SRN-DDR-021: Sustainable Botex Technical Annex

Draft Determination Response

28th August 2024
Version 1.0

from Southern Water

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1. Overview

The proposed Botex allowances are insufficient and place intolerable risk on the statutory and mandatory services, which our asset base is required to deliver to customers and to protect the environment. This appendix addresses the concerns specifically with the capital maintenance of our assets, proposes a remedy to the 4% gap created between the top-down economic models and our October business plan submission, and complements other arguments made within our response on Botex.

Our analysis presented in this appendix considers updated evidence of our Botex requirements and indicates a need for an additional £74m increase from our business plan capital maintenance requirements, to reach our sustainable base maintenance level.

This assessment is based on new evidence presented since October 2023, which demonstrates the required level of capital expenditure as part of base capital maintenance and our views on what are appropriate allowances to provide the expected level of service to customers now and in the future. Furthermore, our analysis of the base maintenance allowance at a lower, asset group level, indicates that the draft determination would undermine the progress that we have made in AMP7, jeopardising the improvement in outcomes for our customers' long-term and immediate interests, as well as the environment and the long-term sustainability of our business.

We acknowledge the Draft Determination seeks to provide higher allowances than in previous settlements. However, this allowance does not go far enough in recognising the effect of three converging factors on our sustainable rate of base maintenance requirement:

1. Upward pressure on base performance, and the principle that more cannot continually be delivered with less.
2. Implicit assumption in the level of allowance that assets can continue to provide resilient performance beyond their design life; and
3. Exogenous factors, such as the climate and increasing pressure on our assets.

When we holistically consider the effect of all three above points, we must put forward our concern for the impending threat on the sustainable operation of our assets, and therefore a need for an 'uplift' of £74m on top of our original October PR24 business plan submission for AMP8.

As a company focused on delivering a turnaround in performance, we have overspent our Botex allowances in AMP7. We are not alone in this and we recognise that Yorkshire Water, Northumbrian Water and Thames Water have all challenged that the Botex models do not provide sufficient allowances. The extra funding above our allowances for AMP7, provided by our shareholders, has allowed us to improve our performance position across the asset base, to improve our understanding of the condition of the asset base and our understanding of the efficient costs of maintenance and future investment. Now that we have a more informed position, we are on a journey to determine the sustainable level of investment requirement to maintain our assets in the long run.

This sustainable level of investment can be described as the minimum allowance required to break the cycle of 'sweating assets' that has been borne from a necessity to employ a reactive asset maintenance strategy because of the allowance provided. Instead, this sustainable level of investment provides a stable and resilient service in a cycle of continuous improvement that is based on our customers' and regulatory priorities. The current Botex models, and resulting allowances generated from them, do not provide this for all areas of our asset base.

Table 1 summarises our position. For Waste Pumping Stations, Rising Mains and Water Service Reservoirs (WSR) asset groups, there is a material difference between Ofwat's modelled allowances and our forward-looking asset health methodology derived sustainable investment requirement. Specific circumstances affect the true cost of efficient capital maintenance for these asset groups and modelling allowances will not suffice to address our critical risks, nor protect delivery to our customers and the environment. We are therefore seeking adjustments to the Draft Determination allowances in the interests of customers and the environment.

Table 1: Summary Assessment of DD Allowance Sufficiency for Sustainable investment requirement

Area	Priority Asset Group	Our position	Key contributing factor
Water	Water Distribution Infra	No change from October PR24 plan position	Gaps exist between PR24 requirement and latest available evidence; however, these are addressed in enhancement claims and mains renewal CAC, and overall allowance challenges
	Water Production	No change from October PR24 plan position	Gaps exist between PR24 requirement and latest available evidence; however, these are addressed in enhancement claims, and overall allowance challenges
	Water Abstraction	No change from October PR24 plan position	Evidence assessed supports the original October PR24 Botex plan submission.
	Water Distribution Non-Infra	Additional £14m uplift required to PR24 business plan	Address escalating costs and compliance risks identified from our aging asset base
Waste	Sewers	No change from October PR24 plan position	Evidence assessed supports the original October PR24 Botex plan submission.
	Rising Mains	Additional £30m uplift required to PR24 business plan	Asset Health data details an increased investment need due to premature failure of Rising Mains. Additional investment required to deliver pollution performance
	Waste Pumping Stations	Additional £30m uplift required to PR24 business plan	Asset Health data details an increased investment need due to aging asset stock. Additional investment required to deliver pollution performance
	Waste Treatment	No change from October PR24 plan position	Evidence assessed supports the original October PR24 Botex plan submission.
	Bioresources	No change from October PR24 plan position	Evidence assessed supports the original October PR24 Botex plan submission.

2. Introduction

The October PR24 Botex Business plan was primarily built on three main components:

1. For our reactive costs and routine maintenance, we primarily used our historic run rate (AMPs 5, 6 and Y1,2 AMP7), as our turnaround programme was still maturing and we were awaiting to see further improvement in our performance, which we now are.
2. For our planned capital maintenance programmes, we used a combination of our deterioration models, and a 'bottom up' build of projects based on our asset risk scoring and engineering judgement.
3. Forecasts of how we will improve performance between 2025 and 2030, using our risk framework, which enables us to link asset risks, activities (or interventions) in the base cost plan and performance benefits.

Since our Business Plan submission, we have continued to develop and strengthen our Asset Risk Management tools which underpin our Botex plan, maturing our approach to Asset Health to a point where we feel it provides a clearer view of the asset requirements and therefore compelling evidence for the true sustainable capital maintenance requirement for certain asset classes. Our approach seeks to understand the true 'health' of our asset base (taking a long-term 25-year planning view), and therefore determine what interventions, and associated level of investment are required.

There are still many areas where the evidence source behind our October 2023 business plan still represents the best approach to management of that asset class. We have undertaken an extensive review of our capital maintenance and operational activities. Based on the evidence available, this gave us the best possible view of the investment needs of our asset base. We have also identified opportunities to improve our business through a series of efficiency and maintenance effectiveness initiatives and are committed to the delivery of these in AMP8, these are explained in SRN-DDR-004.

The challenge with backward-looking methods is that assume that the past is representative of the future. Whilst these methods can be a useful measure to understand the trends in capital maintenance and typical expenditure requirements, they are not well suited to consider the 'effective health' of our asset base, namely, condition, age and performance or the 'efficient' investment profile for our asset base.

To establish an improved understanding of the true sustainable level of Botex we have applied a combination of backwards looking measures, to establish a potential baseline, along with forward looking modelling approaches, including asset health, to better understand and define the future requirements, considering any changes in external factors. The combination of these evidence points, along with our original PR24 estimates, forms a richer evidence base from which we can triangulate on what the true sustainable level of Botex is.

Reflecting the different sources of evidence we've assessed; this chapter is structured as follows:

- Section 3 details the various methodologies we have explored to refine the sustainable Botex level for AMP8 and beyond.
- Section 4 discusses the results of these methods, and the updated sustainable Botex expenditure levels we are proposing for PR24 for Wastewater Network + and Bioresources; and
- Section 5 does the same for Wholesale Water.

As with the previous Draft PR24 submission, the evidence presented in this case, the analysis that supports, and the data that enables the analysis aligns to our PR24 Data and Assurance governance approach (Ref: srn11-data-and-assurance.pdf (southernwater.co.uk)).

3. Methodology

In the following sections, we set out the evidence points that have formed our view of Botex investment required to maintain operations, whilst preserving the health of our asset base.

3.1 Botex evidence sources

To determine the appropriate sustainable Botex level we have had regard to a range of different methodologies:

- **Historical data-based approaches:**
  - *Run rate analysis.* Historical and current costs of operating and maintaining our asset base (our 'historical run rate analysis'), including the *AMP7 Run Rate* and the *AMP6 Run Rate*; and
  - *Exit rate analysis.* Budget forecasting-based analysis of the AMP7 Y5 costs of operating and maintaining our asset base.
- **Predictive modelling-based approaches:**
  - *Asset Health modelling.* Determining the health of our asset base, based on the 'effective age of our assets'; and the investment required to maintain this 'health'; and
  - *Deterioration modelling.* Asset deterioration modelling through our [redacted] Asset Management System.
  - *Performance schemes.* Historical and current performance against our performance commitments and developing 'bottom up' built schemes based on assessments of future benefits for specific proposals to improve performance.
- **Additional external factors** (which influence the level of Botex required such as growth, changing demands of the asset base).

These methodologies allow us to ensure that we understand history, how it provides insight and informs our forward look, which is then complemented by consideration of external factors and pressures. When considered alongside our Risk management framework we are then able to make an assessment to identify where the modelled allowances do not provide appropriate costs to meet the performance expectations.

The methodology for each evidence point is listed below:

Table 2: Points of Evidence

Evidence points	Input	Projection	Description
AMP6 Run Rate & AMP7 Run Rate	• Total outturn cost (AMP6, AMP7) • AMP7 Y5 Forecast • Historic PC performance (AMP6, AMP7) • AMP8 Forecast	Backward looking ←	The summary of average historic expenditure on capital maintenance allocated at an asset class level
AMP7 exit rate	• AMP7 Y5 Forecast		Follows the same methodology as AMP6 Run Rate and AMP7 Run Rate above but uses just the forecast for AMP7 Y5. For comparison of scale with other methods this figure has been multiplied by 5.
Performance schemes	• Performance APR data • Risk register	Forward-looking →	Investment allocations to lower-level asset classes based on performance data and risk register recommendation of schemes required.
Asset Health	• Effective 'age' of assets • Condition • Material • Probability of failure		The analysis of the 'effective age' of our assets and likelihood of failure in any given year. Which develops an investment profile that aims to achieve 'no deterioration' of effective age over a 5 AMP period, made up of replacements and/or repairs that are equivalent to historic 'planned schemes', that aims to achieve 'no deterioration' of effective age over a 5 AMP period
Deterioration Modelling	• Age • Desired performance outcomes • Probability of failure		The level of age-based predictive deterioration of assets and desired performance is optimised to give a steady state level of performance against objectives

3.2 Triangulation

Each piece of analysis described in our methodology above applies different inputs and uses different analysis techniques, as described. Results can therefore vary between methods, dependant on the quality of the data used to support the model, or the operational context of the asset(s) that the method aims to estimate the cost of. Often, with wide-ranging results, a degree of 'Triangulation' is required to identify:

A) What we believe the areas with the most robust evidence are (addressed in Table 3),

B) Of the evidence cases, how we determine what the 'Sustainable level of Botex' is (addressed in the individual asset class cases, Section 4.2, 4.3, 5.2).

We strive to be as transparent as we can, sharing our 'triangulation methodology' applied to assess our evidence points. We have cumulated a wide range of data points for each asset group giving us a recommended 'range' of investment required across the portfolio (see Figure 1 & Figure 10). To assess the appropriate level of investment, we look to key factors that you have applied across recent draft determinations for allowances. These encompass data availability, robustness of the model and the outcomes the predicted level of investment that we have summarised in a series of 'triangulation tests':

Table 3: Evidence Sources Strength Assessment

Assessment Criteria	Criteria 1 – Cost Evidence	Criteria 2 – Performance Evidence	Criteria 3 – Asset Data Quality	Evidence supports an Asset deep dive?
Description	Do costs derived from evidence sources converge on a figure which aligns with the PR24 plan figure (ref. Figure 1 & Figure 10)	Is there significant variability or an obvious decline in performance that prompts further investigation	Is there asset data of sufficient quality to undertake a deep dive asset health assessment or is there new evidence that supports a change in base expenditure requirement.	Do we have cause for concern with this asset class (Criteria 1 & Criteria 2 'Negative') and sufficient additional evidence to explore within this Botex case
Positive	Good convergence of costs, and a limited range across data sources	Stable performance trends or no cause for concern with relevant PC trajectory	Broad and robust datasets available (multiple sources of high-quality data with verified quality)	Additional evidence is explored in this appendix
Negative	Significant variability between cost sources, raises uncertainty on true 'sustainable Botex'	Deviation from target based on current expenditure or significant variability in relevant PC performance suggesting underlying asset health issues	Data does not fully pass quality criteria (Several sources of data of an expected quality and standard)	Additional evidence is not explored in this appendix

By triangulating these evidence points against our assessment criteria, we can be confident in our understanding of the appropriate level of investment needed to maintain a good level of asset health, when compared against top-down modelling approaches only.

Where we have robust cost and asset evidence, combined with demonstratable high risk to performance there is a clear and defendable need for adjustment to the allowances. We then considered the effectiveness of past expenditure to further assure ourselves that customers are not paying twice for service, or that past allowances have not been fully utilised. The results of our Triangulation are shown below:

Table 4: Triangulation Methodology applied to asset groups

Area	Priority Asset Group	Criteria 1 - Cost Evidence	Criteria 2 – Performance Evidence		Criteria 3 – Asset Data Quality	Evidence supports an Asset deep dive?
Water	Water Distribution Infra	Strong alignment	Stable performance	Data quality gateway	High quality data available	Evidence not assessed in this case
	Water Production	Strong alignment	Stable performance		Typical data quality	Evidence not assessed in this case
	Water Abstraction	Strong alignment	Stable performance		High quality data available	Evidence not assessed in this case
	Water Distribution Non-Infra	Variation observed	Deviation observed		High quality data available	Evidence assessed in this case
Waste	Sewers	Strong alignment	Stable performance		Typical data quality	Evidence not assessed in this case
	Rising Mains	Variation observed	Deviation observed		High quality data available	Evidence assessed in this case
	Waste Pumping Stations	Variation observed	Deviation observed		High quality data available	Evidence assessed in this case
	Waste Treatment	Variation observed	Stable performance		Typical data quality	Evidence not assessed in this case
	Bioresources	Consistent trend	Stable performance		High quality data available	Evidence not assessed in this case

From this comprehensive and appropriate approach we identified three specific asset classes where we require higher Botex requirements than our October PR24 Business Plan. These are:

Wastewater Pumping Stations

Rising Mains

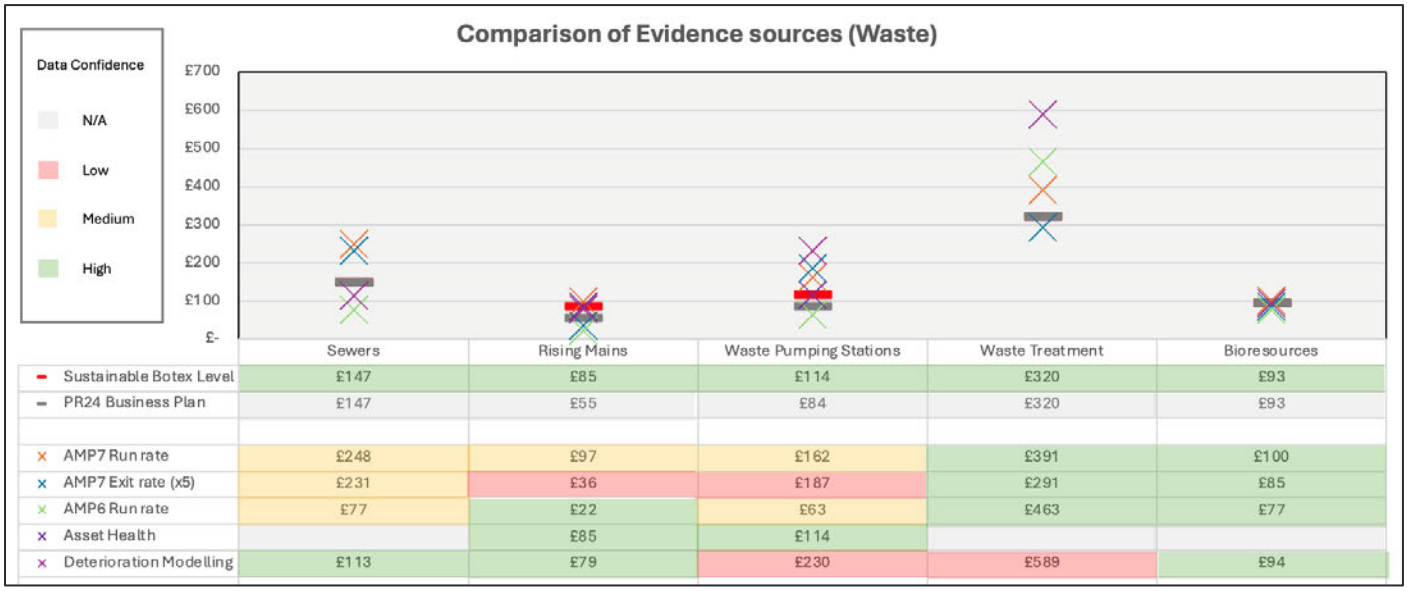
Water Service Reservoirs

Across other asset types, we consider that the Draft Determination expenditure proposals represent a challenging and stretching level of cost efficiency and performance. But remain that our October PR24 business plan represents the most appropriate levels of 'Sustainable Botex' for these asset classes, as we develop a more granular understanding of the sustainable level of expenditure to maintain asset health.

4. Wastewater Network+ and Bioresources Results

4.1 Comparison of evidence sources

The results of our assessments for Wastewater Network + and Bioresources are displayed below. For most asset groups, our results show the 'recommended base expenditure' (red rectangular 'Sustainable Botex Level' marker) remains in line with our October PR24 Botex plan (grey rectangular marker), and therefore not visible on this graph. The October PR24 business plan figures are the appropriate level of expenditure for these asset classes, given the current additional evidence does not identify the need for additional investment (or reduced investment) to undertake the activities described in our Botex plan (see Figure 1). Where the red marker is above the grey marker, we have evidenced a case for higher allowances in Section 4.2 and 4.3.



	Sewers	Rising Mains	Waste Pumping Stations	Waste Treatment	Bioresources
Sustainable Botex Level	£147	£85	£114	£320	£93
PR24 Business Plan	£147	£55	£84	£320	£93
AMP7 Run rate	£248	£97	£162	£391	£100
AMP7 Exit rate (x5)	£231	£36	£187	£291	£85
AMP6 Run rate	£77	£22	£63	£463	£77
Asset Health		£85	£114		
Deterioration Modelling	£113	£79	£230	£589	£94

Figure 1: Comparison of evidence sources for each asset group

Below we summarise Figure 1, and what it means for this Botex case.

Table 5: Asset Class Data Comparison

Asset Group	Evidence Commentary	Reference figure for Sustainable Botex Level
Sewers	• Good cost convergence around PR24 Business plan run rate-based assessment, which sits between AMP6 and AMP7 Run rate values (where we saw high numbers of collapses and associated remedial costs). • Deterioration models are of high-quality evidence base and support an increased level of investment compared to historic (AMP6) requirements	PR24 Business Plan
Rising Mains	• Historic run rate unlikely to be a good guide for the actual requirement due to the replacement lengths delivered over these periods, and the corresponding collapse performance. • New Asset Health based evidence demands that additional capital maintenance expenditure is required to address the increased probability of failure associated with specific material types (such as DI, and small diameter CI, SI and PVC mains). Deterioration modelling assessments indicate the same.	Asset Health (see section 4.3)
Waste Pumping Stations	• New asset health-based evidence dictates that additional capital maintenance expenditure is required to sustainably manage this asset class and bring expenditure closer in line with AMP7 Run Rate to address the historic allowances which have resulted in a disproportionate percentage of assets at or exceeding their maximum design life.	Asset Health (see section 4.2)
Waste Treatment	• Historical run rate data is of a high quality (as per the PR24 Business Plan) and remains the best guide as to the actual Botex requirement. • Deterioration modelling is an obvious outlier, otherwise there is good cost convergence from other sources. Deterioration modelling is of a lower quality than other models due to the aggregation of disparate failure rate data required at a 'site level', and low coverage of supporting condition data for Waste Treatment.	PR24 Business Plan
Bioresources	• Very good convergence of costs around PR24 Botex plan. • Good level of confidence in deterioration modelling due to data being supported by recent condition surveys.	PR24 Business Plan

The analysis in Table 5 demonstrates that for Sewers, Waste Treatment and Bioresources, our PR24 Business Plan remains a challenging, but appropriate expenditure level. Table 5 also indicates where the emergence of new asset health related evidence gathered since October '23 has identified areas where further investment is required. Our analysis warns that without further investment, there is a considerable risk to the performance of these asset classes. These are:

- **Waste Pumping Stations** – We identified that an additional £30m level of investment is needed to offset deterioration and achieve a sustainable level of investment.
- **Rising Mains** – We identified that an increased £30m level of investment is needed to combat deteriorating sewer collapse performance and address underlying asset health issues, particularly with small diameter CI, SI and PVC mains.

The evidence behind this requirement is set out in the following two sections. In each case, we:

- Set the context and evidence defining the AMP8 challenge for each asset group
- Define the level of sustainable Botex required using our triangulation points, and define why this is the appropriate long term sustainable level of Botex
- Set out the impact of the additional Botex requirement, compared to our PR24 Botex plan levels of expenditure.

4.2 Waste Pumping Stations

4.2.1 AMP8 Asset Class Context

As a turnaround company, our pollution performance from our Waste Pumping Stations (WPS) was one of our areas of considerable focus in AMP7. We made significant progress in improving our pollution performance through a short-term surge in expenditure to turnaround our pollution performance funded by our shareholders, which we primarily delivered through remedial repair of our existing Waste Pumping Stations. Which resulted in total increase across our Wastewater capital maintenance programme of c. £150m, £100m of which has been spent on our wastewater network capital maintenance. As a result, we have seen a vast reduction in the total number of pollution incidents over the course of AMP7 (near 47%, or 25% for just Waste Pumping Station).

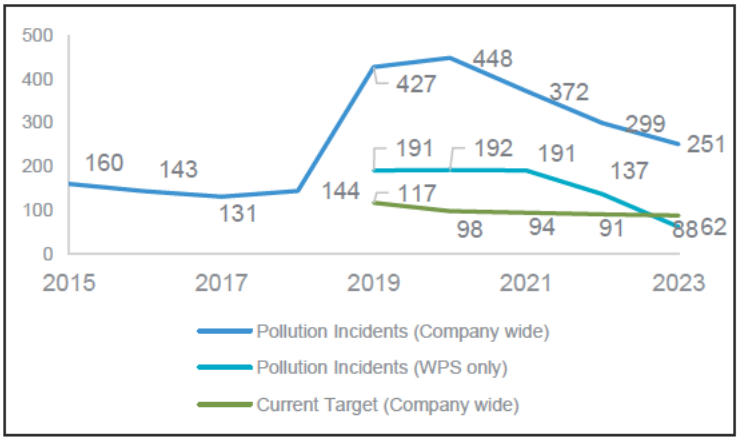


Figure 2: Historic Pollution Performance

Despite vast improvements in our Pollution performance, we remain 56% over our target (88 pollution incidents per 10,000km of pipe for 2023, see Figure 2), demonstrating that more must be done in AMP8 to bring our performance in line with the expectations of our customers and the environment.

Whilst we recognise there is more to be done to improve our pollution performance, we are now also faced with challenges in the management of our asset base. Our asset data shows that we have 62% of our Waste Pumping Station assets at, or nearing, their end of life in AMP8 (Figure 3), and prioritising remedial repairs of our asset base no longer represents the best approach to the sustainable management of our Waste Pumping Stations.

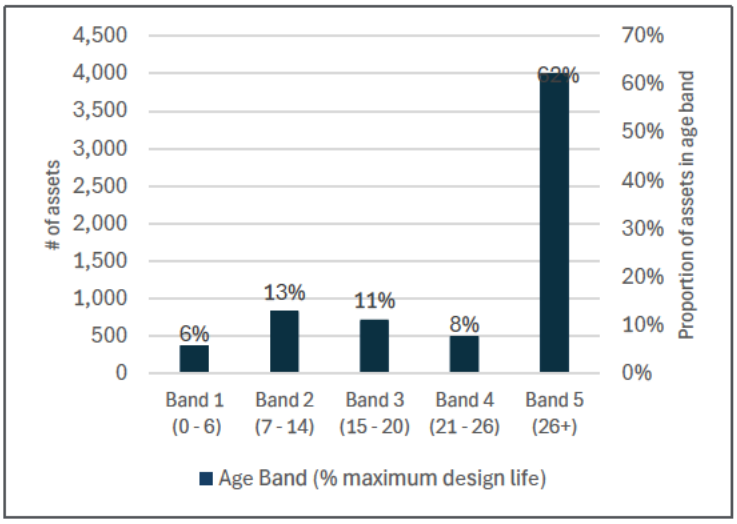


Figure 3: Skewed age distribution of our WPS assets in AMP8

Instead, we must now focus on delivering long-term asset performance for our customers (rather than a short-term turnaround in performance) through larger scale renewals programmes and network calming measures to maintain availability of our Waste Pumping Stations and avoid widespread failures.

We now face significant performance and asset health challenges, and historic Botex expenditure (as per AMP6) have been proven to be insufficient to address these issues. In the following section we determine the true 'sustainable Botex level' for our Waste Pumping Stations, taking into account new Asset Health based evidence, as well as our other triangulation evidence points (refer to Table 6 summary of cost data sources).

Asset Class Triangulation Results

Below, in Table 6 we present our evidence sources and assessment of each source against our sustainable investment requirements for Waste Pumping Stations, concluding that Asset Health provides the most appropriate evidence point for sustainable level of Botex.

Table 6: Summary of cost data source and Sustainable Investment Requirement Results

	PR24 Botex Plan (£m/AMP)		£84
	Sustainable Botex (£m/AMP)		£114
	Evidence Source	£m/AMP	Assessment against AMP8 sustainable investment requirements
Historic cost analysis	AMP6 Run Rate	£63	In AMP6 our analysis showed that high levels of replacement investment were not necessary at the time, therefore our allowance was afforded to our higher priority operational risks in other asset classes, and therefore does not represent the new requirement. AMP6 low level of replacements is a factor in the positively skewed age distribution in AMP8.
	AMP7 Run Rate	£162	We invested shareholder funds to improve our Pollution performance, beyond what we deem to be a sustainable level. Primarily spending in remedial repairs and performance improvement schemes such as automatic resets, which are not optimum in the long term as they drive short-term performance and not asset health, the latter of which drives better long-term, overall performance and lower costs.
	AMP7 Exit Rate	£185 (£37/year)	As per AMP7 run rate above.
Predictive analysis	Asset Health Modelling	£114	**Sustainable level of Botex:** Long-term consideration of asset maintenance suggests relatively high level of investment compared to AMP6 levels, but a proactive strategy that will continue the improving performance trend at a long-term efficient cost. Asset Health Modelling provides a level of expenditure that represents a reasonable compromise with other evidence sources (i.e. Run Rate, and Deterioration Modelling)
	Deterioration Modelling	£230	Low level of confidence that this level of expenditure is required. The increase is, directionally, in line with other evidence sources, but suggests a level of expenditure far in excess of other methods.

Key	
	The limitations of this evidence source make this recommended level of investment not applicable.
	Some of the benefits of this evidence source are applicable and/or aligned to the priorities and/or strategy needed for this asset class in AMP8. However, some of the limitations of this source make it less applicable to the priorities and/or strategy needed. This evidence source can be used as a part of our triangulation.
	The benefits of this evidence source are highly applicable and/or aligned to the priority and/or strategy for this asset class in AMP8. This evidence source should be our main focus for the sustainable level of investment required and aligns well with our triangulation.

In AMP8, we want to adopt a long-view approach of performance improvement by taking a proactive strategy in investing in replacements before failure. This will afford us the opportunity to invest efficiently, whilst continuing to align performance to customer expectations. Subsequently, we have the highest confidence in the asset health modelling figure in representing our sustainable investment requirement for WPS.

Determining the required sustainable funding level

We recognise that the AMP7 level of expenditure, primarily on remedial repairs, is not a long-term, nor sustainable strategy for our Waste Pumping Stations. Particularly given the volume of WPS that are nearing or at their maximum design life. Therefore, since October's business plan submission, using asset health-based analysis techniques we have sought to refine what we think the true long term sustainable level of Botex is for our Waste Pumping Stations.

Our Asset Health assessment shows a distinct need to addresses the critical level of risk arising from 62% of our WPS at or exceeding their maximum design life. This Asset Health model optimises the investment profile to be as low as possible, whilst maintaining a healthy effective asset age (average asset age below the maximum design life of 30 years), and avoiding excessive 'peaks' of investment.

We are requesting an increase of £30m above our Botex plan (£114m total) to bring investment in line with Asset health modelling findings, and in line with the sustainable level of investment necessary to the management of this asset class. The asset health strategy looks to renew a higher proportion of assets in AMP8, thereby maintaining a healthy 'effective age' of our WPS asset stock over a 25-year profile (see Figure 4). This level of investment in AMP8 achieves a stable level of investment over the following 4-AMP period, avoiding excessive or inefficient spend in future

AMP periods (see average investment in AMP9-12 is smoothed (and reduced compared to AMP7 levels) by applying asset health modelling suggested investment in Figure 4).

Using our Triangulation approach, we deem the Asset Health Modelling result to be the appropriate level of sustainable investment needed, for three main reasons:

- It defines the funding required to offset the impending surge of assets nearing or exceeding their maximum design life.
- It reduces expenditure compares to AMP7 levels yet provides enough allowance to allow us to target renewals in our near end of life, and high-risk pumping stations.
- Alternatively, when assessing the appropriateness against our £57m AMP6 levels of expenditure, we recognise this is not sustainable, nor appropriate for AMP8 as they resulted in increased asset age overall, and poor performance.

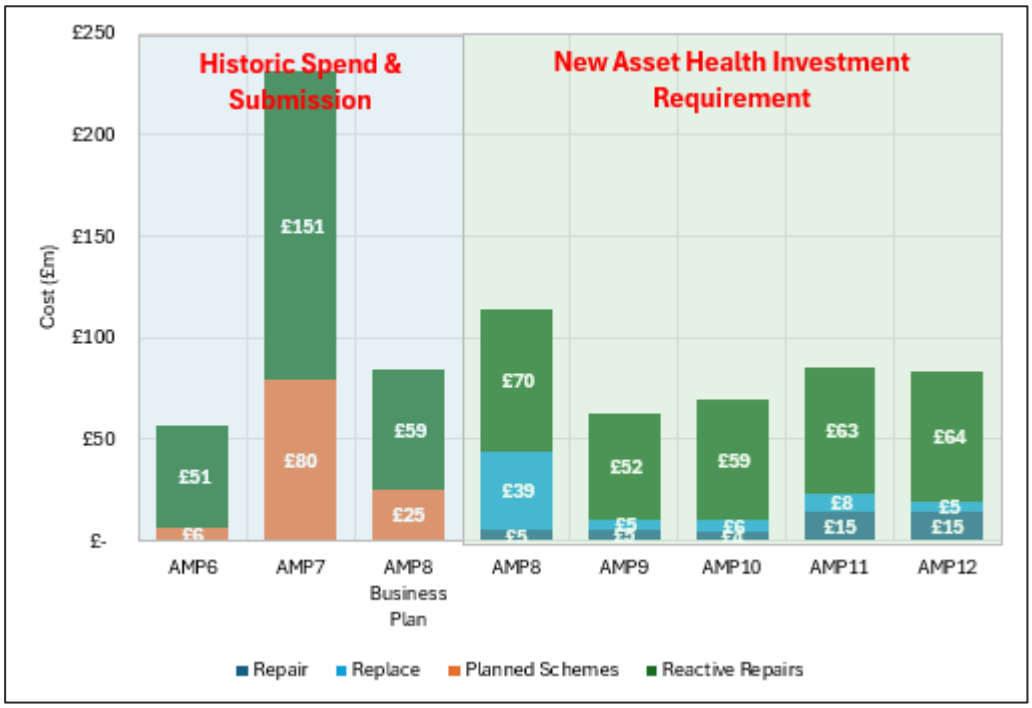


Figure 4: Asset Health Sustainable level of Botex investment profile

Forecasted outcomes from the 'sustainable level of Botex'

Figure 5 below demonstrates the impact of Average Age, and Average Effective Age (which considers the effect of Condition and Probability of Failure on Age) possible from the level of renewals achievable with a £114m investment package[1], as determined through Asset Health Modelling. This investment demonstrates a maintenance of effective asset age below maximum design life over the 25-year planning horizon and beyond (if the strategy is maintained), with a 2-year average reduction in effective age.

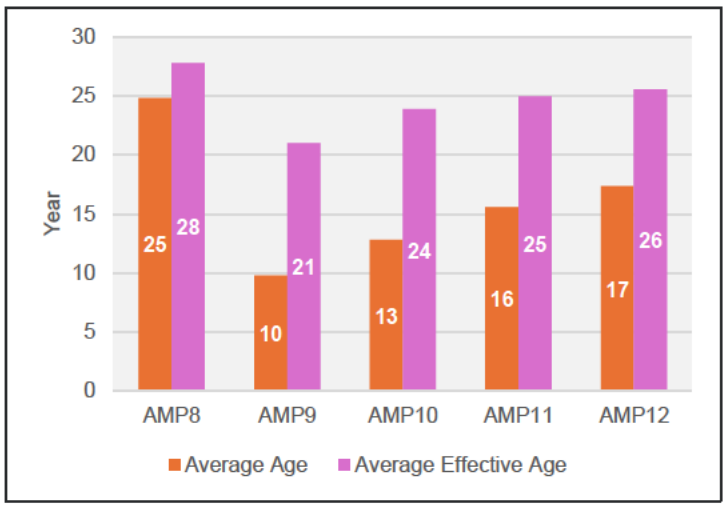


Figure 5: Outcomes on Asset Health from the Sustainable level of Botex

Using the same Asset Health methodology but with an investment level of £84m (proposed in the October business plan), would result in an increase of the average effective age of our Waste Pumping Stations, rising from 28 years at the start of AMP8 to 29 years in AMP9. More significantly, there would also be a net increase in the average failure rate across our Pumping Stations, rising to 3.9% (measured as average probability of failure of our WPS in the AMP) compared to the 2.75% achieved through a £114m investment package. Which demonstrates the material impact that the additional funding will have on the 'health' of our asset base. Delaying the critical investment needed to target the 62% of WPS above maximum design life will only compound the risks associated with an aged asset base and critical probabilities of failure and inevitably cause the cost of resetting Asset Health to be higher than if we address the problem as soon as possible.

We believe this provides us with an efficient long-term approach to manage our WPS asset base. The increase in base expenditure enables the delivery of the 29/30 pollution target of 77, alongside a step change in the effective age of the asset base and minimisation of failure rates to improve performance.

[1] Output from the Asset Health Model shown, model assumes that renewals 'reset' asset age to 0.

4.3 Rising Mains

4.3.1 AMP8 Asset Class Context

Performance of our Rising Mains, and specifically poor performance from failing assets, is an area of increasing regulatory and socioeconomic scrutiny. In AMP7 we invested heavily to curtail a trend of deteriorating pollution performance, a major component of which was the failure of our Rising Mains. This was a product of the degradation of our Rising Mains asset base and an increase in premature (pre-end of life asset) bursts.

This increase in expenditure, like with Waste Pumping Stations, was supported through an injection of shareholder funds to address a rise in reactive repairs, recover our pollution position and avoid further deterioration in our asset base. This resulted in a final AMP7 run rate of £97m, £75m more than our spending in AMP6 and a subsequent stabilisation of our rising mains failures performance (see Figure 6).

Through AMP7, we were able to curtail a deteriorating trend of rising main failures. We achieved this through significant reactive repairs, including targeted air valve maintenance and pump calming activity, which improves short-term performance. The level of repairs mean the short-term condition of the asset is improved to affect in-AMP performance, but this 'patch' repair is unlikely to prevent longer-term wear that is the significant factor behind poor asset health in our Rising Mains.

Whilst we have achieved a stabilisation of current performance. The failure of Rising Mains and resultant pollution performance remains off target. On the whole, Rising Mains failures increased from 45.2 average in AMP6 to 141 average in AMP7 (against a target of 255), and in 2023/24, failures from Rising Mains being the root cause of 12% of all 251 Cat1-3 pollutions.

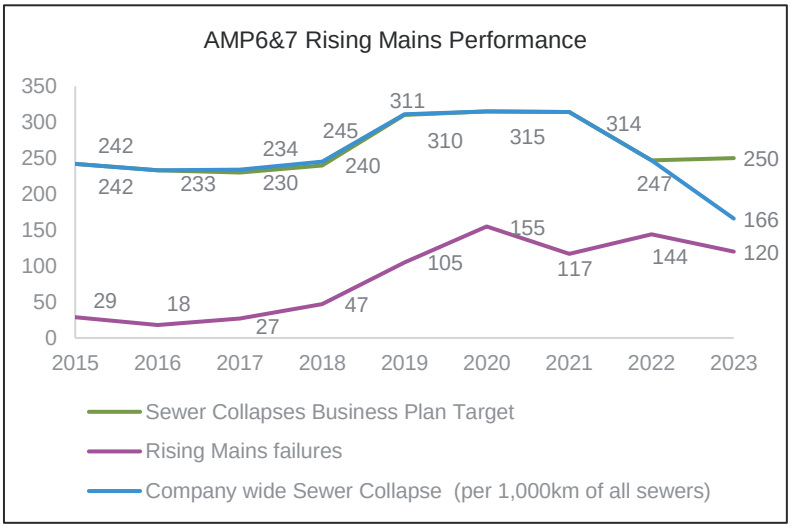


Figure 6: Historic performance of Rising Mains failures

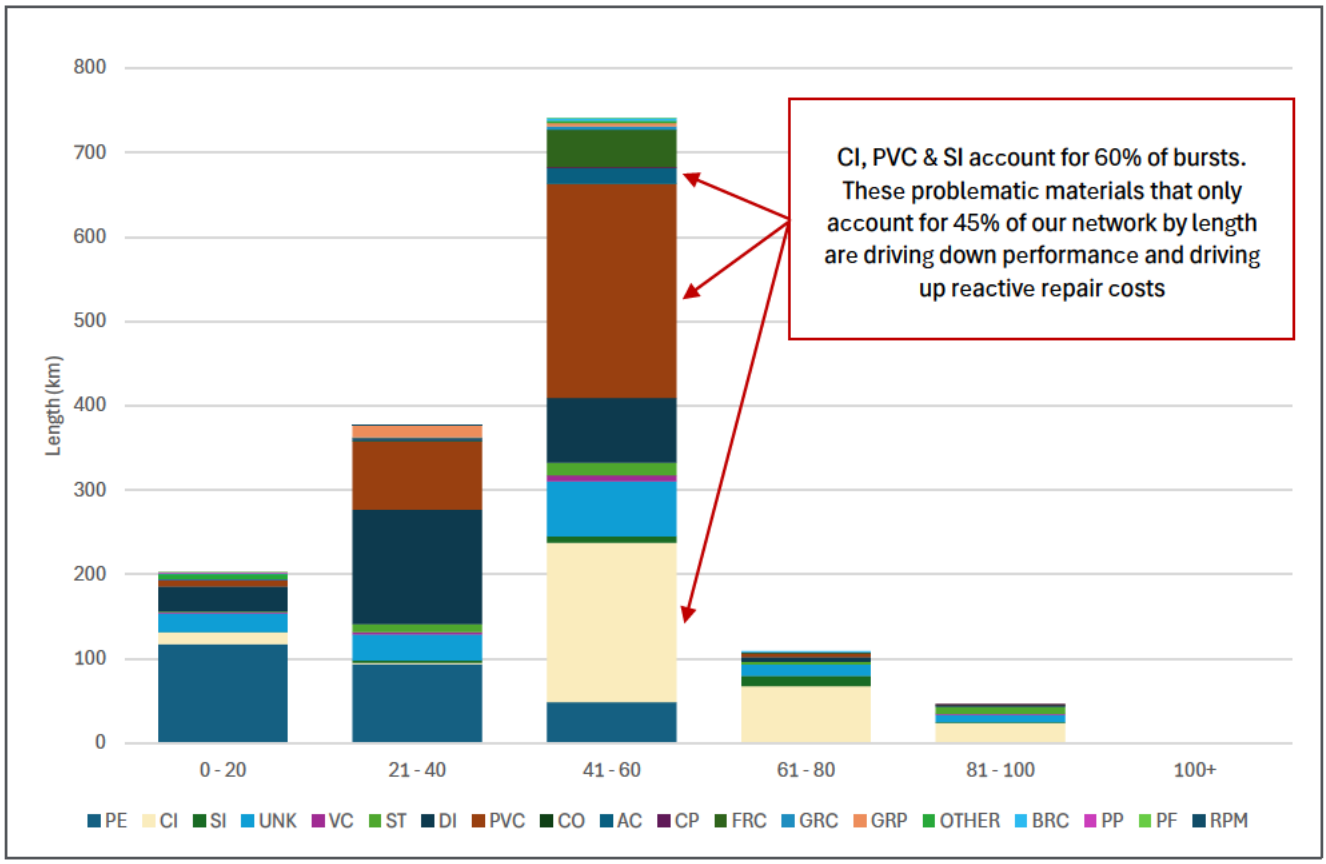
One of the primary causes of our rising main failures is a growing issue with failure in DI Rising Mains, and small diameter CI, SI and PVC mains. Which contribute over 60% of bursts, despite only being 45% of our total network by length (see Figure 7). Consequently, we have reviewed our approach to renewals and our previous assumption of 100-year maximum ages.

Our analysis shows that we have an impending 'bow wave' of PVC, SI and CI mains which are in the 41 – 60 age band, moving towards their maximum design life (these materials within this age band representing 30% of our total network by length, see Figure 7). If the current trend of premature bursts continues, especially without proactive intervention, we would expect to see a proliferation of failures in this, and future AMPs.

The heightened failure rates of these asset classes are accounted for in our Asset Health and Deterioration modelling, both of which predict greater levels of investment are required in AMP8 compared to our historical (pre AMP7) run rate, to reduce this risk with these main types. In AMP7, we renewed 0.5% of our Rising Mains by length (against a historic average of 1.3% per AMP from AMP4 onwards 2005 – 2020), as we had to divert significant expenditure to emergency reactive repairs of some of our large strategically important Rising Mains. And, as a result, we were able to deliver less of our planned mains replacement programme. In AMP8, both our Asset Health Model and Deterioration model predict that we need to increase this to 4% of our total Rising Main length to maintain our asset base over the course of the AMP.

All our evidence and analysis points toward the need for a change in approach for AMP8. This should be supplemented by a shift in our current asset management strategy, from a focus on the most efficient management of our existing Rising Mains, to a strategy that enables a greater level of proactive interventions to prevent inefficient bow waves of investment. From AMP7, we have observed that maintaining our current asset stock is insufficient way to manage our pollution performance, therefore we need to increase the level of prioritised investment in our high-risk mains tor turnaround performance.

Figure 7: Distribution of Asset material type by Asset Age



Asset Class Triangulation Results

Below in Table 7, we present our evidence sources and assessment of each against our sustainable investment requirements for Rising Mains, concluding that Asset Health provides the most appropriate evidence point for sustainable level of Botex.

Table 7: Summary of Sustainable Investment Requirement Results

	PR24 Botex Plan (£m/AMP)		£55
	Sustainable Botex (£m/AMP)		£85
	Evidence Source	£m/AMP	Assessment against AMP8 sustainable investment requirements
Historic cost analysis	AMP6 Run Rate	£22	In AMP6 our analysis showed that high levels of replacement investment were not necessary at the time, therefore our allowance was afforded to our higher priority operational risks in other asset classes, and therefore does not represent the new requirement. AMP6 low level of replacements is a factor in the positively skewed age distribution in AMP8.
	AMP7 Run Rate	£97	We invested shareholder funds to improve our Pollution performance, beyond what we deem to be a sustainable level. Primarily spending in remedial repairs and performance improvement schemes such as automatic resets, which are not optimum in the long term as they drive short-term performance and not asset health, the latter of which drives better long-term, overall performance and lower costs.
	AMP7 Exit Rate	£36 (£7/year)	As per AMP7 run rate above.
Predictive analysis	Asset Health Modelling	£85	**Sustainable level of Botex:** Long-term consideration of asset maintenance suggests relatively high level of investment compared to AMP6 levels, but a proactive strategy that will continue the improving performance trend at a long-term efficient cost. Asset Health Modelling provides a level of expenditure that represents a reasonable compromise with other evidence sources (i.e. Run Rate, and Deterioration Modelling)
	Deterioration Modelling	£79	Low level of confidence that this level of expenditure is required. The increase is, directionally, in line with other evidence sources, but suggests a level of expenditure far more than other methods.

Key	
	The limitations of this evidence source make this recommended level of investment not applicable.
	Some of the benefits of this evidence source are applicable and/or aligned to the priorities and/or strategy needed for this asset class in AMP8. However, some of the limitations of this source make it less applicable to the priorities and/or strategy needed. This evidence source can be used as a part of our triangulation.
	The benefits of this evidence source are highly applicable and/or aligned to the priority and/or strategy for this asset class in AMP8. This evidence source should be our main focus for the sustainable level of investment required and aligns well with our triangulation.

From the evidence presented thus far it is apparent that we need to address our assumptions on the maximum age of our Rising Mains, so that we intervene sooner to address premature failure of our mains. For AMP8 this means we need to accelerate the volumes of renewals we are doing, as well as running a greater amount of Rising main calming measures (through smart air valves and pressure controlling) in turn reducing the volume of reactive repairs and associated costs.

Determining the required sustainable funding level

We recognise that the AMP7 level of expenditure, primarily on reactive repairs, is not consistent with our approach to long term asset stewardship. Our analysis shows that our biggest areas of vulnerability in respect to bursts are Cast Iron (CI), Spun Iron (SI) and PVC (Polyvinyl Chloride) mains, which are facing significant deterioration.

Since October's business plan submission, we have used asset health-based analysis techniques to refine what the true long-term sustainable level of Botex is for Rising Mains.

Our asset health modelling demonstrates a clear and obvious need for additional investment in our Rising Mains, beyond the levels achievable through our Draft Determination Allowance.

We are requesting an increase of £30m above our PR24 Business plan (£85m total) to bring investment in line with Asset health modelling findings, and in line with the sustainable level of investment necessary to the maintenance of this asset class.

The investment profile below demonstrates the Asset Health based forecast of our investment need to achieve a stable effective age over the 25-year planning horizon. This asset health profile demonstrates that an uplift from PR24 Business Plan (based on current forecast) achieves an overall reduced profile in real terms, compared to historic levels over the following 4 AMPs. We have also considered whether this is the start of exponentially rising investment in Rising Mains, however this is not currently the case. This level of expenditure in AMP8 will allow us to 'get ahead' of a clear pattern of premature failures and ensure a smoother, less peaky level investment thereafter.

Using our Triangulation approach, we deem the Asset Health Modelling result to be the appropriate level of investment needed, because:

- Our Asset Health driven assessment suggests a greater level of investment is required than AMP6 levels but falls in line with Deterioration modelling requirements which recommend a 4.4% renewal of our Rising Main stock by length.
- The revised requirement provides sufficient funding for our bottom up built 'risk schemes' to address our most critical, high risk which will have a material impact on our pollution performance.
- It reduces expenditure compares to AMP7 levels yet provide enough allowance to target renewals and calming measures in our high probability of failure mains and those reaching end of life.
- The Asset Health investment profile (Figure 8) smooths investment over a 25-year planning cycle, avoiding inefficient or undeliverable programmes in future AMPs, and returns expenditure to levels of around a half of AMP7 levels.
- Increasing the number of renewals and network calming in AMP8 offsets deteriorating performance in our Rising Mains, which needs focussed investment to continue to return to the levels which our customers expect of us.

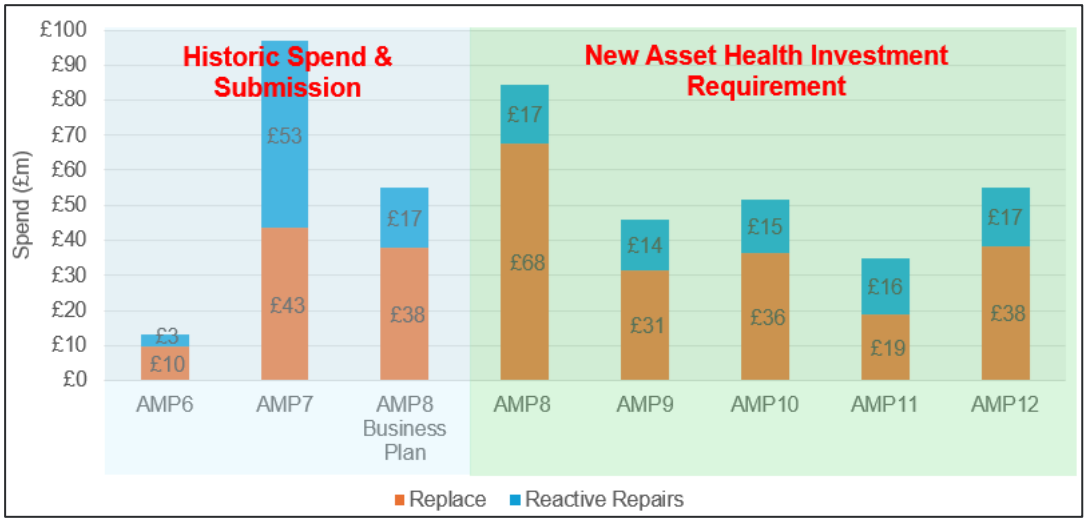


Figure 8: Asset Health Sustainable Level of Botex investment profile

Forecasted outcomes from the 'sustainable level of Botex'

As with Waste Pumping Stations, the investment strategy set out in this case achieves an equivalent effective age in AMP 12 as in AMP8. This approach maintains the current asset base at 'steady state' whilst allowing us to target our high-risk pollution areas and avoid inefficient or undeliverable requirements in any one AMP period.

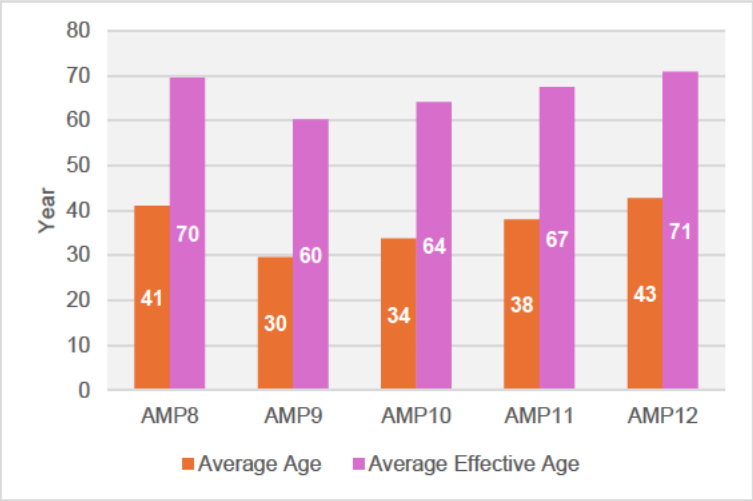


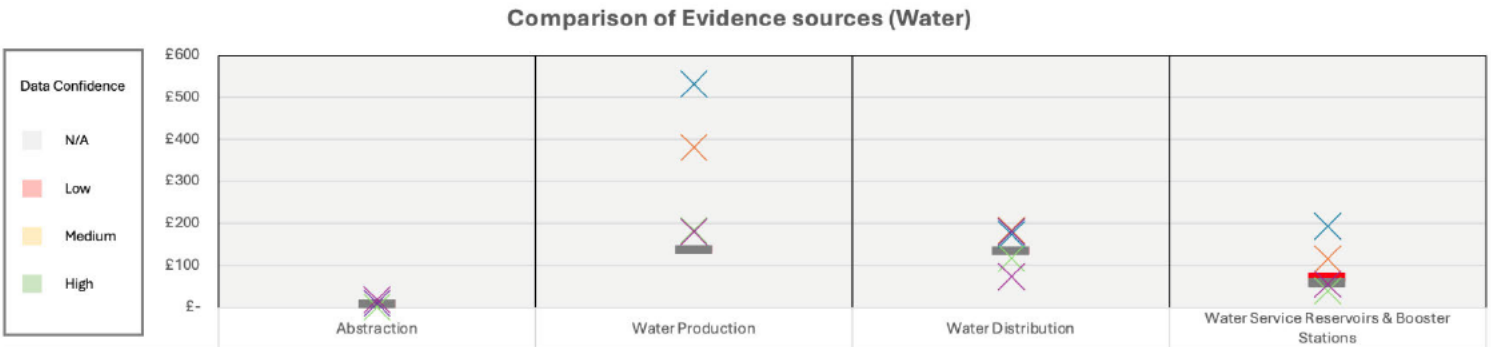
Figure 9: Rising Mains Asset Health Effective Age profile

Using the same Asset Health methodology with the PR24 Botex plan level of £55m, would result in an increase of the average effective age of our Rising Mains assets by half a year at the start of AMP8 to AMP9. In real terms this means there would be further deterioration of our Rising Main asset health, from which we would expect a corresponding increase in the number of Rising Mains failures and potentially serious pollution incidents. In comparison, with an £84m level investment (the 'Sustainable level of Botex') we see a reduction of 10 years in average effective age achieved in AMP8, a marked improvement from the £55m scenario, and in comparison a 2.5% reduction in the average probability of failure.

5. Wholesale Water Results

5.1 Comparison of evidence sources

The results of our assessments are displayed below. As with Wastewater Network +, our results show that for most asset groups, the 'recommended base expenditure' (red marker, 'Sustainable Botex Level'), remains in line with our October PR24 Botex plan (grey rectangular marker). These asset groups where the additional evidence does not identify the need for additional investment to undertake the activities described in our Botex plan (see Figure 10). Where the red marker is above the grey marker, we have evidenced a case for higher allowances in Section 5.2.



	Abstraction	Water Production	Water Distribution	Water Service Reservoirs & Booster Stations
Sustainable Botex Level	£10	£138	£137	£74
PR24 Business Plan	£10	£138	£137	£60
AMP7 Run rate		£381	£183	£115
AMP7 Exit rate (x5)		£532	£175	£194
AMP6 Run rate	£-	£185	£117	£40
Asset Health	£11		£181	
Deterioration Modelling	£19	£181	£73	£56

Figure 10: Wholesale Water Comparison of Botex Sources (values in £m, 22/23 prices)

Table 8: Asset Class Data Comparison

Asset Group	Evidence Commentary	Reference figure for Sustainable Botex Level
Abstraction	• Very good convergence of costs around PR24 Botex plan.	PR24 Business Plan
Water Production	• Very wide spread of costs from all data sources, with PR24 Business Plan representing the lowest source. Although this suggests high-cost uncertainty, this potential gap with DD allowances is addressed elsewhere in SRN-DDR-027: Supply Resilience Enhancement Programme	PR24 Business Plan
Water Distribution	• Moderate cost convergence, and new evidence using the Asset Health model aligns with current run rate expenditure and demonstrates a good correlation with the PR24 Botex plan figures. • The potential gap with DD allowances is addressed elsewhere through the Mains Renewal CAC, and WRMP Mains Replacement case SRN-DDR-028 Water Resources - Demand (Leakage) Enhancement Cost Evidence Case	PR24 Business Plan
Water Service Reservoirs & Booster Stations	• October PR24 plan falls in between AMP7 and AMP6 run rate levels currently, and run rate remains the most robust evidence base for these asset classes. However new WSR evidence suggests that additional uplift to our Botex plan is required to bring our requirement closer to the AMP7 run rate • AMP6 unlikely to be a good guide of AMP8 requirements due to the low amount of planned scheme expenditure over this period.	Run Rate (see Section 5.2)

We have identified areas where further investment is needed, due to the emergence of new asset health related evidence gathered since October '23. Our evidence warns that without further investment, there is a considerable risk to the performance of asset classes. These are:

- **Water Service Reservoirs** – We identified that an additional £14m level of investment is needed to account for rising repair and WSR inspection and remediation programme costs due to our aged asset base.

The evidence behind this requirement is set out in the following section. Where we:

- Set the context and evidence defining the AMP8 challenge for each asset class
- Define the level of sustainable Botex required using our triangulation points, and define why this is the appropriate long term sustainable level of Botex
- Set out the impact of the additional Botex requirement, compared to our PR24 Botex plan levels of expenditure.

5.2 Water Service Reservoirs

5.2.1 AMP8 Asset Class Context

We have a legacy of aging WSR's and on average, the oldest WSR's in the industry - operating half of the pre-1900 Brick & Masonry WSR structures in service today in the UK.

In AMP7, we set in place plans to rationalise our aging WSR asset base, through what we call the 'Network 2030' programme. This programme set out multi-AMP plans to decommission many of our oldest, highest risk reservoirs and rationalise into new larger WSR's. In doing so, reducing the risk of our WSR portfolio, and ensuring we can provide a safe, secure supply for our customers in a cost-efficient manner. This programme would also eliminate some of the issues we have historically faced, isolating, and inspecting our older single effective cell WSR's.

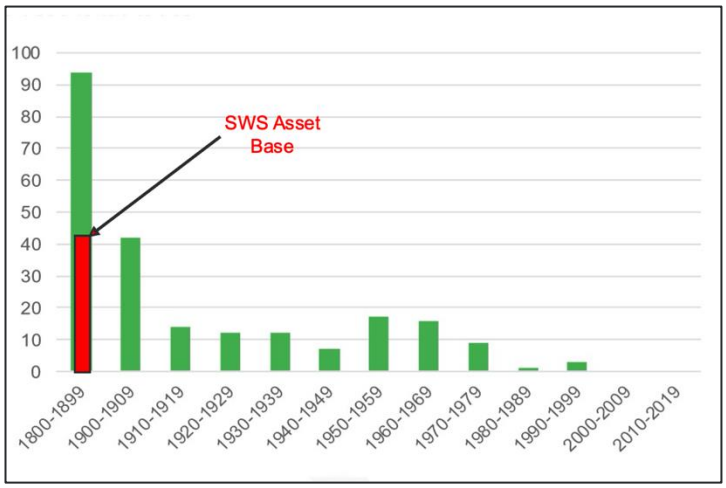


Figure 11: Comparison of Industry WSR age, ref: UKWIR 'Management of Treated Water Storage Assets' (2017)

Faced with challenging Botex allowances and affordability issues in AMP7, we reprioritised our Network 2030 Botex funding to critically important areas within our Wholesale Water business to address water quality challenges and our regulatory commitments to risk mitigation through Hazard Review (HAZREV). We saw the utmost value in continuing this programme of risk mitigation work that would provide continuity of supply to our customers and therefore utilised funds from our shareholders to continue to progress our HAZREV programme in AMP7 beyond what the allowances would have afforded. This has been part of the shareholder funded increase to planned capital investment for our water assets by c. £350m.

This additional expenditure allowed us to address critical water quality risks. But we are now at a point where we need to undertake large-scale network transformation (inclusive of WSRs) that we had planned through Network 2030, or face escalating operational and maintenance costs of our WSR's.

We still have long-term ambitions to rationalise our WSR asset base, and aim to replace, and decommission a total of 30 WSR's over the next 3 AMPs. However, this represents a multi-AMP transformation of our asset base, and in the absence of this programme we still have a legacy of aging WSRs that are prone to CRI risks such as ingress and require increasingly frequent repairs, inspection and cleaning to ensure continuity of supply for our customers. The impact is primarily seen in two ways: Our Run Rate of reactive remedial repairs, and the cost of undertaking our inspection and remediation programme.

Run Rate

Our 46 pre-1900 Victorian brick reservoirs especially require extensive and often costly repairs, and we have seen an increase in our overall requirement for repair work on our WSR asset base, primarily due to age related risks. The result of this continued 'patch' maintenance is that we have seen an exponential rise in our Botex costs since the start of AMP6.

In addition, we have a planned programme of large-scale capital maintenance improvement schemes on our existing Water Service Reservoirs, for critical improvements to the operational resilience at some of our strategically important Water Service Reservoirs such as [redacted], which we are using our Botex allowance for in AMP7 (and not delivered through conditional allowances). Which, due to deliverability challenges and challenges of delivery within our current AMP7 allowances, (as we prioritised the delivery of HAZREV schemes at our greatest risks operational areas, as mentioned above) means that we are delivering these schemes now, late into AMP7 (see inflated exit rate in Table 9). These schemes must be complete and are likely to carry over into AMP8 and have a resulting impact of reducing our actual available AMP8 Botex expenditure to undertake our capital maintenance activity in AMP8. We expect the 'carry over' of these strategically important renewal schemes to amount to £25m of expenditure in AMP8.

Inspection and Remediation Programme

Older WSR's need closer and more frequent inspection, to mitigate the risk of structural or Water Quality issues to maintain our CRI compliance and maintain a clean, high-quality supply of water for our customers. They also often

require more intrusive and complex enabling works due to outdated designs and the lack of available alternative storage.

Our statutory WSR inspections and remediation are prioritised based on a risk-based framework which we agreed with the DWI, which considers a range of factors which impact Water Quality risks (including age) to inform how frequently we must undertake our inspections.

Our aging WSR base requires more frequent inspection and remediation to ensure quality of supply. Often requiring more intrusive and complex enabling works due to outdated designs and the lack of available alternative storage.

Our statutory duties now mean that each reservoir requires more in-depth planning and sometimes enabling work to take out of service (to manage health and safety and security of supply risks), which results in an increase to the cost of our inspection and remediation programme.

Table 9: WSR Inspection Frequency totals

Inspection Frequency	Sites
Yearly	9
Every 3 Years	206
Every 5 Years	132

Furthermore, we are now finding more issues upon inspection than we were at the start of AMP7. For Years 1 – 4 this AMP on average only 11% of the WSR's we inspected we found signs of ingress, this has since risen to 41% this year, another product of our aging asset base. These assets need immediate remedial repairs and are out of service for longer and are further increasing our run rate costs. As a result, we currently have 17 WSR's out of service due to issues found during inspection, against a normal level of 10 out of service at any given time. Meaning that we have had to temporarily pause our AMP7 WSR cleaning programme whilst we undertake these reactive remedial repairs.

Asset Class Triangulation Results

Below in Table 9, we present our evidence sources and assessment of each against our sustainable investment requirements for Water Service Reservoirs. Concluding that updated run rate estimates provide the most appropriate evidence point for sustainable level of Botex.

Table 10: Summary of Sustainable Investment Requirement Results[2]

	PR24 Botex Plan (£m/AMP)		£58.5
	Sustainable Botex (£m/AMP)		£74
	Evidence Source	£m/AMP	Assessment against AMP8 sustainable investment requirements
Historic cost analysis	AMP6 Run Rate	£40	Low level of Botex allowances in AMP6 correlated with low level of performance and lack of major programmes
	AMP7 Run Rate	£115	Progressive increases in run rate costs shown on reactive repairs as well as a step increase in inflated costs from planned schemes have been effective in managing our CRI risk
	AMP7 Exit Rate	£195 (£39/year)	Delays from planned schemes have inflated significant costs, which are likely to carry over into AMP8 but will represent the 'baseline' Run Rate for early AMP8
Predictive analysis	Asset Health Modelling	-	Asset data does not support a deep dive asset health assessment at this time.
	Deterioration Modelling	£56	Deterioration modelling broadly supports the original PR24 Botex plan but does not account for changing statutory requirements, nor the carryover of schemes from AMP7.
	Performance Schemes	£37	Does not consider wider CAPEX base expenditures outside of performance schemes, however used to inform additional investment requirement in relation to PR24 business plan submission.

Key	
	The limitations of this evidence source make this recommended level of investment not applicable.
	Some of the benefits of this evidence source are applicable and/or aligned to the priorities and/or strategy needed for this asset class in AMP8. However, some of the limitations of this source make it less applicable to the priorities and/or strategy needed. This evidence source can be used as a part of our triangulation.
	The benefits of this evidence source are highly applicable and/or aligned to the priority and/or strategy for this asset class in AMP8. This evidence source should be our main focus for the sustainable level of investment required and aligns well with our triangulation.

Determining the Sustainable level of Botex: unlike Waste Pumping Stations and Rising Mains the 'Sustainable Botex' is not directly derived from any one the triangulation methods above. Instead, it is based on a revised forecast for the AMP8 reactive repairs (encompassing 'Patch repairs' and inspection requirements) is due to the findings from our inspection programme, which determined that a greater number of remedial repairs will be required than previously forecast, to maintain this asset class in line with regulatory requirements and quality standards. As this inspection data is still emerging, the current and historic run rate remains our best guide to the sustainable level of Botex, rather than modelling approaches.

The approach set out in this paper allows us to continue to focus efforts on repairs, maintenance, and inspection of our existing WSR asset stock to safeguard against CRI risk today.

[2] All figures quoted here are for Water Distribution Non-Infra, and therefore include both Water Service Reservoir costs as well as Water Booster Stations

Determining the required sustainable funding level

We have seen progressive increases in our capital maintenance expenditure to maintain our aging asset base. Through our run rate analysis, we recognise a need for an uplift of £14m to be able to continue repairs on our aging WSR stock to maintain our existing WSR's and undertake our statutory inspection programme whilst maintaining a low risk level for our customers.

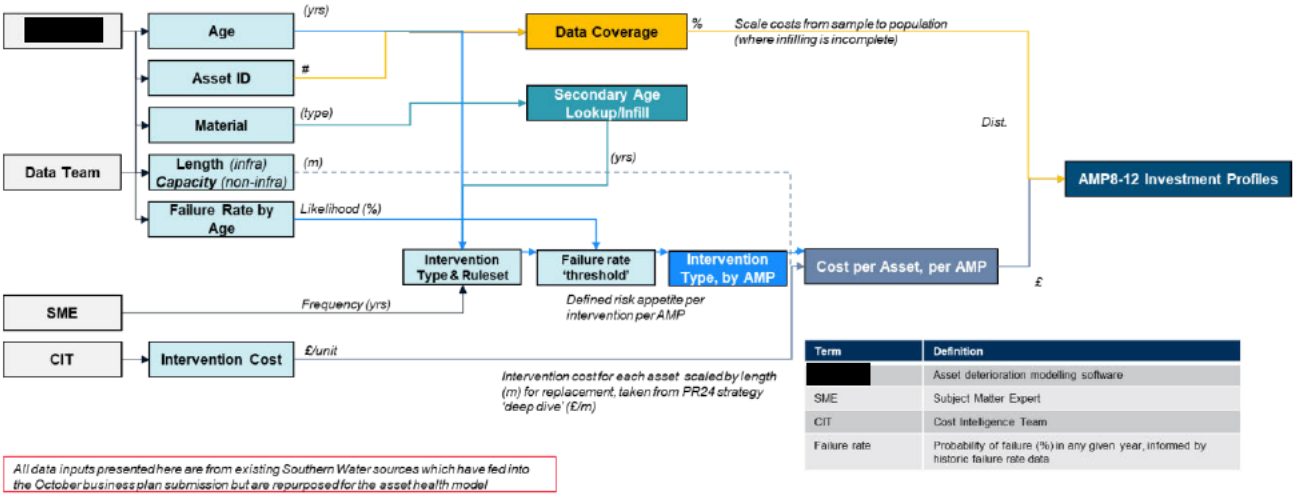
Our Oct-23 submission was based on our historic run rate. However, our analysis since October has shown that the last two years of spend have exponentially increased due to a compounding of risks and challenges that we will expanded on above. Our revised Botex submission aligns closer to our most recent run rate (£115m in AMP7 and £23m/year), that will allow us to continue combating critical risks and complete the carry-over of non-ordinary, large investments such as the repairs at [redacted].

As part of our continued focus on proactive maintenance of our WSR asset base, our planned Capital Maintenance programme aims to deliver critical renewals at a further 6 Water Service Reservoirs in AMP8, including Andover WSR, Fairlight Old WSR, Itchingfield WSR, Queens Park road WSR, Rake WSR, Shoreham WSR (with an average age of 98 between these WSR's)

Therefore, we require elevated levels of Botex to manage our existing WSR base and avoid an intolerable level of CRI risk for our customers. This means we are requesting an additional £14m (£74m total for WSR's and Booster stations) which will allow us to: Undertake our 1, 3, 5 inspection programmes to the new statutory requirements; address the forecasted large volume of patch repairs, building on top of our existing liming removal and membrane replacement programme; complete the carryover of AMP7 planned WSR maintenance schemes.

6.0 Asset Health model logic and assumptions

Figure 12: Model logic



Term	Definition
[redacted]	Asset deterioration modelling software
SME	Subject Matter Expert
CIT	Cost Intelligence Team
Failure rate	Probability of failure (%) in any given year, informed by historic failure rate data

Figure 13: Model Assumptions

Data Inputs summary

To run our asset health models, we have collated a series of data inputs including data from existing platforms and inputs pre-determined by our SMEs. The following inputs in the table below feed into our overall model methodology.

#	Assumption	Relevant asset classes	Dependencies / Risksre
1	The rate of intervention is equivalent to the proportion of assets beyond intervention requirements and assets above the probability of failure threshold (the failure rate for the asset age).	All	Probability of failure threshold acts as a proxy for risk appetite. Probability to be determined on an asset class basis.
2	Age is split into 5 bands to be consistent with condition banding. The band ranges will be consistent across all asset classes and will be: Band 1 - 0-20% of max age Band 2 - 21% - 40% of max age Band 3 - 41% - 60 % of max age Band 4 - 61% - 80% of max age Band 5 - 81 % - 100% of max age This will be used to determine the basis for interventions Note: the maximum age is determined from MED specifications for that asset class.	All	Banding age in equal size bands may misrepresent the total distribution of ages throughout the asset population.
3	If in one AMP period a Replacement is due, then no other interventions will happen within that same AMP period (i.e. Replacement overrides Repair & lining).	All	The asset intervention requirements to be determined based on historic data.
4	Where age data is not known, but material type is, the average age of that material type will be used as a proxy	Infrastructure only	Large proportion of age data gaps result in many asset's having the same assumed age. This has caused clumping of a higher proportion of assets to be promoted for intervention at the same time.