ibid, footnote 2). However, empirical research on stock returns suggests that the effect of liquidity is not trivial: see, for example, Amihud and Mendelson (1986) and Chordia et al (2001). Consequently, the extraction of an estimate for the debt beta from equation (7) is problematic. The QCA's approach is a special case of this approach in which *LIQ* and *DEF* are implicitly assumed to be half of the debt premium, and are now being implicitly assumed to be about 75% of the premium (which has approximately doubled since the QCA's earlier analysis), but no empirical evidence is offered in support of these implicit assumptions. The earlier estimate was at least minimally defensible, because it was midway between the upper and lower bounds, but no such defense can be offered for the current estimate.

The alternative to this approach is to estimate debt betas in the same fashion as that for equity betas, which involves regressing corporate debt returns on market returns. This cannot typically be done for the bonds in question because most corporate debt is not traded. Furthermore, even if they were traded, the resulting estimate would be biased down if (as usual) the debt did not default over the estimation period. These problems can be overcome. For example, Cornell and Green (1991) use 1960-1989 returns data for US funds specialising in the holding of corporate debt. However they can only differentiate between funds that hold "high grade" and "low grade" bonds. These will be crude proxies for the variables that underlie debt betas for individual firms, which include leverage, industry, and debt term to maturity. Thus the relevance of their results to the bonds of a particular firm is limited. Furthermore, due to their use of monthly returns data for estimating the betas of long-term corporate bonds, part of the beta estimates for their corporate bonds will be due to interest rate risk and its inclusion would be inconsistent with treating long-term government bonds as a risk free asset in the CAPM. The best estimate for the debt betas should then be the empirical estimate net of the estimated beta on government bonds of the same maturity. Using Cornell and Green's estimated betas for "high grade" bonds and long-term treasury bonds of 0.22 and 0.20 respectively (ibid, Table 1), the appropriate estimate for the beta of "high grade" bonds is only 0.02. An alternative approach (Schaefer and Strebulaev, 2007) would be to use traded corporate bonds (classified by credit rating) and to regress bond returns on both equity returns and the returns on government bonds of the same maturity; the coefficient on equity returns would then be the debt beta. Schaefer and Strebulaev (2008, Table 4) adopt this approach using US data from 1996-2003 and the resulting estimate for the debt beta of BBB bonds is 0.04.

These estimates suggest that the QCA's estimate of 0.11 is too high, even since the GFC. An alternative estimate would be zero, although this would inevitably be too low. However, as noted by the QCA (2010c, p 126), so long as the same gearing formula is used in converting both equity to asset betas for comparator firms and also for converting asset to equity beta for the firm of interest, errors may not be material. In fact, errors will only arise if the leverage of the comparator firms differs from that of the firm of interest. With debt betas less than 0.10, such errors are likely to be small. For example, suppose that a comparator has an estimated equity beta of 0.60, leverage of 40%, and a debt beta of 0.08 (twice the highest estimate cited in the previous paragraph) whilst the entity of interest has the same debt beta of 0.08 and leverage of 60%. Using equation (3), with T_c = .30 and γ = 0.50, the resulting estimate for the asset beta would be 0.41 and the estimated equity beta for the enity of interest would then be 0.84. By contrast, if the debt beta were treated as zero, the estimated equity beta of the entity of interest would be 0.87. Thus, if the debt beta is estimated at zero, then even in the presence of substantial differences in the leverages of the two firms, the resulting errors in estimating the equity beta of the entity of interest would be small.

In view of all this, I recommend that the debt beta be estimated as zero. Nevertheless, the next section provides an estimate of the asset beta using estimates for the debt beta of both zero and 0.11.

4.8 Asset Beta

In a recent decision relating to the GAWB, the QCA (2010c) favoured an asset beta of 0.40 assuming equation (3) with a debt beta of 0.11. This was based upon a review in 2005 as well as a report commissioned from PwC (2009) that favoured no change. PwC examined three water businesses in the UK and nine in the US, and estimated their average equity betas as 0.29 and 0.55 respectively using equation (3) with leverage of 50% and a debt beta of 0.11 (ibid, Table 6.1); these figures imply asset betas of approximately 0.21 and 0.35 respectively assuming equation (3) with a debt beta of 0.11.[5] In addition, in a recent decision relating to QR Network, the QCA (2010b) favoured an asset beta of 0.45 assuming equation (3) with a debt beta of 0.12. This was based upon a review in 2006 coupled with a report commissioned from ACG (2009). ACG favoured Australian electricity transmission and distribution businesses as comparators for QR Network (ibid, pp. 36-37), and estimated their equity beta at 0.70 to 0.90 based on 60% leverage (ibid, p 28), with these figures being drawn from an earlier report commissioned by various regulated businesses (ACG, 2008); the midpoint equity beta of 0.80 at leverage of 60% is equivalent to an asset beta of 0.41 assuming equation (3) with a debt beta of 0.11. The QCA (2010b) also refers approvingly to a report from the AER (2009) on the betas of regulated

[5] These are approximate because the correct process requires de-levering of the individual company estimated raw equity betas presented by PwC, followed by averaging across companies. We will apply this correct process shortly.

electricity transmission and distribution businesses, which appears to be the most comprehensive recent Australian regulatory report on these businesses. The AER (2009, pp. 343-344) estimated the equity beta of these businesses at 0.80 with leverage of 60%, but indicated that this figure of 0.80 is above that indicated by the empirical results for reasons of "regulatory stability"; this equity beta of 0.80 at leverage of 60% implies an asset beta of 0.41 assuming equation (3) with a debt beta of 0.11. The AER's conclusions are based upon empirical results drawn from a paper commissioned from Henry (2009).

In choosing suitable comparator firms, the choice is limited to listed firms (by the need for market data to estimate betas) and should reflect consideration of the factors that underlie asset betas. As discussed in Lally (2008, section 5.1), these comprise the income elasticity of demand for the product, the nature of the customers, pricing structure, duration of contracts, nature of regulation, degree of monopoly power, extent of real options, degree of operating leverage, and market weight[6]. For metropolitan water businesses, other such water businesses as well as gas and electricity networks would be similar in terms of the income elasticity of demand (low), the nature of the customers (local rather than foreign and individuals rather than businesses), the degree of monopoly power (high), the extent of real options (low), the degree of operating leverage (high), and market weight (low). However, amongst such entities, there are significant variations in regulation.

One form of regulation, applicable to Australian electricity transmitters and some electricity distributors, is "revenue capping". Under this regime, revenues are capped and this essentially protects firms against output (demand) shocks because costs are largely invariant to output (AEMC, 2006, pp. 40-41). In addition, revenues are capped for five years (ibid, pp. 54-56), and this potentially exposes the firms to cost shocks within a regulatory cycle. However regulated firms are largely protected against cost shocks within a regulatory cycle that are "systematic" in nature, because of the right to apply for a reset of the revenue cap in response to unforeseen events (AEMC, 2007, pp. 480-487); systematic cost shocks are, by their very nature, unforeseen.

[6] Operating leverage is the ratio of fixed to variable costs, and it magnifies the effect of demand shocks on equity returns (Mandelker and Rhee, 1984). The market weight of an industry is its value relative to that of the market index, and this affects the beta of the industry (see Lally and Swidler, 2003, 2008).

These features of the regulatory regime collectively suggest that firms would have very low exposure to systematic risks, and therefore a very low asset beta. A similar regime applies to the water companies in England and Wales; they are subject to five year price rather than revenue caps but most customers are not metered and this is equivalent to a revenue cap (Bailey, 2002, pp. 37-44).[7]

A second form of regulation, faced by Australian gas network businesses and some electricity distribution businesses, is "price capping". This regime matches revenue capping except that prices rather than revenues are fixed (typically for five years). Accordingly, firms subject to this regime would face exposure to demand shocks. Since these are partly systematic in nature, the betas of price capped firms should be larger than those of revenue capped firms.

A third form of regulation, faced by most US electric utilities, is "rate of return regulation".[8] Under this regime, prices are set consistent with the firm's actual costs (subject to the possibility of some costs being disallowed) and a prescribed rate of return. In addition, prices are reset if the actual rate of return deviates materially from the prescribed rate, with resetting initiated by either the firm or its customers. The US water companies are subject to the same regime.

In comparing systematic risks under these three regimes, the exposure to demand and cost shocks is fundamental. In respect of demand shocks, revenue-capped firms are not exposed to these shocks, rate-of-return regulated firms face these for shocks for less than five years (because the output price would be reset more quickly than this in response to a demand shock), and price-capped firms with a five year regulatory cycle would be exposed to these shocks for up to five years. In respect of cost shocks, the exposure of firms to these shocks seems similar under the three regulatory regimes. Thus, revenue-capped firms are likely to have the lowest asset betas

[7] A revenue cap is planned for introduction in 2014 by Ofwat (2010).

[8] These firms are either vertically integrated (the activities comprising generation, transmission, distribution and retail) or confined to transmission and/or distribution. Prior to 1998, they were all vertically integrated and all elements of the chain of activities were regulated in all states. Since 1998, deregulation has occurred in some states and has involved opening up retail and generation activities to new (unregulated) firms. However, even in these states, transmission and distribution activities continue to be regulated. Furthermore, in these states, firms that are still vertically integrated continue to be subject to controls upon their retail and generation charges (Joskow, 2005, pp. 56-57).

followed by rate-of-return regulated firms, and then price-capped firms. In all cases, asset betas should be low because exposure to systematic risk is low.

Turning to the SEQ entities, the regime faced by them is price monitoring, which may lead to price control of some form. Commercial prudence would incline them to raise prices in response to upward cost shocks, and their monopoly power coupled with low income elasticity of demand for water would permit them to do so. In addition, fear of price control being implemented coupled with the fact of being public sector entities would incline them to reduce prices in response to downward cost shocks. In both cases, the delay in adjusting prices need not exceed one year because prices are reset annually. Thus, these entities should have asset betas in excess of revenue-capped firms, less than that of price-capped firms, and therefore similar to that of rate-of-return regulated firms. Estimates from firms subject to all three regimes are therefore potentially useful.

We turn now to estimates of the asset beta for these comparator firms. The first set of useful estimates are those for three UK revenue-capped water utilities presented by PwC (2009, Table 6.1), presumably based upon five years of monthly data and the OLS method.[9] The "raw" equity beta for each firm is reported by PwC (ibid, Table 6.1), and I have de-levered these using the firm's leverage coupled with equation (3) subject to using the UK statutory corporate tax rate of 30% in substitution for the imputation-adjusted Australian corporate tax rate. With a debt beta of 0.11, this yields asset betas with an average of 0.22; alternatively, with a debt beta of zero, this yields asset betas with an average of 0.18 (see Appendix 1). The second set of useful estimates are those for nine US rate-of-return regulated water utilities presented by PwC (2009, Table 6.1), presumably based upon five years of monthly data and the OLS method. The "raw" equity beta for each firm is reported by PwC (ibid, Table 6.1), and I have de-levered these using the firm's leverage coupled with equation (3) subject to using the US statutory corporate tax rate of 39% in substitution for the imputation-adjusted Australian corporate tax rate.[10] With a debt beta of 0.11,

[9] The three companies identified by PwC (2009, Table 6.1) are amongst the English and Welsh water companies listed by Bailey (2002, Table 5) and are therefore subject to a de facto revenue cap as described on the previous page.

[10] The US federal rate for the period 1986-1993 was 34% and 35% since then. Addition of state taxes raises these numbers by about 4% (Tax Foundation, 2005). So, I use the figure of 39%.

this yields asset betas with an average of 0.38; alternatively, with a debt beta of zero, this yields asset betas with an average of 0.36 (see Appendix 1). The third set of useful estimates is that for nine Australian electricity and gas network businesses over the period 2002-2008 examined by Henry (2009).[11] The estimates appear in Henry (2009, Table 4.1).[12] Henry does not present the "raw" beta estimates for the firms but these can be deduced from his re-levered betas and the leverage data for each firm that he presents. The "raw" equity beta for each firm is then de-levered using the firm's leverage and equation (3). With a debt beta of 0.11, this yields asset betas with an average of 0.30; alternatively, with a debt beta of zero, this yields asset betas with an average of 0.24 (see Appendix 2). The fourth set of useful estimates are those for eleven US rate-of-return regulated electric utilities over the period 1990-1998 and 2002-2008 examined by Henry (2009, Table 6.5).[13] Again, Henry does not present the "raw" beta estimates for the firms but these can be deduced from his re-levered betas and the leverage data for each firm that he presents. The "raw" equity beta for each firm is then de-levered using the firm's leverage and equation (3) subject to using the US statutory corporate tax rate of 39% in substitution for the imputation-adjusted Australian corporate tax rate. With a debt beta of 0.11, this yields asset betas with an average of 0.37; alternatively, with a debt beta of zero, this yields asset betas with an average of 0.31 (see Appendix 3).[14] These results are summarized in Table 1.

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[11] These firms involve various combinations of electricity transmission businesses, electricity distribution businesses and gas network businesses. The first of these businesses are subject to revenue caps, the second involve revenue caps in some cases and price caps in others, and the third involves price caps. Thus, the set is likely to be similar in its average asset beta to that of rate-of-return regulated businesses, and therefore to the SEQ entities.

[12] Henry presents results for two periods, using both monthly and weekly returns, and using both the OLS and LAD (least absolute deviation) methods. The longer of the two periods is preferred because it enhances statistical precision. In addition, monthly returns and OLS are preferred for consistency with the results from PwC (2009).

[13] Again, Henry presents results for two periods, using both monthly and weekly returns, and using both OLS and LAD (least absolute deviation). The longer of the two periods is preferred because it enhances statistical precision. In addition, monthly returns and OLS are preferred for consistency with the results from PwC (2009).

[14] By way of comparison, Lally (2008, Table 3) presents estimates for US electric utilities over a similar period from a number of commercial providers, with the debt beta assumed to be zero, and the median of these estimates is 0.27. This is very similar to Henry's estimate of 0.31 with a debt beta of zero. Furthermore, if the estimates in Lally (2008, Table 3) relating to the tech-bubble period (1998-2002) are excluded, consistent with the exclusion of data from this period by Henry, the median of Lally's reported results rises to 0.30, which is virtually identical to Henry's estimate. Also, by way of comparison, ACG (2008, Table 4.6) presents beta estimates for 21 US gas or electric utilities over the same period as Henry, with an average equity beta re-levered to 60% of 0.73. Since ACG do not report enough information to deduce the "raw" equity betas, it is not possible to convert their beta estimates to asset betas consistent with equation (3). However, a good approximation would arise by de-levering their average re-levered beta of 0.73 using their leverage of 60% and the levering formula invoked by ACG, which is equation (3) without the debt beta or tax terms. The resulting asset beta is 0.29, which is almost identical to Henry's estimate of

Table 1: Estimated Asset Betas

	No. Coys	Data Period	$\beta_d = 0$	$\beta_d = 0.11$
UK water coys	3	2004-2009	0.18	0.22
US water coys	9	2004-2009	0.36	0.38
Australian energy network coys	9	2002-2008	0.24	0.30
US electric utilities	11	1990-2008	0.31	0.37
Mean			0.27	0.32
Mean excluding UK water coys			0.30	0.35

These estimates have various advantages and disadvantages. Firstly, all foreign estimates are subject to the difficulty that they are estimated relative to a foreign market index, which may differ in its leverage and industry composition from that of Australia and this can affect beta values (Lally, 2002, 2004a); this favours the Australian estimates. ACG (2008, p 51) considers these issues and concludes that they largely net out, but their conclusions are limited to the US for the period 2003-2008. Secondly, estimates for longer periods are more reliable and this favours Henry's US estimates. Thirdly, estimates for a larger set of firms are more reliable and this favours all but the UK water company estimates. Finally, estimates for firms subject to a regulatory regime most closely resembling the SEQ entities are preferred, and this favours all but the UK water company estimates. Taking account of these pros and cons, the UK water company results warrant the lowest weight. If they are disregarded, the mean estimate becomes 0.30 with a debt beta of zero and 0.35 with a debt beta of 0.11. Given that precision to more than 0.05 is unattainable, all of this suggests an estimate for the asset beta of these firms of approximately 0.30 under a debt beta of zero and 0.35 with a debt beta of 0.11. These estimates warrant extrapolation to the SEQ entities.

0.31 with a debt beta of zero. Collectively, these two additional papers (which each involve a larger number of firms than Henry's analysis) confirm Henry's estimates. In addition, both Lally (2008, pp. 73-74) and ACG (2008, pp. 53-54) examine the effect of excluding from their sample the small proportion of firms that are subject to incentive regulation (such as price capping) rather than rate-of-return regulation, and find that there is no material effect. This suggests that Henry's results would be similarly unaffected.

5. WACC Estimates for the SEQ Entities

We are now in a position to estimate the WACC for the SEQ entities. Following section 4.1, the appropriate leverage ratio has been estimated at 60%. Following section 4.2, the appropriate credit rating has been estimated at BBB. Following sections 4.3 and 4.4, the appropriate debt term has been estimated at ten years and credit default swaps are effectively unavailable, which implies the need for the ten year debt premium. Following section 4.4, the transaction costs on interest rate swaps are estimated at 0.148% for swapping ten-to-one year debt and 0.174% for swapping ten-to-three year debt, at both 3 June 2010 and 30 June 2010. Following section 4.5, the risk free rates for one and three years have been estimated as 4.31% and 4.91% respectively for the 20 trading days ending on 3 June 2010, and 4.50% and 4.76% respectively for the 20 trading days ending on 30 June 2010. Following section 4.6, the debt premium on ten year BBB bonds has been estimated as 4.48% for the 20 trading days ending on 3 June 2010 and 4.53% for the 20 trading days ending on 30 June 2010. Following section 4.7, the proposed estimate for the debt beta is zero but an alternative estimate of 0.11 consistent with QCA's GAWB decision (2010c) is also considered. Following section 4.8, the proposed estimate for the asset beta is 0.30 if the debt beta is estimated at zero and 0.35 if the debt beta is estimated at 0.11. Following section 3, the QCA's prevailing estimate of 6.0% for the market risk premium does not require adjustment here. Finally, following section 2, the QCA's prevailing estimate of 0.125% per year for the debt refinancing costs of ten year debt is adopted here.

Since there are two possible values for the equity beta, depending upon the estimate for the debt beta (0 or 0.11), and two possible R_f terms (one or three years) with their associated transaction costs on the interest rate swaps, and two possible averaging periods (ending 3 June or 30 June), there are eight possible WACC values determined in accordance with equations (1), (2), (3) and (5). These are shown in Table 2. These WACC values range from 8.74% to 9.42%. Consistent with my preference for a debt beta of zero (see section 4.7), a one year risk free rate (see section 3) and an averaging period that ends on 30 June 2010 (see section 3), my preferred estimate of WACC is 9.02% as shown in the second row of Table 2. However, if the three year risk free rate were used, the WACC value would rise to 9.30% as shown in the fourth row of Table 2. Using an averaging period that ends on 3 June 2010 would further raise this figure to 9.42% and using a debt beta of 0.11 would lower it to 9.35%.

Table 2: WACC Estimates

	R_f	p_{10}	t_I	f	k_d	ϕ	β_e	k_e	L	$WACC$
One yr, 3 June, $\beta_d = 0$	4.31	4.48	0.148	0.125	9.063	6.0	0.682	8.41	.60	8.80
One yr, 30 June, $\beta_d = 0$	4.50	4.53	0.148	0.125	9.303	6.0	0.682	8.60	.60	9.02
Three yr, 3 June, $\beta_d = 0$	4.91	4.48	0.174	0.125	9.689	6.0	0.682	9.01	.60	9.42
Three yr, 30 June, $\beta_d = 0$	4.76	4.53	0.174	0.125	9.589	6.0	0.682	8.86	.60	9.30
One yr, 3 June, $\beta_d = 0.11$	4.31	4.48	0.148	0.125	9.063	6.0	0.656	8.25	.60	8.74
One yr, 30 June, $\beta_d = 0.11$	4.50	4.53	0.148	0.125	9.303	6.0	0.656	8.44	.60	8.96
Three yr, 3 June, $\beta_d = 0.11$	4.91	4.48	0.174	0.125	9.689	6.0	0.656	8.85	.60	9.35
Three yr, 30 June, $\beta_d = 0.11$	4.76	4.53	0.174	0.125	9.589	6.0	0.656	8.70	.60	9.23
CEG	5.65	3.14	0	0	8.79	6.5	0.90	11.50	.60	9.88

6. Review of the SEQ Submissions

6.1 CEG Report

The SEQ entities jointly commissioned a report from CEG (2010), and I therefore commence with that report. CEG's estimate of the appropriate WACC for the SEQ entities is 9.62% to 10.14% (ibid, Table 1) with a mid-point of 9.88%. Their methodology matches that proposed above in respect of using equation (1), the Officer (1994) model for estimating the cost of equity, a leverage ratio of 60%, a credit rating of BBB+, and the use of energy utilities as comparators in estimating the asset beta.[15] In all other respects, their conclusions differ, as follows.

Firstly, CEG (2010, para 5) favour a risk free rate within the first term of equation (2) and within the cost of debt of ten years rather than that matching the price-resetting period. No discussion is

[15] The credit rating of BBB+ proposed by CEG is equivalent to the rating of BBB proposed by me, because both are estimated using the Bloomberg BBB series.

presented by them on this matter. Consequent upon using the ten year risk free rate within the cost of debt, CEG naturally do not incorporate any allowance for the transaction costs on interest rate swaps, to convert the risk free rate component of the cost of debt into that for either one or three year debt.

Secondly, CEG (2009, section 4.5) favour an averaging period for the risk free rate of five years rather than the standard practice of using a short period preceding the commencement of the regulatory period, because they consider the risk free rate to be unusually low. This issue has been analysed in Lally (2010b, section 4). As discussed there, I favour the standard approach because it avoids ad-hoc judgements about when to depart from it and which historical period to use when doing so, and it avoids an upward bias to WACC from acting in this way only when it favours the regulated firms. Furthermore, there is no clear evidence in CEG (2010, Figure 7) that the current risk free rate is unusually low.

Thirdly, CEG (2009, sections 4.3 and 4.4) favour an equity beta of 0.8 to 1.0 with leverage of 60%. The lower bound of 0.8 is taken from the AER (2009, pp. 343-344), which represents the AER's estimate for electricity network businesses and is based upon analysis by Henry (2009). CEG's upper bound of 1.0 is based upon an examination of returns on six regulated firms relative to the market during the period from January 2008 to March 2009 (ibid, Table 6), and beta estimates over the eight month period from November 2008 to June 2009 (ibid, Table 7). In respect of the AER's estimate of 0.80, and as noted by the AER, the estimate is above that suggested by the empirical evidence in the interests of "regulatory stability" (ibid, p 343). Naturally, it is not part of my role to take account of such considerations. In respect of the upper bound of 1.0, only the analysis shown in Table 7 of CEG's report (involving eight months data) constitute beta estimates in the proper sense of the words. However, betas estimated over such a short period will have little statistical precision, no adjustment is made for leverage differences relative to the benchmark leverage of 60%, and the period appears to have been chosen precisely because it generates a high estimate. By contrast, Henry (2009) uses a period of 16 years to estimate the betas for US electric utilities, and the shortest estimation period used in any of the studies cited in Table 1 is five years. CEG also argue that the period from 1.9.2008 (the commencement of the GFC) should not be excluded when estimating betas, and that Henry

(2009) wrongly excludes this data. I agree with CEG on this point but the addition of the data since 1.9.2008 is unlikely to materially affect Henry's results. Furthermore, just as Henry's exclusion of data since the commencement of the GFC is inappropriate, so too is his exclusion of data in the period 1998-2002 and (as noted in footnote 12) inclusion of this data would lower the estimated betas.

Fourthly, CEG (2010, section 4.6) favour an estimate for the market risk premium of 6.5% rather than the 6.0% favoured by the QCA, with the increment arising due to the GFC. Whilst it is uncontroversial that the market risk premium has risen as a result of the GFC, I do not favour such adjustments because they are entirely arbitrary and will impart an upward bias to WACC estimates because these adjustments are limited to periods in which they would raise WACC. Of course, the (standard) approach of not making such adjustments will lead to underestimation of WACC at various times (such as during the GFC) but this will be counterbalanced over time by other occasions in which the WACC is over estimated (and such counterbalancing over time is sufficient to provide regulated firms with their WACC over the life of their assets). For example, the five year period preceding the GFC was characterized by historically low market volatility and was therefore likely to have been a period in which WACC was over estimated; naturally, regulated entities did not petition regulators to lower WACC during this period and regulators did not do so. Furthermore, CEG's upward adjustment to the market risk premium is inconsistent with its estimation of the risk free rate by averaging over the last five years; the upward adjustment to the market risk premium is designed to estimate the *prevailing* value for the market risk premium and this is inconsistent with the use of a *historical* risk free rate.

Fifthly, CEG (2010, section 5.1) estimate the cost of debt by averaging over the CBA Spectrum and Bloomberg data. Remarkably, they do so in spite of favouring the Bloomberg data; their rationale appears to be that averaging over the two data sources is warranted because their preference for Bloomberg is not sufficiently strong. Thus, despite the difference in behavior, there seems to be no difference in opinion from the QCA on this matter.

Sixthly, CEG (2010, section 5.2) favour estimating the cost of debt by equally weighting over the prevailing cost of debt (estimated over a period of nine trading days shortly before the commencement of the regulatory period) and the average cost over the last five years. CEG claims that this will better approximate the debt costs incurred by a firm than use of the standard practice of averaging over the 20 trading days shortly before the commencement of the regulatory period. This issue has been discussed in Lally (2010b, section 4). As discussed there, I favour the standard approach because it avoids the highly subjective question of when to (partly) invoke historical debt costs. Furthermore, for the first regulatory period of one year, recourse to historical debt costs so as to approximate the costs actually incurred by the firm in the first year should involve a 10% weight on the prevailing cost and a 90% weight over the average cost in the last nine years. Finally, adoption of the standard policy would favour the SEQ entities in this case because prevailing debt costs are larger than the average over the last five years.

Finally, CEG does not include any allowance for debt refinancing costs.

A comparison of the CEG parameters with those recommended in this paper is shown in Table 2 above. Relative to my preferred estimate of the WACC in the second row of Table 2, CEG's mid-point estimate of 9.88% is higher by 0.86%, due to a higher cost of equity (due to both a higher market risk premium and equity beta) outweighing a lower cost of debt (due to a lower debt premium and the absence of both swap costs and debt issue costs outweighing a higher risk free rate).

6.2 Allconnex Water

Allconnex Water (2010, Table 9.1) have proposed a WACC estimate in the middle of CEG's range (9.88%) and therefore matches CEG's analysis except in respect of using an equity beta of 0.90 with leverage of 60% rather than CEG's range for the equity beta of 0.80 to 1.0.

6.3 Unity Water

Unitywater (2010, Table 29) have also proposed a WACC estimate in the middle of CEG's range (9.88%) and therefore matches CEG's analysis except in respect of using an equity beta of 0.90 with leverage of 60% rather than CEG's range for the equity beta of 0.80 to 1.0.[16]

[16] Unitywater mistakenly describes the cost of debt as the "debt margin", mistakenly reports the equity beta as the "asset beta", and mistakenly report the latter figure as 90.00% rather than 0.90. However, these are mere

6.4 QUU

QUU (2010, Table 6) have proposed a WACC estimate of 10.25%, which diverges from the analysis by CEG in many respects[17]. I therefore note the points of difference relative to the analysis proposed here. Firstly, in respect of the cost of debt and the first term within the cost of equity, QUU favours use of the ten year risk free rate rather than the one year rate proposed here and the three year rate also suggested by the QCA. Secondly, QUU favours an asset beta of 0.43 (in conjunction with the gearing model in equation (3) and a debt beta of 0.11) as opposed to the estimated asset beta of 0.35 suggested here under the same conditions. In support of their estimate of 0.43, QUU refers to recent regulatory decisions in which an asset beta of 0.45 was favoured[18]. However, the downward adjustment from 0.45 to 0.43 is not explained. Furthermore, reference to regulatory decisions is a poor substitute for empirical evidence. Finally, QUU favours a debt beta of 0.11 consistent with the QCA (2010c).

QUU has also commissioned a report from PwC (2010d), which offers arguments in support of using the ten year risk free rate within the first term of the CAPM. The first of these arguments is that the analysis leading to the conclusion that the risk free rate should match the regulatory period assumes that the expectations hypothesis fully characterizes the term structure of interest rates, and PwC cites Lally (2004b) in support of this claim (PwC, 2010d, pp. 4-5). However, PwC's claim about Lally (2004b) is not correct; the references to the expectations hypothesis in Lally (2004b) arise only in the course of offering intuition for results and determining the direction of departures from the NPV = 0 result, and do not underpin the fundamental proposition.

PwC's second argument is that the analysis leading to the conclusion that the risk free rate should match the regulatory period requires that shareholders in regulated firms can sell their

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presentational errors. Unitywater plainly states that they have adopted a WACC value in the middle of CEG's range (ibid, p 77).

[17] This figure of 10.25% contrasts with the figure of 9.20% used by them for the purposes of price setting in 2010/2011 (QUU, 2010, p 20).

[18] Only one of these regulatory decisions is identified (QCA, 2010b) and the asset beta aspects of this decision have been referred to in section 4.7 above.

shares at the end of the current regulatory period for the equity component of the RAB and such a result is not guaranteed (PwC, 2010d, page 5). This appears to be a reference to equation (3) in Lally (2004b), in which the market value of the firm matches the RAB when the risk free rate matches the regulatory cycle and three additional parameters (expected operating costs, expected demand and the risk premium) are correctly estimated. If any of these three parameters are incorrectly estimated then the market value of the firm diverges from the RAB, i.e., the NPV = 0 test is not satisfied. However, such estimation errors cannot be mitigated by any alternative choice for the risk free rate. In fact, any alternative choice would in general aggravate the divergence from the NPV = 0 requirement. Thus, even if these three parameters are incorrectly estimated, the risk free rate should still be chosen to match the regulatory cycle so as to minimize violations of the NPV = 0 requirement.

PwC's third argument is that use of the ten year risk free rate within the first term of the CAPM is required to align with the QCA's use of the ten year rate in estimating the market risk premium (PwC, 2010d, page 5). However, this is an issue concerning how the market risk premium is estimated, and has been discussed in section 3 above. As argued there, no adjustment to the estimate for the market risk premium is warranted because of the estimation difficulties in doing so and the lack of clear evidence in support of the need to make such an adjustment.

7. Conclusions

This paper has estimated the WACC for the SEQ entities for the year commencing 1 July 2010, using a methodology consistent with that adopted by the QCA in its recent decisions relating to QR Network and GAWB. The conclusions are as follows.

Firstly, since the SEQ entities are resetting prices annually, the QCA should reset WACC annually using the prevailing risk free rate and the debt premium. The risk free rate used for the cost of equity should then be the prevailing one year rate. The risk free rate used within the cost of debt should also be the prevailing one year rate if relevant comparator businesses engage in approximately annual debt refinancing or interest rate swaps are available to convert the risk free rate component of their cost of debt into the one year rate. Notwithstanding these points, the

QCA has also requested an analysis predicated on triennial resetting of WACC to match the period for which interim price monitoring is required, and this leads to use of the three rather than the one year risk free rate.

In addition, I favour continued use of the QCA's estimate of 6.0% for the market risk premium (based upon the ten year risk free rate) despite the use of the one or three year risk free rate within the first term of the cost of equity. In addition, I favour a 20 day averaging period to estimate the risk free rate and the debt premium, as a compromise between relevance (which favours the observed rate immediately preceding the commencement of the regulatory period) and minimizing exposure to "freak" transactions (which favours averaging over some period). In addition, I favour an ending date for the 20 trading days just referred to of 30 June 2010 because price monitoring operates from 1 July 2010. However, since CEG on behalf of the regulated entities uses the period ending with 3 June 2010 and other regulatory situations have involved a WACC set over a term prior to the commencement of the regulatory period, I have also provided results based upon this ending date.

In addition, I estimate the appropriate leverage ratio at 60%, based upon an examination of the current market leverages of Australian energy network businesses. In addition, I estimate the appropriate credit rating at BBB based upon the current and recent credit ratings of privately-owned Australian energy network businesses. In addition, I favour a debt term of ten years based upon a recent PwC examination of four private-sector energy network businesses without significant unregulated activities. In addition, I consider that credit default swaps (to convert the credit spread on ten year debt into one or three year debt) are effectively unavailable, based upon recent analysis by Evans and Peck. The last two conclusions then imply the need to use the ten year debt premium.

In addition, based again on recent analysis by Evans and Peck, the transaction costs on interest rate swaps are estimated at 0.148% for swapping ten-to-one year debt and 0.174% for swapping ten-to-three year debt, at both 3 June 2010 and 30 June 2010. In addition, I estimate the risk free rates for one and three years as 4.31% and 4.91% respectively for the 20 trading days ending on 3 June 2010, and 4.50% and 4.76% respectively for the 20 trading days ending on 30 June 2010.

In addition, I estimate the debt premium on ten year BBB bonds as 4.48% for the 20 trading days ending on 3 June 2010 and 4.53% for the 20 trading days ending on 30 June 2010.

In addition, I favour an estimated debt beta of zero but an alternative estimate of 0.11 consistent with QCA's GAWB decision is also considered. In addition, I favour an estimate for the asset beta of 0.30 if the debt beta is estimated at zero and 0.35 if the debt beta is estimated at 0.11. Finally, the QCA's prevailing estimate of 0.125% per year for the debt refinancing costs of ten year debt is adopted here.

Since there are two possible values for the equity beta, depending upon the estimate for the debt beta (0 or 0.11), and two possible R_f terms (one or three years) with their associated transaction costs on the interest rate swaps, and two possible averaging periods (ending 3 June or 30 June), there are eight possible WACC values for the SEQ entities. These values range from 8.74% to 9.42%. Consistent with my preference for a debt beta of zero, a one year risk free rate, and an averaging period that ends on 30 June 2010, my preferred estimate of WACC is 9.02%. However, if the three year risk free rate were used, the WACC value would rise to 9.30%. Using an averaging period that ends on 3 June 2010 would further raise this figure to 9.42% and using a debt beta of 0.11 would lower it to 9.35%.

By contrast, CEG favours a mid-point WACC estimate of 9.88% and is therefore higher than my estimate by 0.86%, due to a higher cost of equity (due to both a higher market risk premium and equity beta) outweighing a lower cost of debt (due to a lower debt premium and the absence of both swap costs and debt issue costs outweighing a higher risk free rate). Both Allconnex Water and Unity Water favour CEG's mid-point estimate whilst QUU favours the even higher figure of 10.25%.

APPENDIX 1: ESTIMATED ASSET BETAS OF WATER COMPANIES

This Appendix generates estimates of the asset betas of three UK water companies and nine US water companies using equation (3) along with estimates for the debt beta of both 0 and 0.11.

Table 3: Asset Beta Estimates for UK and US Water Companies

Company	$\hat{\beta}_e$	L	$\hat{\beta}_a \middle\vert \hat{\beta}_d = 0$	$\hat{\beta}_a \middle\vert \hat{\beta}_d = 0.11$
Northumbrian Water Group	0.24	0.60	0.12	0.17
Pennon Group	0.42	0.44	0.27	0.31
Severn Trent	0.24	0.49	0.14	0.18
Mean			0.18	0.22
Artesian Resources	0.35	0.45	0.23	0.27
American States Water Co	0.46	0.34	0.35	0.38
California Service Group	0.47	0.27	0.38	0.40
Middlesex Water Co	0.37	0.38	0.27	0.30
Penninchuck Corp	0.38	0.34	0.29	0.32
SJW Corp	0.73	0.27	0.60	0.62
South West Water	0.71	0.39	0.51	0.54
Aqua America	0.27	0.29	0.22	0.24
York Water Co	0.45	0.29	0.36	0.38
Mean			0.36	0.38

APPENDIX 2: ESTIMATED ASSET BETAS OF AUSTRALIAN ENERGY NETWORKS

This Appendix generates estimates of the raw equity betas $\hat{\beta}_e$ of nine Australian energy network companies from the leverage adjusted estimates $\hat{\beta}_{eL}$ in Henry (2009, Table 4.1), using the following relationship and the values for ω reported by Henry (2009, Table 4.1).

$$\hat{\beta}_{eL} = \hat{\beta}_e \left[\frac{1 + \frac{6}{4}}{1 + \frac{L}{1-L}} \right] = \hat{\beta}_e \left[\frac{1-L}{\frac{4}{10}} \right] = \hat{\beta}_e \omega$$

These estimated raw equity betas are then transformed into estimates of the asset betas of these firms using equation (3), the leverage values L reported in Henry (2009, Table 4.1), and estimates for the debt beta of both 0 and 0.11.

Table 4: Asset Beta Estimates for Australian Energy Companies

Company	$\hat{\beta}_{eL}$	ω	$\hat{\beta}_e$	L	$\hat{\beta}_a \mid \hat{\beta}_d = 0$	$\hat{\beta}_a \mid \hat{\beta}_d = 0.11$
AGK	0.430	1.746	0.246	0.302	0.170	0.209
ENV	0.295	0.731	0.404	0.708	0.132	0.206
APA	0.621	1.066	0.583	0.574	0.272	0.331
GAS	0.188	0.846	0.223	0.662	0.084	0.152
DUE	0.408	0.595	0.685	0.762	0.184	0.265
HDF	0.847	1.336	0.634	0.466	0.364	0.411
SPA	0.367	1.082	0.339	0.567	0.160	0.218
SKI	1.106	1.591	0.693	0.362	0.466	0.503
AAN	0.839	1.467	0.572	0.413	0.358	0.400
Mean					0.244	0.300

APPENDIX 3: ESTIMATED ASSET BETAS OF US ENERGY NETWORKS

This Appendix generates estimates of the raw equity betas $\hat{\beta}_e$ of eleven US energy network companies from the leverage adjusted estimates $\hat{\beta}_{eL}$ in Henry (2009, Table 6.5), using the following relationship and the values for ω reported by Henry (2009, Table 6.5).

$$\hat{\beta}_{eL} = \hat{\beta}_e \left[\frac{1+\frac{6}{4}}{1+\frac{L}{1-L}} \right] = \hat{\beta}_e \left[\frac{1-L}{\frac{4}{10}} \right] = \hat{\beta}_e \omega$$

These $\hat{\beta}_e$ values are then transformed into asset beta estimates using equation (3), the leverage values L reported in Henry (2009, Table 6.5), and estimates for the debt beta of both 0 and 0.11.

Table 5: Asset Beta Estimates for US Energy Companies

Company	$\hat{\beta}_{eL}$	ω	$\hat{\beta}_e$	L	$\hat{\beta}_a \mid \hat{\beta}_d = 0$	$\hat{\beta}_a \mid \hat{\beta}_d = 0.11$
CHG	0.623	1.487	0.419	0.405	0.265	0.306
CNP	0.853	0.932	0.915	0.627	0.377	0.441
EAS	0.697	1.204	0.579	0.518	0.303	0.355
NI	0.628	1.218	0.515	0.513	0.272	0.324
NJR	0.543	1.507	0.361	0.397	0.231	0.271
NST	0.617	1.324	0.466	0.470	0.266	0.313
NU	0.421	0.949	0.443	0.620	0.186	0.250
SRP	1.156	0.644	1.796	0.742	0.521	0.600
UIL	0.890	1.029	0.865	0.588	0.391	0.451
POM	0.637	1.024	0.622	0.590	0.280	0.340
PORT	0.708	1.132	0.626	0.547	0.309	0.365
Mean					0.310	0.370

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