KPMG

PR24 risk analysis for a notional company

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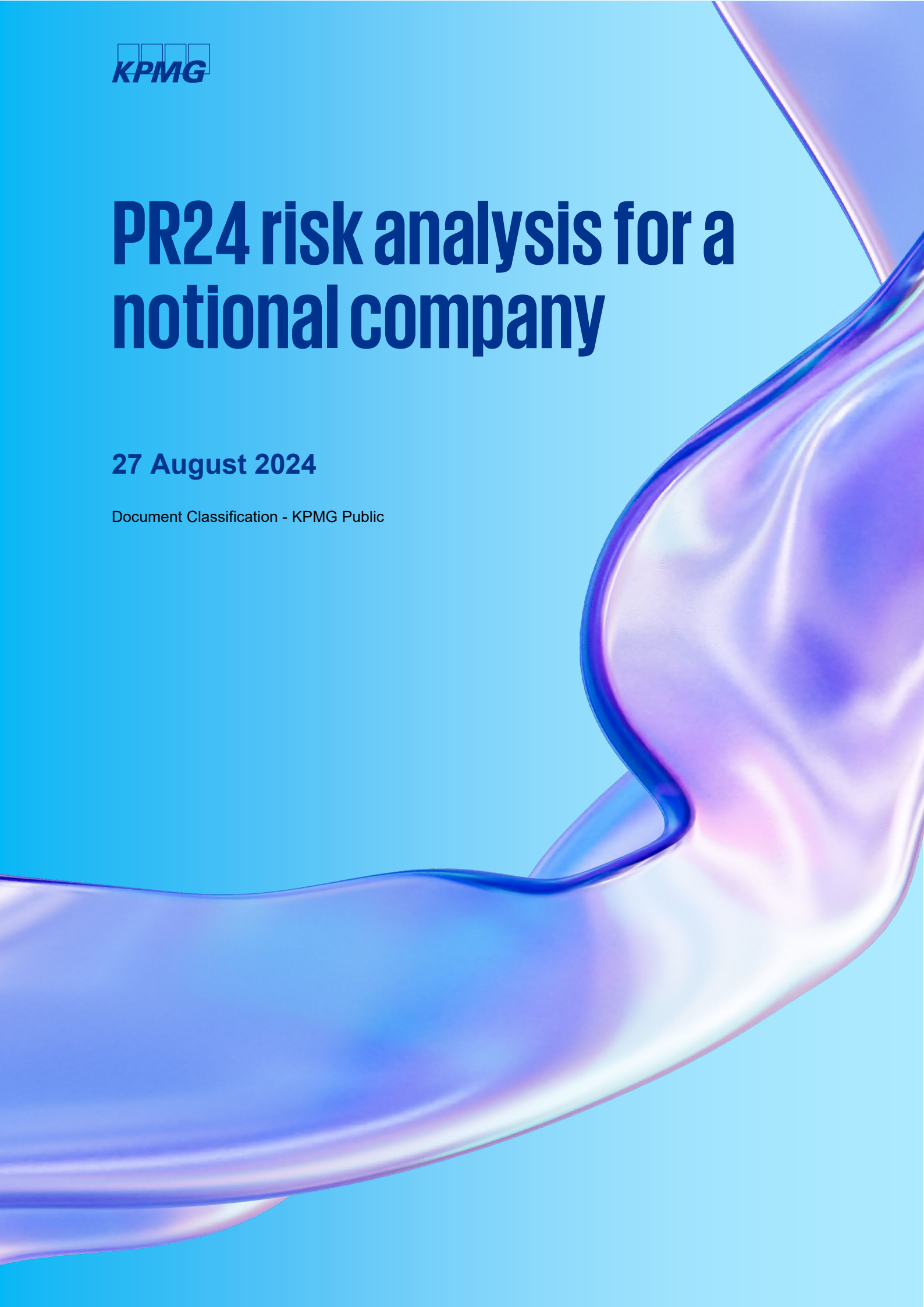

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2 Introduction

Over the next twenty-five years, the water sector will need to deliver large-scale investment for customers and the environment. The sector will need to improve resilience and service levels, adapt to climate change, and work towards net zero emissions. This investment will need to be balanced against affordability constraints. With these goals spanning multiple price controls, continuous access to both debt and equity financing will be critical to ensure that these improvements can be delivered.

In order to attract investment into the sector, debt and equity investors need to earn a reasonable return that provides fair compensation for the risks associated with their investment. This requirement translates into two components. First, the base allowed return needs to reflect forward-looking risk exposure, and second, an efficient company needs to have a reasonable prospect of earning the base allowed return or, to put it differently, a notionally efficient company's expected return needs to equal the allowed return. This report predominantly considers whether the second component holds true given changes to regulatory risk protection mechanisms proposed in the Price Review 24 (PR24) Draft Determinations (DDs).

In the PR24 DDs, Ofwat stated: "*We have calibrated the risk and return package so that equity investors in an efficient company have a reasonable prospect of earning the base allowed return*", while maintaining financial incentives to outperform cost and performance targets and penalties in case of underperformance[1]. Several changes to the regulatory parameters and mechanisms were introduced at DDs to change risk allocation and reduce exposure for companies, namely: designing PC targets that sit between upper quartile and median of business plans, introducing Aggregate Sharing Mechanism (ASM) covering totex, lowering sharing rates for enhancement totex and introducing gated process for more complex projects, introducing energy cost indexation in the base cost and ex-ante labour cost indexation in the retail cost, shifting the C-Mex reward maximum from UKCSI maximum to upper quartile and others. Many of these changes improve the sector's ability to earn the base allowed return. Other changes to the regulatory framework at DDs appear to have the opposite impact on risk exposure, in particular: increase in the ODI rates, wider adoption of price control deliverables (PCD), significant totex efficiency challenges and the introduction of Delayed Delivery Cashflow Mechanism (DDCM).

This report aims to assess, based on the available empirical evidence and historical sector performance data, whether the DD parameters and mechanisms allow the notional company to earn base allowed return on a *median*[2] *expected basis*. This report explores whether additional changes to the calibration of regulatory parameters and mechanisms are required to ensure that the risk is mitigated at source and the notional company can expect to earn the base allowed return.

This report is structured as follows:

- Section 3 presents an executive summary of the key findings of the risk analysis conducted on the DD, the implications of the resulting risk on the PR24 package overall, and examples of regulatory mitigations and adjustments to the cost of capital to align risk and return.
- Section 4 provides further detail behind the simulated notional company's risk exposure in RoRE terms by key risk drivers. It also discusses potential regulatory mitigations and their relative effectiveness in supporting the notional company to achieve the allowed return on a median expected basis.

[1] Ofwat (2024), PR24 draft determinations: aligning risk and return appendix, p. 2.

[2] P50 or Median is the value occurring in the middle of a distribution, with 50% of the data set above and 50% below this point. It gives insight into central data tendencies and typical performance. Mean and Median are the same in a symmetrical, normal distribution but can be very different in asymmetric distributions.

- Section 5 summarises the key conclusions of the analysis and the wider implications for the water sector over the PR24 period.
- Section 6 Appendices provides additional detail on the main drivers of risk, methodology used to analyse risk, approach to notional company calibration and assessment of the risk associated with enhancement projects.

3 Executive summary

The risk analysis in this report has been developed through stochastic simulation of forward-looking performance, considering the water sector's performance in AMP7, performance stretch embedded in the business plan targets and implied in the DDs. The suitability of AMP6 performance data for simulating forward-looking risk in AMP8 is substantially limited due to no differentiation between base and enhancement totex, totex not reflecting the scale and complexity present in AMP8, performance commitment targets set at inconsistent levels, with significant differentiation by company, vastly different ODI rates creating different sets of financial incentives and risk exposures across companies, inconsistency of definitions for some ODIs with AMP8 definitions, and limited cross-sector standardised data.

Forward-looking performance was simulated for a theoretical notional company, based on median company by size among each population of water and sewerage companies (WaSCs) and water-only companies (WoCs) and defined as the first quartile performer in the sector.

Accurate specification of the notional company and its baseline performance is essential for producing meaningful return on regulated equity (RoRE) risk ranges. Performance that is realistically achievable by the top quartile companies in AMP7 to date could act as a benchmark, providing a useful cross-check that the definition of the notional company above is supported by the empirical data. Table 1 shows RoRE performance across each company in the sector in AMP7, with widespread underperformance.

Table 1: Summary sector reported RoRE (%) across the major categories of operational performance

	Co1	Co2	Co3	Co4	Co5	Co6	Co7	Co8	Co9	Co10	Co11	Co12	Co13	Co14	Co15	Co16	Co17	P50	P75
Cumulative totex	-1.6	-5.2	**-0.8**	-6.9	-1.0	-3.1	-1.1	-1.1	-2.0	-2.4	-1.4	**-0.3**	**-0.1**	**0.6**	-1.9	-2.6	-1.7	**-1.6**	**-0.9**
Cumulative ODIs	-0.5	-1.5	**-0.2**	-1.7	**1.1**	-0.5	-0.9	**0.4**	-0.7	**-0.1**	-0.7	-1.1	-1.2	-0.9	-0.4	-0.9	-1.2	**-0.7**	**-0.3**
Cumulative Retail	**-0.1**	**1.5**	-0.5	-0.9	**-0.2**	**0.0**	-0.9	-0.3	-1.1	-0.4	-0.5	-0.5	-0.3	-1.0	-2.6	-0.6	-1.1	**-0.5**	**-0.2**
Cumulative operational RoRE, FY21-FY24	-2.1	-5.2	**-1.3**	-11.0	**0.1**	-3.7	-3.5	**-0.9**	-3.8	-2.8	-2.6	-2.1	**-1.5**	-2.7	-5.1	-4.3	-3.9	**-2.8**	**-1.8**

Source: Annual Performance Reports, FY24; Bold figures highlight upper quartile performers in each category; Grey shading shows companies that performed at or above sector-median on each operational parameter.

During the first 4 years of the AMP7 price control period, the sector reported an average 330 basis points[3] operational underperformance against the baseline equity return, with the main contributors being the ODIs (-65b.p.), wholesale totex (-193b.p.) and retail (-56b.p.). The sector also reported a modest average financing outperformance of 56b.p.[4] driven by the difference between outturn and assumed inflation. Overall, the sector's performance was severely skewed towards underperformance and only a few top-performing companies earned the allowed return.

No company consistently achieved upper quartile performance across each wholesale totex, ODIs and retail, as demonstrated in Table 1. Companies which performed strongly on totex exhibited weaker than median performance on ODIs and retail, and *vice versa*. Only five companies performed at or above the median level on each parameter, highlighted in grey. This demonstrates the level of stretch implied by the combination of performance targets and base totex allowances in AMP7, with no company managing to meet targets and spend within cost allowances.

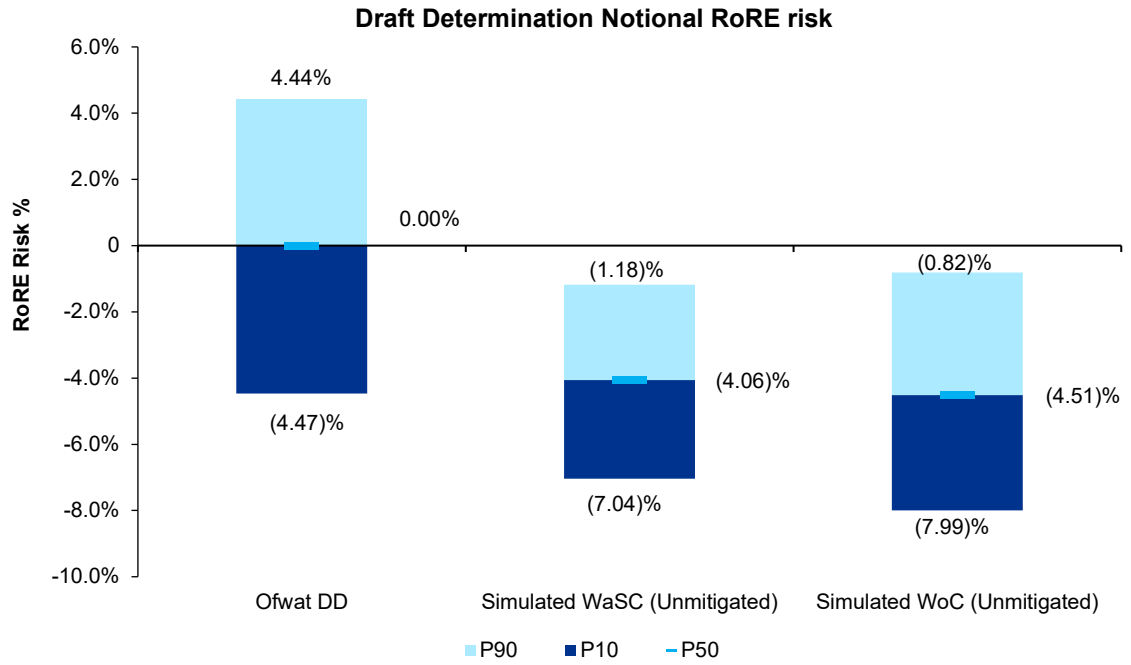
[3] Simple average of reported Total Operational Performance RoRE for FY21-FY24 as per industry APRs; actual return and notional regulated equity.

[4] Simple average of reported cost of debt performance plus simple average of reported hedging instruments for FY21-FY24 as per industry APRs; actual return and notional regulated equity.

It follows from the empirical data presented in Table 1 that a company achieving median[5] performance across all performance parameters in all years could be considered an upper quartile company with respect to overall performance achieved by its peers. This approach factors in the trade-offs between totex and ODI performance, given the limitations of the overall package. The calibration of the notional company based on median sector performance therefore reflects an achievable efficient company and is used in this report as the cornerstone of the risk simulations. Application of this specification, grounded in historical data, demonstrates that there is scope for regulatory miscalibration of performance achievable by the notional company in the DD.

Overall, consolidated analysis of the water sector's risk exposure suggests that the DDs imply a material imbalance between risk and return where the historical performance of the sector and the design of regulatory mechanisms are fully accounted for. Compared to the baseline equity return, there is a negative upside in the best-case scenario (P90)[6], a substantially negative risk exposure in the base-case scenario (P50) and a severe downside in the worst-case scenario (P10). Chart 1 presents simulated risk ranges and key components of risk for a notional WaSC, a notional WoC[7] and compares them to the view of risk in the DDs.

Chart 1: Simulated risk ranges for the notional company based on the PR24 DD[8]



[5] A median separates higher half of a data sample from the lower half and helps define the central tendency of a data array, which is particularly relevant for skewed, non-normal distributions, where mean could be significantly impacted by outliers.

[6] Best-case, base-case and worst-case scenarios are consistently referenced throughout this report as a substitution for the P90, P50 and P10, respectively. The P10, P50 and P90 are percentiles and show how the numbers are distributed in a sample. P50 is the value that features in a sample with an equal number of observations above and below. P10 and P90 are the tail ends and correspond to the 10 percent of lowest and highest values, respectively.

[7] The two different types of a notional company, a WaSC and a WoC have been considered in this report. This is because of significant structural differences between the two types that affect RoRE risk ranges. WaSCs have significantly larger asset base, operate two distinct business units – water and wastewater – and cover larger geographies. WoCs have smaller asset base, operate one distinct business unit – water – and cover smaller geographies. A WoC has higher operational gearing where base totex reflects a higher proportion of RCV than for a WaSC, which results in more negative risk outcomes.

[8] Risk ranges reflect all the risk mitigations proposed at the DDs across ODIs, totex, measures of experience, retail, DPC and Aggregate Sharing Mechanisms (ASMs) on ODIs and totex.

Table 2: RoRE risk ranges presented in the DDs versus those arrived at in this analysis (by component)

	Notional company per DD			Simulated notional WaSC			Simulated notional WoC		
	Worst-case	**Base-case[9]**	**Best-case**	**Worst-case**	**Base-case**	**Best-case**	**Worst-case**	**Base-case**	**Best-case**
Totex	-1.36%	0.00%	1.23%	-2.60%	-1.26%	0.11%	-3.27%	-1.43%	0.98%
Retail	-0.30%	0.00%	0.30%	-2.17%	-0.62%	0.92%	-2.17%	-0.62%	0.92%
Mex & ODI	-2.38%	0.00%	2.01%	-3.68%	-1.72%	0.08%	-3.94%	-2.04%	0.33%
Financing	-0.40%	0.00%	0.90%	-1.85%	-0.34%	1.19%	-1.88%	-0.33%	1.21%
Other	-0.05%	0.00%	0.00%	-0.21%	-0.03%	0.00%	-1.83%	-0.03%	0.00%
RoRE (additive)	-4.48%	0.00%	4.44%	-10.52%	-3.97%	2.30%	-13.08%	-4.46%	3.44%
RoRE (simulated)[10]	**n/a**	**n/a**	**n/a**	**-7.04%**	**-4.06%**	**-1.18%**	**-7.99%**	**-4.51%**	**-0.82%**

Source: KPMG analysis, APRs, DDs

There is a marked difference in the level of risk exposure across the worst-, base- and best-case scenarios between the results presented in the DDs and those arrived at in this analysis. This analysis shows that the outcomes are much poorer across all performance categories than is presented in the DDs.

Based on the detailed workings that were published on the 20 August 2024 by the regulator, it appears that the base-case (P50) risk exposure has not been quantified or analysed in any degree of detail in the DDs. Instead, an assumption was made that the expected return equals allowed return for the presentation purposes. There is also little evidence that historical sector data was used to inform the performance and risk ranges[11].

Despite greater risk variance[12] of the different performance components in this analysis versus the DDs, the total simulated risk variance is higher in the DDs because simple addition was applied to the components of risk, implying a correlation of 1. This analysis assumes that different components of risk are uncorrelated, resulting in the worst-case and best-case scenarios occurring only for some performance parameters while not occurring for others, producing a lower risk variance. The outcome of a simulated best-case scenario is lower than the simple addition of the individual best-case parameters and, similarly, simulated worst-case scenario is less negative than the simple addition of component parts. The overall exposure ranges from -1.18% to -7.04% for a notional WASC and from -0.82% to -7.99% for a notional WOC, which would erode the allowed return in all scenarios.

This level of risk could have an adverse impact on financeability and investability, challenging companies' ability to deliver service for customers and protect the environment. In the context of attracting capital necessary to maintain operations and deliver the investment programmes, risk exposure that is not commensurate with levels investors expect for a stable, predictable regulated utility could raise the return expectations of debt and equity investors and result in higher cost of infrastructure for customers.

[9] In the DDs, there was no P50 base-case explicitly specified and it is assumed that the P50 was zero.

[10] Statistical analysis of the probabilistic outcomes relies on Monte Carlo simulations which produce random outcomes. The consolidated picture of such simulations heavily depends on the relationships between various components of risk or correlations. If one assumes that all the simulated risks have a correlation of 1, it implies that all risks happen simultaneously and result in the probabilistic outcomes being additive in case of symmetric distributions. This is an implicit approach adopted in the DDs, whereby the ranges of outcomes across totex, ODIs, measures of experience, retail and other parameters are being simply added together. In practice, this overstates both the worst- and best-case scenarios because different components of performance are not perfectly correlated. Statistically, it is more prudent to run the Monte-Carlo simulations assuming that different components of risk are uncorrelated, and while for some performance parameters the worst-case scenarios occur, for others they do not, resulting in a lower risk variance.

[11] Ofwat (2024), Risk and return models. Models can be found here.

[12] Variance is the difference between the worst- and best-case scenario (P10 and P90).

Key drivers of risk in AMP8

Notional company risk exposure can be decomposed into risk arising from the asymmetry of regulatory design and risk that the sector's performance targets, combined with cost allowances, are not achievable in practice. These risks are referred to as regulatory design and regulatory calibration throughout this report and they contribute c.160-190 b.p. and 200-230 b.p., of downside in the base-case scenario, respectively.

Table 3: Decomposition of notional company risk

		Risk arising from regulatory design			Implied risk arising from regulatory calibration			Notional Company		
		P10	P50	P90	P10	P50	P90	P10	P50	P90
WaSC	Totex	-2.44%	-0.92%	0.45%	-0.17%	-0.33%	-0.33%	-2.60%	-1.26%	0.11%
	Retail	-1.55%	0.00%	1.55%	-0.62%	-0.62%	-0.62%	-2.17%	-0.62%	0.92%
	DPC	-0.16%	0.00%	0.00%	0.00%	0.00%	0.00%	-0.16%	0.00%	0.00%
	Mex & ODI	-2.90%	-0.80%	0.82%	-0.79%	-0.92%	-0.74%	-3.68%	-1.72%	0.08%
	Financing	-1.52%	0.03%	1.55%	-0.33%	-0.37%	-0.36%	-1.85%	-0.34%	1.19%
	Rev.	-0.05%	-0.03%	0.00%	0.00%	0.00%	0.00%	-0.05%	-0.03%	0.00%
	RoRE (additive)	-8.61%	-1.72%	4.36%	-1.91%	-2.25%	-2.06%	-10.52%	-3.97%	2.30%
	Total RoRE (simulated)	-5.01%	-1.93%	1.01%	-2.02%	-2.13%	-2.19%	-7.04%	-4.06%	-1.18%
WoC	Totex	-2.46%	0.27%	2.36%	-0.81%	-1.71%	-1.38%	-3.27%	-1.43%	0.98%
	Retail	-1.55%	0.00%	1.55%	-0.62%	-0.62%	-0.62%	-2.17%	-0.62%	0.92%
	DPC	-1.78%	0.00%	0.00%	0.00%	0.00%	0.00%	-1.78%	0.00%	0.00%
	Mex & ODI	-3.63%	-1.46%	0.80%	-0.31%	-0.58%	-0.47%	-3.94%	-2.04%	0.33%
	Financing	-1.50%	0.03%	1.54%	-0.37%	-0.36%	-0.33%	-1.88%	-0.33%	1.21%
	Rev.	-0.05%	-0.03%	0.00%	0.00%	0.00%	0.00%	-0.05%	-0.03%	0.00%
	RoRE (additive)	-10.97%	-1.19%	6.25%	-2.11%	-3.27%	-2.81%	-13.08%	-4.46%	3.44%
	Total RoRE (Simulated)	-5.45%	-1.57%	2.19%	-2.54%	-2.95%	-3.01%	-7.99%	-4.51%	-0.82%

Source: KPMG analysis, APRs, DDs

Risks arising from the calibration of *regulatory parameters*

The regulatory calibration risk is based on the sector's observed performance in AMP7. Forward-looking risk includes the differences between expected performance of the notional company and the targets and allowances set out in the DD. There are several key areas where the calibration of regulatory parameters resulted in the downside risk exposure in the base-case scenario.

First, DD performance targets are set between median and upper quartile of the business plans (BPs) targets and assume that there is no risk associated with achieving the FY25 target performance[13]. A data-based approach suggests that there is substantial risk associated with the sector achieving FY25 target performance based on the performance in FY21-FY24. Furthermore, there is also risk associated with setting targets above the median level presented in BPs. Although the DDs suggest that the targets are set at a sector-median level[14], this does not appear to hold true for all performance commitments on closer examination. As demonstrated in the Table 4, DDs imply greater stretch than sector-median for water quality contacts, CRI, pollution incidents, internal and external sewer flooding, mains repairs and leakage. In addition to that, BP targets already imply a substantial improvement from the current level of performance for CRI, supply interruptions (Chart 2), pollution incidents, sewer flooding, leakage and water quality contacts, which requires adequate funding to be deliverable. In total, stretching PC targets in DD add 80 basis points of the downside exposure in the base-case scenario in RoRE terms, excluding any stretch in October 2023 BPs.

[13] Ofwat (2024), PR24 draft determinations: Delivering outcomes for customers and the environment, p. 3.

[14] Ofwat (2024), PR24 draft determinations: Aligning risk and return, p. 8.

Table 4: The level of stretch in selected performance commitments[15] (sector-median)

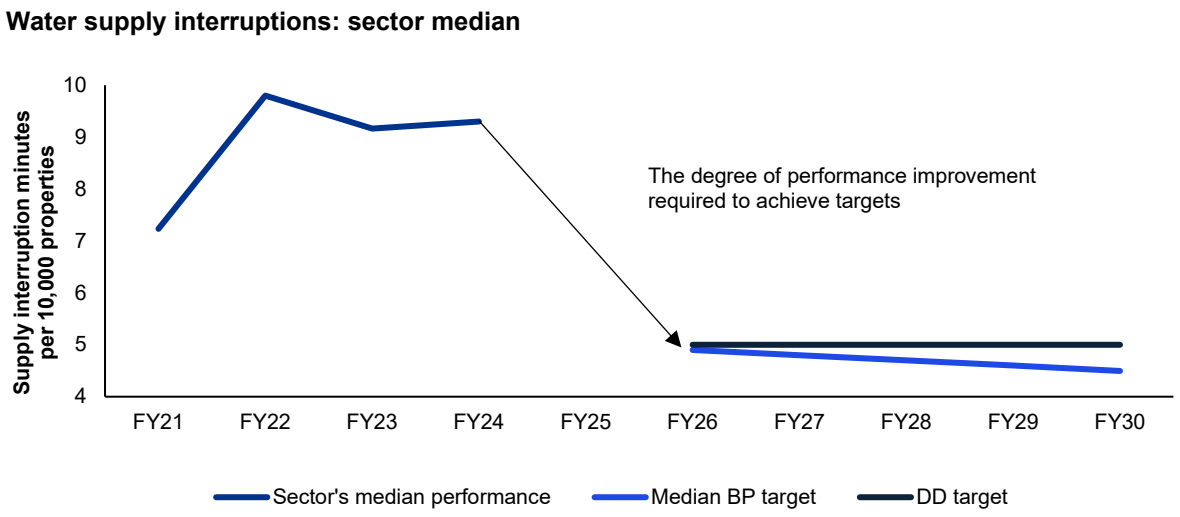
Outcome delivery incentive	Units	The level of stretch, % (in median terms, average of the period)		Performance in physical terms		
		BP targets vs. AMP7 perf.	**DD targets vs. BP targets**	**AMP7 median**	**BP median**	**DD median**
Leakage	*ML/km of mains/day*	18%	1%	7.4	6.1	6.0
Customer Contacts on Water Quality	*# Contacts/ 1,000 pop.*	12%	19%	1.0	0.9	0.7
Water Supply Interruptions	*Minutes / Property*	47%	-6%	8.9	4.7	5.0
CRI	*CRI Score*	57%	20%	2.9	1.3	1.0[16]
PCC	*l/person/day (3yr avg.)*	7%	1%	144.8	134.5	132.7
Mains Repairs	*# Repairs / 1000km mains*	2%	4%	131.8	129.4	123.8
Unplanned Outage	*(Non-outage - % peak week prod. capacity)*100*	0%	0%	98.4	98.0	97.7
Pollution Incidents	*Incidents / 10,000km of sewer*	33%	15%	28.1	18.9	16.0
Internal Sewer Flooding	*Properties / 10,000 connections*	29%	5%	1.8	1.3	1.2
Sewer Collapse	*Collapses / 1,000 km of sewer*	0%	0%	7.5	7.5	7.5
Discharge Compliance (WaSC)	*(% compliance) * 100*	1%	0%	98.9	100.0	100.0
External Sewer Flooding	*Properties / 10,000 connections*	19%	3%	19.4	15.7	15.3

Source: APRs, BPs, DDs

[15] These exclude new performance commitments due to limited and imperfect historical information: bathing water quality, operational greenhouse gases (water), operational greenhouse gases (wastewater), biodiversity, business demand, river water quality, and storm overflows.

[16] The level of deadband at FY30

Chart 2: Sector-median historical performance and targets for water supply interruptions



Source: APRs, BPs, DDs

It is appropriate to consider ODI performance in conjunction with base totex allowances, given the interlinkages between the level of spend and service. Considering the degree of performance improvement embedded in the DD targets versus the current sector performance and the degree of the exhibited overspend against base totex allowances in FY21-FY24, a substantial increase in funding is required to reduce the combined ODI and botex underperformance risk. DD base cost allowances exceed the PR19 allowances by 14% and the outturn cost by 3%[17]. The DD also includes energy indexation mechanism. Additionally, efficient leakage costs changed category and are allowed within enhancement spend.

Comparing this with the sector's overspend against the base totex allowances of c. 22% in FY21-FY24 (post timing adjustments) and considering the benefit of the energy indexation as well as the expected physical asset growth (approximated by the combined average population growth in the UK), the proposed increase in botex would still leave a funding gap in relation to FY21-FY24 performance levels, with performance improvements required in AMP8 significantly underfunded. Tables 4 and 5 present a high-level bridge between the sector performance on base totex in AMP7 and the increase in the AMP8 allowances proposed in DDs, whereby the adjusted underperformance was 19% versus the adjusted increase in the allowance of only 6%. The risk is simulated post sharing rates, so the RoRE exposure in the base-case represents half of the overspend.

Table 5 a, b: Sector median performance against base totex allowances in AMP7 and increase to the allowances as per DDs[18]

Sector performance vs. PR19 base totex allowances	
Reported performance	-18%
Timing adjustment	-4%
Benefit of energy indexation	3%
Final overspend against PR19 botex allowances (pre-RPE)	**-19%**

PR24 allowances vs PR19 botex allowances	
Increase before frontier shift	14%
Frontier shift adjustment (compounded over 5 years)	-5%
Growth in physical assets[19] (approximated by combined annual UK population growth in FY26-FY30)	-3%
Final increase in botex allowances vs. PR19 on a like-for-like basis (pre-RPE)	**6%**

Source: APRs, DDs, ONS (forecast of UK population growth)

[17] Ofwat (2024), PR24 draft determinations: Aligning risk and return, p. 9.

[18] Same price base (22/23) was used to calculate the changes in percentages for presentational purposes

[19] Larger assets require greater maintenance cost, therefore, base cost allowances should factor in the growing asset base

Enhancement spend is the second major area where the calibration of regulatory parameters resulted in downside risk exposure in the base-case scenario. This is because the enhancement programme in PR24 represents a step change in scale and complexity for the notional company and is not well captured by historical data[20]. Delivery of the enhancement programme involves construction and development activity which carries greater risk of delays and cost overruns than maintaining the existing asset base. The risk associated with delivering the PR24 enhancement programme is comparable with the risk of undertaking small to medium infrastructure projects of modest complexity.

For this analysis, the risk is simulated by using the empirical data from the KPMG infrastructure project database[21], which shows that projects comparable in size and complexity to those of the notional company are likely to be delivered late and at a cost exceeding the initial budget. The analysis incorporates the risk mitigations put in place at the DDs: a reduction to cost sharing rates on enhancement overall and even lower sharing rates on particularly large and complex projects, a gated process on key projects and a separate aggregate sharing mechanism for wholesale totex. While these mitigations address a significant component of enhancement risk at PR24, there remains a material cost gap in the base-case and a significant downside asymmetry. Table 6 presents the expected performance of the notional company against the original enhancement budget in the worst-, base- and best-case scenarios, after applying the mitigations proposed in the DDs. In RoRE terms, the gap is equivalent to 92 basis points downside in the base-case in combination with base totex before considering Price Control Deliverables (PCDs), the impact of which is assessed separately as part of the regulatory design.

Table 6: Expected performance of the notional company against the original enhancement spend budget (before the application of PCDs) %

Post-sharing enhancement cost performance	Units	Worst-case scenario (P10)	Base-case scenario (P50)	Best-case scenario (P90)
Notional WaSC enhancement cost underperformance	% Overrun on allowance	10.48%	2.72%	-1.39%
Notional WoC enhancement cost underperformance	% Overrun on allowance	8.27%	3.31%	-0.21%

Source: KPMG analysis based on the KPMG infrastructure project database

Finally, financing risk is the third major area where the calibration of regulatory parameters resulted in the downside risk exposure in the base-case scenario. As presented in Table 7, key contributors to the negative risk exposure in the base-case scenario is performance of the notional company against the allowances on embedded and new debt. This is because DD allowance for the cost of embedded debt is lower than the all-in cost of embedded debt for the median company in the sector. At the same time, the cost of new debt allowance, based on the iBoxx A/BBB indices, is significantly below the cost of new debt issuance achieved by water companies over the last 12 months. The regulator has signalled that it will consider refinements to its methodology and the latest market data in the Final Determinations (FDs), which could address the under-funding currently reflected in the financing risk range based on DDs.

[20] The mid-AMP reported performance is less helpful as it does not take account of the percentage of outputs delivered and can be materially impacted by re-profiling of spend during the AMP and also a shift of some investment into the following AMP.

[21] KPMG infrastructure project database includes publicly available major construction projects across different sectors completed in the last 30 years (see Appendix 6.10 for more detail). It was used for reference class forecasting, which is a method for estimating the future using similar past situations and their outcomes. Enhancement scale and complexity in AMP8 are not well proxied by historical sector data due to the step change in enhancement scale and complexity from previous AMPs. Consequently, a view from outside the water sector is required to appropriately calibrate the risk.

Table 7: Decomposition of financing risk[22]

Financing risk components	Worst-case scenario (P10)	Base-case scenario (P50)	Best-case scenario (P90)
CPIH variance	(1.16%)	--	1.16%
RPI-CPIH wedge variance	(0.31%)	(0.00%)	0.30%
CPI-CPIH wedge variance	(0.02%)	0.02%	0.07%
New debt performance	(0.14%)	(0.09%)	0.04%
Embedded debt performance	(0.62%)	(0.29%)	0.05%

Source: KPMG analysis, including historical sector cost of debt in relation to iBoxx A/BBB and cost of embedded debt allowance, simulations of the forward-looking inflation and interest rates

Risks arising from the *design of regulatory mechanisms*

There are several specific areas where the design of regulatory mechanisms has resulted in a negative RoRE risk exposure in the base-case scenario. These include penalty-only ODIs, proposed design of the C-Mex, absence of the retail cost indexation, imbalance of penalty and reward rates for the timing of delivery PCDs, regulatory discretion in the application of clawbacks to totex allowances under non-delivery PCDs and Delayed Delivery Cashflow Mechanism (DDCM).

Penalty-only ODIs such as serious pollution incidents, discharge permit compliance and compliance risk index (CRI) are inherently asymmetric due to no ability to earn a performance-related reward, and historical performance suggesting penalties in the base-case scenario. The deadband[23] for CRI of 1.0 by FY30 helps reduce risk but residual asymmetry remains given the presence of factors outside of companies' control such as pipework and fittings at customer properties. In addition to penalty-only ODIs, there is implicit asymmetry within some performance commitments where there is much greater scope for underperformance than outperformance, for example supply interruptions. While the collar of -1% RoRE limits extreme risk, it does not eliminate the asymmetry fully. The increase in ODI rates proposed in the DDs amplifies the financial impact of asymmetry across all scenarios. The calibration of the ODI rates at the DDs did not account for several material developments: first, a continuous increase in the stretch of the PC targets in AMP7 and AMP8 cause a different performance range from that indicated by the AMP6 data; second, changes in the ODI definitions over time causes an increase in risk[24]; and third, increasing frequency of severe weather events also causes greater performance risk than indicated by the AMP6 data. As a result, ODI rates are over-estimated and lead to a greater amount of regulated equity at risk than stated when forward-looking performance is considered.

The proposed design of the C-Mex mechanism, which now benchmarks water sector performance against the UKCSI all-sector average score[25] and uses payments in terms of a proportion of RoRE instead of based on allowed retail revenue, causes asymmetric risk exposure for the sector and a downside in the base-case scenario. The UKCSI average is very challenging as it includes customer service performance of organisations operating in highly competitive sectors such as leisure, banking and retail. In these sectors, greater resources are allocated to compete on levels of customer service than in regulated utilities. There is also a more frequent direct contact with customers which contributes to the ability to shape customer views. Based on the historical performance in PR19, only a few companies could achieve an outperformance payment, while the rest of the sector would remain within the underperformance territory. Chart 3 demonstrates that a median performer would not achieve UKCSI average score, based on the historical data, and hence would be in the penalty territory. This causes the base-case downside for the notional company.

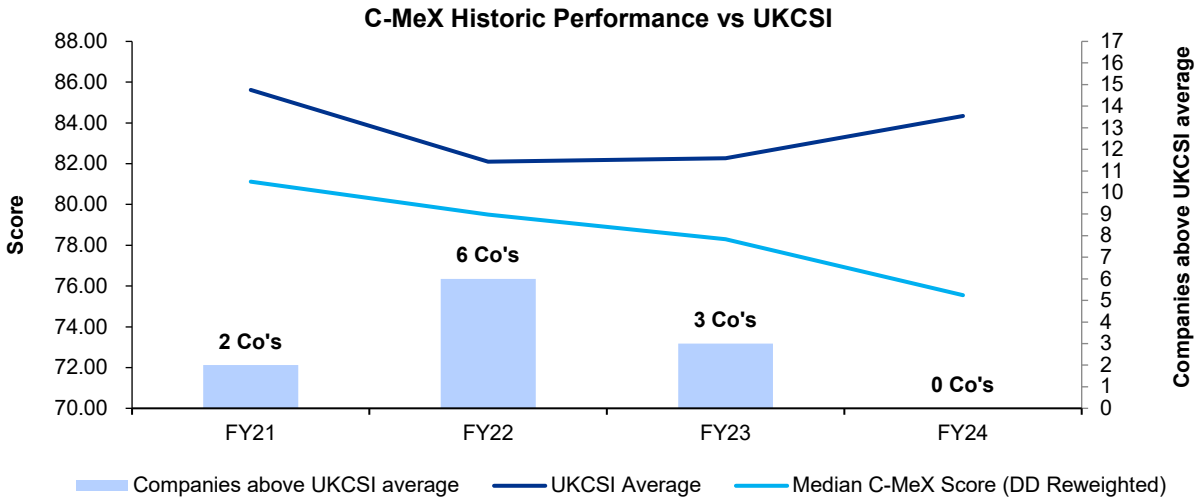
[22] This analysis does not consider where company specification characteristics like size and frequency of issuance may impact the achieved cost of debt and how that may differ from the allowed cost of debt. Should this risk be present, the financing risk ranges presented underestimate the risk.

[23] Deadbands are a range of performance around the PC where ODI payments do not apply; the CRI deadband level at FY26 is aligned with the current PR19 deadband levels (2.0 or 1.5), and then tightens to 1.0 by FY30.

[24] For example, named storms will no longer be excluded in counting pollution incidents in AMP8

[25] This is a change from the UKCSI all sector maximum proposed in the PR24 Final Methodology.

Chart 3: C-MeX historic performance vs UKCSI



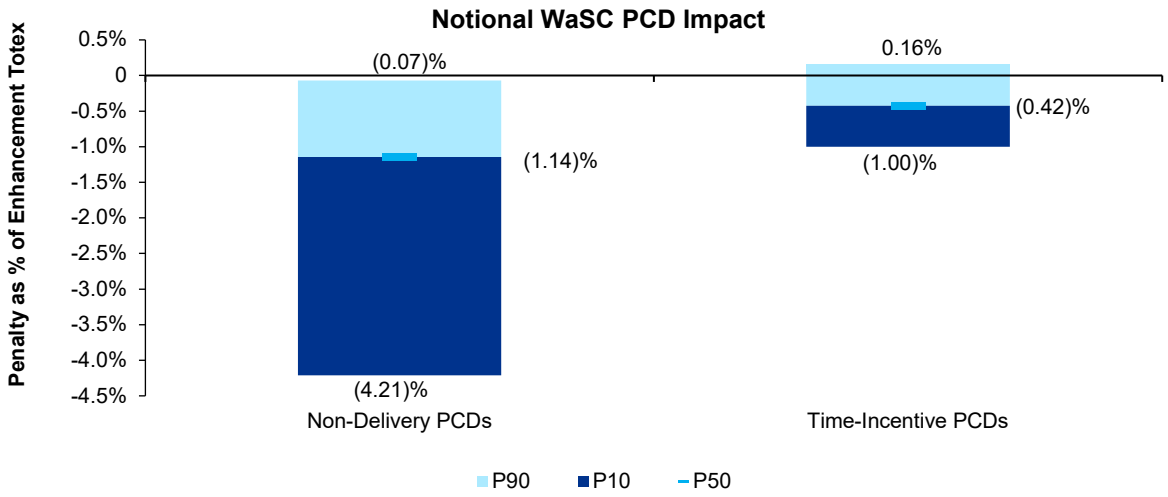
Source: UKCSI average: Ofwat UKCSI benchmark response, C-MeX: KPMG analysis of AMP7 C-MeX per APRs reweighted for DD weightings of CSS and CES

For retail performance the downside in the base-case is driven by treatment of inflation. The introduction of ex-ante indexation on labour costs at DDs has reduced but not eliminated the downside risk. In the absence of full cost indexation, the notional company is exposed to full inflation risk on components of costs excluding labour and to the risk that the outturn inflation rises above the ex-ante level embedded in the revenue allowances for labour costs. Historical data for the FY21-FY24 period demonstrates substantial sector-wide underperformance on retail (see Table 1) and includes the impact of the Covid-19 pandemic on bad debts, spike in inflation observed from 2022 to 2023 and a cost-of-living crisis. While some of these events may not recur in AMP8 (global pandemic), others are driven by the macroeconomic developments and may persist. These risks are captured in the forward-looking simulation, resulting in the negative exposure in the base-case scenario of 62 basis points.

Another significant contributor to the negative RoRE risk exposure in the base-case scenario due to the design of regulatory mechanisms is related to PCDs. The notional company is exposed to risk arising from both non-delivery and time incentive PCDs. PCDs cause exposure to asymmetric risk of late project delivery under non-delivery PCDs because these PCDs are designed to clawback an allowance if delivery is delayed into the next AMP by more than a few months. As is demonstrated by the empirical data in the KPMG infrastructure project database, on average 40% of projects are delayed[26], with the delay lasting from a few months to over a year. The risk arising from the non-delivery PCDs therefore exacerbates the already significant and asymmetric risk from enhancement spend. Performance on "time incentive PCDs" is expected to result in a loss in the base-case due to the calibration of penalty and reward rates. While the DDs propose that the relationship between the reward and penalty rates should be 1:4, empirical data suggests that the ratio is closer to 2:3.

[26] Additional support for the KPMG infrastructure project database results can be found in the US where 40% of the government's infrastructure projects are delayed: Chu A., White, A. & Basarkar, R., (2024, August 12), Delays hit 40% of Biden's major IRA manufacturing projects. *The Financial Times.* Article can be found here.

Chart 4: Asymmetric financial impact of PCDs, quantified as % of enhancement totex

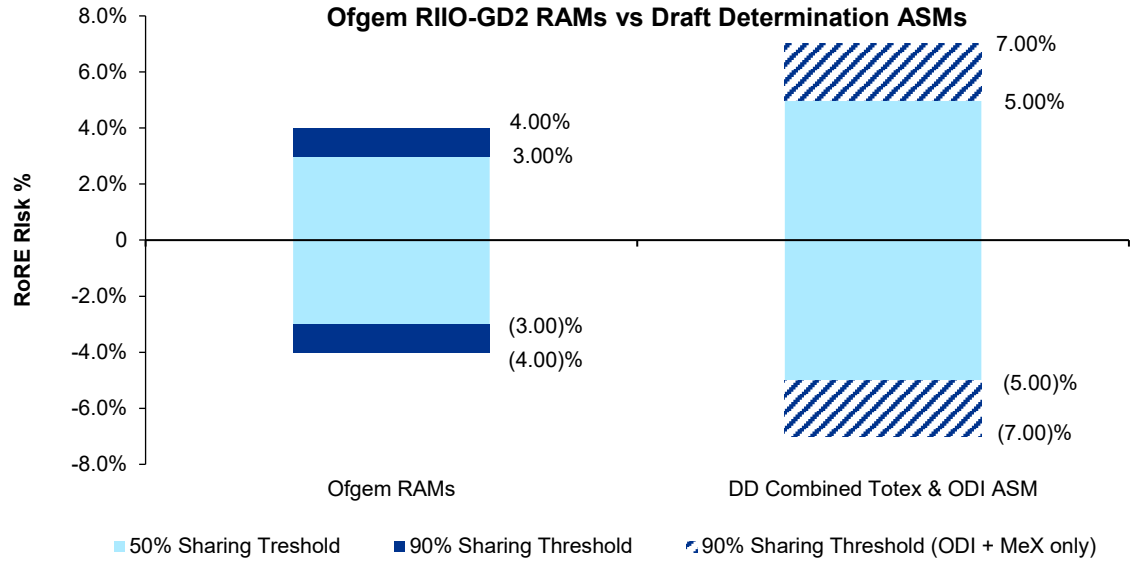


Source: KPMG analysis of PCD impact using data from KPMG infrastructure project database

The Delayed Delivery Cashflow Mechanism (DDCM) also increases the base-case risk due to unintended consequences for the financeability and deliverability. Due to the complex, dynamic and varied avenues the DDCM can take in impacting risk, it has not been simulated in the risk ranges presented. While it is designed to incentivise companies to deliver projects on time and in full by returning funding to customers where companies fail to deliver, it increases the scale of the regulatory discretion in relation to permitting clawed back spend and could cause funding shortfall in the middle of capital deliveries, which would cause greater financing risk exposure. A clawback could reduce cash flows when they are needed most, increasing financeability and deliverability pressures. Companies may opt to delay projects due to cash flow limitations, with project delays increasing the risk of statutory penalties. The new mechanism adds further complexity to the regulatory framework, appears to be duplicative in function and objective with the existing PCD mechanism and could introduce a perverse incentive for companies to deliver late.

Aggregate sharing mechanisms (ASM) for totex and ODIs are helpful in limiting the impact of very extreme out- and underperformance but the thresholds proposed in the DDs are such that they do not afford significant protection from plausible downsides. This contrasts with the return adjustment mechanisms (RAMs) in the energy sector, which result in significantly lower amount of regulatory equity at risk. The two sectors have a comparable equity return while the risk profile of the UK water has much more downside.

Chart 5: Ofgem RIIO-GD2 RAMs vs Draft Determination ASMs: cumulative thresholds



Source: Ofwat DDs, Ofgem RIIO-2

Stochastic simulation of negatively skewed probabilities

Statistical analysis of the probabilistic outcomes relies on Monte Carlo simulations which produce random outcomes. The consolidated picture of such simulations heavily depends on the relationship between various components of risk and on the shape of the probability distributions. For normal distributions, base-case results are additive while for asymmetric distributions base-case results are not just additive but also move towards the mean. As the distributions of the sector's performance in AMP7 were asymmetric to the downside for most parameters (PCs, totex) and as the design of the regulatory mechanisms also causes asymmetry in the case of PCDs, C-Mex and retail, the base-case outcome of fully simulated risk is more negative than the sum of the component parts. The negatively skewed distributions, therefore, represent a separate source of risk for the sector that needs to be considered.

Addressing notional company risk exposure

The identified risk represents a gap between expected and allowed return, which could be addressed by either regulatory mitigations at source, aiming up on the cost of capital or a combination of the two. UK regulatory practice favours addressing risks at source where possible. Mitigating risk at source can prevent customers from paying for risks that have not occurred while sufficiently protecting investors and attracting investment. Accordingly, the analysis considers an example of a suite of risk mitigations aimed at addressing specific risk drivers identified. It aims to demonstrate that it is possible to reduce the risk exposure to a level more commensurate with returns, deliverability and financeability. In this context, it would only be appropriate to aim up on the allowed return to cover any remaining asymmetry in risk exposure, after all regulatory risk mitigations have been applied.

Mitigations have been developed to best address key sources of risk in AMP8. Mitigations closer to the source of risk were prioritised, with an aim to reduce the risk exposure in the base-case. The resulting suite could be grouped into those addressing risk arising from the calibration of the notional company, and those addressing risk arising from the regulatory framework's design.

The first group of mitigations includes:

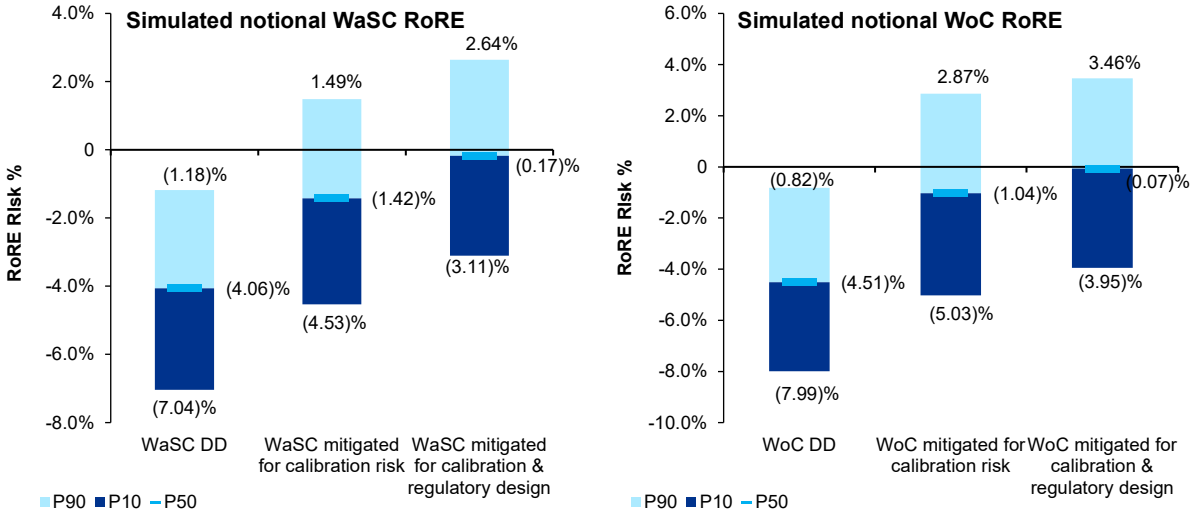
- Adjusting PC targets to consider outturn performance in AMP7 and providing sufficient funding of PC improvements in botex to bridge the gap between historical performance and AMP8 targets.
- Trueing up efficient enhancement costs after the finalisation of feasibility studies, planning permissions and design specifications via a specific reopener (this would reduce mis-budgeting risk) or/and providing additional allowances to reflect asymmetric downside skew in cost performance typical of complex projects or/and setting asymmetric sharing rates on enhancement projects to offset the asymmetric cost performance observed in infrastructure projects (sharing greater proportion of the underperformance with customers).
- Recalibrating the allowed cost of debt for new and embedded debt consistent with water sector's actual financing terms and forward performance expectations.

The second group of mitigations includes:

- Applying deadbands to penalty-only PCs to eliminate downside in the base-case (discharge permit compliance, serious pollution incidents) and adjusting the deadband for CRI.
- Reducing ODI rates to the level commensurate with business plans.
- Rebasing C-MeX target on water sector median instead of using the UKCSI average given the median water company underperformed the UKCSI average[27].
- Introducing a full indexation of retail costs to mitigate inflation risk.
- Modifying application of non-delivery PCDs to reduce regulatory discretion in application of allowance clawback for late delivery by allowing for at 12-18 months' grace period.
- Recalibrating time incentive PCD rates consistently with empirical data on construction delays.
- Redesigning the ODI aggregate sharing mechanism (ASM) and the totex ASM to more closely reflect the risk protecting features of RAMs implemented in the energy sector. This includes recalibrating the lower threshold for totex from 200b.p. to 150b.p. and adding the enhanced sharing threshold of 250b.p. Similarly, recalibrating the upper (enhanced sharing) threshold to 400b.p. of risk for ODIs. Taken together, lower threshold for ODIs and totex is 450b.p. and the upper threshold is 650b.p.
- Redesigning DDCM to completely eliminate the unintended consequences related to greater risk exposure, financeability and deliverability.

[27] Included in Ofwat's Consultation on the measures of experience performance commitments at PR24, the UKCSI cross sector average score was 82.9 out of 100 with only six of 17 water companies achieving this score in 2022 meaning the median company underperformed.

Chart 6 a, b: Unmitigated, partially mitigated and fully mitigated RoRE risk exposure

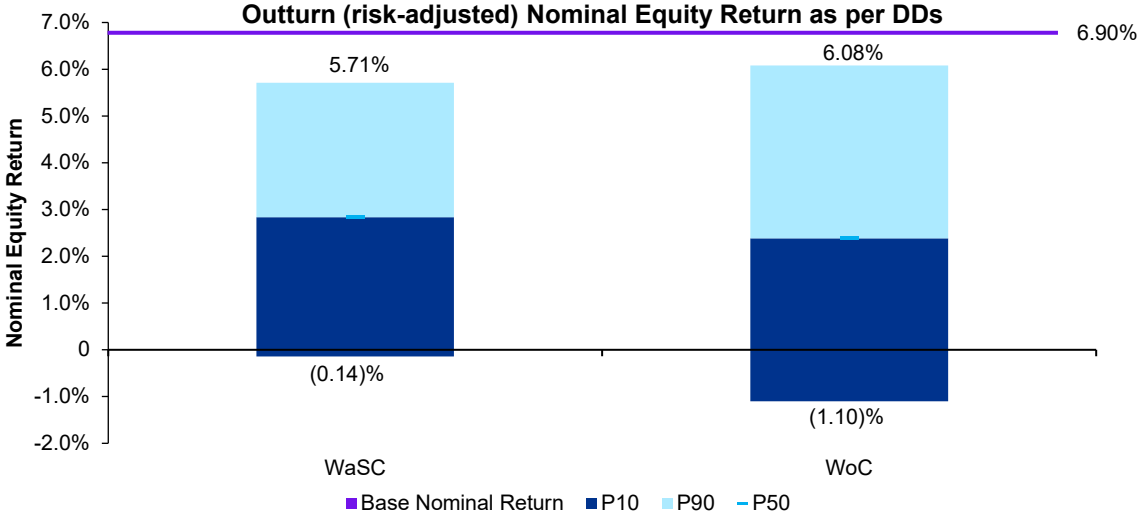


As demonstrated on Chart 6 a, b the application of the proposed mitigations reduces the risk at source and delivers the regulatory package consistent with an efficient notional company being able to earn a baseline return on a median-expected basis.

Key conclusions

This analysis considers that the notional company risk exposure under the DDs implies outturn equity return[28] substantially below the nominal allowed return in the base-case and below zero in the worst-case, as presented on Chart 7. Such risk exposure has a direct negative impact on both debt and equity financeability of the notional company, bringing into question the very deliverability of the AMP8 business plan and associated capital programmes.

Chart 7: Simulated risk-adjusted nominal equity return as per DDs



[28] The risk ranges simulated relied on real totex performance, real ODI rates applied to physical performance ranges, real cost of retendering and real RCV / regulated equity. The real elements of risk in the numerator of the ratio are offset by the real elements in the denominator and represent a conservative estimate of nominal performance over the nominal regulated equity. The ranges also relied on nominal retail profit performance and nominal financing performance. The ranges could be considered a conservative estimate of a nominal risk and have been compared to nominal allowed equity returns. The cash flow-based impact of risk (e.g., on financeability) would in effect be greater than is suggested in these ranges

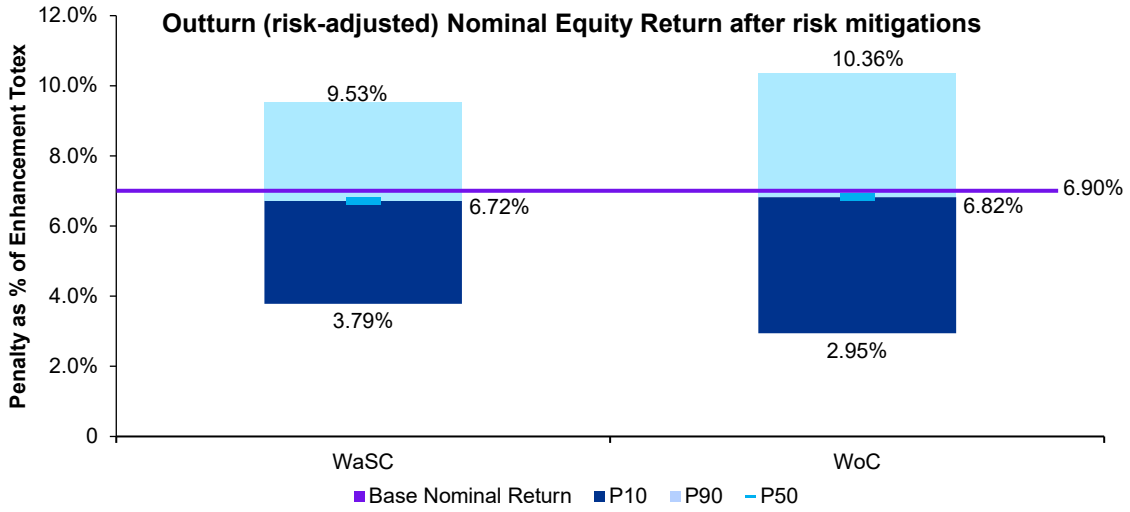
Alignment of risk and return is critical not only in the success of the upcoming price control but also in addressing the major sector's challenges over the next 25 years. These challenges include improving asset health and resilience in the face of climate change and population growth, achieving net zero, delivering better environmental outcomes and ensuring that a good standard of service is provided to the people of England & Wales at a reasonable cost. Without attracting capital to finance the required investment, these improvements can't be delivered.

In order to attract investment into the sector, debt and equity investors need to earn a reasonable return that provides fair compensation for the risks associated with their investment. It means that the base allowed return needs to reflect forward-looking risk exposure and that an efficient company needs to have a reasonable prospect of earning the base allowed return. While DDs state that this objective[29] is achieved, statistical and probabilistic analysis based on empirical data suggests that the notional company will fall significantly short of earning the base allowed return under the base-case.

When considering debt investability, Moody's Ratings has raised material concerns in its assessment of AMP8's impact on credit quality. In their sector analysis for the UK water sector, the agency noted that "risk of cost overruns or future underperformance has increased … [and] companies [are] at increased risk of incurring penalties."[30] Moody's is considering amending their rating methodology factor scores for the sector to reflect the changes to the regulatory framework as less stable and predictable and less likely to support investors earning the allowed return[31]. As a result, it may be more difficult for the companies to maintain existing credit ratings, which would cause higher borrowing costs but also regulatory dividend lock-ups, which, in turn, would increase the equity return required by investors given inability to receive cash yield for an indefinite period of time.

As demonstrated in this report, it is possible to redesign the PR24 regulatory package, including the calibration of allowances, performance targets and regulatory mechanisms in such a way that the risk exposure in the base-case approaches zero, and the package provides a reasonable upside of earning return above the allowed return in the best-case and reduces expected return (but not to zero) in the worst-case. A package offering such a risk exposure would indeed provide an efficient company with a reasonable prospect of earning the base allowed return, as presented on Chart 8.

Chart 8: Simulated nominal equity return after risk mitigations



[29] Ofwat (2024), PR24 draft determinations: Aligning risk and return, p. 2.

[30] Moody's Ratings (2024), Regulated Water Utilities – UK: Ofwat's draft determination increases sector risk, p. 1.

[31] Ibid. p. 11.

To attract debt and equity capital at an efficient cost and encourage confidence in the capital markets, risk exposure of the UK water sector needs to be commensurate with a stable and predictable industry with low volatility of returns. The volatility of returns in AMP7 caused adverse investor reaction across both debt and equity markets. It is in the best interest of consumers to restore investor confidence in the sector and reduce the cost of the infrastructure not just for one price period but for years to come.

4 Notional company RoRE ranges

Financeability and investability assessments consider the implications of aggregate risk where component risk drivers are simulated together. Key risks at PR24 include the scale and complexity of the capital programme, macro-economic uncertainty, increasing impact of climate change on company performance, calibration of the regulatory mechanisms and their overall application to the water sector. The analysis in this Report identifies significant increases in risk and risk asymmetry and considers levers to adjust regulatory calibration to address key drivers of risk at source.

Risk can be decomposed into two primary sources: risk arising from the regulatory framework's design and risk arising from the calibration of the notional company. The DDs recognise that there is a "*slight downward skew from overall operations*" but that this negative skew was mitigated in the PR24 framework by a "*slight upward skew from financing*."[32] While the results of the risk analysis included in this report agree there is a negative skew on operational risk, the quantum is significantly higher as it considers asymmetry arising from additional sources beyond the discharge permit compliance and serious pollutions incidents ODIs highlighted in the DDs.

To mitigate risk at source and capture the wide range of considerations needed to assess the most appropriate mitigations, a set of criteria has been developed. Potential combinations of regulatory mitigations are set out to reduce P50 risk and mitigate severe downside risk. Detailed specification of the mitigations could vary on a company-specific basis.

This section is structured as follows:

- Section 4.1 outlines the sources of risk and describes the high level methodology used to simulate risk over PR24 by risk driver.
- Section 4.2 presents the mitigations considered to address risk at source for a notional company. The mitigations have also been assessed against a set of objective criteria based on Ofwat's statutory duties.
- Section 4.3 presents a potential combination of mitigations and the resulting notional company risk to demonstrate the degree of risk mitigation at source.

[32] Ofwat (2024), PR24 draft determinations: Aligning risk and return appendix, p. 21.

4.1 Risk facing a Notional WaSC and WoC in AMP8

The analysis of the notional firm's risk exposure across AMP8, given the changing risk landscape, results in ranges that are wider than the DDs suggests, have a more negative base-case and more asymmetric to the downside. Tables 8,9 and Chart 9 present the key drivers of risk.

Table 8: Notional WaSC RoRE risk ranges: DDs vs Unmitigated range per this Report

Notional WaSC	DD risk ranges[33]			This report's resulting risk ranges		
	Worst-case	Base-case	Best-case	Worst-case	Base-case	Best-case
Totex	-1.58%	0.00%	1.58%	-4.77%	-1.88%	1.04%
Mex & ODI	-2.31%	-0.25%	1.81%	-3.68%	-1.72%	0.08%
Financing	-0.45%	0.23%	0.90%	-1.85%	-0.34%	1.19%
Other	0.00%	0.00%	0.00%	-0.21%	-0.03%	0.00%
RoRE	**-4.34%**	**-0.02%**	**4.29%**	**-10.52%**	**-3.97%**	**2.30%**

Table 9: Notional WoC RoRE risk ranges: DD vs Unmitigated range per this Report

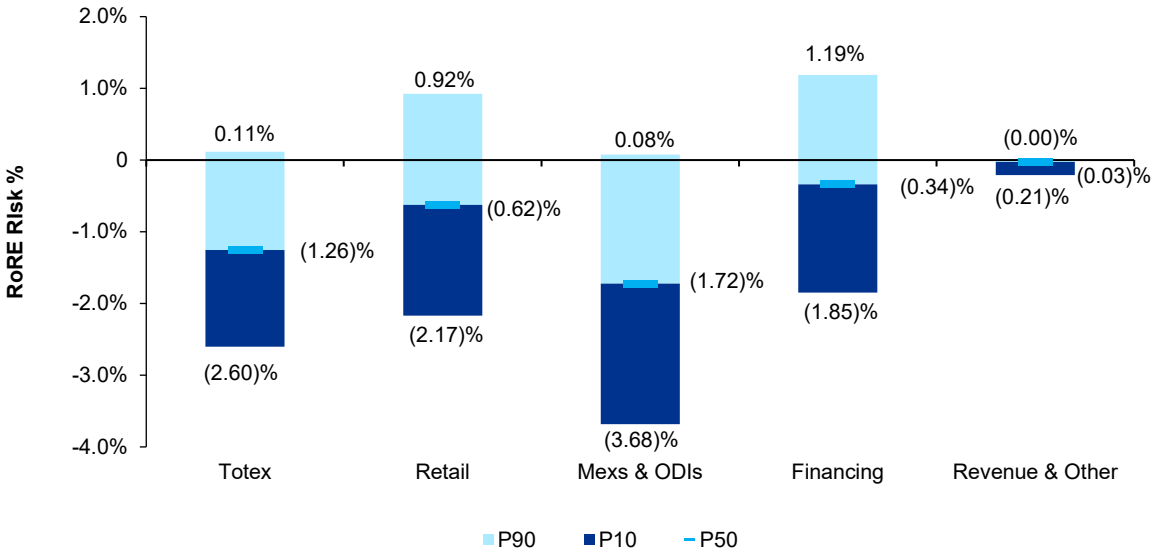
Notional WoC	DD risk ranges[34]			This report's resulting risk ranges		
	Worst-case	Base-case	Best-case	Worst-case	Base-case	Best-case
Totex	-1.29%	0.00%	1.29%	-5.44%	-2.06%	1.90%
Mex & ODI	-2.81%	-0.29%	2.24%	-3.94%	-2.04%	0.33%
Financing	-0.38%	0.26%	0.90%	-1.88%	-0.33%	1.21%
Other	0.00%	0.00%	0.00%	-1.83%	-0.03%	0.00%
RoRE	**-4.41%**	**0.01%**	**4.42%**	**-13.08%**	**-4.46%**	**3.44%**

[33] Ofwat (2024), PR24 draft determinations: Aligning risk and return appendix, p. 6.; the median WaSC risk range (based on width) was South West Water and for a like for like comparison the chart disregards the QAA reward.

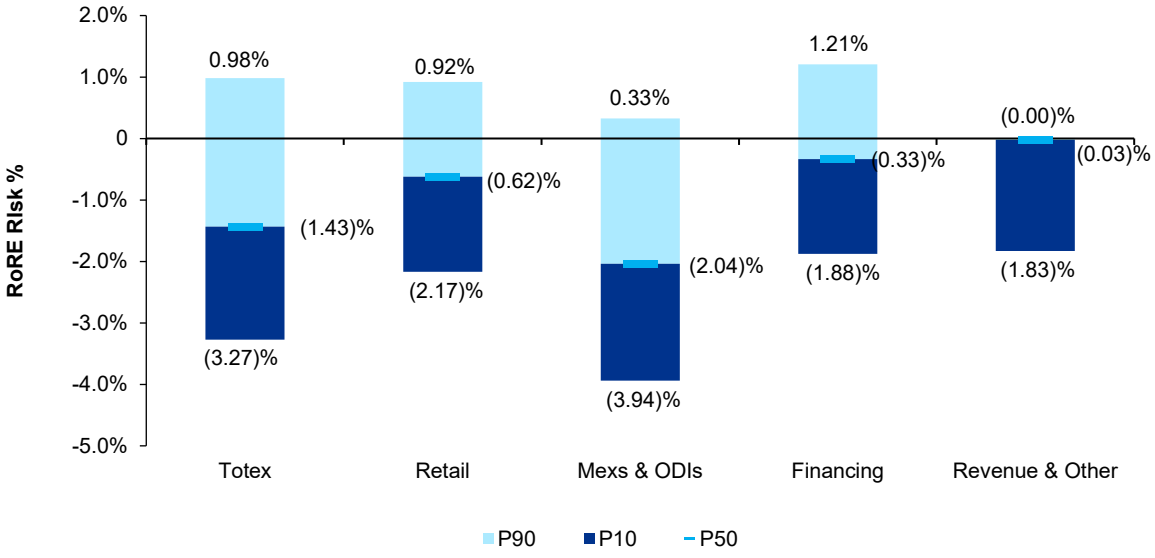
[34] Ofwat (2024), PR24 draft determinations: Aligning risk and return appendix, p. 6.; the median WoC risk range (based on width) was South East Water and for a like for like comparison the chart disregards the QAA reward.

Chart 9 a, b, c: Drivers of the notional company RoRE ranges: Simulated analysis vs DDs

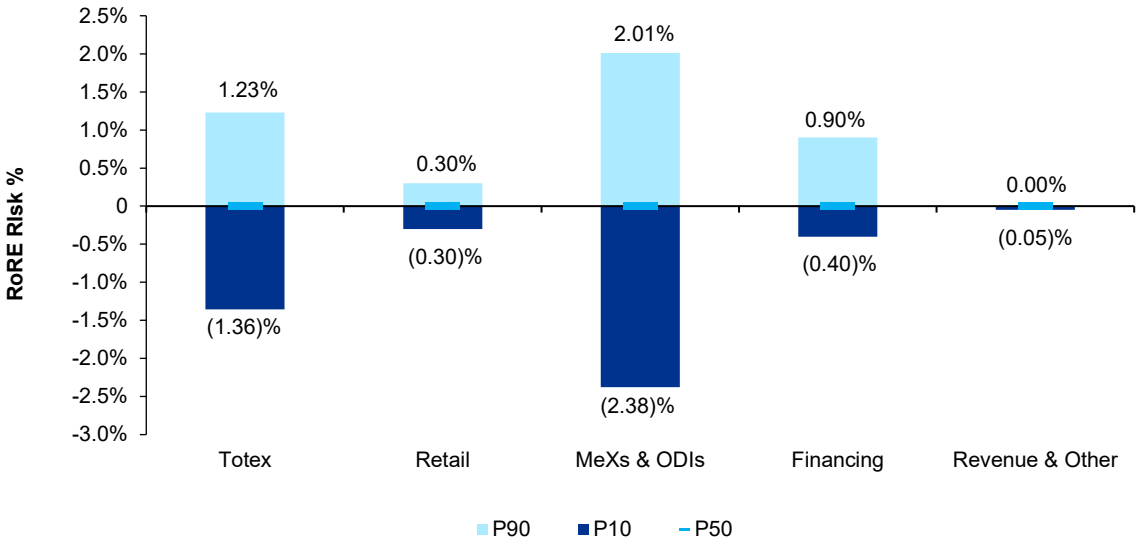
Simulated WaSC Risk Components



Simulated WoC Risk Components



Ofwat Draft Determination Component Risks



The results of the risk analysis set out in the DD and developed in this report are compared on a like for like basis. In the DD, separate components of risk were not simulated but instead were simply added together. While this approach is simpler and intuitive, it does not represent a meaningful view of potential returns available to investors. The risk analysis in this report has been simulated to capture the interrelationships between risk drivers accounting for the benefits of low correlated risk drivers. The resulting total risk ranges on a simulated basis therefore provide insight into potential returns available to investors given historical relationships between risk drivers. The table presents the risk ranges on an additive basis for comparison purposes only.

The risk analysis included in the DDs represents an "overall risk package [that] is broadly balanced."[35] This conclusion is broadly supported by its WaSC and WoC risk ranges importantly because its negative base-case for Mex & ODI is offset by the base-case for financing. The DD acknowledges this offset between component risks that are asymmetric.[36] The risk analysis included in this report directionally agrees with the risk analysis included in the DDs that the Mex & ODI risk driver is negatively skewed, however the risk analysis in this report also points negative asymmetry from financing risk driver as well totex and other risk categories such as retail.

The differences between the risk analysis included in the DD's estimate of risk and the risk ranges presented in this report are driven by methodological choices broken down in [Table 7] below. The subsequent sections provide further detail as to the rationale behind methodological choices in this risk analysis and how alternatives were considered.

[35] Ofwat (2024), PR24 draft determinations: Aligning risk and return appendix, p. 21.

[36] Ofwat (2024), PR24 draft determinations: Aligning risk and return appendix, p. 21.

Table 10: Differences in methodological approach to simulating risk

Risk driver	Methodology applied in the DD[37]	Methodology applied in this report
Historical data considered	• Apr 2015 – Mar 2020	• Generally, Apr 2020 – Mar 2024 with limited exceptions
Distribution types	• Normal distributions used for all risks	• Distribution type determined by a statistical fit test of the historical performance data[38]
Wholesale totex	• Considered totex as a whole in historical data • Calculated risk for time incentive PCDs based on WINEP delivery in 2020 – 2025 • No risk identified for non-delivery PCDs • No correlations specified	• Separated base totex from enhancement totex • Base totex performance simulated based on the FY21-FY24 sector-wide performance • Enhancement cost performance and delay risk based on the KPMG infrastructure project database[39] • Time delay and non-delivery PCDs based on delay performance modelled • Correlation between cost and delay performance based on empirical data from KPMG infrastructure project database
Retail	• Assumed a symmetrical range of +/- 0.30% at P90/P10	• Considered retail net profit over FY21-FY24 and simulated future performance based on the recent past
Mex	• Calculated risk on the maximum and minimum penalty possible with P50 set to nil	• Simulated based on reweighted historical scores as a difference from sector median to UKCSI • The analysis excludes BR-Mex
ODI	• Calculated each ODI generally setting P50 at no out- or under-performance and using historical data to calibrate the P10 and P90 • No correlations specified	• Simulated forward-looking performance for most ODIs based on a baseline of median AMP7 performance and median BP forecasts; used historical performance data to calibrate the P10 and P90 • Correlations specified based on industry performance data collected on a monthly frequency • Simulated PCC and Business Demand based on industry forecast data considering the impact of Covid-19 • The analysis excluded river water quality, bathing water quality, storm overflows, greenhouse gas emissions (for water and wastewater) due to lack of consistent historical data
Financing	• Calculated interest rate risk on new debt issuance based on sector debt issuances performance vs iBoxx A/BBB non-financial 10 year+ index and calibrated allowance to deduct • The analysis excluded embedded debt as a risk • Calculated forward looking CPIH risk based on 8 years of CPIH index data • Calculated forward looking basis risk where CPIH indexed RCV is hedging RPI linked debt in the sector based	• Simulated interest rate risk on new debt issuance based on sector debt issuances performance vs iBoxx A/BBB non-financial 10 year+ index • Simulated risk of embedded debt based on the sector's expected cost of debt performance on embedded debt vs allowance • Simulated forward looking CPIH risk based on 8 years of CPIH index data over a high and low inflation period applied to the notional company capital structure of 33% index-linked debt • Simulated forward looking basis risk where CPIH indexed RCV is hedging CPI linked and RPI linked

[37] Ofwat (2024), PR24 draft determinations: Aligning risk and return appendix, p. 7 - 21.

[38] See appendix 6.2 for detailed methodology for how the historical performance data influences the distribution type modelled.

[39] See appendix 6.10 for description of the projects included in the KPMG infrastructure project database.

Risk driver	Methodology applied in the DD[37]	Methodology applied in this report
	• The analysis excluded basis risk on CPI-CPIH wedge as a conservative assumption that all index-linked debt was RPI-linked and the wedge was historically higher for RPI-CPIH	debt in the sector based on 8 years of CPI and RPI indexes • Interrelationship between financing risks captured by time series analysis
Market based delivery	• The analysis excluded market based delivery as a risk driver	• Considered a broad range of risks that can arise from market based delivery for the appointee • Simulated ranges reflect the risk of a CAP defaulting and the cost of tendering • Number of schemes for the notional company based on sector median number of market based delivery schemes in PR24 DDs • Probability of default for a CAP based on default study of construction companies

One key difference is the choice of distribution type. Distribution types for each risk in this report were based on empirical data to capture the risk dynamics in the historical performance as closely as possible. The analysis employed statistical fit tests to objectively assess the most descriptive distribution for each risk balanced against simplicity by limiting the total number of different distributions included. This was done by identifying preferred distributions where two or more distributions had similar characteristics[40]. Many of the risks present in the water sector are asymmetric in nature and by assuming all risks are normally distributed, the DD risk analysis systematically understates the downside and overstates the upside. Most importantly, as described in the executive summary the base-case is also impacted and becomes more negative.

The selection of time period for historical performance was another point of difference. As discussed in the executive summary, the AMP7 historical data offers a number of advantages over AMP6 data. However, the resulting use of AMP7 data alone has several weaknesses. A sample containing only a portion of AMP7 used to simulate the entirety of AMP8 has an inherent inconsistency. This methodology may also embed idiosyncratic risks experienced in AMP7 like Covid-19, the Russian invasion of Ukraine, and others which may make AMP7 a less representative time period with which to simulate AMP8 performance. However, the advantages of using empirical, representative, sector-wide data sample outweigh the potential limitations.

Another key methodological difference is the specification of correlations. Because low correlations ultimately reduce the simulated risk ranges and high correlations increase the simulated risk ranges, the presence of correlations can materially impact the final outcome. Considering the KPMG infrastructure project database cost and delay performance, granular PC performance data by month and region in the UK, inflation index values and interest rate index values, the correlations identified and included in the simulation are:

- Enhancement cost performance and Enhancement delay risk; +0.51
- Leakage reductions and customer contacts on water quality; +0.20
- Leakage and mains repair; +0.40
- Water supply interruptions and mains repair; +0.21
- Total pollutions incident and serious pollutions incident; +0.19
- Total pollutions incident and external sewer flooding; +0.18
- External sewer flooding and internal sewer flooding; +0.55

[40] For a detailed description of the approach taken to selecting distributions and types of distribution refer to appendix 6.2.

- Cost of embedded debt and cost of new debt; +1.00
- CPIH inflation risk and RPI-CPIH wedge risk; +0.33
- CPIH inflation risk and CPI-CPIH wedge risk; +0.69
- RPI-CPIH wed risk and CPI-CPIH wedge risk; +0.35

Other risks are expected to have relationships but in the absence of empirical data to support the quantification of correlations, the analysis in this report conservatively assumes the correlations to be zero between all other performance parameters. For example, PC performance and base totex, retail profit and CPIH inflation, and PC performance and C-MeX are likely to have relationships that if captured could enhance the reliability of the simulated RoRE ranges. If these correlations, currently specified as zero in the model, are in reality highly positive, the simulated RoRE ranges would be wider. Conversely, if the correlations are highly negative, the simulated RoRE ranges would be narrower.

Each of the following sub-chapters expands on the key drivers of risk in greater detail and provides supporting analysis.

4.1.1 Totex

Risks driving enhancement totex and base totex are materially different and therefore should be considered separately. Base and enhancement performance risk are analysed independently of each other. However, the newly introduced totex aggregate sharing mechanism (ASM) considers the net whole totex risk and applies a sharing rate beyond +/-200b.p. of risk on AMP basis. This helps mitigate extreme downside risk in AMP8.

Enhancement totex

The scale and complexity of the capital programme at PR24 is unprecedented for the sector and drives a significant amount of risk in the notional company. This was well recognised by Ofwat and addressed to some degree in the DDs, however material enhancement totex risk remains and arises from both the design of the regulatory framework and calibration risk of regulatory parameters. There are two key risks included in simulation to capture the enhancement totex RORE ranges: cost performance and delay risk.

Firstly, cost performance risk inherent in construction projects in the infrastructure sector is driven by the following risk drivers: scope change, design change, input price changes and ex ante budget mis-forecasting risk. Scope changes and design changes also materially impact delay risk as well as the knock on impact of higher costs where cash flow shortages can lead to delays. Cost and delay performance is highly interrelated given the shared risk drivers between the two.

- **Scope changes** include when the purpose or objective of the project changes for example a storm tank build originally planned to have 50 Ml capacity increasing the requirement to 80 Ml capacity.
- **Design changes** include when the proposed solution changes either due to factors outside of management control or because of optioneering identifying a better solution, for example a storm tank originally planned as a concrete tank being converted to a nature based solution with the same capacity. This risk can materialise from feasibility assessments or planning permission that invalidate the original project design or voluntary changes due to more preferred alternatives being identified.
- **Input price changes** include supply chain shocks and commodity price volatility.
- **Ex ante budget mis-forecasting risk** includes incorrectly estimating the cost or amount of inputs needed holding constant the scope, design and market prices for inputs. An example of ex ante budget mis-forecasting can include relying on prior cost data that is no longer representative in the market at the time of estimation. A well-documented phenomenon, optimism bias, is a

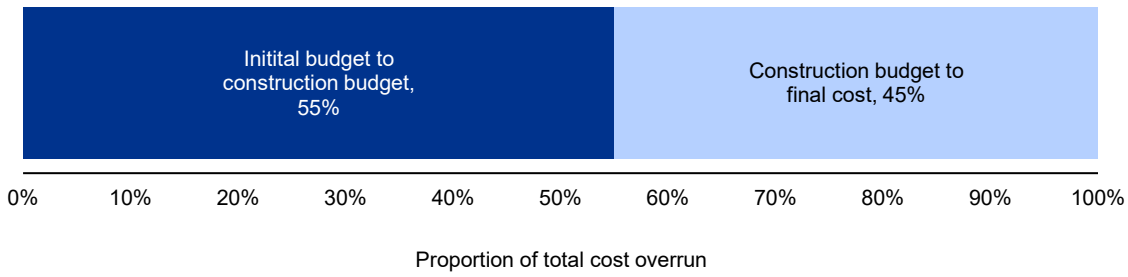
component of this risk where companies can underestimate the cost of delivering projects due to biases in decision making.

An efficient notional company is exposed to scope change, design change and input price changes. An efficient company can also be exposed to ex ante budget mis-forecasting where projects are higher in complexity or involve new or untested technology.

Overall, the regulatory framework addresses many components of enhancement cost performance risk. Market based delivery schemes for the larger and most complex schemes such as DPC reallocate the majority of cost performance risk to the competitive appointed provider (CAP), though this introduces other risk discussed in section 3.1.5. Significant cost performance risk is mitigated through sharing rates: 40:40 sharing rates introduced in the DDs for all enhancement schemes; and sharing rates of 25:25 in place for large, complex enhancement schemes, the gated allowance schemes and the industrial emissions directive (IED) schemes. Scope change is well mitigated through uncertainty mechanisms. Input price risk related to labour costs is now covered by a construction sector specific RPE true-up.

The gated allowances schemes have the added benefit of addressing design change in full, and some degree of input price risk and ex ante budget mis forecasting where allowances are awarded after the development phase and incorporate better information. Empirically, awarding allowances at the beginning of the construction phase like in the gated allowance schemes would result in material reduction in cost performance risk. The below graph demonstrates the degree of risk associated with the development phase of infrastructure projects by comparing the cost performance versus initial budget and the performance versus budget at tendering:

Chart 10: Breakdown of cost overruns between initial and construction budgets



Source: Analysis of KPMG infrastructure project database

Notwithstanding these mitigations, design change risk is present on all schemes except for the schemes with gated allowances and input price risk remains from supply chain shocks on key inputs like concrete and steel. The ex-ante budget mis-forecasting risk also persists but is significantly reduced where enhanced allowances are applied. The primary limitation of the mitigations included in the DD for enhancement risk is that enhanced sharing rates apply only to a limited number of schemes and all the schemes included are from WaSCs. No WoCs had enhancement schemes included in the enhanced sharing rates or gated allowance process.

The simulation also captures delay risk. Enhancement delay risk is not well mitigated by the regulatory framework and is translated into financial penalty by the PCD mechanisms and the DDCM. Allowance clawbacks and time penalties under these mechanisms introduces risk for a notionally efficient company. The DDs clarified the design of non-delivery PCDs to not apply clawbacks where "the length of late delivery is of a few months into 2030-35 period."[41] However, this is insufficient to remove all risk from non-delivery PCD. This excludes scenarios where projects are delayed beyond a few months into AMP9 but partially delivered. Many causes of delay are outside of management

[41] Ofwat (2024), PR24 draft determinations: Expenditure allowances, p. 176.

control such as scope and design changes and would be present in a notional company. Enhancement schemes where projects are partially delivered and delayed create the risk of clawbacks where allowances were already spent. This risk is reflected in the risk ranges presented.

Project characteristics including size, complexity and duration interact with the cost and delay performance. The methodology employed to simulate the enhancement totex risk utilised reference class forecasting and machine learning techniques to capture these dynamics based on the KPMG infrastructure project database[42]. By matching the empirical cost and delay performance to projects of similar characteristics the risk ranges are more reliably simulating potential outcomes.

Risk arising from the *calibration of enhancement allowances*

The empirical distribution of cost performance indicates that the distribution is negatively skewed meaning there were some projects that modestly underspent their initial budgets while many projects modestly overspent their initial budget and some that significantly overspent their initial budget. The database removed projects where scope changes were identified and the cost profile is reflective of risks not well managed by the regulatory framework. The resulting simulated cost performance after applying regulatory mitigations such as rates for a notional WaSC and notional WoC are:

Chart 11: Simulated notional WaSC enhancement totex cost performance excluding PCDs

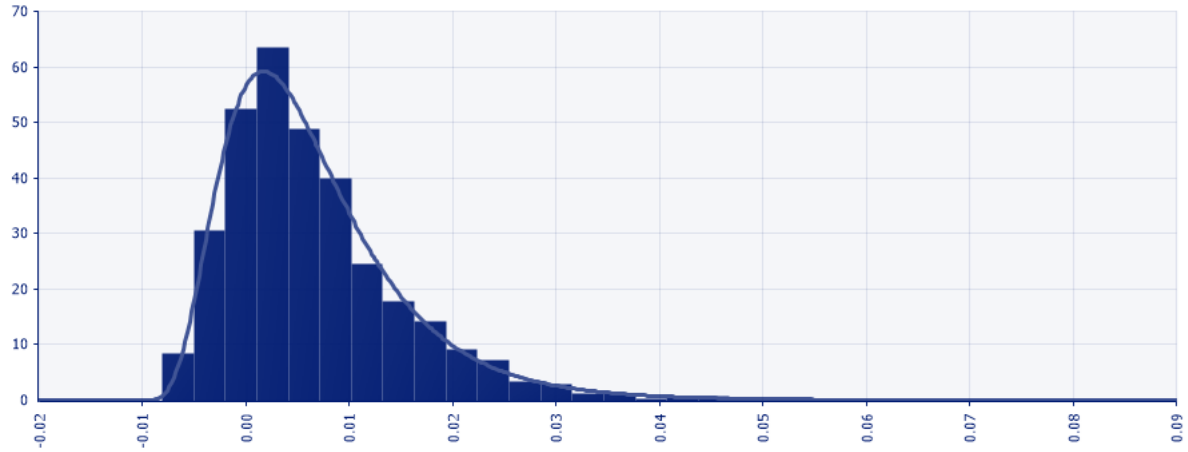
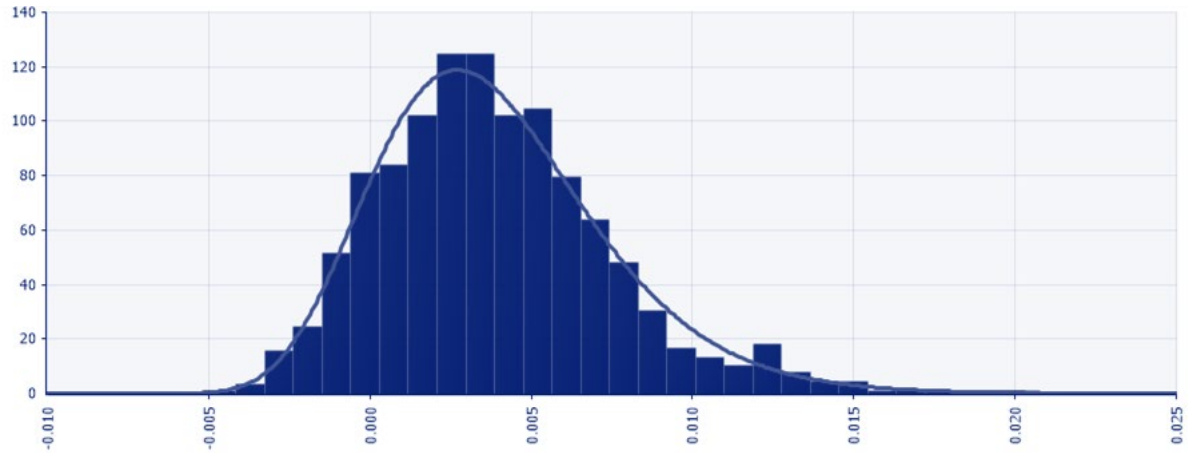


Chart 12: Simulated notional WoC enhancement totex cost performance excluding PCDs[43]



[42] For a detailed methodology on enhancement totex risk please see appendix 6.4.

[43] The distribution for notional WoC is materially less skewed due to the absence of the wastewater price control schemes. In particular WINEP environment given the larger size and complexity is a material driver of the difference in distributions.

The distributions indicate that if water sector enhancement schemes perform similar to projects in the KPMG infrastructure project database of similar size, complexity and duration absent further mitigations have inherently negatively skewed cost performance. If allowances are insufficient to cover the asymmetric nature of cost performance risk then the sector may underperform due to regulatory miscalibration.

Risk arising from the *regulatory design*

First, non-delivery (ND) PCDs are downside only and likely to be triggered, even by an efficient company. The sector has struggled to deliver the entire AMP programme within five years as seen in AMP6; spending related to AMP6 carryover went well into the second year of AMP7. Additionally, the underlying analysis used to calibrate the time incentive PCDs acknowledges that where schemes are late, they are "on average delivered one year late"[44] in setting reward and penalty rates for the time incentive (TI) PCD. The KPMG infrastructure project database finds that projects of similar size, duration and complexity to those in the water sector at AMP8 were delayed on average 20% beyond the initial delivery date. This means projects may be delayed well beyond the grace period permitted by Ofwat of a few months into the next price control. It is also unclear what constitutes a few months which in turn provides scope for regulatory discretion in the application of clawbacks. When considering the degree of carryover spend from AMP6, average scheme delay, and regulatory discretion it is likely that ND PCDs would be triggered in an efficient company on projects partially delivered and therefore form part of the risk ranges.

Second, the TI PCD is negatively skewed because the reward to penalty rate of 1:4 was set based on a non-representative sample of project delay performance. The underlying analysis used to calibrate the time incentive PCD relied on AMP7 WINEP schemes only. The stated intention of the regulatory design of TI PCDs was to set the penalty rates and reward rates on time incentives would net off to zero where companies delivered in line with 20% of schemes late and 80% of schemes on time, or 1:4. Many of the AMP7 WINEP schemes are low complexity and short duration projects. For example, within the WINEP programme, schemes included installing monitors at wastewater treatment works (42% of schemes) and investigations into the presence of monitors at wastewater treatment works (17% of schemes). The sample is not representative of AMP8 enhancement programme as the complexity is not reflective of the AMP8 programme. The KPMG infrastructure project database shows that projects of similar size, complexity, and duration to the AMP8 programme are late ~30% of the time and would require a lower penalty rate for an efficient company to achieve net zero penalties. Therefore, the penalty rate underestimates the degree of lateness an efficient company would deliver and is negatively skewed.

Qualitative assessment of the risk of delay

In addition to the quantification of risk relating to enhancement performance and the PCD mechanisms, the notional company is exposed to a variety of risks that would require considerable assumptions to estimate and are therefore best suited to a qualitative analysis to underscore that the quantitative models do not capture these risks. These factors compound the risk already quantified and therefore suggest the risk ranges may underestimate the true risk facing the notional company.

Direct negative financial outcomes of the risk of timing can primarily arise from multitude of factors, including the following.

- **Performance Commitments:** Delays in enhancement projects may worsen PC performance and result in ODI penalties. Where failure to complete an enhancement project would result in ODI impact, such as discharge permit compliance, the notional company would be exposed to: (1) direct financial penalties from Ofwat, (2) negative media attention and reputational damage, and (3) impact on C-MeX scores. Analysis performed for business plan submission using our data estimated a 3% multiplier impact whereby C-MeX scores are amplified by performance on ODIs, as estimated by the difference between the CES score before and after adjusting for the

[44] Ofwat (2024), PR24 draft determinations: Expenditure allowances, p. 173.

respondents who referenced ODI performance. Whilst this multiplier was derived using our data, it is likely a similar effect would hold true across the sector.

- **Regulatory Fines**: Fines may be issued by a regulator for failure to deliver a project in time that is associated with a statutory requirement. For example, WINEP schemes are required by the EA and failure to deliver would have negative affect on a company's EPA rating. The EA has recently been given unlimited powers to issue fines on companies not complying with EA regulation[45]. There have been 28 court courses and 21 enforcement notices issued by the EA to the water sector in AMP7 thus far[46]. Given the scale of the programmes in AMP8, expected challenges in delivery and expanded power, historical fines would underestimate the degree to which companies are exposed to over AMP8. Furthermore, the DWI is seeing expanded powers to directly impose fines on companies, where they are currently issued through courts.[47] In February 2024, Ofwat was granted new powers to act against water companies which provide poor customer service.[48]
- **Reputational damage with regulators and third parties:** Environmental Performance Assessment (EPA) rating which limits the enhancement solutions able to be proposed and may result in fines and poorer PC performance. Furthermore, the company is likely to experience decreased investor appetite, given a poor environmental record, exacerbated by depressed returns from penalties. Similarly, reputational damage may impact relationships with third parties which could make procurement, contracting and hiring more onerous.
- **Financing challenges**: Ability to raise finance as (1) investors continue to place increased value on a company's sustainability and environmental performance in allocating capital and calculating an interest rate, and (2) investor appetite decreases due to depressed returns from penalties.

Quantification of delay impact is therefore difficult to due to the multitude of direct and indirect factors, and it is likely the ranges adopted understate the true risk.

Base totex

The calibration of allowances through the stochastic cost models complimented by cost adjustment claims where company specific factors drive differences carries inherent risk of miscalibration.

Risk arising from the *calibration of base allowances*

In AMP7 most companies overspent their base allowances with material underperformance across the sector[49]. The base allowances set at the DD rejected cost adjustment claims equivalent to 84% of the total value requested by the sector as seen in the below table. While the base cost model changes resulted in increased base totex allowances, there is a gap between the sector's assessment of base totex allowances and the base allowances awarded at DDs. All companies submitted cost adjustment claims and a small proportion were awarded with four companies receiving no cost adjustment claims and one receiving a reduction in allowances as a result. Companies will need to reassess the adequacy of allowances at DDs given the degree of change from PR24 BPs and DDs and determine if the cost model has determined appropriate levels of funding required to deliver service improvements. The degree and scale of the rejected cost adjustment claims and AMP7 performance suggest there may be residual calibration risk.

[45] DEFRA and the EA (2023), Unlimited penalties introduced for those who pollute environment. Press release can be found here.

[46] EA, Register of Enforcement Actions. Register can be found here.

[47] Plimmer, G. & Hollowood, E., (2023, September 28), England's drinking water watchdog seeks powers to directly impose fines. *The Financial Times.* Article can be found here.

[48] Ofwat (2024), Water companies face fines for poor customer service. Release can be found here.

[49] Analysis of water company Annual Performance Reports for financial year 2023/24 included AMP to date whole totex cost performance showed that material overspend has occurred in AMP7 and is primary driven by inefficiency as reported.

Table 11: Summary of cost adjustment claims at PR24 DD

Sector requested CACs vs Ofwat allowance			
Company	Value requested	Allowance	Rejection %
BRL	24	13	-46%
SEW	68	28	-59%
TMS	600	213	-65%
YKY	746	250	-66%
SRN	481	109	-77%
SES	84	19	-78%
UUW	596	61	-90%
SVE	898	90	-90%
ANH	972	51	-95%
WSX	829	19	-98%
AFW	46	0	-100%
NES	18	0	-100%
SSC	43	0	-100%
SWB	48	0	-100%
HDD	35	-1	-102%
Sector	**5,487**	**852**	**-84%**

Given the nature of cost models as relying on historical data to set allowances, it may underestimate cost drivers that are changing rapidly like extreme weather. For example, the Climate Change Committee recently published in their assessment of the UK's climate risk that "[t]he magnitude of risks is also increasing faster than earlier assessments predicted."[50]The report goes on to state that further changes are expected in the UK's climate[51]. The risks associated with climate change are both material and worsening[52]. Therefore, there is scope for underestimating the impact of severe weather and climate change on the cost performance of the water sector in PR24 and beyond, especially when considering the relationship between PC performance and base totex.

As the DD risk analysis does not consider the risk facing a notional WaSC and WoC separately, it does consider the different levels of operational gearing between a WaSC and WoC and therefore the risk exposure to base totex cost performance. The notional WoC is materially more exposed to base totex performance as it represents a higher proportion of RCV given the smaller size of a median WoC and the economies of scale achieved by a larger median sized WaSC. The correct calibration of base totex is of particular importance for a notional WoC.

4.1.2 Retail

The risk analysis included in the DDs focused on retail totex while this report focuses on retail profit. As the wholesale cost of equity represents what is available to investors net of retail profit performance, it is more meaningful when considering financeability and investability to rely on retail profit to simulate potential returns over AMP8. The risks to retail profit observed in AMP7 were driven by Covid-19 pandemic, higher than normal inflation and the cost of living crisis – the net result was lower revenues due to bad debts and higher costs due to inflation. While these events are unlikely to occur in the future, the risk analysis uses AMP7 data as an input and the base-case performance

[50] Climate Change Committee (2021), Independent Assessment of UK Climate Risk, p. 14.

[51] Climate Change Committee (2021), Independent Assessment of UK Climate Risk, p. 46.

[52] Climate Change Committee (2021), Independent Assessment of UK Climate Risk, p. 56.

likely overstates risk where a pandemic is not expected to occur. However, inflation risk remains a material risk, as do other risk drivers that increase bad debts like a recession or cost of living crisis. The unmitigated risk ranges for retail profit likely overstate the true risk in AMP8 however it is reasonable to expect inflation to occur in the base cost on retail costs and some negative performance expected.

Retail risk is driven by the design of the regulatory framework. The retail revenues are recovered from customers on a nominal basis over the AMP as opposed to wholesale revenues which is recovered on a real basis. This introduces inflation risk into the recovery of efficient costs and profit margin for the notional company's retail business. The DDs addressed a material component of the retail risk through an ex ante true up for inflation by forecasting the salary and wage inflation and building this into allowances and has increased the retail profit margin by 20 percentage points in the DDs. However, this only cover 45% of totex. The design of the recovery mechanism for the retail price control is structurally exposing investors to inflation risks.

4.1.3 Outcome Delivery Incentive

The notional company is exposed to risk on PCs due to both miscalibration and regulatory design.

Risk arising from the *calibration of PC targets*

The PC targets set out in the Draft Determination are not representative of a median performance. These PCLs include stretch above the targets submitted at October 2023 BP. This level of stretch is shown in Table 12 below.

Table 12: Comparison between PCLs per DD targets, BP submissions and AMP7 performance

		The level of stretch (in median terms, average of the period)		Performance in physical terms		
	Units	BP targets vs. AMP7 performance	DD targets vs. BP targets	AMP7 median	BP median	DD median
Leakage, ML/km of mains/day	*ML/km of mains/day*	18%	1%	7.4	6.1	6.0
Customer Contacts on Water Quality	*# Contacts/ 1,000 pop.*	12%	19%	1.0	0.9	0.7
Water Supply Interruptions	*Minutes / Property*	47%	-6%	8.9	4.7	5.0
CRI	*CRI Score*	57%	20%	2.9	1.3	1.0[53]
PCC	*l/person/day (3yr avg.)*	7%	1%	144.8	134.5	132.7
Mains Repairs	*# Repairs / 1000km mains*	2%	4%	131.8	129.4	123.8
Unplanned Outage	*(Non-outage - % peak week prod. capacity)*100*	0%	0%	98.4	98.0	97.7
Pollution Incidents	*Incidents / 10,000km of sewer*	33%	15%	28.1	18.9	16.0
Internal Sewer Flooding	*Properties / 10,000 connections*	29%	5%	1.8	1.3	1.2

[53] The level of deadband at FY30.

		The level of stretch (in median terms, average of the period)		Performance in physical terms		
	Units	BP targets vs. AMP7 performance	DD targets vs. BP targets	AMP7 median	BP median	DD median
Sewer Collapse	*Collapses / 1,000 km of sewer*	0%	0%	7.5	7.5	7.5
Discharge Compliance (WaSC)	*(% compliance) * 100*	1%	0%	98.9	100.0	100.0
External Sewer Flooding	*Properties / 10,000 connections*	19%	3%	19.4	15.7	15.3

This report considers two potential drivers of calibration risk for PCLs and the above table suggests the notional company is exposed to both these risks across most ODIs.

1 **Starting point for AMP8 is unlikely to be achieved given current performance**. The starting assumption for the PCLs set in the Draft Determination are the PR19 targets[54], based on the rationale that improvements implied by AMP7 targets were funded in AMP7. However, sector median performance falls short of these target levels across many ODIs despite material overspend on base totex in AMP7. To achieve the PR19 targets in FY25, the notional company would need a step change in performance without which it would be exposed to systematic underperformance in AMP8 even if it achieved the rate improvement implied by the DD targets.

   The draft determination was released prior to FY24 performance reporting, which increases the risk that current performance is not accounted for the AMP8 targets.

2 **Trajectory of improvement expected in AMP8 too stretching based on historical evidence**. AMP7 provides an objective data point for realistic trajectories of improvement to PCLs. There is a risk the allowances in AMP8 do not facilitate the rate of improvement expected by the DD targets. Even under the assumption the allowances are sufficient, there is risk performance improvements are slowed by deliverability issues relating to, *inter alia*, supply chain issues, labour shortages, or climate change. As with the step change the enhancement programme, the whole water sector having to deliver significant performance improvements concurrently across their services places strain on external resources.

Risk arising from the *regulatory design*

The PR24 FM and Draft Determination include three ODIs which, based on the proposed target levels, are penalty only: CRI, Discharge Permit Compliance, and Serious Pollution incidents. The target levels for these ODIs across all companies are zero and thus no outperformance is achievable. This creates asymmetry in the regulatory framework, applying a negative skew to the P50 and asymmetry to the range between worst- and best-case scenario.

Moreover, these ODIs imply unlimited scope for penalty. Whilst companies should bear some risk where factors are within their control, exogenous circumstances such as extreme weather could impact performance on these ODIs and result in a penalty. Furthermore, median performance in AMP7 indicates baseline performance would fall short of the target levels:

[54] Ofwat (2024), PR24 draft determinations: Delivering outcomes for customers and the environment, p. 53.

Table 13: Median AMP7 performance on penalty-only ODIs

	Units	FY21	FY22	FY23	FY24
CRI	*CRI Score*	2.16	3.02	2.92	3.57
Discharge Compliance	*100 - % Compliance*	0.49%	1.68%	1.43%	0.97%
Serious Pollution Incidents	*No. incidents*	3	3	3	N/A

The DD addresses some of this risk through a decreasing deadband on CRI of 1.83 in FY26 to 1.00 in FY30. However, the level and trajectory of the deadband leaves residual risk when compared with AMP7 performance. Risk is also mitigated through the aggregate sharing mechanism on ODIs, however mitigations are limited due to the very high thresholds (+/- 3% and 5%) and that, unlike the Totex ASM, the impact is calculated annually.

4.1.4 Measures of Experience

In PR19, Customer Measures of Experience ("C-MeX") penalties/rewards were calculated relative to water sector performance only. The DD updated the benchmark for performance to be the UKCSI average[55]. Whilst the PR19 approach of relative performance results in no P50 risk for the notionally efficient company, comparison to the UKCSI average risks baseline underperformance as demonstrated by the historical performance of the water sector against UKCSI in Table 14.

Table 14: AMP7 C-Mex performance vs UKCSI Average

	FY21	FY22	FY23	FY24
UKCSI Average	85.62	82.10	82.27	84.34
Median C-MeX Score	81.12*	79.50*	78.29*	75.55*
Companies above UKCSI average	2	6	3	0

**Reweighted for DD definition*

The objective of using UKCSI average is to prevent companies receiving rewards from decreasing scores. This protects customers from poor service and incentivises the sector to improve scores. However, tougher C-MeX targets may amplify the impact of PC penalties and other fines where companies suffer financial consequences due to falling short of performance standards and for the resulting reputational impact.

Furthermore, in a competitive market consumers would only be influenced by intra-industry customer experience comparisons: a consumer would not rule out the best rated supermarket for customer service because in comparison to other industries the service is worse.

The Draft Determination includes some risk mitigating factors: (1) the re-weighting to 66.6% Customer Service Survey and 33.3% Customer Experience Survey, which puts more weight on customer views with whom companies have had director contract with and therefore provides companies the opportunity to mitigate some of the reputational risks through high quality customer engagement, and (2) the upper bound for reward being the UKCSI Upper Quartile in place of the UKCSI maximum, which increases reward payments above UKCSI average although the notional company would not be expected to benefit from this. Regarding the Customer Experience Survey, there is also potential for factors outside of customer service to impact the survey results. Because this survey targets the wider customer base without regard for whether there was a customer service contact, customers completing this survey may base their scores on other factors like media coverage or recent regulatory actions against the water sector. This would mean C-Mex scores could be influenced by factors other than customer service (i.e., storm overflow or pollution performance). Placing lower

[55] Ofwat (2024), PR24 draft determinations: Outcomes – Measure of experience performance commitments appendix, p. 14.

weight on this component of the score is helpful in keeping the score focused on customer service metrics.

Developer Measures of Experience (D-Mex) remains a relative comparison and thus the efficient notional company – as defined by sector median – is expected to have no out- or under-performance. However, as demonstrated in Table 15 there is asymmetry in the performance whereby downside performance represents a larger underperformance compared with the outperformance on the upside.

Table 15: AMP7 D-Mex performance

	FY21	FY22	FY23	FY24
Median	81.52	80.80	83.08	86.20
P10 Downside	65.89	72.59	75.36	78.33
P90 Upside	86.65	87.93	89.18	88.62
Downside underperformance	15.63	8.21	7.73	7.87
Upside outperformance	20.76	15.35	13.82	10.29

All reweighted for DD definition

The reweighting to 66.6% Developer satisfaction survey and 33.3% Levels of Service metrics puts more emphasis on stakeholders with whom water companies have interacted. As with C-MeX, this adds more weight to scores which companies can influence directly.

The analysis does not include BR-Mex as it is a new incentive for PR24 with no historical performance upon which analysis could performed.

4.1.5 Market Based Delivery

The direct procurement for customers (DPC) and specified infrastructure projects (SIPR) are relatively untested delivery routes introduced by Ofwat for delivering larger and more complex schemes. The structure of the mechanism utilise project finance to raise capital at a potentially higher level of gearing than the appointee or is isolated from some degree of the risk. The appointee is ultimately responsible for the performance of the assets and takes ownership of the assets in the long run. At PR24, Ofwat required companies to assess projects with over £200m whole life totex for suitability under DPC. The sector requested market based delivery in the Business Plan submissions for AMP8 for 33 schemes covering £14b in capital expenditure. The risk allocation between the competitive appointed provider (CAP), which constructs and operates the assets, and the appointee results in some residual risks held with the appointee based on the structure of the deliver route. Given the scale and the residual risk it is important to assess how this relatively new and untested delivery route can impact the appointee.

The analysis points to several different ways that projects delivered under other market delivery routes can impact the appointee based on the result of the design of the regulatory framework. The majority of schemes progressed in the sector are under DPC and the analysis reflects the risk allocation embedded in the DPC framework:

- **Delay and associated statutory penalty**: if the appointee is using other market delivery routes to deliver schemes to comply with statutory requirements like the WINEP programme, WRMP or DWI water quality standards, delays can result in fines and penalties. The CAP is only paid on commissioning of the assets and is well incentivised to deliver on time. However, based on the KPMG infrastructure project database the larger and more complex nature of the projects delivered under this delivery route may be more at risk of delay due to the risk inherent in large construction schemes. Regulators have wide latitude to assess fines and therefore can have a wide range of outcomes should delays be experienced.

- **Impact on credit ratings**: where the appointee retains some degree of risk, credit rating agencies may opt to fully consolidate the CAP into the appointee for purposes of rating assessment. Further analysis is required on a case by case basis to assess the degree of contractual risk transfer from the appointee to the CAP to determine how a rating agency would assess the impact. There are a wide range of outcomes given the bespoke nature of each scheme making the estimation of risk to a notional company challenging.
- **Operational performance**: the CAP is expected to bear the risk of performance; however, it is unlikely to bear the full risk given the difficulty in drafting a contract that covers all possible outcomes. Some appointees may opt to operate the assets themselves in some cases. Given vastly different types, timelines, and profiles of the DPC deliveries, it is not possible to reliably estimate this risk for the notional company
- **Retendering in the event of CAP default**: should the CAP default during the construction phase, the appointee may need to retender the construction contract and award a new CAP. The regulatory framework does not guarantee additional funding for the cost of retendering in the event of a CAP default.

Cost performance risk is fully transferred to the CAP under the Allowed Revenue Directive and offers material protection for the appointee. It is not included in the list as under the DPC programme this is not a risk borne by the appointee.

The delay risk, potential ratings impact, and operational performance risk are not included in the simulated risk ranges but are acknowledged as sources of risk for the appointee. A more bespoke analysis of each scheme should be undertaken to understand the full degree of risk conferred to the appointee and the CAP as well as the impact on overall risk ranges.

However, the risk of retendering in the event of a CAP default is included in the simulated risk ranges. Without an explicit guarantee of subsequent funding, the appointee could be unfunded for the retender costs. The appointee has the option to bring the scheme in-house in most cases in the event of a CAP default, however the appointee would likely bear less risk by retendering where the scheme is large, complex, construction phase is not complete and the appointee is already delivering a large programme. Therefore, the risk is considered in the simulation.

4.1.6 Financing risk

An efficient notional company expects to deliver the majority of its capital programme through debt financing and the correct calibration of efficient costs in the cost of debt allowance is a key driver of risk for the notional company. Risk arises from two key macroeconomic factors (1) non-inflationary interest rate risk and (2) inflationary rate risk.

Recent market volatility following the COVID-19 pandemic, the Russia-Ukraine war and “Trussonomics” highlights the importance of an appropriately set allowance. Increased volatility increases the risk to which the sector and its stakeholders are exposed.

Interest rate risk

Interest rate risk relates to the allowance for cost of embedded and cost of new debt, and the potential delta between these allowances and the debt costs a company is incurring and will reasonably be able to issue at.

Key contributors to the negative risk exposure in the base-case scenario is performance of the notional company against the allowances on embedded and new debt. This is because DD allowance for the cost of embedded debt is lower than the all-in cost of embedded debt for the median company in the sector. At the same time, the cost of new debt allowance, based on the iBoxx A/BBB indices, is significantly below the cost of new debt issuance achieved by water companies over the last 12 months. The regulator has signalled that it will consider refinements to its methodology and the latest market data in the Final Determinations (FDs), which could address the under-funding currently reflected in the financing risk range based on DDs.

Inflationary risk

Inflationary risk is present in the Draft Determination framework because the notional company is not fully protected against (1) deviations between the observed CPIH index and the assumed level, and (2) basis risk as a result of the efficient notional company having to issue index linked debt linked to non-CPIH benchmarks, i.e., resulting in an RPI-CPIH or CPI-CPIH "wedge", when income through RCV and customer bills are linked to CPIH.

- **CPIH inflation**: the actual observed CPIH index values may be higher than the long-term 2% CPIH assumption. PR24 FM and the Draft Determination provides some protection against deviations from the long-term assumption, however this is limited to +/- 1% as this is the level at which the governor of the Bank of England would be required to write a letter to the Chancellor[56]. However, historical series from April-2000 suggest CPIH variation can exceed this with a P10/P90 of 0.9%-4.0%.
- **RPI-CPIH wedge**: The notional capital structure assumes all index-linked debt to be linked to the CPIH index, however in practise a significant portion of RPI linked debt is present in the sector due to limited availability of CPIH linked debt in the market. The Draft Determination assumes am RPI-CPIH wedge of 0.90%, and therefore exposes the efficient notional firm to basis risk should the outturn wedge vary from this assumption. Historical data series from April-2000 indicates a P10 and P90 wedge of 2.08% and 0.05%. Deviation from the assumed 0.90% wedge is predominantly an embedded debt risk given legacy RPI-linked debt and derivatives were used to manage capital structure. The sector is increasingly issuing CPI-linked debt, in place of the scarcely available CPIH debt due to market illiquidity.
- **CPI-CPIH wedge**: The Draft Determination assumes that all non-CPIH index linked debt is linked to RPI as 3% of current debt is indexed to CPI[57]. However, due to the lack of liquidity in the CPIH market, new debt issuances are likely to be CPI linked and thus an efficient notional firm is exposed to the CPI-CPIH wedge which is not provided for in the Draft Determination. Historical data series from April-2000 indicates no wedge exists at the P50, however that a wedge of 0.68% and -0.30% is present at P10 and P90 – thus creating basis risk. Given the negative wedge at the P90, this range presents basis risk to both the efficient company and its customers.

The aforementioned five components of inflationary and non-inflation risk – embedded debt, new debt, CPIH variance, RPI-CPIH wedge, and CPI-CPIH wedge – are included in the simulation and suggest some degree of calibration risk from the cost of debt allowance included in the DD.

The assessment of financing risk for a notional WoC did not take into account company specific characteristics that may warrant a company specific adjustment. Should this risk be present WoC financing risk would be understated by the ranges presented, potentially materially.

4.2 Notional company mitigations

Without mitigations, analysis indicates notional company AMP8 performance (1) has a negative P50, suggesting the allowed return will not be earnt, (2) is asymmetric, with more scope for downside scenarios than upside scenarios, and (3) exhibits a high level of variance, with a wide range between best-case and worst-case scenarios.

A narrower RoRE range, with less downside asymmetry and P50 near zero, would significantly improve notional company attractiveness to investors, and, consequently, the notional company's ability to deliver its AMP8 capital programme. With this view, mitigations could be used to address the notional risk at source, whilst also ensuring sufficient incentive remains in the regulatory framework. This section explores the possible mitigations and determines an example suite that could be applied to the notional company.

[56] Ofwat (2024), PR24 draft determinations: Aligning Risk and Return Appendix, p. 16.

[57] Ibid, p. 18.

Mitigations to the risk identified in the Draft Determination can be decomposed into two categories:

1) Mitigations addressing risk relating to the calibration of the notional company,
2) Mitigations addressing risk relating to the asymmetry of regulatory mechanisms.

Mitigations which may address calibration of the notional company – e.g., changes to allowances or ODI targets – are indicative for the notional company, as a bottom-up assessment of efficient costs or feasible performance improvements is not possible given the synthetic nature of the notional company. This Report does not comment on the sufficiency of allowances or feasibility of targets for any specific company, instead it provides examples of potential effective mitigations.

4.2.1 Objective assessment criteria for mitigations

A consistent, non-discriminative framework for selecting mitigations ensures a systematic approach and consideration of the factors that are most relevant in the regulatory context, including – but not limited to – protecting customer interest and long-term operational and financial resilience.

The selected criteria are as follows:

1) Are the proposed mitigations in the best long-term interest of consumers?
2) Do the proposed mitigations sufficiently preserve the incentive properties of the price control?
3) Do the proposed mitigations address the risk at source?
4) Do the proposed mitigations allocate the risk to the parties best placed to manage it?
5) Are the proposed mitigations consistent with precedents in other RAV-regulated sectors?
6) Are the proposed mitigations helping to achieve a greater risk symmetry?

4.2.2 Possible suite of mitigations

Possible mitigations are shown in Table 16 and Table 17, addressing company calibration risk and regulatory design risk, respectively. These tables show the potential impacts these mitigations would have on (1) underperformance at P50, (2) risk asymmetry, (3) risk variance.

Table 16: Possible mitigations to address company calibration risk

Mitigation	Description	Shifting median upwards	Reducing asymmetry (downside vs. upside)	Reducing variance (range of upside / downside)
Appropriately fund improvements to PCs	Providing sufficient base allowance to ensure the required ODI improvements can be made will reduce the risk of base underperformance experienced in AMP7 and underperformance against ODI targets.	Yes	Yes	Yes
Enhancement project re-opener	When material design changes are required due to unforeseen circumstances at planning, a reopener would be triggered to reassess the efficient notional company's required allowance to deliver the scheme.	Yes	Yes	Yes
Asymmetric sharing rates on enhancement totex	The risk of overspend on the large and complex enhancement projects is high. Ofwat recognised this by reducing sharing rates to 40/40. However, cost outperformance is less likely than	Yes	Yes	Yes

Mitigation	Description	Shifting median upwards	Reducing asymmetry (downside vs. upside)	Reducing variance (range of upside / downside)
	underperformance, implying asymmetry which could be addressed through asymmetric sharing rates.			
Adjust glidepath of ODI targets based on AMP7	The ODI targets outlined in the DD include material stretch when compared with AMP7 performance and improvement trajectory. Targets could be adjusted to factor in (1) companies are unlikely hit FY25 targets which are the baseline for AMP8 targets, and (2) the viable rate of improvement in AMP8 given historical performance.[58]	Yes	Yes	Yes
Appropriately calibrated cost of debt allowance	The KPMG Cost of Debt report[59] demonstrates the allowance per the DD is not sufficient to cover median sector costs to which companies are exposed, and therefore companies will underperform without an uplift to the allowance. It also suggests companies are exposed to basis risk for which no allowance is given in the DD. This is a regulatory design risk but considered alongside CoD allowance for simplicity.	Yes	No	No

[58] See Table 4 which demonstrates the level of stretch in the PC targets in the Draft Determination.

[59] See KPMG August 2024 reports on the cost of debt at PR24, namely, 'Cost of Embedded Debt – analysis of and commentary on Ofwat's DD position' and 'Estimating the Cost of New Debt and Additional Borrowing Costs for PR24', for more detail on the calibration of the cost of debt allowance.

Table 17: Possible mitigations to address regulatory design risk

Mitigation	Description	Shifting median upwards	Reducing asymmetry (downside vs. upside)	Reducing variance (range of upside / downside)
Retail indexation	Indexation of the retail allowance protects companies against high inflation which could occur in AMP8 and was a driver of underperformance in AMP7.	Yes	No	No
Modified application of PCDs	PCDs are inherently asymmetric. Modifications to the PCDs mechanisms could, *inter alia:* • Permit a longer timeframe for delivering enhancement under Non-Delivery PCDs • Refine the reward : penalty ratio of Time-Incentive PCs • Offset other regulatory actions and fines issued to explicitly avoid duplication of penalties	Yes	Yes	Yes
Rebased C-MeX on sector	Water sector C-MeX scores have historically underperformed against UKCSI, the proposed target in the DD. Resultingly, comparison to UKCSI would incur baseline underperformance which could be remedied by using a sector median target consistent with D-MeX.	Yes	No	No
ODI caps, collars and deadbands	This mitigation would re-instate caps and collars for the common ODIs, and deadbands for penalty-only ODIs in AMP8.	Yes	Yes	Yes
Reduced ODI incentive strength	The incentive strength across all ODIs could be recalibrated via scaling down ODI rates, which would reduce RoRE risk. Ofwat's top-down approach to ODI rate setting is based on an explicitly defined regulated equity at risk for each ODI.	Yes	Yes	Yes
Redesigned Aggregate Sharing Mechanism (ASM)	The aggregate sharing mechanisms on Totex and ODIs could be redesigned by reducing the first threshold to 1.5% from 2% and adding a second 90% sharing threshold of 2.5%.	No	Yes	Yes
Return Adjustment Mechanisms (RAMs)	Return adjustment mechanisms protect customers and companies from extreme outcomes with sharing rates effective after +/-3% and enhanced sharing rate of 90% active after +/-4%. There is a precedent of using similar thresholds that encompass both ODIs and Totex in the energy sector.	No	Yes	Yes

4.2.3 Assessing possible mitigations against the criteria

The possible mitigations are compared against the criteria outlined in section 4.2.1 in Table 18.

Table 18: Assessment of possible mitigations against objective criteria

Mitigation	Consumer Interest	Preserve incentive properties	Target risk at source	Allocate risk appropriately	Consistent with precedents	Improves risk symmetry and variance
Appropriately fund improvements to PCs	✓	✓	✓	✓	✓	✓
Enhancement project allowance re-opener	✓	✓	✓	✓	✓	✓
Asymmetric sharing rates	⊙	✓	✓	✓	✓	✓
Adjust glidepath of ODI targets based on AMP7	⊙	✓	✓	✓	✓	✓
Appropriately calibrated cost of debt allowance	⊙	✓	✓	✓	✓	✓
Retail indexation	✓	✓	✓	✓	✓	✓
Modified application of PCDs	✓	⊙	✓	✓	⊙	✓
Rebased C-MeX on sector	✓	✓	✓	✓	✓	✓
ODI caps, collars and deadbands	✓	✓	✓	✓	✓	✓
Reduced ODI incentive strength	✓	⊙	✓	✓	✓	✓
Redesigned Aggregate Sharing Mechanism (ASM)	✓	⊙	⊙	✓	✓	✓
Return Adjustment Mechanisms (RAMs)	✓	⊙	⊙	✓	✓	✓

✓ **Consistent with criterion**
⊙ **Exhibits some degree of inconsistency with criterion**

4.2.4 Determining key mitigations

The mitigations adopted in this analysis to address notional company risk are presented below. The analysis relies more heavily on mitigations that are highly effective at addressing underperformance at P50, risk asymmetry, risk variance, and compliance with objective criteria.

The following section presents other possible mitigations which materially align with the objective criteria set out in section 4.2.1 and could provide effect risk mitigation, but which are not applied to the notional company in this report due to other mitigations addressing the source of risk.

Mitigations addressing calibration risk

- **Appropriately fund improvements to PCs.** Appropriate base allowances to fund the PC improvement required to meet DD targets reduces the downside P50 and RoRE variance on (1) base totex implied by AMP7 underperformance, and (2) ODIs where targets are significantly stretching compared with current performance and adjusting targets would not be palatable – e.g., leakage, total pollution incidents and external sewer flooding.
- **Enhancement project re-opener.** It is common for infrastructure projects to overrun on costs due to uncertainties in planning budgets. The downside P50 is mitigated through the setting of an appropriate enhancement allowance, which is most practically achieved through a re-opener to assess efficient scheme costs similar to the RAPID scheme stage gates.
- **Adjust glidepath of ODI targets based on AMP7.** Adjusting the DD targets to reflect achievable levels of performance at the P50 mitigates downside P50 risk. Revised PCLs consider actual performance in AMP7 and therefore align with expected performance. The targets for leakage, total pollution incidents and external sewer flooding are not revised as these are mitigated through fully funding the required performance improvement. Where ODI underperformance is addressed through fully funding the required improvements or by reducing targets is dependent on stakeholder prioritisation between lower bills and improved performance.
- **Appropriately calibrated cost of debt allowance.** KPMG's Cost of Debt report demonstrates the median company cost of debt is higher than the allowed cost of embedded debt and that it cannot issue at the allowed cost of new debt. It also demonstrates basis risk exposure due to the RPI-CPIH and CPI-CPIH wedge. Financing underperformance therefore occurs, which is remedied through provision of sufficient allowances.

Mitigations addressing regulatory design risk

- **Retail indexation.** The sector materially underperformed against retail allowances in AMP7, significantly – but not exclusively – driven by high inflation. Without indexation of allowances in AMP8, companies would again be exposed to inflationary risk on retail costs. Note, the negative P50 on retail is assumed be fully mitigated by AMP8 indexation. This is a conservative assumption, and some residual risk may remain if historical underperformance was driven by other factors, however insufficient data exists to robustly assess this.
- **Modified application of PCDs.** PCDs are inherently asymmetric and both ND and TI PCD mechanisms generate asymmetric risk for companies. Analysis of the KPMG infrastructure project database suggests 40% of projects are delayed on average, which indicates a reward : penalty ratio of 2:3 is more appropriate than the 1:4 set out in the DD for TI PCDs.

  The DD indicates a delivery buffer of "a few months"[60] into AMP9 for ND PCDs. The regulatory discretion poses risk to companies which is mitigated by applying a 12-month delivery buffer, where no clawback would occur unless projects are a full year late.

[60] Ofwat (2024), PR24 draft determinations Expenditure allowances, p. 176.

- **Rebased C-MeX**. Water sector performance has historically been below UKCSI[61]. Adopting the UKCSI average as the target therefore creates deterministic underperformance for the water sector. This is mitigated by adopting a water sector median as the target, as is the approach for D-MeX.

- **ODI caps, collars, and deadbands.** There is a strong argument for these based on alignment to regulatory framework and regulatory precedent. Deadbands are applied to downside only ODIs – CRI, Discharge Permit Compliance, Serious Pollution Incidents – as deadbands eliminate the negative P50 and asymmetry in the RoRE range resultingly from these ODIs.

  Caps and collars help to limit variance in the RoRE range where possible outcomes for individual ODIs are very broad. Based on historical performance, caps and collars for Leakage and Water Supply Interruptions are applied to the Notional WoC.

- **Reduced ODI incentive strength.** The Draft Determination's top-down methodology based on specified regulated equity at risk and assumed performance ranges results in skewed regulated equity at risk across sector, and significantly more regulated equity at risk compared with Oct-23 Business Plan proposals. The performance ranges utilise historical data covering AMP6, which is a less comparable period given the points made previously. Additionally, the performance ranges do not adjust historical performance for changes in PC definitions for example the EA exemption for extreme weather events on total pollutions incidents being removed. Additionally, the use of the 0.6% of regulated equity threshold for the calibration of ODI rates appears unjustified and significantly increases the overall risk exposure in economic terms. However, excessive reductions in rates could impact incentive properties. The appropriate impact of rates is ultimately dependent on achievable ODI targets. In the example suite of mitigations, rates were scaled down by reducing the RoRE at risk for ODIs with very wide performance ranges – Notional WoC: Leakage and Customer Contacts, Notional WaSC: Pollution Incidents and External Sewer Flooding.

- **Redesigned ASMs.** A broader sharing mechanism is supported by regulatory precedent, the degree of P10 risk in the sector, and helps with stability of bills. The DD introduced an ASM for Totex and included Measures of Experience in the ODI ASM set out in PR24 FM. However, the efficacy of these mechanisms in reducing the risk range is limited by the Totex ASM having only a lower 50% sharing threshold and the ODI ASM having high thresholds. In aggregate, the 50% sharing threshold is 5% of Regulated Equity which is unlikely to provide sufficient protection to customers and companies should ODI targets and totex allowances be set at achievable levels. The ASMs are therefore redesigned as follows:

  - Totex ASM: Lower the 50% sharing threshold to +/- 1.5% RE and add a 90% sharing threshold at +/- 2.5% RE.

  - ODIs & Mexs ASM: Lower the 90% sharing threshold to +/- 4% RE.

  Whilst ASMs do not address the risk at source, they provide a helpful RoRE backstop which aids financeability and customer bill stability.

Other potential mitigations

The following mitigations are not applied in the example notional mitigation suite, however, could provide risk mitigation in place of other mitigations.

- **Asymmetric sharing rates on enhancement.** The Draft Determination reduced enhancement sharing rates to 40:40 reducing the company retained risk in recognition of the step change in size and complexity of the AMP8 enhancement programme. However, as cost underperformance is more likely than outperformance the risk is inherently asymmetric - which could be addressed through asymmetric sharing rates. Lowering retained risk on overruns reduces the incentive strength and increases the propensity for variation in customer bills. This mitigation is therefore

[61] Ofwat (2024), UKSCI benchmarks – response. Data available here. UKCSI average benchmark 85.62, 82.10, 82.27, 84.34 vs sector median of 81.12, 79.50, 78.29, 75.55 in FY21-FY24 respectively.

not applied as enhancement cost overrun risk is instead mitigated through the appropriate calibration of allowance through a re-opener.

- **Further application of caps and collars.** Whilst caps and collars can limit incentive once the cap/collar level is achieved, they reduce the RoRE range width and therefore provide certainty to customers and investors. In the example mitigation suite, ODI risk is mitigated through appropriate funding of PC improvements, revised targets, recalibrated ODI rates, and limited application of caps/collars/deadbands. Should these mechanisms not provide sufficient mitigation, additional caps and collars could be used to achieve appropriate levels of ODI risk.
- **RAMs.** With sufficient Totex allowances, ODI calibration, and ASM configuration, RAMs are not required. However, RAMs are supported by regulatory precedent with application by Ofgem in RIIO-GD2 and in place of ASMs, could provide similar protection to stakeholders. RAMs would also offer the benefit of restricting extreme performance on other risk components such as retail.
- **Tighter ASM thresholds.** If the full suite of Totex and ODI mitigations were not applied, tighter ASM thresholds would be required to achieve appropriate RoRE width and symmetry. A possible application could be +/- 1.5% and +/-2% thresholds for Totex and ODI ASMs to align the overall protection with the 3%/4% thresholds of RIIO-GD2.

Sector views

UK water companies engaged with the Club Risk project had opportunity to provide their views on mitigations. Their support is summarised in Table 19.

Table 19: Company support of mitigation types

Support level	Potential mitigation
General support	• Appropriately fund improvements to PCs • Enhancement project re-opener • Adjust glidepath of ODI targets based on AMP7 • Appropriately calibrated cost of debt allowance • Retail indexation • Rebased C-MeX on sector • ODI caps, collars and deadbands
Mixed support	• Modified application of PCDs • Reduced ODI incentive strength • Return Adjustment Mechanisms (RAMs)

4.3 Mitigated RoRE ranges

4.3.1 Mitigated aggregated RoRE

The suite of mitigations set out in Section 4.2.2 significantly reduce risk exposure for the notional WaSC and WoCs, by limiting negative exposure at P50, the asymmetry between upside and downside exposure and reducing the risk at P10 below the allowed return on equity. This means that equity investors in the notional water company could expect to earn a return close to the allowed cost of equity on a P50 basis and, in a “worst-case” P10 scenario, would still be able to earn a positive return.

Addressing miscalibration risk improves the P50 from (4.06%) to (1.42%) and (4.51%) to (1.04%) for the notional WaSC and WoC respectively. P50 further improves to (0.17%) and (0.07%) when applying mitigations addressing regulatory design risk. The downside P10 scenarios also increase to (3.11%) and (3.95%), crucially below the allowed return on equity.

Chart 13: WaSC RoRE risk through mitigations

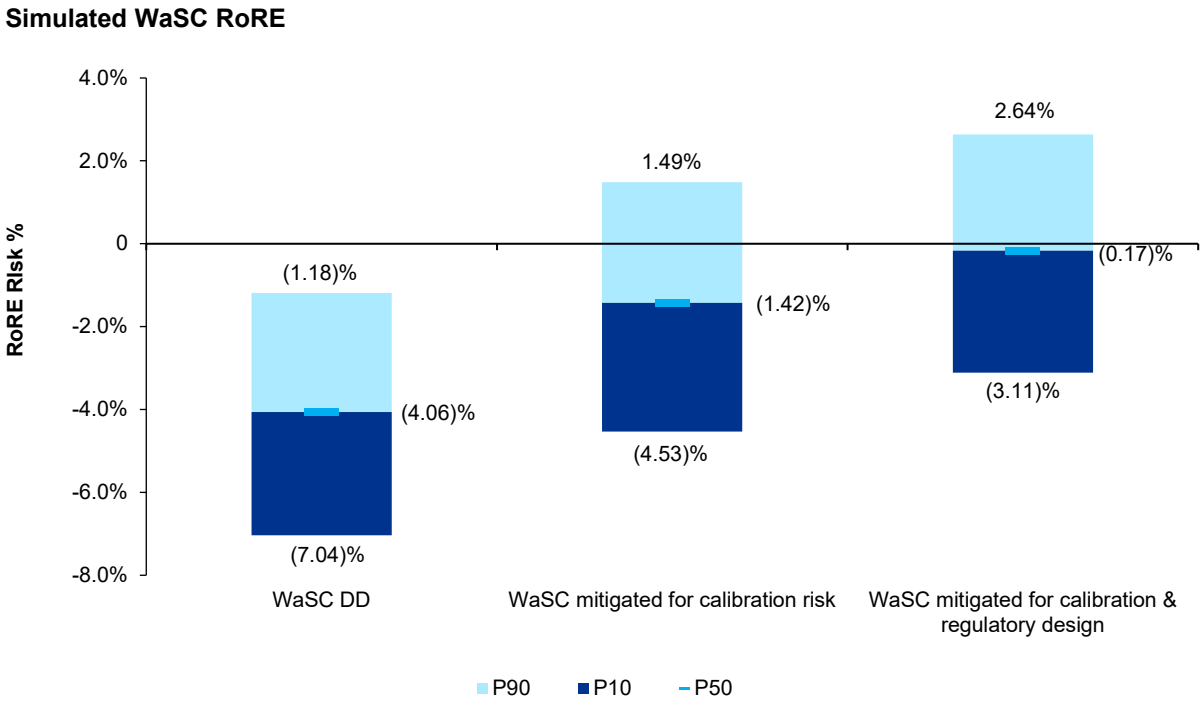
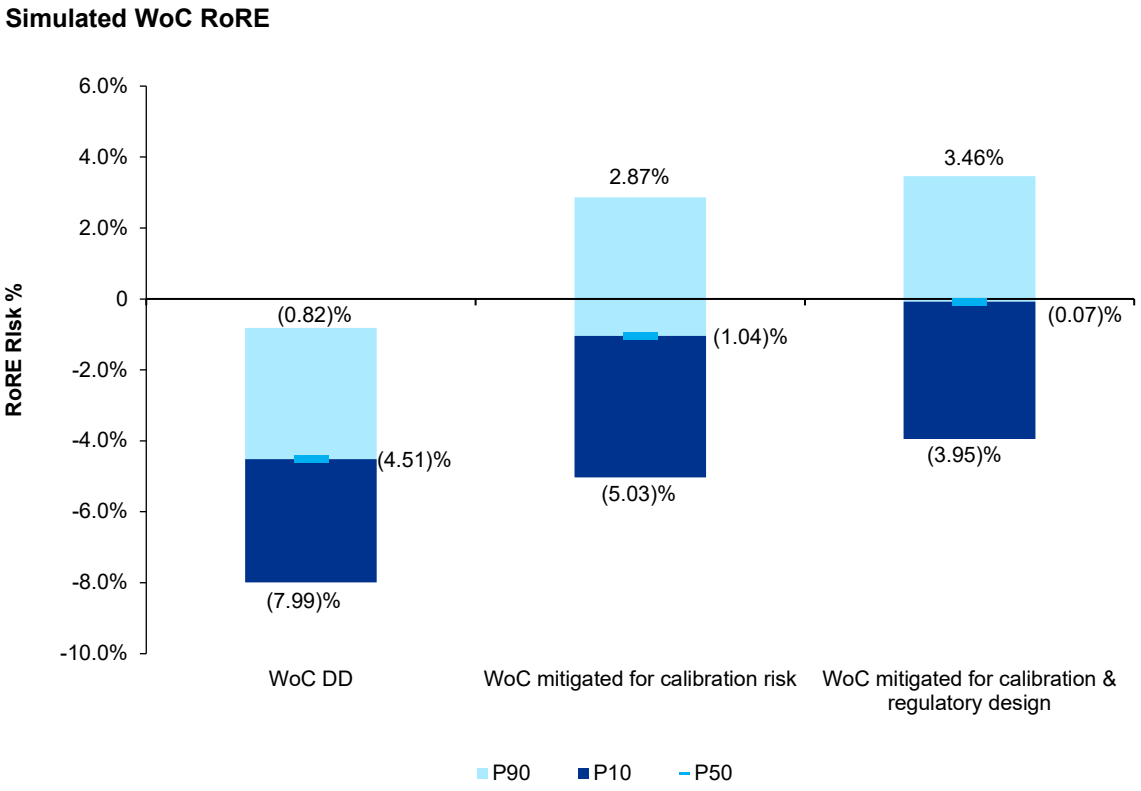


Chart 14: WoC RoRE risk through mitigations



4.3.2 Component level mitigations

The simulated components of risk for a mitigated and unmitigated WaSC and WoC are shown in Chart 15 and Chart 16.

Chart 15 a, b: WaSC components of risk: Unmitigated vs Mitigated

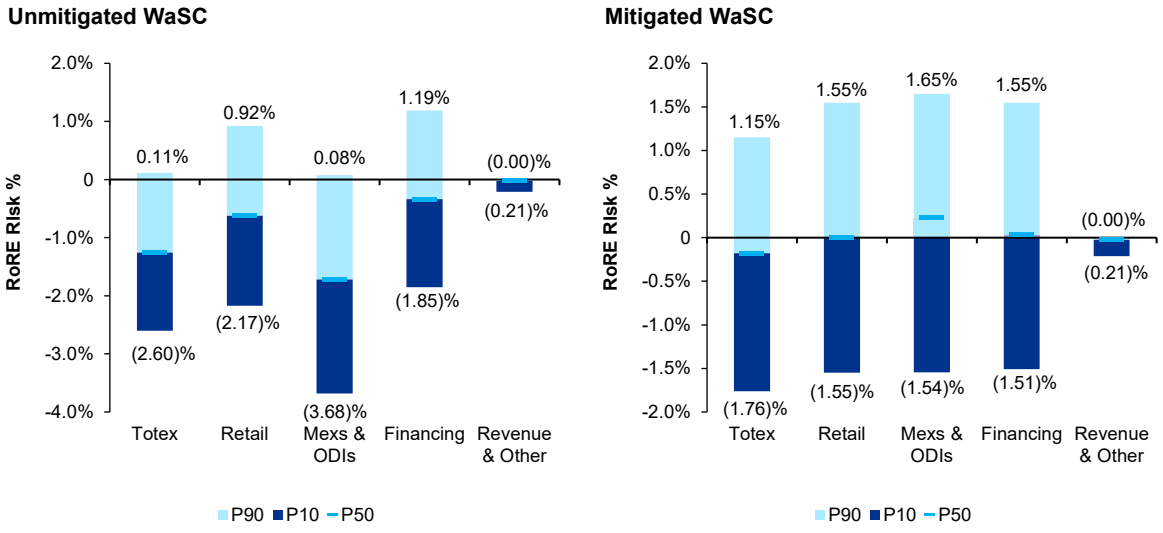


Chart 16 a, b: WoC components of risk: Unmitigated vs Mitigated

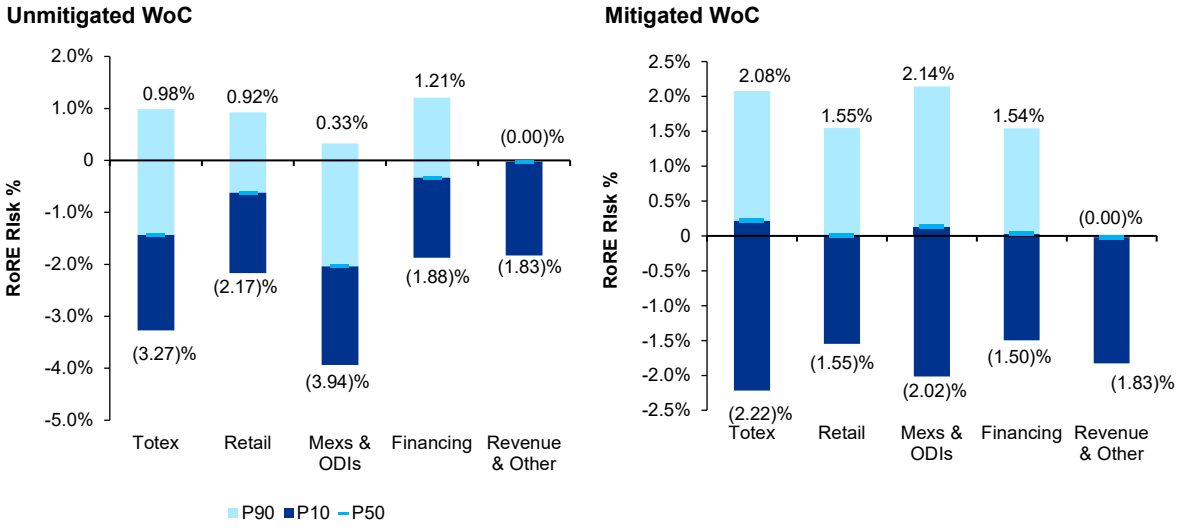


Chart 15 and Chart 16 present the risk exposure on each group of performance variables, the overall risk exposure, and the mitigations impacting each component, for the notional WaSC and WoC respectively.

It is important to note the relationship between risk components and the impact on overall RoRE. The overall RoRE range factors in the relationships between these components and thus the total range is not equivalent to the sum of the components. The combined additive range is not representative of the true overall risk but is shown below for comparability with the risk ranges presented in the DDs.

Analysis of historical performance indicates that performance distributions are downward asymmetric for elements of totex and numerous ODIs. As a result, aggregation of components with P50 = 0 through Monte Carlo can produce a non-zero P50. As a consequence of this statical relationship, to mitigate the P50 risk to near-zero some components require mitigation to the point of outperformance, as the case for ODI in the below table.

Table 20: WaSC unmitigated and mitigated risk ranges

Notional WaSC	Unmitigated			Mitigated			
	P10	P50	P90	P10	P50	P90	Mitigations
Totex	-2.60%	-1.26%	0.11%	-1.76%	-0.18%	1.15%	• Appropriate base funding improves P50 • Enhancement re-opener improves P50 • Modification of PCDs improves P10
Retail	-2.17%	-0.62%	0.92%	-1.55%	0.00%	1.55%	• Retail indexation improves P50
DPC	-0.16%	0	0	-0.16%	0	0	No change
Mex & ODI	-3.68%	-1.72%	0.08%	-1.54%	0.23%	1.65%	• Appropriate funding of PC improvements improves P50 • Adjust glidepath of ODI targets based on AMP7 improves P50 • Deadbands improve P50

							• Reduced ODI incentive strength improves P50 and reduces range • Redesigned ASM reduces range
Financing	-1.85%	-0.34%	1.19%	-1.51%	0.03%	1.55%	• P50 improved through sufficient embedded and new debt allowances and uplift for basis risk.
Rev.	-0.05%	-0.03%	0.00%	-0.05%	-0.03%	0.00%	No change
RoRE (additive)	-10.52%	-3.97%	2.30%	-6.57%	0.05%	5.89%	n/a
RoRE	**-7.04%**	**-4.06%**	**-1.18%**	**-3.11%**	**-0.17%**	**2.64%**	n/a

Table 21: WoC unmitigated and mitigated risk ranges

Notional WaSC	Unmitigated			Mitigated			
	P10	P50	P90	P10	P50	P90	Mitigations
Totex	-3.27%	-1.43%	0.98%	-2.22%	0.22%	2.08%	• Appropriate base funding improves P50 • Enhancement re-opener improves P50 • Modification of PCDs improves P10
Retail	-2.17%	-0.62%	0.92%	-1.55%	0.00%	1.55%	• Retail indexation improves P50
DPC	-1.78%	0	0	-1.78%	0	0	No change
Mex & ODI	-3.94%	-2.04%	0.33%	-2.02%	0.13%	2.14%	• Appropriate funding of PC improvements improves P50 • Adjust glidepath of ODI targets based on AMP7 improves P50 • Deadbands improve P50 • Caps and collars reduce range • Reduced ODI incentive strength improves P50 and reduces range • Redesigned ASM reduces range
Financing	-1.88%	-0.33%	1.21%	-1.50%	0.03%	1.54%	• P50 improved through sufficient embedded and new debt allowances and uplift for basis risk.
Rev.	-0.05%	-0.03%	0.00%	-0.05%	-0.03%	0.00%	No change
RoRE (additive)	-13.08%	-4.46%	3.44%	-9.11%	0.35%	7.31%	n/a
RoRE	**-7.99%**	**-4.51%**	**-0.82%**	**-3.95%**	**-0.07%**	**3.46%**	**n/a**

4.3.3 Significance of mitigations

The analysis indicates the risk exposure as a result of the Draft Determinations is materially skewed downward, with negative P50 and a P10 greater in magnitude than the allowed return. This risk can be separated into:

1) **Regulatory calibration of the notional company**. Analysis of historical performance suggests that the notional company calibration per the DDs is misaligned, and the allowances and

performance levels may not be achievable. It is crucial that the framework is representative of the true characteristics of the sector, and that an efficient firm would reasonably achieve the levels of performance expected.

2) **Regulatory design.** The regulatory framework includes mechanisms which create inherent downside risk. Whilst companies should be held to account for their performance, baseline asymmetry in the framework erodes the ability to offer the allowed return.

Without effective mitigations across both these categories, the level of risk would have material negative impacts on the notional company's:

- **Financeability.** The notional company would not be financeable with the risk allocation indicated by the analysis.
- **Investability.** The downside skew of risk ranges would result in the notional company being unable to attract equity investors through a sufficient rate of return.
- **Ability to deliver the AMP8 capital programme.** The AMP8 capital programme represents a step change in scale and therefore requiring additional capital from debt and equity investors. The inability to raise this finance would impact the deliverability of the proposed programme, which would ultimately harm customers by limiting the scope of service improvements.

The example suite of mitigations presented in Section 4.2.4 is not intended to be prescriptive. Instead, it demonstrates that targeted mitigations could materially improve the notional company's risk profile and therefore financeability and investability in AMP8. Crucially, the P50 risk is closer to zero and the P10 risk is smaller in magnitude than the allowed return – implying investor could access some small positive return in a P10 downside scenario.

P50 risk and asymmetry is not fully mitigated despite an extensive suite of mitigations. Full risk mitigation could be achieved through either:

1) Use of further mitigations. However, these may begin to distort the incentive properties of the framework.
2) Pricing in the residual risk into the cost of equity through an aiming up adjustment.

Asymmetry in risk exposure around the P50 is not fully consistent with the CAPM principles that returns are normally distributed, i.e., that they are clustered around the mean with a symmetric distribution. As a result, even with the risk mitigations, the incentive package would not constitute a 'fair bet' and would therefore warrant an adjustment to cost of equity to compensate for the downside risk asymmetry.

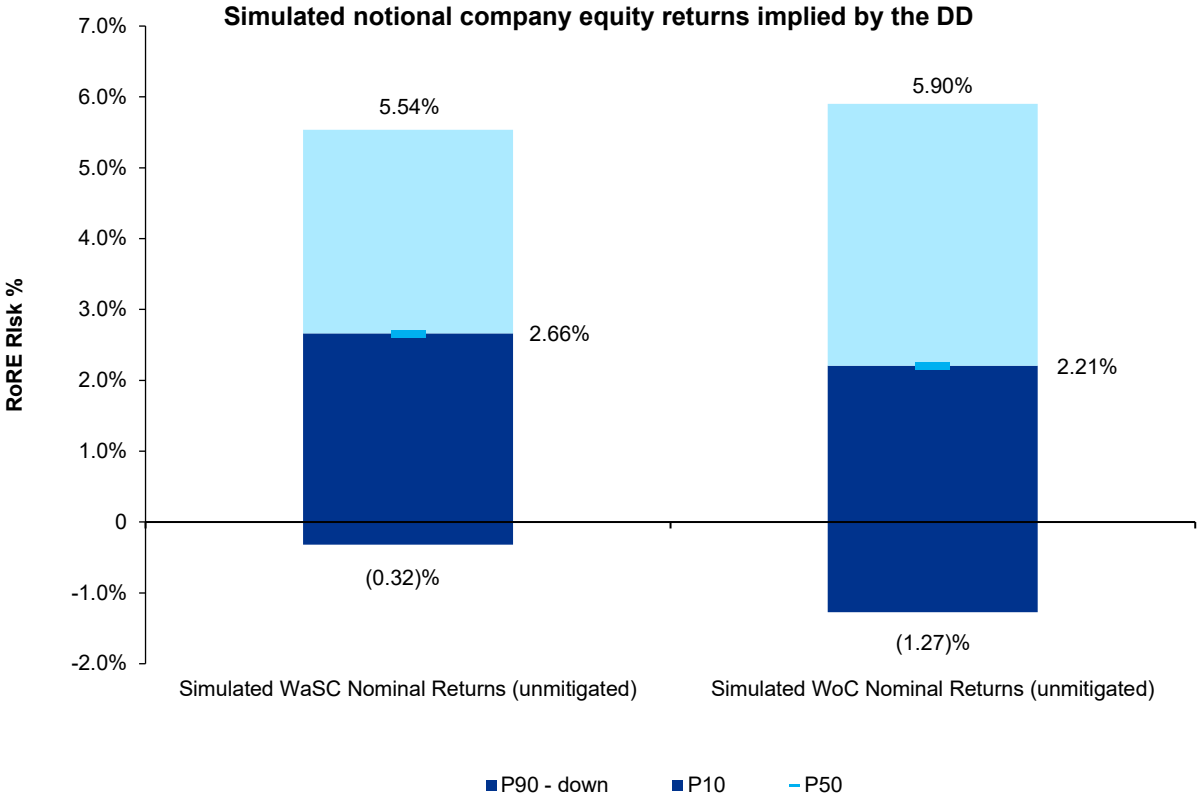
CAPM assumes that all possible future outcomes, including, in particular, downside risks with certain probabilities attached to them, are fully reflected in expected cashflows, i.e., that allowed cashflows already reflect all one-sided or asymmetric downside risks. Where this is not the case, the required returns will increase to compensate investors for these downside risks for the investment overall to constitute a 'fair bet'. These are typically captured through added premia to the required return.

Both corporate finance theory and regulatory precedent (such as CMA decisions for PR19 and SONI appeals, as well as Ofcom's implementation of the fair bet principle) suggest that presence of unremunerated and not-fully mitigated asymmetry is an important criterion for selection of a point estimate for the cost of equity. Asymmetry could also be captured via an asymmetric risk premium, which would ensure the notional company can attract the necessary new equity to fund its enhancement programme.

5 Conclusion

The risk analysis of a notional WaSC and WoC indicates that without mitigations, an efficient notional company would be: (1) unlikely to earn the allowed return on equity; and (2) in the worst-case scenario earn negative nominal returns. In the context of AMP8 where the sector will be seeking new equity and debt capital to deliver the capital programme, investability is of particular importance. An efficient notional company's ability to offer competitive returns given its level of risk is important to attracting this capital in globally competitive markets. Without sufficient capital, the sector will be unable to finance and consequently deliver the capital programme. Investment is needed to prevent deterioration in performance. The government and regulatory bodies have taken action to set tough environmental targets and tighten the standards and requirements related to the baseline expected performance. It will only be possible for the sector to rise to meet these challenges with a well-balanced risk and return profile. Therefore, a balanced risk and return package is in the customers' best interest as it would enable companies to finance and deliver against statutory objectives and improve service in AMP8.

Chart 17: Simulated nominal returns for unmitigated and mitigated WaSC



The balance of risk and return is an important element of the overall PR24 determinations in the context of the "focus on the long term"[62]. Improvement in asset health and resilience require a persistent and targeted effort over an extended period. If returns are not commensurate with the risk currently facing the sector, financing asset improvements may prove difficult and asset base may continue deteriorating while climate change and population growth persist. This could require even

[62] Ofwat (2021), PR24 and Beyond: Creating tomorrow, together, p. 13.

more risk mitigation or a higher cost of capital in future periods. Protecting customer interest today and in the long term involves taking action to balance risk and return at PR24.

The assessment of risk included in the DD: relied on AMP6 data; calculated performance ranges against the AMP8 framework; did not consider the interrelationships between risks; and simplified analysis by adding the resulting risk ranges together instead of randomly simulating them. The risk analysis presented in this paper: relied on AMP7 data; simulated performance against the AMP8 framework with empirically observed correlations; and produced a coherently simulated risk range. The differences between the results can be accounted for by these methodological differences.

It is possible to address risk at source to improve the probability an efficient notional company will be able to finance and deliver the AMP8 capital programme. The mitigations included in this analysis were selected based on their degree of effectiveness at addressing risk at source and consistency with a set of objective criteria. These key mitigations address risk arising from the calibration of performance targets and cost allowances in the AMP8 package as well as risk arising from the regulatory framework's design. Both sources of risk are important to consider in rebalancing risk and addressing risk at source.

The mitigations included in the report provide an example for how risk could be mitigated at source, with any residual risk subject to a separate consideration of a cost of equity uplift. There is a myriad of combinations of regulatory mitigations that can achieve the same outcome. The methodology for selecting mitigations based on the criteria objectively considers the relative advantages and disadvantages of each mitigation. The resulting package of mitigations included in this risk analysis do somewhat alter the incentive properties and in some cases increase customer bills and affordability pressures. However, the benefits to the long-term customer interest, effective risk mitigation at source and improved symmetry outweigh this potential disadvantages.

The regulatory framework presented at DDs would require material changes to improve the balance of risk and return. Moody's Ratings notes that FDs are "typically less onerous" than DDs, but that based on the DDs may "change … our view of the stability and supportiveness of the regime or companies' ability to recover costs and earn a fair return" and result in negative credit pressure on ratings[63]. This is particularly relevant when considering how much risk mitigation is needed and how much mitigation is required.

To arrive at a balanced and investable regulatory package, it may be necessary to consider both risk mitigations and the need for a cost of capital uplift. Where risk mitigations are insufficient to align investor expectations of earning the allowed return on equity, an adjustment to the cost of capital will be required. An aiming up adjustment to the cost of equity can be added to address negative base-case expected risk and where there is more downside risk than upside potential. Aiming up could be an important part of rebalancing of the risk package, given that asymmetric risk is not priced into beta and investors expect a 'fair bet'.

Overall, the regulatory framework can be an excellent tool for supporting the UK water sector to continue innovating to solve some of the greatest challenges facing society today. Addressing the imbalance of risk and return will allow the framework to continue being a source of strength for the sector in future by reducing the cost of privately financed essential infrastructure.

[63] Moody's (2024), Regulated Water Utilities – UK: Ofwat's draft determination increases sector risk, p. 1.

6 Appendices

6.1 Notional company specification and calibration

Appropriate specification of the notional company is important for producing meaningful RoRE risk ranges that are achievable in practice. It should reflect objective and realistic characteristics of an efficient water company that can achieve the set package of cost efficiencies and standards of service. Notional company characteristics and performance must be defined to be representative of the sector as a whole to support any conclusion on the appropriateness of the regulatory framework. Due to material divergences in sector characteristics between WaSCs and WoCs, this analysis presents two notional companies to best align the notional company characteristics to the sector. Notional company allowances, targets and rates are based on median of sector DDs. In general, the DDs set allowances and targets above the median of October 2023 Business Plans and rates were calibrated to put more equity at risk for smaller companies and less equity at risk for larger companies.

The notional company is used to verify the balance of risk and return of the regulatory framework and, more specifically, whether expected performance across costs and quality of service metrics of an efficiently run water company allows it to earn the allowed return on equity, as well as estimate the degree of upside and downside risk exposure. The calibration of the notional company's baseline performance is particularly critical. This can be done by using the observed historical mean or median. A simulated distribution of performance around this baseline can then be applied based on historic distributions of performance.

The mean and median both have advantages and disadvantages and provide different views on risk. The mean is the point in a distribution which minimises the sum of the differences between the mean and all other points in the distribution. The mean is generally additive in nature when working with non-normal distributions and can be more intuitive. However, the mean is particularly sensitive to outliers. The median is the point in the distribution where half the observations are above, and half the observations are below: i.e., the middle of the distribution. It has the advantage of insensitivity to magnitude of outliers in the distribution. In a negatively asymmetric distribution, the mean is typically lower than the median due to the median being less sensitive to outliers. Because the mean is sensitive to outliers, analysis reliant on the mean may need to identify and remove these outliers which can be a subjective process. Therefore, the median is more objective and representative of an efficient notional company and as a result, the median is used as a basis for determining the notional company. Forward-looking operational performance is calibrated based on the median sector performance across totex, ODIs and retail. This approach allows the analysis to retain all observations and therefore avoids any potential distortions or required discretion in identifying and removing outlier companies.

While the notional company is efficient, it must also reflect realistic performance in the sector to produce meaningful ranges for inferring the appropriateness of a price control's package of incentives. Ofwat's duty to support water companies across a number of areas including carrying out their statutory functions, financing their operations, improving resilience in the long-term of the water supply and provision of wastewater services and efficiency apply to all companies. Where companies exhibit different characteristics outside of management control like size or number of business units, the regulatory framework must work for companies reflecting such characteristics. Within the water sector, there are two distinct groups of companies: WaSCs and WoCs. Relative to a WaSC, WoCs generally have smaller asset base by RCV, higher operational gearing defined as base totex relative to RCV and do not provide wastewater services. The notional company construct has been applied to both groups in this analysis to test the appropriateness of the package of incentives at PR24 on both types of companies.

The notional company is assumed to have pursued all available avenues of mitigating risk included in the PR24 FM. This includes Uncertainty Mechanisms for regulatory requirements that may change during AMP8 like WRMP, industrial emissions directive, land bank loss, outstanding WINEP requirements, DWI drinking water nutrient level changes, etc.

The below table outlines the calibration of the notional company across each of the main risk drivers:

Table 22: Notional company calibration by risk driver

Risk driver	Notional WaSC	Notional WoC
RCV	• Median RCV for water price control • Median RCV for wastewater price control	• Median RCV for water price control among WoCs
Base totex allowance	• Based on median relative proportion of water and wastewater base totex to water and wastewater RCV in AMP8	• Based on median relative proportion of water base totex to water RCV in AMP8
Enhancement totex allowance	• Total enhancement programme size based on median capital intensity of the water and wastewater enhancement programme relative to opening AMP8 water and wastewater RCV • Relative proportion of each enhancement totex category based on median proportions	• Total enhancement programme size based on median capital intensity of the water enhancement programme relative to opening AMP8 water RCV • Relative proportion of each enhancement totex category based on median proportions
Enhancement scheme duration and complexity	• Duration estimated of each enhancement scheme based on sector input and expert opinion • Complexity assessed based on a set of criteria included below	• Duration estimated of each enhancement scheme based on sector input and expert opinion • Complexity assessed based on a set of criteria included below
PCDs	• Enhancement totex subject to PCD both non-delivery and time incentive PCDs separately based on median proportion of enhancement totex subject to PCD by scheme • Clawback rate based on the allowance and proportion of enhancement totex subject to non-delivery PCDs • Time incentive rate based on enhancement totex subject to time incentive PCD and allowed WACC.	• Enhancement totex subject to PCD both non-delivery and time incentive PCDs separately based on median proportion of enhancement totex subject to PCD by scheme • Clawback rate based on the allowance and proportion of enhancement totex subject to non-delivery PCDs • Time incentive rate based on enhancement totex subject to time incentive PCD and allowed WACC.
Number of market delivery schemes	• Based on median number of schemes delivered by WaSCs	• Based on medina number of schemes delivered by WoCs
ODI targets, rates, caps, collars & deadbands	• Median of water ODIs and median of wastewater ODIs standardised as appropriate	• Median of water ODIs standardised as appropriate

Risk driver	Notional WaSC	Notional WoC
Retail profit	• Aligned to the 0.06% of RCV based on the retail margin adjustment in the WACC	
Capital structure	• Gearing of 55% made up 74% embedded debt and 26% new debt • Total debt made of 33% index-linked debt, of which 94% is RPI-linked, 6% CPI-linked – new ILD debt is assumed to be raised as CPI-linked in AMP8	

Enhancement scheme complexity is assessed under a framework that evaluates the following dimensions:

Social

Typically, projects are subject to scrutiny particularly when government or regulated monopolies funding is being spent. To mitigate this, the government has a series of departments which are accountable for spend from treasury while in regulated sectors, an independent regulator or authority monitors spend closely and evaluates value to customers. For projects with the lowest levels of complexity, a business case of some form will be required and approved.

Governance

Additional signoffs can be difficult to navigate given the number of public bodies which have been setup to protect certain elements of society. These can include Highways Agency, Environment Agency, Local Authorities, Gas/electricity/broadband suppliers, Canals and River Trust, Parishes etc. Additional consents can make projects difficult to construct and therefore are an indicator of complexity.

Novelty

Some projects can be first-of-a-kind, and some are carried out on a regular basis. Constructing a well-defined asset such as a new road can be easier than building a novel structure such as a football stadium. This is because there is additional design required and the supply chain may not be prepared.

Site

The condition of the site should also be considered when determining whether a project is complex or not. In particular, the location (urban or rural) and development on greenfield vs brownfield can have a significant impact on how difficult a project is.

Each criterion is assessed based on a scale of one to five. The composite score is then a simple average of the individual scores.

6.2 Methodology for selection of probability distributions ("fit test approach")

To simulate expected performance in AMP8, probability distributions must be selected which describe the shape of the range around baseline performance – as described in Section 6.1. Analysis of the AMP7 sector performance data established that most performance distributions were not normal nor symmetric. Resultingly, robust analysis must look to distributions which more appropriately describe the attributes of the underlying data, such as asymmetry.

To determine more representative distributions, a fit test was undertaken to select the most appropriate probability distribution, with the aim to preserve the features of historical data into the forward-looking simulation and reflect more accurately the upside and downside potential. This approach retains the shape of the empirically observed distributions and more appropriately simulates risk on an aggregate basis.

The alternative of using a normal distribution for all risk components – defined via a mean and a standard deviation – could allow outliers to skew results and therefore raise questions about outlier exclusion. Using the full sector performance data for simulating the forward-looking risk limits subjectivity and discretion, is more analytically robust, and more aligned with Ofwat's regulatory duty to ensure all licensees are financeable.

In general, the number of unique distributions was limited by utilising a single distribution type where other distributions were not materially different. This helps to simplify the analysis and makes the methodology easier to understand without reducing the degree of accuracy. Several different distribution types were required based on the results of the fit tests and the criteria outlined in the main body of the report. The key distributions selected as inputs to the risk analysis are described below:

- **Inverse Gaussian Distribution**, also called the Wald or normal-inverse Gaussian, is a member of the exponential distribution family with a single mode and long tail. The distribution is used to model non-negative, positively skewed data and has a wide variety of applications in business, survival analysis, finance, medicine, and even in labour dispute resolution. The distribution's tail decreases slowly compared to the normal distribution. Therefore, it's suitable for simulating phenomena where there is a greater likelihood of getting extremely large values compared to the normal distribution. Most distributions were fit to an exponential distribution type and in most of these cases the Inverse Gaussian was used to capture the degree of skew.
- **PERT distribution,** also called the beta distribution, is a bounded distribution defined typically by the minimum, maximum and mode. The PERT distribution has direct applications in risk analysis especially when simulating uncertain variables or limited observations. It is similar to the triangular distribution type but is curve on both sides instead of a straight line. It is an intuitive tool to model risk and is easy to understand given the direct relationship between input parameters and observed data.
- **Exponential distribution** is another member of the exponential distribution family and declines exponentially from its maximum point towards zero. It is similar to the Inverse Gaussian and can be used where the P10 and P50 are very close together. Given their similarity, the Inverse Gaussian distribution was used where possible and exponential distribution was used only where the P10 and P50 were too close to define an Inverse Gaussian distribution.
- **Normal distribution** is a well-known distribution commonly used in social sciences. It is defined by the mean and standard deviation and importantly is symmetrical with limited tail risk compared to the other distributions included in the analysis.
- **Discrete distributions including Binomial and Poisson** model outcomes where there are only two outcomes and are based on the chance of achieving one outcome over the other.
    - **Binomial distributions** are often used in credit analysis and default simulations based on a probability of default. It is best used when a distinct event can only occur once in a set time frame, such as default.

- **Poisson distributions** are used to model the number of times a binary event may occur over a time period and more appropriate where the modelled event can occur more than once in the time period, like serious pollution incidents.

The below table shows which distribution was applied to each risk based on the criteria outlined in the report:

Table 23: Selected distributions for each risk component

PC	Distribution type	Continuous / Discrete
Net profit margin	Normal	Continuous
Base totex	Inverse Gaussian	Continuous
Enhancement totex	Inverse Gaussian	Continuous
DPC	Binomial	Discrete
C-MeX	PERT	Continuous
D-MeX	PERT	Continuous
Leakage	Inverse Gaussian	Continuous
Customer contacts on water quality	Normal	Continuous
Water supply interruptions	Inverse Gaussian	Continuous
CRI	Inverse Gaussian	Continuous
Mains repairs	Inverse Gaussian	Continuous
Per capita consumption	Normal	Continuous
Unplanned outage	Normal	Continuous
Total pollution incidents	Inverse Gaussian	Continuous
Internal sewer flooding	Inverse Gaussian	Continuous
Sewer collapse	Inverse Gaussian	Continuous
Discharge permit compliance (WaSC)	PERT	Continuous
External sewer flooding	PERT	Continuous
Serious pollution incidents (WaSC)[a]	Inverse Gaussian	Continuous
Serious pollution incidents (WoC)	Poisson	Discrete
Cost of embedded debt	Normal	Continuous
Cost of new debt	Inverse Gaussian	Continuous
CPIH variation	Normal	Continuous
CPI-CPIH wedge	Normal	Continuous
RPI-CPIH wedge	Normal	Continuous

Note: (a) The serious pollution incidents were standardised similarly to total pollution incidents for the purposes of simulating performance and therefore a continuous distribution type was used.

6.3 Methodology for simulating base totex risk

The simulation relies on the sector's observed performance from allowances by water and wastewater price controls adjusted for a number of changes in the AMP8 framework. The adjustments to historical performance are to create a more reliable dataset reflective of risk expected in AMP8. These adjustments to observed AMP7 performance versus allowances includes:

- **Variance due to timing**: this is a self-reported and unaudited figure included in company APRs to decompose the driver of totex performance. The variation due to timing is not reported for base totex specifically and is assumed to proportionally impact the base and enhancement totex based on the proportion of total totex.

- **Energy RPEs**: the DDs introduced a material risk mitigation of an ex post true up for outturn energy costs inflation. One of the major risk drivers in AMP7 on base totex was inflation and therefore AMP7 underperformance is not predictive of AMP8 performance. To remove the impact of energy cost inflation from AMP7 data, AMP7 allowances were adjusted upwards. The amount was estimated by the difference in the proportion of energy costs in botex between AMP7 and AMP6, assuming it was entirely driven by high inflation of power costs.
- **Changes to the cost models**: the DD base cost allowances are higher than in AMP7. The full like-for-like impact of this change could be assessed by taking the full 14% increase in allowances (before frontier shift) and reducing this by population growth (3% compounded over 5 years) and frontier shift (5% compounded over 5 years), arriving at the 6% net like-for-like increase in allowances. While this is a simplification and further analysis of the cost models in warranted, it is the best approximation available. The resulting adjustment was used to improve historical AMP7 performance to be more reflective of performance under the DD allowances.

The historical performance against adjusted allowances feeds into the simulation to produce the reported notional WaSC and WoC results.

6.4 Methodology for simulating enhancement totex risk

The simulation relies on the KPMG infrastructure project database data – a collection of infrastructure projects for which data is available publicly – to set the baseline and performance distribution for cost performance versus initial budget and delay risk. More information about the database can be found in appendix 6.10.

Given the relationship between project characteristics and risk, the methodology must account for differences in project characteristics. To compare projects in the AMP8 capital programme to the projects in the database, the projects were grouped based on their characteristics: initial budget, planned duration, and complexity. The projects in the database's complexity and value were calculated on a consistent basis to the AMP8 projects using the complexity assessment and converting project value based on the World Bank purchasing power parity to 31 December 2022 GBP equivalent.

To eliminate subjectivity associated with matching the projects in AMP8 to the projects in the database with similar characteristics, the analysis relies on the K-means clustering machine learning algorithm to assign projects within the database to groups, from which statistics on cost overrun and delay can be determined. An expectation for cost overrun and delays can then be informed by the database cluster most relevant to the characteristics of the AMP8 project. The algorithm uses the following configuration:

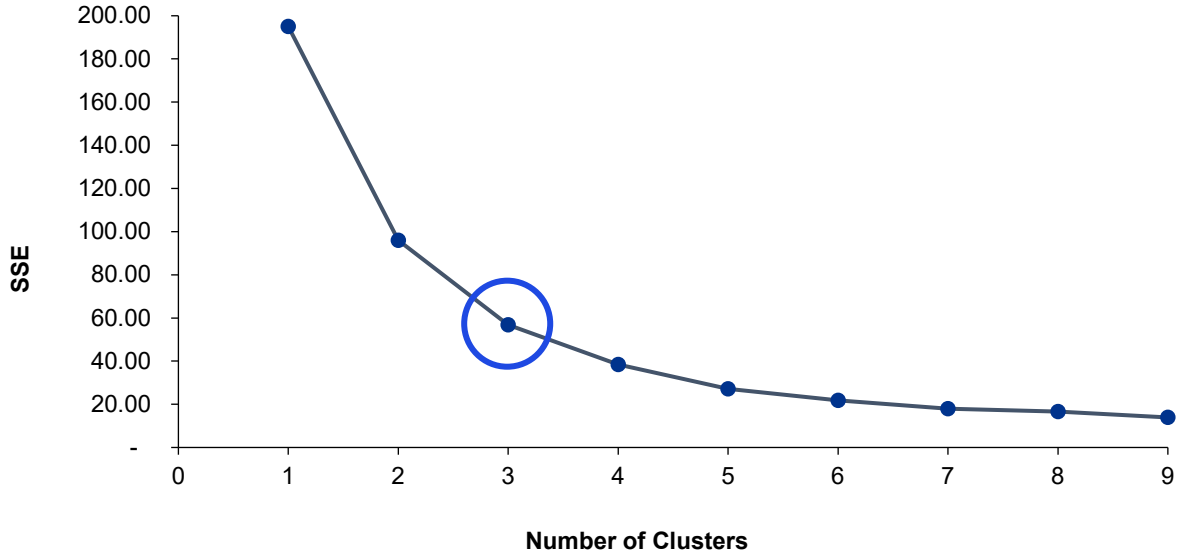
- **Clustering variables**: Initial budget, planned project duration, project complexity.
- **Number of clusters, K**: Three

The clustering variables are standardised to eliminate differences in scale and ensure the algorithm places equal weight on each parameter.

Application of the K-means clustering algorithm is sensitive to K, the number of clusters. To ensure the use of the most appropriate number of clusters, the analysis tests an array of cluster sizes and used the Elbow Method[64] as a guide.

[64] Umargono, E., & Suseno, J. & Gunawan, S.K. (2020), K-Means Clustering Optimization Using the Elbow Method and Early Centroid Determination Based on Mean and Median Formula. Paper can be found here.

Chart 178: K means optimal cluster number - elbow method

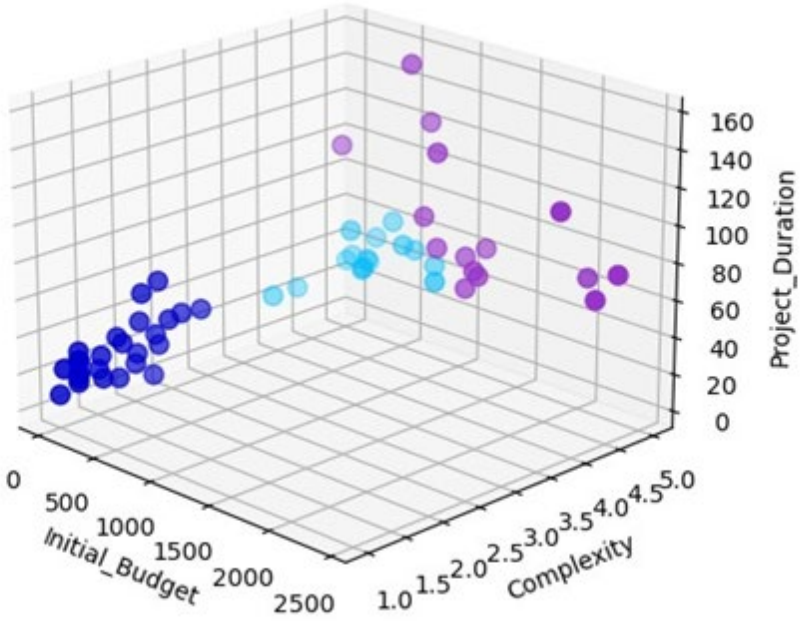


The elbow method dictates that the “kink” or “elbow” in the graph plotting sum of square error, SSE, against number of clusters is the optimal number of clusters. This technique helps quantify the benefit of adding an additional cluster. The inflection point in the graph represents a natural optimisation between the explanatory power of the algorithm and the risk of over-fitting resulting in a small number of projects per cluster.

For the projects in the database, the elbow could be interpreted as occurring at 2, 3 or 4 clusters. Additional clusters increase the accuracy of the analysis, as it places stricter conditions on the likeness of data points allocated to the same clusters, however, increases the computational cost of the clustering and may reduce the number of data points in each cluster and therefore the robustness of the cost and delay statistics. Three clusters are determined to give the most appropriate groupings for application to the notional company’s enhancement performance in AMP8 and ensured sufficient sample population in each cluster.

The results of the algorithm are represented below on the three-dimensional graph. Each database project is plotted across the three variables used in the clustering algorithm: initial budget, complexity, and project duration. Each project is coloured to represent the assigned cluster:

Chart 19: Infrastructure project database clustering



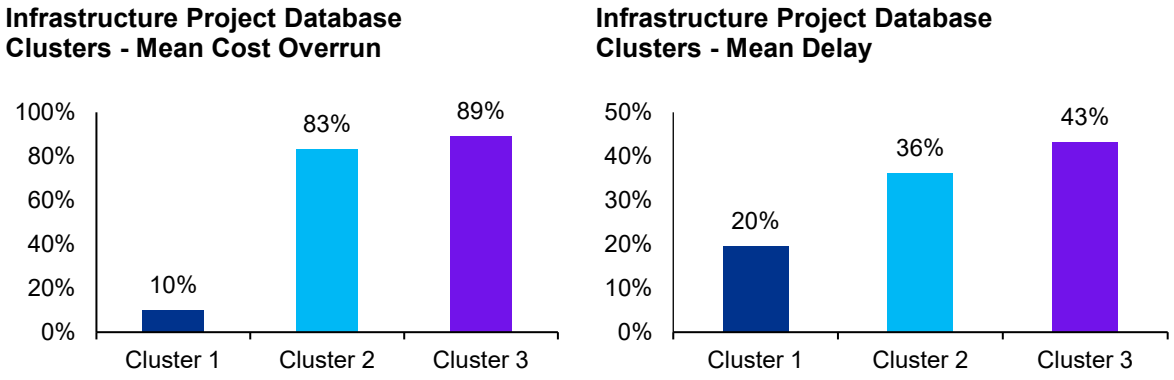
The clusters have the following attributes:

Table 24: Project database cluster characteristics

Cluster	Colour	Population	Average Initial Budget	Average Duration	Average Complexity
Cluster 1	**Navy**	27	£36m	24 months	1.7
Cluster 2	**Blue**	14	£433m	43 months	4.6
Cluster 3	**Purple**	15	£1371m	83 months	4.7

The project performance is also graphed below for comparison purposes:

Chart 20 a, b: Infrastructure project cluster performance against budget (cost, duration)



This analysis demonstrates that projects with similar characteristics to any of the three clusters are, on average, subject to cost overruns and delays - even those of lower scale and complexity. Additionally, projects requiring larger investment and over longer time frames are exposed to greater risk. Consequently, undertaking larger enhancement projects in AMP8 exposes the notional company to greater risk of cost overruns and delays.

Cost associated with extended timelines such as paying for additional use of contractors and machinery is also captured by the cost performance in the database. Cost overrun risk arising from project delays is inherent in the cost overrun calculated from the infrastructure project database.

Each enhancement spend category per CW3 and CWW3 are assigned one of the three clusters from the KPMG infrastructure project database by statistically optimising the cluster allocation[65]. Once the number of schemes within categories are considered, all enhancement categories are allocated to cluster 1. Whilst this is the least complex and best performing cluster from the KPMG infrastructure project database, it notably still has expected cost and timely delivery underperformance.

The statistics of the cost performance for the assigned cluster is used to simulate cost overrun for each enhancement category, with delay statistics facilitating simulation of PCD impact. The analysis uses Monte Carlo simulations with the following inputs to simulate the impact of the regulatory framework:

- A sharing rate of 40:40 for all enhancement totex across each price control and applying enhanced sharing rates of 25:25 based on the schemes in the gated allowance delivery mechanism and the large and complex projects delivery mechanism.
- Correlation between cost performance and time delay is set based on the empirical correlation calculated in the database of +0.51. Logically, a positive result is expected where the common risk drivers like design change can drive both, and delays often cause cost overrun where teams are paid for longer period of time. The degree of allowance clawback under Non-Delivery PCDs is set equal to the proportion of the delay applied to the original allowance estimate.[66]
- Correlations between the cost overrun between enhancement projects and delay between projects are set to nil, meaning performance in one category is unrelated to another's performance. This is a risk conservative assumption in the absence of empirical evidence and is appropriate given water companies may have delivery benefits not captured by the database statistics, such as having delivered similar projects in the past and relying on the same resources to deliver in future.
- Non-delivery PCDs are triggered when projects are delivered more than 3 months late into AMP9 in recognition of the flexibility allowed by the DD. Allowances are clawed back based on the degree of delay as a proxy for scope delivered. If a 60-month project is 12 months late, the clawback would be based on 83% of the scope being delivered (60 months / (60 months initial estimate + 12 months late)).
- Time incentive PCDs are calculated based on the degree of project delivered late. Using the prior example 83% of the project was delivered on time and receives the reward rate while 17% of the project was late and receives the penalty rate.

Relying on a public projects data has its limitations: it is not fully aligned with the risk of delivering water and wastewater infrastructure projects. While matching projects based on their size, duration and complexity helps to manage the data limitations, it cannot be completely eliminated without changing the underlying dataset.

To mitigate some of these limitations, the results are cross checked to industry reports on cost overruns and delays. BCG's International Major Infrastructure Projects Benchmarking Review[67] found average cost overruns of 15% and 31% on UK social infrastructure and UK transport projects respectively. Schedule delays were 5% and 22% respectively. Other reports, such as "Costing of Infrastructure Projects" by the IMF[68] and "Reducing the gap between cost estimates and outturns for

[65] Each enhancement case assigned to the cluster to minimise the sum of squares between the three attributes of the enhancement category and the cluster average.

[66] For example, a delay of 20% would result in a project being 100%/120% complete at the end of the planned duration. Assuming linearity of delivery progress, 83% of the project (100/120) is delivered and therefore 17% not delivered. 17% of the allowance is therefore return as part of the Non-Delivery PCD mechanism.

[67] BCG (2021), International Major Infrastructure Projects Benchmarking Review. Report can be found here.

[68] IMF (2019), Costing of Infrastructure Projects. Report can be found here.

major infrastructure projects and programmes" by the ICE[69] indicate higher cost overruns across transport and infrastructure between 20%-80%.

The aggregate sharing mechanism is applied to the net wholesale totex consistent with the DDs.

[69] Institution of civil engineers (2019), Reducing the gap between cost estimates and outturns for major infrastructure projects and programmes. Report can be found here.

6.5 Methodology for simulating retail profit risk

Retail profit performance for the risk analysis is based on the AMP7 performance of total retail profit achieved relative to the retail margin adjustment removed from the WACC. Retail controls are set as average revenue controls, on the basis of retail costs plus a net margin that covers retail earnings before interest and tax. At PR19, a household retail net margin of 1.0% was allowed. To reflect that, appointee allowed return was adjusted downwards to remove the impact of the allowed retail margin. Expressed as a percentage of RCV, Ofwat's estimate of the retail margin adjustment was 0.04% at PR19. The retail margin adjustment can therefore act as a proxy allowance for retail profit as the appointee must meet the retail profit to earn the full cost of capital.

Historical performance is adjusted to reflect that Ofwat has increased allowances based on ex ante salary and benefits inflation in the retail totex allowances. The historical allowances are adjusted upward to account for the reduced inflation risk by referring to the ex-ante estimate of salary and benefits inflation at the time of PR19 and adding this to historical allowances. Performance is recalculated using higher allowances.

Recalculated performance is simulated over the increased retail profit in AMP8 of 0.06%. This results in the downside in the worst and base-case. The limitations to simulating AMP8 retail profit performance using AMP7 data are acknowledged. While bad debts influenced by the Covid-19 pandemic may not re-occur, high inflation and cost of living crisis may persist given the macroeconomic volatility.

6.6 Methodology for simulating market delivery route risk

Due to the industry-wide increase in required investment, utilizing market-based delivery is necessary for delivering the required asset improvements and increasing whole-system resilience. However, market-based delivery creates exposure to various types of risk. Table 25 details the elements of risk, who bears the risk and whether it was quantified it in this analysis.

Table 25: Risks associated with market-based delivery

Area of Risk	CAP*	*Notional co.	Detail	Quantified
Costs			100% of cost risk remains with a CAP[70] under fixed price contracts or a proportion is shared with customer under target cost contracts (pass through via the revenue directive)	No
Delay and associated statutory penalties			The CAP is expected to bear most of this risk. The notional company would bear residual exposure to the delay risk and be exposed to the risk of associated statutory penalties. The CAP will only be paid upon the delivery of the asset, so it is strongly incentivised to deliver timely. However, our expectation is that delays will be likely due to supply chain constraints.	No
Impact on rating			Ratings agencies' treatment of market-based delivery for key credit metrics may expose the water company to elements of risk	No
CAP default			The notional company may have to re-tender and be exposed to the associated delays in delivery	Yes
Operational performance			CAP is expected to bear most of this risk, subject to a cap. In reality, it will be very difficult to draft the contract in such a way that it covers every possible implication from an operational perspective	No

Note: orange indicates the party bearing the risk.

[70] Competitively Appointed Provider.

The only risk that was quantified in this analysis is related to the default of a CAP because of the difficulty associated with quantifying other sources of risk. Analysis to quantify this exposure in RoRE terms relies on the following evidence:

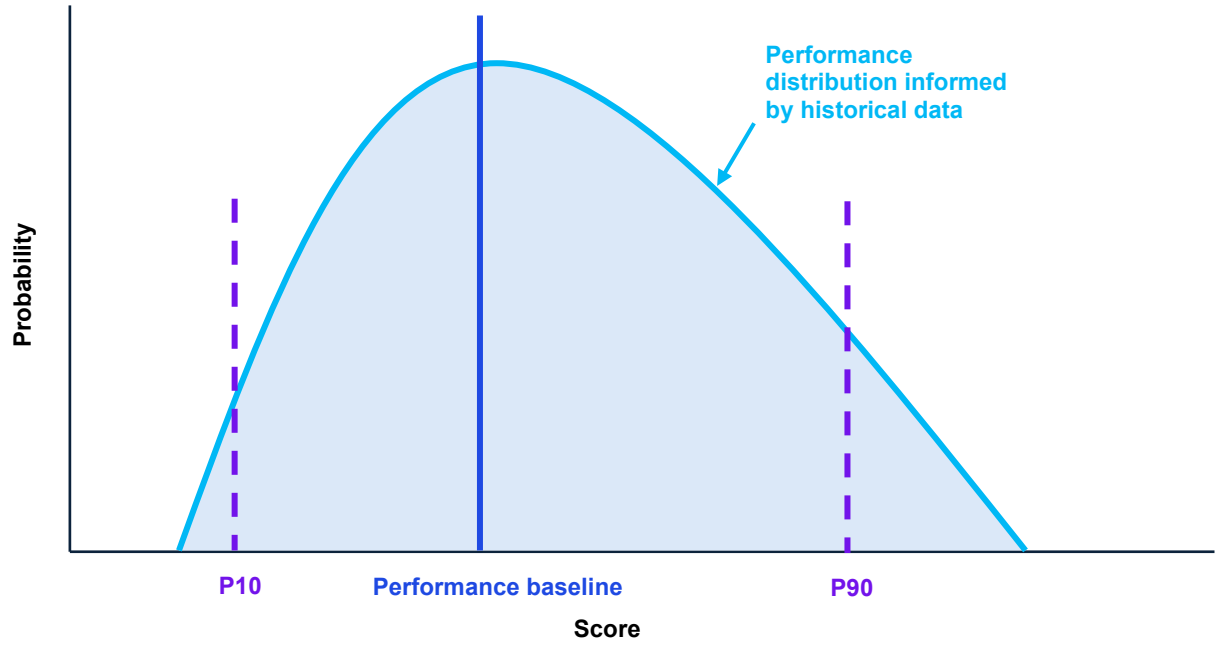
1. **Probability of default** – Moody's Construction Sector Annual Default Rates from 1980-2022 provides data to estimate the probability of a CAP defaulting in a AMP8[71]. In any given 5-year period, Moody's Construction Sector Annual Default Rates average default rate for a CAP is 15.03%.
2. **Cost to retender** – A bottom-up estimation of DPC development costs, focusing on the time and resources required for pre-tender and tender activities of a notional DPC project. This approach enables the development of specific DPC tender cost estimates across eight key activities, in line with Ofwat guidance and industry practices[72]. These activities encompass regulatory engagement, governance, commercial and legal planning, procurement, and market engagement. Detailed workplans for each activity outline the necessary full-time equivalents (FTEs) and their associated costs, categorised into SW internal, technical advisor, financial advisor, and Legal advisor, with day rates estimated for each category. The cumulative result of this analysis is a final tender cost of £5.16m. This figure of £5.16m represents the assumed value-at-risk, in the event of a CAP default necessitating retendering.

As the range of outcomes when considering CAP default are either (1) CAP default, or (2) no default, the problem is binary in nature[73]. Therefore, a binomial distribution is most appropriate when estimating CAP default risk. The simulation inputs are the probability of a CAP defaulting over a five year period and where a default occurs the cost to retender is used as the penalty in the simulation.

6.7 Methodology for simulating measures of experience risk

The simulation relies on observed measure of experience scores, reweighted to match the AMP8 definitions, to determine (1) an expected baseline for notional company performance, and (2) the appropriate distribution of performance around this baseline. This is represented diagrammatically below:

Chart 21: Probability distribution for simulated measures of experience performance



[71] Moody's (2023), Annual default study: Corporate default rate will rise in 2023 and peak in early 2024. Report can be found here.

[72] Ofwat (2019), Anglian Water: Direct procurement for customers detailed actions. Publication can be found here.

[73] When considering DPC default risk, each trial is independent and has only two possible outcomes.

Financial outcomes for C-Mex are calculated relative to the 2022 UKCSI average score for all years in AMP7, and calculated relative to the annual sector median for D-Mex.

The DD introduced new reward and penalty rates based on regulated equity instead of residential retail revenues and developer services revenues. The update to rates is reflected based on the calculated maximum and minimum scores observed that would earn the full reward or penalty. For C-Mex this is the upper quartile and minimum UKCSI score for 2022, and for D-Mex it is the annual maximum and minimum score.

The notional company baseline performance for C-Mex is negative because the median company underperformed the UKCSI in 2022. The D-Mex baseline performance is zero penalty or reward, as by definition the P50 performance for the calibrated notional company is the sector median, which is also the target. The same methodology applies to the notional WaSC and notional WoC.

6.8 Approach to simulating ODI risk

ODI simulations adopt a similar approach to Measures of Experience: adopting a performance baseline and a statistical distribution around that baseline.

- **Performance baseline.** The simulations capture performance risk and potential calibration risk by setting a baseline expected performance different from the median DD targets. The baseline for each PC is the median of the average AMP7 physical performance averaged with the median BP forecast. PCs are standardised wherever possible to remove the impact of different size networks or companies and how this impacts performance. The baseline reflects the average of AMP7 performance and BP forecasts because the BPs may have embedded a material degree of stretch for the median company. Companies were incentivised to build ambitious forecasts and may have been overly optimistic or not appropriately considered the potential impact of changing risk dynamics like extreme weather. In some cases, company forecasts in 2024/25 were revised by Ofwat in setting the DD targets, building in further stretch to PCLs by improving the baseline.
- **Performance distributions.** Performance simulations for each PC are based on the observed distribution of performance versus target over the first four years of AMP7. For water PCs these were assessed for the sector as a whole and applies equally to the notional WaSC and notional WoC. For serious pollutions incident the risk profile is materially different given a WoC does not operate a wastewater network and has limited ways it could commit a serious pollution incident. Therefore, this PC was separated between the WaSC and WoC performance in AMP7. The distribution shapes are maintained, and performance simulated around the baseline.

The resulting simulated physical performance is compared to DD median targets and rates, including enhanced thresholds and enhanced rates, to calculate the notional company's financial impact.

Generally, the methodology laid out in the previous paragraphs is followed for the common PCs with sufficient data available. The below table explains where methodology diverges for a subset of PCs. Some PCs were not modelled due to the lack of historical performance versus an ex ante target.

Table 26: Rationale behind each method of ODI data selection

ODI	Rationale
Method 1:	Simulated as a per cent deviation from upper quartile targets in AMP7
Pre-existing Common ODIs (excl. CRI)	Sufficient data available
Method 2:	Physical performance simulated where targets are zero
Compliance risk index (CRI)	The target was zero and therefore the AMP7 deviation could not be modelled as a per cent deviation from zero.
Serious pollution incidents	Ex-ante proxy target assumed at zero given there is no permissible level of serious pollution.

ODI	Rationale
Alternative targets:	Performance against AMP7 ex ante targets does not represent AMP8 expectations
PCC & Business demand	The Covid-19 pandemic had significant impact on PCC and Business Demand performance. Resultingly, and as the AMP7 targets were set prior to the pandemic, AMP7 performance is unlikely to represent expected AMP8 performance. To simulate ranges, PCC and Business Demand targets were replaced with updated forecasts reflecting the impact of Covid-19 prepared after the pandemic. This is a proxy for capturing risk on these metrics and while there are limitations, is favourable to excluding these ODIs which have historically carried material risk for the sector.
Excluded:	Not simulated
Discharge permit compliance (WoC)	As Ofwat has introduced this ODI for WoCs for the first time in PR24, there is no historical data on WoC discharge permit compliance with ex ante targets. Given the material differences between WaSC discharge permits and WoC discharge permits, this ODI could not be simulated based on WaSC performance and was therefore excluded.
River water quality	The risk associated with this PC is effectively WINEP P-removal scheme delivery risk. There is insufficient data to reliably model the risk of non-delivery for WINEP removal schemes.
Storm overflows	No ex-ante targets were present and therefore cannot be analysed according to the methodology.
Bathing water quality	There is no comparable data equivalent to the proposed required for PC reporting.
GHG emissions (water and wastewater)	Targets are set specific on a company-specific basis. There is no robust method for determining notional company targets and mis-forecasting risk of GHG emissions, which is a key driver of the risk associated with this ODI.
Biodiversity	The PC is based on a novel assessment methodology for biodiversity and therefore does not have an appropriate historical comparator.

The simulation also considers the regulatory mitigations applied to the incentives to limit risk for a notional company. Based on the DDs, the follow were included in the unmitigated notional company simulations reflecting the DD protections:

- Aggregate sharing mechanism: for net reward or penalties that fall between +/-3.0% and +/-5.0% water or wastewater regulated equity a sharing rate of 50% is applied; beyond +/-5.0% water or wastewater regulated equity a sharing rate of 90% is applied. This also includes measures of experience apportioned based on the split of RCV between water and wastewater for a WaSC or entirely to water for a WoC.
- Asset health caps and collars for mains repairs, unplanned outage and sewer collapse a cap and a collar of +/-0.50% apply.
- Compliance risk index deadband set at 1.83 on a glidepath to 1.00 over AMP8 consistent with DDs.
- Water supply interruptions collar set at -1.00%.
- Business demand cap and collar set at +/- 0.50%.

The impacts of mitigations in the DD on ODIs not modelled – caps and collars on Bathing Water Quality, Storm Overflows, and River Water Quality – are not captured as the underlying risk is also omitted.

For a notional WoC, ODI rate calibration resulted in materially higher regulated equity at risk before considering the impact of the caps and collars than for a notional WaSC. This is because the ODI rates published in Ofwat's top-down models were calibrated based on median water company characteristics without separating WaSCs and WoCs.

WoCs have fewer ODIs resulting in greater risk concentration, especially if positive correlations are present.

Correlations are included based on company provided data (performance by month and, where available, region). These data provide greater insight into underlying relationships between PCs which is not visible at an annual aggregated basis. The results for four companies are assessed individually and the results, presented below, take the median of each relationship. Where only one company identified a relationship between two PCs the relationship is not included. The risk of including spurious relationships is mitigated through (1) a materiality threshold of +/-0.15, whereby relationships below this in magnitude were omitted, and (2) confirmation of a logical explanation for observed relationships from operational teams. The relationships identified are listed below with a brief description of the operational explanation:

- **Leakage reductions and customer contacts on water quality; +0.20**
  Where leaks in the network are repaired, this can involve flushing pipes. This displaces sediment in the network and increases the chances of sediment in customer taps. Customer contacts regarding cloudy appearance of drinking water is included the customer contacts on water quality PC.
- **Leakage and mains repair; +0.40**
  By definition, a mains burst results in leakage and would trigger a mains repair and this relationship exhibits a particularly strong correlation. There are a number of common risk drivers that cause bigger leaks like burst mains and smaller leaks throughout the network, for example ground temperature dropping below freezing. When water freezes it expands and can create breaks in the network ranging in size from a smaller pipe to a mains burst. Other extreme weather events like a freeze thaw and named storms are also common risk drivers.
- **Water supply interruptions and mains repair; +0.21**
  A mains burst is a more severe leakage event which can leave the network depleted and customers without water, especially if there is only one main servicing a particular customer. Leakage is not related to water supply interruptions despite a strong relationship with mains repair because leakage is also driven by small leaks in the network which have very little to no impact on supply interruptions.
- **Total pollutions incident and serious pollutions incident; +0.19**
  By definition all serious pollutions incidents are included in the serious pollutions incident PC performance. Serious pollution incidents exclude category 3 pollutions incidents and the majority of the PC performance for total pollutions incidents is driven by category 3 incidents. A small positive correlation therefore tracks with the duplication of the PC performance counting against both PCs while total pollutions includes other incidents.
- **Total pollutions incident and external sewer flooding; +0.18**
  Both PCs are driven by rainfall and the network being overwhelmed. The common risk driver of precipitation explains the small positive relationship.
- **External sewer flooding and internal sewer flooding; +0.55**
  Sewer flooding PCs are both strongly associated with rainfall and wastewater network capacity. This results in a stronger positive relationship as there are common explanatory risk factors.

6.9 Approach to simulating financing risk

Finance risk has five risk drivers considered in this analysis: three inflationary and two non-inflationary. Inflationary risks include CPIH risk on fixed rate debt, RPI-CPIH wedge risk on embedded RPI-linked debt, CPI-CPIH wedge risk on embedded and new CPI-linked debt. Non-inflationary risk includes real interest rate risk on embedded and new debt.

Inflationary risk

CPIH variation is simulated based on variation of outturn CPIH to the long-term 2.00% assumption included in the calculation of real allowances for debt. Where CPIH deviates from the long-term

assumption, the notional company is exposed to variation in nominal allowances received to cover nominal fixed rate debt costs. The DD considers CPIH risk based on a +/-1.00% shock to the long-term assumption. Historical observed variations in inflation imply this range of outcomes does not sufficiently reflect forward looking risk.

The methodology considers historical variation in CPIH inflation index since 2015 separated into two time periods based on an observed structural break. The first time period is March 2015 – November 2021 and was characterised by lower than target inflation. The second period was November 2021 – July 2023 and was characterised by higher than target inflation. CPIH is impacted by a multitude of macroeconomic factors, and therefore has historically had periods of lower volatility and higher volatility dependent on domestic and global events. It is therefore important to consider separate "low volatility" and "high volatility" scenarios – without this separation the variation and thus risk may be overstated.

Using empirically observed CPIH volatility, P10, P50 and P90 observations (worst-case, base-case and best-case in the analysis) is translated into RoRE using Ofwat's approach and the notional company capital structured defined previously:

$$Inflation\ variation\ \times Proportion\ of\ ILD\ \times \left(\frac{Notional\ Gearing}{1 - Notional\ Gearing}\right) \times (1 - Tax\ rate)$$

The basis risk on index-linked debt is simulated based on data going back to April 2000 to July 2023 for CPIH, RPI and CPI using time series analysis. The observed wedges for RPI-CPIH and CPI-CPIH are then calculated on the results on the AMP8 time series simulated. To maintain consistency with the observed empirical dataset in terms of the relationships between CPIH and the two calculated wedges, the correlations below were included:

- CPIH inflation risk and RPI-CPIH wedge risk; +0.33
- CPIH inflation risk and CPI-CPIH wedge risk; +0.69
- RPI-CPIH wed risk and CPI-CPIH wedge risk; +0.35

Non-inflationary risks

Real interest rate risk for new debt risk was simulated based on the empirical sector debt issuances in AMP7 up to August 2023 compared to the iBoxx A/BBB non-financials 10+ years index average. The resulting observed P10, P50 and P90 observations (worst-case, base-case and best-case in the analysis) are used to simulate performance in AMP8. The results are translated into RoRE based on the notional company capital structure defined in Appendix 6.1 - Notional company specification and calibration.

Real interest rate risk on embedded debt was simulated based on the empirical sector embedded cost compared to how Ofwat determines the allowance. Deviation of an efficient notional company's cost of financing from allowances can occur for a number of reasons including timing of issuance, frequency, treasury policy. The resulting observed P10, P50 and P90 observations (worst-case, base-case and best-case in the analysis) are used to simulate performance in AMP8. The results are translated into RoRE based on the notional company capital structured defined in Appendix 6.1 - Notional company specification and calibration.

For simplicity, simulation of financing risk does not differentiate between the notional WaSC and WoC. This means that the simulation does not consider the unique circumstances of individual WoCs, for example whether, as a small company issuing below benchmark size debt or an infrequent issuer that issues benchmark size debt. These would be expected to increase the financing risk for a WoC with these characteristics and should be considered on a company specific basis.

6.10 Infrastructure projects database

The projects in the KPMG infrastructure project database are summarised by the following attributes: country, sector, complexity, £m budgeted cost at initial planning, planned duration. As the planned enhancement for PR24 is at the initial stage, only those projects where initial budget data was available are included. Project costs are translated into GBP and adjusted using the World Bank's purchasing power parity conversion factor to allow comparison at a 31 December 2022 GBP equivalent position.

The below tables summarise the attributes of the projects in the database used in the Phase 1 work.

Table 2726: Summary of the third-party project database

Country	Project count
UK	31
US	5
Australia	4
Germany	4
Hong Kong	3
Sweden	2
Netherlands	2
Japan	2
France	2
Greece	1
Ireland	1

Sector	Project count
Rail	19
Water / Wastewater	12
Road	8
Social	6
Aviation	4
Energy	2
Transport	2
Rail and road	1
Healthcare	1
Education	1
Industrial	1

Complexity	Project count
1.0 - 2.0	16
2.0 - 3.0	11
3.0 - 4.0	1
4.0 - 5.0	21
5	8

Initial Budget	Project count
< £25m	14
£25m - £100m	12
£100m - £250	6
£250 - £500	6
£500+	19

Planned Duration	Project count
< 6 months	1
0.5 - 2 years	11
2 - 4 years	22
4 – 6 years	16
6+ years	7

Source: KPMG infrastructure project database