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PR24

Cost Adjustment Claims

Anglian Water

October 2023

Cost Adjustment Claim documentation structure

On 9 June 2023, we submitted our draft Cost Adjustment Claims (CACs) to Ofwat. We now submit our finalised set of CACs as part of our PR24 Business Plan.

In total we submitted 21 documents in June. These are listed in the Table below. This current document contains eight of those documents: write-ups of six claims as well as the cover letter and Oxera's Assurance statement (documents 1, 2, 3, 5, 9, 12, 17 and 19 in the table below). The five remaining listed documents (documents 8, 14, 16, 18 and 21 in the table below) have been incorporated into a single CAC support document. The eight Excel workbooks (numbers 4, 6, 7, 10, 11, 13, 15 and 20 in the table below) have been included in a single compressed (zipped) file.

Table: Documents submitted on 9 June 2023

Ref		Document title
1.	ANH_CAC_0.0	Cover letter
2.	ANH_CAC_0.1	Oxera Assurance statement
3.	ANH_CAC_1.1	APH CAC
4.	ANH_CAC_1.2	Excel workbook calculations for APH CAC
5.	ANH_CAC_2.1	Lack of large works CAC
6.	ANH_CAC_2.2	Excel workbook calculations for Lack of large works Base case CAC
7.	ANH_CAC_2.3	Excel workbook calculations for Lack of large works Alternative format CAC
8.	ANH_CAC_2.4	Economies of scale in large works white paper
9.	ANH_CAC_3.1	Energy CAC
10.	ANH_CAC_3.2	Excel workbook calculations for day ahead market prices
11.	ANH_CAC_3.3	Excel workbook calculations for Energy implicit allowance and summary
12.	ANH_CAC_4.1	P removal CAC
13.	ANH_CAC_4.2	Excel workbook calculations for P removal opex CAC calculations
14.	ANH_CAC_4.3	STATA do file for P removal by site opex benchmarking analysis
15.	ANH_CAC_4.4	Excel workbook setting out STATA p-removal opex benchmarking data
16.	ANH_CAC_4.5	STATA do file for Implicit Allowances analysis
17.	ANH_CAC_5.1	Leakage CAC
18.	ANH_CAC_5.2	Leakage regression results
19.	ANH_CAC_6.1	Boundary box replacements CAC
20.	ANH_CAC_6.2	Excel workbook calculations for meter penetration analysis
21.	ANH_CAC_6.3	Boundary box failure analysis

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Ofwat

09 June 2023

By email to costassessment@ofwat.gov.uk

Our ref:

Your ref:

Dear Ofwat

Early cost adjustment claim submission

In accordance with the process set out in the PR24 Final Methodology, and the timetable set out in the base modelling consultation, we are pleased to make our early submission of cost adjustment claims.

The Final Methodology stated that Ofwat will treat with caution any claims submitted in business plans that were not included in the early cost claim submission[1]. Accordingly, we submit six claims which we may wish to include in our plan in October.

We do not believe that the sole or best route for the subjects of our claims is necessarily a cost adjustment claim. Furthermore, we submit our claims without knowledge of the base cost models Ofwat will use for setting base allowances. As the price review process continues, and aspects of the methodology become fixed, we may well amend or withdraw our claims.

Our overriding objective is to ensure that we receive efficient allowances for the costs we will incur in 2025-30. Achieving that goal is more important than the route by which it is delivered. We will be pleased to engage further with Ofwat to discuss alternative approaches if it agrees that they may be better than the cost adjustment claim process for any of the subjects of our claims.

We expand briefly here on the claims we have submitted, their net value and our views on the factors which may cause us to amend or withdraw them:

Average pumping head (£131m) and large water recycling centres (£109m) – In accordance with Ofwat's guidance, we have quantified our cost adjustment claim on the assumption that all the consultation water models are used and given equal weight. However, the need for and value of our claim would change should Ofwat use different models or apply different weights.

Phosphate removal costs (£60m) – in the base modelling consultation Ofwat invited stakeholders to suggest options to ensure that its cost assessment approach funded efficient ongoing costs associated with companies' AMP7 P removal programmes[2]. We have submitted a cost adjustment claim covering the net additional cost we will incur in 2025-30 to operate our AMP7 plants but we would withdraw or amend the claim should Ofwat implement an alternative approach which allowed this funding.

Leakage (£68m) – Both Ofwat and the CMA accepted in principle that adjustment should be made to allowances to reflect the higher marginal costs incurred by better performing companies. We submit an updated claim, making use of the richer data which has been provided by companies since PR19. We would withdraw or amend the claim should Ofwat implement a modelling approach which allowed for these higher costs.

[1] Final methodology for PR24, Appendix 9 'Setting expenditure allowances', Ofwat, December 2022, page 33
[2] Econometric base cost models for PR24, Ofwat, April 2023, page 41

Boundary boxes (£138m) – in the 1990s Anglian was the first company to recognise that measured consumption was the best basis for water billing and the first to embark on large-scale meter installation. In AMP7 we have experienced the first widespread failures of meter chamber assets thirty years after their initial installation and we expect the scale of this issue to increase in 2025-30. This is a material maintenance obligation which has not featured in the expenditure of any company in the modelled period and will therefore not be allowed for in the PR24 modelled base cost allowances. Our preference would be to deal with this issue not via a cost adjustment claim but through some form of uncertainty mechanism. Should we get agreement for that approach we would withdraw our claim.
Energy (Water Resources £66m, Water Network+ £211m, Wastewater Network+ £328m) - In addition to these claims, we have also proposed a cost adjustment claim as way of dealing with the substantial challenge of ensuring cost allowances reflect the costs companies will face for energy purchase in 2025-30.

Companies have experienced very significant increases in their costs in the last two years as a result of the rise in the global prices for energy. The current evidence from the market suggests that costs will continue into the next price control period at levels materially above the levels that applied in the modelled period. The allowances from the base cost models cannot therefore provide for the efficient costs of energy purchase in 2025-30. Having considered various options for dealing with this issue, we have concluded that the strategy which works best with the PR24 methodology is to submit a cost adjustment claim to translate the outputs of the base models into costs which reflect the 22/23 market prices for energy and apply real price effects (RPEs) to capture the changes we forecast from 22/23 onwards. The RPE forecasts we will include in our business plan will therefore offset a substantial proportion of the value of our energy claim.

We do not think that a 'CAC+RPE' approach is the best way to deal with this issue. Superior approaches might be some form of indexation of the price control to quoted energy prices or an uncertainty mechanism with true-up, ideally on the basis of a published index. If Ofwat decided that mechanisms such as these would be more successful in aligning risks and incentives in energy purchase we would withdraw our claim.

We considered one additional item as a candidate cost adjustment claim: the additional costs of replacing and maintaining water mains which are vulnerable to the pressures we foresee as a consequence of climate change. Our conclusion was to submit the costs of dealing with climate-vulnerable mains as a component of our enhancement plan in our business plan, recognising this reflects a long term forward-looking approach. As a consequence we do not submit a cost adjustment claim as part of this early submission.

Of the six cost adjustment claims we are submitting, three (APH, large WRCs and leakage) were submitted at PR19. In each case Ofwat has taken steps since PR19 to gather better information, which we have used to submit updated, more robust claims. The other three claims were not submitted at PR24 because they relate to issues which were not present at PR19.

In order to assist stakeholders with the evaluation of our claims we include a suite of supporting documents with this submission. We index those documents in the appendix to this letter.
Performance adjustment claims – company-specific adjustments to performance commitment levels

The Final Methodology identified ways that exogenous factors impacting performance be addressed: [3]

- a mechanism for companies to propose cost adjustments where they consider they are unable to deliver a common level of performance with its efficient cost allowance.
- consider setting company-specific performance commitment levels (PCLs) when there is compelling evidence that performance is materially affected by an exogenous factor not captured in cost models and/or differences in historical enhancement expenditure allowances.

In addition to the cost adjustment claims, we are planning to include proposals, as part of our PR24 business plan, for company-specific adjustments for a small number of the common PCLs. We see a role for adjustments that reflect two main issues:

[3] Ofwat (2022) *Creating tomorrow, together: Our final methodology for PR24 Appendix 9 – Setting expenditure allowances*, page 61.

- **Exogenous regional factors**. Just as there may be regional factors (e.g. treatment complexity, topology, density) that lead to differences in efficient levels of costs, there may be regional factors that lead to differences in the levels of performance achievable for given levels of cost. In some cases the effects of a regional factor may impact costs and performance.
- **Limitations in Ofwat's performance normalisation metrics**. Some of Ofwat's performance commitments (PCs) involve the use of a normalisation metric to compare performance between companies (e.g. the number of pollution incidents per 10,000 km sewer). While some method(s) for normalisation may be required to support performance benchmarking across companies, there is a danger of over-simplification, especially if a metric is used which only captures part of the underlying differences between companies that affect performance. This risks giving a misleading impression of relative performance of companies.

In relation to leakage, we have submitted a cost adjustment claim. Ofwat's PR24 final methodology is for a company-specific performance level for leakage rather than a common PCL for leakage so the two issues highlighted above do not apply directly to the setting of PCLs.

For other PCs we plan to seek adjustments to common PCLs. This is not necessarily the same as setting company-specific PCLs. The PCLs would still be grounded in cross-company comparisons of performance but the way in which the comparison is made would be improved to enable more like-for-like and reasonable comparisons. We envisage a role for symmetrical adjustments from a common PCL starting point, based on empirical evidence (e.g. econometric models).

While the final methodology provides a route for seeking a cost adjustment claim, we consider that an adjustment to the PCL would be more appropriate for these other PCs. There are circumstances in which it would be more logical to make an adjustment away from a common PCL rather than adopting a common PCL and increasing bills via a cost adjustment claim. The reasons for this relate to the factors identified above: (a) exogenous regional factors cause differences in performance between efficient companies; and (b) limitations in Ofwat's performance normalisation metrics.

As always, we would be happy to discuss any matters arising from this submission.

Yours sincerely

[redacted]

Regulation Director

Letter of assurance

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Anglian Water's PR24 cost adjustment claims
9 June 2023

Overview

Oxera was commissioned to provide independent assurance of the robustness of cost estimates underlying Anglian Water's (AWS) PR24 cost adjustment claims (CACs), as submitted to Ofwat on 9th June 2023. This assurance is provided in line with the cost efficiency assurance requirement (Appendix 9 to Ofwat's final methodology)[4] and the broader CAC guidance on the calculation of implicit allowances and symmetrical cost adjustments provided therein.[5]

The scope of this assurance covers: (i) the efficient cost estimates (used to calculate the gross value of the claim); (ii) the implicit allowance calculations (deducted from the gross value, to arrive at the net value of the claim); and (iii) the calculation of a symmetrical cost adjustment (where relevant). We also reviewed AWS's forecasting methodology to ensure that it is generally consistent with Ofwat's PR19 approach (with adjustments to the PR19 approach made where appropriate).[6]

We have reviewed the robustness of the efficient cost estimates by investigating whether they are consistent and correctly calculated and whether they are in line with Ofwat's CAC guidance. We have also checked that all costs reported in real terms are in 2022/23 prices, based on the latest ONS data (thus converting from the historic base of 2017/18 prices, where relevant)

In conducting this exercise, we did not review the accuracy of AWS's outturn and forecast data, nor have we traced other company data back to its original source (for example, confirming the accuracy of data reported in other company annual performance reports, or APRs). Company data received is generally taken as given and accurate, unless stated otherwise.

In certain cases we have conducted the underlying cost assessment and/or efficiency benchmarking underlying the AWS claim. In other cases we have assessed AWS's own cost estimates. We clearly distinguish between these instances below, to indicate where we provide third party assurance for AWS calculations

The review team included consultants with expertise in efficiency assessments. As economics consultants, and not engineers, our review focused on economic assurance of cost efficiency.

This assurance covers estimates for the following CAC areas (and segments):

- Ongoing AMP7 P removal costs (wholesale wastewater),
- Economies of Scale (wholesale wastewater),
- Average Pumping Head (APH) (wholesale water),
- Leakage (in wholesale water), and
- Energy prices (wholesale water, wholesale wastewater and bioresources)

[4] Ofwat (2022), 'PR 24 Final methodology, Appendix 9: Setting expenditure allowances', December 2022, section A1.2.2, page 158.
[5] Ofwat (2022), 'PR 24 Final methodology, Appendix 9: Setting expenditure allowances', December 2022, section A1, pages 154-162.
[6] For example, when the trend of a particular cost driver appears ambiguous or unclear, the latest 2022 value is retained as the forecast value for the whole duration of AMP8 (for example, the case of treatment complexity or economies of scale measures). We consider these as equally, if not more appropriate, forecasts.

As the quantification of the boundary box CAC is bottom up/engineering based we have not assured the efficiency of these cost estimates.

Details of the specific calculations and/or review per area are included in the sections below.

Ongoing AMP7 P removal costs

We reviewed the approach to quantify the gross value of the claim, and conducted the efficient annual scheme opex benchmarking (as the basis on the gross value is estimated) and the implicit allowance (IA) quantification.

The efficient ongoing scheme cost benchmarking is based on Table 7F data from companies' APRs, as received from AWS. We take this data as given and accurate, making only minimal adjustments to company APR data in instances of clear and obvious reporting errors.[7] As set out in the appendix to the CAC, we note that Ofwat has since requested improvements to company submissions of the data, as submissions were, in some places, either incomplete and/or inconsistent with values obtained by the Environment Agency (EA). The estimates obtained on the basis of Table 7F data are thus preliminary, albeit based on the best data available at the time of the submission. As such, this quantification should be updated as and when updated and more complete table 7F data becomes available.

In line with Ofwat's guidance, the ongoing scheme cost benchmarking is based on a unit cost assessment.[8] An upper-quartile (UQ)[9] efficiency challenge has then been applied (consistent with the CMA PR19 appeal determinations).[10] The benchmarking exercise is clearly explained and replicable based on the explanation provided in the appendix to the claim, accompanying Excel workbooks and Stata do files.

AWS's quantification of the gross value of the claim on this basis thus follows an efficient unit cost approach, in line with Ofwat's guidance.[11] We have audited and stress-tested AWS's calculations in this regard. For the latter, we tested the disaggregated approach taken by AWS (using benchmarked efficient ongoing annual costs for schemes with tight- and less tight consents, separately), against the less granular approach of determining the UQ based on all traditional schemes (irrespective of the stringency of consents). Whilst this is arguably a less appropriate approach (given that sites with more stringent consents are generally expected to entail higher ongoing costs), it is less sensitive to any potential reporting errors in the underlying data used for site classification.[12] The sensitivity provides a similar gross value estimate[13] and thus provides assurance on the appropriateness of AWS's approach.

In line with Ofwat's guidance, we quantify the IA by remodelling the wholesale wastewater models without the relevant category expenditure (AMP7 P removal schemes over 2021 – 2022).[14,15] As is the case for the P removal scheme ongoing cost benchmarking, this analysis would need to be updated as more data becomes available (AWS also notes in its CAC). For the time being, we consider the net claim on this basis as accurate and robust.

Unlike the APH or the large works CACs discussed below, the symmetry principle does not apply here as an uplift is expected for every company.

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7 These corrections are discussed in detail in the appendix to the CAC and the accompanying Excel dataset and Stata do file.

8 Ofwat (2022), 'PR 24 Final methodology, Appendix 9: Setting expenditure allowances', December, section A1, pages 160-161.

9 Ofwat (2022), 'PR 24 Final methodology, Appendix 9: Setting expenditure allowances', December, section A1, pages 160-161

10 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – Final report', Competition and Market Authority, March 2021 – paragraph 4.494

11 Specifically, the unit cost approach outlined in Ofwat (2022), 'PR 24 Final methodology, Appendix 9: Setting expenditure allowances', December, section A1, pages

12 Especially given missing data to allow sites classification into tight- or less tight consent categories – as discussed in the appendix to the CAC.

13 In 2022/23 prices, AWS estimates a gross value of some £60m using the disaggregated unit cost approach. The less granular approach yields and estimate of £57m

14 That is, the *B0321PRO_SWT* variable used to construct the disaggregated sewage treatment (SWT)- and top down wastewater network plus (WWNP) botex cost variables used by Ofwat in its modelling suite.

15 Ofwat (2022), 'PR 24 Final methodology, Appendix 9: Setting expenditure allowances', December, section A1, page 160.

Economies of Scale

We reviewed the approach to quantify the gross value of the claim and the IA. In both cases the costs are estimated based on Ofwat's proposed top down econometric models and therefore provide cost estimates relative to other companies.[16] The modelled costs have been subject to a catch-up efficiency challenge in line with Ofwat's guidance to ensure the efficiency of the cost estimates. Consistent with the CMA position at PR19, we have retained a UQ as the reference benchmark. The IA process follows Ofwat's example 2 in section A1.3.1 providing guidance on how the IA can be estimated.[17]

We also derived the AMP8 cost driver forecasts and symmetrical adjustments. While there is no perfect approach to this, we have reviewed whether the approach followed is consistent with Ofwat's PR19 approach,[18] to the extent possible and appropriate,[19] by applying a linear extrapolation of historical trends to most of the cost drivers. For each of the cost driver, the exact assumptions are detailed in the CAC documents and have been part of our auditing process. While they are directly relevant to compute the net value of the claim for AWS, the aim of such forecasts is also to give an indication of what the symmetrical adjustment might look like for each company (though the CACs are yet to be subject to a consultation process, so the exact impact is expected to evolve).

AWS has also estimated the claim based on an alternative approach relying on both a regression and a unit cost analysis as per the CMA approach in Bristol's 2015 appeal. Although we have reviewed the approach based on PR19 models, we have not audited the updated analysis based on PR24 models as this has been performed subsequently by AWS. However, we note that the estimated impact of the claim is well within the envelope of our audited econometric analysis. While AWS has used the lower of the two estimates as its CAC, we would consider the econometric based approach to provide the more robust estimate of the two since the relationship between cost and cost drivers is better captured than with a unit cost analysis.

Average Pumping Head (APH)

We reviewed the approach to quantify the gross value of the claim and the IA. In both cases the costs are estimated based on Ofwat's proposed top down econometric models and therefore provide cost estimates relative to other companies. The modelled costs have not been subject to a catch-up efficiency challenge as the level of the UQ was above one in the IA scenario. The mechanistic application of such an adjustment is counterintuitive since it would increase the value of the estimated costs which departs from the purpose of a catch-up efficiency challenge. Since the current modelling suite does not account for the recent upward cost pressures faced by the industry and would increase the estimated cost impact, until further detail is provided by Ofwat on its PR24 approach to this issue, we consider the net claim as being efficient.

We also reviewed the AMP8 cost driver forecasts and estimated them to be consistent with Ofwat's PR19 approach. [20] We have also audited the symmetrical adjustments, although like for the economies of scale CAC, the exact impact is expected to change with updates of the cost drivers forecasts and the CAC consultation.

[16] Ofwat (2023), 'Stata do file: PR24 wastewater network plus base cost v3', April.
[17] Ofwat (2022), 'PR24 Final methodology, Appendix 9: Setting expenditure allowances', December, section A1.3.1, page 159.
[18] Ofwat (2019), 'Feeder model 3: Wholesale wastewater: Forecast of wastewater cost drivers', December.
[19] Where a trend of a particular cost driver appears ambiguous or unclear, we considered that it is more appropriate that the latest 2022 value is retained as the forecast value (for example, the case of treatment complexity or economies of scale measures).
[20] Ofwat (2019), 'Feeder model 3: Wholesale water: Forecast of water cost drivers', December.

Leakage

The gross value of the claim and the IA was quantified based on Ofwat's proposed top down econometric models and therefore provide cost estimates relative to other companies. [21] The analysis was restricted to the period 2017/18–2021/22 because of limited availability of leakage data. The IA process follows Ofwat's example 2 in section A1.3.1 providing guidance on how the IA can be estimated.[22] The modelled claims, derived by subtracting the IA from the gross claim, have been subject to a catch-up efficiency challenge in line with Ofwat's guidance to ensure the efficiency of the cost estimates. Consistent with the CMA position at PR19, a UQ efficiency challenge was applied.

As for the other CACs, the net claim has been derived based on AWS's AMP8 cost driver forecasts which we have reviewed and deemed them to be consistent with Ofwat's PR19 approach. [23] However, AWS has based the symmetry of the adjustments on the results derived from historical data (2017/18–2021/22), as, unlike other CACs the rate of improvement in leakage across the industry is still highly uncertain at this stage. Given this uncertainty, we consider that this approach is more appropriate than attempting to forecast leakage for all companies.

AWS has also estimated the claim based on an alternative approach relying on the CMA methodology in the PR19 appeal.[24] Although we have reviewed the approach, we have not audited the updated estimates, as this has been performed subsequently by AWS since it depends on company's own leakage expenditure forecasts. However we note that the estimated impact of the claim is consistent with our audited econometric analysis.

Energy prices

We reviewed the approach to quantify the IA of the claim. AWS has followed Ofwat's guidance to estimate the IA by using one of the three recommended approaches, namely running the models with and without the relevant explanatory variable (here, power costs).[25]

While AWS has applied a UQ efficiency challenge for wastewater costs, they did not for water costs for the same reasons highlighted above for the APH CAC—namely, that this would have implied applying an uplift to modelled costs which is counter-intuitive. AWS has estimated the gross claim on bioresources to be below the materiality threshold and we agree.

As Ofwat's CAC template requires a split by price control on the water side, AWS proposed to split the IA between water network+ and water resources based on the observed weight of power costs in these two categories over the last five years. We have stress-tested this and agree that this constitutes a reasonable assumption. For completeness the same methodology has been retained within the water network+ claim in order to differentiate raw water distribution,[26] water treatment and treated water distribution costs. On the wastewater side, for simplicity everything has been reported under the total category.

[21] Ofwat (2023), 'Stata do file: PR24 water base cost v3', April.
[22] Ofwat (2022), 'PR24 Final methodology, Appendix 9: Setting expenditure allowances', December, section A1.3.1, page 159.
[23] Ofwat (2019), 'Feeder model 3: Wholesale water: Forecast of water cost drivers', December.
[24] CMA (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations Final report', para. 8.77, 17 March.
[25] Ofwat (2022), 'PR24 Final methodology, Appendix 9: Setting expenditure allowances', December, section A1.3.1, pages 159-160.
[26] Raw water storage was allocated a weight of zero.

For the purpose of the IA calculation, we also reviewed the AMP8 cost driver forecasts as discussed above. While there is no perfect approach to this, we have reviewed whether the approach followed is consistent with Ofwat's PR19 approach,[27] to the extent possible and appropriate[28], by applying a linear extrapolation of historical trends to most of the cost drivers. For each of the cost driver, the exact assumptions are detailed in the CAC documents and have been part of our auditing process.

However, the gross claim was taken as given as we have not been provided the underlying Excel calculations. The claim is also based on the expected total energy purchased over AMP8 on which we are not able to review the accuracy. However, we have provided comments on the choice of the reference energy price and have estimated it to constitute a reasonable starting point.

[27] Ofwat (2019), 'Feeder model 3: Wholesale wastewater: Forecast of wastewater cost drivers', December and Ofwat (2019), 'Feeder model 3: Wholesale water: Forecast of water cost drivers', December

[28] Where a trend of a particular cost driver appears ambiguous or unclear, we considered that it is more appropriate that the latest 2022 value is retained as the forecast value (for example for the weighted average complexity measure or economies of scale measures).

Introduction our CACs

Whereas in June we submitted six CACs, listing out the cost data as required in tables CW18 and CWW18, for the Business Plan we have included only five of these in those Business Plan tables. The sixth CAC, for Boundary Box replacements, has been excluded on the grounds that we believe that an Uncertainty Mechanism (UM) would be a better way of handling the associated costs. We have left the commentary for the Boundary Box CAC in this document. This is because, were Ofwat not to propose a UM for Boundary Boxes, we would wish to reinstate its CAC.

We appreciate that this approach may appear inconsistent with how we have dealt with the Energy CAC. We felt that, because of the scale of the claim and because a UM is not the only other way in which it could be handled, it was better to leave the Energy CAC in tables CW18 and CWW18.

We would like to bring to Ofwat's attention that four of our CACs are contingent on Ofwat's approach at Draft Determination.

1. Our APH CAC is contingent on whether or not Ofwat uses only Average Pumping Head (APH) as a measure of topography
2. Our Lack of Large Works CAC is contingent on whether or not Ofwat uses only Weighted Average Treatment Size (WATS) as a way of capturing lack of economies of scale
3. Our Energy CAC is contingent of Ofwat not implementing either a true up or a UM
4. Our Boundary Box CAC is contingent of Ofwat not implementing a UM

No other substantive changes have been made to the CACs we submitted in June, aside from correcting any typographical errors found and removing the suggestion that we would update the CACs with 2023 data. Given the timing of data availability and the process of external assurance, this was not feasible.

Average Pumping Head

ANH CAC 1

Document reference	Narrative file: ANH CAC 1.1 APH		
Title of cost adjustment claim	Average Pumping Head CAC		
Price control	Water Network Plus	Symmetrical?	YES/~~NO~~
Basis of claim	APH is generally accepted to be the best available measure of topography for cost modelling purposes. The concerns raised over the quality of APH data during PR19 and the subsequent CMA process have substantially been addressed by the industry since the start of AMP7		
Gross value (£m five years)		£1,780.6 million	
Implicit allowance (£m five years)		£1,650.1 million	
Net value of claim (£m five years)		£130.5 million	
How efficiency of costs are demonstrated		Cost efficiency is demonstrated by using Ofwat's suite of base cost models. Using APH, ANH is 4th most efficient with an efficiency score of 0.99	
Materiality (as % of totex for price control)		3.9%	
How customers are protected		Assurance on this CAC has been provided by Oxera	
Supporting document references		Excel file: ANH CAC 1.2 Oxera assurance: ANH_CAC_0.1 Assurance	

1.1. Initial points to note

This CAC is submitted on a contingent basis. We note the use of APH by Ofwat in some of its suite of models released in April 2023 to take account of the impact of topography models on required costs in the Treated Water Distribution and Wholesale Water. If APH were to be included in all the relevant models used by Ofwat for PR24 as the only topography driver, then this CAC would not be required. Anglian is submitting the CAC in accordance with advice provided by Ofwat during the Cost Assessment Working Groups during 2021 and early 2022.

We have argued consistently during the PR19 and subsequent CMA process that APH ought to be included in its PR19 models. Both Ofwat and the CMA rejected this contention on the grounds that the data quality for APH was not adequate enough at that time. During the PR24 Cost Assessment Working Group process, we once again argued that APH ought to be reinstated and proposed that there should be an industry-wide effort to improve data quality. The subsequent project led by Turner and Townsend and WRc and subsequent efforts by the industry has led to not just a material improvement in data quality but also a re-evaluation on the part of industry members of the value of APH within the business for assessing and improving pumping efficiency. As a result of this renewed focus on APH and its data quality and a separate exercise by Ofwat to assure the cost data used in recent months, the concerns which led it the PR19 claim being dismissed have now been addressed.

During the CMA process, Ofwat agreed that APH is its preferred variable to take account of topography in cost models. The superiority of APH compared to Pumping Stations per length of mains (PS/L) was also highlighted by CEPA in its modelling report (p. 23): "*Most pumping costs are related to treated water distribution so we would expect APH to be most relevant for explaining TWD costs*".[29] Given that Ofwat had been using APH within cost models for two decades, this is unsurprising. The clear causal relationship between APH and pumping power consumed, and the absence of a clear causal relationship for the alternative of Pumping Stations per length of mains (PS/L), made this position entirely uncontentious. In our base cost consultation response, we provided evidence on this point by showing the absence of correlation between PS/L and energy consumption. Consequently, as the only obstacle that stood in the way of using APH was the data quality, which has now been addressed, we would not expect to see any of the PR24 models use PS/L as a 'topography' driver.

Ofwat's triangulation ought to be between *equally valid* alternative explanations of cost causality. We do not think, therefore, that triangulating separate models with APH and with PS/L is valid: the latter is, at the very least, a much poorer measure of topography: we indeed would contend it is not a measure of topography at all.

We have included, and netted off, the Implicit Allowance (IA) included in the Ofwat models for APH. In line with our view of PS/L as not representing a measure of topography, we have taken the existing formulation of the proposed PR24 models as the basis for computing the IA.

In line with the guidance provided by Ofwat, this CAC:

- Relates purely to base costs;
- Includes explicitly calculated IAs;
- Sets out the symmetric adjustments relevant to all other companies; and
- Is above the materiality threshold set for Water Network Plus.

The rest of this CAC is set out as follows:

- Section 1.2 addresses the need for adjustment
- Section 1.3 addresses the efficiency of the costs proposed in the CAC
- Section 1.4 sets out the structure of the CAC
- Section 1.5 sets out the table which make up the CAC
- Appendix 1.1 sets out this CAC's conformity with Ofwat's criteria for assessing CACs

[29] CEPA (2023), 'PR24 Wholesale Base Cost Modelling', April, p.23.

1.2. Need for adjustment

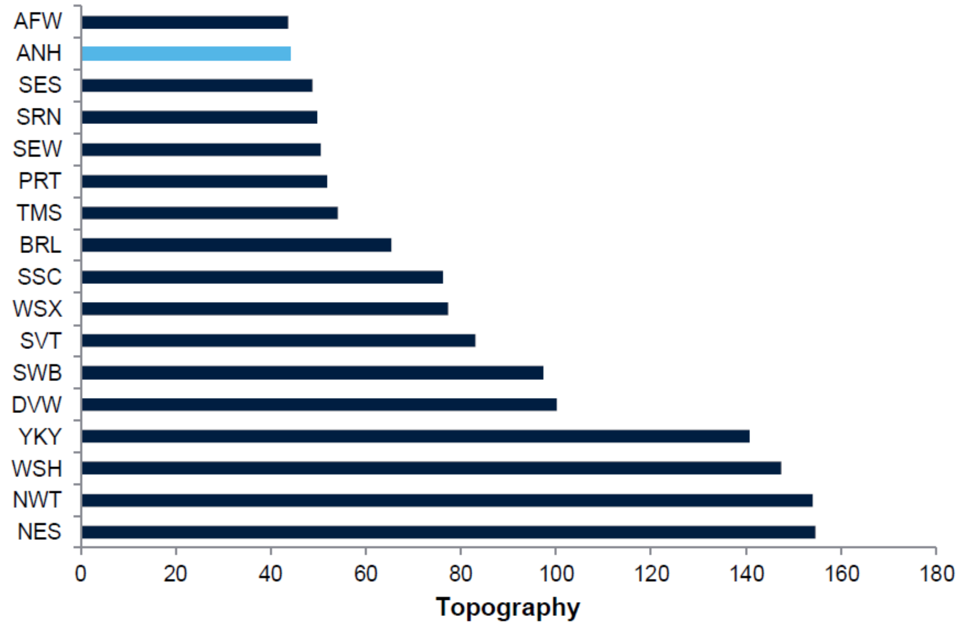
This section provides evidence setting out the unique circumstances which justify this CAC. It also demonstrates the exogeneity of these factors and, as such, that these factors are outside management control. (This section replicates and updates the analysis undertaken by Oxera for us in 2020 during the CMA appeal in that year).

We operate in a region with specific characteristics that drive higher pumping costs relative to other companies. Below, we set out the characteristics that, in combination, make us unique, in particular with regard to topography, sparsity and abstraction.

Topography

First, we operate in a very flat region relative to other water companies. This can be seen in Figure 1. To compute our measure of topography we have taken samples of elevation from Local Authority districts and calculated the standard deviation across this distribution for each water company region. A low score therefore represents a very flat region.

Figure 1: Topography of Water company regions



Source: Oxera analysis of topography data extracted using the Environment Agency's LIDAR Composite DTM (Digital Terrain Model) raster elevation model in combination with our inhouse GIS platform 'MapInfo Professional'.

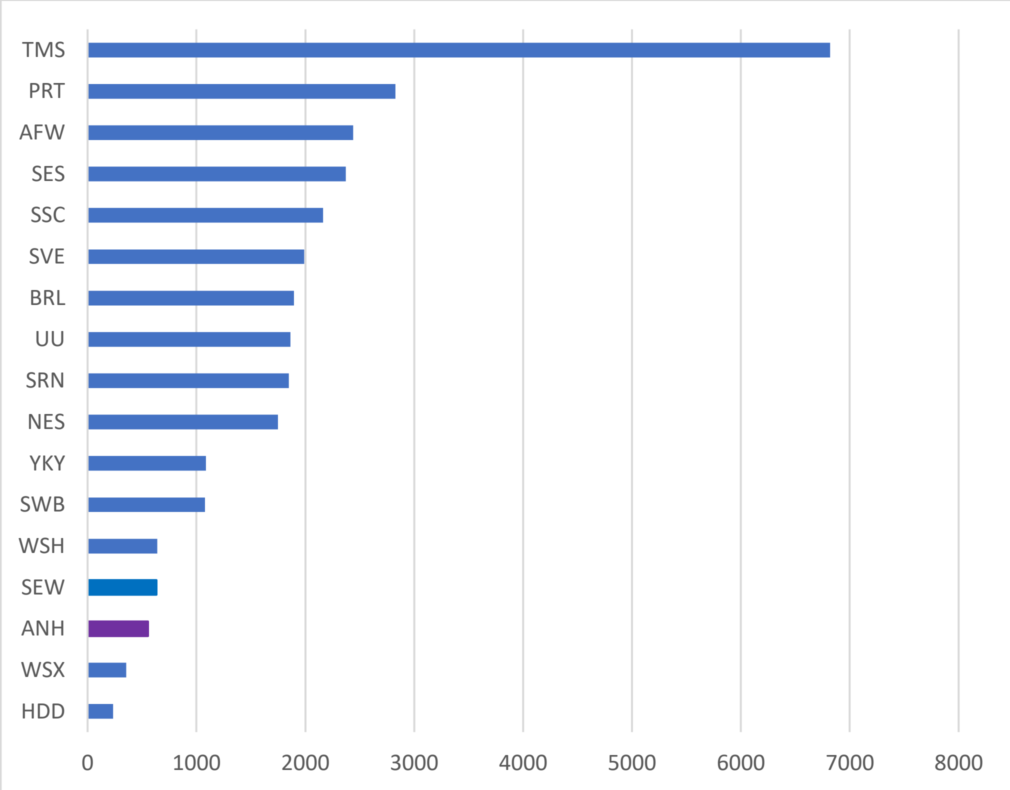
Companies that operate in very flat regions are less able to rely on gravity-fed systems of pumping, and instead must use more energy-intensive high lift pumps and water towers through the treated water distribution network to a much greater extent.

Sparsity

We also operate in a very sparsely populated region. Figure 2 below plots the improved version of the density measure used at PR19, i.e. WAD LAD from MSOA water where a low number represents a sparsely populated region. Other things being equal, a sparser region with few dense areas in it means that more pumping will be required to bring water across relatively longer distances.

While sparsity may be captured, to some extent, in Ofwat's models, they do not capture the *combination* of external characteristics that affect our pumping costs. As such a CAC is incremental to Ofwat's models and we calculate the incremental impact relative to these models.

Figure 2: Density as measured by WAD LAD from MSOA water (2022 data)



Analysis: Anglian Water

Abstraction sources

A third characteristic that will have an impact on a water company's pumping costs is the proportion of distribution input that is abstracted from boreholes and pumped into pumped storage reservoirs. Water abstracted from boreholes and pumped into pumped storage reservoirs will have more energy-intensive pumping requirements compared with abstraction from rivers.

Table 1 shows the proportion of distribution input derived from impounding reservoirs, river abstractions and boreholes shown as a proportion of DI abstracted by source, expressed as a share of the industry average in 2022. It is clear that the proportion of distribution input that we abstract from boreholes and from pumped storage reservoirs is higher than the industry average, whereas the proportion coming from rivers is much lower.

Table 1: Proportion of DI abstracted by source, % of industry average

	Boreholes	Rivers	Pumped storage Reservoirs
Anglian Water	167%	27%	157%
Industry 25th percentile	55%	5%	4%
Industry 75th percentile	220%	155%	113%

Analysis: Anglian Water

Our unique characteristics

We have considered the exogenous characteristics of water companies that are relevant to explaining why certain companies would incur higher pumping costs than others. We:

- Operate in a very flat region;
- Have very low density measures;
- Derive a relatively high proportion of its distribution input from boreholes and pumped storage reservoirs.

We note that it is the *combination* of these three factors that results in our being atypical with regard to the pumping costs it needs to occur. Other companies that operate in very flat regions do not necessarily also have a high level of population sparsity, for instance Affinity. Likewise, highly sparse water regions are often not especially flat (e.g. Wessex Water). Similarly, while Portsmouth has a high proportion of distribution input abstracted from boreholes, it is neither sparse nor flat. It also benefits from being able to use a mostly gravity-fed system (its APH is low both in aggregate and for Water Resources Plus).

SES has a high proportion of distribution input abstracted from boreholes and it is also quite flat (although fairly densely populated). Its APH is high in aggregate—at a similar level to Anglian Water. However, SES successfully secured a cost adjustment claim for abstraction pumping costs at PR19.[30]

We would also like to highlight that these unique characteristics have a direct impact on our energy usage and greenhouse gas emissions. We note that the normalisation of the new operational greenhouse gas emissions performance commitments will be based on distribution input and volume of wastewater treated. This misses a crucial driver of emissions, namely the level of pumping required to move water and wastewater to and from customers. While Ofwat will set company specific performance commitment levels for emissions, relative performance comparisons are less relevant for assessing ambition in performance and regard will need to be given to how proactive companies have been historically, as well as their operating conditions.

[30] See SES Water (2019), 'PR19 Business Plan Resubmission: Cost adjustment claim for wholesale electricity usage'

1.3. Demonstrate cost efficiency

In terms of cost efficiency, our starting point for this CAC was to replicate the approach used by Ofwat and the CMA for setting efficient cost assessments at PR19, but in the context of the PR24 modelling suite. The calculation is made on two separate bases: models excluding APH and instead using Pumping Stations/Length (PS/L) (used to derive the Implicit Allowance for the CAC) and including APH in the TWD and wholesale models in place of PS/L. The arithmetic difference between the two represents the value of the CAC. Taking this approach has the advantage that it automatically generates the value of the symmetric adjustments for all other companies at the same time.

However, we note that in both modelling scenarios the level of an Upper Quartile (UQ) efficiency challenge is above one, implying that the application of a UQ challenge would increase costs. This is counterintuitive but not surprising given the higher cost pressures faced by the industry over the last two AMPs. Indeed, it is 1.021 when we rely exclusively on PS/L and 1.002 when we rely exclusively on APH. We note that this also applies in one of the two scenarios if the benchmark is set to the fourth most efficient company. In this context we do not consider that it is relevant to apply an 'inefficiency' challenge. As such, the estimation of our CAC is based on the difference in predicted costs between both scenarios without any efficiency challenge. This is not directly relevant to this CAC but the increase in efficiency scores raises concerns about the ability of Ofwat's modelling to capture higher cost trends within the water industry, so we would expect Ofwat to consider the issue in advance of PR24 (for example through our CAC on energy costs). In any case, we intend to re-estimate the level of the UQ once the 2022/23 data becomes available in order to check whether this issue is still present.

In 2022/23 Price Base, our APH CAC is estimated to be £130.5 million (see Section 1.5 below). Our Water Network Plus Totex for AMP8 is estimated at £3.4 billion. Given the level of materiality set by Ofwat for Water Network Plus CACs is 1 percent (i.e. £34 million), this CAC clearly exceeds the materiality threshold.[31] While this CAC is derived by comparing a scenario using models with APH only to a scenario using models with PS/L only, we would still submit a CAC if Ofwat were to use both equally in the models. In that case the amount of the claim would decrease to £65.3m while still exceeding the materiality threshold.

Anglian Water submits an Excel spreadsheet showing the different steps undertaken to get the final estimate of the CAC.

Third party assurance for this CAC is provided by Oxera.[32]

[31] This demonstrates materiality.
[32] See ANH_CAC_0.1 Assurance

1.4. Structure of this CAC

In this section we set out the approach we have taken to computing this CAC. Having used only industry data which are freely available and have been thoroughly scrutinised, the approach is both transparent and replicable.

The approach taken was to start from the Ofwat / CMA PR19 approach to assessing base costs[33] but by using Ofwat's proposed modelling suite for PR24 so as to generate an estimate of what may be expected from PR24 Draft Determination.

The Implicit Allowance (IA) is the base cost assessment using the 24 PR24 models for water (six Water Resource Plus, six Treated Water Distribution (TWD) and twelve wholesale models). This was generated using the data set and STATA do file issued by Ofwat in April 2023. Anglian Water then created an Excel file with the updated coefficients and modelled costs generated by STATA.

The models are generated using data from 2012 – 2022. The data sets used were those issued by Ofwat in April 2023. These are used to compute the Upper Quartile as defined by the CMA, which we intended to use for the catch up if it were not above unity. AMP8 cost drivers are generated in the Excel file using the methodology explained in the previous section. Actuals up to 2022 are used, followed by forecast data up to the end of AMP8 using, where appropriate, the same approach as Ofwat at PR19. Where Ofwat used averages of its trended number and the company forecast, we have used just the trended numbers as, naturally, we do not have all companies' forecasts for AMP8 available to us.

The comparator is provided by the same models with the PS/L variable replaced by APH_{TWD} in the three TWD models as well as in the six total wholesale water models.[34] This follows the approach taken by Ofwat in its April 2023 suite of models: Ofwat felt that the data quality for areas of APH other than Treated Water Distribution was still not sufficient to warrant its use in models. Consequently, APH_{TWD} was used in all wholesale models in place of APH_{Total}.

[33] We have followed the same aggregation process as in PR19, namely: applying an equal weight to each model within a single cost aggregation (Treated Water Distribution, Water Resources Plus or Wholesale Water), applying an equal weight between the bottom-up approach and the top-down approach, computing the catch-up efficiency challenge on a historical basis based on triangulated costs.

[34] We have retained this approach as it was the one that required less modifications of Ofwat's do file. However, this is, of course, perfectly equivalent to removing all models with PS/L.

1.5. CAC data tables

As required by the table guidance[35] for CW18 (Water CACs)[36], we quote the IA before the application of Frontier Shift and RPE. For the sake of consistency, the same approach has been taken with the APH versions of the models. However, although Ofwat's guidelines are clear about the need to apply a catch-up efficiency challenge to compute the amount of the claim and the IA, we have not applied it here since the level of the UQ is above unity, which would result in a higher value for the claim.

The figures set out in the following tables are of modelled costs only.

£m, 22/23 PB	PS/L only used in all models	APH_{TWD} only used in all models[37]	Delta APH_{TWD} used in all models	Delta APH TWD only used %
ANH	1,650.1	1,780.6	130.5	7.9%
AFW	1,229.9	1,184.4	-45.5	-3.7%
BRL	420.2	398.7	-21.4	-5.1%
HDD	141.2	135.1	-6.1	-4.3%
NES	1,431.4	1,381.8	-49.5	-3.5%
NWT	2,503.5	2,306.9	-196.6	-7.9%
PRT	201.1	168.5	-32.6	-16.2%
SES	176.4	216.5	40.2	22.8%
SEW	721.4	779.3	57.9	8.0%
SRN	912.1	800.7	-111.4	-12.2%
SSC	503.8	589.5	85.8	17.0%
SVE	3,042.6	2,840.5	-202.1	-6.6%
SWB	795.1	890.4	95.3	12.0%
TMS	4,353.5	5,089.7	736.2	16.9%
WSH	1,317.3	1,207.7	-109.7	-8.3%
WSX	542.8	537.4	-5.4	-1.0%
YKY	1,749.7	1,542.9	-206.8	-11.8%

For the purpose of filling in table CW18, we have disaggregated the Anglian Water's AMP8 modelled costs based on both scenarios. As this CAC only impacts Treated Water Distribution, there is no loss in accuracy of the IA calculation by not splitting Treatment and Raw Water Distribution.

ANH with PS/L 22/23 PB £m	2026	2027	2028	2029	2030	AMP8
Water Resources	33.4	33.6	33.9	34.1	34.4	169.4
Treatment (& RWD)	80.1	80.7	81.2	81.8	82.4	406.2
TWD	211.9	213.4	214.9	216.4	217.9	1,074.4
Total ANH with PS/L	325.4	327.7	330.0	332.3	334.7	1,650.1

ANH with APH 22/23 PB £m	2026	2027	2028	2029	2030	AMP8
Water Resources	36.3	36.4	36.6	36.7	36.8	182.8
Treatment (& RWD)	87.1	87.4	87.7	87.9	88.2	438.4
TWD	230.5	231.2	231.9	232.6	233.3	1,159.4
Total ANH with ANH	353.9	355.0	356.1	357.2	358.3	1,780.6

[35] PR24 business plan table guidance part 3; Costs (wholesale) - water

[36] "The value of the implicit allowance should be calculated after the application of the catch-up efficiency challenge, but before the application of frontier shift and real price effects. Companies should clearly set out the assumption used for the catch-up efficiency challenge." 21.5 p. 88.

[37] In other words, APH_{TWD} has been used in both TWD and WW models.

ANH IA22/23 PB, £m	2026	2027	2028	2029	2030	AMP8
Water Resources	0.0	0.0	0.0	0.0	0.0	0.0
Treatment (& RWD)	0.0	0.0	0.0	0.0	0.0	0.0
TWD	28.5	27.3	26.1	24.9	23.7	130.5
Total IA	28.5	27.3	26.1	24.9	23.7	130.5

Appendix 1.1: Conformity with Ofwat's criteria for assessing CACs

Category	#	Issue	Response
Need For Adjustment: Unique Circumstances	1	Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?	We do not contend that we face unique circumstances regarding the use on non-use of APH within its models. Instead, our argument centres on how APH acts as an effective measure of topography and why Ofwat's concerns over APH data quality have now been addressed
	2	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)?	Not relevant – see answer to 1 above.
	3	Is there compelling evidence of alternative options being considered, where relevant?	At its heart, this CAC focuses on the shortcomings of the alternative option used at PR19, Pumping Stations/Length
Need For Adjustment: Management Control	1	Is the investment driven by factors outside of management control?	The facts that a) topography is a factor influencing our costs; and b) that the topography of our region is outside management control are not at question
	2	Have steps been taken to control costs and have potential cost savings (eg spend to save) been accounted for?	Pumping costs are monitored closely so as to ensure the efficient use of power
Need For Adjustment: Materiality	1	Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?	Yes. The engineering and economic rationale were reprised in the work undertaken by Turner and Townsend and WrC
	2	Is there compelling quantitative evidence of how the factor impacts the company's expenditure? Adjustment to allowances (including implicit allowance)	Yes. The CAC above sets out the quantification of using APH as opposed to PS/L
	3	Is there compelling evidence that the cost claim is not included in our modelled baseline (or, if the models are not known, would be unlikely to be included)? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?	As set out at the start of the CAC, this claim is contingent on APH not being included in the model suite used by Ofwat at PR24.
	4	Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?	Yes

	5	Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?	Not relevant
	6	Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?	The impact of not using APH within the base model suite would be to understate the impact of topography upon cost allowances.
	7	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?	Not relevant – topography does not change from AMP to AMP
	8	If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?	This is intrinsic to this claim. See section 1.2 above.
Cost efficiency	1	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)?	Yes – see associated Excel workbook
	2	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 – see associated Excel workbook
	3	Does the company provide third party assurance for the robustness of the cost estimates?	Yes – this is provided by Oxera[38]
Need for investment	1	Is there compelling evidence that investment is required?	Not applicable
	2	Is the scale and timing of the investment fully justified?	Not applicable
	3	Does the need and/or proposed investment overlap with activities already funded at previous price reviews?	Not applicable
	4	Is there compelling evidence that customers support the need for investment (both scale and timing)?	Not applicable
Best option for customers	1	Did the company consider an appropriate range of options to meet the need?	Not applicable
	2	Has a cost–benefit analysis been undertaken to select proposed option? There should be compelling evidence that the proposed solution represents best value for customers, communities and the environment in the long term? Is third-party technical assurance of the analysis provided?	Not applicable

[38] See ANH CAC 1.3

	3	Has the impact of the investment on performance commitments been quantified?	Not applicable
	4	Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where utilisation will be low?	Not applicable
	5	Has the company secured appropriate third-party funding (proportionate to the third party benefits) to deliver the project?	Not applicable
	6	Has the company appropriately presented the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?	Not applicable
	7	Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views	Not applicable
Customer Protection	1	Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?	Not applicable
	2	Does the protection cover all the benefits proposed to be delivered and funded (eg primary and wider benefits)?	Not applicable
	3	Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including the mechanism for securing sufficient third-party funding?	Not applicable

Absence of Large Water Recycling Works

ANH CAC 2

Document reference	Narrative file: ANH CAC 2.1 Lack of large Water Recycling works		
Title of cost adjustment claim	Absence of large Water Recycling Works CAC		
Price control	Water Recycling Network Plus	Symmetrical?	YES/~~NO~~
Basis of claim	Two alternative approaches are set out. The value of this CAC is the lower of the two values. Approach taken looks at the impact on costs of not having large works Alternative approach (set out but not used) considers the value of the PR24 model suite using only WATS as opposed to not using WATS at all		
Gross value (£m five years)		£ 132.7 million	
Implicit allowance (£m five years)		£ 24.0 million	
Net value of claim (£m five years)		£ 108.7 million	
How efficiency of costs are demonstrated		Through benchmarking comparisons relative to industry	
Materiality (as % of totex for price control)		2.4%	
How customers are protected		Assurance on this CAC has been provided by Oxera	
Supporting document references		Supporting Excel file for preferred approach: ANH CAC 2.2 Supporting Excel file for alternative approach: ANH CAC 2.3 White paper on economies of scale: ANH_CAC_2.4 Assurance: ANH_CAC_0.1 Assurance	

2.1. Initial points to note

This CAC is submitted on a contingent basis. We note the use of alternative variables included by Ofwat in its suite of models released in April 2023 to take account of the large works effect on required costs. If the weighted average treatment size (WATS) variable were to be used as the only driver capturing economies of scale in the models used by Ofwat for PR24, then this CAC would not be required. We are submitting the CAC in accordance with advice provided by Ofwat during the Cost Assessment Working Groups during 2021 and early 2022 and the guidance set out in the PR24 Final Methodology.

We submitted a claim to take account of this issue during the PR19 and subsequent CMA process. The claim was rejected on the grounds of incomplete data (data on large works were not available for 2014, 2015 and 2016). Since the CMA appeal, additional robust data on large sewage treatment works has been collated and there has been an exercise by Ofwat to assure the data used in recent months. This has enabled Ofwat to build alternative cost drivers for PR24. The CMA also gave the fact that we do not appear to be unique in the relevant characteristics as a subsidiary reason for rejecting the PR19 large works CAC. As the current CAC includes symmetric adjustments for all companies, we consider that the issue of uniqueness does not constitute grounds for rejecting this CAC. As such, the concerns which led to the PR19 claim being dismissed have now been addressed.

The size of Water Recycling Centres (WRCs) is an exogenous variable and determined by local factors such as sparsity and topography. Looking at the structure of the cost models used by Ofwat at PR19 for sewage treatment, and at those put forward by Ofwat in the April 2023 suite of models, it appears that Ofwat accepts the basic premise of our claim – that the size of WRCs is an exogenous variable and determines the costs required by companies to run their sewage treatment operations. We say this because Ofwat made it very clear throughout both PR19 and so far during PR24 that it would only use exogenous variables within its models.

Consequently, our concerns with the PR19 models were not that the problem was ignored by Ofwat but that the variables Ofwat had chosen to use (the share of load treated in Bands 1-3 and in Band 6) were not sufficiently tightly defined effectively to account for the issue. This was driven by the lack of more granular data in PR19. It would appear that Ofwat accepts (or at least is prepared to entertain) this contention as well, given that additional disaggregated data has been collated and that the two new variables (the WATS, and share of load treated in works larger than 100,000 p.e.), which Ofwat included in the April 2023 suite of models, are more tightly defined than the PR19 equivalent. However, only WATS is able to fully capture the impact of large works.

We present two alternative approaches to calculating the value of this CAC. The first follows the same approach we took at PR19. In the second, we ran two scenarios: one where WATS is used as the only cost driver capturing economies of scale in both SWT and WWWNP models; and one where the load treated in bands 1-3 *and* the load treated in STWs larger than 100,000 p.e. are used in the modelling suite. The difference between the former and the latter constitutes the net value of the CAC. The value of the updated CAC is significantly lower than the alternative approach. For the purpose of our submission, we are using the lower of the two CACs.

The former approach is set out in sections 2.3 – 2.5, the latter in Appendix 2.2.

In the approach we have used for our submission, we have included, and netted off, the Implicit Allowance (IA) included in the Ofwat PR19 models for economies of scale in sewage treatment. The IA calculation follows the same general approach taken by the CMA in Bristol's 2015 appeal. The CMA overwrote the share of Band 1-3 load with the industry average figure for the most recent year's data. We have extended this approach by adjusting the Band 1-3 variable in PR19 model SWT1 to the 2022 industry average and separately adjusting >100,000 p.e and WATS variables to its industry average figures, also for 2022. In each case we compared the resultant assessment with the baseline assessment. We then triangulated the three differences to produce an overall IA.

In line with the guidance provided by Ofwat, this CAC:

- Relates purely to base costs;
- Includes explicitly calculated IA based on PR24 models;
- Sets out the symmetric adjustments relevant to all WaSCs; and
- Is above the materiality threshold set for Water Recycling Network Plus.

The rest of this CAC is set out as follows:

- Section 2.2 addresses the need for adjustment
- Section 2.3 addresses the efficiency of the costs proposed in the CAC
- Section 2.4 sets out the structure of the CAC
- Section 2.5 sets out the tables which make up the CAC
- Appendix 2.1 sets out this CAC's conformity with Ofwat's criteria for assessing CACs
- Appendix 2.2 sets out the alternative approach to computing the CAC

2.2. Need for adjustment

Our CAC for the impact of not having any very large WRCs is based on the following four propositions:

i) There is a material, observable reduction in the unit cost of treating wastewater as WRC size increases. Economies of scale are monotonic and decreasing up to the very largest works size. The evidence for this is set out in Table 2.
ii) Whether or not a company has very large WRCs is dependent on the demographics of the appointed area – which is exogenous to management control.
iii) It is the absence of large WRCs which causes our overall unit cost to be lower quartile. In other words, as a result of factors completely outside management control, our efficient costs for Wastewater Treatment are higher than other WaSCs
iv) Based on the ratio of our unit costs per Band and the industry unit costs per Band, Anglian Water's costs for waste water treatment are shown to be efficient (better than the Upper Quartile, UQ) for Bands 1 – 6. Indeed, once economies of scale in larger bands are properly accounted for in the econometric modelling (i.e. with WATS), Anglian is estimated to be the most efficient company. (In contrast, the company is found to perform worse than the median or the lower quartile company in Ofwat's other two models (SWT2 and SWT1, respectively), which clearly indicates that Ofwat's proposed models are not able to correctly capture the impact of economies of scale).

Anglian Water has analysed its estate of WRCs and looked to see if there are any cost beneficial opportunities to merge works in order to access additional economies of scale. No such opportunities amongst larger works have been found.

The existence or otherwise of large works is a material driver of expenditure within Sewage Treatment as can be seen from Table 2 below. This underlying rationale for this CAC is not in doubt: Ofwat's PR19 models for Sewage Treatment included variables measuring the share of load handled at small (Bands 1-3) and large (Band 6) works at PR19. And within the suite of models recently released by Ofwat, two new variables have been included: the share of load treated at works handling p.e over 100,000 and the weighted average size of works (WATS) variable. Our purpose in submitting this CAC is that the control variables in PR19 models which are designed to take account of this factor do not do so adequately, and although the load treated at works handling p.e over 100,000 represents a *slight* improvement compared to its PR19 'equivalent' (load treated in bands 6 and above, i.e. >25,000 p.e.), unlike the WATS it is unable to fully capture the greater economies of scale arising from the operation in much larger sewage treatment works.

Were Ofwat to go ahead with the WATS variable in its modelling suite for PR24, this CAC would therefore be unnecessary. However, in line with Ofwat's guidance during the Cost Assessment Working Groups that CACs should be submitted based upon the cost drivers used at PR19, we submit this CAC but recognize that it is contingent on the WATS variable not being used at PR24.

At PR19, Anglian Water started the process of computing the Large Works CAC by proposing five new Bands to replace the existing Band 6, which covers all WRCs handling load from over 25,000 p.e. The proposed Bands are as set out in Table 1 below. Anglian Water fully accepts that the break points for the new Bands are just as arbitrary as those for the existing six Bands. They do however create a more even split of load across the Bands, with the shares being similar for those in Band 7 and above. Such a split also allows to identify Anglian (alongside South West Water and Southern Water) as an outlier in terms of load treated in larger STWs meaning that we do not benefit from the same efficiency opportunities as the rest of the industry.

Table 1: New Band sizes

Band	p.e. in Band
6 (revised)	25,000 – 125,000
7	125,000 – 250,000
8	250,000 – 500,000
9	500,000 – 1,000,000
10	>1,000,000

The analysis reported here is taken from the Excel workbook ANH Large Works CAC calculation.xlsx which forms an integral part of this CAC.

2.3. Demonstrate cost efficiency

Anglian Water analysis

Table 2 shows the unit costs in 2021/22 for each Band in £ per kg of BOD5 load.

Table 2 Unit costs in 2022 (£/kg)

Unit costs 2022 £/kg	Band 1	Band 2	Band 3	Band 4	Band 5	Band 6 mod	Band 7	Band 8	Band 9	Band 10	Total	Ofwat B6
p.e. in Band	**<250**	**250-500**	**500-2,000**	**2k - 10k**	**10k - 25k**	**25k - 125k**	**125k-250k**	**250k-500k**	**500k - 1m**	**>1m**		**> 25k**
ANH	4.08	2.99	1.61	1.02	0.73	0.48	0.42	0.39			0.64	0.43
NES	5.73	3.22	1.34	1.21	0.66	0.78	0.24	0.38	0.77		0.74	0.67
UU	7.73	3.57	2.87	1.28	0.81	0.62	0.43	0.33	0.33	0.28	0.55	0.44
SRN	29.18	4.12	2.75	1.49	1.09	1.53	0.67	0.41			1.17	1.02
SVT	6.67	3.06	2.22	1.33	1.06	0.26	0.42	0.37	0.32	0.24	0.49	0.30
SWB	4.85	3.56	1.99	1.26	1.00	0.95	0.21				1.06	0.74
TMS	5.58	4.12	1.99	1.17	0.83	0.91	0.89	0.52	0.32	0.48	0.59	0.56
WSH	5.69	3.49	1.61	1.13	0.81	0.61	0.65	0.13	0.38		0.72	0.50
WSX	7.25	3.18	1.97	1.20	0.90	0.79	0.62		0.29		0.77	0.59
YKY	3.49	2.37	1.66	0.74	0.61	0.99	0.21	0.50	0.48		0.63	0.58
Total	6.57	3.30	1.95	1.16	0.84	0.75	0.52	0.40	0.42	0.42	0.66	0.53
UQ	5.03	3.09	1.63	1.14	0.75	0.61	0.29	0.36	0.32	0.26		0.46

The following industry trends can be noted from Table 2:

- At an industry level, **unit costs across the Bands are monotonic and decreasing as the Band number increases**. This same trend is also observable for almost every individual company; where there are discontinuities in the trend, they are typically small and associated with a company having a single WRC in that Band;
- The difference in unit costs between Bands is large: **the average industry Band 1 unit cost is 16 times higher than the average industry Band 10 unit cost**;
- **The unit costs for each company's highest Band are (with one exception) significantly lower than the Ofwat Band 6 unit cost for that company**. The discounts range from 11 percent to 71 precent, depending on whether the company has relatively small works (such as Anglian Water), or very large works in Band 10 (such as Thames). As such, not accounting for this continuum of decreasing unit costs will over-estimate the efficiency of companies with very large work such as Thames and under-estimate the efficiency of companies with no very large work such as Anglian.

In addition, the following Anglian-specific information can be noted from Table 2:

- **Anglian Water's largest WRCs are in Band 8**. Its largest WRC is thus smaller than every other company's largest WRC, with the exception of South West Water;
- **Anglian Water's unit costs are below the industry average in all Bands and within the Upper Quartile for Bands 1 – 7 as well as for Ofwat's PR19 definition of bands 6+.**

It is instructive to compare the unit costs in newly defined Bands set out in Table 1 to the Ofwat Band 6 definition, to understand the loss of information resulting from Ofwat's implicit assumption that economies of scale cease at its Band 6. Despite above average unit costs in many individual categories within Bands 6 (revised) –10, the three companies with Band 10 works (as a result of having the largest WRCs in the industry) have very low unit costs when Bands 6 (revised) –10 are aggregated. By contrast, as a result of not having any Band 9 or Band 10 WRCs, Anglian has the fifth highest total unit cost (thus appearing to be inefficient) despite having Upper Quartile unit costs in Bands 1 – 6 (modified) and second Quartile unit costs in Bands 7 and 8.

In 2022/23 Price Base, the Anglian Water Large Works CAC is worth £108.68 million (see Table 13 in Section 5 below). Our Water Recycling Network Plus Totex for AMP8 is forecast to be £4.5 billion. Given the level of materiality set by Ofwat for Water Recycling Network Plus CACs is 1 percent (i.e. £45 million), this CAC clearly exceeds the materiality threshold.

Oxera has provided external assurance for this CAC[39]

Third party corroboration

Anglian Water is familiar with research undertaken at Loughborough University as part of a PhD thesis into "Development of Robust Empirically Implementable Benchmarking Methodologies to Better Inform and Target Managerial Efforts to Improve the Costs and Environmental Sustainability of Water and Waste Water Systems". The following tables are replicated with permission of the candidate from a White Paper[40] published recently which will form a chapter of the candidate's thesis.

The paper draws interesting and useful distinctions between Activated Sludge and Biological treatment works and computes the short and long run economies of scale for each.

However, the key area we would wish to draw to Ofwat's attention is the concluding analysis of Band 6 works by decile, comparing actual and predicted costs for all companies. The econometric underpinning of the analysis is set out in detail in the White Paper. The following three tables 12, 13 and 15, are taken from the White Paper. Tables 12 and 13 set out actual and predicted costs per decile for each company while Table 15 sets out the measured efficiency in each decile for each company.

Table 12 broadly corroborates the analysis in Table 2 above. Tables 13 and 15 together demonstrate that Anglian Water is upper quartile (UQ) efficient across all ten deciles of Band 6.

[39] ANH_CAC_0.1
[40] ANH_CAC_2.4

Table 12 : Actual Unit Cost by Company and Plant Size Decile

Company	1	2	3	4	5	6	7	8	9	10	Total
ANH	0.641	0.638	0.586	0.480	0.659	0.260	0.497	0.507	0.474	0.408	0.544
NES	0.698	0.860	0.720	0.564	0.807	0.437	0.553	0.353	0.472	0.768	0.660
SRN	0.767	0.673		0.616	0.410	0.867	0.644	0.709	0.345		0.646
SVE	0.617	0.504	0.474	0.519	0.564	0.441	0.475	0.432	0.468	0.293	0.484
SWB	1.152	0.986	0.931	0.728	0.607	0.475	0.726		0.410		0.695
TMS	0.828	0.871	0.794	0.971		0.749	0.903	0.612	0.794	0.398	0.731
UU	0.936	0.668	0.793	0.649	0.584	0.701	0.596	0.457	0.445	0.310	0.617
WSH	1.303			0.316	0.632	0.346	0.537	0.508	0.432	0.280	0.509
WSX	1.178	0.831	0.755	0.723	0.703	0.886	0.815	0.384	0.670	0.396	0.753
YKY	0.974	0.588	0.519	0.422	0.636		0.582	0.603	0.523	0.471	0.586
All E&W	0.794	0.706	0.653	0.653	0.597	0.635	0.628	0.538	0.504	0.394	0.611

Company Ranks based on Average Actual Unit Cost

Company											
ANH	2	3	3	3	7	1	2	5	7	6	3
NES	3	7	4	5	9	3	4	1	6	8	7
SRN	4	5	#N/A	6	1	8	7	9	1	#N/A	6
SVE	1	1	1	4	2	4	1	3	5	2	1
SWB	8	9	8	9	4	5	8	#N/A	2	#N/A	8
TMS	5	8	7	10	#N/A	7	10	8	10	5	9
UU	6	4	6	7	3	6	6	4	4	3	5
WSH	10	#N/A	#N/A	1	5	2	3	6	3	1	2
WSX	9	6	5	8	8	9	9	2	9	4	10
YKY	7	2	2	2	6	#N/A	5	7	8	7	4

Table 13: Predicted Unit Cost by Company and Plant Size Decile

Company	1	2	3	4	5	6	7	8	9	10	Total
ANH	0.754	0.681	0.654	0.570	0.730	0.543	0.526	0.463	0.433	0.401	0.583
NES	0.734	0.697	0.608	0.764	0.716	0.571	0.626	0.564	0.495	0.466	0.619
SRN	0.771	0.563		0.607	0.529	0.509	0.478	0.437	0.368		0.526
SVE	0.722	0.631	0.533	0.604	0.621	0.552	0.518	0.529	0.465	0.417	0.570
SWB	0.861	0.840	0.720	0.720	0.534	0.515	0.648		0.481		0.637
TMS	0.757	0.700	0.632	0.751		0.612	0.590	0.551	0.530	0.355	0.582
UU	0.775	0.595	0.647	0.658	0.622	0.532	0.518	0.457	0.464	0.382	0.558
WSH	0.813			0.636	0.675	0.536	0.481	0.468	0.423	0.299	0.524
WSX	0.755	0.578	0.698	0.607	0.618	0.557	0.587	0.390	0.501	0.318	0.575
YKY	0.711	0.637	0.603	0.553	0.504		0.454	0.478	0.444	0.369	0.537
All E&W	0.751	0.650	0.622	0.654	0.606	0.545	0.529	0.485	0.459	0.381	0.569

Company Ranks based on Average Predicted Unit Costs

Company											
ANH	4	6	6	2	9	5	6	4	3	6	8
NES	3	7	3	10	8	8	9	9	8	8	9
SRN	7	1	#N/A	4	2	1	2	2	1	#N/A	2
SVE	2	4	1	3	5	6	5	7	6	7	5
SWB	10	9	8	8	3	2	10	#N/A	7	#N/A	10
TMS	6	8	4	9	#N/A	9	8	8	10	3	7
UU	8	3	5	7	6	3	4	3	5	5	4
WSH	9	#N/A	#N/A	6	7	4	3	5	2	1	1
WSX	5	2	7	5	4	7	7	1	9	2	6
YKY	1	5	2	1	1	#N/A	1	6	4	4	3

Table 15: Overall Cost Efficiency by Company and Plant Size Decile

Company	1	2	3	4	5	6	7	8	9	10	Total
ANH	0.838	0.824	0.854	0.843	0.826	0.944	0.855	0.811	0.801	0.805	0.831
NES	0.822	0.716	0.817	0.783	0.652	0.776	0.790	0.838	0.775	0.607	0.765
SRN	0.694	0.659		0.737	0.755	0.680	0.656	0.681	0.751		0.701
SVE	0.919	0.932	0.940	0.922	0.897	0.908	0.905	0.907	0.888	0.902	0.913
SWB	0.770	0.796	0.801	0.816	0.695	0.822	0.811		0.839		0.781
TMS	0.654	0.634	0.631	0.631		0.644	0.617	0.668	0.572	0.685	0.643
UU	0.706	0.698	0.709	0.773	0.736	0.712	0.724	0.746	0.792	0.752	0.736
WSH	0.703			0.861	0.816	0.864	0.877	0.771	0.801	0.803	0.815
WSX	0.577	0.614	0.669	0.637	0.669	0.611	0.624	0.592	0.662	0.651	0.636
YKY	0.736	0.760	0.767	0.770	0.710		0.711	0.718	0.730	0.717	0.739
All E&W	0.784	0.744	0.785	0.776	0.760	0.751	0.748	0.761	0.765	0.749	0.762

Company Ranks Based on Average Overall Cost Efficiency

Company											
ANH	2	2	2	3	2	1	3	3	3	2	2
NES	3	5	3	5	9	5	5	2	6	8	5
SRN	8	7	#N/A	8	4	7	8	7	7	#N/A	8
SVE	1	1	1	1	1	2	1	1	1	1	1
SWB	4	3	4	4	7	4	4	#N/A	2	#N/A	4
TMS	9	8	8	10	#N/A	8	10	8	10	6	9
UU	6	6	6	6	5	6	6	5	5	4	7
WSH	7	#N/A	#N/A	2	3	3	2	4	4	3	3
WSX	10	9	7	9	8	9	9	9	9	7	10
YKY	5	4	5	7	6	#N/A	7	6	8	5	6

2.4. Structure of this CAC

In this section we set out the approach we have taken to computing this CAC. Having used only industry data which are freely available and have been thoroughly scrutinised, the approach is both transparent and replicable. All of the calculations are set out in the associated Excel workbook, ANH Large Works CAC calculations.

The first stage in calculating the Large Works CAC is to compute the efficient costs for all companies for sewage treatment, based on an average load per Band. Tables 3 and 4 together let us compute what each company would have had as load per Band if it had had the average spread of Band sizes. These are shown in Table 5.

Table 6 sets out the industry Upper Quartile (UQ) unit cost for each Band for each year. Table 7 then sets out the gap to those UQ unit costs for each company in each Band for each year. This then allows us to calculate efficient unit costs for each company. Table 8 does this for all companies as follows: If the actual unit cost is below the UQ unit cost, use the actual cost/kg. Otherwise use UQ cost/kg.

In Table 9, we then convert those efficient unit costs based on average loads into total costs for all companies. In Table 10, we take the same efficient unit costs and convert them into total efficient costs based on the actual load per Band. The difference between Tables 9 and 10 are set out in Table 11: this shows the gross impact on each company of having a spread of loads across Bands which is different to the average spread of loads.

Table 11, is, as we say, a gross measure of the impact of differing shares of load across Bands. To calculate the net CAC, the IAs for scales of economy need to be netted off. Table 12 sets out our calculation of the Implicit Allowance. We have followed the approach taken by the CMA in Bristol 2015, evaluating each of the cost drivers designed to take economies of scale into account at the average 2022 value one by one. We then triangulated the separate approaches to give an overall Implicit Allowance for all companies. Table 12 shows the modelled values before the application of RPE or Frontier Shift.

Finally, in Table 13, we netted off the IAs set out in Table 12 against the Gross impacts set out in Table 11. This provides the symmetric adjustments for all companies.

2.5. CAC Data Tables

All costs shown in this section are shown in 2017/18 Price Base. The final CAC figures, set out in Table 12, are shown in both 2017/18 and 2022/23 Price Bases.

The first stage is to calculate the efficient expected costs based on the average load per Band and lower of Actual or UQ costs for all companies. This covers Tables 3 – 9 inclusive.

Table 3: Total load / day (kg/day)

	ANH	NES	UU	SRN	SVT	SWB	TMS	WSH	WSX	YKY
2022	438,379	180,522	556,198	295,908	623,650	110,077	967,625	248,375	204,350	360,966
2021	430,209	167,700	547,298	300,850	623,157	109,287	954,060	234,352	204,341	349,007
2020	434,526	179,827	546,253	300,315	632,981	109,433	981,892	248,455	197,210	361,199
2019	428,975	178,350	550,281	297,937	629,762	107,427	955,325	246,025	190,108	349,865
2018	417,946	177,871	546,893	296,194	616,752	106,303	970,144	245,516	182,334	343,766
2017	418,393	177,756	537,709	292,432	611,765	105,401	960,572	250,453	185,628	368,290

Table 4: Industry Average Load distribution by Band size

Band	1	2	3	4	5	6	7	8	9	10
2022	0.4%	0.4%	1.9%	6.1%	8.3%	25.3%	14.3%	13.4%	13.8%	16.1%
2021	0.4%	0.4%	1.9%	6.1%	8.4%	26.7%	14.1%	14.5%	11.1%	16.4%
2020	0.4%	0.4%	1.9%	6.2%	8.3%	25.7%	13.9%	14.6%	12.4%	16.3%
2019	0.4%	0.4%	1.9%	6.3%	8.2%	25.7%	14.3%	14.4%	12.2%	16.2%
2018	0.4%	0.4%	1.9%	6.4%	8.1%	26.4%	13.5%	14.4%	12.3%	16.2%
2017	0.4%	0.4%	1.9%	6.3%	8.3%	26.1%	13.5%	13.8%	13.6%	15.8%

So, for example, in 2019/20, 6.2 percent of all load treated was treated in Band 4 works.

Table 5: Load distribution (in kg/day) based on industry averages

This sets out for each company how much load they would have had each year, if they had treated the industry average load shares set out in Table 4

Anglian Water

Band	1	2	3	4	5	6	7	8	9	10
2022	1,787	1,760	8,331	26,687	36,274	111,099	62,804	58,563	60,347	70,727
2021	1,711	1,724	8,278	26,412	36,081	114,966	60,634	62,200	47,833	70,371
2020	1,702	1,731	8,320	27,014	35,916	111,608	60,223	63,331	53,731	70,949
2019	1,690	1,711	8,161	27,007	35,333	110,299	61,172	61,623	52,378	69,601
2018	1,660	1,699	8,028	26,839	33,669	110,425	56,369	60,198	51,265	67,794
2017	1,671	1,727	8,063	26,535	34,522	109,154	56,356	57,657	56,757	65,952

Northumbrian Water

Band	1	2	3	4	5	6	7	8	9	10
2022	736	725	3,431	10,989	14,937	45,750	25,862	24,116	24,851	29,125
2021	667	672	3,227	10,296	14,065	44,815	23,636	24,246	18,646	27,431
2020	704	716	3,443	11,180	14,864	46,188	24,923	26,209	22,236	29,362
2019	702	711	3,393	11,228	14,690	45,858	25,433	25,620	21,777	28,937
2018	706	723	3,417	11,422	14,329	46,995	23,990	25,619	21,817	28,852
2017	710	734	3,425	11,274	14,667	46,375	23,943	24,496	24,113	28,020

UU

Band	1	2	3	4	5	6	7	8	9	10
2022	2,267	2,233	10,571	33,859	46,023	140,958	79,683	74,302	76,566	89,736
2021	2,176	2,193	10,531	33,600	45,901	146,256	77,137	79,128	60,851	89,524
2020	2,140	2,176	10,459	33,960	45,152	140,305	75,708	79,615	67,546	89,192
2019	2,167	2,195	10,468	34,644	45,324	141,490	78,471	79,049	67,190	89,283
2018	2,172	2,223	10,505	35,120	44,056	144,494	73,760	78,771	67,081	88,711
2017	2,148	2,219	10,362	34,103	44,366	140,283	72,427	74,100	72,942	84,760

Southern Water

Band	1	2	3	4	5	6	7	8	9	10
2022	1,206	1,188	5,624	18,014	24,485	74,992	42,393	39,530	40,735	47,741
2021	1,196	1,205	5,789	18,470	25,232	80,397	42,402	43,497	33,450	49,211
2020	1,176	1,197	5,750	18,670	24,823	77,136	41,622	43,770	37,135	49,035
2019	1,174	1,188	5,668	18,757	24,540	76,607	42,486	42,799	36,378	48,340
2018	1,176	1,204	5,689	19,021	23,861	78,257	39,948	42,662	36,331	48,045
2017	1,168	1,207	5,635	18,547	24,129	76,293	39,389	40,299	39,670	46,096

Severn Trent

Band	1	2	3	4	5	6	7	8	9	10
2022	2,542	2,503	11,852	37,965	51,605	158,053	89,347	83,313	85,852	100,619
2021	2,478	2,497	11,990	38,257	52,263	166,528	87,829	90,096	69,286	101,932
2020	2,479	2,522	12,119	39,352	52,320	162,581	87,728	92,256	78,270	103,353
2019	2,480	2,512	11,980	39,648	51,870	161,927	89,805	90,466	76,895	102,178
2018	2,449	2,507	11,847	39,606	49,684	162,952	83,182	88,833	75,650	100,043
2017	2,444	2,525	11,789	38,799	50,477	159,603	82,402	84,305	82,988	96,433

South West Water

Band	1	2	3	4	5	6	7	8	9	10
2022	449	442	2,092	6,701	9,108	27,897	15,770	14,705	15,153	17,760
2021	435	438	2,103	6,709	9,166	29,205	15,403	15,801	12,151	17,877
2020	429	436	2,095	6,803	9,045	28,108	15,167	15,950	13,532	17,868
2019	423	429	2,044	6,763	8,848	27,622	15,319	15,432	13,117	17,430
2018	422	432	2,042	6,826	8,564	28,086	14,337	15,311	13,039	17,243
2017	421	435	2,031	6,685	8,697	27,498	14,197	14,525	14,298	16,615

Thames Water

Band	1	2	3	4	5	6	7	8	9	10
2022	3,944	3,884	18,390	58,905	80,067	245,227	138,626	129,264	133,204	156,115
2021	3,794	3,823	18,357	58,572	80,015	254,957	134,467	137,938	106,077	156,060
2020	3,846	3,912	18,800	61,043	81,160	252,199	136,086	143,109	121,414	160,323
2019	3,763	3,811	18,174	60,145	78,685	245,637	136,231	137,234	116,646	155,000
2018	3,852	3,943	18,635	62,300	78,153	256,321	130,845	139,733	118,997	157,366
2017	3,837	3,964	18,511	60,922	79,257	250,603	129,385	132,373	130,305	151,416

Welsh Water

Band	1	2	3	4	5	6	7	8	9	10
2022	1,012	997	4,720	15,120	20,552	62,946	35,583	33,180	34,191	40,072
2021	932	939	4,509	14,388	19,655	62,627	33,030	33,883	26,056	38,334
2020	973	990	4,757	15,446	20,536	63,816	34,435	36,212	30,722	40,568
2019	969	981	4,680	15,489	20,264	63,259	35,084	35,342	30,040	39,917
2018	975	998	4,716	15,766	19,778	64,868	33,113	35,362	30,115	39,825
2017	1,000	1,034	4,826	15,884	20,665	65,341	33,735	34,514	33,975	39,479

Wessex Water

Band	1	2	3	4	5	6	7	8	9	10
2022	833	820	3,884	12,440	16,909	51,789	29,276	27,299	28,131	32,969
2021	813	819	3,932	12,545	17,138	54,607	28,800	29,544	22,720	33,425
2020	772	786	3,776	12,260	16,301	50,653	27,332	28,743	24,386	32,200
2019	749	758	3,617	11,969	15,658	48,881	27,110	27,309	23,212	30,845
2018	724	741	3,502	11,709	14,688	48,174	24,592	26,262	22,365	29,576
2017	741	766	3,577	11,773	15,316	48,428	25,003	25,581	25,181	29,261

Yorkshire Water

Band	1	2	3	4	5	6	7	8	9	10
2022	1,471	1,449	6,860	21,974	29,869	91,480	51,713	48,221	49,691	58,238
2021	1,388	1,398	6,715	21,427	29,271	93,266	49,190	50,459	38,804	57,089
2020	1,415	1,439	6,916	22,455	29,856	92,774	50,061	52,644	44,663	58,977
2019	1,378	1,396	6,656	22,027	28,817	89,958	49,891	50,259	42,719	56,765
2018	1,365	1,397	6,603	22,076	27,693	90,826	46,364	49,514	42,166	55,762
2017	1,471	1,520	7,097	23,358	30,388	96,083	49,607	50,753	49,960	58,054

Table 6: Upper Quartile £ per kg for each Band

Band	1	2	3	4	5	6	7	8	9	10
2022	5.03	3.09	1.63	1.14	0.75	0.61	0.29	0.36	0.32	0.26
2021	4.35	2.87	2.00	1.11	0.84	0.57	0.42	0.33	0.31	0.26
2020	4.36	3.13	1.65	1.11	0.76	0.51	0.41	0.29	0.30	0.24
2019	4.32	3.26	1.78	1.07	0.73	0.59	0.44	0.34	0.29	0.21
2018	4.04	2.57	1.52	0.95	0.79	0.53	0.43	0.27	0.31	0.28
2017	3.67	2.25	1.53	0.98	0.75	0.55	0.46	0.30	0.32	0.25

Table 7: Gap to Upper Quartile for each Company in each Band

Table 7 sets out the ratio of company unit cost to Upper Quartile (UQ) unit cost. Negative figures are within the UQ. Positive figures are outside UQ

Anglian Water

Band	1	2	3	4	5	6	7	8	9	10
2022	-18.8%	-3.1%	-1.1%	-10.2%	-2.8%	-21.0%	45.8%	8.4%		
2021	-10.5%	-1.8%	-13.2%	-5.3%	-12.2%	-1.4%	5.4%	35.3%		
2020	1.5%	-2.3%	0.5%	-2.5%	-1.1%	9.1%	20.5%	48.3%		
2019	-4.1%	-7.2%	-5.9%	-0.3%	-4.0%	17.7%	5.3%	24.9%		
2018	-2.7%	10.6%	-6.5%	-10.7%	-17.6%	4.2%	20.3%	37.9%		
2017	13.3%	25.9%	4.4%	-0.2%	-0.4%	24.9%	20.6%	41.4%		

Northumbrian Water

Band	1	2	3	4	5	6	7	8	9	10
2022	13.9%	4.1%	-17.3%	6.5%	-12.2%	28.1%	-15.3%	7.4%	141.2%	
2021	-0.3%	5.4%	-15.9%	-0.8%	-1.4%	4.3%	15.2%	278.5%	62.0%	
2020	-12.2%	-18.1%	-10.2%	3.5%	-14.1%	-3.0%	33.1%	257.0%	53.7%	
2019	-10.3%	-1.9%	-2.4%	-0.4%	1.5%	-1.4%	10.4%	220.7%	48.1%	
2018	-20.2%	-0.9%	-0.3%	-3.8%	-0.3%	2.2%	29.0%	314.0%	29.8%	
2017	2.7%	8.2%	7.8%	-5.7%	6.8%	2.8%	4.3%	316.4%	11.8%	

UU

Band	1	2	3	4	5	6	7	8	9	10
2022	53.51%	15.58%	76.45%	11.92%	8.86%	1.20%	49.80%	-8.66%	2.54%	8.29%
2021	64.24%	57.55%	63.58%	19.63%	5.59%	13.98%	7.11%	9.54%	51.24%	19.58%
2020	100.66%	46.79%	74.43%	11.29%	10.96%	21.25%	14.47%	11.67%	32.14%	16.78%
2019	72.70%	19.67%	40.23%	0.91%	-0.50%	16.25%	-9.44%	11.98%	-2.45%	-4.05%
2018	105.79%	66.27%	85.60%	28.97%	7.43%	24.28%	11.21%	61.95%	13.17%	30.74%
2017	123.86%	74.23%	67.87%	14.69%	1.06%	13.36%	-1.77%	33.13%	14.39%	70.49%

Southern Water

Band	1	2	3	4	5	6	7	8	9	10
2022	479.8%	33.4%	69.0%	30.8%	45.9%	150.7%	134.9%	14.8%		
2021	112.2%	67.4%	58.4%	38.1%	29.6%	12.5%	-1.0%	0.3%		
2020	131.7%	23.5%	70.9%	36.7%	39.8%	35.9%	-4.8%	2.1%		
2019	123.2%	43.7%	73.9%	29.9%	29.7%	-17.1%	1.0%	4.3%		
2018	114.8%	66.3%	75.6%	22.7%	13.0%	-9.1%	-12.3%	-1.0%		
2017	33.7%	56.7%	53.7%	38.6%	27.2%	-0.9%	-1.4%			

Severn Trent

Band	1	2	3	4	5	6	7	8	9	10
2022	32.6%	-1.0%	36.3%	16.6%	42.0%	-57.6%	47.1%	2.9%	0.1%	-8.3%
2021	45.8%	13.9%	14.0%	17.4%	22.9%	-53.9%	2.9%	-1.0%	-18.6%	-19.6%
2020	53.9%	7.0%	25.1%	2.7%	11.9%	-14.0%	-9.9%	-6.4%	-8.9%	-16.8%
2019	84.0%	23.4%	34.7%	20.9%	26.2%	-11.2%	-0.3%	-13.0%	2.4%	4.0%
2018	45.7%	32.1%	26.8%	11.4%	1.0%	-4.4%	-3.7%	0.3%	-6.5%	-16.1%
2017	63.8%	48.2%	29.6%	9.6%	3.0%	-14.3%	-10.5%	-0.2%	-12.2%	-24.2%

South West Water

Band	1	2	3	4	5	6	7	8	9	10
2022	-3.6%	15.4%	22.6%	10.4%	34.2%	55.4%	-24.9%			
2021	-0.5%	28.1%	11.9%	29.2%	38.8%	46.8%	-54.7%			
2020	-5.1%	21.8%	25.8%	24.2%	40.4%	22.0%	22.8%			
2019	-5.0%	5.6%	14.8%	34.3%	40.4%	22.2%	33.4%			
2018	-16.0%	28.4%	34.9%	43.1%	25.3%	20.8%	44.4%			
2017	-12.8%	26.7%	24.9%	34.6%	25.6%	44.4%	25.7%			

Thames Water

Band	1	2	3	4	5	6	7	8	9	10
2022	10.9%	33.4%	22.6%	2.2%	10.5%	48.6%	210.8%	47.0%	-0.1%	86.0%
2021	25.7%	25.6%	5.7%	2.5%	16.4%	21.0%	58.1%	16.6%	1.0%	40.7%
2020	88.3%	34.9%	28.7%	5.1%	14.4%	53.9%	78.0%	53.3%	8.9%	33.2%
2019	94.3%	27.8%	7.2%	15.1%	25.8%	53.5%	64.2%	34.7%	32.2%	69.4%
2018	8.1%	-13.8%	-5.2%	12.6%	16.2%	53.4%	70.5%	74.8%	24.1%	16.1%
2017	-0.9%	-2.7%	-1.5%	-2.3%	-0.5%	56.7%	59.2%	59.7%	27.8%	24.2%

Welsh Water

Band	1	2	3	4	5	6	7	8	9	10
2022	13.0%	12.9%	-0.8%	-0.7%	8.5%	-0.4%	126.9%	-62.1%	18.7%	
2021	91.2%	-3.7%	-1.9%	19.2%	4.2%	-18.1%	23.5%	-61.0%	-1.0%	
2020	-0.5%	16.3%	-0.2%	-0.9%	3.3%	-11.4%	21.5%	-32.2%	-22.7%	
2019	13.1%	-24.8%	-7.1%	3.8%	5.9%	4.3%	9.3%	-47.4%	-22.6%	
2018	8.6%	-10.4%	0.9%	14.8%	5.7%	-0.7%	32.1%	-26.9%	-18.6%	
2017	18.9%	-7.1%	-11.8%	0.7%	-1.8%	-11.0%	17.8%	-19.9%	-11.8%	

Wessex Water

Band	1	2	3	4	5	6	7	8	9	10
2022	44.0%	3.1%	21.1%	5.1%	20.7%	29.3%	118.6%		-8.9%	
2021	51.9%	48.1%	12.2%	17.0%	28.0%	43.5%	30.0%		2.1%	
2020	63.6%	14.5%	25.7%	10.9%	35.6%	47.2%	63.5%		15.3%	
2019	67.4%	13.5%	16.8%	9.9%	36.7%	35.3%	53.1%		75.1%	
2018	80.1%	49.6%	31.9%	14.0%	26.1%	43.1%	60.8%		67.2%	
2017	80.2%	69.5%	34.4%	8.7%	34.9%	66.5%	57.2%		16.7%	

Yorkshire Water

Band	1	2	3	4	5	6	7	8	9	10
2022	-30.6%	-23.2%	2.4%	-34.8%	-18.1%	62.2%	-24.9%	40.8%	51.8%	
2021	0.9%	-4.5%	6.5%	-35.2%	-19.3%	10.9%	-8.3%	75.7%	16.4%	
2020	16.3%	-18.6%	-1.5%	-34.0%	-18.9%	29.3%	-10.4%	104.6%	35.9%	
2019	12.2%	13.9%	29.8%	-15.7%	-6.3%	36.2%	-21.5%	61.6%	63.0%	
2018	37.1%	2.7%	69.0%	-35.6%	-12.9%	12.8%	-31.1%	94.9%	6.5%	
2017	-65.1%	-43.2%	-11.0%	15.0%	23.9%	49.4%	32.0%	115.3%	100.2%	

Table 8: Efficient costs (£/kg) defined for all Companies as follows: If Actual cost/kg is below UQ, use actual cost/kg. Otherwise use UQ cost/kg

Anglian Water

Band	1	2	3	4	5	6	7	8	9	10
2022	4.08	2.99	1.61	1.02	0.73	0.48	0.29	0.36	0.32	0.26
2021	3.89	2.81	1.73	1.05	0.74	0.57	0.42	0.33	0.31	0.26
2020	4.36	3.06	1.65	1.08	0.75	0.51	0.41	0.29	0.30	0.24
2019	4.15	3.02	1.67	1.07	0.70	0.59	0.44	0.34	0.29	0.21
2018	3.93	2.57	1.43	0.85	0.65	0.53	0.43	0.27	0.31	0.28
2017	3.67	2.25	1.53	0.98	0.75	0.55	0.46	0.30	0.32	0.25

Northumbrian Water

Band	1	2	3	4	5	6	7	8	9	10
2022	5.03	3.09	1.34	1.14	0.66	0.61	0.24	0.36	0.32	0.26
2021	4.33	2.87	1.68	1.10	0.83	0.57	0.42	0.33	0.31	0.26
2020	3.83	2.56	1.48	1.11	0.65	0.49	0.41	0.29	0.30	0.24
2019	3.88	3.20	1.74	1.07	0.73	0.58	0.44	0.34	0.29	0.21
2018	3.23	2.55	1.52	0.91	0.78	0.53	0.43	0.27	0.31	0.28
2017	3.67	2.25	1.53	0.92	0.75	0.55	0.46	0.30	0.32	0.25

UU

Band	1	2	3	4	5	6	7	8	9	10
2022	5.03	3.09	1.63	1.14	0.75	0.61	0.29	0.33	0.32	0.26
2021	4.35	2.87	2.00	1.11	0.84	0.57	0.42	0.33	0.31	0.26
2020	4.36	3.13	1.65	1.11	0.76	0.51	0.41	0.29	0.30	0.24
2019	4.32	3.26	1.78	1.07	0.72	0.59	0.40	0.34	0.28	0.20
2018	4.04	2.57	1.52	0.95	0.79	0.53	0.43	0.27	0.31	0.28
2017	3.67	2.25	1.53	0.98	0.75	0.55	0.45	0.30	0.32	0.25

Southern Water

Band	1	2	3	4	5	6	7	8	9	10
2022	5.03	3.09	1.63	1.14	0.75	0.61	0.29	0.36	0.32	0.26
2021	4.35	2.87	2.00	1.11	0.84	0.57	0.42	0.33	0.31	0.26
2020	4.36	3.13	1.65	1.11	0.76	0.51	0.39	0.29	0.30	0.24
2019	4.32	3.26	1.78	1.07	0.73	0.49	0.44	0.34	0.29	0.21
2018	4.04	2.57	1.52	0.95	0.79	0.48	0.38	0.27	0.31	0.28
2017	3.67	2.25	1.53	0.98	0.75	0.55	0.45	0.30	0.32	0.25

Severn Trent

Band	1	2	3	4	5	6	7	8	9	10
2022	5.03	3.06	1.63	1.14	0.75	0.26	0.29	0.36	0.32	0.24
2021	4.35	2.87	2.00	1.11	0.84	0.26	0.42	0.32	0.26	0.21
2020	4.36	3.13	1.65	1.11	0.76	0.43	0.37	0.27	0.28	0.20
2019	4.32	3.26	1.78	1.07	0.73	0.52	0.44	0.29	0.29	0.21
2018	4.04	2.57	1.52	0.95	0.79	0.51	0.41	0.27	0.29	0.23
2017	3.67	2.25	1.53	0.98	0.75	0.48	0.41	0.30	0.28	0.19

South West Water

Band	1	2	3	4	5	6	7	8	9	10
2022	4.85	3.09	1.63	1.14	0.75	0.61	0.21	0.36	0.32	0.26
2021	4.33	2.87	2.00	1.11	0.84	0.57	0.19	0.33	0.31	0.26
2020	4.14	3.13	1.65	1.11	0.76	0.51	0.41	0.29	0.30	0.24
2019	4.10	3.26	1.78	1.07	0.73	0.59	0.44	0.34	0.29	0.21
2018	3.39	2.57	1.52	0.95	0.79	0.53	0.43	0.27	0.31	0.28
2017	3.20	2.25	1.53	0.98	0.75	0.55	0.46	0.30	0.32	0.25

Thames Water

Band	1	2	3	4	5	6	7	8	9	10
2022	5.03	3.09	1.63	1.14	0.75	0.61	0.29	0.36	0.32	0.26
2021	4.35	2.87	2.00	1.11	0.84	0.57	0.42	0.33	0.31	0.26
2020	4.36	3.13	1.65	1.11	0.76	0.51	0.41	0.29	0.30	0.24
2019	4.32	3.26	1.78	1.07	0.73	0.59	0.44	0.34	0.29	0.21
2018	4.04	2.22	1.45	0.95	0.79	0.53	0.43	0.27	0.31	0.28
2017	3.64	2.18	1.51	0.96	0.74	0.55	0.46	0.30	0.32	0.25

Welsh Water

Band	1	2	3	4	5	6	7	8	9	10
2022	5.03	3.09	1.61	1.13	0.75	0.61	0.29	0.13	0.32	0.26
2021	4.35	2.76	1.96	1.11	0.84	0.47	0.42	0.13	0.31	0.26
2020	4.34	3.13	1.65	1.10	0.76	0.45	0.41	0.20	0.24	0.24
2019	4.32	2.45	1.65	1.07	0.73	0.59	0.44	0.18	0.22	0.21
2018	4.04	2.30	1.52	0.95	0.79	0.53	0.43	0.20	0.25	0.28
2017	3.67	2.09	1.35	0.98	0.74	0.49	0.46	0.24	0.28	0.25

Wessex Water

Band	1	2	3	4	5	6	7	8	9	10
2022	5.03	3.09	1.63	1.14	0.75	0.61	0.29	0.36	0.29	0.26
2021	4.35	2.87	2.00	1.11	0.84	0.57	0.42	0.33	0.31	0.26
2020	4.36	3.13	1.65	1.11	0.76	0.51	0.41	0.29	0.30	0.24
2019	4.32	3.26	1.78	1.07	0.73	0.59	0.44	0.34	0.29	0.21
2018	4.04	2.57	1.52	0.95	0.79	0.53	0.43	0.27	0.31	0.28
2017	3.67	2.25	1.53	0.98	0.75	0.55	0.46	0.30	0.32	0.25

Yorkshire Water

Band	1	2	3	4	5	6	7	8	9	10
2022	3.49	2.37	1.63	0.74	0.61	0.61	0.21	0.36	0.32	0.26
2021	4.35	2.74	2.00	0.72	0.68	0.57	0.39	0.33	0.31	0.26
2020	4.36	2.55	1.63	0.73	0.62	0.51	0.37	0.29	0.30	0.24
2019	4.32	3.26	1.78	0.90	0.68	0.59	0.34	0.34	0.29	0.21
2018	4.04	2.57	1.52	0.61	0.69	0.53	0.30	0.27	0.31	0.28
2017	1.28	1.28	1.36	0.98	0.75	0.55	0.46	0.30	0.32	0.25

Table 9: Efficient costs per Company (in £million) based on average load per Band and actual load per Company per year

Anglian Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	2.66	1.92	4.89	9.97	9.62	19.57	6.54	7.62	7.02	6.67	76.50
2021	2.43	1.77	5.23	10.10	9.75	23.75	9.40	7.38	5.50	6.55	81.86
2020	2.71	1.93	5.02	10.64	9.84	20.60	8.96	6.65	5.98	6.33	78.65
2019	2.56	1.89	4.99	10.51	9.01	23.64	9.81	7.54	5.53	5.29	80.75
2018	2.38	1.59	4.18	8.29	7.96	21.44	8.82	5.92	5.73	6.87	73.19
2017	2.24	1.42	4.50	9.47	9.40	22.09	9.48	6.29	6.62	6.01	77.54

Northumbrian Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	1.35	0.82	1.68	4.57	3.58	10.21	2.28	3.14	2.89	2.75	33.27
2021	1.05	0.70	1.98	4.12	4.27	9.39	3.67	2.88	2.14	2.55	32.76
2020	0.98	0.67	1.86	4.52	3.54	8.27	3.71	2.75	2.48	2.62	31.39
2019	0.99	0.83	2.15	4.37	3.90	9.69	4.08	3.13	2.30	2.20	33.64
2018	0.83	0.67	1.90	3.80	4.10	9.13	3.75	2.52	2.44	2.92	32.06
2017	0.95	0.60	1.91	3.81	4.01	9.39	4.03	2.67	2.81	2.56	32.74

UU

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	4.16	2.52	6.27	14.09	12.56	31.46	8.30	8.83	8.91	8.46	105.56
2021	3.45	2.29	7.67	13.58	14.12	30.65	11.96	9.39	6.99	8.33	108.45
2020	3.40	2.49	6.31	13.73	12.51	25.90	11.26	8.36	7.52	7.96	99.42
2019	3.42	2.61	6.80	13.53	11.98	30.33	11.39	9.67	6.92	6.51	103.14
2018	3.20	2.09	5.85	12.15	12.64	28.06	11.53	7.75	7.50	8.99	99.75
2017	2.88	1.82	5.78	12.20	12.12	28.39	11.97	8.09	8.51	7.73	99.50

Southern Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	2.22	1.34	3.34	7.50	6.68	16.74	4.42	5.14	4.74	4.50	56.61
2021	1.90	1.26	4.22	7.46	7.76	16.85	6.51	5.16	3.84	4.58	59.55
2020	1.87	1.37	3.47	7.55	6.88	14.24	5.89	4.59	4.13	4.38	54.36
2019	1.85	1.41	3.68	7.32	6.52	13.62	6.81	5.23	3.84	3.67	53.96
2018	1.73	1.13	3.17	6.58	6.85	13.81	5.48	4.15	4.06	4.87	51.83
2017	1.57	0.99	3.14	6.64	6.59	15.30	6.53	4.40	4.63	4.20	53.99

Severn Trent

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	4.67	2.79	7.04	15.80	14.08	14.97	9.31	10.84	9.99	8.70	98.19
2021	3.93	2.61	8.73	15.46	16.07	16.09	13.62	10.59	6.48	7.63	101.22
2020	3.95	2.88	7.31	15.91	14.49	25.81	11.76	9.06	7.93	7.68	106.77
2019	3.91	2.99	7.78	15.48	13.78	30.84	14.35	9.63	8.11	7.76	114.63
2018	3.61	2.35	6.59	13.70	14.26	30.26	12.52	8.73	7.90	8.51	108.44
2017	3.28	2.07	6.58	13.88	13.79	27.69	12.41	9.18	8.51	6.67	104.06

South West Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	0.79	0.50	1.24	2.79	2.49	6.23	1.23	1.91	1.76	1.67	20.62
2021	0.69	0.46	1.53	2.71	2.82	6.12	1.08	1.88	1.40	1.66	20.35
2020	0.65	0.50	1.26	2.75	2.51	5.19	2.26	1.67	1.51	1.59	19.88
2019	0.63	0.51	1.33	2.64	2.35	5.92	2.46	1.89	1.38	1.32	20.43
2018	0.52	0.41	1.14	2.36	2.46	5.45	2.24	1.51	1.46	1.75	19.29
2017	0.49	0.36	1.13	2.39	2.38	5.57	2.39	1.59	1.67	1.52	19.47

Thames Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	7.25	4.38	10.92	24.51	21.85	54.72	14.44	16.82	15.50	14.71	185.10
2021	6.02	4.00	13.37	23.67	24.61	53.44	20.85	16.37	12.19	14.53	189.05
2020	6.12	4.47	11.34	24.67	22.48	46.55	20.24	15.02	13.51	14.31	178.71
2019	5.93	4.53	11.80	23.48	20.90	52.65	21.84	16.78	12.31	11.77	182.01
2018	5.68	3.19	9.83	21.55	22.42	49.77	20.46	13.74	13.30	15.95	175.91
2017	5.10	3.16	10.18	21.30	21.54	50.72	21.78	14.45	15.20	13.81	177.23

Welsh Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	1.86	1.12	2.78	6.25	5.61	13.99	3.71	1.63	3.98	3.78	44.71
2021	1.48	0.95	3.22	5.81	6.05	10.74	5.12	1.57	2.97	3.57	41.48
2020	1.54	1.13	2.86	6.19	5.69	10.44	5.12	2.58	2.64	3.62	41.81
2019	1.53	0.88	2.82	6.05	5.38	13.56	5.62	2.27	2.45	3.03	43.60
2018	1.44	0.84	2.62	5.45	5.67	12.50	5.18	2.54	2.74	4.04	43.03
2017	1.34	0.79	2.37	5.68	5.54	11.77	5.68	3.02	3.50	3.60	43.29

Wessex Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	1.53	0.92	2.31	5.18	4.61	11.56	3.05	3.55	2.98	3.11	38.80
2021	1.29	0.86	2.86	5.07	5.27	11.45	4.47	3.51	2.61	3.11	40.49
2020	1.23	0.90	2.28	4.96	4.51	9.35	4.06	3.02	2.71	2.87	35.89
2019	1.18	0.90	2.35	4.67	4.16	10.48	4.35	3.34	2.45	2.34	36.22
2018	1.07	0.70	1.95	4.05	4.21	9.35	3.85	2.58	2.50	3.00	33.26
2017	0.99	0.63	2.00	4.21	4.19	9.80	4.21	2.79	2.94	2.67	34.42

Yorkshire Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	1.88	1.25	4.07	5.96	6.67	20.41	4.04	6.27	5.78	5.49	61.84
2021	2.20	1.40	4.89	5.61	7.26	19.55	6.99	5.99	4.46	5.31	63.67
2020	2.25	1.34	4.11	5.99	6.71	17.13	6.67	5.53	4.97	5.26	59.96
2019	2.17	1.66	4.32	7.25	7.17	19.28	6.28	6.15	4.51	4.31	63.10
2018	2.01	1.31	3.67	4.92	6.92	17.64	4.99	4.87	4.71	5.65	56.70
2017	0.69	0.71	3.52	8.36	8.30	19.45	8.35	5.54	5.83	5.29	66.04

Next, in Table 10, we calculate the efficient cost per Band based on the actual load per Band for each company in each year.

Table 10: Efficient costs (in £ million) for each company based on actual load / Band in each year

Anglian Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	3.85	3.11	10.27	22.75	17.59	17.65	13.57	7.52	0.00	0.00	96.31
2021	3.54	2.99	11.09	22.11	18.63	19.92	19.97	6.56	0.00	0.00	104.81
2020	3.93	3.24	10.63	23.44	18.13	21.21	17.04	5.91	0.00	0.00	103.53
2019	3.79	3.20	10.55	22.56	17.19	23.69	18.15	7.00	0.00	0.00	106.12
2018	3.64	2.81	8.90	18.61	14.85	22.51	15.80	5.44	0.00	0.00	92.57
2017	3.38	2.50	9.41	21.44	16.84	23.48	17.20	6.10	0.00	0.00	100.35

Northumbrian Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	1.49	0.50	1.86	3.49	3.16	7.24	1.83	2.22	9.19	0.00	30.97
2021	1.34	0.60	1.77	4.02	2.79	10.99	1.77	2.88	6.17	0.00	32.31
2020	1.68	0.68	1.77	4.13	3.45	10.38	1.94	2.66	6.40	0.00	33.09
2019	1.64	0.65	1.80	4.85	2.47	12.43	2.08	2.93	5.98	0.00	34.82
2018	1.56	0.58	1.50	3.85	2.30	11.24	2.02	2.39	6.26	0.00	31.70
2017	1.48	0.49	1.63	4.44	2.69	11.52	2.04	2.74	6.61	0.00	33.64

UU

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	3.56	2.08	2.49	5.92	8.95	30.60	9.71	15.54	4.66	6.75	90.27
2021	3.31	2.02	2.62	6.09	8.99	39.16	12.67	13.69	4.37	6.06	98.97
2020	2.80	1.69	2.66	6.83	9.15	33.92	12.36	11.89	4.20	6.25	91.74
2019	2.64	1.71	2.58	6.74	8.32	37.96	14.37	14.24	4.02	5.44	98.01
2018	2.52	1.50	2.20	5.29	7.75	34.17	13.97	11.42	4.43	6.93	90.18
2017	2.17	1.30	2.48	5.75	8.82	35.36	15.02	12.44	4.52	5.93	93.76

Southern Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	1.01	0.70	3.58	7.76	5.78	21.70	5.18	9.51	0.00	0.00	55.20
2021	0.90	0.74	3.97	7.83	6.72	25.29	7.92	8.82	0.00	0.00	62.19
2020	1.04	0.80	3.72	8.37	6.51	20.23	7.39	9.29	0.00	0.00	57.35
2019	0.93	0.81	3.69	8.41	5.89	26.64	7.93	8.82	0.00	0.00	63.12
2018	0.87	0.70	3.18	6.95	4.80	24.41	7.64	7.02	0.00	0.00	55.57
2017	0.81	0.60	3.53	7.62	6.01	26.14	6.96	7.74	0.00	0.00	59.40

Severn Trent

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	3.03	2.36	6.45	14.40	14.36	33.26	4.49	13.31	8.70	10.07	110.44
2021	2.89	2.20	7.18	14.60	14.63	40.37	5.38	12.05	8.80	9.97	118.07
2020	3.21	2.57	6.78	15.32	14.09	32.21	8.78	11.12	8.51	9.92	112.50
2019	3.21	2.38	6.71	15.16	13.06	37.29	9.53	13.08	8.15	8.11	116.67
2018	2.97	1.89	5.85	11.81	11.92	34.71	8.33	10.28	8.33	10.31	106.40
2017	2.82	1.67	6.14	13.78	14.51	37.42	6.92	11.43	8.70	9.07	112.46

South West Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	2.94	2.12	4.29	6.14	4.04	8.46	2.00	0.00	0.00	0.00	29.99
2021	2.78	2.00	4.62	6.18	4.05	9.87	2.97	0.00	0.00	0.00	32.47
2020	3.14	2.10	4.39	6.09	4.05	9.03	2.85	0.00	0.00	0.00	31.65
2019	2.97	2.03	4.28	6.47	3.92	9.88	2.98	0.00	0.00	0.00	32.52
2018	2.82	1.65	3.68	5.28	3.84	8.48	2.90	0.00	0.00	0.00	28.65
2017	2.59	1.53	3.71	5.98	4.61	8.73	3.05	0.00	0.00	0.00	30.20

Thames Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	0.73	1.06	2.92	8.31	7.25	20.26	10.06	12.57	16.16	43.79	123.11
2021	0.72	0.96	3.19	8.76	6.92	25.37	17.80	12.23	10.27	43.66	129.88
2020	0.94	1.11	2.91	9.18	7.34	21.30	14.95	10.14	15.82	42.00	125.70
2019	0.75	1.15	2.93	8.62	6.86	24.33	15.46	11.75	14.15	34.92	120.92
2018	0.67	1.01	2.62	6.59	6.71	22.78	15.40	9.64	15.30	46.94	127.66
2017	0.65	0.89	2.78	7.58	7.96	23.68	16.62	10.81	16.02	41.18	128.16

Welsh Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	4.30	3.13	5.38	7.36	7.53	11.79	4.48	2.35	6.68	0.00	52.99
2021	3.37	2.48	5.15	7.10	7.13	13.03	6.51	2.08	6.18	0.00	53.05
2020	4.39	3.19	5.63	8.43	8.51	10.41	7.55	1.89	6.21	0.00	56.21
2019	4.03	2.97	5.48	7.83	7.17	12.49	8.24	2.16	5.92	0.00	56.30
2018	4.05	2.78	4.85	6.44	6.21	12.95	6.71	1.74	6.26	0.00	52.00
2017	3.89	2.47	5.40	7.50	8.01	11.54	8.69	1.89	6.83	0.00	56.21

Wessex Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	0.89	0.82	4.12	6.82	7.43	12.60	2.98	0.00	5.77	0.00	41.43
2021	0.89	0.70	4.53	7.10	7.41	14.90	4.42	0.00	5.66	0.00	45.61
2020	1.04	0.77	4.19	7.32	6.96	14.33	3.00	0.00	5.24	0.00	42.86
2019	0.93	0.77	4.24	6.96	6.97	15.35	3.12	0.00	4.81	0.00	43.15
2018	0.91	0.62	3.56	5.93	6.45	12.59	2.95	0.00	4.92	0.00	37.93
2017	0.87	0.59	3.84	6.56	6.95	12.11	3.42	0.00	6.22	0.00	40.57

Yorkshire Water

Band	1	2	3	4	5	6	7	8	9	10	Total
2022	2.43	1.61	3.11	7.72	11.38	14.43	5.19	6.26	12.71	0.00	64.83
2021	2.39	1.45	3.56	8.26	11.55	17.51	6.27	8.96	8.65	0.00	68.59
2020	2.71	1.59	3.42	8.66	12.20	16.25	6.41	8.16	8.57	0.00	67.98
2019	2.57	1.63	3.49	8.82	10.79	16.76	8.08	9.14	7.67	0.00	68.95
2018	2.24	1.35	2.70	6.70	9.56	16.43	6.62	7.36	8.01	0.00	60.98
2017	2.27	1.19	3.09	7.85	11.42	16.41	8.69	5.65	12.98	0.00	69.54

Next, in Table 11, we compare the total efficient costs on both the average and the actual loads per Band for each Company.

A positive figure represents additional efficient costs incurred as a result of not having average load per Band. As all companies have small works but only three have the very largest works, Table 11 captures the impact of having or not having those large works on efficient costs.

Table 11: Efficient costs based on actual load per Band - Efficient costs based on average load per Band (£ million)

	ANH	NES	UU	SRN	SVT	SWB	TMS	WSH	WSX	YKY
2022	19.82	-2.30	-15.30	-1.41	12.26	9.37	-61.99	8.28	2.63	2.99
2021	22.95	-0.45	-9.48	2.64	16.85	12.13	-59.17	11.57	5.12	4.93
2020	24.88	1.70	-7.69	2.99	5.74	11.76	-53.01	14.40	6.96	8.02
2019	25.37	1.18	-5.13	9.16	2.04	12.08	-61.09	12.70	6.93	5.85
2018	19.38	-0.36	-9.58	3.74	-2.05	9.36	-48.24	8.97	4.68	4.27
2017	22.81	0.91	-5.74	5.41	8.41	10.73	-49.07	12.93	6.14	3.50
Total (last 5 years) 17/18 PB	112.39	-0.22	-47.17	17.13	34.84	54.70	-283.50	55.92	26.32	26.06
Total (last 5 years) 22/23 PB	**132.69**	**-0.26**	**-55.69**	**20.22**	**41.13**	**64.58**	**-334.71**	**66.02**	**31.08**	**30.77**

Table 12 sets out our calculation of the Implicit Allowance. We have followed the approach taken by the CMA in Bristol 2015, evaluating each of the cost drivers designed to take economies of scale into account at the average 2022 value one by one. We then triangulated the separate approaches to give an overall Implicit Allowance for all companies. Table 12 shows the modelled values before the application of RPE or Frontier Shift.

Table 12: Implicit Allowance calculation (£ million) NB all in 2017/18 PB until final row which is in 2022/23 PB

	Models impacted	ANH	NES	NWT	SRN	SVH	SWB	TMS	WSH	WSX	YKY
Baseline		1,606.86	668.38	1,876.91	1,469.74	2,008.43	641.07	3,095.23	938.79	829.50	1,352.30
B1-3 avg 3.77%	SWT1, NT2, NT6	1,593.67	672.61	1,900.98	1,478.93	2,023.28	619.72	3,153.20	928.01	827.20	1,362.21
p.e.>100k avg54.56%	SWT2, NT3, NT7	1,590.10	671.94	1,894.03	1,465.80	2,023.47	623.46	3,196.67	940.51	816.63	1,361.27
WATS avg 23,936	SWT3, NT4, NT8	1,575.80	667.51	1,873.18	1,452.35	2,014.67	628.08	3,149.65	936.72	825.36	1,343.61
Triangulated alternatives		1,586.52	670.69	1,889.40	1,465.70	2,020.47	623.75	3,166.51	935.08	823.07	1,355.69
IA in 2017/18 PB		20.34	-2.30	-12.48	4.05	-12.04	17.32	-71.27	3.70	6.44	-3.40
IA in 2022/23 PB		24.01	-2.72	-14.74	4.78	-14.21	20.44	-84.15	4.37	7.60	-4.01

We note in passing that using the PR24 suite of models generates a lower IA than is computed when the PR19 suite of models is used. This is due to the larger number of models being triangulated. Consequently, all other things being equal, using the PR19 models to generate the IA would have given a lower net value to the CAC

Finally, to populate Table CWW18, the gross CAC, the IA and the net CAC are computed on an annualised basis. This is set out in Table 13 below.

Table 13: Annualised figures for CWW18

2022/23 PB £million	2026	2027	2028	2029	2030	AMP8
Gross value of CAC before impact of Frontier Shift	26.54	26.54	26.54	26.54	26.54	132.69
IA	4.80	4.80	4.80	4.80	4.80	24.01
Net value of CAC	21.74	21.74	21.74	21.74	21.74	108.68

Appendix 2.1: Conformity with Ofwat's criteria for assessing CACs

Category	#	Issue	Response
Need For Adjustment: Unique Circumstances	1	Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?	This CAC is put forward to address the contingency that WATS is not used as the cost driver to address economies of scale. This is because, in our view, this measure adequately takes account of economies of scale where the other two variables put forward do not. As such, and given the symmetric nature of the CAC, we do not consider that uniqueness is relevant.
	2	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)?	Yes. This is central to our CAC and is set out in section 3.
	3	Is there compelling evidence of alternative options being considered, where relevant?	Yes. We put forward two alternative approaches within the CAC.
Need For Adjustment: Management Control	1	Is the investment driven by factors outside of management control?	Yes. The size and location of Water Recycling Centres (WRCs) is determined by the demographics of the area served. Demographics are clearly outside management control.
	2	Have steps been taken to control costs and have potential cost savings (eg spend to save) been accounted for?	Yes. We demonstrate the efficiency of our WRCs in section 3 of this CAC
Need For Adjustment: Materiality	1	Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?	Yes. We demonstrate the extent of the economies of scale and the impact of not having very large works in section 4 of this CAC
	2	Is there compelling quantitative evidence of how the factor impacts the company's expenditure? Adjustment to allowances (including implicit allowance)	Yes, this is central to our claim as is set out in section 4 of this CAC
	3	Is there compelling evidence that the cost claim is not included in our modelled baseline (or, if the models are not known, would be unlikely to be included)? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?	Were Ofwat to use WATS as its measure to take economies of scale into account, then this CAC falls away

	4	Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?	Yes, the IA has been calculated explicitly. Two separate approaches have been used to calculate the IA
	5	Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?	Not applicable
	6	Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?	That depends on which cost driver is used to take account of economies of scale. If WATS is used, then the CAC would not be needed.
	7	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?	Not relevant – demographics change little from AMP to AMP
	8	If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?	See response to point 6 immediately above
Cost efficiency	1	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)?	Yes. See section 3
	2	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
	3	Does the company provide third party assurance for the robustness of the cost estimates?	Yes, Oxera has provided assurance.[41]
Need for investment	1	Is there compelling evidence that investment is required?	Not relevant. This CAC is not predicated upon a specific required investment
	2	Is the scale and timing of the investment fully justified?	Not relevant
	3	Does the need and/or proposed investment overlap with activities already funded at previous price reviews?	Not relevant
	4	Is there compelling evidence that customers support the need for investment (both scale and timing)?	Not relevant
	1	Did the company consider an appropriate range of options to meet the need?	Not relevant

[41] See ANH CAC 2.4

Best option for customers	2	Has a cost–benefit analysis been undertaken to select proposed option? There should be compelling evidence that the proposed solution represents best value for customers, communities and the environment in the long term? Is third-party technical assurance of the analysis provided?	Not relevant
	3	Has the impact of the investment on performance commitments been quantified?	Not relevant
	4	Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where utilisation will be low?	Not relevant
	5	Has the company secured appropriate third-party funding (proportionate to the third party benefits) to deliver the project?	Not relevant
	6	Has the company appropriately presented the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?	Not relevant
	7	Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views	Not relevant
Customer Protection	1	Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?	Not relevant
	2	Does the protection cover all the benefits proposed to be delivered and funded (eg primary and wider benefits)?	Not relevant
	3	Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including the mechanism for securing sufficient third-party funding?	Not relevant

Appendix 2.2: Alternative CAC calculation approach

Structure of this CAC

In this section we set out the approach we have taken to computing this CAC. As explained above, the IA calculation follows Ofwat's guidance. That is, it has been estimated by comparing modelled costs resulting from different modelling specifications (i.e. models with WATS compared to models with the share of load treated in works larger than 100,000 p.e. or with bands 1-3). Having used only industry data which are freely available and have been thoroughly scrutinised, the approach is both transparent and replicable. All of the calculations are set out in the associated Excel workbook[42].

First, we have derived cost driver forecasts for the whole industry over AMP8, in a similar way as for the purposes of the APH CAC. Depending on the cost drivers considered, three different types of projections have been made, namely:

- A linear extrapolation of the trend observed over 2011/12-2021/22 for each company with the aim of replicating Ofwat's PR19 approach. This applies to properties, sewer length, total load, pumping capacity, WAD LAD from MSOA and WAD MSOA.
- When a trend appears ambiguous/less obvious we have retained the 2022 value for the whole duration of AMP8. This applies to economies of scale and treatment complexity variables (WATS, load treated in STWs larger than a p.e. of 100,000, load treated in bands 1-3 and load treated with ammonia consents lower than 3mg/L).
- When the variable is highly volatile from one year to another, i.e. for urban rainfall, we have extrapolated forward the average observed over the last four years.

Then we have derived the normalised variables per sewer length by simply taking the ratio of the individual forecasted values. This applies to urban rainfall per sewer length, properties per sewer length and pumping capacity per sewer length.

Second, as explained earlier in the introduction of the claim, we have run two sets of models over the period 2011/12-2021/22, one with WATS as the only cost driver capturing economies of scale in both SWT and WWWNP models, and one with the load treated in bands 1-3 and the load treated in STWs larger than 100,000 p.e. instead (the counterfactual scenario). We have then computed an UQ efficiency challenge on a historical basis (over 2017/18-2021/22), as per the CMA in PR19. We have followed Ofwat's guidance and applied equal weights in the triangulation of models within each level of cost aggregation and across levels of cost aggregation.

Third, by using the estimated coefficients derived in Step 2 and the cost driver forecasts derived in Step 1 above, we have computed the predicted costs of each company over AMP8. To ensure these costs are efficient, as per Ofwat's guidance, we have applied the UQ efficiency challenge derived in Step 2. The net amount of the claim is therefore simply the difference in efficient modelled costs between the two scenarios.

In 2022/23 prices, the gross value of the claim is £1,897 million, the IA £1,763 million which means that **the net value of the claim is £134 million (well above the materiality threshold of c. £45 million)**. This is before the application of a frontier shift target and any RPEs adjustments.

CAC data tables

The final CAC figures, set out in Table Ap2.3 below, summarise the efficient modelled costs under both scenarios (using the UQ challenge displayed in Tables Ap2.1 and Ap2.2) which then allow us to estimate the net value of this CAC. This approach enables the computation of the symmetrical adjustments for the rest of the industry to be made.

Table Ap2.1: Efficiency scores (2017/18 - 2021/22) under the WATS scenario

WSX	0.9445
SVH	0.9687
ANH	0.9803
TMS	0.9976
SWB	1.0001
NES	1.0174
NWT	1.0250
YKY	1.0445
SRN	1.0633
WSH	1.0925
UQ	**0.9846**

Table Ap2.2: Efficiency scores (2017/18 - 2021/22) under the counterfactual scenario

WSX	0.9187
TMS	0.9495
SVH	0.9583
NES	0.9906
SWB	1.0068
ANH	1.0362
NWT	1.0562
WSH	1.0584
YKY	1.0654
SRN	1.1024
UQ	**0.9664**

Table Ap2.3: Efficient AMP8 modelled costs and net claim (2022/23 prices)

	WATS scenario (gross claim)	Counterfactual scenario (IA)	Net claim
ANH	1,897.0	1,763.1	134.0
NES	810.6	807.2	3.4
NWT	2,261.3	2,158.0	103.3
SRN	1,744.9	1,649.1	95.8
SVH	2,313.7	2,292.0	21.6
SWB	717.9	698.8	19.1
TMS	3,534.5	3,653.1	-118.6
WSH	1,066.9	1,082.9	-15.9
WSX	948.0	954.6	-6.6
YKY	1,601.7	1,539.5	62.2

Energy

ANH CAC 3

Document reference	Narrative file: ANH3.1 Energy			
Title of cost adjustment claim	**Energy**			
Price control	Water Resources, Water Network Plus, Wastewater Network Plus	Symmetrical?	~~YES~~/NO	
Basis of claim	The forward looking costs of purchasing energy In AMP8, including non-commodity costs, are much higher than the historic levels experienced by the industry and are thus not adequately reflected in the cost assessment models. Energy prices so far, seem to have peaked in 2022/23 and there is currently an expected significantly negative Real Price Effect (RPE) post 2022/23 and this Cost Adjustment Claim needs to be considered collectively with the negative RPE. The aim is to ensure that after both of these steps the higher cost of energy is adequately funded. We believe that there may well be better ways of resolving this issue but in the absence of an alternative have submitted this Cost Adjustment Claim which should be considered along with the negative RPE adjustment.			
	Water Resources	Water Network+	Wastewater Network+	Total
Gross value (£m five years)	£108.0m	£349.4m	£523.2m	£980.6m
Implicit allowance (£m five years)	£42.5m	£138.5m	£194.9m	£375.9m
Net value of claim (£m five years)	£65.5m	£210.9m	£328.3m	£604.7m
How efficiency of costs are demonstrated	We are taking the future market price for energy compared to the historic rate assumed by the models, and thus as we are assuming the market price is the efficient price, consider efficiency has been demonstrated.			
	Water Resources	Water Network+	Wastewater Network+	
Materiality (as % of totex for price control)	15.4%	6.3%	7.3%	
How customers are protected	This claim is to ensure the expected energy costs are covered adequately in a determination. There are numerous other ways of doing this and true-up mechanisms could be used to deal with the levels of volatility in the market experienced in the last couple of years.			
Supporting document references	ANH_CAC_ 3.2 Day Ahead market prices ANH_CAC_3.3 CAC energy water and summary ANH_CAC_0.1 Oxera Assurance Letter			

3.1. Context of the claim

Energy prices broadly trebled between the long-term costs included in the cost assessment models and 2022/23. Whilst market prices have fallen back since then they are still approximately double the historic levels assumed in the model.

Our understanding of the guidance informs us that we need to use two separate steps within the PR24 methodology to arrive at the correct funding level for energy costs for AMP8. We have this Cost Adjustment Claim and the Real Price Effect adjustment process. It is worth noting that whilst the Real Price Effect (RPE) is written as the second step below, the guidance for this asks us to calculate the RPE based on macro-economic factors outside of the companies' direct control. This drives to use market data, which shows a significant decrease post 2022/23, which in turn means we need to use the same market data in calculating the Cost Adjustment Claim. The effect of this is to end up with a very large cost adjustment claim, a large negative RPE adjustment, and combining the two steps, a large net increase in power costs reflecting the current forecast costs of energy compared to the historic costs used in the cost assessment models.

We do not think however that a 'CAC+RPE' approach is the best way to deal with this issue. A more sensible approach would be some kind of indexation of the price control to quoted energy prices: this reflects good principles of economic regulation as energy is a volatile and large common cost which is mainly uncontrollable and companies would still have an incentive to contract efficiently by using a public index. Failing that, or in addition to it, an uncertainty mechanism with true-up (ideally on the basis of a published index) could also work. If Ofwat decided that mechanisms such as these would be more successful in aligning risks and incentives in energy purchase, we would withdraw our claim.

On the basis there are currently no alternatives to the 'CAC+RPE' approach the steps we have followed are as below.

The **first step** is this cost adjustment claim, calculating the gap between the implicit allowance assumed in the cost models and what that would have been if the 2022/23 energy prices were used in the models instead.

The **second step** is to use the Real Price Effects (RPE) process to pick up the difference between the 2022/23 market price and the latest expected forward rates for forward purchasing in AMP8.

It is essential to view these two steps together to get the overall picture. Changes in the methodology for one of these could well lead to a change in methodology for the other. In particular the methodology for calculating the 2022/23 market rate must be the same in both steps to ensure consistency. The result of the two adjustments together should arrive at the forward market rates for energy that we expect to incur in AMP8.

3.2. Background

The market price for wholesale energy, and the associated forward purchase rates, have risen materially above the historic levels in the industry cost dataset which have been used as inputs to the cost models.

The peak so far has been in 2022/23 when the day forward price rose as high as £527 per MWh, with an average for the year of £187 per MWh. There has been a significant reduction since then, but forward purchase rates remain approximately double the level incurred during the years feeding the cost assessment models. In addition, the non-commodity costs (NCCs) have also been rising.

Whilst we can influence energy usage to a degree, we clearly cannot control the energy prices set by the market. We can, and do, hedge our energy costs through forward purchase contracts, which we build up over time. This basically fixes the price we pay in advance.

It is important to note that we hedge to increase financial certainty and to avoid short term shocks to our cost base. We do not hedge to attempt to outperform the market, which of course is only possible with hindsight. So, as we increase our hedge position we reduce the risk of cost shocks, but also reduce the potential for achieving lower costs should prices fall post securing the hedge. Over time we have both outperformed and underperformed the market price through the approach. In AMP7 our approach has protected us to an extent from the energy cost shock. We had forward contracts in place for 2021/22 and most of 2022/23, but only few forward contracts in place for 2023/24 and 2024/25, so we are now experiencing the cost increases some other companies incurred in 2021/22 and 2022/23.

As soon as the short-term market prices started rising, the longer term AMP8 forward prices rose sharply too, making purchasing forward contracts for AMP8 much more expensive. Since that time forward contract prices have fallen back, but are still double the historic average assumed for the data feeding the cost models. As we follow our hedging strategy, we build up a portfolio of forward price hedges over time. At the point of securing each hedge we simply cannot know do if we will end up above or below the eventual actual market price.

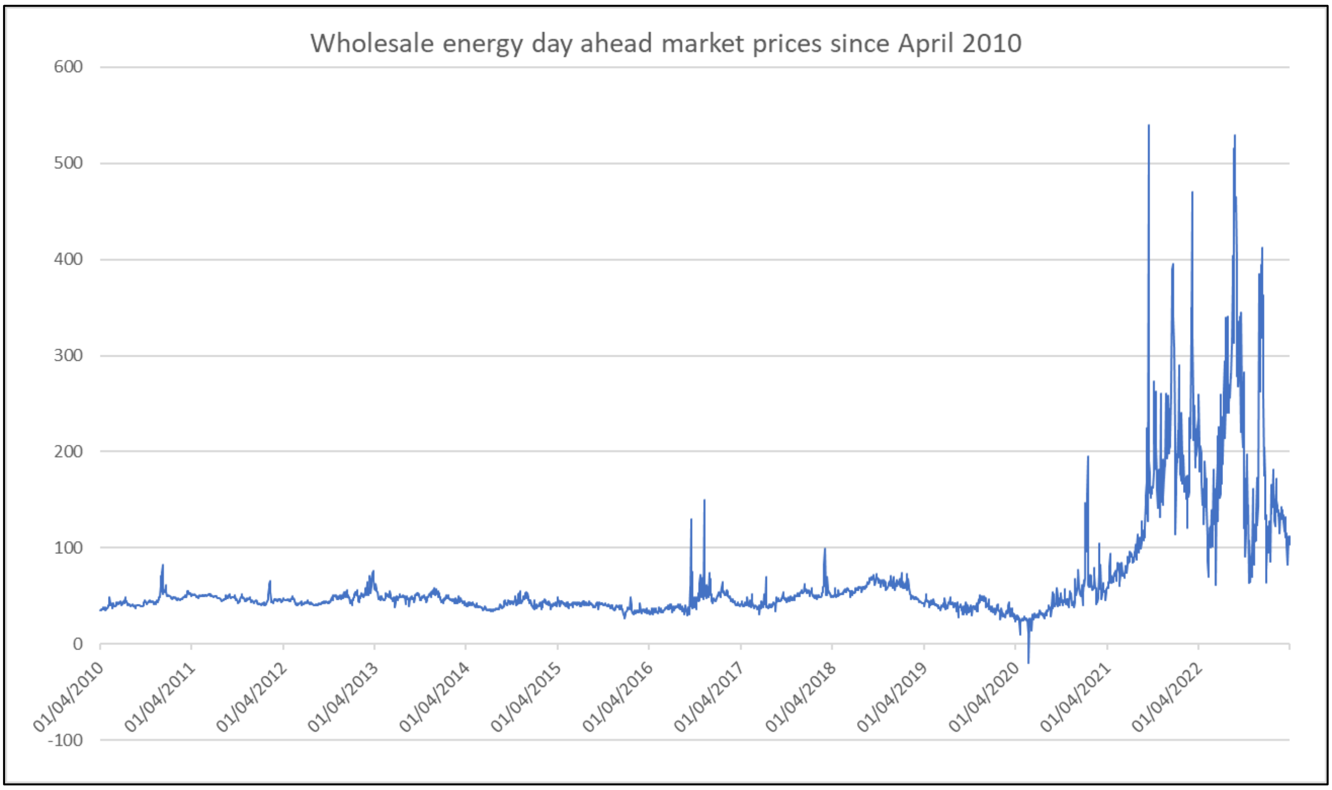
3.3. Materiality

This cost adjustment claim is material for Water Resources, Water Network plus and Wastewater Network plus. We do not believe it is material for Bioresources or for Retail.

The materiality is formally assessed later in this document.

3.4. Volatility

It is worth stressing that the energy market remains volatile, with the external factors causing that volatility still very much evident and so the situation is likely still evolving. The chart below shows the relative stability in the wholesale price prior to the invasion of Ukraine, the huge cost increases in 2021/22 and 2022/23 and the volatility since then. More recently prices have reduced form the peaks but are still approximately double the long term average.



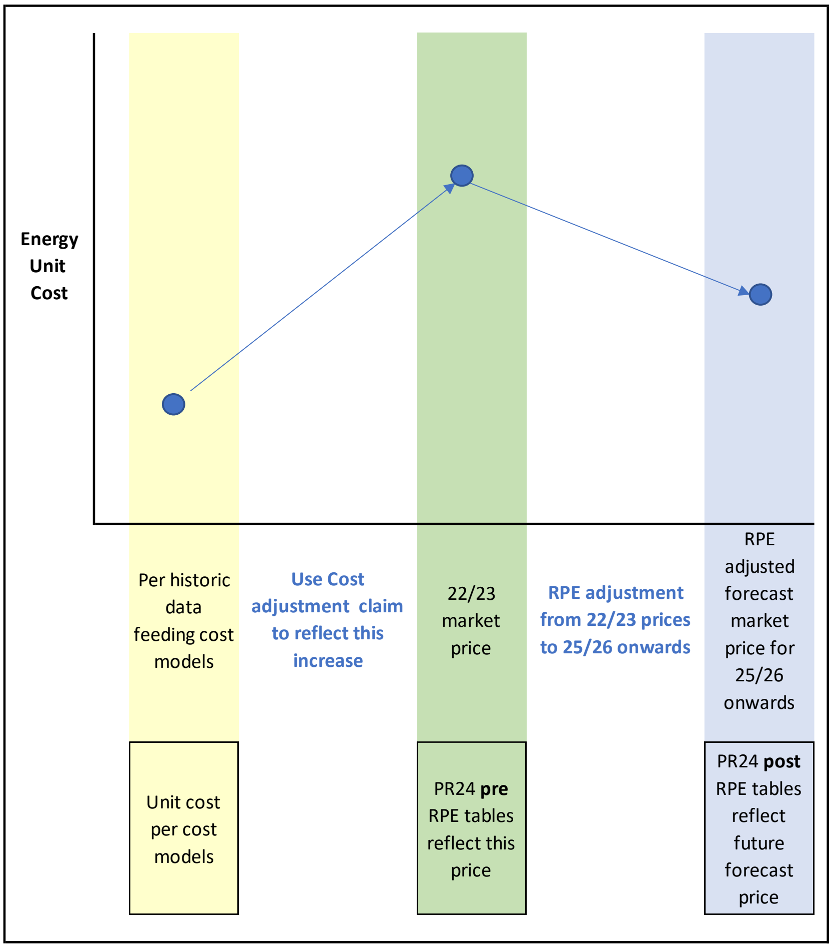
3.5. Symmetrical or non-symmetrical

This is an industry wide matter, with the potential for the material unfunded energy costs that are being suffered in AMP7, to remain unfunded for all companies in AMP8. We therefore conclude that this would be a non-symmetrical cost adjustment claim based on the national increases in energy prices.

This cost adjustment claim ultimately impacts the whole industry in the same way because it is based on the market rate for energy. All companies will have experienced very significant cost increases in 2022/23 for wholesale energy. Whilst we had some protection as a result of our hedging strategy, the underlying cost for 2022/23 is effectively the 2022/23 market rate.

In our approach it is particularly important to also use this 2022/23 rate as the starting point in the calculation of the Real Price Effects (RPE) adjustment. By keeping the methodology on the 2022/23 market price aligned across the two separate adjustments, we ensure we end up at the expected unit cost of energy for AMP8. The graphic below seeks to demonstrate this, and the approach we are taking.

We acknowledge that there are numerous approaches to calculating the cost adjustment claim. Our approach is largely driven by the guidance for calculating Real Price Effects in which we are expected to demonstrate how future costs will move, post 2022/23, in relation to CPIH due to macro-economic factors outside of the companies' direct control. We have concluded that the best way to demonstrate macro-economic factors outside of our control is to use the market price data for 2022/23 and the expected forward market prices. In our approach it is essential that the calculation of the 2022/23 market price is the same in both the Cost Adjustment Claim and the Real Price Effect. In this way, when taking the two adjustments together we arrive at what we consider to be the market price for AMP8. The forward prices change frequently, so we anticipate that the RPE will need recalibrating as we go through the Price Review.


Energy Unit Cost
Per historic data feeding cost models
Use Cost adjustment claim to reflect this increase
22/23 market price
RPE adjustment from 22/23 prices to 25/26 onwards
RPE adjusted forecast market price for 25/26 onwards
Unit cost per cost models
PR24 pre RPE tables reflect this price
PR24 post RPE tables reflect future forecast price

3.6. Methodology for the claim

In this cost adjustment claim we essentially use five data points and then a calculation to derive the size of the claim.

A. The market average wholesale price for 2022/23 (£/MWh)
B. The expected total energy purchased (MWh)
C. The split of energy costs by price control (%)
D. A x B x C x 24 hours x 365 days, divided by a million (which returns a £ million result per price control)
E. The Non-commodity costs incurred for 2022/23 (£ million)
F. The implicit allowance assumed in the cost models (£ million) in 2022/23 prices

The Cost Adjustment Claim can then be expressed for each price control as follows

Cost Adjustment Claim = D + E – F

Part A: Calculating the market average wholesale price for 2022/23 (£/MWh)

We have calculated the average market price for 2022/23 by taking the day ahead rates as quoted on Bloomberg. We have then taken a simple average of these 365 individual prices. We recognise there may be more sophisticated methodologies, for example weighting the daily price by daily usage to get a weighted average price, but we have not done this for two main reasons

1. Our daily usage highs and lows are driven by many external factors which could be different in AMP8 compared to 2022/23 in which we saw record temperatures is the summer, and drought conditions through much of the year.

2. Assuming the same market average wholesale price is used in both the calculation of the Cost Adjustment Claim (CAC) and the calculation of the Real Price Effect (RPE), it doesn't seem to matter which exact point is chosen for the 2022/23 market price, because the combined effect of the CAC and RPE for energy is to arrive at the expected future market prices of energy.

For these reasons we believe a simple average cost is sufficient.

The resulting daily average is £186.97 per MWh. We have included all of the daily rates used in the calculation of the average in an Appendix to this document.

Part B: Total forecast energy consumption

We expect our energy consumption over the five years of AMP8 to be 778MWh per annum as the base position. Whilst we expect this to increase over the AMP due to growth and new obligations, that increase will appear in Enhancement opex and so is excluded from this claim.

	2025/26	2026/27	2027/28	2028/29	2029/30	AMP8
MWh	778,000	778,000	778,000	778,000	778,000	3,890,000

Part C: Energy usage by Price Control (percent)

To get this split we have taken our actual cost per the APR in 2020, 2021 and 2022 and expressed these as a percentage of the total energy cost for that year. We have then added our as yet unaudited costs for 2022/23 in the same format. With these four years' worth of data, we are able to calculate an average percentage split by price control for use in this cost adjustment claim.

We believe this approach is reasonable because it can smooth out any variations in individual years caused by the impact of the prevalent weather conditions for that year. The data actually shows relatively modest variation from year to year, further validating the approach.

The resulting percentages for both the individual years and the average we will use in this cost adjustment claim are shown below:

Proportion of Energy use by Price Control per the audited APR (2020,2021 and 2022) and as yet unaudited 2023					
	Water Resources	Water N+	Wastewater N+	Bioresources	Total
March 2023 APR (draft)	11.51%	35.44%	52.50%	0.56%	100%
March 2023 APR (audited)	11.15%	34.44%	53.66%	0.76%	100%
March 2021 APR (audited)	11.02%	36.31%	53.94%	-1.27%	100%
March 2020 APR (audited)	10.38%	36.56%	53.73%	-0.67%	100%
Average	11.03%	35.68%	53.43%	-0.14%	100%

Part D: A x B x C divided by a million (which returns a £ million result)

This is a mathematical calculation to turn the inputs provided by A and B into an annual cost for wholesale energy in £ million, based on the 2022/23 market price. As per the chart earlier in the document, at the time of writing this is higher than the expected future cost – the RPE adjustment we are proposing will bring this down to the future expected prices.

	% of total	Consumption MwH (AMP8)	Cost per MwH £	Wholesale cost £m
Water Resources	11.03%	429,067	186.97	80.2
Water Netwok+	35.68%	1,387,952	186.97	259.5
Wastewater Network+	53.43%	2,078,427	186.97	388.6
Bioresources	-0.14%	-5,446	186.97	-1.0
Total	100.00%	3,890,000	186.97	727.3

Part E: The non-commodity costs incurred for 2022/23 (£ million)

We incur non-commodity costs (NCCs) on our energy purchases from the grid. In 2022/23 these amounted to £50.4m. This is on top of the wholesale price. We take this total and divide it by usage to get £/MWh rate, which we can use to then spread the cost across the Price Controls.

As with the wholesale cost, the RPE process will pick up any RPE differences between the 2022/23 price we incurred and the for the NCCs we expect to incur in AMP8.

The split of the NCCs across the price controls is shown below. As this is a charge largely levied on energy purchased from the grid, this cost is mostly borne by Water Resources, Water Network Plus and Wastewater Network Plus and is effectively pro-rata the energy purchased. Whilst our

Bioresources sites generate significant amounts of energy, we do still purchase energy from the grid for Bioresources, and thus Bioresources takes a share of the NCCs as well. Whilst we assess that Bioresources does not pass the materiality test, we include it here for completeness and transparency.

	Wholesale cost	NCC	Total Cost
	£m	**£m**	**£m**
Water Resources	80.2	27.8	108.0
Water Netwok+	259.5	89.9	349.4
Wastewater Network+	388.6	134.6	523.2
Bioresources	-1.0	-0.4	-1.4
Total	727.3	252.0	979.3

Part F: The implicit allowance implied by the models

Whilst we have seen the published models, we don't yet know which models Ofwat will use for PR24 and in what combination/proportion they will be mixed together to arrive at a funding level. We have calculated the implicit allowance by Price Control, using an even weighting of the models and using the PR24 dataset.

We run the models twice, using two sets of data. The first set includes power costs, the second set excludes power costs. The difference between the two is assumed to be the implicit allowance for energy costs. The calculations are attached in the excel document 'ANH_CAC_3.3 Energy implicit allowance and summary'.

This approach gives us the implicit allowances set out in the table below, stated in both 2017/18 prices and 2022/23 prices. We acknowledge that the implicit allowance will need to be recalculated once the actual mix of models for PR24 is known.

	£m, 2017/18 prices			**£m, 2022/23 prices**		
	Modelled allowance		Implicit allowance for power	Modelled allowance		Implicit allowance for power
	Including Power	Excluding Power		Including Power	Excluding Power	
Water Resources	340.8	304.9	36.0	402.4	359.9	42.5
Water Network+	1,112.1	994.7	117.3	1,313.0	1,174.4	138.5
Wastewater Network+	1,544.7	1,379.6	165.1	1,823.7	1,628.8	194.9
Bioresources	358.4	384.8	-26.3	423.2	454.3	-31.1
Total	**3,356.1**	**3,064.0**	**292.1**	**3,962.3**	**3,617.5**	**344.8**

3.7. The Cost Adjustment Claim calculation & materiality test

As above this is Part D + Part E – Part F. The table below shows this calculation which includes the expected level of materiality for the relevant price control, and whether the claim passes the materiality test or not. This test confirms that the Bioresources cost adjustment claim is immaterial to the Price Control. The materiality test is passed for the other three price controls.

	£m, 2022/23 prices				
	AMP8 power costs in 2022/23 market	Implicit allowance for power	Net cost adjustment claim	Materiality level for price control	Material to price control
Water Resources	108.0	42.5	65.5	24	YES
Water Network+	349.4	138.5	210.9	36	YES
Wastewater Network+	523.2	194.9	328.3	43	YES
Bioresources	-1.4	-31.1	29.7	45	NO
Total	979.2	344.8	634.4		

3.8. Summary

In three price controls this cost adjustment claim is material and the values of each are shown below. The claim is not material for the Bioresources price control and is thus excluded. The resulting claim is summarised in the table below.

	£m, 2022/23 prices		
	AMP8 power costs in 2022/23 market	Implicit allowance for power	Net cost adjustment claim
Water Resources	108.0	42.5	65.5
Water Network+	349.4	138.5	210.9
Wastewater Network+	523.2	194.9	328.3
Bioresources	Not material		
Total	980.6	375.9	604.7

It is worth noting that in our methodology, the separate RPE adjustment would offset approximately half of this cost adjustment claim, based on the current future energy cost forecasts compared to the peaks seen in the 2022/23 market prices.

Annex 3.1 – Cost Adjustment Claim assessment criteria

Need for adjustment (necessary)

1.1. Unique circumstances

Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?

This claim is not based on the presumption that Anglian Water has unique circumstances. Indeed, other companies are likely to be in the same situation. This claim is based on the fact that the base cost models cannot take account of the recent increase in the costs in question because they were not incurred in the modelled period.

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)?

Not relevant – see above.

Is there compelling evidence of alternative options being considered, where relevant?

Not relevant – see above.

1.2. Management control

Is the investment driven by factors outside of management control?

The energy market price spike is outside of the control of management and has impacted the whole industry and indeed the whole economy, whether businesses or domestic energy users.

Have steps been taken to control costs and have potential cost savings (eg spend to save) been accounted for?

Hedging via forward purchase contracts can give financial certainty in the short to medium term but you cannot secure a defined outcome. Whether hedging means you spend more or less than the eventual actual market price, depends upon the eventual actual market price. In AMP7 our hedging strategy gave us good protection from the cost shocks in 2021/22 and 2022/23 but the higher costs are hitting in year 4 and will do in year 5 as we only had limited forward contracts in place at the time of the price increases.

1.3. Materiality

Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?

The additional costs pass Ofwat's materiality threshold. The sector is heavily reliant on energy and energy is much more expensive today, and forward contract pricing suggests will still be much more expensive in AMP8.

Is there compelling quantitative evidence of how the factor impacts the company's expenditure? Adjustment to allowances (including implicit allowance)

The case and the valuation are set out in the main part of this document.

Is there compelling evidence that the cost claim is not included in our modelled baseline (or, if the models are not known, would be unlikely to be included)? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?

By running the PR24 models as a group with weightings advised by Ofwat, we can work out the allowed funding by Price Control. By running the models again without the energy cost included in the cost data, we can then work out the allowance excluding energy costs, and thus we can calculate the implicit allowance included for energy in the models. We know the historic cost of energy per unit of usage and can then calculate the impact of the unit cost increase on the total.

Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?

The materiality of the claim is demonstrated below:

	£m, 2022/23 prices			
	Water Resources	Water Resources	Water Resources	Bioresources
Total AMP8 energy expenditure	108.0	349.4	523.2	-1.4
Allowance implied by the models	42.5	138.5	194.9	-31.1
Net value of the claim	65.5	210.9	328.3	29.7
Materiality of the claim (as % of totex for the price control)	16%	6%	8%	4%
Materiality threshold (as % of totex for the price control)	6%	1%	1%	6%
Is the claim material?	YES	YES	YES	No

We have only considered one methodology for the implicit allowance because we are able to both include and exclude energy costs from the historic dataset feeding the cost assessment models and thus can isolate the energy costs assumed in the models by doing that.

Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?

This is generally about cost increases, but where energy is generated and exported to the grid there should be a corresponding benefit through a higher sale price. However, this is typically only in the Bioresources price control. We cannot think of any other offsetting benefits.

Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?

Energy is significant part of the cost base and failure to allow the claim would impose a huge and unjustified efficiency challenge to the company, over and above the other efficiency challenges which have been separately calculated and justified.

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?

After a relatively stable decade energy prices roughly tripled from the historic long-term average to 2022/23. Whilst prices have been partially recovering since 2022/23 the forward cost still looks double the historic long-term allowance. Also, the factors causing the volatility are still evident today, so whilst prices have been falling there cannot be any certainty they will continue to do so. We repeat that we don’t think the ’CAC+RPE’ approach is the best way to handle this cost item in the current volatile environment.

If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?

This claim is not about explanatory variables, but about the increase in the market price of energy.

Cost efficiency (necessary)

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)?

We have based our claim on the market price of energy, which is the logical efficient unit cost. Whilst companies may have forward purchasing contracts in place these are just as likely to be more expensive than less expensive. We do not hedge to ‘beat’ the market price. We hedge for short-term financial certainly and to avoid short-term cost shocks impacting our financials. Therefore, we believe the market price to be the efficient price.

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?

The historic market data has been drawn from Bloomberg historic day ahead data. The forward prices have been taken from Lloyds. These forward contract process will change on a frequent basis as the market moves. The analysis could therefore be replicated and updated as prices move. As above we don’t think the ’CAC+RPE’ approach is the best way to handle this cost item in the current volatile environment.

Does the company provide third party assurance for the robustness of the cost estimates?

Our forecasts are based on actual forward prices from Lloyds. The historic data is all from Bloomberg. Our claim has been reviewed by our external assurers.

Need for investment (where appropriate)

Is there compelling evidence that investment is required?

Not applicable – this relates to ongoing base opex energy unit cost

Is the scale and timing of the investment fully justified?

Not applicable – this relates to ongoing base opex energy unit cost

Does the need and/or proposed investment overlap with activities already funded at previous price reviews?

Not applicable – this relates to ongoing base opex energy unit cost

Is there compelling evidence that customers support the need for investment (both scale and timing)?

Not applicable – this relates to ongoing base opex energy unit cost

Best option for customers (where appropriate)

Did the company consider an appropriate range of options to meet the need?

Not applicable – this relates to ongoing base opex energy unit cost

Has a cost–benefit analysis been undertaken to select proposed option? There should be compelling evidence that the proposed solution represents best value for customers, communities and the environment in the long term? Is third-party technical assurance of the analysis provided?

Not applicable – this relates to ongoing base opex energy unit cost

Has the impact of the investment on performance commitments been quantified?

Not applicable – this relates to ongoing base opex energy unit cost

Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where utilisation will be low?

Not applicable – this relates to ongoing base opex energy unit cost

Has the company secured appropriate third-party funding (proportionate to the third party benefits) to deliver the project?

Not applicable – this relates to ongoing base opex energy unit cost

Has the company appropriately presented the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?

Not applicable – this relates to ongoing base opex energy unit cost

Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views

Not applicable – this relates to ongoing base opex energy unit cost

Customer protection (where appropriate)

Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?

No, but given the volatility an uncertainty mechanism with true-up (ideally on the basis of a published index) could work to pick up any difference between a reasonable cost allowance and the eventual market price. Such a mechanism could protect customers from paying more than the real cost of energy.

Does the protection cover all the benefits proposed to be delivered and funded (eg primary and wider benefits)?

No, but if an uncertainty mechanism were introduced it would depend on the mechanism.

Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including the mechanism for securing sufficient third-party funding?

Third-party funding and delivery are not relevant to this Cost Adjustment Claim.

AMP7 phosphorus removal operating expenditure

ANH CAC 4

Title of cost adjustment claim	Narrative file: ANH 4.1 AMP7 phosphorus removal operating expenditure		
Price control	Wastewater Network Plus	Symmetrical?	~~YES~~/NO
Basis of claim	The enhancement opex companies will incur in 2025-30 to operate the phosphorus removal schemes they built in 2020-25 will not be allowed for by the base cost models. Separate allowance will therefore be required for these costs.		
Gross value (£m five years)	60.1		
Implicit allowance (£m five years)	0.0		
Net value of claim (£m five years)	60.1		
How efficiency of costs are demonstrated	Oxera has analysed the opex reported by companies in Tables 7F of their APRs for 20/21 and 21/22 to derive efficient opex costs for P removal schemes		
Materiality (as % of totex for price control)	1.3%		
How customers are protected	Phosphorus limits are included in the environmental permits of all WRCs that were included in our AMP7P removal programme and will be enforced by the Environment Agency.		
Supporting document references	ANH_CAC_4.2 CAC calculations P removal opex.xls ANH_CAC_4.3 P removal by site opex benchmarking.do ANH_CAC_4.4 STATA P removal opex benchmarking.xls ANH_CAC_4.5 Implicit allowance analysis.do ANH_CAC_0.1 Oxera assurance letter		

4.1. Introduction

This is a claim for the base cost allowance made for Anglian Water at PR24 to include funds to enable the efficient operation of the phosphorus (P) removal schemes which Anglian installed in AMP7. We make the claim because the models Ofwat uses to determine our base cost allowance at PR24 will likely include neither the appropriate cost data nor the cost driver variables needed to forecast these costs. Ofwat recognises this in the base cost modelling consultation[43]:

"We recognise that the additional ongoing cost associated with more stringent phosphorus removal programmes across the sector may not be fully captured in our proposed base cost models. We are exploring alternative options to ensure that our cost assessment approach funds efficient ongoing P removal costs"

One of the alternative approaches to account for additional ongoing p-removal costs being considered by Ofwat is the cost adjustment claims process (alongside other potential measures, such as a post-modelling adjustment or eventually including a P removal cost driver in the relevant base cost models).[44]

This CAC is thus submitted on a contingent basis.

For the time being, none of the models proposed by Ofwat in its suite of models released in April 2023 included variables to control for phosphorus removal costs incurred from 2025/26 onwards as a result of companies' AMP7 P removal programmes. Furthermore, a negligible proportion of the costs companies have incurred are included in the historical years used for model estimation. Accordingly, it is highly unlikely that sufficient allowances for these costs can be made by Ofwat's current modelling suite. Should this be incorrect, we would withdraw or amend this claim accordingly.

We are submitting the CAC in accordance with advice provided by Ofwat during the Cost Assessment Working Groups during 2021 and early 2022 and the guidance set out in the PR24 Final Methodology.

We set out the data we have used to calculate the value of our claim in the associated Excel file, '*ANH4.2 - CAC calculations P removal opex.xls*'. Oxera's supporting calculations on (i) the efficient annual opex of AMP7 P removal schemes and (ii) the implicit allowance for AMP7 P removal opex from the current base models are also appended therein.

Our claim is based the following main data sources: (i) the Annual Performance Reports for 2021-22 (APR22) published by companies in table 7F and (ii) the cost and cost-driver data used in Ofwat's wastewater network plus consultation models as at April 2023. We will update our claim for the October business plan, making use of the table 7F data from companies' 2022/23 APRs (APR23).

[43] 'Econometric base cost models for PR24', Ofwat, April 2023 – page 41
[44] 'Econometric base cost models for PR24', Ofwat, April 2023 – page 41

4.2. Background

High levels of phosphorus in the final effluent returned to rivers from water company water recycling centres (WRCs) is a major cause of nutrient enrichment of rivers. Nutrient enrichment encourages algal growth which depletes the river of oxygen, with adverse consequences for riverine ecology and biodiversity. Reduction of phosphorus loading of rivers from WRCs is therefore seen as a key intervention to improve the ecological status of rivers. The Environment Agency identifies rivers where the need for intervention is greatest and the WRCs where reductions in phosphorus concentrations are required. It enforces these requirements by imposing, or tightening, limits for P concentrations in the discharge permits for those WRCs.

The technology to reduce phosphorus concentrations in waste water typically involves dosing incoming waste water at the head of the WRC with ferric or ferrous salts. These salts combine with soluble phosphorus in the waste water to form flocs of ferric or ferrous phosphate which precipitate on settlement or clarification and can be removed with the waste water sludge.

Additional operating costs are incurred once the P removal scheme has been installed. Opex is primarily incurred for the purchase of chemicals, power for running dosing pumps, the tankering of additional sludges and the maintenance of the relevant assets. These ongoing opex costs, incurred beyond AMP7, are the focus of our claim.

4.3. Our AMP7 P removal programme

At PR19 we agreed a programme of work with the Environment Agency to install the treatment plant required to reduce the concentration of phosphorus in the final effluent from a large number of our WRCs over the period 2020-25 (AMP7). At the end of March 2022 our AMP7 programme comprised 176 separate schemes and we envisaged total capital expenditure of £336 million (in nominal terms). The funding for this programme was allowed through the final determination of price limits made by Ofwat.

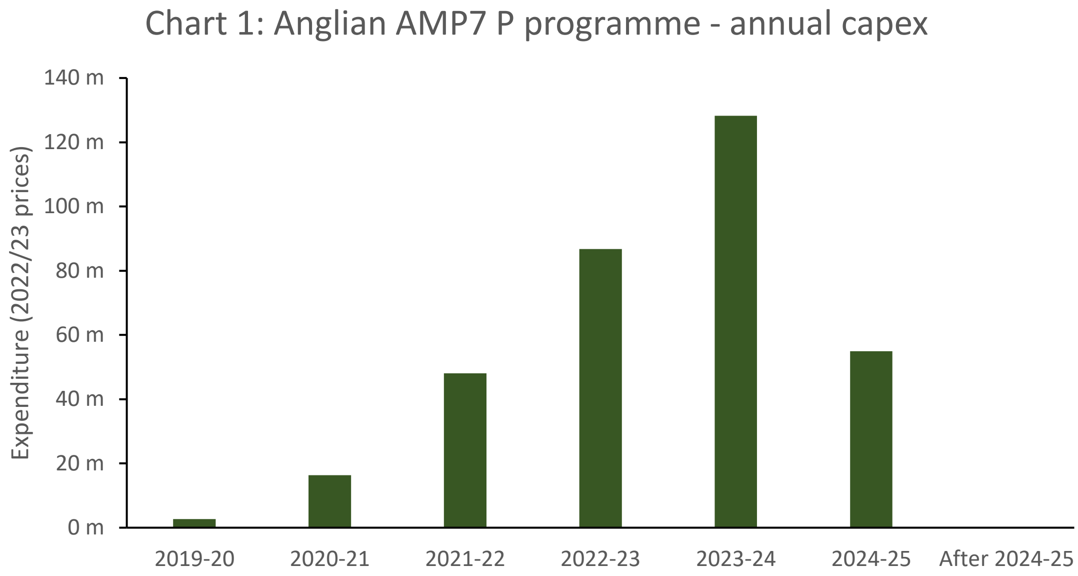
Charts 1 and 2 [45] below shows the **capital expenditure profiles** for delivering the AMP7 P removal programmes, respectively for Anglian and the industry as a whole. These profiles are calculated based on company Table 7F data[46] and costs have been converted to real terms, in 2022/23 prices.[47] Both paint the same picture, showing that expenditure peaks in year four of the price control period (2023/24), indicating that the majority of the schemes will be completed in years four and five (and thus predominantly only operational by 2024/25). The only noticeable difference between the industry's profile and our own is that a material proportion of the industry's expenditure is to be made after the end of the price control period (driven by Thames Water's volume of late investments[48]).

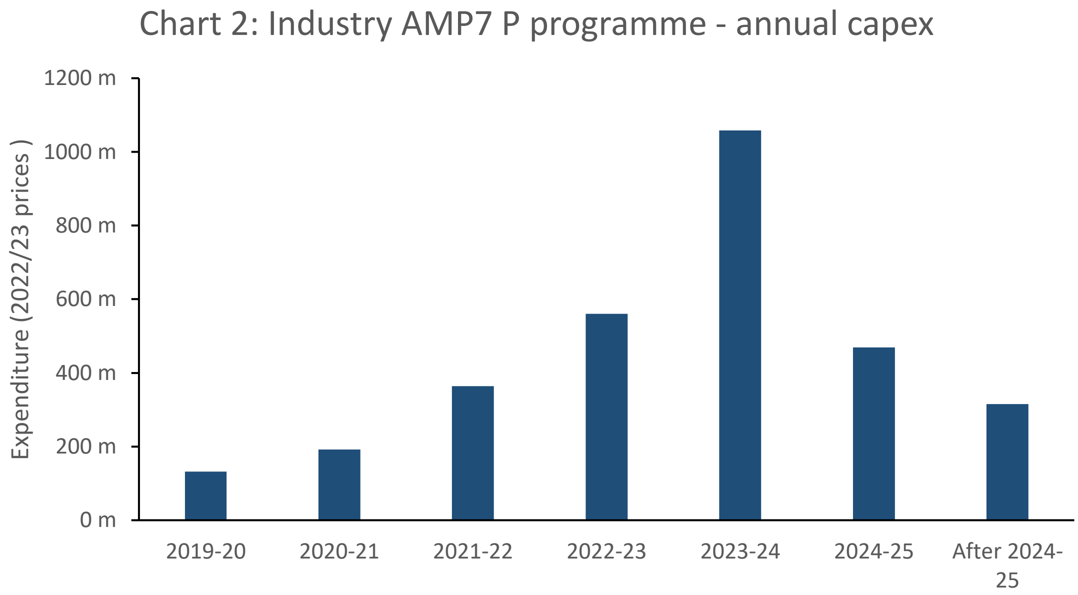
[45] Anglian Water analysis of companies' APR22 table 7F data in *ANH4.2 – CAC calculations P removal opex.xls*

[46] We note that there is a minor discrepancy between the opex reported for industry AMP 7 P removal schemes, when comparing company APR data with the aggregate cost series reported in Ofwat's wastewater consultation dataset over 2020/21 and 2021/2022. In 2017/18 prices, the former reports a total industry opex over the period of ¬£6m and the latter ¬£8m. Given that the AMP7 P removal scheme cost data underlying Ofwat's base cost consultation modelling is neither available on a disaggregated basis, nor over the entire AMP7 period, we base our analysis in this section on company APR data. The differences in costs reported by the datasets are also minor, such we do not expect them to have a material impact on the outcomes of the analysis.

[47] Based the latest CPIH series published by the ONS, available here.

[48] Thames' APR data indicates that some 70% of its AMP 7 scheme capex, or £ 307.4 million (in nominal terms), will only be made after 2024/25. See accompanying Anglian Water analysis of companies' APR22 table 7F data, sheet *3. Industry data>>aggregation>Totals* in *ANH4.2 – CAC calculations P removal opex.xls*.

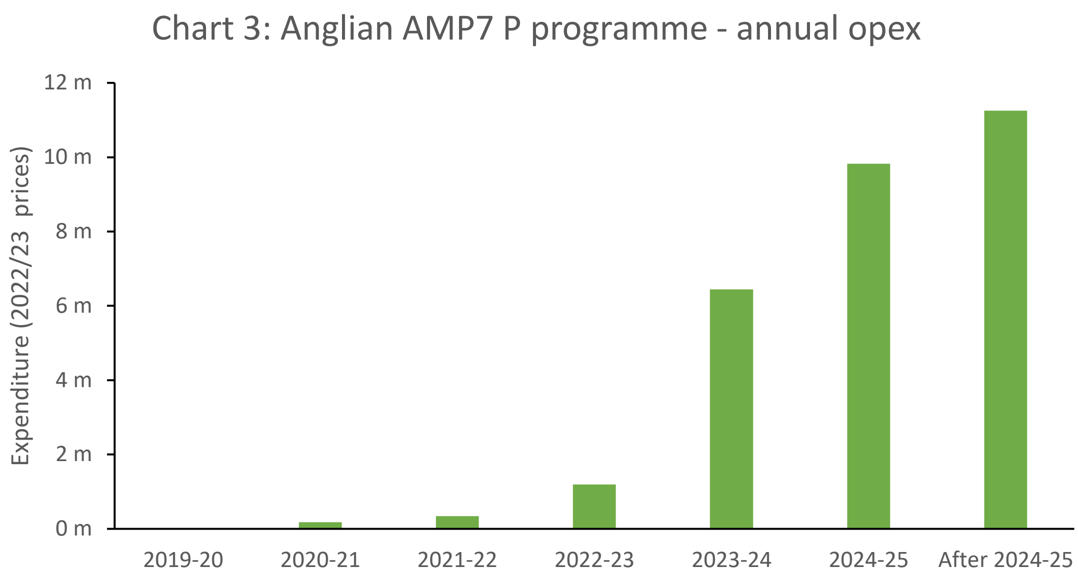


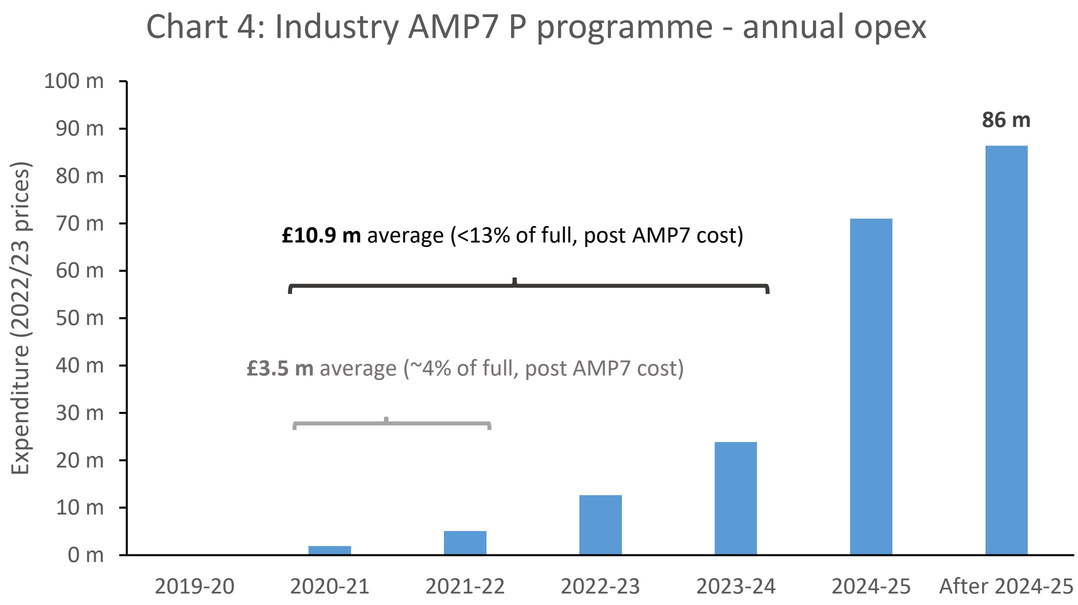


Note: SRN capex data after 2024-2025 corrected for seeming reporting error (see accompanying Excel workbook).

The enhancement **opex profiles** associated with our own and the industry's respective AMP7 P removal programmes are set out in **Charts 3 and 4**[49] below. Unsurprisingly, given the similarity in the capital expenditure profiles, our opex profile is very similar to the industry's. Opex levels are very low in the first three years of the price control period, and only start becoming material as more schemes become operational from 2023/24 onwards - i.e. beyond the current base cost modelling period. Furthermore, the full impact of these programmes on our own (and likewise, industry) opex costs will not be realised until the first year of AMP8. This is entirely consistent with the profile of scheme completion shown above and the fact that opex is incurred only once schemes are completed.

[49] Anglian Water analysis of companies' APR22 table 7F data in *ANH4.2 – CAC calculations P removal opex.xls*





The key takeaway from these observations is that the additional operating costs from the industry's **AMP7 P removal programme are scarcely represented at all until 2024/25, and are not fully represented until at least 2025/26** (or possibly even later[50]). As shown in Chart 4, over the first two years for which we have AMP7 scheme outturn data, namely 20/21 and 21/22 (relevant to Ofwat's current consultation base modelling), the average industry opex per annum was only 4 percent of what annual opex costs currently expected to be required after 2024/25 (all considered in real terms).[51] Moreover, as Ofwat does not model the step change in industry spend that occurred since 2015/16, the impact of this increase in opex that is contained within the base cost modelling is further reduced.

[50]. That is, should some schemes be delayed and only become fully operational later than initially planned.

[51] See accompanying Anglian Water analysis of companies' APR22 table 7F data, sheet *3. Industry data>>aggregation>Totals* in *ANH4.2 – CAC calculations P removal opex.xls*

4.4. Allowing for the ongoing costs of our AMP7 P removal programme

At PR24 Ofwat must determine the efficient level of expenditure companies will incur to deliver their statutory duties. These duties include the requirement to meet their permitted phosphorus standards in treated waste water effluent. The cost allowances must therefore provide for the operation of P removal plants which companies installed in AMP7.

Historically, Ofwat had modelled enhancement opex as part of totex-based enhancement models. However, these ongoing opex costs are no longer considered under enhancement models, but considered under base cost modelling from PR24.[52] Furthermore, historical total cost (or 'totex') enhancement modelling only considered the opex for AMP7 schemes that fell within the AMP7 period (2020/21 to 2024/25). The ongoing opex costs for existing AMP7 schemes over the 2025/26 to 2029/30 (or AMP8) period would thus need to be covered within the base cost modelling, as it falls outside the scope of either PR19 or PR24 enhancement models.

This brings us to the extent to which ongoing AMP7 P removal opex will be provided for through Ofwat's proposed PR24 base cost models. Ofwat's preferred approach is to derive cost allowances from cost models. These models establish the relationship between expenditure and the factors which drive expenditure on the basis of historical evidence, then use these relationships – in conjunction with forecasts of cost drivers – to assess future expenditure needs. Therefore, if ongoing P removal costs are not captured in either the costs or the cost drivers used in the models, they are not accounted for in the cost allowances.

Ofwat's proposed base cost models, as set out in the consultation, do not appropriately consider the ongoing cost of AMP7 P removal schemes through either (i) the cost to be modelled or (ii) the cost drivers included in the model. More specifically:

- Based on the current company APR data, we estimate that Ofwat's proposed base cost models (as set out in its consultation) account for ongoing industry opex for AMP7 P removal schemes of, at most, £3.5 million per annum.[53] This is only 4 percent of the £86.4 million per annum expected for all AMP7 schemes after 2024/25 (all in 2022/23 prices). As shown in Chart 4, this is expected to increase to no more than 13 percent of the full ongoing costs by the time of Ofwat's final determination modelling, (considering outturn data up to 2023/24). Note that these are conservative estimates of the total annual industry opex expected over 2025-30, as some companies have seemingly not provided opex data for all their sites and/or years.[54] Moreover, as stated above, as Ofwat does not model the step change in industry spend that occurred since 2015/16, the impact of this increase in opex is further watered down.
- Ofwat has also not accounted P removal as a cost-driver in its models (which we discuss in more detail below)

A modelling approach to derive the costs of companies' AMP7 P removal schemes is theoretically possible, should it be accounted for in both the costs and cost drivers of Ofwat's base models. In other words, it is conceivable that the relationship between P removal levels and the base expenditure associated with achieving those levels could be established. This relationship could then be used to forecast the operating costs companies will incur beyond 2025 as a result of their AMP7 P removal programmes. However, in its April 2023 consultation on base cost modelling for PR24[55] Ofwat has not included the ongoing costs associated with P removal as a cost driver, based on the following explanation:

[52] As noted by the 'PR 24 Final methodology, Appendix 9: Setting expenditure allowances', Ofwat, December 2022 – pages 5 and 11, and in the 'Econometric base cost models for PR24', Ofwat, April 2023 – page 35.

[53] As noted above, this is based on company APR data. Based on the industry aggregate ASMP7 P removal opex data used in Ofwat's wastewater network plus consultation models, the annual average is £4.7 million p.a. over 2021-22 (or 5.5% of the post 2024/25 expected opex in the APR data).

[54] For example, SWB has only provided opex data for two of its 30 planned AMP7 schemes (presumably only those that are already completed); whilst SRN has not provided any costs ongoing costs for sites after 2024/25 (which seems based on an incorrect interpretation, as the ongoing lifetime of a P removal plants would be several years – if not decades – after its construction). Anglian Water analysis of companies' APR22 table 7F data

[55] 'Econometric base cost models for PR24', Ofwat, April 2023 – page 40

"Treatment complexity is a key cost driver of sewage treatment costs. Tighter discharge permit limits tend to require more, or larger, treatment process units and are therefore more costly to comply with. In addition, tighter permits are associated with additional raw material costs, mainly driven by energy and chemical requirements.

Our proposed models retain the PR19 treatment complexity variable. This is the percentage of load with ammonia permit <= 3mg/l. We include this explanatory variable in sewage treatment (SWT) and wastewater network plus (WWNP) models.

We considered alternative treatment complexity variables:

- *percentage of load with a Total Phosphorus (P) permit <= 0.5mg/l or <= 1mg/l;*
- *percentage of load with a Biochemical Oxygen Demand (BOD) permit <= 7mg/l or <= 10mg/l; and*
- *percentage of load with an Ultra-Violet (UV) treatment permit.*

None of the alternative variables improved on the PR19 complexity variable. They did not generate statistically significant results. The coefficient on the UV variable was also found to be of the wrong sign, predicting that tight permits have a negative impact on costs. For BOD <= 7 mg/l, we found that the data does not have a sufficient variation across the sector with a very limited proportion of load subject to these permits. This could lead to spurious results.

CEPA included percentage of load with ammonia permit <= 3mg/l in its recommended models and did not recommend any other sewage treatment complexity variables."

On this basis, Ofwat recognises that the 'additional ongoing costs associated with more stringent phosphorus removal programmes across the sector may not be fully captured in [its] proposed base cost models', and that a cost adjustment claim is one means by which it may ensure that its approach funds efficient ongoing P removal costs.[56]

On a forward-looking basis, given the lack of historical AMP7 P removal costs, we are sceptical that a robust modelling approach will be found that satisfactorily provides for the ongoing opex associated with companies' AMP7 P removal programmes. Illustratively, in the consultation document Ofwat discussed models proposed by companies which included alternative variables for treatment complexity. However, none of these models included variables for phosphorus limits only (although it is likely that companies will have attempted to build them). Further, as we discuss below, the cost data available also does not account for the incremental, ongoing costs of AMP7 P removal schemes over AMP8. We thus submit this cost adjustment claim for use in the event that these matters remain unaddressed by Ofwat's approach at the time of the final determinations.

[56] 'Econometric base cost models for PR24', Ofwat, April 2023 – page 41

4.5. Valuing our claim

We calculate the value of our claim as the efficient annual cost of operating our AMP7 P removal programme less the allowance for these costs implied by Ofwat's PR24 base cost models. In accordance with the guidance in the PR24 Final Methodology document we have not applied any adjustment for frontier shift. We have not made any adjustments either for any real price effects which we may apply to our cost proposals in our final business plan.

4.6. Gross value of our claim

We calculate the gross value of our claim as the number of P removal schemes in our AMP7 programme which we shall have to operate in 2025-30, multiplied by the efficient operating costs of operating those schemes. In table 7F of our APR22 we projected completing 162 schemes in our AMP7 programme.

We asked Oxera to analyse the APR22 table 7F data to derive an estimate of the efficient operating cost for each P removal scheme. The approach followed and accompanying results of Oxera's analysis are summarised in Appendix 1. Oxera's analysis found that the operating costs we expect to incur in operating our AMP7 P removal schemes are between around 20 percent and 70 percent lower than the average costs realised or projected by the rest of the industry. This conclusion holds whether the analysis is conducted on (i) only those schemes which were completed by the end of 2021/22 (for which actual, outturn data is available) or (ii) when looking at the figures companies project to the end of the AMP7 period (2024/25).

Consistent with the Competition and Market Authority's decision on the company appeals at PR19[57], we use the upper quartile efficiency cost when calculating the operating costs we claim from operating our AMP7 P removal schemes in 2025-30.

Oxera calculated two values for the upper quartile annual operating cost of P removal schemes: (i) one based on those schemes which were complete to the end of 2021/22 and (ii) another based on the costs companies project for the whole programme. We base our claim on the latter, as the sample used for the former is very small (only 12 schemes were completed to the end of 2021/22) and may thus be unrepresentative if it excludes larger and more expensive schemes which will not be completed until later in the price control period.

Oxera also calculated two sets of annual opex cost estimates, separately for the subset of industry schemes with tight consents and those with less tight consents. Tight consents were defined as having a permitted limit of 0.5 mg/l or less. Schemes with tight consents are more expensive to run than those with less tight consents, so our cost adjustment claim calculation takes account of the number of schemes in each category.

The table below shows the calculation of our cost adjustment claim. We calculate the total annual ongoing cost for AMP7 sites over 2025-30 as the product of the number of sites multiplied by the efficient (upper-quartile) cost per site (treating schemes with tight and less tight consents separately).

Scheme type	**No. of ANH schemes**	**Upper quartile operating cost**	**Total annual cost (after 2024/25)**
	No.	*(£m/yr)*	*(£m/yr)*
Tight consent	84	0.090	7.558
Less tight consent	78	0.034	2.621
Total	**162**		**10.179**

[57] 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – Final report', Competition and Market Authority, March 2021 – paragraph 4.494

In 2017/18 prices, the total annual figure is £10.179 million per annum. Note that this is a conservative estimate, as our number of completed sites may be higher.[58] Note that the efficient operating cost estimate may change as updated company Table 7F data becomes available.[59]

In 2022/23 prices this amounts to £12.017 million per annum. The **gross value of our cost adjustment claim therefore is this annual figure multiplied by five, which is £60.087 million.**

[58] The 162 scheme-number above does not consider the remaining 14 schemes for which we do not yet have annual opex estimates

[59] As noted above, companies have seemingly not provided opex data for all their sites and/or years. Cost driver data is also not complete. For example, we note that Severn Trent and Yorkshire Water have not reported consent requirements for most of its schemes in the APR data (presumably those still to be completed). The calculation in the table above assumes that all of these sites do not have tight constraints (<0.5 mg/l). Reallocating some these sites to the tight consents category could change the upper quartile / efficient operating cost estimates.

4.7. Implicit allowance

Companies report the enhancement opex associated with their P removal programmes and these costs are included in the dependent variable in all of the wastewater network plus models proposed by Ofwat in its April 2023 base cost modelling consultation.[60]

As already alluded to above, only a very small proportion of companies' ongoing AMP7 costs will be used in the total cost assessment. For example, by the time Ofwat makes its draft determinations, it will only consider opex incurred up until 2022/23, and only up to 2023/24 for the final determination. As shown in Chart 4 above, even by 2023/24 the average annual opex incurred over the AMP7 period will only represent a minor share of the annual opex expected to be incurred once sites become fully operational over 2025-30. By the time of the draft determinations (using data to 2022/23), the average annual AMP7 opex considered by the base models will be less than 8 percent of the full, annual ongoing costs of the AMP7 schemes. By the time of the final determinations (2023/24), it will still be less than 13 percent of the full ongoing costs of these sites.

For avoidance of doubt, the AMP7 expected P removal costs are distinct from and incremental to the historical P removal costs from previous AMPs already included in industry base costs. In our experience, AMP7 schemes are (i) predominantly at sites where there were no P removal schemes previously, or (ii) in some cases at sites where there may have been pre-existing schemes but where tighter consents have since been implemented (e.g. with consents tightening say from 2 mg/l to 0.5 mg/l).[61]

Therefore, as these incremental costs are not appropriately included in the cost metrics, nor considered by model cost drivers, we do not expect there to be any implicit allowance in the models. Moreover, as stated above, as Ofwat does not model the step change in industry spend that occurred since 2015/16, the impact of this increase in opex is further watered down.

We have asked Oxera to calculate the implicit allowance for these AMP7 P removal schemes over the AMP8 period, based on Ofwat's PR24 consultation models. The approach and results are summarised in Appendix 2. Oxera's remodelling indicates that our efficient cost allowance would have been higher if Ofwat excluded AMP 7 P removal opex over 2020/21 to 2021/22 from companies' botex. We thus make the conservative assumption that the implicit allowance is zero (instead of applying an uplift to the gross value of the claim).

Accordingly, **the net value of our cost adjustment claim is thus equal to the gross value**, given the scope of the expected cost and cost driver coverage of Ofwat's base cost models at time of writing.

In line with Ofwat's guidance, we do not submit a symmetrical cost adjustment claim, as this claim does not relate to costs that have been incurred in the past.[62] As the full ongoing costs to be incurred over AMP8 are not accounted for in Ofwat's base cost modelling, we foresee that the entire industry will require an uplift for the ongoing cost of AMP7 P removal schemes over 2025-30 (though to varying extents per company, contingent on the scale and efficiency of the ongoing costs incurred on their respective AMP7 P removal schemes).

[60] More specifically, through the *B0321PRO_SWT* variable used to construct the disaggregated sewage treatment (SWT)- and top down wastewater network plus (WWNP) botex cost variables used by Ofwat in its wastewater consultation models.
[61] In the latter case we thus assume that companies have reported the incremental opex required over AMP7 to meet the new tighter P consents, rather than the new total cost of P removal at the respective sites.
[62] PR 24 Final methodology, Appendix 9: Setting expenditure allowances', Ofwat, December 2022 – pages 32.

4.8. Need for adjustment (necessary)

1.4. Unique circumstances

Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?

This claim is not based on the presumption that Anglian Water has unique circumstances. Indeed, other companies may be in a similar situation. This claim is based on the fact that the base cost models cannot take account of the costs in question because they were not incurred in the modelled period. As stated above, this has been recognised by Ofwat.[63]

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)?

Not relevant – see above.

Is there compelling evidence of alternative options being considered, where relevant?

Decisions on the most efficient solutions for meeting the environmental outcomes were agreed at PR19. These decisions took into account the ongoing enhancement opex costs that would be incurred into the future. Alternative options were considered at the time.

1.5. Management control

Is the investment driven by factors outside of management control?

The environmental standards to be achieved at each water recycling centre are set by the Environment Agency. Anglian Water has a statutory duty to comply with these standards. Management can control the type of solution which is employed to meet those standards, and decisions on this were made at PR19, as discussed above. Management can also control the ongoing efficiency of operating the solution which has been created. This claim is only for the efficient opex costs of the solutions it has created, as assessed by Oxera's analysis.

Have steps been taken to control costs and have potential cost savings (eg spend to save) been accounted for?

The efficient ongoing cost of operating our P removal plants has been determined from analysis of industry data, based on an upper quartile efficiency challenge. In accordance with Ofwat guidance, a frontier shift has not been applied.

1.6. Materiality

Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?

The additional costs pass Ofwat's materiality threshold. There is an accepted case for both the need for P removal and the approach which we have taken to achieve it.

Is there compelling quantitative evidence of how the factor impacts the company's expenditure? Adjustment to allowances (including implicit allowance)

The case and the valuation are set out above.

Is there compelling evidence that the cost claim is not included in our modelled baseline (or, if the models are not known, would be unlikely to be included)? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?

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[63] 'Econometric base cost models for PR24', Ofwat, April 2023 – page 41

There are no variables to control for P removal costs in any of the waste water network plus models proposed by Ofwat in its April base cost modelling consultation. The consultation document discusses how P removal variables had been tested but not selected and reports that CEPA did not recommend any P removal variables. P removal costs are not controlled by any of the other variables included in any of the waste water network plus models which Ofwat consulted on.

Even if these cost drivers were considered, the full ongoing costs associated with the industry's AMP7 P removal programmes over 2025-30 are not appropriately captured in the data series that will be considered by Ofwat in its modelling at the time of the draft- and final determinations. By 2022/23 the average annual AMP7 opex considered will be less than 8% of the full, annual ongoing costs of the AMP7 schemes and by 2023/24 it will still be less than 13% of the full ongoing costs of these sites (note that these are conservative estimates, as discussed above). Moreover, as stated above, as Ofwat does not model the step change in industry spend that occurred since 2015/16, the impact of this increase in opex is further watered down.

As mentioned above, we have asked Oxera to calculate the implicit allowance from Ofwat's current consultation models over the AMP8 period. The analysis confirms that the consultation models does not provide any implicit allowance for ongoing costs of the incremental P removal schemes (see Appendix A2[64]).

Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?

The materiality of the claim is demonstrated below:

	£m
Total AMP8 wastewater network plus expenditure (June 23 estimate)	4,000
Enhancement opex to be incurred in AMP8	60
Allowance implied by the models	0
Net value of the claim	60
Materiality of the claim (as % of totex for the price control)	1.5%
Materiality threshold (as % of totex for the price control)	1.0%
Is the claim material?	Yes

We estimate the implicit allowance to be zero because:

- Only a small proportion of our AMP7 costs (those incurred in 2022/23) will be used in the assessment of costs Ofwat makes at the draft determination. The models Ofwat uses for the final determination may include the costs we incur in 2023/24, but these will still represent only a minor share of the costs we will incur annually in the next price control period
- These costs will represent only a minor share of the total base costs in the long modelled period used by Ofwat such that it is unlikely to have meaningful impact on model parameters.
- None of the waste water network plus models proposed by Ofwat in its April base cost modelling consultation included variables to control for P removal costs.
- Oxera's analysis confirms that the consultation models in their current form provide no implicit allowance for ongoing costs of the incremental P removal schemes. This analysis would however need to be updated as more data becomes available over 2023 and 2024.

Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?

[64] Oxera estimate the implicit allowance from the current consultation models to be -£0.71 million over AMP8 (in 2022/23 prices) – which would technically require an uplift to the gross value of the claim. We have, however, assumed an implicit allowance of zero to be conservative.

By basing our claim on efficient costs, as benchmarked against the industry upper quartile, our figures capture any cost savings we can achieve, or that should have been achieved in the past. We cannot think of any offsetting benefits.

Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?

Failure to allow the claim would impose a substantial and unjustified efficiency challenge to the company, over and above the other efficiency challenges which have been separately calculated and justified.

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?

Deferring this expenditure to later regulatory periods is not an option if we are to meet our statutory obligations. These costs represent ongoing costs of running p-removal schemes which have already been accepted by Ofwat at PR19.

If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?

We have not used a modelling approach to calculate the cost adjustment. Attempts to do so have not been successful, as Ofwat confirmed in its base cost modelling consultation.

4.9. Cost efficiency (necessary)

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)?

We have based our claim on the efficient cost, as represented in the annual opex of the upper quartile (as measured by Oxera on the efficiency of AMP7 annual opex[65]). These numbers were derived based on Oxera's analysis of the current table7F APR data (set out in Appendix A1).

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?

The estimate is set out in the accompanying Excel workbook and accompanying Stata do-files and underlying datasets, in addition to being summarised above. All the data on which it is based are derived from companies' annual performance reports.

Does the company provide third party assurance for the robustness of the cost estimates?

Oxera has provided assurance for all the original analysis conducted by them, as well as the subsequent use of their analysis in our estimates of the Gross and Net value of the claim.

Our cost estimates are all sourced from companies' APRs. Whilst we cannot provide assurance on the accuracy of the underlying data on ongoing AMP 7 P removal cost data provided in company APRs, every company's Board confirms the accuracy and completeness of the information it has supplied, including those in its APR. We acknowledge, however, that the table 7F data for various companies are still at various stages of completeness, and that updated estimates would be required as updated data becomes available.

[65] Thus based on efficiency with respect to P removal opex, and not based on efficient company performance as modelled in Ofwat's consultation base cost models.

4.10. Need for investment (where appropriate)

Is there compelling evidence that investment is required?

The investment was approved at PR19.

Is the scale and timing of the investment fully justified?

The scale and timing of the investment was approved at PR19.

Does the need and/or proposed investment overlap with activities already funded at previous price reviews?

These investments are independent of investments made at previous price reviews.

Is there compelling evidence that customers support the need for investment (both scale and timing)?

Customers' views were taken into account in approving the investment at PR19.

4.11. Best option for customers (where appropriate)

Did the company consider an appropriate range of options to meet the need?

Optioneering was carried out when the investment was approved at PR19.

Has a cost–benefit analysis been undertaken to select proposed option? There should be compelling evidence that the proposed solution represents best value for customers, communities and the environment in the long term? Is third-party technical assurance of the analysis provided?

Cost-benefit analysis was carried out when the investment was approved at PR19.

Has the impact of the investment on performance commitments been quantified?

Failure to make the investment will impact the company's performance against the treatment works compliance performance commitment. Other performance commitments may also be adversely impacted.

Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where utilisation will be low?

Optioneering was carried out when the investment was approved at PR19.

Has the company secured appropriate third-party funding (proportionate to the third party benefits) to deliver the project?

Third-party funding and delivery are not relevant to these investments.

Has the company appropriately presented the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?

Assessment of the potential application of DPC was conducted when the investment was approved at PR19.

Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views

Customers' views were taken into account in approving the investment at PR19.

4.12. Customer protection (where appropriate)

Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?

Customers are protected via the treatment works compliance performance commitment, which returns money to customers if the companies' treatment works fail to meet their permit conditions. Other performance commitments may also be adversely impacted.

Does the protection cover all the benefits proposed to be delivered and funded (eg primary and wider benefits)?

Yes.

Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including the mechanism for securing sufficient third-party funding?

Third-party funding and delivery are not relevant to these investments.

Appendix 4.1 – Oxera's analysis of the efficient cost of P removal schemes

The first part of this appendix summarises the average annual opex for sites in the current AMP 7 period (in 2017/18 prices), based on the first year in which they are fully operational (as reported in the Table 7F data).

In short, we estimate annual opex as a scheme's first full year's opex and focus on traditional P removal schemes (separately from catchment areas, which have different cost profiles – as described below). The efficient annual opex is calculated as the upper quartile efficiency benchmark, based on the distribution average scheme AMP 7 P removal enhancement opex across companies for two sub-sets of AMP7 schemes. We conduct this analysis separately for schemes with tight consents (of 0.5 mg/l or less), and those with less tight consents. We also conduct the same analysis considering two different time periods: (i) considering only scheme reporting actual annual opex (and thus already completed by 2021/22) and (ii) considering the broader set of schemes to be completed in the current AMP7 period.

The main elements of our approach are summarised below, and should be read alongside the accompanying Stata do-file (*ANH4.3 – P removal_by site opex benchmarking analysis.do*) and the underlying Excel dataset constructed based on company APR data (*ANH4.4 - stata p-removal_opex benchmarking data.xls*). The sample considered and any necessary assumptions and adjustments made based on the underlying data are as follows:

- **Data set considered:** We consider company APR data as received from Anglian Water as at February 2023. This dataset did not include HDD and we are aware that Ofwat has since requested improvements to company submissions on the data, as submissions were in some places either incomplete and/or inconsistent with values obtained by the Environment Agency (EA) at the time of PR19. The estimates are thus preliminary, based on the best data available at the time (and should be updated as and when updated, more complete table 7F data becomes available).
- **Data adjustments:** We have made minimal adjustments to company APR data – reserved only for instances of clear and obvious reporting errors. This includes: (i) only considering sites that report opex within the AMP7 period, (ii) correcting SRN's seeming misreported capex after 2024/25 (as they seem to have incorrectly reported the aggregate of their earlier AMP 7 capex, instead of the capex still to be incurred after 2024/25), (iii) coding instances where sits report negative opex to zero, and (iv) merging duplicate reported schemes. We also exclude observations that are clearly not individual AMP7 P removal schemes. All these adjustments are clear in the accompanying Excel constructed dataset and Stata do files.
- **Treatment of missing cost-driver data**: Note that we have not made adjustments for incomplete cost driver data (most notably for SVH and YKY, who only seem to report cost drivers for completed sites). Our categorisation of schemes into those with tight consents (<=0.5 mg/l) and not so tight consents (>0.5 mg/l) assumes that all sites that do not report consent levels have not so tight consents.
- **Inflation assumptions:** On a historical basis (2019/20 to 2021/22), we use the ONS CPIH series as used by Ofwat in its latest base cost consultation datasets. For 2022/23, we update the series with the latest available data directly from the ONS. On a forward-looking basis, we forecast the CPIH series from 2023/24 to 2025/26 based on Ofwat's latest draft financial model.
- **Real cost conversions:** We use the actual and forecast CPIH series above to convert companies annual capex and opex costs (as reported in the Table7F APR data) to real values, all in 2017/18 prices. Note that for both the total remaining scheme capex- and ongoing annual scheme capex after 2024/25, we use the CPIH forecasted for 2025/26 to convert values to 2017/18 terms.
- **Identifying catchment areas**: We identified schemes that are clearly catchment areas (or some other type of nature-based solution, treated equivalently here), and treat them separately than traditional P removal sites (discussed above). However, the table 7F data at the time of use did not include an explicit column in which companies indicated whether a site is a catchment area. We thus identified catchment areas based on (i) scheme names (which would in some instances indicate whether a site is a catchment area) and/or (ii) comments in the cost driver columns (where catchment solutions would often have both a backstop and stretch P removal limit, for example). It is possible that some underlying catchment areas, i.e. those that had no indication as such in the data, may have been incorrectly categorised under traditional schemes.

- **Separate treatment of catchment areas and from traditional p-removal schemes**: For traditional sites we take the relevant opex to be the first full year for which opex is reported (as opposed to catchment solutions, where we take the period average – given costs here fluctuate more on a year-to-year basis).
- **Definition of first full year costs**: For traditional schemes, the first full year is taken as either the first or second year in which a site reports opex – depending on which is higher. The assumption is that if opex is lower in year one, this may be due to the fact that the site was only operational for part of that year (and not reflective of full operational costs).

The main results are summarised below for each of the two respective periods and type of consent stringency considered:

- Sites currently operational: This considers all sites reporting opex by 2021/22, thus those delivered so far in AMP7 (in the strict sense). The sample of sites is fairly small – only 83 sites (or 9% of those reported in the table 7F data). We break down annual unit costs by traditional scheme and catchment area, and within traditional by those with tight consents (<0.5 mg / L) and those that do not have tight consents. ANH only has traditional sites, and catchment sites are considered separately given their much higher costs (£681,000 per annum). The table below summarises how ANH site costs compare to the industry average (that is, all site costs divided by the number of sites):

	Traditional sites (all)		**Tight consent**		**Not tight consent**	
	Average annual opex	**Nr of sites**	**Average annual opex**	**Nr of sites**	**Average annual opex**	**Nr of sites**
ANH	0.040	12	0.047	7	0.031	5
Industry	**0.06**	**79**	**0.076**	**24**	**0.054**	**55**
% difference	**-34%**		**-38%**		**-43%**	
Upper quartile			**0.053**		**0.031**	

- All sites expected operational in AMP7: This benchmarks ANH costs to all sites reporting opex by 2024/25, thus all those expected to be operational within AMP7. This sample of sites is much larger: 611, or 66 percent of sites reported. The main results are as follows:

	Traditional sites (all)		**Tight consent**		**Not tight consent**	
	Average annual opex	**Nr of sites**	**Average annual opex**	**Nr of sites**	**Average annual opex**	**Nr of sites**
ANH	0.059	162	0.084	84	0.032	78
Industry	**0.111**	**607**	**0.108**	**207**	**0.112**	**400**
% difference	**-47%**		**-22%**		**-72%**	
Upper quartile		**607**	**0.090**	**207**	**0.034**	**400**

Appendix 4.2 – Oxera's Implicit Allowance estimate

The second part of this appendix summarises the implicit allowance (IA) of Ofwat's proposed wastewater network plus (WWNP) models for PR24 for the ongoing costs of AMP7 P removal schemes over the AMP8 period. We calculate the IA by comparing the triangulated efficient modelled costs for AMP8 with and without ongoing AMP7 P removal costs.

The cost drivers forecasts used for the purpose of the calculation of the IA are exactly the same as those used for the CAC for large sewage treatment works. The different steps of the IA calculation are summarised below (to be read with the accompanying Stata do file named '*ANH4.5 – Implicit allowances analysis.do*' and Appendix 2 of the summary Excel workbook '*ANH4.2 – CAC calculations P removal opex.xls'*):

- **Remove AMP7 ongoing P removal costs** (variable *B0321PRO_SWT)* from companies' SWT and WWNP BOTEX plus in order to run models with and without P removal costs.
- **Obtain coefficients for Ofwat consultation models with and without P removal costs.**
- **Obtain cost driver forecasts for AMP8** (summarised in the accompanying Excel workbook[66]). Depending on the cost drivers considered, three different types of projections have been made, namely:
    - A linear extrapolation of the trend observed over 2011/12-2021/22 for each company with the aim of replicating Ofwat's PR19 approach. This applies to properties, sewer length, total load, pumping capacity, WAD LAD from MSOA and WAD MSOA.
    - When a trend appears ambiguous/less obvious we have retained the 2022 value for the whole duration of AMP8. This applies to economies of scale and treatment complexity variables (WATS, load treated in STWs larger than a p.e. of 100,000, load treated in bands 1-3 and load treated with ammonia consents lower than 3mg/L.
    - When the variable is highly volatile from one year to another, i.e. for urban rainfall, we have extrapolated forward the average observed over the last four years.
- **Estimate Anglian's efficient modelled costs over AMP8 with and without the relevant ongoing P removal costs based on industry cost driver forecasts.** In each case, we apply a UQ efficiency challenge estimated with the last five years of data (2017/18-2021/22) in line with Ofwat's guidance.
- **Calculate the IA for ANH as the difference between AMP8 efficient modelled costs with and without P removal costs.**
- **Convert the IA in 2022/23 prices.**

As shown in the table below, we estimate the IA for ANH from the current consultation models to be -£0.71 million over AMP8 (in 2022/23 prices). That is, ANH would receive a greater allowance if Ofwat's current consultation models did not include the AMP7 P removal enhancement opex over 2020/21 and 2021/22, as is currently the case.

	With P removal	**Without P removal**
ANH efficient predicted costs (£m)	1,823.75	1,824.46
IA (£m)		-0.71

This is the result of changes in the UQ challenge based on the remodelling without the relevant P removal costs, which counteracts (and has a relatively greater effect on) the impact of the marginally lower costs in the models without P removals.

[66] See the accompanying Excel workbook, sheet *Annexes_Oxera calculations>>>A2_Implicit allowance>>add. model inputs and outputs>>Cost driver forecasts* in *ANH4.2 – CAC calculations P removal opex.xls*

Leakage

ANH CAC 5

Document reference	Narrative file: ANH5.1 Leakage		
Title of cost adjustment claim	**Leakage**		
Price control	Water Network Plus	Symmetrical?	YES/~~NO~~
Basis of claim	This cost adjustment claims reflects the additional costs we face to maintain leakage levels (i.e. before any enhancement investment is applied) because of our leading position on leakage compared to other companies.		
Gross value (£m five years)		1,091.912	
Implicit allowance (£m five years)		1,024.314	
Net value of claim (£m five years)		67.60	
How efficiency of costs are demonstrated		Oxera has analysed the leakage cost and performance data reported by companies through Ofwat's information requests during AMP8. This derives an efficient cost to deliver our level of leakage based on industry data.	
Materiality (as % of totex for price control)		2.0%	
How customers are protected		Leakage performance is reflected in the suite of common performance commitments for PR24. Underperformance would result in a financial penalty against this performance commitment.	
Supporting document references		ANH_CAC_5.2 – Leakage regression results ANH_CAC_0.1 Oxera Assurance Statement	

5.1. Need for adjustment

Unique circumstances

a) Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?

We face unique circumstances related to our frontier performance on leakage in the water industry, which is driven by the supply-demand needs of the Anglian region. We have taken action to manage demand as part of the WRMP for multiple AMPs, and a key part of this demand strategy has been leakage reduction. Our continued reduction in leakage has led us to be the water sector's top performer in this area.

The data below from Discover Water shows that in 2021/22 we had the lowest leakage in the industry based on cubic metres per km of main, and lowest WaSC on a litres per property basis. We have held that frontier position in the sector for at least the last decade. https://www.discoverwater.co.uk/leaking-pipes

These unique circumstances were recognised in the PR19 Final Determination. The CMA allowed a cost adjustment claim to reflect our unique circumstances on leakage.

b) 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)?

The cost of implementing and maintaining the leak detection and repair technologies is greater for us as a result of our higher performance. This was recognised in the CMA's Final Determination at PR19 which concluded:

"Since we conclude that there is a link between current performance on leakage and the costs to achieve that level of leakage, then those companies currently performing better than upper quartile are likely to be incurring more cost than will be reflected in the base cost models. 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."[67]

c) Is there compelling evidence of alternative options being considered, where relevant?

This cost adjustment claim is based on a top-down view of costs based on data submitted by companies to Ofwat on base performance and costs. The basis of this cost adjustment claim is therefore drawn from observed costs of leakage maintenance rather than specific options to address leakage. This approach allows us to take an agnostic view to how leakage is addressed for the purpose of this cost adjustment claim.

Management control

d) Is the investment driven by factors outside of management control?

This investment is driven by factors outside of management control. Our strong leakage performance has been driven by the twin track approach to addressing the supply-demand balance and securing water resilience in the driest region of the country[68]. We also face a number of factors in relation to the combination of aggressive soils, extreme weather conditions and vulnerable and aging pipes that create conditions which are unfavourable for

[67] CMA (2021), "Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations", para. 8.59, 17 March.
[68] As referred to in our draft Water Resources Management Plan 2024

driving leakage reduction[69]. We have simultaneously rolled out significant metering and water efficiency measures to reduce demand as well. Therefore, had our strong performance on leakage not been delivered, there would have been a significantly greater risk to water supply in our region.

This can also be shown regressing leakage per km of mains against a range of regional and company-specific factors. Following a general-to-specific modelling approach we derive a model which has an R^2 of over 72 percent (see Table 1). That is, much, but not all, of the variation in leakage can be explained by regional characteristics. This result indicates how initial leakage levels are largely outside of company control. In particular, the variables included in this regression model are either completely outside of management control (such as property density, soil type[70] 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). These include some of our challenging factors (such as dryness of the region, as given by rainfall, and soil type). As stated above, given our unique circumstances, we have taken action to reduce leakage more than other companies over multiple AMPs as part of the WRMP.

Table 1 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: Oxera, based on Ofwat data.

e) Have steps been taken to control costs and have potential cost savings (eg spend to save) been accounted for?

This CAC is based on a top-down assessment using data from companies' submissions to Ofwat. It therefore takes an agnostic view to the measures we are taking to reduce costs.

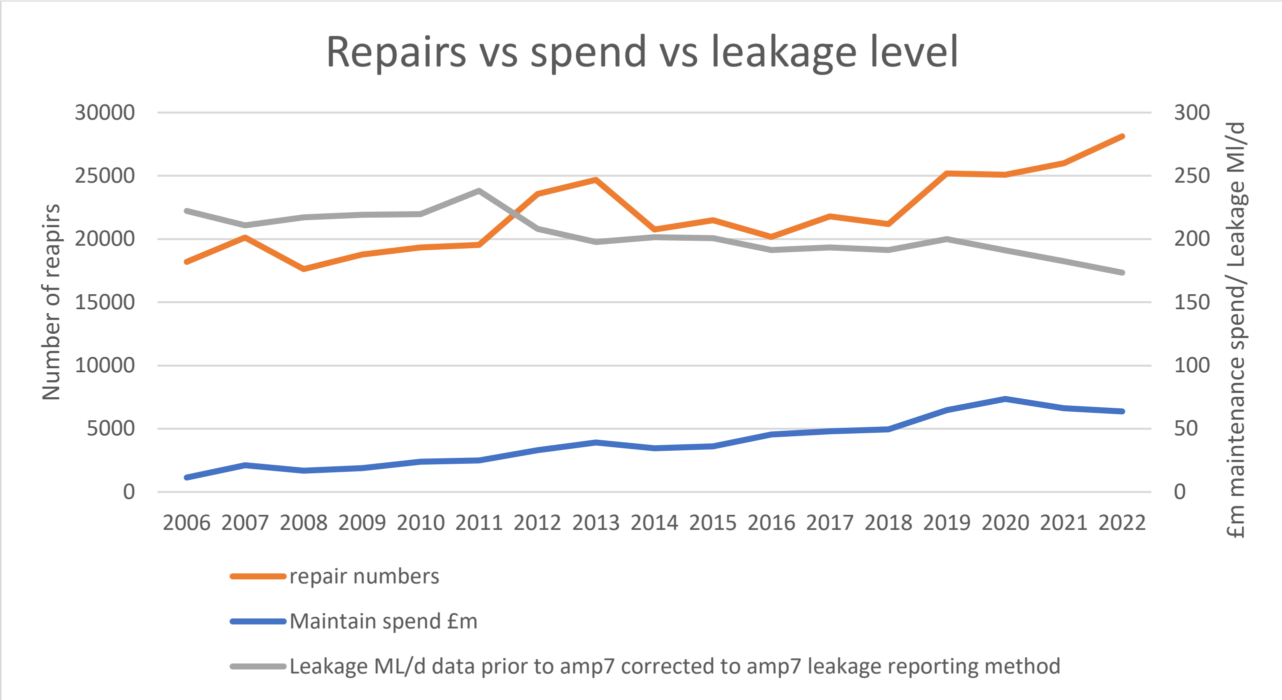
Materiality

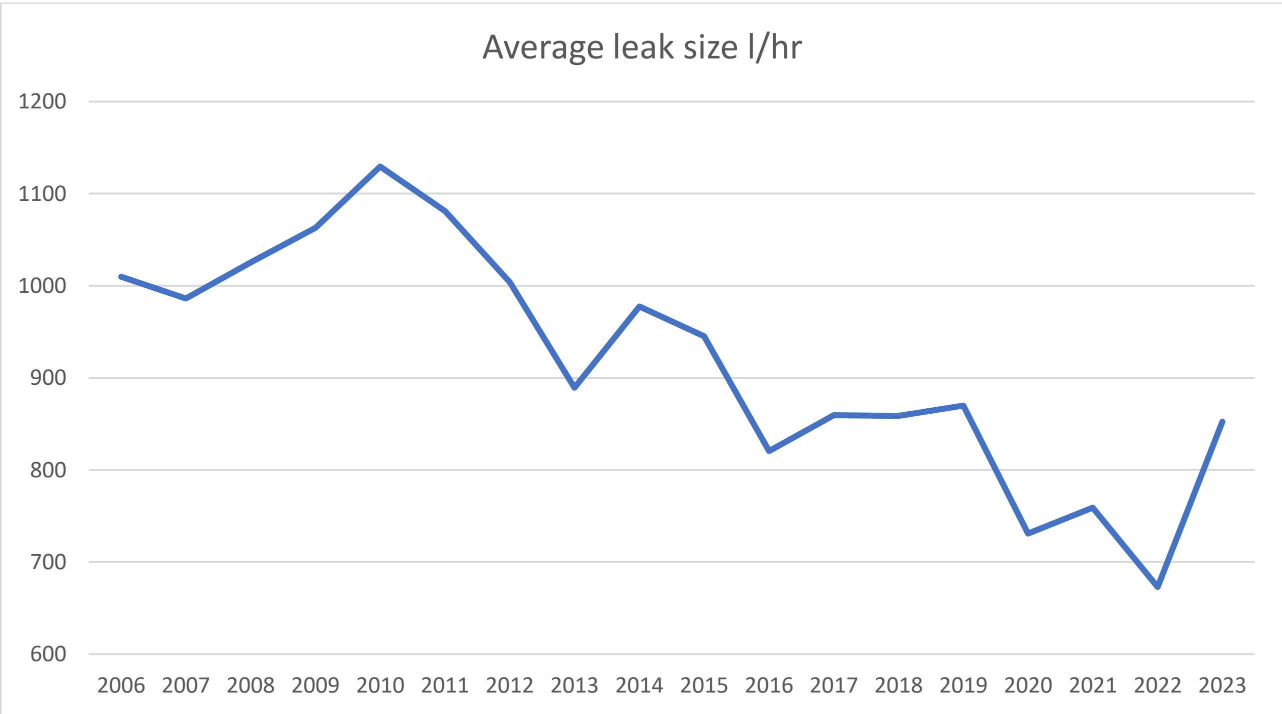
f) Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?

The PR19 Final Determination recognised the cost impact of maintaining lower leakage levels. We have also observed that as leakage levels decrease, there are higher repair numbers, repair costs and the size of leaks to repair gets smaller (meaning more leaks need to be fixed to maintain leakage at the current level).

[69] See Anglian Water response to CMA provision findings. Annex PF014: The impact of environmental factors on leakage in the Anglian Water region

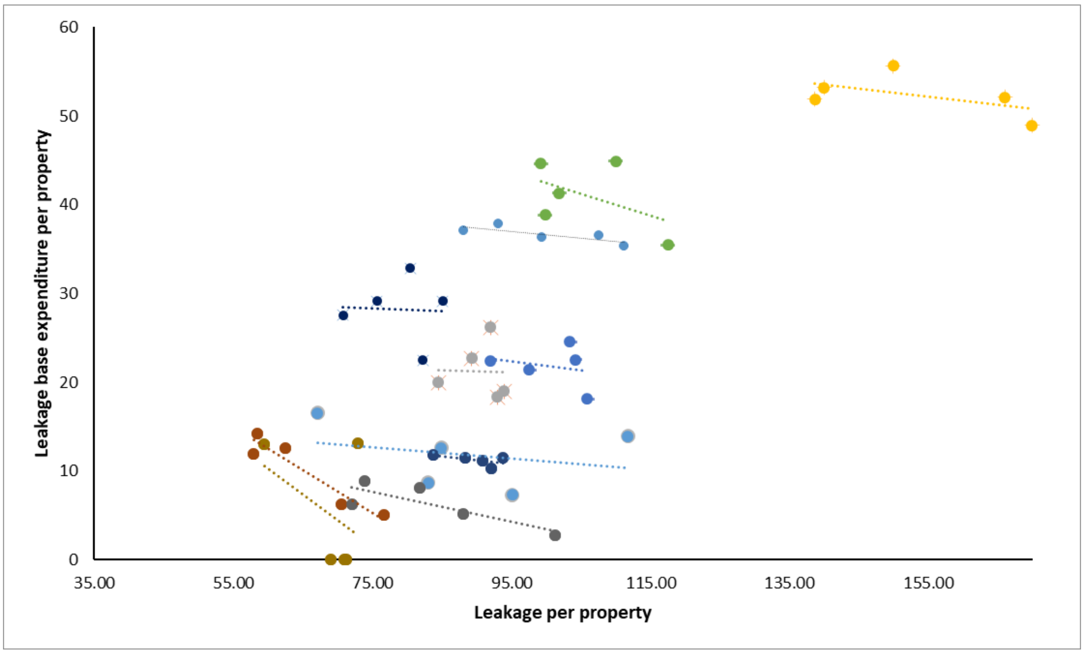
[70] Shrink-swell soil is defined as the combination of argillic/argillaceous and clay-based terrains, whose tendency to shrink and swell as a consequence of rainfall can lead to leaks and bursts in water ducts.





This cost adjustment claim is based on an economic modelling approach which uses the industry dataset for leakage base costs. This data shows that as companies reduce leakage, leakage maintenance costs increase. In the chart below each set of observations of the same colour represents the leakage outturn and leakage expenditure of an individual company for five separate years.

As explained in detail in the following sections, the impact of maintaining frontier performance in terms of leakage volume per km of mains is estimated to be equal to c. 3 percent of total AMP8 wholesale water modelled expenditures, that is significantly above Ofwat's materiality threshold of 1 percent.



g) Is there compelling quantitative evidence of how the factor impacts the company's expenditure?

The impact of leakage on company expenditures can be demonstrated through a number of robust econometric approaches:

1. Controlling for leakage by adding leakage per km of mains as an independent variable in the TWD and WW regression models (and testing for endogeneity);
2. Controlling for leakage by adding leakage per km of mains to the TWD and WW models, but separately assessing the leakage and non-leakage components of TWD (and testing for endogeneity). The latter is modelled as per Ofwat's proposed base models, while leakage costs would be derived by using leakage per km of mains instead of the pumping variables;
3. Utilising "out-of-samples" predictions based on the appended models used in approaches 1 and 2, whereby the performance of a company is compared to that of a hypothetical identical company that is characterised by a leakage performance equal to the median.[71] Once the impact of improving leakage performance by reducing cost efficiency is taken into account, the catch-up efficiency challenge to the UQ is applied.

These three, separate approaches rely on different estimation techniques and are based exclusively on the latest versions of data published by Ofwat in the "PR24 Cost Assessment Master Dataset, Wholesale Water Base Costs v4" and in the Leakage dataset published in April 2022.

As a cross-check, we also update the CMA's approach from the PR19 redetermination. In the PR19 redetermination the CMA estimated the adjustment to base costs for maintaining leading levels of leakage as the percentage of outperformance of the industry upper quartile leakage level[72] multiplied by the forecast costs. (Although, the leakage cost dataset was not available to the CMA at the time of the PR19 appeals).

All the approaches described present consistent results in terms of both the direction and magnitude of the impact of leakage on AWS' expenditures (see below).

[71] The median is selected as it appropriately captures the trade-off between cost efficiency and leakage performance. The trade-off concerns the performance of the entire industry and should not be mistaken for an efficiency challenge.

[72] Leakage performance is calculated as the geometric mean of leakage volume per km of mains and per property connected over the last three years of available data.

Adjustment to allowances (including implicit allowance)

h) Is there compelling evidence that the cost claim is not included in our modelled baseline (or, if the models are not known, would be unlikely to be included)? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?

There is an implicit allowance within the Botex Plus models as all companies have some expenditure on leakage. However, none of the factors in the proposed cost models reflect leakage directly or indirectly. This was recognised in the PR19 Final Determination, and the approach we have taken to developing this cost adjustment claim has focused on taking into account the incremental leakage costs linked to frontier performance which we consider are not reflected in Ofwat's Botex Plus models.

i) Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?

The results from each approach are as follows:

1. Approach 1 (adding leakage per km of mains to the initially proposed models) leads to an increase in the modelled AMP8 allowance of **£61.0 million**;[73]
2. Approach 2 (separately modelling leakage and non-leakage TWD) leads to an increase in the modelled AMP8 allowance of **£68.5 million**;[74]
3. Approach 3 (estimating an out-of-sample prediction based on median leakage performance) leads to an average increase in the modelled AMP8 allowance of **£73.3 million**.[75]

Taking the average across these three approaches results in a claim for maintaining a leading level of leakage of **£67.6 million**, above the materiality threshold of 1 percent.

These estimates are below the outcome from using methodology used by the CMA in the PR19 appeal, which produces an adjustment claim of **£81.2 million**. This is based on our current outperformance rate of 21.8 percent (calculated over the years 2019/20-2021/22), which is similar to the CMA's forecast of 21.7 percent,[76] which was based on the stretch in the relative PC performance in 2019/20. At PR19 this methodology resulted in a £42.6 million increase in base allowance (£50.3 million in 2022/23 prices),[77] whereas the current forecast of £374 million in base leakage costs leads to an adjustment claim of £81.2 million.

Lastly, the change in total allowances deriving from the suggested adjustments is symmetric at the industry level. Looking at the historical period used in our analysis (2018-2022), the industry's total triangulated wholesale modelled costs decrease by **0.04 percent** in the case of approach 1. and by **0.8 percent** in the case of model 2.

We based the symmetry of the adjustments on the results derived from AMP7 historical data, as the exact impact on forecast years is expected to evolve with continuous updates of the cost drivers forecasts and the CAC consultation. AMP8 forecasts for leakage across the industry are particularly uncertain, given the different starting positions, the impact of regional factors and management focus.

[73] Similar results are obtained when using leakage per connected property or the geometric average of the two measures.
[74] Again, the results are consistent when using alternative measures.
[75] In particular, the adjustment is equal to £67m and £80m when based on Approaches 1 and 2 respectively.
[76] CMA (2021), "Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations", para. 8.78, 17 March.
[77] This is based on inflating the CMA's £42.6m figure by 18.06% to 2022/23 prices. Source: CMA (2021), "Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations", para. 8.78, 17 March.

j) Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?

The modelled approach we use takes implicit account of the impacts of leakage on our overall costs (positive and negative).

k) Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?

By developing this cost adjustment claim using only base cost data and focussing on those costs which are not covered by Ofwat's base models, we exclude any costs which are covered by either the base models or enhancement allowances. The cost adjustment claim therefore presents the leakage costs that are not covered by other cost allowances in the round.

l) 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?

We have taken a long-term view of our required leakage base costs. There is a continued need within our WRMP to continue to drive leakage down. This will require both base allowances to maintain the level of leakage we have previously achieved and enhancement expenditure to drive leakage down beyond the leakage level we have already reached.

m) If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?

In Approach 2, we substitute the pumping activity variable with leakage when modelling leakage-related TWD costs, as it provides a more direct operational driver. However, given the absence of any leakage-related variable in the original models, our cost adjustment claim incorporates the costs associated with leakage reduction in a way which the base models will simply assume to be inefficiency. The analysis carried out by Oxera shows that part of what the base models will assume to be inefficiency in fact reflects the costs associated with maintaining a lower level of leakage than other companies.

5.2. Cost efficiency

a) 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 cost efficiency of the estimates is supported by the range of cost models we have tested in order to reach the value of this CAC. The analysis can easily be replicated and the supporting files shared if needed. The data used in the analysis comes from both v4 of the wholesale water base cost dataset and the leakage dataset published by Ofwat following the April 2022 data request. Since the latter only covers the period 2018-2022 and the data from the two sources is used jointly, the timeframe of the analysis has been reduced to the five-year period 2017/18-2021/22.

The whole process for each of the estimates provided and the different steps undertaken are outlined below.

For approaches 1 and 2 we control for leakage by adding leakage per km of mains and compare the result of the models with and without this variable, thereby following one of Ofwat's suggestions for calculation implicit allowances.[78] In particular the steps involved are as follows:

1. In the case of Approach 1, Ofwat's proposed TWD and wholesale models for PR24 are estimated with leakage per length of mains as an additional cost driver. In the case of Approach 2, the same analysis is performed but separately assessing the leakage and non-leakage component of TWD. The analysis period in both approaches was restricted to 2018–22 due to the limited availability of leakage data;
2. Computation of an upper quartile efficiency challenge for each of the two scenarios, based on the last five years of data, as per Ofwat approach in PR19.
3. Production of 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 these variables 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.
4. Computation of AMP8 predicted costs for each scenario, using the estimated regression coefficients derived in Point 1 and cost drivers forecasts derived in Point 3. The same triangulation process as Ofwat's was applied, i.e. first derive modelled costs for each sub-model and then average them.
5. Subtract from the costs predicted at Point 4 the predicted costs derived from Ofwat's original models, so as to get the net value of the claim.
6. Apply the historical upper quartile efficiency challenge computed in Point 2 to the claim figure estimated at Point 5 so as to obtain the final efficient net value of the claim.

In the case of Approach 3:

- The starting point coincides with the econometric models developed in Approaches 1 and 2;
- Instead of comparing the modelled allowance once leakage is added as an additional independent variable, an hypothetical company identical to AWS is constructed, the only difference being that its leakage performance corresponds to the industry median;
- The upper-quartile efficiency challenge, based on the last five years of data, is applied.
- The CAC is then calculated as the gap in AWS' modelled costs and the costs modelled for the hypothetical company that has a median leakage performance, thus representing the additional costs due to above-median leakage performance.

We also tested for endogeneity in the regression models once leakage is added as an independent variable. Consistent with standard econometric practice, we performed the Durbin-Wu-Hausman test to ensure that endogeneity was not undermining the validity of the claims—the results show that endogeneity is not an issue.

[78] Ofwat (2022), "Appendix 9 Setting expenditure allowances", para. A.1.3.1, December.

The various models proposed all present similar results, and the CAC figure is hence based on the average of the three.

b) 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?

All the data used in the analysis is the latest version of datasets published by Ofwat, while the few assumptions made in the analysis are clearly stated and assessed.

c) Does the company provide third party assurance for the robustness of the cost estimates?

Our cost estimates were developed independently by a third party provider (Oxera).

5.3. Need for investment

a) Is there compelling evidence that investment is required?

There is an expectation among customers, and a requirement in our WRMP, to reduce leakage further in AMP8. Whilst enhancement allowances are expected to cover the required reduction in leakage, we will also face higher costs to maintain the base level of leakage that this reduction builds upon. This makes the ongoing activity to maintain leakage essential to ensure further reductions in leakage can be made.

b) Is the scale and timing of the investment fully justified?

The scale and timing of the investment for this CAC is fully justified as it reflects the costs of maintaining the current level of leakage before any improvement is made. Without the cost allowances in the CAC we would expect leakage performance to deteriorate, putting at risk our supply-demand balance and going against a key customer priority.

c) Does the need and/or proposed investment overlap with activities already funded at previous price reviews?

There is no overlap with funding from previous price reviews. At PR19, we were allowed a cost adjustment claim on the same basis that this one is being made – i.e. to reflect the costs of maintaining leakage performance at a better level than other companies. These ongoing costs remain and we remain a top performer on leakage, and so the basis of that claim means it is still a valid one to make at PR24. Enhancement allowances were made at PR19 to reduce the level of leakage in AMP7, but the costs reflected in this cost adjustment claim only reflect the allowance to maintain leakage levels, not for leakage improvement.

d) Is there compelling evidence that customers support the need for investment (both scale and timing)?

Our customer engagement has shown that leakage control is a top priority for customers, so leakage reduction has been a big focus of our efforts to manage demand as part of the WRMP. To achieve further leakage reduction, as supported by customers, necessitates carrying out the activities required to maintain the level of leakage that we have previously achieved. As this cost adjustment claim is required to deliver the costs of this leakage maintenance, it is clear that customers support the scale and timing of this maintenance activity.

5.4. Best option for customers

a) Did the company consider an appropriate range of options to meet the need?

This cost adjustment claim is not explicitly tied to delivering leakage maintenance through specific means, instead using the data available to Ofwat to present the efficient additional costs presented by us to maintain leakage levels compared to other companies. The nature of this claim is therefore agnostic to the options that we will use to maintain leakage levels. However, it has been recognised that our performance levels mean that we have to implement additional measures to maintain leakage levels that other companies do not have to deploy.

As the industry leaders on leakage performance, we are constantly innovating with new leak-detection technologies such as thermal imaging drones (which identify differences in soil temperature which could be caused by water escaping from a pipe), acoustic noise logging, satellite imagery and analytics and smart meters to help locate otherwise elusive leaks in a time- and cost-efficient way.

We have a pressure calming programme to reduce leakage, reduce pressure transients and prevent mains bursts. In collaboration with Cranfield University, we developed a predictive forecast model to assess where burst water mains are likely to be observed based on environmental data science modelling of weather, soil, and infrastructure variables.

Leak detection allows us to prioritise repairs and fix small leaks early before they result in burst pipes, disrupt supply and become more costly to fix. Such solutions are more costly in the short term but cheaper in the long-term. After a leak is detected, technicians will investigate and repair. Our Integrated Leakage and Pressure Management provides a visualisation platform for the whole leakage process, including from effective targeting of high areas of leakage, deployment of field resources and resolution. Controlling leaks is therefore a combination of labour (e.g. technicians) and technology (e.g. noise loggers).

b) Has a cost–benefit analysis been undertaken to select proposed option? There should be compelling evidence that the proposed solution represents best value for customers, communities and the environment in the long term? Is third-party technical assurance of the analysis provided?

As set out above, the nature of this claim is agnostic to the options that we will use to maintain leakage levels. We deploy a range of prevention, awareness, location and fixing methods to ensure we deliver a portfolio of leakage control which represents good value for customers, communities and the environment. Through the approach we have taken to developing the costs for this claim, using data provided by all companies to Ofwat, we have put forward a cost adjustment claim which is benchmarked to ensure we are putting forward a cost adjustment claim which represents efficient expenditure.

c) Has the impact of the investment on performance commitments been quantified?

This investment will have an impact on the leakage performance commitment. Allowance of the amount requested would (along with the base implicit allowance) reflect the costs required for maintenance activity required (alongside the enhancement allowance) to deliver the leakage performance commitment level. If the cost adjustment is not allowed or partly allowed, we would expect to see a deterioration in leakage performance (notwithstanding any leakage-impacting enhancement allowances which are granted).

d) Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where utilisation will be low?

N/A

e) Has the company secured appropriate third-party funding (proportionate to the third party benefits) to deliver the project?

N/A

f) Has the company appropriately presented the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?

No, as this cost adjustment claim covers activities which take place across our water supply network, it is not a discrete activity which would be suitable for delivery through a third-party through DPC.

g) Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views.

This cost adjustment claim considers the efficient cost for maintaining leakage levels using a top-down econometric approach rather than the costs of delivering specific solutions to maintain leakage levels.

5.5. Customer protection

a) Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?

Customers are protected from the cancellation, delay or reduction in scope of this investment by the common performance commitment on leakage. If any of the leakage benefit within the scope of this cost adjustment claim or any leakage enhancement is not delivered, this will result in a greater penalty against this performance commitment.

b) Does the protection cover all the benefits proposed to be delivered and funded (eg primary and wider benefits)?

The common performance commitment and associated ODI are directly linked to the purpose of this investment (i.e. delivery of funded leakage levels).

c) Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including the mechanism for securing sufficient third-party funding?

N/A

Boundary box replacements

ANH CAC 6

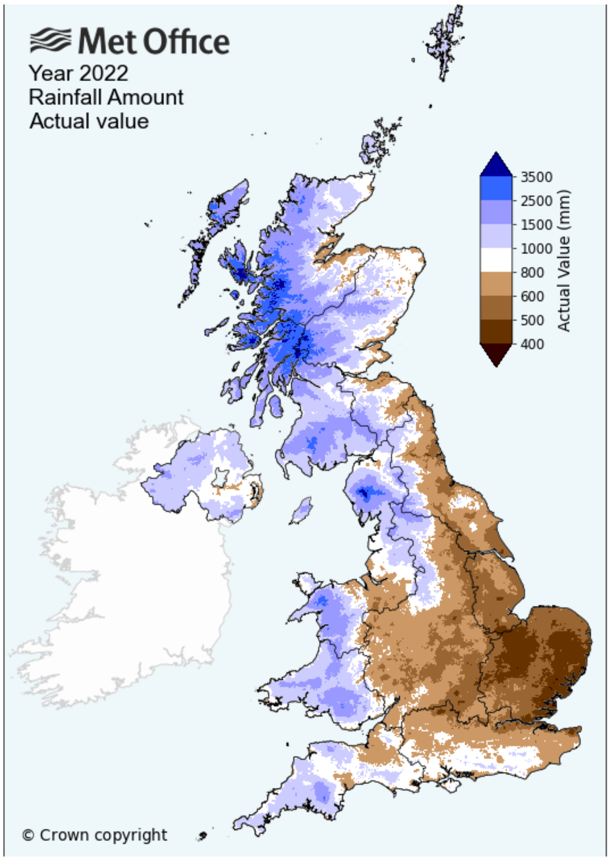
Document reference	Narrative file: ANH_CAC_6.1 Boundary box replacements		
Title of cost adjustment claim	**Boundary box replacements**		
Price control	Water Network Plus	Symmetrical?	~~YES~~/NO
Basis of claim	We were an early adopter in significantly rolling out metering. The housing of these meters have a limited asset life and see deterioration over time due to factors such as ground movement. Because we installed meters earlier than other companies we are now experiencing higher rates of failure (and thus the cost to repair and replace) of this meter housing. We expect these volumes to materially increase in AMP8. This cost adjustment claim reflects our expected costs to resolve this increasing volume of failures. Cost recovery for this activity could be reflected through an upfront cost adjustment claim, or through a true-up mechanism where costs are recovered ex-post on a unit rate basis.		
Gross value (£m five years)		155.4	
Implicit allowance (£m five years)		17.4	
Net value of claim (£m five years)		138.0	
How efficiency of costs are demonstrated		The unit rate is derived from market testing of costs from potential suppliers of boundary box replacements. We have assumed a further efficiency challenge on the basis of economies of scale.	
Materiality (as % of totex for price control)		4.1%	
How customers are protected		Customers would be protected either: Through a price control deliverable mechanism if this activity is treated as a cost adjustment claim or; Allowances only being made upon delivery of replacements if this activity is treated as an uncertainty mechanism.	
Supporting document references		ANH_CAC_6.2 – Meter penetration analysis ANH_CAC_6.3 – Boundary box failure analysis	

6.1. Need for adjustment

Unique circumstances

a) Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?

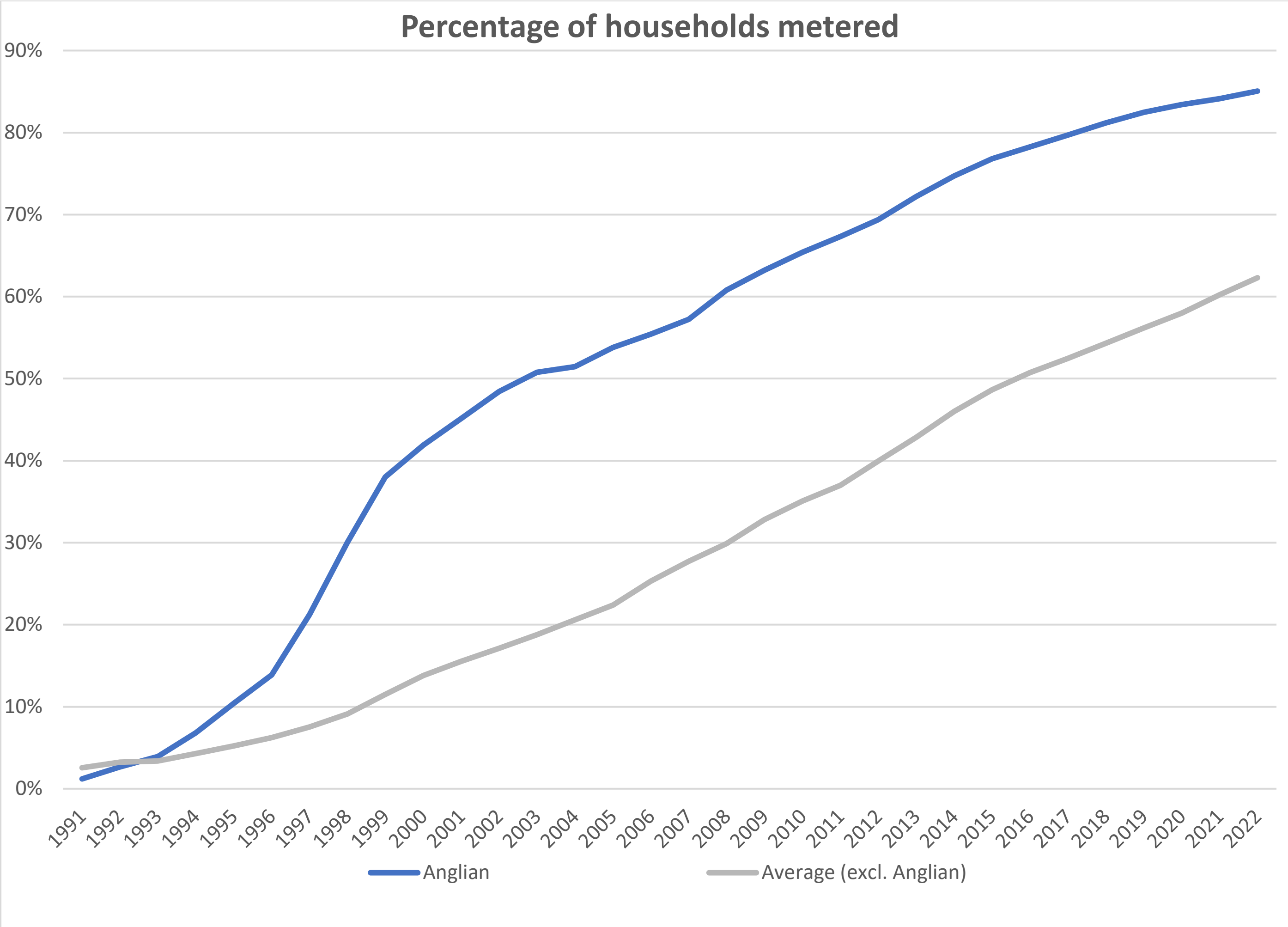
We operate in the driest region of the UK. It has been recognised for multiple AMPs that this puts particular strain on the supply-demand balance compared to other companies. This can be seen by the 2022 rainfall amount as summarised by the below map from the Met Office[79].



It is because of this that we have historically sought (and continues to seek) ways to ensure security of supply to customers whilst protecting the environment and being appropriately prepared for future supply-demand stresses from climate change, population growth and the need for greater environmental protection. This has required a twin-track approach of supply and demand side measures. There has been a historical preference to make sure that we make the most of demand-side measures to address the supply-demand balance. One of the ways to do this was to be the first mover on implementing the large scale rollout of meters to allow customers to be charged based on their water usage and support the implementation of incentives to improve water efficiency in homes and businesses (alongside a programme to drive down the leakage frontier for the industry). By the year 2000, we had reached a meter penetration rate of 42%. This compares with a rate of the next highest company of 23% and an overall industry average (excluding Anglian) of 14%.

The need for these measures within the Anglian region has been recognised for a long time, and thus we were the first WaSC to install meters on a large scale across our customer base.

[79] We included the same map in our base cost modelling submission.

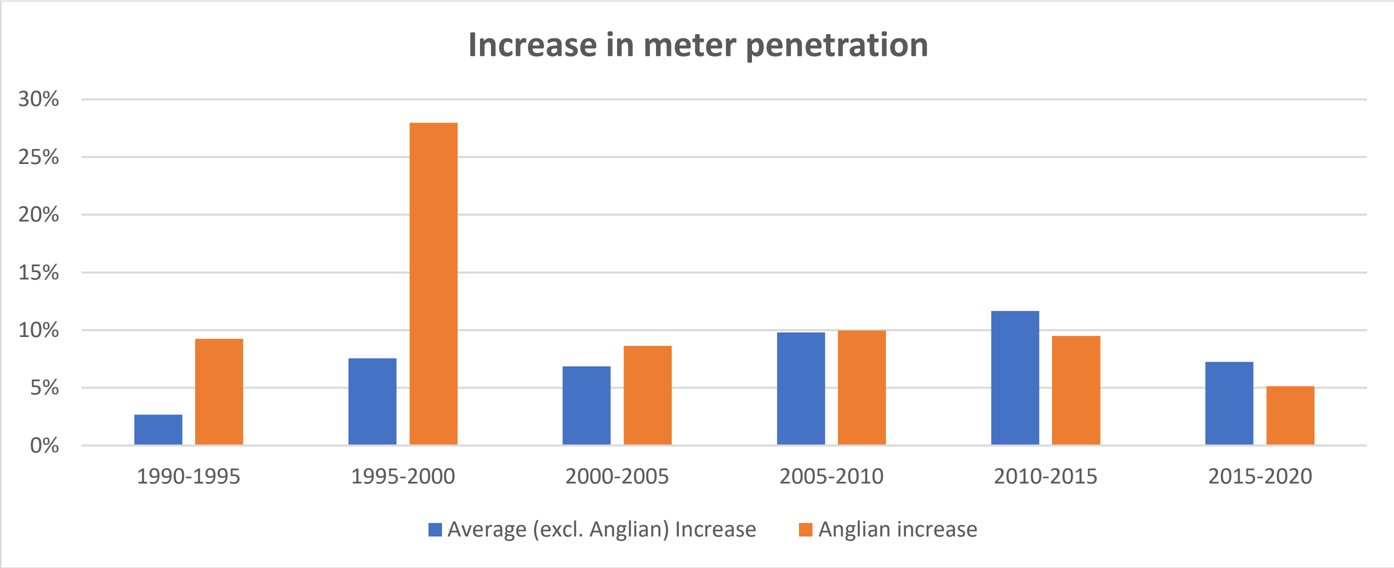


Within our region most water meters are located within a boundary box at the edge of a customer's property. This enables easy access to the meter, allowing them to be read. As with all assets, these boundary boxes have an asset life at the end of which, one would expect it to be replaced to avoid negative customer impacts such as leakage.

Due to the combination of high meter penetration, early installation of meters beginning in AMP1 (10% penetration by 1995 and 42% by 2000, compared to an average of 5% and 14% for other companies respectively) and their housing, and the asset life of these boundary boxes, Anglian is in a unique position of seeing higher maintenance costs than other companies for the replacement of these boundary boxes in AMP8.

This is a new cost adjustment claim for PR24 (i.e. it has not been requested in previous price reviews) because the above factors are coming together at this particular point in time to lead to a significant increase in boundary box replacement in AMP8 compared to AMP7 and previous AMPs. Given that Anglian was the first company to install these assets at a large scale and other companies have subsequently seen an increase in their meter penetration, we would expect some other companies to be in a similar position in future AMPs.

Whilst boundary box replacements are a cost that we expect to see increase across the industry as more of these assets reach the end of their expected lifespan (c. 30 years), Anglian faces unique circumstances in AMP8 because of the significant early rollout of meters (and their boundary boxes) in the late 90s. Furthermore, this is not a cost which balances out over multiple AMPs because Anglian still has a meter penetration rate which is c. 20 percentage points above the industry average. This is illustrated in the chart below, showing the increase in meter penetration over each five year period since 1990 (using the same data as the chart above). The blue bars show that boundary box replacements are likely to increase in future AMPs with Anglian's rate broadly following the industry for installations after 2000, but before then Anglian faces a significant increase in replacements as those installed before 2000 reach the end of their asset life.



As set out later in this cost adjustment claim, we are already experiencing increasing boundary box replacement volumes in AMP7 as those boundary boxes installed in the early 90s reach the end of their asset life. Based on the installation dates above, we expect a further significant increase in AMP8.

b) 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)?

We have considered the costs that all companies face in relation to the installation and maintenance of meters. Our early installation programme for example means that in recent AMPs and in AMP8, we will face lower costs than other companies for new installations due to smaller volumes of new meter installations being needed. However, this is reflected in lower enhancement scope allowances for new meter installations.

Compared to other companies that have higher meter penetration, we face higher efficient costs because of the initial timing of meter installations (i.e. there is a period between meter installation and the boundary box reaching the end of its asset life where no maintenance costs are required to replace the boundary box). Boundary boxes have an expected asset life of 25-30 years, and so we are now experiencing a significant increase in the number of boundary boxes that need replacing as we reach 25-30 years after the initial installation of these boundary boxes.

c) Is there compelling evidence of alternative options being considered, where relevant?

We have carefully considered the different options available to us to manage the costs associated with maintenance of meters and their chambers, both upon initial installation and when the boundary box fails and needs replacing. These options typically come down to a) where the meter is located and b) the material that is used to house the meter.

Meter location

The key causes of boundary box failures include their exposure to the surrounding environment, deterioration of the boxes in line with their expected asset life, and impact from other external factors such as traffic. The alternative option to externally located meters would be to house meters internally within the customer's property. This would limit the exposure of the boundary box to the strains which cause them to fail and ultimately increase the expected life of the asset. However, this must be considered alongside the other impacts this would have and the context within which meters were first installed.

Historically, meters have been located externally for a number of reasons:

- In 1995, our increase in meter penetration was brought about by high customer demand for switching from unmeasured to measured charges. This meant that the meters being installed were at existing properties

with existing infrastructure in place (external stop taps, a communications pipe from the main to the stop tap and a customer's supply pipe from the stop tap to the property.)
- The ability to be able to monitor the supply pipe for leakage. Having an external meter allows this.
- Manual meter reading of an external meters is less expensive and disruptive to our customers than having to gain access to read an internal meter.
- Future meter replacement costs are significantly cheaper for external meters than for internal ones.

Further to this, internal housing would have led to much greater direct interruption to customers (and indirectly – higher costs) for smart meter installation. Overall, in the vast majority of cases, housing meters externally rather than internally offers greater adaptability and greater value to customers.

Meter housing material

When installing a new meter externally, there are four baseline options: high density plastic (HDP) boundary boxes; wall mounted meter boxes; cast iron and; composite chambers. Which casing is installed depends on a number of factors including the cost to install, the expected asset life and associated maintenance costs. As well as these direct cost related factors, the adaptability and level of regret associated with each option needs to be considered.

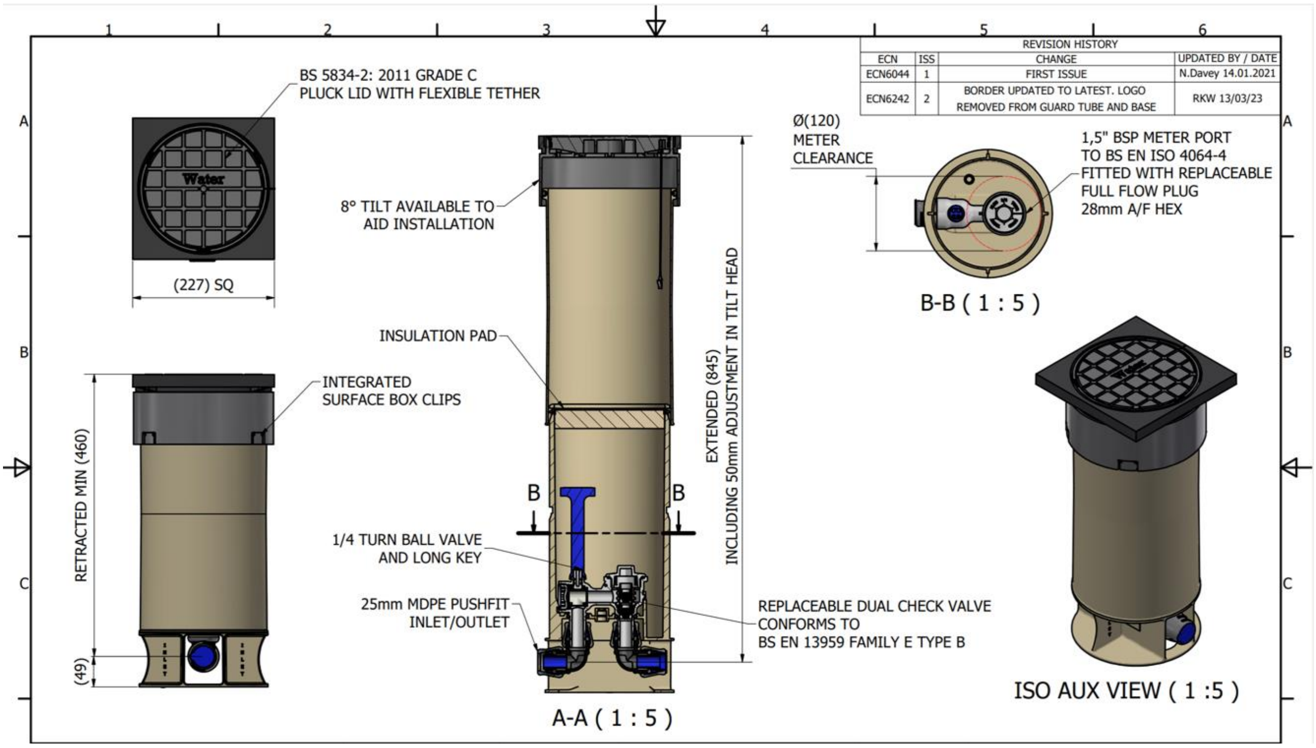
	HDP boundary box	**Wall mounted meter boxes**	**Cast iron chamber**	**Composite chamber**
ROM cost to install/ replace	Reactive: £1,011 Proactive: £965 Avg: £987	N/A – installation infeasible due to incompatibility with smart metering (see below)	N/A – installation infeasible due to incompatibility with smart metering (see below)	£8,738
Expected asset life	25-30 years			30-40 years
Compatible with smart metering?	Yes	No - Current versions do not have enough space in them to accommodate smart meters	No – smart meter signal would not be able to pass through cast iron, and boxes are too small to house a smart meter (therefore requiring a retrofit)	No –signal would not be able to pass through. This can however be mitigated by using a plastic rather than metal lid.
Additional Benefits	• Small excavation footprint • Use of recycled material • Ease of installation and adjustment to surface type			• Security of cover (locakable)
Overall level of regret	Low	High	High	High

As the table above demonstrates, whilst cast iron and composite chambers have longer asset lives, they have higher installation costs and crucially are less adaptable than HDP boundary box. This is particularly important with the rollout of our smart meter programme. For example, had we installed cast iron chambers for meters, they would have needed to be replaced well before their expected asset life with a chamber that allows smart meter capability to be exploited – thus resulting in a much higher whole life cost.

We have the option to replace the HDP boundary boxes within which meters are housed with an alternative boundary box upon failure. On the basis of the analysis above, we have decided against this. Cast iron chambers are incompatible with smart meters which during AMP8 will cover over 50% of our meter stock and over 95% by the end of AMP8. Composite chambers would significantly increase the size of this cost adjustment claim at a price review where there is already a very large capital programme and significant pressure on customer bills – and would present a higher regret option should technological developments in metering in future AMPs mean that these assets become redundant or need replacing early, as would have been the case if we had initially installed meters within brick built chambers on initial installation.

Retrofitting of wall mounted boxes at existing properties, whilst technically possible, would create additional future risks. Replacing a meter in an existing boundary box with one in a wall mounted box in another location requires locating the entry point at the property, and two excavations to remove the old box and install the new one, increasing the cost significantly. Wall mounted boxes are also predominantly made out of HDP and do not offer a significantly longer asset life.

The image below provides an illustration of what an HDP boundary box looks like:



Management control

d) Is the investment driven by factors outside of management control?

In a long-term context, this investment is driven by the combination of high meter penetration being reached by Anglian and the asset life of HDP boundary boxes. The high meter penetration was achieved in response to the supply-demand needs of the Anglian region. This is driven by factors such as climate and population growth which are outside of Anglian Water's control. In a shorter-term context, this activity is driven by assets which are known to have failed either from a customer contact, a leak, low pressure, supply interruption or a meter being inoperable. This means that we have to respond to failures quickly.

e) Have steps been taken to control costs and have potential cost savings (eg spend to save) been accounted for?

The decision on which type of boundary box to install and therefore the asset life of the boundary boxes is within management control. However, the decision on the boundary box to choose was taken with the long-term costs and benefits in mind (see 1c).

We have also taken broader consideration of savings options including:

- Options to repair rather than replace boundary boxes
- Actions to increase the life of boundary box assets
- Options to maximise the value of the boundary box replacements
- Potential to reduce costs through economies of scale
- Planned Repair Programme for boundary boxes to reduce customer impact and improve efficiency of delivery.

Options to repair rather than replace boundary boxes

Whether a boundary box needs to be replaced or repaired (or replacing only part of the asset) depends on the failure mechanism of the boundary box. The most common types of failure which provide the opportunity for a repair over replace resolution are that of the lid, external casing, pipe work or the meter spindle.

The table below sets out the options that are available to us to address any of these failures.

	Option 1	Option 2	Option 3
Lid	Minor Split or wearing to the lid surface: **Repair lid**	Damaged Lid Seal: **Replace Seal**	Cracked/Broken Lid: **Replace Lid**
External casing	Misaligned Upper or Cracked Surround: **Reseat or Repack**	Damaged Upper (cracked or crumbling): **Replace Box**	Collapsed Box Casing or significant structural failure (e.g the base): **Replace Box**
Pipe work	Leaking Inlet/Outlet Join: **Tighten or Replace fitting**	Leaking Ball Valve or Double Check Valve: **Replace the Valve**	Split Internal Pipe or Hole in Moulded Internal Pipe: **Replace the box**
Meter spindle	If Light Wear and Tear: Look to **repair or replace spindle** (depending on box type)	Spindle Stripped or Significant Structural Deterioration: **Replace the Box**	Spindle Cracked, Split or Broken: **Replace the Box**

In the case of each failure, we will progress with the best value option, rather than a one-size fits all response of replacing the entire boundary box. This triage approach resulted in *circa* 8,300 boundary boxes being repaired rather than replaced in 2022/23. This cost adjustment claim refers only to the costs required where the appropriate response to a failure is to replace the boundary box (i.e. where a failure can be fixed by a repair, we are assuming all of these costs to be part of the implicit allowance from the botex models).

Increasing the life of existing meter assets

As a means to limit the cost impact of boundary box maintenance, we have considered if there are options to extend the life of assets to allow phasing of replacements. As the assets are highly dispersed, taking actions which can increase the asset life of boundary boxes is not possible. The factors that drive the failure of assets are also outside of management control including the soil type and geology of the earth surrounding the boundary box.

Maximising the value of boundary box replacements

Given the scale of the meter rollout undertaken by Anglian, we have recognised that the maintenance of these assets will be an important base cost driver in future. Therefore, we have taken an active role in the development of boundary boxes to ensure that we can maximise the value of the new boundary boxes that we install (e.g. by ensuring the asset life of the new box increases over time).

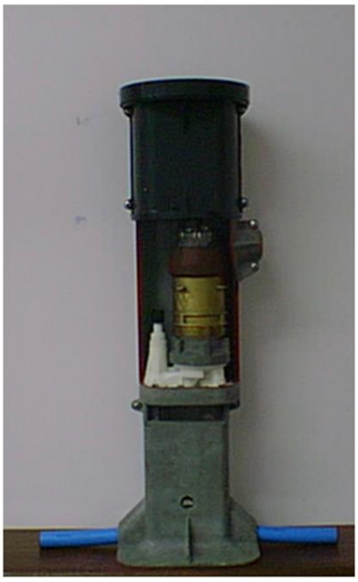
To this end, we have worked with suppliers on the development of technical changes and product development, this learning then formed the basis of the testing criteria for the re-let of the boundary box framework. As illustrated by the tables below the test criteria were broken into three headline categories of Installation, Usability and Maintenance with each supplier being assessed against the questions within each category.

Boundary Box Product Trial Scoring
20 questions: all to be given a score between 0 to 10 (with 10 being the highest score)

[redacted]

[redacted]

Where we replace HDP boundary boxes in AMP8, these will be third-generation boundary boxes which have improved capabilities from previous first, second and third generation models pictured left to right below. We will continue to further develop the solutions moving forward.



Notable updates in design between generations of box:

- Generation 1 to Generation 2:
    - Improved material used for body of the box itself, less brittle
    - Improvement to the internal manifold and non-return valve structure.
- Generation 2 to Generation 3:
    - Significant re-design to the box casing to allow for greater flexibility in depth of installation
    - Improved materials used in construction
    - Addition of the supporting lip around the lid to improve stability of the box and reduce movement once installed
    - Change to push-fit connection increasing flexibility of installation and reduces risk of leakage on joints over previous models
    - Updated internal manifold with improved materials and functions.

Economies of scale

The extent of metering in the Anglian region shows that the scale of the need for maintenance relating to boundary boxes to be a large scale investment. We therefore consider that whilst the scale of capital maintenance will increase, the unit cost should decrease compared to the past when fewer replacements were made. Some examples of these opportunities are bulk purchase of materials, improved scheduling of jobs to reduce travel time and opportunity to introduce one-stop end-to-end (E2E) delivery. The increase in the work basket has also unlocked the potential to approach delivery of the replacements in new ways so as to make the most of the scheduling and E2E opportunities in particular, see Planned Repair Programme detail below.

We have applied a unit cost which is not based on the costs we are currently seeing and have seen historically but have built in an efficiency assumption around economies of scale (see table below).

Historic unit cost	£1,011/ replacement
CAC unit cost (with economies of scale)	£649.45/ replacement

Planned Repair Programme

Recognising the increasing scale of the boundary box replacement volumes and the challenges this presented, even when taking into account economies of scale, we have recognised that the delivery model needed to be expanded. To this end in 2021 a new process under the title of *Planned Repair Programme* was developed on the principle of batching work together so as to more efficiently deliver it in a planned and programmatic way. The figure below expands on how this founding principle was further developed and the productivity benefit realised to date, which contributes to the efficiency of the wider boundary box replacement workbasket.

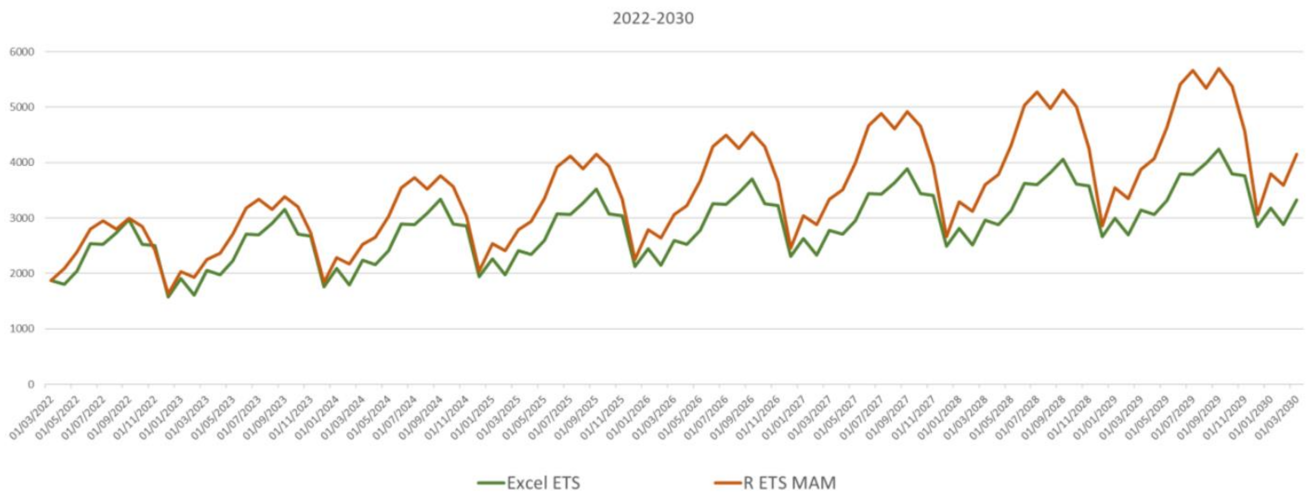
Materiality

f) Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?

We have analysed the actual number of boundary box replacements required in AMP7 to date and the expected replacements needed in AMP8 to understand the scale of replacements expected in AMP8 and future AMPs. Using data on expected failures from the date of meter installation, the expected asset life of 30 years (see q1a 'increase in meter penetration' chart[80]), the observed increase in boundary box failures in AMP7 and statistical trend analysis of likely failures in future years, we expect to see a material increase in the number of replacements required in AMP8. The

[80] Note that we do not expect the number of replacements to exactly mirror the number of installations from 30 years ago, as while the expected asset life is 30 years, the observed asset lifespan will be a spread around this figure (i.e. some will fail earlier, and some later than 30 years)

chart below shows the expected forecast increases of replacements using statistical analysis carried out by Aecom. The estimated number of replacements required in AMP8 is 239,331.



g) Is there compelling quantitative evidence of how the factor impacts the company's expenditure?

The observed average costs to replace each failed HDP boundary box is £987 per replacement (see q1c ‘meter housing material’ table). With the increase in volumes expected in AMP8, and the potential this provides for more proactive replacements and potential economies of scale we aim to reduce this unit rate to £649.45 per replacement. This gives an expected expenditure requirement of £155.4m in AMP8 (the gross value of this cost adjustment claim) – a significant additional driver of expenditure in AMP8.

Whilst there is uncertainty over the precise number of failures we will see in AMP8, the direction of travel based on the engineering and economic rationale around expected asset lives of meters installed in the 1990s is clear.

Adjustment to allowances (including implicit allowance)

h) Is there compelling evidence that the cost claim is not included in our modelled baseline (or, if the models are not known, would be unlikely to be included)? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?

The cost drivers for the base models are not expected to include factors which reflect the scale of meter penetration for each company, nor do any of the cost drivers which are likely to be included in the base models indirectly reflect the variability between companies of the cost drivers that are increasing our costs for boundary box replacements.

The data on the number of boundary boxes that will need replacing in the next AMP clearly shows a significant increase occurring which is both a) above the level of replacements undertaken in previous AMPs, and b) a rate of increase which has not been seen in previous AMPs. Therefore, the rate of replacement and the increase in the number of replacements are not sufficiently reflected in the level of performance and performance improvements expected from the base cost model allowances.

Our actual volumes of replacements required shows a more than doubling since 2017/18. These volumes will start to be reflected in the base modelling, but a) we expect this only to be seen for Anglian due to the effect of earlier meter installations and b) this is not fully reflected of the scale of further increase that we expect to see in AMP8. Therefore, we do not consider that this factor is reflected in base modelling.

Date	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Volume	12,000	11,423	12,175	14,994	16,196	23,334	24,588

i) Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?

Considering that the cost drivers in the base cost model do not include factors that reflect the boundary box replacement rates behind this cost adjustment claim, it is not possible to calculate an implicit allowance through the exclusion of cost drivers in the base models.

We have therefore sought to understand the implicit allowance for boundary box replacements by following the same engineering and economic rationale which forms the basis of these claims (i.e. using the expected meter failure rates across the industry using data available on meter installation dates).

To do this, we have analysed the data submitted by companies through APRs and June Returns on the level of meter penetration since 1990. The only continuously running dataset relating to this is on the proportion of properties with metered billing. Whilst an imperfect measure of meter installation rates (i.e. some households will have a meter but not be billed by a meter) we consider this to be a reasonable proxy to compare the proportion of meters installed for Anglian against the industry as a whole (and by extension, a reasonable proxy to compare the volume of boundary boxes installed in each period for Anglian compared to the industry average).

Given the expected asset life for boundary boxes of 30 years, we assume that the base models reflect the activity required on average to replace the boundary boxes installed with new meter installations up to the year 1995 (i.e. thirty years before the start of the PR24 period). We have then compared the new meter installation volumes observed by Anglian in the period 1995-2000 (i.e. thirty years before AMP8) as it is these installations which will drive the bulk of our expected boundary box replacements in AMP8.

This data shows that the industry as a whole increased its meter penetration rate by 3.14 percentage points over the 1990-95 period. Over 1995-2000 we increased our meter penetration rate by 27.99 percentage points. We have therefore assumed that 11.23% of the expected costs for boundary box replacements referred to in this cost adjustment claim are reflected implicitly within the base models.

On this basis the assumed implicit allowance for this cost adjustment claim is as set out in the table below:

	Base cost (£m)
Total expected cost	155.4
Implicit allowance (total cost x 0.1123)	17.4
Cost adjustment claim	138.0

The cost adjustment claim value is therefore greater than the materiality threshold for water network plus[81] and is therefore worthy for inclusion as a cost adjustment claim.

j) Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?

The activity covered by this cost adjustment claim is to maintain current levels of service to customers rather than delivering any improvements. There are a number of activities which this investment will support, but all activities covered by this cost adjustment claim are needed to maintain existing capabilities.

One of the key issues with broken boundary boxes is that they contribute to an increase in leakage. These are not existing leaks that enhancement leakage activity seeks to drive down, but leaks that would increase the level of leakage were no further action taken. We therefore consider that whilst with this funding the level of leakage would be lower than the counterfactual (i.e. replacements are not undertaken) the activity only prevents a deterioration in performance. Further details on our assumptions of the leakage impact are highlighted in response to q3a. It should also be noted that because this CAC is referring to activities which have not taken place at this scale in the past, it does not overlap with the leakage cost adjustment claim (which reflects the efficient rate of maintaining leakage at the industry frontier based on historical data across the industry).

k) Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?

We consider that cost allowances in the round include:

- Modelled base costs allowances
- Unmodelled base cost allowanced (including other cost adjustment claims)
- Enhancement cost allowance.

We have set out above how we consider that the cost adjustment claim is net of any modelled base cost allowances.

Of the unmodelled base cost allowances, we consider that there is no overlap. There is a separate cost adjustment claim to maintain current frontier levels of leakage. Whilst leakage forms part of the performance that this boundary box CAC seeks to maintain, the allowance requested for the leakage CAC takes a top-down view drawing from existing observations of leakage performance and costs from companies across the industry. The scale of boundary box replacement activity that this CAC covers is not something which has previously been observed in the industry, and therefore the new increase in required replacement rates are not factored into the leakage CAC.

Our business plan will include enhancement activity on both leakage and metering. These enhancement activities are distinct from the activities covered by this cost adjustment claim. The leakage enhancement activity covers specific activities to expand our capability to reach lower levels of leakage through additional capability which we do not currently have. The metering enhancement covers upgrading the meter itself (rather than its chamber which in most cases will not need to change) to a smart meter, or the installation of new meters at properties which do not currently have a meter.

[81] 3.9% versus a materiality threshold of 1.0%

l) 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?

We have taken a long-term view of the expected replacements required in future AMPs to support our view of expected activity required in future AMPs. Our current estimates over a four AMP period are as follows.

AMP	Boundary box replacements
6 (2015-20)	66,788
7 (2020-25)	146,613
8 (2025-30)	239,331
9 (2030-35)	332,890

This increase in the volume of replacements is reflective of asset lives and the increase in the number of meter installations over multiple AMPs in the past. This data shows that this is an area which will require significant activity and investment in future AMPs. Ultimately, we expect this to be a cost which the whole industry incurs in the longer term, and will eventually be reflected within the modelled allowance. However, as these costs have not historically been incurred by companies, and we face a unique position in being the first mover on meter installations in the five year period between 1995 and 2000, there is a need for a cost adjustment claim at PR24 to reflect these unique costs.

The allowance requested in this period is reflective of the view that any phasing of investment to future AMPs has a twofold disbenefit. Firstly, customers will experience the issues associated with boundary box failures for a longer period of time as the resolution of the failure is delayed, and secondly, a delay to the activity would increase the pressure on replacement required in AMP9 and beyond.

On a broader point, as we expect this to be a significant cost incurred for the industry over multiple AMPs, sustainable funding solutions which are fair to customers and don't lead to ever growing costs year-on-year should be considered. Options include the consideration of whether legislative change is required such that customers (rather than water companies) own their boundary box, as is the case for gas and electric meters[82]. This would transfer costs and control of assets to individual customers rather than the generality of customers. Clearly, such a solution is beyond the scope of this cost adjustment claim but presents one possibility long-term cost control.

m) If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?

The key alternative explanatory variable that would be used to calculate this cost adjustment claim is meter penetration. Combined with the expected asset lives of boundary boxes this explains the scale of replacements that are currently required. None of the explanatory variables within the proposed Treated Water Distribution cost models reflect (directly or indirectly) the level of meter penetration.

[82] Note, we set this out as an illustrative option for debate, not to present this as a preferred view.

6.2. Cost efficiency

a) 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)?

Comparable cost data on boundary box replacements are not available at an industry or international level and so industry benchmarking is not as straightforward as it is for other activities. Cost models do not currently take into account costs driven by meter penetration levels and so industry cost models are unavailable for use.

One of the closest comparable datasets that we have considered for cost benchmarking is the enhancement benchmark models for new meter installations. However, this does not provide a suitable comparator because of the different characteristics of the activity of new meter installations compared to new boundary box replacements. For example, many new meter installations are internal and screw-in meter installations which do not require excavation of footpaths, unmade ground or carriageways which are more costly and make up the entirety of meter boundary box replacements. We would therefore expect unit costs for boundary box replacements to be greater than meter installation costs. Without industry data on the proportion of different meter installation types, a reliable cost comparison cannot be made to undertake cost benchmarking.

For this cost adjustment claim we have therefore considered that market testing is the most effective way to understand cost efficiency. We have sought unit costs for boundary box replacements from different suppliers, and based this cost adjustment claim on the lowest unit rate we currently have available.

At the time of submission of this cost adjustment claim[83], we continue to seek opportunities to compare our costs to external benchmarks to triangulate and further scrutinise the efficiency of the costs in this claim.

b) 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?

Our cost estimate has been derived from market testing of costs to replace boundary boxes (as described above). This has given a cost estimate for boundary box replacements where these are carried out in a carriageway (typically highest cost), footway and unmade ground (typically lowest cost). The table below shows how the cost estimate of this cost adjustment claim has been arrived at using these assumptions.

Replacement surface type (expected % of total volume)	Number of expected boundary box replacements	Total cost (£m)
Unmade (23%)	55,046	27.3
Footway (74%)	177,105	121.4
Carriageway (3%)	7,180	6.7
Total expected volume (100%)	239,331	**155.4**

[83] 9 June 2023

c) Does the company provide third party assurance for the robustness of the cost estimates?

As set out in section 2a, we plan to undertake further work to ensure the efficiency of these costs - we will undertake third-party assurance on these final costs ahead of our business plan submission.

6.3. Need for investment

a) Is there compelling evidence that investment is required?

The ultimate driver of this investment is the age profile and lifespan of boundary boxes. Where boundary box failure occurs, and no action is taken this would lead to significant deterioration in customer service.

Impact on leakage maintenance

One significant impact of boundary box failure is an increase in the level of leakage. Not replacing the boundary boxes included in this cost adjustment claim would lead to increase in leakage of 70.56 Ml/d by 2030 above base levels. This is based on observations that where a boundary box fails, 50% of these failures lead to a leakage impact, with an average leakage of 720 l/Day for visible leaks (30% of failures) and 216 l/day for non-visible leaks (70% of failures). With the expected volumes of failures of 239,331 we expect this to lead to an additional 15.68 Ml/d impact each year with a 70.56 Ml/d leakage impact in 2029/30 should the failed boundary boxes not be replaced.

In addition to the direct leakage impacts, there are corollary safety and behavioural impacts of boundary box failures. Where leaks occur, they are close to the ground surface, leading to a very visible leakage impact. This would have a further impact on public safety by presenting slip and trip hazards to the public, and also impact on resilience during times of water shortage. Our customer engagement has demonstrated that customers are less likely to feel they should reduce their own water usage where there is a perception that their water company is not playing its part by addressing leaks.

Low pressure and interruptions to supply

In addition to the leakage, health and safety and behavioural impact of failures, there are impacts on low pressure at affected properties. Where a failure occurs, we have seen that 0.5% of boxes that leak lead to low pressure impacts. This would lead to low pressure issues at an additional 120 properties per annum.

Customer's may also experience interruption to supply from severely failed boundary boxes. We approximate this to be affecting 0.2% of boxes which are leaking, affecting approximately 48 customers on average per annum.

Customer experience

We currently have 2,166,894 metered customers. At an average expected failure rate in AMP8 of 47,868 boundary boxes/year, we expect 2.2% of our customers with a water meter will be affected by the failure of boundary boxes and remediation per annum. Whilst the work we carry out will improve customer experience relative to the counterfactual where the boundary box failure persists, this is ultimately activity carried out to maintain service and avoid negative impacts to customers rather than improve customer experience.

b) Is the scale and timing of the investment fully justified?

The scale and timing of this investment is based on the need to avoid the negative impact on customers highlighted above, and on expected failure rates in AMP8 and future AMPs should no action be taken. Any phasing of investment by delaying the replacement of boundary boxes would extend the period over which the negative impacts of boundary boxes would be experienced by customers, and push investment into future AMPs where the number of boundary box replacements required will be even higher.

Conversely, we do not consider that it would be appropriate to bring additional boundary box replacements into PR24. Whilst this would in effect increase the number of proactive replacements which take place before failures occur, this needs to be balanced against feasible deliverability and customer affordability when the expected scale of investment required in PR24 is much higher than has been seen in previous AMPs.

c) Does the need and/or proposed investment overlap with activities already funded at previous price reviews?

This investment does not overlap with activities funded at previous price reviews. Previous price reviews have covered the costs of new meter installation, through enhancement allowances. However, this reflects the one-off costs of installing a new meter, and not its ongoing maintenance. Base cost allowances are assumed to reflect the ongoing maintenance of assets which, within the lifespan of boundary boxes we have assumed to be reflected within the base cost models. However, the base cost models include no driver for the significant cost of boundary box replacements at the end of their lifespan, and due to the timing of meters reaching the end of their lifespan in AMP8, this is not a cost that Anglian, or other companies, have experienced in previous AMPs.

d) Is there compelling evidence that customers support the need for investment (both scale and timing)?

This investment is ultimately driven by the supply-demand needs of our region, and the desire in the 1990s for our customers to be charged based on their water usage. The scale and timing of this investment is ultimately based on these expenditure drivers.

6.4. Best option for customers

a) Did the company consider an appropriate range of options to meet the need?

See 6.1c.

b) Has a cost–benefit analysis been undertaken to select proposed option? There should be compelling evidence that the proposed solution represents best value for customers, communities and the environment in the long term? Is third-party technical assurance of the analysis provided?

See 6.1c

c) Has the impact of the investment on performance commitments been quantified?

The main performance commitment that this would have an impact on is leakage. As set out in response to 6.3a, if we only invested the base implicit allowance in meter chamber replacements, we estimate that this would have the effect of deteriorating leakage performance in 2030 by 70.56ML/d compared to the 2025 baseline. This is an impact that we would not see were we not a company which had made an early start on significant meter penetration in the 1990s. Investing the request from this cost adjustment claim will be enough to maintain current leakage levels from boundary boxes, not to deliver any improvement in performance.

d) Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where utilisation will be low?

Cost uncertainties exist in relation to this cost adjustment claim in that the cost of boundary boxes may change between now (2023) and the required new installation date of boundary box installation. Should the out-turn costs vary from that expected from our current market testing, then the pain/benefit from this will be shared with customers through cost sharing.

On benefits, we have a high level of certainty that our proposed solution will deliver the expected benefits (i.e. that meters will be housed in a new boundary box, removing the negative customer impacts of leakage, low pressure etc. referred to earlier).

We are confident that there will be high utilisation of the solutions. Smart meters are a pivotal part of our Long-Term Delivery Strategy and Water Resources Management Plan. There is therefore a negligible risk that the investment delivered through this cost adjustment claim will lead to stranded assets as every smart meter needs to be appropriately housed in a chamber which allows it to function effectively.

e) Has the company secured appropriate third-party funding (proportionate to the third party benefits) to deliver the project?

The issues that this investment resolves (e.g., on leakage and customer experience) ultimately benefit two parties: the generality of Anglian customers, and the specific customer whose boundary box is replaced. It could reasonably be proposed therefore that the costs of this investment (or a portion of the costs) should be borne by the individual customer rather than the generality of our customer base. However, as the housing of meters is currently the sole responsibility of water companies, and not individual customers, there is no existing mechanism to reflect third-party funding from the individual customer benefitting from this cost adjustment claim. We therefore do not consider there to be third-party funding sources to support this cost adjustment claim.

f) Has the company appropriately presented the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?

The investment is heavily integrated into the network and our business, with each boundary box being closely integrated into our network. Information on which boundary boxes are in need of being replaced is also heavily integrated into our business, making this investment indistinct from other parts of our business. We have therefore concluded that this activity would not be appropriate for delivery through DPC.

g) Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views

In selecting the preferred option we have taken into account customer views on smart metering, leakage and asset replacement, alongside other criteria for the selection of the proposed solution outlined in 1c. Our customer engagement has shown that customers are less willing to take action to reduce their own water consumption if there is a perception that we are not doing everything we can to manage leakage and look after our assets.

6.5. Customer protection

a) Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?

The costs of this programme could be covered by a payment-by-results method. Such a method would ensure that we are only given funding for boundary box replacements that we have actually delivered. Such a mechanism would negate the need for an upfront cost adjustment and a price control deliverable as Anglian would not receive an upfront allowance for boundary box replacements and therefore not need to return any funding back to customers if the investment is cancelled, delayed or reduced in scope.

If such an uncertainty mechanism is not possible to implement, customers would be protected through a price control deliverable based on the efficient unit rate to deliver each boundary box replacement. This would return the proportion of the cost adjustment claim back to customers should any of the expected boundary box replacements not happen in AMP8.

b) Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?

By tying an uncertainty mechanism or price control deliverable to the delivery of boundary box replacements, the mechanism would inherently cover all the benefits that would be delivered from this cost adjustment claim.

We have considered alternative customer protection mechanisms tying to leakage, or low pressure but consider that a) a single protection mechanism which is directly linked to the delivery of the CAC is both simpler and better serves the principle of customer protection than multiple outcome-focussed PCDs, b) has less reliance on assumptions around benefits that will be delivered by the CAC, and c) reflects the asset health benefits which are more difficult to reflect in multiple outcome-focussed protection mechanisms.

c) Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including the mechanism for securing sufficient third-party funding?

As highlighted in 6.4e, we do not anticipate any third-party funding for this investment.