

Setting the Allowed Return on Equity for PR24

19 March 2025

A Report prepared for Northumbrian Water and Wessex Water



Contents

1. Summary	3
2. Introduction	11
3. Theoretical background and framework	11
3.1. Key CoE concepts.....	11
3.2. The Capital Asset Pricing Model	12
3.3. Investment horizon.....	12
3.4. Unconditional and conditional estimates.....	13
3.5. Notable guidance and precedent.....	13
4. Estimation of the CAPM-derived CoE	15
4.1. Introduction.....	15
4.2. Risk-Free Rate	15
4.3. Total Market Return.....	31
4.4. Beta.....	37
4.5. Combined results for CAPM-derived Market-CoE.....	60
5. Moving from the estimated CAPM-CoE to the Allowed-RoE	61
5.1. Introduction.....	61
5.2. Cross checks from alternative approaches to estimating the Market-CoE	61
5.3. Asymmetry in the choice of parameters.....	74
5.4. Welfare impact from underinvestment.....	76
5.5. Asymmetry in the package.....	81
5.6. Financeability.....	82
5.7. Overall Allowed-RoE	82

Appendix A: Regression results for beta analysis

Appendix B: Full regression results for MFM analysis

Setting the Allowed Return on Equity for PR24

1. Summary

- 1) Kairos Economic Consulting Limited (Kairos) has been asked by Northumbrian Water Limited (NWL) and Wessex Water Services Limited (WWS) to develop an evidence-based assessment of the appropriate allowed return on equity (Allowed-RoE) for PR24 and comment upon Ofwat's approach and Allowed-RoE in its Final Determination for PR24 (FD24). The Allowed-RoE is intended to capture the market cost of equity (Market-CoE), which is a cost that needs to be remunerated in order for equity investment to be attracted and retained.
- 2) We adopt the following framework and concepts in this report:
 - a. Our primary estimation model for the Market-CoE is the capital asset pricing model (CAPM). The Market-CoE that is derived under this model is referred to as the 'CAPM-CoE'.
 - b. We distinguish between unconditional estimates, which reflect long-run averages that do not take into account current market conditions, and conditional estimates, which do.
- 3) We adopt the now widely accepted problem statement, which is to estimate the conditional Market-CoE over PR24, for a long-term investor. We refer to this as the regulatory investment horizon (RIH).
- 4) Despite using the CAPM as the primary model, we are mindful of the widespread understanding amongst academics and investment practitioners that it has flaws. We therefore cross check our CAPM-CoE with other models, in particular multi-factor models (MFM-CoE).
- 5) When selecting a point estimate for the Allowed-RoE, we take into account, inter alia, the MFM-CoE and MARs cross checks, a modelled probability distribution for our CAPM-CoE (and the likely asymmetric consequences of mistakenly setting the Allowed-RoE above versus below the Market-CoE) and the step change in the level of investment required at PR24.
- 6) Our analysis of the component parameters of the CAPM-CoE finds the following:
 - a. **Beta:** We consider that unconditional beta estimates are the best estimate of beta over the RIH, given the uncertainty associated with estimating conditional betas over long term horizons. Unconditional betas should be estimated using a long-run of historical data for which the operating environment is deemed to be sufficiently reflective of potential outcomes, which for regulated water

companies supports a c.10-year historical window of data. We therefore estimate c.10-year betas for three listed water companies: Severn Trent (SVT), United Utilities (UU) and Pannon (PNN). We test whether the spin-off of PNN's waste-management business, Viridor, in 2020, had a statistically significant effect on the PNN beta and find that it did not. We therefore include PNN in our set of comparators. We further test whether the Covid-19 lockdowns had a statistically significant effect on the outturn betas. We find that the Covid-19 restriction periods (and lockdowns) had a material and statistically significant downward effect on water betas. On the assumption that it is unlikely for similar lockdowns to take place over the RIH, we estimate beta under an assumed scenario where Covid-19 restrictions repeat with a negligible probability. We test daily, weekly and monthly sampling frequencies and settle on the use of daily estimates because we find highly variable effects from the choice of the reference day in weekly and monthly samples. We estimate an unlevered beta of 0.319 to 0.337 for a portfolio of the listed water companies, over a c.10-year period, adjusted for the effects of the Covid-19 restrictions and the Viridor spinoff. Finally, we consider whether betas over PR24 may be above those estimates that form our unconditional beta range, in particular because of the large investment programme that is planned. We examine the relationship between capital expenditure (capex) and beta for listed water stocks and find a positive relationship. Given the step change in investment at PR24, we consider that the forward-looking beta may therefore be above the mid-point of our unconditional beta range, estimated using historical data. We reviewed Ofwat's approach, which yields an unlevered beta of 0.282. The main drivers of the difference between our estimated range and Ofwat's is, firstly, that Ofwat has made no adjustment for the effects of the Covid-19 lockdowns, which has a downward effect on its beta, given the material reduction in water betas during the lockdowns. This is exacerbated by its inclusion of betas estimated over 5-year historical windows, which are impacted to a greater extent by the Covid-19 lockdowns. Secondly, Ofwat excludes PNN on the basis that it considers that the Viridor spin-off may distort the betas. However, given that we do not find a statistically significant effect of the Viridor spin-off on the PNN beta, we consider that Ofwat's analysis excludes important information from a listed regulated water company. This also serves to depress Ofwat's beta.

- b. **Risk-free-rate (RFR):** We examine yields on index-linked gilts (ILGs), nominal gilts, AAA-rated corporate bonds and SONIA swaps. We find that ILGs are a suitable proxy for the RFR, albeit they should form a lower bound. Under the Brennan model (an improvement on the 'simple' CAPM), the RFR should lie between the risk-free lending and borrowing rates. When we compare tenor matched AAA-corporate bond yields with nominal gilt yields, we observe a 0.17% average spread. We therefore consider that the RFR range should lie

between a AAA-rated corporate bond yield (the risk-free borrowing proxy) and ILGs (the risk-free lending proxy). We also reviewed the literature on whether gilt yields may be distorted downwards due to the existence of a convenience yield, driven by special 'money-like' qualities of gilts. Unfortunately, the literature does not extend to tenors comparable to the RIH. However, given that there appears to be no relationship between tenor and a materially positive convenience yield at shorter tenors in the UK studies, we consider that the evidence on convenience yields further supports our approach of setting the RFR slightly above the ILG yield, by bounding the upper end of our range with estimates of AAA-corporate bond yields. In order to derive a RFR that compensates investors for the risk of the Allowed-RoE being based on a fixed RFR for PR24, we apply a forward-uplift, which reflects current market-based quotes for 'locking in' the RFR (for the duration of the RIH) at points over PR24. Our outturn range is 2.3%-2.6% in real-CPIH terms. This compares to Ofwat's FD24 estimate of 1.52%, which was based solely on ILGs using data from September 2024. A key reason for the difference between the Kairos and Ofwat figures is market movements, as we have seen a significant increase in interest rates since Ofwat's FD24 analysis. However, setting market movements aside, we consider that Ofwat's sole reliance upon ILGs means that its RFR is likely to be below the true-RFR because it fails to capture the difference between risk-free lending and borrowing rates and the literature on the existence of a convenience yield in gilts. In addition, Ofwat does not apply an uplift for the market-based quotes for locking in the RFR, over the PR24 price control period, which given the current market forecasts understates the RFR for the RIH.

- c. **Total market return (TMR):** We estimate TMR using unconditional estimates, based on long-run averages of outturn equity returns ('long-run ex post') and long-run forward-looking expectations of returns ('long-run ex ante'), using data from the widely used Dimson Marsh and Staunton (DMS) 2024 data set. We consider that the ex post estimates are more robust than ex ante estimates, so we set our range based solely on the long-run ex post approach which gives a range of 6.86% to 6.97% in real-CPIH terms, with a midpoint of 6.92%. Ofwat's TMR estimate is c.9bp below our figure at 6.83% because they place weight on their long-run ex ante estimates, one of which adopts a different implementation of the Fama French model.

- 7) Overall, therefore, our CAPM-CoE range is based upon; long-run ex post TMR figures, unconditional betas for SVT, UU and PNN, excluding Covid-19 lockdown periods and a RFR based on a range from ILGs to an estimate of AAA corporate bond yields over the RIH. This approach results in a CAPM-CoE range of 5.5-5.9% in real-CPIH terms, compared to Ofwat's midpoint CAPM-CoE of 4.8% and its Allowed-CoE of 5.1%.

- 8) Having derived our CAPM-CoE range, we then consider whether we should aim-up above the midpoint when setting the Allowed-RoE. In order to do so, we consider the UKRN's five criteria:

- a. **Cross checks from alternative models:** It has long been established in academic and investment management circles that the CAPM may have omitted variables, performs poorly for low beta stocks (like utilities) and that the true model of returns is a multifactor-model (MFM). Indeed, as Fama and French (2004) conclude:

*"The version of the CAPM developed by Sharpe (1964) and Lintner (1965) has never been an empirical success. In the early empirical work, the Black (1972) version of the model, which can accommodate a flatter trade-off of average return for market beta, has some success. But in the late 1970s, research begins to uncover variables like size, various price ratios, and momentum that add to the explanation of average returns provided by beta. The problems are serious enough to invalidate most applications of the CAPM."*¹

Importantly, the CAPM's failure to consider relevant asset pricing variables leads to biased estimates of the beta coefficient. We therefore sense check our CAPM-CoE using a MFM applied to UK data. Applying the q-factor MFM, based upon publicly available data, results in an MFM-CoE estimate of 6.1% to 6.6%, which is materially above the CAPM-CoE. We note that Ofwat rejected MFMs, primarily because it considered that the CAPM was superior for charge control purposes. A paper written by Dr Tharyan and Professor Gregory² addresses Ofwat's and its academic advisers' critique of the MFM, compared to the CAPM. We endorse the points therein but more importantly, even if one agrees that the CAPM is superior for the specific application to regulatory charge controls, that does not invalidate MFMs as a useful cross check, especially given the known flaws with CAPM and the widespread use of MFMs outside of economic regulation. In addition, we derive an implied Market-CoE from market to asset ratios (MARs) of the listed water companies, which results in an implied CoE range of 5.2-6.8%. Our implied CoE range from MARs is above Ofwat's implied CoE range of 4.3-6.3%, primarily because Ofwat assumes an RCV growth assumption of 0-2% into perpetuity, which we find difficult to reconcile with the current and planned investment programme for UK water. We consider that it is evident from both the MFM-CoE and implied CoE from MARs that: i) Ofwat's CAPM-CoE is mis-calibrated, and ii) a CAPM-

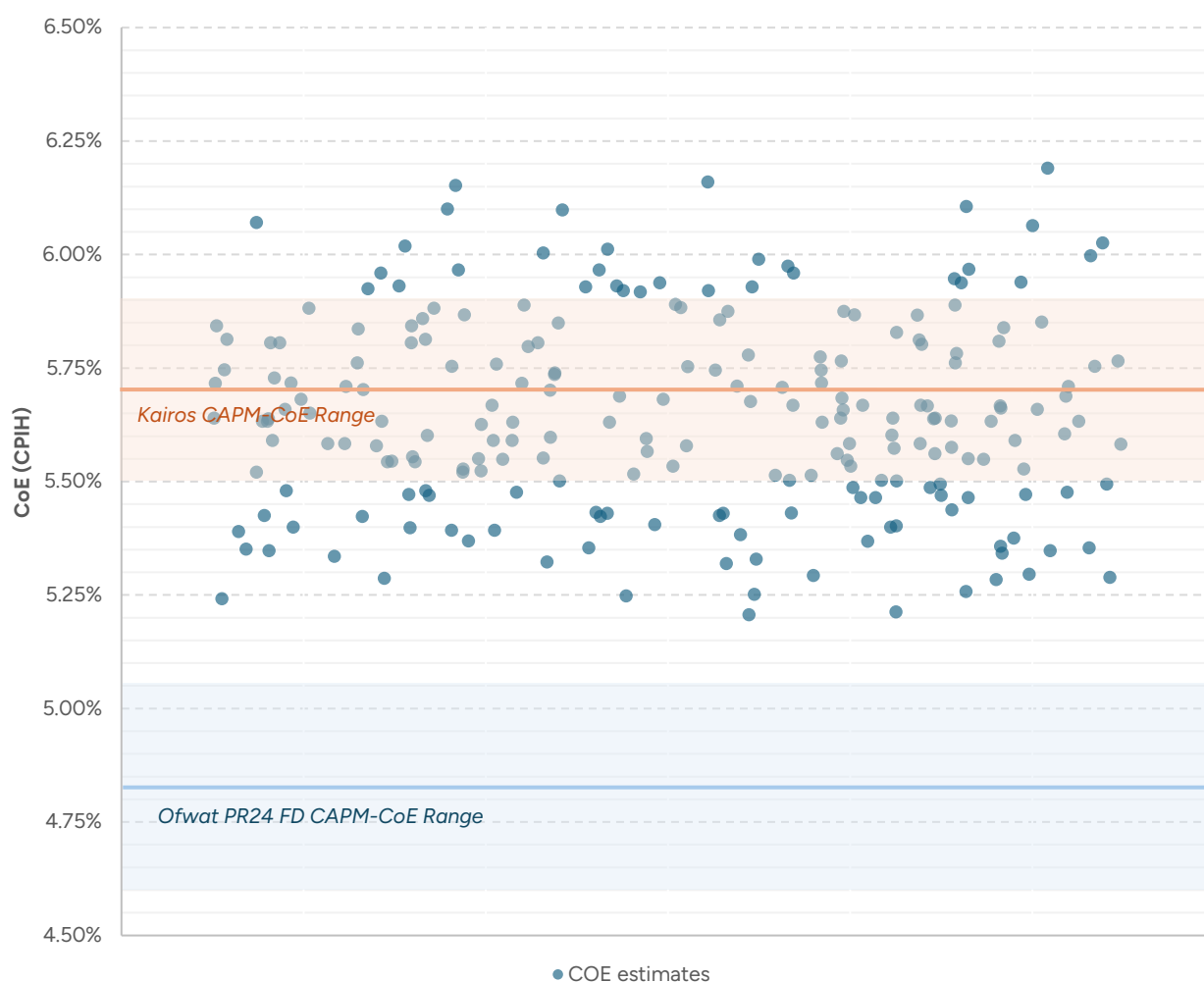
¹ Eugene F. Fama, and Kenneth R. French, The Capital Asset Pricing Model: Theory and Evidence (Fama and French 2004), January 2004, page 27.

² Tharyan, Gregory and Chen, Responses to Mason, Robertson and Wright on the use of MFMs at PR24, March 2025 (Tharyan, Gregory and Chen response to MRW 2025).

derived Market-CoE may be below the true Market-CoE due to the CAPM not fully pricing the risks faced by investors.

- b. **Asymmetry in the choice of parameters:** We consider whether there is asymmetry in our CAPM-CoE parameters or resulting estimates. Overall, we did not consider there to be a material bias in our TMR or RFR but considered that the mid-point of our unconditional beta may be below the forward-looking beta, in light of our evidence on the relationship between capex and beta for UK water stocks and the larger investment programme at PR24. Given our assessment of the component parameters of the CAPM-CoE (summarised above), we consider that Ofwat's CAPM-CoE is likely to be biased downwards across all of the parameters. This is evident from Figure 1 below, which overlays the Kairos and Ofwat CAPM-CoE ranges over a plot of possible combinations of estimates of the CAPM-CoE input parameters that are assessed.

Figure 1: The range of estimates for the CAPM-CoE under different parameter estimates for the RFR, TMR and beta



Source: Kairos analysis

- c. **Welfare impact from underinvestment:** The CAPM-CoE is estimated with uncertainty. In other words, there is estimation error in the estimates of each component parameter, which means that one cannot be certain that an estimated Market-CoE under the CAPM is correct. We consider that there are likely to be asymmetric consequences from setting the Allowed-RoE too high versus too low, with the former causing higher bills but the latter causing a wide-range of adverse effects, some of which are monetary, such as higher debt costs (which are ultimately passed-on to consumers under Ofwat's approach to the cost of debt) but others may be much more wide ranging, such as underinvestment and its knock-on consequences. We therefore model the probability distribution in our CAPM-CoE estimate using the standard errors from our beta and TMR calculations and a prudent assumption that RFR is known with certainty. We find that aiming-up by 0.5% is required to achieve the 67th percentile, in line with the regulatory precedent from New Zealand. Targeting the 67th percentile means there is a 33% chance of mistakenly setting the Allowed-RoE too low under a purely CAPM-based approach. Ofwat has not modelled the uncertainty in its CAPM-CoE, so it is difficult to understand where it considers it sits with respect to the trade-off of setting the Allowed-RoE too high versus too low. We note that Ofwat's Allowed-RoE sits at the 31st percentile of our modelled probability distribution.
- d. **Asymmetry in the package:** It is beyond the scope of this report to assess whether there is asymmetry in the overall charge control package. However, we note that Ofwat finds an expected loss of 20bp on outcome delivery incentives (ODIs) for the notional company that it considers is offset by expected outperformance on financing. As a matter of principle, we would not expect there to be expected outperformance on financing for the notional company (even if for individual companies there may be expected out/(under)-performance) as the cost of capital should be calibrated in such a way that it reflects the expected cost of capital for the notional company. Assuming Ofwat's ODI analysis is correct and the cost of capital is (re)calibrated correctly, then a residual expected loss of 20bp remains, which needs to be adjusted for by aiming-up (if it is not addressed at source).
- e. **Financeability:** Ofwat's financeability assessment hinges on £12.7bn of new equity being raised across the sector. Given our findings that Ofwat's Allowed-RoE has a 69% chance of being below the Market-CoE (based solely upon a CAPM-based CoE), we do not consider that Ofwat can be confident that this £12.7bn of new equity will be forthcoming. We note that this is consistent with views of the recent report published by S&P Global, a rating agency, which

states that it 'anticipates that the amount of equity raised over AMP8 will likely fall short of the regulator's assumptions'³.

- 9) Taking all of the above considerations into account, we consider that there is a strong case for aiming-up above our CAPM-CoE midpoint. At PR19, the Competition and Markets Authority (CMA) aimed up by 25bp. Adopting the same uplift as the CMA takes us to the top of our CAPM-CoE range at c.5.9%. However, we consider that there is evidence to support aiming-up further at PR24, by 50bp, resulting in an Allowed-RoE of 6.2%. A 50bp uplift to 6.2% is consistent with; i) targeting the 67th percentile of our modelled probability distribution for the CAPM-CoE, ii) the mid-points from MFMs (c.6.3%) and implied CoE from MARs (6.0%) and iii) the larger investment programme at PR24, which we consider may increase the forward-looking beta above the mid-point of our unconditional beta range and is supportive of the need to aim-up further than the CMA did at PR19.
- 10) We note that Ofwat aims up by 27bp to the top of its CAPM-CoE range, but that this is added to a downwardly biased CAPM-CoE midpoint of 4.82%, such that Ofwat has not actually aimed-up. Instead, as we set out above, we estimate that Ofwat's Allowed-RoE is at the 31st percentile of the CAPM-CoE probability distribution.
- 11) Our CAPM-CoE range and Allowed-RoE is set out in the summary table below, alongside an explanation for why it deviates from Ofwat's estimates in its FD.

³ S&P, U.K. Water Regulatory Framework Support, Low Financial Flexibility In Coming Regulatory Period Drive Rating Actions (**S and P Water Rating Action 2025**), 18 February 2025, page 4.

Table 1: Summary of Kairos' and Ofwat's CAPM-CoE and Allowed-RoE

	Ofwat (midpoint)	Kairos (low)	Kairos (high)	Comment
RFR	1.52%	2.3%	2.6%	There have been significant market movements since FD24 cut-off Ofwat places sole weight on ILGs, whereas Kairos places weight on both AAAs and ILGs to meet Brennan model requirements and reflect evidence of convenience yield distortions in ILGs
Unlevered beta	0.282	0.319	0.337	Ofwat estimates betas over 5- and 10-year windows, using SVT and UU only and makes no adjustment for Covid-19 Kairos estimates betas over 10-year windows, using SVT, UU and PNN and excludes distortive effects from Covid-19 lockdowns. This is on the basis of the statistical insignificance of the effects of the Viridor spin-off on the PNN beta and the material and statistically significant impact of the Covid-19 lockdowns on water betas
TMR	6.83%	6.86%	6.97%	Both Ofwat and Kairos estimate TMR using long-run approaches Kairos' range is based on long-run ex post estimates. Ofwat's figure is slightly lower because it also relies on long-run ex ante estimates and within that, a different implementation of the Fama French ex ante model
CAPM-CoE	4.82%	5.5%	5.9%	
Aiming-up	0.27%	0.25%	0.50%	Ofwat aims-up for negative investor sentiment towards the water sector and the significant amount of external equity and debt capital required at PR24 Kairos' lower end is consistent with the top of our CAPM-CoE range and the CMA PR19 precedent of aiming-up by 25bp. The upper end is supported by the larger investment programme at PR24 which we expect may increase the forward-looking beta, cross checks from alternative models including MFMs (c.6.3% mid-point) and MARs (6.0% mid-point) and a modelled probability distribution for the CAPM-CoE, which shows that aiming-up by 50bp is needed to achieve the 67th percentile
Allowed-RoE	5.1%	5.9% - 6.2%		Ofwat's 5.1% is outside our CAPM-CoE range and at the 31st percentile of our modelled probability distribution for the CAPM-CoE

2. Introduction

- 12) In December 2024, Ofwat published its FD24, which set out the price, service and incentive package for water companies for the period 2025-30.
- 13) The boards of NWL and WWS have decided to seek a redetermination of FD24 by the CMA.
- 14) As part of the evidence base for the redetermination, NWL and WWS have asked Kairos to develop an evidence-based assessment of the appropriate Allowed-RoE for the PR24 price control period. This report sets out our recommendations for the Allowed-RoE, including the supporting evidence. We also comment upon Ofwat's approach and Allowed-RoE, based on the analysis and conclusions in its FD24.
- 15) This report has benefited from the academic insights, empirical analysis and review of Professors Alan Gregory and Richard Harris.
- 16) The remainder of this report is structured as follows:
 - a. Theoretical background and framework;
 - b. Estimation of the CAPM-derived Market-CoE; and
 - c. Moving from the estimated CAPM-CoE to the Allowed-RoE.

3. Theoretical background and framework

3.1. Key CoE concepts

- 17) The Allowed-RoE that is provided under the regulatory framework over the charge control period is intended to remunerate investors for their cost of equity, or 'Market-CoE', which in this context, is the return required by investors to make an investment in a regulated water asset and accept its associated risks. It is an effective cost that needs to be remunerated in order for equity investment to be attracted and retained.
- 18) However, the Market-CoE is not directly observable and therefore must be estimated. As such, estimates for the Market-CoE are inherently uncertain. Indeed, as we will explain, this uncertainty is considerable (see Section 5.4). Furthermore, there are well-established policy reasons for why it may be appropriate to deviate from an unbiased estimate of the Market-CoE, when setting the Allowed-RoE.
- 19) The Allowed-RoE is therefore distinct from the Market-CoE, with the best unbiased estimate of the Market-CoE being an intermediate step towards reaching a view on the Allowed-RoE.

3.2. The Capital Asset Pricing Model

- 20) The primary model used by UK economic regulators for estimating the Market-CoE has, to date, been the CAPM. Consistent with regulatory precedent, we also rely on the CAPM as the primary model for the purposes of estimating the cost of equity as an input into setting the Allowed-RoE. We use the term 'CAPM-CoE' to refer to an estimate for the Market-CoE that is estimated using the CAPM.
- 21) The CAPM-CoE is a function of the risk-free rate (RFR), the systematic risk of the relevant investment (referred to as the equity beta), and the difference between the expected return on the market portfolio (TMR) and the RFR (referred to as the equity risk premium (ERP)). The CAPM-CoE is calculated as follows:

$$CoE_{CAPM} = RFR + \beta_{equity}(TMR - RFR)$$

Where:

- a. *RFR* is the rate of return required by the market to make an investment in a riskless asset.
 - b. *TMR* is the expected return on a fully-diversified portfolio of marketable assets. In UK economic regulation, it is typical to use the FTSE All-Share Index as a proxy for a well-diversified portfolio.⁴
 - c. β_{equity} is a measure of relative (non-diversifiable) risk which is used to inform the premium above the risk-free rate for a particular security.
- 22) It is important to note that the CAPM is an imperfect model of the Market-CoE. Indeed, it has long been established in academic literature that the CAPM is an inferior model for explaining returns, with multi-factor models (MFMs) being preferred alternatives. It is therefore important to have regard to the shortcomings of the CAPM and consider the evidence provided by alternative approaches, when setting the allowed return.

3.3. Investment horizon

- 23) Investors in regulated water assets are generally assumed to have a long-term investment horizon to reflect the long-term nature of the assets. It is generally assumed that this long-term horizon extends for a duration of between 10 and 20 years⁵.
- 24) Under Ofwat's regime, the Allowed-RoE is fixed for the duration of the PR24 period (i.e. 2025-2030). The Allowed-RoE therefore needs to capture the expected return required by an investor from an equity investment in a notionally-financed regulated water company⁶ with a 10-20 year investment horizon, for the duration of the PR24 price

⁴ Ofwat, PR24 Final Methodology – Appendix 11 Allowed return on capital, (**FM24 Appendix 11 Allowed Return**), December 2022, page 24.

⁵ FM24 Appendix 11 Allowed Return, page 9.

⁶ Strictly, the notional water company

control period. We refer to this as the regulatory investment horizon, or 'RIH', in the remainder of this report.

3.4. Unconditional and conditional estimates

- 25) In the context of estimating the Market-CoE for a regulated equity investment in a water company over the RIH, it is important to distinguish between unconditional and conditional expectations of relevant returns.
- 26) Unconditional expectations of relevant returns are expectations that do not incorporate currently available information that is available to investors, such as the prevailing market conditions. As a consequence of being invariant to prevailing market conditions, the adoption of unconditional expectations as a basis for setting the Allowed-RoE is sometimes referred to as a 'through-the-cycle' approach. Estimates of unconditional expectations of returns are referred to as unconditional estimates.
- 27) Conditional expectations of relevant returns, on the other hand, do incorporate currently available information that is available to investors, and may therefore be dependent upon prevailing market conditions. Estimates of conditional expectations of returns are referred to as conditional estimates.
- 28) For example, an unconditional estimate of the TMR over the RIH may essentially reflect the long-term average of returns over the RIH on the market portfolio. A conditional estimate of the TMR over the RIH may instead incorporate information provided by current market conditions, and may therefore lie above or below unconditional estimates of the TMR over the RIH, reflecting expectations of whether current returns are likely to lie above or below long-run averages.
- 29) In a world of perfect information, where the Market-CoE is known with certainty, we would rely on conditional expectations of returns over the RIH when setting the Allowed-RoE. This is to ensure that returns are sufficient at the point of investment. However, the Market-CoE is not observable and must be estimated. Therefore, it is important to consider whether conditional estimates are sufficiently accurate, stable, robust, and interpretable, for the purposes of setting the Allowed-RoE over the 5-year PR24 price control period, or whether unconditional estimates may provide superior, practicable alternatives. Nevertheless, where an unconditional approach is used, it is important to consider conditional evidence, even where there is considerable uncertainty, to understand whether unconditional estimates are likely to over or understate true parameter values over the RIH being assessed. This consideration is particularly important when moving from estimating the CAPM-CoE to setting the Allowed-RoE, which we address in Section 5.

3.5. Notable guidance and precedent

- 30) It is important to take into account regulatory best practice when setting the Allowed-RoE, given the benefits of predictability and stability to retaining and attracting

investment. However, regulatory precedent does and should move on, where new evidence is presented that improves the accuracy or robustness of the Allowed-CoE.

31) Throughout this report, we refer to the following regulatory guidance and decisions:

- a. The 2018 study by Wright, Burns, Mason and Pickford on setting the regulatory CoE, commissioned by the UK Regulators' Network (UKRN), (the 'UKRN 2018 CoE Study');⁷
- b. The 2023 UKRN guidance for regulators on the methodology for setting the cost of capital (the 'UKRN 2023 Guidance');⁸ and
- c. The CMA's Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited Price Determinations, Final Determinations, 17 March 2021 (CMA FD19 Decision).⁹

32) Before proceeding to consider the CAPM-CoE parameters and the case for deviating from the CAPM-CoE when setting the Allowed-RoE, it is important to note the following areas of broad agreement in the regulatory community:

- a. The CAPM is the primary model for estimating the Market-CoE for economic regulatory purposes.¹⁰ However, it has known flaws, so it is important to consider likely biases in the CAPM results, as well as alternative models and cross-checks.
- b. The Market-CoE should be estimated over a long-term investment horizon e.g 10-20 years and importantly, the component parameters need to be estimated in a manner which is consistent with the chosen investment horizon;¹¹
- c. The Allowed-RoE is set in real CPIH terms, with the inflation component of returns being provided for via indexation of the regulatory asset base. Using inflation swaps or long-run inflation forecasts from official sources are recognised as acceptable approaches for deflating nominal estimates;¹² and
- d. The CAPM-CoE is estimated with uncertainty and needs to be tested against other cross checks. Five considerations are taken into account when determining the Allowed-RoE: i) cross-checks from alternative models and market evidence, ii) the welfare impact from underinvestment, iii) asymmetry

⁷ [UKRN 2018 CoE Study](#).

⁸ [UKRN 2023 Guidance](#).

⁹ [CMA FD19 Decision](#).

¹⁰ See for example the UKRN 2023 Guidance, pages 10 and 11.

¹¹ See for example the UKRN 2018 CoE Study recommendation 2, page 29, and UKRN 2023 Guidance, page 14.

¹² See for example, the UKRN 2023 Guidance, page 15.

in the choice of CAPM parameter estimates, iv) asymmetry in the overall charge control package and v) financeability.¹³

- 33) We adopt the areas of broad agreement described at paragraph 32 in the rest of this report and refer to the detailed positions by UKRN and the CMA in the relevant sub-sections, as necessary.

4. Estimation of the CAPM-derived CoE

4.1. Introduction

- 34) This section sets out our analysis and evidence on the CAPM-CoE by component before arriving at a range. We also discuss and comment upon Ofwat's approach and corresponding estimates.
- 35) Our analysis relies on data that was available to us on 17 January 2025. This date should be taken as our data 'cut-off' date, unless otherwise specified.

4.2. Risk-Free Rate

Theory and key regulatory guidance

- 36) As set out in Section 3.2, the RFR is the rate of return that an investor can expect to receive on an investment in a riskless asset. An appropriate assessment of the RFR requires consideration of the eligible set of riskless instruments, and the time and duration of the investment. Given the specification of the investment horizon under the regulatory framework, it is necessary to determine the RFR over the RIH.
- 37) In practice, perfectly riskless, distortion-free assets do not exist. Therefore, it is typical to consider proxy instruments, whose returns are considered to be sufficiently riskless. In line with recent regulatory precedent¹⁴, we consider the following set of proxy instruments that: a) are regarded as being representative of assets having negligible risk that issuers will fail to fulfil their payment obligations; and, b) are traded between market participants with sufficient liquidity:
- a. **Nominal gilts:** A nominal gilt is a UK Government liability that is denominated in sterling, issued by HM Treasury and listed on the London Stock Exchange, under which the holder is paid a regular fixed cash payment (coupon) until the maturity date.
 - b. **Index-linked gilts (ILGs):** ILGs differ from nominal gilts in that the coupon payments and the principal repayment are adjusted in line with the UK Retail Prices Index (RPI).

¹³ See UKRN 2023 Guidance, pages 26 and 27.

¹⁴ See UKRN 2023 Guidance, page 14.

- c. **AAA-rated corporate bonds:** GBP-denominated bonds issued by corporate entities holding the highest credit rating or equivalent, which are judged by rating agencies to be of the highest quality with minimal risk.
 - d. **SONIA swap rates:** The Sterling Overnight Index Average (SONIA) reflects the average of the interest rates that banks pay to borrow sterling overnight from other financial institutions and other institutional investors and is administered by the Bank of England (BoE). Whilst the benchmark itself is ultra short-term (being overnight), bilateral swap agreements between counterparties agreeing to exchange fixed payments with payments based on the SONIA benchmark, can be used to infer (albeit with some uncertainty, as we come onto) longer-term rates.
- 38) It is generally accepted that conditional estimates of the RFR over the RIH that rely on yields provided by one or more of the proxy instruments above, are sufficiently representative of a riskless asset to avoid the need to consider unconditional RFR estimates.
- 39) Recent regulatory decisions typically place considerable weight on yields on long-dated ILGs when setting the RFR. The CMA FD19 Decision also placed weight on AAA-rated corporate bonds to reflect the Brennan extension of the CAPM¹⁵, which recognises that in practice, there is likely to be a difference between risk-free rates at which investors can borrow and lend, requiring the RFR to be set at a point between them, and evidence that a convenience yield for ILGs may distort estimates based on ILG yields below the true RFR.¹⁶ These points are discussed in more detail in paragraphs 48 to 53 below.
- 40) The UKRN 2023 Guidance notes that ILGs *have ‘many characteristics that qualify them as a good proxy for the true risk-free rate, due to a combination of inflation protection, low default risk and low liquidity risk that is not typically found to the same extent in other proxies’¹⁷*, and that *‘nearly any risk-free proxy stripped of accurately measured risk premia should give a value close to the ‘true’ risk-free rate’¹⁸*. Therefore, it is important to assess the likely extent to which estimates of the RFR based on proxy instruments may be distorted when defining the range of suitable values for the RFR for use in the CAPM-CoE.¹⁹
- 41) Under its regulatory framework, Ofwat sets an Allowed-RoE that is fixed for the price control period. It is generally agreed that this decision to set a fixed allowed return on equity is a policy-decision taken by each regulator.²⁰ Therefore, as explained in Section 3.3, the calculated CAPM-CoE should reflect estimates of the return required by equity investors to accept the risks associated with an investment in regulated water assets at a

¹⁵ Brennan, ‘Capital Market Equilibrium with Divergent Borrowing and Lending Rates’ (Brennan 1971), 1971.

¹⁶ CMA FD19 Decision, paragraphs 9.263 to 9.265.

¹⁷ UKRN 2023 Guidance, page 14.

¹⁸ Ibid.

¹⁹ See UKRN 2023 Guidance, page 14.

²⁰ The alternative is indexation, which Ofgem adopts – see UKRN 2023 Guidance, page 15.

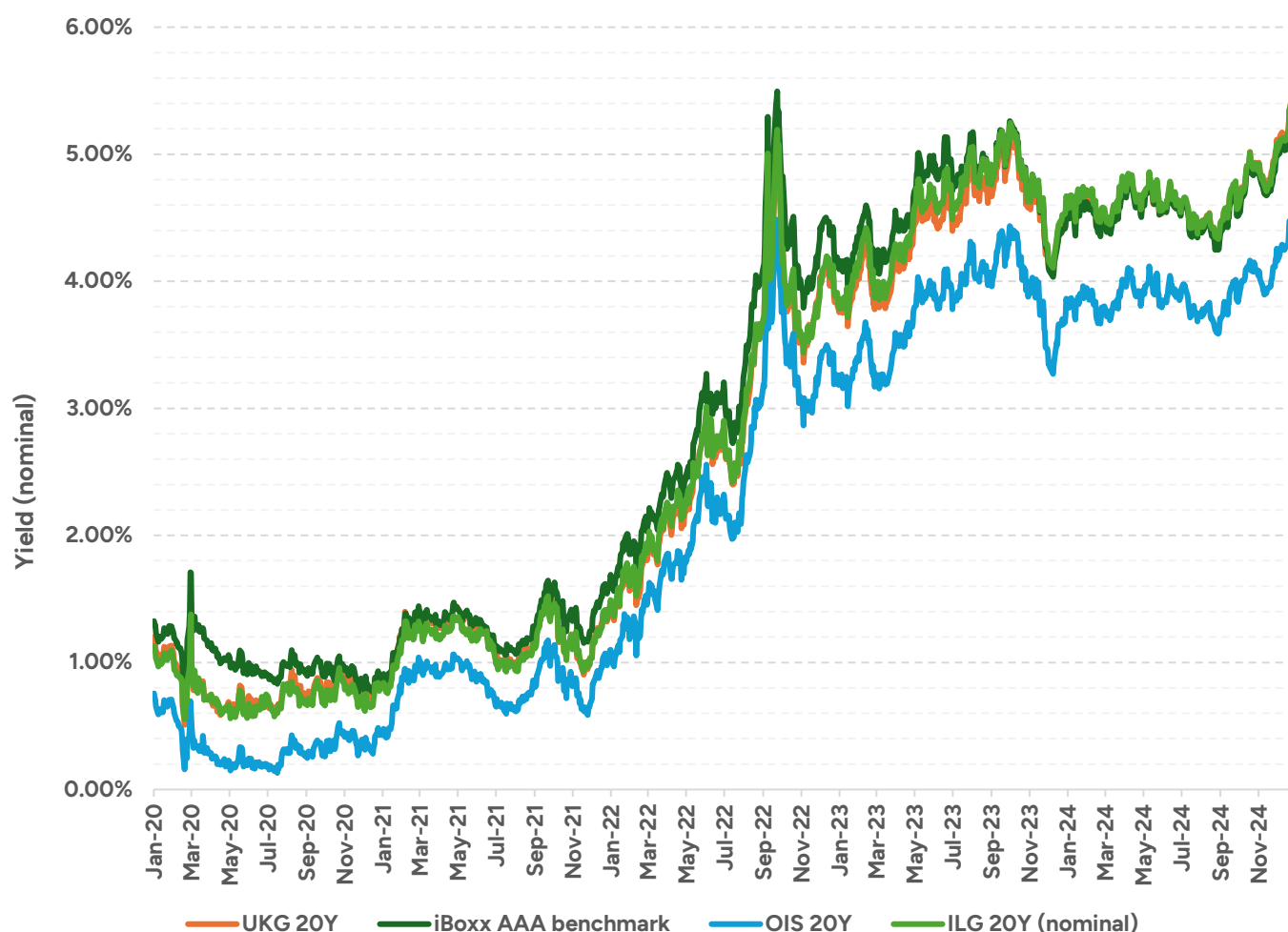
point in time over the PR24 price control period, for the duration of the RIH. There is some debate about how the potential evolution of the RFR over the RIH at future points in time should be captured in the regulatory assessment, with regulators considering different lengths of averaging periods and forward uplifts, based on market forecasts.²¹ These points are discussed in more detail at paragraphs 74 to 77 below.

- 42) Figure 2 below shows yields derived from the set of proxy instruments containing ILGs, nominal gilts, AAA-rated corporate bonds and SONIA swap rates for maturities that represent the RIH, in nominal terms, over time.
- 43) In the remainder of the section, we discuss the evidence provided by the set of proxy instruments containing ILGs, nominal gilts, AAA-rated corporate bonds and SONIA swap rates. Estimates of yields below incorporate a 1-month trailing average (unless specified otherwise). We consider that a 1-month trailing average period strikes an appropriate balance between mitigating the risk of relying on observed yields that are driven by idiosyncratic market movements that are not reflective of current market expectations, and embedding outdated data. This approach is consistent with Ofwat's approach in its FD24²².

²¹ See UKRN 2023 Guidance, page 14.

²² Ofwat, PR24 final determinations: Aligning risk and return - allowed return appendix, (**FD24 Allowed Return Appendix**), page 19.

Figure 2: Yields derived from ILGs, nominal gilts (UKGs), AAA-rated corporate bonds and SONIA swap rates since January 2020 in nominal terms²³



Source: Refinitiv, Bank of England, Kairos analysis

ILGs

- 44) Consistent with the specification of the RIH and the approach applied by Ofwat in its PR24 final determinations²⁴, we consider the yield on ILGs having a remaining life of 20 years. During the 1-month period preceding 17 January 2025, average spot (i.e. with investment occurring immediately) 20-year yields on ILGs were 1.8% in RPI terms.
- 45) The rebasing of these yields in CPIH-terms is discussed at paragraphs 64 to 73 below.

²³ Yields derived from nominal gilts and SONIA swap rates are 20-year spot rates, which are presented in their natural nominal bases. Yields derived from ILGs are 20-year spot rates that are rebased in nominal terms using corresponding RPI inflation swap quotes at a 20-year maturity. Yields derived from AAA-rated corporate bonds are an average of weighted average redemption yields for the iBoxx GBP Non-Gilt AAA 10+ and iBoxx GBP Non-Gilt AAA 10-15 indices, in nominal terms.

²⁴ FD 24 Allowed Return Appendix, page 21.

Nominal gilts

- 46) Consistent with the specification of the RIH, we consider the yield on nominal gilts having a remaining life of 20 years. During the 1-month period preceding 17 January 2025, average spot 20-year yields on nominal gilts were 5.4% in nominal terms.
- 47) The rebasing of these yields in CPIH-terms is discussed at paragraphs 64 to 73 below.

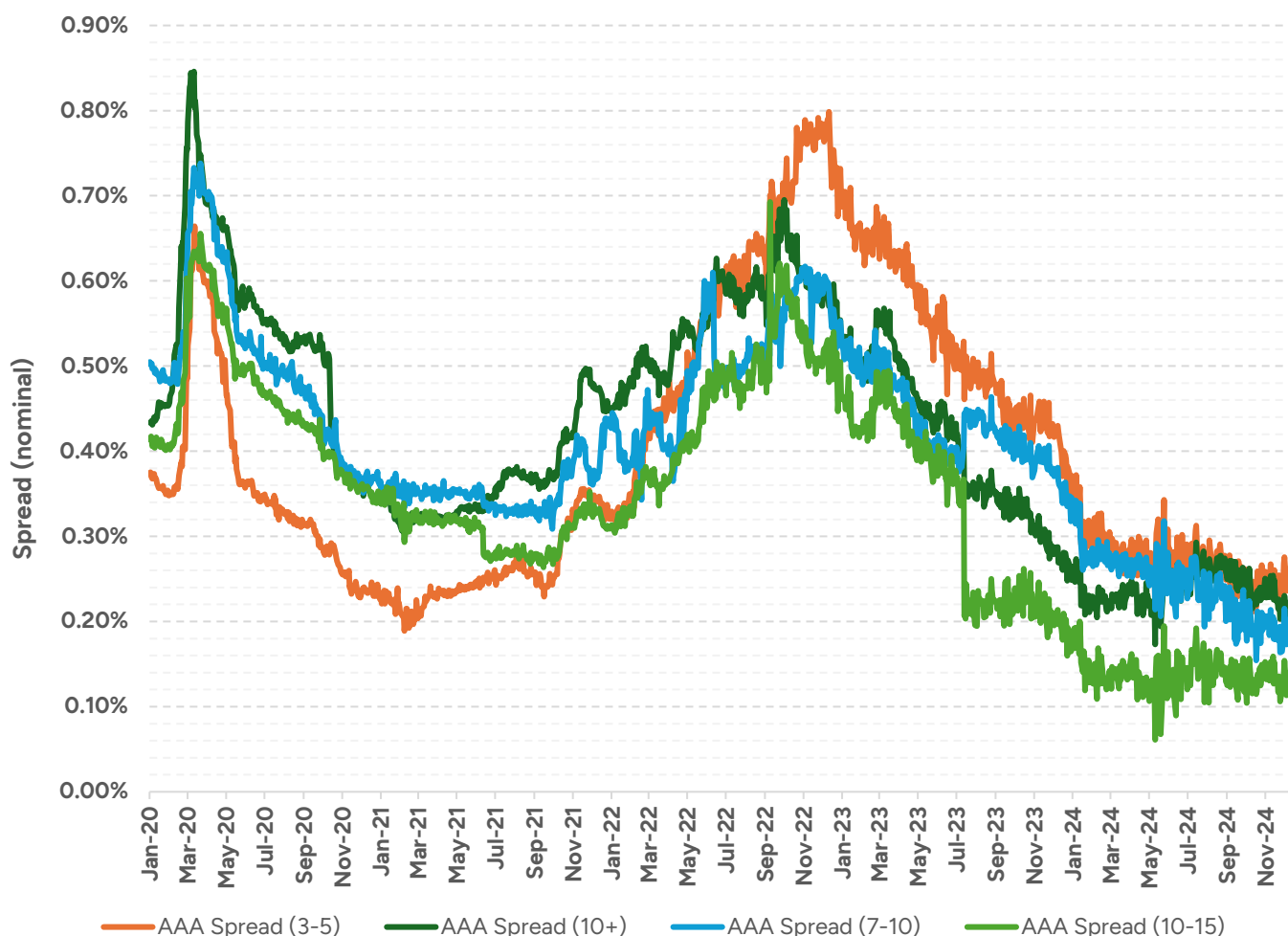
AAA yields

- 48) Following regulatory precedent set by the CMA FD19 Decision, we consider the yields on two broad based indices of GBP-denominated AAA-rated long-term corporate bonds, which are the iBoxx GBP Non-Gilt AAA 10+ and iBoxx GBP Non-Gilt AAA 10-15 indices. During the 1-month period preceding 17 January 2025, average yields on an equally weighted portfolio of both indices were 5.1% in nominal terms.
- 49) In practice, there may be a difference between the riskless rates at which investors can lend or borrow. We investigate whether a material difference exists by examining the difference between yields on AAA-rated corporate bonds (being the rates at which the highest quality corporate entities may borrow) and nominal gilts (the rates at which investors may lend to the UK government). For the bonds contained in each index, we observe the average of the differences between the yield on each bond in the index, and the yield of the nominal gilt with an equivalent tenor, weighted according to its specified weight in each index²⁵. This provides the weighted average spread between relevant AAA-rated corporate bonds and their nominal gilt equivalents. We observe an average spread of 0.17%, during the 1-month period preceding 17 January 2025.
- 50) The existence of a material spread between AAA-rated corporate bonds and their government-issued equivalents indicates that there is likely to be a difference between riskless lending and borrowing rates in practice. Under these circumstances, it is typical to appeal to the Brennan extension of the CAPM. Brennan finds that under certain assumptions, the true RFR that should be used as an input into the CAPM-CoE lies between the riskless lending and borrowing rate.²⁶

²⁵ This metric is published by S&P Dow Jones Indices. Calculations are set out in their technical document 'iBoxx Bond Index Calculus' (October 2024)

²⁶ See for example pages 440 and 441 of Corporate Finance, 5th Edition by Berk and DeMarzo (referred to as 'Berk and DeMarzo 5th Edition' in future references).

Figure 3: Weighted average spreads between yields on bonds in the iBoxx GBP Non-Gilt AAA indices against tenor-matched nominal gilt benchmark equivalent bonds over time



Source: Refinitiv, Bank of England, Kairos analysis

- 51) Figure 3 above shows the weighted average spreads between yields on bonds in the iBoxx GBP Non-Gilt AAA indices against tenor-matched gilt benchmark equivalent bonds over time, for different classes of tenors.

Table 2: Weighted average spreads between yields on bonds in the iBoxx GBP Non-Gilt AAA 10+ and iBoxx GBP Non-Gilt AAA 10-15 indices against tenor-matched gilt benchmark equivalent bonds on average during the 1-month period preceding 17 January 2025

iBoxx GBP AAA 10-15 spread	iBoxx GBP AAA 10+ spread	Average
0.13%	0.21%	0.17%

Source: Refinitiv, Bank of England, Kairos analysis

- 52) Table 2 above shows weighted average spreads between yields on bonds in the iBoxx GBP Non-Gilt AAA 10+ and iBoxx GBP Non-Gilt AAA 10-15 indices against tenor-matched

gilt benchmark equivalent bonds, on average, during the 1-month period preceding 17 January 2025. These spreads are calculated with reference to benchmark gilts. Therefore, in order to infer a spot 20-year yield on bonds that are representative of those in the iBoxx indices, we calculate the sum of: i) the 20-year nominal gilt yield, being 5.35%; and ii) the weighted average spreads of AAA bonds in the relevant iBoxx indices over the equivalent tenor-matched gilt yield, being 0.17%. We therefore estimate a spot 20-year yield on AAA corporate bonds of 5.5% in nominal terms.

- 53) It is important to note that simply considering the spread between average yields on an equally weighted portfolio of relevant iBoxx indices and the spot yield on 20-year nominal gilts may not accurately capture the difference between lending and borrowing rates at equivalent tenors. Under this approach, averages are likely to be distorted by differences between tenors of the bonds in the iBoxx indices and the 20-year tenor of the appropriate benchmark bond, and the non-linearity of the yields on AAA-rated corporate bonds at different tenors. Therefore, it is necessary to consider the 'average of the spreads' rather than the 'spread of the averages'.

SONIA swaps

- 54) Following regulatory precedent set by the CMA FD19 Decision²⁷ and UKRN 2023 guidance²⁸, we consider whether 20-year spot yields derived from market quotes on SONIA swaps are useful proxies. During the 1-month period preceding 17 January 2025, we observe an average 20-year spot rate derived from market quotes of SONIA swaps of 4.4% in nominal terms.
- 55) Certain properties of swap agreements themselves mean that swaps may be subject to a number of distortions, including collateralisation mechanisms, liquidity risk and transaction costs. As discussed at paragraph 37d above, it is typical for counterparties agreeing to enter into swap agreements to exchange fixed payments with payments based on the SONIA benchmark, to also agree to an embedded collateralisation mechanism. Under this mechanism, counterparties are obligated to exchange collateral with sufficient value to limit the exposure to loss in the event of one or more of the parties defaulting on its obligations. This obligates investors to potentially make or receive payments on a frequent basis, which does not strictly meet the requirements of a riskless asset with a duration equal to the RIH. Furthermore, the prices at which market participants are willing to enter into swap agreements are likely to be affected by the level of market liquidity, and transaction costs of swaps themselves, or associated transactions.
- 56) Figure 2 shows that there is a persistent material difference between 20-year spot yields derived from SONIA swaps and the other proxy instruments considered. Furthermore, it may be observed that the spread between spot yields derived from SONIA swaps and

²⁷ CMA FD19 Decision, paragraphs 9.52, 9.179 to 9.182, 9.194 to 9.197.

²⁸ UKRN 2023 Guidance, page 12.

nominal gilts across tenors is not constant over time. This indicates that the distortion in spot yields, derived from SONIA swap rates, from the embedded collateralisation mechanism and other market frictions, is likely to be significant, and reduces the reliability of SONIA swap rates as a measure of the true RFR.

The existence of a convenience yield

- 57) Consistent with regulatory guidance²⁹, we consider whether ILG and nominal gilt yields are likely to contain distortions (such as risk premia that would not be a feature of a true risk-free asset) that should be accounted for, before they can be interpreted as unbiased estimates of the true RFR.
- 58) According to financial literature³⁰, investors may be willing to sacrifice a level of return, in order to hold government bonds issued by countries with high credit ratings because such instruments possess 'money-like' characteristics. Such 'money-like' characteristics may include being a stable store of value or being readily refinanceable as collateral under a lending agreement. This is known as the 'convenience yield'. There is therefore a risk that gilt yields might be lower than the true RFR, which should be accounted for.
- 59) There is a considerable base of evidence in support of the existence of a material convenience yield. Indeed, Ofwat's review of four academic studies finds an estimated convenience yield of 0.38% for 2-year UK gilts, and average convenience yield estimates in excess of 0.3% for the US³¹. Although studies are largely focused on the US, Diamond and Van Tassel (2021) find convenience yields in excess of 0.15% for two-year maturities across the US, UK, Eurozone, Switzerland and Canada. In addition, CEPA's implementation of the CAA's H7 approach of comparing yields of constituent bonds in the iBoxx AAA Non-Gilt 10+ index with yields of benchmark nominal gilts with similar maturity, finds an average spread of 0.23% (excluding outliers), which may fall to 0.12% after removing the effects of heightened liquidity and default risks³².
- 60) Table 3 below shows updated analysis from Diamond and Van Tassel, published in January 2025³³.

²⁹ UKRN 2023 Guidance, page 14.

³⁰ FM24 Appendix 11 Allowed Return, A1: Convenience Yield, pages 93 to 97.

³¹ FM24 Appendix 11 Allowed Return, page 93.

³² CEPA PR24 Cost of Equity: Ofwat, 11 July 2024 (**FD24 CEPA CoE July**), Appendix B.

³³ Diamond, William and Van Tassel, Peter, 'Risk-Free Rates and Convenience Yields Around the World' (**Diamond and Van Tassel 2025**), January 2025.

Table 3: Average convenience yields for government bonds with 2-year maturities across various countries estimated by Diamond and Van Tassel (2025)

Country	Estimated convenience yield (2-year maturity)
USA	0.35%
UK	0.29%
Euro	0.24%
Switzerland	0.14%
Canada	0.29%

Source: Diamond and Van Tassel 2025

- 61) While there is reasonable uncertainty across estimates of the convenience yield (or associated adjustments), the estimates presented above are materially greater than zero, and consistently above zero for government bonds of all developed nations in scope of the analysis.
- 62) We note that the estimates of the convenience yield in the analysis rely on short-term instruments, with estimates of the convenience yield provided at tenors no longer than two years. This is considerably shorter than the nominal and ILG yields in question, which have tenors of 20 years in duration. In principle, bonds of greater duration face increased interest rate risk, which would decrease price stability, and it is plausible that measures of liquidity decline with tenor, which would suggest that the convenience yield is not invariant to tenor. However, the precise extent to which investors incorporate these effects that would result in a significant decrease in the convenience yield for longer tenors, is not clear. In this respect, we note that Diamond and Van Tassel's analysis³⁴ shows no clear trend between tenor and convenience yield at shorter tenors.
- 63) Estimates of the convenience yield also rely on yields provided by nominal gilts, which may over- or underestimate the convenience yield that applies to ILGs. Relatedly, it is not clear whether and to what extent the 'money-like' characteristics, such as price stability and liquidity, for which investors may sacrifice a return, differ between nominal gilts and ILGs. At 17 January 2025, the total principal amount of ILGs outstanding was £625 bln, representing approximately 24% of the outstanding stock of both nominal gilts and ILGs³⁵. This would suggest that the liquidity of ILGs may not be sufficiently different to that of nominal gilts to warrant a material adjustment to an estimate of the convenience yield for ILGs on the basis of liquidity alone. It is possible that ILGs may even carry

³⁴ Diamond and Van Tassel 2025, Table 2.

³⁵ United Kingdom Debt Management Office (<https://www.dmo.gov.uk/data/pdfdatareport?reportCode=D1A>).

additional benefits for which investors may sacrifice a return, beyond those provided by nominal gilts, which would warrant an increase in the convenience yield above that of nominal gilts.

Rebasing estimates in real-CPIH terms

- 64) Yields on proxy instruments are naturally estimated with reference to the price index on which they are based. For ILGs, yields are naturally quoted in real-RPI terms, and the remaining proxy instruments are quoted in nominal terms. As explained at paragraph 32(c) above, Ofwat's Allowed-RoE is quoted with reference to the CPIH price index, as a consequence of the method of indexation of the Regulatory Capital Value (RCV). Therefore, it is necessary to rebase the relevant yields on proxy instruments into CPIH terms before they may be used as an estimate of the RFR for CAPM-CoE estimates.
- 65) There are typically two types of methods for rebasing yields on proxy instruments into alternative price bases. These may be characterised as relying on: (i) official, or consensus forecasts; or (ii) market quotes of inflation swaps.
- 66) Official or consensus forecasts may rely on published forecasts of reputable bodies (e.g. the Office for Budget Responsibility (OBR)³⁶), or surveys of market participants (e.g. the compilation of forecasts by independent organisations included in the HM Treasury's 'Forecasts for the UK economy: a comparison of independent forecasts'³⁷). In the past, regulators have typically relied on official or consensus forecasts to rebase proxy instruments in RPI or CPIH terms, and the CMA relied upon the Bank of England's stated objective of achieving 2% inflation over time at its PR19 Redeterminations³⁸. Whilst official or consensus forecasts are a reasonable proxy for market expectations of inflation, they may not accurately represent market forecasts at a particular point in time. Additionally, official or consensus forecasts do not capture the level of inflation risk premium that is embedded in expected returns on applicable instruments to compensate investors for accepting a degree of inflation risk, which should be captured when rebasing estimates into alternative price bases.
- 67) Market quotes provided by RPI and CPI inflation-linked swaps provide an alternative basis for rebasing yields on proxy instruments. RPI and CPI inflation swaps are actively traded between market participants, and are agreements between counterparties to exchange payments that are linked to the RPI or CPI price indices, with payments that are agreed at inception. Using inflation swaps, an investor may synthetically replicate exposure to the returns of a riskless asset on an alternative price basis to the one in which it is naturally quoted. For example, an investor may replicate a CPI-linked ILG by purchasing an amount of ILGs with a particular tenor and entering into an agreement to swap their RPI-linked cashflows that are received under the purchased ILG, for CPI-linked cashflows with an equivalent tenor. Inflation swaps embed market forecasts of inflation and relevant

³⁶ See OBR, Economic and fiscal outlook, October 2024, for example.

³⁷ HMT, Forecasts for the UK economy: a Comparison of Independent Forecasts (**HMT Forecasts August 2024**), August 2024.

³⁸ CMA FD19 Decision, paragraph 9.36.

inflation risk premia, which should be captured when rebasing estimates into alternative price bases. However, inflation swaps suffer from similar shortcomings as SONIA swaps, meaning that market prices may be distorted as a result of collateralisation mechanisms, liquidity risk and transaction costs.

- 68) Under the approach of using official or consensus forecasts, and consistent with the CMA in its PR19 Redeterminations, we rely on the Bank of England's stated objective of achieving 2% CPI inflation over time as an estimate of official or consensus forecasts for CPI, for the purposes of rebasing yields on our set of proxy instruments over the 20-year RIH. We estimate official or consensus forecasts for RPI by compounding short-run forecasts provided by the latest publication by the OBR until 2029³⁹, and a 2% long-run forecast to reflect the plans of the Office for National Statistics (ONS) to transition the RPI to CPIH from 2031 (with a transition year in 2030, when the average of the forecasts for 2029 and 2031 is used). This gives an estimate of CPI and RPI forecasts of 2% and 2.26% respectively, with an implied RPI-CPI wedge of 0.25%.
- 69) Under the approach based on inflation swaps, we observe average RPI and CPI inflation swap rates of 3.35% and 3.0% respectively, during the 1-month period preceding 17 January 2025, with an implied RPI/CPI wedge of 0.33%.
- 70) Under both approaches, we rely on a typical assumption for the wedge between CPI and CPIH for the purposes of rebasing yields on our set of proxy instruments over the 20-year RIH of zero, which is based on the average outturn annual difference between CPI and CPIH since 1989 being approximately zero (as we are not aware of CPI/CPIH swaps being publicly traded).
- 71) For the approach based on official or consensus forecasts during the 1-month period preceding 17 January 2025, we estimate that:
 - a. Average spot 20-year yields on ILGs were 2.1% in CPI terms;
 - b. Average spot 20-year yields on nominal gilts were 3.3% in CPI terms;
 - c. Average yields on an average of the iBoxx GBP Non-Gilt AAA 10+ and 10-15 indices were 3.5% in CPI terms; and
 - d. Average spot 20-year yields derived from SONIA swaps were 2.4% in CPI terms.
- 72) For the approach based on inflation swaps during the 1-month period preceding 17 January 2025, we estimate that:
 - a. Average spot 20-year yields on ILGs were 2.1% in CPI terms;

³⁹ OBR Economic and fiscal outlook October 2024.

- b. Average spot 20-year yields on nominal gilts were 2.3% in CPI terms;
- c. Average yields on an average of the iBoxx GBP Non-Gilt AAA 10+ and 10-15 indices were 2.4% in CPI terms; and
- d. Average spot 20-year yields derived from SONIA swaps were 1.4% in CPI terms.

73) In Table 4 below, we present a comparison of average yields of proxy-RFR instruments in CPIH terms under both deflation approaches set out above.

Table 4: A comparison of average yields of proxy-RFR instruments in CPIH terms under both deflation approaches set out above

Deflation method	ILG (20y)	Nominal gilts (20y)	AAA-rated corporate benchmark	SONIA swap (20y)
Official or consensus forecasts	2.1%	3.3%	3.5%	2.4%
Inflation swaps	2.1%	2.3%	2.4%	1.4%

Source: Bank of England, Refinitiv, Kairos analysis

Reflecting future investment during PR24

- 74) As set out at Section 3.3, Ofwat sets an allowed return on equity that is fixed for the price control period. Therefore, the calculated CAPM-CoE should reflect estimates of the return required by equity investors to accept the risks associated with an investment in regulated water assets at a certain point in time over the PR24 price control period, for the duration of the RIH. The estimated RFR should therefore reflect the return an investor can expect to achieve on a riskless asset, at a specified point in time over the PR24 price control period, for the duration of the RIH.
- 75) Given observed yields on proxy instruments across a range of tenors, we can derive associated forward rates. A forward rate is the level at which an investor can guarantee the return provided by a risk-free instrument of a specified duration today, with payment for the investment occurring at a future date. Therefore, forward rates that are quoted today, provide estimates of the level at which an investor can lock in the RFR, at a specified point in time over the PR24 price control period, for the duration of the RIH.
- 76) We consider that an uplift should be applied to the spot estimates of the RFR, to reduce the risk that the RFR estimated today is no longer reflective of the RFR at the point in time at which an investor will be comparing an investment in a regulated water asset, to alternative investment opportunities. The uplift should be based on the relevant forward rate, because it is the RFR for a future point in time that an investor can 'hedge' or 'lock in'

today. Whilst other statistical predictions or market forecasts for an uplift can be used, they will effectively generate a positive or negative value for an investor today to the extent that the forecasts differ from the relevant forward rate.

- 77) We calculate the average of the differences between the 20-year forward rate that is implied by the ILG yield curve in CPI-terms (using RPI and CPI inflation swap quotes at corresponding tenors), and the 20-year spot rate, at points over the PR24 charge control period as 0.14%.

The CMA's approach at PR19

- 78) In its PR19 Redetermination, the CMA set the bottom of its RFR estimate range as the average of the yields on 20-year ILGs, and set the top of its range as the average of the iBoxx GBP Non-Gilt AAA 10+ and 10-15 indices. The CMA's estimates of inflation were based on an official or consensus forecast approach⁴⁰.
- 79) Under the CMA's approach described above⁴¹, we calculate a range of 2.1% to 3.1% in real-CPIH terms, with a midpoint of 2.6%, real-CPIH, for yields observed during the 1-month preceding 17 January 2025.

Evidence in the round

- 80) We consider below the strength of the evidence provided under each component of the assessment of an appropriate estimate for the RFR above.
- 81) In respect of the set of proxy instruments discussed above, we consider that yields on ILGs and the modelled yield on AAA-rated corporate bonds are a) sufficiently representative of assets having a negligible risk that issuers will fail to fulfil their payment obligations and b) are traded between market participants with sufficient liquidity to warrant material weight. Whilst we consider that market quotes provided by SONIA swaps also meet these criteria, the distortions in SONIA swap rates as an estimate of the true RFR, due in part to their collateralisation mechanism, are likely to be significant. Therefore, we consider that the reliability of SONIA swap rates as a measure of the true RFR that is required for present purposes does not meet the required threshold, when a number of other more reliable proxy instruments are available. As a result, we place no weight on evidence provided by SONIA swap rates when forming our range of appropriate estimates for the RFR. This is consistent with regulatory precedent set by the CMA in its FD19 Decision,⁴² and Ofwat's conclusion in its FD24 Allowed Return Appendix, which states that 'the SONIA swap rate is less intuitively interpreted than other risk-free proxies as an investment return, as it typically involves posting collateral rather than the outlay of invested funds'.⁴³

⁴⁰ CMA FD19 Decision, paragraph 9.241.

⁴¹ For the benchmark representing AAA-rated corporate bonds, we take the average of the yields provided by the indices (rather than applying a AAA spread based on the iBoxx AAA indices as presented above), which is consistent with the CMA's approach at PR19.

⁴² CMA FD19 Decision, paragraphs 9.196 and 9.197.

⁴³ FD24 Allowed Return Appendix, page 15.

- 82) In respect of the convenience yield, we consider that the analysis presented by Diamond and Van Tassel is strong evidence of the presence of a convenience yield on nominal bonds issued by a number of governments in developed markets, including the UK, at tenors between 3 months and 2 years. Whilst the estimates appear to be variable over time, across countries and carry a degree of uncertainty, it is likely that the true convenience yields are greater than zero. For nominal gilts and ILGs having tenors that meet the RIH, we are not aware of evidence suggesting that the 'money-like' characteristics of short-term nominal gilts for which investors may sacrifice a return, do not apply to a sufficient degree to warrant the conclusion that the relevant convenience yields are negligible. We also note that the outstanding principal of ILGs in issue at January 2025 is considerable, and comparable with that of outstanding nominal gilts in issue, which suggests that there is unlikely to be a material difference in liquidity premia. Therefore, we consider that unadjusted yields on ILGs and nominal gilts at 20-year tenors are likely to be biased beneath the true RFR. Setting the RFR above the ILG yield, due to evidence for a convenience yield on gilts is consistent with regulatory precedent set by the CMA in its FD19 Decision.⁴⁴
- 83) In respect of a difference between lending and borrowing rates and the introduction of the Brennan extension to the CAPM, we consider that the evidence presented above on the average difference between maturity matched AAA corporate bond yields and nominal gilts shows a material difference between the riskless rates at which investors can lend and borrow in nominal terms. The results from our approaches to deflation of the yields in their natural basis implies that the difference between nominal lending and borrowing rates would persist in real CPIH-terms. Therefore, we consider that under the Brennan extension, the true RFR would lie between the relevant ILG-yield and the AAA-rated corporate bond yield in CPIH-terms. Setting the RFR above the ILG yield because of a difference between lending and borrowing rates is consistent with regulatory precedent set by the CMA in its FD19 Decision.⁴⁵
- 84) In respect of the approach to deflation of yields of proxy instruments from their natural basis to CPIH, we consider that there is merit in considering both approaches of relying on official or consensus forecasts, and market quotes of RPI and CPI inflation swaps. This is because regulators have typically relied on official or consensus forecasts to rebase proxy instruments in RPI or CPIH terms, and the approach is consistent with that of the CMA at its PR19 Redeterminations⁴⁶. However, official or consensus forecasts may not accurately represent market forecasts at a particular point in time, and do not capture the level of inflation risk premium that is embedded in expected returns on applicable instruments to compensate investors for accepting a degree of inflation risk, which should be captured when rebasing estimates into alternative price bases. In contrast, inflation swap-based estimates do embed market forecasts of inflation and relevant inflation risk premia, which should be captured when rebasing estimates into alternative

⁴⁴ CMA FD19 Decision, paragraph 9.264.

⁴⁵ CMA FD19 Decision, paragraph 9.264.

⁴⁶ CMA FD19 Decision, paragraph 9.36.

price bases, but may suffer from distortions as a result of collateralisation mechanisms, liquidity risk and transaction costs.

- 85) In respect of reflecting investment at a point in the future during PR24, we consider that the estimated RFR should reflect the return an investor can expect to achieve on a riskless asset, at a specified point in time over the PR24 price control period, for the duration of the RIH. This forward return is captured by the forward uplift, which we consider should be applied. It is important to note that the purpose of the forward uplift is not to forecast the path of the RFR over time, but to reflect the RFR at a future date that can be 'locked in' by an investor today. Uplifts based on other approaches (or no uplift) will generate a windfall gain or loss for an investor obligated to invest in a riskless asset at a future date.
- 86) In light of the above discussion and evidence, we consider estimates of the RFR based on the following methods, when deriving our range for the CAPM-CoE:
- a. Yields on 20-year ILGs and our modelled AAA-rated corporate bond yield (which is calculated as the yield on 20-year nominal gilts plus the AAA benchmark spread), under both approaches to deflation (i.e. using official or consensus forecasts and inflation swap quotes) plus the 14bp forward uplift; and
 - b. A roll-forward of the CMA's approach from PR19.
- 87) These estimates are shown in Table 5 below.

Table 5: A comparison of yields of proxy-RFR instruments in CPIH terms (January 2025 average) including an estimate of the average forward uplift

Deflation method	ILG (20y)	AAA-rated corporate benchmark	CMA PR19 approach
Official or consensus forecasts	2.2%	3.6%	2.1 – 3.1%
Inflation swaps	2.3%	2.6%	-

Source: BoE, Refinitiv, Kairos analysis

- 88) On the basis of the evidence in Table 5, we consider that a range of 2.3-2.6% (real, CPIH) is appropriate. This is because:
- a. Our modelled AAA-rated corporate bond yield, deflated using official forecast may be biased upwards to some degree by the existence of a non-zero inflation risk premium;

- b. The range is in line with an approach that sets the ILG yield as the lower end and the modelled AAA rated bond yields as the upper end, which meets the Brennan model requirements; and
 - c. The range is subsumed within the CMA PR19 roll-forward range.
- 89) Following regulatory precedent set by the CMA at PR19⁴⁷, we don't directly include adjustments for the convenience yield in our range, but instead consider that incorporating the higher AAA-rated benchmark yields in our range takes into account the potential distortions in the ILG yield from the convenience yield.

Discussion of Ofwat's approach at PR24

- 90) In its FD24 Allowed Return Appendix, Ofwat determines a point estimate for the RFR of 1.52%, real CPIH, with no range.⁴⁸ We consider that Ofwat's estimate is likely to be below the true RFR because of the shortcomings set out below.
- 91) Ofwat places sole weight on 20-year ILG yields, and disregards evidence provided by AAA-rated corporate bonds because:
- a. It considers that there is a benefit in terms of simplicity and coherence around operating a single CAPM framework that has strong backing in previous regulatory decisions and in corporate finance textbooks;
 - b. The Brennan (1971) framework is not used in other regulatory jurisdictions;
 - c. The ILG rate is in principle a risk-free rate which is consistent with the Brennan framework, provided that the marginal investor is a net lender; and
 - d. The choice of a 20-year proxy provides some inbuilt headroom (in the form of a higher term premium) against the possibility that ILGs are downwardly-distorted proxies for the true RFR⁴⁹.
- 92) We address these points in turn below, in light of our findings above.
- 93) Whilst we agree that there is a simplicity around operating in a single CAPM framework, we consider that the benefits of incorporating features that occur in practice and better reflect reality outweigh the cost of a more detailed exercise. In other words, there is a trade-off between simplicity and accuracy and it is not clear to us why simplicity should overrule accuracy in this case, particularly where there is already regulatory precedent in support of an approach.
- 94) Even if it were the case that a particular investor could be identified as the marginal investor in principle, it is unlikely that the identity of the marginal investor and their

⁴⁷ CMA FD19 Decision, paragraph 9.264.

⁴⁸ FD24 Allowed Return Appendix, page 21.

⁴⁹ FD24 Allowed Return appendix, page 13.

lending or borrowing behaviour could be determined in practice to demonstrate whether an ILG-rate is consistent with the Brennan framework.

- 95) With regards to Ofwat's position that a 20-year proxy builds in 'headroom' that takes account of ILG distortions, we consider that it is more appropriate to adjust for distortions at source where possible, rather than solely relying on embedded term-premia to compensate for distortions in estimation. In addition, we are in favour of a 20-year RIH, where specificity is required, as is the case with the RFR parameter.
- 96) Ofwat disregards evidence of a convenience yield because it concludes that 'there is insufficiently strong evidence to accurately calibrate an adjustment at our 10-20 year CAPM horizon'⁵⁰. Whilst we agree that estimates appear to be variable over time, across countries and carry a degree of uncertainty, it is likely that the true convenience yields are greater than zero for the reasons mentioned at paragraphs 61 to 63 above, which therefore warrants an adjustment for distortions in ILG rates due to the convenience yield.
- 97) Ofwat concludes that forward rates are unreliable and produce inferior forecasts compared to using a 30-day spot average. Whilst it may or may not be the case that forward rates produce inferior forecasts compared to using a 30-day spot average historically, forward rates are nevertheless the rates at which an investor can 'lock in' today on a riskless asset at a future investment date. Uplifts based on other approaches or no uplift will generate a windfall gain or loss for an investor obligated to invest in a riskless asset at a future date.
- 98) Ofwat states that it prefers swap-based deflators to convert risk-free proxies to a CPIH-real basis, but recognises the benefits of predictability and stability in retaining its approach of placing equal weight on swap-derived deflators and official forecasts-derived deflators to derive an RPI-CPIH wedge to apply to ILGs. We agree that weight should be placed on both inflation swap-based deflators and deflators based on official or consensus forecasts, recognising the shortcomings with both approaches.

4.3. Total Market Return

Theory and key regulatory guidance

- 99) As set out in Section 3.2, the TMR is the expected return on the market portfolio. The Equity Risk Premium (ERP) is the difference between the TMR and the RFR. It reflects the additional compensation that investors require to invest in the market compared to a risk-free asset. The TMR is not directly observable, nor are there proxy instruments that provide sufficiently robust and reliable estimates of the TMR directly, like RFR. Instead, the appropriate TMR over the RIH has to be estimated.

⁵⁰ FD24 Allowed Return appendix, page 18.

100) There are typically three approaches to estimating the TMR:

- a. **Long-run 'ex post' approaches:** Estimates using historical returns on a broad-based portfolio over a long period of time that provide estimates of the unconditional TMR;
- b. **Long-run 'ex ante' approaches:** Estimates using historical data on a broad-based portfolio over a long period of time that rely on assumptions between expected returns and fundamental data (such as dividend yields) to provide estimates of the unconditional TMR; and
- c. **Forward-looking approaches:** Estimates that typically rely on market prices of traded instruments or surveys of market participants to infer estimates of the conditional TMR.

101) Regulators have typically placed weight on estimates of TMR based on gross returns under long-run 'ex post' approaches and long-run 'ex ante' approaches. This implicitly takes the view that: i) estimating the TMR on the basis of gross returns is more reflective of expected returns on the market portfolio than estimating the ERP on the basis of excess returns, and ii) the long-run unconditional estimate of the TMR is the best approximation for the expected return on the market portfolio that is required by an investor at a point during the charge control period, over the RIH. This preference for a long-run unconditional estimate of the TMR is often referred to as a 'through-the-cycle' approach to the TMR.⁵¹

102) In its FD19 Decision, the CMA placed weight on long-run 'ex post' and long-run 'ex ante' approaches, having expressed reservations about the robustness of the forward-looking evidence.⁵² In its recent regulatory guidance, the UKRN recommends 'that the TMR should be primarily based on historical ex post and historical ex ante evidence'.⁵³

Deflating historical returns and the long-run approach

103) Estimating the TMR in real terms often involves the deflation of historical return series by historical price indices that represent the appropriate basis on which the TMR is quoted. During the CMA's PR19 Redetermination, there was significant debate regarding the approach to deflating the series of nominal returns since 1900 to derive a real TMR estimate, when the available historical inflation series were imperfect. The historical inflation series considered were a composite series that was comprised of Consumption Expenditure Deflator (CED) and the RPI series (CED/RPI), and a composite series that was comprised of CED, a 'backcast' CPI forecast series and the CPI series (CED/CPI). The choice of historical inflation series had an impact of approximately 80 basis points on the outturn estimate of the long-run TMR.⁵⁴ The CMA ultimately placed 50:50 weight on

⁵¹ See for example, UKRN 2023 Guidance, page 19.

⁵² CMA FD19 Decision, paragraphs 9.393 and 9.394.

⁵³ UKRN 2023 Guidance, page 21.

⁵⁴ See for example CMA FD19 Decision, Figure 9-4.

CED/CPI and CED/RPI⁵⁵, landing on an estimate for TMR of 6.8%, real-CPIH (assuming CPI is broadly equivalent to CPIH).

104) Against the above background, it is important to note that:

- a. The regulatory community has since coalesced behind the use of a composite CPIH series (i.e. CED/CPIH) for deflating historical returns. But it remains accepted that any measure of inflation over the c.125-year time horizon over which long-run estimates are derived will be imperfect.⁵⁶ There is therefore still a material source of uncertainty when estimating the unconditional real TMR using historical returns that have been deflated using these historical inflation series.
- b. Part of the CMA's reasoning for gaining comfort with the inherent uncertainty in the unconditional real TMR estimates arising from the choice of inflation series, was that the assumption that estimating the TMR on the basis of gross returns is more reflective of expected returns on the market portfolio than estimating the ERP on the basis of excess returns - whilst still the most appropriate primary assumption - should not be taken as a claim that the ERP moves precisely 1:1 in the opposite direction to the RFR⁵⁷. This is consistent with the UKRN 2023 Guidance, which states *"However, it is important to recognise that depending on the macroeconomic environment, this largely 'through-the-cycle' approach [to TMR] could either overstate or understate returns required by investors in a specific price determination."*⁵⁸

105) Whilst regulatory guidance and precedent is to rely on an unconditional estimate as the primary approach for estimating TMR, forward-looking dividend discount models (DDMs) have also been considered as cross checks. For example, in the RIIO-2 appeals, the CMA panel recognised *"...the value of such approaches as cross-checks in providing some insight into market expectations of returns in the relatively near term."*⁵⁹ However, their robustness for precise calibration is questionable due to the sensitivity of estimates to inherent assumptions within the DDM model, in particular the dividend growth assumption.⁶⁰

Long-run ex post and ex ante evidence

106) In support of its Draft Determination (DD) response, NWL asked Kairos to review Ofwat's estimate of the TMR in its DD24 and to propose appropriate alternative estimates where

⁵⁵ The CMA also adjusted its estimate downwards by 30 basis points to account for the 'formula effect'.

⁵⁶ See UKRN 2023 Guidance, page 20.

⁵⁷ CMA FD19 Decision, paragraph 9.387.

⁵⁸ See UKRN 2023 Guidance, page 19.

⁵⁹ CMA, Cadent Gas Limited, etc - Final determination: Volume 2A: Joined Grounds: Cost of equity (CMA RIIO-GD and T2), 28 October 2021, paragraph 5.286.

⁶⁰ See UKRN 2023 Guidance, page 19.

we found or had concerns that material errors had been made, or inconsistencies were present. We prepared a short report⁶¹, which:

- a. Found that Ofwat's decision to place weight on arithmetic averages of historical UK equity market returns that are deflated using a composite CED/CPIH inflation series under long-run ex post and ex ante approaches, is broadly consistent with recent regulatory precedent;⁶² and
- b. Identified and addressed an error in the underlying dataset used for one of Ofwat's long-run ex ante estimates.⁶³

107) Building on our previous report, we provide estimates of TMR under long-run ex ante and long-run ex post approaches in CPIH-terms in Table 6 below. These estimates are computed using historical data published in the Dimson-Marsh-Staunton Global Returns 2024 (DMS) dataset, which are deflated using a composite historical series based on the CED, and the CPIH ONS back-cast and official series.

108) The long-run ex post estimates use arithmetic averages of annual returns, and overlapping 10- and 20-year returns. We adopt arithmetic averages because setting the allowed return on equity to compensate investors for their cost of equity at the point of investment over the RIH, requires estimation of required returns over a multi-period horizon. Challenges in estimating the TMR over a multi-year horizon using annual returns has given rise to a range of estimators that are designed to surmount different issues. Blume (1974)⁶⁴ proposes an estimator to address the bias in compounded arithmetic and geometric averages of returns. Jacquier, Kane and Marcus (2004)⁶⁵ propose an unbiased estimator and an estimator that minimises the mean-square error of its estimate. Cooper (1996)⁶⁶ proposes an estimator that is unbiased when setting discount rates for capital budgeting purposes that results in estimates in excess of the arithmetic average return. It is not clear whether estimators reflecting the perspective of an investor requiring compounded returns to forecast a future portfolio value, or estimators reflecting the perspective of an investor taking a capital budgeting approach to their decision to invest in a regulated water asset, are the right ones. Therefore, we consider that arithmetic averages strike a balance between both perspectives⁶⁷.

109) The long-run ex ante estimates of expected UK equity market returns are derived using two methods. First, an approach that is based on the long-run properties of average fundamental dividend yield and growth data to estimate the unconditional expected

⁶¹ NES90 - NWL Response to Ofwat DD24, Kairos Economics - A Review of Ofwat's Total Market Return (**NWL DDR Kairos Ofwat Review**), August 2024.

⁶² NWL DDR Kairos Ofwat Review, paragraph 9.

⁶³ NWL DDR Kairos Ofwat Review, paragraphs 10 to 15.

⁶⁴ Blume, M., Unbiased Estimators of Long-Run Expected Rates of Return, Journal of the American Statistical Association, September 1974, Vol. 69, No. 347, pages 634-638 (**Blume 1974**).

⁶⁵ Jacquier, E., Kane, A. and Marcus, Alan J., Optimal Estimation of the Risk Premium for the Long Run and Asset Allocation: A Case of Compounded Estimation Risk, Journal of Financial Econometrics, 2005, Vol. 3, No 1, 37-55 (**Jacquier, Kane and Marcus 2005**).

⁶⁶ Cooper, I. Arithmetic versus Geometric Mean Estimators: Setting Discount Rates for Capital Budgeting, 1996, European Financial Management, 2(2), 157-167 (**Cooper 1996**).

⁶⁷ Schaefer, Stephen M., Comments on CMA views of Estimating Expected Returns, 15 April 2020 (**Schaefer and Stephen 2020**).

return is used ('The Fama French Method'). Second, the 'Decomposition Method' from the publication 'Global Investment Returns Yearbook 2024' by Dimson, Marsh and Staunton, which decomposes historical returns into average dividend yield, dividend growth and expansion in the ratio of price to earnings. The method supposes that the component of historical returns that is attributable to the expansion in the ratio of price to earnings is likely to be non-repeatable. The return implied by the remaining components is then taken to be an estimate of investors' ex ante expectations of the TMR.

Table 6: Long run ex post and ex ante TMR estimates (real-CPIH)

Method		Estimates
Long-run ex post	Arithmetic average 1-year	6.93%
	Arithmetic (overlapping) average 10-year	6.86%
	Arithmetic (overlapping) average 20-year	6.97%
Long-run ex ante	Fama French Method	6.92% ⁶⁸
	Decomposition Method	6.85%

Source: Kairos Economics analysis of data provided by: DMS (2024), Bank of England 'A millennium of macroeconomic data for the UK' (version 3.1), ONS

Evidence under alternative approaches

- 110) In line with regulatory precedent, we consider that, for current purposes, long-run unconditional estimates of the TMR are the best approximation for the expected return on the market portfolio that is required by an investor in a regulated water asset at a point during the charge control period, over the RIH, balancing stability, robustness and accuracy.
- 111) However, we recognise the view held by the authors of the UKRN 2018 CoE Study (which is a comment relied upon by the CMA at PR19)^{69,70} that if conditional estimates of the ERP do not move precisely in an inverse one-for-one relationship with the RFR, then the long-run 'stable-TMR' approach may under or overestimate the true conditional TMR over the RIH, depending on where the conditional RFR lies, compared to the unconditional RFR.
- 112) Based on our estimate of the conditional RFR during January 2025, we do not consider that there is strong evidence to suggest that the conditional RFR is materially in excess of the long-run historical average RFR. Coupled with the view that, for current purposes, long-run unconditional estimates of the TMR are the best approximation for the expected

⁶⁸ We note that estimates based on the Fama-French method may vary depending on assumptions for the definition of 'dividend yield' that is presented in the DMS dataset.

⁶⁹ UKRN 2018 CoE Study, page 39.

⁷⁰ CMA FD19 Decision, paragraph 9.387.

return on the market portfolio that is required by an investor in a regulated water asset, we do not make any adjustment to our TMR range for the alternative approach of assuming a stable ERP.

Evidence in the round

- 113) Given the statistical and data-driven complexities with conditional TMR estimates, particularly over 10-20 year time horizons, and the regulatory precedent of using long-run ex post and ex ante approaches to set TMR, we consider that the primary approach should be to estimate the TMR using unconditional long-run ex post methodologies, with long-run ex ante methodologies used as a cross check. This is because we consider that long-run ex ante methodologies are more susceptible to modelling assumptions, or more unstable parameter estimates.
- 114) In this respect, the Fama-French method uses the outturn real dividend growth from each year to project forward the expected growth in a simple Dividend Growth Model. This gives growth expectations that are volatile on a year-to-year basis. Resulting estimates are naturally determined as the equivalent of an expected geometric return, which is converted to the equivalent of an arithmetic average by adjusting the estimate for the difference in volatility between the dividend growth estimate and the observed historical price estimate. Additionally, in the early years of the DMS dataset, dividends are only observed annually, so the precise timing of the dividend receipts is not known and so dividend yields and their interpretation is subject to some ambiguity. In the later years dividends are observed monthly and later still, daily. By contrast, the Dimson, Marsh and Staunton “decomposition” approach uses the geometric mean of dividend growth since 1900. However, this number is surprisingly volatile. Over the past five years the growth estimate, according to Tables 11 or 12 of the 2020-24 Yearbooks has evolved as: 1.03%; 0.57%; 0.69%; 0.66% and 0.75%. DMS then add this to the geometric mean of the dividend yield, and propose an uplift to obtain an arithmetic average equivalent. The net result is that the ex ante estimates made year-to-year are more volatile than the equivalent long run ex post arithmetic mean.
- 115) The TMR range using long-run ex post approaches is 6.86% to 6.97%, real CPIH. We consider that this is broadly consistent with the long-run ex ante figures but we do not use the ex ante figures to form our range, for the reasons given above.

Discussion of Ofwat’s approach

- 116) Ofwat’s TMR range of 6.68% to 6.98% (mid-point 6.83%), is based on the following overall approach:
- a. An assumption that TMR is more stable than ERP and that the best approaches for estimating TMR directly are long-run ex post and ex ante (Fama French and

DMS decomposition) methodologies.⁷¹ Ofwat's range is then bounded by the mid-point of the two approaches;

- b. A range for ex post estimates that is based on arithmetic overlapping averages for 10-20 year holding periods, and a range for ex ante estimates that are based on the 'Fama-French' and 'Decomposition' approaches;
- c. Placing sole weight on the historical back-series of CPIH containing the ONS's 2022 modelled series of historical CPIH, from 1950-1988, when converting historical nominal estimates to real estimates; and
- d. Disregarding evidence that TMR over the RIH is above the long-run average, on the basis that: i) TMR is more stable than ERP, ii) even if there is a relationship between ERP and RFR, RFR is not historically high, with the 1900-2023 average sitting at 2.18%, compared to its RFR point estimate of 1.52%, real CPIH, and iii) there is little evidence from historical charge controls that investors have overall been undercompensated by the regulatory approach to TMR.⁷²

117) We agree with Ofwat that the primary approach for estimating TMR should be to rely on arithmetic averages of long run estimates that are deflated using the CED/CPIH series. Our estimates from applying the long-run approaches differ to Ofwat's by c.9bp. This is because Ofwat relies on long-run ex ante as well as long-run ex post estimates to form its range (whereas we rely solely on long-run ex post to form our range) and its implementation of the Fama-French approach adopts a different interpretation of the dividend yield from DMS than NWL DDR Kairos Ofwat Review.

118) Whilst we agree with Ofwat that the primary approach should be to assume a stable TMR and estimate TMR directly, we consider that whether investors have on average been sufficiently compensated for TMR in historical charge controls is not directly relevant to the question of the most robust approach to estimating the TMR for the RIH at PR24. The Allowed-RoE needs to be sufficient to compensate investors for the Market-CoE over the RIH, regardless of what has happened in the past. It is therefore not clear to us what additional informational value is provided by Ofwat's analysis at Figure 3 of its Allowed Return Appendix and corresponding conclusion that there is little evidence from historical charge controls that investors have overall been undercompensated by the regulatory approach to TMR.⁷³

4.4. Beta

Theory and key regulatory guidance

119) Under the CAPM, an asset's 'beta' is the level of systematic risk faced by its investors. It represents the component of returns that is perfectly correlated with the return on the

⁷¹ FD24 Allowed Return Appendix, page 27.

⁷² FD24 Allowed Return Appendix, pages 27 and 28.

⁷³ FD24 Allowed Return Appendix, page 28.

market portfolio and is calculated as the covariance of the asset's distribution of returns with those of the market portfolio over the RIH, normalised by the variance of the distribution of returns on the market portfolio.

- 120) The equity beta is the beta of a company's equity assets in issue. It is well known that the equity beta is sensitive to the level of a company's outstanding debt that has been issued as a proportion of its assets (known as 'gearing'). Therefore, it may be preferable to calculate a company's 'asset beta', which is the beta of the assets of the firm, if it were financed with equity only. Under certain assumptions, a company's asset beta can be calculated with knowledge of its equity beta, debt beta (which is the beta of its portfolio of outstanding debt issuance), and level of gearing.
- 121) As with TMR, an asset's beta is not directly observable and so must be estimated. Equity betas are typically estimated with a regression of equity returns against returns on the market portfolio, based on a historical dataset of returns that are calculated using market prices of assets that are listed on one or more financial exchanges. Under this approach, regression results produce estimates of 'raw equity betas', which are estimates of beta for the equities of particular companies under analysis. Estimates of debt beta and gearing are required to form estimates of asset beta.
- 122) Estimating beta under a regression methodology for the purposes of estimating the CAPM-CoE for regulated water assets for PR24 requires a number of considerations, including:
- a. A set of comparator companies having comparable risk to a regulated water investment whose equities are listed on financial exchanges and readily available;
 - b. An appropriate time period over which historical data is required;
 - c. A frequency at which returns on financial assets are measured; and
 - d. Whether fundamental shifts in the operating environment may mean that certain historical periods are more or less reflective of potential outcomes over the RIH and should be accounted for.
- 123) For the regulated water sector, regulatory precedent considers listed water stocks as comparator companies. The UKRN lists Severn Trent, United Utilities, and 'going forward' Pennon as the appropriate proxies for water, with a footnote explaining that Severn Trent and United Utilities are close to pure play for England and Wales water and sewerage companies, as is Pennon following its disposal of Viridor which completed on 8 July 2020.⁷⁴

⁷⁴ UKRN 2023 Guidance, page 23 and footnote 65.

- 124) Regulatory precedent and guidance suggests a range of estimation windows should be used, with the UKRN 2023 Guidance⁷⁵ noting a trade-off between relevance and reliability, with longer samples generating more reliable estimates that are less heavily influenced by atypical and transient events which may not be representative of the ensuing control period than shorter samples, but may be less relevant to market expectations for future risk.
- 125) It is noteworthy that in the UKRN 2018 CoE Study, two academic authors of the study advocated for deviating from the standard regulatory practice of using a range of short-term sampling windows, in favour of estimating unconditional betas, given that the unconditional beta is likely to be the best proxy for a conditional beta over the long-term RIH:
- 126) *"Thus, as well as a conditional beta, we would ideally like to estimate the unconditional (or "long-run") beta, which is the ratio of the unconditional covariance to the unconditional variance of the market return. It is long-run beta that will determine the impact of systematic risk over the horizons relevant to regulators."*⁷⁶
- 127) Regulatory precedent and guidance have coalesced on daily sampling frequency, given the liquid nature of the listed stocks and the sensitivity of less frequent sampling frequencies to the reference day used. However, the CMA did consider daily, weekly and monthly sampling frequencies at PR19.⁷⁷
- 128) Regulatory precedent and guidance in relation to whether and how to incorporate adjustments for fundamental shifts in the operating environment, such as the effects of the Covid-19 pandemic, has been context specific. The UKRN 2023 Guidance states that *"a 'one-size-fits-all' approach for regulators is unlikely to be appropriate, and regulators must be free to exercise their judgement in a manner best suiting the prevailing circumstances."*⁷⁸ Regarding the treatment of the Covid-19 period specifically, it is noteworthy that in its Redeterminations at PR19, the CMA placed less weight on its estimates that included the Covid period as it considered that the pandemic represents a systematic event that is relatively rare and that it is likely to be over-weighted in its range of beta estimates⁷⁹. The CAA at H7 relied on an approach that reweighted observations that it considered were affected by the Covid-19 period⁸⁰.

Comparator firms

- 129) For the purposes of estimating the CAPM-CoE for regulated water assets for PR24 and in line with regulatory guidance, we consider the listed equities of an initial set of eligible

⁷⁵ UKRN 2023 Guidance, page 23.

⁷⁶ UKRN 2018 CoE Study, page 147.

⁷⁷ CMA FD19 Decision, paragraphs 9.463 to 9.465.

⁷⁸ UKRN 2023 Guidance, page 23.

⁷⁹ CMA FD19 Decision, paragraph 9.493.

⁸⁰ Economic regulation of Heathrow Airport Limited: H7 Final Decision Section 3: Financial issues and implementation, March 2023 (CMA H7 Heathrow S3 Financial Issues).

comparators that is comprised of the regulated water companies: United Utilities Group plc (UU), Severn Trent plc (SVT), and Pennon Group plc (PNN).

- 130) It is necessary to consider whether any of the listed water companies may not be sufficiently comparable to a regulated water investment. In its FD24, Ofwat considers that SVT and UU can be considered as near 'pure-play' companies in the years following 2006, following the divestment of most of their non-water activities⁸¹.
- 131) In respect of PNN, on 8 July 2020, PNN completed the sale of Viridor (a recycling and waste management company) to KKR for net proceeds of £3.7 bn. On 3 June 2021, PNN announced that it had acquired 100% of the issued share capital of Bristol Water Holdings UK Limited and its subsidiaries, alongside a return of capital to shareholders, consisting of a special dividend of c.£1.5 bn, and a share buy-back programme of up to £0.4 bn⁸². Therefore, it may be the case that prior to the spinoff of Viridor on 8 July 2020, PNN was a company that was not sufficiently 'pure-play' and did not represent sufficiently comparable risks to a regulated water investment. We consider further the question of whether PNN is sufficiently comparable to a regulated water investment to be included in our final set of listed comparators in paragraphs 155 to 162 below.

Estimation period

- 132) As discussed in Section 3.3, in order to determine an appropriate allowed return for PR24, we would ideally observe the return required by an investor to accept an investment in regulated water assets for the duration of the RIH, at the point of investment during the PR24 price control period.
- 133) Under the CAPM approach, this strictly requires knowledge of the conditional beta, which is the covariance of the distribution of returns with those of the market portfolio over the RIH, normalised by the variance of the distribution of returns on the market portfolio, given the prevailing market conditions at the point of investment. However, estimating the conditional beta is a complex exercise that may generate less robust estimates with a higher degree of uncertainty, which may not be suitable as a primary approach for a regulatory assessment. Therefore, we consider that the most appropriate method for estimating beta in the first instance, for the purposes of setting an allowed return on equity over the RIH, is by estimating the unconditional beta using a long-run of historical data for which the operating environment is deemed to be sufficiently reflective of potential outcomes for PR24. This is because this method is likely to generate more robust estimates with less statistical uncertainty than estimates of the conditional beta, even though it may carry a degree of upward or downward bias. This is consistent with the views of two of the academic authors of the UKRN 2018 CoE Study, as outlined at paragraph 125 above.

⁸¹FD24 Allowed return appendix, page 137.

⁸² <https://www.pennon-group.co.uk/system/files/press/announcement-pennon-02-06-2021.pdf>.

- 134) In order to assess the length of time for which the operating environment is likely to be reflective of potential outcomes for PR24, we rely on statistical tests of ‘structural breaks’⁸³. A report published by Gregory, Harris and Tharyan⁸⁴ during the CMA’s PR19 Redeterminations found that a structural break occurred at 30 September 2014. Therefore, the estimation period for the purposes of our beta analysis contains observations from 30 September 2014 to our data cutoff of 17 January 2025, which is a period of approximately ten years in duration.
- 135) Nevertheless, we consider that it is important to assess whether unconditional beta estimates over a long-run of historical data following a structural break are reflective of forward-looking beta estimates for PR24, or whether they are likely to be over- or underestimates. In order to assess this, we adopt the following approaches:
- a. First, we identify specific effects of lockdowns and associated restrictions that were imposed during the Covid-19 period on the betas of regulated water companies;
 - b. Second, we examine specific effects associated with Pennon’s spinoff of its waste management operations, Viridor, on its equity beta; and
 - c. Third, we examine whether forward-looking risks that are specific to the water sector for PR24 from the planned increase in the investment programme may affect regulated water company betas.
- 136) We also consider evidence for how macroeconomic conditions may affect regulated water company betas by considering estimates of conditional betas under an implementation of a model presented by Ferson and Harvey (1999)⁸⁵.
- 137) Regulatory precedent and guidance have typically considered estimation periods of various lengths, regardless of whether or not there is evidence to suggest that older data beyond these breakpoints is reflective of the price control period under assessment. The UKRN 2023 Guidance considers that all regulators should ‘typically [use] a range of estimation periods (e.g. 2-year, 5-year and sometimes longer estimation windows)’⁸⁶. This is because it considers that ‘there is a trade-off between relevance and reliability. Recent data may be more relevant to market expectations of future risk than historical data, but the longer the sample of observations used, the more reliable (statistically

⁸³ To test statistically for evidence of structural breaks, it is common to perform regressions that includes ‘dummy variables’, which take a value of zero before the point at which the structural break is hypothesised to have occurred, and one after. A structural break is deemed to have occurred if the coefficient that is associated with the interaction between the dummy variable and the excess market return is statistically significant.

⁸⁴ Gregory, A., Harris, R., and Tharyan, R., (2020), “A Response to The CMA’s Provisional Findings on Water and the Estimation of Beta”, October (Gregory, Harris and Tharyan 2020).

⁸⁵ Ferson, Wayne E. and Harvey, Campbell R., Conditioning Variables and the Cross-Section of Stock Returns, the Journal of Finance Vol LIV, No 4 (Ferson and Harvey 1999), August 1999.

⁸⁶ UKRN 2023 Guidance 2023, page 22.

robust) estimates will be, and the less heavily influenced by atypical and transient events which may not be representative of the ensuing control period'.⁸⁷

138) When estimating the unconditional beta, we recognise the concern with whether the use of longer estimation periods may include observations that are no longer relevant.

139) However, we consider that the approach of relying primarily on unconditional betas estimated over a long-run of historical data following a structural break, and subsequently examining whether the unconditional beta estimates are reflective of expectations over PR24 and the RIH, is more likely to generate more robust, statistically accurate estimates, whilst addressing concerns with the relevance of older observations.

Unconditional beta estimates

140) To derive estimates of unconditional betas of the listed equities of the proposed set of comparators, we estimate raw equity betas by regressing excess returns of UU, SVT and PNN over returns on short-dated UK government-issued bills, on excess returns⁸⁸ of the FTSE All-Share Index, where returns are observed at daily, weekly and monthly frequencies⁸⁹, between 30 September 2014 and our data cutoff of 17 January 2025.

141) Raw equity betas are converted into unlevered beta estimates using the 'Harris-Pringle' formula (which is based on a typical interpretation of the Modigliani and Miller theorem under standard assumptions concerning personal and corporate tax rates and debt management policies^{90,91}) using average levels of gearing that are calculated as the ratio of the value of net debt, to the sum of the value of net debt and market capitalisation, for each listed comparator.

Capturing the Covid-19 period

142) As set out above, it is important to consider whether fundamental shifts in the operating environment may mean that certain historical periods are more or less reflective of potential outcomes for the PR24 price control period and should be accounted for.

143) It is uncontroversial that the Covid-19 period was an exceptional time for the UK and global economy. As our estimation period is approximately 10 years in length and captures the Covid-19 period in its entirety, it is likely that any idiosyncratic effects during that period that are not expected to recur with a comparable frequency over the RIH will be over-represented and may bias estimates of the unconditional beta for PR24. We emphasise that the idiosyncratic effects are not limited to those that might simply be

⁸⁷ UKRN 2023 Guidance 2023, page 23.

⁸⁸ We also consider regression analyses using gross listed equity and index returns in place of excess returns and find negligible differences.

⁸⁹ Weekly returns are calculated using a snapshot of market values at the end of the week (i.e. Friday), and monthly returns are calculated using a snapshot of market values at the end of the month.

⁹⁰ Appleyard, Tony R., Strong Norman C., Beta Geared and Ungeared: The Case of Active Debt Management, Accounting and Business Research, Vol 19, No 74, pages 170-174, 1989 (**Strong and Appleyard 1989**).

⁹¹ For more information on the Harris Pringle approach, please see Harris, RS and Pringle, JJ (1985), [Risk-Adjusted Discount Rates-Extensions From The Average-Risk Case](#).

expected to recur following the emergence of another pandemic, but also includes the economic and social responses to the Covid-19 pandemic specifically. Therefore, we consider whether and to what extent the Covid-19 period influenced our estimates of the unconditional beta.

144) To account for the effect of the Covid-19 period, we modify the regression approach set out at paragraph 140 and implement the following specification:

$$R_{P,t} - R_{F,t-1} = \alpha + \beta_M(R_{M,t} - R_{F,t-1}) + \alpha_D D_t + \beta_D D_t(R_{M,t} - R_{F,t-1}) + \varepsilon_{p,t}$$

where:

- a. $R_{P,t}$, $R_{F,t}$, $R_{M,t}$ are the returns on the equities of the listed comparators, the yield on government-issued short-dated bills, and the return on the FTSE All Share Index, respectively;
- b. D_t is a dummy variable representing the periods of time during Covid-19 for which considerable restrictions were in place for one or more sectors of the economy⁹², (taking the value of 1 during relevant periods, and zero otherwise).

145) Under this approach, results for the parameter β_M from the regression analysis will provide an estimate of the equity beta under the condition that idiosyncratic effects from the Covid-19 period, which include the economic and social responses to the pandemic, as measured by the restrictions placed on one or more sectors of the economy, will recur with a negligible likelihood during the RIH. Equity beta estimates are converted into unlevered beta estimates under the same approach set out at paragraph 141.

146) Table 7 below shows the estimates for unlevered beta under the typical regression methodology set out at paragraph 140, which does not account for the exceptional nature of the Covid-19 period, and under the regression specification set out at paragraph 144 above, which does. The estimates are calculated based on data observed at daily, weekly, and monthly frequencies over the estimation period from 30 September 2014.

⁹² Restriction periods capture dates between 16 March 2020 (when the halting of non-essential contact and travel was recommended) and 23 June 2020 (when restrictions were relaxed and the 2m social distancing rule was imposed), and between 14 September 2020 (when social gatherings above six were banned in England) and 19 July 2021 (when most legal limits on social contact were removed in England and final closed sectors of the economy reopened). As a robustness check, we test whether our findings are particularly sensitive to the method of accounting for Covid-19 based on periods of restrictions, by testing the impact based on dates of lockdown (23 March 2020 to 15 June 2020, 5 November 2020 to 2 December 2020, and 6 January 2021 to 12 April 2021). We find that our results are robust to the method of accounting for Covid restrictions. (Dates and descriptions of lockdowns and other restrictions obtained from: Institute for Government, Timeline of UK government coronavirus lockdowns and measures, March 2020 to December 2021 ([IfG Covid Timeline](#))).

Table 7: Unlevered beta estimates over the estimation period (from 30 September 2014) using data at daily, weekly, and monthly frequencies that do, and do not, account for the period of Covid-19 restrictions

Comparator	Daily		Weekly		Monthly	
	Unadj.	Covid-19 adj.	Unadj	Covid-19 adj.	Unadj.	Covid-19 adj.
UU	0.290	0.315	0.296	0.299	0.268	0.330
SVT	0.297	0.322	0.288	0.316	0.289	0.359
PNN	0.336	0.378	0.332	0.380	0.246	0.360

Source: Refinitiv, Kairos analysis. Notes: The 'Unadjusted (Unadj.)' columns show the estimates for unlevered beta under the typical regression methodology, which do not account for the exceptional nature of the Covid-19 period. The 'Covid-19 adj.' columns show the estimate for unlevered beta under the regression specification set out at paragraph 144, which does account for the exceptional nature of the Covid-19 period under the assumption that the idiosyncratic effects from the Covid-19 period will recur with a negligible likelihood during the RIH. Weekly and monthly estimates are calculated using observations taken at the end of each week and month.

147) Table 7 above shows a substantial difference between beta estimates that do, and do not account for the period of Covid-19 restrictions, and we find that the estimated effect is statistically significant at a daily frequency for all listed comparators⁹³. Under the assumption that there is a negligible likelihood of a repeat of the restrictions that were imposed as a response to a future pandemic during the RIH, estimates of the unconditional beta for UU, SVT and PNN over the estimation periods at daily, weekly and monthly frequencies are between 0.315 to 0.378, 0.299 to 0.380 and 0.330 to 0.360, respectively.

148) These results demonstrate the exceptional nature of the period of Covid-19 restrictions, the considerable size of its effect on estimates of unlevered betas, and the importance of adjusting for any idiosyncratic effects of responses to a future pandemic that are not expected to recur with a comparable frequency during the RIH.

Reference day risk

149) Beta estimates using weekly returns are calculated using a snapshot of market values at the end of the week (i.e. Friday). Those using monthly returns are calculated using a snapshot of market values at the end of the month. Estimates of beta can be sensitive to the reference day on which weekly and monthly returns are calculated (which is known as 'reference day risk').

150) To examine the degree of reference day risk, we calculate raw equity beta estimates at a weekly frequency, using different days of the week as the reference day. We also calculate raw equity beta estimates that account for the period of Covid-19 restrictions

⁹³ A full set of regression results is shown in Appendix A.

under the approach set out at paragraph 144 above, with respect to different reference days. The results are shown in Table 8 below.

Table 8: Raw equity beta estimates over the estimation period (from 30 September 2014) using data at a weekly frequency, across different reference days of the week, with and without adjustments for Covid-19 restrictions

Comparator (Unadj. / Covid-19 adj.)	Monday	Tuesday	Wednesday	Thursday	Friday
UU	0.735 / 0.660	0.668 / 0.738	0.434 / 0.721	0.635 / 0.751	0.637 / 0.643
SVT	0.641 / 0.641	0.596 / 0.715	0.378 / 0.680	0.548 / 0.713	0.579 / 0.636
PNN	0.705 / 0.771	0.622 / 0.774	0.425 / 0.758	0.648 / 0.809	0.618 / 0.708

Source: Refinitiv, Kairos analysis. Notes: Figures shown in bold are estimates for raw equity betas under the regression specification set out at paragraph 144, which accounts for the exceptional nature of the Covid-19 period under the assumption that the idiosyncratic effects from the Covid-19 period will recur with a negligible likelihood during the RIH. Other figures shown are estimates for raw equity betas under the typical regression methodology, which does not account for the exceptional nature of the Covid-19 period.

- 151) For raw equity betas that are calculated under the standard approach, Table 8 above demonstrates a high degree of variability across days of the week that are chosen as the reference day. We note in particular that estimates for the reference day Wednesday are markedly lower than for other days of the week.
- 152) For raw equity betas that are calculated under the approach that accounts for the period of Covid-19 restrictions, Table 8 above shows that there continues to be a reasonable degree of variability between estimates. We also note that estimates for the reference day Wednesday are now broadly similar to estimates for other days of the week.
- 153) We investigate the outlying nature of the betas estimated with respect to a Wednesday reference day and the effect of the inclusion of an adjustment for the Covid-19 restriction period. We find that the observed effect is largely due to returns observed during an exceptional period in March 2020, when return variability across the listed comparators and the FTSE All-Share Index is extreme. We attribute this to the effect of the exceptional nature of the Covid-19 period of restrictions on financial returns. This period is contained within the period of Covid-19 restrictions that are accounted for in the estimates of unlevered beta at Table 8, which explains to a large degree the magnitude of the change between standard and Covid-19 adjusted weekly raw equity betas having Wednesday as a reference day.
- 154) We consider that this finding further highlights the exceptional nature of the Covid-19 lockdown periods, and the importance of adjusting for any idiosyncratic effects that are not expected to recur with a comparable frequency during the RIH, such as the Covid-19 lockdowns.

The value of Pennon as a listed comparator

155) As set out above, it may be the case that prior to the spinoff of Viridor on 8 July 2020, PNN was a company that was not sufficiently 'pure-play' and did not represent sufficiently comparable risks to a regulated water investment. We consider below the question of whether PNN is sufficiently comparable to a regulated water investment to be included in our final set of listed comparators.

156) We examine whether the Viridor spinoff influenced the equity beta of PNN using a statistical approach. To investigate the effect of the Viridor spinoff, we extend the regression approach that was set out at paragraph 144 and implement the following specification:

$$R_{P,t} - R_{F,t-1} = \alpha + \beta_M(R_{M,t} - R_{F,t-1}) + \alpha_1^D D_{1,t} + \alpha_2^D D_{2,t} + \beta_1^D D_{1,t}(R_{M,t} - R_{F,t-1}) + \beta_2^D D_{2,t}(R_{M,t} - R_{F,t-1}) + \varepsilon_{p,t}$$

where:

- $R_{P,t}$, $R_{F,t}$, $R_{M,t}$ are the returns on PNN, the yield on government-issued short-dated bills, and the return on the FTSE All Share Index, respectively;
- $D_{1,t}$ is a dummy variable representing the periods of time during Covid-19 for which restrictions were in place using the same approach set out at paragraph 144 (taking the value of 1 during relevant periods, and zero otherwise); and
- $D_{2,t}$ is a dummy variable representing the period of time following the disposal of Pennon's Viridor business, which was completed on 8 July 2020⁹⁴ (which takes a value of one for returns observed after the date of completion of the Viridor sale, and zero otherwise).

157) Under this approach, estimates for the sum of the parameters $\beta_M + \beta_2^D$ from the regression analysis will provide an estimate of the equity beta for PNN after accounting for the Viridor spinoff and the influence of the Covid-19 restriction on the unlevered beta estimates. Table 9 below presents the unlevered beta estimates for PNN after accounting for the Viridor spinoff and the influence of the Covid-19 restrictions (UU and SVT unlevered beta estimates are also shown for completeness).

⁹⁴ <https://www.pennon-group.co.uk/media/news/completion-viridor-sale-board-changes-and-notice-agm>.

Table 9: Unlevered beta estimates over the estimation period (from 30 September 2014) using data at daily, weekly, and monthly frequencies, accounting for the period of Covid-19 restrictions and the spin-off of Viridor

Comparator	Daily		Weekly		Monthly	
	Covid-19 adj.	Covid-19 + Viridor	Covid-19	Covid-19 + Viridor	Covid-19	Covid-19 + Viridor
UU	0.315	0.315	0.299	0.299	0.330	0.330
SVT	0.322	0.322	0.316	0.316	0.359	0.359
PNN	0.378	0.410	0.380	0.386	0.360	0.385

Source: Refinitiv, Kairos analysis. Notes: The 'Covid-19 adj.' columns show the estimates for unlevered beta under the regression specification set out at paragraph 144, which accounts for the exceptional nature of the Covid-19 period under the assumption that the idiosyncratic effects from the Covid-19 period will recur with a negligible likelihood during the RIH. The 'Covid-19 + Viridor' columns show the estimates for the unlevered beta of PNN under the regression specification set out at paragraph 156, which accounts for the Viridor spinoff and the influence of the Covid-19 restrictions (with UU and SVT also shown for reference).

- 158) We test statistically whether there was an effect of the Viridor spinoff on the beta of PNN by considering whether the estimated parameter β_2^D , which is associated with the dummy variable that represents the period of time following the disposal of Pennon's Viridor business, is statistically significant. We find that for regressions using data at daily, weekly and monthly frequencies, the relevant coefficient is statistically insignificant. Therefore, we cannot reject the null hypothesis that the spinoff of Viridor did not affect the equity beta of PNN, under all observation frequencies. Therefore, we consider that there is no statistical basis for excluding PNN from our set of listed comparators.
- 159) Second, the results in Table 9 above show that despite the lack of statistical significance, it is nonetheless noteworthy that the betas of Pennon are higher when the Viridor dummy is included. Additionally, the estimates of the unlevered beta for PNN increase across daily, weekly and monthly frequencies. Therefore, the results would suggest that if the Viridor spinoff did influence the equity beta of PNN, then there is evidence to indicate that the period of time following the Viridor spinoff may be associated with a positive increase in the equity beta.
- 160) Estimates above have been presented for individual listed comparators only. To arrive at a beta estimate, we combine the estimates of equity betas for the set of listed comparators using the following portfolio approaches across UU and SVT (UU/SVT), and UU, SVT and PNN (UU/SVT/PNN):
- For UU/SVT, we calculate the unlevered beta of the weighted average of the individual equity returns, where the weights are calculated according to the market capitalisation of each comparator;
 - For UU/SVT/PNN, to incorporate an adjustment for the Viridor spinoff, we calculate the weighted average of the unlevered equity betas, where the

weights are calculated according to the average market capitalisation of each comparator over the period. This is because the Viridor adjustment only applies to PNN, and not to UU or SVT; and

- c. For UU/SVT/PNN, we calculate the portfolio beta under an alternative approach to accounting for the Viridor spinoff, where we calculate the unlevered beta of the weighted average of the individual equity returns, but where the weights are calculated according to the market capitalisation of UU and SVT only, before the completion of the Viridor spinoff on 8 July 2020, and of UU, SVT and PNN after. This is because it is uncontroversial that PNN is a 'pure-play' water company after that date.

161) For UU/SVT/PNN, we also consider an equally-weighted version, where equal weights are applied to UU and SVT only, before the completion of the Viridor spinoff on 8 July 2020, and to UU, SVT and PNN after. Table 10 below shows estimates of the unlevered equity beta under the approaches for the UU/SVT and UU/SVT/PNN portfolios set out above.

Table 10: Unlevered beta estimates over the estimation period at a daily frequency, accounting for the Covid-19 period of restrictions and the Viridor spinoff

Portfolio	Unadjusted	Adjusted for Covid-19 and Viridor	Adjusted for Covid-19 with portfolio inclusion of PNN after Viridor completion
UU/SVT (VW)	0.294	0.319	0.319
UU/SVT/PNN (VW)	0.302	0.337	0.324
UU/SVT/PNN (EW)	0.308	0.349	0.327

Source: Refinitiv, Kairos analysis. Notes: The 'Unadjusted' columns show the estimates for beta under the standard regression specification, without accounting for Covid-19 restrictions or the Viridor spinoff. The 'Adjusted for Covid-19 and Viridor' column refers to the weighted average of the unlevered equity betas across each portfolio, accounting for the Covid-19 restrictions and the Viridor spinoff. The 'Adjusted for Covid-19 with portfolio inclusion of PNN after Viridor completion' column refers to the unlevered beta of the weighted average of the individual equity returns, but where the weights are calculated according to the market capitalisation of UU and SVT only, before the completion of the Viridor spinoff on 8 July 2020, and of UU, SVT and PNN after. 'VW' refers to a value-weighted portfolio, and 'EW' refers to an equally weighted portfolio.

Incorporating sector-specific risks at PR24

162) It is important to consider whether unconditional beta estimates, based on a long-run of historical data, are reflective of forward-looking betas. In this section, we consider whether evidence provided by beta estimates that account for changes in sector-specific risks suggests that unconditional beta estimates over the estimation period are likely to be over- or underestimates of beta over the RIH at PR24.

163) Proposals from water companies for PR24 involve a considerable level of capital expenditure to deliver the planned investment programme. We consider below the extent to which there is evidence to support the claim that the size of the investment

programme is likely to increase the level of systematic risk faced by regulated water companies, and therefore an increase in the return required by investors.

- 164) Capital investment to develop new projects, or expand existing projects, carries a multitude of associated risks. Whilst a number may be considered as linked to the execution of the project and idiosyncratic in nature, there is an important channel through which investment can increase the systematic risk of regulated water businesses. Upon committing to investing during a project with a considerable level of associated fixed costs, companies can find themselves facing uncertainty over the potential distribution of associated revenues. For regulated companies specifically, this can include uncertainty in cost recovery mechanisms, delays in delivery caused by external factors, and penalties for failure to meet regulatory targets. This may give rise to an increase in the degree of operating leverage faced by a company, given by the relative proportion of fixed versus variable costs. All else being equal, a higher proportion of fixed costs will increase the sensitivity of a project's cashflows to underlying systematic risks, thereby increasing the beta.
- 165) We examine whether there is empirical evidence to support the theoretical argument that an increase in capital expenditure can increase the systematic risk of a regulated water company. We recognise that regulated water companies benefit from risk mitigation mechanisms under the regulatory regime that may not expose investors to the same level of risk as other non-regulated companies. However, it is likely that considerable risks remain. Therefore, our examination of the relationship between capital expenditure and the beta for a regulated water company proceeds in two parts. First, we investigate how much risk is associated with investment by looking at international evidence on the relationship between changes in investment and CAPM beta. In particular, we note that privatised utilities are a feature of the US, European and other developed markets, and so examine each of these to shed light on the relationship. Second, we test empirically for an effect from capital expenditure on estimates of beta for the UK listed water comparators UU, SVT and PNN (consistent with the set of listed water comparators that were considered under the beta analysis above).
- 166) In relation to international evidence on the relationship between changes in investment and CAPM beta, we look at data from portfolio returns formed on the basis of size and investment and combine those with factor returns available from the online data library provided by Kenneth French (KFDL)⁹⁵. We make use of this data library to obtain the factor and portfolio data for the US, Europe and Developed Markets (ex US), finding remarkably consistent relationships across markets.
- 167) The KFDL presents value-weighted portfolio returns for portfolios sorted by both size (market capitalisation) and investment (change in total assets divided by opening total assets). These are 5x5 sorts on all companies excluding financials. In the analysis below

⁹⁵ https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

we utilise only the largest size quintile of investment portfolios, leaving us five portfolios of the largest stocks sorted by degree of investment ranging from low investment to high investment

168) 'Fama French 5-factor' model data is available on a daily basis back to the 1960s for the US. Consistent with an estimation period of approximately 10-years in duration, we present our analyses using data from 1 January 2015 to 31 December 2024 (which is the last observation on the KFDL at the time of writing). For the purposes of this analysis we focus solely on the "conservative investment minus aggressive investment" factor (CMA) which is formed on the basis of low investment minus high investment.

169) Regulation in Australia, Canada, Germany, New Zealand and the USA commonly uses an allowed rate of return model, though with some differences in model application⁹⁶. It would also appear to be the case that other countries use a similar allowed rate of return approach to regulated utilities (Belgian regulators use a version of the CAPM to set the allowed return for its grid operator (Elia), for example). Given this commonality of regulatory frameworks, it seems reasonable to consider evidence internationally on the relationship between investment and return.

170) To investigate the relationship between investment changes and returns we analyse the '5 x 5' size and investment portfolio returns available from the KFDL. Although these data are available for all five size quantiles, recognising that the two listed water companies preferred as proxies by Ofwat in the UK are FTSE100 companies, we report results for the "big" company quintile only. We analyse Europe, Developed Markets ex-US, and the US itself.

171) In focusing on data from 1 January 2015 to 31 December 2024, we are mindful of the breakpoints utilised in segregating the data into quantiles. These are shown in detail for the US in the KFDL, and show that the bottom quintile of firms contain companies with negative investment.⁹⁷ We also note that the top deciles seem to contain some very large increases in assets, which are likely to be associated with M&A activity. Given this, we focus our attention on the differences in beta between the 2nd lowest and 4th largest quintiles, but also report the beta of the CMA factor itself in these markets.

⁹⁶ For a detailed analysis, see Sudarsanam, S., Kaltenbronn, U. and Park, P., Cost of Equity for Regulated Companies: An International Comparison of Regulated Practices, prepared for the Competition Commission, 12 November 2011 (**Sudarsanam, Kaltenbronn and Park 2011**).

⁹⁷ This is similar to the position in the UK dataset available on the Northumbria University website.

Table 11: CAPM betas for international investment portfolios (Largest companies only)

Portfolio	Europe	Developed markets (ex-US)	US
Low	0.953	0.957	0.847
2	0.946	0.961	0.871
3	0.983	1.001	0.943
4	0.973	1.007	0.946
High	1.057	1.062	1.162
Difference between 4th and 2nd quintiles	0.027	0.046	0.075
CMA	-0.077	-0.121	-0.113

Source: KFDL, Kairos analysis

172) With the exception of the lowest investment portfolios, the general tendency is for the CAPM beta to increase as investment increases. The fact that this phenomenon of the CAPM beta increasing as investment increases, and that the beta of the CMA factor is strongly negative (bearing in mind that the factor is 'low minus high' not 'high minus low') is observed internationally suggests that there is a relationship between investment and CAPM beta for large firms.

173) Regulated water companies benefit from risk mitigation mechanisms under the regulatory regime that may not expose investors to the same level of risk as other non-regulated companies. Therefore, we examine whether there is a relationship between investment and beta for regulated water companies, specifically.

174) To test empirically whether the beta is sensitive to the level of capital expenditure of a water company, we conduct an analysis whereby excess returns on portfolios of listed comparators (UU, SVT and PNN) over the return provided by short-dated government-issued bills are regressed against excess returns of the FTSE All Share Index, and observable variables that proxy for the level of 'capital intensity' (which is defined by Ofwat as the level of capital expenditure to opening RCV) using daily observations over the estimation period from 30 September 2014 (consistent with the estimation period used in the analysis above), under the following specification:

$$\begin{aligned}
 R_{P,t} - R_{F,t} = & \alpha + \beta_M (R_{M,t} - R_{F,t-1}) + \sum_{i=1}^p \beta_i^D D_{i,t} (R_{M,t} - R_{F,t-1}) + \sum_{i=1}^q \beta_i^C C_{i,t} (R_{M,t} - R_{F,t-1}) \\
 & + \sum_{i=1}^p \alpha_i^D D_{i,t} + \sum_{j=1}^q \alpha_j^C C_{j,t} + \varepsilon_{p,t}
 \end{aligned}$$

where:

- 175) $R_{P,t}$, $R_{F,t}$, $R_{M,t}$ are the returns on the portfolio of listed comparators, the yield on short-dated government-issued bills, and the return on the FTSE All Share Index, respectively;
- a. $D_{i,t}$ are dummy variables representing the periods of restrictions during Covid-19 that are described above;
 - b. $C_{i,t}$ are observable variables that proxy for capex intensity and gearing (which is measured as the outstanding amount of net debt as a proportion of the enterprise value).
- 176) To proxy for capex intensity, we consider the amount of prevailing capital expenditure expressed as a proportion of: (i) lagged observations of total assets, (ii) lagged observations of property, plant and equipment, and (iii) concurrent observations of the enterprise value.^{98,99}
- 177) It should be noted that we would expect the relationship between beta and capital expenditure to be non-linear. Therefore, results under the regression specification set out above will represent a linear approximation to the true relationship, meaning that the estimated coefficients may only be accurate for small changes in capex intensity.
- 178) The results of our analysis are shown in Appendix A. We find statistically significant evidence that increases in capex intensity are associated with increases in beta for portfolios of listed comparators comprised of UU and SVT, and UU, SVT and PNN, across all three proxy measures of capex intensity.
- 179) Parameter estimates show that a 0.25 percentage point increase in capex intensity is associated with a change in the equity beta of at least 0.02. However, standard deviations of capex intensity (measured as the ratio of capital expenditure to total assets) for the portfolios of UU and SVT, and UU, SVT and PNN over the estimation period are between 0.6 and 0.9 percentage points. As described above, these estimates represent linear approximations to the true non-linear relationship, and may therefore not represent accurate estimates at the level of increase proposed under the PR24 investment programme, which Ofwat calculates to be 2.9 percentage points¹⁰⁰ (measured as the difference between the average annual capex-to-RCV over the 2025-30 control period and the average over the past 15 years). Nevertheless, we can be confident on a statistical basis of the positive association between small changes in capex intensity and beta.

⁹⁸ Aggregated values of the specified variables across the portfolio of listed water comparators are used.

⁹⁹ Whilst market prices and traded data are available at a daily frequency, values relating to accounting data are only available periodically. Therefore, in the dataset, calculated values of capex intensity are taken to be those most recently reported.

¹⁰⁰ FD24 Allowed Return Appendix, page 48.

180) Additionally, there is a perception that the relative risk associated with an investment in regulated water assets has increased. In this regard we note that a report published by S&P Global concludes that 'the changes in the current and upcoming regulatory periods that would indicate a heightened risk perception for the sector are no longer consistent with our strongest regulatory advantage assessment'¹⁰¹. Relatedly, in its allowance for the cost of new debt, Ofwat applies a 30bp uplift to take account of 'the current evidence of elevated debt spreads and also the need for water companies to raise significant finance to support their 2025-30 investment programmes'¹⁰², which signals that the cost of debt for the notionally financed company has risen in relative terms against the iBoxx A/BBB benchmark.

181) There are a number of factors that may drive a relative increase in spreads of the cost of debt versus a consistent benchmark. Of those factors, a perceived increase in the risk that a company will not be able to fulfil its payment obligations is likely to drive an increase in the cost of debt and equivalent risks associated with an equity investment. As equity beta is calculated as the covariance between the equity return and the market portfolio, normalised by the variance of the returns on the market portfolio, an increase in the riskiness of a regulated water investment will lead to an increase in the associated equity beta, all else equal.

Accounting for the current macroeconomic environment

182) We consider that the most appropriate method for estimating beta in the first instance, for the purposes of setting an allowed return on equity over the RIH, is to estimate the unconditional beta using a long-run of historical data for which the operating environment is deemed to be sufficiently reflective of potential outcomes for PR24. Nevertheless, we consider whether evidence provided by time-varying short-run betas conditional on the recent information set reflecting changing macroeconomic conditions suggests whether unconditional beta estimates using data over the estimation period from 30 September 2014 are likely to be reflective of PR24 on a forward-looking basis.

183) To derive estimates of the conditional beta that incorporate current macroeconomic conditions, we consider an implementation of the approach presented by Ferson and Harvey (1999). This is performed as a regression of excess returns of the listed equity comparators against excess return of the broad-based FTSE All-Share Index, and a number of macroeconomic variables (listed below), where returns and macroeconomic variables are observed at a daily frequency over the estimation period from 30 September 2014. The regression specification is given by:

¹⁰¹ S and P Water Rating Action 2025, page 3.

¹⁰² FD24 Allowed Return Appendix, page 98.

$$\begin{aligned}
R_{P,t} - R_{F,t-1} = & \alpha + \beta_M(R_{M,t} - R_{F,t-1}) + \sum_{i=1}^p \beta_i^D D_{i,t}(R_{M,t} - R_{F,t-1}) + \sum_{j=1}^q \beta_j^C C_{j,t-1}(R_{M,t} - R_{F,t-1}) \\
& + \sum_{i=1}^p \alpha_i^D D_{i,t} + \sum_{j=1}^q \alpha_j^C C_{j,t-1} + \varepsilon_{p,t}
\end{aligned}$$

where:

184) $R_{P,t}$, $R_{F,t}$, $R_{M,t}$ are the returns on the portfolio of listed comparators, the yield on government-issued bills, and the return on the FTSE All Share Index, respectively;

- a. $D_{i,t}$ are dummy variables representing the periods of time during Covid-19 for which restrictions were in place using the same approach set out at paragraph 144, and the period of time following the disposal of Pennon's Viridor business; and
- b. $C_{i,t}$ are the values of the macroeconomic conditioning variables which are the: (i) 1-month yield on UK government bills, (ii) dividend yield of the FTSE All-Share Index, (iii) the term spread between the 10-year and 1-year yields on UK government bonds, (iv) the credit spread between AAA-rated and BBB-rated corporate bonds, and (v) the spread between returns on 3-month and 1-month UK government bonds. These variables are used by Ferson and Harvey (1999) in their publication.

185) Estimates of conditional betas that incorporate the information provided by the macroeconomic variables set out above are calculated as: $\beta_t = \beta_M + \sum_{i=1}^p \beta_i^D D_{i,t} + \sum_{j=1}^q \beta_j^C C_{j,t-1}$.

186) The regression approach set out above relies on an assumption of stationarity¹⁰³ of the variables considered. Whilst not considered by Ferson and Harvey in their analysis, we consider that the assumption of stationarity for the 1-month yield on UK government bills may be questionable. Therefore, we also consider an implementation of the approach described above whereby the 1-month yield on UK government bills is transformed by 'stochastic detrending', which is implemented for present purposes by calculating the difference between each observation and its 21-day moving average. The estimates of the conditional betas under the approaches described above is set out in Table 12 below.

¹⁰³ The stationarity of a time series refers to a property whereby the distribution of outcomes for each observation does not vary through time.

Table 12: Conditional unlevered beta estimates using the Ferson and Harvey (1999) approach under various specifications at a daily frequency over the estimation period (from 30 September 2014), accounting for the Covid-19 restrictions and the Viridor spinoff

Comparator	Unconditional beta	Conditional beta	
		Unadjusted	Stochastically detrended
UU	0.315	0.440	0.325
SVT	0.322	0.467	0.323
PNN	0.410	0.627	0.429

Source: Refinitiv, Kairos analysis

187) Table 12 above shows that the conditional unlevered equity betas under the unadjusted specification used by Ferson and Harvey in their analysis are considerably above the unconditional betas estimates, with a range of between 0.440 and 0.627. However, as set out above, we consider that the assumption of stationarity for the 1-month yield on UK government bills may be questionable. The estimates of conditional unlevered equity betas under the detrended approach are between 0.323 and 0.429.

188) Whilst these estimates are above the range of unconditional betas for the listed comparators separately of 0.315 and 0.410, we consider that they are broadly corroborative, given the increased uncertainty and volatility of the conditional estimates.

189) We recognise that the beta parameter estimates under the approach set out above are volatile and sensitive to the precise specification used. This justifies our preference for relying on unconditional betas using a long-run of historical data for which the operating environment is deemed to be sufficiently reflective of potential outcomes for PR24. Furthermore, short-run beta estimates that account for the recent information set reflecting changing macroeconomic conditions are only informative about beta over the long-run to the extent that the macro-variables are very persistent (which they are unlikely to be). Nevertheless, the conditional betas of 0.315 to 0.410 are broadly corroborative, albeit slightly above, our unconditional beta range.

Evidence in the round

190) Given the statistical complexities with estimating the conditional equity beta and the variability of estimates calculated under the approaches that we have implemented, we consider that setting an allowed return on equity during a price control period having a five-year duration is best estimated using an unconditional beta, based on a long-run of historical data for which the operating environment is deemed to be sufficiently reflective of potential outcomes for PR24. Accordingly, we place primary weight on unconditional estimates.

- 191) In relation to reference day risk, we consider that the evidence presented above shows that weekly estimates of equity beta vary considerably depending on the day of the week that is used as the reference day. We would expect that monthly estimates are also affected by reference day risk. There is some evidence¹⁰⁴ that monthly betas may be affected by reference day risk but consistent with the Dimson, Marsh and Staunton data and the LSPD Monthly data set used in testing monthly factor models, we stay with the generally accepted convention of measuring monthly returns on the last trading day of the calendar month. Therefore, whilst weekly and monthly estimates may provide evidential value in some circumstances, such as illustrating the effects of the Covid-19 period on beta estimates, we consider that daily estimates are likely to provide the most evidential value. As a result, we place limited weight on weekly and monthly estimates.
- 192) We consider that there is strong evidence that estimating unlevered equity betas without accounting for the effect of the exceptional Covid-19 lockdowns is likely to capture the idiosyncratic effects during that period that are not expected to recur with a comparable frequency. Therefore, the effects of the Covid-19 lockdowns will be over-represented in a sample of data based on our estimation period, and are likely to bias unadjusted estimates of the unconditional beta for PR24. As a result, we disregard the estimates of unconditional beta that do not account for the Covid-19 period.
- 193) In relation to the value of PNN as a listed comparator, our analysis shows that there is no statistical evidence for the exclusion of PNN as a listed comparator as a result of the Viridor spinoff. Therefore, we consider that an appropriate set of listed comparators is comprised of UU, SVT and PNN. Whilst our analysis finds that there is no statistical basis to conclude that the Viridor spinoff affected the beta of PNN, if the Viridor spinoff did have an effect on the equity beta of PNN, then there is evidence to indicate that the spinoff may be associated with a positive increase. Therefore, we place weight on the estimates for PNN's equity beta that account for the Viridor spinoff.

Table 13: Unlevered beta estimates over the estimation period at a daily frequency, accounting for the Covid-19 period of restrictions and the Viridor spinoff

Portfolio	Unadjusted	Adjusted for Covid-19 and Viridor	Adjusted for Covid-19 with portfolio inclusion of PNN after Viridor completion
UU/SVT (VW)	0.294	0.319	0.319
UU/SVT/PNN (VW)	0.302	0.337	0.324
UU/SVT/PNN (EW)	0.308	0.349	0.327

Source: Refinitiv, Kairos analysis. Notes: The 'Unadjusted' columns show the estimates for beta under the standard regression specification, without accounting for Covid-19 restrictions or the Viridor spinoff. The 'Adjusted for Covid-19 and Viridor' column refers to the weighted average of the unlevered equity betas across each portfolio, accounting for the Covid-19 restrictions and the Viridor

¹⁰⁴ Acker, D. and Duck, Nigel W., Reference-day Risk and the Use of Monthly Returns Data, Journal of Accounting, Auditing & Finance, 2007 (Acker and Duck 2007).

spinoff. The 'Adjusted for Covid-19 with portfolio inclusion of PNN after Viridor completion' column refers to the unlevered beta of the weighted average of the individual equity returns, but where the weights are calculated according to the market capitalisation of UU and SVT only, before the completion of the Viridor spinoff on 8 July 2020, and of UU, SVT and PNN after. 'VW' refers to a value-weighted portfolio, and 'EW' refers to an equally weighted portfolio.

194) Under the results presented in Table 13 above, and based on the value-weighted portfolios of UU/SVT and UU/SVT/PNN that account for the Covid-19 restrictions and Viridor spinoff, we consider that an appropriate range for the unlevered beta is 0.319 to 0.337.

195) Whilst our range is based upon unconditional betas, we considered evidence on the relationship between capital expenditure and beta, finding a materially positive relationship. We consider that this evidence, coupled with a perceived increase in the riskiness of the sector for PR24, suggests that the mid-point of the range set out at paragraph 194 may underestimate the forward-looking beta that reflects the sector-specific risks at PR24. This is discussed further in the section on asymmetry in the choice of parameters for the CAPM below, when moving from the estimated CAPM-CoE to the Allowed-RoE.

Debt beta

196) Debt beta is the beta on a company's portfolio of outstanding debt in issuance. The UKRN regulatory guidance¹⁰⁵ highlights the following approaches¹⁰⁶:

- a. **Direct method:** Observed excess bond returns are regressed on excess returns on the market portfolio, in a similar manner to regression-based approaches for the equity beta.
- b. **Indirect method:** Methodologies relying on modelled and structural relationships to infer estimates of the debt beta, such as estimating the sensitivity of excess debt returns are to excess equity returns; and then multiplying equity betas by this elasticity to derive debt betas.
- c. **Structural method:** Debt and equity are modelled as contingent claims on the assets of a firm, the value of which is uncertain.
- d. **Decomposition method:** Deductions are made from the observed market debt premium to leave the component of the premium attributable to systematic market risk, from which the debt beta is inferred.

197) The CMA at PR19 concluded that *'the debt beta is difficult to measure and has a relatively small effect on the overall WACC. In our view, the choice of the debt beta*

¹⁰⁵ UKRN 2023 Guidance, page 24.

¹⁰⁶ Drawing upon: CEPA, [Considerations for UK regulators setting the value of debt beta](#) (CEPA Debt Beta 2019), 2 December 2019, page 7.

*should be set at a level which is consistent as far as possible with the overall framework for the WACC, without acting contrary to financial market evidence.*¹⁰⁷

198) Following the regulatory precedent set by the CMA in its Redeterminations at PR19, we consider that 0.05 – 0.10 represents an appropriate range for the debt beta for setting the regulatory allowed return on equity for PR24. Furthermore, in light of the evidence suggesting that there is a perception that the relative risk associated with an investment in regulated water assets has increased and Ofwat's recognition that the cost of debt for the notionally financed company has risen in relative terms, we consider that there is merit in setting our range for debt beta between the midpoint and the top of the range, being 0.075 – 0.1. We note that the top end of our range is consistent with Ofwat's midpoint estimate for debt beta in its FD24¹⁰⁸.

Discussion of Ofwat's approach

199) Ofwat's unlevered beta estimate is 0.282, with a range of 0.27 to 0.30, which is based on the following overall approach:

- a. Ofwat relies upon two listed water comparators – SVT and UU. Ofwat did not place weight on data from PNN, because it considered that the waste-management firm Viridor had distorting effects both before and after the sale and given these distortions, there was not a sufficiently long span of clean data for their preferred estimation period;
- b. Ofwat regresses the returns of SVT and UU against the returns of the FTSE All Share index to derive its estimates of the equity beta. Ofwat concludes that a daily sampling frequency is most appropriate, due to it considering that daily data has greater precision of estimates and is not distorted by the reference day effect observed with lower-frequency data;
- c. Ofwat considers 5- and 10-year estimation periods, due to: i) the greater transparency and predictability of using familiar fixed length periods as opposed to statistical breakpoints, and ii) longer time windows being less distorted by unusual events such as Covid-19 and the Ukraine war. Regarding the latter, Ofwat considers that re-weighting or omitting data relating to periods affected by Covid-19 and the Russia-Ukraine war is unnecessary and reliant upon subjective judgements. Ofwat concludes that whilst the CAA H7 reweighting approach (see paragraph 128 above) might avoid any issues of distortion, it was not convinced that a distortion existed for water betas;¹⁰⁹
- d. Ofwat de-gears 'raw' equity beta estimates and regears asset beta estimates to the 55% notional gearing level using the so-called Harris-Pringle formula and

¹⁰⁷ CMA FD19 Decision, paragraph 9.517.

¹⁰⁸ FD24 Allowed Return Appendix, page 60.

¹⁰⁹ FD24 Allowed Return Appendix, page 45.

using comparator gearing estimates based on the ratio of net debt to the sum of net debt and the market capitalisation of the relevant company. Ofwat uses a debt beta range of 0.05-0.15, based on estimates from its economic advisors FTI Consulting;¹¹⁰ and

- e. Ofwat considers that no adjustment should be made to the estimated betas for the potential impact of the capital programme at PR24 on beta because: i) the ratio of capital expenditure to RCV that is expected at PR24 is only slightly above historical averages, ii) the link between capex intensity and beta risk is weak, iii) they did not consider that regression models trained on a sample dominated by non-regulated companies could be used to robustly calibrate uplifts to water betas, iv) the FDs provide enhanced risk protection, v) adjusting econometric estimates of beta in proportion to capex is rare in UK regulation and vi) there is a risk of double counting the impacts, given that betas will already to some extent reflect the future.¹¹¹

200) We consider that Ofwat's approach to the estimation of equity beta contains a number of shortcomings. These are set out below.

201) As we evidence above, contrary to Ofwat's conclusion that it was not convinced a distortion existed from the Covid-19 pandemic on water betas, we find that the Covid-19 period of restrictions has a material and statistically significant impact on the estimates of the unlevered beta for the UU/SVT portfolio. Simply using the 5- and 10-year estimation periods without accounting for the effect of Covid-19 is akin to assuming that restrictions are expected to occur again over the RIH. Indeed, given the 10-20 year investment horizon, Ofwat is effectively assuming that c. four periods of restrictions are expected to occur over the RIH (i.e. effectively two pandemics with a similar government response, including full lockdowns, will take place). We consider this to be extremely unlikely given the frequency of pandemics with severe restrictions historically, and the known consequences of lockdowns explained above. The likelihood of lockdowns reoccurring is of course a matter of judgment (which is outside our areas of expertise), but: i) excluding or placing lower weight on periods affected by Covid-19 has regulatory precedent from both the CAA in H7 and the CMA at PR19; and ii) our interpretation of Ofwat's FD24 is not that it is opposed to an adjustment per se, but rather that it is not convinced that the restrictions depressed water betas. Our evidence shows that the latter assumption is incorrect.

202) Ofwat's selection of 5- and 10-year estimation periods is arbitrary. We consider that equity beta is best estimated as an unconditional beta, using a long-run of historical data for which the operating environment is deemed to be sufficiently reflective of potential outcomes for PR24. We use the existence of a structural break at the start of PR14 that

¹¹⁰ FD24 Allowed Return Appendix, pages 38 to 40.

¹¹¹ FD24 Allowed Return Appendix, page 48.

was found by Gregory, Harris and Tharyan¹¹² in their report during the CMA Redeterminations for PR19. Accordingly, this supports the sole use of a c.10-year time window. In addition, Ofwat's estimates based on its 5-year estimation period exacerbates the downwards effect that its decision not to account for periods impacted by Covid-19 lockdowns has on its beta estimates, given that the restrictions occurred for a considerable part of the 5-year window.

- 203) Ofwat excluded PNN on the basis that estimates relying on the estimation period before the spinoff of Viridor are likely to have been affected by PNN not being sufficiently 'pure-play'. However, our analysis of the Viridor spinoff demonstrates that there is no statistical basis for excluding PNN due to a distortion effect of Viridor. We therefore conclude that Ofwat incorrectly excluded PNN from its beta analysis.
- 204) Ofwat has made no discrete/separate adjustment for the increased capital programme at PR24 and the effect that this has on risk. We agree with Ofwat that estimating such an adjustment robustly is difficult, particularly where comparators from outside the water sector are used. However, we have analysed the relationship between capex and beta for SVT, UU and PNN specifically and find a material positive relationship. In addition, whilst calibrating a robust adjustment is challenging, that should not render the evidence moot. As we explain above, even if betas based on historical data are used to form the CAPM-CoE range, consideration should still be given as to whether the forward-looking beta will be above the betas estimated using historical data, when setting the Allowed-RoE. We discuss this further in Section 5 below.
- 205) As a result of the methodological differences between our approach and Ofwat's, discussed above, Ofwat's range and point estimate for unlevered beta are materially below our range of econometric estimates under a variety of specifications.
- 206) Finally, even setting aside the downward bias in Ofwat's estimate, Ofwat does not sufficiently take into account the degree of uncertainty in beta estimation and the impact this has on the overall uncertainty in the estimated Market-CoE, using the CAPM. We address this issue in more detail in Section 5.4.

4.5. Combined results for CAPM-derived Market-CoE

- 207) Table 14 below sets out our range for the CAPM-derived Market-CoE. As set out in more detail in the individual subsections by parameter, we adopt the following methodological approaches as the primary evidence base for our range:
- a. **RFR:** 20-year ILG yields to implied AAA-rated corporate bond benchmark yields, uplifted for an estimate of the forward uplift.

¹¹² Gregory, Harris and Tharyan 2020.

- b. **TMR:** The long-run ex post arithmetic averaging approaches, with long-run ex ante estimates used as a cross-check;
- c. **Beta:** Unconditional estimates of the unlevered betas of portfolios of listed comparators comprised of SVT and UU, and SVT,UU and PNN, estimated over historical returns observed at a daily frequency since the structural break at September 2014, accounting for Covid-19 restriction periods and the Viridor spinoff.

Table 14: CAPM-derived CoE range (real-CPIH) at 55% notional gearing

	Ofwat PR24 FD (midpoint)	Kairos PR24 (low-end)	Kairos PR24 (high-end)
Notional gearing	55%	55%	55%
RFR	1.52%	2.3%	2.6%
TMR	6.83%	6.86%	6.97%
Beta (Unlevered)	0.282	0.319	0.337
Debt beta	0.1	0.1	0.075
CoE (before aiming-up)	4.82%	5.5%	5.9%

Source: Kairos analysis

5. Moving from the estimated CAPM-CoE to the Allowed-RoE

5.1. Introduction

208) This section sets out the evidence under each of the UKRN's aiming-up criteria¹¹³, before arriving at our recommendation for the Allowed-RoE at PR24.

209) Ofwat also evaluates the case for aiming-up using the five criteria set out in the UKRN 2023 Guidance.¹¹⁴ After our own evaluation of the evidence against each criterion, we discuss Ofwat's assessment of that criterion, before finally discussing the evidence in the round.

5.2. Cross checks from alternative approaches to estimating the Market-CoE

210) Whilst the CAPM is the primary model used for estimating the Market-CoE in UK regulation, it is estimated with considerable uncertainty and has known flaws. Cross checks from alternative models and wider market evidence should therefore be used to test the results.

¹¹³ UKRN 2023 Guidance, pages 26 and 27.

¹¹⁴ FD24 Allowed Return Appendix, page 62.

Multi-factor models

211) The CAPM has been the primary model for estimating the cost of equity in UK regulation since privatisation. Nevertheless, it has been proven to perform poorly for some time.

212) Indeed, as Fama and French (2004) conclude: *"The version of the CAPM developed by Sharpe (1964) and Lintner (1965) has never been an empirical success. In the early empirical work, the Black (1972) version of the model, which can accommodate a flatter trade-off of average return for market beta, has some success. But in the late 1970s, research begins to uncover variables like size, various price ratios, and momentum that add to the explanation of average returns provided by beta. The problems are serious enough to invalidate most applications of the CAPM."*¹¹⁵

213) Importantly, the CAPM is likely to suffer from omitted variables bias and has been proven to perform particularly poorly for low beta stocks:

- a. **Omitted variables bias:** As set out in Section 3.2 above, under the CAPM, the expected return of any marketable security over the risk free rate can be determined as a function of the expected return on the market portfolio over the risk free rate, where the 'loading' on the market portfolio is determined by a single factor – beta. Under the CAPM, investors are only compensated for risk that is correlated with the market portfolio. The underlying rationale is that the market portfolio is the efficient portfolio (i.e. the portfolio that optimises the risk/return trade-off and therefore maximises return for a given level of risk). However, it is likely that the market portfolio is not the efficient portfolio, and investors require compensation for accepting different sources of risk (i.e. not just the risk that is correlated with the market portfolio). In such a world, the CAPM has omitted variables and will not accurately capture expected returns.¹¹⁶ In academic and investment practitioner circles it has long been established that simply holding the market portfolio does not yield the greatest return for a given level of risk, and that models based on alternative portfolios representing different sources of risk are likely to capture expected returns more accurately. Where this is the case, we would expect such multi-factor models to: i) better explain historical returns and ii) be used by investment practitioners on a forward-looking basis.
- b. **Particularly poor performance for low beta stocks:** Empirical tests of the CAPM also find that the relationship between beta and returns is flatter than the CAPM would predict.¹¹⁷ The Brennan model is one solution for this, whereby the flattening is partially corrected by setting the RFR above the gilt rate. However, betas are ordinarily estimated relative to the gilt rate (including in our empirical analysis within Section 4.4) hence the derived CAPM beta will

¹¹⁵ Fama and French 2004, page 27.

¹¹⁶ See Fama and French 2004 for a discussion of the literature on the CAPM's performance.

¹¹⁷ Fama and French 2004, page 27.

systematically underestimate the beta for low beta stocks. This feature of the CAPM has been further explored by Frazzini and Pedersen (2014), who find that investing in low beta assets compared to high beta assets (i.e. adopting an investment strategy that is long low beta assets and short high beta assets), generates excess returns.¹¹⁸

- 214) The above shortcomings of the CAPM are particularly important for regulated utilities given that the beta is less than 1, so the resulting CAPM-CoE will suffer from both of the above shortcomings. Given the issues with the CAPM, we consider that cross checking the CAPM-CoE with an MFM-CoE is an essential cross check that has, to date, been underutilised in economic regulation.
- 215) Under MFMs, the expected return is calculated in a similar way to the CAPM, with expected returns given by the sum of the expected premia provided by each factor portfolio, multiplied by their corresponding betas. Broadly speaking, 'factor betas' are calculated in a similar way to the CAPM beta, with equity returns regressed against those of alternative portfolios.
- 216) A paper published by Tharyan et al. (January 2025)¹¹⁹ investigates the performance of MFMs in the UK and tests the CAPM, Fama-French 5 factor (FF5F), and Hou et al. (2015)¹²⁰ q-factor models in a UK setting. The authors find that testing the models over a 44-year period (from 1980-2024) suggests that either the FF5F model or the q-factor model has better explanatory power when pricing the cross section of larger UK stock returns than does the CAPM¹²¹. It is important to note that even if some of the factor returns are deemed to be not significantly different from zero, and/or the coefficients on the factors are statistically insignificant, the CAPM beta would still be biased because of the covariances between the factors and the market risk factor.
- 217) Dr Tharyan and Professor Gregory have also responded to a critique of their MFM approach conducted for Ofwat by Mason, Robertson and Wright (MRW)¹²². We would draw out the following points from the paper (but note this is not comprehensive and should be read alongside the detailed paper):
- a. First, MRW's critique relates to preliminary test results submitted to Ofwat during the PR24 process. However, an updated dataset and test results, based upon the academic version of the research was available to Ofwat and MRW via the Northumbria University website, which MRW have not engaged with.

¹¹⁸ Frazzini, A. and Pedersen, Lasse H., Betting against Beta, Journal of Financial Economics, Volume 111, Issue 1, January 2014, pages 1-25 (**Frazzini and Pedersen 2014**).

¹¹⁹ Tharyan, R., Gregory, A. and Chen, B., An investigation of multi-factor asset pricing models in the UK, January 2025 (**Tharyan et al January 2025**).

¹²⁰ Hou, K., Haitao, M., Xue, C. and Zhang L., Which Factors, Review of Finance, 2019, 1-35 (**Hou et al 2019**).

¹²¹ Tharyan et al January 2025, page 16.

¹²² Tharyan, Gregory and Chen, Responses to Mason, Robertson and Wright on the use of MFMs at PR24, March 2025 (**Tharyan, Gregory and Chen response to MRW 2025**).

- b. Second, MRW test the validity of the MFM with respect to tests that are not used in the academic literature, where the latter tends to focus on the ability of asset pricing models to explain the cross-section of observed returns. With regards to this point in the Dr Tharyan and Prof. Gregory rebuttal, we understand that additional, non-academic criteria may come into play when considering the most appropriate model for regulatory charge controls and relatedly that the continued use of the CAPM as the primary model may support predictability and regulatory consistency. But that should not mean that the standard academic tests are not applied or that MFMs have zero informational value.
- c. Third, under the principal tests actually used to assess asset pricing models in the academic literature, MFMs outperform the CAPM. It is for this reason that the CAPM's limitations are widely acknowledged in academia and indeed an event study around long-run returns is unlikely to be acceptable for publication if it was based upon the CAPM.

218) We estimate below the MFM-CoE under the q-factor model that is presented in the paper by Tharyan et al. (January 2025) for the value-weighted portfolios of listed comparators that were considered as part of our analysis on beta above, being UU and SVT, and UU, SVT and PNN. For the portfolio of UU, SVT and PNN, to account for the Viridor spinoff, PNN receives zero-weight before the completion of the Viridor spinoff, and is weighted according to its market capitalisation after (which is consistent with an approach under our beta analysis)¹²³. Our estimates also account for the effect of the restrictions during the Covid-19 period. Regressions are performed under the following specification:

$$R_{P,t} - R_{F,t-1} = \alpha + \beta_M(R_{M,t} - R_{F,t-1}) + \beta_{Size} Size_t + \beta_{INV} INV_t + \beta_{ROE} ROE_t + \alpha_D D_t \\ + \beta_M^D D_t(R_{M,t} - R_{F,t-1}) + \beta_{Size}^D D_t Size_t + \beta_{INV}^D D_t INV_t + \beta_{ROE}^D D_t ROE_t + \varepsilon_{p,t}$$

Where:

- a. $Size_t$, INV_t , ROE_t , are returns on portfolios that represent size (small minus big companies), investment (conservative minus aggressive levels of investment) and profitability (high minus low operating profit) factors¹²⁴; and
- b. D_t is a dummy variable representing the periods of restrictions and lockdown during Covid-19 that are described in the beta analysis above.

219) Factor information is available until 31 December 2024, and since factors are formed using LSPD data for consistency, we estimate regression models using this same dataset.

¹²³ We also calculate estimates for the UU/SVT/PNN portfolio using an equally weighted approach and find that the estimates of the CoE are slightly above those under a value-weighted approach.

¹²⁴ A comprehensive explanation of factor portfolio construction is contained in Tharyan et al. January 2025. These portfolios are downloadable from the Northumbria University website: [Risk Factors for the UK](#).

Paragraph 218 shows that dummy variables are interacted with all the terms in the model (i.e. $R_{M,t} - R_{F,t-1}$, $Size_t$, INV_t , and ROE_t) so that shifts in factor exposures during Covid-19 restrictions are fully and properly captured.

- 220) We calculate the annualised factor premia for complete calendar years starting in June 1980 and ending on 30 June 2024, which are adjusted for average CPIH inflation during the formation year. These annualised premia are shown in Table 15 below.

Table 15: Estimates of factor premia for the q-factor model

Basis	Size portfolio	INV portfolio	ROE portfolio
Nominal	1.50%	5.77%	1.94%
CPIH	1.51%	5.55%	1.87%

Source: Northumbria University, Kairos analysis

- 221) For the purposes of calculating the CoE, we assume a TMR estimate of 6.93% in real-CPIH terms (which is the 1-year arithmetic average under the approach set out in Section 4.3 above). Factor premia are inflation adjusted on the same basis as for our TMR estimate. We assume an estimate of the RFR of 2.5% in real-CPIH terms (which is consistent with our range set out in Section 4.2 above). Table 16 below shows the estimated CoE under the q-factor model.

Table 16: Estimates of the cost of equity under the q-factor model (with all factors adjusted for Covid effects) (real-CPIH)¹²⁵

Factor	Factor premium	UU / SVT (Lockdown)	UU / SVT / PNN (Lockdown)	UU / SVT (Restrictions)	UU / SVT / PNN (Restrictions)
Market	4.43%	2.93%	2.95%	3.07%	3.11%
Size	1.51%	-0.35%	-0.33%	-0.24%	-0.21%
Inv	5.55%	0.31%	0.25%	0.42%	0.40%
RoE	1.87%	0.69%	0.68%	0.75%	0.75%
RFR	2.50%	2.50%	2.50%	2.50%	2.50%
CoE	-	6.09%	6.05%	6.51%	6.55%

Source: Northumbria University, Kairos analysis. Notes: The portfolio UU/SVT/PNN is a value-weighted portfolio of the comparators where PNN receives zero-weight before the completion of the Viridor spinoff, and is weighted according to its market capitalisation after. Columns marked 'Restrictions' and 'Lockdown' show results for the model having a Covid dummy variable that represents the period of Covid restrictions, and the period of Covid lockdowns, respectively.

¹²⁵ A full suite of results is shown in Appendix B.

222) Table 16 above shows that we find an estimated range for the CoE based on the portfolios UU/SVT and UU/SVT/PNN, of between 6.1% to 6.6% (real-CPIH)¹²⁶. These estimates under an alternative asset pricing model show that the CAPM-based estimates that form the basis of our CAPM-CoE range of 5.5% to 5.9% (real-CPIH) may be biased downwards and that the CAPM is not providing adequate remuneration for systematic risks proxied by factors including firm size, level of investment, and profitability.

Market values of listed water companies

223) Under standard assumptions in the theory of corporate finance, the enterprise value (EV) of a firm's operations to investors will be equal to the value of the sum of the stream of expected cashflows returned to investors, discounted at the market cost of capital.

224) Under the regulatory model, if expected cashflows returned to investors are equal to the product of the allowed return on capital and the RCV, then the EV should be equal to the RCV. Regulators often therefore look at the ratio of the EV to the RCV (which is referred to as a 'market-to-asset' ratios, or MAR) as a way of assessing whether the allowed return on capital is broadly reflective of the market cost of capital.

225) The relationship described at paragraph 224 above can also be used to impute an implied market cost of capital, where the EV and forecast profits are known or assumed. Under a number of assumptions, the implied discount rate that equates the discounted value of the forecast cashflows to investors to the EV can be used as a cross-check for the cost of capital, and the discount rate that equates the discounted value of the forecast cashflows to equity investors to a company's market capitalisation can be used to cross-check the Market-CoE. Regulators, including Ofwat, therefore typically derive an implied-CoE from market prices and forecast profits of regulated companies as a cross-check to the CAPM-CoE.¹²⁷

226) There are three listed 'pure-play' regulated water companies in the UK, where the activities are predominantly regulated by Ofwat's charge controls, and whose MARs are typically used as cross checks to the CAPM-CoE. When relying on MARs to cross check the CAPM-CoE, it is important to remember that inferences from MARs and implied CoE estimates from market prices and forecast profits may suffer from a number of distortions that should be accounted for, including:

- a. **Outperformance or underperformance:** Where a listed company is expected to out or under-perform other aspects of the 'building blocks' of the regulatory regime – such as an expected over/under-spend on totex, expected net reward or penalty on ODIs and expected out/under-performance relative to the cost of debt allowance, forecasted profits will deviate from the allowed return. It is therefore important to adjust (to the extent possible) for market expectations

¹²⁶ Estimates are provided at actual levels of gearing, which are slightly beneath the level of notional gearing of 55%. This means that the CoE estimates are slightly conservative on this basis.

¹²⁷ FD24 Allowed Return Appendix, pages 67, 68 and 69.

of out- or under-performance for the company in question and to bear in mind the inherent uncertainty in such assumptions when interpreting results.

- b. **Incorporating uncertainty in the regulatory regime:** Aiming-up above the midpoint CAPM-CoE (the merits of which are discussed in Section 5.4) may generate MARs in excess of one, which is essentially a necessary consequence of aiming-up for uncertainty. There are exceptions however, such as: i) where aiming-up is required to address an expected loss elsewhere in the package (i.e. it simply compensates for expected underperformance by aiming-up on the Allowed-RoE) or ii) the aiming-up is to incorporate uncertainty and the unbiased estimate of the CAPM-CoE was indeed incorrect by virtue of it being below the Market-CoE.
- c. **Regulatory approach to setting the allowed return on capital:** Where parameters used to set the allowed return on capital have been set using unconditional estimates (e.g. TMR) or rely on trailing averages of historical estimates (such as RFR and (in effect) embedded debt), it should be expected that MARs will deviate from one. Where the conditional cost of capital at a particular point in time is above long-run averages, this would, all else equal, result in MARs estimates below one, and an implied cost of capital above the allowed return on capital and vice versa.¹²⁸
- d. **Uncertainty in forecasts:** Implied estimates of the market cost of capital typically require forecasts of profits and dividend payouts. Forecasts of profits and dividend payouts far into the future are likely to suffer from a significant degree of uncertainty, given the difficulties with accurately forecasting profits, dividend payouts and terminal values. Significant forecast uncertainty can generate significant uncertainty in the implied estimates of the cost of capital, which must be borne in mind when interpreting any results.

227) Whilst MAR analysis is typically conducted using listed comparators, it should be noted that the implied cost of capital or equity estimates from private transactions may also add additional distortions (such as the phenomenon known as 'winner's curse') that should be accounted for.

228) Despite these shortcomings, we consider that estimates of the implied cost of equity under a MAR analysis should form one of the cross checks on the CAPM-CoE, provided that sensitivities are undertaken on the key assumptions, and the results are interpreted with caution, bearing in mind the aforementioned considerations.

229) We consider the approach taken by Ofwat in its FD24¹²⁹, which was set out in its Final Methodology¹³⁰. Under this approach, to estimate the implied cost of equity for a

¹²⁸ A similar explanation of points 'a' through to 'c' can be found on page 69 of the UKRN 2018 CoE Study.

¹²⁹ FD24 Allowed Return Appendix, pages 67 and 68.

¹³⁰ FM24 Appendix 11 Allowed Return, A2: Ofwat revised MARs Approach.

particular company, Ofwat estimates the cost of equity under a perpetual dividend growth model, where dividends expressed as a percentage of regulatory equity are set equal to the return on regulatory equity, less the profit that is retained each year to finance the increase in regulatory equity. The ratio of the market price paid for the firm's equity to the value of the firm's regulatory equity is calculated with reference to the MAR for the company in question, under an assumption that the total enterprise value of the company is invariant to gearing¹³¹.

230) It is well known that values calculated from perpetual dividend growth models are sensitive to assumptions for the growth rate of dividends in perpetuity, which in this case is linked to the assumptions for the growth of the RCV in perpetuity. We consider an amended approach, where the value of the stream of dividends is truncated into a short-term period, and a terminal value. Under this amended approach, assumptions for the RCV growth over the short and long-term may be set separately, and are more easily interpretable when relying on empirical evidence to support assumptions. We consider a period of 20 years for our short-term period, which is consistent with the RIH.

231) We update Ofwat's model under a truncated approach, and using assumptions for medium-term growth of 2.3% in the short-term (which reflects Ofwat's analysis of the real RCV growth rate of the water industry from AMP3 to AMP6¹³²) and long-term real RCV growth of 1%, an assumed expected level of outperformance of 1% (which is the midpoint of Ofwat's range for the expected level of outperformance based on their analysis of historical outperformance, which we recognise may not apply during PR24¹³³) and market price data for UU, SVT and PNN during the 1-month preceding 17 January 2025¹³⁴. Table 17 below presents the results, which supports an implied CoE range of 5.2% to 6.8%.

Table 17: Estimates of the CoE implied by MARs of listed comparator regulated water companies during January 2025

	MAR estimate	Implied CoE (CPIH)
UU	1.04	5.8%
SVT	1.12	5.2%
PNN	0.94	6.8%

Source: Refinitiv, Ofwat, Kairos analysis

¹³¹ FM24 Appendix 11 Allowed Return, page 99.

¹³² FM24 Appendix 11 Allowed Return, page 102.

¹³³ FM24 Appendix 11 Allowed Return, page 101.

¹³⁴ RCV values rely on the most recent values (30 September 2024) from Ofwat's MARs analysis in its FD24 Allowed Return Appendix, following a query requesting underlying data.

232) On 29 January 2025, Pennon announced a proposed capital raise of approximately £490mn by way of a fully underwritten rights issue of new ordinary shares¹³⁵. Its stated purpose was to enable Pennon to deliver the 'step change in investment required through the K8 period to March 2030, whilst ensuring appropriate and sustainable gearing is maintained throughout'¹³⁶. We note that the subscription price represented a 35.2% discount to the theoretical ex-rights price, based on the closing price on 28 January 2025 (being the last business day before the announcement of the terms of the rights issue)¹³⁷. On 18 February 2025, Pennon announced that it had received valid acceptances of new shares representing approximately 93% of the total number of shares to be issued under the fully underwritten rights issue¹³⁸. Under the terms of the rights issue, the substantial discount to the theoretical ex-rights price generates an implied CoE (for the share of the firm to which the rights apply) under the approach set out above of 7.6% in real-CPIH terms. This may indicate the substantial additional returns required for a regulated water company to be confident of successfully raising additional equity investment via a rights issue. (It should be noted that this estimate is calculated using the share of the company associated with newly subscribed rights only, and not the MAR of Pennon as a whole).

Equity versus debt premia

233) Investors ordinarily expect a higher return for holding equity than debt, owing to the lower protections and relatively higher unpredictability of future cashflows.

234) The wedge between the return on equity and debt is markedly different at PR24, compared to PR19. This point is clear graphically from Figure 4 below.

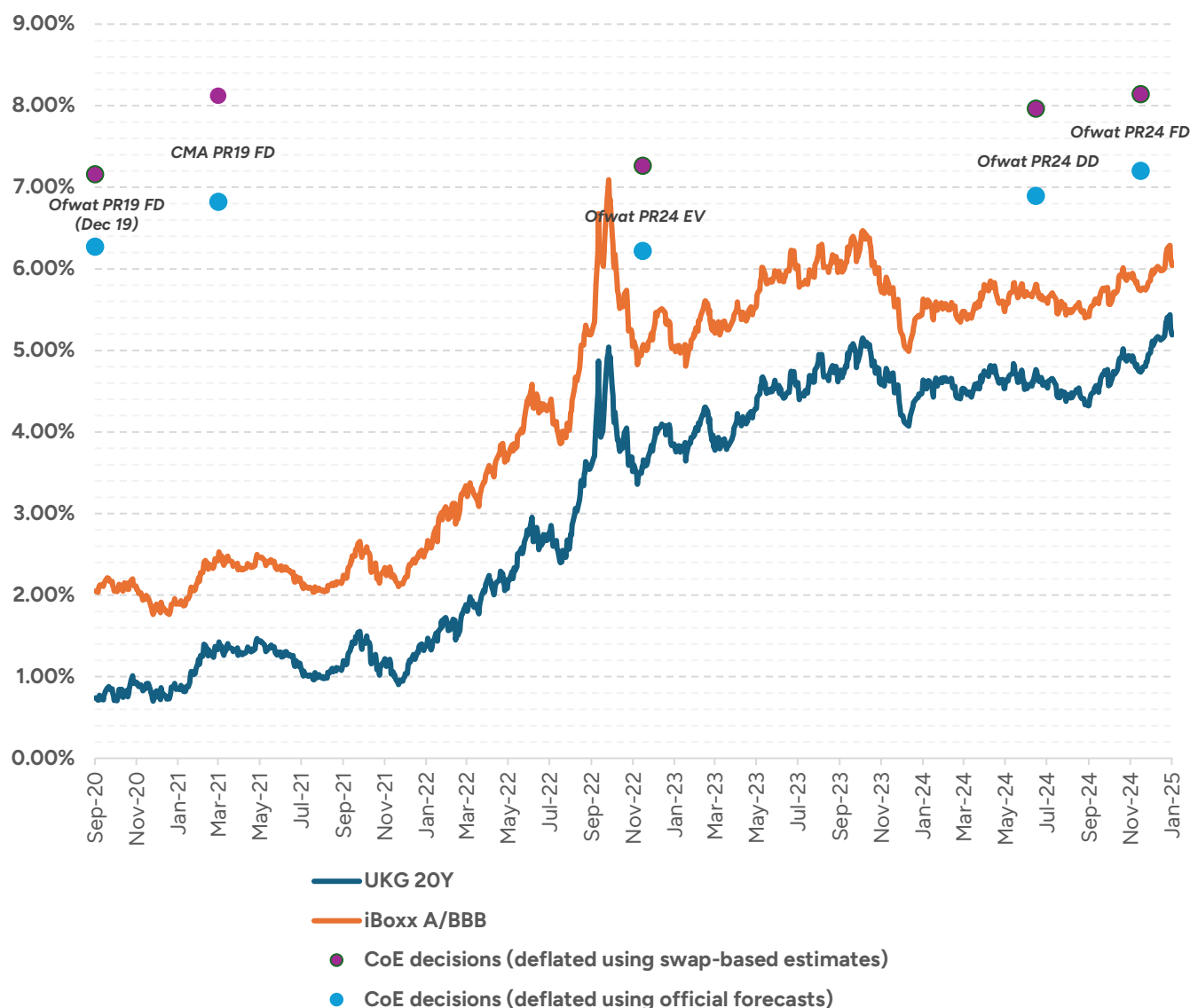
¹³⁵ Pennon Group plc, 13 for 20 Rights Issue of 185,928,002 New Ordinary Shares at 264 pence per New Ordinary Share (**Pennon Rights Issue Launch**), 29 January 2025, page 1.

¹³⁶ Ibid.

¹³⁷ Ibid.

¹³⁸ Pennon Group plc 'Results of Rights Issue' (**Pennon Results of Rights Issue**), 18 February 2025.

Figure 4: Comparison between gilt and corporate bond yields and Ofwat's allowed return on equity over time in nominal terms



Source: Refinitiv, Bank of England, Ofwat, CMA, Kairos analysis

235) This issue has become more acute since the publication of FD24, because yields on 20-year nominal gilts have increased by approximately 60bp since Ofwat's data cut-off for its PR24 FD. The difference between Ofwat's allowed CoE and forecasts of Ofwat's new debt allowance based on iBoxx A/BBB yields (uplifted by 0.3% to account for the underperformance wedge) during the 1-month period preceding January 2025 is 0.84% in nominal terms (using official or consensus forecasts of inflation) and 1.89% in nominal terms (using swap-based measures of inflation).

236) Whilst it is difficult to determine a 'bright line' for the appropriate size of the difference between required returns estimated for debt and equity for the notionally financed water

company, it is clear that differences are considerably lower at PR24 than under the CMA's decision at PR19.

237) This evidence further supports the issues we raised with respect to Ofwat's estimate of the CAPM-CoE. It is also relevant when considering where to select a point estimate.

Discussion of Ofwat's approach

238) Ofwat's approach and assessment of cross checks is broadly:

- a. That the CAPM is the primary tool for estimating the Market-CoE in UK regulation and given its long track record of use, there should be a high evidential bar to placing reliance on alternative frameworks as a primary methodology. But there is nevertheless 'a role for alternative approaches to potentially inform' their decision on where to select a point estimate within the CAPM-CoE range.¹³⁹
- b. Ofwat did not undertake its own analysis of the MFM-CoE. Rather it received evidence on the MFM-CoE from KPMG, with academic support from Professor Gregory, throughout the PR24 process. Ofwat commissioned MRW to assess the MFM-CoE evidence it received from KPMG and Professor Gregory.¹⁴⁰ MRW developed three criteria for evaluating MFMs and CAPM; i) estimated betas must be stable and statistically significant from zero, ii) estimated factor risk premia must also be stable and statistically different from zero and iii) any additional data construction should be replicable, and produce consistent estimates, which they combined with the two criteria from the UKRN 2018 CoE Study of implementability and defensibility. MRW and Ofwat conclude that the CAPM is superior to MFM across all of the criteria. Ofwat then concludes *that 'the use of MFMs would materially depart from our intended regulatory purpose and any use of MFMs would disproportionately take up significantly more resource for very limited, if any, net benefit.'*¹⁴¹ Ofwat then placed no weight on MFMs when choosing a point estimate.¹⁴²
- c. Ofwat considered that MAR analysis was widely used by investors and utility equity analysts as a guide to investor sentiment and that deriving an implied CoE from MARs can provide an indication of the required return on equity. Nevertheless, Ofwat noted the uncertainties with MARs analysis and concluded that it was *'better suited to providing an indicative range within which the likely required return on equity lies, rather than a precise calibration of a point estimate.'*¹⁴³ Ofwat undertook an analysis of MARs and implied CoE analysis

¹³⁹ FD24 Allowed Return Appendix, pages 62 and 63.

¹⁴⁰ Donald Robertson and Stephen Wright, Multifactor Models and Cost of Equity Estimates: an assessment of KPMG's arguments, a report to Ofwat (**Robertson and Wright 2024**), 21 May 2024.

¹⁴¹ FD24 Allowed Return Appendix, pages 72 to 76.

¹⁴² FD24 Allowed Return Appendix, page 82.

¹⁴³ FD24 Allowed Return Appendix, page 67.

from the share prices and forecasts of SVT, UU and Pennon. Ofwat estimated an RCV-weighted MAR premium as at September 2024 of 9% and an implied CoE of 4.3-6.3%. The latter adopted the approach of forecasting cashflows into perpetuity (as this means no assumption on terminal value is required), assumed 0-2% RCV growth and 0-2% expected outperformance. Ofwat concluded that the implied CoE of 4.3%-6.3% was consistent with its CAPM-CoE range of 4.58% - 5.07%, such that there was not a clear case for aiming-off the mid-point due to his evidence.¹⁴⁴

- d. Ofwat considered that any comparison of the debt premium versus equity premium, should use break-even inflation from the maturity-matched swap rate to convert the nominal yield on debt to a real yield before a comparison is made.¹⁴⁵ Using a range of debt benchmarks – including the iBoxx A 10yr+, A/BBB 10yr+, A/BBB 10yr+ and two specific bonds issued by SVT and SWW - Ofwat then derives an implied risk premium for equity over and above the premium on debt of 1.63% to 2.38%¹⁴⁶ (nb: 2.38% is the risk premium relative to the iBoxx A 10yr+, the range excluding this benchmark is 1.63%-1.92%).

239) We have the following main comments on Ofwat's evaluation of cross checks:

- a. Professor Gregory has responded to the critiques of the MFM-CoE made by MRW in a separate paper (see Tharyan, Gregory and Chen 'Responses to Mason, Robertson and Wright on the use of MFMs at PR24', March 2025). The main conclusions are that MRW concerns are either not valid or not sufficient to render the MFM-CoE any more or less flawed as a model than the CAPM.
- b. Even accepting the MRW conclusion (adopted by Ofwat) on the CAPM's superiority as the primary tool for estimating the Market-CoE for regulatory charge controls, such a conclusion does not mean that the MFM-CoE has zero informational value as part of the cross check criterion. Indeed, the purpose of the cross checks is not to supplant CAPM but to stress test its results.
- c. We do not agree with Ofwat's implied Market-CoE from MARs of 4.3%-6.3%. We have obtained Ofwat's model and undertaken a revised MARs analysis, which yields an implied Market-CoE range of 5.2-6.8%.
- d. We recognise Ofwat's concern regarding the use of break-even inflation to deflate nominal debt costs, before any assessment of the relative premium on equity and debt is made. We also have sympathy with the concerns that it is difficult to precisely calibrate what the equity versus debt differential should be, without resorting back to the models (and assumptions therein) for

¹⁴⁴ FD24 Allowed Return Appendix, Table 14.

¹⁴⁴ FD24 Allowed Return Appendix, pages 67, 68 and 69, Figure 10, Tables 15 and 16 and Table 19.

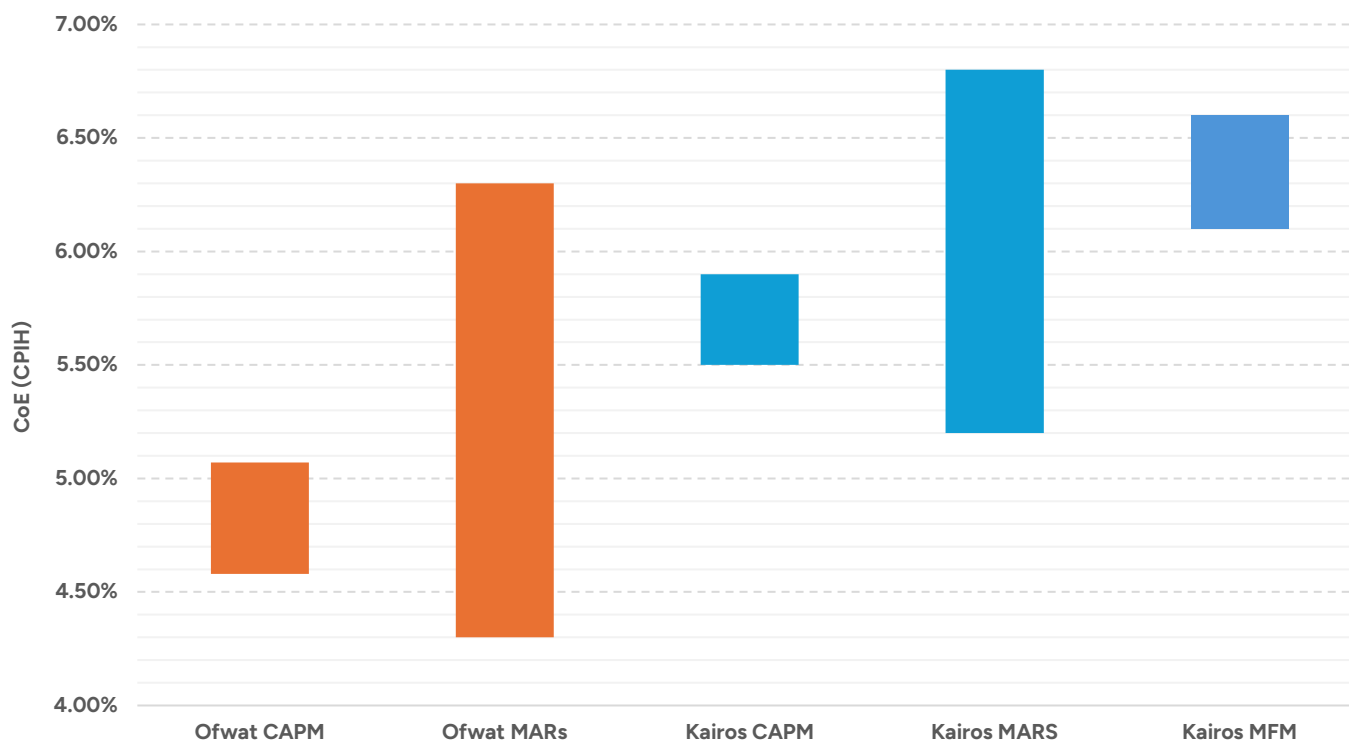
¹⁴⁵ FD24 Allowed Return Appendix, page 64.

¹⁴⁶ FD24 Allowed Return Appendix, Table 14.

estimating the Market-CoE. However, we consider that Ofwat should have been cognisant of the significant reduction in the relative premium between equity and debt at PR24 compared to PR19, when coming to its overall Allowed-RoE.

- e. Finally, and perhaps most importantly, even where individual cross checks are estimated with uncertainty and require judgment and assumptions, that is not the same as concluding that a triangulation exercise has no informational value. Figure 5 below shows the results of such a triangulation exercise by plotting Ofwat's CAPM-CoE against the implied CoE from MARs, the MFMs-CoE and the Kairos CAPM-CoE. It is evident that Ofwat's CAPM-CoE appears too low in this context and we consider that Ofwat should have drawn such a conclusion, following a proper evaluation of cross checks.

Figure 5: A comparison between ranges of estimates of the CoE derived under alternative approaches



Source: FD24 Allowed Return Appendix, Kairos analysis

5.3. Asymmetry in the choice of parameters

Asymmetry in our CAPM-CoE range

240) The range presented in Section 4.5 above for the CAPM-CoE represents the range derived solely using results from different estimators for the parameters RFR, TMR and beta. We consider that we have taken a balanced view of the available evidence for each parameter and therefore that our proposed range for the CAPM-CoE should have no material bias in either direction (albeit as we discuss in Section 5.2 above, the CAPM itself may introduce bias if it does not fully price the risk faced by investors).

241) In order to further assess whether our CAPM-CoE is unbiased, we consider the range of estimates for the CAPM-CoE under different parameter estimates for the RFR, TMR and beta that are discussed in Section 4 above. Estimates for the CAPM-CoE that result from all combinations of parameter estimates considered in Section 4 are shown in Figure 6 below. Whilst different estimators attract different weights based on considerations such as robustness, accuracy and bias, which are set out in the relevant sections above, the graph shown in Figure 6 can be used to indicate to what extent biases in estimates at the parameter level may result in a more significant bias when calculating the resulting CAPM-CoE.

Figure 6: The range of estimates for the CAPM-CoE under different parameter estimates for the RFR, TMR and beta



Source: Ofwat, Kairos analysis

- 242) On the basis of the parameter estimates presented in Figure 6 above, we consider that our CAPM-CoE is unlikely to be materially biased in either direction. However, there is a step change in the amount of investment required at PR24. In Section 4.4, we present evidence on the relationship between capex and beta for UK water companies, which suggests that higher capex leads to a higher beta and that in turn the forward-looking beta may be above the unconditional beta estimates, which we use in our CAPM-CoE range (and which form the bases of the CoE estimates presented in Figure 6 above). As a result, we consider that more weight should be placed at the top of our CAPM-CoE range, which we discuss further in Section 5.7.

Asymmetry in Ofwat's CAPM-CoE

- 243) Ofwat says there is no downward-bias in its CAPM-CoE. We disagree because:

- a. We consider that Ofwat's RFR is likely to be downward biased because there is evidence from AAA-rated corporate bonds and several studies on convenience yields in ILGs, which both demonstrate that the ILG yield is below the true RFR. In addition, Ofwat's RFR is now notably below market rates, given changes in interest rates since its FD24 analysis.
- b. Ofwat's beta is materially below our unconditional beta estimates, which include the effects of Covid-19 restrictions and include Pennon as a listed comparator. In light of the evidence on both of these considerations in Section 4.4. above, we are firmly of the view that an unlevered beta estimate of 0.282 is an underestimate. This finding is also consistent with our analysis of the relationship between beta and capex, which suggest that the forward-looking beta may be above the beta estimated using historical data, in light of the step change in the level of investment at PR24.
- c. Ofwat's long-run TMR is slightly depressed due to its reliance on a Fama-French estimate, which relies on a contemporaneous, rather than trailing dividend yield approach.

244) Overall, we consider that there is a downward bias in Ofwat's CAPM-CoE range. This is consistent with the range of potential estimates for the CAPM-CoE under different parameter estimates that lie mostly above Ofwat's CAPM-CoE range in Figure 6 above.

5.4. Welfare impact from underinvestment

245) As discussed in Section 3.1 above, the Market-CoE is unobservable and so must be estimated. Any estimate of the Market-CoE will be affected by a degree of uncertainty over the extent to which it accurately reflects the true Market-CoE. This uncertainty arises for a number of reasons, including because:

- a. economic models are always imperfect approximations for the real-world that make a number of assumptions, which don't necessarily hold in practice; and
- b. estimates for the Market-CoE will suffer from estimation error, as a result of estimation error in component parameters under given models.

246) It is well documented in economic regulation that there may be asymmetric consequences of unknowingly setting the Allowed-RoE at a level such that the return expected by investors is not equal to the Market-CoE. If the Allowed-RoE is set at a level such that the return expected by investors is above the Market-CoE, then consumers will overpay for the services they receive in their bills. If the Allowed-RoE is set at a level such that the return expected by investors is below the Market-CoE, then it may not be possible to attract or retain investment in the water network, which may have severe and

far-reaching consequences, some of which may be difficult to quantify in monetary terms.¹⁴⁷

An analysis of the need to aim-up for investment

- 247) If the Allowed-RoE is set at a level such that the return expected by investors is above the Market-CoE, then the scale of aggregate consumer harm that arises from unnecessarily high bills may be estimated as the product of the excess return that is expected by investors over their required return, and the relevant RCV.
- 248) Quantifying the consumer harm that arises if the Allowed-RoE is set at a level such that the return expected by investors is below the Market-CoE, is more challenging. However, in this respect we would note the following:
- a. If the levels of equity required to maintain the appropriate credit rating for a notionally financed company that is assumed by Ofwat cannot be raised, then the credit rating of the notional water company will deteriorate. Lower credit ratings represent an increased risk that an issuer will not be able to fulfil their payment obligations (or an increased risk that the loss suffered by the debtholder in this event is higher). All else equal, a deterioration in the credit quality of an issuer will increase the cost of their debt financing. For regulated water companies, this cost will impact customer bills directly via the cost of debt allowance.
 - b. In extremis, an inability to attract and retain sufficient equity could lead to a downward spiral of rising debt costs and rising default risk, which ultimately could see companies entering the special administration regime – which may ultimately cost consumers a greater amount through higher bills.
 - c. Out of necessity, companies may try and deliver on their commitments whilst spending less by implementing solutions that may cost less in the short-term, but more in the longer-term, for example. Implementing shorter-term solutions that cost less than longer-term ones may be the only route to effectively increase the expected return to investors to meet the Market-CoE that is required. However, under the assumption that the package of costs and outcomes has been calibrated correctly, then this may lead to sub-optimal levels of investment in the regulated water network with a wide-ranging impact on consumers, that stretches beyond the long-term cost of increasing bills to repair or upgrade assets.
- 249) On balance, we consider that the incremental harm to consumers from setting the Allowed-RoE at a level such that the expected return to investors is beneath the Market-CoE, is likely to be greater than the incremental harm from the expected over-

¹⁴⁷ This issue is explained, alongside references to the main studies and regulatory precedent on pages 70 and 71 of the UKRN 2018 CoE Study.

remuneration of investors. Therefore, given estimates of the Market-CoE suffer from a significant degree of uncertainty, and the consumer harm from the under-remuneration of investors is likely to be greater than their over-remuneration, an optimal estimate that balances the degree of incremental harm will lie above the mid-point of unbiased estimates. 'Aiming up' to account for the asymmetric effect on welfare due to estimation uncertainty was considered by the CMA in its PR19 Redeterminations¹⁴⁸, and is discussed in detail in the UKRN 2018 CoE Study.¹⁴⁹ For PR24 in particular, the degree of incremental harm from the under-remuneration of investors may be more severe, in light of the substantial investment programme.

250) Given that aiming-up above the mid-point of unbiased estimates is likely to be in the consumer interest, we consider below the extent to which aiming up above an unbiased estimate of the Market-CoE is appropriate. Whilst we recognise that there are a number of factors generating uncertainty in the estimates, such as those identified at paragraph 245, we consider only the uncertainty due to estimation error, as a result of estimation error in component parameters under the CAPM, for reasons of tractability. Nevertheless, we consider that this is a prudent approach (in the sense that it may be an underestimate of uncertainty) because it is likely that the uncertainty arising from the implementation of imperfect economic models would increase the overall level of uncertainty, and hence the degree of aiming up required.

251) Under the CAPM approach, it is necessary to estimate the RFR, TMR and beta parameters. Accordingly, we estimate below the level of estimation uncertainty in the CAPM-CoE that arises from estimation uncertainty in the component parameters beta and TMR. We take the conservative approach of ignoring the estimation uncertainty in the RFR for tractability reasons and because the RFR is relatively more observable than TMR and beta. We calculate the standard error in the CAPM-CoE estimate using the standard error from the estimate of the unconditional raw equity beta of the portfolio comprising of UU and SVT at a daily frequency over the estimation period, and the standard error from the estimate of the arithmetic average of annual returns¹⁵⁰. Relying on other parameters of the CAPM-CoE for the calculation, we calculate a standard error in the CAPM-CoE due to estimation uncertainty of 124 basis points assuming estimation uncertainty in both the beta and TMR.

252) Table 18 below shows the required level of aiming-up above unbiased estimates of the Market-CoE for different levels of likelihood that the true Market-CoE will lie below the

¹⁴⁸ CMA FD19 Decision, paragraphs 9.1269 to 9.1285.

¹⁴⁹ UKRN 2018 CoE Study, pages 71 and 72.

¹⁵⁰ To compute the standard error of k-year returns for k=1, 10 and 20, we use a bootstrap procedure. For each bootstrap simulation, actual annual returns are resampled to create a simulated sample of length 125 years. We observe a small degree of serial correlation in the actual annual return data and so serial correlation is imposed on the simulated sample using the first-order serial correlation coefficient estimated using actual annual returns. Overlapping compounded k-year returns are computed from the simulated annual returns. The arithmetic mean of k-year returns is then computed and annualised by uncompounding over the return horizon. The bootstrap simulation is repeated 100,000 times and the standard deviation of the resulting distribution is used as an estimate of the standard error of the annualised mean k-year return. We find standard errors without a serial correlation adjustment for 1, 10 and 20-year returns of 1.716%, 1.814%, and 1.897%, respectively, and with a serial correlation adjustment for 1, 10 and 20-year returns of 1.716%, 1.803%, and 1.889%, respectively. For the purposes of the overall calculation of the standard error for the CoE, we conservatively take the minimum value of 1.7%. Beta standard errors are taken from regular OLS standard error calculations.

adjusted estimate, on the basis of the CAPM-based approach. We present the degree of aiming-up required if the 67th and 75th percentiles are targeted. This is based upon regulatory precedent from the New Zealand Commerce Commission, which represents an in-depth regulatory precedent of the degree of aiming-up for uncertainty that is required.¹⁵¹ We note that a High Court decision settled upon the 67th percentile, hence we utilise this assumption in our overall assessment of aiming up in Section 5.7.¹⁵²

Table 18: Required level of aiming-up above unbiased estimates of the Market-CoE for different levels of likelihood that the true Market-CoE will lie below the adjusted estimate on the basis of the CAPM-based approach due to uncertainty in beta and TMR

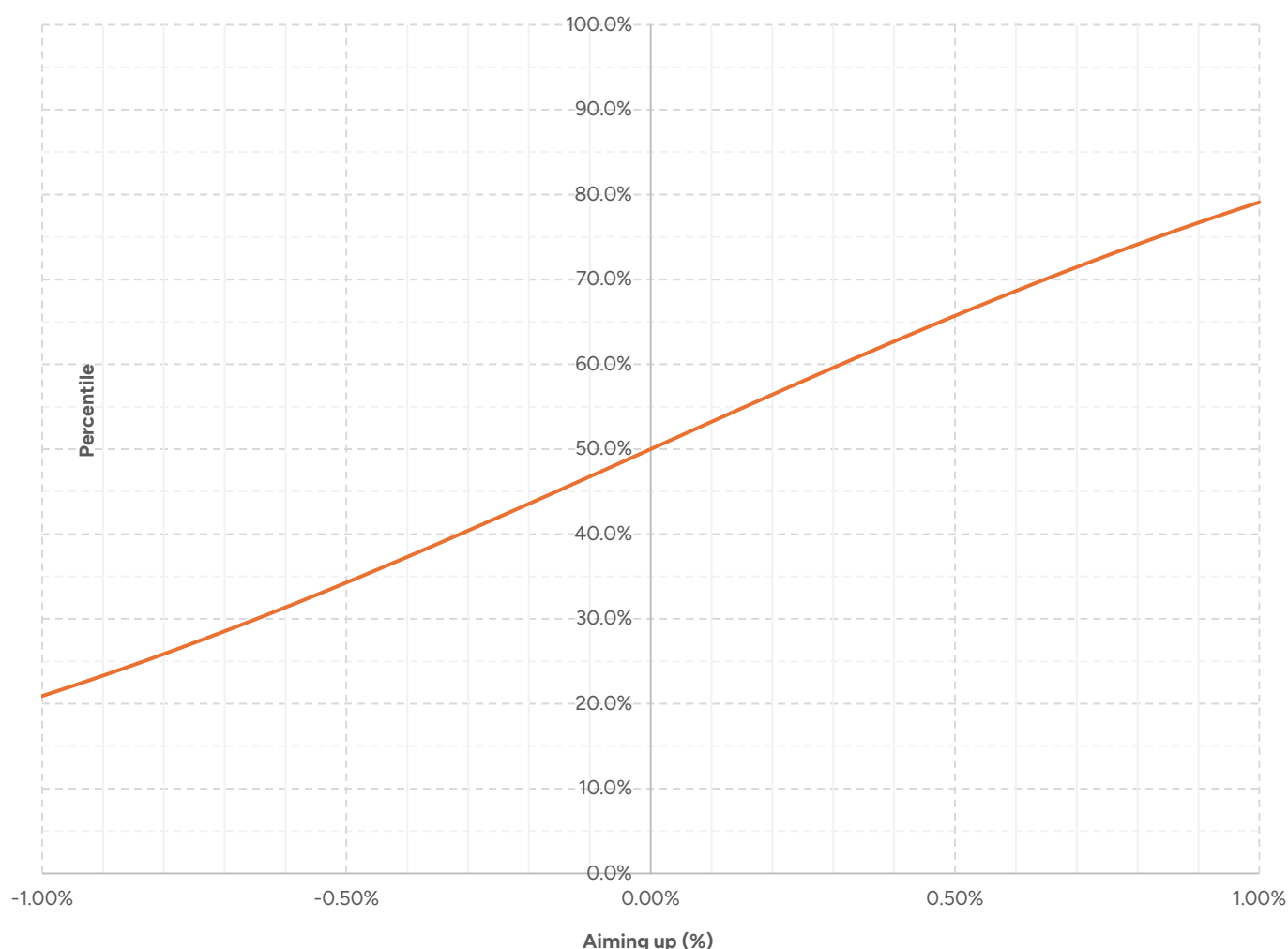
67 th percentile	75 th percentile
0.5%	0.8%

Source: Kairos analysis

¹⁵¹ This is summarised at page 70 of the UKRN 2018 CoE Study.

¹⁵² UKRN 2018 CoE Study, page 70.

Figure 7: Likelihood that the true Market-CoE will lie beneath estimates of the Market-CoE at different levels of aiming up on the basis of the CAPM-based approach due to uncertainty in beta and TMR



Source: Kairos analysis

253) Figure 7 above shows the likelihood that the true Market-CoE will lie beneath estimates of the Market-CoE at different levels of aiming up on the basis of the CAPM-based approach.

254) Our analysis shows that even under the conservative approach of considering only the estimation uncertainty in beta and TMR under the CAPM-based methodology, aiming up above unbiased estimates of the Market-CoE by at least 25 basis points is required to achieve a 42%¹⁵³ likelihood that the resulting estimate is not sufficient to cover the true Market-CoE, and by at least 50 basis points to achieve a 34% likelihood that the resulting

¹⁵³ In its PR19 Redeterminations, we note that the CMA considered that its 'own modelling which follows a similar approach suggests that a cost of equity of around 25bp above the mid-point would in practice be around the 77th percentile on a probability-weighted basis' (CMA FD19 Decision, paragraph 9.1306).

estimate is not sufficient to cover the true Market-CoE based on statistical uncertainty in the beta and TMR.

Ofwat analysis of the need to aim-up for investment

255) Ofwat states that *'while it is logical that the allowed return will play a role in determining investment decisions, it is far from clear that the allowed return is the only, or even the most important consideration to incentivising investment'*.¹⁵⁴ It notes that *'water regulation in England and Wales is characterised by a mature and well-developed framework for incentivising investment which contains numerous financial incentives to prevent under-investment'*.¹⁵⁵ Whilst we agree that there are likely to be other considerations beyond the expected return when investors consider making an investment in regulated water assets, we consider that the expected return is typically a critical input into the decision-making process. In addition, whilst it may be the case that numerous financial incentives exist under Ofwat's regulatory framework to prevent under-investment, it is reasonable to assume that investors will ultimately consider whether the 'all-in' expected risk-adjusted return will be sufficient to justify investment.

256) We recognise that Ofwat does 'aim-up' by 27 basis points to account for low investor sentiment towards the water sector following investor engagement at its series of roundtables and the results of broker surveys and to support companies to secure the external financing required to deliver the PR24 investment programme¹⁵⁶. It is unclear to what extent this is driven by uncertainty in its estimates, as Ofwat has not modelled the uncertainty in its CAPM-CoE, but we consider in Section 5.7 below whether its adjustment is sufficient to result in an appropriate Allowed-RoE.

5.5. Asymmetry in the package

257) It is not within the scope of this report to evaluate the balance of risk in the package for the notional company.

258) However, we note that Ofwat does model an expected loss on ODIs of 20bp in the FD, which it says is offset by expected outperformance on financing.¹⁵⁷ Regarding the latter, we consider that the notional company should not be expected to outperform on financing ex ante if the allowed return has been calibrated to approximate the expected cost of capital for the notional company.

259) It follows that if the CMA resets the cost of capital and this cost of capital reflects the market cost of capital for the notional company, then a 20bp expected loss on ODIs will remain, under Ofwat's own FD analysis. Assuming Ofwat's 20bp expected loss on ODIs is correct, it should be taken into account when aiming-up.

¹⁵⁴ FD24 Allowed Return Appendix, page 81.

¹⁵⁵ Ibid.

¹⁵⁶ FD24 Allowed Return Appendix, page 84.

¹⁵⁷ FD24 Allowed Return Appendix, page 77 - Table 18.

5.6. Financeability

260) Our main observation with regards to financeability is that Ofwat's assessment hinges upon the sector being able to raise £12.7bn of new equity during PR24.¹⁵⁸ This makes it all the more important that the allowed CoE is sufficient. In our view, for all the reasons and evidence set out in this report, Ofwat cannot be confident that its allowed-CoE is in line with the Market-CoE and in turn that this £12.7bn of new equity will be forthcoming.

5.7. Overall Allowed-RoE

Kairos overall Allowed-RoE

261) Overall, we consider that there is strong evidence in support of aiming-up above the mid-point of 5.7% from our CAPM-CoE.

262) Substantial new investment is needed at PR24. Our evidence on the relationship between capex and beta for UK water companies suggests that higher capex leads to a higher beta and that in turn the forward-looking beta may be above the mid-point of the unconditional beta, which we use in our CAPM-CoE range. In addition, where new investment is needed, there is a good case for aiming-up above the 50th percentile. The CMA aimed-up by 25bp at PR19, which would result in an Allowed-RoE at the top of our CAPM-CoE range of c.5.9%. 5.9% is therefore our estimate of the Allowed-RoE, should an approach be adopted that relied solely on our CAPM-CoE range and CMA precedent from PR19, with respect to the amount of aiming-up.

263) However, whilst 25bp is consistent with CMA PR19 precedent and the top of our CAPM-CoE range, we consider that there is evidence supporting aiming-up by 50bp to an Allowed-RoE of 6.2%. In particular:

- a. The CMA's 25bp from PR19 was in the context of a lower investment programme than PR24;
- b. Whilst the CAPM has been the primary asset-pricing model used in economic regulation to date, it is well-documented that it has omitted variables bias and will tend to underestimate the CoE, particularly for low beta stocks.¹⁵⁹ This is supported by ample evidence that MFMs better explain the cross section of returns and the MFM-CoEs for water stocks of 6.1% to 6.6% (mid-point of 6.35%) being outside of the CAPM-CoE range of 5.5-5.9%;
- c. Our adjusted version of Ofwat's own MARs analysis supports an implied CoE range of 5.2-6.8%, with a mid-point of 6.0%; and

¹⁵⁸ Ofwat, PR24 final determinations: Aligning risk and return – appendix (FD24 Risk and Return Appendix), December 2024, page 71.

¹⁵⁹ See paragraphs 216) and 217).

- d. The modelled uncertainty in our CAPM-CoE, shows that to achieve the 67th percentile, aiming-up by 50bp is required.

264) Finally we note that under Ofwat's analysis there is 20bp asymmetry in the ODI package. This further supports aiming-up above the mid-point of the CAPM-CoE, if not corrected at source by the CMA.

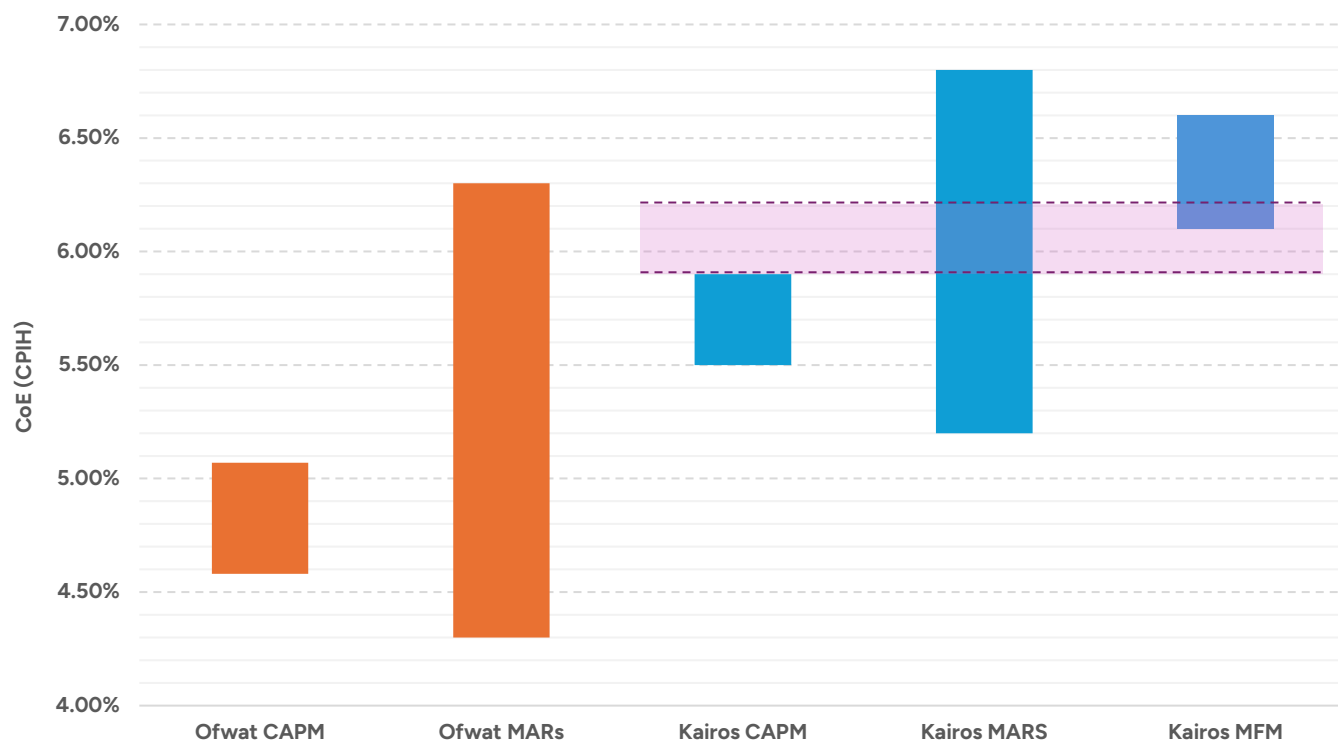
265) Overall, an Allowed-RoE of 5.9% is consistent with the top of our CAPM-CoE range and the CMA PR19 precedent on the amount of aiming-up. However, we consider that there is evidence to support aiming-up by 50bp for PR24, resulting in an Allowed-RoE of 6.2%.

Discussion of Ofwat's overall Allowed-RoE

266) Ofwat concludes that it has aimed up by 27bp to 5.1%. Whilst for the reasons outlined above we agree with Ofwat that aiming-up is required at PR24, we do not consider that Ofwat's aiming-up is sufficient because:

- a. We consider that Ofwat's CAPM parameters are downwardly biased, such that 5.1% is below the low end of our CAPM-CoE range of 5.5%, suggesting that Ofwat has not actually aimed up, despite there being good reason to do so at PR24, but instead aimed down. Indeed, Ofwat's 5.1% is at the 31st percentile of our modelled probability distribution for the CAPM-CoE.
- b. 5.1% is below the mid-point of Ofwat's own implied CoE from MARs of 4.3-6.3%, below our implied CoE from MARs of 5.2-6.8% and takes no account of the evidence that MFM-CoEs are 6.1-6.6%, which is substantially above CAPM-CoE for water stocks.
- c. Under Ofwat's analysis there is 20bp asymmetry in the ODI package, which if correct should have been adjusted for in the allowed return, to ensure that an equity investment in a notional water company is a fair-bet.
- d. Whilst Ofwat's notional financeability assessments show ratings in line with Baa1, Ofwat cannot take comfort in this because it cannot be confident that the new equity upon which its financeability assessment rests, will be raised at its depressed 5.1% Allowed-RoE.

Figure 8: A comparison between ranges of estimates of the CoE derived under alternative approaches and our overall Allowed-RoE



Source: FD24 Allowed Return Appendix, Kairos analysis. Notes: Our overall Allowed-RoE range is shown in purple.

Appendix A: Regression results for beta analysis

267) The table below presents full regression results for unconditional beta estimates for the listed comparators separately and the UU/SVT value-weighted portfolio at a daily frequency over the estimation period, under the model that includes a dummy variable for the period of Covid-19 restrictions only, and the extension that includes a dummy variable for the period following the Viridor spinoff (and interaction terms).

Table: Regression results for unconditional beta estimates for the listed comparators separately and the UU/SVT value-weighted portfolio at a daily frequency

Parameter	(1)	(1)	(1)	(1)	(2)
	UU	SVT	PNN	UU+SVT	PNN
(Intercept)	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
ftse_excess_return	0.678***	0.648***	0.704***	0.664***	0.675***
	0.031	0.029	0.035	0.029	0.041
	0.034	0.032	0.039	0.032	0.040
dummy_restriction	0.001	0.000	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001
ftse_excess_return:dummy_restriction	-0.220***	-0.203***	-0.319***	-0.213***	-0.320***
	0.061	0.058	0.070	0.058	0.070
	0.109	0.099	0.100	0.098	0.099
dummy_post_viridor_sale					-0.001
					0.001
					0.001
ftse_excess_return:dummy_post_viridor_sale					0.088
					0.064
					0.082

Source: Refinitiv, Kairos analysis. Notes: Figures presented in grey are regular OLS standard errors. Italicised grey figures are robust standard errors. *, **, *** represents estimates that are significant at the 5%, 1%, and 0.1% level, respectively.

268) The table below presents the results for the regression that test the relationship between investment and beta for the value-weighted portfolios UU/SVT and UU/SVT/PNN, whilst accounting for the period of Covid-19 restrictions and the level of gearing. The variable taken as the proxy for capex intensity in the tables below is the ratio of capital expenditure to the (lagged) value of total assets. The variable 'ftse_xreturn x portfolio1_cta_dem' shows significantly positive estimates for the parameter associated with the interaction term between the excess return on the market portfolio, and the ratio of capital expenditure to total assets. This demonstrates a positive association between capital intensity and beta.

Table: Results for the regression that test the relationship between investment (measured as the ration of capital expenditure to total assets) and beta for the value-weighted portfolios UU/SVT and UU/SVT/PNN

	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
(Intercept)	0.000 (0.476)	0.000 (0.597)	0.000 (0.556)	0.000 (0.711)	0.000 (0.530)	0.000 (0.667)	0.000 (0.643)	0.000 (0.594)
ftse_xreturn	0.612*** (<0.001)	0.665*** (<0.001)	0.665*** (<0.001)	0.664*** (<0.001)	0.610*** (<0.001)	0.668*** (<0.001)	0.672*** (<0.001)	0.674*** (<0.001)
dummy_restriction		0.001 (0.571)	0.001 (0.578)	0.001 (0.276)		0.001 (0.534)	0.001 (0.537)	0.001 (0.576)
ftse_xreturn x dummy_restriction		-0.213* (0.025)	-0.260** (0.006)	-0.278** (0.007)		-0.234* (0.011)	-0.252** (0.007)	-0.257** (0.006)
portfolio1_cta_dem			0.008 (0.843)	0.043 (0.311)			0.002 (0.936)	0.053 (0.130)
ftse_xreturn x portfolio1_cta_dem			17.253** (0.002)	15.723** (0.010)			13.286** (0.003)	11.137* (0.027)
portfolio1_gearing_dem				-0.006** (0.003)				-0.006*** (<0.001)
ftse_xreturn x portfolio1_gearing_dem				0.204 (0.486)				0.277 (0.293)
R2	0.187	0.192	0.196	0.199	0.188	0.193	0.197	0.201
Num.Obs.	2603	2603	2603	2603	2603	2603	2603	2603

Source: Refinitiv, Kairos analysis. Notes: The first four columns show the results for the value-weighted portfolio UU/SVT, and the final four columns show the results for the value-weighted portfolio UU/SVT/PNN, over the estimation period. The variable 'ftse_xreturn x portfolio1_cta_dem' shows the estimates for the parameter associated with the interaction term between the excess return on the market portfolio, and the ratio of capital expenditure to total assets.

Appendix B: Full regression results from MFM analysis

269) The table below presents full regression results for the value-weighted portfolios UU/SVT and UU/SVT/PNN that are discussed under our MFM analysis.

	UU/SVT	UU/SVT/PNN	UU/SVT	UU/SVT/PNN
Covid treatment	Lockdown (LD)	Lockdown (LD)	Restrictions (RES)	Restrictions (RES)
Model	q-factor	q-factor	q-factor	q-factor
rmrf	0.661	0.665	0.694	0.702
	(0.000)	(0.000)	(0.000)	(0.000)
size	-0.231	-0.218	-0.157	-0.137
	(0.000)	(0.000)	(0.000)	(0.001)
inv	0.0567	0.0451	0.0761	0.0713
	(0.261)	(0.374)	(0.148)	(0.178)
roe	0.370	0.366	0.399	0.400
	(0.000)	(0.000)	(0.000)	(0.000)
LD	0.0014	0.00140		
	(0.178)	(0.181)		
LDrmrf	-0.218	-0.229		
	(0.001)	(0.001)		
LDsize	-0.525	-0.533		
	(0.000)	(0.000)		
LDinv	-0.265	-0.280		
	(0.120)	(0.102)		
LDroe	-0.00670	0.0344		
	(0.964)	(0.819)		
RES			0.0009	0.000934
			(0.230)	(0.213)
RESrmrf			-0.227	-0.241
			(0.000)	(0.000)
RESsize			-0.388	-0.413

			(0.000)	(0.000)
RESinv			-0.0936	-0.134
			(0.483)	(0.318)
RESroe			-0.0913	-0.0840
			(0.423)	(0.462)
_cons	0.0001	0.000108	0.0001	0.0000456
	(0.559)	(0.652)	(0.739)	(0.853)
N	2590	2590	2590	2590
R-sq	0.234	0.232	0.237	0.237

Source: Kairos analysis. Notes: Values in parentheses are p-values.

This report has been prepared under agreements between Kairos Economic Consulting Limited ('Kairos or 'We') and Northumbrian Water Limited ('NWL'), dated 23 May 2024 and Wessex Water Services Limited ('WWS'), dated 13 March 2025.

As set out in the terms and conditions of our engagement, Kairos accepts no liability for any conclusions drawn or reliance placed upon the information in this report by any third parties.

