Cost of Capital for Price Determination Cases

A report for Ofwat

Last updated 19 August 2014

CONFIDENTIAL

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Appendices

1 Disclaimer

1.1 This report is provided in accordance with our appointment under the Call-Off Contract under the terms and conditions of Ofgem's Framework Agreement for the Provision of Economic, Financial and Related Consultancy Service, ref CON/SPEC/2011-092F, Ofwat's Terms of Reference dated 21 November 2013 and our quotation dated 04 December 2013.

1.2 We have satisfied ourselves, so far as possible, that information presented in our report is consistent with other information which was made available during the course of our work in accordance with the terms of our appointment. We have not verified the accuracy of the data or the information and explanations provided by the third parties and therefore accept no liability in relation to this.

1.3 This report has been prepared exclusively for Ofwat. To the fullest extent permitted by law, we do not accept or assume responsibility to anyone other than Ofwat for our work, our report and other communications, or for any opinions we have formed. We do not accept any responsibility for any loss or damages arising out of the use of the report by Ofwat for any purpose other than in connection with this project. We draw your attention to the limitation of liability in our appointment.

1.4 Ofwat agrees that Grant Thornton would be informed of any request to disclose this report made under the Freedom of Information Act 2000 ("the Act") or similar legislation (including without limitation the Environmental Information Regulations 2004 ("the Regulations").

2 Executive summary

2.1 Ofwat is determining the appropriate price for the supply of non-potable water to three separate, large industrial customers (the Cases). We have been appointed by Ofwat to estimate the appropriate activity specific Weighted Average Cost of Capital (WACC) for the Cases. The WACC, the investment return allowed on the assets used in the Cases, is an important determinant of the appropriate price as water supply is capital intensive.

2.2 The cost of capital reflects the returns required by different providers of capital (equity and debt) for exposure to the risk they accept when investing in a project. Investors are able to diversify risk by creating a portfolio of investments and consequently they need only to be remunerated for the risk they take which cannot be diversified, the systematic risk.

2.3 However, water supply to specific customers entails different exposure to systematic risk than water supply as a whole which suggests that different costs of capital should be applied. Similarly, the overall cost of capital for a company can be different from the cost of capital for specific activities as the systematic risk can vary across activities (e.g. supplying water to industrial users as opposed to general water supply). Hence, a water company which invests in a specific project which is more or less risky than its general business should use an appropriate cost of capital for appraising that project and subsequently for determining costs and prices.

2.4 We find that there are material differences in systematic risks between the general business activity of a regulated water company and the Cases, crucially:

- Large industrial users are metered and therefore fluctuations in demand result in fluctuations in revenues, whereas a large proportion of non-industrial users are not metered so revenues from those customers are invariant to usage. This indicates that the sale of non-potable water to industrial customers is exposed to greater systematic risk
- Compared to general water supply, pumping/energy costs, which are largely non-diversifiable, are a greater proportion of the total costs to supply large industrial users and hence exposure to systematic energy cost risk is higher for the Cases

2.5 As a result, in our view, it is appropriate to use a different cost of capital for the Cases than that used for the overall regulated business of a water company.

2.6 To ensure a consistent approach in calculating the costs of capital across the sector, we have used as our starting point the cost of capital parameters from Ofwat's guidance for Price Review 2014 (PR14) and adjusted them to reflect the specific systematic risk profile of the Cases. We have also adopted a consistent approach to all the Cases as they are considered to have similar risk profiles despite some differences in each Case. The rationale for this is detailed in the main report.

2.7 We calculate a real pre-tax cost of capital (in line with PR14) for the supply of industrial non-potable water in the range of 4.49% to 4.94% with a central estimate of 4.81%. **Table 1** presents the key findings in real terms, i.e. stripping out the impact of inflation.

Table 1: Key WACC inputs and estimated cost of capital for the Cases

	Central	Low	High	References in the report
Real risk-free rate	1.25%	0.75%	1.25%	5.2, **Table 2**
Equity market risk premium	5.50%	5.50%	5.50%	
Equity beta	0.93	0.88	0.99	4.12 - 4.14, 4.18 - 4.20, 5.4 - 5.14, 5.23 - 5.27
Cost of equity (post-tax)	**6.37%**	**5.58%**	**6.69%**	
Overall industry cost of debt including fees	2.75%	2.70%	2.90%	5.2, **Table 2**
Additional debt risk premium	0.22%	0.22%	0.22%	4.16 & 4.17, 5.15 - 5.22,
Overall cost of debt (pre-tax)	**2.97%**	**2.92%**	**3.12%**	
Gearing	57.5%	55%	60%	4.18 - 4.20, 5.23 - 5.27
WACC (Vanilla)	**4.41%**	**4.12%**	**4.54%**	
Effective tax rate	12.80%	12.80%	12.80%	5.3, **Table 3**
Real WACC for the cases(pre-tax)	**4.81%**	**4.49%**	**4.94%**	

2.8 We have finally discussed potential areas of challenges to this analysis and the rationale for the positions taken:

- **Input data taken from PR14** has been used in this analysis, which we consider being best current estimate of the cost of capital for the water industry. Should Ofwat revise its guidance on the cost of capital prior to a decision being made in the Cases, we would propose refreshing this analysis to reflect the revised WACC variables that were adjusted
- **Assessment of the systematic component of volatility in industrial revenue**: our analysis is based on a sound theoretical approach to isolating the systematic component of a single stock's or portfolio's standard deviation. However, this is an area in which there is limited precedent to guide analysis
- **The pre-tax cost of debt** has been adjusted using the data on the impact of the default risk on the cost of debt to reflect the risk of supply of industrial non-potable water as compared to general water supply
- **Additional factors**: alternative assessments of additional factors may lead to a different cost of capital assessment. The methodology used to assess these returns remain relatively novel and subjective. The assessment we have made is consistent with the precedents available and gives results which appear reasonable
- **Self-supply options**: our assessment of the cost of capital for self-supply is based on the third party supply WACC calculation. As Iggesund (the self-supply option) is a paper company, an assessment of the cost of capital for Iggesund and its parent company Holmen Group could be considered relevant (pre-tax nominal cost of capital of 11% as indicated in the latest annual report). However, this is the cost of capital for a paper company rather than the cost of capital for the supply of industrial, non-potable water

3 Introduction and background

Scope of work

3.1 Grant Thornton has been appointed by Ofwat to estimate the appropriate activity specific WACC for three cases of supply of non-potable water to large industrial customers. This assignment consists of two tasks:

1 The calculation of the asset betas for the Cases and an appropriate estimate of the gearing and cost of debt
2 The calculation of the overall cost of capital

3.2 Our work is to support Ofwat to determine the price for the supply of non-potable water in the Cases by estimating the WACC. The WACC is the return on the assets required to make these non-potable water supplies and is an important determinant of the price of the water, as water supply is a capital intensive activity.

Price Determination cases

3.3 The law relating to water companies in England and Wales is contained principally in the Water Industry Acts 1991 and 1999 and the Water Act 2003. Other legislation relevant to water supply and sewerage in England and Wales are the Water Resources Act 1991 and the European environmental legislation, particularly the Water Framework Directive 2000/60/EC which is currently being implemented.

3.4 The Cases are all being disputed under the Water Industry Act 1991. This Act relates to the water supply and the provision of wastewater services in England and Wales. This Act governs the water companies and states the duties of the water companies with respect to water supply and sewerage.

[redacted]

Iggesund v United Utilities

3.7 This case is a dispute between Iggesund Paperboard (Workington) Limited (Iggesund) and United Utilities Group plc (UUW). UUW provides non-potable water to Iggesund which claims that the price UUW is charging is too high. Iggesund has therefore raised a complaint against UUW under Section 56 of the Water Industry Act 1991 requesting Ofwat to determine the price of supply.

3.8 Iggesund commissioned a study into the price of providing this service to its site from a single water source. From this study Iggesund believes that the cost for this service should be lower than that charged by UUW.

3.9 As a result of the study Iggesund has reviewed the possibility of self-supply and has acquired an old pumping station as well as an abstraction licence. Iggesund has stated that it will implement this self-supply plan if it cannot secure a more suitable price through the determination.

[redacted]

Structure of the report

3.14 The remainder of this report is organised as follows:

- In **Section 4**, we describe the conceptual framework used to estimate the activity specific cost of capital
- In **Section 5**, we calculate the relevant cost of capital for the Cases based on Ofwat's PR14 guidance and our amendments to relevant case specific inputs
- In **Section 6**, we identify potential areas of challenge and the rationale for the approach adopted

3.15 In addition as listed in the table of contents there are a number of appendices providing supporting information on the Cases, further details of our approach, data underlying our analysis and its source, and a glossary of terms.

4 Our approach to the activity specific cost of capital for the Cases

4.1 In this section, we set out:

- Why the cost of capital for the Cases is different to the regulated cost of capital
- Our conceptual framework for determining the cost of capital

Why the cost of capital for the Cases is different to the regulated cost of capital

4.2 The cost of capital reflects the returns required by different providers of capital (equity and debt) for exposure to the risk they incur when investing in a project. Investors are able to diversify risk by investing in a portfolio and consequently they only need to be remunerated for risk which cannot be diversified, the systematic risk:

- **Systematic (non-diversifiable) risks** affect all equity investments simultaneously in the same direction to a greater or lesser extent and hence cannot be diversified away. Movements in economy-wide factors such as changes in GDP, interest rates, savings rates and inflation contribute to systematic risk
- **Specific (diversifiable) risks** are specific to a company or activity. They can be eliminated or 'diversified away' by holding a well-diversified portfolio of investments in which, on average, investments which perform badly for specific reasons can be expected to be offset by investments which perform well for specific reasons and vice versa

4.3 Water supply for specific classes of customers may entail different systematic risk than water supply as a whole which suggests that different costs of capital should be applied. Similarly, the corporate cost of capital can be different from the cost of capital for a specific activity the company undertakes as the systematic risk can vary across activities (e.g. supplying water to industrial users as opposed to general water supply). Therefore, it is generally accepted that it is important to reflect the riskiness of a particular project when appraising that project. It would not be correct to appraise a risky project (e.g. a start-up clothes boutique) using the cost of capital of a relatively low risk company (e.g. a major supermarket chain). A supermarket chain which invested in a start-up boutique only expecting the returns achieved in its core business would not be properly compensated for the risks of adding this investment to its overall portfolio. By corollary, a water company which invests in a specific project which is more or less risky than its general business, should use an appropriate cost of capital for appraising that project, and subsequently for determining costs and prices. See **Section 4** for our approach to estimating the activity specific cost of capital.

4.4 As the Cases have a specific risk profile, there is a prima facie rationale for the cost of capital specific to the Cases to be different to the cost of capital applied to water companies under PR14.

4.5 While there are similarities between the Cases and the typical activities of a water company, there are also important differences which are relevant to the risk of the Cases and hence the cost of capital. A key similarity is that both involve the supply of water using a series of pipes, pumps and water resources while facing a common set of environmental regulations. For both these industrial customers and domestic customers, water is an essential service.

4.6 However, there are a number of key economic non-diversifiable risks that suggest that the specific cost of capital for the Cases may be materially different from the regulated cost of capital derived from the general business activity of supplying water:

- Pumping / energy costs which are largely non-diversifiable, are a greater proportion of the total costs, hence exposure to energy cost risk is higher for the Cases
- Industrial customers are more sensitive to changes in price and GDP than domestic customers whose revenues are broadly constant across years. Large industrial users are metered and therefore fluctuations in demand result in fluctuations in revenues, whereas a large proportion of non-industrial users are not metered so revenues from those customers are invariant to usage
- The Cases are for the supply of water treated to a lower standard and hence there is a potential lower risk of damages regarding failure against water quality standards and lower risk of cost shocks

Framework for estimating the activity specific cost of capital

4.7 To ensure a consistent approach in calculating the costs of capital across the sector, we have used as our starting point cost of capital parameters from Ofwat's guidance for PR14 and adjusted them to reflect the specific systematic risks of the Cases. While some parameters from Ofwat's cost of capital remained unchanged, we adjust the underlying asset beta, the cost of debt and gearing figures from Ofwat's PR14 guidance[1] to account for the impact of a change in systematic risk.

4.8 Ofwat has provided guidance on the WACC[2] for the water sector as part of PR14. We have used this guidance as a key input into our analysis as it is based on current, detailed analysis of the cost of equity and debt. Ofwat has been estimating the cost of capital for the water sector for 20 years. The methodology Ofwat uses is consistent with that used by other regulators and has been refined on the basis of close scrutiny from regulated companies, investors, public bodies such as the Competition Commission, and other interested stakeholders.

4.9 We have also adopted a consistent approach to all the Cases as they have relatively similar risk profiles. Key common risk characteristics of the Cases include:

- The supply of non-potable water at scale to a large commercial customer under a long term contract. These contracts do not include disposal of waste water
- For all of the customers, non-potable water is an essential input into a water-intensive process used to produce a 'basic product' ([redacted] and paper) and consequently variation in demand is likely to be influenced significantly by general economic conditions
- These large users are metered and therefore fluctuations in use result in fluctuations in revenues
- [redacted]
- The supplies are made by major regulated water companies
- The Cases are being brought under the Water Industry Act

[redacted]

4.10 We note that the assessment of the cost of capital is imprecise and subject to judgement. Where available we have tested precedents as far as possible. Details can be found in **Section 5** and in the relevant annexes.

4.11 Our conceptual framework for estimating the WACC is set out in more detail in **Appendices F** and **G**. The rest of this section details our approach to adjusting key variables of the WACC to reflect the specifics of the Cases in the cost of capital calculation.

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[1] Details of these adjustments are provided further below and are detailed in Section 4 and in the relevant Appendices.

[2] Setting price controls for 2015-20 – risk and reward guidance, Ofwat, January 2014.

Cost of equity adjustment

4.12 The cost of equity, the potential returns that investors would receive by investing in the equity of a project, asset or company, is one of the key variables of the WACC and we have adjusted it to reflect the specifics of the Cases. We have used the CAPM as a key tool to estimate the cost of equity, as it has strong academic credentials and it is widely used by regulators and financial analysts. A key feature of the CAPM framework is that it distinguishes between non-systematic and systematic risks.

4.13 Based on this framework we develop a methodology that enables us to calculate an adjusted asset beta for the Cases, using as the starting point of our assessment the asset beta from Ofwat's PR14 guidance. We adjust the asset beta to reflect the greater systematic risk of the Cases. We then "relever" the asset beta to generate the adjusted equity beta[3] for the Cases. Details of this adjustment are provided in **Section 5**.

4.14 Whilst we use the adjusted asset beta and adjusted gearing to calculate the overall adjustment to the cost of equity for the Cases, the Equity Market Risk Premium (EMRP) and the risk free rate from Ofwat's PR14 guidance remain unchanged.

Debt adjustment

4.15 Another key variable in the WACC calculation is the contribution and payment to debt providers. The cost of debt (e.g. the interest rate on debt) and the gearing are the two elements in the WACC calculation which reflect the required return on debt raised for an investment or a project. The risk profile of the project impacts upon the cost of debt, all other things being equal, more risk implies a higher cost of debt which influences the optimal level of gearing. Adjustments to reflect the specifics of the Cases are detailed below.

Interest rate adjustment

4.16 The interest rate, or cost of debt, represents the return required by providers of debt to finance a company. The cost of debt can be estimated with reference to the yields on benchmark indices with comparable ratings. Ofwat's PR14 guidance on the cost of debt is based on analysis of the yields from the IBoxx indices for A and BBB rated corporate bonds with maturities of ten or more years, and the current yields on traded water company bonds.

4.17 Ofwat's PR14 cost of debt is adjusted to reflect the specifics of the Cases and particularly the higher risk of the Cases as compared to the regulated supply of water to the market as a whole. In paragraphs 5.16 to 5.22 we present our approach to adjusting the cost of debt.

Gearing adjustment

4.18 The weights applied to the costs of equity and debt in the WACC formula are a function of the gearing or the proportion of debt in the firm's capital structure. In the context of regulatory determinations, it is often estimated as net debt divided by the regulatory capital value (RCV). Regulators usually choose notional gearing estimates i.e. the average gearing for an efficient firm operating in the sector rather than the actual gearing for the firms under consideration.

4.19 Ofwat's PR14 gearing (net debt: RCV) of 62.5% is based upon evidence in relation to:

- The actual gearing of water companies

[3] In the CAPM framework, an equity beta of one indicates that the variation in the return to an asset is similar to that of the market portfolio and therefore the expected return would be the same. A beta of less than one indicates that the returns of the asset are less variable than the return of the market and so an investor is less exposed to risk and would expect less return than the market provides. An equity beta greater than one indicates the converse. Therefore, investors would expect higher returns.

- Whether current low interest rates have encouraged gearing levels above the long-term efficient level
- The gearing range consistent with an investment grade credit rating and financeability requirements
- Regulatory benchmarks for gearing in other sectors

4.20 In our analysis, Ofwat's PR14 gearing figure is adjusted to reflect activity specific risks for the Cases as a higher cost of debt reduces the optimal gearing. In **Section 5** we present our approach to adjusting the PR14 gearing figure.

5 The estimated cost of capital for the Cases

5.1 We set out below our calculation of the cost of capital and provide the rationale for this approach. A similar approach is used for third party supply and self-supply.

5.2 As set out in **Section 4**, the starting point of the adjustments to reflect activity specific systematic risks is Ofwat's PR14 cost of capital guidance. **Table 2** summarises Ofwat's guidance on key variables for the appointee WACC.

Table 2: Ofwat's guidance on key variables of the appointee WACC for PR14

Input	Point estimate	Range
Real risk-free rate	1.25%	0.75% to 1.25%
Equity market risk premium	5.5%	5.5%
Gearing (net debt : RCV)	62.5%	60% to 62.5%
Asset beta	0.3	0.3
Equity beta	0.8	0.75 to 0.80
Cost of equity (post-tax)	5.65%	4.9% to 5.7%
Cost of debt	2.65%	2.6% to 2.8%
Allowance for debt fees	0.1%	0.1%
Overall cost of debt	2.75%	2.7% to 2.9%
Appointee (vanilla) WACC	3.85%	3.6% to 3.9%

Source: Table 8, Setting price controls for 2015-20 – risk and reward guidance, Ofwat, January 2014

5.3 We have adjusted the PR14 asset beta (and consequentially the implied equity beta), gearing and cost of debt for the Cases as these are the elements of the WACC which are company / activity specific. All of the other variables in the WACC calculation are generic such as the risk free rate of interest which is, in practice, the interest rate at which the government can borrow, and have not been adjusted. The key inputs informing our analysis are set out in **Table 3**.

Table 3: Key components of WACC analysis for third party supply

Input	Source	Values
Real risk free rate (Rf)	PR14	1.25%
Equity Market Risk Premium (EMRP)	PR14	5.5%
Asset beta for water sector (βa, total)	PR14	0.3
Relative volatility	Asset beta adjustment factor to account for the volatility of industrial non-potable water revenues (systematic element only)	1.32
Gearing (G)	PR14 gearing level adjusted for the risk of the Cases	57.5%
Pre-tax cost of debt (Rd)	PR14 pre-tax cost of debt adjusted for the risk of the Cases	2.9%
Effective tax rate (T)	PR14	12.8%

Source: PR14, Ofwat data, Grant Thornton analysis

Cost of equity adjustment

5.4 To adjust the overall cost of equity to capture risks specific to the Cases, the following steps have been used:

- Adjustment of the asset beta to capture the pure systematic risk element of the Cases
- Adjustment of the gearing, which is used to 'relever' the asset beta to obtain an equity beta
- Calculation of the adjusted equity beta
- Calculation of the adjusted cost of equity using CAPM

5.5 Each of these steps is set out below.

Asset beta adjustment

5.6 We have adjusted the water sector asset beta so that it reflects the systematic risk of the supply of industrial non-potable water. As already noted, the demand for industrial non-potable water is more variable and more correlated with general economic conditions, and hence riskier, than the total demand for water. Consequently, we would expect that the beta for the supply of industrial non-potable water to be higher than the beta for the water sector, as **Figure 1** below shows.

Figure 1: Calculation of the asset beta for industrial non-potable water supply[4]

Calculation of β_a

Adjustment of the β_a to reflect the systematic element of the volatility of industrial non-potable water revenues

$$\beta a, Industrial = \beta a, total \times Adjustment\ factor$$

$$Adjustment\ factor = \frac{\sigma Industrial}{\sigma Total} \times \frac{\rho\ Industrial,GDP}{\rho Total,GDP}$$

Systematic risk of supply to industrial customers

Systematic risk of supply to all customers

where:

$\beta_{a,Industrial}$ is the asset beta for suppliers of industrial non-potable water (0.4)

$\beta_{a,total}$ is the asset beta from PR14 (0.3)

$\sigma_{Industrial}$ is the standard deviation of the revenues for the supply of industrial non–potable water (2.35)

σ_{Total} is the standard deviation of the total revenues for water companies (1.51)

$\varrho_{Industrial,GDP}$ is the correlation factor of the revenues for the supply of industrial non-potable water and UK GDP (0.46)

$\varrho_{Total,GDP}$ is the correlation factor of total revenues for all water companies and UK GDP (0.54)

[4] For this calculation, we have used data provided by Ofwat, for details see **Appendix G**.

5.7 As shown in **Figure 1**, we have derived an adjustment factor that applied to the water sector asset beta ($\beta_{a,total}$) captures in terms of systematic risk, the difference between the general activity of supplying water relative to the supply of non-potable water to large users only.

5.8 To be consistent with the CAPM model we would ideally use information on profitability to derive this adjustment. However, data on the profitability of industrial, non-potable water supply is not available. Nevertheless, as many of the costs of supplying industrial non-potable water are fixed, any change in revenue will produce a similar change in profits. Therefore, the adjustment factor is estimated based on the analysis of revenues for industrial non-potable water users and total company revenues. **Appendix G** explains in detail the rationale and the analytical approach adopted to derive this adjustment.

5.9 The derived adjustment factor is 1.32 and is greater than 1. This is consistent with our analysis as it indicates that supplying non-potable water to industrial customers is subject to greater systematic risk than the water supply industry as a whole.

5.10 Overall, the estimated asset beta for the Cases is the industry asset beta (0.3) multiplied by the adjustment factor (1.32) resulting in an asset beta of 0.4.

5.11 To check the robustness of our methodology we have calculated the ratio of the systematic risk of supply to non-industrial customers compared to the systematic risk of supply to all customers. This ratio is very close to 1 (0.995) indicating that the two systematic risks are almost equal. This is to be expected given that non-industrial supply accounts for the bulk of total water supply and hence the bulk of the non-systematic risk of supply to all customers.

Adjusted Cost of equity[5]

5.12 The adjusted asset beta (0.4) is "relevered" to obtain an adjusted equity beta (0.93). We perform this by applying the Harris-Pringle formula which is consistent with Ofwat's PR14 guidance. In applying this approach we rely on the adjusted gearing figure calculated for the Cases (which is explained below).

5.13 All of the CAPM parameter values to calculate the adjusted cost of equity are presented in **Table 4**.

Table 4: Adjusted cost of equity

Asset Beta	Equity Beta	Equity Market Risk Premium	Risk free rate	Adjusted cost of equity (post-tax)
0.4	0.93	5.5%	1.25%	6.37%

5.14 This compares with a cost of equity (post-tax) of 5.65% calculated in Ofwat's PR14 guidance.

Debt adjustment

5.15 We have adjusted the cost of debt to take account of the different risk profile and in doing so we have also taken into account revisions to the interest rate and gearing.

[5] Please, refer to **Appendix F** to further detail of the framework for this analysis.

Cost of debt adjustment

5.16 The specific risk in the Cases compared to the risk profile underlying the PR14 cost of capital analysis has an impact on the cost of debt. This is because more volatile cash flows mean that the cost of debt should be higher to compensate debt providers for the increased risk. We have therefore adjusted the PR14 cost of debt to reflect the specific risk of the Cases.

5.17 All other things being equal, a higher asset beta indicates a higher risk of default on debt and therefore a lower credit rating. As a result we expect that:

- A decrease in credit rating can be partly compensated by a lower gearing level which tends to be the route for companies with higher risk of default on the debt
- A higher risk of default in debt will also lead to debt providers requiring a premium on their returns and results in higher interest rates on the debt, which in turn leads companies to raise less debt as it is more expensive (i.e. a lower gearing) further mitigating a downgrade in the credit rating

5.18 As a result, for a notional water company that only supplied industrial users, we expect that a higher risk of default will cause it to raise less debt which in turn avoids a significant change in creditworthiness with respect to the notional PR14 water company. Therefore, we consider that the effect of an increase in the asset beta will not result in a substantial reduction in the target credit rating of the notional water company supplying commercial customers for the Cases.

5.19 Further, while the increase in risk indicated by the asset beta is quantifiable and non-trivial, it is not so different as to suggest a significant change in the investability of the company. Moreover equity holders will have an incentive to maintain a clear investment grade credit rating so as to retain access to less costly debt markets and so will use financial levers to minimise any adverse effect on credit ratings.

5.20 Consequently, we assess that a one-notch reduction in the credit rating, being the minimum which would have an impact, is that which it is appropriate to apply to our assessment of the cost of debt for the Cases. Considering that the water companies have on average a credit rating of BBB+, our estimated credit rating for the Cases is BBB, the next credit rating down.

5.21 We have used differences in the cost of debt between debt of different credit ratings to establish the uplift to the cost of debt as the risk profile of a business increases. For example, an increase in business risk might cause a reduction in the credit ratings of a company from BBB+ to BBB and so increase the cost of debt. This increase can be estimated by benchmarking the yield on BBB+ and BBB rated corporate debt.

5.22 **Table 5** details the difference in bond spreads as credit rating varies for non-financial corporate bonds. As shown in the table, the change in spread between an A and BBB bond (3 notches) is 65bp (129bp – 64bp). Thus the estimated change in margin between a BBB+ rated bond and a BBB rated bond (1 notch), which is in the range of A to BBB bonds, is 22 bps indicating an incremental cost of debt of 0.22% as a result of the greater default risk of the Cases as compared to a notional water company. The adjusted cost of debt for the Cases is 2.97% as compared to 2.75% cost of debt for a notional water company.

Table 5 European corporate bond spreads

Non-financial rating	Spread (basis point)
AA	49
A	64
BBB	129

Non-financial rating	Spread (basis point)
BB	293
B	511

Source: Exhibit 5, Morgan Stanley Research, Global Credit Strategy, 3rd December 2013

Gearing adjustment

5.23 As shown in the previous section, we have estimated an increase in the cost of debt for the Cases as a result of the impact of greater volatile cash-flows which they are exposed to. Therefore, economics predicts opposite effects impacting upon on the gearing level for the Cases:

- An increase in the cost of debt would tend to require greater equity contribution for the optimal capital structure. If a notional water company were transformed into a company solely supplying industrial users, we would expect gearing to reduce to ensure that debt will be repaid on time despite the increased revenue risk. We would therefore expect that the gearing level for the Cases to be lower than the 62.5% gearing level calculated in Ofwat's PR14 guidance
- We have already determined that the cost of equity for the Cases is higher than in Ofwat's PR14 guidance. Therefore, the extent of substitution between equity and debt is reduced by the higher cost of equity

5.24 Given the impact of these two opposite effects, assuming that the cost of equity and debt appropriately reward the increased risk of the Cases, we would expect the gearing level to be below but be broadly comparable to the 62.5% gearing figure used in Ofwat's PR14 guidance. Further, this is consistent with our view that the notional water company that only supplied industrial users would not see its credit rating significantly downgraded.

5.25 To inform any adjustment to the 62.5% gearing level calculated in Ofwat's PR14 guidance, we look at other companies operating in a regulated environment for an appropriate comparator.

5.26 Airports such as Gatwick and Heathrow operate in a regulated environment and their services are supplied with long lived assets similar to a water company. But most importantly, they are exposed to greater demand risk when compared to a water company as their customers are large commercial airlines whose demand is significantly more sensitive to variations in general economic conditions. Given that airports are paid a fixed price per passenger, their regulated cash-flows are overall more variable when compared to the notional water company which makes airports a suitable comparator.

5.27 The Civil Aviation Authority (CAA) has assumed a gearing level (debt over regulatory asset base) of 55% for Gatwick Airport and 60% for Heathrow as part of its price determination in February 2014[6]. Both these figures are broadly comparable with a 60%-62.5% gearing range set out by Ofwat in the PR14 cost of capital guidance. Therefore, to reflect the higher risk of the Cases relative to a notional water company we propose a 57.5% central gearing level for the Cases, with a range between 55%-60%. The proposed range covers the gearing level for Gatwick and the lower end of the range determined by Ofwat in the PR14 guidance.

Additional factors

5.28 The Cases are subject to risks which we have not reflected in the above analysis as they are either de minimis or are captured in the operating costs allowed for the Cases:

[6] Estimating the cost of capital: technical appendix for the economic regulation of Heathrow and Gatwick from April 2014: Notices granting the licences, CAA, February 2014

- **Policy and regulatory risk** are limited and with regard to regulatory customers they are shared by the water company. The incremental systematic risk in the Cases is judged to be de minimis
- **Contractual uncertainty** to reflect the possibility of contractual disputes and litigation between supplier and customer. This cost is covered by the operating costs allowed for the cases

Ranges for the cost of capital estimates

5.29 The assessment of the cost of capital is imprecise and subject to judgement. Reflecting this, we have estimated a high and low value for each of the three WACC inputs which are most uncertain which is intended to generate a plausible range for the overall WACC. The inputs for which we have estimated a range are:

- The real risk free interest rate
- The overall industry cost of debt
- Gearing

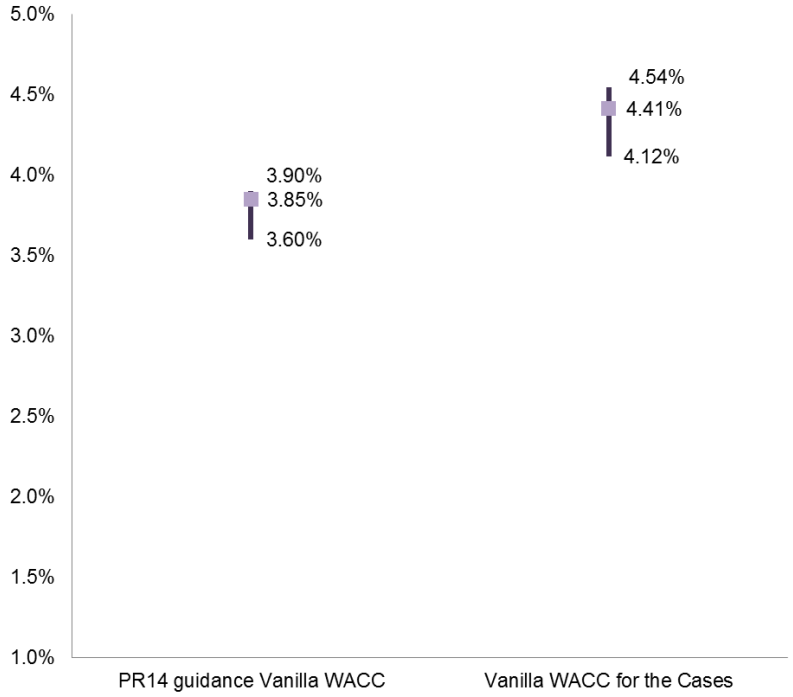
5.30 There is also uncertainty associated with other inputs in the cost of capital calculation and the most appropriate methodology to combine different ranges across the key parameters to estimate a full range. We take the view that combining all of the low values for the three key inputs provides a value for the cost of capital which appropriately reflects the lower end of the plausible range and reflects uncertainty in other parameters such as the beta estimates. Similarly, combining all of the high values provides a plausible estimate of the top of the range for the WACC. As it is unlikely that all of the lowest values or the highest values of these inputs coincide we can have confidence that the actual value is likely to lie within the range so calculated.

5.31 For the key WACC inputs we have a central estimate and a range (see **Table 6**). For the following variables, our central estimate is not the middle of the range for the following reasons:

- Real risk free rate, the central estimate of 1.25% is at the top end of the range (0.75% to 1.25%) as forward interest rate curves suggest that long-term risk-free rates will rise modestly
- The central estimate of the overall cost of debt is 2.97%, with a range of 2.92% to 3.12%. This is consistent with the yield on bonds issued by corporates with a credit ratings of BBB. As water companies have historically outperformed debt benchmarks, the central estimate is towards the low end of the range

5.32 **Figure 2** shows the ranges for the cost of capital for the Cases against the PR14 guidance cost of capital and shows that there is no overlap between the two ranges and that the central cost of capital for the Cases are higher than the PR14 guidance WACC. This confirms that a different cost of capital for the Cases is justified.

Figure 2: Overview of the cost of capital range for the Cases and PR14 guidance



Source: PR14 and Grant Thornton analysis

Required return for third party supply

5.33 Pulling together our analysis of the cost of equity and debt, the central estimate of the total required return (real, pre-tax) is 4.81% with a range of 4.49% to 4.94% as presented in **Table 6.** The estimated real cost of debt (pre-tax) is 2.97%, the cost of equity (post-tax) is 6.37% and the Vanilla WACC is 4. 41% for the central estimate.

Table 6: Estimated real required return for the Cases

	Central	Low	High
Real risk-free rate	1.25%	0.75%	1.25%
Equity market risk premium	5.50%	5.50%	5.50%
Equity Beta	0.93	0.88	0.99
Cost of equity (post-tax)	**6.37%**	**5.58%**	**6.69%**
Overall industry cost of debt including fees	2.75%	2.70%	2.90%
Additional debt risk premium	0.22%	0.22%	0.22%
Overall cost of debt (pre-tax)	**2.97%**	**2.92%**	**3.12%**
Gearing	57.5%	55%	60%
WACC (Vanilla)	**4.41%**	**4.12%**	**4.54%**
Effective tax rate	12.80%	12.80%	12.80%
Real WACC for the Cases (pre-tax)	**4.81%**	**4.49%**	**4.94%**

Required return for self-supply

5.34 In the case of Iggesund we have been asked to assess whether Iggesund's own cost of capital for the provision of water would be different to that determined above. Iggesund is a paper mill and has a materially different cost of capital to a water company. However, as noted above, a company should apply a project specific cost of capital when appraising a business case and therefore it is that, not the cost of capital of a water company or a paper mill which is relevant.

5.35 As the risks associated with Iggesund self-supplying are similar to those of a water company supplying the service, our analysis is based on the methodology developed above.

5.36 In self-supplying Iggesund would face additional risks not faced by a water company with an integrated network. In particular, Iggesund would be dependent on a single point of abstraction. That point may not remain valid in all environmental conditions. Abstraction rights have limitations which restrict when water can be taken and, for example, should water levels be low Iggesund might not be able to abstract. The Environmental Agency also has the power to revoke abstraction rights. Risks from intermittent abstraction restriction could be mitigated through securing secondary supplies and should be reflected in the estimated operating costs rather than the cost of capital.

5.37 Considering the analysis above, the cost of capital for the self-supply option is the same as for the third party supply case. Details on the cost of capital estimate can be found in **Table 6** and the central estimated required return (real, pre-tax) is 4.81% with a range of 4.49% to 4.94%.

6 Potential areas of challenge

6.1 In this section we discuss potential areas of challenge to this analysis and the rationale for the positions taken.

Input data from PR14

6.2 To be consistent with the methodologies used by Ofwat in determining the cost of capital in other cases, we have used WACC inputs from the latest Ofwat price review, PR14. The PR14 guidance on the WACC inputs was published on 27 January 2014 and reflects market conditions, tax rates and gearing levels at that time. In our view, this analysis is the best current estimate of the cost of capital for the water industry.

6.3 As indicated in **Sections 4** and **5**, we have made adjustments to a number of the WACC inputs to reflect the specific risk profile of the Cases. We have made adjustments both for supply by third parties and also self-supply in the case of Iggesund.

6.4 Should Ofwat revise its guidance on the cost of capital prior to a decision being made in the Cases, we would propose refreshing this analysis to reflect the revised WACC variables.

Assessment of the systematic component of volatility in industrial revenue

6.5 Our analysis is based on a sound theoretical approach to isolating the systematic component of a single stock's or portfolio's standard deviation[7]. We have used the relative correlation of GDP with total water sector revenue and revenues for the supply of industrial non-potable water to assess the systematic component of the asset beta (see **Figure 1**). However, this is an area in which there is limited precedent to guide analysis.

Adjustment to pre-tax cost of debt

6.6 To reflect the risk of supply of industrial non-potable water as compared to general water supply, we have adjusted the pre-tax cost of debt using the data on the impact of default risk on the cost of debt.

Additional factors

6.7 Alternative assessments of additional factors may lead to a different cost of capital assessment. The methodology used to assess these returns remain relatively novel and subjective. The assessment we have made is consistent with the precedents available and gives results which appear reasonable.

Self-supply option

6.8 Iggesund has the option to self-supply non-potable water. Our assessment of the cost of capital for self-supply is based on the third party supply WACC calculation.

6.9 As Iggesund is a paper company, an assessment of the cost of capital for Iggesund and its parent company Holmen Group could be considered relevant (pre-tax nominal cost of capital of 11% as indicated in the latest annual report). However, this is the cost of capital for a paper company rather than the cost of capital for the supply of industrial, non-potable water.

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[7]Isolating the Systematic Component of a Single Stock's (or Portfolio's) Standard Deviation, Cara M. Marshall, Ph.D.

A Detailed data sources

The table below summarises the detailed data sources used in this analysis.

Input	Source
Asset beta for water sector	PR14
Effective tax rate	PR14
Equity Market Risk Premium	PR14
Gearing	PR14 Estimating the cost of capital: technical appendix for the economic regulation of Heathrow and Gatwick from April 2014: notices granting the licences, CAA, February 2014
Pre-tax cost of debt	PR14 Morgan Stanley Research, Global Credit Strategy, 3rd December 2013
Real risk free rate	PR14
Relative volatility	Ofwat revenue data between 2006 and 2011
Total equity market return	PR14
UK GDP Data	Office of National Statistics (ONS)

B Glossary of terms

Term	Definition
Additional factor	Additional return premia added to the cost of capital to account for project or activity specific risks.
Asset beta	A measure of the volatility of a security or a portfolio in comparison to the market as a whole excluding the effect of the level of indebtedness of the company or group of companies.
Bond	A debt investment in which an investor loans money to an entity that borrows the funds for a defined period of time at a fixed interest rate.
Capital structure	The capital structure is how a firm finances its overall operations and growth by using different sources of funds, comprising debt and equity.
CAPM	The capital asset pricing model (CAPM) is widely used by regulators and others to estimate the cost of equity for a specific security. CAPM describes the cost of equity as equal to the risk free rate plus a premium that investors bear to reflect the systematic risk inherent in the market.
Correlation factor	Correlation a statistical measure of how closely two sets of data move in relation to each other.
Cost of capital	Cost of funds used to finance a project or a business. Many companies use a combination of debt and equity to finance their businesses, and for such companies, their overall cost of capital is a weighted average of all capital sources, widely known as the weighted average cost of capital (WACC).
Cost of debt	The returns required by providers of debt to finance a company. The cost of debt can be calculated on a pre-tax and post-tax basis.
Cost of equity	The returns required by providers of equity to finance a company. The cost of equity can be calculated using the CAPM.
Debt	An amount of money borrowed by one party from another.
Effective tax rate	The effective tax rate for a firm is the average rate at which its pre-tax profits are taxed. The effective tax rate is computed by dividing total tax expenses by the firm's earnings before taxes.
Equity	Equity is a security representing an ownership interest. On a company's balance sheet, it is the value of the funds contributed by the owners (the stockholders) plus the retained earnings (or losses).
Equity beta	A measure of the volatility, or systematic risk, of a security or a portfolio in comparison to the market as a whole.
Equity market risk premium	The equity market risk premium is an economy-wide generic parameter that represents the excess return of the equity market over the risk-free interest rate and hence reflects compensation for exposure to systematic risk.

Term	Definition
Gearing	Gearing measures the level of indebtedness of a company or group of companies. For the water sector, gearing is normally calculated as the ratio of net debt to the Regulatory Capital Value (RCV).
Iboxx index	This is a specially constructed index designed to provide a reliable benchmark of corporate bond investments. Indices are built for bonds with a similar credit rating, for instance AAA or BBB.
Investment grade	A rating that indicates that a municipal or corporate bond has a relatively low risk of default. Bond rating firms, such as Standard & Poor's, classify bonds at or above BBB as "investment grade".
Net debt	A company's overall debt equal to the value of a company's liabilities and debts less its cash and other liquid assets.
Price determination	Determinations by Ofwat on prices for the certain water and sewage supplies in England and Wales.
Price review	Ofwat sets price controls for the water and sewerage companies every five years including in 2014 (PR14). These price controls will apply to customers' bills and the services they receive between 2015 and 2020.
RCV	Regulatory capital value.
Real value	A real value is a nominal value adjusted to remove the effects of general price level price changes.
Risk free rate	The risk-free interest rate is the theoretical return required over a particular period of time on a loan with zero risk. The risk free interest rate would be based on benchmark government bond yields.
Specific risk	Specific risks are specific to a company or activity. They can be eliminated by holding a well-diversified portfolio of securities.
Standard deviation	A measure of the dispersion of a set of data from its mean. The more spread apart the data, the higher the deviation.
Systematic risk	Systematic risk arises as a result of a range of macroeconomic factors that affect all equities on the same market.
Total equity market return	Total equity market return is the overall return an investor can expect from investing in the market as a whole.
Volatility (of a security)	Volatility is a statistical measure of the dispersion of returns for a given security or market index. Volatility can be measured by using the standard deviation of an equity.
WACC	The weighted average cost of capital is calculated by summing the cost of debt and equity weighted by the proportion of debt and equity respectively in the capital structure of the company.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

8 [redacted]

D Iggesund v United Utilities

This case is a dispute between Iggesund Paperboard (Workington) Limited (Iggesund) and United Utilities Group plc (UUW). UUW provides non-potable water to the site and Iggesund believe that the price UUW is charging is too high. Iggesund has therefore raised a complaint against UUW under Section 56 of the Water Industry Act 1991 which relates to determining the price of supply to non-domestic consumers.

Iggesund commissioned a study into the price of providing this service to its site from a single water source. From this study Iggesund believes that the cost for this service should be lower than that charged by UUW.

As a result of the study Iggesund have reviewed the possibility of self-supply and have acquired an old pumping station as well as an abstraction licence. Iggesund has stated that they will implement this self-supply plan if the company cannot secure a more suitable price through the determination.

This case was opened in September 2010.

Background

Iggesund is a large paperboard manufacturer with two main paper mills, one in Workington, Cumbria and the other in Sweden.

Current status

Europe Economics have carried out initial modelling into the pricing of the non-potable water. This initial modelling requires updating as the work was completed in March 2012. The internal Ofwat team is undertaking the production of depreciation and asset lives data to be used in updating Europe Economics and by an external consultant to assess as appropriate cost of capital for this case.

Ofwat's internal team is also preparing a tender for an independent engineer to review the data on the assets that have been provided by the parties.

Once the modelling inputs are updated, the cost of capital analysis and the engineering review are completed, the internal Ofwat team will prepare a draft decision for presentation to the Project Board to review.

[redacted]

F WACC calculation methodology

To calculate the Weighted Average Cost of Capital (WACC) we would propose using CAPM. The formula and approach to deriving inputs is shown below:

WACC pre-tax = (k_d x D / (D + E)) + (k_e x E / (D + E) x 1 / (1 - t))

where,

k_d = Cost of debt

k_e = Cost of equity

D = Net debt

E = Equity Market capitalisation

t = Tax

As this estimate is for water companies and the Regulatory Capital Value (RCV) is a more relevant measure than capital employed (D + E) in the estimate of the gearing, Grant Thornton has replaced D+E in the WACC formula with the RCV.

Cost of debt (k_d)

The cost of debt is the effective interest rate a company pays for its debt. The cost of debt is calculated as the risk-free interest rate plus the debt premium of a company.

$k_d = R_f + D_p$

where:

R_f = Risk free rate

D_p = debt risk premium

Risk free rate (R_f)

The risk-free interest rate is the theoretical return required over a particular period of time on a loan with zero risk. The risk free interest rate would be based on benchmark government bond yields.

Debt risk premium (D_p)

The debt risk premium is the excess of the market yield on a basket of companies' debt over the risk-free interest rate. Our approach to calculating the debt premium for the WACC calculation will involve:

- Obtaining the annual average of market yields for fixed rate corporate bonds from market data
- Obtaining the annual average of UK Gilts

- Deriving the market premium by calculating the additional yield from corporate bonds over the UK GILT rates

Cost of equity (k_e)

The cost of equity would be estimated using the Capital Asset Pricing Model (CAPM). The CAPM describes the cost of equity as equal to the risk free rate plus a premium that investors bear to reflect the systematic risk inherent in the market. Systematic risk arises as a result of a range of macroeconomic factors that affect all asset classes with different magnitudes. The value of the premium (Beta or ß) is reflected by the volatility of the company's equity shares compared to the broader investment market.

The model assumes that equity investors require their investment to yield at least the return available on risk-free instruments (typically estimated using the yield on a relevant government bond as a proxy) plus a premium for the systematic risk involved in an equity investment. The latter is estimated as the product of the generic equity market risk premium and the equity beta of that investment.

The cost of equity can be expressed using the following formula:

$k_e = R_f + (ß_e \times EMRP)$

where:

k_e = Cost of equity

R_f = Risk free rate

$ß_e$= Equity beta

EMRP = Equity market risk premium

The equity beta is a measure of the degree of 'systematic risk' of a particular investment and it is the parameter specific to the company or activity in the CAPM. For a listed company the beta is estimated by regressing the price of its shares to a broader benchmark market price index. Since equity investors can diversify away specific risks and so avoid exposure to them, they do not affect required returns, and under the CAPM framework are not reflected in the cost of equity. Required or expected equity returns reflect only exposure to systematic risk.

Equity market risk premium (EMRP)

The EMRP is an economy-wide generic parameter that represents the excess return of the equity market over the risk-free interest rate and hence reflects compensation for exposure to systematic risk and would be calculated using historic market data.

The EMRP and the risk-free rate are the two generic components of the CAPM framework and are independent of the company under consideration.

Beta ($ß_e$)

The equity beta of a company is defined as the covariance between the share price of the company and the market price index. The company beta (ße) is a measure of systematic, or diversifiable, risk of a company.

The value of the equity beta reflects business risks and also the risks induced by financial leverage. Equity betas have therefore been adjusted to normalise for different gearing across companies and for the same company over time. This measure, the Asset Beta ($ß_a$) can be calculated to reflect tax effects as:

$ß_a = ß_e / (1 + D/E \times (1- t))$

where:

$ß_a$ = Asset Beta

$ß_e$ = Equity Beta

D = Net debt

E = Equity Market capitalisation

t = tax

Alternatively, the Harris & Pringle formula details the relationship between the $ß_a$ and $ß_e$ excluding the effect of tax as detailed below.

$ß_a = ß_e / (1 + D/E)$

Gearing

The gearing ratio used in this analysis is Ofwat's PR14 notional gearing applied to the water industry which has been reduced basing the adjustment factor on benchmark gearing of utilities with a similar risk level.

Tax rate (t)

To estimate a post-tax WACC the pre-tax WACC is adjusted for corporation tax.

Use of historic data

In common with most cost of capital studies and Ofwat's recent analysis we have used appropriate historical data as a guide to the future cost of equity. Our cost of capital is forward looking but as market forecasts of the cost of equity tend to be inaccurate and are theoretically weak[10], we use historical data to underpin our analysis of the cost of equity. Where appropriate recent data is used to reflect current market conditions.

[10] See Fama, Eugene F. (September–October 1965). "Random Walks In Stock Market Prices". Financial Analysts Journal 21 (5): 55–59

G Asset beta adjustment

We determine the beta which would apply to the supply of non-potable water to large users by applying an adjustment consistent with the CAPM model to the PR14 beta. Intuitively, we apply a factor to the water sector asset beta which captures how more or less risky is the supply of non-potable water to large users than the general supply of water services as captured by the regulatory asset beta. This factor captures the difference in risk by comparing the systematic risk in providing non-potable water to large users, with the systematic risk in the general provision of water services as expressed in equation (1).

In the CAPM, beta is a relative measure of risk for a stock, as it measures that stock's systematic risk relative to the overall market risk. As shown by Cara Marshall, the beta for a single stock i can be expressed as:

$$\beta_i = \frac{\sigma_i * \rho_{i,M}}{\sigma_M} = \frac{absolute\ systematic\ risk\ stock\ i}{absolute\ systematic\ risk\ of\ the\ market\ portfolio} \quad (1)$$

Where σ_i is the volatility of the return of stock i, and $\rho_{i,M}$ is the correlation coefficient between the return of stock i and the market portfolio, and σ_M is the risk of the broader market portfolio. As beta is a relative measure of systematic risk, it is straight forward to see that a stock's absolute systematic risk is given by the numerator in equation (1), i.e., $\sigma_i * \rho_{i,M}$. It is important to note that a stock's volatility σ_i is influenced by systematic and unsystematic risk, and so it is adjusted[11] to account for the contamination by unsystematic risk.

This approach is a departure from previous analysis of the cost of capital for price determination cases, where σ_i was assumed to be free of unsystematic risk, an assumption that is only likely to apply to overall market volatility. Our approach removes this restrictive assumption and therefore adjusts the σ_i to remove unsystematic risk.

If A is the activity of water supply in the Cases and I is the whole industry then by applying equation (1) we can derive expressions for the beta of the Cases and the industry:

$$\beta_A = \frac{\sigma_A * \rho_{A,M}}{\sigma_M} \quad \textbf{(2)}$$

and

$$\beta_I = \frac{\sigma_I * \rho_{I,M}}{\sigma_M} \quad \textbf{(3)}$$

If we divide equations (2) by equation (3), we can derive the relationship between the Cases beta and the "industry-wide" beta:

$$\beta_A = \beta_I * \frac{\sigma_A * \rho_{A,M}}{\sigma_I * \rho_{I,M}} = \beta_I * \frac{systematic\ risk\ of\ "the\ Cases"}{systematic\ risk\ for\ the\ "industry"} = \beta_I * ratio\ adjustment \quad \textbf{(4)}$$

[11] Note that the correlation coefficient can take values between -1 and 1.

As we can see from equation (4), the beta for the Cases is the industry beta adjusted by the ratio of the absolute systematic risk of the Cases to the industry absolute systematic risk, the "ratio adjustment". For the Cases we would expect that the "ratio adjustment" to be greater than 1.

Equation (4) provides us with the means to calculate the asset beta for the Cases based upon the industry asset beta – this maintains a consistent approach to the cost of capital across the water sector.

We have used the following variables as estimates of the elements in equation (4):

- β_I is estimated as the asset beta from PR14 which maintains consistency with the costs of capital applied in the water sector
- We have used the observable volatility of revenue as a proxy for the volatility of returns of the Cases, σ_A. As many of the costs of supplying non-industrial potable water are fixed, revenue is a key driver of changes in returns and hence revenue is a good proxy for returns
- GDP is a good proxy for the overall market systematic risk because GDP is a measure of total national economic activity and hence is a good proxy for returns across the market as a whole . Therefore, we have used the correlation coefficient between revenues and GDP to approximate $\rho_{A,M}$ and $\rho_{I,M}$ in equation (4)

Revenue data has been chosen to estimate the volatility of returns in the Cases as:
- It is a relevant measure when estimating correlation with overall industrial activity (for which using UK GDP as a proxy is best practice)
- The correlation of revenue and GDP is meaningful as both variables are measured in the same units (pounds)
- In the absence of data for profitability of the Cases, revenue is a better proxy for volatility of returns than say volume of water delivered

We have used data for the period 2006 -2011 which is the longest recent period over which data for water companies' non potable revenue (considered as the best proxy for profit is available. While our aim is to produce a forward looking cost of capital, we have relied on historical data as forecasts of future revenues and GDP measures are inherently uncertain. Therefore, we consider the results from using historical data as the best approximation for future realizations of these economic variables.

In calculating the volatility and correlation coefficients we normalised and de-trended the industrial non-potable water revenues, total water revenues and UK GDP. This approach is statistical best practice as it avoids spurious correlations and is consistent with the approach used in previous price determination cases. This approach mitigates the impact on the analysis of the economic instability during the latter part of this period (Lehman's Brothers' bankruptcy in September 2008 followed by the Eurozone crisis from 2009). The impact of this instability on the beta adjustment is limited as a result of de-trending the data and because we are looking at the ratios of standard deviations and correlation coefficients. These mitigate the impact on our analysis as follows:

- De-trending removes the impact of this economic instability which could otherwise distort or obscure the standard deviations and correlations which are the focus of the beta adjustment analysis
- As we are looking at ratios any remaining impact of economic instability on both data series is filtered out, e.g. comparing the standard deviations of non-potable water revenue and total water revenue, the impact of economic instability is cancelled out when we divide one

by the other

The steps followed were:

1 Water revenues (total and industrial non-potable for all water companies with revenues from industrial non-potable water for at least two years) and GDP are indexed against their average over the analysis period (2006-2011). We did this by dividing each value in a series by the simple average for the series over the whole period
2 These indexed revenues and GDP are de-trended by subtracting from each value a 'trend value' calculated using the linear least squares method
3 Standard variation and correlation factors are calculated based on the de-trended and indexed revenues and GDP. In particular, the standard variation and correlation factors were calculated using the percentage difference between the actual data and the trend values for the data calculated in step 2

The results of these calculations are summarised in **Table 7**.

In the calculation of volatility and correlation coefficient, we have used data provided by Ofwat which breaks down revenues for water companies between non-potable water delivered to large users and other (water delivered to households and large customers) for the financial years ending March 2006 to March 2011. We have selected companies with revenues available for at least two years over the period covered, excluding merged companies, and have summed the total annual revenue from non-potable water supply for the selected companies

As detailed in **Figure 1** and equation (4), the asset beta adjustment components are summarised in **Table 7**.

Table 7: Asset beta adjustment

	Industrial non-potable water revenue	**Total water revenue**
Standard deviation (A)	2.35	1.51
Correlation factor against UK GDP (B)	0.46	0.54
Systematic risk (A*B)	1.0790 (C)	0.8187 (D)
Ratio adjustment (C/D)	1.32	

The asset beta ratio adjustment is 1.32 which indicates that the systematic risk of the Cases is greater than the industrial-wide systematic risk.

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