Appendix

YKY58_WACC assessment

[Redacted]

Contents

1. Introduction

A fair balance of the overall risk and return, that is attractive enough to raise the necessary capital to fund our planned investment, whilst delivering an acceptable level of service and price for our customers, and ensuring the company remains financially resilient is crucial to a successful business plan.

The allowed return, which is calculated using a weighted average cost of capital (WACC) is a key element within the overall balance of risk and return. The three key elements within WACC are:

- cost of equity;
- cost of debt; and
- gearing

The WACC is multiplied by our RCV to calculate the allowed return within our business plan. The RCV is also indexed by inflation in each year, and therefore the cost of capital is expressed in real terms.

Key considerations when assessing an estimate of the WACC are:

a) The financing duty: the cost of capital needs to be sufficient for an efficient firm to finance the performance of its statutory functions;

b) The consumer objective: the protection of consumers; and

c) The resilience objective: if significant investment is required in resilience, the cost of capital needs to be sufficient to provide incentives to the firms to meet those investment requirements.

An appropriate WACC needs to be high enough to ensure the necessary funds can be raised to finance our plan and achieve the benefits associated with the financing and resilience duties, without conflicting with the consumer objective to ensure that our customer's bills are as low as possible.

Within this document we assess the 'early view' of WACC provided within Ofwat's PR24 methodology and determine the appropriate WACC to include within our plan.

2. Ofwat's 'early view' of WACC

Ofwat has used the CAPM to determine the cost of equity within its early view of WACC and we agree that the CAPM an appropriate approach.

The table below compares Ofwat's 'early view' of WACC for PR24, versus both the CMA and Ofwat final determinations for PR19, on both an actual 60% gearing basis and also an adjusted 55% gearing basis for consistency with PR24 figures.

WACC analysis (CPIH)	Ofwat PR24	CMA PR19	CMA 55% gear	Ofwat PR19	PR19 55% gear
Total equity market return	6.46%	6.81%	6.81%	6.50%	6.50%
Real risk free rate	0.47%	-1.34%	-1.34%	-1.39%	-1.39%
Equity market risk premium	5.99%	8.15%	8.15%	7.89%	7.89%
Notional gearing	55.00%	60.00%	55.00%	60.00%	55.00%
Aiming up	0.00%	0.25%	0.25%	0.00%	0.00%
Asset beta	0.33	0.33	0.33	0.36	0.36
Debt beta	0.10	0.08	0.08	0.13	0.13
Equity beta	0.61	0.71	0.64	0.71	0.64
Cost of equity	**4.14%**	**4.73%**	**4.15%**	**4.20%**	**3.69%**
Embedded debt	2.34%	2.47%	2.47%	2.42%	2.42%
New debt	3.28%	0.19%	0.19%	0.53%	0.53%
Ratio	83.00%	83.00%	83.00%	80.00%	80.00%
Liquidity and fees	0.10%	0.10%	0.10%	0.10%	0.10%
Cost of debt	**2.60%**	**2.18%**	**2.18%**	**2.14%**	**2.14%**
Appointed WACC	**3.29%**	**3.20%**	**3.07%**	**2.96%**	**2.84%**
Wholesale WACC	**3.23%**	**3.12%**	**2.99%**	**2.92%**	**2.80%**

The analysis above shows that the proposed WACC for PR24 is higher than PR19; however this increase is principally caused by market increases in the cost of debt; whilst the cost of equity is broadly consistent with the CMA's PR19 figure, despite significant market increases since the CMA's report in April 2021.

A fair cost of equity is critical to ensure we can attract the necessary investment to finance our plan; however we are concerned that the proposed cost of equity of 4.14% is insufficient to attract the necessary investment. In particular, we note that the cost of equity is broadly consistent with the CMA's PR19 gearing adjusted cost of equity of 4.15%, despite significant market movements, as illustrated by a 1.86% increase in the risk free rate from -1.39% to +0.47%.

This is largely because Ofwat has chosen to disregard a number of the changes made by the CMA as part of the PR19 appeal, which included:

- Recognition of both the RPI and CPIH datasets when assessing an appropriate range for the total market return (TMR)
- The recognition of a convenience yield within the risk free rate
- The need to 'aim up' to achieve an appropriate balance of risk in the round

Ofwat has also chosen to reduce the notional gearing from 60% to 55%; however we continue to believe insufficient evidence has been presented to support this change. We have already expressed our concerns with all of the above changes within our response to Ofwat's PR24 methodology consultation; therefore do not repeat them again in detail here, but summarise below our key points of concern:

- Maintenance of the CMA's credible position of the primary role of the WACC in ensuring the notionally efficient company is financeable.
- **Consistency and regulatory precedent:** Consistency is a key factor in ensuring investors believe there is a "fair bet" of ensuring a fair balance between risk and reward over time. However, throughout the PR24 methodology Ofwat's proposals contain a number of contradictions, or inconsistencies with other proposals.
- **Lack of evidence:** Regulatory precedent is a key element of investor confidence in the water sector. If there is to be a change from regulatory precedent, there needs to be substantive evidence to support this change; however, there is a lack of compelling evidence presented by Ofwat within its methodology to support any of the changes proposed.
- **Notional structure and financeability:** We do not agree with the proposed changes to the notional capital structure and cannot see any compelling reasons for the proposed changes.

Ofwat's 'early view' of WACC was based on data to September 2022; however we note that in the ten months to July 2023 there have been further significant changes in market data and Ofwat has stated its intention to review WACC for latest market data at both draft and final determination; therefore in the following section we consider the potential impact of market changes.

3. Market update of Ofwat's 'early view' for data to July 2023

Within their final methodology Ofwat highlighted that their proposed WACC would have been 3.53% if October 2022 data had been used instead of September 2022 data. Whilst Ofwat considered the October data to be inconsistent at that point in time, over the subsequent months the market data has continued to be higher than the September 2022 datapoint used, such that based on current data we would expect WACC to be above that October estimate when Ofwat revisit their WACC calculations as part of their draft and final determinations.

To determine what a market updated WACC based on current market data would be, we commissioned First Economics (FE) and Oxera to provide an updated WACC calculation, using Ofwat's methodology and updating purely for latest market data to July 2023.

Ofwat's embedded debt methodology uses data taken from Table 4B of the 2021/22 APR's and rolls that data forward to estimate an industry median embedded debt at March 2025. As 2022/23 APR's have now been published, we have updated Ofwat's model to start from 2023 data rather than 2022 data. This results in an increase in the median cost of embedded debt from 2.34% to 2.65%. First Economics and Oxera have reviewed and utilised this updated cost of debt data within their reports. The full detail and reasoning behind the First Economics and Oxera figures included below can be found within A1 and A2 respectively.

WACC analysis (CPIH)	Early view PR24	Oxera July	FE July	Avg July	July proposal
Total equity market return	6.46%	6.46%	6.46%	6.46%	6.46%
Real risk free rate	0.47%	1.54%	1.49%	1.52%	1.52%
Equity market risk premium	5.99%	4.92%	4.97%	4.95%	4.94%
Notional gearing	55.00%	55.00%	55.00%	55.00%	55.00%
Aiming up	0.00%	0.00%	0.00%	0.00%	0.00%
Asset beta	0.331	0.33	0.33	0.332	0.33
Debt beta	0.10	0.10	0.10	0.10	0.10
Equity beta	0.61	0.62	0.61	0.62	0.61
Cost of equity	**4.14%**	**4.59%**	**4.53%**	**4.56%**	**4.55%**
Embedded debt	2.34%	2.65%	2.65%	2.65%	2.65%
New debt	3.28%	3.74%	3.75%	3.75%	3.74%
Ratio	83.00%	83.00%	85.00%	84.00%	83.00%
Liquidity and fees	0.10%	0.10%	0.10%	0.10%	0.10%
Cost of debt	**2.60%**	**2.94%**	**2.92%**	**2.93%**	**2.94%**
Appointed WACC	**3.29%**	**3.68%**	**3.64%**	**3.66%**	**3.66%**

The analysis above shows that an update for the latest market data to July 2023 would result in an increase in the WACC from 3.29% to 3.66%. This increase reflects increases to both the cost of equity and the cost of debt.

The market data to July 2023 shows that the current yield on investment-grade BBB debt is 6.33%, or 4.25% on a CPIH stripped basis, assuming long term inflation in line with the Government's target of 2%. Whilst current yields are expected to be inflated slightly by the current high inflation it is clear that the yields on investment-grade debt are now comparable to the returns on equity being proposed by Ofwat. On this basis we see little reason why a rational investor would choose to invest equity in water companies rather than buy investment grade corporate debt.

In light of our continuing concerns in relation to the proposed cost of equity we commissioned expert reports from First Economics and Oxera, as well as participating in an industry project with KPMG. These are discussed further in the next section.

4. First Economics, Oxera and KPMG review of WACC

To help us assess whether we could adopt Ofwat's WACC methodology and the WACC of 3.66% that updated market data suggests is likely to result, we commissioned expert reports from First Economics and Oxera as well as participating in an industry cost of equity project with KPMG.

The full reports can be found in A1, A2 and A3 respectively.
The table below provides a summary of the constituent elements of WACC within each of the expert ranges. (n.b. KPMG did not assess cost of debt; therefore we have included Oxera's estimate to provide an illustrative WACC range)

WACC analysis (CPIH)	Ofwat PR24	July update	Oxera Low	Oxera High	FE Low	FE High	KPMG Low	KPMG High
Total equity market return	6.46%	6.46%	6.70%	7.70%	6.50%	6.80%	6.39%	6.96%
Real risk free rate	0.47%	1.52%	1.75%	1.75%	1.49%	2.13%	1.93%	1.93%
Equity market risk premium	5.99%	4.94%	4.95%	5.95%	5.01%	4.67%	4.46%	5.03%
Notional gearing	55.00%	55.00%	55.00%	55.00%	55.00%	55.00%	60.00%	60.00%
Aiming up	0.00%	0.00%	0.00%	0.00%	0.00%	0.25%	0.15%	0.15%
Asset beta	0.33	0.33	0.32	0.35	0.32	0.34	0.36	0.38
Debt beta	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Equity beta	0.61	0.61	0.59	0.66	0.58	0.64	0.75	0.80
Cost of equity	**4.14%**	**4.55%**	**4.66%**	**5.67%**	**4.39%**	**5.37%**	**5.43%**	**6.10%**
Embedded debt	2.34%	2.65%	2.69%	2.69%	2.47%	2.65%		
New debt	3.28%	3.74%	3.84%	3.84%	3.75%	3.90%		
Ratio	83.00%	83.00%	83.00%	83.00%	85.00%	85.00%		
Liquidity and fees	0.10%	0.10%	0.10%	0.10%	0.10%	0.25%		
Cost of debt	**2.60%**	**2.94%**	**2.99%**	**2.99%**	**2.76%**	**3.09%**	**2.99%**	**2.99%**
Appointed WACC	**3.29%**	**3.66%**	**3.74%**	**4.20%**	**3.49%**	**4.12%**	**3.96%**	**4.24%**

Overall, the analysis from First Economics and Oxera suggests a WACC range of 3.49% to 4.20% versus the updated Ofwat methodology figure of 3.66%. KPMG did not provide a cost of debt figure; however assuming the 2.99% Oxera methodology update figure was utilised, this would result in a range of 3.96% to 4.24%.

The midpoint of the range of our three experts would be 3.87% (3.49%-4.24%).

Ofwat's methodology, updated to include data up to July 2023, produces a WACC of 3.66% which sits towards the lower end of the plausible range of PR24 cost of capital values of 3.49% to 4.24%. (Ofwat's 3.29% 'early view' figure falls outside of the plausible range.)

The conclusion we take from this analysis is that Ofwat, while not ever stepping

outside the boundaries of good practice, has repeatedly selected low-end values for each parameter in the cost of capital calculation.

Within Section 3.11 of A1 First Economics note the following three pieces of evidence to support this conclusion:

- First, commentary from equity analysts has turned decidedly negative in recent months. This was typified by the view expressed during Severn Trent's annual results briefing that Ofwat's cost of capital calculation is "from a different era".

- Second, one of the three listed water companies, Pennon Group, has seen its market-to asset ratio fall very close to 1. Pennon is one of three companies in the sector that benefits from a very low embedded cost of debt and a near-guarantee of future RORE financing out-performance, making a MAR of close to 1 more eye-catching that it might first appear.

- Third, the uptick in the cost of debt has pushed the yield on BBB rated debt (6.33% during July 2023 on Ofwat's chosen iBoxx index) above Ofwat's 'early view' of the return on equity (6.22% in nominal terms). Even with an upward correction on account of the increase in the risk-free rate, this challenges why a rational investor would choose to invest equity in water companies rather than buy investment-grade corporate debt.

Within Section 5 below we highlight further cross checks for the cost of equity which we encourage Ofwat to consider when they revisit their WACC calculation. If these cross checks highlight that the cost of equity is potentially too low then we believe some of the differences in methodology, which result in the range of cost of equity presented in the table above should be

revisited. A summary of these differences within the core constituent elements of WACC is presented below, with further detail available in the full reports provided in A1, A2 and A3.

4.1 Total market return (TMR)

Ofwat estimate the TMR using 'ex-post' and 'ex-ante' historical approaches, adjusting for inflation using the recently published ONS CPIH back series spanning 1950 to 1988.

The TMR, by its nature, is meant to be a stable, long-term benchmark for the returns that investors have historically taken from stock market estimates and, therefore, expect to earn from stock markets in the future. Although additional data appears from time to time (e.g. the ONS's new 2022 back-cast of CPIH) we consider that insufficient time has passed to justify a 0.35% reduction in the TMR from the figure that the CMA reached two years ago.

Within Section 2.4 of their report Oxera highlight the following concerns with Ofwat's estimate of TMR:

- Oxera agree with the use of the updated CPIH back-cast; however they believe there is still merit in also using the historical RPI series because it was compiled and published contemporaneously and is therefore not subject to the same estimation uncertainty as a back-cast series.

- Ofwat relies on the ex-ante approach for setting the lower-bound of its TMR range, however Oxera do not believe that placing weight on the ex-ante approach is informative due to its subjective nature. While its aim is to be forward-looking, the sensitivity of input assumptions and degree of subjectivity involved makes it less reliable than the historical average of actual returns.

When re-assessing WACC we encourage Ofwat to reconsider using the RPI dataset as well as the CPIH dataset and to place less weight on the 'ex-ante' approach.

4.2 Risk free rate (RFR)

The RFR measures the expected return on an asset that is free of risk. Ofwat use 20-year index-linked gilts (ILG) as the basis of their estimate of the RFR. Within Section 3.3 of their report FE highlight that the CMA expressed very clear views about the 'specialness' of ILG's in its PR19 report. Subsequently the CAA, the NI Utility Regulator and Ofgem, in their different ways, have all expressed sympathy with this critique in decisions issued during 2022 and 2023.

One indicator of ILG's continued 'specialness' is that there continues to be a hard-to-explain differential between the yields on index-linked and nominal gilts. Oxera identify a further issue in Section 2.2.3 of their report. Here they identify that using ILG's to determine the RFR can lead to a violation of the Modigliani-Miller (MM) theorem. This is caused by a convenience premium which pushes down yields on ILG's relative to the RFR.

Both experts agree with the CMA PR19 appeal that including the yield on AAA bonds within the RFR range provides an appropriate proxy to resolve the issues identified with using solely ILG's

When re-assessing WACC we encourage Ofwat to reconsider including AAA bond data within its RFR range.

4.3 Beta

The equity beta in the CAPM is a measure of how risky an equity investment is compared with the average of the market portfolio. Ofwat estimates beta from Severn Trent and United Utilities data across a range of estimation periods.

The analysis above has highlighted that the cost of equity now appears to be too low in comparison to the cost of debt and our experts all agree that the proposed reduction in beta is a primary cause of this.

Within Section 2.3 of their report Oxera recommend the inclusion of the third listed water company, Pennon, within the source data analysis. They note that the impact of including Pennon is consistent, both before and after, the sale of Viridor; therefore exclusion of Pennon data based purely on the past inclusion of Viridor does not appear appropriate.

Within Section 2.1 of their report KPMG highlight the increased systematic risk arising from the increased investment anticipated across the next five years, which means that additional comparators such as National Grid (NG) should also be included within the source data analysis, as NG's historical RCV growth better reflects the level of growth expected within the water sector going forwards.

When re-assessing Beta we encourage Ofwat to reconsider including other comparators, such as Pennon and National Grid.

4.4 Aiming up

Both First Economics and KPMG continue to believe an element of 'aiming up' remains appropriate, as a large part of the CMA's rationale still stands insofar as PR24, even more so than PR19, is a review in which:

- companies are required to finance larger investment programmes;
- credit ratios are likely to be stretched; and
- it will be vital for the sector to retain the confidence of current and potential equity investors.

In these circumstances, we believe it is perfectly reasonable to take the view that the regulator should show some caution and actively seek to avoid a situation in which the allowed return is inadvertently set below the cost of capital.

4.5 Notional gearing

We continue to believe the proposed reduction in notional gearing to 55% is not supported by robust market evidence or corporate finance principles. The analysis within Section 3.4 of Appendix: Notional financeability analysis highlights that if notional gearing had been retained at 60% then it would be unlikely that we would be able to assure that our plan was notionally financeable; therefore the change to notional gearing has a critical impact on the financeability assessment.

Further comment on notional gearing can be found in Section 9 of KPMG's report.

4.6 Cost of new debt

Ofwat have applied a 0.15% reduction to the benchmark index when setting their cost of new debt allowance; however we continue to believe there is insufficient market evidence to support this 'outperformance' adjustment.

Within Section 3.7 of their report First Economics note that the CMA reviewed the same data as Ofwat and concluded that there was no evidence that water companies were able to outperform the benchmark index. The CMA also noted that a possible driver of past 'outperformance' was an upward-sloping yield curve and the scope for companies to issue at shorter tenors; however current yield curves show this is no longer applicable.

Within Section 3.2 of their report Oxera has expanded the CMA's analysis to include bonds issued after the conclusion of the CMA appeal and their analysis also finds insufficient evidence of like for like outperformance of water company debt versus the broader market.

On this basis, within our financial resilience assessment we have included forecast interest costs in line with the benchmark index during July 2023 (5.97%) without any 'outperformance' deduction.

5. Cross checks between cost of debt and cost of equity

The analysis conducted by First Economics, Oxera and KPMG has illustrated that there is currently an insufficient premium between the cost of equity and the cost of debt. On this basis we see little reason why a rational investor would choose to invest equity in water companies rather than buy investment grade corporate debt. This suggests that further cross checks are required between the cost of equity and the cost of debt.

Oxera consider the differential between the asset risk premium (ARP) and debt risk premium (DRP) to be an additional cross check. (See section 4 within A2 for further details). The analysis highlights an ARP-DRP differential within Ofwat's 'early view' of WACC of only 0.65%, versus an equivalent differential at PR19 of 1.70% (Ofwat FD) and 1.75% (CMA FD) as illustrated within the table below.

Table 4.1 ARP-DRP results comparison

	Oxera low[1]	Oxera high[1]	Ofwat PR24 FM[2]	Updated Ofwat PR24[3]	Ofwat PR19[4]	CMA PR19[5]	Ofwat PR09[6]
RfR, CPIH real	1.75%	1.75%	0.47%	1.54%	-1.39%	-1.34%	2.00%
TMR, CPIH real	6.70%	7.70%	6.46%	6.46%	6.50%	6.81%	7.40%
Asset beta	0.30	0.35	0.33	0.33	0.36	0.33	0.40
ARP	**1.48%**	**2.09%**	**1.98%**	**1.64%**	**2.84%**	**2.78%**	**2.16%**
CoND, nominal	5.92%	5.92%	5.34%	5.82%	2.54%	2.19%	5.70%
RfR, nominal	4.75%	4.75%	3.71%	4.55%	1.10%	0.86%	4.19%
Expected loss	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
DRP	**0.87%**	**0.87%**	**1.33%**	**0.97%**	**1.14%**	**1.04%**	**1.21%**
ARP-DRP	**0.61%**	**1.22%**	**0.65%**	**0.67%**	**1.70%**	**1.75%**	**0.95%**

Oxera also note that the interest rate environment was most similar at PR09 to currently, with Ofwat's PR09 ARP-DRP differential of 0.95% sitting within the upper half of the Oxera range, while Ofwat's PR24 methodology updated to July 2023 provides a differential of 0.67% which is below the PR09 figure.

Through further analysis of the relationship between ARP, DRP and gearing, Oxera suggest that at a notional gearing level of 55% there would be a theoretical lower bound on the ARP of 1.76% using Ofwat's market updated methodology, or 1.58% at the lower end of Oxera's recommended range. In order to ensure a minimum ARP of 1.58% Oxera have increased the beta within the lower end of their range.

We believe that when Ofwat reassesses its WACC it will be critical for it to cross check the cost of equity versus current BBB debt yields and the ARP-DRP framework detailed by Oxera to ensure there is an adequate incentive for a rational investor to choose to invest equity in water companies rather than just buy investment-grade debt.

6. Conclusion – PR24 WACC

We expect Ofwat to revisit their WACC estimate to reflect latest market data at both draft and final determination. The expert opinion we have received suggests that a revision based on current market data to July 2023 would result in an increased WACC of 3.66%.

As detailed in Section 9.8 of our plan, the YW Board has assured that our plan is financeable on a notional company basis once Ofwat's early view of WACC is updated to 3.66% based on latest market data.

The midpoint of the ranges provided by First Economics, Oxera and KPMG would be 3.87% (3.49%-4.24% range) .

Despite our continuing concerns with a number of aspects of Ofwat's methodology for WACC, we have adopted the WACC methodology used by Ofwat within our plan. Based on the evidence detailed within this report we have adopted a WACC of 3.66% which reflects latest market data to July 2023.

We have adopted this updated WACC of 3.66% within our plan, rather than waiting for Ofwat to update the figure, to ensure the financeability of our plan and provide clear transparency of the potential cost for our customers.

We consider the financeability of the notional company to be at the margin of acceptability, even when the updated WACC of 3.66% is utilised. On this basis we encourage Ofwat to consider the points made in the reports by First Economics, Oxera and KPMG when they re-assess WACC. In particular, we would draw Ofwat's attention to the following key points:

- Further cross checks are required to ensure there is a sufficient premium between the cost of equity and the cost of debt, in order to attract the necessary equity investment required across the sector.

- The cross checks we have highlighted within this report suggest that there is currently an insufficient premium within the cost of equity; therefore we encourage Ofwat to revisit their methodology for the constituent elements of the cost of equity, with a particular focus on:

    - the inclusion of other comparator companies, such as Pennon and National Grid within their equity beta assessment;

    - the inclusion of AAA bond data within their RFR assessment; and

    - the inclusion of the RPI dataset in addition to the CPIH dataset, plus less weight being assigned to the 'ex-ante' approach when assessing the appropriate range for TMR

In conclusion, although we have assessed that certain elements of Ofwat's methodology result in elements of WACC that are set at the very low end of, or even below an acceptable range, we have been able to adopt Ofwat's methodology and an expected WACC of 3.66% as part of the overall risk and return package set out in our plan.

Prior to our final determination market conditions could change further, which may result in a change to the outlook for the 2025-30 period. The final PR24 rate of return will need to be assessed closer to the time of the final determination, considering all the information that is available to us in 2024. We have also adopted Ofwat's methodology and the proposed WACC of 3.66% that currently generates on the expectation that Ofwat will update their calculations for latest market data.

7. AMP9 Preliminary WACC assessment

When assessing the WACC to include within our financial resilience assessment for AMP9, our initial starting point was Ofwat's PR24 market updated methodology based WACC of 3.66% as concluded above. We have only considered updating any figures where there is reasonable evidence to support an amendment. Elements where we consider a change may be appropriate are as follows:

- Cost of debt
- The notional structure; in particular the cost of index-linked debt following the proposed alignment of RPI and CPI from 2030.
- Ofwat's statutory duty to secure that companies can finance the proper carrying out of their functions – We have considered the impact of the above changes on notional financeability and Oxera's ARP-DRP framework (see above) to cross check whether the cost of equity in totality remains appropriate, rather than individually assessing the individual elements of the cost of equity.

7.1 Cost of debt

Recent gilt curve forecasts for AMP9 suggest that our cost of new debt will remain close to the iBoxx data for July 2023 used to determine the cost of new debt for AMP8 (5.97%). On this basis we have included within our base forecasts a continuing interest rate of 5.97% throughout AMP8 and AMP9.

Cost of new debt

We have included a cost of new debt of 5.97% for AMP9, which is consistent with the iBoxx data for July 2023 used to determine the cost of new debt for AMP8 above. We have not included any 'outperformance' deduction versus the source index figure as we have not included any outperformance within our base forecasts for AMP8 or AMP9. This is because the analysis conducted by Oxera (see A2) and the CMA as part of its PR19 appeal found no evidence of outperformance versus the index.

Cost of embedded debt

Utilising an assumed cost of new debt of 5.97% we estimate that our cost of embedded debt (excluding our swaps) will increase from 4.61% in 2025 (PR24 "all-in" figure per Ofwat spreadsheet) to 4.98% in 2030, an increase of 0.37%.

We note that other companies will not necessarily have the same profile of debt refinancing, or new debt requirements across the 2025-30 period as us; therefore we have also considered the potential impact on Ofwat's chosen index across the period. Assuming a cost of debt of 5.97% across the 2023-30 period we estimate the following trailing and collapsing historical averages at 2025 and 2030:

Index forecast trailing average	25 years		20 years		15 years	
	Trailing	Collapsing	Trailing	Collapsing	Trailing	Collapsing
March 2025	4.95%	4.80%	4.61%	4.47%	4.11%	3.94%
March 2030	4.88%	4.80%	4.57%	4.51%	4.50%	4.66%

We note that the sector average cost of debt at 2025 as calculated by Ofwat's cost of debt model, updated for latest data at July 2023 is 4.70%, which falls between the 25 year collapsing average and the 20 year simple trailing average; however at PR19 the sector average approximated to the 15 year collapsing average. This variance suggests that the index is not necessarily a good forecasting tool for average sector debt costs. However, forecast rates at March 2030 are much more closely aligned across the different averaging periods than previously.

We consider that the low interest rate environment in past periods has reduced the equivalent trailing average period, particularly as a result of low floating rate debt costs. Given that the average sector maturity of debt is 12.5 years we would expect a 25 year trailing index to be more reflective of sector debt when current interest rates are more consistent with historic rates, as is currently expected to be the case in 2025 and 2030.

The 25 year collapsing average is forecast to remain consistent at 4.80% in 2030, in comparison to our forecast of our own costs (excluding swaps) increasing by 0.37%.

We have decided to adopt a prudent below average increase across the two methodologies of 0.15% to our PR24 estimate of 4.70%, resulting in an AMP9 estimated cost of embedded debt of 4.85%, which sits within the range of the 25 year simple trailing and collapsing averages.

Proportion of new debt

Within our long term delivery statement (LTDS) statutory pathway we are forecasting a slight reduction in capital expenditure from AMP8 to AMP9, which results in our proportion of new debt in AMP9 being broadly consistent with AMP8. As the expected level of capital expenditure is primarily driven by environmental requirements, we expect our position to be comparable across the industry; therefore we have assumed a consistent proportion of new debt of 17%.

The two proposed changes discussed above result in an increase in the cost of debt from 2.94% to 3.09% as illustrated by the table below.

WACC analysis (CPIH)	July start	Debt update
Total equity market return	6.46%	6.46%
Real risk free rate	1.52%	1.52%
Equity market risk premium	4.94%	4.94%
Notional gearing	55.00%	55.00%
Aiming up	0.00%	0.00%
Asset beta	0.33	0.33
Debt beta	0.10	0.10
Equity beta	0.61	0.61
Cost of equity	**4.55%**	**4.55%**
Embedded debt	2.65%	2.80%
New debt	3.74%	3.89%
Proportion of embedded	83.00%	83.00%
Liquidity and fees	0.10%	0.10%
Cost of debt	**2.94%**	**3.09%**
Appointed WACC	**3.66%**	**3.75%**

7.2 Notional structure

As noted above we believe Ofwat has provided insufficient evidence to support the reduction in notional gearing from 60% to 55% at PR24. Our notional financeability analysis detailed in Section 9.8 of our PR24 plan highlights that our notional gearing is expected to increase from 55% in 2025 to 62% in 2030. As a result of the continuing elevated levels of capital expenditure planned in AMP9 within our LTDs statutory pathway, we would anticipate notional gearing remaining above 60%, unless there was a material injection of new equity.

We have maintained notional gearing at 55% in AMP9 within our base forecasts, but consider that this reduction in opening AMP9 gearing from 62% could only be achieved if there was a material increase in the cost of equity from the 4.55% estimated for PR24 based on July 2023 data.

As detailed further below we have use notional financeability analysis and Oxera's ARP-DRP analysis to determine an appropriate total cost of equity, rather than forecasting individual elements of the cost of equity.

Within our base forecasts we have adopted the statutory LTDS pathway, but note that the core pathway involves a significant increase in capital expenditure. If this pathway were ultimately to be adopted we believe notional gearing would need to be increased and a higher cost of equity would be required to achieve the desired level of investment.

Secondly, at PR24 Ofwat assumes that all opening index-linked debt is RPI related, despite the full transition to CPIH. From 2030 RPI is currently expected to converge with CPI; therefore from 2030 we believe it reasonable to assume that all index-linked debt will be CPIH related.

7.3 Ofwat's financing duty

The changes to the cost of debt, together with the changes to the notional structure result in a significant reduction in notional ICR as highlighted by the theoretical notional ICR analysis below:

Notional ICR analysis	July start	Debt update	Notional structure
RCV	11,500	11,500	11,500
Gearing	55.0%	55.0%	55.0%
IL debt proportion	33.0%	33.0%	33.0%
Fixed debt proportion	67.0%	67.0%	67.0%
Total debt	6,325	6,325	6,325
Fixed rate debt	4,238	4,238	4,238
IL debt	2,087	2,087	2,087
Nominal interest rate	5.00%	5.15%	5.15%
Real interest rate	1.94%	2.08%	3.09%
WACC	3.66%	3.74%	3.74%
Return revenue	421.3	430.6	430.6
Cash interest	252.1	261.6	282.5
Notional ICR	**1.67**	**1.65**	**1.52**

We have also replicated Oxera's ARP-DRP analysis to determine the impact of the change in the cost of debt as illustrated by the table below:

ARP - DRP analysis	July start	Debt update	Notional structure	Ofwat PR09
RFR CPIH real	1.52%	1.52%	1.52%	2.00%
TMR CPIH real	6.46%	6.46%	6.46%	7.40%
Asset beta	0.33	0.33	0.33	0.40
ARP	**1.64%**	**1.64%**	**1.64%**	**2.16%**
Cost of new debt nominal	5.82%	5.97%	5.97%	5.70%
RFR, nominal	4.55%	4.55%	4.55%	4.19%
Expected loss	0.30%	0.30%	0.30%	0.30%
DRP	**0.97%**	**1.12%**	**1.12%**	**1.21%**
Differential	**0.67%**	**0.52%**	**0.52%**	**0.95%**
Notional gearing	55.0%	55.0%	55.0%	57.5%
ARP lower bound	**1.76%**	**2.03%**	**2.03%**	**2.10%**

The analysis above shows that the ARP-DRP differential has reduced from the PR24 proposed level, with the ARP of 1.64% also being below the theoretical lower bound of 2.03%, suggesting that the cost of equity is insufficient.

As Oxera noted, market conditions in AMP8 and AMP9 are most similar to those experienced at PR09; therefore PR09 figures have been provided for comparative purposes. The PR09 comparison highlights that the DRP is similar to PR09; however the ARP is considerably lower, suggesting that the cost of equity is too low.

Both the notional financeability analysis and the ARP-DRP analysis highlight that the proposed AMP9 cost of equity is too low. We have therefore considered the impact on both of these factors of increasing the cost of equity and find that if the cost of equity is increased to 5.43% (which remains within the top of the range provided by Oxera for PR24 of 5.67% - see A2 and analysis above) then notional financeability returns to proposed PR24 levels and the ARP-DRP differential aligns with both PR09 and the theoretical lower bound. On this basis we consider a cost of equity of 5.43% to be a reasonable minimum level to use within our base forecasts.

This increase in total cost of equity could be achieved via 'aiming up', an increase to beta, the total market return (TMR), or a combination of all three; however for simplicity we have simply amended beta on a consistent basis to Oxera's analysis as illustrated below:

ARP - DRP analysis	July start	Debt update	Notional structure	Beta remedy	Ofwat PR09
RFR CPIH real	1.52%	1.52%	1.52%	1.52%	2.00%
TMR CPIH real	6.46%	6.46%	6.46%	6.46%	7.40%
Asset beta	0.33	0.33	0.33	0.41	0.40
ARP	**1.64%**	**1.64%**	**1.64%**	**2.03%**	**2.16%**
Cost of new debt nominal	5.82%	5.97%	5.97%	5.97%	5.70%
RFR, nominal	4.55%	4.55%	4.55%	4.55%	4.19%
Expected loss	0.30%	0.30%	0.30%	0.30%	0.30%
DRP	**0.97%**	**1.12%**	**1.12%**	**1.12%**	**1.21%**
Differential	**0.67%**	**0.52%**	**0.52%**	**0.91%**	**0.95%**
Notional gearing	55.0%	55.0%	55.0%	55.0%	57.5%
ARP lower bound	**1.76%**	**2.03%**	**2.03%**	**2.03%**	**2.10%**

We also repeat the notional financeability analysis below.

Notional ICR analysis	July start	Debt update	Notional structure	Beta remedy
RCV	11,500	11,500	11,500	11,500
Gearing	55.0%	55.0%	55.0%	55.0%
IL debt proportion	33.0%	33.0%	33.0%	33.0%
Fixed debt proportion	67.0%	67.0%	67.0%	67.0%
Total debt	6,325	6,325	6,325	6,325
Fixed rate debt	4,238	4,238	4,238	4,238
IL debt	2,087	2,087	2,087	2,087
Nominal interest rate	4.99%	5.15%	5.15%	5.15%
Real interest rate	1.94%	2.08%	3.09%	3.09%
WACC	3.66%	3.75%	3.75%	4.14%
Return revenue	421.3	430.7	430.7	476.0
Cash interest	252.1	261.6	282.5	282.5
Notional ICR	**1.67**	**1.65**	**1.52**	**1.68**

The analysis above shows that with the elevated cost of equity the notional ICR increases to 1.68 which is consistent with the level proposed for PR24. As our PR24 notional financeability assessment concludes that our plan is only financeable if the WACC is updated for latest market data at July 2023; a consistent notional ICR is considered to be the minimum level at which the AMP9 plan could be considered to be notionally financeable.

7.4 Conclusion

Reflecting all of the above would result in a WACC of 4.14% as illustrated by the table below:

WACC analysis (CPIH)	July start	Debt update	Notional structure	AMP9
Total equity market return	6.46%	6.46%	6.46%	6.46%
Real risk free rate	1.52%	1.52%	1.52%	1.52%
Equity market risk premium	4.94%	4.94%	4.94%	4.94%
Notional gearing	55.00%	55.00%	55.00%	55.00%
Aiming up	0.00%	0.00%	0.00%	0.00%
Asset beta	0.33	0.33	0.33	0.41
Debt beta	0.10	0.10	0.10	0.10
Equity beta	0.61	0.61	0.61	0.79
Cost of equity	**4.55%**	**4.55%**	**4.55%**	**5.43%**
Embedded debt	2.65%	2.80%	2.80%	2.80%
New debt	3.74%	3.89%	3.89%	3.89%
Proportion of embedded	83.00%	83.00%	83.00%	83.00%
Liquidity and fees	0.10%	0.10%	0.10%	0.10%
Cost of debt	**2.94%**	**3.09%**	**3.09%**	**3.09%**
Appointed WACC	**3.66%**	**3.75%**	**3.75%**	**4.14%**

Based on the notional financeability analysis conducted above, we consider this to be the minimum level at which our indicative AMP9 plan could be considered notionally financeable.

In order to attract the additional equity required to finance our PR29 plan we consider that a higher cost of equity will ultimately be required, but we consider the above minimum position to be a reasonable and prudent assumption for our AMP9 financial resilience analysis.

Annex 1: First Economics – PR24 Cost of capital prepared for Yorkshire Water (10 August 2023)

PR24 Cost of Capital
Prepared for Yorkshire Water

FIRST ECONOMICS

www.first-economics.com

10 August 2023

1. Introduction

This paper provides an assessment of the PR24 allowed rate of return. It is structured into two main parts, as follows:

- section 2 updates Ofwat's 'early view' of the cost of capital using market data up to 31 July 2023; and
- section 3 takes a step back and gives our assessment of the plausible range that a company might currently arrive at if permitted to estimate the cost of capital from a clean sheet of paper.

2. An Update of Ofwat's 'Early View' Calculation

2.1 Background

Ofwat's December 2022 PR24 methodology paper stated that Ofwat's 'early view' of the likely value of the allowed rate of return for the period 2025-30 was 3.29%. Ofwat's calculations are reproduced as table 1 below.

Table 1: Ofwat's December 2022 cost of capital calculation

Parameter	Value
Gearing	0.55
Risk-free rate	0.47%
Expected market return	6.00% to 6.92%
Unlevered beta	0.26 to 0.29
Debt beta	0.15 to 0.05
Equity beta	0.58 to 0.64
Cost of equity	3.67% to 4.60%
Cost of embedded debt	2.34%
Cost of new debt	3.28%
Share of new debt	17%
Issuance and liquidity costs	0.1%
Cost of debt	2.60%
Vanilla WACC	3.08% to 3.50%
Mid-point	3.29%

Note: all percentage values are in real, CPIH-stripped terms.

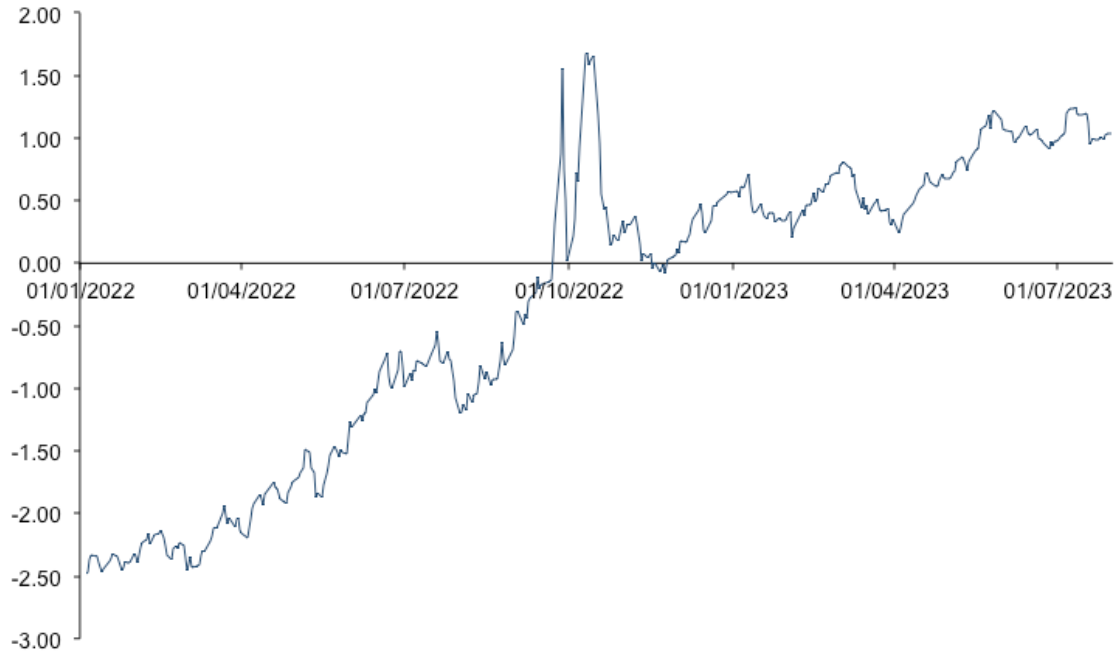
Ofwat was explicit in its methodology paper that the above estimates were made using a cut-off date of 30 September 2022. Ofwat also said that it would keep market data under review and revise its estimates as necessary prior to reaching its final PR24 determination.

The updated position using data from July 2023 is summarised below.

2.2 Risk-free rate

Figure 1 overleaf plots Ofwat's preferred proxy for the risk-free rate.

Figure 1: Yields on 20-year index-linked gilts (%)



Source: Bank of England.

The chart shows that index-linked gilt yields have continued on an upward trend during 2023. The average yield in the month ending 31 July 2023 was 1.09% (in real, RPI-stripped terms), up from Ofwat's estimate of -0.05% for the month ending 30 September 2022.

Table 2 converts the RPI real yield into a CPIH real equivalent.

Table 2: Calculation of the CPIH real risk-free rate

	Month ending 30 September 2022	**Month ending 31 July 2023**
20-year index-linked gilt yield	-0.05%	1.09%
RPI-CPIH wedge	0.54%	0.40%
CPIH real risk-free rate	0.47%	1.49%

Note: the 20-year RPI-CPIH wedge is lower in July 2023 compared to September 2022 due to (a) revised inflation expectations for the period 2023 to 2027 and (b) the closer proximity to the planned 2030 alignment of RPI and CPIH.

The final row of the table shows that there has been a material increase in the risk-free rate of around 100 basis points. All other things being equal, this adds approximately 18 basis points to Ofwat's 'early view' estimate of the cost of capital.

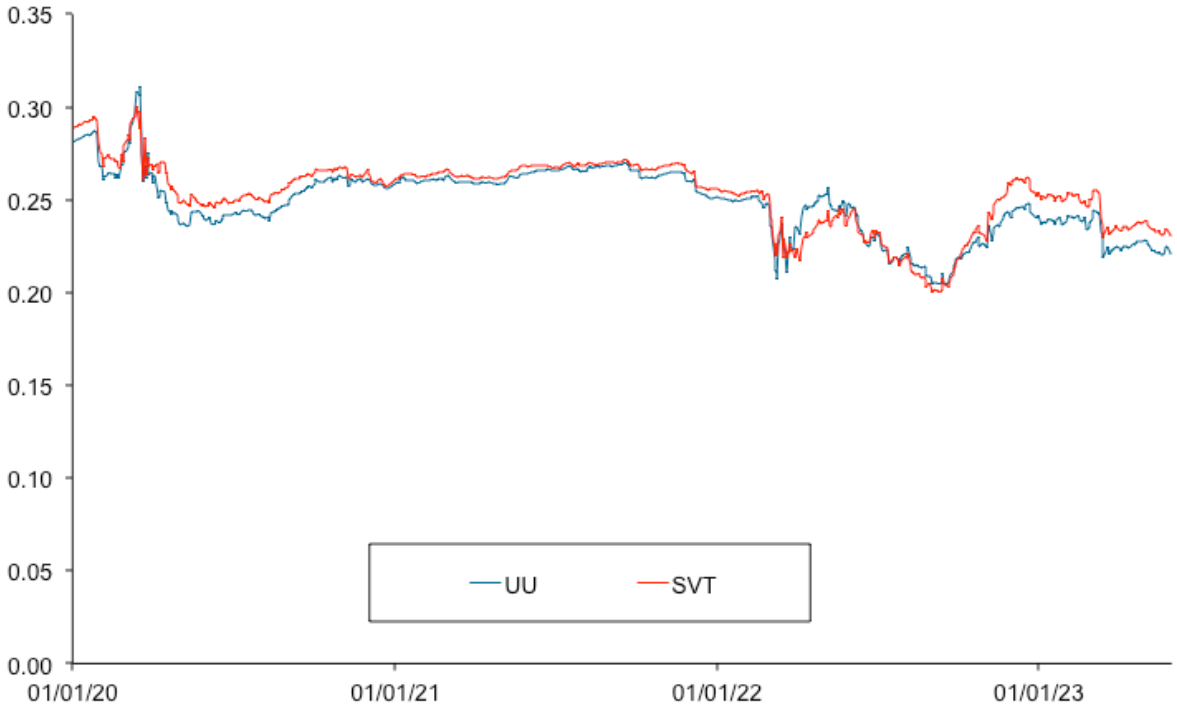
2.3 Expected market return

Ofwat's PR24 methodology treats the CAPM expected market return as a constant. We do not, therefore, update Ofwat's stated 6.00% to 6.92% TMR range.

2.4 Beta

Figure 2 plots recent estimates of Severn Trent's and United Utilities' unlevered betas. In both cases, each point in the chart is calculated using two years of daily data.

Figure 2: Rolling two-year unlevered betas



Source: Bloomberg and First Economics' calculations.

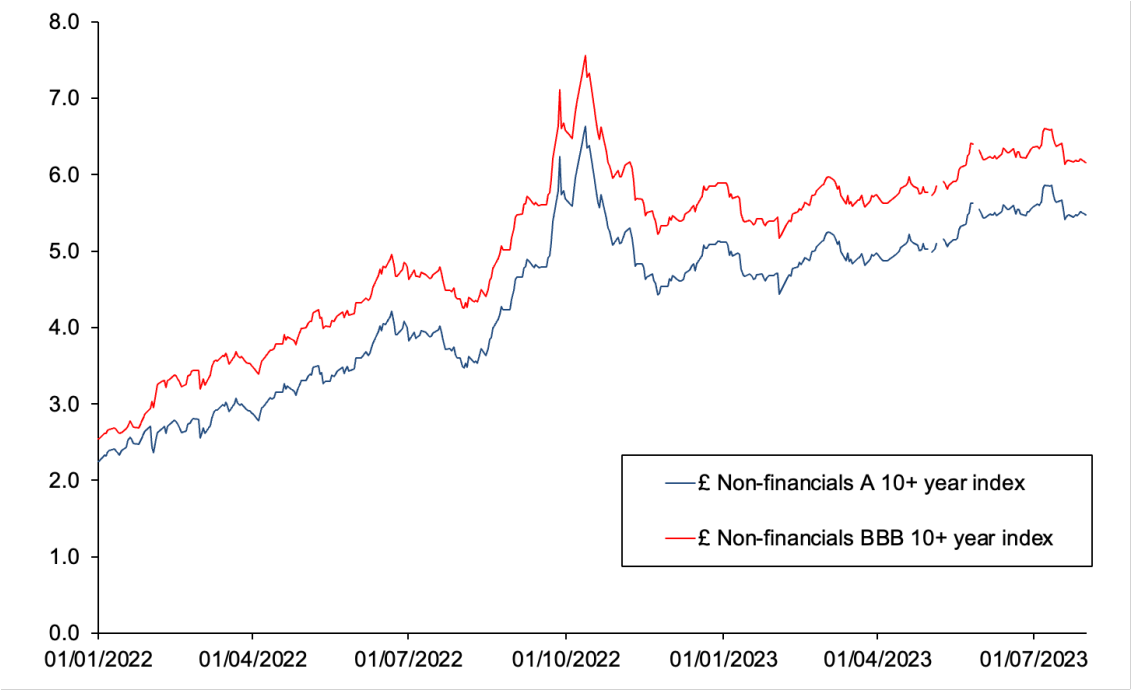
The chart shows that estimated betas have remained low during the last eight months. There was a short period last autumn when Severn Trent and United Utilities were behaving like high-beta companies (producing the small uptick in the two-year rolling beta values seen in the chart at the end of 2022). But since the start of the year, water companies share prices have once again moved with only a very small covariance to movements in the wider stock market.

The latest data does not constitute a material change from the picture that Ofwat was looking at when it issued its 'early view'. Accordingly, we have no reason to revise Ofwat's 0.26 to 0.29 unlevered beta range.

2.5 Cost of new debt

Figure 3 plots Ofwat's preferred benchmarks for the cost of debt.

Figure 3: Yields on corporate debt (%)



Source: S&P Markit website.

The chart has a similar profile to figure 1, albeit with a less steep gradient. The average iBoxx rate in July 2023 was 5.97% compared to a reading of 5.49% in September 2022 – i.e. a change of ~50 basis points.

Table 3 completes Ofwat's calculation of the allowed cost of new debt.

Table 3: Calculation of the CPIH real cost of new debt

	Month ending 30 September 2022	**Month ending 31 July 2023**
Average iBoxx yield	5.49%	5.97%
Benchmark index adjustment	(0.15%)	(0.15%)
Allowed cost of new debt, nominal	5.34%	5.82%
Allowed cost of new debt, real	3.28%	3.75%

Note: the conversion from nominal to real uses a 2% per annum CPIH inflation assumption.

All other things being equal, the small increase in the cost of new debt in the final row of the table adds around 4 basis points to Ofwat's 'early view' estimate of the cost of capital.

2.6 Cost of embedded debt

Ofwat defines the cost of embedded debt as the cost of all borrowing that companies will bring into and then carry through the 2025-30 regulatory period, inclusive of the interest costs that companies will pay after refinancing debt that is due to mature before 2030.

The shift up in interest rates identified in the earlier sections of this paper translates into a higher cost of embedded debt through three principal channels:

- companies that have had to fix debt costs during 2022/23 have incurred higher costs than Ofwat envisaged in its 'early view';

- a higher Bank of England base rate increases the cost of all floating rate debt; and
- the small increase in the cost of new debt shown in table 3 increases the forecast cost of all debt that needs to be issued/refinanced between 2023 and 2030.

Yorkshire Water has informed us that it has updated Ofwat's published spreadsheet calculations to include of the additional instruments reported in companies' 2022/23 annual returns, a forecast base rate of 5% and a forward-looking cost of debt of 5.82% (nominal). The calculated allowance for embedded debt costs after making these changes is 2.65% in real CPIH terms.

Yorkshire Water has asked us to use this figure in this update. All other things being equal, this adds around 14 basis points to Ofwat's 'early view'.

2.7 Weights for new and embedded debt

Ofwat's methodology paper used weights of 17% and 83% respectively for the costs of new and embedded debt. However, there was a mistake[1] in Ofwat's arithmetic which caused it to overstate the first figure and understate the second figure. The correct weights ought to have been <5% and >95% respectively.[2]

During the last six months it has become clear that companies will need to increase the scale of their enhancement programmes. The exact size of the overall increase in industry expenditure will not be clear until next year, but it seems safe to say that Ofwat's assumption of a 2% per annum real terms increase in the industry RCV significantly understates requirements.

If, for the purposes of illustration only, we assume that companies are looking at an increase in the value of nominal RCVs of more than 50% over the period 2023 to 2030, the weighting for the cost of new debt would need to increase to around 15%.

2.8 Issuance and liquidity costs

We have no reason to update Ofwat's allowance for illiquidity and issuance costs of 0.1%.

2.9 Overall summary

Table 4 brings the preceding calculations together into an updated estimate of the PR24 cost of capital.

Table 4: Overall update of Ofwat's 'early view'

Parameter	September 2022	July 2023
Gearing	0.55	0.55
Risk-free rate	0.47%	1.49%
Expected market return	6.00% to 6.92%	6.00% to 6.92%
Unlevered beta	0.26 to 0.29	0.26 to 0.29
Debt beta	0.15 to 0.05	0.15 to 0.05
Equity beta	0.58 to 0.64	0.58 to 0.64
Cost of equity	3.67% to 4.60%	4.10% to 4.97%

[1] The mistake relates to a double count of debt that is due to be refinanced between 2025 and 2030. Ofwat allowed for the cost of this refinancing twice: once within the calculation of embedded debt costs; and a second time when computing the amount of new debt that companies would issue in AMP8.
[2] Calculated by eliminating refinanced debt from Ofwat's projections of new debt issuance.

Cost of embedded debt	2.34%	2.65%
Cost of new debt	3.28%	3.75%
Share of new debt	17%	15%
Issuance and liquidity costs	0.1%	0.1%
Cost of debt	2.60%	2.92%
Vanilla WACC	3.08% to 3.50%	3.45% to 3.84%
Mid-point	3.29%	3.64%

The mid-point of the updated range for the vanilla WACC is 3.64%. This is 35 basis points higher than Ofwat's 'early view' estimate.

3. A Clean Sheet Estimate of the Cost of Capital

The analysis in section 2 of this paper is deliberately constrained by Ofwat's published PR24 methodology. We consider next what a fair and reasonable range for the cost of capital might be if we bring wider regulatory 'good practice' to bear on the calculations.

3.1 CMA vs Ofgem vs Ofwat

To give an overall sense of the degrees of freedom that there might be, table 5 highlights the areas in which Ofwat's PR24 methodology departs from the assumptions and allowances used by the CMA and Ofgem in recent decisions.

Table 5: Recent cost of capital decisions

	CMA, 2021	**Ofgem, 2022**	**Ofwat, 2022**
Gearing	60%	60%	55%
Risk-free rate	Fixed estimate Basket of index-linked gilt yields and AAA non-government bond yields	Annual indexation 20-year index-linked gilt yields plus 70 bps RPI-CPIH conversion factor	Fixed estimate 20-year index-linked gilt yields plus 54 bps RPI-CPIH conversion factor
Expected market return	6.81%	6.5%	6.46%
Unlevered beta	0.29 based on SVT/UU share price data up to February 2020	0.311 based on SVT/UU/PNN/ NG share price data up to 2020	0.275 based on SVT/UU share price data up to September 2022
Debt beta	0.075	0.075	0.1
Aiming up	Yes, 25 bps	No	No
Cost of embedded debt	In line with sector-median cost of debt	In line with sector-average cost of debt	In line with sector-median cost of debt
Cost of new debt	Yield on iBoxx A/BBB non-financials bond yield indices	Yield on iBoxx utilities bond yield index	Yield on iBoxx A/BBB non-financials bond yield indices less 15 bps 'halo effect'
Debt issuance and liquidity costs	10 bps	25 bps	10 bps

The table records eight specific points of difference, of which:

- in seven instances, Ofwat appears to have taken a tougher approach than the CMA and/or Ofgem; and
- in only one case can Ofwat's methodology be said to be in any way generous to companies (the proposal to set the cost of embedded debt in line with the median large company cost of debt, rather than the average cost of debt).

This gives an indication that Ofwat's 'early view' is likely to be at the lower end of the range of admissible cost of capital estimates. In the sub-sections below, we identify plausible ranges for each individual parameter, before presenting a plausible overall range for weighted average cost of capital.

3.2 Gearing

Ofwat's move down from 60% gearing to 55% gearing is primarily a consequence of concerns about financeability and the challenges that companies could face in AMP8 in relation to interest cover and credit ratings. However, lower gearing also has a non-trivial impact on the calculated cost of capital. As the CMA discussed at length in its 2019/20 NATS price control inquiry, the standard beta re-gearing formula used by regulators has a quirk which sees higher assumed gearing result in a higher overall cost of capital. Ofwat's 55% gearing assumption eliminates this effect and, in doing so, knocks 7 basis points off the 'early view' cost of capital.[3]

We do not see any reasonable basis for disagreeing with Ofwat's position on notional gearing. Nor can we conceive of any plausible reason why Ofwat should reinstate the 'lost' return as it anchors its PR24 determination to a less-geared balance sheet. Our wider range for the cost of capital therefore uses Ofwat's proposed 55% gearing figure.

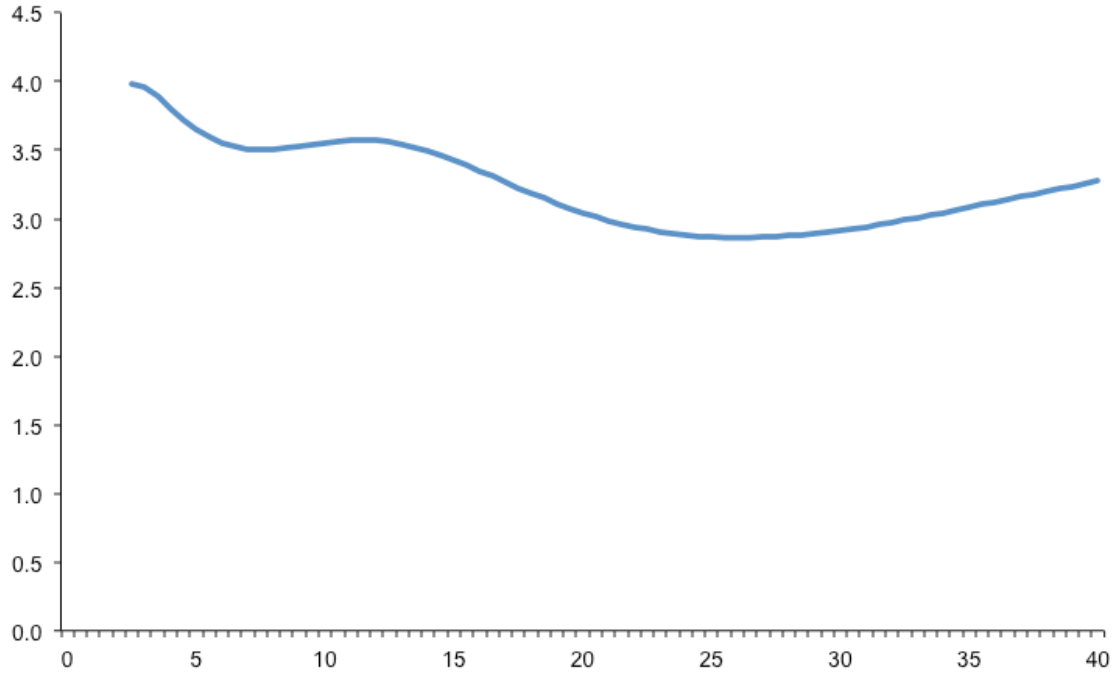
3.3 Risk-free rate

Yorkshire Water will recall that the CMA expressed very clear views about the 'specialness' of index-linked gilts in its PR19 report. We have subsequently seen the CAA, the NI Utility Regulator and Ofgem, in their different ways, all express sympathy with this critique in decisions issued during 2022 and 2023. This leaves Ofwat's PR24 methodology as a clear outlier in terms of its absolute trust in index-linked gilt yields.

As one indicator of index-linked gilts' continued 'specialness', figure 4 shows that there continues to be a hard-to-explain differential between the yields on index-linked and nominal gilts,

[3] Note that the higher risk-free rate in the July 2023 update of the 'early view' flattens the relationship between gearing and the cost of capital. This reduces the impact of the move to 55% gearing by about half.

Figure 4: Instantaneous forward 'break-even' inflation curve (%), 31 July 2023



Source: Bank of England.

The most obvious anomaly in this curve is the absence of any structural break in 2030 (year 7 in the chart) at the point when RPI is due to be aligned with CPIH. But the oscillations in gradient and the overall level of 'break-even' inflation throughout the period are also out of line with conventional economic forecasts, suggesting that there is a fundamental distortion of some kind affecting gilt prices.

We therefore think that there is ample justification for bringing alternative proxies for the riskless asset into the risk-free rate calculation.[4] Table 6 provides updated calculations of the CMA's proposed measures.

Table 6: The CMA's alternative risk-free rate calculations, July 2023

	iBoxx £ AAA non gilts 10+ years	**iBoxx AAA non-gilts 10-15 years**
Average yield, July 2023	4.89%	4.92%
Expected inflation	(2.05%)	(2.11%)
Risk-free rate, CPIH real	2.78%	2.75%

A comparison between the final row of this table the earlier table 2 shows that the differential between the risk-free rate calculated using AAA non-gilt yields and Ofwat's preferred index-linked gilt yield measure remains broadly in line with the ~1 percentage figure that the CMA identified two years ago.

If we follow the CMA's lead and take a 50:25:25 average of the three risk-free rate readings, we arrive at an upper bound measure of the risk-free rate of 2.13%.

[4] See First Economics (2022), The risk-free rate, which was submitted to Ofwat in August last year, for further detail.

3.4 Expected market return

The CMA's PR19 report, along with a different CMA panel's decision later that same year in the RIIO-2 appeals, has had a notable chilling effect on what had hitherto been a very fierce debate about the value of the CAPM expected market rate of return.

As a consequence, the TMR values in regulatory decisions issued in the last two years have all fallen in very narrow range of 6.5% to 6.8%. The lower bound of the range is the estimate that Ofgem and Ofwat originally alighted on in 2019, and which the CMA declared was "not wrong" in its RIIO-2 appeal decision. The upper bound of the range is the CMA's preferred point estimate from its PR19 redeterminations.

We use a 6.5% to 6.8% range in our range for the plausible value of the PR24 rate of return. The TMR, by its nature, is meant to be a stable, long-term benchmark for the returns that investors have historically taken from stock market estimates and, therefore, expect to earn from stock markets in the future. Although additional data appears from time to time – e.g. the annual Dimson, Marsh & Staunton updates of average stock market returns since 1900, the ONS's new 2022 backcasts of CPI and CPI inflation – we think that insufficient time has passed for us to question the opinions that the CMA reached two years ago.

3.5 Beta

Figure 2 in section 2 showed that observed betas have remained at very low levels during 2022 and 2023. This could be said to indicate that the lower end of Ofwat's 'early view' range could be moved lower still. At a cut-off date of 31 July 2023, this would mean starting the range from a low-end estimate of around 0.22.

The problem with this line of thought is that beta values of less than 0.25 feel too low to be credible. As we highlight later in section 3.11, we are already at the point where the estimated cost of equity sits uncomfortably close to the cost of debt. A further move down in beta would likely violate the principle that the cost of equity cannot be lower than the cost of debt.

We also think that it is important to consider the possibility that companies' risk profiles during AMP8 will differ from historical risk profiles and, hence, that backward-looking estimates of betas serve as an imperfect predictor of future betas. Two key considerations in this regard are: the scale of the industry's investment programme; and the extent/design of any risk-sharing arrangements for input price variation. At the time of writing, we do not have sufficient detail on either of these points to make an informed assessment. But we can envisage scenarios in which a higher exposure to cost risks could increase betas.

We therefore stick with Ofwat's 0.26 to 0.29 range as a holding assumption only.

3.6 Aiming up

The CMA's decision to aim up in its cost of capital range was arguably the most controversial aspect of the PR19 redeterminations. Ofwat was fiercely opposed to the CMA's 25 basis points allowance from the moment that it was first proposed and has shown no indication that it accepts the CMA's assessment of the costs and benefits of setting the allowed return too high rather than too low. That being said, a good part of the CMA's rationale still stands insofar as PR24, even more so than PR19, is likely to be a review in which:

- companies will be required to finance large investment programmes;
- credit ratios are likely to be stretched; and

- it will be vital for the sector to retain the confidence of current and potential equity investors.

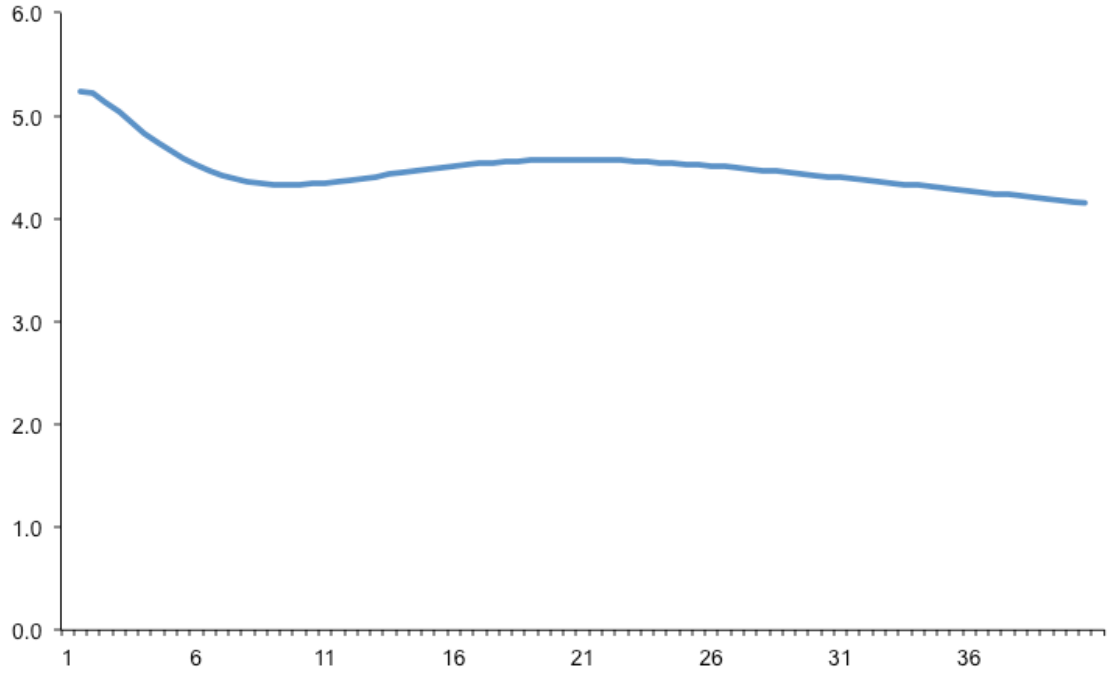
In these circumstances, there is a basis for a company to take the view that the regulator should show come caution and actively seek to avoid a situation in which the allowed return is inadvertently set below the cost of capital.

We therefore include at the high end of our range a small amount of aiming up. There is an argument that ~15 basis points of the CMA's 25 basis points paid for asymmetry in the calibration of the PR19 ODIs, and that, pending detail of Ofwat's PR24 ODI design, the CMA's analysis points to a need for only 10 basis points of aiming up this time around. However, we use the full 25 basis points amount in our calculations on the grounds that PR24 imposes much greater challenges on equity investors compared to PR19.

3.7 Cost of new debt

Ofwat's proposed allowance for the cost of new debt is a straight rollover of Its PR19 approach. The one aspect of this approach that companies objected to at the time is the deduction of a "benchmark index adjustment" or "halo effect" of 15 basis points. Here we note that the CMA reviewed much the same set of data as Ofwat and concluded that there was no evidence that water companies would be able to out-perform the chosen iBoxx benchmark. Figure 5 below also shows that the key factor that Ofwat and the CMA identified as the driver for possible 'out-performance' – i.e. an upward-sloping yield curve and the scope for companies to issue at shorter tenors than the iBoxx benchmark – has all but disappeared.

Figure 5: Yield curve for nominal gilts (%)



Source: Bank of England.

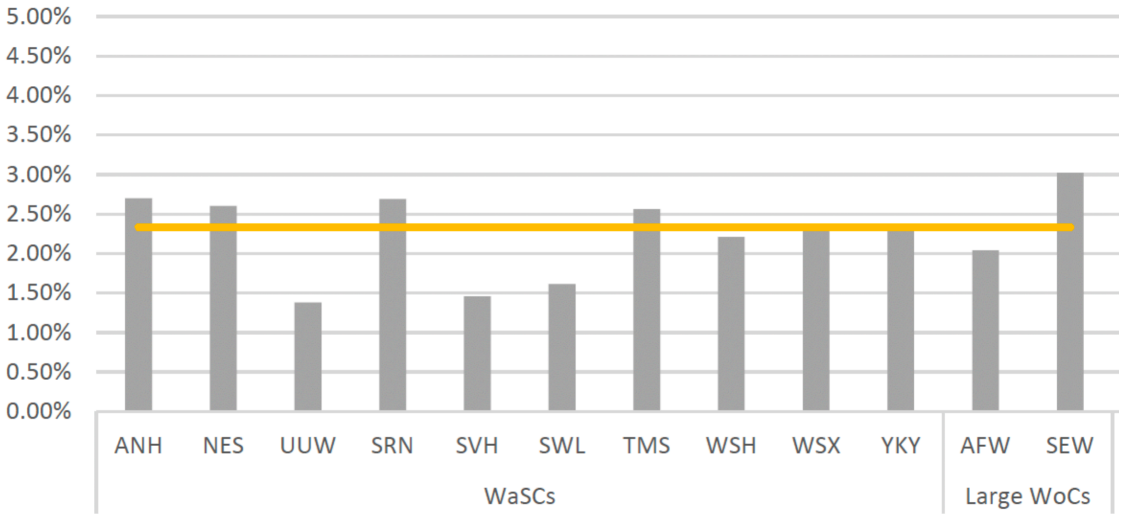
In light of the above data, and given the difference of opinion that the CMA had with Ofwat, we think there is a reasonable argument that Ofwat should set the cost of new debt in line with the chosen iBoxx benchmark but excluding any downward adjustment.

3.8 Cost of embedded debt

Ofwat's proposal to set the PR24 allowance for embedded debt costs in line with actual industry interest rates aligns with the approach that other regulators have adopted in other regulatory reviews. The questions that follow are: how exactly should Ofwat calculate actual company interest costs; and what industry benchmark should Ofwat anchor its allowance to?

On the second of these points, figure 6 below, taken from Ofwat's methodology document, shows that the industry median interest rate is higher than the industry average rate. This means that Ofwat's decision to refer to the median value is arguably somewhat generous to companies, in that it requires customers to pay a little over £100 in bills for every £100 that the industry pays out to lenders.

Figure 6: Ofwat's analysis of projected 2025-30 debt costs



	Sector		WaSCs and Large WoCs	
	Nominal	CPIH	Nominal	CPIH
Company average ('All in')	4.60%	2.18%	4.21%	2.17%
Company average ('Actual-notional')	4.24%	2.20%	4.27%	2.23%
Company median ('All in')	4.61%	2.56%	4.38%	2.33%
Company median ('Actual-notional')	4.39%	2.34%	4.39%	2.34%

Source: Ofwat.

The lower end of our plausible PR24 cost of capital range uses the large company average cost of debt in preference to Ofwat's median. This is a figure of 2.47%, which is slightly higher than the 2.23%/2.34% shown in the table on account of the move up in interest rates since September last year (see section 2.6).

3.9 Issuance and liquidity costs

Ofwat's 'early view' allowance for additional debt-related costs is explicitly an allowance for issuance and liquidity costs only. Ofwat noted that its 10 basis points is lower than Ofgem's 25 basis points RIIO-2 allowance, but said that it not received evidence that water companies have incurred or should incur the costs that energy networks have identified in relation to the cost of carry and RPI-CPIH basis mitigation risk.

Our reading of the methodology document is that Ofwat was not shutting the door completely on such costs. If Yorkshire Water is able to demonstrate that it does/will incur a cost of carry and that it makes sense to hedge RPI/CPIH basis risk ahead of the impending completion of the transition to full CPIH indexation in 2025, there is room for Ofwat to add to its 10 basis points later on in the PR24 process.

We therefore provide for 25 basis points at the top end of our range.

3.10 Overall summary

Table 7 brings the preceding estimates together into a range for the overall cost of capital as at 31 July 2023.

Table 7: A plausible range for the PR24 cost of capital, July 2023

Parameter	Low	High
Gearing	0.55	0.55
Risk-free rate	1.49%	2.13%
Expected market return	6.5%	6.8%
Unlevered beta	0.26	0.29
Debt beta	0.15	0.05
Equity beta	0.58	0.64
Aiming up	-	0.25%
Cost of equity	4.39%	5.37%
Cost of embedded debt	2.47%	2.65%
Cost of new debt	3.75%	3.90%
Share of new debt	15%	15%
Debt-related costs	0.1%	0.25%
Cost of debt	2.76%	3.09%
Vanilla WACC	3.49%	4.12%
Mid-point	3.81%	

The key takeaway from this table is that Ofwat's methodology, updated to include data up to July 2023, produces a number – 3.64% – that sits towards the lower end of the plausible range of PR24 cost of capital values. (NB: Ofwat's 3.29% 'early view' figure falls outside of the plausible range.)

The conclusion to take from this analysis, therefore, is that Ofwat, while not ever stepping outside the boundaries of good practice, has repeatedly selected low-end values for each parameter in the cost of capital calculation. The consequence this has is that Ofwat's overall cost of capital is lower than the likes of Ofgem or the CMA's PR19 panel would calculate when presented with the same raw data.

3.11 Cross-checks

We offer three further pieces of evidence to support this conclusion.

- First, commentary from equity analysts has turned decidedly negative in recent months. This was typified by the view expressed during Severn Trent's annual results briefing a fortnight ago that Ofwat's cost of capital calculation is "from a different era".
- Second, one of the three listed water companies, Pennon Group, has seen its market-to-asset ratio fall below 1.[5] Pennon is one of three companies in the sector that has historically benefited from a very low embedded cost of debt and a near-guarantee of future RORE financing out-performance, making a MAR of close to 1 more eye-catching that it might first appear.
- Third, the uptick in the cost of debt shown in figure 2 has pushed the yield on BBB rated debt (6.33% during July 2023 on Ofwat's chosen iBoxx index) above Ofwat's 'early view' of the return on equity (6.22% in nominal terms). Even with an upward correction on account of the increase in the risk-free rate, this rather begs the question of why a rational investor would choose to invest equity in water companies rather than buy investment-grade corporate debt.

4. Conclusions

Our understanding of Ofwat's December 2022 methodology document is that Ofwat is expecting companies to use its 'early view' number in business plans that are to be submitted to the regulator at the start of October and certify that these plans are financeable. However, unless the recent rise in interest rates quickly reverses, Yorkshire Water's board is going to find it very difficult to certify that a plan containing a 3.29% rate of return is financeable from an equity perspective.

It goes beyond the scope of this assignment to advise on the position that Yorkshire Water should adopt when dealing with this apparent incoherence. The view that we can feed into forthcoming internal discussions is that:

- on a straight re-application of Ofwat's 'early view' methodology, the required return has increased to 3.64%; and
- the plausible range for the PR24 cost of capital, if not constrained by Ofwat's previous statements, is 3.49% to 4.12%.

[5] Pennon's market capitalistion on 30 June 2023 was £1.84 billion. Pennon's results for the year ended 31 March 2023 reported an RCV of £4.7 billion and net debt of £2.84 billion.

Annex: Retail Margin Deduction

The rate of return that Ofwat has said it would apply to Yorkshire Water's RCV under its 'early view' of the cost of capital is 3.23%, 6 basis points lower than the headline figure of 3.29%. The downward adjustment reflects Ofwat's view that it is necessary to make a deduction to account for the margin that Yorkshire Water will earn in its retail price control.

The precise justification for this adjustment has changed since it was first introduced in 2014:

- in PR14, when retail and wholesale were first separated, Ofwat allocated the whole of the existing RCV to wholesale activities. This meant that past investments that were supporting the delivery of retail services were remunerated via wholesale price controls and via the 1% retail margin, creating a double count that Ofwat sought to eliminate by making a deduction from the wholesale rate of return;
- by PR19, the legacy retail assets had been fully depreciated. Ofwat nevertheless retained a retail margin deduction on the reasoning that retail activities are less risky than wholesale activities and, hence, the estimated appointee cost of capital, calculated with reference to observed appointee betas, overstates the required return on the RCV;
- in it PR24 'early view', Ofwat did not make any reference to relative riskiness. It did, however, run a calculation that shows that the required retail margin during the 2020-25 has been approximately half of the 1% margin currently included in retail price controls. It therefore said that it would retain a retail margin deduction in the calculation of the wholesale cost of capital in order to ensure that companies do not make excess profits.

Ofwat's position aligns to the view that the CMA took in its PR19 redetermination. This suggests that Yorkshire Water should treat the retail margin deduction as fixed part of the PR24 methodology. However, we do offer the following observations:

- the calculations that Ofwat has so far run to calibrate the required PR24 retail margin, and hence the retail margin deduction, are wholly backward-looking. As Ofwat itself notes, it will need to update the calculation to give a more forward-looking perspective on the appropriate size of the deduction when it has companies' projected costs for 2025-30;
- in methodological terms, adjusting wholesale price controls to account for a faulty calibration of retail controls now looks very odd. It would be far more logical for Ofwat to account for any overstatement of the retail margin by reducing that margin (e.g. from 1% to ~0.5% under Ofwat's 'early view' calculations) rather than by making a contrived adjustment to the wholesale rate of return; and
- this would then shine a spotlight on the main issue that we think emerges from Ofwat's 'early view' – i.e. the question of whether it is realistic to expect shareholders to finance a household retail business in exchange for an annual profit margin of only ~0.5%.

Our recollection of previous work in this area is that there are no comparable industries (e.g. non-household retail, energy retail, high-street retail, train operator contracts) in which investors accept returns of less than 1%. We therefore think that there is a discussion to be had with Ofwat about a potential understatement of the required retail margin and, by implication, a potential overstatement of the proposed retail margin deduction.

Annex 2: Oxera – Cost of capital for PR24, Final report for Yorkshire Water (25 August 2023)

Cost of capital for PR24

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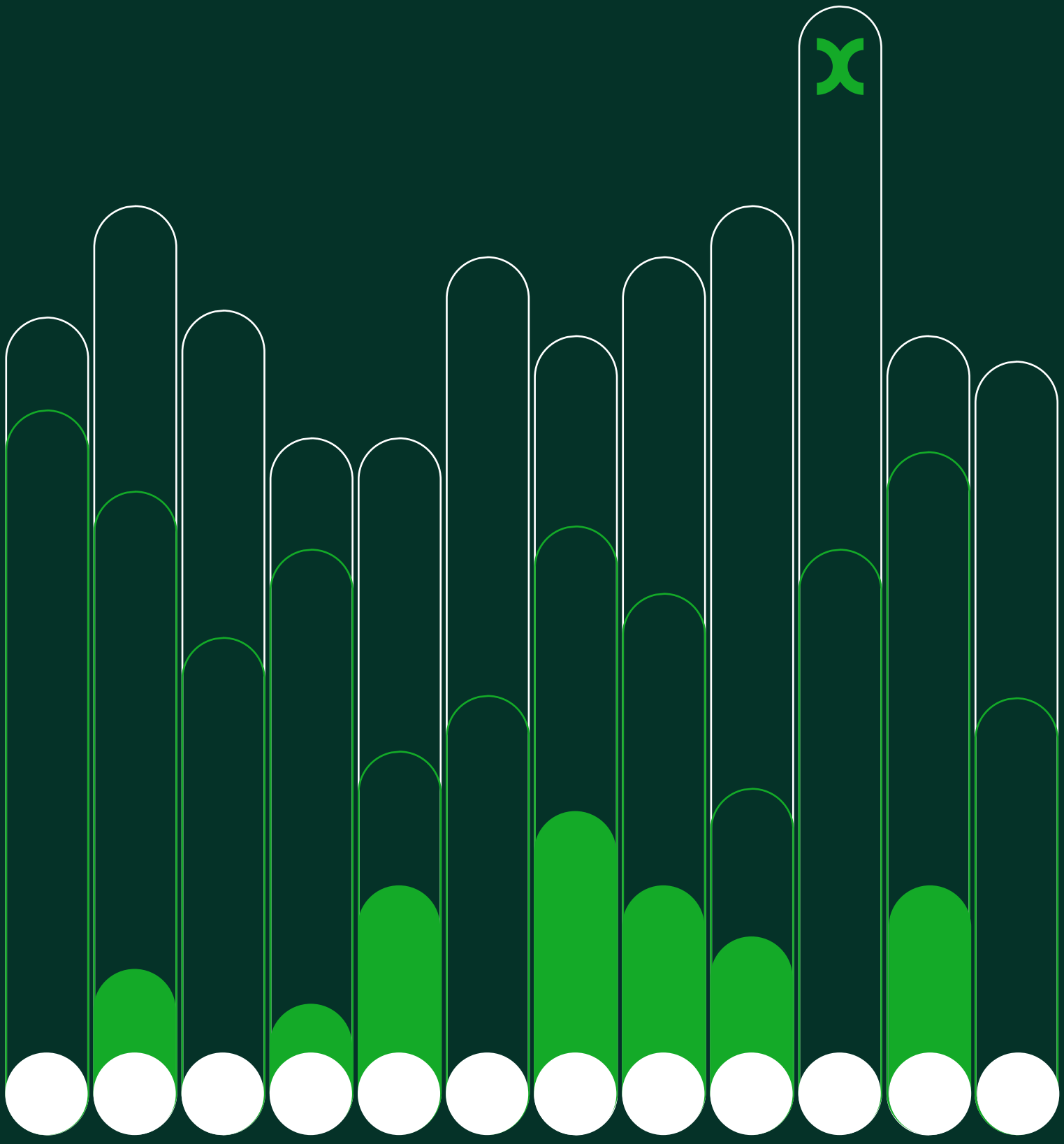
Final report for Yorkshire Water Services Limited

25 August 2023



Contents

Executive summary

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In December 2022, Ofwat published the final methodology for setting the allowed return on capital for PR24, including the allowed return on equity, the allowed return on debt and the retail margin adjustment.[1] These allowances are necessary to provide debt and equity investors with a reasonable return: one that is commensurate with the level of risk that underpins their investment.

To inform the decision on the value to use for the cost of capital, Yorkshire Water Services Limited instructed Oxera to provide an independent view on the methodology that should be used to estimate the weighted average cost of capital (WACC) and each of its components.

Ofwat's report focuses on the use of the capital asset pricing model (CAPM) to estimate the CoE. The CAPM includes three parameters: the risk-free rate (RFR), the total market return (TMR), and the equity beta. In this report, we present our review of Ofwat's methodology to estimate each of the CAPM parameters. We also compare the risk premia on equity and debt.

To estimate the cost of debt, Ofwat determines a cost of embedded debt (CoED), based on the actual debt instruments issued by water companies and the cost of new debt (CoND) based on a bond index. The cost of embedded and new debt are weighted based on the 'share of new debt' that reflects water companies financing needs to sustain RCV growth and refinance expiring debt instruments during the AMP8 regulatory period.

We summarise below our approach for estimating each of the above parameters.

Risk-free rate

Ofwat is proposing to draw on a one-month average of RPI-linked gilt yields as its primary source of evidence, transforming this number into CPIH-real terms using the RPI-CPI wedge. Ofwat determines the wedge taking the average of the 'official forecast' approach and the 'inflation swaps' approach.

Our methodology for estimating the risk-free rate is aligned to the one of Ofwat in a number of regards (e.g. using RPI-linked gilts and the estimation of the RPI-CPI wedge).

However, in this report we provide evidence that supports the existence of a convenience premium, which demonstrates that using gilt yields to estimate the RFR results in an underestimation of the 'true' rate.

Moreover, since the cost of capital is fixed for a future regulatory period it is necessary to consider evidence on expected future interest rates. Thus, we present the rationale of adding a forward premium.

[1] Ofwat (2022), 'Appendix 11: Allowed return on capital', December.

Beta

Ofwat is proposing to estimate the beta with reference to a sample of 'pure play' water companies (United Utilities and Severn Trent) and is looking at estimation windows of two, five and ten years.

To de-lever the equity betas of the comparators, Ofwat is proposing to use a notional gearing level of 55% and a debt beta in the range 0.05 to 0.15 (with 0.10 as the mid-point).

Our methodology focuses on the use of daily observations, estimating raw equity betas with the same estimation windows as Ofwat. To de-lever the equity betas we use the same notional gearing of 55% and debt beta mid-point of 0.10. Re-estimating the notional gearing and the debt beta is outside the scope of this report.

However, in our analysis, we observed how the inclusion of Pennon in the estimation sample moves the equity betas by the same magnitude regardless of the estimation window analysed (2-, 5- or 10-year).[2] The absence of a convergence between the beta of Pennon and those of Severn Trent and United Utilities may indicate that the beta of Pennon based on financial data before the second quarter of 2021 is reliable evidence on the beta for a water company. For these reasons we include Pennon in the equity beta estimation sample.

Total market return

Ofwat is proposing to estimate the TMR using primarily the historical ex post and ex ante approaches.

First, in relation to the ex post approach, we agree with Ofwat that the ONS recently published CPIH backcast should be used to estimate the CPIH-real TMR. Moreover, we also estimate the TMR in RPI-real terms transforming the estimates into CPIH-real using the RPI-CPI wedge.

In addition, the correct averaging method of historical returns should be used to estimate the unbiased expected TMR. We provide evidence that demonstrates that an arithmetic average should be used. Specifically, we demonstrate that there is no evidence of serial correlation of annual returns and hence there is no basis to deviate from using the arithmetic average applied on one-year holding periods.

Second, in relation to the ex-ante approach, we note that this methodology does not add new evidence to the ex post approach. The arbitrary classification of the elements and events that are 'unlikely to be repeatable' make the results of this approach more subjective than the results of the ex post approach. Therefore, we consider that no weight should be placed on this approach.

Cost of embedded debt

Since a full consideration of the most appropriate approach for estimating the cost of embedded debt is outside the scope of this report, we therefore apply the balance sheet approach implemented

[2] We observed that for all the estimation windows the effect of including Pennon in the sample is of increasing the re-levered equity betas by 0.03.

by Ofwat, using updated data for FY2023. However, we test the impact of aligning the instruments selection with the one used by the CMA as part of the PR19 appeal.[3]

Thus, we calculate the cost of embedded debt including interest rate swaps, junior debt and intercompany loans on the basis that the CMA did not exclude these categories of instruments and that these are widely used across the sector.

Cost of new debt

The cost of new debt approximates the cost of the debt instruments that companies will be raising during the control period both for financing RCV growth and for refinancing the expiring debt instruments.

Ofwat estimates the cost of new debt for PR24 as the one-month average yields of the iBoxx £ non-financials A/BBB 10+ indices applying a downwards benchmark index adjustment of 15bps.

We agree with the iBoxx indices selected by Ofwat, since they are consistent with the credit rating and tenor of debt assumed for the notional company. However we add a forward premium to reflect the market expectation of rates for the AMP8 years and to be consistent with the RfR estimation.

Finally, our results support the conclusion of the CMA's review of PR19[4], that there is insufficient evidence of like for like outperformance of water company debt vs broader market. These results confirm the conceptual perspective that there is no reason to expect yields on bonds issued by the water sector to systematically deviate from a benchmark index that is matched by credit rating and tenor.

Hence we have not found enough evidence to apply an outperformance wedge to reduce the cost of new debt.

Comparison of risk premia on equity and debt

We have used the above methodology for calculating a range in which the cost of capital for AMP8 can be estimated. Our analysis points to a range for the cost of capital of the wholesale business from 3.57% to 4.14%, CPIH-real.[5]

We have then compared the risk premia on equity and debt, by unlevering the cost of equity and deducting the risk-free rate to calculate an asset risk premium (ARP). This is compared against the debt risk premium (DRP) for new debt. The cost of capital range generates a positive ARP-DRP implying that the cost of capital estimates reflect the fundamental principle of risk aversion in finance, where holders of capital assets with higher risk demand a higher return.

[3] Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – Final report', 17 March, paras 9.602–9.637. Henceforth in the report, referred to as 'the CMA redetermination (2021).
[4] The CMA redetermination (2021).
[5] A review of the 6bps 'retail margin adjustment' that is deducted by Ofwat from the Appointee WACC is outside the scope of this report.

We have then further corroborated the principle that the ARP-DRP differential should always be greater than zero considering the relationship between risk premia and gearing.

Specifically, the DRP should be close to zero when gearing is close to zero, and increases with gearing. This increase is driven by the greater likelihood and cost of financial distress, which are positively correlated with gearing. As gearing approaches 100%, the DRP must approach the ARP, as the company is now financed almost entirely by debt. Applying this conceptual framework we have determined a theoretical lower-bound on the ARP. We have used this theoretical lower-bound to truncate the equity beta range determining our cost of capital final interval of 3.68% to 4.14%.

The table below summarises our estimates, while comparing them with the ones of Ofwat at PR24 Final Methodology and the ones of Ofwat determined by updating the cut-off date of the analysis from 30 September 2022 to 31 July 2023. Taking any individual parameter from the 'Oxera low' scenario out of context, for example combining the beta estimate with a lower value for the TMR, would breach the lower bound for the ARP.

Oxera WACC range, Ofwat PR24 WACC estimate and Ofwat's WACC estimate based on an updated cut-off date

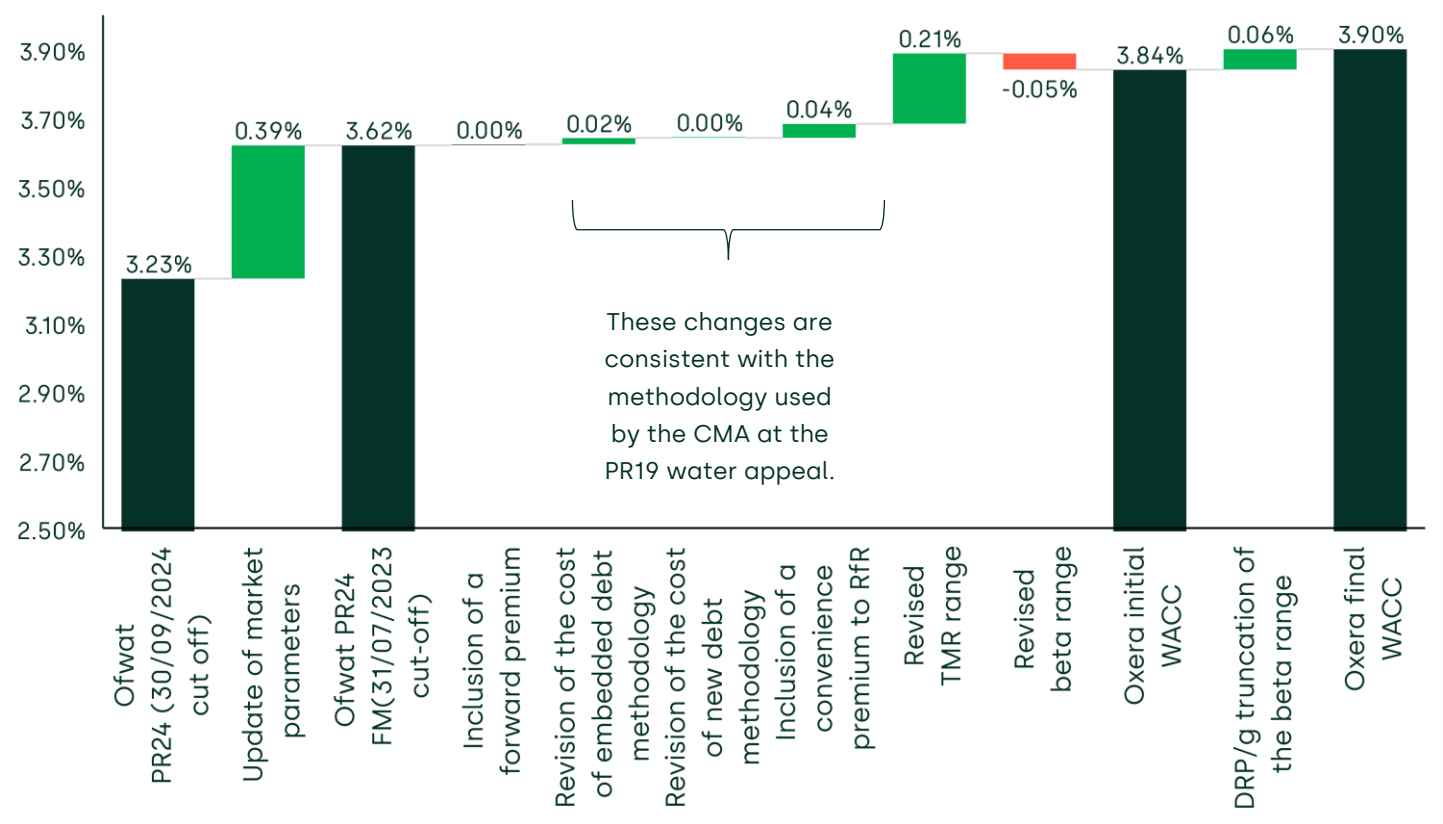
Parameters	Ofwat final methodology	Ofwat updated cut-off	Oxera low	Oxera high
Gearing	55%	55%	55%	55%
Total market return	6.00–6.92%	6.00–6.92%	6.70%[1]	7.70%[1]
Risk-free rate	0.47%	1.54%	1.74%[2]	1.74%[2]
Notional equity beta	0.58–0.64	0.62	0.59	0.66[3]
Return on equity	**3.67–4.60% (4.14% mid-point)**	**4.59%**	**4.67%**[4]	**5.67%**[4]
Cost of embedded debt	2.34%	2.65%	2.69%[5]	2.69%[5]
Cost of new debt	3.28%	3.74%	3.84%[6]	3.84%[6]
Share of new debt	17%	17%	17%	17%
Return on debt	**2.60%**	**2.94%**	**2.99%**[7]	**2.99%**[7]
Appointee WACC (real, vanilla)	**3.29%**	**3.68%**	**3.74%**[8]	**4.20%**[8]
Retail margin deduction	0.06%	0.06%	0.06%	0.06%
Wholesale WACC (real, vanilla)	**3.23%**	**3.62%**	**3.68%**	**4.14 %**

Note: The cut-off date for the Oxera scenarios is 31 July 2023. [1] These numbers come from section 2.4.1. [2] See Table 2.7. [3] The higher number of the notional equity beta range comes from Table 2.9. The lower bound of the range has been determined by applying the constraint identified through the theoretical lower bound on the ARP to the equity beta. [4] The return on equity is calculated using the CAPM framework as explained in section 2.1. [5] As summarised in section 3.1. [6] See Table 3.1. [7] See Table 3.3.

Source: Ofwat PR24 Final Methodology report and Oxera analysis.

Finally, the bridge chart below summarises the steps we have implemented to update the WACC determined by Ofwat in PR24 with the most recent market data and our view on the methodology for how the cost of capital should be calculated.

Steps to update Ofwat's PR24 WACC



Note: The vertical axis has been scaled to make increments more visible. [1] In updating Ofwat's analysis we have used new market data for the calculation of the RfR (including the RPI-CPI wedge) and the CoND. [2] DRP/g is the debt risk premium divided by the notional gearing level and imposes a theoretical lower-bound on the asset risk premium.
Source: Oxera analysis.

1 Introduction

1.1 Context for this report

In December 2022, Ofwat published the final methodology for setting the allowed return on capital for PR24. This details the methodology for setting the allowed return on equity, the allowed return on debt and the retail margin adjustment.[6] These allowances are necessary to provide debt and equity investors with a reasonable return: one that is commensurate with the level of risk that underpins their investment.

As part of the price control process companies are required to submit to the regulator their business plans for the price control period. This requires companies to include their view on which value to use as the cost of capital, and for company Boards to assure that the plans are financeable on this basis.

The cost of capital is an input to the calculation of the companies' allowed revenues and is used to calculate the returns that the companies need to earn to compensate their debt and equity investors.

To inform the decision on the value to use for the cost of capital, Yorkshire Water Services Limited instructed Oxera to provide an independent view on the methodology that should be used to estimate the WACC (weighted average cost of capital) and each of its components. This report presents the corresponding range for the WACC estimate resulting from an application of this methodology.

1.2 Structure of this report

The remainder of this report is structured as follows:

- section 2: presents our calculation of the cost of equity based on the CAPM (capital asset pricing model), and the methodology that underpins each of the CAPM components;
- section 3: summarises our view on the calculation of the cost of debt estimate and the relevant estimation methodology;
- section 4 calculates the ARP-DRP (asset risk premium relative to debt risk premium) cross check;
- section 5: draws from the precedent sections to determine the cost of capital.

[6] Ofwat (2022), 'Appendix 11: Allowed return on capital', December.

2 The cost of equity

This section outlines Oxera's approach to estimating the cost of equity, for the water industry in the PR24 control, along with the resulting parameters. We align our estimation methodology and analysis with Ofwat's Methodology where reasonable, and carefully consider where adaptation of the approach is needed to reflect capital market and academic evidence.

2.1 CAPM framework

Cost of equity (CoE) is the rate of return required by equity investors in order to invest in a particular company or project. The CAPM is the most common method used by practitioners, regulators and academics to calculate CoE, in the context of setting the allowed revenues for regulated companies: other methods—such as the asset risk premium relative to debt risk premium—can be used as cross-checks to outputs obtained through the CAPM framework.[7] The relevant formula for the CAPM is the following:

$$CoE = risk\ free\ rate + \ equity\ beta * equity\ risk\ premium$$

In essence, the CAPM assumes that the CoE of a particular investment is related to its exposure to 'systematic' or non-diversifiable equity market risk. The return required by equity investors consists of the return on a risk-free investment, and a risk premium that reflects how correlated the returns on the particular investment in question are with the market overall. The CAPM assumes that in equilibrium the expected return for bearing non-systematic risk will be zero, since the model assumes that these risks can be diversified away by holding a portfolio of assets.

The exposure to systematic risk is measured by the equity beta. An investment with no systematic risk (i.e. with no correlation with returns on the market) would have an equity beta of zero. An investment in the equity of a company of average market risk would have an equity beta of 1—in other words, the premium over the RfR that equity investors expect to earn on such an investment would be the same as the average for the overall market (i.e. equal to the ERP - equity risk premium).

We summarise below our approach to estimating input parameters for the CAPM formula in the context of estimating an appropriate allowed rate of return for PR24.

2.2 Risk-free rate (RfR)

The RFR measures the expected return on an asset that is free of risk—i.e. where the realised return on the investment will be equal to the expected return. In the CAPM framework, this notional riskless asset is also referred to as a 'zero-beta asset' (i.e. an asset with zero sensitivity to overall market risk). The CAPM assumes that all investors can borrow and lend an unlimited amount at the RFR. This is an important

[7] See section 4 for an application of the ARP-DRP cross-check.

assumption because it informs the set of instruments that can be used to estimate the RFR.

In economies with low sovereign default risk, regulators have typically estimated the RFR with reference to the yield to maturity on government-issued bonds (also known as 'gilts' in the UK). These bonds are assumed to be notionally free of default and systematic risk.[8]

However, more recently, there has been a debate in the UK and in elsewhere Europe as to whether government bonds provide the best estimate of the RfR. It has been observed that even borrowers with very low credit risk cannot borrow at the same rate as the government—e.g. the yield on the highest rated corporate bonds (i.e. AAA) is usually above the yield on government bonds of the same maturity. It has also been argued that government bond yields are below the return on a zero-beta asset because they have special properties that give rise to a price premium (which we refer to as a 'convenience premium' in this report) that lowers their yields below the RfR. As explained in section 2.2.3, we believe it is important to account for the convenience premium when estimating the risk-free rate.[9]

Furthermore, since the cost of capital is fixed for a future regulatory period, we believe it is necessary to consider evidence on expected future interest rates when calculating the risk-free rate. This will generate what we refer to as a 'forward premium'. As explained in section 2.2.4, expected future interest rates can be estimated using spot rates of bonds with different maturities.

For comparison we report in Box 2.1 below a summary of Ofwat's approach for estimating the risk-free rate.

Box 2.1 Ofwat's approach in estimating the risk-free rate

In the PR24 final methodology Ofwat relies on the following set of parameters in order to come up with a point estimate for the risk-free rate.

1) 20-year index-linked gilts (ILG): due to the recent environment of high inflation Ofwat believes that estimating the risk-free rate using nominal instruments is particularly challenging, therefore Ofwat focuses on 20-year ILG yields.

[8] Note that, in the past, regulators have typically followed this approach while allowing for a certain amount of additional headroom.
[9] Allowing for a convenience premium adjustment in the calculation of the RFR (e.g. by including highly-rated corporate bonds in the assessment of an appropriate RFR) is an approach increasingly used by other European regulators. For example, see the CMA redetermination (2021); Civil Aviation Authority (2022), 'Economic regulation of Heathrow Airport Limited: H7 Final Proposals - Section 3: Financial issues and implementation'; Civil Aviation Authority (2022), 'Economic regulation of NATS (En Route) plc: Appendices to initial proposals for the next price control review ('NR23')', October; UREGNI (2022), 'GD23 - Gas Distribution Price Control 2023-2028 - Final Determination - Main Report', October.

2) Averaging period: Ofwat selects a 1-month trailing average of 20-year ILG yields in order to have a point estimate that is not excessively dictated by recent market movements.

3) Convenience and forward premia: Ofwat does not believe there is sufficient evidence, at present, supporting the use of either of the two premia.

4) Inflation: the RPI-real risk-free rate is converted into CPIH-real terms using the RPI-CPI wedge. The wedge is calculated by looking at both the 'inflation swaps approach' and the 'official forecast approach'.

Source: Ofwat (2022), 'Appendix 11: Allowed return on capital', December, section 3.3.

As reported in Box 2.1 and visible from the following sections, our estimation methodology of the RfR is aligned with that of Ofwat with the exception of the averaging period and adding a convenience and a forward premium. The below sections summarise our approach in estimating the risk-free rate. In particular:

- section 2.2.1 shows our updated estimate and our view on the most appropriate averaging period for the gilts component;
- section 2.2.2 discusses the calculations of the RPI-CPI wedge;
- section 2.2.3 summarises the evidence supporting the inclusion of a convenience premium and its estimation;
- section 2.2.4 computes the magnitude of the forward premium;
- section 2.2.5 summarises the findings of the precedent sections reporting our final RfR estimate.

2.2.1 Calculating the point estimate of the gilt component

As summarised in Box 2.1 Ofwat calculates the RFR based on the one-month average of 20-year index-linked gilts estimated with a cut-off date at 30 September 2022.

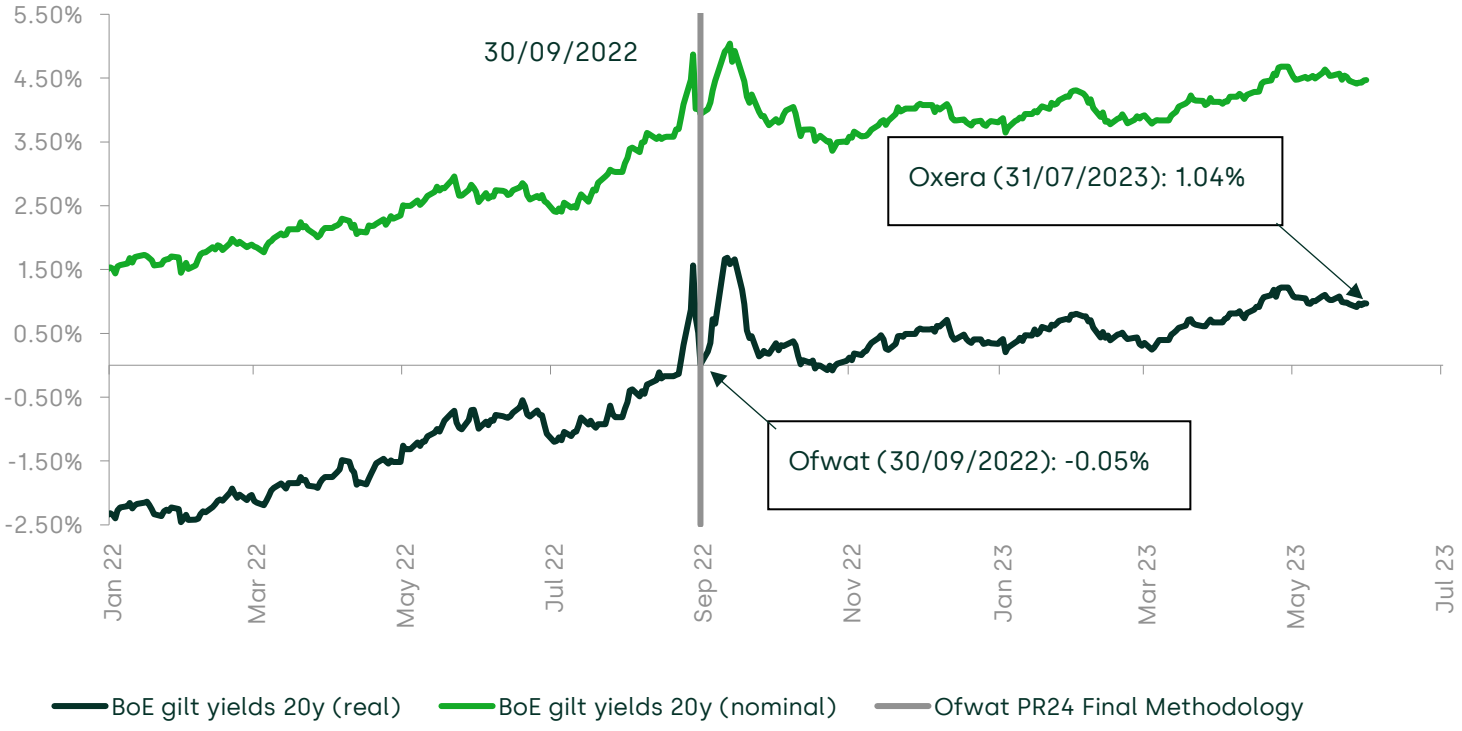
We agree with the use of 20-year gilts as the starting point for calculating the risk-free rate; this is aligned with the methodology outlined by the CMA in the PR19 water appeal report.[10] The CMA observes that ILGs closely match the key requirement of the RFR. The UK government enjoys a strong credit rating of AA/Aa3, and as a sovereign nation has monetary and fiscal levers to support debt repayment that are not available to commercial lenders.[11]

However, we believe that looking at the spot value of the gilts is more informative than taking a trailing average. The latter approach implicitly assumes that rates will move towards the trailing average. Such a forecast may conflict with other forecasts, such as forward rates derived from the gilt yield curve.[12] We also have updated the cut-off date of Ofwat analysis to 31 July 2023 in order to reflect the most recent market movements in our numbers.

[10] CMA redetermination (2021), para. 9.241.
[11] CMA redetermination (2021), para. 9.103.
[12] Alternative approaches (e.g. trailing averages over short periods or indexation) could be used provided they are applied consistently over time.

Figure 2.1 below shows the evolution of the yields for the 20-year nominal and index-linked gilts.

Figure 2.1 Nominal and real 20-year gilts' rates



Note: The cut-off date is 31 July 2023.
Source: Bank of England.

Based on the cut-off date of 31 July 2023 the spot yield on 20-year index-linked gilts is 1.04% RPI-real. To use this number in the cost of equity formula it needs to be converted into CPIH-real terms using the RPI-CPI wedge, as we explain in section 2.2.2.

The most recent estimate of 1.04% is higher compared to the one identified by Ofwat in the PR24 Final Methodology of -0.05%.[13] This is due to market rates having moved up when compared to the end of September cut-off date. Moreover, Ofwat's number is pushed downwards by the one-month average that includes a period of relatively lower rates.

To cross-check the RfR estimate Ofwat considered the evidence from SONIA swaps, however noting that longer durations of SONIA swaps tend to have a lower rate than nominal gilt yields.

We do not believe that using SONIA swap rates as a cross-check for the RfR is informative since it only adds more noise and distortions to the estimation. As we have extensively explained in a previous publication in response to Ofwat's PR24 consultation[14] a variety of distortions and market frictions lead to significant and persistent differentials in swap rates relative to gilt yields. For instance, at the longer end of the yield curve, SONIA swap rates are distorted by, for example, the excess

[13] Ofwat (2022), 'Appendix 11: Allowed return on capital', December, Table 3.5.
[14] Oxera (2022), 'RFR methodology for PR24', September, section 3.5.

demand generated by the hedging operations of pension funds, relative to the limited supply due to stringent regulatory requirements (i.e. high capital requirements) for swap dealers. This tends to lead to excess demand for swaps at this maturity and makes the SONIA swap rate an unreliable proxy of the underlying RFR.

2.2.2 Estimation of the RPI-CPI wedge

In November 2020, the Chancellor announced that the UK Statistics Authority could introduce its RPI to CPIH transition unilaterally from 2030. These planned reforms will align the changes in the Retail Price Index (RPI) with the changes in the Consumer Price Index including owner occupier housing costs (CPIH).[15]

Against this background, Ofwat is considering a number of methodologies for estimating the RPI/CPIH wedge in order to convert RPI-linked ILG yields into CPIH-real RfR estimates.

In setting the RPI-CPIH wedge Ofwat considers both the 'official forecast' approach,[16] and the 'inflation swaps' approach,[17] taking an average of the two to determine the final point estimate. Both approaches return an estimate of the RPI-CPI wedge and Ofwat assumes the CPI-CPIH difference to be negligible.

In this section we have updated both approaches based on new market data.

Our analysis using data from Bloomberg, shown in Figure 2.2, finds that the latest spread of RPI-CPI swap rates is around 45bp (as of 31 July 2023).

Figure 2.2 Weekly average of 20-year RPI-CPI spread

[15] UK Statistics Authority (2020), 'Response to the joint consultation on reforming the methodology of the Retail Prices Index', https://uksa.statisticsauthority.gov.uk/news/response-to-the-joint-consultation-on-reforming-the-methodology-of-the-retail-prices-index/

[16] Ofwat (2022), 'Appendix 11: Allowed return on capital', December, p. 21.

[17] Ofwat (2022), 'Appendix 11: Allowed return on capital', December, p. 19–21.

Note: Seven-day moving average. The cut-off date of the analysis is 31 July 2023.
Source: Oxera analysis using Bloomberg data.

Table 2.1 below, shows our update of the 'official forecast' approach. We have used the most recent OBR inflation forecasts up to 2027 (the longest forecast horizon).[18] We have assumed RPI and CPI to be equal to their long-term target for the years 2028 and 2029, and treated 2030 as a transition period with RPI equal to 2.50%.[19] Both rates equal 2% thereafter. By construction, the official forecasts approach assumes that the RPI inflation rate implied by the ILGs will equal the CPI inflation rate with 100% probability from 2031 onwards.

Table 2.1 20-year official forecast approach based on OBR data

	RPI inflation	CPI inflation	RPI-CPI wedge
2023	8.88%	6.13%	2.59%
2024	1.62%	0.86%	0.76%
2025	0.97%	0.12%	0.86%
2026	1.73%	0.50%	1.22%
2027	2.80%	1.57%	1.21%
2028	3.00%	2.00%	0.98%
2029	3.00%	2.00%	0.98%
2030	2.50%	2.00%	0.49%
2031–42	2.00%	2.00%	0.00%
Geometric average			**0.45%**

Source: Oxera analysis using data from OBR (2023), 'Economic and Fiscal outlook – March 2023', March.

Table 2.2 below compares the RPI-CPI wedges calculated under the two approaches for different time-horizons.

Table 2.2 Summary of inflation wedge estimation results

	Official forecast	Inflation swaps	Average
10-year	0.91%	0.69%	0.80%
15-year	0.60%	0.52%	0.56%
20-year	0.45%	0.42%	0.44%

Note: The cut-off date of the analysis is 31 July 2023.
Source: Oxera analysis based on Bloomberg and OBR data.

As we can see in Table 2.2, looking at the 20-year horizon that matches the maturity of the gilts, the two approaches lead to very similar results (i.e. 0.42–0.45).

As such, we have selected an RPI-CPI wedge of 0.44% equal to the average of the 20-year 'official forecast' approach and the 20-year

[18] The OBR forecasts have been published in March 2023.
[19] Aligned with Ofwat we treat 2030 as a transition year with RPI matching 2.50% that is equivalent to the midpoint between RPI inflation of 3% and the long-term CPI inflation target of 2%.

spot difference in inflation swaps. Table 2.3 below applies the identified wedge on top of the previously identified 20-year gilts' yield.

Table 2.3 Translating 20-year RPI-real gilts into CPIH real

	Formula	Spot
20-year ILG yields, RPI-real	[A]	1.04%
20-year RPI-CPI wedge	[B]	0.44%
20-year CPIH-real yield	**[C]=(1+[A])*(1+[B])-1**	**1.48%**

Note: The cut-off date of the analysis is 31 July 2023.
Source: Oxera analysis based on Bloomberg and Bank of England data.

2.2.3 Convenience premium (CP)

The CAPM defines the RfR as the rate of return on a zero-beta asset, and assumes that there is a single RfR at which investors can undertake risk-free borrowing and lending. However—as noted earlier—this assumption might be violated when considering an estimate of the RfR that is based on yields on government bonds.

In 2020, Oxera published a paper that investigated the relationship between sovereign yields and the CAPM.[20] In that paper, we explain that using the yield on government bonds as the RFR in the CAPM model can lead to a violation of the Modigliani-Miller (MM) theorem.[21] We explain that this is caused by a convenience premium, which pushes down yields on government bonds relative to the RFR.

In essence, the convenience premium is caused by excess demand for highly rated government bonds driven by regulatory requirements and the use of government bonds in hedging strategies—e.g. interest rate hedging. Hence, the convenience premium reflects the money-like safety and liquidity characteristics of government bonds.

The excess demand for government bonds used in hedging strategies is confirmed by the recent market turmoil of September 2022, where the Bank of England had to intervene in the gilt market and provide a new liquidity facility for a subset of gilt market participants (Liability Driven Investment funds) to halt a potential fire sale of long-dated gilts. The liability driven investment market created a leveraged demand for gilts as a hedge against long-dated pension funds liabilities, recognising the money-like safety and liquidity characteristics of government bonds.

Therefore, when estimating the RFR for use as an input to the CAPM from government bond yields, adjustments are required to account for the convenience premium. This is consistent with the approaches increasingly used by other regulators, which include an explicit allowance to account for the convenience premium in the calculation of the risk-free rate.[22]

[20] Oxera (2020), 'Are sovereign yields the risk-free rate for the CAPM?', prepared for the Energy Networks Association, 20 May.
[21] Ibid., p. 6.
[22] Allowing for a convenience premium adjustment in the calculation of the RFR (e.g. by including highly-rated corporate bonds in the assessment of an appropriate RFR) is an

Therefore, to estimate the RfR using the yields on government bonds, it is necessary to adjust the benchmark yield upwards to account for the convenience premium.

In adjusting for the inclusion of a convenience premium the CMA considered whether highly rated, non-government bonds may improve the RfR estimation in the context of price controls. The CMA assessed the IHS iBoxx UK non-gilt AAA 10+ index and the IHS iBoxx UK non-gilt AAA 10-15 index.[23] The CMA concluded that the constituents of these indices are not 'risk-free' in the same way as government bonds denominated in the home country's currency are. This is because investors in these non-government bonds still bear liquidity risks, as well as the additional default risks associated with the issuer. That said, the CMA recognised that the default risks of these high-quality bonds are exceptionally low, and evidence from actual performance suggests that the expected loss is significantly lower than the debt premium.[24] As a result, the CMA concluded that the yields on AAA-rated non-government bonds are suitable inputs to the RFR estimation.[25]

In line with the decision of the CMA, the CAA in its recent price control decision for Heathrow conclude that it is appropriate to place a 50% weighting on AAA-rated non-government bonds.[26] More specifically, the CAA states that:

> We remain of the view that ILGs may exhibit a "convenience yield" or other specific factors that mean that the yields on ILGs may underestimate the "true" risk free rate. Stakeholders' submissions to date have not included new evidence that has altered this view. We therefore consider that there is still a case for **placing weight on an alternative risk free rate benchmark that does not exhibit a convenience yield.** [emphasis added]

The CAA proposes to estimate the convenience premium embedded in gilts by comparing the returns on these indices to the closest nominal gilt in maturity for each of the iBoxx non-Gilts AAA-rated 10+ years and 10-15 years indices. This approach is equivalent to using the AAA-rated bonds directly in the weighting formula for the RFR.

Figure 2.3 presents the nominal spreads of the iBoxx £ AAA non-gilt 10+ and 10-15 indices. These yield spreads have consistently been positive over the past ten years. Thus, when using ILGs as a proxy for the RfR, a convenience premium must be added to the yield implied in the prices of ILGs in order to obtain a correct estimate for the RfR.

approach increasingly used by other European regulators. For example, see CMA redetermination (2021); Civil Aviation Authority (2022), 'Economic regulation of Heathrow Airport Limited: H7 Final Proposals - Section 3: Financial issues and implementation'; Civil Aviation Authority (2022), 'Economic regulation of NATS (En Route) plc: Appendices to initial proposals for the next price control review ('NR23')', October; UREGNI (2022), 'GD23 - Gas Distribution Price Control 2023-2028 - Final Determination - Main Report', October.

[23] CMA redetermination (2021), para. 9.145.

[24] CMA redetermination (2021), para. 9.146.

[25] CMA redetermination (2021), para. 9.162.

[26] CAA (2022), 'Economic regulation of Heathrow Airport: H7 Final', section 3, paras 9.247–9.250.

Figure 2.3 Nominal spreads of AAA bond indices

Note: The spreads are calculated by deducting yields on maturity-matching nominal gilts.
Source: Oxera analysis of HIS Markit and Bank of England data.

Our view is broadly in line with that of the CMA in its redetermination for PR19, namely that the estimate of the RFR should be based on both the ILGs and the AAA-rated bonds. Our view is also in line with that of the CAA in its latest proposals for the regulation of Heathrow Airport, in which the ILG rates are augmented by a convenience premium that reflects the yield spreads of the AAA-rate bonds.

In order to account for the convenience premium we have looked at the iBoxx £ non-gilts AAA 10-15 and the iBoxx £ non-gilts AAA 10+. Table 2.4 below summarises the main characteristics of these indices.

Table 2.4 iBoxx AAA characteristics

	iBoxx £ non-gilts AAA 10-15	iBoxx £ non-gilts AAA 10+
Number of bonds in the sample	4	13
Average remaining life of the bonds	13 years	30 years
Spread of the bonds in the sample[1]	0.31%	0.76%

Note: [1] The spread has been calculated by subtracting the yield of the bond with the lowest yield from the yield of the bond with the highest yield.
Source: Oxera analysis of HIS Markit data and Bloomberg data.

iBoxx provides the yields of its indices only in nominal terms. In order to deflate the nominal values into CPIH-real we have followed the process below:

- Step 1: we look at the 20-year breakeven RPI inflation.[27]

[27] The breakeven RPI inflation is determined as the difference in yield between 20-year nominal gilts and 20-year index-linked gilts.

- Step 2: we deflate the breakeven RPI inflation by the RPI-CPI wedge discussed in section 2.2.2 in order to convert the nominal iBoxx.

Table 2.5 below provides a summary of our calculations.

Table 2.5 Process to deflate the iBoxx indices into CPIH-real values

	Formula	Spot value at 31/07/2023
20-year breakeven inflation	[A]	3.40%
20-year RPI-CPI wedge[1]	[B]	0.44%
Difference in the above	[C]=(1+[A])/(1+[B])-1	2.95%
iBoxx £ non-gilts AAA 10-15, nominal	[D]	4.81%
iBoxx £ non-gilts AAA 10+, nominal	[E]	4.80%
Average of AAA indices, CPIH real	**[F]=(1+avg([D],[E]))/(1+[C])-1**	**1.80%**

Note: [1] See Table 2.3. The cut-off date of the analysis is 31 July 2023.
Source: Oxera analysis using data from HIS Markit and Bank of England.

In order to determine our risk-free rate estimate, we take the average of the CPIH-real yield implied by the 20-year gilts of 1.48% (as shown in Table 2.3) with the value identified in Table 2.5 of 1.80%.

2.2.4 Forward premium (FP)

Since the cost of capital is fixed for a future regulatory period, it is necessary to consider evidence on expected future interest rates. Expected future interest rates can be estimated using spot rates of bonds with different maturities. Specifically, the expected interest rate of a bond with maturity $(t_a - t_b)$ in t_b years can be estimated according to the following formula:

$$Forward\ rate = \left[\frac{(1+i_a)^{t_a}}{(1+i_b)^{t_b}}\right]^{\frac{1}{t_a - t_b}} - 1$$

Where:

- i_a is the yield on bond a of t_a periods;
- i_b is the yield on bond b of t_b periods.

The forward premium is then computed as the difference between the forward curve and the spot rate of a bond with the same maturity.

The forward premium should reflect the yield on the RfR expected at the mid-point of the control period. This is because the aim is to approximate the average RfR of the entire control period, assuming that capital investment will be spread approximately evenly across that period.

We have estimated a forward-rate adjustment based on the implied forward curve of the 20-year index-linked gilts' yields. Table 2.6 presents the result of a 5-year forward premium[28] on a 20-year maturity gilt, computed with the yield on the five- and 25-year

[28] We estimate a 5-year forward premium to reflects rates in 2028, which is approximately the mid-point of the control period.

government bonds as illustrated below. Following this methodology we have identified a forward premium of 0.11%, as reported in Table 2.6.

Table 2.6 5-year forward premium (20-year index-linked gilts)

Parameter	Formula	Yield
Five-year gilts' yield	$[i_b]$	0.93%
25-year gilts' yield	$[i_a]$	1.10%
Forward rate	$[A]=\left[\frac{(1+i_a)^{t_a}}{(1+i_b)^{t_b}}\right]^{\frac{1}{t_a-t_b}}-1$	1.14%
20-year gilts' yield	[B]	1.04%
Forward premium	**[C]=[A]-[B]**	**0.11%**

Note: The cut-off date of the analysis is 31 July 2023.
Source: Oxera analysis based on Bank of England data.

2.2.5 RfR estimate

Using the results obtained in the precedent sections, we now compute the RfR. Table 2.7 below summarises our point estimates for each of these parameters and the resulting RfR equal to 1.64%.

Table 2.7 Estimation of the RfR

	Formula	Spot
Average of AAA indices, CPIH-real[1]	[A]	1.80%
20y ILG, CPIH real[2]	[B]	1.48%
RfR estimate	[C]=avg([A],[B])	1.64%
Forward premium (5Y)[3]	[D]	0.11%
Oxera RfR estimate	**[E]=[C]+[D]**	**1.74%**

Note: [1] See Table 2.5. [2] See Table 2.3. [3] See Table 2.6. The cut-off date of the analysis is 31 July 2023. Numbers might not sum due to rounding.
Source: Oxera analysis.

2.3 Equity beta

The equity beta in the CAPM is a measure of how risky an equity investment is compared with the average of the market portfolio. The risk arising because of a company's general exposure to the market is known as 'systematic risk'. An equity beta of one means that the stock return on average moves in line with the average market return. An equity beta between zero and one means that it tends to move in the same direction as the market return, but to a lesser magnitude (or greater magnitude, for a beta above one).

Beta is a measure of systematic risk in the CAPM. Although it is a forward-looking concept, in practice its estimation requires interpretation of historical market data.

For a company listed on the stock market, estimating the equity beta using simple regression analysis is relatively straightforward because market data is publicly available.[29] For companies that are not listed,

[29] Since the market portfolio is unobservable it is standard practice to proxy it using an equity index as, for example, the FTSE All Share.

listed comparator companies need to be identified that can be used as a proxy. Observable equity betas for these comparators need to be adjusted to the level of gearing for the company for which the CoE is being estimated, in order to be comparable (i.e. de-levering and re-levering needs to be consistently undertaken with reference to the capital structure of the target company).

This is the case for regulated companies. Since the regulator regulates companies on the basis of a notional capital structure, it does not attempt to calculate the beta for any company specifically. Instead it calculates betas based on a sample of comparators and adjusts them to reflect the gearing level of the notional company. Box 2.2 below summarises Ofwat's approach to estimating the equity beta component.

Box 2.2 Ofwat's approach to estimating the beta

Ofwat, in its PR24 Final Methodology publication, calculates the equity beta starting from the following set of assumptions.

1) Listed comparator set: Ofwat proposes to place weight on water companies Severn Trent and United Utilities, but excludes Pennon as it is not considered to be 'pure-play' in the water industry.

2) Frequency of data: given the 'reference day' issue, which refers to betas being consistently lower or higher on certain days of the week or month, Ofwat maintains its position to rely on daily data for raw equity beta estimation.

3) Estimation period: Ofwat recognises that macroeconomic events such as the Covid-19 pandemic and the Ukraine War may impact on betas for the water sector. However, it considers that such data should not be eliminated from the data series from which the beta estimates are derived. Ofwat considers instead that it is more appropriate to recognise that recent, more volatile data presents a case to revisit the trade-off between longer and shorter estimation periods. In doing so, it proposes to consider evidence from all proposed estimation periods (2Y, 5Y and 10Y) while ultimately placing most weight on longer estimation periods and longer trailing averages.

4) Gearing and debt beta: Ofwat intends to use enterprise value gearing[30] as the working definition of gearing for delevering raw beta using the Harris-Pringle formula. For the estimation of the debt beta Ofwat relies on a number of different methodologies based on direct, indirect, structural and decompositional methodologies, identifying a debt beta in the range of 0.05 to 0.15.

[30] The enterprise value of gearing is computed as net debt divided by market capitalization plus net debt.

5) Based on the above set of assumptions Ofwat took an 'in the round' approach, identifying an equity beta range of 0.58 to 0.64.

Source: Ofwat (2022), 'Appendix 11: Allowed return on capital', December, section 3.5.

There are several practical issues involved in beta estimation. These include:

- comparator selection;
- data frequency and the timeframe of analysis;
- de- and re-gearing betas;
- the inclusion of a 'debt beta'.

We now discuss our approach with regard to each of these issues. The methodology we follow is consistent with that of Ofwat in many respects.

2.3.1 Comparator selection

As outlined in Box 2.2, Ofwat calculates the raw equity betas starting from a sample of only two companies: Severn Trent and United Utilities. The selection of these two companies is aligned with the methodology implemented by the CMA in the PR19 water appeal.[31]

Both Severn Trent and United Utilities are 'pure-play' water companies and have a time series of returns sufficiently long to allow the estimation of raw equity betas with a 2-year, 5-year and 10-year estimation window. These characteristics make these two companies good comparators for the notional water company Ofwat is trying to regulate.

Ofwat does not take Pennon into consideration in the equity beta sample, based on the following reasons.[32]

Following its sale of Viridor, Pennon retained a significant amount of cash on its balance sheet. This has had the effect of temporarily reducing its net debt and therefore its gearing. Whilst Pennon's net debt level has returned to more stable levels following its acquisition of Bristol Water in 2021 and the payment of a special dividend, this only occurred at the end of the second quarter of 2021, reducing the period of unaffected data to 15 months given we are using a cut-off data point of 30 September 2022. Given the limited amount of unaffected data available for Pennon, we propose for our early view to rely only on data from Severn Trent and United Utilities, as beta calculations incorporating more than 15 months of data would be impacted by the effects of the Viridor sale. We will review again the use of data from Pennon at draft and final determinations when more data is available.

Compared to Ofwat's cut-off date of 30 September 2022, our updated cut-off date of 31 July 2023 allows us to use ten extra months of

[31] Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – final report', 17 March, para. 9.479.
[32] Ofwat (2022), 'Appendix 11: Allowed return on capital', December, section 3.5.2.

'unaffected data' for Pennon when estimating betas with a 2-year windows.

Moreover, in our analysis, we observed how the inclusion of Pennon in the estimation sample moves the equity betas by the same magnitude regardless of the estimation window analysed (2, 5 or 10-year).[33] The absence of a convergence between the beta of Pennon and those of Severn Trent and United Utilities may indicate that the beta of Pennon based on financial data before the second quarter of 2021 is reliable evidence on the beta for a water company. If Viridor had a higher beta than Bristol Water then we would have expected the betas to converge after the acquisition of Bristol Water. For these reasons we include Pennon in the equity beta estimation sample.

2.3.2 Data frequency, timeframe and index selection

Equity betas can be estimated using daily, weekly or monthly observations. The statistical robustness of the beta estimate is directly proportional to the number of observations used in the regression analysis, which suggests that use of daily data is preferable. This assumes that daily returns are not serially correlated, and that the impact of any general market event is incorporated into the stock price on the same day. Following this principle we estimate the raw equity betas starting from daily stock prices.

In terms of timeframe, our approach is consistent with that taken by the CMA in the PR19 water redeterminations and Ofwat in its PR24 Final Methodology.[34,35] We look at betas estimated starting from 2, 5 and 10-year estimation windows.

Finally, we considered the index used for regressing each company's returns. A consideration when estimating the equity beta is whether to use a domestic, regional or global market benchmark index. This decision depends on how well the individual capital markets are assumed to be integrated, and what the relevant market portfolio for the marginal investor in the stock is—i.e. the equity market index that an investor will typically use to benchmark the performance of an investment in a given company. Assuming that investors will diversify their portfolios within the relevant currency zone, the use of a currency-specific index that matches the currency in which each company's shares are traded is preferred. Therefore, we have calculated the raw equity betas regressing each company's returns on the FTSE All-Share.

2.3.3 Equity beta estimate

Table 2.8 below summarises the estimated equity and asset betas for the sample of companies in our peer group, based on the methodology outlined in the preceding sections.

[33] We observed that for all the estimation windows the effect of including Pennon in the sample is of increasing the re-levered equity betas by 0.03.
[34] CMA redetermination (2021), Table 9-7.
[35] Ofwat (2022), 'Appendix 11: Allowed return on capital', December, section 3.5.4.

In order to calculate the raw equity betas we have regressed the returns for each of the companies on the FTSE All-Share, based on an estimation window of 2, 5 and 10-years.

To determine the asset beta, we de-levered each company's raw equity betas using the Harris Pringle equation:

$$\beta_{asset} = \beta_{equity} * (1 - g) + \beta_{debt} * g$$

Where:

- β_{debt} is set at 0.10, aligned with the mid-point of the PR24 final methodology range;[36,37]
- g is the level of gearing defined as: net debt/(net debt + market capitalisation). This methodology is aligned with that of Ofwat, which looks at the enterprise value of gearing to de-lever the raw equity betas.[38] We estimate the level of gearing based on daily data for the market capitalization value of equity and quarterly data for net debt, averaged over the estimation window.

The following table summarises the raw equity betas, the level of gearing and the corresponding asset betas for the three companies in our sample at different estimation windows.

Table 2.8 Summary of equity and asset betas for the comparator group

	Raw equity beta	Gearing level	Asset beta
Two-years betas			
Severn Trent	0.46	49%	0.29
United Utilities	0.48	52%	0.28
Pennon	0.53	48%	0.33
Average	**0.49**	**50%**	**0.30**
Five-years betas			
Severn Trent	0.53	52%	0.31
United Utilities	0.55	55%	0.30
Pennon	0.51	39%	0.35
Average	**0.53**	**49%**	**0.32**
Ten-years betas			
Severn Trent	0.59	50%	0.34
United Utilities	0.61	54%	0.33
Pennon	0.57	41%	0.38
Average	**0.59**	**48%**	**0.35**

Note: [1] The asset betas are determined based on the formula above. The cut-off date is 31 July 2023.
Source: Oxera analysis based on Bloomberg data.

[36] Ibid., 3.5.5.
[37] We use the mid-point of the debt beta range identified by Ofwat, re-estimating the debt beta is outside the scope of this report.
[38] Ibid., Table 2.1.

Starting from the asset beta numbers identified above we have re-levered them based on a notional level of gearing of 55% and the debt beta of 0.10, using the following formula.[39]

$$\beta_{equity\ re-levered} = \frac{\beta_{asset} - \beta_{debt} * g_{notional}}{1 - g_{notional}}$$

The table below summarises the results of the re-levering process.

Table 2.9 Summary of the re-levered equity betas

	Two-years	Five-years	Ten-years
Severn Trent	0.51	0.56	0.64
United Utilities	0.51	0.56	0.62
Pennon	0.60	0.66	0.72
Average	**0.54**	**0.58**	**0.66**

Note: The cut-off date of the analysis is 31 July 2023. Debt beta assumed as 0.1 and notional gearing (PR24) is 55%.
Source: Oxera analysis based on Bloomberg data and Ofwat PR24.

Based on the above analysis we have identified an equity beta in the range 0.54 to 0.66.

2.4 Total market return (TMR) and equity risk premium (ERP)

The ERP is a premium above the RFR that investors demand for investing in a market equity portfolio. The ERP is calculated as the difference between total market return (TMR) and the RfR. UK regulators and the CMA have tended to follow the view that expected real TMR is relatively stable over time, and that changes in the real RfR are largely offset by changes in the ERP.

The TMR can be estimated using a range of different methodologies. There are three possible approaches to estimate the TMR:

- historical ex post: based on the average of observable historical returns. This is the most widely used method and the one that produces the most robust results;

Two other approaches are:

- historical ex ante: based on the average of adjusted historical returns, where the adjustment accounts for 'unexpected' events that generated a return lower/higher than the expected return;
- forward-looking: based on investor's expectations of future returns. Different methodologies can be used to estimate this, from survey evidence to dividend discount models.

We compute, in section 2.4.1, the estimate of the TMR using the 'historical ex post' approach calculated on the historical arithmetic average of the nominal DMS (Dimson, Marsh and Staunton) series. We deflate the DMS series using the CPIH backcast inflation to come up

[39] We use the same level of notional gearing as the one identified by Ofwat in PR24 Final Methodology. Re-estimating a notional gearing level is outside the scope of this report. However, we present in Appendix 5A1 a sensitivity and the relative impact on the WACC of using the 60% level of gearing determined for PR19.

with an estimate for the TMR in CPIH-real terms. At the same time, there is still merit in using the historical RPI series because it was compiled and published contemporaneously and it is therefore not subject to the same estimation uncertainty as a backcast series. For this reason, we also present a TMR estimate calculated starting from historical RPI series and transformed into CPIH-real terms using the forecast RPI-CPI wedge.

For context Box 2.3 below summarises Ofwat's approach in setting the TMR.

Box 2.3 Ofwat's approach in estimating the TMR

In PR24 Final Methodology Ofwat proposes the following approach to TMR.

1) Approaches: Ofwat proposed to derive a range for the TMR using 'ex-post' and 'ex-ante' historical approaches, stating that the subjectivity of some forward-looking approaches makes them unsuitable as a primary tool for estimating the TMR.

2) Averaging technique: for the ex-post approach, Ofwat proposed to focus on an ex-post arithmetic range derived using overlapping 10-20 year holding periods.

3) Treatment of inflation: Ofwat set out that the newly published ONS CPIH back series spanning 1950 to 1988 was likely to be a more suitable inflation series to deflate historical equity returns than the historical RPI series, reflecting that Ofwat is setting a CPIH-based allowed return.

Source: Ofwat (2022), 'Appendix 11: Allowed return on capital', December, section 3.4.

Moreover, as outlined in Box 2.3, Ofwat in its 'early view' publication relies on the 'historical ex-ante' approach in order to set the lower-bound of its TMR range. We summarise in section 2.4.2 our previous publications on why we do not consider any weight can be placed on the 'historical ex-ante' estimation method.

2.4.1 The ex post TMR

The ex post TMR approach is based on the assumption that the average historical return provides an unbiased and reliable indicator of expected future returns.

This approach is adopted by many regulators in the UK. For instance, Ofgem, Ofcom, Ofwat (PR19) and the CAA used this methodology as the primary indicator to estimate the TMR in their most recent regulatory reviews.

To estimate the TMR using the ex post approach, one needs to average a series of historical returns. The Dimson-Marsh-Staunton (DMS)

dataset[40] provides a useful starting point to calculate this historical average. However, as regulators in the UK are interested in real returns, it is necessary to combine the DMS data with a reliable measure of inflation to estimate the real historical returns. In addition, one needs to make a choice of which averaging method to use (i.e. geometric or arithmetic).

In the next subsections, we explain how to deflate the nominal return series and how to average the real returns to obtain an unbiased and reliable measure of the TMR.

Treatment of Inflation

As we explained in a previous Oxera report in response to the UKRN consultation on the methodology for estimating the cost of capital for regulated companies,[41] nominal historical returns should be deflated using the CED series (for the period 1900–49) and the new backcast series for the CPIH for the period 1950–88. The new backcast CPIH series addresses the most concerning errors found in the previous release. The new CPIH backcast should therefore be used instead of the old CPI backcast when estimating historical returns in CPIH-real terms. For the period 1988–2022 the ONS has been publishing annually the CPIH inflation levels.

Moreover, we believe there is still merit in using the historical RPI series because it was compiled and published contemporaneously and it is therefore not subject to the same estimation uncertainty as a backcast series. For this reason, we also present a TMR estimate calculated starting from the historical RPI series and transformed into CPIH-real terms using the forecast RPI-CPI wedge.

Averaging historical returns

As explained in detail in our previous publication in response to the UKRN consultation[42] there are two options to estimate the average TMR: to calculate the geometric mean or to calculate the arithmetic mean. The geometric mean of any set of numbers is always lower than the arithmetic mean unless all the numbers are equal (in which case the means are the same). For a series of returns, equality between the geometric and arithmetic means would occur only if there is no volatility at all (i.e. if returns are constant). While there is debate about which is the more appropriate averaging method in any given context, the academic literature is broadly supportive of adopting the arithmetic average for estimating the ERP to use when computing required equity returns for valuation and capital budgeting purposes.

[40] Dimson, E., Marsh, P. and Staunton, M. (2023), 'Credit Suisse Global Investment Returns Yearbook 2022'.
[41] Oxera (2022), 'A review of the methodology used to estimate the allowed cost of equity for regulated companies', November, p. 19.
[42] Oxera (2022), 'A review of the methodology used to estimate the allowed cost of equity for regulated companies', November, p. 22.

This conclusion is consistent with the CMA decision in the PR19 redetermination, where the CMA stated that:[43]

> […] in the absence of clear modelling of the regulator's decision, the most appropriate estimate to use is the arithmetic mean. […]
>
> On balance, we consider that using the arithmetic mean is preferable due to its simplicity and transparency, and also given that at the current time, there is no reason to conclude that one perspective, either that of the capital budgeter or of the portfolio investor, is 'correct'.

Finally, in order to determine a TMR estimate we rely on non-overlapping annual holding periods over the entire DMS series. Using non-overlapping holding periods compared to overlapping ones ensures no serial correlations in the returns. In our previous publication in response to the UKRN consultation[44] we applied the Ljung-Box test to the DMS series assuming different non-overlapping holding periods.[45] The results shown that for each non-overlapping holding period (i.e. 1-year, 5-year, 10-year and 20-year) we do not find statistically significant serial correlation in the returns.

Estimating the TMR

Based on the aforementioned assumptions on inflation, the averaging period and consistent with our previous publications, we estimate the TMR starting from UK nominal returns data published by DMS.

Table 2.10 below summarises our CPIH-real estimates of the TMR.

Table 2.10 The ex post TMR

	Low	High	Average
1900–2022 arithmetic average real equity returns[1] (using CPIH backcast inflation series)	6.92%	7.01%	6.96%
1900–2022 arithmetic average real equity returns[1] (using RPI inflation series and the RPI-CPI wedge)[2]	7.34%	7.44%	7.39%

Note: The update from the ONS affects only the data points between 1950 and 1988. To cover the pre-1950 period, we use Consumption Expenditure Deflator (CED) data published by the Bank of England in its Millennium database. However, we note that this is an imperfect method as the CED is theoretically and empirically a closer proxy for RPI than CPI. [1] The range in real equity returns is driven by the range of potential values for the 2021 and 2022 UK equity returns used by DMS. In particular, we have the yearly breakdown of the data used by DMS for the period 1900–2020, but not for 2021 and 2022. We infer the estimates in the table from the 1900–2020 and 1900–2022 nominal average returns. [2] The RPI-CPI wedge used is determined looking at the long-run wedge estimated

[43] Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – Final report', 17 March, para. 9.329.
[44] Oxera (2022), 'A review of the methodology used to estimate the allowed cost of equity for regulated companies', November, p. 22.
[45] The Ljung–Box test is a quantitative method that tests for autocorrelation at multiple lags jointly. Ljung, G.M. and Box, G.E.P. (1978), 'On a Measure of a Lack of Fit in Time Series Models', *Biometrika*, **65**:2, pp. 297–303.

by the OBR: OBR (2023), 'Economic and Fiscal outlook – March 2023', March, and equal to 0.92%.
Source: Oxera analysis based on ONS, DMS and Bank of England data.

From the above analysis we have identified a point estimate for the TMR of c. 7.2% (the average between 6.96% and 7.39%). It is appropriate to express this parameter as a range to reflect some of the uncertainty around this number at the beginning of the new regulatory period. Thus, we add ±50bps around the point estimate determining a TMR that can span from 6.70% to 7.70%.

2.4.2 The ex-ante TMR

As summarised in Box 2.3, while Ofwat relies on the ex-ante approach for setting the lower-bound of its TMR range, we do not believe that placing weight on the ex-ante approach is informative due to its subjective nature.

Specifically, this approach attempts to identify investors' reasonable expectations of returns by making adjustments to the historical series of returns. These adjustments attempt to identify one-off outcomes of good or bad 'luck', i.e. those that investors might not expect to be repeated in the future.

In the PR24 Final Methodology paper, this ex ante approach was discussed, with Ofwat using the DMS decomposition method. The DMS decomposition approach involves decomposing the ERP into the mean dividend yield, the growth rate of real dividends, the expansion of the price/dividend ratio, and the change in real exchange rate.

The adjustment to the derived TMR then arises from subjective adjustments to the average value of one or more of these components.

It is necessary to clarify the use of the term 'ex ante approach'. An estimate of the TMR today, i.e. the expected future return obtained using the simple historical mean return, can be described as 'ex ante' in the sense that the estimate applies to future returns. This should be clearly differentiated from the DMS decomposition methods, which instead try to assess whether the returns that investors were expecting in the past are well approximated by the historical mean.

In effect, the ex-ante decomposition approach attempts to substitute actual returns by predicted returns. While it is therefore applied to inform a forward-looking estimate, the sensitivity of input assumptions and degree of subjectivity involved make it less reliable than the historical average of actual returns.

We thus consider this ex ante (decomposition) approach to be more appropriately labelled as an 'adjusted ex post approach', since it uses an adjusted historical data series to estimate the TMR. This should be contrasted against an actual ex-ante approach, which would attempt to predict an event before it occurs.

Given that decomposing the TMR (and the ERP) can involve many different variables and result in many different forms, it is a subjective exercise that requires one to choose which elements to include in the

decomposition, and which should be classified as 'unlikely to be repeatable'. Materially, there is no guarantee that a variable that exhibits 'unrepeatable' behaviour when included in the decomposition with another variable would exhibit the same behaviour in conjunction with a third and different variable.[46]

Considering the subjective nature of the adjustments made to derive the adjusted ex post TMR, we conclude that no weight should be placed on this approach in estimating the TMR. While its aim is to be forward-looking, the sensitivity of input assumptions and degree of subjectivity involved makes it less reliable than the historical average of actual returns.

[46] See also Oxera (2022), 'A review of the methodology used to estimate the allowed cost of equity for regulated companies', November, p. 24.

3 Cost of Debt (CoD)

The cost of debt component of the WACC reflects the return required to compensate debt investors for lending to a business.

There are two main approaches for estimating the CoD.

- The market CoD can be estimated with reference to yields of comparable market-traded debt instruments, using similar credit ratings and debt tenors. For example, to estimate the CoD of a company rated BBB, one can refer to BBB rated bonds in the market or a BBB rated index such as the BBB iBoxx non-financial corporate bond index.
- The actual CoD can be calculated with reference to the sector's existing debt obligations. This information is generally available in the financial statements of companies within the sector.

Ofwat in setting the cost of debt allowance uses a mix of the two approaches:

- the regulator looks into actual debt instruments of the sample of regulated UK water companies for setting the notional cost of embedded debt (CoED). The cost of embedded debt approximates the costs of the debt instruments that companies have raised before the start of the new regulatory period;
- At the same time Ofwat looks at a market index in order to determine the notional cost of new debt (CoND). The cost of new debt approximates the cost of the debt instruments that companies will be raising during the control period both for financing RCV growth and for refinancing the expiring debt instruments.

Box 3.1 below summarises Ofwat's approach in setting the cost of embedded and new debt for PR24.

Box 3.1 Ofwat's approach in estimating the cost of debt

As part of the PR24 final methodology report Ofwat implements the following methodology for the estimation of the cost of embedded debt.

1) Approach used: Ofwat looks on the balance sheet approach as the primary method, looking at company-level issued debt instruments to set a single sector allowance. Ofwat places weights on benchmarks derived using all eligible instruments ('all in costs'), and using only fixed and index-linked instruments constrained to the weights of the notional structure ('actual-notional costs'). Since WaSCs and large WoCs account for over 99% of outstanding embedded debt Ofwat considers it appropriate to set a single allowance based on the median value for these companies.

2) Exclusions from balance sheet approach: Ofwat proposes to exclude debenture stock, preference shares, intercompany debt,

junior debt and interest rate swaps from the benchmark assessment for the notional company, on the grounds that these instruments were insufficiently debt-like (or had equity-like features), or were not relevant to the notional company. In addition Ofwat proposes to exclude liquidity facilities on the grounds that their cost was covered in the 'issuance and liquidity cost allowance'.

For setting the cost of new debt Ofwat follows the approach below.

1) Choice of benchmark index: Ofwat proposes to set the cost of new debt based on the average of the A and BBB-rated iBoxx GBP non-financials 10+ indices, due to its consistency with the credit rating stated as the target for the notionally-structured company.

2) Averaging period: Ofwat proposes to use an averaging period of 1-month to derive the initial assumption for setting the cost of new debt allowance. Justifying this assumption with maintaining a good balance between keeping data in the sample recent enough to be relevant, while limiting the weight placed on unrepresentative data.

3) Addressing uncertainty: Ofwat said that it will continue to index the new debt allowance with an end-of-period reconciliation, consistent with the approach at PR19.

4) Benchmark index adjustment: Ofwat adjust downwards the estimated CoND number by an outperformance wedge. This adjustment is further explained in Box 3.2.

The CoED and the CoND are then weighted based on the share of new debt that represents the requirements that the companies have during the regulatory period to finance RCV growth and refinance expiring debt. An extra 10bps allowance for issuance and liquidity costs is added on top of the final estimate.

Source: Ofwat (2022), 'Appendix 11: Allowed return on capital', December, section 4.

Based on the above description the cost of debt can be calculated using the following formula.

$$K_d = ((1 - w) * CoED) + (w * CoND) + Li$$

Where:

- *w*: is the share of new debt; and
- Li: represent the extra allowance for issuance and liquidity costs.

The following sections summarise our approach for setting the cost of debt allowance.

3.1 Estimating the cost of embedded debt

The cost of embedded debt approximates the costs of the debt instruments that companies have raised before the start of the new regulatory period.

Since a full consideration of the most appropriate approach for estimating the cost of embedded debt is outside the scope of this report, we therefore apply the balance sheet approach implemented by Ofwat. However, we have updated the Ofwat model for FY23 financial data, including updating SONIA rates and new debt interest rate, as per the latest market update. We then test the impact of aligning the instruments selection with the one used by the CMA as part of the PR19 appeal.[47]

Thus, we calculate the cost of embedded debt including interest rate swaps, junior debt and intercompany loans on the basis that the CMA did not exclude these categories of instruments and that these are widely used across the sector. Ofwat estimates a CoED at PR24 of 2.34% CPIH-real, as of 30 September, 2022. Updating the Ofwat CoED model as of 31 July 2023, we get an updated CoED of 2.65% CPIH-real. This is largely due to SONIA rates going up, and the floating rate debt cost going up subsequently. The further impact of aligning the instruments selection with the one used by CMA as part of the PR19 appeal is:

- c. +5 bps accounting for junior debt;
- c. -1 bp accounting for swaps.

The inclusion of intercompany loans has no impact on the CoED level at two decimal places. This is aligned with the findings of Ofwat at PR24.[48]

Thus, by aligning the instruments selection with that of the CMA at PR19, we determine an embedded cost of debt of 2.69%.[49]

3.2 Estimating the cost of new debt

The cost of new debt approximates the cost of the debt instruments that companies will be raising during the control period both for financing RCV growth and for refinancing the expiring debt instruments.

As summarised in Box 3.2 Ofwat estimates the cost of new debt for PR24 as the one-month average of yields on the iBoxx £ non-financials A/BBB 10+ indices applying a downwards benchmark index adjustment of 15bps.

We agree with the iBoxx indices selected by Ofwat, since they are consistent with the credit rating and tenor of debt assumed for the national company. However we make the following modifications in the estimation approach:

- we update the cut-off date from 30 September 2022 to 31 July 2023, to reflect the most recent market data;
- we look at the spot estimate of the average of the iBoxx A/BBB rather than at the one-month average in order to align the averaging period

[47] Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – Final report', 17 March, paras 9.602–9.637.
[48] Ofwat (2022), 'Appendix 11: Allowed return on capital', December, p. 64.
[49] The Ofwat embedded debt dataset utilised for running the analysis is based on data to 31 March 2023 and a forecast for debt that will be raised over the remainder of AMP7. It will therefore need to be updated at draft and final determinations.

to the one we use for the RfR and to place more weight on the latest market observations;
- we add a forward premium to reflect the market expectation of rates for the AMP8 years and to be consistent with the RfR estimation (see section 2.2.4).

Based on the above we have estimated a cost of new debt of 3.84%. Table 3.1 summarises our results.

Table 3.1 Cost of new debt estimates

	Formula	Spot
iBoxx A/BBB 10+, nominal	[A]	5.81%
CPIH inflation[1]	[B]	2.00%
iBoxx A/BBB 10+, CPIH real	[C]=(1+[A])/(1+[B])	3.74%
Forward premium (5Y)	[D]	0.11%
Cost of new debt, CPIH real	**[E]=[C]+[D]**	**3.84%**

Note: [1] We use 2% long term CPIH inflation to deflate the nominal iBoxx into CPIH-real terms. This is aligned with Ofwat at PR24. The cut-off date is 31 July 2023.
Source: Oxera analysis of HIS Markit and Bank of England data.

Section 3.2.1 below summarises our position on why we do not consider it relevant to apply a benchmark outperformance adjustment, as Ofwat assumes (i.e. a 'halo effect' for utilities) on top of this estimate.

3.2.1 Benchmark index adjustment

A benchmark index adjustment might be required in the presence of any systemic premium or discount in yield at issuance across the sector vs the comparable index, e.g. the iBoxx A/BBB £ Non-Financials index. It has been Ofwat's view that water companies have the ability to issue debt at yields lower than suggested by Ofwat's chosen benchmark (a halo effect). Box 3.2 below summarises Ofwat's approach in setting the benchmark index adjustment.

Box 3.2 Ofwat's approach to the benchmark index adjustment

In the PR24 Final Methodology, Ofwat considers the yields at issuance for GBP, fixed rate bonds, with a tenor at issuance of 10+ years, issued since 2015 and calculates spreads against the average yields of the iBoxx A/BBB £ Non-Financials 10+ indices. The full sample consists of 60 bonds. A lower yield at issuance of 35 bps is observed for the full sample, and a yield discount of 41 bps for a narrower sample of 13 Baa1 rated bonds.

Hence, Ofwat adjusts the allowed return on debt, applying a downward adjustment of 15 bps to the trailing average of the benchmark index used for calculating the cost of new debt.

Source: Ofwat (2022), 'Appendix 11: Allowed return on capital', December, section 4.3.5.

We tested Ofwat's conclusions applying a slightly different methodology. The key difference in our approach compared to Ofwat is the filtering criteria applied to the sample of instruments issued by water companies and the benchmark index to which each bond's yield is compared. From a conceptual perspective there is no reason to expect yields on bonds issued by the water sector to systematically deviate from a benchmark index that is matched by credit rating and tenor.

In order to calculate the benchmark index adjustment, we apply the following filtering criteria to the full sample of instruments included in the (updated for FY23) cost of debt model issued by Ofwat along with the PR24 Final Methodology.[50] Our filtering criteria are aligned with those used by the CMA at PR19,[51] and are as follows:

- water company bonds issued during the AMP7 period (1 April 2020 to 31 March 2025), which are:
  - GBP denominated;
  - non-callable; and
  - fixed rate.

Our sample consists of 27 bonds.[52]

We start calculating the spreads by first matching the tenor at issuance of each of the bonds in our sample to the average of iBoxx A/BBB index that most closely matches the tenor of the bond. For example, for a bond with tenor at issuance of 8 years, the spread was calculated against iBoxx £ Non-Financials A/BBB 7-10 (matching the issuance date of the bond).

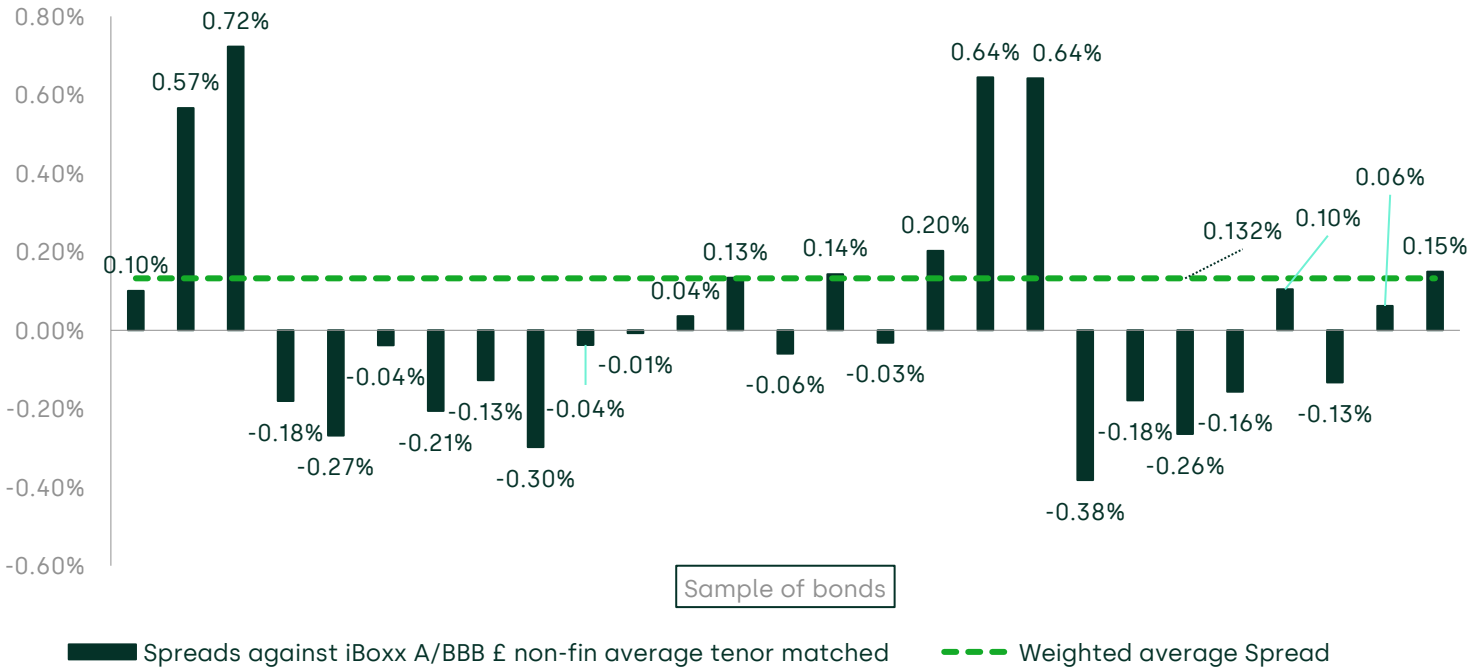
Our choice of index reflects the fact that the majority of the bonds in our sample are either A- or BBB+. Hence, we have selected a benchmark index that is similar in credit rating, thus removing the spread that exists between bonds with different credit ratings. Tenor matching the bonds to the index controls for the term premium that would otherwise be (incorrectly) included in the spreads, that is different for bonds of different tenors (typically higher for longer tenors if we assume the yield curve is upward sloping). For example, shorter maturity bonds will have lower yields, so controlling for tenor is an important step in calculating spreads accurately.

Based on the above methodology and sample of bonds, we determined a weighted average spread of 13 bps, with the weights being the issuance/facility size. This means that bonds were on average issued at higher yields than the benchmark index.

[50] Ofwat (2022), 'PR24 balance sheet cost of debt model', 13 December, updated for 2023.
[51] Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – final report', 17 March.
[52] Ofwat's sample sizes are n=60 and n=13 for the full sample and smaller sample (Baa1 bonds only) respectively. Our sample size (n=27) is different first because Ofwat has considered bonds issued from 2015 onwards, while we consider bonds issued during the AMP7 period (1 April 2020 to present). Second, while Ofwat includes only bonds with tenor at issuance of 10+ years, we have included bonds with all tenors that fit within our filtering criteria.

Figure 3.1 below shows the identified spreads.

Figure 3.1 Spreads against iBoxx £ Non-Financials A/BBB tenor matched



Note: The cyclical pattern in the spreads, suggests that any differences in the indexes used are not systematic. We formally test this hypothesis below and find the same result. The broken green line represents the weighted average spread, weighted by the original issuance size.
Source: Oxera analysis of Ofwat and IHS Markit data.

To test if the identified underperformance of 13bps is statistically different from zero, we conducted a one sample t test.[53] This is a statistical hypothesis test[54] used to determine whether an unknown population mean is significantly different from a specific value. In this case, we hypothesized that the mean spread is not different from zero (null hypothesis), while the alternative hypothesis was that spreads are different from zero, hence a two tailed test. Our chosen level of significance was 0.05. As our results show in

Table 3.2, the 95% confidence interval contains zero, and the p value is 0.769, both implying that we fail to reject the null hypothesis at our chosen level of significance. Hence we do not find the spreads to be significantly different from zero.

Table 3.2 One sample t test results

Number of observations	27
Mean	0.042%[1]
Std deviation	0.297%

[53] T test conducted because the population standard deviation is unknown, and our sample size is small (22 bonds). If the sample size was larger than 30, standard normal distribution could have been used to approximate the student's t distribution. One sample t test is conducted here because we have data on a single variable (spreads), and there is no comparison made between groups.
[54] A procedure based on sample evidence and probability theory to determine whether the hypothesis is a reasonable statement.

Std error	0.057%
Critical values[2]	-2.056, 2.056
Test statistic[3]	0.7388
95% Confidence Interval[4]	-0.075%,0.160%
p value[5]	0.466
Degrees of freedom[6]	26

Note: [1] The mean reported in this table is a simple average of our spreads, while the mean reported in Figure 3.1, (13 bps) is a weighted average of the spreads, weighted by the original issuance size. [2] The dividing points between the regions where the null hypothesis is rejected and the region where it is not rejected. [3] A value determined from sample information, used to determine whether to reject the null hypothesis. [4] A range of values so defined that there is a specified probability (95% in this case) that the value of a parameter lies within it. [5] The probability of observing a sample value as extreme, or more extreme, than the value observed, given that the null hypothesis is true. [6] The number of independent values or quantities which can be assigned to a statistical distribution. There is a family of t distributions, different for each degree of freedom. As the degree of freedom increases, the shape of the t distribution approaches that of the standard normal distribution.
Source: Oxera analysis of Ofwat and IHS Markit data.

As such, our results support the conclusion of the CMA at PR19,[55] that there is insufficient evidence of like for like outperformance of water company debt vs broader market. As discussed in the beginning of this section, these results confirm the conceptual prediction that there is no reason to expect yields on bonds issued by the water sector to systematically deviate from a benchmark index that is matched by credit rating, tenor and pricing date. Hence there is not enough evidence to apply an outperformance wedge to reduce the cost of new debt.

3.3 The cost of debt estimate

This section draws from the precedent sections on the level of embedded and new debt to calculate the final cost of debt allowance.

When computing the cost of debt Ofwat provisionally uses a share of new debt level of 17% (aligned with the CMA at PR19) and adds an extra allowance of 10bps on top of the final cost of debt estimate to account for issuance and liquidity costs. Since re-estimating these parameters is outside the scope of this report we use the ones determined by Ofwat. However, we present in Appendix A1 a sensitivity showing the impact on cost of debt and on the overall cost of capital of deviating from these estimates. The table below reports our final cost of debt number of 2.99%.

[55] Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – final report', 17 March.

Table 3.3 Cost of debt estimate

	Formula	Estimate
Cost of embedded debt[1]	[A]	2.69%
Cost of new debt[2]	[B]	3.84%
Share of new debt	[C]	17%
Issuance and liquidity costs	[D]	0.10%
Cost of debt	**[E]=[A]*(1-[C])+[B]*[C]+[D]**	**2.99%**

Note: [1] See section 3.1. [2] See Table 3.1. All numbers are in CPIH real terms.
Source: Oxera analysis.

4 Comparison of risk premia on equity and debt

In March 2019, as part of the Energy Network Association's response to Ofgem's RIIO-2 Sector Specific Methodology, Oxera submitted evidence to Ofgem on how calculations of the CoE of regulated companies compared with their risk in the debt markets (the first 'Oxera ARP–DRP report').[56] We explained that the differential between the ARP (asset risk premium) and DRP (debt risk premium) can be used as a cross-check to the estimation of the allowed CoE.[57]

In the next subsections, we explain the ARP–DRP framework and how it can be used to cross-check the CoE of regulated utilities.

4.1 Underpinnings and use case of the ARP-DRP framework

The ARP–DRP framework is founded upon the fundamental principle of risk aversion in finance, where holders of capital assets with higher risk demand a higher return. As debt-holders have priority claims ahead of equity investors over a company's assets, equity investors are thus subject to greater risks and demand a higher return. Where this principle is breached by CoE estimates being too low relative to the market pricing of debt, it suggests an error in the application of the CoE estimation.

The ARP reflects the excess return required by investors in return for providing capital to risky assets compared with the risk-free rate, while the DRP reflects the excess return required by investors in return for acquiring risky debt. As an asset (debt) becomes more risky, the ARP (DRP) also increases.

There are several advantages inherent within the ARP–DRP framework, which are altogether beneficial to improving the robustness of cost of capital estimates. The first is that the ARP-DRP framework can be employed to correct bias in estimates of the WACC as its specification mitigates the attenuation bias apparent in the CAPM beta arising from measurement errors in the independent variable (i.e. market returns).[58] By constructing the ARP–DRP delta, any measurement errors embedded within each of the asset and debt beta estimates will tend to offset each other, thus providing a more reliable estimate of the difference between the asset and debt risk premiums.

Secondly, the ARP–DRP framework provides a method for the evaluation of financeability in a way that is neutral to the treatment of inflation. In other words, the differential derived from nominal parameter values will be the same as that derived from RPI-real or CPIH-real parameter values.

Following the first Oxera report, our evidence and methodology was updated in a later submission to Ofgem in September 2020 (the second

[56] Oxera (2019), 'Risk premium on assets relative to debt', 25 March.
[57] For a summary of the ARP-DRP intuition see also Oxera (2023), 'What does the cost of debt tell us about the cost of equity?', 31 May.
[58] Regression dilution, also known as regression attenuation, is the biasing of the linear regression slope towards zero, caused by measurement errors in the independent variable.

Oxera ARP–DRP report),[59] where we set out further support for the ARP–DRP framework to be given greater weight and consideration in assessing the allowed CoE. In reviewing Ofgem's assessment process for the setting of the allowed return on equity for RIIO-2, the CMA noted that 'the theoretical principles behind ARP–DRP may be valid'.[60]

4.2 Results of the ARP-DRP framework

Based on the above principles and underpinnings we have calculated the ARP-DRP differential for two Oxera scenarios (identified through the range in the TMR and equity beta) as well as for Ofwat PR24 and a number of precedent regulatory determinations that are useful for benchmarking our ARP-DRP estimates.

Aligned with the above principle that the ARP-DRP framework provides a method for the evaluation of financeability in a way that is neutral to the treatment of inflation we have estimated the ARP starting from CPIH-real numbers and the DRP starting from nominal rates. This allows us to treat inflation consistently within the ARP calculation and within the DRP calculation.

The relevant formulae for calculating the ARP-DRP differential are summarised below.

$$ARP = Asset\ beta * (TMR - RfR)$$

$$DRP = CoND - RfR - Expected\ loss$$

Where, in the DRP formula, the 'expected loss' parameter represents the annualised probability of default multiplied by the losses that a debt investor will suffer if a borrower defaults. We have estimated this parameter to be equal to 0.30%.[61]

Moreover, we use the allowance for newly issued debt (CoND) and not the overall cost of debt allowance in the DRP formula, as this makes the comparison forward-looking.

Table 4.1 below compares the results of the ARP-DRP analysis on our numbers and the relevant benchmarks.

[59] Oxera (2020), 'Asset risk premium relative to debt risk premium', 4 September.
[60] Competition and Markets Authority (2021), 'Cadent Gas Limited, National Grid Electricity Transmission plc, National Grid Gas plc, Northern Gas Networks Limited, Scottish Hydro Electric Transmission plc, Southern Gas Networks plc and Scotland Gas Networks plc, SP Transmission plc, Wales & West Utilities Limited vs the Gas and Electricity Markets Authority. Final determination Volume 2A: Joined Grounds: Cost of equity', 28 October, para. 5.717.
[61] For the full methodology behind the 0.30% point estimate see: Oxera (2019), 'Risk premium on assets relative to debt', 25 March, p. 11.

Table 4.1 ARP-DRP results comparison

	Oxera low[1]	Oxera high[1]	Ofwat PR24 FM[2]	Updated Ofwat PR24[3]	Ofwat PR19[4]	CMA PR19[5]	Ofwat PR09[6]
RfR, CPIH real	1.74%	1.74%	0.47%	1.54%	-1.39%	-1.34%	2.00%
TMR, CPIH real	6.70%	7.70%	6.46%	6.46%	6.50%	6.81%	7.40%
Asset beta	0.30	0.35	0.33	0.33	0.36	0.33	0.40
ARP	**1.49%**	**2.09%**	**1.98%**	**1.64%**	**2.84%**	**2.78%**	**2.16%**
CoND, nominal	5.92%	5.92%	5.34%	5.82%	2.54%	2.19%	5.70%
RfR, nominal	4.75%	4.75%	3.71%	4.55%	1.10%	0.86%	4.19%
Expected loss	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
DRP	**0.87%**	**0.87%**	**1.33%**	**0.97%**	**1.14%**	**1.04%**	**1.21%**
ARP-DRP	**0.62%**	**1.23%**	**0.65%**	**0.67%**	**1.70%**	**1.75%**	**0.95%**

Note: [1] The RfR (real and nominal) for the Oxera scenarios includes the convenience premium and the forward premium. The CoND in the Oxera scenarios includes the forward premium. [2] All numbers for Ofwat PR24 are taken from the final methodology report, with the exception of the nominal RfR that has been calculated as the 1-month average of 20-year nominal gilts at Ofwat 30 September cut-off, since Ofwat does not provide this number in the final methodology report. In order to calculate the ARP-DRP differential we have estimated the DRP parameters following Ofwat methodology and thus not including the forward and convenience premium. [3] The updated Ofwat PR24 scenario has been calculated using Ofwat methodology but updating all market parameters based on the cut-off date of 31 July 2023. [4] All numbers for Ofwat PR19 comes from the final determinations report where Ofwat includes both estimates in real and nominal terms. [5] The ARP for the PR19 CMA scenario takes into account the 25bp aiming up allowance on the cost of equity used by the Authority. All numbers for the CMA scenario comes from the CMA final redetermination. [6] The RfR and TMR numbers for Ofwat PR09 are RPI-linked due to the nature of the price control. All ARP estimates are available on the Ofwat's PR09 methodology document. The CoND and RfR nominal have been re-estimated looking at the iBoxx A/BBB 10+ index and 20-year nominal gilts from September 2009.
Source: Oxera analysis and Ofwat (2022), 'Appendix 11: Allowed return on capital', December; Ofwat (2019), 'PR19 final determination – Allowed return on capital technical appendix', December; CMA redetermination (2021); Ofwat (2009), 'Setting price limits for 2010-15'.

The above table shows that both our results and Ofwat's PR24 ARP-DRP differential are greater than zero, implying that the cost of capital estimates reflect the fundamental principle of risk aversion in finance, where holders of capital assets with higher risk demand a higher return.

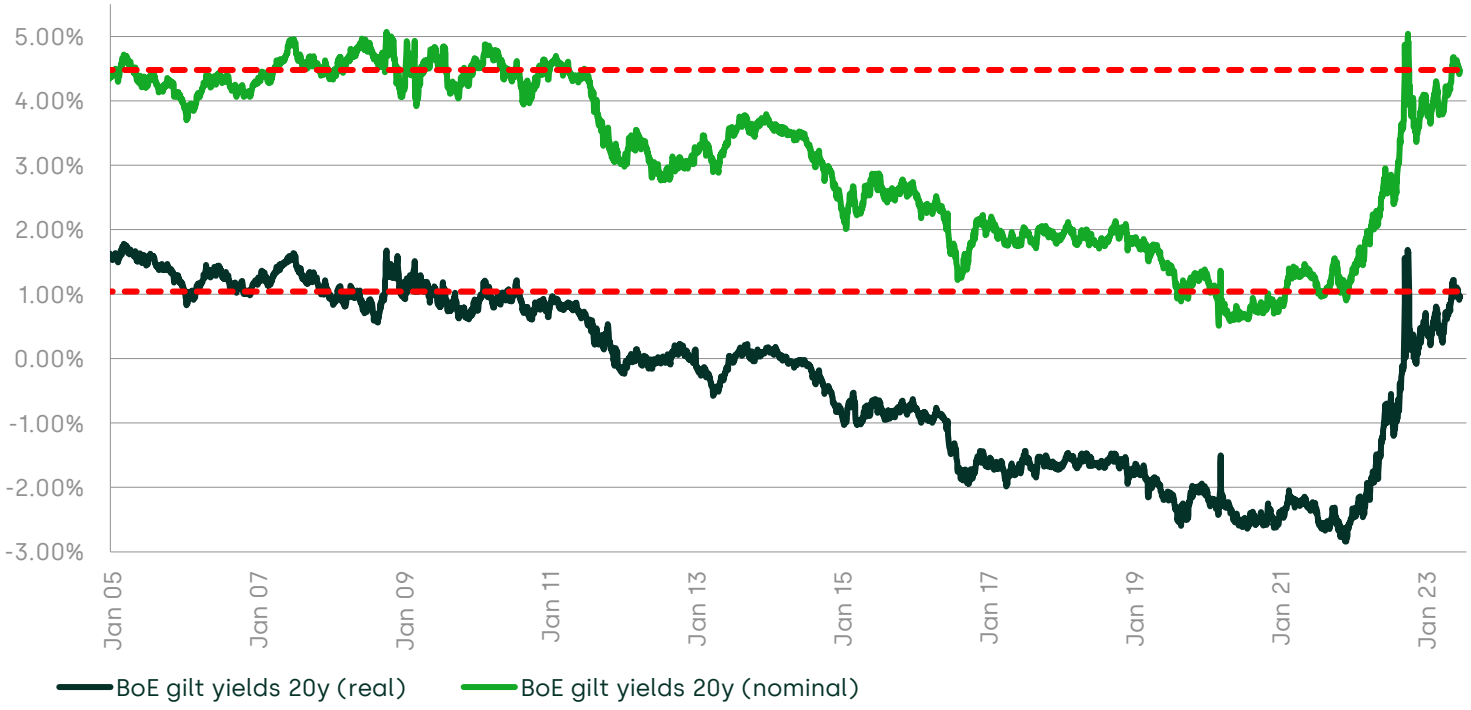
However, it is visible that for both our scenarios and the Ofwat PR24 ones the ARP-DRP differential is significantly lower compared to the level in the PR19 decisions. This represent a significant narrowing in the risk premium on equity relative to the risk premium on debt. This result is primarily a consequence of the increase in interest rates combined with a fixed TMR assumption.

When interest rates increase, assuming a fixed TMR has the effect of reducing the ERP, negatively affecting the ARP. Therefore, the relevance of recent precedents as benchmarks for the differential could be questioned.

This concern can be addressed by comparing the ARP-DRP estimate to the one of a period with similar market rates. The figure below shows how current rates are similar to the ones experienced in the period

2009–11. For this reason we have looked at Ofwat's PR09 decision and calculated the corresponding ARP-DRP differential. The results of our analysis show that once compared to the relevant benchmark, our ARP-DRP range is aligned with previous decisions. Ofwat's PR09 estimate sits near the middle of the Oxera range, while Ofwat's WACC updated to 31 July 2023 yields an ARP-DRP that is below the PR09 estimate.

Figure 4.1 Historical real and nominal gilts



Note: The cut-off date of the analysis is 31 July 2023. The red line indicate the spot value for nominal (4.48%) and index-linked gilts (1.04%) to facilitate comparison with previous periods.
Source: Oxera analysis of BoE data.

4.3 The relationship between ARP, DRP and gearing

The principle that the ARP-DRP differential should always be greater than zero, can be further corroborated by considering the relationship between risk premia and gearing.

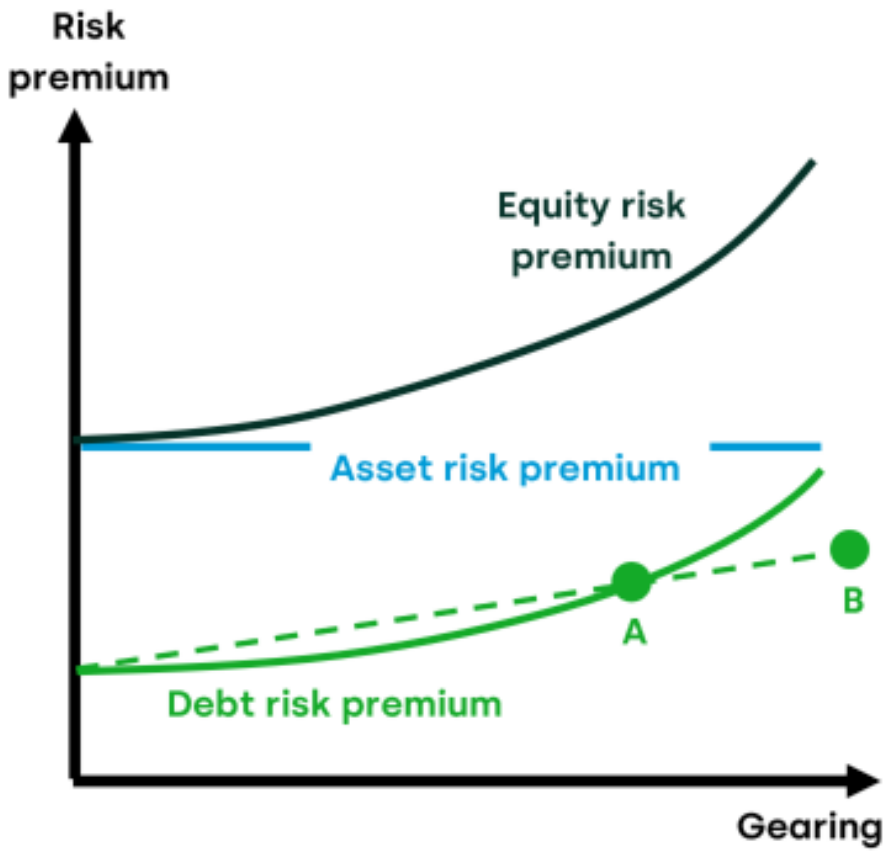
Specifically, the DRP should be close to zero when gearing is close to zero, and increases with gearing. This increase is driven by the greater likelihood and cost of financial distress, which are positively correlated with gearing. As gearing approaches 100%, the DRP must approach the ARP, as the company is now financed almost entirely by debt. On this basis, the ARP–DRP differential should strictly be greater than zero at less than 100% gearing.

By the same logic, the minimum level of the ARP–DRP differential can also be further deduced using the relationship between the risk premia and gearing. These relationships are visually illustrated in Figure 4.2.

The DRP is associated with the company's level of gearing and is depicted by point A in the figure. The relationship between the DRP and

gearing is also shown. The DRP should be close to zero when gearing is close to zero, and increases with gearing. The risk profile of debt will resemble the risk profile of the assets as gearing approaches 100% of enterprise value and therefore the risk premium of debt converges to the risk premium of the assets (i.e. the unlevered cost of equity minus the risk free rate).

Figure 4.2 The relationship between risk premia and gearing



Source: Oxera.

The cost of debt and by implication the DRP are usually assumed to be a convex function of gearing,[62] and estimating this function is not straightforward. However, extrapolating the line connecting the origin and point A provides a prediction of the debt risk premium at 100% gearing (point B). The slope of the line is given by dividing the observed DRP by the observed gearing (point A). Multiplying the slope by 100% provides the DRP at point B. For example, if a DRP of 100bp is observed at 50% gearing (point A) then a DRP of 200bp is predicted at point B. A linear extrapolation to 100% gearing will underestimate the asset risk premium if debt risk is a convex function of gearing. Therefore, the risk premium on unlevered equity should be strictly greater than the risk premium on debt linearly extrapolated to 100% gearing.

The table below tests this constraint on the identified ARP-DRP range presented in Table 4.1.

[62] For example see Berk, J. and DeMarzo, P. (2019), 'Corporate Finance – fifth edition', 11 June, p. 536.

Table 4.2 Theoretical lower-bound on the ARP

	Formula	Ofwat updated	Oxera low	Oxera high
Notional gearing	[A]	55%	55%	55%
ARP	**[B]**	**1.64%**	**1.49%**	**2.09%**
DRP	**[C]**	**0.97%**	**0.87%**	**0.87%**
Lower-bound on the ARP	**[D]=[C]/[A]**	**1.76%**	**1.58%**	**1.58%**

Source: Oxera analysis.

As visible from Table 4.2 above, under the 'Ofwat updated' scenario, the theoretical relationship between the risk premia on debt and on assets supports a higher ARP than the midpoint of the Ofwat range. This means that the cumulative impact of decisions embodied by the PR24 cost of capital methodology has resulted in a cost of equity that is too low relative to the market evidence on the cost of debt. Corrections to one or more of the parameters used by Ofwat in the CAPM to estimate the cost of equity are required to reach the minimum ARP that is consistent with the cost of debt.

The lower bound on the ARP is lower based on the Oxera methodology than on the Ofwat methodology. This is because the Oxera methodology accounts for a convenience yield in the risk-free rate used to calculate the debt risk premium. This reduces the value calculated for the debt risk premium, which is one of the two inputs to the calculation of the lower-bound on the ARP.[63] This lower bound is above the low scenario for the ARP under the Oxera methodology. In order to reach the 1.58% lower bound the asset beta has to increase from 0.30 (as reported in Table 4.1) to 0.32. This translates to an equity beta of 0.59.

The effect of the higher equity beta on the WACC range is summarised in the next section.

[63] The other difference is that the Oxera methodology does not apply a 15bp deduction to the benchmark iBoxx index when calculating the cost of debt allowance. This increases the debt risk premium compared with using the Ofwat methodology but the impact is more than offset by the allowance for the convenience yield.

5 Cost of Capital

Based on the parameters presented in earlier sections, we now calculate the cost of capital determining a high and a low scenario in which the cost of capital can be settled. To do this, we use the following formula.

$$Cost\ of\ Capital = Cost\ of\ Equity\ *\ (1 - gearing) + Cost\ of\ Debt\ *\ gearing$$

Our approach is aligned to that of Ofwat in many respects, apart from:

- the approach in calculating the risk-free rate: where we add a convenience and forward premium, and we look at spot values;
- the approach in calculating the total market return: where we do not consider it appropriate to use the evidence coming from the 'ex ante' approach;
- the approach in calculating the betas where we focus on daily betas using 2-, 5-, and 10-year estimation windows;
- the approach to checking that the resultant range for the cost of equity is consistent with the cost of new debt;
- the approach in calculating the cost of embedded debt: where we include swaps, junior debt and intercompany loans that are excluded by Ofwat in the calculations;
- the approach in calculating the cost of new debt: where we add a forward premium, we look at the spot value and we have found no evidence supporting the need for an outperformance wedge.

Table 5.1 below summarises the parameters for the low and high scenarios, and compares these with the parameters proposed by Ofwat in its final methodology report. We apply a retail margin adjustment of 0.06% in order to determine the wholesale WACC estimate. This is aligned with the estimate determined by Ofwat at PR24. Re-estimation of this parameter is outside the scope of this report.

Table 5.1 Summary of WACC parameters

Parameters	Ofwat final methodology	Ofwat updated cut-off	Oxera low	Oxera high
Gearing	55%	55%	55%	55%
Total market return	6.00–6.92%	6.00–6.92%	6.70%[1]	7.70%[1]
Risk-free rate	0.47%	1.54%	1.74%[2]	1.74%[2]
Notional equity beta	0.58–0.64	0.62	0.54[3]	0.66[3]
Return on equity	**3.67–4.60% (4.14% mid-point)**	**4.59%**	**4.43%[4]**	**5.67%[4]**
Cost of embedded debt	2.34%	2.65%	2.69%[5]	2.69%[5]
Cost of new debt	3.28%	3.74%	3.84%[6]	3.84%[6]
Share of new debt	17%	17%	17%	17%
Return on debt	**2.60%**	**2.94%**	**2.99%[7]**	**2.99%[7]**
Appointee WACC (real, vanilla)	**3.29%**	**3.68%**	**3.63%[8]**	**4.20%[8]**
Retail margin deduction	0.06%	0.06%	0.06%	0.06%
Wholesale WACC (real, vanilla)	**3.23%**	**3.62%**	**3.57%**	**4.14%**

Note: The cut-off date for the Oxera scenarios is 31 July 2023. [1] See section 2.4.1. [2] See Table 2.7. [3] See Table 2.9. [4] The return on equity is calculated using the CAPM framework as explained in section 2.1. [5] As summarised in section 3.1. [6] See Table 3.1. [7] See Table 3.3. [8] This number is determined through the WACC formula presented above the table. All numbers are CPIH real.
Source: Ofwat PR24 Final Methodology report and Oxera analysis.

The table above shows that Ofwat's WACC estimate from the Final Methodology falls below the low number of the range we have estimated. The midpoint WACC from updating Ofwat's methodology to 31 July 2023 is slightly above the bottom of the range that we have estimated. More specifically, our 'low' number indicates that a wholesale WACC of at least 3.57% is needed, while our 'high' scenario points to a WACC of 4.14%.

These results are further benchmarked using the theoretical lower-bound on the ARP, as described in section 4,to determine a final interval. As explained in section 4.3, convexity in the relationship between debt risk premium and gearing would imply that assets require a risk premium higher than identified by the lower bound.

Using our ARP-DRP framework to derive the lower bound on the asset risk premium points to a lower-bound equity beta of 0.59 and a WACC in the range 3.68% to 4.14%. Taking any individual parameter from the 'Oxera low' scenario out of context, for example combining the beta estimate with a lower value for the TMR, would breach the lower bound for the ARP.

Table 5.2 Final Oxera WACC range

Parameters	Ofwat final methodology	Ofwat updated cut-off	Oxera low	Oxera high
Gearing	55%	55%	55%	55%
Total market return	6.00–6.92%	6.00–6.92%	6.70%[1]	7.70%[1]
Risk-free rate	0.47%	1.54%	1.74%[2]	1.74%[2]
Notional equity beta	0.58–0.64	0.62	0.59[3]	0.66[3]
Return on equity	**3.67–4.60% (4.14% mid-point)**	**4.59%**	**4.67%**[4]	**5.67%**[4]
Cost of embedded debt	2.34%	2.65%	2.69%[5]	2.69%[5]
Cost of new debt	3.28%	3.74%	3.84%[6]	3.84%[6]
Share of new debt	17%	17%	17%	17%
Return on debt	**2.60%**	**2.94%**	**2.99%**[7]	**2.99%**[7]
Appointee WACC (real, vanilla)	**3.29%**	**3.68%**	**3.74%**[8]	**4.20%**[8]
Retail margin deduction	0.06%	0.06%	0.06%	0.06%
Wholesale WACC (real, vanilla)	**3.23%**	**3.62%**	**3.68%**	**4.14%**

Note: The cut-off date for the Oxera scenarios is 31 July 2023. [1] See section 2.4.1. [2] See Table 2.7. [3] The higher number of the notional equity beta range comes from Table 2.9. The lower bound of the range has been determined by applying the constraint identified through the theoretical lower bound on the ARP to the equity beta. [4] The return on equity is calculated using the CAPM framework as explained in section 2.1. [5] As summarised in section 3.1. [6] See Table 3.1. [7] See Table 3.3. [8] This number is determined through the WACC formula presented above the table. All numbers are CPIH real.
Source: Ofwat PR24 Final Methodology report and Oxera analysis.

A1 Sensitivity around the cost of capital parameters

In this section we present the results of the sensitivities around a number of parameters:

- notional gearing: we present the impact of using 60% as the notional gearing assumption (aligned with the PR19 level)[64] instead of 55%;
- the share of new debt: we present the impact that using a higher share of new debt would have on the cost of debt and on the overall WACC allowance;
- borrowing costs: we present the impact of moving away from a 10bps borrowing costs assumption and aligning this number to the one of Ofgem at RIIO-2 (25bps).[65]

In turn, the tables below present the sensitivites. In the following tables the Oxera low scenario presented is before the theoretical lower-bound on the ARP is calculated. As such, the ranges presented below are illustrative and the results still need to pass the ARP test.

Table A1.1 Sensitivity around the gearing—60% notional gearing

Parameters	Ofwat final methodology	Oxera low	Oxera high
Gearing	55%	60%	60%
Total market return	6.00–6.92%	6.70%	7.70%
Risk-free rate	0.47%	1.74%	1.74%
Notional equity beta	0.58–0.64	0.60	0.73
Return on equity	**3.67–4.60% (4.14% mid-point)**	**4.70%**	**6.09%**
Cost of embedded debt	2.34%	2.69%	2.69%
Cost of new debt	3.28%	3.84%	3.84%
Share of new debt	17%	17%	17%
Return on debt	**2.60%**	**2.99%**	**2.99%**
Appointee WACC (real, vanilla)	**3.29%**	**3.67%**	**4.23%**
Retail margin deduction	0.06%	0.06%	0.06%
Wholesale WACC (real, vanilla)	**3.23%**	**3.61%**	**4.17%**

Note: The cut-off date for the Oxera scenarios is 31 July 2023.
Source: Ofwat PR24 Final Methodology report and Oxera analysis.

[64] Ofwat (2022), 'Appendix 11: Allowed return on capital', December, p. 5.
[65] Ofgem (2022), 'RIIO-ED2 Final Determinations Finance Annex', 30 November, Table 2.1.

Table A1.2 Sensitivity around the share of new debt—30% new debt level

Parameters	Ofwat final methodology	Oxera low	Oxera high
Gearing	55%	55%	55%
Total market return	6.00-6.92%	6.70%	7.70%
Risk-free rate	0.47%	1.74%	1.74%
Notional equity beta	0.58-0.64	0.54	0.66
Return on equity	**3.67-4.60% (4.14% mid-point)**	**4.43%**	**5.67%**
Cost of embedded debt	2.34%	2.69%	2.69%
Cost of new debt	3.28%	3.84%	3.84%
Share of new debt	17%	30%	30%
Return on debt	**2.60%**	**3.14%**	**3.14%**
Appointee WACC (real, vanilla)	**3.29%**	**3.72%**	**4.28%**
Retail margin deduction	0.06%	0.06%	0.06%
Wholesale WACC (real, vanilla)	**3.23%**	**3.66%**	**4.22%**

Note: The cut-off date for the Oxera scenarios is 31 July 2023.
Source: Ofwat PR24 Final Methodology report and Oxera analysis.

Table A1.3 Sensitivity around the borrowing costs—25bps as per Ofgem at RIIO-ED2

Parameters	Ofwat final methodology	Oxera low	Oxera high
Gearing	55%	55%	55%
Total market return	6.00–6.92%	6.70%	7.70%
Risk-free rate	0.47%	1.74%	1.74%
Notional equity beta	0.58–0.64	0.54	0.66
Return on equity	**3.67–4.60% (4.14% mid-point)**	**4.43%**	**5.67%**
Cost of embedded debt	2.34%	2.69%	2.69%
Cost of new debt	3.28%	3.84%	3.84%
Share of new debt	17%	17%	17%
Return on debt	**2.60%**	**3.14%**	**3.14%**
Appointee WACC (real, vanilla)	**3.29%**	**3.72%**	**4.28%**
Retail margin deduction	0.06%	0.06%	0.06%
Wholesale WACC (real, vanilla)	**3.23%**	**3.66%**	**4.22%**

Note: The cut-off date for the Oxera scenarios is 31 July 2023.
Source: Ofwat PR24 Final Methodology report and Oxera analysis.

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Annex 3: KPMG – Estimating the cost of equity for PR24 (September 2023)

[This content has been redacted due to it containing commercial sensitive material]