PR24 Cost adjustment claims

Initial submission

June 2023

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1. Introduction

1.1 Approach

This document sets out the cost adjustment claims (CACs) that are required for inclusion in the PR24 cost assessment process, to reflect the unique cost drivers for Bristol Water (BRL) and South West Water (SWW) that are currently inadequately captured within the econometric models.

These CACs have been identified through a systematic selection process, defined in section 2, which began with a longlist of potential claims and was cut down to a shortlist that meets Ofwat's criteria. The process reviewed the potential need for adjustments from both a top-down econometric perspective and a bottom-up assessment of our cost drivers.

We have closely followed the requirements for this submission, as set out in Ofwat's PR24 Final Methodology,[1] and especially Annex 1 of Appendix 9, which defines the assessment criteria for CACs.

The analysis has drawn on research into CACs at PR19, especially those of SWW and BRL, and the subsequent appeals to the Competition and Markets Authority (CMA) and its final decisions. SWW and BRL have also engaged with Ofwat through the Cost Assessment Working Group and in company-specific meetings to provide their views on key cost drivers (in particular through the January cost model submission and our May 2023 response to the base econometric cost model consultation) and the implications for CACs. We were supported by the economics consultancy Oxera Consulting LLP (Oxera) in the identification and shortlisting of potential claims.

Throughout the CAC identification process, we have sought to identify any areas where a downward adjustment would be applicable to our costs due to favourable operating conditions. We have not identified any such factors that met the relevant materiality thresholds. This is consistent with the nature of the operating areas and the very specific cost adjustment claims that we have identified.

We have also calculated symmetric impacts / implicit allowances where relevant, for example with the leakage claim.

These are provisional initial claims and, as requested by Ofwat, are based on the Ofwat models as proposed in the base cost econometric model consultation. We believe other CACs are likely as part of enhancement cases, depending on the form of the PR24 enhancement cost assessment for which there are currently no details available. The canal cost (CRT) and leakage claims are highly unlikely to vary depending on Ofwat's final selection of base econometric models. The bioresources claim would not be required if our position on the bioresources unit cost models was reflected in the final model suite. These claims are also based on assuming that other characteristics of our operating environments are correctly accounted for in Ofwat's final selection of base econometric models. However, depending on Ofwat's final selection, we may have additional claims to make (for example, if APH is not used as the sole driver of topography and some weight is placed on models using number of pumping stations, then we would consider that there would be need for an additional claim).

[1] Ofwat (2022), 'Creating tomorrow, together: Our final methodology for PR24', December.

The CRT claim reflects a factor for the BRL area that was accepted at previous reviews, and the proposed methodology reflects the PR19 approach. The leakage claim reflects the service-cost relationship approach taken by BRL and the CMA at PR19, and is consistent with the development of the approach we set out towards the PR24 methodology consultations. Therefore, these claims have significant regulatory precedent for their consideration as the factual circumstances have ostensibly not changed.

Based on the Ofwat consultation models, we have not identified any Retail Cost Adjustment Claims. We have considered BRL and SWW jointly in line with the expected approach for PR24, which meant that potential CACs (e.g. transience in the Bristol area) are not expected to be material across the wider region.

The CACs are summarised in the tables in section **Error! Reference source not found.**.

1.2 Overview of claims

This section summarises the robustness of the three CACs submitted for PR24, including cross-references to the Ofwat CAC template.

The CRT CAC has a gross value of £12.7m and a net value of £12.2m; its basis is summarised in the table below.

Table 1.1 Canal Cost (CRT) CAC

Name of Claim	Canal cost	Section 3
Unique circumstances		
Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?	Yes. BRL has to source around half of its distribution input from a single source and has limited scope to find alternative sources of similar reliability. The CRT costs are additional to the abstraction costs paid by all companies.	Section 3.1
Is there compelling evidence that the company faces higher efficient costs in the round compared to its peers?	Yes. Prices are negotiated periodically and subject to arbitration. An examination of the claim by the CMA after the PR19 final determination accepted that the higher costs faced by BRL were efficient.	Section 3.2
Is there compelling evidence of alternative options being considered, where relevant?	Yes. Explanations of alternative solutions and their unsuitability are presented in this claim and none is practical.	Section 3.4.1
Management control		
Is the investment driven by factors outside of management control?	There is no investment involved in this CAC (it is OPEX only).	N/A
Have steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	Yes. There are periodic negotiations with recourse to arbitration. These negotiations are also used to obtain commitments to maintenance to ensure continuity of supply.	Section 3.4.2
Materiality		
Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?	Yes. Materiality exceeds the threshold (see below) and the rationale is based on ensuring security of water supply at the lowest practicable cost.	Section 3.4.3
Is there compelling quantitative evidence of how the factor impacts the company's expenditure?	Yes. Materiality is 14% of base TOTEX, above the threshold of 6%.	Section 3.4.3
Adjustment to allowances (including implicit allowances)		
Is there compelling evidence that the cost claim is not included in our modelled baseline? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?	Yes. CRT costs are not directly accounted for in the base cost modelling due to the absence of relevant cost drivers. Only a tiny fraction of these costs are captured in the models—less than 3%, which we have deducted from the gross claim as an implicit allowance.	Section 3.4.4
Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?	Yes. Calculation of implicit allowance was discussed in the CMA decision and subsequent work has built on that.	Section 3.4.4
Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?	No cost savings were identified.	Section 3.4.4
Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?	The need for a claim was accepted by Ofwat in PR19 and by the CMA—the disagreements with the company focused on the implicit allowances.	Section 3.4.4

Has the company taken a long-term view of the allowance and balanced expenditure requirements between multiple regulatory periods? Has the company considered whether our long-term allowance provides sufficient funding?	Yes. The triggering of price reviews is contractually defined and this is the basis of the forecasts.	Section 3.4.1
If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in Ofwat's cost models?	No alternative explanatory variable is used to support the claim.	N/A
Cost efficiency		
Is there compelling evidence that the cost estimates are efficient (for example similar scheme outturn data, industry and/or external cost benchmarking, testing a range of cost models)?	The gross costs are set by negotiation and arbitration and external comparison formed part of that process. The efficiency of the CRT costs was acknowledged by the CMA decision at PR19.	Section 3.5
Does the company clearly explain how it arrived at the cost estimate? Can the analysis be replicated? Is there supporting evidence for any key statements or assumptions?	Yes. The gross claim reflects forecasts based on contractual obligations for the period until the next renegotiation in the final years of the regulatory period. The net claim is the gross less the implicit allowance, whose calculation is explained. The analysis can be easily replicated.	Section 3.4.4
Does the company provide third-party assurance for the robustness of the cost estimates?	This claim closely follows the CMA's final decision, where the claim was supported subject to a recalculation of the implicit allowance. More recently, Turner & Townsend has provided technical assurance on the claim and its data sources.	Section 3.5

Source: South West Water.

The leakage CAC is summarised in the table below.

Table 1.2 Leakage CAC

Name of Claim	Leakage	Section 4
Unique circumstances		
Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?	Yes. BRL performs consistently at the industry frontier, thus incurring unique levels of expenditure to maintain low leakage volumes. SWW also performs above the industry median. Moreover, leakage is largely affected by exogenous factors, either regional or company-specific, and as such each company's performance is to be considered unique.	Section 4.3.1
Is there compelling evidence that the company faces higher efficient costs in the round compared to its peers?	Yes. Several econometric methodologies are presented supporting the existence of higher costs related to the maintenance of lower levels of leakage.	Section 4.2

Is there compelling evidence of alternative options being considered, where relevant?	Water resource management plans and Government targets (including for the environment) require companies to improve leakage performance. At lower levels of leakage, it is accepted that there will be higher costs of maintaining leakage at that level, which for ongoing costs (as this claim can be made symmetrically) is a base efficiency factor outside of management control.	Section 4.3.2
Management control		
Is the investment driven by factors outside of management control?	Water resource management plans and Government targets (including for the environment) require companies to improve leakage performance. At lower levels of leakage, it is accepted that there will be higher costs of maintaining leakage at that level, which for ongoing costs (as this claim can be made symmetrically) is a base efficiency factor outside of management control.	Section 4.3.2
Have steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	Bristol changed its operating and contracting approach to leakage in 2019, which included the in-house control of leakage detection, planning and scheduling. There is also a smart leakage network that allows effective identification and monitoring of leaks. The Isle Utility report also provides evidence of approach. As this claim is about the higher costs of better performance, this claim does not adversely affect cost saving incentives, given long term company specific targets for leakage reduction.	Section 4.3.3
Materiality		
Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?	Yes, several econometric approaches rooted in operational rationale show adjustments consistently greater than 1% of WNP costs. The claim is currently estimated at 1.85% for BRL.	Section 4.2
Is there compelling quantitative evidence of how the factor impacts the company's expenditure?	Yes. Three separate econometric approaches are presented, all pointing to similar and consistent results.	Section 4.2
Adjustment to allowances (including implicit allowances)		
Is there compelling evidence that the cost claim is not included in our modelled baseline? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?	Yes. No variables included in the current models take into account the impact of leakage reduction and maintenance on base costs, despite it representing a significant share of costs. This is correct from an efficiency model perspective, but for company base costs should reflect the service cost relationship, particularly at lower levels of leakage.	Section 4.2
Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?	Yes, the claims consistently pass the 1% threshold of materiality.	Section 4.2

Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?	This is a standard and potentially symmetrical claim, based on performance against the industry upper quartile. Therefore offsetting circumstances are inherent within the claim,	Section 4.2
Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?	It is accepted that there is a higher base cost necessary to maintain lower levels of leakage, once these are achieved through enhancement. Therefore as the CMA found on the service/cost relationship, for leakage an allowance is required.	Section 4.1
Has the company taken a long-term view of the allowance and balanced expenditure requirements between multiple regulatory periods? Has the company considered whether our long-term allowance provides sufficient funding?	Yes, as the 50% long term reduction from 2017 levels is company specific, and therefore (although subject to recalculation) the principle of the claim is long-term.	Section 4.5
If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?	No variable inherent to the cost adjustment is currently included into the model. We agree that it is not appropriate to include leakage as a variable within cost models, but an adjustment should either be made to modelled costs or efficiency results – we show both alternatives. As such, the proposed alternative are necessary for controlling for leakage performance.	Section 4.2
Cost efficiency		
Is there compelling evidence that the cost estimates are efficient (e.g. similar scheme outturn data, industry and/or external cost benchmarking, testing a range of cost models)?	Yes. A number of alternative cost models were tested, all providing similar and consistent results.	Section 4.4
Does the company clearly explain how it arrived at the cost estimate? Can the analysis be replicated? Is there supporting evidence for any key statements or assumptions?	Yes. Further detail is provided in the methodological annex. The underlying data consists exclusively of the latest versions of datasets published by Ofwat, and as such the entire analysis can be fully replicated. Assumptions are stated clearly and consistently tested against possible alternatives.	Section 4.2
Does the company provide third-party assurance for the robustness of the cost estimates?	Yes, the analysis was performed by Oxera, and also replicated using the BRL approach that was adopted by the CMA at PR19. As part of the internal assurance process, Turner & Townsend provided technical assurance on the claim against the guidance and the data sources	Section 4.6

Source: South West Water.

The Liming & Bioresources CAC is summarised below.

Table 1.3 Liming & bioresources CAC

Name of Claim	Liming & Bioresources	Section 5
Unique circumstances		Section 0
Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?	Yes. The average percentage of sludge treated by raw liming in the industry is 7%, while on average this amounts to up to 73% for SWW. The exogenous driver is the peninsula nature of the region and farming disposal route requires a highly limed product to maintain the land back. Alternative disposal methods require regulator enhancement support, with implementation lead times.	
Is there compelling evidence that the company faces higher efficient costs in the round compared to its peers?	Yes. Although Ofwat's current modelling suite estimates SWW's costs to be 19–23% higher than the upper quartile, we are placed among the two or three most efficient companies once raw liming is accounted for. This clearly demonstrates that our costs are efficient.	
Is there compelling evidence of alternative options being considered, where relevant?	Alternative options have been considered for AMP8 enhancement through WINEP, but do not for AMP8 avoid the higher base costs. Past proposals for additional storage have not received regulatory or planning support.	
Management control		Section 0
Is the investment driven by factors outside of management control?	The choice of sludge treatment technology results from the operating area of the company (e.g. topography and sparsity), the external farming environment, and environmental legislation and oversight.	
Have steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	Trials of alternative options have been considered at previous reviews but none have fundamentally allowed for better options for disposal route for the region. AMP8 WINEP proposals for an alternative is a EA choice of driver.	
Materiality		Section 0
Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?	Yes, raw liming is a material driver of bioresources expenditure as this sludge treatment technology is much more expensive than alternative AD technologies. This is perfectly in line with the economic rationale and confirmed by the econometric modelling. This accounts for 12% (in a range of 11–14%) of our projected TOTEX for bioresources in AMP8, thereby significantly exceeding Ofwat's materiality threshold for the bioresources price control (6%).	

Is there compelling quantitative evidence of how the factor impacts the company's expenditure?	Yes, the impact of raw liming on companies' costs has been robustly quantified econometrically. It has been estimated that it increased costs significantly across various models. Raw liming is always statistically significant at the 1% level, which means that the estimated impact is robust and accurate.	
Adjustment to allowances (including implicit allowances)		Section 0
Is there compelling evidence that the cost claim is not included in our modelled baseline? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?	Raw liming is not covered by any of the cost drivers included in Ofwat's cost models.	
Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?	After the deduction of the implicit allowance, which in that this case is simply the modelled costs under Ofwat's proposed modelling suite for PR24, the claim is material as it accounts for 12% (in a range of 11 – 14%) of projected TOTEX for AMP8. We have also considered a range of estimates and run different scenarios to cross-check the accuracy of our initial estimate based on our January submission (see Section 0 for the details of these different models).	
Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?	There are no offsetting cost savings – this is a model driver as an outlying factor which is clear from the model options.	
Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?	It is clear that none of Ofwat's proposed models for PR24 are able to capture the higher costs we have to incur regarding the sludge treatment process. Therefore if no adjustments were made, this would leave SWW insufficiently funded for AMP8.	
Has the company taken a long-term view of the allowance and balanced expenditure requirements between multiple regulatory periods? Has the company considered whether our long-term allowance provides sufficient funding?	This question is more appropriate for enhancement rather than base claims. The whole life cost could be lowered in the long term but this would require regulator support for the enhancement investment and change of disposal route, which is not currently in place under WINEP priorities.	
If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?	While the additional explanatory variable might not be necessary or immaterial for an average company, its inclusion is required to account for the specific circumstances that SWW is facing as the company is a clear outlier in terms of sludge treatment technology.	
Cost efficiency		Section 0

Is there compelling evidence that the cost estimates are efficient (e.g. similar scheme outturn data, industry and/or external cost benchmarking, testing a range of cost models)?	Yes, there is strong evidence that the cost estimates presented are efficient. First, they have been estimated based on Ofwat's proposed modelling suite for PR24 with an additional explanatory variable, which means that they have been subject to a robust benchmarking exercise within the industry (11 years of data for the whole industry, i.e. 110 observations). Second, the resulting econometrics models are robust and can be relied on (see Appendix 0 for the statistical results). Third, as per Ofwat's own guidance, cost estimates have been subject to a catch-up efficiency challenge (based on the upper quartile, consistent with the CMA decision at PR19), which we note is more stringent with the inclusion of the additional explanatory variable.
Does the company clearly explain how it arrived at the cost estimate? Can the analysis be replicated? Is there supporting evidence for any key statements or assumptions?	Yes, the whole process can easily be replicated and all of the different steps are detailed in section 5. It simply consisted of adding an additional explanatory variable to Ofwat's proposed modelling suite for PR24. Our January submission, as well as Anglian's, can be used as a starting point for the definition of the additional explanatory variable (raw liming in our case and AD treatment for Anglian's submission). Alongside this document, we are also providing an Excel workbook with all of the results.
Does the company provide third-party assurance for the robustness of the cost estimates?	As part of the internal assurance process, Turner & Townsend provided technical assurance on the claim against the guidance and the data sources

Source: South West Water.

2. CACs selection process

2.1 Introduction

The relatively small number of CACs (only three) being submitted is the result of a rigorous selection process that began with over a dozen potential claims. This section describes the selection process used and what factors were considered.

2.2 Initial longlist

An initial longlist was drawn up from:

- claims submitted in PR19, in case they might still be valid;
- corporate perceptions within the company of how the company's region's topographic and demographic characteristics incur additional cost;
- a consideration of whether some exogenous characteristics might result in lower costs.

It was established that a number of the PR19 claims were no longer relevant, mostly because investments had been made with the intended effect or they were not estimated to pass the PR24 materiality threshold. No characteristics that could lower costs were identified.

An additional exercise was then commissioned for Oxera to examine every CAC submitted by all companies in PR19; this was to identify if any potential CACs had been missed by the previous process. However, this exercise did not produce any additional topics for a claim and therefore did not extend the longlist.

2.3 Subsequent elimination

The next stage was to consider the availability of evidence to support the subjective view of higher costs. In some cases, these views—for example, a belief that the capacity to support a transient summer population logically leads to higher costs—could not be supported due to lack of available industry-wide data. However, there is evidence emerging in this case (in particular from smart metering) that will allow this evidence to be reconsidered and explored further. For now, the structure of the PR24 proposed models do not suggest that material claims are likely, but we continue to review this (noting a significantly higher bar for claims not evaluated at this stage). In our view, this factor will need to be considered across enhancement (capacity) and base costs in order to meet the CAC tests, which we cannot achieve at this stage without PR24 enhancement models.

In other cases, it was accepted that factors such as topography, which could lead to higher costs, were already being considered within the econometric models.

This process of elimination led to four possible CACs:

- Canal cost;
- liming & bioresources;
- leakage;
- coastal works and complexity (and in particular UV treatment).

In all cases, we considered there to be a valid claim, based on the econometric evidence; however, a UV treatment may fall short of the materiality requirements, although this may be sensitive to the final form of Ofwat PR24 models given that coastal works are being considered in that consultation. Given that UV is not the only factor, a composite complexity measure, as set out in our base econometric model consultation response, would appear to provide the best way forward. This is because a symmetrical UV claim may revert to the modelling we have proposed. We may revisit whether this claim becomes material in light of 2022/23 data and the final model selection, noting our view above on a composite complexity claim.

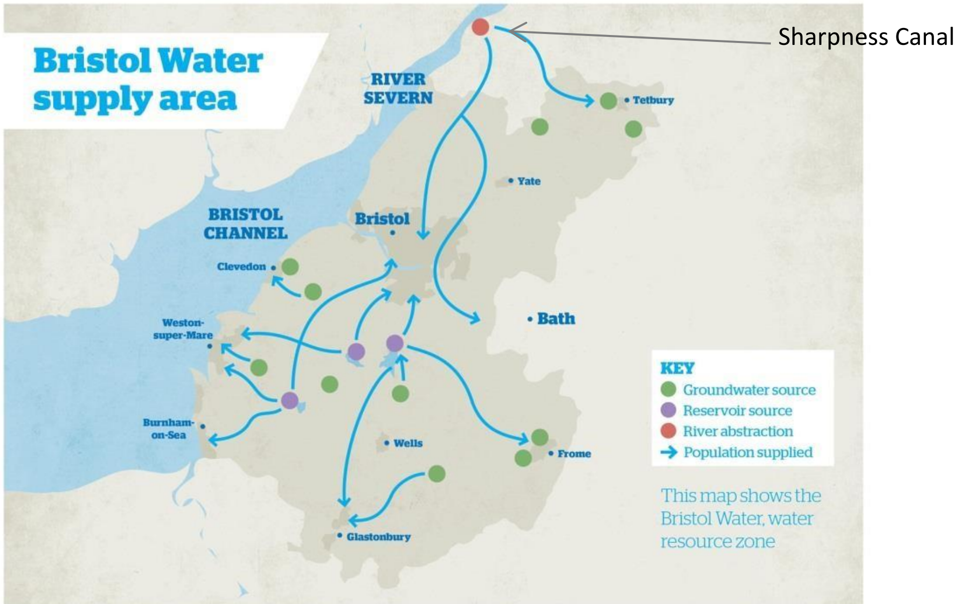
Eliminating this claim for the time being left us with three claims at the end of the selection process: CRT, leakage, and liming & bioresources. These three claims are now presented, in turn, in the following sections.

3. Canal cost (CRT) CAC

3.1 Contractual background

The Gloucester and Sharpness Canal is owned and operated by the CRT. Water levels in the canal are sustained by the River Severn. Since 1962, there has been a long-term contractual agreement with the CRT charity to allow the purchase of water from the Gloucester and Sharpness Canal, which is outside of the area of appointment. The agreement permits unrestricted abstraction for an annual average of 210Ml/d with a maximum daily abstraction of 245 Ml/d, although in river regulation (dry) and high tide periods this can be limited to 195Ml/d. The water is abstracted close to Sharpness docks, outside of our supply area to the north, to supply our water treatment works at Purton and Littleton (as illustrated in the figure below).

Figure 3.1 BRL supply area



Source: Bristol Water.

In this agreement, BRL makes an annual payment to the CRT charity to cover the cost associated with the purchase of water, which would otherwise be used in the canal network and the maintenance of the canal system to facilitate abstraction; and provisions to cover any emergency situations preventing abstraction. The CRT explains that such 'water sales are contracts we enter into with third parties to sell our surplus water (typically this is water that is surplus to the amount needed to meet the level of service).'[2] The water abstracted represents about half of BRL's Distribution Input. The size of the payment is contractual—it has a fixed and a variable cost component, both of which are inflated by RPI from 1998 (reflecting the latest terms):

- fixed cost: BRL can abstract up to 57,000Ml per annum at a cost of £1m inflated by RPI;

[2] CRT (2015), 'Putting the water into waterways: Water Resources Strategy 2015–2020', p. 17, https://canalrivertrust.org.uk/refresh/media/thumbnail/24335-water-resources-strategy.pdf.

- **variable cost:** BRL can abstract between 57,000Ml and 76,650Ml per annum, at an additional cost of £20/Ml inflated by RPI.

The agreement runs to 2055, and the price can be reviewed every ten years after 1 April 2008, providing either party gives notice for a review in the two years prior to this. Therefore, the next review date trigger is 1 April 2028. A review was not triggered in 2008, but was triggered in 2018 by the CRT, which requested an increase from c. £1.8m p.a. to as much as £17.5m p.a., based on a 'market value of water'.

There then followed a process of arbitration, with the arbitrator rejecting the CRT's market value for water arguments but, based on the potential future expenditure and maintenance needs (driven by climate change and the need to protect the structure of the canal), allowing a £300,000 p.a. increase in costs payable by BRL. The new total (c. £2.1m p.a.) continues to be inflated by RPI. The £20/Ml excess volumetric charge remains unaltered (and has not been triggered in recent years).

Given the arbitrator's findings, the only relevant factor should be the future maintenance and operational needs of the canal, and therefore given the arbitrator's confirmation that the contract is clear about the "cost" basis of the agreement, there is reasonable certainty as to the future costs for 2025-2030. The contract is at the same basis as structured for PR99, when Ofwat allowed an initial lump of cost to secure the resilience of the canal for Bristol supplies, rather than the development of alternative sources, emphasising this is a strategic water resource.

Ahead of the 2028 potential charges review (which can be triggered from 1 April 2026), BRL will emphasise to the CRT that it is in both parties' interests that the CRT engage with BRL on its current and anticipated costs in relation to the canal. The actual cost of the canal should be informative. Should the CRT not do so, and the matter proceed to arbitration again, the CRT's failure to engage on costs would likely be damaging to itself (in terms of both the outcome of the arbitration itself and any costs award). The CAC is necessary to protect customers from similar elevated future claims from CRT as in 2018, as suggesting that there are alternative sources to that historically agreed and that the sourcing decision is inside of management control could undermine the principle that Bristol Water customers water customers have contributed to the assets water supply use and maintenance (including the wider scheme for the River Severn in the 1960s), and that the contract should reflect these ongoing costs rather than a market value of water approach being appropriate.

These water purchase costs are in addition to the costs that all companies pay to the Environment Agency for abstraction licensing. The abstraction licence held by the CRT for abstracting at Gloucester Docks specifies the purposes as being for public water supply abstraction at Purton, and is paid for as a separate transaction by BRL. In the reporting of the wholesale cost data, BRL's payments to the CRT are allocated to the line 'Other Operating Expenditure excluding renewals', with a portion (approximately 5%) allocated to 'Third Party Services' in the Water Resource price control, to reflect the volume proportion charged to Wessex under the agreement for treated water supply at Newton Meadows (11 Ml/d maximum). Payments to the CRT for the purchase of water therefore represent an additional water resource cost included in Ofwat's base cost modelling that we incur compared to other companies.[3]

3.2 Regulatory background

There is an established precedent for a CAC based on payments to the CRT, confirmed by previous Final Determinations by Ofwat and redeterminations by the CMA.

[3] This is separate and additional to the CRT maintenance charges as incurred by some companies (including BRL).

At PR14, BRL submitted a CAC and sought £8.1m to cover the estimated payments to the CRT over the five-year period (2014/15 to 2019/20). Ofwat, in its final determination allowed £6.3m, reflecting a downward adjustment to the claim value to account for what it considered was already presumably accounted for in the models and an upper quartile efficiency challenge. In the redetermination, the CMA assessed that there was 'no basis to use a figure for the adjustment that differed from Bristol Water's claim of £8.1 million'[4] and therefore allowed the claim in full.

In comparison to the PR14 CAC submission, for PR19, BRL proposed that payments to the CRT for the purchase of water formed a cost exclusion case because:

- Ofwat had sought to exclude abstraction charges and discharge consents from its models published in the cost model consultation;[5]
- Ofwat had sought to exclude third-party costs from its models published in the cost model consultation[6] (which accounted for c. 5% of BRL's payments to the CRT);
- there was a lack of cost drivers collated at an industry level, which would capture the activity of buying and selling raw water from third parties (i.e. water trading).

At PR19, the CMA did not determine that a cost exclusion approach should be used but again allowed the CAC, albeit with a calculation of the Implicit Allowance based on a method proposed by Ofwat (which was not substantially different in quantum from the approach and cross-check on this approach proposed by BRL). The CMA decision is reproduced below.[7]

[4] CMA (2015), 'Bristol Water plc: A reference under section 12(3)(a) of the Water Industry Act 1991: Appendices 1.1 – 4.3', A4(3)– 5, https://assets.publishing.service.gov.uk/media/5627995aed915d101e000001/Appendices_1.1_-_4.3.pdf.
[5] Ofwat (2018), 'Cost assessment for PR19: a consultation on econometric cost modelling', March, p. 15, https://www.ofwat.gov.uk/wp-content/uploads/2018/03/Cost-assessment-for-PR19-A-consultation-on-econometric-cost-modelling.pdf.
[6] Ofwat (2018), 'Cost assessment for PR19: a consultation on econometric cost modelling', March, p. 15, https://www.ofwat.gov.uk/wp-content/uploads/2018/03/Cost-assessment-for-PR19-A-consultation-on-econometric-cost-modelling.pdf.
[7] CMA (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report'.

> 4.1021 It is clear that Bristol bears additional costs in relation to purchasing water from the G&S canal and that management has limited influence over the level of these costs. We are not persuaded on the one hand that Bristol makes offsetting savings elsewhere from this arrangement, nor on the other hand that Bristol's costs for treatment of water from the G&S canal are atypical and not adequately provided for by base costs. In considering the cost adjustment claim, the key issue is then the level of implicit allowance Bristol already receives from base costs and deduct this from the allowance provided.
>
> 4.1022 Calculating implicit allowances within base costs is problematic due to the aggregated nature of how modelled costs are produced. However, whilst none of the methods either party has provided is without flaws, we conclude that Ofwat's Approach One is reasonable.

Source: CMA (2021) Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report'.

Ofwat's Approach One is summarised as follows (emphasis added).

> 4.1007 In Approach One, Ofwat removed all of the bulk supply costs from the historical modelled base costs (dependent variable of the base models) and re-calculated the modelled base costs allowance for Bristol by re-running the base models.

Source: CMA (2021) Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report'.

BRL has adopted Ofwat's Approach One, with one modification, namely it is excluding *raw water bulk supply costs only* as these are most relevant to the CRT provision. This appears to calculate the approach that the CRT undertook and is appropriate for a water resources CAC.

Reflecting the continued arrangement with the CRT, this claim is required for the business planning period 2025/26 to 2029/30. Due to the long-term arrangement with the CRT, payments for the purchase of water are included in historical costs as reported to Ofwat, and are therefore likely to be included in the costs to be modelled in Ofwat's PR24 econometrics.[8] No assumption is made concerning a contract price change following possible renegotiation in 2028.

In summary, on this basis we propose that the costs associated with the purchase of water from the CRT continue to be accounted for as a CAC.

[8] Except the c. 5% of the CRT costs related to third-party services.

3.3 Quantification of the claim

The quantification of the claim requires a three-stage process.

1 Reporting of historical costs from 2010/11 to 2022/23 (in 2022/23 real CPIH terms) and estimation of forecast costs out to 2029/30, based on an RPI-based indexation that assumes constant real prices in RPI terms.

2 Deduction of an implicit allowance using a method defined in section 3.4.4.

3 Calculation of the net claim by deducting the allowance from the gross claim.

The outcome of this process is a gross claim of £12.7m (2022/23 CPIH constant prices), an implicit allowance of £0.5m, and a net allowance of £12.2m. These calculations exclude 5% of the costs of third-party services to Wessex.

Claim calculations

Supporting calculations for the submission template are provided in a separate Excel file (CAC CRT.xlsx). A brief explanation of each individual line of the associated submitted template is provided below.

Line (row)	Description
CW18.1	Description of claim is Canal & River Trust
CW18.2	This claim reflects Regional Operating Circumstances
CW18.3	The claim is non-symmetrical, as the adjustments through the implicit allowance are not significant enough to merit a symmetrical adjustment
CW18.8	The historical expenditure reflects that reported each year (which is already net of the 5% allocated to Wessex for the bulk supply at Newton Meadows). This has been converted to 2022/23 prices using CPIH (see Note 1 below). The entire amount is allocated to water resources.
CW18.5	The future contract costs are taken to outturn prices using forecast RPI, and then deflated to CPIH using forecast CPIH (both average year. The 5% deduction is then made (see Note 2).
CW18.6	The implicit allowance of £0.458m has been calculated based on forecast cost drivers as shown in table 3.1. The details can be found in the supporting file 'CAC CRT.xlsx', sheet 'Implicit Allowance', cells B53:G55.
CW18.9	Estimated control TOTEX of £88m has been included only for the purposes of indicating expected materiality. This is based on initial internal modelling in April 2023.

Note 1: Historical CRT data

	Original reported data	CPIH average index (2022/23 123.04)	CW18.8 value (after 5% bulk supply)
2010/11	£1.461m	90.91	£1.879m
2011/12	£1.541m	94.31	£1.910m

	Original reported data	CPIH average index (2022/23 123.04)	CW18.8 value (after 5% bulk supply)
2012/13	£1.629m	96.58	£1.971m
2013/14	£1.669m	98.60	£1.979m
2014/15	£1.676m	99.73	£1.965m
2015/16	£1.711m	100.17	£1.997m
2016/17	£1.734m	101.54	£1.996m
2017/18	£1.790m	104.22	£2.008m
2018/19	£1.854m	106.43	£2.037m
2019/20	£1.900m	108.24	£2.051m
2020/21	£2.869m	109.11	£3.073m[9]
2021/22	£2.298m	113.12	£2.375m

Note 2: Forecast CRT data

Year	CRT payment (nominal – forecast inflated by RPI)	Average RPI index (short term BoE forecast and 3% from 2025/26)	Average CPIH index (short term BoE forecast and 2% from 2025/26)	Total after 5% bulk supply deduction (2022/23 CPIH deflated)
2022/23 (actual)	£2.481m	351.22	123.04	£2.357m
2023/24	£2.649m	375.04	128.15	£2.417m
2024/25	£2.755m	390.04	130.84	£2.462m
2025/26	£2.838m	401.75	133.45	£2.486m
2026/27	£2.923m	413.80	136.12	£2.510m
2027/28	£3.011m	426.21	138.84	£2.535m
2028/29	£3.101m	439.00	141.62	£2.560m
2029/30	£3.194m	452.17	144.45	£2.585m

Annual figures are presented in the business model template. We now present the evidence to support this claim.

3,4 Need for the claim

Ofwat's evidence requirements for demonstrating that a cost adjustment is necessary are defined as:

- unique circumstances;
- management control;
- materiality;
- adjustment to allowances (including implicit allowance).

Each is now considered in turn.

[9] 2020/21 include back payment of the £0.3m p.a. increased charge to 2018 which was the outcome of the arbitration.

3.4.1 Unique circumstances

Regarding unique circumstances, there are three tests, as follows.[10]

- Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?
- Is there compelling evidence that the company faces higher efficient costs in the round compared to its peers (considering, where relevant, circumstances that drive higher costs for other companies that the company does not face)?
- Is there compelling evidence of alternative options being considered, where relevant?

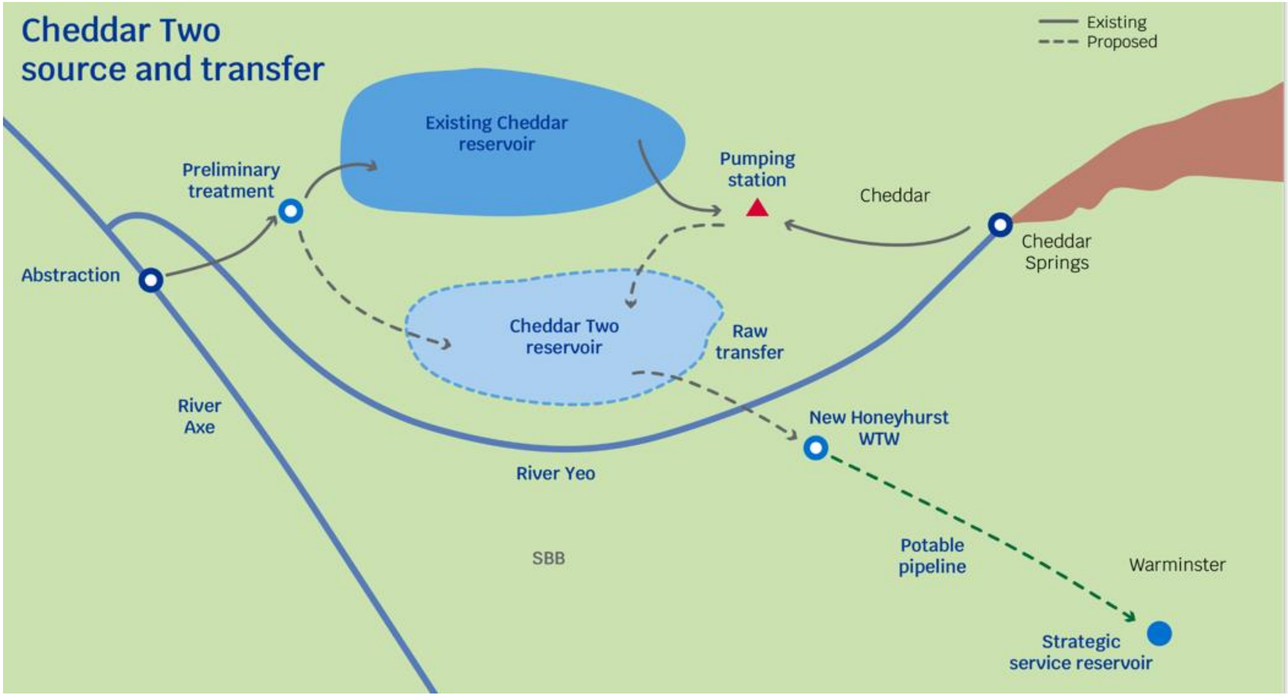
The situation where about half of the Distribution Input for raw water is obtained from a third party from a single source is exceptional, and, in correspondence with the CRT, it commented 'that this [BRL arrangement] is one of the largest raw water transfers in the country', adding elsewhere in the same correspondence that the CRT's 'most recent large raw water contracts to the Utilities sector have attracted charges of £200/Ml'.[11] Comparing the current charges charging arrangement we have to the £200/Ml quoted by the CRT, suggests that the third-party payments made by BRL are much lower.

A more in-depth examination of alternative options is presented below and shows that it is not possible to provide the 210Ml/d or 130Ml/d from alternative sources.

Alternative options

Even if the largest potential options were pursued (e.g. a second reservoir at Cheddar, no transfer to Wessex, 10Ml/d purchased water from a third party, and 6.5Ml/d of leakage reduction), just over half (66Ml/d) of the average water and one third of the maximum that BRL currently sources from the Sharpness Canal could be resourced from alternative options. The capital cost alone of delivering these options is estimated to be over £300m[12] equivalent to the cost of 135 years of continued water sales from the CRT in 2022/23 prices). Furthermore, examination of wider water resource options in the West of England suggests that existing sources could not provide this volume of water. The Cheddar 2 source is now expected to be required to supplement West Country Water Resource future supplies including Bournemouth and South West.

[10] Appendix 9, Annex 1.2, PR24 Final Methodology
[11] BRL correspondence with the CRT charity, dated 2017.
[12] From Cheddar 2 SRO gateway 2 submission, excluding transfer costs.



Source: Ofwat

Other theoretically plausible options could include construction of a water main that takes water from the Severn at Gloucester, thereby bypassing the canal or a water trading option in relation to the River Severn or the sources that feed the canal. This is a less feasible option than at PR19 as the use of the Severn and canal system is a potential SRO option for the Severn to Thames transfer.

Source: Ofwat

These alternatives demonstrate that BRL has not been complacent in accepting the status quo and is justified in viewing the current arrangement as the best-value option. Ofwat and Environment Agency feedback on the draft Water Resources Master Plan (WRMP) considers that sufficient options have been considered. The options appraisal in the draft WRMP are at a far lower yield than available from the Gloucester and Sharpness Canal.

Table 12-4: Yield and AIC of supply-side options.

ID	Short description	Estimated yield (Ml/d)	AIC (p/m^3)
P08	Increased production at WTW	7	1
R014	Direct Effluent Re-use	10	2
P06	Catchment Management to manage outage risk from algal blooms	0.7	6
R016	Internal transfer	20	6
R007	Pumped refill of reservoir	25	14
P01-02	Increase performance of existing sources to increase deployable output to near licensed volume	1.59	15
R24	Revive existing groundwater source	2.4	12
P01-01	Increase performance of existing sources to increase deployable output to near licensed volume	0.7	17
R005	New reservoir	13.5	59
R08-03	New river water source	1.1	60
R08-02	New river water source	1.4	65

Source: WRMP

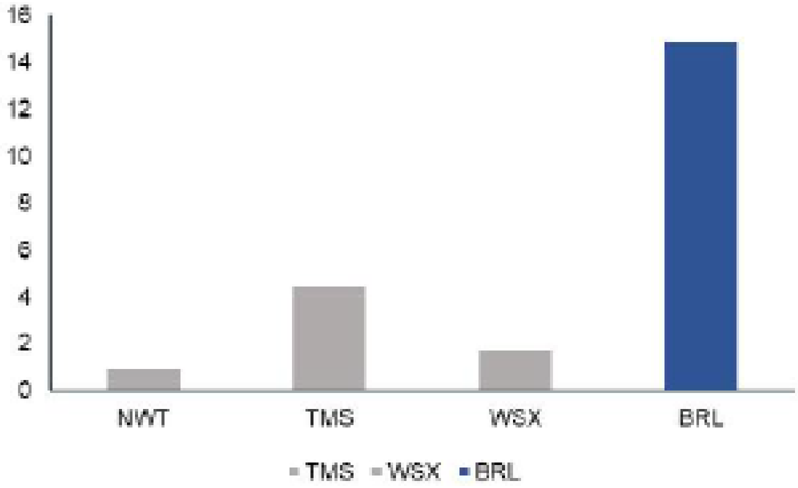
It is also relevant that, in the history of purchasing water from the CRT, the Gloucester and Sharpness Canal has proved a reliable source of water, providing uninterrupted supply with the exception of one event—in June 1990, the canal burst its banks and this was the only time that the supply failed. Since this event, BRL has funded the CRT for emergency standby cover that will enable it to supply a minimum of 100Ml/d to the Purton abstraction point, even in the event of canal failure.

Ensuring that the cost of water purchased from the CRT is fair and cost-reflective is important to BRL, reflecting commitment to delivering value for money to our customers and security of supply.

Evidence that other companies do not face a similar cost was covered in the NERA review for Bristol Water at PR19[13].

[13] NERA (23 August 2019): Review of Ofwat's PR19 Draft Determination on Bristol Water's Special Factor on Canal and River Trust Payments; prepared for Bristol Water

Figure C15 – Payments to the Canal and River Trust (£ per property)[295]



Source: NERA analysis of Ofwat data.

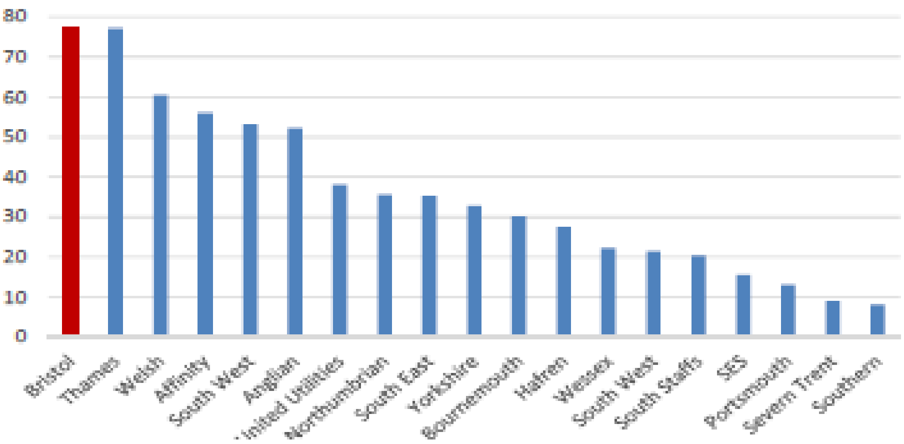
Source: NERA report for Bristol Water

In this analysis, we sought to identify examples of other companies making similar payments and commissioned a report by NERA which compared our costs to other companies that undertake water trading and purchase water from the CRT. The latter showed that our payments are significantly greater than other companies in the sector, again demonstrating the uniqueness of our circumstances. We did not agree with Ofwat that there are other examples that are comparable, but in terms of Ofwat's efficiency modelling used for Elan Valley in an attempt to calculate a generous estimate (as we have imperfect knowledge of all arrangements that may exist).

However, we have analysed the APR bulk supply data that is now available (from 2020/21) in our calculation of the implicit allowance, which allows us to improve on the PR19 calculation of data available at the time. Further details on this calculation are available in section 3.4.4.

Similarly, our calculation at PR19 of complexity treatment was informative in both a water treatment (immaterial ultimately) complexity claim and in evidencing that CRT costs did not have offsetting cost savings. We do not repeat the PR19 analysis in this initial claim as we assume it is now accepted following the PR19 CMA redetermination that the implicit allowance calculation is a sufficient methodology for this claim.

Figure C16 – Average proportion of water treated at complexity levels 5 and 6 (2012-2019)[310]



Source: NERA report for Bristol Water

3.4.2 Management control

Ofwat's evidence requirements for demonstrating that the claim is beyond management control are:[14]

- is the investment driven by factors outside of management control?
- have steps been taken to control costs and have potential cost savings been made (e.g. spend to save)?

As mentioned above, since 1962 BRL has maintained a contractual arrangement with the CRT to purchase water from the Gloucester and Sharpness Canal (as part of a collaboration with both public and private users of water from the River Severn). In this respect, therefore, the purchase of water from the CRT, like any other third-party water trading arrangement, is a decision that is theoretically within management's control.

However, in the absence of this arrangement, BRL would not be able to provide half of the Distribution Input that the Gloucester and Sharpness Canal can otherwise provide. Therefore, from a resilience and security of supply perspective, the decision to purchase water from the CRT is now beyond the control of management and in the short term more generally (2024/25–2029/30). Delivering half of the Distribution Input from alternative sources would require a more long-term solution, if indeed such alternatives were cost-beneficial and commercially viable.

As regards steps to contain costs, the description of the contractual arrangements in section **Error! Reference source not found.** includes details of the periodic negotiation prices with the assistance of an independent arbitrator.

3.4.3 Materiality

The claim represents 13.9% of BRL's Water Resources TOTEX, thereby passing Ofwat's materiality threshold for the Water Resource price control of 6%.

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[14] Appendix 9, Annex 1.2, PR24 Final Methodology.

3.4.4 Adjustment to allowances

A key element in the calculation of the claim is the implicit allowance. In the past, this has been the main area of contention between BRL and Ofwat. In the previous redetermination, as noted above, Ofwat proposed two approaches, as did BRL. As noted in section 0, we have followed Ofwat's Approach One, as used by the CMA, with the slight refinement that this claim is based on removing the costs for raw water only, not total water.

The rationale for removing raw water costs only seems to be that the costs associated with the supply of raw water differ from that of treatment and ready-treated water (the other components of total water). The use of total water costs by the CMA might have reflected the availability of data at the time.

We have identified raw water costs from APRs, mapping them to the following items: water resources, raw water distribution and storage costs of line 4J.3 of the last two APRs (2020/21 and 2021/22), abstraction licensees, raw water abstraction, transport and storage costs of line 4D.4 of the 2015/16–2019/20 APRs, water resources bulk supply imports (including raw water distribution) of line A7 of 2012/13–2014/15 APRs, raw water distribution and water resources costs (related to bulk supply) of line T21 for the 2011/12 APR.[15] The amount subtracted for each company and each year is reported in Appendix 0.

Once raw water costs have been subtracted from companies' water resources plus BOTEX and wholesale water BOTEX plus, we have re-run Ofwat's PR24 modelling suite and compared the outcome with models using the entirety of BOTEX figures. In both cases, we have used our cost driver projections for AMP8 (detailed in Appendix A1.2) to derive final allowances.

The implicit allowance is then simply the difference in BRL's modelled costs under the two different scenarios: total BOTEX and BOTEX minus raw water costs. The outcome is summarised in the table below.

Table 3.1 Calculation of the implicit allowance (£m, 2022/23 prices)

BRL's modelled costs (total BOTEX)	BRL's modelled costs (BOTEX minus raw water costs)	Implicit allowance
366.55	366.09	0.46

Note: For the reasons outlined in section 3.5, modelled costs have not been subject to a catch-up efficiency challenge.
Source: South West Water analysis from Ofwat's PR24 modelling suite and 2011/12–2021/22 APRs.

3.5 Cost efficiency

Ofwat's evidence requirements for demonstrating that a CAC is efficient are: [16]

- is there compelling evidence that the cost estimates are efficient (e.g. similar scheme outturn data, industry and/or external cost benchmarking, testing a range of cost models)?
- does the company clearly explain how it arrived at the cost estimate? Can the analysis be replicated? Is there supporting evidence for any key statements or assumptions?
- does the company provide third-party assurance for the robustness of the cost estimates?

[15] Since water resources and treatment costs are aggregated together in 2011/12, we have kept constant the 2012/13 split with the aim of excluding treatment costs as per all other years.
[16] Appendix 9, Annex 1.2, PR24 Final Methodology.

The costs incurred for this activity are efficient, as evidenced through our current engagement in a contractual price negotiation process with the CRT and an independent arbitrator, and a comparison of our costs incurred with the next best alternative source of supply. This was acknowledged by the CMA in its decision.[17]

> 4.1023 […] Further, since the Ofwat Final determination, it has been confirmed that the costs Bristol will pay CRT have increased by £300k per annum, effective from 1 April 2018.
>
> 4.1024 Consequently, we make the following adjustments to Bristol's cost adjustment claim of £8.6m: […]
> (c) We add £1.4m to reflect a CRT cost increase (£300k over 5 years less 5% for third party water sales).

Source CMA (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report'.

To support our view with benchmarking would be desirable, although it must be acknowledged that benchmarking of our water purchase costs from the CRT with similar arrangements held between the CRT and other water companies is not possible, as this information is not available in the public domain. We do not have access to the breakdown in order to better assess the efficiency of these costs beyond the analysis presented above.

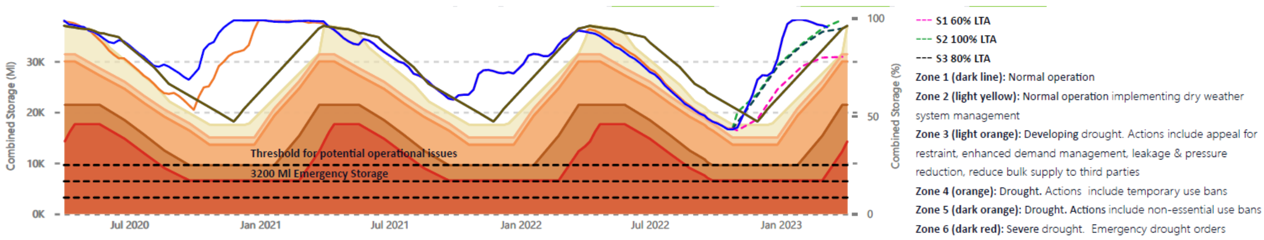
Consistent with the CMA's approach, we have therefore not included an efficiency challenge adjustment in the forecasting of this CAC. Equally, we have not included adjustments for input price pressures above inflation for payments to the CRT claim; this is because the main pressure influencing prices is the contractual agreement, not the input price pressures per se, although this does influence the prices set by the CRT.

For this provisional claim, we have not repeated the evidence we provided that there were no offsetting water treatment savings, as this approach did not ultimately inform the PR19 decisions. Additional evidence is available from the experience of the 2022 drought. The Bristol area was one of only two areas in England not to reach the first stage of drought. The additional cost of maintaining this resilience is through the Gloucester and Sharpness Canal supply, the energy and chemicals used at Purton Treatment Works, and the additional pumping around the network (including through the Southern Resilience Scheme) to the south of the region.

The volume used by Purton during 2022/23 was therefore much higher than in previous years, which had less exceptional weather (provisionally a c. 1-in-30-years weather event). However, the higher treatment and distribution costs than in the cheaper Mendip reservoirs is clear from 2022/23 cost information. Although this requires a number of assumptions based on cost allocation and reflects one overall integrated network (and therefore is only indicative), the costs for the Purton/Littleton system were c. £261/Ml in 2022/23 compared to £109/Ml for other sources.

[17] CMA (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report'.

As seen below, the shape of the total reservoir storage curve between 2021 and 2022 is similar, which is due to maximising use of the Mendip reservoirs (minimise cost mode) in 2021 and 'save water' mode in 2022 by maximising use of the canal supply / Purton to protect water in the Mendip reservoirs. The Mendip reservoirs ultimately refilled to 100% by January 2023, broadly remaining at that level through to May 2023. This emphasises that there is not a specific cost saving for equivalent resilience, as reflected in the drought plan for the Bristol area—drought actions including temporary use bans, drought permits and drought orders were avoided and this evidences that the canal reflects part of this system rather than something where cheaper alternatives should be considered more efficient.



Source: South West Water

3.6`Customer perspective

We consider that the current arrangement is the best option for customers because of the resilience of supply it has offered. It sources around half of its Distribution Input from the Gloucester and Sharpness Canal (typically c45% - 46% in 2022/23, reflecting actions taken to avoid drought plan measures being required). The purchase of this water from the CRT therefore provides security of supply to BRL's customer base and BRL has not experienced a problem with long-term resource availability from the Sharpness Canal in the history of the arrangement. As the draft WRMP demonstrates, looking at the Bristol area in isolation, the core pathway does not require new water resources before 2050, and the options for Cheddar 2 are being considered from a West Country Water Resource regional plan perspective.

Our customers have separately expressed that it is of high importance to them for BRL to provide a regular and reliable supply. In Bristol Water's Annual Customer Survey 2022[18] and 2023[19], customers rated [providing] a regular and reliable supply as the highest importance to them. In both surveys, customers also rated BRL as having a high performance in providing this service, which demonstrates the supply resilience the Gloucester and Sharpness Canal brings to our customers.

In our Customer Forum for Drought Management[20] held in November 2022, customers evidenced that the lack of restrictions in Bristol compared to other parts of the country was a testament to Bristol's water supply resilience. Some positive comments include "I assumed the heat wave was handled well because I didn't hear about any disruptions. I didn't know about any issues from other people either. No news is good news." and "I thought they handled [it] very well, no hosepipe bans, no mass panic, they showed they had a lot of forward planning - it was quite calming."

[18] Bristol Water Customer Survey 2022 Final Report prepared by Future Focus Research.
[19] Bristol Water Customer Survey 2023 Final Report prepared by Future Focus Research.
[20] Bristol Water Customer Forum: Drought management (November 2022) facilitated by Traverse

3.7 Summary of evidence

This section has demonstrated the need for the CRT claim, that the claim is beyond management's control, and that the costs are efficient. It is not considered appropriate to provide evidence of the need for investment or that the investment represents the best option for customers, as the claim seeks an adjustment to baseline BOTEX costs only. The claim does not relate to a capital project involving strategic options appraisal where customer protection to ensure performance improvements are delivered, therefore this is not considered here. The table below assesses the evidence presented in this section against Ofwat's requirements as stated in the annex to Appendix 9. We have already detailed how the CAC meets Ofwat's sub-criteria (see Table 3.2).

Our assurance review supported by Turner & Townsend found the claim to be logically structured and responding clearly to the criteria. They noted the source from SAP of the historical records and consistency with previous claims. The review identified a few minor changes in historical APR lines (including raw water storage and transport in with bulk supply water resource abstraction from raw water) which we reflected in the final calculation of the implicit allowance.

Table 3.2 Summary of evidence presented in this section

Evidence	Assessment	Comments
Unique circumstances	Passed	Ofwat does not collect data that could capture the activity of taking water from the Gloucester and Sharpness Canal (i.e. water sales). We propose that this be treated as a cost adjustment.
Management control	Passed	In the absence of this arrangement, BRL would not be able to source half of the Distribution Input on a long-term basis, without developing an alternative source.
Materiality	Passed	Well above threshold at c. 14%
Adjustments	Passed	Adopted CMA approach (based on Ofwat's method).
Cost efficiency	Passed	The claim reflects the actual level of payments made to the CRT, as reflected by the CMA decision (see section 3.5). Comparison with alternative sources of supply suggests that costs represent value for money.
Need for investment	N/A	The claim does not relate to an investment, therefore no cost–benefit analysis of options is required; the claim seeks an adjustment to baseline BOTEX costs only.
Best option for customers	Passed	Ensures continuity of supply without significant CAPEX. No WRMP suggestion or feedback that the supply should be replaced with an alternative Strategic Resource Option.
Customer protection	N/A	Customer protection in the event that the project is cancelled is not applicable, as the case is not an investment project.

Source: South West Water.

3.8 Conclusion

We make payments to the CRT charity for the purchase of water from the Gloucester and Sharpness Canal (water sales). This activity is in addition to Environment Agency abstraction licensing, and is therefore unlikely to be captured by the cost drivers included in Ofwat's PR24 cost models. Calculated according to the contract, we forecast that this will cost £12.22m (net over the PR24 period). This is an existing claim and, naturally in this case, the circumstances cannot have been expected to materially change since PR19.

4. Leakage CAC

4.1 Background

Leakage expenditure represents c.40% of treated water distribution costs[21] over the period 2018–22. Leakage performance is affected both by management decisions and 'by regional differences that may include some favourable operating conditions or adoption of new assets in response to growth. Low starting levels of leakage may also reflect previous levels of investment'.[22]

In PR19, Ofwat provided AWS with an additional base cost allowance for maintaining leading leakage levels. This would have also applied to BRL, except there was one of the six additional models used for testing allowances (not one of the two which directly related to leakage) that showed lower, rather than higher, allowances. Following the appeal of PR19, in its final determination, the CMA decided that companies should receive an additional allowance for leakage performance above upper quartile levels, based on the percentage outperformance multiplied by the company projections of efficient future base expenditure needs. This followed the approach proposed by BRL, in taking the geometric mean of the two scaled leakage performance metrics (per km of mains and per property), establishing the gap to the upper quartile level of performance, then applying this to estimate an additional cost allowance to reflect that there was a service/cost relationship between lower levels of leakage and ongoing base costs than were reflected in base cost allowances.[23]

For BRL, the CMA calculated an additional base cost allowance of £4.1m in respect of its leading leakage performance. [24] However, the CMA also considered that this additional allowance was not required as 'Bristol's TOTEX gap is already largely covered by our calculation of base cost allowances, meaning its overall allowance is almost in line with its view of the efficient costs needed in AMP7'. [25]

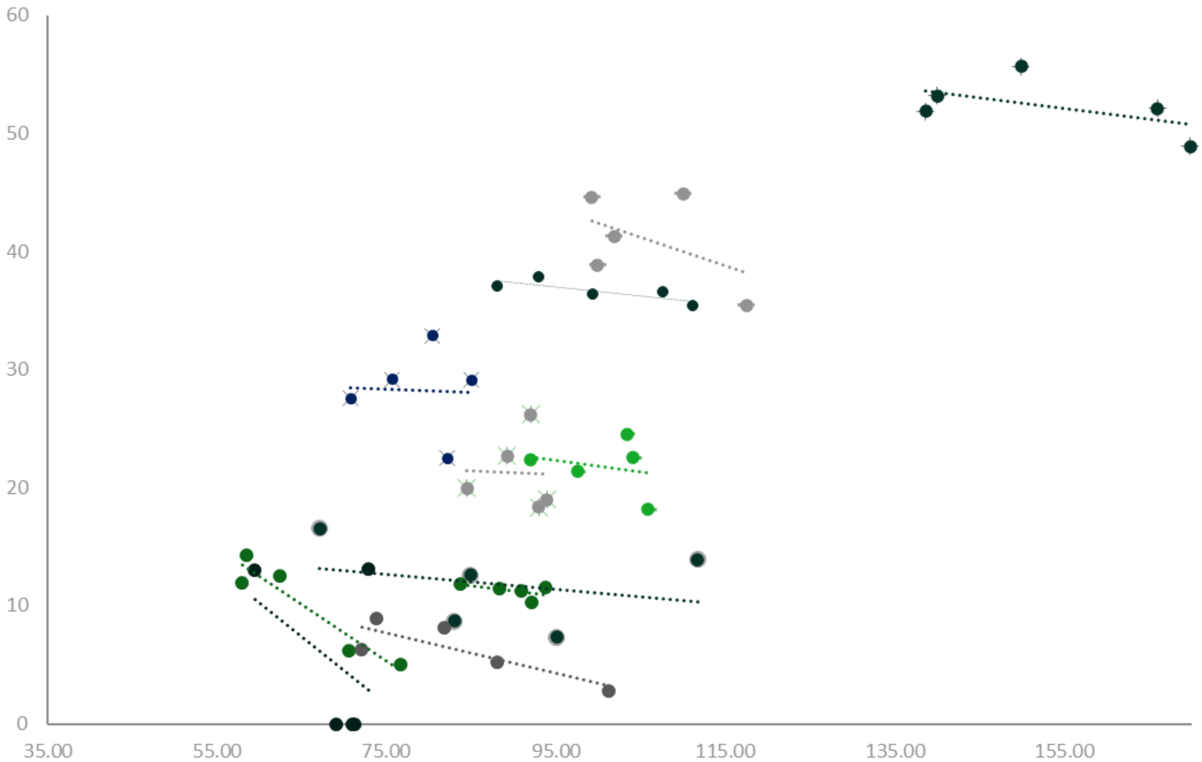
This merely reflected that the CMA agreed with BRL's position that there were a range of adjustments that together suggested that BRL's plan (draft determination response) was an efficient level of base costs, but the relief BRL sought was merely to reflect the TOTEX allowance, plan and outcome levels and incentives as a package. As this was the request of the company, the CMA did not apply this allowance as it would have gone beyond the TOTEX we believed to be efficient. However, the CMA accepted the basis for the calculation and that it should apply to all upper quartile companies, including BRL.

[21] The industry's leakage expenditure over the period 2018-22 was £4,070m, as opposed to £10,652m of TWD expenditures over the same period. Source : "PR24 Cost Assessment master Dataset, Wholesale Water Base Costs v4" and "Ofwat Leakage Dataset following the April 2022 Data Request".
[22] CMA (2021), Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations - Final report, para. 8.72.
[23] CMA (2021), Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations - Final report, paras 8.73–8.74.
[24] CMA (2021), Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations - Final report, para. 8.79.
[25] CMA (2021), Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations - Final report, para. 8.81.

While the CMA accepted that 'marginal costs of leakage control rise as lower leakage levels are reached',[26] the current suite of proposed base cost models does not control for this relationship. We queried the treatment of this in our PR24 draft methodology consultation response as it was ambiguous whether this approach would be considered as part of 'what base buys' analysis or should be considered as part of a CAC. Given that Ofwat stated to the CMA at PR19 that BRL should have put the case forward as a CAC (although not unique circumstances, and the common leakage definition data was not available until draft determination), we have followed this approach to PR24.

A simple scatter plot of leakage per property against leakage base costs seems to indicate that costs are increasing with poor leakage performance. However, this ignores important regional effects and the panel nature of the data, that is the fact that we have data on different companies over time. As shown in **Error! Reference source not found.**, when taking this into account, the relationship between leakage volumes and expenditure is negative for a majority of companies (11 out of 17). That is, at the company level, base costs increase as leakage levels are reduced. This is consistent with the CMA's determination and Ofwat's provision of an additional base cost allowance in acknowledgment of the additional costs associated with maintaining leading leakage levels.

Figure 4.1 Leakage base expenditure vs level, by company



Note: For presentational clarity, the chart shows only the 11 companies (out of 17) that present a negative relationship between leakage levels and expenditure.
Source: Oxera, based on Ofwat data.

[26] CMA (2021), Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations - Final report, para. 8.72.

4.2 Quantification of the claim

We first quantify the impact of leading leakage performance on base costs using the methodology used by the CMA at PR19. In addition to the CMA's methodology, we have undertaken a number of alternative approaches as a cross-check, so as to increase the robustness of the estimates.

The CMA approach involves first calculating outperformance of the industry upper quartile on leakage. The selected measure is the geometric mean of leakage per km of mains and leakage per property[27], calculated over the last three years of available data. The CMA's estimates presented in its final determination hence refer to 2017–20, while more recent estimates are based on 2019–22 data. The resulting outperformance is then applied to the companies' forecast leakage costs.

These results can then be applied to all companies in the form of a symmetrical adjustment based on historical leakage performance. Symmetry would require the benchmark to be set with reference to the median, rather than the upper quartile.

Based on the data from the Ofwat service delivery report for 2021/22, we have calculated the following update to the calculation.

Table 4.1 Leakage performance by company (2019/20–2021/22)

leak/km	2020–22	rank	leak/prop	2020-22	rank	Geometric mean	2020–22	rank	Symmetrical adj.
AFW	10.03	16	AFW	109.77	11	AFW	33.183	13	-21%
ANH	4.70	1	ANH	81.31	4	ANH	19.556	2	34%
BRL	5.23	2	BRL	65.68	1	BRL	18.526	1	42%
HDD	5.28	3	HDD	130.87	16	HDD	26.291	10	0%
NES	7.53	11	NES	96.08	7	NES	26.893	11	-2%
PRT	7.40	10	PRT	77.21	2	PRT	23.909	6	10%
SES	6.72	8	SES	79.66	3	SES	23.133	3	13%
SEW	6.19	6	SEW	95.69	6	SEW	24.347	7	8%
SRN	6.81	9	SRN	83.61	5	SRN	23.869	5	10%
SSC	9.47	14	SSC	109.44	10	SSC	32.194	12	-18%
SVE	9.42	13	SVE	120.30	13	SVE	33.657	15	-22%
SWW	6.33	7	SWW	108.80	9	SWW	26.250	9	0%
TMS	19.09	17	TMS	152.96	17	TMS	54.031	17	-51%
NWT	10.02	15	NWT	125.17	15	NWT	35.406	16	-26%
WSH	5.93	5	WSH	112.90	12	WSH	25.873	8	1%
WSX	5.43	4	WSX	104.05	8	WSX	23.762	4	10%
YKY	9.08	12	YKY	123.66	14	YKY	33.505	14	-22%
BRL UQ outperformance	0%			14%			29%		

[27] Total number of properties equals the sum of "Total household connected properties at year end" (BN2161) and "Total non-household connected properties at year end" (BN2221).

Source: SWW, based on Ofwat data.

Based on the Ofwat leakage data for 2019/20 to 2021/22, SWW underperforms the upper quartile, as it ranks as the median company, while BRL outperforms it by 29%.

BRL base costs (in 2022/23 CPIH) amount to a five-year total of £40.02m, which produces an upper quartile adjustment of **£11.4m**. The symmetrical adjustment for each company in percentage terms is also shown in Table 4.1. This would be calculated on an equivalent basis using the leakage maintenance (LK1) data table collected by Ofwat. The calculation for the LK1 data is included within our audit trail for all companies. For BRL, the data is shown in the table below.

	LK1 line maintenance expenditure	CPIH index – 2022/23 123.04	BRL Leakage maintenance (2022/23 CPIH prices)	Average
2019/20	£6.877m	108.24	£7.817m	
2020/21	£7.908m	109.11	£8.918m	
2021/22	£6.690m	113.12	£7.277m	
Average				£8.004m
5-year				£40.021m

The equivalent calculation for SWW is a five-year total of £85.963m. The other company data can be used to make a pre-model symmetrical adjustment, rather than the CMA approach to upper quartile post-model adjustments.

As an additional cross-check, we have tried three new, alternative approaches.

As a first alternative, we tested adding leakage measures as independent variables into both the TWD and the WW models. Using leakage per km of mains, we can estimate an allowance increase of **£12.6m**, or 2.1%, for BRL, and **£19.5m**, or 1.8%, for SWW. Increases in allowances are also material when using the geometric mean of leakage per km of mains and property, consistent with the CMA's approach, with similar results also in terms of model quality.

Second, given the operational difference in drivers determining the various components of TWD expenditures, we also performed a similar analysis at a more disaggregated level. In particular, we separated the leakage and non-leakage-related costs of TWD, applying to each only the relevant cost drivers. In the case of non-leakage TWD, we maintained the original cost drivers proposed by Ofwat, whereas for leakage TWD, we replaced the pumping variables with leakage per km of mains. In this case, we estimate again an allowance increase of **£8.6m**, or 1.4%, for BRL, and **£10.8m**, or 1.0%, for SWW.

On average, the impact of the various model specifications adding leakage per km of mains and leakage per property as an independent variable leads to a **£9.3m** allowance increase for BRL (in line with the estimate obtained through the CMA approach benchmarked against the upper quartile), and **£11.9m** for SWW.

Third, we separately estimated the additional costs linked to lower leakage by performing an out-of-sample prediction. In particular, we forecast the companies' costs in case they were maintaining a level of leakage equal to the industry's median and compared it with the forecasts derived with the previous approaches. The resulting additional costs due to above-median performance are **£10.4m**, or 1.7%, for BRL and **£24.1m**, or 2.2% for SWW when using leakage per km of mains, and are similarly material with other measures.

These econometric approaches allow the trade-off between costs and leakage to be explicitly modelled before then applying an efficiency challenge. The use of the industry median as a benchmark is necessary in order to ensure that the trade-off between cost efficiency and leakage performance is correctly accounted for. This is achieved by estimating the additional costs incurred because of above-median leakage performance, before then applying an upper quartile efficiency challenge. Applying an upper quartile leakage benchmark ahead of the catch-up efficiency challenge, also based on the upper quartile, would impose an inappropriate double-challenge.

In the case of the methodologies presented above, we performed the Durbin–Wu–Hausman test to ensure that endogeneity was not undermining the validity of the results—the results show that endogeneity is not an issue. Moreover, as set out in section 0 and in the discussion around **Error! Reference source not found.**, while management can improve leakage levels over time, 'starting' leakage levels are largely outside of company control, being driven by regional factors (when regressing leakage per km of mains against a group of regional and company-specific factors, the deriving model has an R^2 of over 72%).[28]

Nevertheless, we recognise the concerns in relation to endogeneity expressed by the CMA and others of including leakage variables within the econometric models. Therefore we focus on the CMA approach and use the alternatives as cross-checks.

There is no specific guidance in the PR24 final methodology of how symmetrical adjustments should be presented in data tables, and therefore we set out a view of how this should be considered, as an alternative to the company specific cost adjustment claim presented above.

Supporting calculations for the submission template are provided in a separate Excel file

Line (row)	Description
CW18.11	Description of claim is Leakage
CW18.12	This claim reflects Regional Operating Circumstances
CW18.13	The claim is can be symmetrical although could also be presented as a company specific cost adjustment claim. We categorise as symmetrical consistent with the methodology.
CW18.18	The historical expenditure is the 2017/18 prices treated water distribution expenditure for BRL taken from the Ofwat cost modelling .do file. This has been updated to 2022/23 prices using 18.06%, reflecting the 2022/23 average CPIH index of 123.04 and 2017/18 of 104.22
CW18.15	The future TWD costs are taken using the 6 PR24 Ofwat models from the Ofwat .do files. See Note 1. The project for BRL includes the forecast cost drivers shown in Appendix A2.1. The projected model output costs (triangulated equally as clarified in May 2023 email) is then repriced from 2017/18 prices to 2022/23 prices as above.

[28] Furthermore, excluding the impact of leakage on base costs would result in omitted variable bias, thus its inclusion in the base cost models improves that aspect of the model robustness.

Line (row)	Description
CW18.16	The cost post the cost adjustment claim is the relevant value from CW18.5, plus 29% of the BRL base annual leakage cost of £8.004m, based on the gap in geometric leakage performance to the upper quartile (£2.285m in 2022/23 prices). This may be an underestimate as it excludes the higher base cost of further leakage reductions beyond the three year leakage total to 2021/22. We would therefore propose this CAC is updated using the methodology once 2022/23 and 2023/24 industry data is available. The alternative adjustment of a symmetrical adjustment to the median as a pre-model adjustment is not shown in the CW18 table, but is included in the audit trail and in Table 4.1 above.
CW18.9	Estimated control TOTEX of £616m has been included only for the purposes of indicating expected materiality. This is based on initial internal modelling in April 2023.

Note 1: Calculation of CW18:5 and CW18:6

BRL adjustment on UQ basis	2023	2024	2025	2026	2027	2028	2029	2030
mod7	37.600	37.900	38.200	35.400	35.700	36.000	36.400	36.700
mod8	41.800	42.300	42.700	39.800	40.200	40.600	41.100	41.500
mod9	37.500	37.800	38.100	34.600	34.900	35.300	35.800	36.100
mod10	37.100	37.000	36.900	35.100	34.600	34.100	33.600	33.200
mod11	41.400	41.300	41.200	38.900	38.300	37.700	37.100	36.500
mod12	37.600	37.600	37.500	34.800	34.400	34.100	33.700	33.400
2017/18 prices	38.833	38.983	39.100	36.433	36.350	36.300	36.283	36.233
2022/23 prices (IA)	45.847	46.024	46.161	43.013	42.915	42.856	42.836	42.777
Gross CAC	48.132	48.309	48.447	45.299	45.200	45.141	45.121	45.062

Source: SWW and Oxera calculation from audit trail.

4.3 Need for the claim

4.3.1 Unique circumstances

While different metrics can be used to assess a company's performance in terms of leakage, it is clear that BRL consistently performs above the upper quartile. When measured by the geometric mean of leakage per length of mains and leakage per property, it ranks first in the industry over the period 2019–22. As such, BRL holds a unique position concerning the costs it faces as a result of its leading levels of leakage.

4.3.2 Management control

As already mentioned, the level of leakage can partly be considered to be within company management's control in the long term but not in terms of base cost once the profile of reduction to long-term government targets have been set. In particular, in regard to improving its leakage (and maintaining a leading leakage performance) over time, the higher efficient cost of lower leakage is outside of management control. At PR19 all companies were given a target to reduce their leakage by at least 15%, and a company's 'starting level of leakage' is also largely affected by regional and company-specific factors (see Figure 4.1). These range from completely exogenous factors, such as the soil type and the amount of rainfall, to network features, such as the pipe age and material, or the level of metering penetration.

In particular, as shown in Table 4.2, when regressing leakage per km of mains against a group of regional and company-specific factors, the deriving model has an R^2 of over 72%. This result indicates how 'starting' leakage levels are largely outside of company control. The variables included in this regression model are either completely outside of management control (such as property density, soil type and rainfall) or are company-specific and represent 'legacy' features of the network that cannot easily be altered (such as pipe material or metering penetration).

Table 4.2 Regressing leakage performance against regional and company-specific factors

	Rationale	Lnleak_km
Ln property per km of mains	Density	-8.63**
Square of ln property per km of mains	Density (quadratic)	1.11**
% shrink-swell soil	Soil type	0.34
% iron pipes	Asset material	0.31
Nr days with >10mm rainfall	Rainfall	0.065
2022 metering penetration	Metering	-0.39
Constant		11.49
R^2		**0.723**

Source: South West Water, based on Ofwat data.

These results are consistent with the rationale highlighted in Figure 4.1: **while companies can actively reduce the level of leakage by incurring additional costs, factors outside of management control widely contribute to determining each company's 'starting level' of leakage.**

Moreover, improvements in levels of leakage being associated with higher costs (and providing additional allowance to cover those costs) was also accepted by the CMA.[29]

[29] For example, CMA para. 8.52. 8.59 (8.72 not nec. accepts higher MC) 8.74, see CMA (2021), "Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – final report", March 17.

> 8.59 In order to maintain their current level of performance, these high performing companies would be expected to incur costs that exceed the implicit allowance for leakage costs that is included in the base cost allowance.
>
> Source: CMA (2021) Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report'.

These costs are associated with both higher intensity of preventive and control activities and greater technical difficulties, thus determining an intrinsically increasing nature of marginal costs.

As a consequence, for the dynamics relevant to the setting of a cost adjustment, we can consider leakage expenditures to be outside of management control.

Lastly, and somewhat irrespective of analytical results, the WRMP process in deciding future levels of leakage and phasing to meet government targets does not negate the need to recognise a service-cost relationship for leakage, where the evidence is stronger than for a range of other performance metrics in terms of base spend once the lower level of leakage has been achieved.

4.3.3 Materiality

The various methodologies presented indicate an average adjustment of between 1% and 3% of BRL and SWW's Water Network plus TOTEX, thereby passing Ofwat's materiality threshold for the Water Resource price control of 1%.

4.3.4 Adjustment to allowances

The impact of leakage performance is not taken into account in any of the proposed TWD models, despite the significant share of expenditures represented. This concerns the use of either direct performance indicators, or of exogenous factors that may affect the leakage performance.

As a consequence, given the high costs required for companies to maintain leading levels of leakage, the base allowances calculated in the proposed models are not sufficient.

The claims are material after the deduction of an implicit allowance, calculated according to the CMA's methodology, and have been estimated following several separate methodologies.

4.4 Cost efficiency

There is evidence that the cost estimates are efficient since we have tested them across a number of models and over the entire industry. The analysis can easily be replicated and the supporting files shared if needed.

The process and the different steps undertaken are outlined below.

- Run the different models by using the leakage per length of mains as an additional cost driver in Ofwat's proposed models for PR24. Alternatively, perform the same analysis by separately assessing the leakage and non-leakage component of TWD, both under a total cost and a unit cost approach. The analysis period was restricted to 2018–22 due to the limited availability of leakage data collected by Ofwat following the April 2022 'Leakage data request'. This has improved the assessment approach since the CMA PR19 modelling, which in itself was hampered by the common definition of leakage at the earlier stages of PR19.

- Calculate an upper quartile efficiency challenge for each of the four scenarios, based on the last five years of data as per Ofwat in PR19.
- Produce AMP8 forecasts for the relevant cost drivers, namely: the length of mains, the WAD LAD from MSOA and the WAD MSOA, number of properties, APH TWD, number of booster pumping stations, WAC, percentage of water treated in bands 3 to 6 as well as leakage level. While all of them have been part of an internal specific bottom-up forecasting process, the two WAD measures as well as leakage have been derived following a simple extrapolation of the compound annual growth rate observed over 2011/12–2021/22.
- Calculate AMP8 predicted costs for each scenario, using the estimated coefficients derived in the first step. and cost driver forecasts derived in the previous step. We have followed the same triangulation process as Ofwat, i.e. first derive modelled costs for each sub-model and then average them.
- Apply the historical upper quartile efficiency challenge calculated in the second step to AMP8 predicted costs to get the final allowances and the gross value of the claim.
- Restart the whole process based on Ofwat's models (i.e. without using the first two total cost models) to get the final allowances and the implicit allowance.
- Deduct the implicit allowance from the gross value of the claim to get the net value of the claim.
- Convert it to 2022/23 prices.

Moreover, independent efficiency of company operations for BRL was demonstrated at PR19 through the report from Isle Utilities 'Bristol Water Leakage Management Review' (October 2020).

Isle concluded as follows.

Isle surmises that BW is the leading leakage performer in the UK based on 19/20 data when normalised for properties (4th when normalised for mains length). In addition, when comparing water companies, the different operating environments which they face are significant factors in higher base cost and marginal cost of future reductions. A recent leakage management benchmarking programme (LMBP) undertaken by Isle compared these factors. As a result, BW can demonstrate it's starting position in relation to pipe age and material, soil conditions, urban density, network configuration and topography and metering penetration give it a more challenging environment in which to operate than other companies that are upper quartile and this environment has an impact on their base and incremental costs. The Infrastructure Leakage Index ILI, arose from work carried out by the International Water Association in 1999. The Index allows a comparison of company performances, where companies have disparate, systems and connection densities. Enabling within country and global performance comparisons between companies. The system can compare whole and sub systems. Generally, a system in the range of 1 to 2 can be considered very well managed while systems with no active leakage management programme and poor asset condition can have ILI's greater than 10. Bristol Water has the lowest Infrastructure Leakage Index (ILI) amongst the UK water companies that took part in Isle's LMBP, with an ILI value of 1.22. Their unit cost to achieve leakage reduction is low compared to the rest of the industry.

In terms of use of technology, Isle concluded as follows.

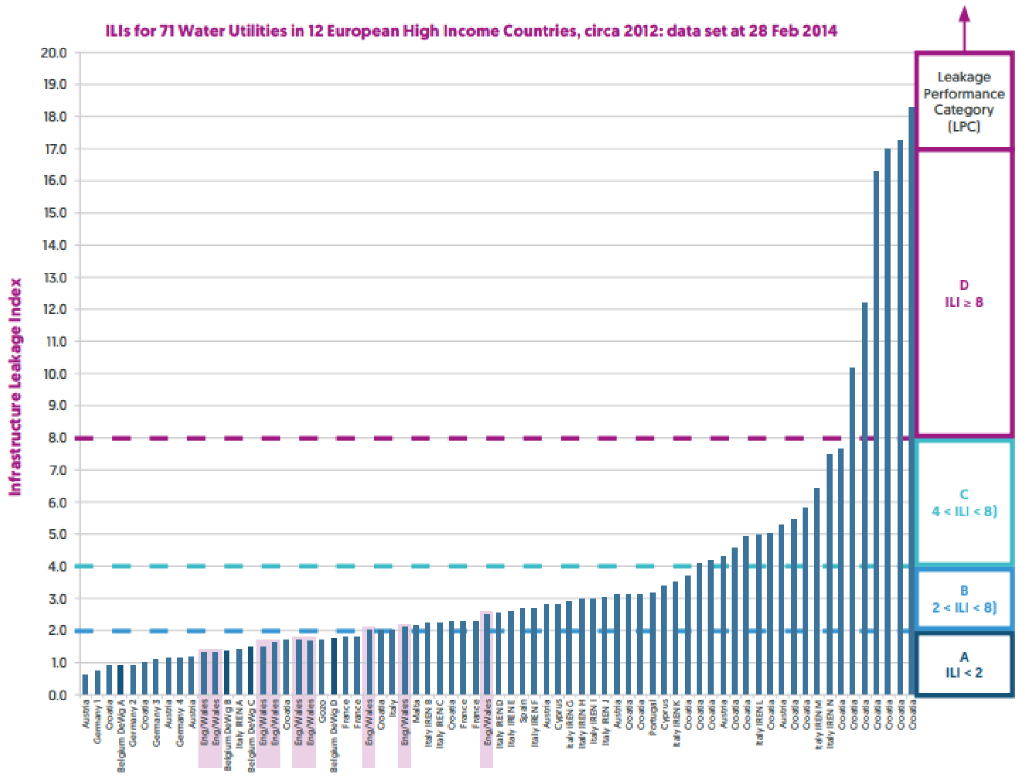
'Isle have questioned the leakage options selected by BW, in context of technology options that are adopted in other parts of England and Wales, to understand if greater efficiency could be made by a different investment strategy or adoption of newer technologies. Isle finds BW's leakage approach to be based around strong foundational techniques that include well developed District Metered Areas combined with widespread pressure management and active leak control through an in-house Leakage Technician team. We conclude that BW's AMP7 strategy for managing leakage is to use approaches that - at high-level - appear to be least cost when compared to other options available. Some newer technology options (satellite leak detection and permanent acoustic logger deployment) should have the potential to enable BW to reduce leakage even further but BW's own trials of these technologies appear to show high investment costs to do so and so we agree that BW's strategy for reducing leakage (more active leakage control, and more pressure reduction) would not be more efficient with adoption of newer technologies'

4.5 Customer perspective

In March 2022, the Leakage Routemap to 2050[30] was published, which provides a framework for water companies to triple the rate of leakage reduction by 2030 and halve leakage by 2050. The 2030 target was set out in the 2019 Public Interest Commitment while the 2050 pledge has been endorsed by the National Infrastructure Committee. This recognised Bristol Water as the only company that had already met the Water UK 2030 commitment.

The Water UK report also highlighted the relevance of the Infrastructure Leakage Index and supports the efficient and effective leakage management approach that Isle Utility confirmed.

Figure 4.2 Infrastructure Leakage Index seen across Europe



Source: Water UK., Routemap to Net Zero 2030

Our customer research has shown that customers similarly share this government priority. In our Customer Forum for Drought Management held in November 2022,[31] customers felt that it is very important for leaks to be controlled and suggested 'Leakline' should be advertised all-year round instead of just in times of dry weather. This sentiment is echoed in our PR24 Customer Priorities Report[32] where SWW, Bournemouth and BRL customers all consider reducing leakage a high priority for investment, as they consider improving infrastructure as a key area for us to focus on in the long term. These investments are valued as leaks are perceived to negatively affect customers e.g. in the form of higher bills, lower pressure and lower supply.

[30] A Leakage Routemap to 2050 | Water UK
[31] Bristol Water Customer Forum: Drought management (November 2022) facilitated by Traverse
[32] South West Water PR24 Customer Priorities (February 2023)

In our customer research work performed under the West Country Water Resource Group[33], reducing leakage was one of the two most supported demands options to encourage reductions in water usage. Leakage was consistently highlighted as a high priority by participants, with many considering it as wasteful. Some comments include 'The more leaks that are fixed, the less is actually getting wasted, so I was just thinking fix all the leaks and the water builds up itself.'

In the re-run report[34] for SWW, customers believed that reducing leakage protects and improves the environment, with 77% of the respondents agreeing that fixing leaks is the best way to reduce the amount of water taken from the environment. Reducing leaks was seen as a priority and 80% customers stated that leaks should be fixed even if that causes significant disruption to local communities, and 77% felt that leaks should be minimised regardless of the cost.

4.6 Summary of evidence

As presented in the previous sections, the evidence in support of a CAC for leakage performance meets the outlined requirements.

The review with Turner & Townsend confirmed that the CAC narrative was structured logically, clearly responding to each claim criteria and sub-criteria. The review checked that the calculation from the source data had been reflected in the Impact Assessment modelling.

Table 4.3 Summary of evidence presented in this section

Evidence	**Assessment**	**Comments**
Unique circumstances	Passed	Uniqueness is shown both in company's own performance (BRL) and in the unique impact of regional and company-specific factors.
Management control	Passed	Both the specific level of leakage and the corresponding level of expenditures incurred are to be considered largely outside of management control.
Materiality	Passed	Above 1% of WNP costs threshold.
Adjustments	Passed	Adopted CMA approach (based on Ofwat's method).
Cost efficiency	Passed	Several alternative econometric models present similar and consistent results in terms of cost adjustment.
Need for investment	N/A	The claim does not relate to an investment, therefore no cost–benefit analysis of options is required; the claim seeks an adjustment to baseline BOTEX costs only.
Customer protection	Not Applicable	The service-cost relationship established for leakage and ODI incentives provide suitable customer protection, and this case is merely to ensure accurate base cost allowances with a symmetrical leakage level adjustment, outside of the model variables

[33] WCWRG Deliberative Research Report (September 2021)

[34] Customer Research to inform the best value Water Resource Plan for the South West (February 2023)

Source: South West Water.

4.7 Conclusion

The lack of adequate cost drivers in the current models, combined with the uniqueness of each company's performance due to the impact of regional and company-specific effects, means that frontier performance in leakage levels is unlikely to be captured by the cost drivers included in Ofwat's PR24 cost models. The estimated adjustment is **£11.4m** for BRL and **£0m** for SWW, using the PR19 methodology. A symmetrical adjustment is presented as an alternative for Ofwat to consider. We would anticipate that 2022/23 and 2023/24 data will be available to update the value of this claim. This suggests that an adjustment, using this methodology, may also apply to SWW, and therefore this claim anticipates this outcome (the cross-checks also support such an adjustment for SWW may be appropriate, depending on the final model cost data and leakage performance for the industry).

5. Liming & bioresources CAC

5.1 Background

The SWW peninsula limits the opportunities for advanced anaerobic digestion, and the nature of the land bank and maintenance of a farming disposal route means that liming is the preferred technology. This is outside of management control to the extent that it requires regulatory approval through WINEP to obtain enhancement funding for alternative disposal routes, and the lead time would be c.10 years. Therefore, for AMP8 a cost adjustment claim for bioresources remains.

5.2 Quantification of the claim

The quantification of the claim requires a four-stage process.

1. Production of AMP8 forecasts for the relevant cost drivers (see Appendix 0), namely: the total amount of sludge produced, the number of connected properties, the number of sewage treatment works, the percentage of load treated in bands 1 to 3, the percentage of sludge treated by raw sludge liming (or the percentage of sludge treated by conventional/advanced AD), the WAD LAD from MSOA and the WAD MSOA. While most of them have been part of an internal specific bottom-up forecasting process, the two WAD measures have been derived following a simple extrapolation of the compound annual growth rate observed over 2011/12–2021/22.
2. Calculation of AMP8 bioresources allowances by using the percentage of sludge treated by raw sludge liming as an additional cost driver (as per our January submission) in Ofwat's proposed models for PR24. As a sensitivity check, we also derived alternative models based on Anglian's proposal to rely on the percentage of sludge treated by conventional/advanced AD as an additional explanatory variable. The whole process is detailed in section 0.
3. Deduction of an implicit allowance using a method defined in section 0.
4. Calculation of the net claim by deducting the allowance from the gross claim.

The outcome of this process is a gross claim of £171.2m–£181.3m, an implicit allowance of £139.6m–£142.4m, and a net claim of £31.6m–£38.9m. All of the modelling results and the associated statistical tests or robustness checks are included in Appendix 0.

5.3 Need for the claim

5.3.1 Unique circumstances

Historically, the average percentage of sludge treated by raw liming in the industry is 7%, while on average this amounts up to 73% in SWW's case, which is ten times higher than a 'typical' company. In 2022, after SWW, Anglian is the company with the largest percentage of raw liming but this only represents 14%, as opposed to 75% in our case. We are a clear outlier within the industry and while Ofwat's models would work quite well to estimate the baseline expenditure required for the rest of the industry, they fail to consider the specific circumstances we are facing.

Unless raw liming (or conventional/advanced AD) is accounted for, it is clear, from Ofwat's modelling, that we face higher costs compared to the industry, as our costs are estimated as being 19–23% higher than the upper quartile. In contrast, once raw liming (or conventional/advanced AD) is accounted for, we are placed among the two or three most efficient companies. Neither the estimated coefficient of the additional explanatory variable included in the model nor its magnitude are sensitive to the removal of SWW from the analysis. This shows that the model is robust as it is not influenced by us as an outlier in terms of sludge treatment technology. Indeed, the estimated coefficient of raw liming is very stable, lying between 0.008 and 0.010, and is always highly significant at the 1% level. Our modelling results also indicate that our costs incurred with raw liming are lower than an average company since the estimated coefficient of raw liming is higher, by c.10%, when SWW is excluded from the analysis. This means that the results can be relied upon and that our estimated efficiency is robust.

5.3.2 Management control

The choice of sludge treatment technology results from the operating area of the company (e.g. topography and sparsity), the external farming environment, and environmental legislation and oversight.

Environmental legislation does not specifically mandate liming over other methodologies for waste treatment, and indeed SWW uses different technologies for treating a small proportion of its waste. However, our choice of liming for approximately 70% of our wastewater disposal is dictated through other considerations, in particular:

- the relatively acidic soils in our catchment area;
- the high proportion of grassland;
- the agreed WINEP which covers AMP8 (see next paragraph);
- our need to comply with the Biosolids Assurance Scheme (BAS) incorporating the requirements of the Safe Sludge Matrix and Sludge (Use in Agriculture) (1989) (SuIA) standards.

While the land bank remains the disposal route for the South West, liming remains the *exogenous* technology choice because to get the sludge to land requires the alkalinity that liming adds. While we are proposing enhancement expenditure on alternative treatment technology to reduce reliance on liming, this requires the proposed costs being included in our WINEP programme and subsequently accepted. As such, the treatment route remains exogenous *within* an AMP. SWW also effectively acts as a waste 'supplier of last resort' in Devon & Cornwall for tankered waste with the closure of third-party facilities that cannot comply with regulations. This affects the bioresources options.

As stated above, we implement rigorous cost control measures, consistent with best practice and affordability, to ensure that customers benefit from environmentally friendly methods of treating sludge at low cost. In particular, we:

- monitor technological developments in this area constantly; and
- assess individual capital expenditure programs for value for money, according to best practice.

We note that, once allowance is made for our choice of a different methodology for treating wastewater, we are upper quartile in our efficiency compared to other companies.

5.3.3 Materiality

Raw sludge liming is a material driver of our bioresources expenditure and the fact that Ofwat does not consider it at all in its modelling suite would leave us underfunded for the next price control. The claim represents 11.3–13.9% (12.2% triangulated over the four approaches we take) of our forecast bioresources TOTEX, thereby significantly exceeding Ofwat's materiality threshold for the bioresources price control (6%).

5.3.4 Adjustment to allowances

Liming is not covered by any of the cost drivers included in Ofwat's cost models, which justifies the need for an adjustment.

As mentioned above, to ensure the robustness of our quantification, we have considered a range of estimates for the implicit allowance, using four different scenarios, namely:

1. total cost models with the percentage of sludge treated by raw sludge liming as an additional cost driver;
2. unit cost models with the percentage of sludge treated by raw sludge liming as an additional cost driver;
3. total cost models with the percentage of sludge treated by conventional/advanced AD as an additional cost driver;
4. unit cost models with the percentage of sludge treated by conventional/advanced AD as an additional cost driver.

In each case we have ensured that the models and the estimated coefficients are robust (see Appendix 0 for all of the details, including the results of modelling sensitivities where SWW is excluded from the analysis as a supplementary robustness check).

The different steps to get to the final estimate of the claim are outlined in Table 5.1 and Table 5.2 below. Although we consider that modelling on a unit cost basis is more appropriate given the form of the bioresources price control (see our base cost consultation response for further details on our position), for completeness, we also present the results of total cost models. This process resulted in a range of estimates lying from £31.6m to £38.9m, as mentioned in section 0.

To make sure an efficiency target was applied to our AMP8 predicted costs, we have adjusted the predictions based on an upper quartile efficiency challenge, ranging from 86% to 92% depending on the scenario considered. In each case, the catch-up efficiency challenge was more stringent under our amended models accounting for raw liming/AD than under Ofwat's proposed models. The exact range of efficiency scores under each scenario is displayed in Appendix 0.

Table 5.1 Net CAC under a unit cost approach (£m, 2022/23 prices)

	Implicit allowance (Ofwat's scenario)	Liming as an additional explanatory variable	AD as an additional explanatory variable
Modelled costs (pre upper quartile efficiency challenge)	155.5	205.7	196.1
Upper quartile	91.58%	88.11%	89.82%

	Implicit allowance (Ofwat's scenario)	Liming as an additional explanatory variable	AD as an additional explanatory variable
Modelled costs (post upper quartile efficiency challenge)	142.4	181.3	176.1
Net CAC	**N/A**	**38.9**	**33.7**

Source: South West Water analysis from Ofwat's PR24 modelling suite.

Table 5.2 Net CAC under a total cost approach (£m, 2022/23 prices)

	Implicit allowance (Ofwat's scenario)	Liming as an additional explanatory variable	AD as an additional explanatory variable
Modelled costs (pre upper quartile efficiency challenge)	155.3	199.5	191.4
Upper quartile	89.90%	85.92%	89.42%
Modelled costs (post upper quartile efficiency challenge)	139.6	171.4	171.2
Net CAC	**N/A**	**31.9**	**31.6**

Source: South West Water analysis from Ofwat's PR24 modelling suite.

Given that this cost claim accounts for about 20% of our projected AMP8 TOTEX on bioresources, it is clear that the base cost allowances would be significantly insufficient to undertake our sludge treatment process if no adjustments were made. This would of course apply to AMP8 but also to our long-term allowance.

We do not see any circumstances in this area which offset the considerations set out above. We act as a supplier of last resort to other disposal routes in order to protect the wider environment, and given the sensitive nature of the location we serve, our past attempts to gain support for other options and storage/disposal opportunities have not been supported.

Using an additional explanatory variable to account for disposal routes and treatment options is strongly supported by econometric evidence and allows the modelling to account for the specific circumstances we are facing. While sludge treatment technologies might be largely under management control for some companies, this is not the case for SWW for the reasons discussed above, and our amended models clearly show that Ofwat's proposed models are not adequate to reflect the higher unit costs we have to incur compared to the rest of the industry given our operating area.

5.4 Cost efficiency

There is evidence that the cost estimates are efficient since we have tested them across both a large range of models and over the entire industry.

In addition to not being sensitive to the removal of SWW from the analysis, they are also not sensitive to the form of the modelling (unit cost vs total cost assessment) or to the choice of the cost driver retained (the percentage of sludge treated by raw sludge liming or the percentage of sludge treated by conventional/advanced AD).

The analysis is summarised in the supporting file and can easily be replicated. We have also undertaken third-party assurance to make sure of the robustness and the accuracy of the cost estimates.

The whole process and the different steps undertaken are outlined below.

- Run the different models by using the percentage of sludge treated by raw sludge liming (or the percentage of sludge treated by conventional/advanced AD) as an additional cost driver in Ofwat's proposed models for PR24, both under a total cost and a unit cost approach. In order to benefit from models on a like-for-like basis between the unit cost and the total cost approach and given the low statistical significance of Ofwat's first two total cost models we have not used them in our analysis. Another adjustment we have made is the removal of the load treated in bands 1 to 3 as a cost driver in the first unit cost model as the coefficient became marginally negative.[35] This means that we use Ofwat Unit cost models 1,2,3 and 4 and Total cost models 3,4,5 and 6. These references are used in Appendix 3 and in the supporting files. The Stata outputs show the 10 models in terms of OLS and Random effects outputs, with the Random effects used as per the Ofwat cost model consultation. Methodology 1 supporting outputs file shows liming, and methodology 2 shows AD.
- Calculate an upper quartile efficiency challenge for each four scenarios, based on the last five years of data as per Ofwat in PR19.
- Produce AMP8 forecasts for the relevant cost drivers, namely: the total amount of sludge produced, the number of connected properties, the number of sewage treatment works, the percentage of load treated in bands 1 to 3, the percentage of sludge treated by raw sludge liming (or the percentage of sludge treated by conventional/advanced AD), the WAD LAD from MSOA and the WAD MSOA. While most of them have been part of an internal specific bottom-up forecasting process, the two WAD measures have been derived following a simple extrapolation of the compound annual growth rate observed over 2011/12–2021/22 (respectively 0.32% for WAD MSOA and 0.42% for WAD LAD from MSOA). They are displayed in Appendix 0
- Calculate AMP8 predicted costs for each four scenarios, using the estimated coefficients derived in the first step and cost driver forecasts derived in the third step. We have followed the same triangulation process as Ofwat, i.e. first derive modelled costs for each sub-model and then average them (note that we naturally never triangulate outcomes between unit cost and total cost models).
- Apply the historical upper quartile efficiency challenge calculated in the second step to AMP8 predicted costs to get the final allowances and the gross value of the claim.
- Restart the whole process based on Ofwat's models (i.e. without using the first two total cost models) to get the final allowances and the implicit allowance.
- Deduce the implicit allowance to the gross value of the claim to get the net value of the claim.
- Convert it into 2022/23 prices.

[35] This is explained by two effects: first this cost driver is usually not very stable and depends on the model specification (low p-value in a few wastewater models) and second we would expect the treatment technology to have a much higher impact on costs that the percentage on load treated in smaller bands. However an estimated negative sign does not arise when we use AD as a cost driver so we have kept it in that case.

Supporting calculations for the submission template are provided in separate Excel files (Template BIO.xlsx, CAC liming methodology 1.xlsx, CAC liming methodology 2.xlsx). In all cases, the entire amount is allocated to sludge treatment.

The cost model drivers for 2025-2030 are based on current business projections. Increased loads reflect current view of increased nutrient removal from enhancement treatment and population growth. These assumptions will be updated to be consistent with business plan data tables.

Line (row)	Description
CWW18.1	Description of claim is Liming & bioresources
CWW18.2	This claim reflects Regional Operating Circumstances
CWW18.3	The claim is assumed not to be symmetrical as the use of lime is region specific, and implicit allowance adjustment is made. If the alternative approach of using models that reflect this (as opposed to the consultation proposed models), then this claim is not required, and is the equivalent to a symmetrical adjustment being made for this factor.
CWW18.8	The historical expenditure is the difference for each year between the average gross claim and the calculation of the implicit allowance (based on PR24 Ofwat bioresources models).[36] The approach is therefore an average of the 4 Total Cost (TC) and 4 Unit Cost (UC) model approaches. As data is not available for 2010/11, we have used the average of the following four years of AMP5. The calculation is summarised in Note 1 (relevant cells highlighted in green).
CWW18.5	2022/23 forecasts to 2024/25 forecasts have been set based on 2021/22 modelled costs. We will revisit these forecasts in our business plan and based on 2022/23 forecast data – this reflects that the process for the claim uses standard industry models and therefore will be updated as part of that process. The gross claim is the average of the four approaches we have used (liming and AD, unit cost and total costs), together with the forecast model variables. A simple average (equal weighting) approach is used as per Ofwat's May 2023 email expectation. As required by Ofwat, the gross claim has been subject to a catch-up efficiency challenge (here, an upper quartile). See extract of calculation in green cells highlighted in Note 1.
CWW18.6	The implicit allowance reflects the Ofwat model consultation models[36] (simple average as above) after the application of an upper quartile efficiency challenge, using the forecast cost drivers. See extract of calculation in green cells highlighted in Note 1.
CWW18.9	Estimated control TOTEX of £279m has been included only for the purposes of indicating expected materiality. This is based on initial internal modelling in April 2023.

Note 1: The calculation of lines CWW18.5, CWW18.6 and CWW18.8 is available in the supporting file 'Template BIO.xlsx'. The outcome is summarised in the table below, with the green cells being used in the final submitted template. Additional explanations on the retained methodology are provided below.

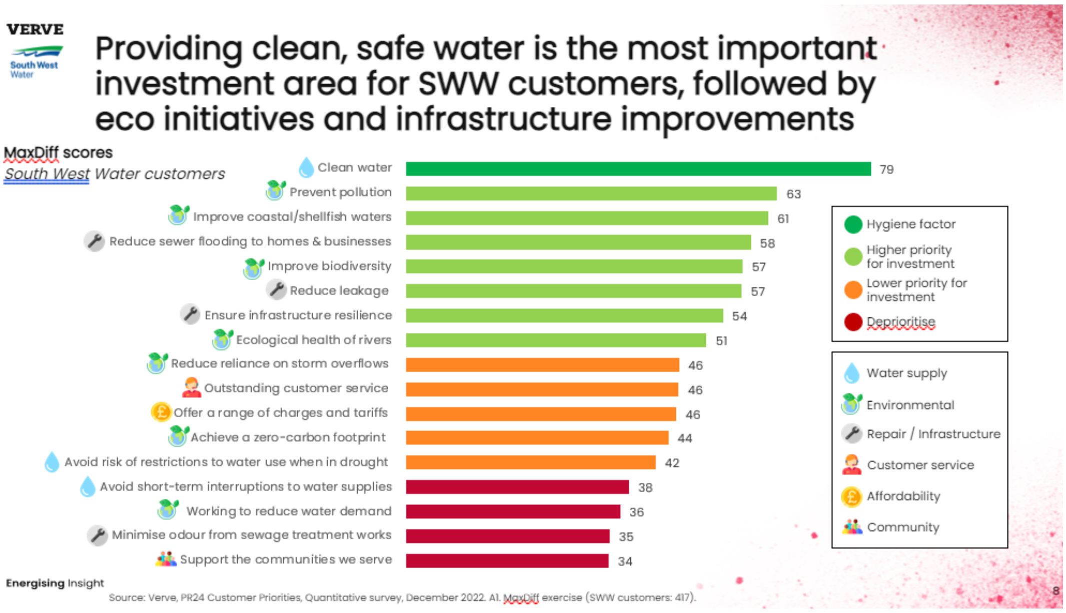
[36] Excluding the first two total cost models, as explained above.

codecombine	Average gross claim (22/23 prices) (CWW18.5)	Average IA (22/23 prices) (CWW18.6)	Historical data and net claim, 22/23 prices (CWW18.8)
SWB2012	40.674	30.370	10.305
SWB2013	38.373	28.930	9.443
SWB2014	35.249	26.995	8.254
SWB2015	35.779	26.337	9.442
SWB2016	32.162	23.996	8.166
SWB2017	33.014	25.062	7.952
SWB2018	32.416	24.604	7.812
SWB2019	31.191	23.914	7.277
SWB2020	32.675	25.010	7.664
SWB2021	35.441	26.903	8.538
SWB2022	35.992	26.653	9.338
SWB2026	33.295	26.961	6.334
SWB2027	34.164	27.596	6.568
SWB2028	35.107	28.284	6.823
SWB2029	35.827	28.800	7.027
SWB2030	36.614	29.338	7.276

- The historical total expenditure between 2011/12 and 2021/22 results from the average difference between the modelled costs of our 4 TC and 4 UC models with an additional explanatory variables accounting for liming/AD and the same 8 models under Ofwat's approach. 2022/23 forecasts to 2024/25 forecasts have been set based on 2021/22 modelled costs. As these years are prior to AMP8, the costs have not been subject to a catch-up efficiency challenge.
- The historical total expenditure for the year 2010/11 has been set to the average of the last four years of AMP5.
- Both the gross claim and the implicit allowance have been estimated by taking the average modelled costs of the UC and the TC approach, under their respective model specifications (with and without the additional explanatory variable). The second and the third columns above (CWW18.5 and CWW18.6) indicate modelled costs after the application of a UQ efficiency challenge, as per Ofwat's guidance.

5.5 Customer perspective

This question is believed to be more appropriate to enhancement cost adjustment claims. The liming approach and maintaining land disposal route through farming forms part of an overall bioresources and pollution prevention strategy, which are both reflected in customer priorities. Odour is a relatively low priority and therefore the sludge facilities / land disposal route remains a preferred customer option overall.



5.6 Summary of evidence

This section has demonstrated the need for the sludge treatment claim given that this is mostly beyond management control and driven by the particular characteristics of our operating area, the external farming environment, and environmental legislation and oversight.

The econometric results supporting the claim are reliable and robust and have been derived using different scenarios in order to ensure the accuracy and consistency of the estimates across all approaches and assumptions considered.

An upper quartile efficiency challenge has been applied to our predicted allowances to make sure that the costs presented are efficient.

The materiality bar is easily reached since the net claim is more than three times higher than Ofwat's materiality threshold of 6% of the bioresources TOTEX for AMP8.

It is not considered appropriate to provide evidence of the need for investment or that the investment represents the best option for customers as the claim seeks an adjustment to baseline BOTEX costs only and to costs that have already been incurred historically. The claim does not relate to a capital project involving strategic options appraisal where customer protection to ensure performance improvements are delivered, therefore this is not considered here. The table below presents an assessment of the evidence presented in this section to Ofwat's requirements.

Our review with Turner & Townsend helped us to identify improvements that we made to the description of the claim calculations and links to the supporting audit trail. We highlight in our commentary where data that will emerge during the PR24 process would be used to update the calculation of this claim, given that it is based on modelling. We have not duplicated points made in the cost model consultation response which provide evidence of the alternative to the cost adjustment claim and options for bioresources, which are being considered separately through the WINEP programme, which are highlighted in the early claim but may be clarified in our business plan.

Table 5.3 Summary of evidence presented in this section

Evidence	Assessment	Comments
Unique circumstances	Passed	The average percentage sludge treatment with raw liming for the rest of the industry is 3% in 2022 with a maximum of 14% for Anglian, while this amounts to 75% in our case. This warrants an adjustment since the modelling is not able to capture the higher costs faced by a single outlier.
Management control	Passed	The choice of sludge treatment technology results from the operating area of the company (e.g. topography and sparsity), the external farming environment, and environmental legislation and oversight.
Materiality	Passed	Well above threshold.
Adjustments	Passed	We used Ofwat's guidance to make adjustments and calculate the implicit allowance. We simply added an additional explanatory variable to the models and compared the projected final allowances with and without it.
Cost efficiency	Passed	As required by Ofwat, a catch-up efficiency challenge has been applied in both cases.
Need for investment	N/A	The claim does not relate to an investment but to costs that have been incurred historically and will continue going forward over AMP8.
Best option for customers	N/A	This claim does not relate to investment but ongoing costs. Customer priorities are broadly consistent with maintaining the current land disposal route until alternative technologies can present an alternative option.
Customer protection	N/A	Customer protection in the event that the project is cancelled is not applicable, as the case is not an investment project.

5.7 Conclusion

It is clear that none of Ofwat's proposed models for PR24 are able to capture the higher costs we have to incur regarding our sludge treatment process. The proposed base cost models will leave us insufficiently funded for AMP8 as we have estimated our additional efficient costs related to raw liming to amount to about 20% of our projected bioresources. There is then a need to make an adjustment to our base cost allowances. While we have derived four different scenarios here, to fill the associated Excel template we have retained the average net claim value, £34.0m.

A1 Canal cost (CRT)

A1.1 Raw water costs subtracted from WRP BOTEX and WW BOTEX plus (£m, nominal prices)

Company code	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
AFW	0.00	0.00	0.00	0.00	0.00	1.18	1.27	1.15	0.84	1.44	1.47
ANH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BRL	0.20	0.20	0.20	0.20	0.13	0.02	0.02	0.02	0.15	0.02	0.01
HDD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.49	0.56	0.55
NES	2.00	2.00	2.30	2.20	2.75	1.01	1.00	0.98	0.92	1.08	0.93
NWT	1.50	1.50	1.60	1.60	0.00	0.00	0.00	0.00	0.00	0.14	0.13
PRT	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
SES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SEW	0.60	0.60	0.56	0.53	0.61	0.74	1.32	1.04	0.94	1.04	1.03
SRN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSC	0.01	0.00	0.00	0.02	0.02	0.02	0.01	0.01	0.00	0.01	0.01
SVE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.20	8.00	6.52	7.70
SWB	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TMS	0.01	0.00	0.10	0.20	0.00	2.22	2.58	4.26	4.78	4.40	4.08
WSH	0.87	0.87	0.77	1.07	0.51	-1.12	0.16	0.14	0.14	0.15	0.17
WSX	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
YKY	3.80	3.80	3.94	4.00	3.85	3.79	3.80	3.87	3.80	3.89	3.98
DVW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SVT	7.00	7.00	7.20	7.40	7.59	7.99	8.97	0.00	0.00	0.00	0.00

Source: SWW analysis based on APR data on bulk supply costs.

A1.2 Preliminary cost drivers forecasts for AMP8

Cost driver	2026	2027	2028	2029	2030
Number of connected properties	556835	561765	566675	571585	576495
Length of mains	7034	7060	7087	7114	7141
Water treated in bands 3-6	99.54	99.54	99.54	99.54	99.54
Number of booster pumping stations	87	87	87	88	88
APH TWD	68.23	63.80	59.66	55.78	52.16
WAC	5.77	5.77	5.77	5.77	5.77
WAD MSOA	3664.07	3694.89	3725.98	3757.33	3788.94
WAD LAD from MSOA	1964.68	1982.24	1999.95	2017.83	2035.86

Source: South West Water.

A2 Leakage

A2.1 Preliminary cost driver forecasts for AMP8

BRL					
Cost driver	2026	2027	2028	2029	2030
Number of connected properties	556835	561765	566675	571585	576495
Length of mains	7034	7060	7087	7114	7141
Water treated in bands 3-6	99.54	99.54	99.54	99.54	99.54
Number of booster pumping stations	87	87	87	88	88
APH TWD	68.23	63.80	59.66	55.78	52.16
WAC	5.77	5.77	5.77	5.77	5.77
WAD MSOA	3664.07	3694.89	3725.98	3757.33	3788.94
WAD LAD from MSOA	1964.68	1982.24	1999.95	2017.83	2035.86
Leakage rate (%)	11.86%	11.60%	11.34%	11.09%	10.84%
Leakage rate by mains length (%)	0.47%	0.46%	0.45%	0.44%	0.43%

SWW					
Cost driver	2026	2027	2028	2029	2030
Number of connected properties	1098393	1108113	1118049	1127628	1136779
Length of mains	18720	18778	18836	18894	18952
Water treated in bands 3-6	97.24	97.24	97.24	97.24	97.24
Number of booster pumping stations	203	203	203	204	204
APH TWD	82.59	80.71	78.88	77.09	75.35
WAC	5.20	5.20	5.20	5.20	5.20
WAD MSOA	2113.33	2122.55	2131.81	2141.10	2150.44
WAD LAD from MSOA	1095.55	1100.10	1104.66	1109.24	1113.84
Leakage rate (%)	13.16%	12.85%	12.55%	12.26%	11.98%
Leakage rate by mains length (%)	0.46%	0.45%	0.45%	0.44%	0.43%

Source: South West Water

A2.2 Modelling results of WW models including leakage per mains length as an additional explanatory variable (2017/18–2021/22)

Cost driver	Explanatory variable	WW1	WW2	WW3	WW4	WW5	WW6	WW7	WW8	WW9	WW10	WW11	WW12
Scale	Connected properties (log)	1.080*** {0.000}	1.061*** {0.000}	1.061*** {0.000}	1.049*** {0.000}	1.034*** {0.000}	1.017*** {0.000}	1.065*** {0.000}	1.050*** {0.000}	1.051*** {0.000}	1.043*** {0.000}	1.024*** {0.000}	1.011*** {0.000}
Complexity	Water treated at complexity levels 3 to 6 (%)	0.005* {0.096}		0.003 {0.356}		0.004 {0.356}		0.004** {0.042}		0.002 {0.507}		0.003 {0.423}	
	Weighted average treatment complexity (log)		0.655* {0.059}		0.454 {0.296}		0.546 {0.304}		0.574** {0.035}		0.285 {0.460}		0.443 {0.378}
Topography	Booster pumping stations per length of mains (log)	0.328*** {0.001}	0.288*** {0.001}	0.343*** {0.000}	0.320*** {0.001}	0.243 {0.234}	0.228 {0.241}						
	Average pumping head (log)							0.278*** {0.008}	0.247** {0.018}	0.299** {0.010}	0.281** {0.016}	0.173 {0.366}	0.153 {0.414}
Density	Weighted average density - LAD from MSOA (log)	-2.436*** {0.000}	-2.242*** {0.000}					-2.496*** {0.000}	-2.325*** {0.000}				
	Weighted average density - LAD from MSOA (log) squared	0.170*** {0.000}	0.154*** {0.000}					0.169*** {0.000}	0.155*** {0.000}				
	Weighted average density – MSOA (log)			-5.947*** {0.000}	-5.540*** {0.000}					-6.834*** {0.000}	-6.526*** {0.000}		
	Weighted average density – MSOA (log) squared			0.375*** {0.000}	0.347*** {0.000}					0.424*** {0.000}	0.403*** {0.000}		
	Properties per length (log)					-4.831 {0.176}	-3.549 {0.352}					-5.038 {0.118}	-4.049 {0.237}
	Properties per length (log) squared					0.567 {0.184}	0.41 {0.371}					0.572 {0.144}	0.451 {0.278}
Leakage	Leakage per km of mains	-0.093 {0.326}	-0.049 {0.632}	-0.092 {0.310}	-0.068 {0.497}	-0.058 {0.583}	-0.029 {0.793}	-0.06 {0.569}	-0.026 {0.811}	-0.092 {0.385}	-0.075 {0.502}	-0.048 {0.653}	-0.025 {0.823}
Constant	Constant	-0.928 {0.498}	-1.794 {0.235}	14.454*** {0.001}	12.708*** {0.006}	1.279 {0.859}	-1.569 {0.843}	-2.570* {0.078}	-3.142** {0.039}	15.919*** {0.000}	14.733*** {0.005}	0.564 {0.937}	-1.526 {0.839}
Model robustness tests and additional information													
Statistical diagnostic tests	R-squared	0.975	0.974	0.971	0.970	0.961	0.960	0.973	0.972	0.969	0.967	0.959	0.958
	RESET test	0.872	0.964	0.962	0.988	0.947	0.770	0.508	0.656	0.364	0.425	0.806	0.816
Model information	Estimation method	RE	RE	RE	RE	RE	RE	RE	RE	RE	RE	RE	RE
	Observations	85	85	85	85	85	85	85	85	85	85	85	85
	Dependent variable	Wholesale water botex plus network reinforcement						Wholesale water botex plus network reinforcement					

Source: SWW based on Ofwat's modelling suite.

A2.3 Modelling results of TWD models including leakage per mains length as an additional explanatory variable (2017/18–2021/22)

Source: SWW based on Ofwat's modelling suite.

Cost driver	Explanatory variable	TWD1	TWD2	TWD3	TWD4	TWD5	TWD6
Scale	Length of mains (log)	1.104*** {0.000}	1.049*** {0.000}	1.092*** {0.000}	1.096*** {0.000}	1.045*** {0.000}	1.081*** {0.000}
Topography	Booster pumping stations per length of mains (log)	0.331*** {0.000}	0.308*** {0.001}	0.307 {0.109}			
	Average pumping head TWD (log)				0.338*** {0.000}	0.393*** {0.000}	0.319*** {0.005}
Density	Weighted average density - LAD from MSOA (log)	-3.199*** {0.000}			-3.292*** {0.000}		
	Weighted average density - LAD from MSOA (log) squared	0.251*** {0.000}			0.252*** {0.000}		
	Weighted average density – MSOA (log)		-6.378*** {0.000}			-7.065*** {0.000}	
	Weighted average density – MSOA (log) squared		0.440*** {0.000}			0.478*** {0.000}	
	Properties per length of mains (log)			-15.610*** {0.000}			-15.934*** {0.000}
	Properties per length of mains (log) squared			1.969*** {0.000}			1.985*** {0.000}
Leakage	Leakage per km of mains (log)	-0.165 {0.211}	-0.095 {0.494}	-0.145 {0.299}	-0.136 {0.273}	-0.091 {0.425}	-0.142 {0.283}
Constant	Constant	4.227*** {0.004}	17.984*** {0.000}	25.109*** {0.000}	2.216 {0.148}	18.117*** {0.000}	23.652*** {0.000}
Model robustness tests and additional information							
Statistical diagnostic tests	Adjusted R-squared	0.965	0.961	0.968	0.970	0.972	0.975
	RESET test	0.661	0.985	0.674	0.179	0.155	0.288

Source: SWW based on Ofwat's modelling suite.

A2.4 Modelling results of leakage-related TWD models including leakage per mains length as an additional explanatory variable (2017/18–2021/22)

Cost driver	Explanatory variable	TWD1	TWD2	TWD3
Scale	Length of mains (log)	1.532*** {0.000}	1.440*** {0.000}	1.450*** {0.000}
Density	Weighted average density - LAD from MSOA (log)	-6.685*** {0.000}		
	Weighted average density - LAD from MSOA (log) squared	0.493*** {0.000}		
	Weighted average density – MSOA (log)		-13.514*** {0.000}	
	Weighted average density – MSOA (log) squared		0.885*** {0.000}	
	Properties per length of mains (log)			-11.828 {0.116}
	Properties per length of mains (log) squared			1.560* {0.098}
Leakage	Leakage per km of mains (log)	-0.419 {0.394}	-0.365 {0.421}	-0.455 {0.330}
Constant	Constant	8.516** {0.012}	38.742*** {0.001}	8.8 {0.477}
Model robustness tests and additional information				
Statistical diagnostic tests	Adjusted R-squared	0.921	0.9	0.873
	RESET test	0.598	0.901	0.494

Source: SWW based on Ofwat's modelling suite.

A3 Liming & bioresources

A3.1 Modelling results under Ofwat's approach on a unit cost basis

Cost driver	Explanatory variable	BR3	BR4	BR5	BR6
Scale	Sludge produced (log)	1.134*** {0.000}	1.119*** {0.000}	1.039*** {0.000}	1.024*** {0.000}
Economies of scale in sludge treatment, and location of STWs relative to sludge treatment centres	Load treated in bands 1-3 (%)		0.073*** {0.004}		
	Weighted average density - LAD from MSOA (log)			-0.23 {0.185}	
	Weighted average density - MSOA (log)				-0.305 {0.263}
	Number of STWs per property (log)	0.275 {0.174}			
Constant	Constant	0.808 {0.316}	-1.654** {0.014}	0.667 {0.362}	1.488 {0.301}
Model robustness tests and additional information					
Statistical diagnostic tests	Adjusted R-squared	0.784	0.817	0.779	0.775
	RESET test	0.374	0.278	0.07	0.344
	VIF (max)	3.359	2.455	2.156	2.268
	Pooling / Chow Test	0.974	0.944	0.864	0.935
	LM test (Pooled OLS vs RE)	0	0	0	0
	Normality of model residuals	0.04	0.141	0.048	0.045
	Heteroskedasticity of model residuals	0.757	0.197	0.124	0.305
Model information	Estimation method	RE	RE	RE	RE
	Observations	110	110	110	110
	Dependent variable	Bioresources botex including growth enhancement			
Efficiency score distribution	Minimum	0.60	0.68	0.59	0.58
	Maximum	1.47	1.53	1.43	1.47
	Range	0.87	0.85	0.84	0.89
Sensitivity tests	Removal most efficient company	A	A	A	A
	Removal least efficient company	A	G	A	A
	Removal first year	G	G	G	A
	Removal last year	G	G	G	G

Source: SWW analysis based on Ofwat's PR24 modelling suite.

Company code	Company	Triangulated
ANH	Anglian Water	1.14
NES	Northumbrian Water	0.61
NWT	United Utilities	0.84
SRN	Southern Water	0.93
SVH	Severn Trent Water + Hafren Dyfrdwy	0.89
SWB	South West Water	1.10
TMS	Thames Water	1.05
WSH	Dŵr Cymru	1.47
WSX	Wessex Water	1.14
YKY	Yorkshire Water	1.30
	Upper quartile	**0.8990**

Source: SWW analysis based on Ofwat's PR24 modelling suite.

A3.2 Modelling results under Ofwat's approach on a unit cost basis

Cost driver	Explanatory variable	BR1	BR2	BR3	BR4
Economies of scale in sludge treatment, and location of STWs relative to sludge treatment centres	Load treated in bands 1-3 (%)	0.051 *** {0.000}			
	Weighted average density - LAD from MSOA (log)		-0.199* {0.073}		
	Weighted average density - MSOA (log)			-0.276* {0.086}	
	Number of STWs per property (log)				0.172* {0.061}
Constant	Constant	-0.997*** {0.000}	0.626 {0.422}	1.375 {0.273}	0.605 {0.410}
Model robustness tests and additional information					
Statistical diagnostic tests	Adjusted R-squared	0.239	0.124	0.108	0.133
	RESET test	0.508	0.000	0.005	0.445
	VIF (max)	1	1	1	1
	Pooling / Chow Test	0.875	0.626	0.75	0.881
	LM test (Pooled OLS vs RE)	0	0	0	0
	Normality of model residuals	0.051	0.040	0.046	0.021
	Heteroskedasticity of model residuals	0.252	0.790	0.835	0.955
Model information	Estimation method	RE	RE	RE	RE
	Observations	110	110	110	110
	Dependent variable	Bioresources botex including growth enhancement divided by sludge produced			
Efficiency score distribution	Minimum	0.62	0.58	0.58	0.57
	Maximum	1.52	1.44	1.48	1.49
	Range	0.90	0.86	0.90	0.92
Sensitivity tests	Removal most efficient company	G	G	G	G
	Removal least efficient company	G	G	G	G
	Removal first year	G	G	G	G
	Removal last year	G	G	G	G

Source: SWW analysis based on Ofwat's PR24 modelling suite.

Company code	Company	Triangulated
ANH	Anglian Water	1.14
NES	Northumbrian Water	0.61
NWT	United Utilities	0.84
SRN	Southern Water	0.93
SVH	Severn Trent Water + Hafren Dyfrdwy	0.89
SWB	South West Water	1.10
TMS	Thames Water	1.05
WSH	Dŵr Cymru	1.47
WSX	Wessex Water	1.14
YKY	Yorkshire Water	1.30
	Upper quartile	**0.8990**

Source: SWW analysis based on Ofwat's PR24 modelling suite.

A3.3 Modelling results on a total cost basis, including the percentage of sludge treated by raw liming as an additional explanatory variable

Cost driver	Explanatory variable	BR3	BR4	BR5	BR6
Scale	Sludge produced (log)	1.175*** {0.000}	1.071*** {0.000}	1.243*** {0.000}	1.152*** {0.000}
Economies of scale in sludge treatment, and location of STWs relative to sludge treatment centres	Load treated in bands 1-3 (%)		0.011 {0.767}		
	Weighted average density - LAD from MSOA (log)			-0.294** {0.019}	
	Weighted average density - MSOA (log)				-0.242 {0.270}
	Number of STWs per property (log)	0.15 {0.353}			
Sludge treatment	Sludge treated by raw liming (%)	0.008*** {0.003}	0.008** {0.013}	0.009*** {0.001}	0.009*** {0.002}
Constant	Constant	-0.524 {0.402}	-1.291* {0.075}	0.031 {0.954}	0.262 {0.796}
Model robustness tests and additional information					
Statistical diagnostic tests	Adjusted R-squared	0.806	0.800	0.832	0.810
	RESET test	0.008	0.027	0.158	0.049
	VIF (max)	3.568	4.814	3.317	2.956
	Pooling / Chow Test	0.941	0.772	0.773	0.92
	LM test (Pooled OLS vs RE)	0	0	0	0
	Normality of model residuals	0.144	0.12	0.421	0.21
	Heteroskedasticity of model residuals	0.54	0.181	0.589	0.569
Model information	Estimation method	RE	RE	RE	RE
	Observations	110	110	110	110
	Dependent variable	Bioresources botex including growth enhancement			
Efficiency score distribution	Minimum	0.69	0.68	0.74	0.70
	Maximum	1.71	1.77	1.56	1.68
	Range	1.01	1.09	0.83	0.98
Sensitivity tests	Removal most efficient company	A	R	A	A
	Removal least efficient company	A	A	A	A
	Removal first year	G	A	G	G
	Removal last year	G	A	G	G

Source: SWW analysis based on Ofwat's PR24 modelling suite.

Company code	Company	Triangulated
ANH	Anglian Water	1.20
NES	Northumbrian Water	0.70
NWT	United Utilities	0.83
SRN	Southern Water	1.01
SVH	Severn Trent Water + Hafren Dyfrdwy	0.92
SWB	South West Water	0.84
TMS	Thames Water	0.96
WSH	Dŵr Cymru	1.67
WSX	Wessex Water	1.21
YKY	Yorkshire Water	1.39
	Upper quartile	**0.8592**

Source: SWW analysis based on Ofwat's PR24 modelling suite.

A3.4 Modelling results on a unit cost basis, including the percentage of sludge treated by raw liming as an additional explanatory variable

Cost driver	Explanatory variable	BR1	BR2	BR3	BR4
Economies of scale in sludge treatment, and location of STWs relative to sludge treatment centres	Weighted average density - LAD from MSOA (log)		-0.109 {0.254}		
	Weighted average density - MSOA (log)			-0.071 {0.541}	
	Number of STWs per property (log)				0.02 {0.786}
Sludge treatment	Sludge treated by raw liming (%)	0.008*** {0.001}	0.008*** {0.004}	0.008*** {0.003}	0.008*** {0.007}
Constant	Constant	-0.914*** {0.000}	-0.124 {0.860}	-0.347 {0.719}	-0.744 {0.266}
Model robustness tests and additional information					
Statistical diagnostic tests	Adjusted R-squared	0.196	0.246	0.213	0.203
	RESET test	0.370	0.602	0.653	0.512
	VIF (max)	1	1.08	1.179	1.482
	Pooling / Chow Test	0.887	0.664	0.723	0.785
	LM test (Pooled OLS vs RE)	0	0	0	0
	Normality of model residuals	0.075	0.048	0.063	0.057
	Heteroskedasticity of model residuals	0.048	0.203	0.167	0.191
Model information	Estimation method	RE	RE	RE	RE
	Observations	110	110	110	110
	Dependent variable	Bioresources botex including growth enhancement divided by sludge produced			
Efficiency score distribution	Minimum	0.65	0.64	0.64	0.65
	Maximum	1.76	1.61	1.69	1.73
	Range	1.11	0.97	1.05	1.08
Sensitivity tests	Removal most efficient company	G	G	G	G
	Removal least efficient company	G	A	A	A
	Removal first year	G	G	G	G
	Removal last year	G	G	G	G

Source: SWW analysis based on Ofwat's PR24 modelling suite.

Company code	Company	Triangulated
ANH	Anglian Water	1.32
NES	Northumbrian Water	0.65
NWT	United Utilities	0.85
SRN	Southern Water	0.97
SVH	Severn Trent Water + Hafren Dyfrdwy	1.00
SWB	South West Water	0.80
TMS	Thames Water	0.97
WSH	Dŵr Cymru	1.69
WSX	Wessex Water	1.11
YKY	Yorkshire Water	1.42
	Upper quartile	**0.8811**

Source: SWW analysis based on Ofwat's PR24 modelling suite.

A3.5 Modelling results on a total cost basis, including the percentage of sludge treated by conventional and advanced AD as an additional explanatory variable

Cost driver	Explanatory variable	BR3	BR4	BR5	BR6
Scale	Sludge produced (log)	1.117*** {0.000}	1.038*** {0.000}	1.171*** {0.000}	1.093*** {0.000}
Economies of scale in sludge treatment, and location of STWs relative to sludge treatment centres	Load treated in bands 1-3 (%)		0.019 {0.533}		
	Weighted average density - LAD from MSOA (log)			-0.289*** {0.009}	
	Weighted average density - MSOA (log)				-0.265 {0.223}
	Number of STWs per property (log)	0.159 {0.307}			
Sludge treatment	Sludge treated by conventional/advanced AD (%)	-0.007*** {0.000}	-0.007*** {0.000}	-0.007*** {0.000}	-0.007*** {0.000}
Constant	Constant	0.475 {0.404}	-0.532 {0.425}	1.058** {0.039}	1.397 {0.238}
Model robustness tests and additional information					
Statistical diagnostic tests	Adjusted R-squared	0.829	0.824	0.850	0.834
	RESET test	0.033	0.076	0.051	0.048
	VIF (max)	3.423	3.632	2.66	2.618
	Pooling / Chow Test	0.764	0.724	0.25	0.593
	LM test (Pooled OLS vs RE)	0	0	0.007	0
	Normality of model residuals	0.117	0.085	0.332	0.212
	Heteroskedasticity of model residuals	0.125	0.047	0.165	0.158
Model information	Estimation method	RE	RE	RE	RE
	Observations	110	110	110	110
	Dependent variable	Bioresources botex including growth enhancement			
Efficiency score distribution	Minimum	0.69	0.69	0.73	0.69
	Maximum	1.70	1.76	1.57	1.66
	Range	1.02	1.07	0.84	0.97
Sensitivity tests	Removal most efficient company	G	R	A	G
	Removal least efficient company	G	G	A	G
	Removal first year	G	G	G	G
	Removal last year	A	A	G	G

Source: SWW analysis based on Ofwat's PR24 modelling suite.

Company code	Company	Triangulated
ANH	Anglian Water	1.25
NES	Northumbrian Water	0.70
NWT	United Utilities	0.85
SRN	Southern Water	1.04
SVH	Severn Trent Water + Hafren Dyfrdwy	0.98
SWB	South West Water	0.86
TMS	Thames Water	0.99
WSH	Dŵr Cymru	1.67
WSX	Wessex Water	1.16
YKY	Yorkshire Water	1.32
	Upper quartile	**0.8942**

Source: SWW analysis based on Ofwat's PR24 modelling suite.

A3.6 Modelling results on a unit cost basis, including the percentage of sludge treated by conventional and advanced AD as an additional explanatory variable

Cost driver	Explanatory variable	BR1	BR2	BR3	BR4
Economies of scale in sludge treatment, and location of STWs relative to sludge treatment centres	Load treated in bands 1-3 (%)	0.011 {0.001}			
	Weighted average density - LAD from MSOA (log)		-0.148* {0.072}		
	Weighted average density - MSOA (log)			-0.148 {0.155}	
	Number of STWs per property (log)				0.069 {0.232}
Sludge treatment	Sludge treated by conventional/advanced AD (%)	-0.007*** {0.001}	-0.007*** {0.000}	-0.007*** {0.000}	-0.007*** {0.001}
Constant	Constant	-0.310* {0.087}	0.805 {0.159}	0.91 {0.269}	0.297 {0.518}
Model robustness tests and additional information					
Statistical diagnostic tests	Adjusted R-squared	0.292	0.348	0.315	0.297
	RESET test	0.016	0.195	0.009	0.096
	VIF (max)	1.684	1.019	1.046	1.178
	Pooling / Chow Test	0.586	0.364	0.496	0.615
	LM test (Pooled OLS vs RE)	0	0	0	0
	Normality of model residuals	0.056	0.044	0.058	0.049
	Heteroskedasticity of model residuals	0.467	0.566	0.481	0.44
Model information	Estimation method	RE	RE	RE	RE
	Observations	110	110	110	110
	Dependent variable	Bioresources botex including growth enhancement			
Efficiency score distribution	Minimum	0.67	0.66	0.66	0.66
	Maximum	1.77	1.61	1.69	1.72
	Range	1.09	0.95	1.03	1.07
Sensitivity tests	Removal most efficient company	G	G	G	G
	Removal least efficient company	G	A	G	G
	Removal first year	G	G	G	G
	Removal last year	A	G	G	A

Source: SWW analysis based on Ofwat's PR24 modelling suite.

Company code	Company	Triangulated
ANH	Anglian Water	1.33
NES	Northumbrian Water	0.66
NWT	United Utilities	0.87
SRN	Southern Water	1.01
SVH	Severn Trent Water + Hafren Dyfrdwy	1.03
SWB	South West Water	0.83
TMS	Thames Water	0.99
WSH	Dŵr Cymru	1.70
WSX	Wessex Water	1.11
YKY	Yorkshire Water	1.35
	Upper quartile	**0.8982**

A3.7 Modelling results, including the percentage of sludge treated by raw liming as an additional explanatory variable but excluding South West Water from the analysis

Cost driver	Explanatory variable	BR3	BR4	BR5	BR6
Scale	Sludge produced (log)	1.173*** {0.000}	1.099*** {0.000}	1.238*** {0.000}	1.130*** {0.000}
Economies of scale in sludge treatment, and location of STWs relative to sludge treatment centres	Load treated in bands 1-3 (%)		0.041 {0.323}		
	Weighted average density - LAD from MSOA (log)			-0.294** {0.015}	
	Weighted average density - MSOA (log)				-0.241 {0.247}
	Number of STWs per property (log)	0.189 {0.248}			
Sludge treatment	Sludge treated by raw liming (%)	0.010*** {0.002}	0.010*** {0.005}	0.010*** {0.001}	0.010*** {0.002}
Constant	Constant	-0.184 {0.759}	-1.522** {0.031}	0.05 {0.926}	0.365 {0.705}
Model robustness tests and additional information					
Statistical diagnostic tests	Adjusted R-squared	0.790	0.798	0.811	0.790
	RESET test	0.000	0.074	0.133	0.016
	VIF (max)	2.5	1.893	2.386	2.083
	Pooling / Chow Test	0.725	0.718	0.551	0.703
	LM test (Pooled OLS vs RE)	0	0	0	0
	Normality of model residuals	0.324	0.19	0.629	0.381
	Heteroskedasticity of model residuals	0.192	0.045	0.225	0.195
Model information	Estimation method	RE	RE	RE	RE
	Observations	99	99	99	99
	Dependent variable	Bioresources botex including growth enhancement			
Efficiency score distribution	Minimum	0.68	0.70	0.73	0.69
	Maximum	1.62	1.62	1.55	1.63
	Range	0.94	0.92	0.81	0.94

Source: SWW analysis from Ofwat's PR24 modelling suite.

Cost driver	Explanatory variable	BR1	BR2	BR3	BR4
Economies of scale in sludge treatment, and location of STWs relative to sludge treatment centres	Weighted average density - LAD from MSOA (log)		-0.116 {0.187}		
	Weighted average density - MSOA (log)			-0.104 {0.330}	
	Number of STWs per property (log)				0.067 {0.352}
Sludge treatment	Sludge treated by raw liming (%)	0.010*** {0.002}	0.010*** {0.004}	0.010*** {0.003}	0.010*** {0.004}
Constant	Constant	-0.912*** {0.000}	-0.067 {0.917}	-0.086 {0.921}	-0.352 {0.572}
Model robustness tests and additional information					
Statistical diagnostic tests	Adjusted R-squared	0.109	0.169	0.138	0.134
	RESET test	0.099	0.998	0.576	0.731
	VIF (max)	1	1.041	1.039	1.044
	Pooling / Chow Test	0.33	0.428	0.438	0.488
	LM test (Pooled OLS vs RE)	0	0	0	0
	Normality of model residuals	0.181	0.105	0.138	0.121
	Heteroskedasticity of model residuals	0.783	0.906	0.939	0.788
Model information	Estimation method	RE	RE	RE	RE
	Observations	99	99	99	99
	Dependent variable	Bioresources botex including growth enhancement divided by sludge produced			
Efficiency score distribution	Minimum	0.65	0.64	0.64	0.64
	Maximum	1.72	1.56	1.63	1.63
	Range	1.07	0.92	0.99	0.99

Source: SWW analysis from Ofwat's PR24 modelling suite.

A3.8 Modelling results, including the percentage of sludge treated by conventional and advanced AD as an additional explanatory variable but excluding South West Water from the analysis

Cost driver	Explanatory variable	BR3	BR4	BR5	BR6
Scale	Sludge produced (log)	1.118*** {0.000}	1.134*** {0.000}	1.173*** {0.000}	1.085*** {0.000}
Economies of scale in sludge treatment, and location of STWs relative to sludge treatment centres	Load treated in bands 1-3 (%)		0.097*** {0.000}		
	Weighted average density - LAD from MSOA (log)			-0.296*** {0.008}	
	Weighted average density - MSOA (log)				-0.302 {0.133}
	Number of STWs per property (log)	0.208 {0.152}			
Sludge treatment	Sludge treated by conventional/advanced AD (%)	-0.008*** {0.001}	-0.009*** {0.000}	-0.008*** {0.000}	-0.008*** {0.000}
Constant	Constant	0.996 {0.118}	-1.038*** {0.001}	1.144** {0.026}	1.825 {0.106}
Model robustness tests and additional information					
Statistical diagnostic tests	Adjusted R-squared	0.817	0.843	0.833	0.819
	RESET test	0.000	0.124	0.026	0.002
	VIF (max)	2.455	1.792	2.353	2.042
	Pooling / Chow Test	0.199	0.149	0.102	0.155
	LM test (Pooled OLS vs RE)	0	0.453	0.022	0.002
	Normality of model residuals	0.194	0.324	0.381	0.294
	Heteroskedasticity of model residuals	0.038	0.005	0.051	0.051
Model information	Estimation method	RE	RE	RE	RE
	Observations	99	99	99	99
	Dependent variable	Bioresources botex including growth enhancement			
Efficiency score distribution	Minimum	0.68	0.78	0.73	0.69
	Maximum	1.62	1.49	1.56	1.62
	Range	0.94	0.71	0.83	0.93

Source: SWW analysis from Ofwat's PR24 modelling suite.

Cost driver	Explanatory variable	BR1	BR2	BR3	BR4
Economies of scale in sludge treatment, and location of STWs relative to sludge treatment centres	Load treated in bands 1-3 (%)	0.064*** {0.001}			
	Weighted average density - LAD from MSOA (log)		-0.168** {0.030}		
	Weighted average density - MSOA (log)			-0.210* {0.061}	
	Number of STWs per property (log)				0.125* {0.065}
Sludge treatment	Sludge treated by conventional/advanced AD (%)	-0.009*** {0.000}	-0.008*** {0.001}	-0.008*** {0.000}	-0.008*** {0.001}
Constant	Constant	-0.293* {0.082}	1.082* {0.057}	1.532* {0.099}	0.899 {0.133}
Model robustness tests and additional information					
Statistical diagnostic tests	Adjusted R-squared	0.349	0.303	0.283	0.270
	RESET test	0.152	0.298	0.141	0.383
	VIF (max)	1.002	1.004	1.019	1.016
	Pooling / Chow Test	0.071	0.057	0.062	0.11
	LM test (Pooled OLS vs RE)	0.093	0.001	0	0
	Normality of model residuals	0.085	0.074	0.101	0.074
	Heteroskedasticity of model residuals	0.388	0.377	0.431	0.339
Model information	Estimation method	RE	RE	RE	RE
	Observations	99	99	99	99
	Dependent variable	Bioresources botex including growth enhancement			
Efficiency score distribution	Minimum	0.70	0.66	0.66	0.65
	Maximum	1.52	1.57	1.62	1.63
	Range	0.82	0.91	0.96	0.98

Source: SWW analysis from Ofwat's PR24 modelling suite.

A3.9 Preliminary cost driver forecasts for AMP8

Cost driver	2026	2027	2028	2029	2030
Sludge produced	47.40	48.60	49.90	50.90	52.00
Number of connected properties	786885	794424	802080	809484	816575
Number of STWs	654	654	654	654	653
Percentage of sludge treated by raw liming	67.00	67.00	67.00	67.00	67.00
WAD MSOA	1847.92	1853.79	1859.67	1865.58	1871.50
WAD LAD from MSOA	955.96	959.93	963.92	967.92	971.94
Percentage of sludge treated by conventional/advanced AD	30.00	30.00	30.00	30.00	30.00
Percentage of load treated in bands 1-3	10.04	9.94	9.83	9.74	9.58

Source: South West Water.

A4 Log of supporting files

File	Description
Overall	
Early CAC template BRL	Excel template for Bristol area
Early CAC template SWW	Excel template for SWW area
Canal costs	
CRT Audit Trail 2	Calculation file for data table – from source Abstraction costs and modelling in CRT early submission file through to completed CAC template
CAC CRT2	Implicit allowance calculation – output from modelling and raw water data summarised
CRT Raw Water data_updated	Data source for raw water bulk supply data
Do file water – amended BOTEX for the CRT CAC	Stata file for implicit allowance calculation
Customer Forum Drought Management report	Support for section 3.6
BW128 Review of Ofwats PR19 Draft Determination on Bristol Waters Special Cost Factor on Canal and River Trust Payments NERA	Support for section 3.4.1
A5d Annual Customer Survey	Support for section 3.6
CRT-early submission	Historical reported data from PR19 Cost Adjustment Claim
Abstraction costs	Source records and calculation of contract costs
Leakage	
Leakage econometrics – audit trail	Outputs from alternative econometric models
1.3 2022 March BRL Customer Survey Report Final 21-22	Support for section 4.5
2.2 WCWRG Deliberative Research Report 2021 September	Support for section 4.5
2.8 South West Water WCWRG Re-Run Summary Report Draft February 2023	Support for section 4.5
Industry LK1 Collated	Source of base leakage data for UQ calculations
Isle_BW_Leakage_Review_FINAL	Section 4.4
Leakage Audit Trail_IM	Calculation file of upper quartile with data linked through to CAC template
Intermediate data	Data file to and from Stata for alternative models
Oxera SWW econometric audit do file	Stata do file for econometric alternative models. Includes instructions on how to link to modified input/output data file

Leakage_data	Stata data file from Ofwat WW4 data for alternative models
Bioresources	
Do file bioresources – AD approach	Stata file for bioresources modelling
Do file bioresources – liming approach	Stata file for bioresources modelling
CAC liming methodology 1 updated	Outputs from liming methodology 1
CAC liming methodology 2 updated	Outputs from AD methodology 2 and summary of both approaches
Liming audit trail including template_IM update	Summary of source data and link into submission template
OXERA – updated cost driver forecast	Cost driver forecasts used in econometric / total cost model projections
Template BIO	Summary of allowances from the source modelling to the template – see section 5.4

South West Water

Bournemouth Water

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