



Dŵr Cymru
Welsh Water

Enhanced Investment
Case:
WSH52-CW04 –
Working towards a Lead-
Free Wales

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Executive Summary

This investment will improve water quality and reduce the health risks associated with lead in drinking water. Our investment within AMP 8 moves us towards the goal of halving the number of lead pipes within our network by 2050, as we continue our journey to an ultimately lead-free Wales.

We have structured this document using the enhancement assessment criteria set out in section A1 of Appendix 9 (Setting Expenditure Allowances) in the PR24 final methodology. The enhancement assessment criteria are divided into four criteria groupings:

- need for enhancement investment (5 sections);
- best option for customers (4 sections);
- cost efficiency (2 sections); and
- customer protection

Need: Lead pipes were used until c1970 to connect households to our water distribution network. Since this time, research into lead and its effects on human health when consumed, even in trace amounts, showed detrimental impacts to human health and in particular children's mental development. The use of lead pipes was prohibited in the 1970s, but the majority of existing assets remain today.

Infants and children are most vulnerable to the adverse effects of lead and there is evidence that this vulnerability increases for those living in poverty. One of the main objectives of the AMP 8 strategy is to ensure that, where possible, lead pipe renewals carried out in this period will mainly benefit those most vulnerable. The AMP8 strategy includes the development of a model that combines poverty and age profile statistics with supply pipe data to identify post code areas where lead pipe renewals would be most health beneficial and cost effective. This evidence-based approach will support the delivery of lead pipe renewals for vulnerable Dwr Cymru Welsh Water (DCWW) customers in AMP 8.

It is not feasible to replace all lead pipes immediately (we currently estimate we have around 150,000 of each communication pipes and external supply pipes within our network as reported in the 22/23 APR submission) so we, like many other water companies, create environments that minimise the leaching of lead from the pipes into the water supply, typically by dosing ortho-phosphate at our water treatment works (WTWs). However, while this is a relatively simple to implement solution it does not eliminate this risk, and its sustainability in future is questionable as standards tighten and with phosphate being a valuable and finite resource.

We continue to update our model of lead pipes within our network, identifying those at highest risk and prioritising replacements. The Drinking Water Inspectorate has indicated support for this programme for AMP8.

Options: Our lead replacement strategy continues to evolve based on previous investment periods. Our approach to pipe replacements is three-fold.

- Part 1a: Opportunistic Identified Renewals – replace when a lead pipe is identified during routine reactive or proactive maintenance. For example, we would not make a leak repair on a lead pipe but would instead replace it.
- Part 1b: Targeted Identified Renewals – based on our lead predictor model, populations of higher risk, and potential lead non-compliance. To work with stakeholders in the Water Health Partnership to identify housing improvement initiatives in low-income areas in Wales where Welsh Water could collaborate to provide cost effective lead pipe replacement. ~5,000 pipes replacements combining Part 1a&b.
- Part 2: Pilot trial – an “island zone” has been identified where if we replace all the lead pipes within the zone, we can decommission the phosphate dosing at the supply treatment works. ~300 pipes replacements
- Part 3: offer a grant scheme to support customers who require additional support to replace lead supply pipes independently. ~2,200 pipes replacements

What We Will Deliver: This Enhancement Case will deliver 7,500 lead communication and supply pipe replacements within our water distribution networks. Included in this figure is the provision of 2,200 grants for customers wishing to replace their external supply lead pipework.

Efficient Costing: We will invest £15M (post efficiency, 22/23 price base) to replace 7,500 lead pipes within our network. Our costs are based on historical data for this high volume, low cost, low risk, activity.

It is noted that customer can be reluctant to replace their supply line (scars through drives, or gardens etc, impact to fitted kitchens) we are to trial a grant system where we contribute to the overall replacement.

Customer Protection: This will be ringfenced through a price control deliverable (PCD) linked to the volume of work delivered.

Benefits: The investment will improve the quality of tap water, reduce health risks to the most vulnerable and provide valuable data for future investment cycles as we progress to a lead-free Wales.

As lead pipes have a remaining life but are not acceptable for Water Quality reasons, all lead pipe replacement will be counted within this investment case as enhancement.

Our approach has been independently assessed by Jacobs (Engineering and Costs) and Economic Insight (CBA).

1. Introduction

This Enhancement Case will continue the investment in replacing lead pipes for the last two AMP periods. We will enhance this approach by targeting vulnerable customers, reducing health risks, and improving confidences in quality of water supplied.

This Enhancement Case comprises of Replacement of lead communication and supply pipes within our network. Part of a long term programme, designed to support Welsh Government ambition of 'a lead free Wales'.

7,500 lead (communication and supply combined) pipe replacements: £14.804M (Enhancement).

This enhancement investment will also identify, test, and develop innovative solutions to lead pipe identification and replacement that will improve cost efficiency and maximise benefits for customers. The findings will be fed into the following AMPs.

The benefits of these investments are directly realised by our customers, as their water quality will improve, and the health risks associated with lead will be reduced.

Although lead naturally occurs in waters around the UK, the water leaving our treatment works readily meets the lead standard of 10 µg/l. However, the compliance point is at customers taps and this can then fail the standard due to lead dissolving into the water as it passes through lead pipes between our water main and the taps in customers' homes. Historically (up to the 1970s) lead pipe was used to connect water mains to customers properties. Since this time studies have revealed that lead in water can harm human health and is particularly damaging to children whose mental development may be impacted. In response UK and Welsh Government have published legislation to manage exposure to lead in drinking water. Companies have responded by removing lead pipes from the network when they are excavated as part of mains renewal, or when customers water quality fails the lead standard. Due to the nature of our raw waters being so soft we have previously had to invest in phosphate dosing equipment at WTW which reduces the rate at which lead will leach into water. These changes have produced significant benefits but have not fully removed the risk of lead failures and are not regarded as a long term solution.

The diagram below taken from our customer information material shows the communication pipe owned by Welsh Water between the main and the customers property boundary, the supply pipe (owned by the customer) linking the communication pipe to the property and the internal pipework within the property. Communication pipes, supply pipes and internal pipework can all be made of lead. We are accountable for the communication pipe, but as set out below we will also look to replace supply pipes and provide information to customers to help them manage their internal pipework.

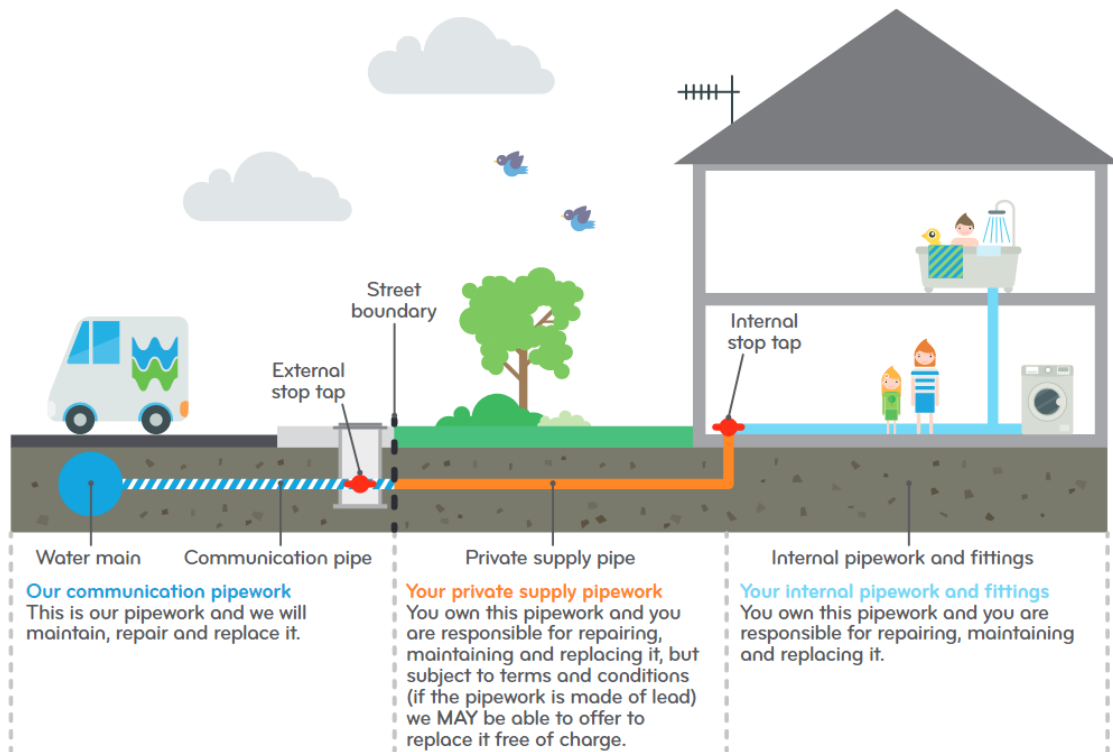


Figure 1: Welsh Water network descriptions, and likely locations of lead pipe work and fittings.

The lead communication pipe will be replaced, and customers will be offered supply pipe replacement up to the internal stop tap as shown below.

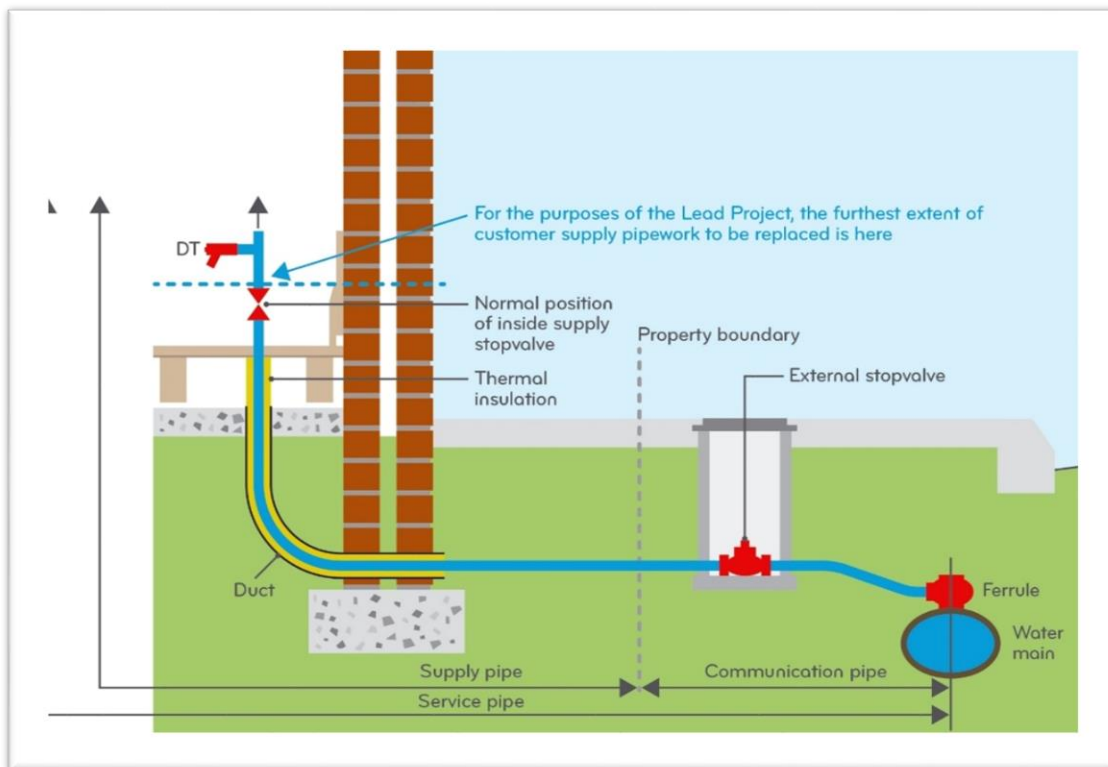


Figure 2: Supply pipe replacement

To comply with Water Supply (Water Quality) Regulations 2018 and the Water Supply (Water Fittings) Regulations 1999, we aim to replace at least half of lead pipes and fittings by 2050 and encourage all suppliers to use lead free materials.

Legislation, Policy and Strategy Specific to Wales

The societal health benefit of reducing lead exposure is recognised by a range of organisations in Wales and supported by several initiatives:

Table 1: List of key organisations in Wales supporting lead replacement initiative

Key Policies & Visions	Excerpt / Summary
The Wellbeing of Future Generations Act 2015	<p>...“Requires public bodies in Wales to think about the long term impact of their decisions, to work better with people, communities and each other, and to prevent persistent problems such as poverty, health inequalities and climate change”</p> <p>Gives a legally-binding common purpose – the seven well-being goals– for specified public bodies to improve the well-being of Wales. They provide a focus for any strategy development on water and health issues and delivering a lead-free Wales will meet five of the seven well-being goals (Figure 3)</p>
Welsh Government Strategy for Wales 2015	<p>Recognises the issue of lead in drinking water and stated the aim to “<i>keep exposure to lead as low as reasonably practicable therefore we will consider management options to reduce exposure to lead and related health effects</i>’.</p> <p>Recognises that phosphate resources are limited and that it “<i>does not remove the long term risks from lead pipe and fittings</i>” and that it has “<i>consequences for sewage treatment and water pollution</i>”</p> <p>WG will “<i>work with DWI, water companies and others to investigate best practice and options for addressing the risk of lead leaching into water supplies</i>”</p>
Public Health Wales	<p>Public Health Wales are UK leaders on the surveillance of Lead levels in blood and on implementing measures to identify and reduce lead exposure that includes assessing the contribution from drinking water that has passed through lead pipes.</p>
Welsh Water 2050	<p>The challenge: <i>‘to become a truly world class, resilient and sustainable water service for the benefit of future generations’</i></p> <p>18 Strategic Responses to meet this challenge including ‘<i>Towards a Lead-Free Wales</i>’ :</p> <p>...<i>‘We have the opportunity to help improve public health and propose a targeted replacement of lead communication and supply pipes, as part of a wider societal effort to address lead in drinking water.’</i></p> <p>Contains key commitments, which will begin to be delivered through AMP7 and align with FGA wellbeing goals:</p> <p>...<i>“A resilient Wales.....The phased replacement of lead piping, initially targeting the most vulnerable and those with the least ability to pay will help to promote health amongst all customers, equally”</i></p> <p>...<i>“A more equal Wales.....Reducing the health effects associated with lead piping will help to improve the health of Welsh Water’s customers”</i></p>

<https://www.dwrcymru.com/en/Company-Information/Business-Planning/Welsh-Water-2050.aspx>

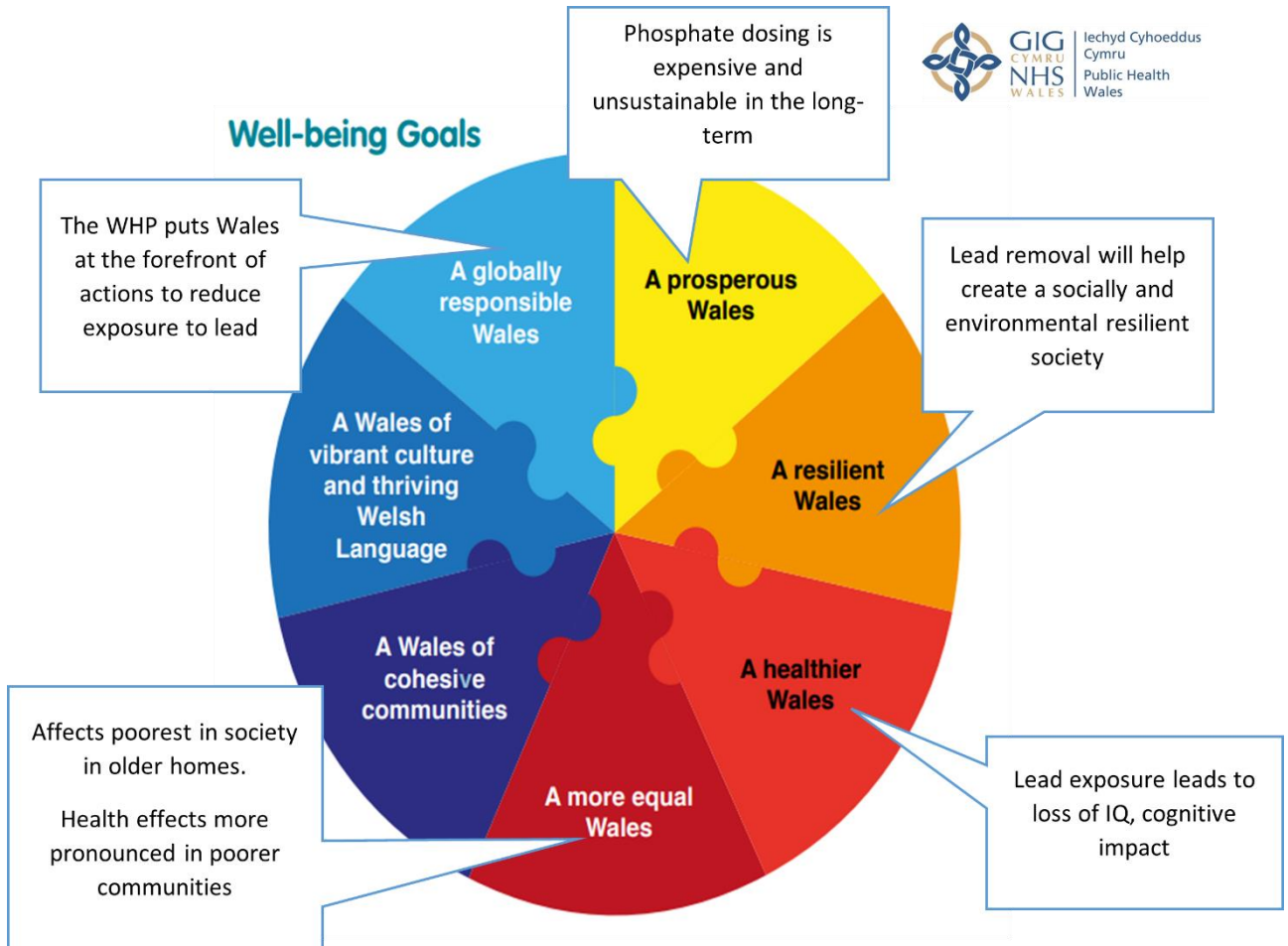


Figure 3: Well-being Goals

The Water Health Partnership for Wales

The Water Health Partnership for Wales (WHP) brings together public health professionals to work on issues related to water and health. The scope includes private and public drinking water supplies as well as recreational waters. The main aims of the partnership are to keep up to date on emerging issues and to work together to share information and develop strategies to protect public health. It involves all the responsible organisations in Wales and Herefordshire.

Membership is free and is open, by invitation, to anyone working in water and health-related roles. Although the partnership receives modest financial support from Welsh Water, to hold meetings and an Annual Conference, it is the voluntary contribution of colleagues from participating organisations that enables the Partnership to deliver on its strategic aims.

A Steering Group with representatives from each organisation meets quarterly with for the purpose of providing clear leadership and strategic direction for the Partnership.

- Facilitating communication between members.
- Initiating events, training, etc.
- Raising awareness of water-related health issues.
- Sponsoring and monitoring the work of Task and Finish Groups (T&Fs).

The membership of the Partnership includes a range of organisations with the following actively participating in the work of the Steering Group and Task and Finish Groups:

- Consumer Council for Water, Wales
- Drinking Water Inspectorate
- Dŵr Cymru Welsh Water
- Food Standards Agency
- Hafren Dyfrdwy
- Natural Resources Wales
- Pembrokeshire County Council
- Powys County Council
- Public Health England - CRCEH
- Public Health Wales
- Swansea Council
- Welsh Government
- Water Regulations Approval Scheme

1.1 Structure of this Document

We have structured this document using the enhancement assessment criteria set out in Ofwat's PR24 Final Methodology, Appendix 9 (Setting Expenditure Allowances), Section A1.1:

ID from Appendix 9	Abbreviated Assessment Criterion	Addressed
A1.1.1 Need for enhancement investment	a Is there evidence that the proposed investment is required?	Section 2.1
	b Is the scale and timing of the investment fully justified?	Section 2.1
	c Does the proposed investment overlap with Base Maintenance activities?	Section 2.2
	d Does the need and/or proposed investment overlap/duplicate with previously funded activities or service levels?	Section 2.3
	e Does the need clearly align to a robust long term delivery strategy within a defined core adaptive pathway?	Section 2.4
	f Do customers support the need for investment?	Section 2.1
	g Have steps been taken to control costs, including potential cost savings?	Section 2.5
A1.1.2 Best option for customers	a Have a variety of options with a range of intervention types been explored?	Section 3.1
	b Has a robust cost-benefit appraisal been undertaken to select the proposed option?	Section 3.1
	c Has the carbon impact, natural capital and other benefits that the options can deliver been assessed?	Section 3.2
	d Has the impact of the proposed option on the identified need been quantified?	Section 3.2
	e Have the uncertainties relating to costs and benefit delivery been explored and mitigated?	Section 3.3
	f Where required, has any forecast third party funding been shown to be reliable and appropriate?	Not applicable to this case
	g Has Direct Procurement for Customers (DPC) delivery been considered?	Please refer to WSH50-IP00 Our Approach to Investment Planning (Section 3.4.1)
	h Have customer views informed the selection of the proposed solution?	Please refer to Stepping up to the Challenge: Business Plan 2025-30 (Section 2.2)
A1.1.3 Cost efficiency	a Is it clear how the company has arrived at its option costs?	Section 4.1
	b Is there evidence that the cost estimates are efficient?	Section 4.2
	c Does the company provide third party assurance for the robustness of the cost estimates?	Section 4.1
A1.1.4 Customer protection	a Are customers protected if the investment is cancelled, delayed or reduced in scope?	Section 5.1
	b Does the protection cover all the benefits proposed to be delivered and funded?	Section 5.1
	c Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments?	Not applicable to this case

2. Need for Enhancement Investment

This section will set out the drivers behind the Enhancement Case and describe the context within which it has arisen.

We describe the health risks to our customers posed by the presence of lead pipes and the reasons (outside of managements control) why we have lead pipes in our network. The need to invest in AMP8 is quantified by legislative compliance, driven by consumer health. We set out overlaps with our Base Maintenance programme, which we have examined and removed from the Enhancement Case and give confidence that past allowances have been effectively invested.

The proposed investment aligns with our long term delivery strategy – responding to the need for long term stewardship and improvement in service.

2.1 Evidence that Enhancement is Needed

Is there evidence that the proposed enhancement investment is required?

Is the scale and timing of the investment justified?

Where appropriate, is there evidence that customers support the need for investment?

– Ofwat’s final methodology for PR24, Appendix 9, A1.1.1a, A1.1.1b and A1.1.1f

Schedule 1 of the Water Supply (Water Quality Regulations) 2018 present the Prescribed Concentrations and Values (PCV) for metals in tap water.

The PCV for lead is currently 10 µg/l measured at the consumers’ tap.

This standard has tightened through time:

- In December 1998, the PCV for lead was halved from 50 µg/l at the consumers’ tap to 25 µg/l because of EU Directive (98/83/EC).
- In December 2013, the EU then adopted the new WHO quality standard for lead in drinking water of 10 µg/l.

The standard is expected to tighten further: Given the latest advice from WHO and EFSA, the present recast of the EU Drinking Water Directive proposes a further halving of the drinking water standard for lead to 5 µg/l in the next decade. To align with WHO advice and the future anticipated value we have set an internal target of 5 µg/l.

Water companies are required to achieve the lead standard by whatever means; the legislation does not prescribe how this should or could be done. Guidance published by the DWI in September 2017 (Drinking Water Inspectorate, 2017) states that water companies are expected to implement risk-based strategies to achieve compliance with the lead standard.

Companies are expected to identify an ‘appropriate integrated package of measures to mitigate any risks identified’.

Welsh Specific legislation – Wellbeing of Future Generations Act 2015 - refers to working towards a Lead-Free Wales, this has gone beyond standards set in England where they have not made any similar commitments. As well as assessing the risk of drinking water lead exposure to consumers for each water supply zone, the Guidance requires the package of measures to include a mixture of direct actions to control lead exposure in the supply network and approaches to protect and safeguard consumers that are at most risk from the effects of lead.

DWI are supportive of the approach to replacing lead pipes. They have indicated through our presentation of PR24 plans that our ambition should be greater and would not be satisfied with a lower level of spend or pipe replacement than we proposed at PR19 for the present AMP. The nature

of this investment means that a Notice is not the appropriate tool for the DWI to support this investment but have indicated overall support for our AMP8 programme.

2.1.1 Evidence of Customer Support

Our approach to customer engagement is set out in Stepping up to the Challenge: Business Plan 2025-30 (Section 2.2).

Customers are generally supportive of investment to improve water quality.

2.1.2 Scale and Timing of Investment

In keeping with the guidance “water companies are expected to implement risk-based strategies to achieve compliance with the lead standard”.

To continue our investment levels from AMP7 into AMP8, move us towards the long term position agreed with stakeholders and to respond to likely tightening of the lead standard there is a need to continue the pro-active replacement of lead pipes.

Throughout AMP 8 we are to continue with opportunistic replacements during maintenance tasks, but also within this investment period we will utilise and improve our lead prediction model that prioritise the highest risk consumers and infrastructure. A grant scheme for customers reluctant to replace supply pipes due to cost of remediation and to trial a lead free WQZ are also included.

This AMP investment aligns with our long term goal of a lead-free Wales, which aims to have replaced 100,000 lead pipes by 2050 and will further guide the implementation and costing of future investment periods. To meet this target, it is acknowledged that lead replacement rates will need to increase significantly in the subsequent AMP periods leading to 2050.

The enhancement activities to be delivered are based on a three-pronged approach outlined in Table 2 below which has been established from our wider long list of options:

Table 2: Lead pipe replacement approach

Area	Description	Lead Renewals
Part 1a – Opportunistic Identification Renewals	<p>Continuing the delivery of lead pipe renewals:</p> <ul style="list-style-type: none"> ○ Identified in the ground e.g., from ongoing repair and maintenance works through local depots or through lead water quality failures; and, [e.g. from boundary box installation] ○ When customers identify lead pipes and request support. 	Circa 5,000
Part 1b - Targeted Identification Renewals	<p>Based on the improvements in data assessment (namely the Lead Predictor Model, GIS supply pipe length assessments and post code area vulnerability assessments), commercial assessments and practical delivery a programme can be developed with a focus on whole streets / post codes to renew lead that would present an opportunity for efficiencies.</p> <p>Build on engagement with the Health Partnership for Wales and Social Housing Organisations throughout AMP7 to build a programme of work targeting vulnerability within Social Housing throughout AMP8.</p>	

Area	Description	Lead Renewals
	Our ambition is to investigate 10% of all Social Housing in Wales which we believe to be circa 23k properties.	
Part 2 – Pilot Trial Programme	In 2022, 95% of customers supplied by Welsh Water received phosphate dosed drinking water. In line with our ‘2050 Lead Free Wales’ vision, conducting pilot trials in discreet areas informed by vulnerability information and data to pave the way for understanding how such an ambitious target can be reached.	Circa 300
Part 3 – Grant Scheme	Through learning at AMP7, an opportunity has been identified offer a grant scheme to support customers who require additional support to replace lead supply pipes independently. Further learning would need to be taken from a small trial to better inform potential larger schemes for future AMPs.	Circa 2,200

2.2 Overlap with Activities to be Delivered through Base

Does the proposed enhancement investment overlap with activities to be delivered through base?

– Ofwat’s final methodology for PR24, Appendix 9, A1.1.1c

The activities assigned to the Enhancement Case will be above and beyond those already delivered in base. Typically, a Base Maintenance activity will be any lead pipe repaired as part of a leakage job. Any lead pipe replacement will be classed as enhancement spend and be counted against our target as typically, they would have a considerable remaining life.

We will continue to dose phosphate into our at-risk water quality zones to manage the short to medium term risk of lead pipes. This activity will continue from our Base Maintenance.

2.3 Overlap with Funding from Previous Price Reviews

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

– Ofwat’s final methodology for PR24, Appendix 9, A1.1.1d

In AMP7 Ofwat accepted a £14M investment case for lead pipe replacement. This work is being delivered and the target number of pipes remain on track will be removed.

The proposed investment does not overlap or duplicate with this activity but will continue the implementation of the work to additional properties.

This enhancement investment will deliver a service level beyond that funded in previous AMPs.

2.4 Alignment with the Long Term Delivery Strategy

Is the need clearly identified in the context of a robust long term delivery strategy within a defined core adaptive pathway?

– Ofwat’s final methodology for PR24, Appendix 9, A1.1.1e

Lead forms a specific part of Welsh Water's long term delivery plan with milestones and a long term plan beyond 2050 developed.

Welsh Governments longer term ambition is to deliver a "Lead Free Wales" and Welsh Water's Long Term Delivery Strategy is in line with this ambition.

Further details of Welsh Water's Long Term Delivery Strategy for lead can be found in WSH01 Long Term Delivery Strategy.

Welsh Water have a core pathway which looks to replace 100,000 each of lead communication and supply pipes by 2050.

Several alternative pathways have been considered focused around potential changes to Welsh Government "Lead Free Wales" time scales, as well as different levels of uptake from customers to allow Welsh Water to replace lead pipes on customer property.

2.5 Management Control of Costs

Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings been accounted for?

– Ofwat's final methodology for PR24, Appendix 9, A1.1.1g

Lead pipes feeding customers properties were predominantly installed pre-1970, long before the risks of lead were known. This is a legacy issue which must be addressed.

To assist with keeping our costs to targeting our investment low we have developed a lead predictor model. This model has been created to help predict the location of lead service pipes in the Welsh Water potable water distribution system. The model has been developed by combining the location data of Welsh Water lead compliance results, and lead pipes identified when undertaking operational tasks on the distribution system. Further refinement of the model to assist in the prioritisation of lead pipe replacement schemes for vulnerable groups has been achieved by incorporating the Index of Multiple Deprivation data, as defined by Welsh Government, and the rates of children (0-5 years inclusive) and live births per households. The model will be used as a "live" tool and will be continually updated, therefore refining its outputs based on the best available data. Model outputs will allow Welsh Water to monitor the proportion of pipe replacements carried out in areas with different categories of risk to ensure that targets for vulnerable groups are met.

To manage the delivery programme we will undertake

- Monthly meetings between relevant stakeholders (such as the Network Services Team, Network Alliance and Zonal Study teams) where project performance, cost and risk will be routinely tracked, challenged, issues managed and learning opportunities taken on board. Issues of an agreed severity will be escalated immediately and managed through the project or via business process.
- Quarterly Lead Strategy Reviews will be completed which involves high level policy, wider strategic initiatives covering Lead. This will include Heads of Service and authorities within Communication, Water Quality, Public Health, and Innovation disciplines. This approach ensures that awareness of the Lead project is maintained, as well as ensuring its alignment with wider strategic and business needs.
- At least quarterly meetings for other relevant task and finish groups / workshops / steering groups pertaining to Lead. This will aim to include multiple water companies exploring the same goal of finding and renewing Lead pipes.
- Annual updates will be provided to the relevant Welsh Water Board Committee through paper submissions and any interim papers as required.
- Other stakeholder meetings and roadshows will be undertaken as required to ensure the wider business understands the progress of the project, what's expected and in optimising the identification of lead pipes.

Performance monitoring and reporting will play a key part and will be supported through a project dashboard. The project dashboard will support visualising project metrics, support the early identification of trends and decision making against the project goals such as the number of renewals completed that satisfy OFWAT criteria whilst taking account of post code areas classed as vulnerable wherever possible in the programme of works.

The dashboard will contain information as per the below table to help in measuring the success of the project and other benefits realised over time.

Table 3: Dashboard performance monitoring criteria

Metric*	Description
Work basket	Numbers and the source of renewal jobs available, with separation for number of jobs e.g. within post code areas classed as containing 'vulnerable' groups, leaking jobs etc.
OFWAT Renewals	Number of renewals completed that satisfy the OFWAT criteria
Cost	Average cost per job and individual cost scrutiny
Targets	Work completed against target, in renewal and cost terms
Vulnerable groups	Relationship between jobs completed and post code areas classed as vulnerable
Spatial Plots	Geographical plots of all job locations and their status
Data Quality	A coded / logic-based process to support the review of project data (e.g. SAP data entry) to ensure it is sufficient for audit.
Targeting and recovery mapping	Tools to plot recovery when managing target deficits, forecast delivery over time, and support planning of jobs based on priority (e.g. focussing on post codes area classed as containing 'vulnerable' groups).

* H&S and customer service requirements of delivery are managed via existing processes within the Network Alliance but will form part of general project discussions

The dashboard will visualise the key information and provide high level opportunities to aid decision making. The following figure shows example of the dashboard.

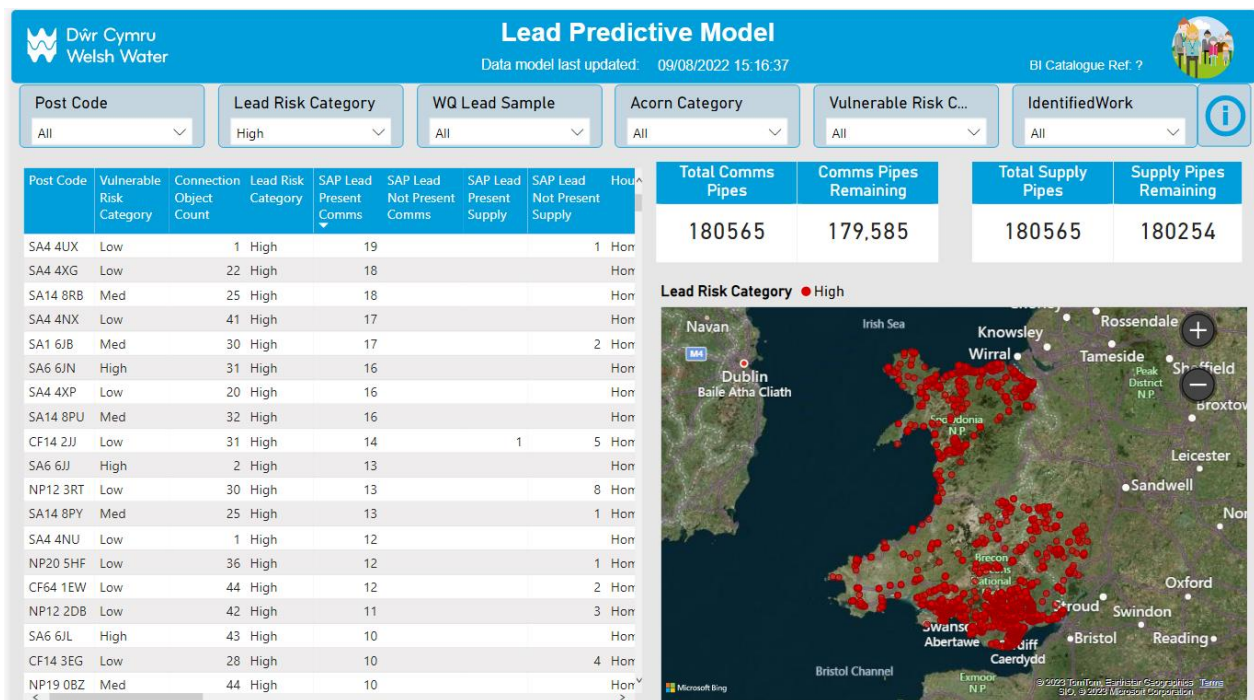


Figure 4: Example of dashboard

3. Best Option for Customer

In this section we will describe how we have developed options for managing the risk of lead. We have reviewed practices across the industry and considered different approaches for tackling the challenge. In particular we have focused on how we can best engage with customers to maximise the benefits of interventions by replacing communication pipes as well as supply pipes, these include:

- **Engaging with social housing organizations:** We have sought to benefit from economies of scale by collaborating with social housing organizations, allowing them to obtain the necessary permissions from a single property owner to replace lead pipes across multiple properties, streamlining the process.
- **Refining our prioritisation model:** To prioritise lead pipe replacement for vulnerable groups, we have used deprivation area data and demographic factors to enhance our statistical lead model. Vulnerable customers are identified based on properties likely to be fed by lead pipes, higher susceptibility to health impacts from lead consumption, and an inability to afford the full cost of lead supply pipe replacement.
- **Introducing customer Incentives:** Recognizing the high rejection rate from customers due to driveway reinstatement disruptions, we plan to introduce incentives in AMP8, including grants to partially fund lead supply pipe replacement, independent contractor selection advice, and inspections to ensure work quality.
- **Addressing driveway reinstatement costs:** For customers with expensive driveways who can afford to pay for their lead supply pipe replacement, we plan to offer to replace the pipe for free during communication pipe replacement but expect the customer to cover any additional costs for non-standard reinstatement. If the customer declines, they will be offered the alternative incentives mentioned earlier.

3.1 Identification of Solution Options

Has the company considered an appropriate number of options over a range of intervention types to meet the identified need?

Is there evidence that the proposed solution represents best value for customers, communities, and the environment over the long term?

– Ofwat’s final methodology for PR24, Appendix 9, A1.1.2a and A1.1.2b

In line with the DWI guidance, we have a risk-based approach to ensure lead compliance within our networks these include:

- Optimised corrosivity control measures including continuing phosphate dosing at the appropriate WTW
- Enhanced, risk-based sample monitoring – approximately 2,000 samples per year
- Recommending customers to replace lead pipes and advise the flushing of taps until lead pipes are removed.

These activities will remain in our base maintenance approach. However as shown below in our long listing approach this will not be enough to meet our aspirations or obligations.

With lead pipes within our distribution network, the hazard remains. The only option to remove the hazard is the replacement of the lead pipe. Due to the number of lead pipes within our network these must be prioritised, where possible, so that we replace the highest risk pipes or those serving our highest risk customers. The options to approach this are outlined below.





The prioritisation of pipes to replace was optioneered based on four risk profiles and a range of work volumes as can be seen in Table 4. These risk profiles are based on the vulnerability of customers in areas that are and are not dosed with phosphate for plumbosolvency and the relative number of replacements in each category.





Please note the values quoted here are based on the latest best estimates of numbers of lead pipes during plan development.

Table 4: Lead pipe replacement optioneering

Programme	Number of Replacements of each Communication & External Supply Pipe (Estimated values)
Vulnerable in Non-Phosphate Dosed	1,106
Non-Vulnerable in Non Phosphate Dosed	6,087
Vulnerable in Phosphate Dosed	30,239
Non-Vulnerable in Phosphate Dosed	166,359
Total number of replacements	203,791

Table 5: Longlist of options considered

Option	Type of Option	Brief Description of Option and Comments	Potentially Viable, i.e., progress to shortlisting?
1	Eliminate, reduce or delay the need for change. Do Nothing	Not Viable - This approach would rely on continued dosing of phosphate in out at risk zones but would involve no replacement of Lead pipes. This means we would be compliant with our water quality goals but this approach would not meet DWI or Welsh Government expectations or the next step on our Long Term Delivery Strategy path.	
2	Enhance existing resources or add new resources. Reactive Only basis	Not Viable - This approach would be to only replace lead for customers who have identified lead at their property or where a water quality failure would indicate an issue. This would not deliver the level or replacement to meet our Long Term Delivery Strategy or DWI/ Welsh Government expectations.	
3a	Enhance existing resources or add new resources. Replacing Lead for Vulnerable Customers in Non Phosphate Dosed Zones	Viable - We would replace lead pipes (communication and external supply) pipes for customers with lead present in zones where we don't currently dose phosphate. Although we believe the number of customers in this option is minimal these are considered the highest risk group. This will be delivered within all options below.	
3b	Enhance existing resources or add new resources. Replace Lead for All vulnerable customers in All Areas	Viable - We would replace lead pipes (communication and external supply) pipes for all vulnerable customers in all zones, including those that are non-phosphate and phosphate dosed. Although phosphate dosing minimises plumbosolvency, customers who are vulnerable in terms of health would still be more susceptible to the effects of lead and over shorter periods of time.	

Option	Type of Option	Brief Description of Option and Comments	Potentially Viable, i.e., progress to shortlisting?
3c	<p>Enhance existing resources or add new resources.</p> <p>Replace Lead for All customers in Non-phosphate Dosed Zones</p>	<p>Viable - This option would look to replace lead pipes (communication and external supply) pipes for all customers in zones that are not currently phosphate dosed. This builds on Option 3 whereby we would replace lead for both vulnerable and non-vulnerable customers. However, the number of replacements is higher and may not be viable to engage with all customers.</p>	
3d	<p>Enhance existing resources or add new resources.</p> <p>Replace Lead for non-vulnerable customers in Phosphate dosed zones</p>	<p>Viable - This option would look to replace lead pipes (communication and external supply) pipes for all customers in zones that are phosphate dosed. This is the biggest cohort of customers, it is taken forward for shortlisting but not likely to be affordable within a single AMP period. Variations on this will be undertaken to assess affordability levels.</p>	
3e	<p>Enhance existing resources or add new resources.</p> <p>Continuation of AMP7 investment value</p>	<p>Viable - This option would replicate a similar level of investment to AMP8. However, this option would look at a level of Lead replacement that was more strategic by prioritising vulnerable and low income customers, introduction of a grant system for others as well as a closer working relationship with housing association and similar organisations.</p>	
3f	<p>Enhance existing resources or add new resources.</p> <p>Replace Lead for all customers</p>	<p>Not Viable - This option would include replacing all the remaining identified lead supplies in our operating area. However the complexity and cost of this option would make it inhibitive to achieve in a single investment period.</p>	

All the findings from the investment within this AMP will be utilised to enhance our approach (by further improving our risk and pricing model) for future AMPs to achieve the goal of removing 50% of lead pipes by 2050, ultimately achieving a lead-free Wales.

3.1.1 Assessment and Selection of Solution Options

Our approach to cost benefit appraisal and its role in decision making is set out in WSH50-IP00 Our Approach to Investment Planning (Section 4.3).

While phosphate dosing at our treatment works remains the most cost effective and large scale option for compliance with the lead standard, our optioneering approach has not identified any other viable options for detailed cost benefit assessment other than lead replacement.

We must also establish the rate at which we should intervene to meet our long term goals.

- Part 1: Improve existing lead identification and cost models to assist with planning future AMPs, which are further broken down into.
 - a. Opportunistic Identified Renewals: Continuing the delivery of lead pipe renewals:

- i. Identified in the ground (part of based maintenance) e.g., from ongoing repair and maintenance works through local depots or through lead water quality failures; and,
 - ii. When customers identify lead pipes and request support:
 - b. Targeted Identified Renewals: Based on the improvements in data assessment (namely the Lead Predictor Model, GIS supply pipe length assessments and post code area vulnerability assessments), commercial assessments and practical delivery programme will be developed with a focus on whole streets / post codes to renew lead that would present an opportunity for efficiencies. DWI indicated that a reduced level of investment and replacement in AMP8 would be unacceptable in terms of reducing the overall risk to customers. Following this we decided that a programme of comparable expenditure and replacement to AMP7 would be chosen.
- Part 2: Trial a lead-free zone with the goal of removing the need to dose phosphate, or other lead mitigation chemicals at the treatment works.
 - a. This requires the identification of a “island” zone that is fed by a single Treatment Works with phosphate dosing, no augmentation or blending (other than in emergency situations). We believe that this approach, while attractive, will be difficult to achieve in practice. The decision to switch off the dosing would rely on the confidence that every lead pipe in that zone had been removed up to the customer tap (as this is where compliance is measured). In anything other than a very small zone, this is likely to be impractical to establish fully.

The table below has been completed using data from our cost benefit spreadsheets to illustrate the value generated by the proposed investment (note All monetary values are expressed in 2022/23 prices and are prior to portfolio adjustments for corporate overheads and efficiency challenge. Welsh Water ref: SMF version 5).

Table 6: Cost Benefit Analysis of options considered

Solution Option	Option Name	CapEx	Present Value Whole Life Costs (WLC)	Present Value Whole Life Benefits (WLB)	Benefit/ Cost Ratio	Net Present Value (=WLB - WLC)
Option S1	£4M - High Risk High Area	£3.918M	£3.517M	£21.774M	6.191	£18.256M
Option S2	£15M	£16.316M	£14.645M	£56.226M	3.839	£41.580M
Option S3	£30M	£32.632M	£29.291M	£131.992M	4.506	£102.702M
Option S4	£45M	£48.948M	£43.936M	£146.923M	3.344	£102.987M
Option S5	£60M	£65.264M	£58.582M	£192.272M	3.282	£133.690M
Option S6	£102M(All High Risk People)	£111.017M	£99.649M	£319.429M	3.206	£219.780M
Option S7	Non Vulnerable in Non Phosphate Dosed Zones	£25.475M	£22.867M	£24.505M	1.072	£1.639M
Option S8	Vulnerable People in Phosphate Dosed Zones	£132.573M	£118.999M	£322.161M	2.707	£203.162M

Solution Option	Option Name	CapEx	Present Value Whole Life Costs (WLC)	Present Value Whole Life Benefits (WLB)	Benefit/Cost Ratio	Net Present Value (=WLB - WLC)
Option S9	Non Vulnerable People in Phosphate Dosed Zones	£589.392M	£529.042M	£359.490M	0.680	-£169.551M

The cost-benefit analysis resulted in option S1 producing the highest benefit-cost ratio and S3 producing the highest net benefit, relative to cost. However, we have selected option S2 as our preferred option as a cost of £33M was beyond what was deemed as affordable for our plan in the round. Option 1, while delivering a high benefit-cost ratio, does not provide the overall benefit we require for our plan. Option 2 is therefore our preferred option as it balances a reasonable cost with a strong net-benefit value. We remain hopeful of the ability to increase the rate of investment in future price control periods as the cost-benefit analysis demonstrates a lot of potential benefit in this area.

Third-party technical assurance of cost–benefit appraisal has been completed by Economic Insight who have confirmed that our approach is robust and in line with Ofwat expectations. Full details are given in WSH50-IP00 Our Approach to Investment Planning (Section 6).

3.2 Quantification of Benefits

Has the company fully considered the carbon impact, natural capital and other benefits that the options can deliver?

Has the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?

– Ofwat’s final methodology for PR24, Appendix 9, A1.1.2c and A1.1.2d

Our approach to cost benefit includes assessment of a wide range of factors set out in our service measure framework. Details are provided in WSH50-IP00 Our Approach to Investment Planning (Section 4.3).

We have quantified the overall benefits of the programme using our Service Measure Framework (SMF) and have provided an overview in the table below. As can be seen all the benefits relate to improvements in health and safety in this case.

Table 7: Profile of Benefits from our preferred option

Scenario	Benefits from AMP8 Spend relative to baseline	
	Health & Safety	Total
Preferred –	100%	100%

3.2.1 Quantifying the Impact on Need and Performance Commitments Our need is set out in 2.1 and is the requirement to manage lead risk – this is measured via the number of lead pipes in our network (the hazard) and also by water quality compliance.

The removal of a lead pipe delivers a clear resolution of the need.

Removing lead pipes has the potential to improve Compliance Risk Index (CRI) performances. However, the nature of sampling for CRI relative to the volumes of homes at which lead is removed means that any impact would be at the 4th or 5th decimal place.

The absolute number of lead failures against the 10µg/l standard is also reported to DWI, as is performances in the 5-10 µg/l range. The likelihood of these failures would decrease, but again given the nature of the sampling programme we would not declare a step change in performance.

Our investment in AMP8 moves us towards our long term goal of a lead-free Wales, and as more and more pipes are replaced in future AMPs we will begin to see more changes in the measured lead exposure.

3.3 Uncertainties relating to cost and benefit delivery

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

– Ofwat's final methodology for PR24, Appendix 9, A1.1.2e

The selected option has high confidences for cost and benefit assessment and we have assessed a variety of different options with varying risk, innovation and cost profiles.

The replacement of communication and supply pipes is a standardised activity of which the company performs many every year. The cost of supply pipe replacement are more variable than communication pipe replacement due to the varying length of customers gardens and surface types (block paving versus lawns). However, the high volume of work gives confidences that the average figure will be robust for financial planning as those which are more difficult to perform will be balanced against those which are simpler.

The removal of the lead pipe removes the hazard and as such there is also high confidence in benefit realisation.

Other options considered and discounted, such as localised phosphate dosing, have high levels of cost and benefit uncertainty.

4. Costing Efficiency

In this section we give specific details on our approach to costing and benchmarking. Our overarching approach to developing efficient costs is set out in WSH50-IP00 Our Approach to Investment (Sections 4.10 and 7).

The two sub sections below correspond to the three criteria set out in Ofwat's PR24 Final Methodology, Appendix 9 (Setting Expenditure Allowances), Section A.1.1.3.

4.1 Developing a cost for Lead risk reduction

Is it clear how the company has arrived at its option costs? Is there supporting evidence on the calculations and key assumptions used and why these are appropriate? Does the company provide third party assurance for the robustness of the cost estimates?

– Ofwat's final methodology for PR24, Appendix 9, A1.1.3a and A1.1.3c

Our approach to costing is set out in full in WSH50-IP00 Our Approach to Investment (Sections 4.10 and 7).

Given the large volume of historic data available we have used a bottom-up approach to costing this investment case. We have generated unit rates from our historic expenditure which we have applied to our proposed outputs highlighted in our plan.

This approach is appropriate as this programme of work is low value, high volume, which the costs can vary depending on location, local topography etc. Taking an average rate from our schemes, which is representative of our programmes of work, allows us to have confidence in our costing, when we apply these rates to our planned outputs.

Welsh Water has a wealth of experience in replacing lead supply and communication pipes. We have systematically recorded historic programmes of work in our unit cost database, including comprehensive outturn costs and various characteristics of the schemes. Using dominant cost drivers such as pipe length and diameter, we have established unit costs for both communication and supply pipes. The average cost of a communication pipe replacement from the first 3 years of AMP7 is approximately £0.002M per replacement and the average cost of an external supply pipe for the first 3 years of AMP7 is approximately £0.005M per replacement. However, the cost of each of these replacements can vary significantly depending on the length and complexity of replacement and reinstatement.

The key assumption is that our historical expenditure across the previous AMPs is reflective across our AMP8 programme. In previous AMPs we have in instances replaced customer side supply pipes also, which we can draw information from which ties with our approach in AMP8. Through the systematic recording of these programmes of work we can see that this is a fair and appropriate assumption to provide confidence in the costing approach.

Along with our overall costing strategy being reviewed and assured by Jacobs, we have also employed third party consultants to review single Enhancement Cases to provide confidence that the estimates within them are robust, efficient and deliverable. Please refer to WSH50-IP00 Our Approach to Investment Planning (Section 6) for more information regarding the review and assurance undertaken.

4.2 Benchmarking our approach

Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)?

– Ofwat's final methodology for PR24, Appendix 9, A1.1.3b

To demonstrate our efficiency, we provide an analysis of our historical costs compared to others' costs and performance.

Four water companies took on bespoke performance commitments (PCs) at PR19 that relate to lead pipe replacement.

- Hafren Dyfrdwy. Number of lead pipes replaced.
- Southern Water. Replace lead customer pipes.
- Welsh Water. Lead pipes replaced.
- Wessex Water. Lead communication service pipes replaced (Wessex Water assets).

These companies have reported data on their performance in these areas in every Annual Performance Report (APR) since PR19 (this data covers 2020/21, 2021/22 and 2022/23).

The APR also contains information on water company annual TotEx on 'meeting lead standards. This data can be combined to estimate an average annual per unit cost of replacing lead pipes for each of these four companies. This is calculated by:

1. Dividing TotEx of 'meeting lead standards' by company performance on their bespoke PC.
2. Taking the average value for each of the four water companies over the period 2020/21 to 2022/23.

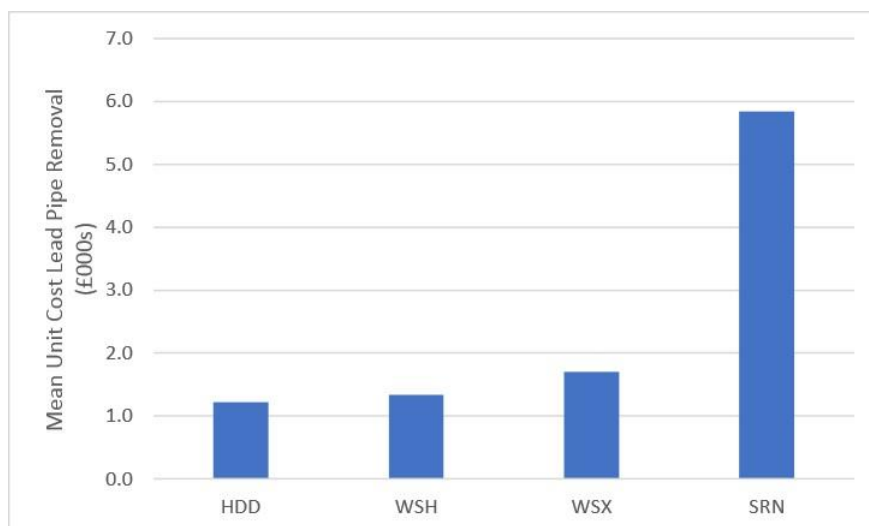


Figure 5: Average Unit Cost Lead Pipe Removal for Hafren Dyfrdwy, Southern Water, Welsh Water and Wessex Water per year

Based on this data, we have the second lowest unit cost of lead pipe replacement of the four water companies that committed to replacing lead pipes at PR19 (by setting a bespoke PC).

Note that it is possible that this result is driven by the nature of work being conducted by each company. For example, Southern Water are replacing 'lead customer pipes' which may refer to pipes on the customer's property, which are likely more expensive to replace than pipes outside of the property boundary.

Our proposed unit cost of £0.002M for the 2025-30 price control period is within a reasonable range of the small sample available above and is reflective of the law of diminishing returns as we progress from completing the easier to replace pipes to the more difficult, complex and costly ones.

5. Providing Customer Protection

In this section we set out the template for the proposed price control deliverable. This is designed to provide strong controls in terms of work delivered against funding allowed – if the proposed volumes of replacement are not delivered, funding will be returned to customers on a proportional basis.

The below corresponds to the three criteria set out in A.1.1.4 of Ofwat Final methodology Appendix 9 (Setting Expenditure Allowances). There is no third-party funding for this Enhancement Case.

5.1 Proposed Price Control Deliverable (PCD)

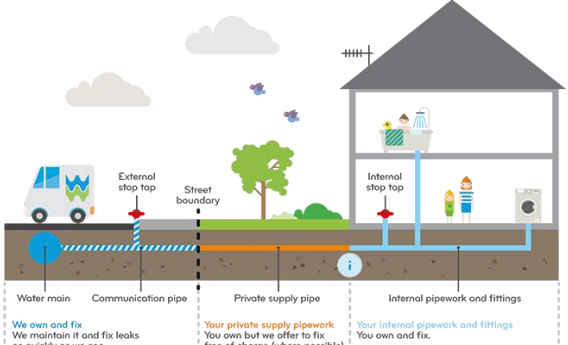
Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?

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

– Ofwat’s final methodology for PR24, Appendix 9, A1.1.4a and A1.1.4b

Customers are protected via a proposed PCD, details are set out below.

Customer Facing Description of Enhancement Case	Working towards a Lead-Free Wales
Short Description of Enhancement Case / PCD Area	Lead Pipe Replacement
PCD Number	PCD7
Summary of deliverable	Number of lead communication/supply pipes replaced and lead removal grants provided

<p style="text-align: center;">Description</p>	<p>Lead in drinking water is a risk to human health. Whilst water leaving the company's water treatment works is low in lead, it's passage through lead pipes connecting the mains in the road to customers taps (communication and supply pipes) means that lead levels can be elevated at the tap.</p> <p>The Welsh Government have a long term target for drinking water to be "lead free". In addition, the Drinking Water Inspectorate (DWI) continue to request progress towards removing sources of risk related to lead poisoning from the drinking water network.</p> <p>The company estimate that there are currently around 150,000 each of communication and external supply pipes made from lead in our operating area. Ownership of these pipes is split between the customer and the company (see illustration).</p> <p>The company are looking to replace 100,000 lead communication pipes by 2050 to minimise risk to customers and meet the Welsh Government's ambition. We are also working to support customers to replace their supply pipes.</p> <p>In AMP8 the company will replace 7,500 lead pipes.</p> <p>This activity will be in addition to lead pipes replaced with structural rehabilitation work.</p> 						
<p style="text-align: center;">Measurement and Reporting</p>	<p>The company will track the number of lead communication and supply pipes replaced each year. At the end of each year, the company will provide a summary report to DWI.</p> <p>Supply pipe replacement will always be delivered alongside communication pipe replacement i.e., the company will not replace a supply pipe if we are not simultaneously working to replace the communication pipe.</p> <table border="1" data-bbox="627 1585 1476 1742"> <thead> <tr> <th></th> <th>Communication Pipe</th> <th>Supply Pipe</th> </tr> </thead> <tbody> <tr> <td>AMP8 Total Volume</td> <td>4,010</td> <td>3,490 (Including 2,200 via grant)</td> </tr> </tbody> </table> <p>The total number of Lead communication pipes which the company is aware of is reported in the APR in Table 6C, lines 6C.18. Our data PR24 tables show a reduction in this total figure through AMP8 matched to the proposal set out in this Enhancement Case. This line provides a means for Welsh Water to report on progress against this</p>		Communication Pipe	Supply Pipe	AMP8 Total Volume	4,010	3,490 (Including 2,200 via grant)
	Communication Pipe	Supply Pipe					
AMP8 Total Volume	4,010	3,490 (Including 2,200 via grant)					

	investment case, subject to changes resulting from additional data gathering around lead pipe numbers.												
Conditions on scheme	No additional conditions identified.												
Assurance	The company will agree an appropriate assurance framework with Ofwat as part of Final Determination.												
Price control deliverable payment rate	<p>The company will track the number of lead communication/ supply pipes replaced each year and the number of grants for lead removal which have been made.</p> <p>Communication pipe replacement is fully within the control of Welsh. The replacement of supply pipes and the acceptance of grants depends on customers uptake. Whilst customer uptake is well understood it is beyond the control of Welsh.</p> <p>Any shortfall in delivery at the end of AMP8 will:</p> <ol style="list-style-type: none"> 1) result in funds being returned to customers in line with the rates set out below or 2) see funding relocated to deliver activities within the other workstreams at the rates set out below. <table border="1"> <thead> <tr> <th></th> <th>Communication Pipe</th> <th>Supply Pipe</th> <th>Grants</th> </tr> </thead> <tbody> <tr> <td>AMP8 Total Volume</td> <td>4,010</td> <td>1,290</td> <td>2,200</td> </tr> <tr> <td>£/unit</td> <td>£1,583.96</td> <td>£5,205.90</td> <td>£789.57</td> </tr> </tbody> </table> <p>Prices are in 2022/3 price base post efficiency.</p> <p>For every 2 grants not taken up we will replace 1 additional communication pipes. Or return this funding to customers. For every supply pipe not taken up we will replace 3 additional communication pipes. Or return this funding to customers.</p>		Communication Pipe	Supply Pipe	Grants	AMP8 Total Volume	4,010	1,290	2,200	£/unit	£1,583.96	£5,205.90	£789.57
	Communication Pipe	Supply Pipe	Grants										
AMP8 Total Volume	4,010	1,290	2,200										
£/unit	£1,583.96	£5,205.90	£789.57										

<p style="text-align: center;">Impact performance in relation to performance commitments</p>	<p>Removing lead pipes has the potential to improve Compliance Risk Index (CRI) performances. However, the nature of sampling for CRI relative to the volumes of homes at which lead is removed means that any impact would be at the 4th or 5th decimal place.</p> <p>The absolute number of lead failures against the 10µg standard is also reported to DWI as is performances in the 5-10µg range. The likelihood of these failures would decrease, but again given the nature of the sampling programme we would not declare a step change in performances.</p> <p>The company's investment in AMP8 moves towards the long term goal of a lead-free Wales, and as more and more pipes are replaced in future AMPs the company will begin to see more changes in the measured lead exposure.</p>
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5.1.1 Extent of Protection

The PCD set out above is focused on the primary benefits of the activity – removal of the hazard of lead supply and communication pipes.

Secondary benefits, for example to leakage, will be immaterial and are not included as a wider benefit.

6. Appendices

Appendix A

The table below shows the total CapEx enhancement costs in Amp 8 for this Enhancement Case. The Ofwat drivers this Enhancement Case maps to are:

- Lead communication pipes replaced or relined; enhancement CapEx (CW3b.106)
- External lead supply pipes replaced or relined, enhancement CapEx (CW3b.109)

No other Enhancement Cases contribute to these drivers.

Table 8: Allocation of Costs in Data Tables

Driver Ref	Year in AMP8					Grand Total
	1	2	3	4	5	
CW3b.106	£1.279M	£1.261M	£1.260M	£1.268M	£1.283M	£6.352M
CW3b.109	£1.702M	£1.678M	£1.677M	£1.688M	£1.708M	£8.453M
Total	£2.981M	£2.939M	£2.937M	£2.956M	£2.991M	£14.804M
Total CapEx in AMP8 Plan in 2022/23 prices						

What We Will Deliver: This Enhancement Case will deliver 7,500 lead communication and supply pipe replacements within our water distribution networks. Included in this figure is the provision of 2,200 grants for customers wishing to replace their external supply lead pipework.