Appendix
YKY46_Cost adjustment claims [Redacted]

YorkshireWater

Navigating this document

This Appendices document is separate to and supports the main business plan document.

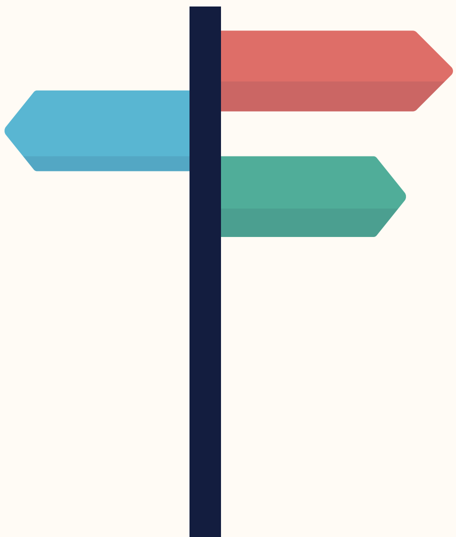
Links outside of this report

Read more links
This icon can be clicked on to link to any further documents or resources outside of this report

Read more about this at
websiteaddress.com or link

Business plan links
This icon can be clicked on to go to the main Yorkshire Water Business Plan document where more information can be found.

More detail on this subject can be found in **Chapter 8 Part 2: What our plan will deliver**



Contents

[Content in this document has been redacted due to it containing commercially sensitive information]

1. Our Cost Adjustment Claims Approach

Ofwat assesses efficient Botex+ costs for each price control at PR24 using a set of econometric models. These models are created by testing the relationship of historic expenditure across the industry with different 'explanatory variables' that may drive these costs. Ofwat then decides on a subset of explanatory variables that it believes best describes differences between companies that meet its modelling principles.

The variables used typically account for differences between company scale (and economies of scale), treatment complexity, population density, topography and deprivation. However, it is recognised that models are a simplification of reality and that given they are based on a small number of variables, and a small number of companies, they are unlikely to be perfect.

1.1 Cost Adjustment Claims

The Cost Adjustment Claim (CAC) process allows companies to submit further evidence to Ofwat for costs that are not accounted for in the modelling. The process allows a company to present evidence in its business plan of unique operating circumstances, non-standard legal requirements or new base expenditure which drive higher efficient costs for the company relative to its peers or to the industry's historical spend.

We have engaged with the Ofwat process throughout, identifying key drivers, and raising areas of concern with the base cost modelling approaches. The cost adjustment claims contained within this appendix and in data tables CW18 and CWW18 are consistent with these messages. They have been developed via a detailed internal process to understand where future business expenditure needs are not included in the historic costs feeding the base models or reviewing drivers that disproportionately impact YW compared to the industry average.

To do this we have engaged extensively across our business and worked closely with several external advisors to ensure that our evidence is robust. These include:

- Oxera – providing economic modelling analysis, understanding efficient costs and assessing implicit allowances.
- Stantec, our strategic planning partner, providing technical support and evidence supporting our needs.
- Turner &Townsend & KPMG our technical and regulatory assurers, reviewing our submissions against the Final Methodology and guidance documents.

Our claims have only been raised in cases where we believe that they meet Ofwat's high evidential bar and meet the materiality threshold. However, we note that there are several drivers of cost which we believe adversely impact us, or the industry in AMP8, which we have not included in our claim. These drivers may have not been material individually, or subject to significant uncertainty, that meant we could not fully evidence them against Ofwat's criteria. A non-exhaustive list of these is show in the Section 1.6.

1.2 Early Submission – June 2023

We submitted an early view of our cost adjustment claims to Ofwat in June 2023 where we provided detailed evidence for two claims in the Wastewater Network Plus price control. These were a non-symmetrical claim for the additional operating costs due to the AMP7 Phosphorus removal programme and a symmetrical claim to account for the prevalence of combined sewers in the YW region.

Read more about this at
https://www.ofwat.gov.uk/regulated-companies/price-review/2024-price-review/cost-adjustment-claims-june-2023/

We also noted that there were still areas where we were developing our strategies, whilst trying to align the affordability and deliverability of our plan in-the-round. At the time of the early submission, the uncertainty about the scale of investment we would be proposing in our plan, our ongoing enhancement programmes and our delivery approaches meant that we could not provide the evidence required to meet Ofwat's CAC requirements for the early submission.

We recognised that Ofwat stated it will treat CACs not captured as part of this process with caution but noted that any new claims would be forward-looking and activity-based so would be non-symmetrical and would not impact on other companies' allowances.

We now confirm that we have included a further three non-symmetrical claims in our final submission. The first for a large increase in Meter replacement required and the second and third for a targeted allowance to maintain and improve asset health in the Water Network Plus price control in infrastructure and non-infrastructure assets.

1.3 Our approach to identifying cost adjustment claims

The Botex Cost Models may omit efficient costs for a company for two broad reasons.

Firstly they may exclude a particular explanatory variable that is an important differentiator of costs between companies, and where an adjustment would likely be symmetrical with corresponding downward adjustment to companies in the industry less impacted.

Secondly, allowances may not be appropriate where costs do not appear in the historic dataset as they have not been incurred by companies in the recent past. There may be several reasons for this that include:

- The impact of recent enhancement programmes, the ongoing operation of which is considered to be base but is not linked to any explanatory variables.
- The increase in what is expected to be delivered through base allowances (more stringent application of existing legislation by quality regulators, tightening of performance commitment targets and definitions)
- Step changes in costs during the modelling period.
- Industry-wide investment in assets being lower than the long-term required rate.
- Company specific lumpy investment.

1.4 Variables Excluded from the Models

We submitted cost models as part of our January submission that highlighted what we considered to be the key underlying drivers of cost at each level of aggregation. These had been developed as a combination of engineering assessment and economic analysis to ensure any drivers we proposed were robust and supported.

The release of Ofwat's consultation models allowed us to assess whether any particular drivers were still unaccounted for in the base cost models. Where Ofwat's modelling had not, or had only partially accounted for the variables, we were able to assess against the CAC criteria in the final methodology our evidence for the claim.

Even if we have not included a CAC, we still believe that the variables submitted and the detail in our Base Cost Modelling consultation response in these submissions should be considered as Ofwat develops its final models for Draft Determination.

1.5 Costs outside of the historic dataset

Our Asset Strategy teams have worked with our wider business to develop a bottom-up view of the expenditure requirements to deliver our performance commitments and achieve our statutory compliance through base maintenance. For each of the areas of investment in this bottom up build we have considered whether the activity and the costs are allowed for in Ofwat's base modelling allowances.

Where we believed that there were additional future costs than were implicitly funded we assessed each area against the CAC criteria to decide on the inclusion of a claim.

1.6 Areas assessed but not included as a claim

Table 1.1 Cost Pressures not considered but not included as a claim

Name	Price Control	Symmetrical?	Reason not included
The proportion of cellared properties in Yorkshire	WWN+	Yes	Incorporated in PC target adjustment claim for ISF.
Inflationary Pressures in AMP7 Costs	All	No	Industry level issue which is difficult to forecast without further detail on Ofwat's benchmarking approach. We have fed-back our views on this in our responses and believe this should be addressed in cost modelling.
Lane Rental Scheme – expected increased charges for roadwork activity.	N+	No	Uncertainty of cost impact / materiality
NHH 'meter reading/data collection' costs (formerly non-price control)	WN+	No	Materiality
Required long term asset health investment in Wastewater Network Plus	WWN+	No	We limited our targeted allowance claims to WN+ only. Primarily for affordability reasons and targeting WN+ assets where asset health has the most direct impact.
Opex impact of wider AMP7 enhancement programmes (non phosphorus)	WN+ /WWN+	No	Materiality

1.7 Price Control Deliverables

For each claim we have considered carefully whether additional customer protection is required in the form of a price control deliverable. We have included PCDs for the claims that for activity we are committing to over and above historic levels. The claims we have identified where a PCD is particularly appropriate are the water claims in meters and asset health (where we commit to specific activity and/or spend). However, we also propose a PCD to protect customers in the event of any late delivery of the AMP7 phosphorus programme beyond 31 Mar 2025 to ensure customers are not paying for assets that are not being operated.

Consistent with our PCDs for enhancement cases and the costs set out in these claims all values are presented prior to the application of real price effects and frontier shift efficiency.

1.8 A Summary of our Claims

Table 1.1 below summarises the Cost Adjustment Claims included in our final business plan submission.

Table 1.2 Summary of YW Cost Adjustment Claims at PR24

Code	Title	Price Control	Value	Symmetrical?	In Early Submission
CWW01	Impact of AMP7 WINEP - Phosphorus	WWN+	**£110.10m**	No	Yes
CWW02	Combined Sewers	WWN+	**£88.16m**	Yes	Yes
CW01	Meters	WN+	**£110.13m**	No	No
CW02a	Targeted Allowance Asset Health Infra	WN+	**£250.94m**	No	No
CW02b	Targeted Allowance Asset Health Non-Infra	WN+	**£186.75m**	No	No

Note: All costs are prior to the application of Real Price Effects and Frontier Efficiency

2. CWW01 – Ongoing Operating Costs of AMP7 WINEP Phosphorus Removal Programme

2.1 Executive Summary

This document provides Yorkshire Water's evidence for a cost adjustment claim related to the ongoing operating costs associated with our AMP7 WINEP Phosphorus (P) Removal Programme in Wastewater Network Plus (WWN+).

Yorkshire Water (YW) is currently delivering schemes to meet tightened Phosphorus consents at 80 sites in the 2020-25 period with all schemes expected to be completed before 31 March 2025. These have undergone extensive design and optioneering to ensure the best option for customers has been selected.

Enhancement cost models developed by Ofwat and built on by the CMA at PR24 allowed YW a Totex value of £549.8m (17/18 prices) in Wastewater Network Plus to build new assets to deliver P-removal at 80 sites serving a population equivalent of c. 4,460,000 and to operate these up until 31 Mar 2025. No allowance has made for the ongoing operation and maintenance of these assets from 2025 onward.

This investment is crucial to maintain the benefits delivered by these improvements so that customers and the environment continue to receive them beyond 2025.

The current modelling process assumes that ongoing costs of maintaining compliance become base maintenance in future periods. Additional allowance may become available, if the investment programme impacts on a cost driver that is used in the cost models (e.g. an increase to treatment complexity). However in this case there is no impact on the cost variables being used in Ofwat's base models as currently proposed. So despite the large increase in treatment costs assumed to be base maintenance in AMP8, there is no corresponding uplift to allowances.

Our total claim for P-removal after the reduction of a calculated implicit allowance is **£22.03m p.a.** or **£110.13m** for the 2025-30 period.

We have updated this claim slightly following our early cost adjustment claim submission in June 23 to incorporate both the latest APR23 data, an updated implicit allowance calculation and our latest engineering estimate of the costs associated with the phosphorus schemes that are being delivered.

This claim is supported by a detailed analysis document completed by Oxera which can be found in the Oxera cost adjustment claim analysis appendix.

More detail on this subject can be found in
Link to the Oxera cost adjustment claim analysis appendix

The sections below set out:

- A background on our PR19 submission and the WINEP requirement.
- Our approach to identifying the best solution within our AMP7 allowances and estimating the ongoing operating costs.
- Economic analysis – top down and bottom up to set out evidence that YW's costs are efficient at an industry level.
- Discussion of implicit allowances and symmetrical adjustments.
- A customer protection mechanism.

Table 2.1 below points to the locations in the document where we address Ofwat's cost adjustment claim assessment criteria.

Table 2.1 References in Document to Ofwat's Cost Adjustment Claim Criteria

Cost Adjustment Claim Assessment Criteria	Sections
Need for adjustment	2.2, 2.3, 2.5
Cost efficiency	2.4, 2.6
Need for investment	2.2
Best option for customers	2.5
Customer protection	2.9

2.2 Introduction

2.2.1 What is the Water Industry National Environment Programme (WINEP)?

Ahead of PR19, Yorkshire Water (YW) worked with the EA and Natural England to apply and interpret their Water Industry Strategic Environmental Requirements (WISER) to our region. The final WINEP3, agreed with these environmental regulators, listed the extensive statutory obligations to meet these regulatory requirements and ambitions.

The WINEP programme required of YW at PR19 was the most extensive and ambitious ever. The range of solutions varied from conventional engineering approaches, to the largest ever programme of catchment interventions.

2.2.2 Phosphorus Removal

The key driver impacting on the scale of Yorkshire Water's WINEP3 programme was Phosphorus (P) removal. The P Drivers set out in WINEP3 for each company came under one of 3 drivers:

- Urban Wastewater Treatment Directive (UWWTD) Improvement U_IMP2
- Water Framework Directive (WFD) – Improvement WFD_IMP G,M
- Water Framework Directive (WFD) – No deterioration WFD_ND

Each site in the programme had one or more of the above drivers and an associated permit limit for the works to achieve to meet the driver. Typically, the WFD_IMP drivers are more stringent than the UWWTD_IMP driver on the same site. Yorkshire Water had no obligations under the WFD_ND driver.

The key variables impacting on the relative efficient cost of meeting P removal obligations set by environmental legislation included the following:

Number and size of sites. The scale of STWs that are affected by obligations. Companies with more affected sites, or larger sites, will – all else being equal – face greater costs of meeting their obligations. The size of sites is typically measured by load or by a site's Population Equivalent (PE).

Permit level. The lower the absolute level of permit, the more costly it is to achieve. For example, it is more costly to achieve a permit level of 0.5mg/l than it is to achieve a permit level of 1mg/l. This is because lower limits require additional treatment units and additional chemicals leading to increased capital and operating costs.

Change in permit level. Enhancement costs reflect step changes from current levels of service. The extent to which permit levels change can vary between companies, and therefore this drives differences in costs between companies. Companies that have received enhancement cost allowances in the past to achieve the UWWTD (typically a set 1 or 2 mg/l limit), may have less of a change to meet the WFD standard (set based on the output of river modelling) than a company that currently has no permit and must achieve both standards.

Type of obligation. The type of designation affects what solutions can be applied to achieve the required permit levels. The UWWTD is clear in that permit levels must be achieved by treating wastewater before it is discharged from the treatment works. Whereas the WFD applies no such restrictions. Therefore, less costly technologies (e.g. catchment-based solutions) can be used to meet WFD obligations compared to UWWTD obligations. The cost differential is likely to be greatest on larger sites, however catchment approaches at all scales show greater benefits due to their additional impact in a six capitals valuation.

An additional consideration linked to the type of obligation was that UWWTD is a statutory driver that stipulates end-of-pipe treatment by law, and as such the solution was not subject to cost benefit analysis by the EA before inclusion in the WINEP, whereas WFD drivers were.

For sites with both drivers, the EA's cost-benefit analysis of the WFD element was based on only the incremental cost between achieving the UWWTD limits and the WFD limits whereas the benefit achieved by both drivers was assumed.

This means that WFD schemes that would not be cost beneficial on their own became beneficial for YW's WINEP3. More expensive WFD schemes at other companies not subject to UWWTD drivers may have been rejected on cost benefit grounds and been excluded from Ofwat's modelled dataset (see 2.2.4 below).

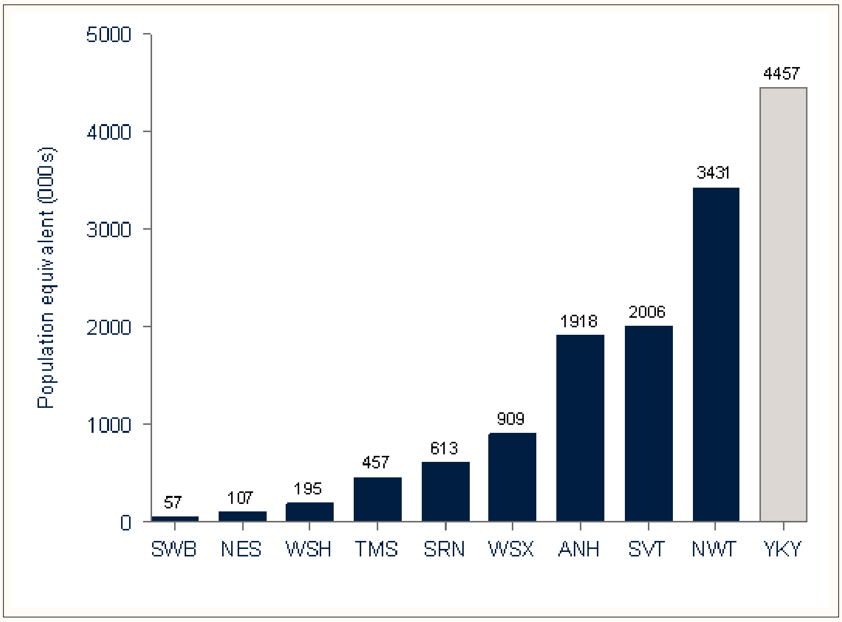
The final WINEP was confirmed on 31 March 2017 and contained 81 new phosphorous limits, with 11 limits driven from the Urban Waste Water Treatment Directive Sensitive Designations, 32 limits driven from the Water Framework Directive and 39 limits driven by both drivers. One site required no action in AMP7 as it already met the standard.

2.2.3 The Scale and Challenge of YW's AMP7 Programme

The WINEP programme for Yorkshire Water was different to those for other companies in that:

- It had the largest total PE of sites with new phosphorus drivers in the industry. This meant that it had the largest scale driver of costs (Figure 2.1).

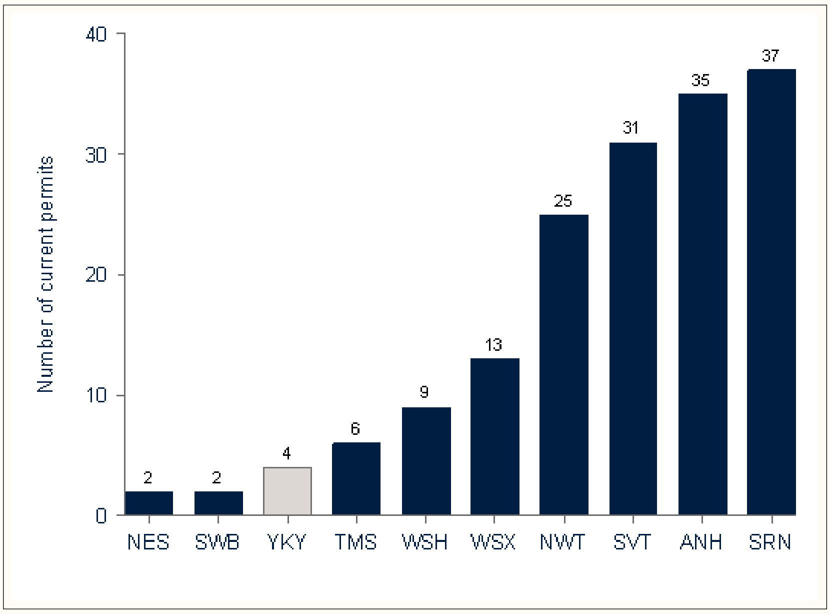
Figure 2.1 Population Equivalent impacted by new P permits for each company (in AMP7)



Source: Oxera analysis AMP7 WINEP

- YW had not had significant P-removal obligations in previous National Environment Programmes and hence did not have existing treatment in place. This meant that the level of improvement in P permits at YW sites, was larger than companies that already had permits in place (often going from no permit to an extremely tight permit). Companies with existing treatment in place may have been able to achieve improvements by minor modifications or optimisation of existing approaches or through catchment management at a significantly lower cost than if no treatment is currently in place. This is represented in Figure 2.2.

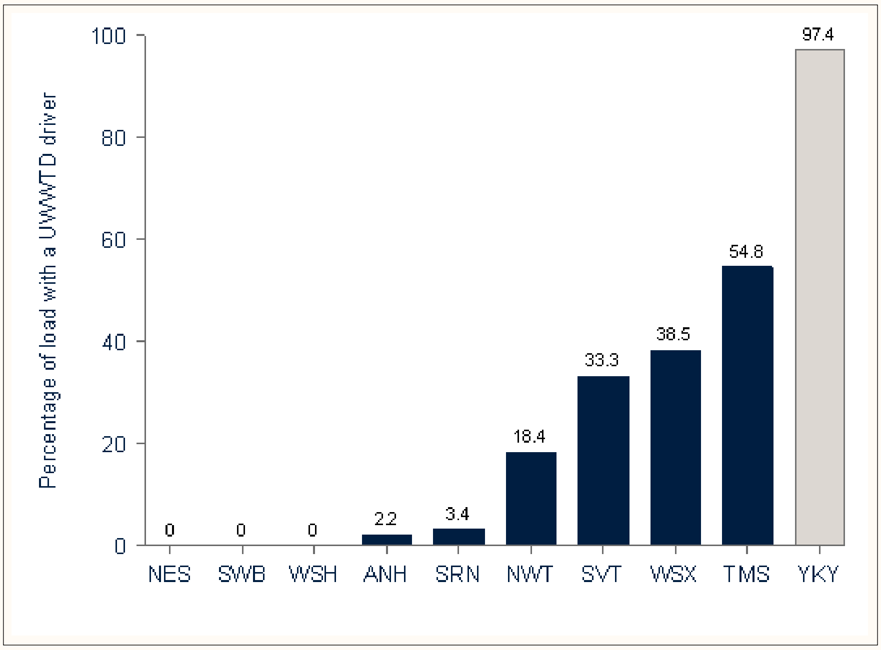
Figure 2.2 Number of Sites with new P Drivers that have Existing P Permits



Source: Oxera analysis AMP7 WINEP

- Approximately half of YW sites had both a U_IMP Driver and a WFD_IMP Driver. This was unique in the industry and the proportion was particularly large when viewed weighted by load (Figure 4). Many companies received UWWTD drivers in previous periods and were allowed enhancement funding to deliver improvements at the works. Further improvements to meet WFD drivers may have been achieved through catchment management and minor modifications of existing approaches. However, the requirement in the UWWTD that “urban wastewater entering collecting systems shall before discharge be subject to secondary treatment or an equivalent treatment…” meant the solutions and efficiency available to Yorkshire Water were limited by the need for end of pipe treatment. Figure 2.3 shows how YW’s UWWTD obligations were proportionally much greater than the rest of the industry.

Figure 2.3 Proportion of AMP7 programme subject to new UWWTD obligations (by load)



Source: Oxera analysis AMP7 WINEP

In summary, YW had the industry's largest set of Phosphorus removal obligations in AMP7. As we had not previously had obligations under the UWWTD we are installing end-of-pipe solutions as mandated by the directive. This means that more efficient costs options (e.g. process optimisation or catchment management) are not available to YW as they are to other companies who have received funding in previous price reviews to achieve UWWTD phosphorus limits.

2.2.4 Phosphorus Modelling at PR19

The PR19 cost models for Phosphorus removal went through several iterations between the IAP stage and the CMA's final determination.

The final decision from the CMA was to adjust Ofwat's FD slightly and to use 8 models to estimate Yorkshire Water's efficient Totex costs within AMP7. These were triangulated to create the final allowance.

Table 2.2 Model specifications for AMP7 Totex Allowances

Model	Drivers	Model	Drivers
1	Population Equivalent with new P permits & No. of Sites with P-removal drivers	**5**	As 1 but excluding 4 UU large catchment interventions
2	Population Equivalent with new P permits & % sites with <=0.5 P permit	**6**	As 2 but excluding 4 UU large catchment interventions
3	Population Equivalent with new P permits & % sites with <=1 P permit	**7**	As 3 but excluding 4 UU large catchment interventions
4	Population Equivalent with new P permits & % sites with no current permit	**8**	As 4 but excluding 4 UU large catchment interventions

The CMA's final determination modelling outcome, following a WINEP in-the-round efficiency challenge for Yorkshire Water resulted in an AMP7 totex allowance of £549.8m (17/18 prices) in Wastewater Network Plus to deliver P-removal at 80 sites serving a population equivalent of c. 4,460,000.

2.3 The Need for a PR24 Adjustment

The challenge facing companies, and particularly Yorkshire Water in AMP8, is that the AMP7 totex allowances were provided to complete the building of the capital schemes and the operation of any sites delivered early until March 2025.

There was no allowance made for the ongoing cost of operating and maintaining the P-removal process from April 2025 onward.

Ofwat's approach is that the ongoing operating costs of enhancement schemes become part of base cost allowances in the next period. However, unless the interventions delivered by the enhancement programme impact the explanatory variables in the econometric Botex models then no allowance will be made to fund the ongoing compliance with the new obligations.

P-consent levels are neither directly included as cost drivers in the modelling suite, nor are they sufficiently captured by existing cost drivers. This is shown in Table 2.3below, which shows the correlation of load treated at P-consent levels below or equal to 0.5m/l with the cost drivers included in the relevant sewage treatment (SWT) and wastewater network plus (WWN+) models. We note that correlation analysis alone cannot offer comprehensive evidence on whether a cost driver is appropriately captured by a set of models but can provide a starting point in the investigation.

Table 2.3 Correlation of load treated at P-consent levels ≤ 0.5mg/l with relevant cost drivers

Cost driver	Correlation coefficient
Load (log)	0.0145
Pumping capacity per sewer length (log)	0.0429
Load treated with ammonia consent ≤ 3mg/l	0.2378***
Load treated in size bands 1 to 3 (%)	-0.1586*
Load treated in STWs ≥ 100,000 people (%)	0.1458
Weighted average treatment size (log)	-0.0455
Urban rainfall per sewer length (log)	0.0062

Note: *** and * indicate statistical significance at the 1% and 10% levels, respectively.
Source: Oxera analysis of PR24 Cost Assessment Master Dataset, Wholesale Wastewater Base Costs v4, published on 5 April 2023, and 2023 APR tables

Only the correlations with the cost drivers load treated with ammonia consent ≤ 3mg/l and load treated in size bands 1 to 3 (%) are statistically significant. In addition, the correlation coefficients of 0.2378 and 0.1586 are low in magnitude. Overall, Table 2.3 indicates that the cost drivers in Ofwat's proposed models only capture P-removal activities to a very limited extent. Ofwat has recognised this in its recent Base Cost Modelling consultation stating:

> *"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*

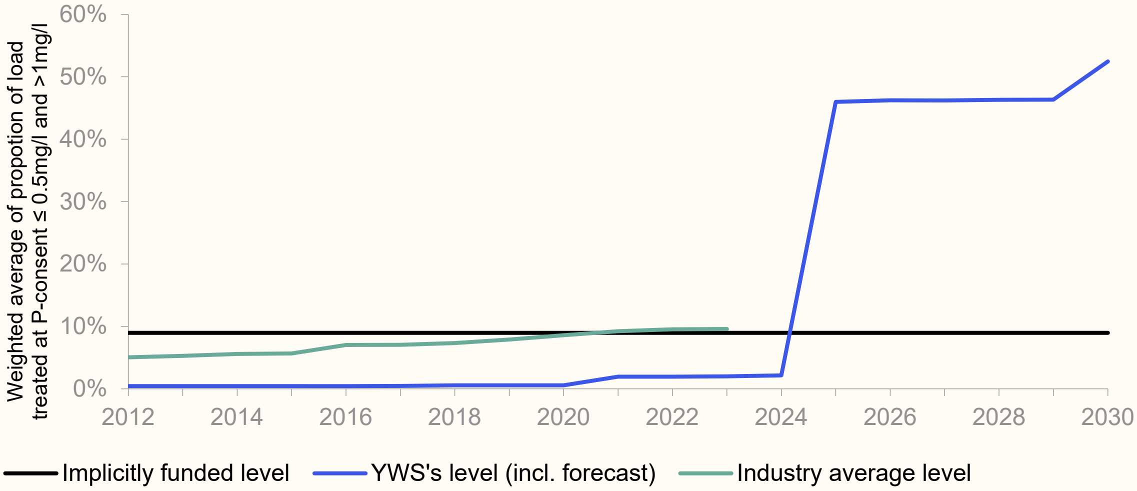
assessment approach funds efficient ongoing P-removal costs, which we welcome company views on:

- *We will continue to consider models with a P-driver (e.g. percentage of load with a P permit <= 0.5mg/l) fixed at the 2024-25 level. This will have the impact of funding the additional base expenditure associated with phosphorus removal enhancement schemes funded at PR19 and completed by the end of AMP7.*
- *We are considering whether we can calculate an accurate post-modelling adjustment that funds efficient ongoing opex associated with P-removal using data provided by companies in annual performance reports (APRs).*
- *The cost adjustment claim process."*

We are pleased that Ofwat has identified this gap and accept that the efficient ongoing costs allowance could be allowed for in multiple ways. Given this guidance, we included a cost adjustment claim as part of the Early Submission but would equally support an appropriate modelling, or post-modelling, adjustment to ensure that efficient costs are recognised.

While the models' inability to reflect the costs associated with P-removal is a general modelling issue that could (in principle) affect all companies, YW in particular is materially affected by the omission of P-removal cost drivers. Figure 1.4 below shows how YW's P-removal activity is expected to change in AMP8 relative to the rest of the industry.

Figure 2.4 Historical and forecast P-removal activity



Note: The implicitly funded P-removal activity ('implicit allowance') is based on the five-year industry average for the years 2019 to 2023 as Ofwat tends to use the last five years of modelled data to determine the appropriate benchmark. Tight (<0.5mg/l) and lax (>1mg/l) P consents are weighted at proportion of 3:1 based on YW cost analysis.

Source: Oxera analysis of PR24 Cost Assessment Master Dataset, Wholesale Wastewater Base Costs v4, and YWS forecast data.

The figure shows that historical P-removal activity across the industry is low. This means that estimating the cost of P-removal activities using econometric analysis on historical data is difficult, because P-removal activities only account for a small share of the relevant cost areas. Moreover, omitting P-removal activity in the models would mean that the implicitly funded level of P-removal activity in the models will likewise be low. In contrast, YW expects to rapidly increase the percentage of load treated at strict P-consent levels from 2022 to 2025, substantially above implicitly funded levels, requiring additional and more complex P-removal activities.

We discuss the calculation of implicit allowances later in this document.

2.4 Yorkshire Water's Efficient Cost Requirements

This cost adjustment claim is aimed at providing YW with adequate operating cost funding to operate the new P-removal sites. Construction of the new assets is underway, and we are working towards a compliance date of December 2024.

YW's processes, through using the totex hierarchy and having a rigorous design and feasibility process supported by a procurement process that is designed to find the most efficient costs possible through the market place, are implemented to ensure customers are protected as far as possible from unnecessary cost exposure. YW is confident that its costs are robust and efficient and, with the customer protection mechanism in place described below, protect customers as much as possible.

Each scheme is allocated a scheme sponsor whose role it is to manage and steer the scheme through the concept, optioneering, design and delivery processes to the point that the need, technical solution and the funding requirement is authorised in our corporate governance process. We have a framework of delivery partners who are incentivised to find further efficiencies where possible.

The final determination at PR19 for P-removal was significantly less than we had initially identified would be needed. Factors that we argued were important were recognised by both the CMA and Ofwat and included in final models, however, they were then triangulated with models that did not include them.

Our AMP7 programme has been re-evaluated to achieve compliance within our PR19 Totex allowances. Given the cost challenges outlined above, there are cases where the best value solution is not available given the additional AMP7 Totex cost. We have had to make trade-offs, often moving away from more expensive capital solutions (biological nutrient removal or nature-based solutions) to other less capital-intensive options that offer less value in the long-term as the annual operating costs are higher.

We welcome that Ofwat has recognised and sought to address the 'best-value' issue at PR24 but the issue with AMP7 allowances remains. We set out our approach to designing and optimising our PR19 programme below and understanding the operating cost impact that forms our CAC.

The table below summarises our planned approach to delivering the P-programme by solution type:

Table 2.4 Final YW Decisions on AMP7 Phosphorous Treatment Solutions

Treatment Technology	No of permits
P-removal – Chem Precipitation	71
Biological Nutrient Removal	1
Nature Based Solution	4
Catchment Solution	2
Sewer Out	2
TOTAL	**80**

To identify the ongoing operating cost requirements, YW deploys a rigorous set of cost models across several categories. We hold and utilise models for the following key opex components:

- Chemical Use
- Power Use

- Business Rates
- Sludge Transport and Disposal
- Additional Manpower Requirements
- Proactive Maintenance Requirements

The table below summarises the calculated annual opex we require in in each key category to maintain P-compliance at the required permit level:

Table 2.5 Total Operating Costs of P Solutions split by Category

Opex category	Annual requirement (£m)
Chemical Use	13.200
Power Use	7.492
Business Rates	2.309
Proactive Maintenance Requirements	3.343
Total annual WWN+ Operating Cost Requirement	**26.344**
Sludge Transport and Disposal (not part of claim)	4.341
Total annual operating cost requirement	**30.685**

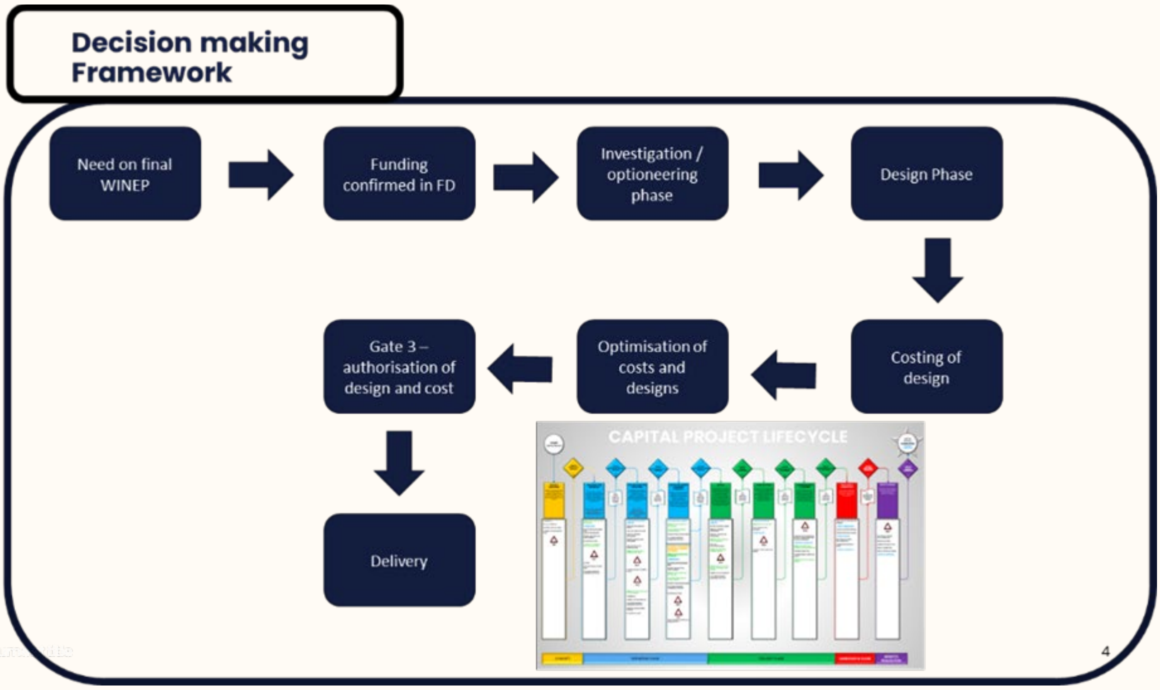
Costs in EDA inflated to 22/23 FYA

We note that the 'business rates' element of these costs is reported in our Local authority and Cumulo rates line of table CW2 but is a base cost pressure related to the AMP7 enhancement programme. We have not included sludge transport and disposal in our claim as the scale variable or the use of unit rates in the sludge base cost models will account for the increase costs.

2.4.1 Design, costing and decision-making process

We undertake a robust assessment of costs, optioneering and efficiency through our end-to-end delivery process. Our Decision Making Framework (DMF) is embedded within this process and involves taking the need from the final WINEP and assessing all available options to achieve the best value outcome within cost constraints provided. Challenging the robustness of the cost based on the design and ensuring cost efficiency is built into the planning process. Figure 2.5 below shows our overall process from need through to authorisation to deliver the scheme.

Figure 2.5 Decision Making Framework Process



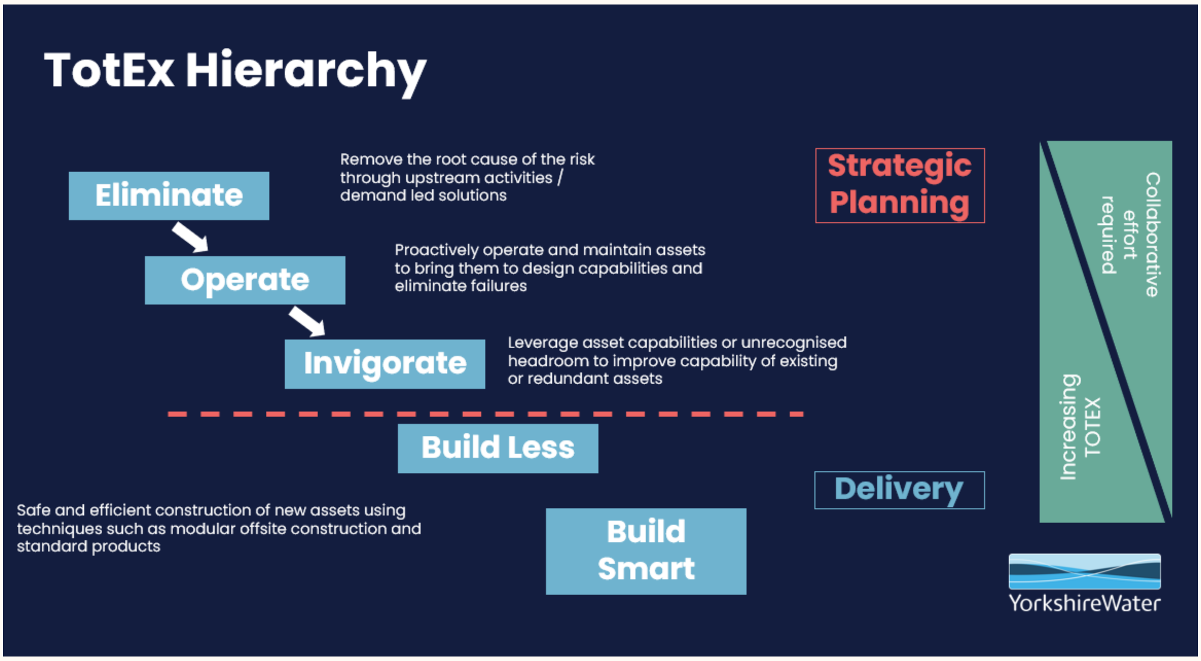
2.4.2 Investigation and optioneering phase

All 80 limits requiring action were entered into the investigation and optioneering phase of our delivery process. We worked closely with our Strategic Planning Partner, Stantec, and the Environment Agency to assess the range of possible options to deliver our obligations for best value within our Totex constraints.

The decisions made at this stage on the solution type impact our ongoing operating costs and hence the value of the claim.

We deploy the totex hierarchy in all our decision-making. Our philosophy, guided by ensuring a low carbon approach where possible and providing best value for money to customers, is to find ways to minimise the construction of new assets to provide better value. The totex hierarchy we deploy is shown here in Figure 2.6.

Figure 2.6 Totex Hierarchy



Using this hierarchical approach to totex the following intervention types have been assessed for AMP7 delivery:

Catchment Permit Trading – this is a minimise build approach which involves working with the Environment Agency to manage the overall river water quality objectives set out in the Water Framework Directive (WFD) by reviewing and amending permit limits (e.g., including dry weather flow sacrifice and permit trade), ultimately resulting in at least an equal benefit to the watercourse. This approach minimises construction of new assets and therefore additional operating costs in the future providing more sustainable, long-term solutions. We have been able to deploy this approach at several sites by optimising the requirement against flow leading to a less stringent limit required, therefore reducing the opex requirement. This option is only available for WFD drivers.

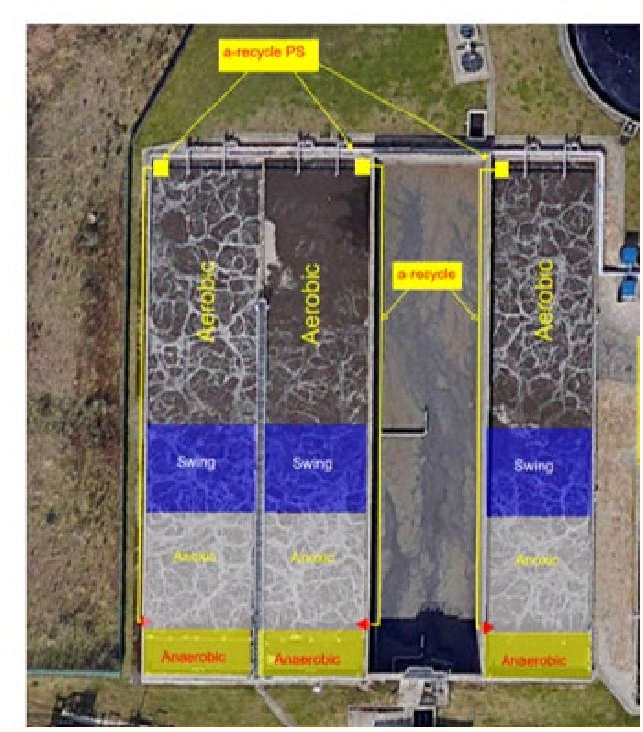
Nature-Based Solutions – Where suitable land allows, and treatment load is relatively small, there is the option to install a nature-based solution such as a treatment wetland. Wetlands involve a slow rate natural process of removing P over a long period of time. A good example of this is our Clifton site near Doncaster – shown in Figure 2.7 below. The option has multi long-term sustainable benefits offering a low carbon solution, low operating costs, increased biodiversity and provides an amenity for the local community.

Figure 2.7 Clifton Wetlands – Low Carbon and Opex Solution

Sewering Out – where two wastewater treatment works are close to each other there is the option to close the upstream site down and send (pump or gravitate) the influent to the next treatment site downstream. This can save large amounts of capex and opex by combining two requirements into one site, providing good value to customers and cost efficiency. The receiving wastewater treatment site will then be subject to the same options assessment as other sites. This option is available for both drivers.

P-Removal through Biological Processes – this is an alternative P-removal process which includes zoning off various parts of the process into aerated and non-aerated compartments (shown in Figure 1.8 below) and using chemicals, but to a lesser extent than full chemical removal. The process can provide a better long-term value solution than standard chemical removal but is only cost-effective where there is an existing activated sludge process. The process incurs high capex, however, and whilst it often presents better long-term value it may not be affordable within short-term Totex constraints. YW completed extensive cost assessment of this at PR19. This option is available for both WFD and UWWTD drivers.

Figure 2.8 Biological Treatment Process Example



P-removal through chemical precipitation – this is the standard P-removal process which involves using a suitable chemical e.g. Ferric Sulphate to bind to the P and precipitate it out of the effluent. A tertiary solids capture unit may also be installed where required to capture the extra solids. Additional chemical may also be used to correct for water alkalinity. The process is relatively low in capex but high in opex and provides limited environmental benefit outside of removing the P from the final effluent. The option is available for all drivers.

Soneco –As an alternative to chemical dosing, an electro coagulation process made from specific metals can be used to treat the water. The process can be used for all drivers and reduces the overall need for chemical and therefore opex.

We use our DMF to assess the suitability of all options available at each site. The DMF considers costs and benefits in the short and long-term and incorporates our six capitals approach.

Table 2.6 below summarises all the optioneering we did for AMP7 delivery in this phase. It includes a comparison between the planned solutions at PR19 and what is now being delivered.

Table 2.6 Phosphorus Solutions Considered and Savings Identified

	Full Chemical Removal	Biological nutrient removal	Sewering Out	Wetland Option	Catchment Permit Trading	Soneco	Opex Savings from PR19 FBP
No of sites in PR19 (FD)	71	7	3	0	0	0	
No. sites assessed*	81	20	10	10	15	10	
AMP7 Solution	66	1	2	4	2	5	**£4.1m**

*Number of sites for which each solution type was considered (in design & feasibility stage)

Despite some non-best value decisions being required to deliver our programme within our AMP7 allowances, this totex hierarchy-led optioneering process has generated savings of £4.1m Opex per year which have been removed from our costs shown in Table 2.5.

2.4.3 Design Phase

After the concept phase, the chosen outline solution was designed by our Strategic Planning Partner - Stantec. Stantec bases an outline design on a high-level indicative site layout to enable the delivery partner to confirm costs. Stantec undertakes a buildability review looking at site layout, tanker access, following design guidance and standard designs from the Engineering Team e.g. dosing kiosks. Where necessary additional expertise was sourced to outline design more bespoke solutions such as EBPR, Soneco and Wetland interventions.

2.4.4 Costing

As designs become more detailed this allows us to get more detailed and accurate costs. This included both capital costs using our established UCD process and our operating cost approach which aims to identify the operating cost impact of the designed solution.

Our Opex costs are completed for each scheme at the level shown in Table 1.5 with each key cost category being assessed using a range of methodologies at the best level of detail available at the time.

We have used our bottom-up costing tool within our decision-making framework system (EDA) where possible to estimate the costs. Where bottom-up outputs were not available we used expertise from our strategic planning partner Stantec to estimate the costs. The below sections describe more detail on each of the cost categories.

Chemicals

Chemical usage rates have been calculated using internal design guidance, specifically ‘Chemical Dosing for P-removal design guidance’. These calculations consider; existing site technology type, site population equivalent (PE) and permitted dry weather flow (DWF). All estimates are based on theoretical per capita loading and molar dose ratios as defined in the guidance.

All solutions have been designed and costed to achieve compliance for a forecast 2035 population equivalent.

Our chemical unit prices were sourced from our chemical framework procurement process. The framework provides contractual guarantees on price to ensure costs are efficient and as part of the contract we use Ernst and Young annually to verify our rates are efficient.

Energy/Maintenance/Business Rates

For all sites, energy, maintenance and business rates requirements for the chemical dosing and tertiary solid capture were calculated by Stantec based on a mixture of bottom-up detail and top-down assessments where relevant to the cost type. All solutions have been designed and costed to achieve compliance for a forecast 2035 population equivalent.

The assets that are costed included dosing systems or ‘package’, mixing systems, safety showers and water booster package where available. Rateable assets include civils assets such as storage tanks. Maintenance is applied to M&E assets.

Key values for the assessment used are:

- **Energy / Power** – Assumed a 26p/kw hour for power consumption (KW requirements assume a 75% loading rate, a 60% average use factor, and 90% overall pump efficiency for M&E Assets).
- **Maintenance** - 2.44% of total M&E capex (where applicable) is applied as the annual rate for maintenance.
- **Business Rates** - 0.04% of the total civils capex (where applicable) is applied as the annual rate for business rates.

The labour estimated included an assumption on time based on an Optimiser role as well as a time-based assumption on a Senior Operator role, with cost rates based on YW bands and SAP rates. The time required per site per week includes travel time, and is based on information from AMP6 delivered activity.

Sludge

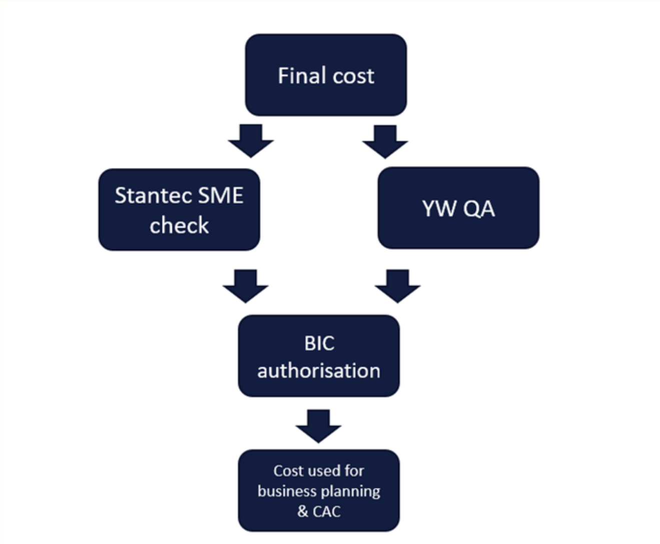
We have estimated our sludge costs based on the additional load that these processes are anticipated to.

We then use have used our internal cost models to understand the additional sludge operating cost impact. We do not however set these out here as these costs do not form part of this claim.

2.4.5 Assurance and corporate governance

The decision on the final designs and subsequent cost calculations were presented and authorised through our corporate governance process on 22 November 2022 (Board Investment committee). This followed a process of internal YW quality assurance and external review from a Stantec subject matter expert. Figure 2.9 below summarises our assurance process for costs

Figure 2.9 Cost and Solution QA and Assurance Process



The latest view of the costs are now reported in Table 7F of our APR submission, used for our programme planning, and inform the size of this claim.

2.5 Best Option for Customers

The WINEP programme undergoes CBA by the Environment Agency and we have ongoing discussions on how compliance with the specified sites will be achieved. The above optioneering work described sets out how we have identified the most efficient solutions to meet the requirements of the WINEP for P Removal.

The design and optioneering of these schemes have been completed and the new processes will be built by March 2025. The cost adjustment claim is for the expected ongoing operational costs with these agreed solutions so the 'best option for customers' criteria is not directly applicable to these costs.

2.6 Calculating the Claim Value

As shown earlier in Figure 1.4, historical P-removal activity is very low across the industry at the tightest consent levels. Table 2.7 below shows the shares of load treated at P-consent levels below 0.5mg/l and above 0.5mg/l, respectively (during the past five years, and as forecast for AMP8), the weighted average of these as well as the calculation of the implicit allowance. We use operational insight that opex associated with P-removal at consent levels below 0.5mg/l is approximately three-times as expensive opex associated with P-removal at consent levels above 0.5mg/l, to assign weights to both measures.

Table 2.7 Calculation of share of claim beyond implicit allowance

P-removal activity corresponding to consent levels:	<=0.5mg/l	>0.5mg/l	Weighted average
weights (relative costs based on bottom-up evidence)	3	1	
YW's current level of P-removal activity	1.0%	2.5%	1.4%
Industry average level of P-removal activity	2.0%	29.8%	9.0%
YW's AMP8 forecast level of P-removal activity	56.3%	21.3%	47.5%
% of claim relating to meeting implicit allowance			**16.4%**
% of claim going beyond implicit allowance			**83.6%**

Note: YW's current and the implicitly funded level of P-removal activity refer to 2018-2023 averages. Forecast share refers to YW's forecast value for 2026. P-removal activity is defined as the share of load treated at P-consent levels ≤ 0.5mg/l

Source: Oxera analysis of PR24 Cost Assessment Master Dataset, Wholesale Wastewater Base Costs v4. and APR23.

The table shows that the weighted average of YW's load treated at P-consent levels is currently 1.4%. Given that the industry average of 9% is implicitly funded, YW is currently overfunded in terms of its P-removal activities. However, YW forecasts its weighted average load treated at P-consent levels to be 47.5% in AMP8. This means that 16.4% of YW's gross claim relates to meeting the implicit allowance, while 83.6% goes beyond it.

We have calculated the gross claim per year by our bottom-up estimate of opex relating to P-removal activities. This reflects the estimated additional expenditure required by YW to meet the more stringent P-consent requirements. Table 1.9 below presents how a net claim value over 5 years can be calculated from this.

Table 2.8 Calculation of Claim Value

	in £ million
Gross claim p.a.	**26.344**
Net claim p.a.	**22.019**
Net claim over 5 years	**110.097**

The gross claim reflects our bottom up build of costs as set out in Table 2.5 (however, some of this gross claim value (c. 16.4%, see Table 1.8) reflects costs associated with YW 'catching up' to the level of P-removal currently implicitly funded through the models. The net claim is calculated by multiplying the gross claim value (£26.34m p.a.) with the share of the claim going beyond the implicit allowance (83.6%). Based on this analysis, the net claim amounts to c. **£22.0m per year, or £110.1m** over a five-year period.

2.7 Economic Benchmarking – Empirical Analysis

Section 2.4 sets out in detail the approach we have taken to designing our solutions and understanding the ongoing operating costs. However, to support this, we have worked with our economic consultancy partner, Oxera, to develop econometric evidence on the efficiency of our costs.

Oxera has taken two approaches to assess what could be considered an industry level efficient cost:

- Firstly, it has used the data submitted by companies in APR table 7F to assess an efficient unit rate for the ongoing operating costs associated with additional treatment of phosphorus in the AMP7 WINEP.
- Secondly, it has explored the impact of including a composite complexity variable involving P-removal in the base cost modelling. It has completed further analysis to confirm its assumptions in the weighting of P-removal in the complexity variable using the data submitted by companies in APR table 7B for large treatment works. Insights from this have been used to confirm operational insights into the relative costs of P-removal and ammonia-removal (and other complexity measures).

These are described in detail in a separate Oxera CAC Appendix. The calculations will be made available in the accompanying datasheets and can be provided upon request. We have updated all of this modelling to reflect the latest data in APR2023.

More detail on this subject can be found in **Oxera cost adjustment claims analysis appendix**

Table 2.9 Summary Table of Oxera Model Findings

	Net claim value (£m p.a.)
Analysis based on APR tables 7F	19.76
Ofwat proposed models with added composite treatment complexity variable	40.79
YW' bottom-up estimate	**22.03**

Source: Oxera analysis.

Oxera's analysis considers the reasonable range for a cost adjustment claim based on P-removal to be in range of **£19.76m** to **£40.792m** per year. YW's bottom-up estimate of **£22.03m p.a.** is consistent with the efficient end of this range.

2.8 Symmetrical Adjustments

In theory, the cost adjustment claim can be symmetrical as companies could undertake future P-removal activities below the implicitly funded historical average. However, forecast data indicates that all companies expect to significantly increase their P-removal activities in the coming years, due to tightening P-consent levels. In practice, we do not expect many companies to be affected by negative cost adjustments due to this claim.

2.9 Customer Protection

Whilst we are investing to complete our construction at all 80 sites by December 2024, we propose a protection mechanism for this cost adjustment claim to protect customers if any schemes are delivered late.

We propose to use the reported values in Table 7F of the APR which contains a value for operating expenditure 'after 2024-25'. See Figure 2.10 below.

Figure 2.10 APR Table 7F

Pro forma 7F

Yorkshire Water

Wastewater network+ - WINEP phosphorus removal scheme co

B	C	D	L	M	N	O	P	Q	R	S
				Operating expenditure						
	Units	DPs		2019-20	2020-21	2021-22	2022-23	2023-24	2024-225	After 2024-25
Ackworth WwTW	£m	3		0.000	0.000	0.000	0.000	0.011	0.092	0.092

We propose a mechanism where we would return a proportion of the annual operating costs associated with each late delivered scheme based on the number of months late (rounded up to the nearest month). Where 'late' is defined as not achieving the compliance date (December 2024 or March 2025).

For example if Ackworth were delivered 6.5 months late we would return 7/12 x £0.092m = £0.0536m. If it were delivered 15 months late we would return 15/12 x £0.092m = £0.115m

We would welcome engagement with Ofwat on the suitability of this mechanism before final determinations. We would propose that the most up to date APR table 7F available is used to set the rates as there will a further iteration of this table before final determination.

2.10 Data Table Commentary

	Title	Commentary
CWW18.1	**Description of cost adjustment claim**	The base cost impact of YW's AMP7 Phosphorus Removal Programme unfunded through base modelling
CWW18.2	**Type of cost adjustment claim**	We have assigned this to 'new legal requirements' as the claim is for the costs to maintain compliance with new legal requirements not in the historic dataset.
CWW18.3	**Symmetrical or non-symmetrical**	This is a forward-looking claim and therefore non-symmetrical.
CWW18.4	**Reference to business plan supporting evidence**	Refers to this document as this is the Early submission.
CWW18.5	**Total Gross Value of Claim**	We populate the gross value of the claim to align our costed ongoing operating costs excluding Sludge. We do not populate claim values for the period 2022-25 as we assume that any operating costs in this period are allowed for through the PR19 Totex allowance.
CWW18.6	**Implicit Allowance**	This has been calculated as set out in Section 1.5 above
CWW18.7	**Total Net Value of Claim**	Calculated from above two lines
CWW18.8	**Historic Base Expenditure**	The investment to address these new obligations has only begun in AMP7 with the first operating expenditure seen in 2021/22 so we have not included historic base expenditure for years prior to this. A small value (as reported in APR table 7F Column O has been reported in 2021/22) as the first small schemes with early compliance dates have been delivered.
CWW18.9	**Totex for the control**	We are not required to populate Totex value but include a WWN+ value
CWW18.10	**Materiality**	N/A We note that the size of the claim is significantly higher than 1% of WWN+ Totex historically.

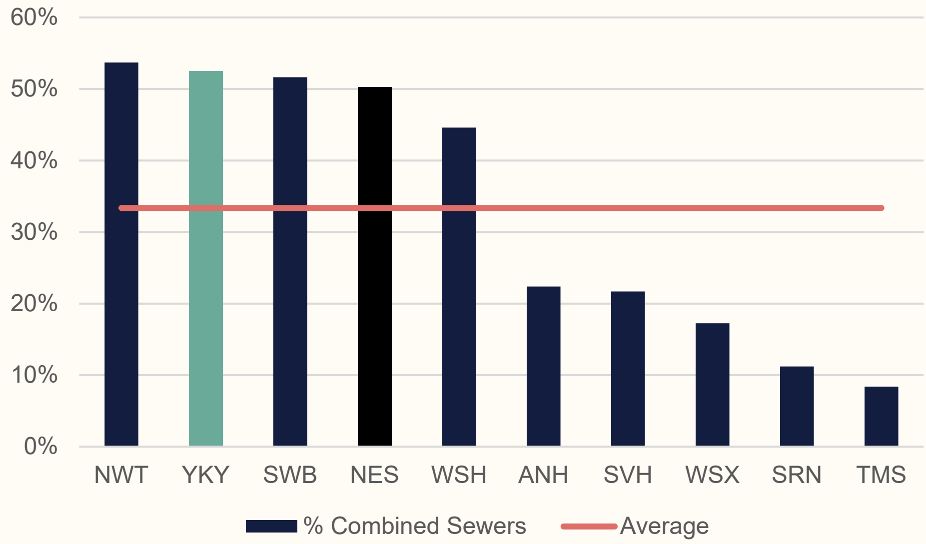
Table 2.10 Data Table CWW18 - Cost Adjustment Claim - Commentary

3. CWW02 – Combined Sewers

3.1 Executive Summary

This document sets out the case for an upward adjustment of £**17.62m p.a. (£88.2m** over the 2025-2030 period) of costs for operating and maintaining a wastewater (WW) network with a materially higher proportion of combined sewers than the industry average (Figure 3.1).

Figure 3.1 Industry proportion of combined sewers (legacy assets)



Combined sewers carry both foul and surface water and hence are more susceptible to cause sewer flooding and overflow spills than separated systems. We believe this drives significant differences between the level of performance companies are achieving. Also, following the decision to set common internal sewer flooding performance commitment levels, this materially impacts the costs that impacted companies are incurring as they implement operational strategies to minimise penalties.

Cost Adjustment Claims (CACs) are in place to capture company-specific factors not reflected in Ofwat's econometric base models. We believe that there are a variety of factors that impact our internal sewer flooding (ISF) performance that may have led to this CAC being larger, but the Percentage of Combined Sewers is the factor that is both supported by economic and engineering rationale and by robust high-quality data available in Ofwat's PR24 dataset.

The value of this claim is driven by the difference between the inclusion and exclusion of this driver in Ofwat's base econometric models. This calculated value does not provide YW with sufficient allowance to overcome the differences in operating circumstances that impact on performance levels (current relative performance is not included in the models) but it describes the cost impact of this factor given the current performance differences (excluding penalty payments).

Customers will benefit from the adequate funding of the sewer network as we will be better able to invest in the services we deliver and to deliver the stretching PCs set out in our plan.

This claim is supported by a detailed analysis document completed by Oxera which can be found in the Oxera cost adjustment claim analysis appendix.

More detail on this subject can be found in **Oxera cost adjustment claim analysis appendix**

We have updated this claim from that submitted as part of the early CAC submission in June 2023 by incorporating the latest APR data into the analysis.

Table 3.1 below points to the locations in the document where we address Ofwat's cost adjustment claim assessment criteria.

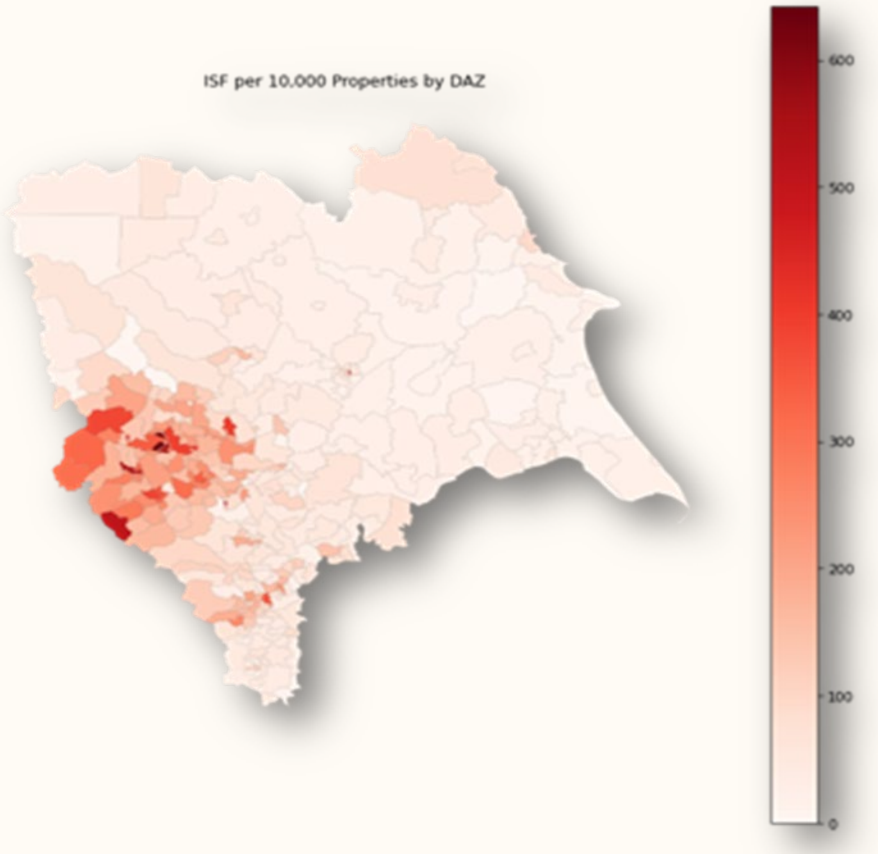
Table 3.1 References in Document to Ofwat's Cost Adjustment Claim Criteria

Cost Adjustment Claim Assessment Criteria	Sections
Need for adjustment	3.2, 3.3, 3.5
Cost efficiency	3.4, 3.6
Need for investment	3.2
Best option for customers	n/a
Customer protection	3.9

3.2 Introduction

Without accounting for regional differences, Yorkshire Water has both overall poorer performance and higher costs than the industry average in its wastewater networks. The performance (and therefore cost) issues are not however spread evenly across our region and are primarily focused in the far west as shown for internal sewer flooding incidents in Figure 3.2.

Figure 3.2 Geographical representation of Internal Sewer Flooding per 10,000 properties in individual Drainage Area Zones



Our analysis shows that the cost of operating a sewer network within a fixed performance envelope is directly impacted by a variety of exogenous factors that have historically not been captured in Ofwat's econometric modelling. These include, but may not be limited to:

- the prevalence of **combined sewers** – sewerage and surface water entering the same system.

- the propensity of the area to experience blockages (e.g**. food service establishments** adding fats, oils and greases to the sewer network).
- the prevalence of **cellared properties** impacting internal sewer flooding).
- the **age and material of the network** (exogenous in the short and medium term) increasing the propensity of a sewer to block (due to a combination of minor imperfections and solids from the toilet naturally depositing on the invert) and collapse.
- heavy rainfall in urban areas – meaning more surface water requiring removal.

These factors work in tandem to materially impact company cost and performance in sewage networks (and at the receiving STW assets.). An event (for example an internal sewer flooding) is often the culmination of factors – an example causal flow is set out below.

- A rainfall event meaning there is water landing on roofs and roads that enter the sewerage system.
- A combined sewer which means that sewerage and rainwater are carried into the same system.
- A partial blockage of the sewer due to the natural deposition of solids (e.g. wipes) that catches on slight gap between pipes (e.g. 2mm) that leads to further solids collecting and when combined with rainfall leads to an escape.
- A property with a cellar which receives the escaped diluted sewage.

We believe that Yorkshire Water is impacted by all the above factors in a way that negatively impacts both our costs and performance in sewerage networks. See Figure 3.3

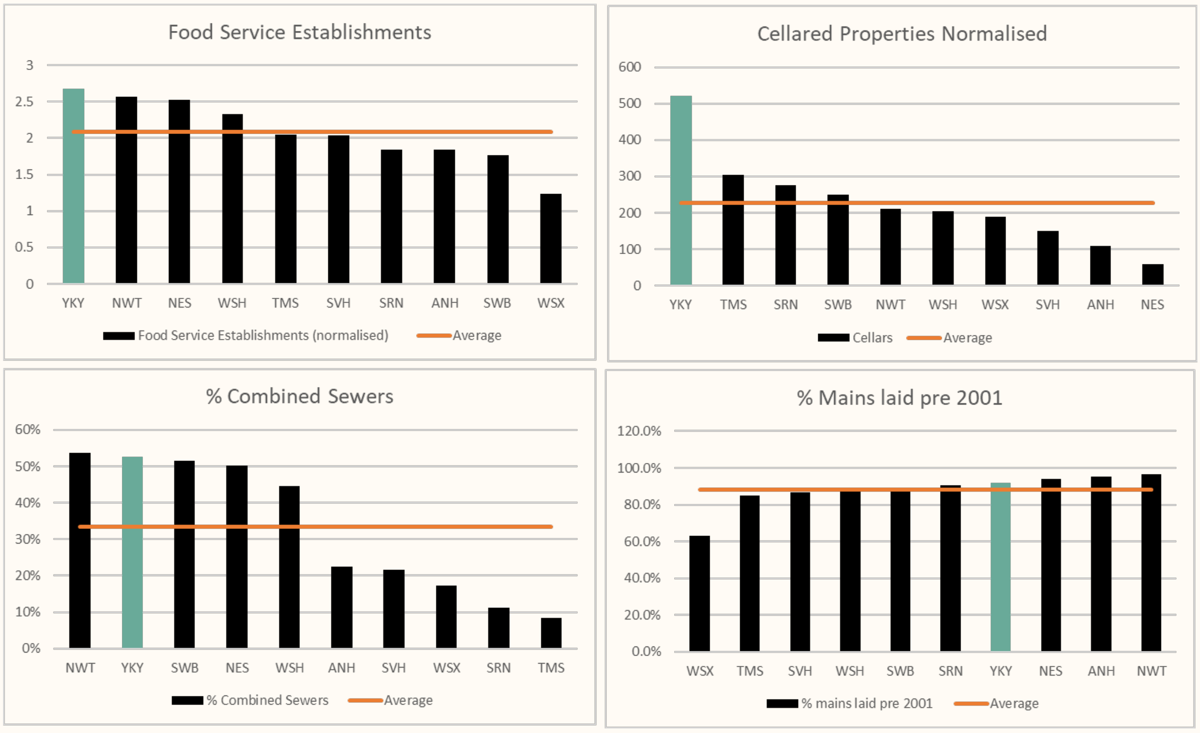


Figure 3.3 Industry comparison of key factors influencing network performance

We believe that all the above factors in combination lead to the overall higher costs and lower relative performance experienced by Yorkshire Water in managing its network performance. For this cost adjustment claim, we have focused on percentage combined sewers, because: (i) it is an operationally relevant driver of expenditure that can readily be incorporated into Ofwat's cost models; (ii) it performs well in such models from a statistical perspective; and (iii) the data is readily available in Ofwat's PR24 cost modelling dataset.

We are also developing an evidence base that demonstrates that the current performance differences in internal sewer flooding (not reflected in the cost models) are driven by multiple combination of exogenous factors and that it is appropriate to adjust PC targets to reflect exogenous factors where it is in customers' interest to do so.

Potential Overlap with Performance Target Adjustments

Whilst it may intuitively look like there is an overlap with this claim and the evidence provided for adjusting our performance targets, we do **not** consider this to be the case.

The cost models are built on historic expenditure data which is independent of relative company performance and therefore solely reflect the cost differences between companies at current (and historic) performance levels. Companies with high CS% see higher costs (accounted for in the models) as well as poorer performance (not reflected in the models).

The performance models adjustment therefore solely account for the observed performance differences between companies, independent of cost allowances.

3.3 Combined Sewers – The Basis of our Claim

Many sewer systems were designed to carry stormwater and wastewater in separate pipes. However, in older towns and cities, combined sewers were commonly installed. This practice was stopped for new development post-World War II.

A key challenge associated with combined sewers compared with separated sewers is that when it rains, stormwater and wastewater flow into the combined sewer system simultaneously. In heavy rainfall events, this can lead to the system exceeding its designed capacity (hydraulic flooding), but more commonly the sewer does not have the capacity to convey the surface water from smaller rainfall events when there is a blockage (which does not have to fully block the pipe) or partial collapse. This event leads to flows backing up.

Depending on the location of these events, it can cause internal and external sewer flooding, and property damage, and poses a risk to public health and the environment.

The combined sewers, when built, were not designed to withstand a consistent rainfall return period, unlike newer developments which use drainage models to inform their design.

To manage hydraulic overload in the combined sewer network, pre-privatisation storm overflows were built to protect the main sewer network from flooding. Typically, since privatisation, new storm overflows have not been built and additional infrastructure, such as storage tanks, has been required to temporarily store and divert excess flows, increasing the complexity and cost of the sewer network.

A further challenge is that the age and location of the combined sewers that receive wastewater and surface water in and around properties leads to more flooding. For example, the formation of more partial or full blockages leading to flooding. Proportionally, flooding occurs significantly more from combined sewers than foul sewers, compared with our combined sewer and foul sewer percentage split.

The below diagrams (Figure 3.4 and Figure 3.5) show analysis across Yorkshire Water's Drainage Area Zones (DAZ) on normalised ISF performance and percentage combined sewers. Figure 3.4 shows the raw data and Figure 3.5 a more detailed analysis showing this relationship at YW. In this the drainage area zones are clustered into 10% bands and the box and whisker graph shows the increasing trend of ISF incidents as zones progress through the bands.

Figure 3.4 Data points %CS v ISF in each YW Drainage Area Zone

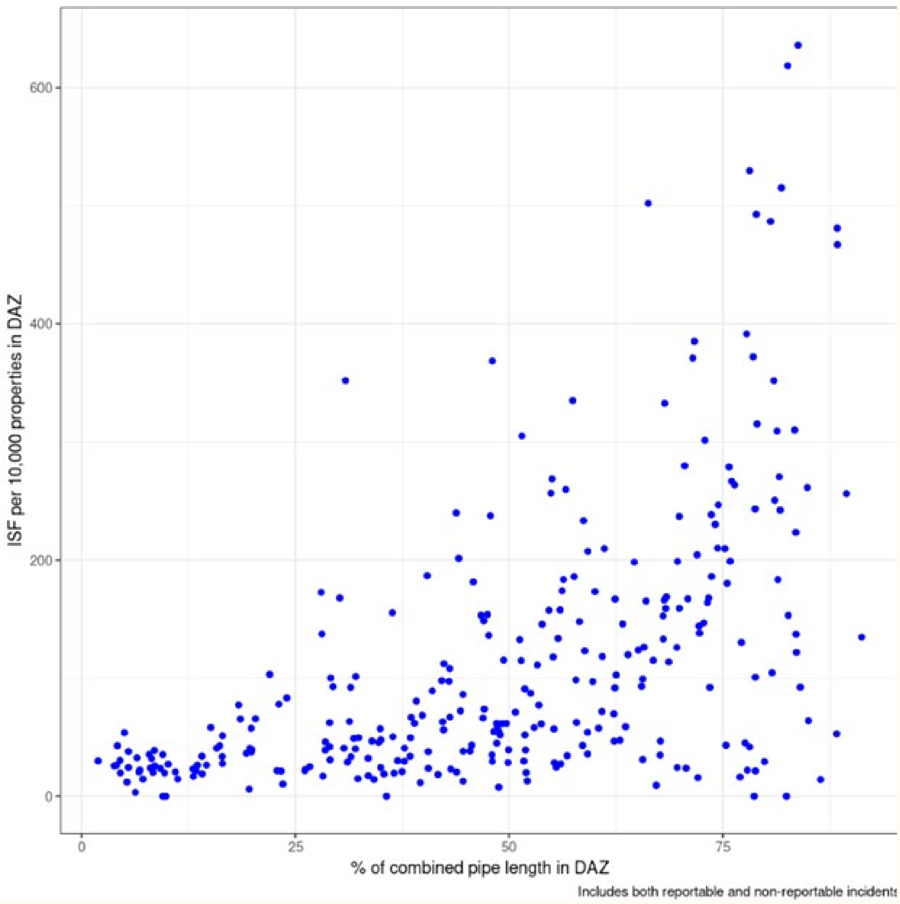
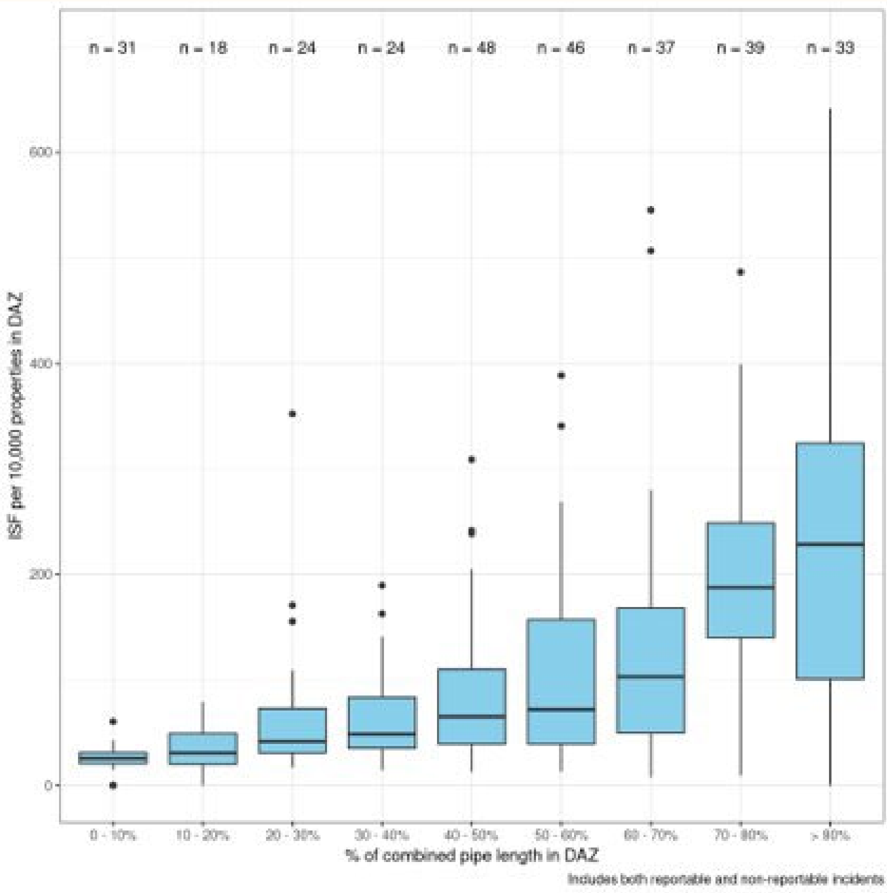


Figure 3.5 YW %CS v ISF Further Analysis



Several companies submitted models that control for combined sewers as a cost driver in the PR24 modelling consultation. However, Ofwat assessed that its inclusion could ‘perversely incentivise companies not to separate sewers into surface water and foul’[1]. Therefore, Ofwat prefers to use another cost driver, namely urban rainfall, and argues that it captures a similar impact while qualifying it as being more exogenous in nature.

The main benefit of combined sewers as opposed to separate systems is that there is less network to maintain and replace. This is already accounted in the cost modelling by the use of sewer length as a scale driver.

Ofwat’s arguments for exclusion of combined sewers are incorrect as:

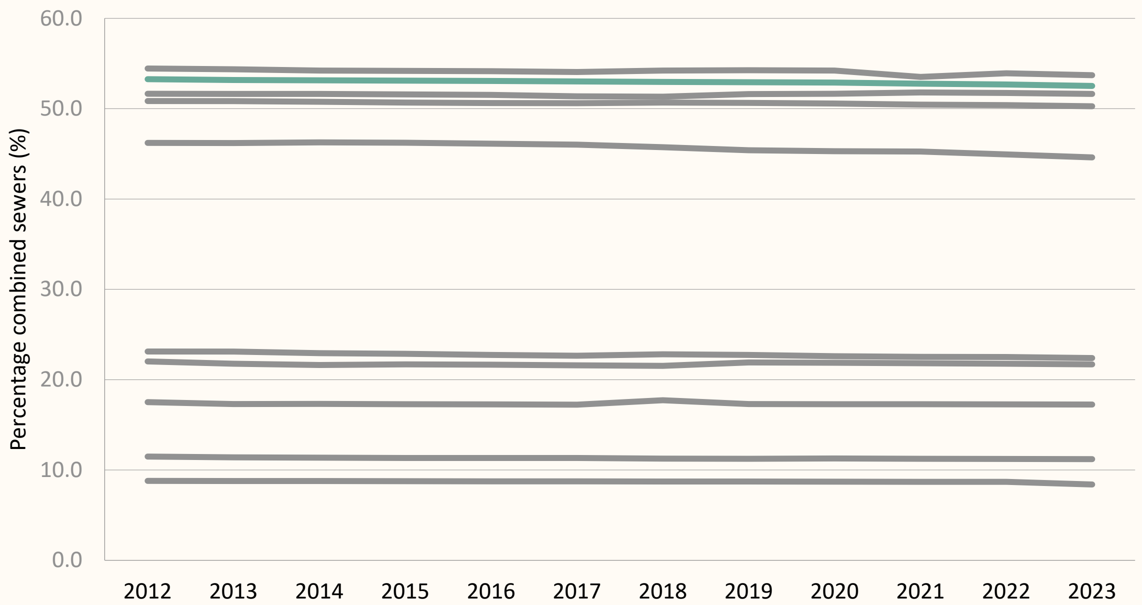
(i.) Companies cannot influence their asset base in the short run.
(ii.) Urban rainfall is not a substitute driver for combined sewers to explain sewage flooding, storm overflow performance and costs. Each driver captures a different characteristic (i.e. the inclusion of urban rainfall in the cost models does not preclude the inclusion of combined sewers as an additional driver).

On the first point, Ofwat uses ‘asset-based’ cost drivers across its modelling suite, where companies have some control of the driver in the long run but not in the short run, including:

- the length of the water network in Ofwat’s TWD models; and
- the length of the sewer network in Ofwat’s SWC and WNPW models.

We consider Ofwat’s argument that companies may be incentivised to invest in combined sewers to receive higher cost allowances to be unrealistic. In the current context, combined sewers are associated with higher costs, yet these high costs are not reflected when setting cost allowances. Therefore, if combined sewers were indeed endogenous in the short run, companies would have had strong incentives to reduce the percentage of combined sewers of their asset base to perform better in the cost assessment models.

Figure 3.6 Evolution of the percentage of combined sewers over time



Note: YWS is highlighted in green.
Source: Oxera analysis.

[1] ‘Econometric base cost models for PR24’ Ofwat. April 2023. p. 45.

The evolution of the percentage of combined sewers in the last eleven years of available data is very small, with 8 of the 10 wastewater companies showing a change smaller than one percentage point in this period. Therefore, the extent to which companies will have any substantial control and, by implication, the extent to which the models may lead to perverse incentives, is limited.

The stability of combined sewers levels is not a choice for companies as replacing combined sewers with separate systems piecemeal is not an option. Large proportions of a network would need redesigning and replacing at once or in substantial stages – over multiple AMPs.. If we have a collapsed combined sewer, it cannot just be replaced with a separated sewer as it needs to match with the surrounding sewers, which are likely combined.

We would need to replace c.10,000km of combined sewers with separated systems in order for our network to match the average combined sewers of the industry. This would cost billions

The new obligations and performance commitment related to spill frequency provide companies with further incentives not to increase the lengths of combined sewers. Companies are investing significantly to keep water out of the network as a primary option (through SUDs etc.) rather than extending the combined sewer network and creating additional challenges to downstream compliance.

We typically invest in smaller lengths of the higher risk sewers and as we are not redesigning whole sewerage systems, it would also not be economic or in our customers' interest for us to do so.

On the second point, Ofwat argues that the inclusion of other cost drivers, such as urban rainfall, has a similar impact to the inclusion of percentage of combined sewers.[2] The rationale behind Ofwat's argument is not clear, but we consider that Ofwat may have applied the following logic:

1. Combined sewers are more prone to sewer flooding. As such, the costs associated with having combined sewers are typically related to dealing with sewer flooding.
2. Urban rainfall is also intended to capture (among other things) the costs relating to sewer flooding.
3. As there is already a cost driver that captures a characteristic that leads to increased sewer flooding (urban rainfall), there is no need to include another cost driver that also captures costs associated with increased sewer flooding (combined sewers).

This line of reasoning is incorrect. The observation that urban rainfall increases sewer flooding says nothing about whether combined sewers also increase sewer flooding — the two cost drivers are not intrinsically related to each other, nor can they be treated as proxies or substitutes. Two companies that operate in a region with similar urban rainfall may experience different levels of sewer flooding depending on the composition of their assets (e.g. the number of combined sewers). Similarly, two companies that operate a similar composition of assets may experience different levels of sewer flooding depending on the level of urban rainfall. We note that Ofwat controlled for both population density and STW size in its bioresources models at PR19, despite the fact that both cost drivers were intended to capture different aspects of the cost-impact of STW-level economies of scale.[3]

We also noted in our base cost consultation response Ofwat's comment that the 'variable does not take into account that the volume of rainfall may differ within a company's operating area'. This is crucial in our understanding of the risks of escapes in our region. As seen previously in Figure 3.2 it is the west of the region where we experience the greatest service issues, and this

---

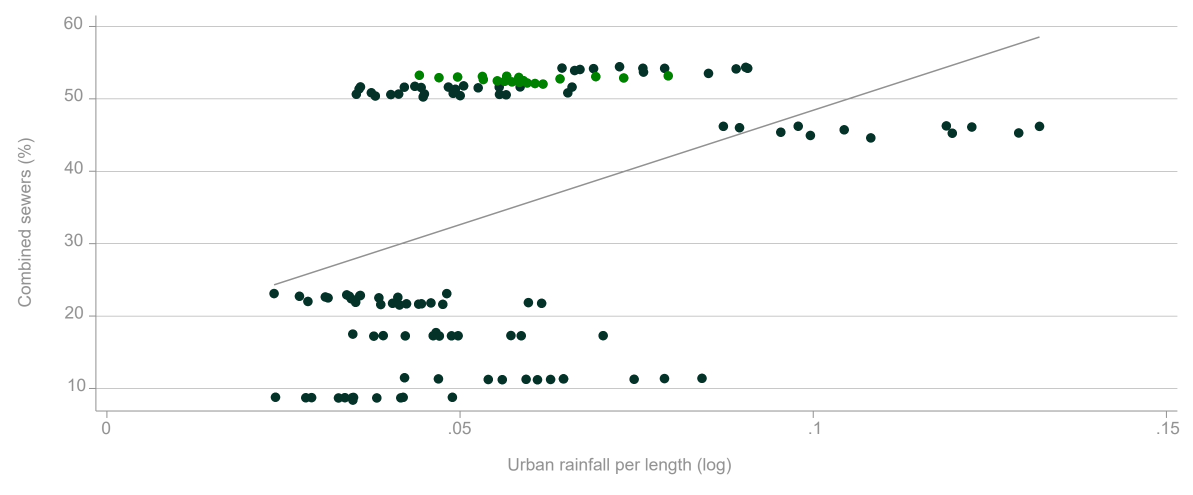
[2] Econometric base cost models for PR24' Ofwat. April 2023. p. 45.
[3] See Ofwat (2019), 'PR19 final determinations: Securing cost efficiency technical appendix', December, Table A2.2. Note that Ofwat has presented similar models as part of the PR24 modelling consultation. See Ofwat (2023), 'Econometric base cost models for PR24', April, Table 7.15.

is where we have significantly higher daily rainfall. The east of our region performs relatively well but is much more sparsely populated and much drier.

We believe that Ofwat's urban rainfall driver could be improved to be more granular to capture where the rainfall occurs, and to effectively account for the size of surface connected to each sewer and hence the additional flow carried.

Figure 3.7 below shows the correlation between urban rainfall and combined sewers in the last eleven years.

Figure 3.7 Relationship between percentage of combined sewers and urban rainfall (2012-23)



Note: The dots represent each company's average for the last 11 years of data. YWS is shown in green. The trendline is shown in a dotted grey line.
Source: Oxera analysis

The chart shows that urban rainfall and combined sewers should not be seen as substitute cost drivers. Although there is some correlation between the urban rainfall and combined sewers, urban rainfall dos not capture the variability present in combined sewers. Therefore, urban rainfall cannot be considered as a 'substitute' or a 'proxy' for combined sewers. In the case of YW, the percentage of combined sewers is significantly higher than its level of urban rainfall would suggest (i.e. it is above the regression line). Therefore, failing to account for combined sewers will lead to biased outcomes for YW.

Figure 3.8 Percentage of Combined Pipes by DAZ

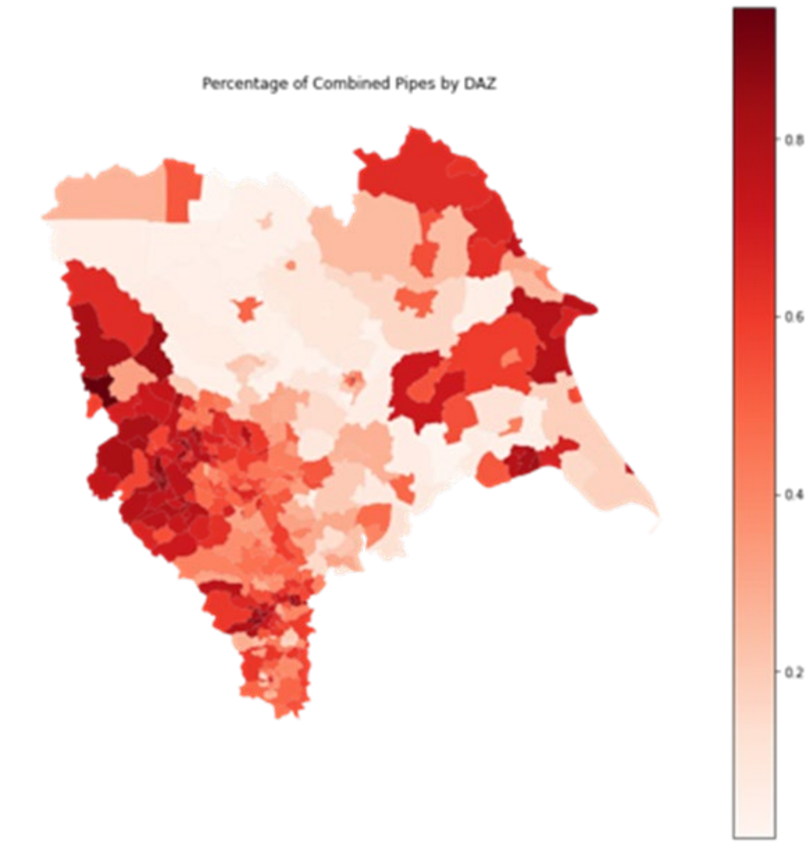
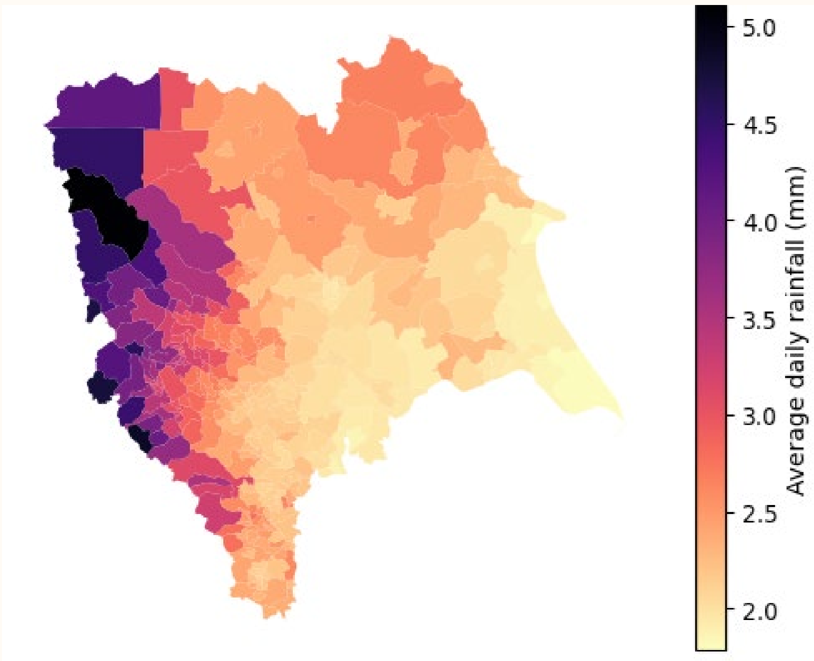


Figure 3.9 Rainfall by DAZ (01.01.2020-31.03.2023)

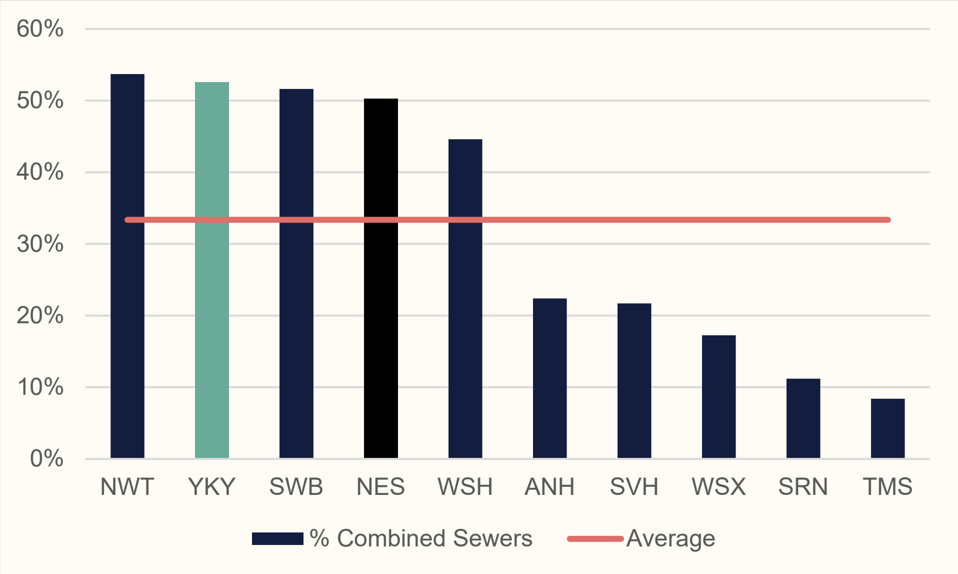


Visually this can be seen in Figure 3.8 and Figure 3.9 above where it is the combination of combined sewers and rainfall location within the region that drive the service issues represented in Figure 3.2.

3.4 Why is an adjustment required?

Figure 3.10 shows the percentage of combined sewers for each of the companies offering the wholesale wastewater service. YW stands out second in the industry with c. 53% of combined sewers, behind NWT with 54%. In contrast, the industry average is c. 34%. This implies that our percentage of combined sewers is around 20 percentage points above the average.

Figure 3.10 Industry proportion of combined sewers (legacy assets)



Note: The chart shows the average percentage of combined sewers for each company in the last five years (2018–22). The industry average is shown in a dotted grey line.
Source: Oxera analysis.

We have used legacy assets to develop these percentage values. We do not have industry data to estimate the splits between combined, foul and surface water for adopted assets (c. 40% of our assets) and hence we believe the most appropriate assumption is to assume the splits across legacy assets are proportional across the whole sewer asset base.

We believe the combination of a nationally available, accepted data set, industry level analysis, and internal YW evidence, alongside the economic rationale set out in section 3.6, mean that % Combined Sewers is the most appropriate factor to include in a Cost Adjustment Claim at this stage.

3.5 Cost Efficiency

Yorkshire Water has optimised and invested significantly in recent years in order to maintain and improve internal sewer flooding. We are confident that, whilst we can continue to improve, we are not doing anything substantially different to the rest of the industry. It is the exogenous factors discussed above that explain our cost (and performance) positions.

We describe below some of the initiatives and investment we have undertaken to drive service improvements in recent years.

As part of our plan to improve sewer flooding performance from AMP6 to AMP7, we developed processes to reduce internal flooding other causes in discrete, higher risk zones across our region (e.g. targeting cellared properties for internal sewer flooding) as well as significantly increasing proactive sewer network investigation CCTV and increasing repair programmes of work supported by the introduction of larger scale defects rectification programmes for more complex solutions.

We insourced all non-civils work into the business in May 2019 and purchased additional vans, CCTV units and tankers. This allowed us to spend longer investigating individual jobs, therefore providing a better-quality service with more detailed investigations meaning improved raising of follow-on work, which in turn leads to less re-work.

During AMP7 we have engaged with multiple WASCs including Northumbrian Water, United Utilities and Severn Trent Water to identify commonalities in driving improvements in operational efficiency; learning that we are implementing many similar initiatives.

Key activities implemented throughout AMP7 include:

- Elimination at source:
  - Increased proactive programme of work (Sewer Maintenance Programme, SMP), including improved targeting of this programme to prevent initial flooding incidents occurring.
  - Installation of circa 40,000 Customer Sewer Alarms by 2025 (22,000 already installed by May 2023), to provide alerts on the formation of blockages which can then be resolved prior to any impacting flooding incidents.
  - Dedicated customer campaigns and focus on education via the network protection team (including for example visiting all Food Service Establishments (FSEs) in Yorkshire's high-risk areas).
- Enhanced initial response:
  - Focus on initial action following notification of a flooding incident, response times to customers have improved significantly (between March 2022 and September 2023 we've driven a 66% and a 59% improvement in our response time for ISF and ESF respectively).
  - Restructuring our customer field services flooding teams to give more dedicated focus where required.
  - Improved tracking of key metrics including process reviews and competency levels.
- Reduction in repeat incidents:
  - Dedicated hubs supported by dynamic data to allow increased scrutiny of incidents and quicker resolution.
  - Escape Report Assurance process implemented which again improves the length of time it takes to resolve incidents and therefore minimised repeats.
- Management information & governance
  - Escape Optimisation Engineers giving training roadshows for operational colleagues, to improve competence around sewer flooding and data capture.
  - Continued improvement of regular reporting processes from the Sewer Flooding Team and Data Science to ensure standardised information to every level of the business from practitioner to director level.

Overall, the improvements made over the last three years have been delivered through sustained, coordinated efforts across the business and with our service partner, Avove. We continue to drive additional improvements through further optimisation of all the above, along with our ongoing transformational approach (Wastewater Networks 2.0) and further reduction of private demand, to enable reinvestment/targeting of resources to proactive activities and improving first time response.

3.6 Cost Efficiency - Empirical analysis

As Ofwat's base modelling consultation dataset contains data on combined sewers, the net value of the CAC can be estimated by comparing YW's cost allowance under Ofwat's PR24 models to YW's cost allowance under models that control for combined sewers. The most straightforward approach is to compute the implicit allowance as YW's allowance under Ofwat's PR24 models, and the gross value of the claim as YW's allowance under alternative models that account for combined sewers.

We have worked with Oxera to assess the impact of incorporating combined sewers into the Ofwat cost models (updated to include APR23 data).

More detail on this subject can be found in Oxera cost adjustment claim analysis appendix

The table below shows how Ofwat's SWC models perform when combined sewers is included as an additional cost driver.

Table 3.2 PR24 SWC models with the introduction of combined sewers (updated for APR23)

	SWC1	SWC2	SWC3	SWC4	SWC5	SWC6
Sewer length (log)	0.854***	0.955***	0.932***	0.862***	0.942***	0.918***
Pumping capacity per sewer length (log)	0.418***	0.700***	0.650***	0.404***	0.656***	0.604***
Properties per sewer length (log)	1.123***			1.088***		
Weighted average density (LAD to MSOA) (log)		0.273***			0.290***	
Weighted average density (MSOA) (log)			0.445***			0.468***
Urban rainfall per sewer length (log)				0.0918***	0.133***	0.129***
Combined sewers (%)	0.290***	0.529***	0.559***	0.201[1]	0.403[1]	0.436*
Constant	-8.931***	-8.002***	-9.288***	-8.576***	-7.524***	-8.883***
R-Squared	0.923	0.914	0.916	0.920	0.920	0.920
RESET test	0	0.000486	0.000217	0	5.33e-05	1.92e-05
VIF	3.038	2.274	2.326	3.039	2.322	2.364

Note: 1 The P-values on the coefficient on combined sewers are 0.14 and 0.12 in models SWC4 and SWC5, respectively.
Source: Oxera analysis.

The inclusion of combined sewers as a cost drivers leads to an improved model fit in all SWC models, with the improvement ranging from 0.2 percentage points in SWC4 to 2.2 percentage points in SWC3. Moreover, the coefficient on combined sewers is positive (directionally in line with operational expectations) in all specifications and statistically significant in four out of the six specifications. Where the coefficient is statistically insignificant, the p-value on the coefficient is close to the 10% level.

Note that models SWC4–SWC6 include urban rainfall, which Ofwat argued captured a similar effect in the models. Nevertheless, the coefficient on combined sewers is still statistically significant (or close to) in all three of the models. Moreover, the VIF statistic (Ofwat's preferred measure of multicollinearity) for these models is always materially below Ofwat's threshold of 10, pointing to little collinearity among the independent variables. The observation that both urban rainfall and combined sewers are positive and statistically significant (or close to), and that the models do suffer from strong multicollinearity concerns, suggests that the two cost drivers capture different operational characteristics.

Table 3.3 below shows the equivalent analysis for Ofwat's network plus (WWN+) models.

Table 3.3 PR24 models for WWNP with the introduction of combined sewers and associated efficient allowances

	WWN+1	WWN+ 2	WWN+ 3	WWN+ 4
Load (log)	0.720***	0.814***	0.838***	0.772***
Pumping capacity per sewer length (log)	0.470***	0.505***	0.493***	0.400***

Proportion of load treated in size bands 1–3) (%)		0.0233***		
Proportion of load treated with ammonia consents <3mg/l (%)	0.00474***	0.00441***	0.00460***	0.00504***
Proportion of load treated at STWs serving >100k people (%)			-0.00496***	
Weighted average treatment plant size (log)				-0.0838***
Urban rainfall per sewer length (log)				
Combined sewers (%)	0.332***	0.357***	0.436***	0.306***
Constant	-4.055***	-5.352***	-5.326***	-3.878***
R-Squared	0.952	0.959	0.960	0.959
RESET test	0.213	0.0462	0.00939	0.0514
VIF	4.755	6.204	6.718	4.937

	WWN+ 5	WWN+ 6	WWN+7	WWN+8
Load (log)	0.706***	0.799***	0.828***	0.761***
Pumping capacity per sewer length (log)	0.438***	0.475***	0.460***	0.358***
Proportion of load treated in size bands 1–3) (%)		0.0236***		
Proportion of load treated with ammonia consents <3mg/l (%)	0.00497***	0.00468***	0.00487***	0.00534***
Proportion of load treated at STWs serving >100k people (%)			-0.00527***	
Weighted average treatment plant size (log)				-0.0934***
Urban rainfall per sewer length (log)	0.0560**	0.0492**	0.0565**	0.0647**
Combined sewers (%)	0.260**	0.292***	0.368***	0.220**
Constant	-3.676***	-4.991***	-4.989***	-3.421***
R-Squared	0.951	0.959	0.960	0.960
RESET test	0.0188	0.00741	0.000991	0.00192
VIF	5.152	6.526	6.896	5.220

Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels. The VIF has been computed using OLS with the same specification.
Source: Oxera analysis.

The coefficient on combined sewers is positive and statistically significant in all WWNP specifications. Moreover, the inclusion of combined sewers leads to an improvement in model fit relative to Ofwat's models of between 0.3 percentage points (in WWNP8) and 1.6 percentage points (in WWNP3). The coefficient on combined sewers remains statistically significant even in models that already control for urban rainfall, and the VIF remains below Ofwat's threshold of 10. This indicates that these models do not suffer from strong multicollinearity and that urban rainfall and combined sewers may be capturing different effects in the model.

Table 3.4 shows how YW's allowance under models with and without combined sewers as a cost driver. Note that we have applied an upper-quartile benchmark to the predicted costs in each suite of models. Therefore, the cost predictions and CAC value can be considered efficient.

Table 3.4 YW's estimated allowances for AMP8

	PR24 models	PR24 models with combined sewers	Difference
YWS's estimated allowances	£1,764.8m	£1,853.0m	£88.2m

Note: Allowances are presented in 2022/23 prices. The allowances estimated using the PR24 models with the inclusion of combined sewers constitute the gross value of the claim. The allowances associated with the PR24 models yield the implicit allowances. Finally, the difference corresponds to the net value of the claim..

Source: Oxera analysis.

Ofwat's PR24 consultation models predict YW's cost allowance to be c. £1764m. in AMP8. The inclusion of combined sewers in the SWC and WWN+ models increases YW's predicted allowance to c. £1853m, an increase of c. 88.2m. Therefore, the analysis indicates that the net value of the CAC relating to combined sewers is c. £88.2m.

3.7 Claim Value and Materiality

Combined sewers is a material driver of expenditure that Ofwat has omitted from its PR24 consultation models. The driver is sufficiently exogenous in the short-term to pass Ofwat's exogeneity criterion, and its inclusion in the cost assessment models leads to an improvement in the statistical quality of the models across a range of metrics. As such, Ofwat should consider including combined sewers in its cost assessment models at PR24.

Based on the current evidence, we estimate the net value of the CAC to be c. £17.6m p.a. in AMP8, or £88.2m over the full AMP.

Data Table CWW18 calculates this materiality as 2.30% which is significantly above the materiality threshold of 1%.

3.8 Symmetrical Adjustments

As this CAC relates to an omission in Ofwat's cost models, we consider an appropriate solution is for Ofwat to amend its PR24 models to account for combined sewers.

The table below shows the impact of including combined sewers in Ofwat's models on companies' allowances on an outturn basis, based on cost predictions in the last five years (2019–23). These values may change with variations to explanatory variables on a forward-looking basis (as the value for YW does).

Table 3.5 Symmetrical Adjustments by Company due to this claim

	Gross value of the claim	Implicit allowance	Net value of the claim
ANH	£1,825m	£1,842m	-£17m
NES	£841m	£826m	£15m
NWT	£2,370m	£2,231m	£139m
SRN	£1,688m	£1,707m	-£19m
SVH	£2,290m	£2,338m	-£49m
SWB	£711m	£703m	£9m
TMS	£3,524m	£3,638m	-£115m
WSH	£1,101m	£1,085m	£16m
WSX	£873m	£932m	-£59m
YKY	£1,695m	£1,619m	£76m

Note: all values are computed on a historical outturn basis (2019-2023) in 2022/23 prices. £88m claim value calculated on a forward looking basis.
Source: Oxera analysis

3.9 Customer Protection

This claim is not a discrete piece of activity, rather an adjustment to the cost modelling, so it is therefore not applicable for a customer protection mechanism beyond the existing process of setting appropriate stretching performance commitments and ODIs.

3.10 Data Table Commentary

	Title	Commentary
CWW18.11	**Description of cost adjustment claim**	This claim is due to the non-inclusion of a combined sewers variable in the base cost modelling.
CWW18.12	**Type of cost adjustment claim**	This claim is related to a regional operating circumstance.
CWW18.13	**Symmetrical or non-symmetrical**	Symmetrical
CWW18.14	**Reference to business plan supporting evidence**	Refers to this document as this is the Early submission.
CWW18.15	**Total Gross Value of Claim**	We have used totals identified through the modelling and split these costs across the SWC value chain using the average splits across YW's last 7 APRs
CWW18.16	**Implicit Allowance**	We have not included an implicit allowance as the value of the claim has been derived from the difference between models including and excluding the % combined sewer driver so already excludes implicit allowance.
CWW18.17	**Total Net Value of Claim**	Calculated from above two lines
CWW18.18	**Historic Base Expenditure**	We have used our modelling to estimate historic implicit combined sewer allowances from 2012-2022. See Appendix 2. We have used the net values from this to populate the 'historic total expenditure' in the CWW18 data table and split the costs across the value chain using a) the in-year value chain split as reported in APR or b) the average value chain split for 2016-2022 if a is not available (or is a forecast cost).
CWW18.19	**Totex for the control**	We are not required to populate Totex value but identify that the claim sits in the WWN+ price control.
CWW18.20	**Materiality**	N/A We note that the size of the claim is significantly higher than 1% of WWN+ Totex historically.

Table 3.6 Data Table CWW18 - Cost Adjustment Claim CWW02 Commentary

4. CW01 – Meter Replacement

4.1 Executive Summary

The majority of Yorkshire Water's mechanical meter and automatic meter reading (AMR) assets have reached the end of their asset lives, with the vast majority requiring replacement in the upcoming period to avoid failure, inaccurate readings and a return to costly manual metering. At the same time our Water Resource Management Plan (WRMP) has identified that rather than replace our existing meters like-for-like we need to roll out a programme of Smart metering to drive future demand reductions (leakage detection and customer consumption).

We have undergone an extensive scenario assessment process to ensure that the best option for customers has been selected.

Smart meters are more expensive than conventional metering solutions. In line with Ofwat's guidance, we have included only the additional cost of the Smart meter rollout and functionality (including the associated technologies at the meter and enabling systems and network communications) in our Smart enhancement Case, apportioning the costs that account for the replacement of existing assets to base.

More detail on this subject can be found in the **Smart Metering enhancement case appendix**

Ofwat's Botex models can be considered to allow on average the expenditure based on the rate of meter replacement delivered by all companies in the benchmarking period. This level of meter replacement is extremely low compared to the required rate going forward to address the end of asset life of YW's meter stock and to enable our Smart Metering programme to deliver an accelerated and wider meter deployment (faster than a natural cutover plus additional unmeasured to metered accounts).

We have calculated that 1,389,315 meters and AMR assets require replacement in AMP8 at a gross cost of £**141.11m** of base Capex. We calculate the implicit allowance in the base cost modelling as £14.99m and in addition have challenged ourselves to deliver the difference between our AMP7 activity and what could have been deemed implicit in the PR19 models . This removes a further £15.60m from our claim resulting in a total cost adjustment claim of **£110.13m.**

We have challenged the efficiency of these costs by going through an extensive market engagement and tendering programme and benchmarked our costs against industry data through an independent third Party (RPS Group). The unit rate associated with this claim is fixed through our agreed framework so further efficiencies beyond this cost are unlikely.

We have broad customer support for the implementation of Smart metering, particularly amongst those customers with existing meters. Customers will benefit through this expenditure by improved leakage, PCC and ultimately long term supply/demand resilience.

We propose to protect customers in this area by proposing a price control deliverable (linked with the PCD for Smart Metering Enhancement costs) where we will commit to returning any excess costs to customers of undelivered meter replacements. This is in addition to the protection that customers will already have tied to our actual PCC and Leakage performance and associated ODI payments for under-performance of this activity.

This request for Cost Adjustment Claim was not included within our Early Cost Adjustment Claim package as our final metering strategy and WRMP, overall plan affordability, and delivery route optionality were still being evaluated at the time. The evidence required to meet Ofwat's guidance was not available at the time of submission. We understand this CAC to be a non-symmetrical claim so other companies are not disadvantaged by Yorkshire Water not revealing it at the Early Submission stage.

Table 4.1 References in Document to Ofwat's Cost Adjustment Claim Criteria

Cost Adjustment Claim Assessment Criteria	Sections
Need for adjustment	3.3, 3.4
Cost efficiency	3.7
Need for investment	3.2
Best option for customers	3.2, 3.8
Customer protection	3.9

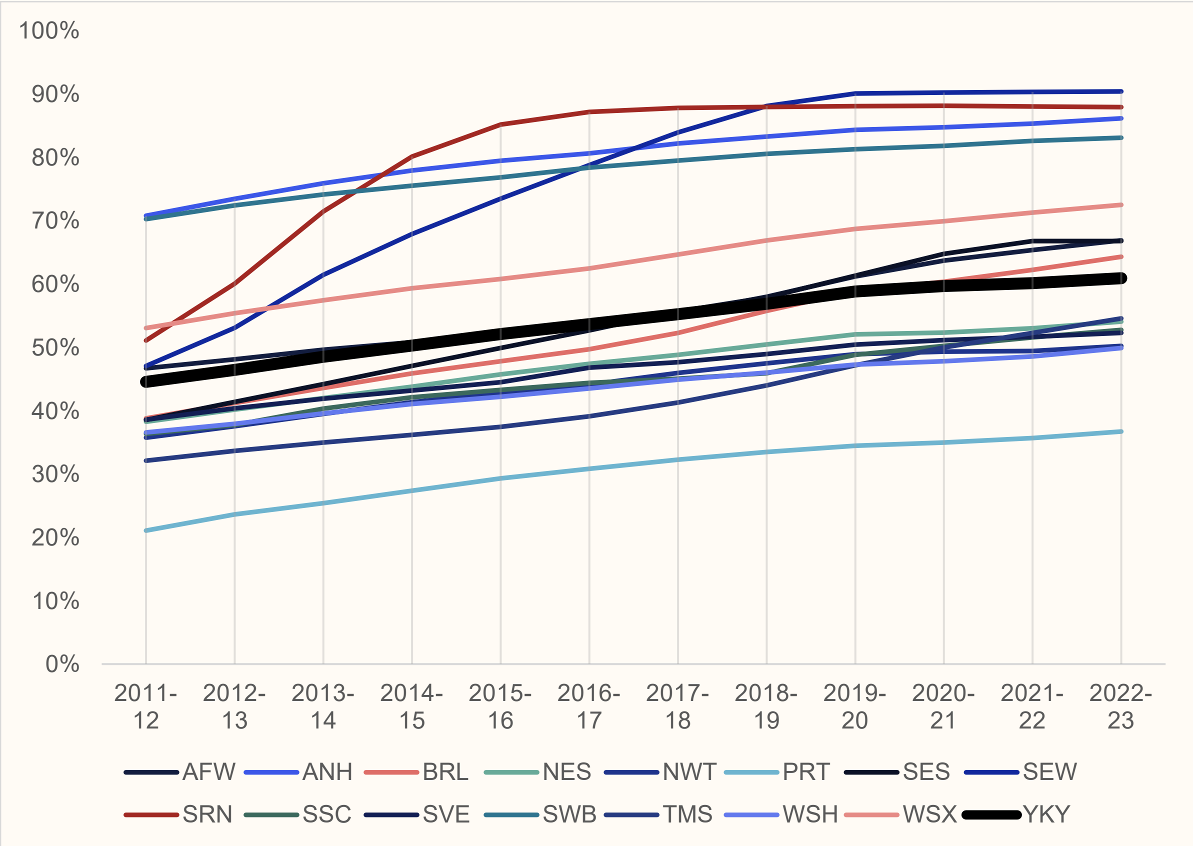
In summary, our case below sets out the need for a material increase in meter and AMR replacement in AMP8 over and above what is allowed for in the base models. We have appropriately allocated these costs to base however, our Smart metering strategy and the WRMP outputs for leakage and customer demand (PCC) are not deliverable without an allowance to reflect the material increase in meter replacement rates for the period 2025-30.

4.2 Overview and Need for Investment

Yorkshire Water's customer meter stock (household and non-household) has increased steadily since metering was first introduced. We have rolled out meters to many of our customers in line with our statutory obligations offering a free installation for those opting for a meter and installing new meters on new developments and more recently at a change of occupancy event.

Yorkshire has never been regarded as a water stressed region and we therefore had no obligation or power to take a near-universal metering approach to new meter installs unlike some companies. The chart below shows Yorkshire Water's meter penetration (as a % of connected domestic properties) has increased from 45% in 2011/12 to 60% by 2021/22. This represents a fairly modest growth in metering over the decade compared to several other water companies as shown in Figure 4.1.

Figure 4.1 Industry Meter Penetration over Time



Source: Ofwat PR24 dataset

We now have 1.524 million meters across the Yorkshire Water customer base (c.1.4 million domestic and 120k business customers). Please note that this number includes void properties with and connections/ properties with one or more meters.

We anticipate our meter penetration to increase to c. 69% by 2030.

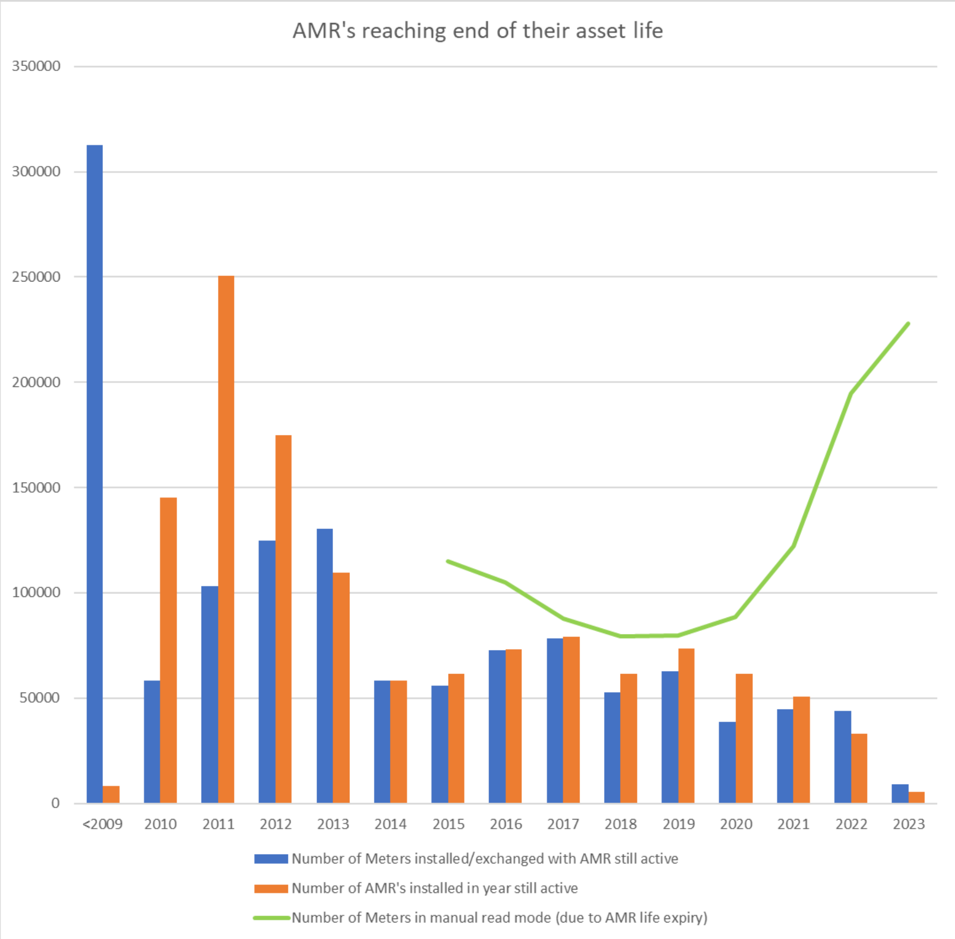
Since AMP5 Yorkshire Water has selected AMR technology for its metering solution. This solution allows for the meter to be read and alarms collected during a “walk by” or “drive by” field visit, without needing to visually read the meter register or inconvenience customers with appointments. This technology from over a decade ago has enabled some meter reading efficiencies to be realised, as well as maintaining a high level of Billed customer satisfaction and modest leakage benefit through “leak alarms” inbuilt to AMR loggers that are presented to Yorkshire Water once a walk-by or drive by visit is scheduled and actioned (so certainly not near real-time).

AMR meters were installed by either replacing older ‘dumb’ mechanical meters with a new mechanical meter including an AMR function or by retrofitting AMR caps to existing meters that still had many years of metrological life. This activity represented our last major meter replacement activity.

Yorkshire Water was an early adopter of AMR technology and planned a 15 year replacement cycle based on expected battery life constraints within the AMR technology. Through AMP6 and AMP7 the AMR technology battery life has been established as having an average battery life of around 10 years. Internally located AMR meters lasting slightly longer due to more favourable conditions. Externally located AMR meters exposed to extremes of temperature, achieve a slightly shorter battery life. Note the underlying metrology of the meter asset remains consistent with non-AMR capable meters, with many of these having been operational in situ for well over a decade.

We are now in a position where the vast majority of our AMR enabled meters (in built or retrofitted AMR caps) are reaching their effective asset life and require replacement in AMP8.

Figure 4.2 Analysis of YW Metering Asset Base



Analysis of YW Metering Asset Base
Source: YW Analysis

In Figure 4.2 above the blue columns show the age profile of our meter asset base, where the AMR is still active as of August 2023. The orange columns shows the age profile of our AMR asset base, for AMR's which are still operating as of August 2023.

The differential in years 2022 and 2023 where the AMR installed number is lower than the meter installed number, is due to YW moving to AMI technology for New Developments and for some targeted replacements. AMI numbers are not shown in this figure.

The green curve shows the number of meters which historically have had an AMR installed but are now operating in manual visual read as of August 2023.

The shape of the profile visually describes the historic investment strategy. Through AMP5 the strategy was a blend of retrofit AMR's to existing meters and new installs to be fitted with an AMR as standard. From AMP6 onwards AMRs have been installed as standard pre-paired with the meter. Where the orange bar exceeds the blue bar, this shows where Yorkshire Water have invested in additional AMR replacement where AMR devices have broken/ battery expired.

The AMR meters which have subsequently reached asset life has increased significantly since 2021 in line with the ~10 year asset life of the AMR's which were retrofitted in AMP5. Given the failure rate of AMR's and the age of our meter asset base, both the meter and AMR will require replacing in AMP8.

Currently 85% of installed meters have an operational AMR. Given the current failure rate of AMR batteries and known battery life for AMR's currently installed, this will require Yorkshire Water to replace all AMRs installed up to the install year 2020, by the end of 2030. The need is therefore to reinvest through base funding in meters and AMR of circa 1.4 million devices. Yorkshire Water proposes to replace these assets as AMI, with enhancement funding, and are submitting an enhancement claim for the cost delta between Metered AMR vs Metered AMI accordingly.

4.2.1 AMP7 Activity

We have managed our metering assets in the 2020-25 period in a way that has been efficient and maximised their lives however we are acutely aware that our AMP7 activity has been lower than is sustainable in the long term.

We identified this risk during the PR19 process where we noted at Draft Determination that in order to absorb the costs of service improvements into our base costs we would have to reduce our planned capital expenditure and move to a more reactive approach in many areas. Metering is one particular area where a more reactive approach has been required to ensure that we could achieve service targets within the stretching cost allowances.

We describe the wider issue of the regulatory framework and its impact on long-term capital maintenance more fully in Section 5 – Targeted Allowances Asset Health. We set out why a Totex and outcomes framework with no formal requirement for a certain level of asset replacement activity does not mean that a certain rate of activity has been funded in the past. However for metering we have challenged ourselves to deliver the difference between our AMP7 activity and what could be deemed implicit in the PR19 and PR24 models within our base allowances.

4.2.2 Water Resource Management Plan

Yorkshire Water has stretching leakage, PCC and business customer demand targets to deliver over the next 25 years in order to meet our supply demand balance and to achieve these targets as set out in our Water Resource Management Plan.

To achieve these targets we not only need to replace our life expired meters and the AMR technology deployed over the past ~13 years but also improve the insight which can be derived from customer meters, by transitioning to Advanced Metering Infrastructure (AMI) (Smart meters).

Yorkshire Water has already begun this transition to AMI technology to avoid future asset replacement before the end of operational life and to gain experience with how the solutions perform to aid the leakage, PCC and NHH demand reduction targets this period.

Yorkshire Water undertook a trial starting in 2020 in Sheffield where ~1800 meters were installed, with the subsequent evidence identifying that YW should move to a strategy where AMR’s would no longer be installed to avoid future asset write off or accepting a decade of AMR technology which would limit future service improvements. As such all new developments and DMO customers will have AMI meters installed as standard from 2023.

4.2.3 Timing of investment

Yorkshire Water has an asset base for meters and AMR which will be largely life expired in AMP8. The 91% (~1.385 million) of meters and/or AMR which will be beyond asset life in AMP8 are included in the proposed plan for AMP8. The 9% of meters which are not expected to be beyond AMR battery life are not included in the AMP8 plan and will be subject to investment in AMP9.

To maintain meter accuracy relating to Meter under registration, Meter reading efficiency relating to AMR’s being end of life and to maintain and improve PCC, NHH demand reduction and leakage, investment in the life expired assets is required in AMP8.

Figure 4.3 sets out a variety of strategy scenarios considered by Yorkshire Water within the Water Resource Management Plan for our metering assets. It demonstrates that we do not have the option to spread this investment over multiple periods, because asset performance is limited by the life of battery powered components. If we don’t invest in life expired assets in AMP8 to maintain service, significantly higher opex would be required to perform manual meter reading activities. Additionally, it would erode benefits from leakage, PCC and NHH demand reduction, putting at risk the resilience of the Yorkshire Water supply demand balance within the WRMP. Further additional miles driving to manually read meters, would impact Yorkshire waters zero net carbon strategy and impact accuracy of billing, causing a regression in customer satisfaction.

Figure 4.3 Scenario Analysis undertaken for YW's Metering Strategy and WRMP

<table>
<tr><th>Scenario No</th><th colspan="2">Investment Scenario</th><th>Cost Delta (Millions, 1st investment cycle 0-15 years)</th><th>Benefit Delta DI MLD (AMP8)</th><th colspan="2">Outcome</th></tr>
<tr><td rowspan="3">1</td><td colspan="2">No AMR meter Replacement- Revert to visual Read</td><td>Base Totex: – £64.00
Enhancement Totex: £0</td><td>- 8 MLD, regression</td><td colspan="2">Rejected: Regression in service is not aligned with strategic requirement to reduce Water Demand</td></tr>
<tr><td colspan="6">Description: Allow AMR solution batteries to fail and do not replace with new AMR. Attempt to maintain 6 monthly reading cycle with increased meter reading resource. Lose capability to understand AMR alarms, such as continuous flow leak alarm, limiting capability to target customer side leakage.</td></tr>
<tr><td>Customer Side Leakage impact</td><td>Leakage Targeting impact</td><td>Per Capita Consumption impact</td><td>Non Household Demand impact</td><td>C-Mex impact</td><td>BR-Mex impact</td></tr>
<tr><td rowspan="3">2</td><td colspan="2">AMR for AMR replacement end of life</td><td>Base Totex: £0
Enhancement Totex: £0</td><td>0 MLD</td><td colspan="2">Progressed: Included as the baseline assumption for WRMP scenario modelling</td></tr>
<tr><td colspan="6">Description: Replace end of life AMR meter, with an new AMR meter. Service levels and capabilities will be maintained as BAU service.</td></tr>
<tr><td>Customer Side Leakage impact</td><td>Leakage Targeting impact</td><td>Per Capita Consumption impact</td><td>Non Household Demand impact</td><td>C-Mex impact</td><td>BR-Mex impact</td></tr>
<tr><td rowspan="3">3</td><td colspan="2">AMR for AMR replacement, smoothed AMP impact</td><td>Base Totex: £36.00
Enhancement Totex: £0</td><td>-4 MLD, regression</td><td colspan="2">Rejected: Regression in service to attain a reduction in Water Demand and higher whole life cost to customers.</td></tr>
<tr><td colspan="6">Description: To mitigate bill impact of large AMR meter replacement programme in 1 AMP, replace ½ the AMR meters in AMP8 and the second half in AMP9. Attempt to maintain 6 monthly reading cycle with increased meter reading resource, for meters with end of life AMR's. Half of meters lose capability to understand AMR alarms, such as continuous flow leak alarm, limiting capability to target customer side leakage. Performance would recover during 2nd AMP with AMR EOL replacement.</td></tr>
<tr><td>Customer Side Leakage impact</td><td>Leakage Targeting impact</td><td>Per Capita Consumption impact</td><td>Non Household Demand impact</td><td>C-Mex impact</td><td>BR-Mex impact</td></tr>
<tr><td rowspan="3">4</td><td colspan="2">AMR for AMI replacement End of life</td><td>Base Totex: £0
Enhancement Totex: £80.0</td><td>19.3 MLD DI reduction</td><td colspan="2">Progressed: Included as option for delivering service improvement and long term DI target attainment.</td></tr>
<tr><td colspan="6">Description: Replace end of life AMR meter, with an new AMI meter. IT systems, process, customer communications, maintenance, future DMO and New Developments all Smart. Note enhancement costs include cost delta for DMO & New Developments vs AMR.</td></tr>
<tr><td>Customer Side Leakage impact</td><td>Leakage Targeting impact</td><td>Per Capita Consumption impact</td><td>Non Household Demand impact</td><td>C-Mex impact</td><td>BR-Mex impact</td></tr>
<tr><td rowspan="3">5</td><td colspan="2">AMR for AMI replacement, smoothed AMP impact</td><td>Base Totex: £36.00
Enhancement Totex: £80.0</td><td>5.65 MLD DI reduction</td><td colspan="2">Rejected: Over a 15 year Whole life cost, this model is more costly, impairing AMP8 performance improvements and regressing service levels in areas of delayed AMR replacement.</td></tr>
<tr><td colspan="6">Description: To mitigate bill impact of large AMR meter replacement programme in 1 AMP, replace ½ the AMR meters in AMP8 and the second half in AMP9. Attempt to maintain 6 monthly reading cycle with increased meter reading resource, for meters with end of life AMR's. Half of meters lose capability to understand AMR alarms, such as continuous flow leak alarm, limiting capability to target customer side leakage. Benefits for ½ of region with AMI replacement would be eroded against less ability to respond to continuous flow alarms which would no longer be generated from AMR's with expired batteries. Note enhancement costs include cost delta for DMO & New Developments vs AMR.</td></tr>
<tr><td>Customer Side Leakage impact</td><td>Leakage Targeting impact</td><td>Per Capita Consumption impact</td><td>Non Household Demand impact</td><td>C-Mex impact</td><td>BR-Mex impact</td></tr>
<tr><td rowspan="3">6</td><td colspan="2">AMR for AMI, Change of Occupancy metering</td><td>Base Totex: £0
Enhancement Totex: £74.25</td><td>13.00 MLD DI reduction</td><td colspan="2">Progressed: Included due to strategic alignment and service improvement acceleration option. Required to achieve "full Smart metering".</td></tr>
<tr><td colspan="6">Description: When a new occupier contacts Yorkshire Water to become the bill payer, Yorkshire Water would install a meter at that property for billing purposes. This would speed up the transition to Full Smart Metering, but increasing the number of unmetered properties per which would switch to Metered charging, enabling all the benefits of water efficiency to be realised through a link to the customer bill. This has a dependency on scenario 4 which would deliver the capabilities to realise a service improvement. In the first AMP of adopting this policy circa 167.7K properties would have a meter installed through this policy change. If selected, constraint may be required to start in AMP9, as delivery of AMP8 programme may be overambitious to include this additional volume of meters.</td></tr>
<tr><td>Customer Side Leakage impact</td><td>Leakage Targeting impact</td><td>Per Capita Consumption impact</td><td>Non Household Demand impact</td><td>C-Mex impact</td><td>BR-Mex impact</td></tr>
<tr><td rowspan="3">7</td><td colspan="2">AMR for AMI, enhanced Domestic Metering Programme</td><td>Base Totex: £0
Enhancement Totex: £14.38</td><td>2.32 MLD DI reduction</td><td colspan="2">Progressed: Included due to strategic alignment and service improvement acceleration option. Required to achieve "full Smart metering".</td></tr>
<tr><td colspan="6">Description: Through proactive campaigns and targeting, enhance the number of customers opting to have a meter installed. This would equate to 31.5K properties in AMP8 and 24.5K properties in AMP7. This has a dependency on scenario 4 which would deliver the capabilities to realise a service improvement. This option has a relationship with scenario 6, both policies are not to be selected together as the overlap in customers targeted is too great. If chosen, scenario 6 would take precedent.</td></tr>
<tr><td>Customer Side Leakage impact</td><td>Leakage Targeting impact</td><td>Per Capita Consumption impact</td><td>Non Household Demand impact</td><td>C-Mex impact</td><td>BR-Mex impact</td></tr>
</table>

Figure 4.3 shows which of the scenarios were carried forward for optimisation within the Water Resources Management plan. The "Cost delta" column demonstrates the Totex change in investment over the next 15 years compared to a baseline of replacing AMR like for like at end of asset life. A negative figure demonstrates a reduction in costs, a positive figure demonstrates an increase in costs.

Benefits impact are shown as a Red, Amber, Green status across key performance commitments. Red indicating a negative impact, Amber as marginal impact, Green being a positive impact. A quantified leakage benefit is shown in the Benefit Delta box.

Within our AMP8 programme, no investment is being proposed to be brought forward from AMP9. Circa 100k AMR meters are due to be replaced as end of life in AMP9. These have not been brought forward due to risks to deliverability increasing the AMI further beyond that proposed in AMP8.

The best available data in the progression to submitting a revised draft WRMP is that scenario 4 is the strategy to adopt, with Change of Occupancy (scenario6) as being a preferred option to include from AMP9. The figure above shows £0 Base Totex as the assumption within WRMP, this assumes that a Cost Adjustment Claim would be successful allowing funding the Base element of the smart metering programme, with enhancement funding supported by the WRMP to provide the upgrade from AMR to AMI and releasing the benefits from Smart Metering.

As such the Yorkshire Water Metering Strategy over the next 3 AMPs is as shown in Figure 4.4. This is predicated on a base maintenance allowance that funds the efficient replacement of ~1.4 million end of life assets in AMP8, with Enhancement funding based on our WRMP allowing for the cost of achieving Smart capability.

Figure 4.4 Summary of YW Metering Strategy

	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35
Policy & Hardware	No old technology installed by end of yr4 AMP7 - New Developments - DMO - Broken Meters	AMR to AMI upgrades -All life expired AMR's & dumb meters upgraded to AMI - Continuation of AMP7 policies - Testing of innovative SM solutions	Progress to Full Smart Metering - Implementation of additional policies (*Change of Occupancy, tactical compulsory metering)** - Iteration of smart metering specifications
Capability	-Minimum viable product -Specification of at scale requirements -Tec Transition plan	-Delivery of tec solutions for at scale smart operation - Gen 1 Customer water use view delivered -Embedding & maturation of benefits cases -Development of future smart tariff strategy	- Implementation of smart tariff strategy - Incremental improvement in benefits realisation & customer views of data - Development of Billing journey for compulsory customers
Scale	~110K Meters	~1,600K Meters	~350K Meters
Cumulative Smart Meters	~110K Meters 5% Smart penetration	~1,710K Meters 70% Smart Penetration	~2,150K Meters >86% Smart Penetration

Table 4.2 YW Overall metering strategy AMP8 – Activity and Cost

	Number of meters (AMI)	Base Cost	Enhance ment Cost	Total Cost	Data table references
New Smart Meters (DMOs, change of occupancy, new developments)	185,620	0	£47.45m	£47.45	CW 3.62 3.65 3.68
Replacing Existing Meters and AMR with Smart Meters.	1,389,314	£141.11m	£27.81m	£168.92m	Base - CW 2.16 CW18.1-10 Enhancement - CW3.71, 3.74. 3.77, 3.80, 3.83, 3.86
Smart Meter Enabling Technology	n/a	0	£58.81m	£58.81	CW3.89
Total Metering Strategy Cost	**n/a**	**£141.11m**	**£134.07m**	**£275.18m**	

4.2.4 Customer Support

We engage with our customers on an on-going basis, but at regular intervals we carry out specific research to inform our future plans. In January 2023 and August 2020, we completed a research programme called "My water usage" and "Customer views on Smart Metering" to inform our PR24 plans and AMP7 business planning. This research provides an assessment of the views of Yorkshire Water's customers and stakeholders. It identifies the opinions of customers relating to engaging with leakage and water efficiency, as well as their views on

Yorkshire Water collecting more data and understanding more about their property water usage to help improve service.

This research demonstrates that Yorkshire's customers are largely in favour of driving water efficiency through improved visibility of water leaks and water efficiency. Achieving these goals through smart metering is also largely supported and should be a significant part of the overall strategy to protect the environment, ensure water security and enable customers to manage their water use habits more effectively positively impacting their bills.

This information has been important in building our plans for WRMP24, AMP8 and transitioning to a "smart only" strategy. Whereby new meters being installed or exchanged will utilise AMI technology from August 2023, ensuring Yorkshire Water limit the chance of investing in "old technology" which needs to be replaced before the end of its asset life, ensuring the customer doesn't "pay twice".

4.3 Need for Adjustment

Ofwat's models are based on historic expenditure and activity but do not specify where this expenditure takes place. Companies respond to an outcomes framework by investing (which they are strongly incentivised not to overspend) in a way that maximises their performance and meets their statutory obligations. It is therefore not accurate to say that a specific level of activity has been 'funded' in the models' historically or will be going forward.

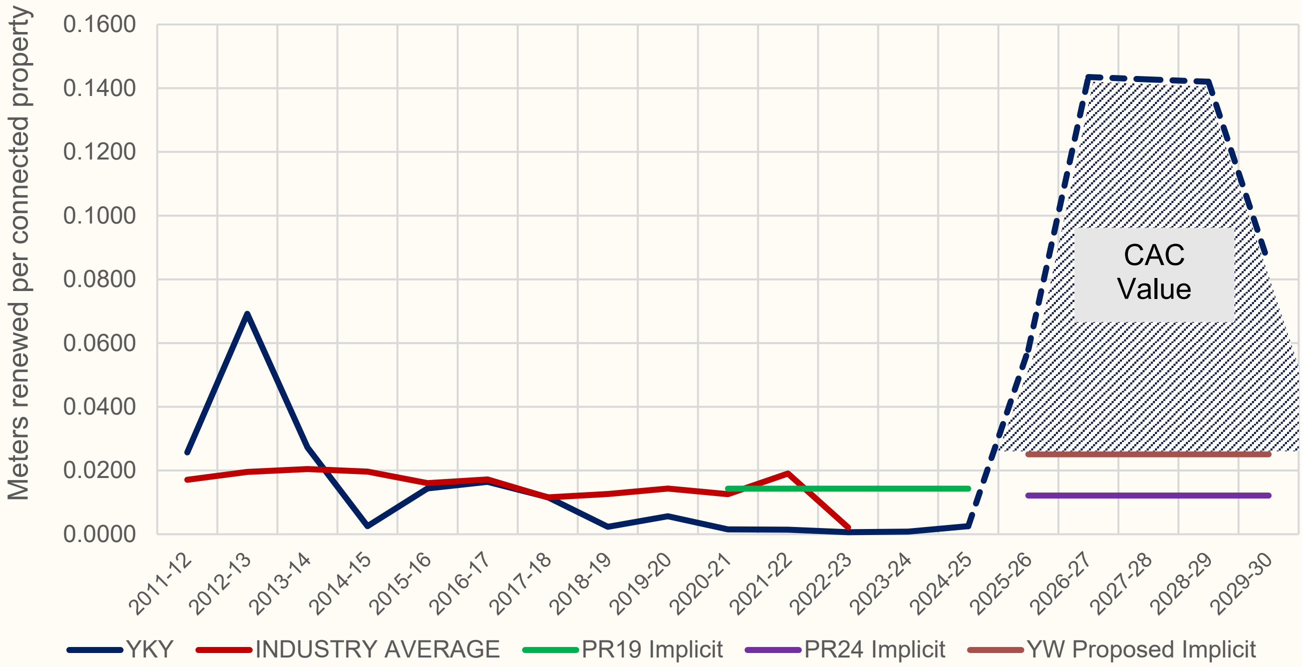
However we recognise that there is an element of maintenance activity in each asset group contained within the model outputs if companies in the industry have been spending on those assets historically. Ofwat's models are backward looking and therefore it is the activity of the industry historically that is deemed implicit in the base allowances. As Ofwat uses the 5-years leading up to the price review to set the efficient cost benchmark company (2018-23), it is this period where industry historic investment is most valid.

Therefore a simple way of estimating an implicit allowance in a certain area is to look at the average amount of activity delivered by the industry in that area over the 5 year cost benchmarking period normalised by any scale variable used in setting cost allowances.

The scale variable in treated water distribution and water networks plus is ***the 'number of connected properties'*** so to estimate an implicit allowance we could have used the historic replacement rates of meters across the industry normalised by this variable (noting that not all properties have meters).

This results in a value for both AMP7 (using 2015-20 data as per the CMA) and AMP8 (using 2017-22 data as in Ofwat's current cost models) of 0.014 meters per property per year.

Figure 4.5 YW Historic and Future Meter Replacement Rates vs Industry Average and implied modelled allowances



Source: PR24 Cost Dataset, APR23, YW Analysis

Our current rate of replacement in AMP7 is c. .00015 meters / property /yr. which significantly below the industry average for AMP6 (on which the PR19 models were based). This has occurred partially due to the challenging expenditure allowances and stretching performance commitment targets set by Ofwat in recent AMPs.

We have kept bills low and met our leakage targets but it has led to an increasingly reactive approach to delivering service. This is apparent across the industry with reducing capital maintenance activity levels as investment is redirected to more short-term activity aimed at meeting in-year performance targets. We discuss this in more detail in our other water cost adjustment claim on Targeted Allowances for Asset Health.

However despite our view that the base modelling cannot be considered to have ‘funded’ any particular activity levels for metering we have challenged ourselves by excluded both a calculated PR24 implicit allowance and the difference between our AMP7 activity and what could have been deemed implicit in the PR19 models from our claim.

4.4 Calculating the Net Value of the Claim

Table 4.3 and Table 4.4 show our calculations to assess the value of the cost adjustment claim. To do this we have included our total replacement requirement of 1,389,315 meters, and assumed an average 2,372,646 connected properties (APR23) plus an efficient unit cost of £101.57/meter including installation costs. (NB: This is the Base element of the full meter replacement cost with a smart meter. The smart meter increment is in our enhancement claim).

We have excluded the forward-looking implicit rate of renewal and our committed base investment to rates that may have been considered implicit when PR19 determinations were made.

Table 4.3 Calculating the Metering Claim Value

	Rate of replacement (meters/prop/yr)	Total meters (rate x props x 5)	Cost (£m)
(A) Implicit Allowance in AMP8 Models	0.0121	147,562	14.988
(B) 'Funded' at PR19	0.0143	170,024	17.269
(C) Delivered in AMP7 (Forecast)	0.0014	16,449	1.671
(D) AMP7 Shortfall (B)-(C)	0.0130	153,575	15.599
(E) Total Rate assumed implicit within base (A) + (D)	**0.0251**	**305,016**	**30.981**
(F) AMP8 Total Requirement	**0.1143**	**1,389,315**	**141.113**
(G) Net Rate included in Claim (F) – (E)	**0.0892**	**1,084,299**	**110.132**

The Steps are described in more detail below:

- Step (A) – using the 2019-23 industry average rate of meter replacement by year (informing the current PR24 models)
- Step (B) – the 2015-2020 industry average unit rate (informing the CMA PR19 models)
- Step (C) – our forecast AMP7 rate of delivery
- Step (D) – the difference between our AMP7 rate and what could have been considered implicit in the PR19 models (B)-(C)
- Step (E) – Our stretching assumption of what we will deliver through base (A) + (D)
- Step (F) – Our total requirement in AMP8 to replace our asset life expired meters and to enable our Smart Metering Strategy
- Step (G) – The Net Value of our claim (F)-(E)

This results in a gross claim of £141.11m for the period and a net claim of £110.13m

Table 4.4 Cost Adjustment Claim summary by year

	2025-26	2026-27	2027-28	2028-29	2029-30
Nr Meters Replaced	139,281	347,154	347,154	347,154	208,572
Gross Claim by Yr (£m)	14.147	35.260	35.260	35.260	21.185
Net Claim by Yr (£m)	**7.951**	**29.064**	**29.064**	**29.064**	**14.989**

4.5 Materiality

The claim value of £110.13m is significantly above the materiality threshold of 1% of the Water Network Plus price control (calculation in CW18 indicates 3.93%).

4.6 Unique Circumstances and Management Control

These two tests are not relevant to this claim as they are primarily focussed on variables within Ofwat's modelling. This claim is about forward-looking investment that is not allowed for in the historic baseline we may not be unique in requiring this. We also have limited control over the historical meter replacement rates of the industry.

4.7 Cost efficiency

Cost efficiency is a core tenet in our PR24 Business Case planning. We have been proactive in integrating best practices, leveraging new markets and collaborations, harnessing innovative technologies, and building an excellent procurement system to deliver cost efficiency across our whole business plan. This is no different for our metering assets.

A meter exchange programme consists of 4 cost categories:

1. Meter Hardware
2. Data as a service
3. Meter exchange
4. Battery life warranty (part of whole life cost assessment but not unit cost)

Yorkshire Water has undertaken an efficiency assessment across all 4 aspects, as described below and summarised in Table 4.5.

4.7.1 Meter Hardware

In 2021 we undertook premarket engagement exercise and industry benchmarking to understand the UK industry costs of Smart Metering Hardware and Data as a Service (DaaS). The benchmarking and subsequent procurement activity was led by Efficio, who are our strategic procurement partner. The benchmarking exercise established that for the predominant smart meter deployed across the UK for the most common meter size (DN15), that a target for DN15 meters was ~£54 per unit.

The DN15 meter represents 96.8% of Yorkshire Waters proposed exchange programme in AMP8.

As shown in Figure 4.6, Yorkshire Water then entered an OJEU process with the selected vendors significantly outperforming the efficient rate as highlighted above.

4.7.2 Data as a Service

The above benchmarking exercise established that for the predominant smart meter deployed across the UK the target cost for data as a service would be £4.50 per meter per year. This benchmark was significantly higher than the cost per meter using AMR data collection.

As shown in Figure 4.6, Yorkshire Water then entered an OJEU process with the selected vendors significantly outperforming the efficient rate as highlighted above.

4.7.3 Exchange costs

The exchange programme Yorkshire Water will be completing in AMP8 has been designed to deliver the most efficient outcome. Focusing on a conurbation, road by road exchange strategy, allowing for high volumes of external meters to be exchanged per day, with appoints within the prioritised conurbations occurring for internally metered and Non-household customers.

Yorkshire Water has undertaken Market pre-engagement with suppliers able to provide meter exchange services to help design the requirements for the exchange programme to go to tender by October 2023. They have provided indicative costs for an exchange programme which have been included as the unit costs for YW exchange programme.

Benchmarking for exchange/install cost is complex, especially when using a single unit cost value to compare efficiency across companies. This difficulty arises due to large variance in cost being driven by company specific factors, which are hard to normalise across.

Below is a summary of the cost impacting factors which will cause a variation in unit cost of any metering exchange programme:

- Proportion of properties in metering programme with existing chamber/ ancillaries in place
- The split of external to internal meter location
- The breakdown of meter sizes to be included within the metering programme
- The proportion of meters which are Non-household and the blend of NHH's which have water critical operations
- The ratio of meters which are no longer accessible (built over or constructed into ducting by property owner)
- The customer willingness to allow access to property, which will change with customer base demographics
- The ancillaries required to adjust meter lay length (pipe length either side of the inline meter) if a change in meter manufacturer occurs this may vary exchange cost.
- What costs have been included in the calculation of exchange cost (programme team, overheads etc)

Yorkshire Water utilised RPS to undertake a benchmarking of dWRMP meter exchange unit costs. The resultant industry average was established as with the YW average unit cost being providing assurance that YW is proposing an efficient exchange cost.

This content has been redacted due to it containing commercially sensitive material

4.7.4 Overall efficiency

Yorkshire Water has based its WRMP24 and PR24 smart metering hardware and DaaS costs from the framework agreement costs put in place in 2022 for Yorkshire Water. This framework significantly beat the market benchmarking for the most common meter type, and also provided significant efficiency for Daas. The exchange cost is more efficient than the assessed industry average exchange cost. Yorkshire Water did not use APR data to inform cost efficiency as a planned programme of meter exchange would derive a significantly different cost efficiency than an "on demand" reactive meter exchange programme.

Yorkshire Water assessed the costs for the OJEU process as a 30-year whole life cost assessment, considering:

1. Meter Hardware cost
2. Data as a Service cost
3. Exchange costs
4. Battery life warranty (leading to how many reinvestment cycles would be required over 30 years)

Table 4.5 Summary of YW Efficiency Cost Benchmarking

This content has been redacted due to it containing commercially sensitive material

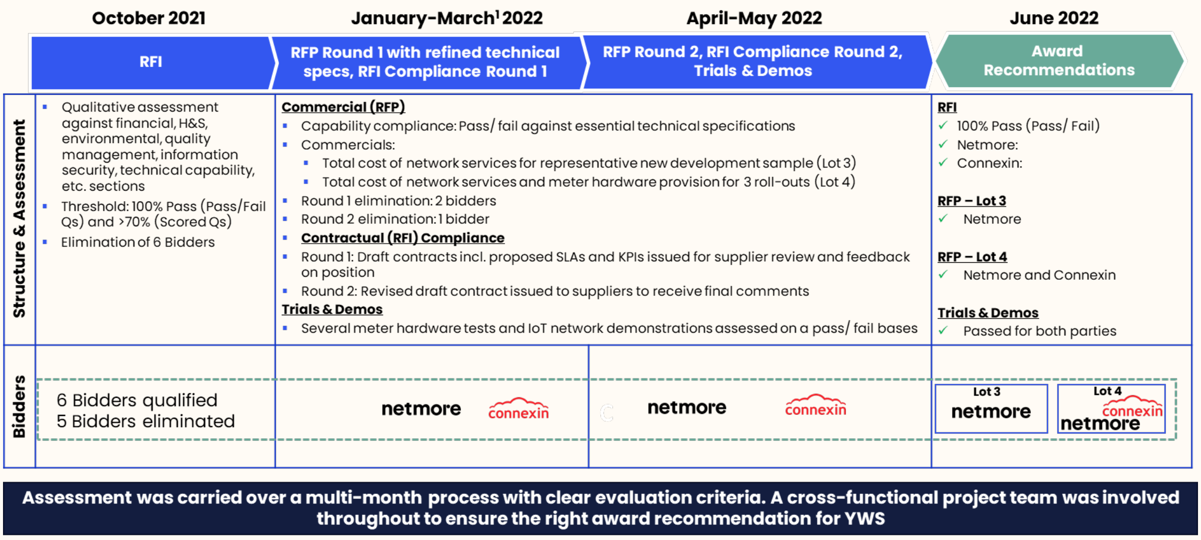
Yorkshire Water has aimed for a battery life warranty of 10 years, with a operational design of 12-15 years. Driving circa 2 investment cycles over 3 years, as opposed to solutions which have a shorted battery life and may therefore require additional investment cycles at a greater whole life cost over 30 years.

Together the Whole Life Cost saving over 30 years was circa 40% compared to the benchmarked cost. The prescribed OJEU process was followed for this Framework award with a competitive market engaging through the process.

Yorkshire Water will be undertaking a new framework exercise for the AMP8 scope of work. AMP8 costs put forward at PR24 align to existing known costs. Given the challenges in Microchip and Metal production across the globe affecting meter manufacture costs, it is not expected that significant further efficiency will be realised.

Figure 4.6 below shows the process followed in awarding the current YW framework for smart metering, from which the PR24 costs have been submitted.

Figure 4.6 Pictorial Summary of OJEU tendering process



4.8 Best option for customers

We discussed in Section 4.2.3 our approach to assessing the range and timing of interventions in our Smart Metering strategy and Water Resource Management Plan. We considered both cost and performance impacts of different strategies which identified that our proposed solution was the only way to achieve our WRMP statutory requirements whilst delivering our ambitions for customer service. We set this out in Figure 4.3.

Once the best solution was decided upon we also explored what the best funding and delivery route should be. We undertook a range of analysis and market engagement relating to alternative funding mechanisms. We worked extensively with Sia partners and Baringa to understand the benefits of a potential DPC route for metering (prior to clarification from OFWAT that DPC was not considered a favourable funding mechanism). The DPC analysis showed that the supply chain/market had operated in this manner in other utility sectors, however those who were mature in the financial structuring were not mature in water sector knowledge and therefore presented a higher risk when considering successful deliverability. Companies that were familiar with Water sector smart meter rollout programmes, were immature in their ability to finance such activity.

Other funding options have also been considered, but the lowest cost to customers over the entire life cycle of the asset is through a “traditional” funding mechanism, as opposed to an opex driven solution. An assessment including, cost of capital, financial write off period, scale & outsource efficiencies has been conducted to arrive at this position. As such the best option for customers supported by Yorkshire Water is to invest in the metering assets through a traditional capital maintenance (and ongoing operational cost) solution.

4.9 Customer protection

Customers are protected from non-delivery of this activity by the performance commitment ODIs on leakage and Per Capita Consumption which will not be achievable without the rollout of our Smart Metering Programme which relies on this capital activity. However we also propose additional customer protection in the form of a PCD for our Smart Metering Rollout. The enhancement element of this PCD is covered in our enhancement metering case but an additional customer protection is proposed to ensure that the element of base being requested through this CAC is spent in the right area.

We set out our proposed PCD parameters and payment rate in the following tables.

Figure 4.7 PCD for Metering Cost Adjustment Claim

PCD Delivery Expectation	
Description	We propose a PCD for the activity associated with this claim which is the additional base element of our metering programme in AMP8 to fast-track smart meter rollout for both household and non-household customers. This PCD works in conjunction with the PCD for the enhancement programme of metering which is for the smart element of the full volume of meter replacements plus new meters arising from optants and new developments.
Output measurement and reporting	Company must deliver the number of replacement meters in line with the profile specified in the 'forecast deliverables' table. The activity / investment over and above the assumed implicit allowance is subject to the PCD. Namely the 'Meters Replaced (CAC)' value.
Assurance	The company must commission an independent, third-party assurer, with a duty of care to Ofwat, to assure, to its satisfaction, that the conditions below have been met and the outputs of the scheme set out below have been delivered. Assurance of this PCD will occur alongside the PCD for metering enhancement. It may be appropriate to combine these PCDs at final determination.
Conditions on Scheme	n/a
Forecast Deliverables	The deliverables that we propose are protected through this claim are the total proposed number of meters replaced each year, less the assumed value funded through existing base allowances.

Deliverable	Unit	Forecast Deliverables				
		2025/26	2026/27	2027/28	2028/29	2029/30
Total meters replaced	Nr	139,281	347,154	347,154	347,154	208,572
Meters Replaced (implicit)	Nr	61,003	61,003	61,003	61,003	61,003
Meters Replaced (CAC)	Nr	78,278	286,151	286,151	286,151	147,569

Cumulative Forecast Deliverables

Cumulative deliverable	Unit	Cumulative forecast deliverables				
		2025/26	2026/27	2027/28	2028/29	2029/30
Cumulative meters replaced	Nr	139,281	486,435	833,589	1,180,743	1,389,315
Cumulative Meters Replaced (implicit)	Nr	61,003	122,007	183,010	244,013	305,016
Cumulative Meters Replaced (CAC)	Nr	78,278	364,428	650,579	936,730	1,084,299

PCD Payment Rate

This PCD protects all totex expenditure that forms part of this cost adjustment claim. We propose to apply the PCD payment per unit to the difference between the forecast (CAC) and actual cumulative number of meters delivered at the end of 2029/30.

End of Period output PCD
Unit Rate = £101.57/meter

Cumulative Meters (CAC) (2029-30) – Total Meters Replaced x £101.57

Annualised time delivery incentive
We consider the PCs and ODIs associated with meter replacement provide sufficient protection for customers against late installation of meters for each year of AMP8. This investment is required to enable the performance targets set out in our plan.

Our ODI exposure, as set out in our metering enhancement case, for non-delivery of our smart metering strategy is £20.75m which is greater than 3.5% of the totex associated with this claim. Consistent with Ofwat's guidance IN 23/05, we do not propose an additional time incentive mechanism.

4.10 Data Table Commentary

Figure 4.8 CW01 Metering Cost Adjustment claim data table commentary

	Title	Commentary
CWW18.11	**Description of cost adjustment claim**	"Meter and AMR replacement not funded in the base cost models. Enabling Smart Programme and WRMP delivery."
CWW18.12	**Type of cost adjustment claim**	We have assigned this to 'atypically large investment' as the claim is for a large programme of meter replacement over and above what can be considered funded through the base models.
CWW18.13	**Symmetrical or non-symmetrical**	This is a forward-looking claim and therefore non-symmetrical.
CWW18.14	**Reference to business plan supporting evidence**	Refers to Cost Adjustment Claim Appendix.
CWW18.15	**Total Gross Value of Claim**	We populate the gross value of the claim as the total Base cost element of the metering programme for AMP8 as set out in out cost adjustment claim appendix. We do not claim for any costs in 2022-25 so these cells are left blank. The costs all sit within Treated Water Distribution.
CWW18.16	**Implicit Allowance**	We populate an implicit allowance* by estimating and adding: what could be considered funded at PR24 based on industry meter replacement rates in the benchmarking period and the difference between our anticipated AMP7 activity and what could have been considered funded this period. We then multiply these values by our average unit rate for meter installation. *We note that in reality no such allowance is made in a Totex and Outcomes framework.
CWW18.17	Total Net Value of Claim	Calculated from above two lines
CWW18.18	Historic Base Expenditure	We have populated these lines with our historic levels of expenditure in meter replacement inflated to 2022/23 prices.
CWW18.19	Totex for the control	We are not required to populate Totex value as it is a calculated cell but identify that this claim is in the WN+ price control.
CWW18.20	Materiality	N/A We note that the size of the claim is significantly higher than 1% of WN+ Totex historically.

5. Targeted Allowances for Asset Health – Overview

Sections 5,6 and 7 set out our request for additional capital investment in asset health in Water Network Plus (WN+). Section 5 sets out a high level overview of our case and Sections 6 and 7 set out our specific cost adjustment claims for infrastructure (CW02a) and non-infrastructure (CW02b) respectively.

Our Case for a targeted allowance to increase capital expenditure in AMP8

- The drivers behind our request for a targeted allowance are not unique to Yorkshire Water but rather they are part of an industry-wide issue.
- Operating within historic totex allowances water companies including Yorkshire Water have become more reliant on reactive and opex based interventions to deliver the service improvements required by Ofwat and expected by our customers.
- Ofwat's backward-looking econometric models will reflect this short-term approach and imply that service improvements can continue to be delivered through similar levels of investment, thereby embedding a short-term approach to achieving service which is unsustainable and at odds with the long-term, asset health focus to which the sector should be committed.
- Our assumed totex allowance for the water network plus price control, when all our other commitments are considered, will potentially enable us to renew around 335km of our ageing water network, filters or clarifiers at one or two critical sites, and five or six average sized service reservoirs (SREs) or clean water tanks (CWTs) in AMP8.
- Our investment modelling and asset management planning process tells us that we need to replace more than 3 times the allowed amount of our mains network to simply maintain stable asset performance (burst rate). We need to refurbish filters and clarifiers at 18 sites and have 15 high risk SREs / CWTs in the poorest condition grades (CG4 and CG5) which need to be replaced or substantially refurbished in AMP8.
- Without a sustained increase in investment levels we will see more assets move into in CGs 4 and 5. Assets will remain in service well beyond their expected lives with consequential risk to service, experiencing more frequent failures and driving up reactive and operating costs to unsustainable levels.
- Beginning the transition now to a more forward-looking approach which will enable proactive long-term investment which will deliver a sustainable, healthy asset base and share the costs and benefits of achieving it equitably with current and future customers.

5.1 Executive Summary

Yorkshire Water supports the principles set out in Ofwat's PR24 Methodology, Creating Tomorrow Together, including the priority given to focusing on long-term planning and asset health. We propose that AMP8 should mark the start of a transition to a more forward-looking approach which will allow much needed investment in long-life assets. We have a vision for a thriving Yorkshire, that is right for customers and right for the environment. We have an extensive varied asset base distributed across our region, and improvement of the health of these assets is a key pillar of this vision.

Successive price reviews and their associated incentive regimes have driven service improvements and reduced costs in the sector, to the benefit of customers. Within the available final determination totex constraints, we seek to maximise the service benefits for our customers within each AMP period. However, this may require us to place greater reliance on reactive interventions and increased opex, rather than proactive replacement or refurbishment of long-life assets, which may not arrest their underlying deterioration. The current economic regulatory model challenges water companies to balance the tension between efficiency and affordability within a price control period and the need to provide long-term value which is not a simple task for regulator or regulated company. It is important therefore that particular choices, appropriate at a point in time, do not get baked into the econometric modelling and regulatory price setting approach in such a way that steers the industry down a sub-optimal route that requires future customers to pick up an unfair share of the costs to rectify that position.

Asset condition will tend to deteriorate over time, and with our complex asset base, this is not a uniform, linear trend. Within an efficient whole-life cost approach to asset management there will be periods when that deterioration in condition can be managed effectively through more reactive and operational responses. However, there will come a phase in the asset life cycle, where it becomes more economic to replace or refurbish those assets to minimise whole-life cost and reduce risk to service. In the context of increasing future service expectations and more stretching performance targets, the need for that transition will tend to be brought forward in time as the value of those future service improvements increases.

This transition is not sharply delineated and in truth is part of a continuum but when considering particular groups of assets, such as those included in this claim, it becomes clear in aggregate that the transition is occurring and a change in investment is needed.

Following discussion between Yorkshire Water and Ofwat, we are presenting this claim through the Ofwat Cost Adjustment Claim mechanism in line with Ofwat's advice, however we do not consider this case to be a typical cost adjustment claim. Yorkshire Water is not basing this request for a targeted investment allowance on any unique circumstances or on the grounds of one-off, atypical investment needs arising. Rather we consider that the econometric models used to determine cost allowances are not able to determine a forward-looking investment need when they are built using backward looking expenditure and performance data. AMP7 has seen a decline in asset replacement and a rise in the proportion of opex within overall totex spending. Performance improvements achieved in this way are unlikely to be sustainable for multiple AMPs because they effectively address symptoms rather than underlying asset health.

Our Claim - The claim is for an additional **£437.7m** of base capex in the WN+ price control to allow us to target ageing water mains, service reservoirs and clear water tanks and clarifiers and filters which represent the greatest risk to long term service in areas such as mains repair, discolouration contacts, compliance risk index (CRI) and unplanned outage (UPO).

Need for investment – our investment planning process and supporting models, indicate that current levels of investment in our long-life assets is insufficient to keep pace with the underlying deterioration rate of those assets. Yorkshire Water has spent on average £131.2m p.a. in the last 8 years on base Capex (at 22/23 prices) in this price control, our PR19 allowance was an implied allowance of £128m p.a. If not addressed we will see a growing proportion of our network being expected to remain in operation well beyond any reasonable expected asset life and remain an outlier on the main asset health metric (mains repairs per 1000km). In the area of our non-infrastructure assets, we are seeing growing risk to water quality (as measured by CRI) due to ageing stock of clean water tanks and service reservoirs, whilst deterioration in the condition of some of our filters and clarifiers is driving a rise in asset failures requiring assets to be taken out of service whilst reactive capex and opex interventions are deployed (impacting our UPO performance).

Need for adjustment - We do not have sufficient headroom within our overall totex allowance to address the needs outlined above in a more proactive manner, whilst maintaining adequate levels of investment to meet our other statutory, regulatory and customer service obligations. Companies can delay replacement through operational measures, but at some point, extensive and more expensive replacement is needed, this point is reached by companies at different times and therefore a stretching totex allowance will tend to under-compensate when they do. Yorkshire Water is at that critical point and therefore a separate allowance is needed.

Efficiency – We are proactive in integrating best practices, leveraging new markets and collaborations, harnessing innovative technologies, and building an excellent procurement system to deliver cost efficiency across our whole business plan. These efficiencies are captured and built into our costing systems to ensure they reflect efficient costs. Our mains replacement unit costs which drive the largest component of our claim are efficient compared to other unit rates published by some of our peers.

Right for our customers – We have considered a wider range of scenarios which address the long-term challenges relating to the health of our water asset base. In doing so we have sought to carefully balance the short-term affordability of our programme against the long-term fairness to future customers. The proposed programme strikes the appropriate balance, whilst enabling us to provide the necessary stewardship of our asset base. Our customer feedback shows that investment in infrastructure is a priority, with customers indicating that other attributes will be solved as a consequence and a long-term way to reduce bills by being efficient and reducing costs.

We recognise that this is a significant uplift in investment that we are requesting to address very specific issues which are important to our customers. We also recognise therefore that customers have a right to expect that those interventions proposed are actually delivered. We have therefore proposed simple and transparent price control deliverable (PCD) mechanisms that will provide the necessary assurance that we will deliver what we set out in this claim or will return the money to customers.

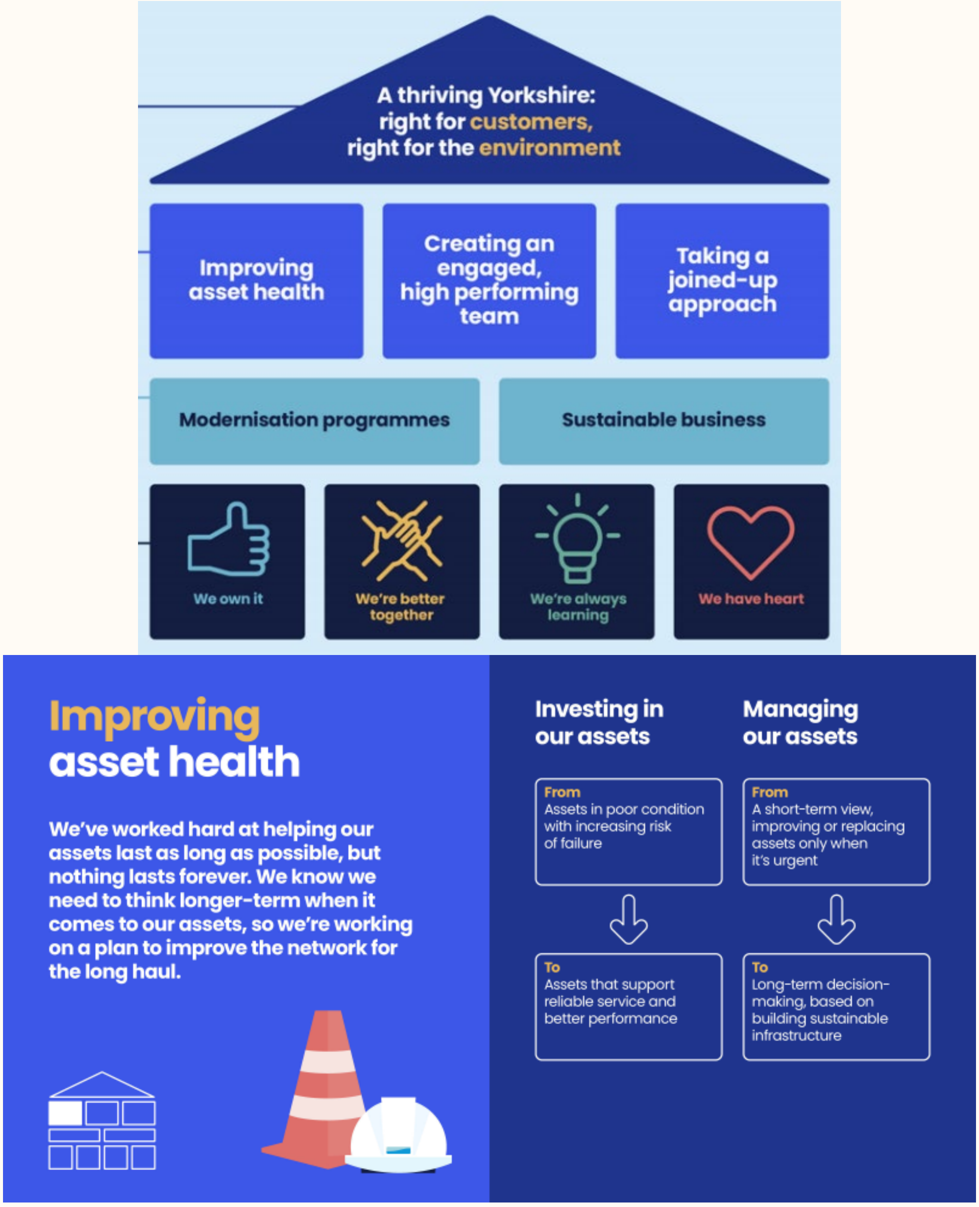
Our customers consistently tell us that providing a continuous supply of water that is safe to drink is their number one priority and we recognise it as one of our primary duties. In recent AMPs we have relied to an increasing extent on operationally focussed interventions in order to discharge that duty. Our long-term delivery strategy (LTDS) recognises that we will need to increase our investment activities in the future to enable us to deliver more for our customers and this request for a targeted allowance in AMP8 is a step in that direction. We trust that Ofwat will support us in our objectives of creating tomorrow together and that collaboratively, as an industry we can shape the next phase in the evolution of a healthy and sustainable water sector.

5.2 Long-term Strategy for Water Asset Health

5.2.1 Yorkshire Water Asset Management & Asset Health

Yorkshire Water's vision is for a thriving Yorkshire, that is right for customers and right for the environment. We have an extensive varied asset base distributed across our region, and improvement of the health of these assets is a key pillar of this vision.

Figure 5.1 Yorkshire Water's Vision for Asset Health



We have operated a risk-based asset management approach for over 20 years which has helped keep costs for customers low, and targeted our investment to meet the challenges set by the regulator on both costs and performance. This mature asset management system is certified to ISO55001, and it ensures all our processes and activities continue to deliver strategic outcomes, with sustainability and the improved health of our assets at the core of that decision making.

However our asset management processes have identified a growing misalignment between our need for investment in long term sustainable asset health and the Totex and performance expectations allowed for in the 5 yearly price review process.

We therefore include a cost adjustment claim to request a Targeted Allowance of £437.7m to start to bridge the emerging gap between base allowances and the needs of the business to maintain assets into the long term. This allowance will have specific deliverables and associated customer protection. We have focused this claim on assets within the Water Network Plus price control due to the greater customer risk these assets pose and affordability limitations.

Table 5.1 Summary of Targeted Adjustment Claim Areas

Claim	Investment Area	Net Claim size
CW02a Infra	Water Networks	£250.9 m
CW02b Non-Infra	Water Treatment Process Civils Assets	£75.6 m
	Treated Water Storage	£111.2 m
	Total	**£437.7 m**

The sections below set out:

- Our high-level evidence on the impact of historic cost and performance targets on our ability to invest in long term asset health.
- An overview of YW's asset health

We move on later in this document to provide the other evidence required for cost adjustment claims regarding the need for the adjustment, our cost efficiency, optioneering and customer protection. This is separated in to two discreet claims;

1. A targeted allowance for below ground water mains replacement (CW02a Section 6)
2. A targeted allowance for above Water Treatment Works, Tanks and Service Reservoirs (CW02b Section 7)

We welcome Ofwat's increasing focus on asset health through the PR24 process and beyond and in particular we look forward to working closely with Ofwat during AMP8 to begin to implement the principles of the Operational Resilience Monitoring framework and strengthen asset management approaches across the sector in line with the AMMA review.

AMP8 will provide an important opportunity to build greater knowledge and understanding about how to measure asset health and use data and insights to inform improved long-term decision making. We are keen to work with Ofwat and our peers in a collaborative spirit to share best practice to the benefit of the wider water industry and the customers and communities it supports.

5.3 Ofwat's base modelling approach & maintenance

Companies are expected to maintain or improve the health of their assets as part of base maintenance costs to meet long-term customer needs across several performance commitments. As historic maintenance expenditure is included in Ofwat's modelled base costs definition, an allowance in this area is therefore funded through the BOTEX models.

We recognise Ofwat's need for an econometric toolkit to assess comparative efficiency as part of its Price Review decision making. However, we have consistently, through our PR19 responses, our CMA referral and our PR24 consultation responses highlighted potential drawbacks of using solely historic data and exogenous variables to assess forward looking cost requirements.

The cost models do not account for differences in maintenance activity (such as when large groups of assets approach the end of their useful lives), nor service quality, either between companies or over time. This means that the base models fund the level of service achieved in the historical period by efficient companies and cannot disentangle, amongst other things, service improvements that were achieved historically by companies through additional enhancement funds from those achieved through productivity improvement.

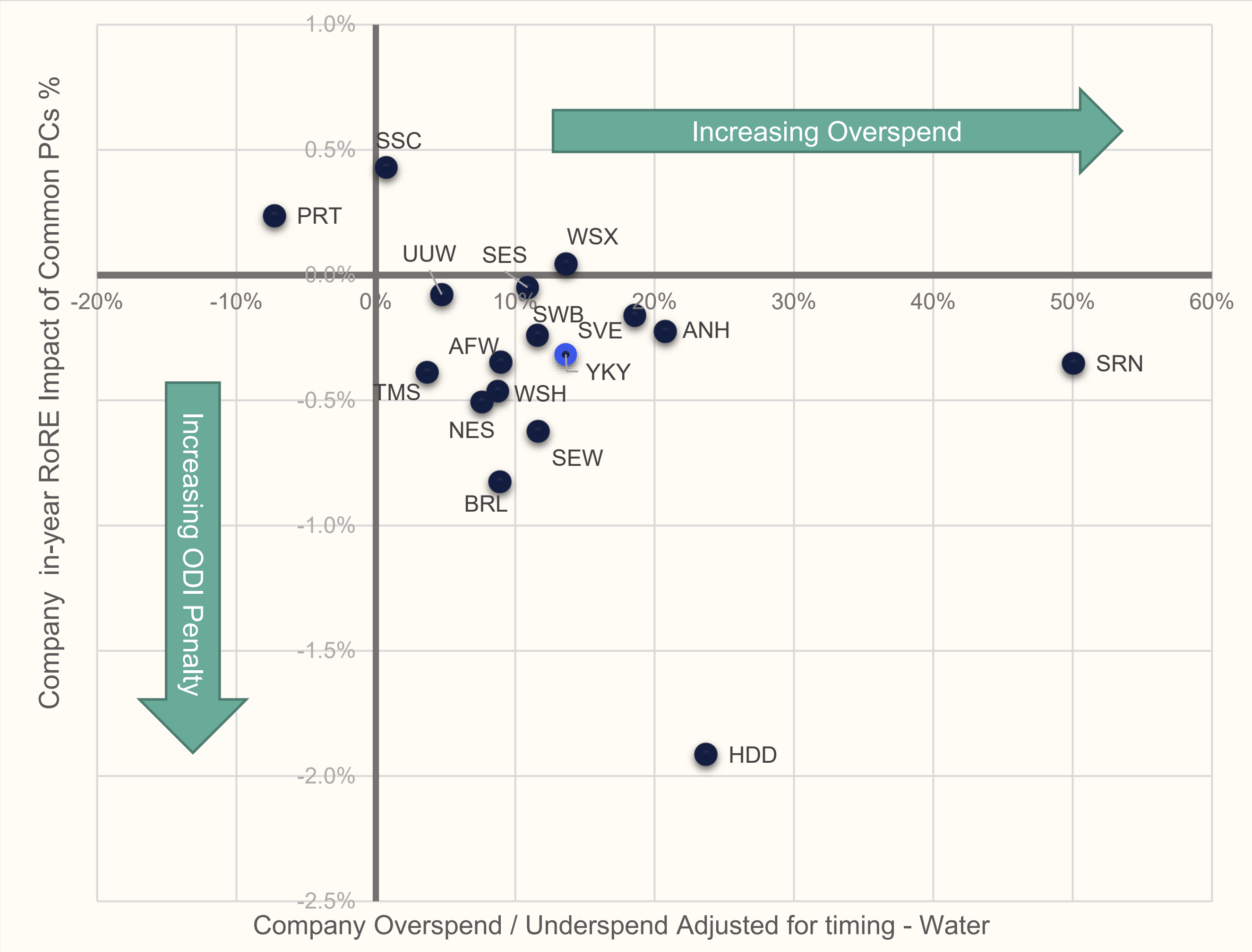
The econometric modelling approach was introduced at PR14 and was based on historic costs incurred by the industry. Companies were therefore set an allowance that reflected the level of spend of the benchmark companies at that time. The models made the assumption that the benchmark companies were investing sufficiently to achieve service levels going forward into AMP6.

At PR19 this approach was developed further and used a historic dataset of investment that would have been influenced by the allowances set at the previous settlement. This was combined with an even more stretching benchmark and frontier shift efficiency assumptions, along with the introduction of upper quartile performance expectations outside of the modelling. We are concerned that this approach does not sufficiently account for the real costs of long-term service maintenance, and improvement in the industry, and has led to a base allowance that is unsustainable to maintain long-term asset health.

The stringency of the PR19 settlement has been compounded by recent, unforeseen macroeconomic developments, such as the material increase in input prices that were not sufficiently accounted for in the determinations. Consistent with our duty to maintain an efficient and economical water supply system, we balance our expenditure in each AMP period, within the overall totex allowances. We do so in a way which seeks to maintain and improve services in line with performance commitments, whilst meeting our other statutory obligations. Within tighter totex constraints and stretching performance targets, that balance may favour shorter-term reactive or operational interventions, which provide immediate mitigation of risks to service rather than more proactive longer-term asset investment. With a maturing asset base, we consider that the overall base totex allowances will need to be increased in future AMPs to allow that longer term investment to proceed alongside necessary levels of reactive expenditure in such a way that balances future programmes in a way which offers best value to customers.

Figure 5.2 below shows that increasingly companies are failing to achieve the common PC targets, and overspending their totex allowances. This position has deteriorated each year, with no companies reporting a net reward for common PCs at APR23. We anticipate this will continue through the rest of AMP7 as targets tighten further.

Figure 5.2 AMP7 Yr 1-3 Average Totex over/underspend vs ODI RORE impact of common PCs – Water Price Controls

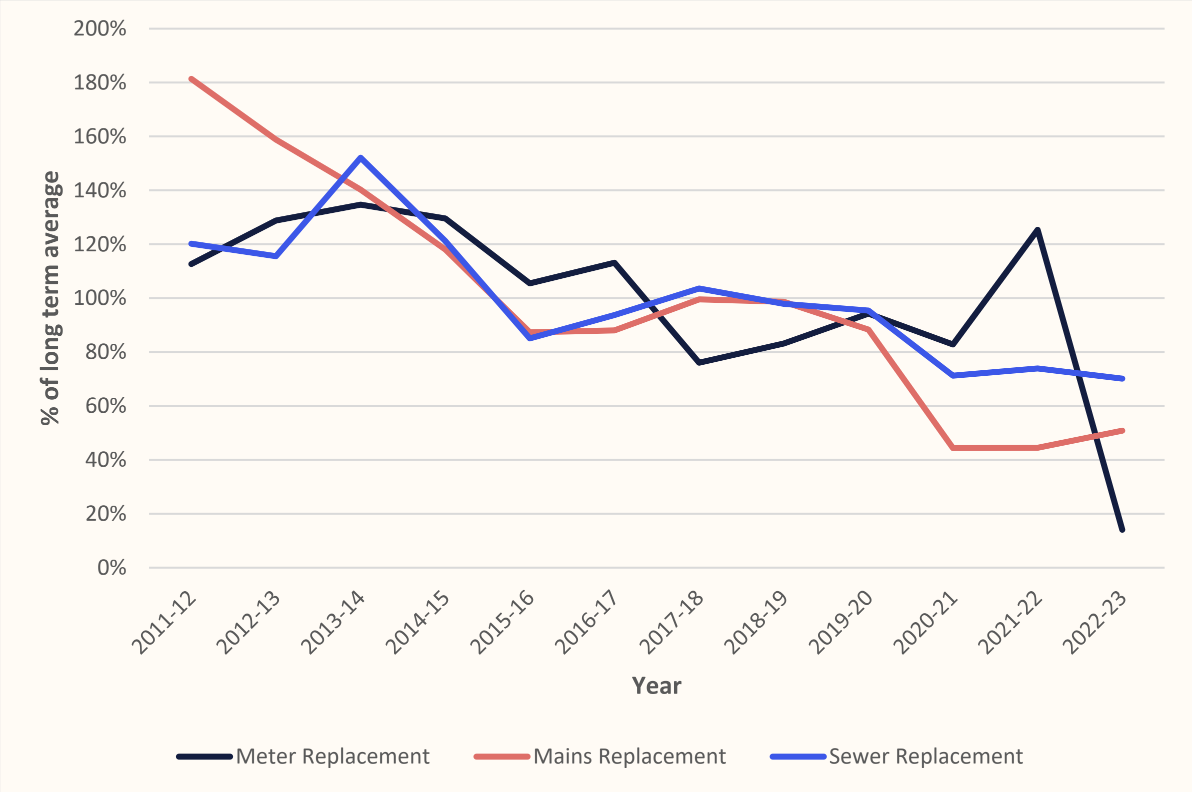


Source: APR 20/21,21/22,22/23

In the course of delivering our investment plans, we continuously have to re-prioritise expenditure in response to events (including extreme weather or unplanned asset outages), emerging issues and stretching performance commitments. Within a constrained base totex allowance we inevitably prioritise actions which will ensure we maintain a safe and compliant service for our customers. Averting imminent service disruption may require a different and more urgent intervention than a long-term proactive replacement approach. In this context, the consequential deferral of capital investment in long-life assets, as available funding is deployed on more tactical and operational interventions can be seen to be in customers best interests, and has the lowest service impact of our available options to reprioritise investment.

However, if over successive AMP periods, there is insufficient headroom within overall base totex allowances to accommodate the necessary proactive asset replacement, this approach will not serve customers best interest in the long-term. Tightening totex allowances and stretching performance targets appear to be driving an industry wide trend towards reducing proactive asset replacement. The industry replacement rates of a variety of assets have reduced over the last 12 years as is shown for some selected asset groups for which industry level data is available.

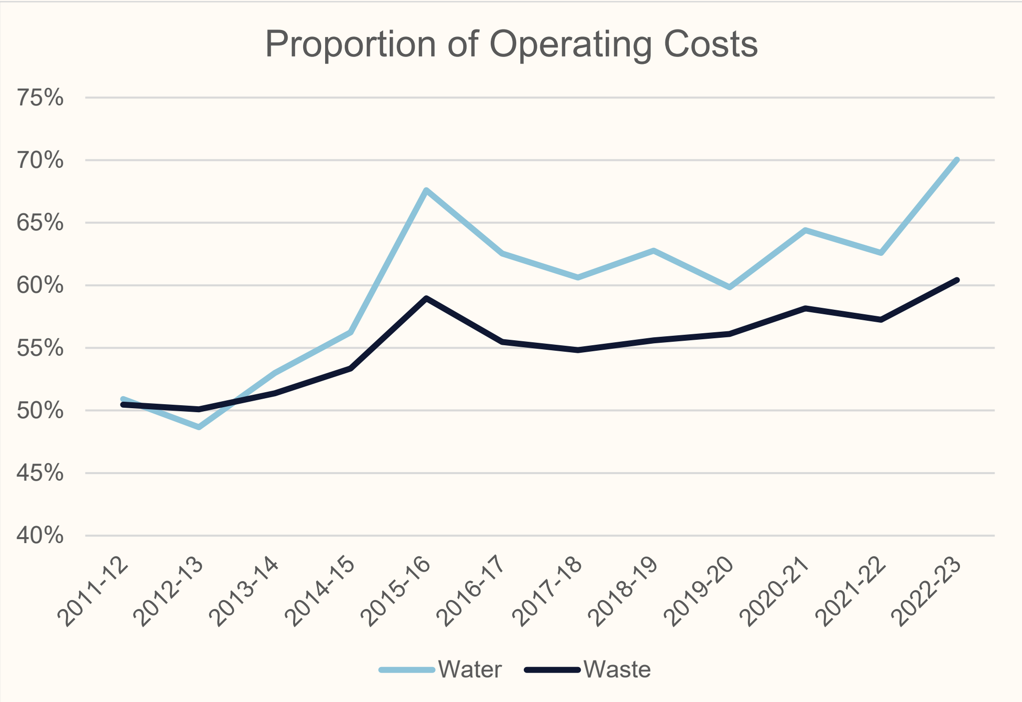
Figure 5.3 Industry trend of selected asset replacement 2012-23



Source: APR data for asset groups where this is available

We also note that the proportion of operating costs has increased across the industry on average over the modelling period in both water and wastewater. This is a somewhat simplified assessment as it doesn't account for changes in accountancy rules or the proportion of reactive vs proactive capex, but it further evidences the increasing challenge in long-term asset health investment under the current methodology.

Figure 5.4 2012-23 Proportion of operating costs in Water and Wastewater Base Totex



This challenging approach to cost and service has benefitted customers in the short-term by keeping bills low. Past actions were optimal for outcomes and our customers, within the constraints of the price control settlement, but given the changing position of asset condition in a number of water asset types our capital maintenance expenditure for refurbishment and renewal needs to increase. We set in the upcoming chapters several initiatives how we have efficiently delivered to keep service stable or improving whilst simultaneously keeping costs low for customers. We also set out why it is now time to implement a more proactive approach in future AMPs to ensure that these improvements can be sustained into the longer term.

This required investment will not be funded through the econometric modelling because of its backwards looking nature and hence a cost adjustment is required to ensure that the company can deliver its stretching performance targets into AMP8 and beyond.

The investment needs set out in this document are specifically focused on AMP8 but as we discuss extensively below, there is a need for a longer-term rebalancing of the approach to regulatory price setting to accommodate a more sustainable and proactive approach to investment particularly in some of our longer life assets. The level of funding we are requesting is likely to be needed into the future, but we are hopeful that Ofwat's modelling approach can be adapted for future price reviews such that this level of investment will become implicit and subsequent cost adjustment claims will not be required. We are keen to work with Ofwat to ensure future models capture wider investment needs going forward.

5.4 Yorkshire Water Asset Health

This cost adjustment claim case focuses on 4 areas in the water business where we have identified a particular AMP8 investment need. We recognise that Totex allowances cover asset renewal across the whole asset base and have considered whether there are asset groups which were having higher renewal rates in AMP7 that can subsequently be reduced.

However our AMP7 activity does not imply this, it is not that our capital maintenance is spent on proactive activity in other asset groups, it is that the Totex allowances are insufficient in the long-term to deliver on initiatives that maintain compliance, target service performance, minimise penalty and improve asset health.

Yorkshire Water has spent on average £131.2m p.a. in the last 8 years on base Capex (at 22/23 prices), our PR19 allowance was an implied allowance of £128m p.a. This is across all water asset groups from impounding reservoirs, raw water assets, treatment works, treated water storage, water networks, pumping stations, communications pipes and meters. It also includes all M&G (IT, fleet, security) and health and safety (statutory and non-statutory) investment allocated to the water business unit.

A risk-based approach has been applied, but all areas of proactive capital maintenance have been challenged compared to long term required levels.

The four areas of investment need in this plan (plus our metering claim) sum to nearly this capex value again. It is not reasonable to expect that this need can be absorbed by spending no capital maintenance elsewhere (much of which is statutory or reactive or in areas that have had similar low investment levels in recent periods).

5.4.1 Understanding Asset Health - Condition Grade Analysis and Modelling

As part of our planning and in response to Ofwat's AMMA assessment and asset health framework we are in the process of reassessing the condition of our non-infra asset base applying a structured visual inspection approach implemented by experienced operators and technicians. This assessment builds on previous inspections at PR09 and PR14.

The guidance and training provided to the asset survey teams helps to ensure broad consistency of approach although the approach may be prone to an element of subjectivity and by its nature may not be able to reveal issues related to the internal condition of an asset however the results of the latest surveys, particularly with respect to the proportion of assets assessed as being in condition grades 4 (poor) or 5 (very poor) indicates a steady deterioration of elements of the asset base which it is important to manage for the long-term health of those assets.

The figures below illustrate the overall trends in condition grade from PR09 to date. Assets are graded on a five point scale with condition grades being defined as follows

- 1 – Good
- 2 – Fair
- 3 – Adequate
- 4 – Poor
- 5 – Very Poor

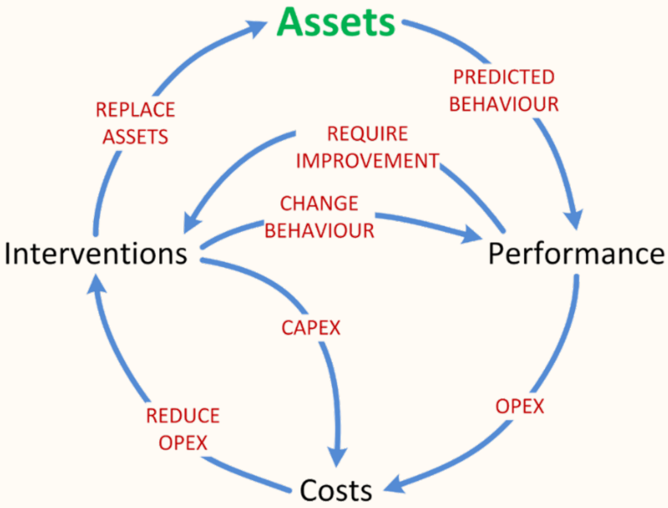
The graphs show the average condition grade (weighted by number of asset components in each category) as well as the percentage of assets in condition grades 4 (poor) or 5 (very poorl) and how these are changing over time.

Figure 5.5 Comparison of non-infra condition grade analysis from subsequent Price Reviews

Performance levels have improved over the period in both water and wastewater price controls but this has been down to better targeting of investment and operational responses and mitigation. This performance improvement cannot be sustained or continued without addressing the underlying asset health.

Our suite of asset models, which underpins the Decision-Making Framework (DMF) provide a forward-looking view of asset health and operational performance, giving the optimum level of investment required to meet specific, targeted service levels or Totex constraints. Our asset models use proven statistical techniques to predict and calculate deterioration rates for most of our asset base (Infrastructure/Non-Infrastructure) based on existing asset information and intervention costs derived from our Unit Cost Database (as applied elsewhere in the programme). These models can be optimised to model a wide range of outcomes depending on input parameters (such as cost constraints, desired service level or carbon performance).

Figure 5.6 Our Asset Planning Approach



Asset modelling provides critical insight into our asset base which accurately reflects the true picture of condition and serviceability across YW. It is important where possible, to provide empirical evidence of why investments are required and where, with a high degree of granularity and confidence. This provides an alternative, asset centric data and evidence which goes beyond the realm of historic, econometric modelling used to define investment needs.

There are two key model suites supporting this document, namely:

- Our Infrastructure Deterioration models (IDET) – for Clean Water and Waste Water networks based on regression models which predict deterioration
  - Modelled inputs and variable include Age, Material, Diameter, Soil Characteristics, Water pressure, customer count, Leakage, Interruptions data
  - Cost data for capital interventions based on intervention types (Open Cut/Directional Drilling)
- Our Non-Infrastructure Deterioration models (NITRO) – For all above ground assets (treatment works, service reservoirs, pumping stations, boreholes) based on asset equipment deterioration curves (Weibull)
  - Modelled inputs and variable include equipment types, attributes, size, installation year, condition grade.
  - Cost data for capital interventions based on equipment specific UCD models, including Embodied Carbon impact

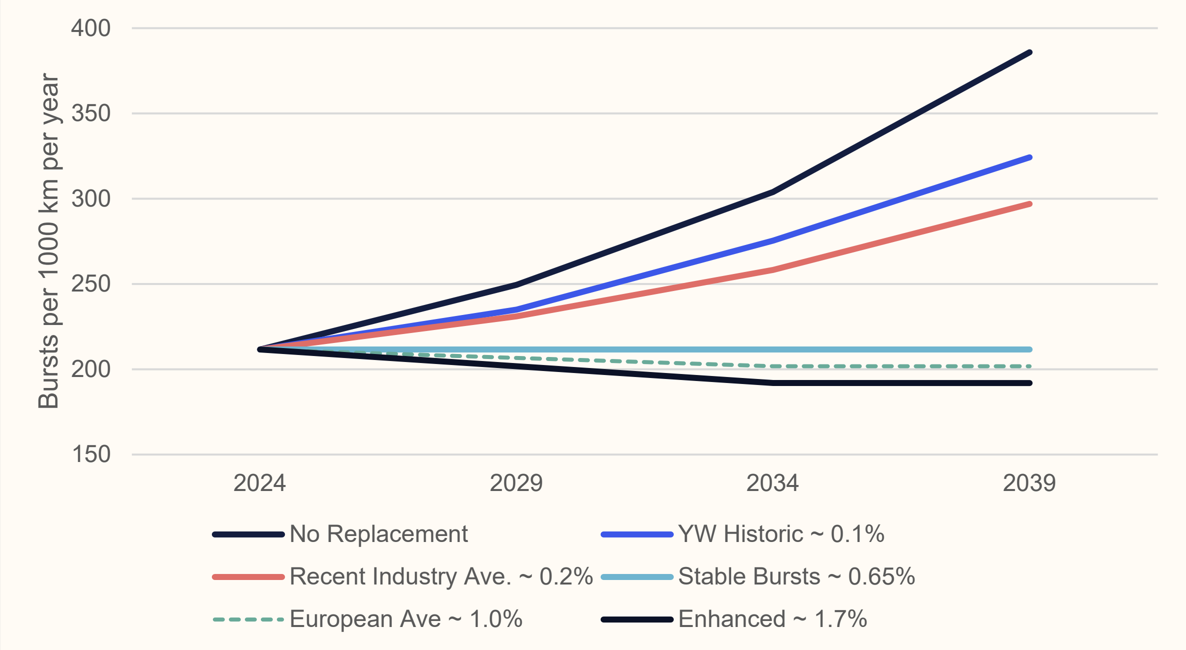
Our investment modelling for PR24 indicates that base capex significantly above that suggested in Ofwat's draft econometric models will be required to ensure the long-term health of our asset base. Implied levels of investment from the econometric models would be insufficient to allow us to deliver the most cost-beneficial, long-term solutions for improving service to customers and achieving the stretching PC targets proposed in our plan. Without a sustained uplift in base allowances we would have to continue to defer replacement or refurbishment of assets requiring us to rely increasingly on reactive and opex based responses.

Further, it suggests that significant uplift in asset refurbishment and renewal is required to maintain stable asset health and service in the future.

In past AMPs we have been able to defer such investment on a risk-based approach, to benefit customers and because it was the most efficient intervention. This cannot be continued indefinitely and to do so is not likely to represent best whole life value or provide inter-generational fairness. We are concerned that some asset types, where the price control totex allowance is deficient, are beginning to exhibit deteriorating asset health and increased risk to service which we need to address through targeted, long-term replacement programmes.

Evidence from the modelling outputs have been used to support our argument as they provide valuable insight into service and asset health, whilst supporting our need for targeted investment. Our burst forecast rate for water mains under a range of alternative mains replacement rates is shown in Figure 7 below is a cornerstone of why we need to increase expenditure in this area in AMP8. Our mains repair (burst) performance, the key infrastructure asset health metric, will increase significantly if our historic or even recent industry average replacement rates are adopted in the coming AMP periods. To stabilise bursts at their current level would require an average replacement rate of around 0.65% over the next 3 AMP periods. This would still be below the average replacement rate in the rest of Europe which in 2020-21 was around 1%.

Figure 5.7 Burst rate forecast to 2040 under different renewal scenarios



Yorkshire Water has carried out a water infrastructure condition grade analysis which is in line with Ofwat's PR24 methodology. The results are shown in Table 5.2 below. There are 2,485 km of water mains that are within the condition grade 4 and 5. This represents 7.7% of the total water main asset base this is described as in either poor (500-1000 mains repairs per 1000km) or very poor (>1000 mains repairs per 1000km) condition. The consequence of this poor asset health includes leakage, interruptions to supply and water quality contacts together with increased reactive capex and opex costs.

Table 5.2 Condition Grade analysis of Yorkshire Water potable mains

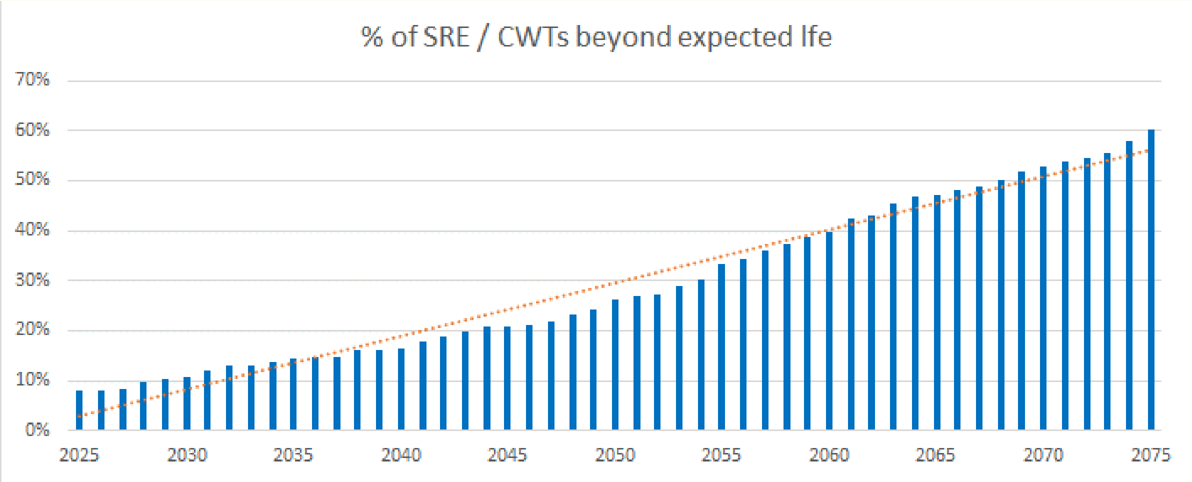
Length of potable mains by Condition Grade	1	2	3	4	5	TOTAL (KM)
Potable mains (<320mm)	42.8%	26.3%	15.8%	6.1%	1.6%	29,882
Potable mains (greater than 320mm)	7.25%	0.05%	0.04%	0.01%	0.00%	2,385

Asset condition will tend to deteriorate over time, and with our complex asset base, this is not a uniform, linear trend. Within an efficient whole-life cost approach to asset management there will be periods when that deterioration in condition can be managed effectively through more reactive and operational responses. However, there will come a phase in the asset life cycle, where it becomes more economic to replace or refurbish those assets in order to minimise whole-life cost and reduce risk to service. In the context of increasing future service expectations and more stretching performance targets, the need for that transition will tend to be brought forward in time as the value of those future service improvements increases.

This transition is not sharply delineated and in truth is part of a continuum but when considering particular groups of assets, such as those included in this claim, it becomes clear in aggregate that that transition is occurring and a change in investment is needed.

Our analysis indicates that with respect to certain key, long-life asset groups we need to begin that transitional investment in AMP8 in order to ensure the long-term health of our asset base, in terms of their ability to efficiently perform their required functions within our overall water supply system. For example, in the case of treated water storage tanks (CWTs and SREs) which are crucial to the quality and resilience of water supplies the age profile of this asset base shows that by the end of AMP8 more than 10% will be in operation beyond the end of their expected asset lives, rising to 60% over the next 50 years if we do not begin a phased programme of replacement as the figure below illustrates. Whilst we make appropriate risk based interventions to extend asset lives it is not appropriate to defer indefinitely the need to renew these critical assets, particularly those at condition grade 4 and 5.

Figure 5.8 Proportion of Treated Water Tanks Reaching End of Expected Asset Life



The document now moves on to provide the evidence required for cost adjustment claims regarding the need for the adjustment,

- Section 6 – CW02a A targeted allowance for below ground water mains replacement
- Section 7 – CW02b A targeted allowance for above ground water asset structures and Water Treatment Works, Tanks and Service Reservoirs (SREs)

6. CW02a Targeted Allowances for Asset Health – Infra

6.1 Overview of Our Claim

This cost adjustment claim is based on the need to transition from our historic mains replacement rates to a rate which will ensure improving asset health in a sustainable way which shares the costs fairly between current and future customers. Historically, we have been able to deliver good service to customers, despite lower asset renewal rates, typically achieving our targets for leakage and low rates of supply interruptions, whilst being an outlier in terms of our rate of mains repairs (second highest after Thames Water).

Continuing with current rates of renewal would see the average age of our network grow and the proportion of the network where the age of mains exceeded the maximum expected asset life to grow significantly. Stabilising asset health for our network may ultimately require renewal rates around 0.7% to 1.0% per annum, which is far higher than our historic renewal rates or current industry average. According to research published by Economic Insights on behalf of Water UK (Options for a Sustainable Approach to Asset Maintenance and Replacement) replacement rates for water mains in the rest of Europe were 1.0% (in 2021). The National Infrastructure Commission (in its letter to Ofwat of 18 May 2023) highlighted the need for a more forward-looking multi-AMP approach to ‘the investment required to maintain asset health and, consequently, service performance and reliability’. Whilst we do not consider that there is sufficient evidence to justify a move to the 0.7% to 1% replacement rates immediately, it is clear that a substantial increase from historic replacement rates is now required.

Indeed, the principles set out in Ofwat’s PR24 Methodology, Creating Tomorrow Together and the priority given to focussing on the long-term, suggest that Ofwat too, recognise the need for a transitional approach starting in AMP8 which will support sustainable investment in long-term asset health.

Whether through our deterioration modelling, asset life assessments or comparison with European renewal rates, all evidence points to a need to move to higher mains renewal rates in order to maintain the health of water networks in a fair and sustainable manner (in Yorkshire Water and across the sector). In AMP8 we consider that it is necessary to increase our mains replacement rates to 0.66% per annum which would enable us to address all of the worst performing (Condition Grade 4 and 5) cast iron and asbestos cement mains in our network (over the next two AMPs) and enable us to achieve our AMP8 PC targets whilst reflecting the overall affordability of our programme.

As we monitor the impacts of this programme during AMP8, we will be able to update and improve our asset models in order to determine whether a move to higher rates of replacement (the 0.7 to 1.0% figures previously discussed) is necessary in future.

We assess that Ofwat’s models would include an implied allowance for replacing 0.205% per annum (based on average replacement rates across the sector). In this cost adjustment claim, we are therefore seeking additional funding of **£250.9m** to support the additional 0.455% replacement above assumed base allowances. This is a capex-only claim sitting entirely within the water network plus price control.

6.1.1 Evidencing our Claim

We have undertaken extensive modelling of future asset performance under a range of alternative replacement rates (using our IDET model) as well as assessing the scope for alternative interventions to target mains repair rates (such as pressure management and calm networks training) in order to arrive at our proposed AMP8 mains replacement programme. Relative to recently published cost adjustment claims (Thames and Wessex Water) we are confident that our unit rate for replacement £336.3 / m) is efficient. On this basis we are confident that the proposed programme represents the best option for customers (both current and future customers). The overall value of the cost adjustment claim clearly exceeds the materiality threshold for the water network plus price control (at 1% of the price control totex value of £2,743m the threshold would be £27.4m).

6.2 Need for Investment

In this section we set out why there is a need to increase long-term investment in our water infrastructure and why that process needs to start during AMP8. In section 4.5 we discuss why this increased investment cannot be accommodated within the overall base totex allowances in the water network plus price control.

6.2.1 Introduction

Despite our good performance in reducing leakage and maintaining supply interruptions Yorkshire Water is currently an outlier in terms of mains repair rates (second highest in the industry after Thames Water). Our network is above average in terms of overall asset age and includes a large cohort of cast iron and asbestos cement mains with significantly above average failure rates. In previous AMPs we have opted for efficient interventions to extend asset lives and minimise cost to customers. We have sought to reduce pressures in our network to reduce leakage and supress bursts because it was economic to do so. We have also ensured that our network management practices minimised the incidence of transient-induced mains failures (our 'Calm Networks' strategy). There is limited scope to achieve further benefits on mains repair rates from such initiatives.

Similarly, during AMP3 and AMP4 when DWI water quality programmes were being undertaken across the sector (Section 19 undertakings) we adopted an innovative relining approach to address the water quality risks associated with cast iron mains rather than opt for large scale asset replacement. This ensured that we maximised the useful lives of those assets, whilst ensuring customers' bills stayed as low as possible. Companies which opted for mains replacement to address this water quality risk will have benefitted in terms of reducing the age of their network and future burst rate on the back of the quality programme.

Averting imminent service disruption may require a different and more urgent intervention than a long-term proactive replacement approach. In this context, the consequential deferral of capital investment in long-life assets, as available funding is deployed on more tactical and operational interventions, can be seen to be in customers best interests. In this context, in line with the rest of the industry, we have seen our mains renewal rates reduced in recent years in order to enable us to target investment on in-AMP performance for key performance commitments and customer outcomes. Whilst this was a wholly appropriate and rational deployment of our totex allowance, in the context of stretching performance commitments, we recognise that a significant improvement in our mains repair performance will require a step change in mains replacement rates in the future.

Furthermore, we recognise that current renewal rates will see our network's average age increase significantly over the coming decades to the point where 100 years from now, over 70% of our mains would have exceeded the maximum life expectancy for pipes of that material. Whilst asset age is not the only factor driving service and performance it would be unrealistic to expect assets to achieve such longevity and deferring the point at which we begin the transition to a sustainable long-term renewal rate will unfairly transfer the costs and service risk to future customers.

6.2.2 Network Characteristics

Yorkshire Water owns, operates and maintains 32,267.4km of potable water mains across 3,335 Distribution Management Areas (DMAs), utilising 1,800 Pressure Reducing Valves (PRVs), and 4,647 DMA flow meters.

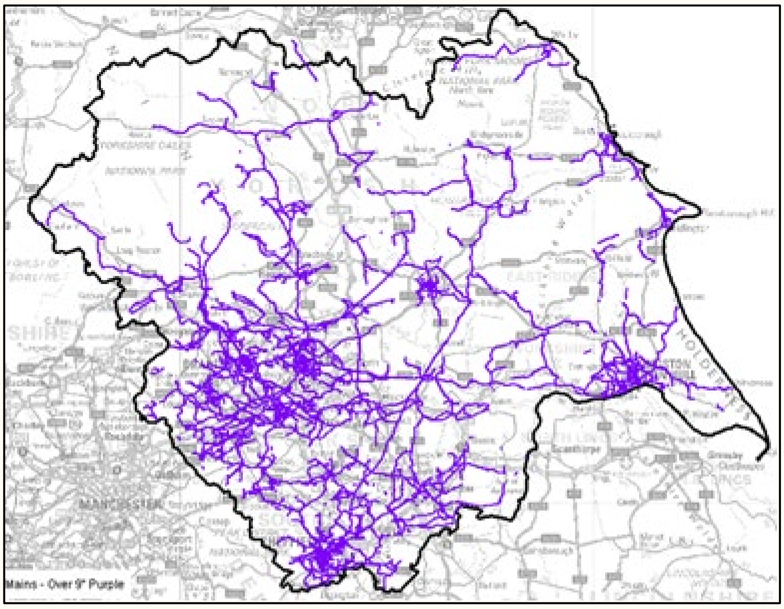
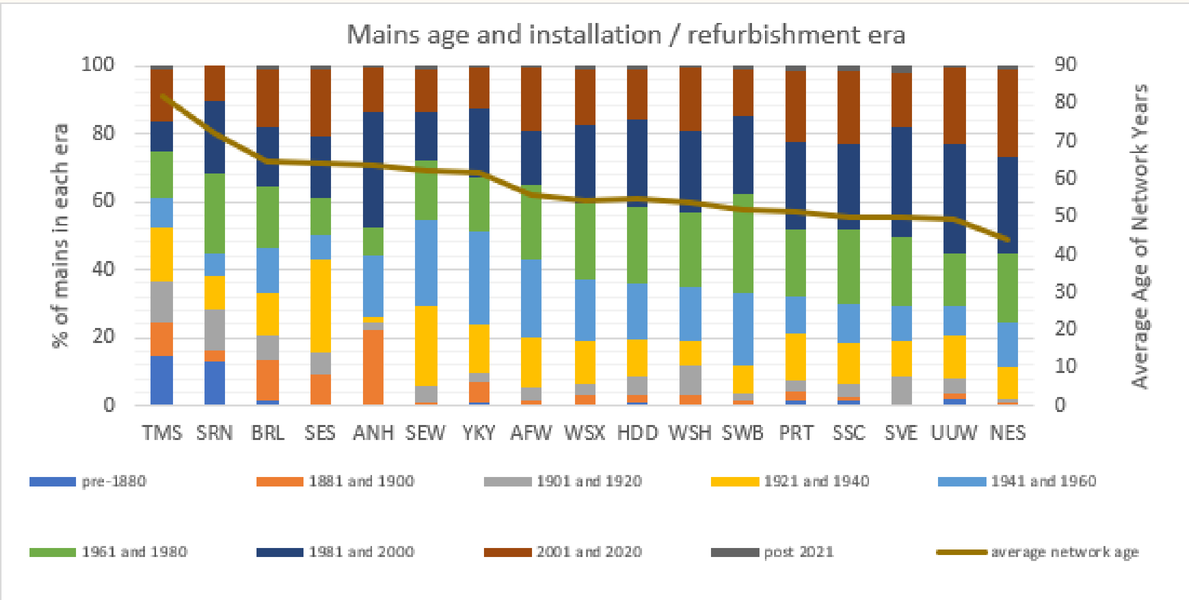


Figure 6.1 Our Water Network

Comparative industry information (2022-23 APR) shows that Yorkshire Water has an average water network age of 61.8 years, with the industry average being 57.9 years as shown in Figure 6.2 below.

Figure 6.2 Mains materials proportions across the industry



Pipe age itself is not the only determining factor in driving asset performance and we have carried out extensive analysis to understand the performance of different pipe cohorts within our network. Figure 11 below is an example of how this analysis provides insight into the performance of different pipe materials (failure rate per km per year) against the age of the pipe.

They clearly show the significantly higher failure rates arising within the asbestos cement and cast-iron pipe materials. These deterioration curves underpin our IDET network investment planning tool thereby supporting efficient targeting of mains replacement on the cohorts which will have the biggest beneficial impact on service.

Figure 6.3 Failure Rates by Material

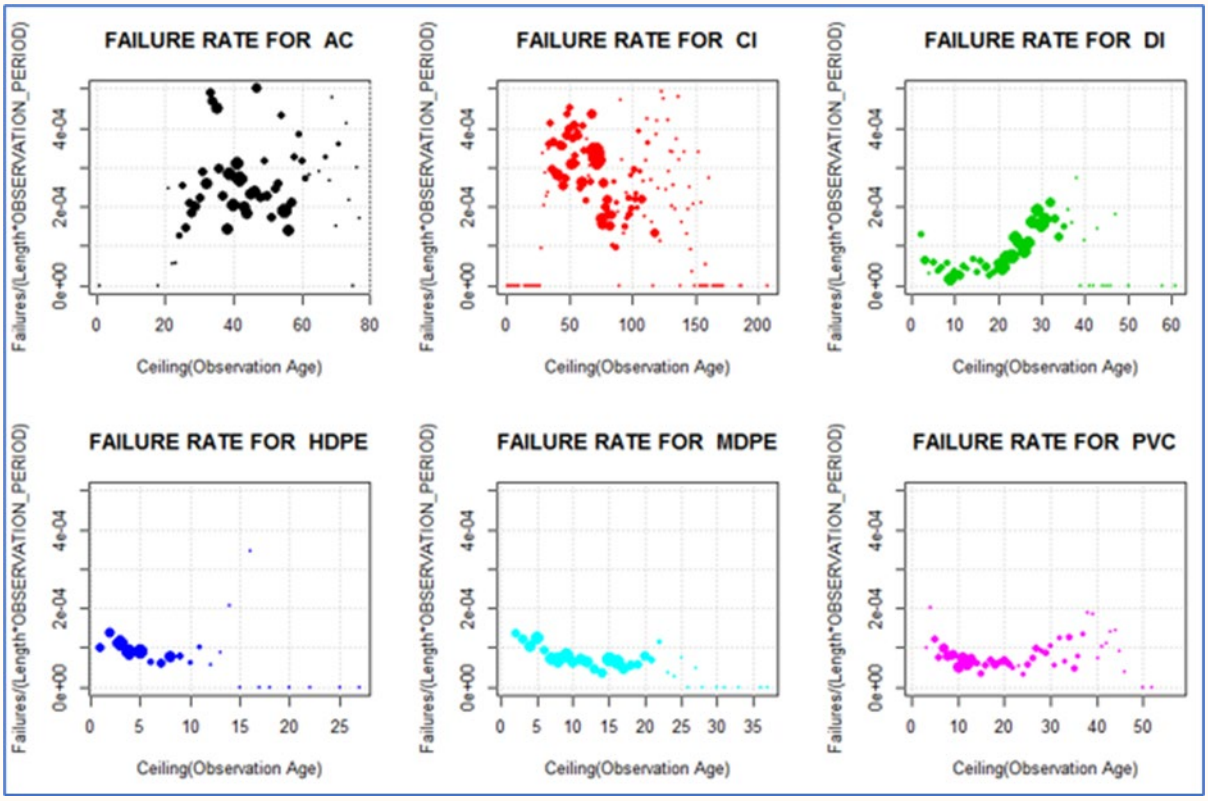
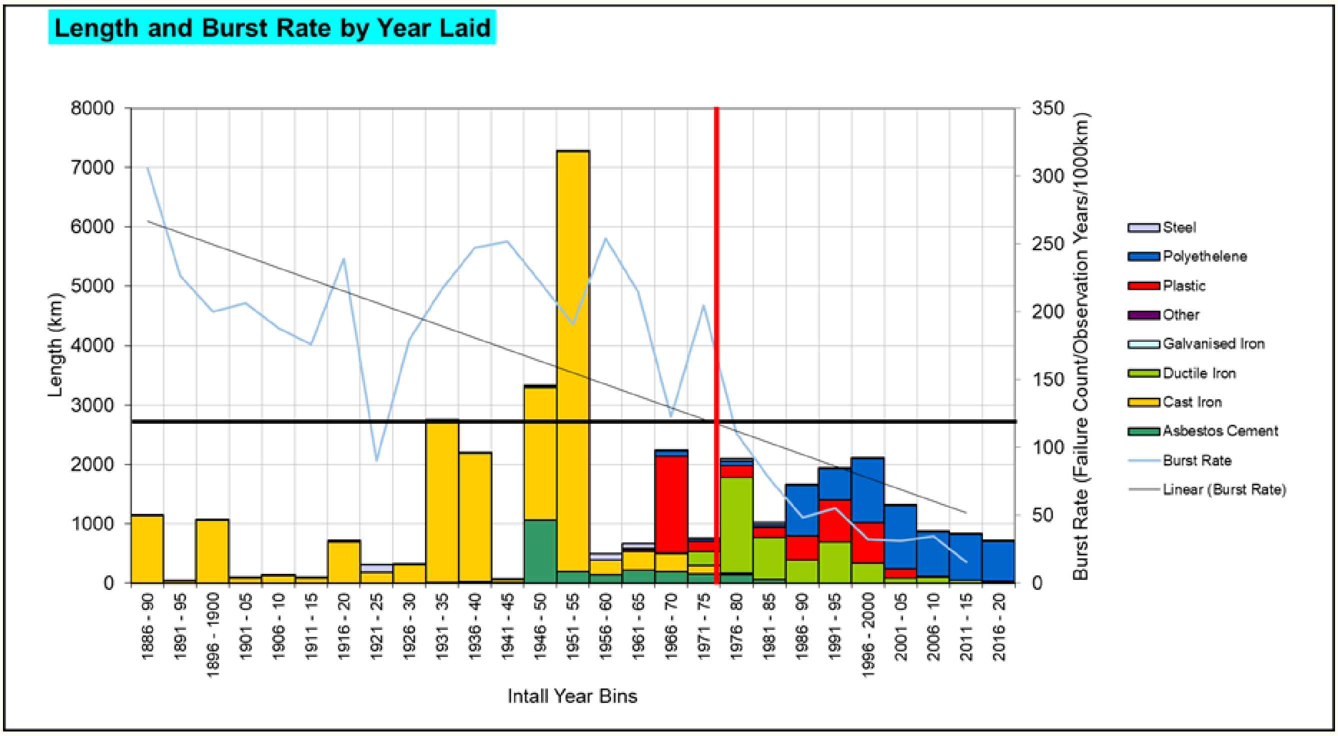


Figure 6.4 below shows our asset base by installation year and material plotted against burst rates. Of our 32,267.4km of treated water mains, there are 23,600km (73%) of water main where the average mains repair rate is 197 per 1000km, versus an industry average of 113 per 1000km (2021-22). These mains are predominantly cast iron and asbestos cement.

Figure 6.4 Pipe material age and burst rate.



Whist individual pipes may continue to function well beyond their assumed asset lives, there are nevertheless broadly recognised expected asset life ranges for the pipe materials in use within Yorkshire Water. Recently published research by UKWIR suggested that the expected useful life for MDPE mains could be between 100 and 140 years. If that is the case a future renewal rate of between 0.71% and 1.00% would be necessary to maintain stable asset health within the MDPE pipe cohort. Other materials used in the past such as asbestos cement and PVC have much shorter asset lives and given their date of installation may already be reaching end of life. The table below summarises the current position for our network.

Table 6.1 Asset Life of Yorkshire Water Network

Material	Assumed Asset Life (yrs)	Present Day		
		% of network	Ave Age	Max Age
CI	80 – 100	58.9%	82	108
AC	40 – 65	5.8%	68	75
DI	80 – 100	10.9%	39	50
PVC	50 – 75	8.8%	39	50
MDPE	100 - 140	15.6%	14	30
		100.0%	**62**	
		% beyond assumed life	**15%**	

This shows that an estimated 15% of our network already exceeds the upper end of the assumed asset life range. As mentioned above, whilst individual pipes by virtue of historic operating history, benign ground conditions and quality of installation may continue to function beyond their assumed asset life, it would be a cause for concern if that percentage of life-expired assets continued to grow significantly.

6.2.3 Network Management Approach

Over the last 30 years we have made significant progress in maintaining and improving the distribution network. Our principal concern has been to remove the legacy of iron and manganese in the network and to reduce the level of leakage from previously unacceptable levels to achieve an economic level of leakage. Throughout this period, we have sought to deliver improved service to customers at the most efficient cost.

In 1990 we took ownership of a network that had developed over some 150 years. Its development had been undertaken by many different bodies each adopting a different strategy and exploiting different developments in materials and construction. Since that time we have sought to build an ever-greater understanding of our network and its performance in order to form network management strategies.

Improved data collection and monitoring has helped develop asset records and decision support tools including hydraulic network models and our network investment planning tool (IDET). In combination these tools allow us to determine strategic levels of investment required and to target those interventions in the most effective manner.

Our network management approach is based on this understanding of the network and the issues faced by our customers before deploying the appropriate interventions. Using a risk-based approach we have delivered the least cost solutions that resolve and deliver improvements in service and performance. Seeking, where appropriate, to prolong the life of what remains an effective, but aging network.

Mains replacement is costly, and we recognise that there are other interventions which can deliver improved service in terms of mains bursts, leakage and water quality at lower cost. Our policy is to deliver renewal or rehabilitation which meets the needs of our customers in an economic manner that aligns with our risk-based approach to investment which includes considering operational solutions, to ensure we provide the lowest whole life cost to service delivery. We describe below, the rationale behind our historic approach to managing our network.

Mains renewal policy

Over the last 20 years we have invested in mains that have failed 5 or more times in the last 5 years, over a 1km stretch or between isolating valves. This is meant we have focused on shorter sections of mains that have been frequently failing and causing loss of supply, general disruption to customers (such as frequent road closure), or other additional issues such as discolouration or milky / air appearance to the water. During any given AMP period other risks or performance issues may emerge where resolution is more urgent in order to maintain customer service. Therefore not all mains meeting the five-in-five criteria will necessarily be replaced in that period. Balancing and reprioritising our programme on an in-AMP basis is a necessary function within our overall asset management programme, particularly since the advent of the totex and performance commitment era.

Pressure Management

As a result of the harsh winters experienced late in AMP4 and the impact this had on both our leakage and mains repair performance, between 2010 and 2012 we installed approximately 200 Pressure Reducing Valves (PRVs). This created new pressure reduced DMAs or PMAs. These areas were targeted due to the high burst rate we were experiencing which was impacting our Water Infrastructure Serviceability measure.

After analysing the pre and post-installation mains repair data from each of these DMAs we can see that in the five years post installation, burst rates were typically 18.6% lower in these pressure managed areas. Looking beyond 5 years, post installation we see burst rates returning to their previous levels. This suggests that the pressure management strategy has helped to reduce the rate of deterioration of those mains but cannot eliminate it entirely. As we have rolled out our pressure management programme since 2010, opportunities for further deployment have diminished. Network hydraulics and the need to maintain adequate supply pressure for customers creates a limit to the extent of deployment, useful though this approach has been in the areas targeted.

Calm Networks Training

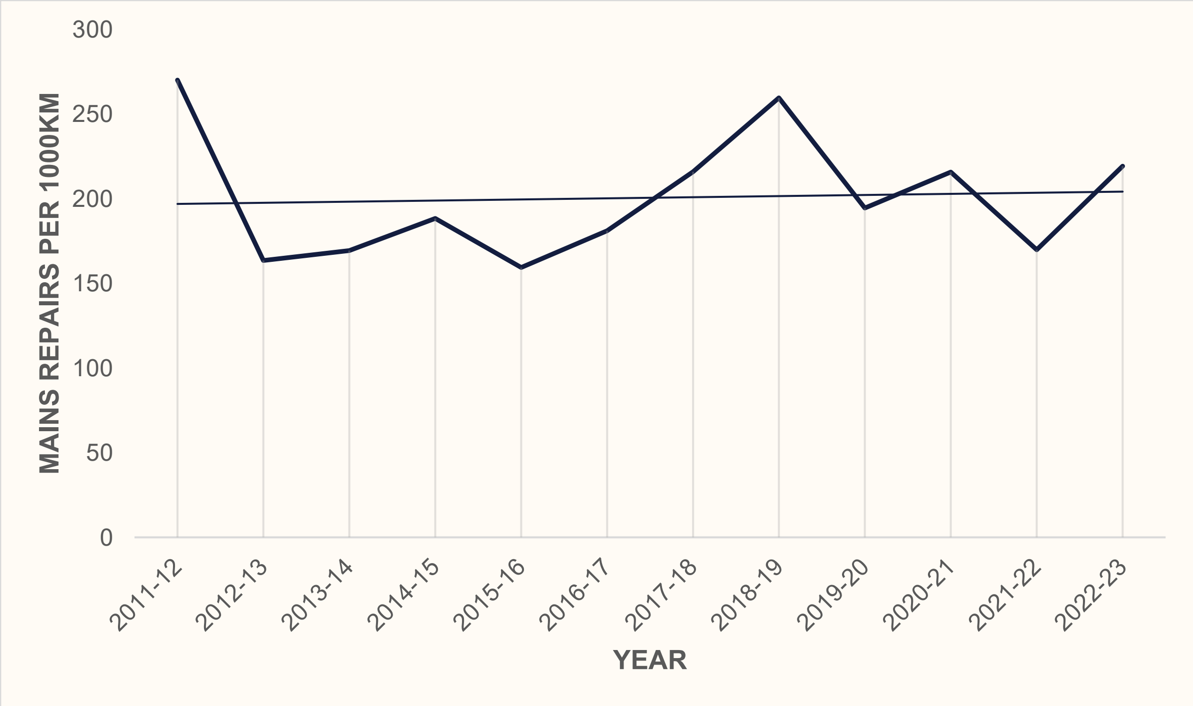
The way we operate the network can have an impact on the number of mains repairs that take place. Rapid closure of valves has been shown to cause damaging pressure surges on the network, which can lead to mains failure and lead to discolouration events. Our calm networks training is designed to minimise the risk of inadvertent damage due to operational activity. All employees that are authorised to operate the network have to complete calm networks training as part of their 'license to operate'. This training focusses on reducing the speed of valve closure which in turn, reduces the chance of surge generated mains failures. Whilst we continue to reinforce the calm network training and approach there is limited scope to improve burst performance through this approach in future.

6.2.4 Network Performance

Yorkshire Water has historically performed well in its customer service and water network performance commitments, typically achieving leakage targets and keeping water supply interruptions low. However, behind Thames Water, we have consistently had one of the highest rates of mains repairs per 1000km in the industry.

Our historic network management approach as described above has ensured that burst rate remained broadly stable, as shown in Figure 6.5 below, albeit at a higher level than most of our peers.

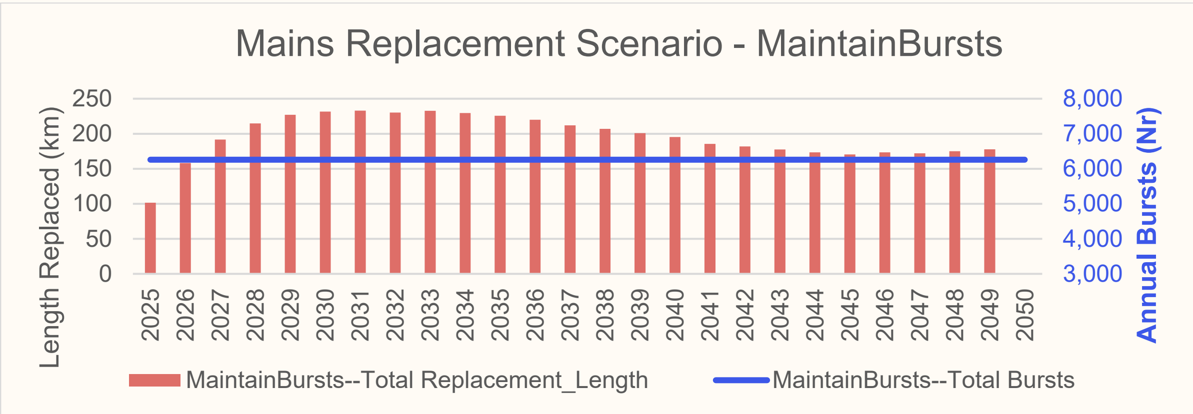
Figure 6.5 Long term Mains Repair performance at YW



With the increasing focus on mains repair rate as a proxy for asset health and the desire on the part of Ofwat to set stretching targets for reducing burst rates, we recognise that a different approach will be required going forward.

Using our investment planning model IDET, as described above, we have developed forecasts for future burst rates based on a range of asset replacement scenarios. The figure below shows one of the IDET scenarios tested, namely the mains replacement rates required to ensure burst rate remains stable at its current level. The red bars illustrate the length of mains required to be replaced each year in a fully optimised scenario. The profile varies because the age and condition of the mains varies and the model targets those mains where the service benefit per unit cost is the greatest.

Figure 6.6 Mains replacement required to stabilise current burst rate



The average annual percentage mains replacement rate under this scenario over the next five AMPs is shown in Table 6.2 below.

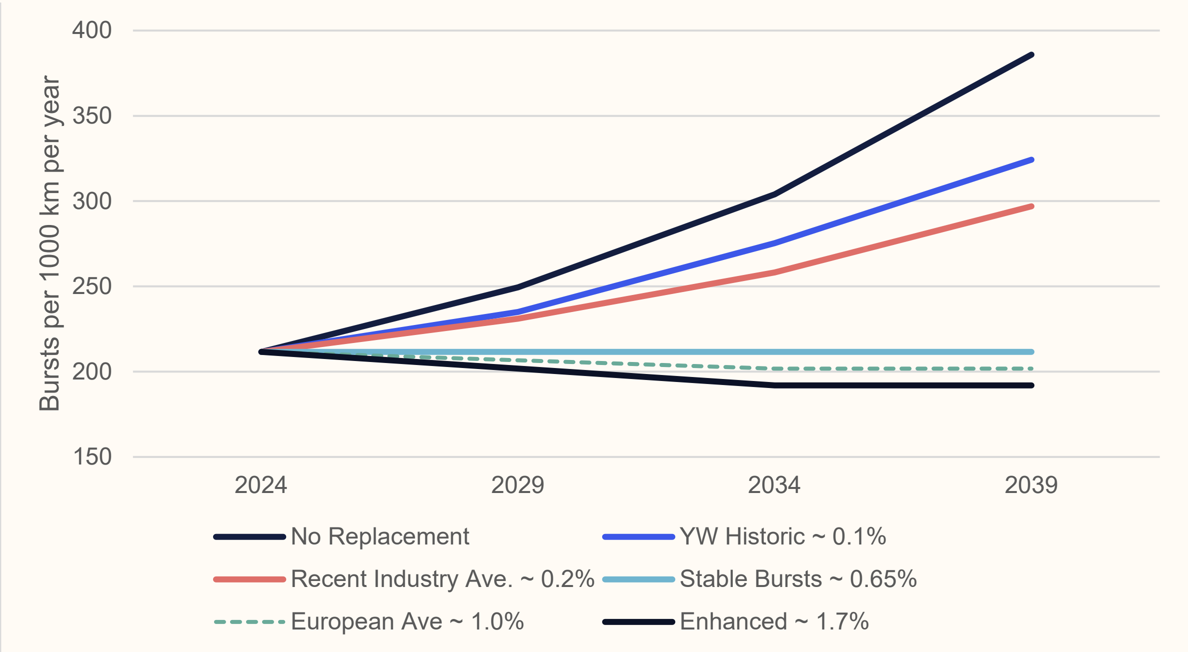
Table 6.2 Mains replacement rates required to stabilise current burst rate

	AMP8	AMP9	AMP10	AMP11	AMP12	Overall
Ave annual % replaced	0.56%	0.73%	0.67%	0.57%	0.55%	0.61%

If we consider the next three AMP periods, the average annual replacement rate required to stabilise bursts at their current levels would be 0.65% (or 0.64% considering the next 10 years).

In the graph below, we show a range of alternative replacement rate scenarios, including the stable burst scenario described above, to illustrate the impacts of continuing to replace our mains network at recent historic rates for Yorkshire Water or the average for the industry.

Figure 6.7 Burst rate forecast to 2040 under different renewal scenarios



As Figure 6.7 above shows, our current renewal (0.1% on average over the last 10 years) would see burst rates increase by over 50% by 2040. Were we to increase renewal rates to 0.2% (industry average over the last five years) we would still see a rise in burst rate of around 40% over the same period. To achieve a reduction in mains repairs in future, we will need to increase our mains replacement rate to something above the 0.65% rate required to achieve stable bursts. We discuss our proposed mains replacement strategy in more detail below.

Mains replacement strategy – Building on the IDET scenarios above we have assessed options for mains replacement rates over the next two AMP periods to determine an appropriate, medium-term programme that will enable us to achieve anticipated improvements in our mains repair performance and generate the efficiency opportunities that such a clear and sustained programme can generate though our supply chain. Looking at increments in percentage replacement rates (above the ten-year average of 0.64% required to maintain stable burst rates) we have determined that a replacement rate of 0.66% per annum will deliver the required improvements by the end of AMP8 (after accounting for the small reduction in burst rates which will arise from our AMP8 pressure management programme which is one of our leakage and WRMP options). This replacement rate will allow the declining trend in burst rate to be sustained through AMP9.

The ten-year replacement programme at this rate of replacement will also allow us to virtually eliminate the cohort of cast iron and asbestos cement pipes in condition grades 4 and 5 from our network.

In addition to our mains deterioration-based modelling, a simple analysis of the age of our network, relative to expected asset lives for the various pipe materials present indicates that we would need to move to replacement rates, above 0.7% per annum to avoid a significant proportion of our network having to operate well beyond any realistic expectation of asset lives. Indeed, a recent UKWIR study suggested that the MDPE pipes which are now the default material in most distribution networks could have asset lives of between 100 and 140 years. This would imply a renewal rate of between 0.71% and 1.00%.

Throughout this period, we will keep our long-term strategy for mains replacement under review using the insights gained from the ongoing monitoring of network performance as it responds to these higher rates of replacement. This will enable us to determine whether subsequent increases in replacement rates towards the 0.7% to 1.0% range are required. We will be able to update and improve the forecasting capability of our IDET model, through these additional insights.

Our proposed ten-year mains replacement programme represents a transition towards a more sustainable long-term approach to mains renewal.

We anticipate that Ofwat will set stretching PR24 targets for mains repairs with associated penalties (and the removal of dead-bands) therefore we will need to significantly increase and sustain renewal rates for the long term.

Mains renewal will not only provide a benefit to the health of infrastructure assets but also contributes to our plans for long term sustainable improvement to our service and performance commitments of leakage, customer minutes lost, water quality contacts and low pressure which are accounted for in our AMP8 PCLs and revised draft WRMP.

6.2.5 Level of required investment

Based on our asset modelling analysis, we have determined that a long-term renewal rate of 0.66% per annum in AMP8, is required to allow us to maintain serviceability and asset health on our existing network, whilst mitigating risks associated with growth.

Our modelling takes account of historic failure and various asset attributes (age, material, pressure, soil corrosivity) which provides insight not available to Ofwat's econometric models.

This replacement rate will require a water network infrastructure renewal investment in AMP8 of **£364.0m**. Based on our analysis of industry average replacement rates over the past five years, we consider that it is reasonable to assume that Ofwat's models would allow for a 0.205% replacement rate. This claim covers the additional 0.455% per annum, mains replacement amounting to accounting for **£250.9m** attributable to this claim.

The investment will be focused on our unlined cast-iron and asbestos cement pipes of which we have a greater than average proportion compared to the industry. The condition grade analysis, shown in Table 2, highlights that 2,485 km of our water mains are in grade 4 and 5. These are described as 'poor' or 'very poor', with cast iron and asbestos cement making up the majority of mains within these condition grades, with a very small amount of steel main included.

Whilst performance and service risk will remain the primary drivers for mains replacement, and the basis on which we target our investment, our asset-age based analysis (summarised in the table below) suggests that a long term replacement rate approaching 1.0% per annum (over the next 100 years) would be required to move us to a position where the average age of our network was around 55 years and we would have no life expired assets. A replacement rate of 0.66% would see a slight increase in asset age and proportion of life expired assets over the same period.

Continuation of recent historic rates for Yorkshire Water or indeed the industry average replacement rates (0.1% and 0.2% respectively) would see a significant increase in the proportion of life-expired assets to between 64% and 74% of our network over the 100-year timescale.

Delaying the increase in renewal rates beyond AMP8 will only serve to increase the required uplift in future AMPs or result in Yorkshire Water having to accept the risk of even higher proportion of life-expired assets in the future. We are confident that our customers and wider stakeholders would consider that to be an acceptable position. Renewing these assets at a pace that is consistent with their age, condition and underlying rate of deterioration is the fairest way to share costs between current and future customers.

Table 6.3 Impacts of replacement rate on asset age

Scenario	Average Age of Network	% of Network beyond maximum expected asset life
Present Day	62	15%
Year 2123 with 0.10% replacement	143	74%
Year 2123 with 0.20% replacement	133	64%
Year 2123 with 0.65% replacement	77	18%
Year 2123 with 1.00% replacement	55	0%

Our unlined cast iron and asbestos cement mains will be the focus for our replacement activity in AMP8. This is the cohort which has a significantly above industry average rate of mains repairs. We recognise that there is a wide range of uncertainty regarding mains deterioration rates and that replacing significant amounts of our mains network earlier than necessary would not be in customers' interests. Nevertheless, there is a clear imperative to begin the process of moving towards a long-term sustainable replacement strategy. We propose therefore to implement a 10-year programme of investment, at an average renewal rate of 0.66% per annum, which will enable us to renew approximately 2,182 km of the poorest performing cast iron and AC mains over that time. This would result in the replacement of 8.9% of the mains cohort which is currently above the industry average mains repair rate.

This investment will deliver an overall improvement to network asset health and performance for Yorkshire Water's customers. This will be an appropriate period over which to evaluate the benefits of the replacement strategy and gain even clearer insights into the expected performance of our growing network of MDPE pipes. We will then be able to re-evaluate our long-term strategy and determine an appropriate adjustment to the future replacement rate which is equitable for current and future customers.

Our analysis shows that for Yorkshire Water to achieve mains repair rates in line with current industry average performance by 2040, would require replacement rates above 1.75% per annum. This would place significant burden on customers over the short to medium term and potentially exceed the capacity of our supply chain to deliver the required outputs. A more gradual transition is therefore proposed with an initial 10-year replacement strategy at 0.66% per annum which will be reviewed and adapted as required prior to AMP10.

6.2.6 Unique Circumstances

Unique circumstances, not reflected in the data upon which Ofwat's econometric models are based, is one of the criteria which is considered as an appropriate basis for a cost adjustment claim.

The basis of this claim however is not that Yorkshire Water's network has unique characteristics but rather that the backward-looking nature of the econometric models cannot capture long-term future investment requirements, when the industry as whole has been reducing asset renewal rates and focusing on more short-term and operational interventions to maintain service.

Characteristics of our network such as its average age and the high proportion of cast iron and AC mains with elevated burst rates, contribute to the specific scale of our claim but it is evident that this is an industry-wide issue requiring an industry-wide response involving both companies and regulator, to achieve a sustainable pathway to delivering long-term asset health and service improvements for present and future customers.

As discussed in section 4.2.2 this is an issue affecting the whole industry, although the impact of certain policy decisions, together with the historical evolution of each company's asset base will mean that the scale and timing of these emerging investment needs will vary between companies.

This claim is based on the need for a step change in the rate at which Yorkshire Water replaces its assets and that this necessary step change is demonstrably not funded through allowances from the econometric models which can only take account of recent historic replacement rates across the industry.

We have considered alternative options that involve less activity in these areas however, as set out in the rest of this document, those options would not be in customers best interests, impacting our ability to meet out performance commitments and being less efficient in the long term.

Given the above, the test for "unique circumstances" is not relevant to this claim.

6.2.7 Management control

The issue of management control relates to whether the investment if driven by factors outside of management control and whether steps have been taken by management to control costs before seeking to make a cost adjustment claim.

Regarding our network infrastructure, the drivers of investment are fundamentally related to the underlying rate of deterioration of our water mains, together with external factors such as ground conditions, temperature, traffic loading and therefore not under management control. Where we do exercise control is in the decisions we make to prioritise areas of investment within our overall base allowances. Had we opted to invest more in mains replacement historically, the increase we are requesting in AMP8 may have been smaller, but we consider that our in-AMP prioritisation decisions have been, appropriate and based on achieving customer service expectations and performance targets across the whole of our asset base.

We have taken action in the past such as our pressure management programme, calm networks training and mains re-lining programmes to control costs with respect to network performance and defer the need for capital replacement. We are now at a point where opportunities for further deferral are not available and we need additional base funding if we are to ensure the long-term health of our water network.

We also presented analysis earlier in this document to show that within the overall base totex envelope, there is no scope to reduce other programmes or statutory activities in order to create the necessary headroom to accommodate our required mains replacement programme.

We have set out our view, that previous price reviews and the PR24 final methodology is unlikely to sufficiently fund the required long-term capital maintenance in 4.2 above. Without a change in the overall funding envelope, there are no remaining levers under management control which will enable us to achieve all the required outcomes and statutory requirements.

6.2.8 Implicit allowance for mains replacement

This targeted allowance is based on expenditure in base required above that expected to be funded through the totex models. We recognise that a level of ongoing mains replacement investment is implicitly funded in the models and should be netted off from the gross value of investment required in the assets which are the subject of our claims.

Ofwat does not provide discrete allowances by asset type for maintenance activity, nor does it explicitly fund specific outputs such as a length of main (km) to be renewed in each AMP. Companies are set a totex allowance based on Ofwat's cost modelling, with an implicit flexibility for that investment to be directed to where it most effectively supports achievement of performance commitments and statutory duties during a regulatory period.

Therefore, whilst companies may in theory have been funded to deliver a certain level of maintenance activity based on historical cost models, companies may deliver more or less maintenance activity in different areas of their asset base, depending on the company's priorities subject to delivering the outcomes set on them in the context of an in-the-round totex envelope.

Within such an in-the-round allowance, it is not appropriate for Ofwat to imply that companies seeking an uplift in a specific area, above the levels Ofwat deem to have been funded in the past are asking customers to pay twice. If companies have spent their overall totex allowance within the relevant price control, prioritising other asset types and or different interventions in their network, then customers have simply paid for different things historically than they are being asked to pay for in the future. So whilst Ofwat states: "we will take account of renewals companies have previously been funded to deliver when assessing claims to ensure that customers do not pay twice for mains renewals previously funded", we suggest that it is not appropriate for Ofwat to expect companies to make up for an implied rate of asset replacement that was neither a specific requirement in previous AMPs nor the appropriate priority for investment in those periods.

Despite lower levels of proactive capital maintenance including mains renewal over this period, Yorkshire Water has overspent its allowances in water in response to challenging PC targets, inflationary pressures and weather events. We have not benefitted from this reduced investment in mains renewals we have simply targeted investment elsewhere, in the interests of maintaining customer service and therefore customers are not being asked to pay twice.

Implicit Allowance – Water Mains Replacement

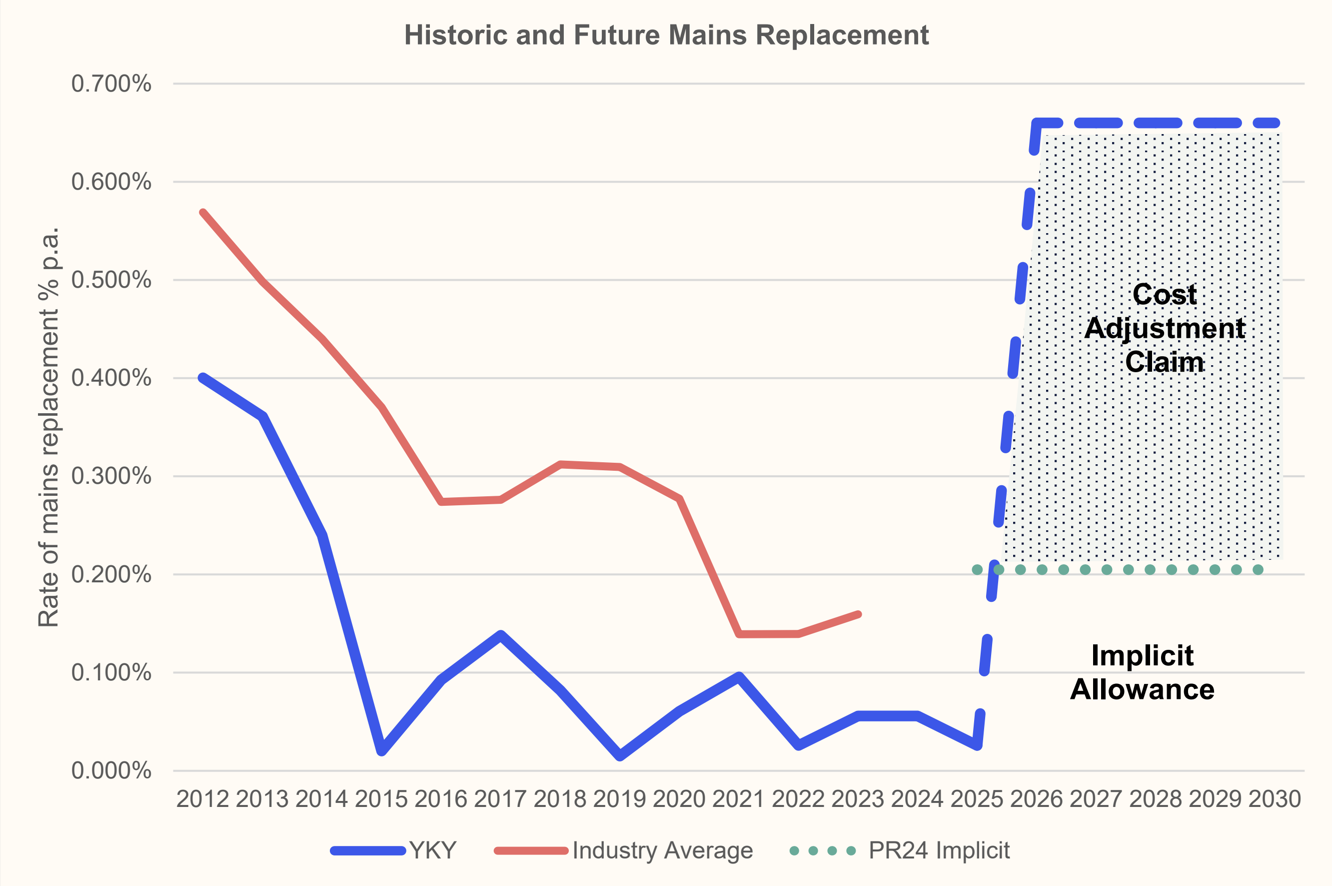
A view of the implicit allowance in the base models for water mains replacement is relatively simple to calculate as we have the mains replacement activity data from the industry available over the modelling period. The base models are benchmarked on a 5-year historic basis and therefore we can assume that the implicit rate within the models is the industry average rate of replacement over the 5-year period.

This value based on Annual Performance Reports from 2019-2023 is 0.205% p.a[4]

[4] We note that Ofwat has stated that a replacement rate of 0.4% was funded at PR19. We strongly disagree with this assessment, firstly 0.4% was the industry average rate proposed in September 2018 plan submissions. Final determinations were subject to significant reductions in costs which would lead companies to make changes to their delivery approaches. We consider that had an implicit allowance been assessed at the time it would be based on the 5 year benchmarking period (0.302% p.a. based on 2015-20).

Secondly, and more importantly, on the basis set out in the narrative above it is not appropriate in a totex regime to expect a specific level of activity to be delivered and subsequently made up for where no PCD or ODI was specified.

Table 6.4 Long-term mains replacement and future requirement – Showing CAC value and implicit allowances



We therefore conclude that 0.205% is an appropriate assumption for the implicit allowance within the base totex models, which leaves a remaining 0.455% p.a. as the basis of our mains replacement claim. This implicit allowance is likely to be an overestimate given that some proportion of this activity will have been funded by enhancement and therefore not be part of the historic base costs used to set allowances.

When applying our efficient unit rate to these activity levels, this leaves our claim at £250.9m.

Table 6.5 Valuation of Cost Adjustment

	Rate %	Cost £
Total Mains Replacement Required	0.660% p.a.	£364.0m
Implicit Allowance	0.205% p.a.	£113.1m
Net Claim	**0.455 % p.a.**	**£250.9m**

6.2.9 Materiality

Our Water Network Plus Totex programme is £2,743m so a 1% materiality threshold on this claim would be £27.4m. The water network infrastructure component of our cost adjustment claim, at £250.9m, exceeds the materiality threshold.

6.3 Cost efficiency

Cost efficiency is a core tenet in our PR24 Business Case planning. We have been proactive in integrating best practices, leveraging new markets and collaborations, harnessing innovative technologies, and building an excellent procurement system to deliver cost efficiency across our whole business plan.

Yorkshire Water's business plan for PR24 encompasses a range of business cases and our approach to cost efficiency reflects this diversity of needs. Yorkshire Water uses data gathered over the last 20 years to inform our Unit Cost Databases (UCD) which we use to estimate capital cost based on historical norms.

Whenever a scheme is completed, the actual observed cost information is used to create historical cost models for activities undertaken. Taking actual observed costs ensures we only allow for the costs likely to occur. We do not build in any overestimates by assessing scheme risk separately. By doing this, we are modelling the efficient and effective delivery processes and materials used. Our UCDs are used subsequent to a technical identification and optioneering process to give a notional view of project and unit costs. The outputs of our UCD are then subject to internal quality assurance and portfolio optimisation. Our OPEX cost models and carbon cost modelling are generated in a similar way to our UCDs, utilising real, observed costs to estimate future costs.

There are some projects where this modelling heavy approach isn't appropriate, and their use varies across some business cases. For business cases which have not been priced with our UCDs, we have generated costs with alternative methods. We have utilised 3rd party consultants, historical experience delivering similar projects, and 'going to market' to source indicative costs from potential suppliers.

We have been exploring opportunities for further efficiencies to meet the unprecedented cost challenges we currently face and as part of our continuous evolution as we move into AMP8. As part of this work will continue to undertake opportunities assessments to identify where efficiencies could be made across the programme from a commercial perspective. Aggregation (batching) and the introduction of more mini-competition for the mains renewal programme in AMP8 will be developed. This will include assessing whether it is beneficial from both a delivery and cost perspective to allow partners to price and deliver multiple DMA level schemes as part of a batch of work.

The are eight partners on the infrastructure framework, of which six cover clean water infrastructure related capital work. In order to ensure each scheme is delivered in the most cost efficient way, partners are invited to submit costs via a 'mini-tender' process. This allows us to compare prices and ensure we are delivering schemes for the most efficient unit rates. This process has been in place in AMP7 and the benefits of this work will be built upon as we move into AMP8.

Other cost adjustment claims for mains replacement activity have been submitted by Wessex Water and Thames Water. Their unit rates are £350/m and £999/m (non-London) respectively. Our proposed rate of £336.3/m appears efficient relative to these proposals.

6.4 Best option for customers

As discussed in section 6.2.3 above, there are limited options with regard to maintaining asset health of our network infrastructure other than replacing pipes that have reached the end of their economic asset lives. Although interventions such as pressure reduction and calm networks training will help to extend asset lives or minimise the incidence of inadvertent, surge induced bursts, these mitigations have been extensively deployed with minimum scope for further reduction in burst rates to be achieved by these means.

Our options then come down to determining the appropriate level of mains replacement to a satisfactory outcome in terms of mains repairs, which reflects short-term affordability constraints, without unfairly passing cost on to future customers.

After considering a wide range of possible future replacement rates we concluded that 0.66% mains replacement per annum over the next 10 years strikes that appropriate balance. A lower rate is likely to result in continued deterioration in asset health. A significantly higher rate would place an unacceptable bill impact on customers at a time when there are significant cost of living pressures to which they are exposed.

Moving to a renewal rate of 1.0% per annum would require an uplift in base capex or £440m, equivalent to 16% of our water network plus totex for AMP8 which would not fit within our affordability expectations.

6.5 Customer protection

Whilst PCDs are normally designed for enhancement expenditure in the regulatory framework we recognise the need for customer protection for this Cost Adjustment Claim.

For mains replacement, customers are protected partially against non-delivery of this investment by the performance commitment penalties in Mains Repairs, Water Supply Interruptions and Leakage which will not be achievable without increased capital maintenance investment. However, we also propose an output related PCD for this area to demonstrate our commitment that the investment is invested in the asset health of our water mains.

We set out our proposed PCD parameters and payment rate in the following tables.

Table 6.6 PCD for Mains Replacement Cost Adjustment Claim

PCD Delivery Expectation	
Description	We propose a PCD for the activity associated with this claim which is the replacement of 0.455% p.a. of our mains above the implicit allowance.
Output measurement and reporting	Company must deliver the length of mains in line with the profile specified in the ‘forecast deliverables’ table. The activity / investment over and above the assumed implicit allowance is subject to the PCD. Namely the ‘Mains replaced (CAC)’ value.
Assurance	The company must commission an independent, third-party assurer, with a duty of care to Ofwat, to assure, to its satisfaction, that the conditions below have been met and the outputs of the scheme set out below have been delivered.
Conditions on Scheme	n/a
Forecast Deliverables	The deliverables that we propose are protected through this claim are the total length of mains replaced each year, less the assumed value funded through existing base allowances.

Deliverable	Unit	Forecast Deliverables				
		2025/26	2026/27	2027/28	2028/29	2029/30
Total length of mains replaced	Km	215.1	215.8	216.4	217.1	217.8
Length of mains replaced (implicit)	Km	66.8	67.0	67.2	67.4	67.7
Length of Mains replaced (CAC)	Km	148.3	148.7	149.2	149.7	150.2

Cumulative Forecast Deliverables

Deliverable	Unit	Cumulative Forecast Deliverables				
		2025/26	2026/27	2027/28	2028/29	2029/30
Total length of mains replaced	Km	215.1	430.8	647.3	864.4	1,082.2
Length of mains replaced (implicit)	Km	66.8	133.8	201.0	268.5	336.1
Length of Mains replaced (CAC)	Km	148.3	297.0	446.2	595.9	746.1

PCD Payment Rate

This PCD protects all totex expenditure that forms part of this cost adjustment claim. We propose to apply the PCD payment per unit to the difference between the forecast (CAC) and actual cumulative length of mains delivered at the end of 2029/30.

End of Period output PCD
Unit Rate = £336,348/km

(Cumulative length of main (CAC) (2029-30) – Total length of main replaced) x £336,348

Annualised time delivery incentive
We do not propose an annualised time delivery incentive. Annual protection will be in the form of PC ODIs.

6.6 Data Table Commentary

Table 6.7 Data Table Commentary CW18 Lines 11-20

	Title	Commentary
CW18.11	**Description of cost adjustment claim**	Targeted Allowance – Asset Health - Infra
CW18.12	**Type of cost adjustment claim**	We have assigned this to 'other' – and specified - a required step change in asset maintenance requirements above historical levels
CW18.13	**Symmetrical or non-symmetrical**	This is a forward-looking claim and therefore non-symmetrical.
CW18.14	**Reference to business plan supporting evidence**	Refers to Cost Adjustment Claim Appendix.
CW18.15	**Total Gross Value of Claim**	We populate the gross value of the claim as the total Base cost element of the mains replacement programme for AMP8 as set out in out cost adjustment claim appendix. We do not claim for any costs in 2022-25 so these cells are left blank. The costs all sit within Treated Water Distribution.
CW18.16	**Implicit Allowance**	We populate an implicit allowance* by estimating what could be considered funded at PR24 based on industry mains replacement rates in the benchmarking period and multiplying by our average unit rate for meter installation. *We note that in reality no such allowance is made in a Totex and Outcomes framework.
CW18.17	**Total Net Value of Claim**	Calculated from above two lines
CW18.18	**Historic Base Expenditure**	We have populated these lines with our historic levels of expenditure in mains replacement inflated to 2022/23 prices.
CW18.19	**Totex for the control**	We are not required to populate Totex value as it is a calculated cell but identify that this claim is in the WN+ price control.
CW18.20	**Materiality**	N/A We note that the size of the claim is significantly higher than 1% of WN+ Totex historically.

7. CW02b Targeted Allowances for Asset Health -Non-Infra

7.1 Overview of Our Claim

Filters, clarifiers and treated water storage assets play a key role in delivering a reliable and safe supply of drinking water to our customers. Unlike mechanical, electrical and instrumentation type components of our asset base, these assets can have long lives and are not usually prone to sudden or catastrophic failures. More typical of this asset group is a gradual deterioration of condition and structural integrity which can begin to compromise their function over time.

Faults such as cracking, spalling of concrete, breaching of seals on joints arise cumulatively over the life of an asset. As such faults are identified through inspection and maintenance cycles, we can implement repairs and mitigations, short of major capital refurbishment or replacement to extend the service life of these assets. Over time the extent or frequency of such interventions can become uneconomical as increasing opex and reactive capex expenditure is required to maintain service. The accumulation of defects over time can result in increasing risk of water quality failures and unplanned outages even with multiple, tactical mitigations in place.

Many of our treated water storage tanks (Service Reservoirs (SREs) and Clean Water Tanks (CWTs)) were constructed well before the privatisation of the water industry and were built to standards which would not be applied today. Around 9% of these assets would be beyond there assumed useful asset lives (based on a typical design life of 80 years) by the start of AMP8 and without a significant replacement programme this will grow to almost 40% in 25 years' time.

Our analysis indicates that for a number of critical non-infrastructure assets, we have reached a point in the asset life cycle, where it is no longer appropriate to attempt further service life extension and we need to begin a planned programme of replacement over multiple AMPs. Failing to begin that process now, will result in greater whole life cost and require an even greater increase in costs and customers' bills within the next 25 years.

This claim relates to the additional investment, over and above our assumed base allowance, which will be required to ensure a sustainable, long-term approach to maintenance of:

- Treated water storage tanks (SREs and CWTs)
- Filters (RGFs and GACs)
- Clarifiers

The gross value of the proposed investment in these assets is £227.0 m but we estimate that Ofwat's modelled base costs would include an implicit allowance of £40.25 m therefore the net value of this claim is **£186.75 m** (£111.20 m for treated water storage and £75.55 m for filters and clarifiers).

The gross value of the proposed investment in these assets is £227.0 m but we estimate that Ofwat's modelled base costs would include an implicit allowance of £40.25 m therefore the net value of this claim is £186.75 m (£111.20 m for treated water storage and £75.55 m for filters and clarifiers).

Evidencing our Claim – We draw on a variety of sources to support the need for a cost adjustment claim in relation to key non-infrastructure assets in AMP8. These include the outcomes of our most recent service reservoir inspection programme, recently completed asset condition surveys (together with historic condition surveys from PR09 and PR14), the bottom-up, risk-based programmes identified by our asset planning teams and data from our non-infrastructure asset planning tool NITRO.

7.2 Need for Investment

In this section we set out why there is a need to increase long-term investment in our water non-infrastructure asset base and why that process needs to start during AMP8. In section 7.3.2 we discuss why this increased investment cannot be accommodated within the overall base totex allowances in the water network plus price control.

7.2.1 Introduction

Despite achieving good performance with respect to our water treatment works (as measured by unplanned outage) we are concerned that future performance improvements cannot be efficiently and sustainably achieved without a transition to a more proactive long-term investment strategy for these assets. In recent AMPs it has been necessary to adopt a more reactive and operationally focused approach to achieve stretching performance commitments. Whilst this approach has been effective and appropriate within the context of the available funding, a transition is needed, beginning in AMP8 to ensure long term health of our assets for current and future generations of customers.

The asset which are the subject of this cost adjustment claim, have a significant impact on the quality of water supplied to our customers and we consider that our ability to ensure that quality and avoid interruptions to service, requires a targeted, proactive investment programme to address the underlying deterioration of those assets.

7.2.2 Non-Infrastructure Asset Base Characteristics

Yorkshire Water owns, operates and maintains 48 Water Treatment Works across the Yorkshire region. The type of treatment employed varies, broadly ranging from reservoir fed Dissolved Air Floatation sites in the west/Pennine area, to a small number of generally large, river fed sites in the central/north part of the region, before borehole sites dominate in the south/east, as illustrated in the figure below.

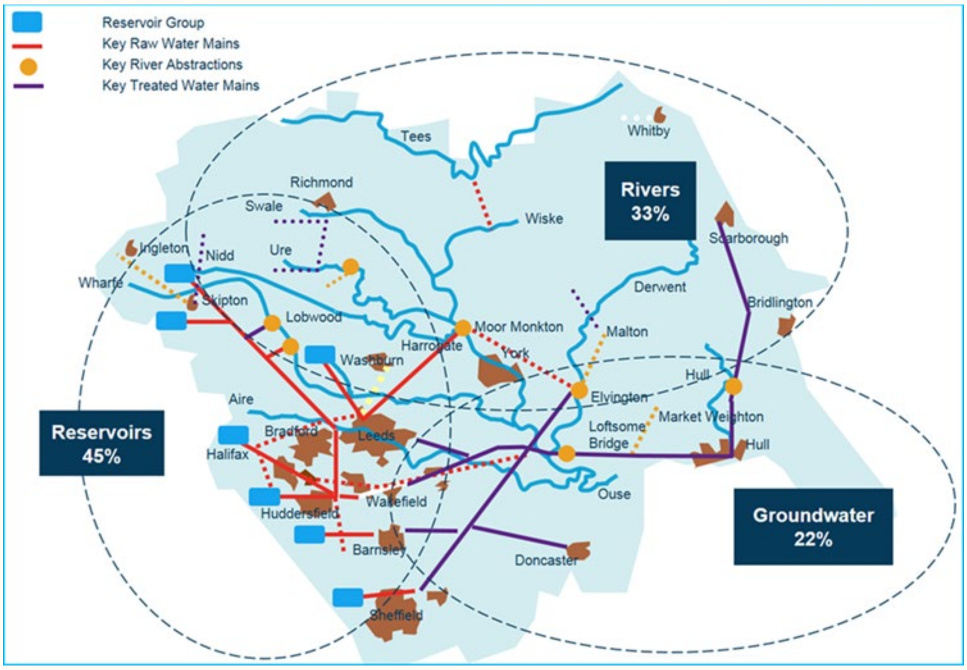


Figure 7.1 Yorkshire Water Strategic Supply System

Despite YW's treatment works utilising a range of raw water sources and with daily flows ranging from less than 1 Mld, to over 200 Mld, most WTW's, aside from pristine boreholes in the south-east, utilise some form of filtration. Of the 48 WTW's, 35 use either Rapid Gravity (31) or Brimac filtration (4) as a core part of their treatment process. Regionally, this equates to 203 RGF's and 16 Brimac Filters.

In general, most water is treated locally (the main exception to this is the YW Grid) and to ensure sufficient resilience and storage to accommodate diurnal and seasonal demand patterns and emergencies, a network of CWT's and SRE's are used to ensure the potable water supply can meet demand.

YW has 40 CWTs, 395 SREs and 27 WTRs. These storage facilities are a vital part of the distribution system. They hold sufficient water to enable the system to meet peak flow levels and spread the demand placed on the WTWs over the whole day. SREs are generally refilled overnight when demand is lower. SREs are generally located on high ground. This allows water to gravitate down into the distribution area. The asset condition of SREs is deteriorating with coliforms being detected due to the structural integrity of these assets becoming inferior over time.

It is essential not only from a service point of view but to also protect water quality and public health, that we invest in these assets to ensure that their condition is not compromised. Our aim is to constantly drive improvement in compliance along with ensuring our assets are fit for purpose and are able to perform consistently and reliably.

In the future, focused investment within the distribution system is vital in order to not only improve the asset health but also to drive further improvement in water quality compliance and the resilience of our assets. However, investigations have indicated that the condition grade of our assets and most notably those towards the end of their asset lives are deteriorating. Our SRE assets are diverse in terms of age and material construction, with investment in AMP8 having a clear focus on design and construction of new assets and the refurbishment of those which lives can be economically extended.

One of the more common issues with SREs is failures at roof joints and 'up stands' (hatches) which lead to minor ingress. Such integrity in recent years has been severely challenged by severe winters where structural damage has been caused not only by duration of ice but also by its penetration. Our programme of inspections has given us a clear view of where best to invest for maximum benefit, whilst our cleaning and inspection programme drives a process of continual improvement by targeted remedial investments such as roof joint replacement and provision of bonded membranes.

7.2.3 Non-Infrastructure Asset Management Approach

Managing Treated Water Storage Assets

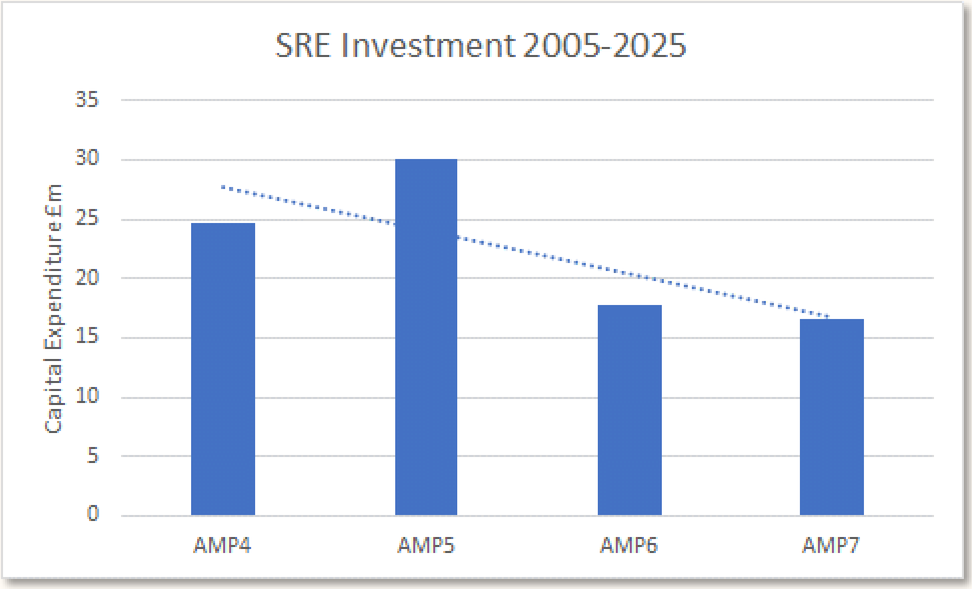
In 2008/09, Yorkshire Water were subject to a DWI Undertaking for SRE's relating to Escherichia. coli (E. coli). The enhanced inspection and maintenance regime emerging from that undertaking remains in place today.

We now target an average of three years between inspections, with a range of six months to five years based on asset condition and risk. In addition, the inspection frequency is dynamic and is reviewed at each inspection subject to the findings. We increased our resources dedicated to this function, in order to sustain the necessary frequency of inspections.

Where inspection identifies the risk, or actual occurrence, of ingress we have developed a policy of rapid remediation, which will continue into AMP8. We have been working with contractors to develop better techniques of making robust flexible seals and having capacity to respond to our routine and exception-based repair programme. We continue to use a single specialist contractor for all this type of activity whose methods, training, personnel, and timely response, meet our needs.

Over the last 20 years, other investment priorities have meant that the capital expenditure allocated to treated water storage assets has had to be reduced, as illustrated in Figure 7.2 below. Those decisions were appropriate to the prevailing service risks and operating environment at the time but it is now necessary to reverse that trend and take forward some of the deferred investment in our highest risk treated water storage assets.

Figure 7.2 20-Year SRE Investment Profile



This investment has allowed us to maintain and safeguard water quality, through implementation of our rapid remediation approach, but without a more proactive long-term programme of refurbishment and replacement of such assets, water quality risks are likely to escalate in coming AMPs.

<u>AMP7 Legal Instrument – Tank Inspections</u>

In year 2 of AMP7 we received a Legal Instrument from the DWI regarding our service reservoir assets. A Legal Instrument is a document published by the DWI which sets out a list of activities the recipient water company is obliged to carry out. If these activities are not complied with then enforcement action will follow. This emphasises the importance of this asset group to delivering safe drinking water and the need to focus on a long-term programme to address risks from the ageing asset base.

<u>Recent investment in CWTs</u>

After a busy period of new CWT construction in the 1980's and 90's (21 new CWT's), there have only been 2 rebuilds since that time. East Ness in 2000 (a relatively small site) and Irton in 2018. There has been no major refurbishment or rebuilds in the 2020-25 period. As a priority we need to replace the CWT at Aysgarth WTW (another small site) in AMP8, as it has severe condition issues associated with its construction material (Glass Reinforced Plastic (GRP)) and will become an unacceptable water quality risk if not addressed. There are other CWTs which are of similar concern but without an uplift in base capex we would not be able to address them fully in AMP8.

During the recent periods, our focus has been on inspection and targeted maintenance to monitor asset condition, extend asset life and reduce risk. As part of this programme on ongoing inspection and maintenance YW inspects its service reservoirs on a 6 month to 5-year frequency – dependent on structure and integrity.

The frequency is set through a detailed risk assessment by YW Senior Asset Engineers based on a variety of parameters including condition of structure, ingress integrity under flood test conditions, water quality history and previous repairs undertaken. Any faults found are remedied immediately, usually before the asset would be returned to service, and the risk assessment reviewed to determine the new inspection frequency. Any major repairs are generally checked after a 12-month period to check efficacy of the remediation.

The tanks are removed from service by the operation team, a drop test carried out for any leakage before they are drained. The empty tank is inspected internally by YW Senior Asset Engineers and cleaned by the Reservoir Maintenance Team. The roof structure of the tank is flooded to check for ingress whilst the internal inspection is underway. It is cleaned, filled and returned to service following a passed suite of samples (for water quality). A record of the inspection, condition grade and ancillary details are kept on a YW IT systems. This information is used to understand and prioritise WQ risk, inspection frequency and required future interventions to maintain asset condition and health. Other checks take place routinely by operations on a quarterly, these proactive visual inspections include grounds maintenance, vermin checks, overflow and underdrain checks, hatch and fly screen integrity, site security.

Managing Filtration & Clarification Assets

We have spent an average of £7.8m per AMP on Rapid Gravity Filter (RGF) refurbishment in the last two AMPs (AMP6 and AMP7 forecast outturn). The AMP7 investment will enable the basic refurbishment of up to 28 RGF units out of the full asset base of 203 units. In addition, we have completed additional activity as part of larger WTW level refurbishments (6 x units at Fixby WTW in AMP7).

Such refurbishment schemes are undertaken on a risk-based approach and include a range of scope from a basic replacement of filter media to wholesale replacement of the nozzles, pipework, flooring, valves and penstocks. The current totex allowance constrains the scope of these interventions to the essentials required to ensure the filter can operate effectively, often not addressing longer term asset health issues (i.e. patching or lining of concrete rather than full replacement of aging tanks, basic refurbishment of flooring rather than renewal, leaving a small number of filters uncovered and exposed to the environment). As a result, elements of the overall asset health of our filter stock continues to decline.

Capital maintenance associated with our Granular Activated Carbon filters has been limited to £3.7 m per AMP (AMP6 and AMP7 forecast outturn) in 2020-25 , with the majority of the AMP7 investment being targeted on regeneration of the carbon media. Other improvements being promoted in line with our standard Asset Planning policies, on a risk-based approach.

There has been minimal capital expenditure on Clarification units in the AMP7 period other than the finalisation of some schemes that began at the end of the previous period. Again, this is in line with our risk-based approach to asset management with investigations showing that issues relating to clarifiers, with some exceptions, generally require an opex, rather than capex solution. The exceptions here are two of our larger sites, Chellow WTW and Eccup No.1 WTW, which have been included in this claim.

We have made significant interventions to manage the risk of these assets on water quality within totex allowances. We have an established ‘Filter Management Group’ working as an expert panel to continuously monitor and review clean water filter performance and taking a risk-based approach, to recommend remedial work on filters, both proactively and reactively. Asset management subject-matter-expert sponsors have been allocated for similar initiatives on our GAC and clarification processes.

These expert insights help to ensure that our maintenance activity is targeted on the highest risk assets, but the scale of emerging needs is such that we typically have to restrict our interventions to the minimum necessary to return units to service, rather than undertake wholesale refurbishment which would deliver improved asset health and performance for the long-term. The number of needs arising also means that deteriorating assets have to be left in service for longer, with refurbishment often only taking place when an asset becomes critical or near failing and increased risk of unplanned outages.

As a result of the increasingly responsive, rather than proactive, approach to WTW processes in general, we hold a block allocation to maintain a stock of critical spares to reduce the time required for reactive refurbishment across various asset types. However, given the scale of these works, despite these initiatives, individual filtration units RGF and similar large process units are often out of service for several months once they have failed (as some redundancy is built into the process).

The development of our UPO Hub and associated performance dashboard has also increased awareness of current outages and their root cause, allowing the identification of high impacting assets and created a more robust escalation route for short-term risks to try to avoid outage occurring.

7.2.4 Non-Infrastructure Asset Performance

Although Yorkshire Water has performed well in terms of the main WTW performance metric (Unplanned Outage), outperforming our targets in the first three years of AMP7, we anticipate more stretching performance will be expected in AMP8 to close the gap to the better performing companies with respect to UPO. The other key measure of concern with respect to this claim is water quality related, the compliance risk index (CRI). Whilst our performance in this measure has been poorer than we'd planned in AMP7, it is more related to network performance than WTW assets as our asset management approach prevents significant risks coming to fruition. Nevertheless, the performance of treated water storage assets and particularly CWTs has the potential to adversely affect CRI in future if the underlying deterioration of the asset base is not reversed through proactive investment.

Performance of Treated Water Storage Assets

Clean Water Tanks (CWTs) at Water Treatment Works can provide both treated water storage and, on some sites, the final disinfection stage. Yorkshire Water has 40 CWTs, two of which (Chellow East CWT and North Newbold No.1) are asset life expired at over 80 years old. By the end of AMP 8, 5 CWT's will be asset life expired, 8 by the end of AMP10 and 12 by the end of AMP12.

Many of these tanks were built to standards that would not be acceptable today and as a result have been improved and modified over the years to comply with modern regulations.

One example of this is where some of the oldest tanks (e.g., Chellow East CWT) were initially built without a roof covering, leaving the water open to environmental contamination. As water quality standards improved, such tanks were enhanced by the addition of roof structures. Indeed, one was added to Chellow CWT in the 1980's. While effective, such remedial work was never considered during initial design and construction and heavily modified tanks are among those that we consider most require replacement to ensure their ongoing fitness for purpose.

Table 7.1 Yorkshire Water CWT Age Profile

Asset Name	Year Of Constructi
CHELLOW HEIGHTS/WTW/1 CWT	1901
NORTH NEWBALD/WTW/1 CWT	1938
NORTH NEWBALD/WTW/2 CWT	1948
KELD HEAD/WTW/CWT	1950
MALTON NORTON/WTW/CWT	1950
DALTON/WTW/CWT	1954
CAYTON CARR LANE/WTW/CWT	1960
ETTON WOLD/WTW/CWT	1960
FIXBY/NO 2 WTW/NO 1 CWT	1963
ECCUP/CWT	1965
OLDFIELD/WTW/CWT	1968
HIGH SHAW/WTW/CWT	1970
LONGWOOD/NO 2 WTW/CWT	1973
ELVINGTON/CWT	1975
CHELLOW HEIGHTS/WTW/2 CWT	1976
THORNTON STWD/WTW/CWT	1976
ACOMB LANDING/NO 2 WTW/CWT	1980
LOFTSOME BRIDGE/WTW/CWT	1980
AYSGARTH/WTW/CWT	1981
BLACKMOORFOOT N/CWT	1981
NUTWELL/CWT	1983
ALBERT/WTW/CWT	1984
HUBY/WTW/CWT	1984

Asset life expired End Amp 8	No.
Asset life expired (80+yrs)	5

Asset life expired End Amp 10	No.
Asset life expired (80+yrs)	8

Asset life expired End Amp 12	No.
Asset life expired (80+yrs)	12

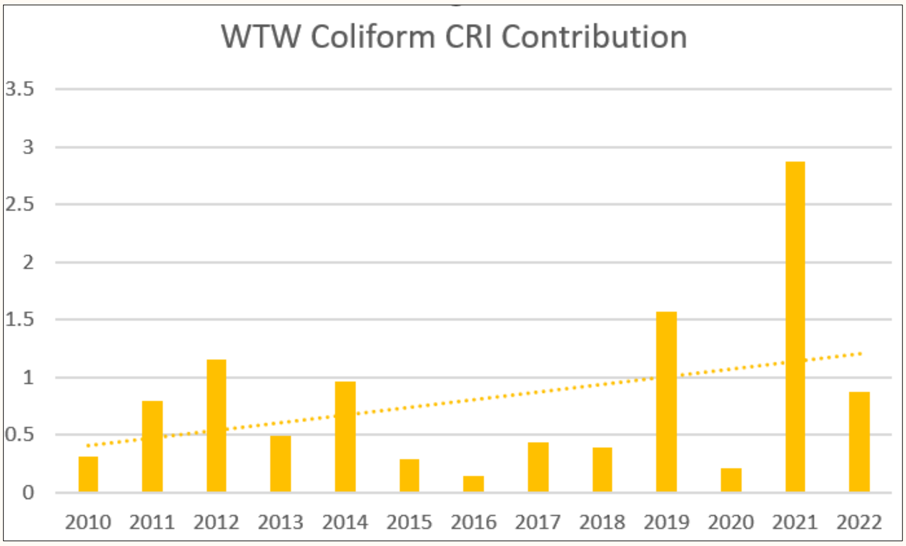
A significant proportion of our CWT's are over 50 years old and although the current process of monitoring, inspection and remediation has been effective, it cannot forever hold back structural deterioration by patching of defects and short-term interventions. Our assets continue to age, and we are at a point where we will start experiencing the impact of this.

Some of our CWTs are large assets and replacement is costly. The oldest CWT (Chellow E) has a capacity of almost 150 Ml. The modelled cost to rebuild this asset life expired tank is £68.0m, which would account for almost half of the estimated modelled Base Allowance that we would be able to allocate to Water Production assets. As a result, this investment will not be affordable without impacting asset health and performance elsewhere. Whilst we may be able to intervene on smaller tanks such as Aysgarth within our allowed costs, the medium/large assets have such costs associated with a rebuild as to make them unaffordable.

Figure 7.3, below shows the contribution of WTW Coliform failures to the company CRI score (back casted to 2010). The compliance risk index is the industry's key measure of water quality and has regulatory target of 0.

There is a clear, increasing trend in the contribution of coliform failures at WTW's and CWT condition is understood to be a major contributor.

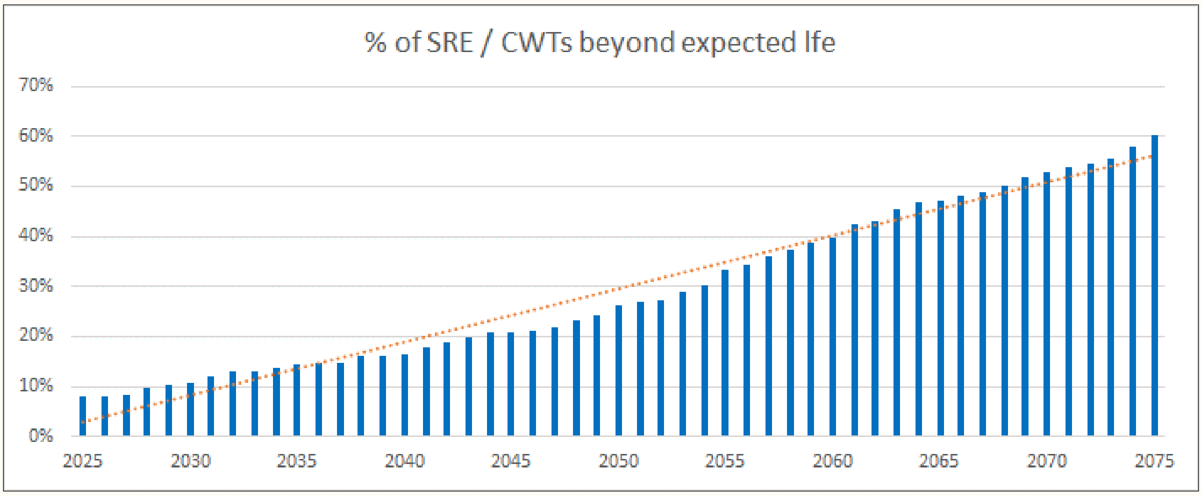
Figure 7.3 Treatment Works Contribution to CRI 2010 to date



Treated Water Storage – Service Reservoir Case Studies and condition grades

Around 8% of our treated water storage assets are already beyond their assumed useful asset lives (80 years) and in the absence of significant replacement or refurbishment programme that proportion will continue to grow by around 5% each AMP (see Figure 7.4 below). Whilst we will continue to seek innovative ways to extend asset lives, it is inevitable that over the coming decades these assets will eventually have to be replaced. A balanced and even programme represents the most pragmatic and fairest approach for current and future customers.

Figure 7.4 Proportion of Treated Water Tanks Reaching End of Expected Asset Life



We set out below some detail on specific high-risk assets which are currently some of our top priorities for investment in AMP8. These case studies are provided to demonstrate why for such assets a short-term reactive response and patching up the identified defects is no longer appropriate.

<u>Chellow East CWT (£68.0M)</u>

Chellow East CWT is the oldest CWT in Yorkshire and was built in 1903 so is now over 120 years old, against an asset life of 80 years and is amongst the highest risk Clean Water Tanks due to it's age and condition. The tank was last inspected in Oct 2021 where the condition was assessed at Grade 4 (poor) due to the condition of certain structural elements, particularly the walls which display multiple vertical cracks and the condition and construction of the floor, which is now covered by paving slabs, making accurate assessment of the overall condition difficult, although structural cracking has been observed previously.

There are only 4 CWT's within YW with a higher risk score than Chellow E CWT;

- Aysgarth CWT – replacement planned for Amp 8.
- Kirkhamgate CCSB Tank – supplies single commercial customer who are responsible for capex associated with asset. No further investment current planned.
- Longwood CWT – structurally sound but requires improvements to roof/membrane to address ingress issues. Currently under review for Amp8 base investment.

Chellow E CWT is of a unique design with coated masonry faced mass concrete walls with a mass concrete floor underlain by puddle clay. Originally open to the environment, a roof was added along with 950 supporting columns around 40 years ago to improve water quality. The large, 155 Ml tank provides drinking water to over 290,000 properties in West Yorkshire.

Ongoing maintenance to minimise ingress is required, although the persistent cracking evident in the walls is likely to be contributing to continual leakage from the tank. At the last inspection, four points of ingress were noted. This is typical of this asset given it's age, construction method and ongoing modification over the years - constant patch repairs are required to ensure it can remain in service. The asset consists of a single compartment and removing it from service for inspection and repairs significantly reduces the resilience of potable water supplies in the Bradford area.

In addition, the hydraulics of the tank are not sufficient to ensure suitable amounts of mixing of all water. Attempts have been made over the years to address this via the installation via the installation of additional 'short walls'/baffle curtains to improve circulation, but this still falls short of modern standards.

Summary:

- Oldest CWT in Yorkshire Water (asset life expired)
- Condition grade 4
- Supplies up to 290,000 properties with potable water
- Structural cracking to walls and floor
- Ongoing remedial work required to minimise ingress
- Historic bacteriological failures and ongoing risk

Figure 7.5 Plan and cross section showing the general arrangement of the single compartment, Chellow East CWT

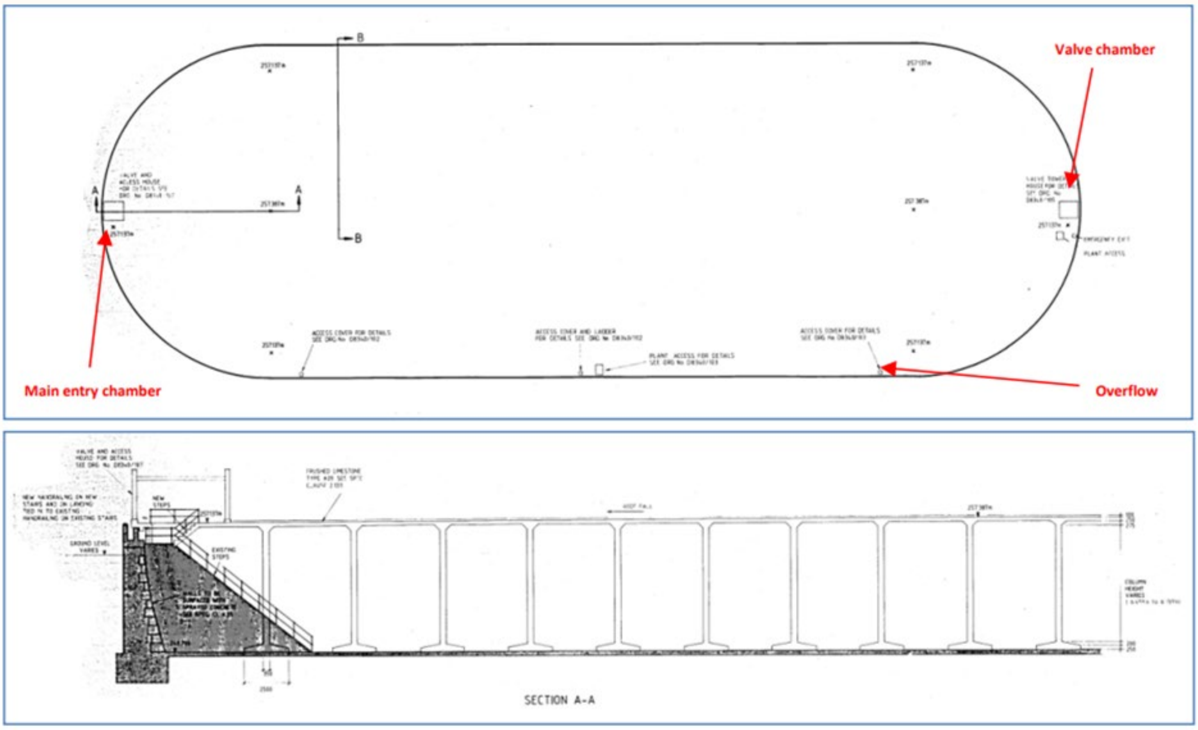


Figure 7.6 Photograph of the floor of Chellow E CWT

The original floor has been covered by paving slabs which mask the condition of the original floor, previously observed to have structural cracking.

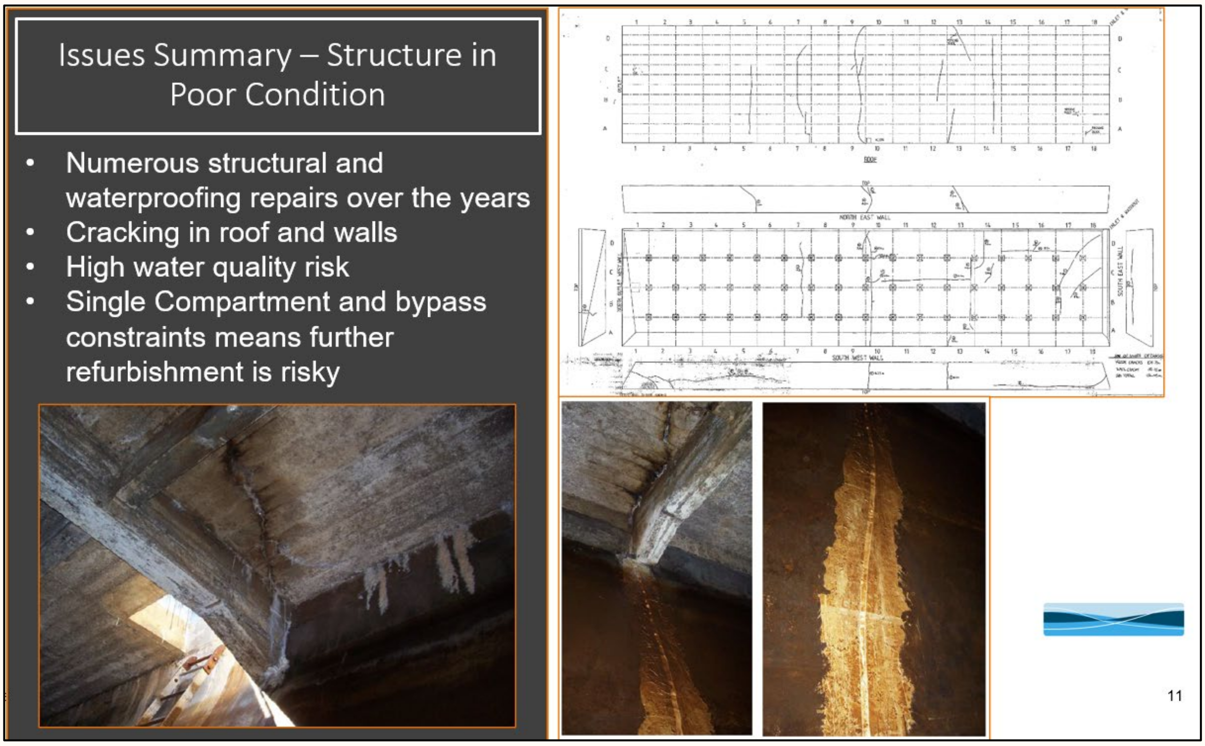
Figure 7.7 An example of the vertical cracking evident to the walls of Chellow E CWT

<u>Barnoldswick Parkhill SRE (£6.7M)</u>

The current Barnoldswick SRE has been in service for 95 years, with a design life of 80 years. At present this SRE has been identified as one of the highest risk SREs due to its expired asset life and condition. The latest report issued on the SRE has identified the SRE is a Condition Grade 5 due to the cracking and internal damage showing within the structure to the SRE. The tank itself is constructed of a single compartment therefore repairs, maintenance and inspections are not easily achievable due to the current configuration and risk to customer supplies with no SRE in service.

Ingress has been identified upon each cyclical inspection which is currently set at an annual frequency due to its very poor condition (CG5). The south west wall in particular has exhibited ingress on every inspection since 2012 in addition to the roof wall joint and upstand / roof interfaces. Numerous historical repairs are evident throughout the structure which increase year on year.

Figure 7.8 Barnoldswick SRE condition assessment



Summary

- End of asset life
- Condition grade 5
- Drinking Water Safety Plan red risk
- Annual cyclical investment required
- Difficult to take / keep out of service
- Historical repairs throughout
- Bacteriological failure risk
- Annual maintenance and inspection frequency

<u>Thornton Moor SRE (£5M)</u>

Thornton Moor SRE is a twin compartment 2.72 ML service reservoir in the Bradford High Level, part of the Chellow Water Supply System (WSS). The SRE is composed of two above ground cylindrical steel tanks built in 1979. In 2009 routine SRE inspections found multiple structural issues with both SRE compartments, including jointing failing to keep the SRE watertight, with daylight visible from within the tanks. Remedial work was carried out but did not permanently remove the issue.

Figure 7.9 Thornton Moor integrity failures (routine inspection, 2009)

In 2019 and 2020, hazards were raised to report that the fitted roof membrane had come away from the main structure on both compartments, posing a WQ ingress contamination risk. This demonstrates the poor structural condition of Thornton Moor SRE, likely movement and strong winds around the high exposed site contributing to the repeated issues with the roof.

Bracken Bank CRE (£6.3M)

Bracken Bank CRE is a critical asset at the head of Keighley WSS, feeding 5 DMAs and 6535 properties. Bracken Bank CRE is at the end of its asset life, having been constructed in 1926. Over the last 15 years, the 3 compartment service reservoir has deteriorated in water tight integrity with evidence of persistent ingress in all 3 compartments. New evidence of ingress is found routinely whilst the SRE Inspection team carry out their inspections.

The SRE inspection team have undertaken significant repairs to most areas of this asset over many years yet we still identify new areas of ingress on most inspections. All three compartments are on an enhanced inspection frequency being inspected every year at increased operational cost.

Figure 7.10 Bracken Bank ingress pathways and overall poor condition

The above case studies are consistent with the wider findings of our regular SRE Risk Profile Assessment which includes internal inspection by qualified engineers, to assess construction type, condition and water quality risk, 19 assets are currently listed as amber risk (35-49 points). Red risk (50+) requires urgent attention to avoid unacceptable WQ impact. Six CWT's, including Aysgarth and Chellow East are close to the upper limit of the amber risk scores and ongoing inspections suggest the risk scores are likely to increase over the coming AMP resulting in them being classed as red risks.

For SREs within the SRE Risk Profile Assessment, 2 SREs are two points (48 points) from a 'red' category (50 points) and 11 SREs are within five points (45 points +) of a 'red' category. There are 12 assets are within the 'green' category (<25 points) 404 assets are within the 'amber' category (25-49 points). Based upon the condition grades observed as part of the SRE Risk Profile Assessment, the % of assets within each condition grade are shown in Table 10 below.

Table 7.2 Treated Water Storage Assets Condition Grade PR24

Condition Grade	Number of assets by CG (SRE, CWT, WTR)	% of assets by CG (SRE, CWT, WTR)
1	54	14.6
2	120	32.2
3	144	38.6
4	38	10.2
5	16	4.4

Without additional funding to remedy some of the poorest CWT's, particularly those whose asset life has already expired, asset health will deteriorate and the impact to performance, notably CRI, is likely to increase.

Furthermore, there is the risk of an unaffordable cliff edge scenario. Given the cost and even with a successful cost adjustment claim at PR24, it is unlikely that more than 2-3 CWT's can be replaced in each Amp. Without additional funding to address the most critical sites between 2025 and 2035, there is the real risk that rather than spreading the investment out over several periods, a significant amount will be required in a much shorter time frame. By 2050, we forecast the number of CWT's that are asset life expired and will result in service impact will reach 12 (30%). As such, it is crucial we act now to address the poorest sites and follow up with an efficient, affordable plan over subsequent price reviews to address the next cohort of CWTs reaching the end of their serviceable life.

Performance of Filtration and Clarification Assets

The main asset health metric for Water Treatment Works (WTWs) is Unplanned Outage (UPO), which measures actual WTW availability against 'peak week' production capacity.

Whilst YW has outperformed the PR19 targets for UPO for the first 3 years of AMP7, our outturn performance has been below average in comparison to many other companies (3.26% vs industry average of 2.26%). This is explained by the fact that YW's regional Grid system increases resilience across many parts of the region and allows customer supplies to be maintained even when local treatment works shut down. Effectively, we have historically been able to maintain above average performance in CML by increased network connectivity, rather than by outperforming UPO. This is supported by the fact that although UPO performance is below average, water supply interruptions performance is average or above average.

Many of the improvements made in UPO are as a result of increased operating expenditure and improvements in our reactive response to failure, rather than significant proactive improvements and investments in long-term asset health. As described in Section 4.2.2 this is consistent with the incentive regimes set by Ofwat at recent price reviews and with the broad approach taken by much of the industry in the recent past. There has been an industry focus on performance improvements (E.g. the symptoms), rather than underlying asset health (the cause).

The key industry performance commitment measuring WTW Asset Health is Unplanned Outage.

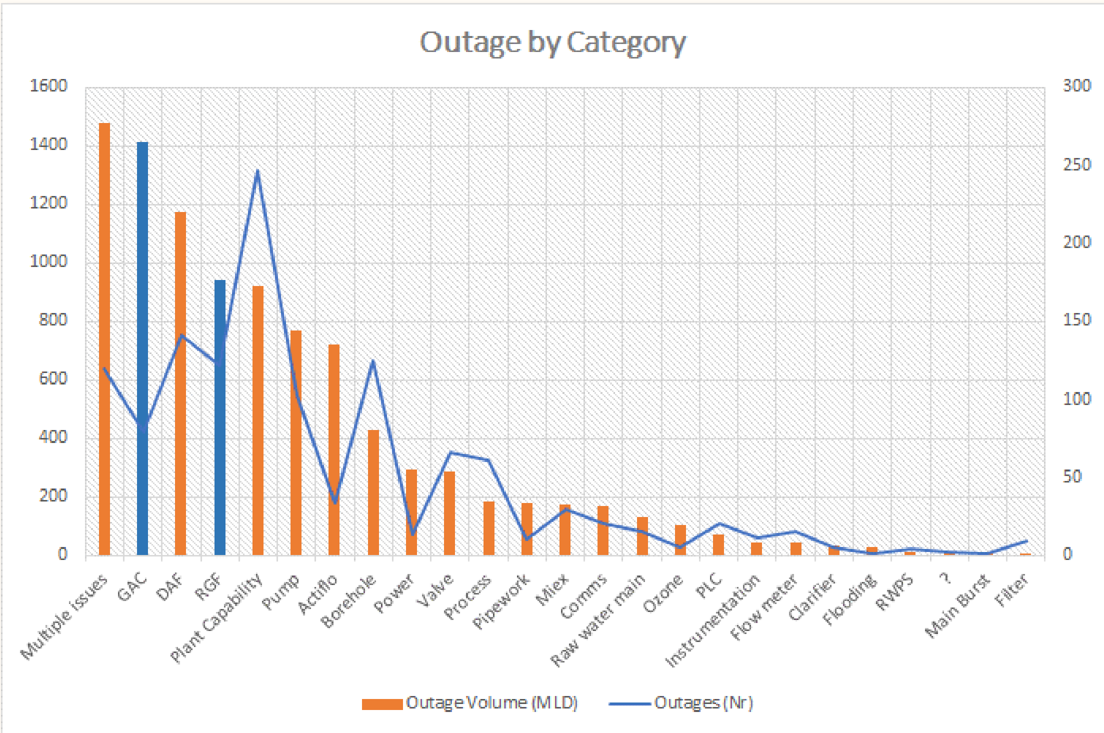
YW operates 203 rapid gravity filter units of which;

- 79% are >25 years old,
- 53% are >30 years old, and
- 26% are >40 years old.

Deterioration of these assets continues and as well as issues relating to valves, penstocks and media, concrete degradation is now a major issue, impacting RGF performance, blocking nozzles and increasing underbed pressures to the point filters can no longer function. The concrete degradation issue is also impacting GAC units – to date, two WTW's are known to have serious structural/concrete issues impacting performance and reliability. Floor design of some filters is also no longer fit for purpose. This is compounded by concrete degradation meaning filters are failing more frequently and require more complex and expensive refurbishment, that takes longer to deliver once the filter has failed. As a result, RGF's are among the most significant contributors to UPO (See Figure 7.13 below).

Although GAC and DAF units are also amongst the highest contributors to UPO, outages to these assets are more often due to issues with raw water quality, operation, chemical dosing, or maintenance (DAFs) and media issues (GACs), rather than inherent asset condition issues as we see with RGF's. We do still have asset health issues associated with these units (e.g. at Chellow WTW and Eccup No.1 WTW), but regionally, the investment required is not at the same level our RGF stock and can generally be managed with the existing base allowances and asset policies.

Figure 7.11 Drivers of Unplanned Outage

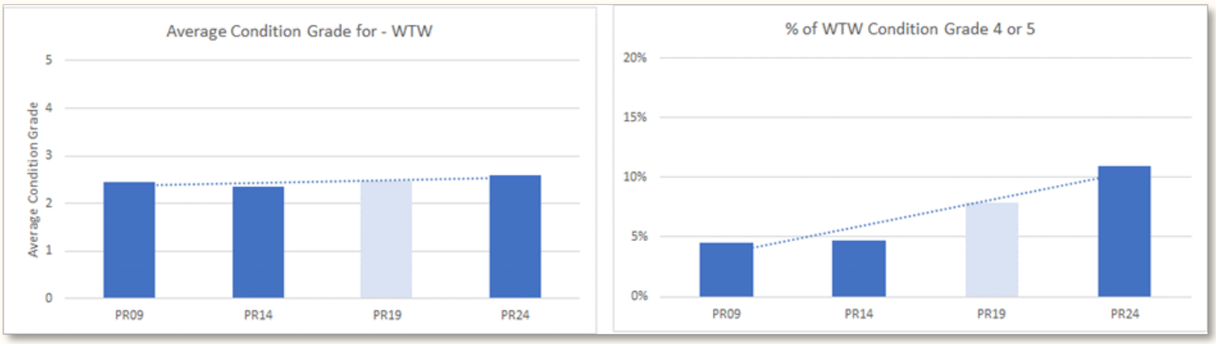


Filtration and Clarification (+DAF) are key WTW processes that exist in all but our most simple works. They consist of a combination of civils assets (typically concrete tanks) and associated mechanical and electrical equipment such as valves, penstocks and mixing equipment. Filters also contain a variety of media such as sand or carbon that carry out the task of removing contaminants from water as it passes through.

The issues outlined above outline why current base expenditure is insufficient to maintain a suitable level of asset health and performance on RGF's, GAC's and Clarifiers. Our primarily reactive, fix-on-fail approach does not allow us to carry out the interventions that are the best long-term way to secure asset health and customer service in these assets.

This view is supported by the increase in WTW assets categorised as condition grade 4 and 5 (poor, terrible), between AMP 4 and AMP 7 in the recent asset condition grade surveys we have completed (Figure 7.14 below)

Figure 7.12 Condition Grade Profiles for WTWs Assets PR09 to PR24



Without a base cost adjustment, we do not forecast to be able to sustain further improvements in UPO in AMP8 within our implicit Base allowance. Our current forecast is that with the base allowances set out in the Ofwat econometric models we will only be able to maintain Unplanned Outage at 2025 levels rather than drive further improvements set out in our performance commitment. In addition to this the risk of CRI impacting asset failure will continue to grow.

7.2.5 Level of Investment Required

Additional Investment in CWTs and SREs

A bottom-up exercise has been undertaken to analyse our treated water storage asset base and to identify the assets with the poorest asset health and potential impact on our ability to achieve our Performance Commitments. This assessment was based, on age, asset condition, and water quality risk. Based on these criteria, one clear CWT was flagged as needing replacement.

- **Chellow Heights E CWT**

This tank is the oldest in YW at c.122 years old. Originally open to the environment, a roof was retrospectively added around 40 years ago to improve water quality. The large, 155 Ml tank provides drinking water to over 290,000 properties in West Yorkshire. Ongoing maintenance to minimise ingress is required and the hydraulics of the tank are not sufficient to ensure uniform contact time. At the last inspection, four points of ingress were noted. This is typical of this asset as given it’s age, construction method and ongoing modification over the years, constant patch repairs are required to ensure it can remain in service. Overall condition is mixed, with some areas being in good condition, but other older parts being in poor condition with multiple vertical cracks evident.

In addition to the CWT programme, we have also identified a number of high-priority SRE’s for investment in AMP8 (some examples of these are discussed in the case studies in section 7.2.4). We have looked at those reservoirs with a risk score above 40, which are considered to be in condition grade 4 or 5 and where we have had to increase the inspection frequency from our standard 3 years to annual frequency due to growing concern about deterioration identified through previous inspections. The additional investment required is summarised in the table below.

Table 7.3 High Priority Treated Water Storage Investment Needs

Site	Cost (£m)
Chellow Heights E CWT	68.0
AYSGARTH/WTW/CWT	4.0
BARNOLDSWICK PARKHILL/SRE	6.7
BRADLEY/NO 2 SRE	3.6
HAINWORTH/NO 1 SRE	3.7
HAINWORTH/NO 2 SRE	3.7

HARTLINGTON RAIKES/1 CRE	3.5
HARTLINGTON RAIKES/2 CRE	3.5
THORNTON MOOR/1 SRE	2.5
THORNTON MOOR/2 SRE	2.5
BRACKEN BANK/CRE	6.3
Total	**108.0**

Additional Investment in Filtration and Clarification

A site-by-site, bottom-up exercise has been undertaken to investigate and understand asset health issues across our treatment asset base which has highlighted significant risk represented by Rapid Gravity Filters, Granular Activated Carbon Filters and Clarifier asset base. The risk posed by each asset was assessed and those which were categorised as high risk or poor/very poorl condition were flagged as requiring remedial work. The local area Sponsors then investigated and costed the best solution from both a Totex and Asset life/condition perspective.

The total costs required to resolve the most urgent assets in AMP8 to improve asset health and performance are as follows;

- RGF's - £55.1 m
- GAC's - £17.0 m
- Clarifiers - £15.5 m

Total base requirement to improve asset health of WTW Process units = £87.6 m

The above funding would enable us to proactively target 31 of the poorest condition RGF's, whilst retaining sufficient funding to address emerging risks in other RGFs which will inevitably arise during AMP8. The funding will facilitate a return to proactive, rather than reactive 'fix on fail' approach which has been necessary in AMP7.

Further details of specific schemes are included in the tables below. Table 7.4 provides a summary of the priority investments in rapid gravity filters for AMP8.

Table 7.4 Required AMP8 Capital Maintenance on rapid gravity filtration units

Site	Solution	Cost (£m)
Loftsome	Replace 3x temp RGF's with permanent units, refurb 3x units & replace DWW system	9.7
Eccup 1	Major Refurbishment of 8 x RGF Units and associated plant	9.4
Eccup 1	RGF Units open to environment. Solution to cover	5.7
Eccup 2	RGF Units open to environment. Solution to cover	8.3
Chellow	RGF Units open to environment. Solution to cover	5.4
Huby	Replace 1x RGF unit and backwash tank	1.6
Albert	Major Refurb 1x RGF and back wash water system	3.1
Chellow	Major Refurbish 4x RGF	1.9
Elvington	Major Refurbish 3x RGF	1.2
Regional	Regional scheme for reactive refurbishment over the Amp	8.7

Thornton Steward	install pressure monitors	0.1
Total		**55.1**

Table 7.5 below, shows the priority sites for investment in our GAC assets.

Table 7.5 Required AMP8 Capital Maintenance on granular activated carbon filter units.

GAC Filters Site	Solution	Cost (£m)
Loftsome	GAC refurb plus penstocks	3.5
Headingley	GAC refurb	2.6
Huby	Repairs to GAC tanks	0.2
THL	Enhanced carbon regen to maintain T+O	6.4
Regional	Regional scheme for carbon regeneration	4.3
Total		**17**

Table 7.6 Required AMP8 Capital Maintenance on clarifier units

Clarifiers Site	Solution	Cost (£m)
Chellow	Addressing concrete degradation	14.7
Eccup 1	Addressing concrete degradation	0.8
Total		**15.5**

The site by site analysis was supported by our Non Infrastructure asset modelling outputs which demonstrate that proactive investment at the above sites will significantly reduce the risk of outage, water quality and reactive failure rates. This is based on the assumed deterioration of the asset base, from historical asset failures dating back to AMP3.

7.3 Need for Adjustment

We are not unique in the industry in requiring more long-term investment to maintain asset health. As demonstrated in section 4.2.2 this is an issue affecting the whole industry, although the impact of certain policy decisions will have impacted some companies more than others.

This claim is based on the need for a step change in the rate at which YW replaces its assets and that this necessary step change is not adequately funded through allowances from the econometric models.

We have considered alternative options that involve less activity in these areas however, as set out in the rest of this document, those options would not be in customers best interests impacting our ability to meet out performance commitments and being less efficient in the long term.

Given the above, the test for “unique circumstances” is not relevant to this claim.

7.3.1 Management Control

The issue of management control relates to whether the investment if driven by factors outside of management control and whether steps have been taken by management to control costs before seeking to make a cost adjustment claim.

Regarding our filter, clarifier and treated water storage assets, the drivers of investment are fundamentally related to the underlying rate of deterioration of these long-life assets and the point they have reached in their expected asset lives. Where we do exercise control is in the decisions, we make to prioritise areas of investment within our overall base allowances. Had we opted to invest more in these assets in previous AMPs it would have been at the expense of targeting areas with more urgent needs. We consider that our in-AMP prioritisation decisions have been, appropriate and based on achieving customer service expectations and performance targets across the whole of our asset base.

We have taken action in the past such as re-lining and covering reservoirs, patching up concrete on our filters and clarifiers in order to extend asst lives and defer the need for capital replacement. We are now at a point where opportunities for further deferral are limited, and we need additional base funding if we are to ensure the long-term health of our water network.

We also presented analysis earlier in this document to show that within the overall base totex envelope, there is no scope to reduce other programmes or statutory activities in order to create the necessary headroom to accommodate our required programme for investment in filters, clarifiers and treated water storage assets.

We set out why previous price reviews and the PR24 final methodology are unlikely to sufficiently fund ongoing capital maintenance in Section 5.3 above.

7.3.2 Implicit Allowances

This targeted allowance is based on expenditure in base required above that funded through the totex models. We recognise that a level of forward-looking investment is implicitly funded in the models and should be netted off from any future claims. (We explain how we have calculated these for each of our asset areas below).

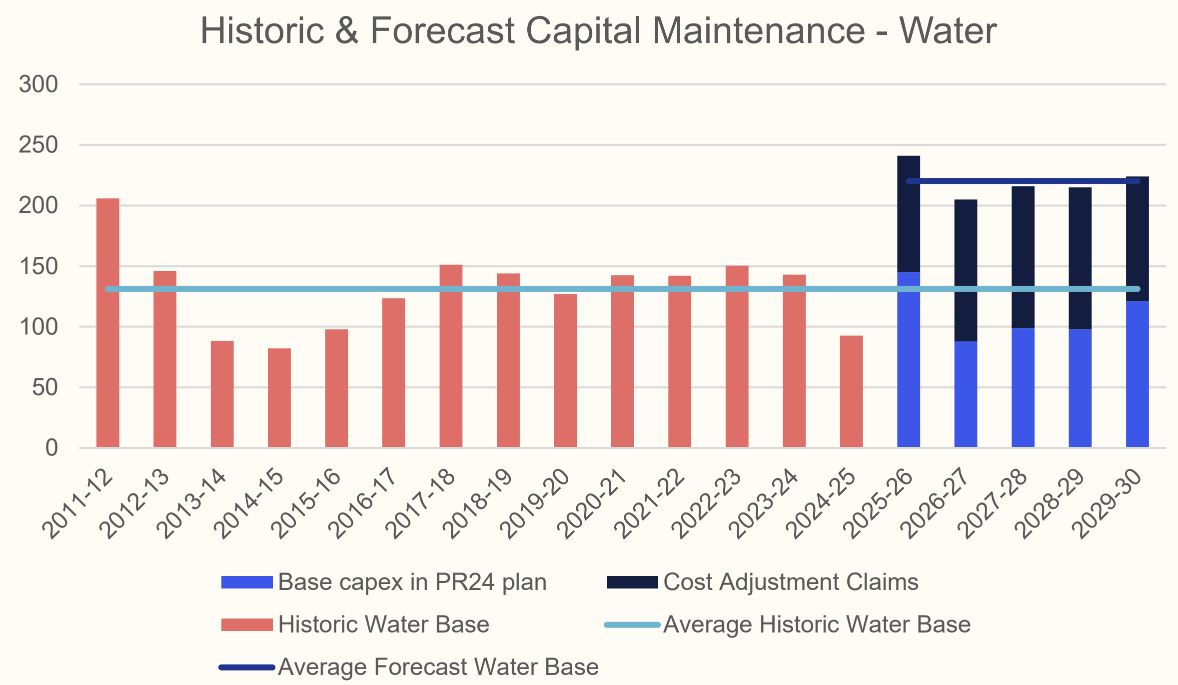
The implicit allowance for non-infrastructure assets is more challenge to calculate than for infrastructure as we do not have reported data at an asset level of the activities undertaken. Our assessment of Ofwat's cost models suggest that a similar, if not lower, level of base costs will be set in the water price control as at PR19 and that similarly stretching PC targets will be received.

An estimated base cost allowance for YW based on analysis of the Ofwat cost models (as shared in May 2023) is approximately c.£380-400m p.a. totex across the WR and WN+ price controls once unmodelled costs are added. The proportion of Opex in these costs, having accounted for our own efficiency improvements, has increased in our forward-looking analysis for a variety of reasons including energy and chemical prices as well as changes to principle use recharge. Given the plan we are proposing, we expect this to leave £110-120m p.a. for base capital maintenance to invest in all water assets and management and general assets apportioned to the water price controls.

For the asset groups we are claiming additional non-infra capital investment for, we have assumed an implicit allowance in line with our average historical capital spend in Water assets (2011-2023) which is likely to be higher than the inferred value in our cost allowance.

The figure below illustrates our long-term historic trends in base capital expenditure for water and the proposed uplift required as set out in this cost adjustment claim.

Figure 7.13 Long-term Investment Trends in Water



The below table shows an indicative long term average capital maintenance for the asset groups in the Water price controls.

Table 7.7 Yorkshire Water Historic Capex Investment and Estimate of Implicit Allowances

Expenditure Category	YW Long term average base spend (2012-2023) (£m p.a.)
Water Network Replacement	£11.14
Meter replacement	£5.52
IT Capex (Water)	£16.27
Other M&G (fleet, facilities, security, innovation)	£12.82
Water Treatment Works	£25.77
Leakage Maintenance Capex	£4.96
Statutory Reservoir Safety Activity	£12.69
Service Reservoirs & Water Towers	£5.51
Non-mains Infrastructure capex blocks (stop taps, street furniture, PRVs etc)	£14.85
Diversions (gross)	£4.55
Other	£17.12
Total	**£131.20**

Under the long-term base spend profile of £131.2 m p.a. we have seen condition of assets slowly deteriorate as set out earlier in this document. When comparing both totals with our assumed PR24 allowance of c.£110-120m p.a. it demonstrates there is minimal opportunity for base maintenance to be redirected from other areas of the programme to meet the investment needs set out in both this and the Metering cost claim (CW01), which amount to almost an additional £100 m per annum.

Cost Adjustment Claim Uplifts:	Additional Metering	£22m p.a.
	Additional Mains Replacement	£50m p.a.
	Additional Non-Infra	£37m p.a.

We have therefore assumed that our available capex from the PR24 plans for each of these asset groups is similar to the average spends in historic periods in these areas and that this is the implicitly funded allowance.

Table 7.8 Breakdown of Our Non-Infrastructure Cost Adjustment Claim

	WTW – Filtration and Clarification	Treated Water Storage
Total Investment	£87.60 m	£139.40 m
Implicit Allowance	£12.05 m	£28.20 m
Net Claim	**£75.55 m**	**£111.20 m**

7.3.3 Materiality

Our Water Network Plus Totex programme is £2,743m so a 1% materiality threshold on this claim would be £27.4m. This water non-infrastructure claim is larger than this threshold in aggregate and for each individual component.

Table 7.9 - Materiality Assessment

	Net Claim	Materiality
WTW Filtration	£75.6 m	2.8%
Treated Water Storage	£111.2 m	4.1%
TOTAL	**£186.8 m**	**6.8%**

7.4 Cost efficiency

Cost efficiency is a core tenet in our PR24 Business Case planning. We have been proactive in integrating best practices, leveraging new markets and collaborations, harnessing innovative technologies, and building an excellent procurement system to deliver cost efficiency across our whole business plan.

Yorkshire Water's business plan for PR24 encompasses a range of business cases and our approach to cost efficiency reflects this diversity of needs. Yorkshire Water uses data gathered over the last 20 years to inform our Unit Cost Databases (UCD) which we use to estimate capital cost based on historical norms.

Whenever a scheme is completed, the actual observed cost information is used to create historical cost models for activities undertaken. Taking actual observed costs ensures we only allow for the costs likely to occur. We do not build in any overestimates by assessing scheme risk separately. By doing this, we are modelling the efficient and effective delivery processes and materials used. Our UCDs are used subsequent to a technical identification and optioneering process to give a notional view of project and unit costs. The outputs of our UCD are then subject to internal quality assurance and portfolio optimisation. Our opex cost models and carbon cost modelling are generated in a similar way to our UCDs, utilising real, observed costs to estimate future costs.

As discussed in Chapter 4 of our business plan, the combination of our capital delivery partner tendering approach and our capital delivery process, which incentivises efficient solution identification and development we bring an end-to-end focus on maximising efficient costs across our capital programme. These costs are in turn captured and built into our future programme costing as described above. Using these actual observed costs ensures we only allow for the efficient costs likely to occur for given asset types. We do not build in any overestimates by assessing scheme risk separately. By doing this, we are modelling the efficient and effective delivery processes and materials used.

More detail on this subject can be found in **Chapter 4: Efficiency and Innovation**

7.5 Best option for customers

As discussed in previous sections of this document, the assets which are the focus of this cost adjustment claim, are critical to the safe and reliable functioning of our water supply system. They are also long-life assets some of which are notionally already life expired (beyond their assumed working asset lives). We have been able to extend those asset lives through a combination of short-term, tactical mitigations together with operational responses and reactive maintenance. Continuing the approach into AMP8 is not in the best interest of current customers, nor is it fair to future customers to continue to defer the inevitable replacement or major refurbishment of these assets.

The tipping point when it becomes clearly more economical to proactively invest in those assets cannot be determined with precision but by targeting the most urgent assets and developing a programme that aligns with the age profile of the asset base and emerging evidence of deteriorating condition, we consider that this is a no regrets course of action.

The additional £186.8 m we are seeking through this non-infrastructure component of our proposed cost adjustment in AMP8, allows us to proactively invest ahead of forecast failure and sets our asset health on an improving but sustainable trend whilst meeting our affordability expectations.

7.6 Customer protection

Whilst PCDs are normally designed for enhancement expenditure in the regulatory framework we recognise the need for customer protection for this Cost Adjustment Claim.

For our non-infrastructure investment proposals, customers are protected partially against non-delivery of this investment by the performance commitment penalties in Unplanned Outage, CRI and Drinking Water Quality Contacts will not be achievable without increased capital maintenance investment. However, we also propose an expenditure related PCD for this area to demonstrate our commitment that the investment is invested in the asset health of our non-infrastructure assets.

We set out our proposed PCD parameters and payment rate in the following tables.

Table 7.10 PCD for Asset Health Non-Infra Cost Adjustment Claim

PCD Delivery Expectation	
Description	We propose a PCD for the activity associated with this claim which is the expenditure of £186.75m of additional Capital Maintenance on the asset groups of: • Rapid Gravity Filters • Granular Activated Carbon • Service Reservoirs • Clean Water Tanks Whilst we understand that it is preferable for a PCD to be linked to specific outcomes or outputs, it is our view that customers will benefit from the ability to optimise and reprioritise this expenditure across the named asset groups in AMP8 to ensure that the best asset health outcomes are achieved in-AMP. Our case above gives our current view of our highest risk assets and the basis of our programme. However, we have ongoing inspection, asset monitoring regimes and risk management groups that continually assess our assets. As this investment is to address asset health over the next 2-7 years we consider that a financial PCD best protects customers from underinvestment whilst encouraging us to invest the additional capital maintenance in the assets that need it the most at that time.
Output measurement and reporting	Company must spend the total value of the claim on capital maintenance of the asset groups that form the claim. The proposed profile is specified in the 'forecast deliverables' table. The activity / investment over and above the assumed implicit allowance is subject to the PCD. Namely the CAC expenditure value.
Assurance	The company must commission an independent, third-party assurer, with a duty of care to Ofwat, to assure, to its satisfaction, that the conditions below have been met and the expenditure has been delivered over, and above the funding allowed for in the base plan.
Conditions on Scheme	n/a

Forecast Deliverables

The deliverables that we propose are protected through this claim are the expenditure associated with the claim related to the asset groups of WTWs Clarifiers, Filtration, Clean Water Tanks and Service Reservoirs.

Deliverable	Unit	Forecast Deliverables				
		2025/26	2026/27	2027/28	2028/29	2029/30
Total Expenditure	£m	32.335	36.690	49.755	54.110	54.110
Estimated Value Implicit in base allowances	£m	8.050	8.050	8.050	8.050	8.050
Total Claim Value	£m	24.285	28.640	41.705	46.060	46.060

Cumulative Forecast Deliverables

Deliverable	Unit	Cumulative Forecast Deliverables				
		2025/26	2026/27	2027/28	2028/29	2029/30
Total Claim Value	£m	24.285	52.925	94.630	140.690	186.750

PCD Payment Rate

This PCD protects all totex expenditure that forms part of this cost adjustment claim. We propose to apply the PCD payment at the end of 2029/30 to the difference between the claim value and the actual spend for the assets within the claim.

End of Period output PCD

Total Expenditure Allowance (Claim) – Total Expenditure in the asset groups (WTW Clarifiers & Filters, SREs, CWTs)

If this value is positive it will be returned to customers.

Annualised time delivery incentive

We do not propose an annualised time delivery incentive. Annual protection will be in the form of PC ODIs.

7.7 Data Table Commentary

	Title	Commentary
CW18.21	Description of cost adjustment claim	CW02a -Targeted Allowance Asset Health – Non-Infra
CW18.22	Type of cost adjustment claim	We have assigned this to 'other - a required step change in asset maintenance requirements above historical levels' as it does not meet the options set out in the guidance.
CW18.23	Symmetrical or non-symmetrical	This is a forward-looking claim and therefore non-symmetrical.
CW18.24	Reference to business plan supporting evidence	Refers to Cost Adjustment Claim Appendix.
CW18.25	Total Gross Value of Claim	We populate the gross value of the claim as the total Base cost element of the non-infra capital investment programmes in filters, clarifiers, clean water tanks and service reservoirs as set out in our cost adjustment claim appendix. We do not claim for any costs in 2022-25 so these cells are left blank. The costs are split between Treated Water Distribution and Water Treatment in line with our view of investment requirements.
CW18.26	Implicit Allowance	We populate an implicit allowance using the historic expenditure in these asset groups with no industry activity data at this level to determine rates of activity.
CW18.27	Total Net Value of Claim	Calculated from above two lines
CW18.28	Historic Base Expenditure	We have populated these lines with an estimate of our historic levels of expenditure in in filters, clarifiers, clean water tanks and service reservoirs. We note that these are estimated based on recent proportions (AMP6/7) as many are a subset of other larger drivers and historic data is not available at that level. Historic Service Reservoir costs are included in Treated Water Distribution with the rest allocated to Water Treatment
CW18.29	Totex for the control	We are not required to populate Totex value as it is a calculated cell but identify that this claim is in the WN+ price control.
CW18.30	Materiality	N/A We note that the size of the claim is significantly higher than 1% of WN+ Totex historically.

Table 7.11 Data Table Commentary CW18 Lines 21-30

8. Our commentary on other companies' early cost adjustment claim submissions

Ofwat in its methodology for PR24 has amended its approach to CACs to make claims more symmetrical in nature.

In Ofwat's view, if its models are biased against some companies as a result of a certain operational characteristic, then the models must be biased in favour of other companies as a result of the same characteristic.

The symmetrical approach is not appropriate for characteristics that are expected to change in AMP8, such as the expansion of P-removal programmes, or for investment activity that is not part of the historic cost modelling (i.e. high levels of meter or mains replacement).

Companies submitted 34 CACs as part of the initial CAC consultation in June 2023. We have asked Oxera to complete an independent assessment of the symmetrical CACs to assess whether any are relevant for adjusting YW's allowance upwards or downwards.

The symmetrical CACs fall into the following categories:

- Regional wages
- Network reinforcement and enhancement
- Leakage
- Population transience.
- Network complexit
- Wastewater drainage.

Table 8.1 summarises Oxera's findings on each of these areas, with a detailed analysis and commentary set out in the Annex to this document.

More detail on this subject can be found in **Oxera CAC Appendix**

Table 8.1 Summary of Oxera analysis of other company symmetrical CACs

Category	Summary of findings
Regional wages	• The claim submitted by AFW is based on econometric models which show an economically unintuitive relationship between regional wages and costs. While the coefficient on regional wages is positive and significant, the coefficient is inappropriately large, suggesting that the regional wage cost driver is picking up other factors (including the relative efficiency of companies with large or small regional wages) and/or that an inappropriate wage measure is employed. • The claim submitted by SRN does not present robust evidence that regional wages are not already captured by the PR24 cost drivers. SRN only considers the correlation between regional wages and population density, and even this analysis suggests that there is a relatively strong relationship between density and regional wages (the correlation coefficient is c. 0.48–0.59). • Neither SRN's nor AFW's analysis accounts for the fact that regions with higher wages also have high levels of labour productivity. Therefore, both companies are likely to overestimate the value of the CAC.
Network reinforcement and enhancement	• Some companies have submitted claims relating to increased reinforcement or enhancement activity in AMP8. While cost lines of the activity are included in the modelled cost base, the models do not count for explicit drivers of such activity. Therefore, it is likely that the models underestimate the reinforcement and enhancement requirements of some companies.

	• However, the extent to which these claims can be considered 'symmetrical' depends largely on the level of activity that the industry is expecting in AMP8. For example, YWS is submitting a CAC on maintenance requirements to account for an anticipated maintenance activity. Therefore, we do not consider that it would be appropriate to adjust our allowances at this stage without other forward-looking information on activities from other companies.
Leakage	• The general premise that improvements to service quality can require additional efficient costs is economically valid. However, the coefficient on leakage in the models presented by ANH and BRL is consistently statistically insignificant across specifications and do not satisfy Ofwat's modelling criteria. • ANH and BRL present analysis showing that leakage is largely driven by exogenous characteristics, such as population density. We agree with the premise that companies' ability to meet service targets can be influenced be exogenous characteristics, and evidence of this kind can be used to adjust companies' performance commitments as well as allow additional costs.
Population transience	• Population transience does not perform well as a cost driver in Ofwat's PR24 consultation models. While it may be an operationally relevant driver of costs, the observation that it performs poorly in the models could suggest that it is not relevant in explaining industry-wide costs on the current dataset. • The top-down evidence supporting the value of the CACs is based models that are not robust. First, the data used to model population transience is based on outdated forecasts from the ONS—companies may perform well or poorly in these models on the basis of forecasting errors, rather than genuinely good or bad performance. Second, the population transience driver performs poorly in the models presented—the coefficient is volatile across specifications, it is negative in two of the 11 models and statistically insignificant in seven of the 11.
Network complexity	• APH is an operationally relevant driver of expenditure and is indeed included in half of the TWD and WW models, and all of Oxera's TWD and WW models. However, as noted by SVE in its CAC on the issue, booster pumping stations per lengths of main is also an equally operationally relevant driver of expenditure that performs well alongside APH in the models (both can be included in the TWD and WW models jointly). We do not consider that it is appropriate for booster pumping stations per lengths of main to be omitted from the cost models. • SVE has further argued that APH (WRP) should be included in the cost models. While APH (WRP) may also be an operationally relevant driver of expenditure, the models perform poorly when this driver is included. Specifically, the coefficients on the treatment complexity drivers become insignificant, suggesting that the cost-impact of APH WRP is already captured (at least partially at the industry average) through the treatment complexity variables.
Wastewater drainage	• NWT submitted a CAC relating to the increased drainage costs associated with combined sewers and urban rainfall. This is consistent with YWS's own views that exogenous factors associated with sewer networks have a material impact on cost and service. • As YWS has submitted a CAC in relation to combined sewers, and Oxera's models control for both combined sewers and urban rainfall in all of its relevant network plus models, it would be inappropriate to adjust YWS's allowance again on the basis of this CAC, providing Oxera's recommendations are adhered to.