UUW60

Water Quality Enhancement Case

October 2023

Chapter 8 supplementary document

This document sets out the service enhancement expenditure and activity that we will undertake, through our 2025-2030 business plan.

This case includes:

- Case 1: Water resources
- Case 2: Vyrnwy re-lining in AMP8
- Case 3: Lead replacement
- Case 4: SEMD and NIS-D
- Case 5: Raw water quality deterioration

United Utilities

Water for the North West

1. Water Quality Enhancements

1.1 Structure

1.1.1 This document contains our Water quality enhancement cases and is structured as below:

- Case 1: Water resources
- Case 2: Vyrnwy re-lining in AMP8
- Case 3: Lead replacement
- Case 4: SEMD and NIS-D
- Case 5: Raw water quality deterioration

UUW60

Water WINEP

October 2023

Enhancement Case 1

United Utilities

Water for the North West

Contents

Appendices

1. Enhancement submission

<table>
<tr><th colspan="2">Enhancement submission</th></tr>
<tr><td>Title:</td><td>Water Resources WINEP</td></tr>
<tr><td>Price Control:</td><td>Water Resources (100%)</td></tr>
<tr><td>Enhancement headline:</td><td>United Utilities Water (UUW) must ensure it meets environmental obligations in AMP8, as identified through the Environment Agency's (EA) Water Industry National Environment Programme (WINEP) and Natural Resources Wales' (NRW) National Environment Programme (NEP).

This particular enhancement case includes expenditure required to meet WINEP/NEP obligations relating to UUW's water price control.

Following completion of options development our WINEP/NEP for AMP8 is forecasting to deliver £651.394M of Wider Environmental Outcomes (WEO) (assessed using the EA's methodology) for a Totex investment of £105.495M across 110 actions (55 schemes and 55 investigations based on primary driver).</td></tr>
<tr><td>Enhancement expenditure

(FY23 prices)</td><td>
<table>
<tr><th></th><th>AMP8 Capex inc TI (£m)</th><th>AMP8 Opex (£m)</th><th>AMP8 Totex (£m)</th></tr>
<tr><td>Pre RPE and Frontier Shift</td><td>73.209</td><td>34.484</td><td>107.693</td></tr>
<tr><td>Post RPE and Frontier Shift</td><td>71.827</td><td>33.667</td><td>105.495</td></tr>
</table>

The table above shows the total expenditure, inclusive of accelerated programme and transitional investment, on both a pre-efficiency (i.e. pre frontier shift and real price effects basis, consistent with the cost data tables), and a post efficiency and RPE basis (i.e. consistent with the value we propose to be recovered from price controls). All numbers referenced hereafter in this enhancement case are on a post efficiency and RPE basis.</td></tr>
<tr><td>Benefit (30 Year NPV): (£)</td><td>£728.842m (Ofwat Driver Total: WEO & risk based metrics)</td></tr>
<tr><td>This case aligns to :</td><td>WINEP/NEP (and it supports future Water Resource Management Plan (WRMP)). For full reconciliation between enhancement costs and data table lines, see enhancement mapping tabs in UUW117 – Project allocations CW3 and CWW3.</td></tr>
<tr><td>PCD</td><td>The only Ofwat driver sub-category that is over the 1% water totex value is the biodiversity and conservation driver. We therefore propose a PCD for projects falling under that category. Customers are protected in terms of delivery of all projects as WINEP is a statutory deliverable measured through the Environmental Performance Assessment (EPA).</td></tr>
</table>

2. Enhancement case summary

Gate	Summary	Location reference
Need for enhancement investment	Table 1 sets out the required expenditure by Ofwat driver relating to this enhancement case.	Table 1
	UUW must ensure it meets new environmental obligations in AMP8, as identified through the EA's WINEP and NRW's NEP.	3.1.5 - 3.1.10
	WINEP/NEP is a regulatory obligation, developed as a framework for water companies to deliver the requirements of (water); • The Water Environment (WFD) Regulations 2017; • Drinking water protected areas; • Habitat regulations; • Eel regulations; • Invasive Non Native Species (INNS); • Sites of Special Scientific Interest (SSSI); • NERC biodiversity priority; • Environmental Destination/Water Resource Management Plans; • Salmon and Freshwater Fisheries Act; and, • Environmental Permitting Regulations.	
	In line with Stage 2 of the EA's WINEP methodology[1] we have developed a robust process to identify the actions we must undertake in AMP8. Driver guidance has been reviewed in collaboration with the EA, NRW and Natural England (NE).	4.2.1 - 4.3.44.3.3
	Table 2 provides the summary of the environmental priorities and associated WINEP/NEP drivers, timescales for completion and the methodology used to identify actions we have put forward on the AMP8 WINEP/NEP.	Table 2
	UUWs internal Risk and Value (RV) process has been followed for all actions identified as required. The first stage of this was to produce requirements statements for all actions being taken forward so that the need could be verified.	4.3.7 - 4.3.9
	All UUWs proposed actions are statutory and statutory plus obligations with deadlines within AMP8.	4.4.1
	There is no overlap with activities we are undertaking through base maintenance.	4.5.2
	We have worked to ensure our WINEP/NEP integrates with other strategic planning frameworks.	4.6
	Customer support indicates that the environment is a priority for customers and will become even more so in the future.	4.8
	Despite WINEP/NEP obligations being outside management control we have fully engaged with the process to ensure best value for customers through best value analysis and the adoption of a large investigation programme for AMP8.	4.9.1 - 4.9.6
	WINEP delivery counts towards the EA's EPA for which the business aims to be 4*.	

[1] DEFRA (2022) *Water Industry National Environment Programme (WINEP) methodology*. Available here.

Best option for customers	UUW wants to ensure the Water WINEP/NEP programme represents best value for customers whilst also delivering its statutory environmental obligations.	5.1.1
	Our options development and assessment process has been undertaken in line with the EA's WINEP/NEP guidance and we have aligned this with the fundamental principles of UUW's defined value management process. Risk and Value for PR24 (RV) was a three stage process (RV0-RV2), aimed at positively challenging our projects to ensure we have sufficient evidence behind decisions.	5.2.1
	For schemes where there is uncertainty over the issue, solution or benefits UUW has proposed a programme of investigations ahead of action to ensure that any future investment in interventions is based on sound evidence and can therefore ensure best value.	5.2.3
	Each requirement was categorised into a generic high level solution and passed through a number of stages – unconstrained options, constrained options, costing, to identify the preferred option.	5.2.4
	A large proportion of the water WINEP/NEP programme is based around catchment interventions and nature based solutions and therefore options development was largely bespoke for each requirement. Solutions were in the main based on previous investigation reports, site specific requirements, expert judgement based on past experience of similar schemes, and in conjunction with other partners including the Rivers Trust and NE who helped co-develop options.	5.3.1 - 5.3.3
	Due to a large AMP7 investigation programme, which included an options appraisal assessment, informing AMP8 schemes all water WINEP options came out as single option. These options were costed and assessed for deliverability and feasibility.	5.4.15.4.3 - 5.4.5
	Once options had been agreed to proceed through RV2 best value analysis was undertaken. Best value analysis was undertaken through our internal PR24 Value Tool, which quantifies the risk of not meeting a requirement and the value of implementing the solution. It incorporates the EA's Wider Environmental Outcome (WEO) metrics in quantifying value.	5.5.1 - 5.5.9
	All statutory plus water WINEP/NEP schemes came out with a 'cost-benefit' ratio above 1 and therefore, despite the schemes being single option, we are confident that they are providing good value to the customer and have therefore been taken forward as our least cost best value options.	5.6.3
	We are forecasting we will deliver WEO value of £651.394M with a whole life carbon reduction of 480, 252.84 tonnes of CO2 equivalent, as detailed in Figure 11, as well as a number of direct benefits to the environment as set out in 00.	5.6.5 - 0
	We have sought opportunities for partnership working and obtaining grant funding, such that the best value for customers and the environment is secured. We are confident in our ability to achieve grant funding based on our historic evidence.	5.7.1 - 5.7.6
Cost efficiency	The water WINEP programme comprises of 55 implementation schemes and 55 investigations (based on primary driver). These actions are largely bespoke projects based on very site specific circumstances. Our Risk and Value (RV) process ensures we are investing effectively. Equally our history of delivering WINEP/NEP schemes since AMP3 means we have a comprehensive understanding of costs, resources and opportunities.	6.1.1 - 6.1.5 6.1.6

	Costs were developed through a bottom up estimating approach, using historical outturn costs, scope items detailed in investigation reports, estimator judgement and cost curves. UUW's PR24 capital cost estimating approach has been based on data collected over a number of AMPs (AMP3 to AMP7) updated to reflect the present market conditions under which UUW and the UK Water Industry are operating. Mott Macdonald (MM) have provided an estimating service to UUW over AMP6 and AMP7. MM also provide an estimating service to a number of other UK Water Companies, which allows them to provide a benchmarked approach to UUW's PR24 capital cost estimates. A third party was engaged to carry out a bottom-up benchmarking exercise by comparing our cost build ups against similar companies. This resulted in an additional internal challenge on costs. As a result, the third party considers our costs to be efficient Cost build ups have been detailed out by similar scheme groupings with an explanation of how costs were developed and why these are robust: • Catchment and land management schemes • Water resource flow schemes • Fish passage schemes • West Cumbria infrastructure removals schemes • Eel schemes • Invasive non-native species (INNS) schemes • Water resources – heavily modified waterbodies schemes • Investigation programme	6.1.7 6.1.10 6.1.11 6.2 6.3 6.4 6.5 6.6 6.7 6.8 6.9
Customer protection	This section details out the price control deliverable (PCD) to be put forward for the biodiversity and conservation driver block. Section 7 sets out the PCD detail and Table 21 indicates the associated schemes and payback rates.	Section 7 Table 20

3. Introduction

3.1.1 This particular enhancement case includes expenditure of £105.495 million to ensure UUW meets its environmental obligations from environmental legislation and UK government policy as well as adapting to climate change in AMP8, as identified through drivers in the EA's WINEP and NRW's NEP relating to UUW's water price control, see Table 1.

Table 1: AMP8 Water WINEP expenditure by Ofwat driver

Ofwat line description	AMP8 post frontier shift and Real Price Effect (RPE) assumptions Totex including Transitional Investment (TI) (£M)
EA/NRW environmental programme (WINEP/NEP)	
Biodiversity and conservation; (WINEP/NEP) water capex	14.736
Biodiversity and conservation; (WINEP/NEP) water opex	32.695
Biodiversity and conservation; (WINEP/NEP) water totex	47.431
Eels/fish entrainment screens; (WINEP/NEP) water capex	2.404
Eels/fish entrainment screens; (WINEP/NEP) water opex	0.143
Eels/fish entrainment screens; (WINEP/NEP) water totex	2.548
Eels/fish passes; (WINEP/NEP) water capex	1.976
Eels/fish passes; (WINEP/NEP) water opex	0.000
Eels/fish passes; (WINEP/NEP) water totex	1.976
Invasive Non Native Species; (WINEP/NEP) water capex	4.166
Invasive Non Native Species; (WINEP/NEP) water opex	0.077
Invasive Non Native Species; (WINEP/NEP) water totex	4.242
Drinking Water Protected Areas; (WINEP/NEP) water capex	7.003
Drinking Water Protected Areas; (WINEP/NEP) water opex	0.000
Drinking Water Protected Areas; (WINEP/NEP) water totex	7.003
Water Framework Directive; (WINEP/NEP) water capex	15.218
Water Framework Directive; (WINEP/NEP) water opex	0.746
Water Framework Directive; (WINEP/NEP) water totex	15.964
Wetland creation; (WINEP/NEP) water capex	0
Wetland creation; (WINEP/NEP) water opex	0
Wetland creation; (WINEP/NEP) water totex	0
Trade effluent discharge flow monitoring; (WINEP/NEP) water capex	0
Trade effluent discharge flow monitoring; (WINEP/NEP) water opex	0
Trade effluent discharge flow monitoring; (WINEP/NEP) water totex	0
25 year environment plan; (WINEP/NEP) water capex	0
25 year environment plan; (WINEP/NEP) water opex	0
25 year environment plan; (WINEP/NEP) water totex	0
Investigations; (WINEP/NEP) - desk based study only water capex	0
Investigations; (WINEP/NEP) - desk based study only water opex	0
Investigations; (WINEP/NEP) - desk based study only water totex	0
Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water capex	2.837
Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water opex	0

Ofwat line description	AMP8 post frontier shift and Real Price Effect (RPE) assumptions Totex including Transitional Investment (TI) (£M)
Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water totex	2.837
Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water capex	23.488
Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water opex	0.006
Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water totex	23.494
Investigations total; (WINEP/NEP) water capex	26.325
Investigations total; (WINEP/NEP) water opex	0.006
Investigations total; (WINEP/NEP) water totex	26.331
Total environmental programme expenditure; (WINEP/NEP) water totex	**105.495**

3.1.2 The water industry has taken steps over the last 4 decades to improve the water environment. However, there is a collective ambition for the WINEP/NEP to deliver more for the environment, for customers and for communities. This reflects society's high expectations and the UK government's ambition to leave the environment in a better state for the next generation.

3.1.3 It has been recognised by the UK government that, without a change in the way water companies operate, by 2050 there could be issues with water availability, increased pressure to meet the demands of customers, industry and agriculture as well as increasing issues with flooding and resilience in the natural environment. Therefore water companies have been challenged to mitigate for their activities and provide a resilient, cost efficient service that benefits both customers and the natural environment.

3.1.4 The ambition to improve the environment and achieve clean and plentiful water within a generation is set out in the UK government's 25 year Environment Plan[2], with the specific outcomes that water companies must achieve in AMP8, around water quality, quantity and biodiversity, being set out in the Environment Act 2021[3].

3.1.5 The Water Industry Strategic Environmental Requirements (WISER)[4] issued by the EA and NE provides strategic guidance for water companies developing their business plans in relation to environmental obligations.

3.1.6 The WINEP sits underneath the WISER and provides the detail regarding specific actions that need to be taken to meet the environmental legislative requirements. The EA have published the WINEP methodology, and associated technical documents, outlining the overarching process for design, development and delivery of the AMP8 WINEP to ensure new environmental obligations are met.

3.1.7 UUW's operations also abstract water from sources in Wales and we must therefore ensure that we meet environmental obligations in AMP8 identified through NRW's NEP.

3.1.8 The WINEP/NEP is the most important and substantial programme of environmental investment in England and Wales. It consists of asset improvements, investigations, monitoring, and catchment interventions. It sets out how the water industry will contribute to improving the natural environment.

3.1.9 The water sector is also moving towards a "best value" approach, promoted by the regulators, with a best value option being one which drives the best outcomes for the environment, society and water companies over the long term.

[2] UK Government (2018) *25 Year Environment Plan*. Available here.

[3] UK Government (2021) *Environment Act 2021*. Available here.

[4] DEFRA (2022) *Water industry strategic environmental requirements (WISER): technical document*. Available here.

3.1.10 Water companies are required to deliver requirements against the following environmental drivers (more detail on drivers can be found in Appendix A):

- The Water Environment (WFD) Regulations 2017;
- Drinking Waters;
- Habitat Regulations;
- Eel Regulations;
- Invasive Non Native Species (INNS);
- Sites of Special Scientific Interest (SSSI);
- NERC Biodiversity Priority;
- Environmental Destination/Water Resource Management Plans;
- Salmon and Freshwater Fisheries Act; and,
- Environmental Permitting Regulations.

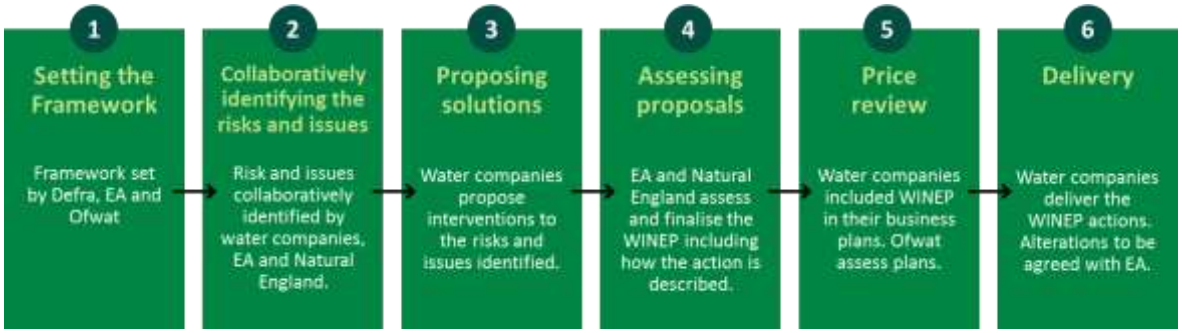
3.1.1 As one of the country's largest private land owners, with over 56,000 hectares of land, it is UUW's duty to be custodians of the environment in the North West. Much of the land contains protected habitats of global significance and maintaining the health of this land plays a vital part in protecting biodiversity and raw water quantity/quality entering the reservoirs, especially with a view to increasing resilience to climate change. As landowners we have control over how we manage our land for our benefit.

3.1.2 According to the International Union for Conservation of Nature IUCN, 70% of drinking water supplied in the UK originates from peatland sources. This value is particularly the case for UU customers, with the majority of England's peat in the North West. Peatland is a hugely important carbon sink holding 550 gigatonnes of carbon globally, more than twice the mass stored in all forests. Restored peat is therefore a significant delivery route for carbon net zero, not just for UUW but for the industry and country as a whole. UUW owns a significant estate (56,000 hectares) of which the majority is situated around the upland reservoir catchments. This provides a unique opportunity for us as a landowner and water utility to maximise restoration effort through WINEP delivery and partnership working to deliver benefits for society.

3.1.3 The purpose of this document is to set out the overall approach that UUW has taken in the development of its WINEP/NEP submission. This has been informed by the key regulatory guidance including: the WINEP methodology, WINEP options development guidance, WINEP options assessment guidance, WINEP driver and supporting guidance[5]. Our approach reflects the specific context within which we operate in the North West of England.

3.1.4 Figure 1 sets out the WINEP development process as detailed in the EA's WINEP methodology.

Figure 1: Stages set out in WINEP methodology



[5] DEFRA (2022) *Various guidance documents sitting under the Methodology*. Available on EA internal sharepoint shared with UUW.

4. Need for enhancement investment

4.1.1 This section will discuss how we have identified the actions that are required to meet the obligations set out in the WINEP/NEP.

4.2 Enhancement investment

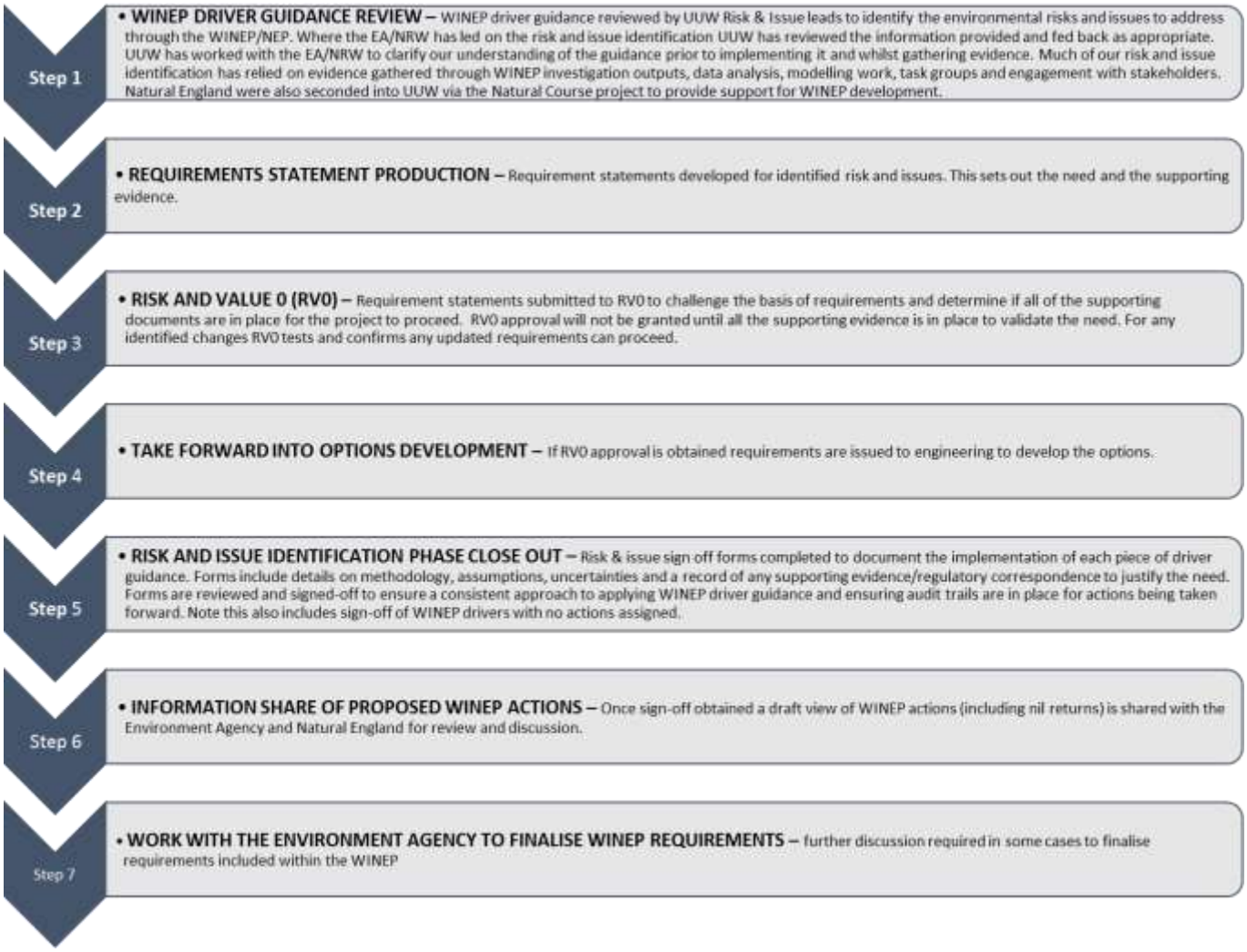
4.2.1 This particular enhancement case includes expenditure required to meet WINEP/NEP obligations relating to UUW's water price control. This programme of enhancement investment is driven by the AMP8 WINEP/NEP which includes statutory environmental obligations arising from legislative requirements and government policy.

4.2.2 The WINEP/NEP sits underneath the WISER and provides the detail regarding specific actions that need to be taken to meet the environmental legislative requirements. The EA have published the WINEP methodology[6], and associated technical documents, outlining the overarching process for design, development and delivery of the AMP8 WINEP to ensure new environmental obligations are met.

4.2.3 In line with Stage 2 of the EA's WINEP methodology UUW developed a robust, systematic and well evidenced process to ensure the production of an AMP8 WINEP/NEP programme that satisfies all required environmental outcomes whilst delivering best value for customers. This involved collaboratively identifying environmental issues that need addressing and risks that require further monitoring/investigation through the WINEP/NEP. Our risk and issue identification process followed a staged approached, shown in Figure 2, which has enabled us to identify where action is required to deliver compliance with our environmental obligations.

[6] Water industry national environment programme (WINEP) methodology (DEFRA) 2022 Link

Figure 2: Risk and issue identification process stages



4.3 Need for enhancement - approach to risk and issue identification

4.3.1 Steps 1, 2 and 3 of the process flow chart in Figure 2 were followed in order to support the robust identification of AMP8 actions for investment in WINEP/NEP enhancement drivers.

4.3.2 The approach UUW has taken to identify WINEP/NEP actions is in line with stage 2 of the EA's WINEP methodology. Step 1 required a review of all the driver guidance and collaboration between UUW subject matter experts (SME's) and external SME's (namely from the EA, NRW and NE). This allowed the identification of environmental issues that need addressing and risks that require further monitoring/investigation through the WINEP/NEP. Appendix A provides details of all WINEP drivers.

4.3.3 Where the EA/NRW led on risk and issue identification we reviewed the information provided and fed back as appropriate. The implementation of each piece of driver guidance has been documented internally with a methodology, assumptions and any uncertainties. These have been reviewed and signed-off to ensure a consistent approach to applying guidance and robust audit trails to support all requirements going in to the WINEP/NEP submission.

4.3.4 Table 2 provides a summary of the methodology used to identify the relevant actions under the associated WINEP/NEP drivers.

Table 2: Summary of the relevant environmental priorities, timescales for completion, number of actions, and identification methodology

PR24 WINEP/NEP drivers	Driver codes and regulatory dates (S = statutory obligations) (S+ = statutory plus obligations)	Number of actions	Methodology for identifying actions
Water Resources (Hydrological Regime)	WFD_INV_WRFlow (S) (investigation to determine impact of abstractions and appraisal of options for an effective solution to achieve good ecological status (surface water). Completion date 31/12/2026). WFD_NDINV_WRFlow (S) (investigation to determine the likelihood that future abstraction will cause deterioration in any element affecting the ecological status of a water body and identify effective solutions. Completion date 31/12/2026). WFD_ND_WRFlow (S) (action to protect / ensure no deterioration in status (surface water). Completion date 31/03/2030). WFD_IMP_WRFlow (S+) (action to improve ecological status (surface water). Completion date 31/03/2030).	WFD_INV_WRFlow = 1 investigation WFD_NDINV_WRFlow = 9 investigations WFD_ND_WRFlow = 28 schemes WFD_IMP_WRFlow = no schemes	EA led. The EA provided a list of abstraction licence sites and surface water bodies that may be impacted by abstraction or at risk of deterioration from future growth in abstraction. UUW reviewed the list with the EA to determine the required schemes and investigations for AMP8. Discussions were had with regard to phasing 19 implementation schemes into AMP9 due to current on-going investigations that will not conclude until 2024 therefore resulting in some uncertainty over the solution. This highlights UUW's commitment to ensuring our investment proposals are profiled in the most cost effective way for customers. However the EA deemed that these schemes should be delivered in AMP8 and therefore will not be phased.
Water Resources Artificial and Heavily Modified Water Bodies	WFD_INV_WRHMWB (S) (investigation and appraisal of options to determine the impact of abstraction and/or water storage infrastructure on achievement of good ecological potential in an Artificial or Heavily Modified Water Body (water resources use). Completion date 31/12/2026). WFD_NDINV_WRHMWB (S) (investigation to determine the likelihood that abstraction and/or water storage infrastructure will cause deterioration in ecological potential of an Artificial or Heavily Modified Water Body (water resources use) and identify effective solutions. Completion date 31/12/2026). WFD_ND_WRHMWB (S) (action to protect / ensure no deterioration in ecological potential. Completion date 31/03/2030).	WFD_INV_WRHMWB = 3 investigations* WFD_NDINV_WRHMWB = no investigations W_WFD_WRHMWB_INV1 = 1 NEP investigation* WFD_IMP_WRHMWB = 2 schemes* W_WFD_WRHMWB_IMP1 = 1 NEP scheme*	EA/NRW led. AMP8 actions identified through the site list provided by EA/NRW that included AMP7 investigations using the WR A/HMWB driver and HMWB designated for water resources uses that have missing mitigation measures. UUW reviewed list with EA/NRW to determine AMP8 requirements. For Pennington and Vyrnwy, where there have been no AMP7 investigation requirements despite implementation deadlines in AMP8, UUW have negotiated the inclusion of the investigation phase into the AMP8 implementation schemes in order to ensure the need is fully understood and the solution will satisfy the requirements for the benefit of the environment and customers.

PR24 WINEP/NEP drivers	Driver codes and regulatory dates (S = statutory obligations) (S+ = statutory plus obligations)	Number of actions	Methodology for identifying actions
	WFD_IMP_WRHMWB (S+) (action to achieve good ecological potential. Completion date 31/03/2030).	WFD_ND_WRHMWB = 1 scheme. *Undertaking both an investigation and scheme in AMP8 at Pennington and Vyrnwy - both actions therefore have an investigation and implementation driver.	
WFD Physical Habitat and Fish Passage	WFD_INV_PHYSHAB (S) (investigation to determine: impacts from water company owned/utilised physical modification on fish passage or physical habitat and Impact to WFD water body status/potential objectives – e.g. is the physical modification a reason for not achieving good status/potential? Completion date 30/04/2027). WFD_IMP_PHYSHAB (S+) (actions to address barriers to passage of fish or impacted physical habitat in WFD failing waterbodies not designated artificial or heavily modified for water resources uses. Completion date 31/03/2030).	WFD_INV_PHYSHAB = no investigations. WFD_IMP_PHYSHAB = 2 schemes.	Water company led. Schemes identified for implementation in AMP8 were all subject to investigation in AMP7. The AMP7 investigations included an optioneering stage and have proposed the solutions which are being taken forward for delivery in the AMP8 WINEP.
Groundwater	WFDGW_INV (S) (Groundwater good status investigation relating to water resource or water quality. Completion date 30/04/2027). WFDGW_NDINV (S) (Groundwater prevent deterioration investigation relating to water resource or water quality. Completion date 30/04/2027). WFDGW_ND (S) (Groundwater prevent deterioration action relating to water resource or water quality.	WFDGW_INV = no investigations. WFDGW_NDINV = 1 investigation. WFDGW_ND = no schemes. WFDGW_IMP = no schemes.	EA and water company led. UUW's pre Water Resource Management Plan (WRMP) information spreadsheet lists the groundwater requirements to investigate the impact of groundwater abstractions. This information was shared and discussed with the EA. The WINEP driver guidance states "where groundwater abstraction changes are in the WINEP to improve surface water flows then use the WFD_WRFlow or WFD_ND_WRFlow drivers". Other groundwater abstraction changes have therefore been included under the Water Resources (Hydrological Regime) driver.

PR24 WINEP/NEP drivers	Driver codes and regulatory dates (S = statutory obligations) (S+ = statutory plus obligations)	Number of actions	Methodology for identifying actions
	Completion date 31/03/2026 or 31/03/2030 depending on deterioration status). WFDGW_IMP (S+) (Groundwater good status improvement action relating to water resource or water quality. Completion date 31/03/2030).		
Drinking Water Protected Areas (DrWPA)	DrWPA_INV (S) (Investigations for 'at risk' DrWPAs or groundwater safeguard zone to identify actions to prevent deterioration and/or to reduce treatment. Completion date 30/04/2027). DrWPA_IMP (S+) (Implementation of actions through a scheme to improve water quality so the level of purification treatment can be reduced over time. Completion date 31/03/2030). DrWPA_ND (S) - Implementation of actions through a catchment scheme, or at a wastewater treatment works, to prevent deterioration (or improve following a deterioration) in water quality to avoid an increase in the level of water purification treatment. Completion date 31/03/2030).	DrWPA_INV = 21 investigations. DrWPA_IMP = 1 scheme. DrWPA ND = 2 schemes. W_DrWPA_NDIMP1 = 1 NEP scheme.	Water company led. AMP8 implementation schemes: DrWPA AMP7 investigations identified the AMP8 required schemes. AMP8 investigations: analysis of relevant data (raw water quality, final water quality, customer contacts, and parameters for concern) for all our water treatment works was undertaken alongside a review of Drinking Water Safety Plan (DWSP) risks. This highlighted where we had a raw water quality parameter of concern. The data was reviewed and shared with the EA DrWPA leads, who undertook further statistical analysis. A review of the outcomes of seven AMP7 algae investigations undertaken at Piethorne, Ridgegate, Rivington, Mitchells, Laneshaw, Ashworth Moor and Haslingden Grane identified that further investigation into taste and odour compounds rather than algae is required to continue understanding the issues and thereby presenting an appropriate solution. It was therefore agreed that these sites would be put forward for further investigation in order to ensure customer's money is spent wisely. Discussions took place to finalise the list of schemes to be taken forward.

PR24 WINEP/NEP drivers	Driver codes and regulatory dates (S = statutory obligations) (S+ = statutory plus obligations)	Number of actions	Methodology for identifying actions
European Sites	HD_IMP (S) (action to contribute to restoration of a European site or Ramsar site to move towards meeting the conservation objectives. Completion date 31/03/2030). HD_ND (S) (action to contribute to maintenance of (prevent deterioration of) a European site or Ramsar site at favourable conservation status. Completion date 31/03/2030). HD_INV (S) (investigation and or options appraisal to determine impacts of water company activities, or permit / licence conditions/standards on a European site or Ramsar site or to determine the costs and technical feasibility of meeting targets. Completion date 30/04/2027).	HD_IMP = 5 schemes. HD_ND = no schemes. HD_INV = no investigations.	EA and water company led. A review of all European designated sites was undertaken to review the conservation objectives and where improvements were necessary. Infrastructure removal schemes are those which have been committed to as part of the River Ehen Compensatory Measures project i.e. infrastructure removal in West Cumbria. UUW has undertaken a large programme of Habitats Regulations projects, both investigations and implementation schemes, following the EA Review of Consents process in previous AMPs. As such, no further infrastructure removal projects have been identified. NE and EA advised that any SSSI sites with European Designations should be raised against the European Sites driver to better reflect the importance of the conservation objectives. Of the 4 SSSIs identified for improvement (Haweswater, Bowland, West Pennine Moors and South Pennine Moors) only the South Pennine Moors has a significant area designated as SAC and therefore this scheme has been included under the European Sites driver.
Eels	EE_INV (S) (investigation required to confirm eel entrainment/identify that a structure is a barrier to eel passage and to determine appropriate action. Completion date 30/04/2027). EE_IMP (S+) (schemes to improve diversion structures to prevent the entrainment of eel (for example screening intakes) and to address barriers to the passage of eel (for example building and maintaining eel passes). Completion date 31/03/2030).	EE_INV = 6 investigations. EE_IMP = 2 schemes. W_EEL_IMP1 = 1 NEP scheme.	EA/NRW and water company led. The requirement for any schemes and investigations was determined using UUW's eel action plan7 and the EA's list of abstraction intakes. UUW's 'eel action plan' identifies high/medium/low priority sites (abstractions). High priority sites have been/are being addressed in AMP7, with the exception of one site which will be addressed in AMP8. Two additional AMP8 schemes were identified following review of the EA's list of prioritisation scores for medium

[7] UUW (2023) *Eel Action Plan*. Internal document

PR24 WINEP/NEP drivers	Driver codes and regulatory dates (S = statutory obligations) (S+ = statutory plus obligations)	Number of actions	Methodology for identifying actions
			priority intakes. Other medium priority sites on the EA's list are to be investigated in AMP8. EA confirmed that they do not hold a list of priority barriers to eel that UUW needs to address.
Invasive non-native species (INNS)	INNS_INV (S) (investigations – includes pathway analysis, prevention of deterioration and actions to achieve conservation objectives. Completion by 31/03/2027). INNS_ND (S) (Delivery - Actions to prevent deterioration by reducing the risks of spread of INNS and reducing the impacts of INNS. Completion by 31/03/2030). INNS_IMP (S, S+) (Delivery - Improvement schemes to reduce the impacts of INNS, where INNS is a reason for not achieving conservation objectives or good status. Completion date by 31/03/2030). INNS_MON (S+) (Surveillance - Set up of surveillance programmes. Completion date by 31/03/2030).	INNS_INV = 2 investigations INNS_ND = 1 schemes INNS_MON = 2 monitoring actions INNS_IMP = no schemes.	EA and water company led. INNS actions have been identified through AMP7 investigations, risk assessments and options appraisals and following discussion with task groups from Hydroecology and INNS water UK networks (EA in attendance).
Sites of Special Scientific Interest (SSSI)	SSSI_IMP (S+) (action to contribute to restoration of a SSSI to favourable condition. Completion date 31/03/2030). SSSI_ND (S+) (action to contribute to maintenance of (prevent deterioration of) the condition of a SSSI. Completion date 31/03/2030) SSSI_INV (S+) (investigation and/or options appraisal to determine impacts of water company activities, or permit or licence conditions/standards on a SSSI or to determine the costs and technical feasibility of meeting targets. Completion date 30/04/2027).	SSSI_IMP = 3 schemes SSSI_ND = no schemes SSSI_INV = no investigations	EA, NE and water company led. Schemes – data on the NE Designated Sites System8 regarding the condition status, threats and remedies for both SSSIs owned and SSSI influenced by UUW is reviewed annually. Any changes to the overall condition report are investigated. Where investment is required then the SSSI is identified for the next WINEP. No new SSSIs requirements have been identified through this process; only those already known about. Existing AMP7 SSSI schemes were reviewed by UUW and NE specialist advisers to identify the potential for further site implementation in AMP8. NE shared a list of current/new opportunities for UUW to invest in SSSI improvements. The resulting list of SSSI schemes has been shared and agreed with NE and EA.

[8] Natural England. *Designated Sites Portal*. Link here

PR24 WINEP/NEP drivers	Driver codes and regulatory dates (S = statutory obligations) (S+ = statutory plus obligations)	Number of actions	Methodology for identifying actions
Biodiversity	NERC_INV (S+) (investigations and/or options appraisal for changes to permits or licences, and/or other action that contributes towards biodiversity duties, requirements and priorities. Completion date 30/04/2027). NERC_IMP (S+) (Changes to permits or licences, and/or other action that contributes towards biodiversity duties, requirements and priorities. Completion date 31/03/2030)	NERC_INV = 1 investigation NERC_IMP = 4 schemes	EA, NE and water company led. Schemes – liaison with UUW, NE and the EA was undertaken to review biodiversity and monitoring data to identify opportunities for implementation schemes under the biodiversity driver given the expected biodiversity benefit to be delivered by catchment interventions. This approach and list of biodiversity schemes was agreed with NE and EA. Investigations – EA requested inclusion of an investigation into fish passage improvements at a UU owned weir due to the impact on salmon (priority species).
Environmental Destination/Water Resources Management Plans (WRMPs)	EDWRMP_INV (S) (investigations, options appraisals or feasibility studies for actions identified within the WRMP to meet regional planning requirements that do not fit with WFD driver requirements. Completion date 31/12/2026). EDWRMP_IMP (S+) (actions identified within the WRMP to meet regional planning requirements that do not fit with WFD driver requirements. Completion date 31/03/2030).	EDWRMP_INV = 11 investigations. EDWRMP_IMP = no schemes.	Water company led. These drivers are to meet environmental requirements that are beyond current WFD objectives. This driver can be used to identify investigations and solutions to contribute to the environmental destination as set out in WRMP24 and the Regional plan. In accordance with the driver guidance, we have identified investigations to contribute to the environmental destination as set out in the draft WRMP24 Environmental destination technical report[9] and the Water Resources West Regional Plan appendix D10. The methodology followed to identify the investigations is outlined in both of the supporting documents. Section 3 of UU's draft WRMP24 technical appendix shows the iterative process that has been developed in collaboration through the Water Resources West environmental destination work stream. The resulting list of schemes has been shared and agreed with the EA.

[9] UUW (2024) *Draft WRMP24 Environmental destination technical report*. Internal issue.

[10] UUW (2022) *Water Resources West Regional Plan appendix D*. Available here.

4.3.5 Appendix B provides a full list of identified WINEP/NEP actions for delivery in AMP8. Appendix C provides a full list of WINEP/NEP actions with their associated costs.

4.3.6 The driver guidance review identified that UUW has no actions to address under two of the overarching drivers – monitoring for flow compliance and salmon and sea trout entrainment. UUW submitted a nil return document to the EA detailing out why no actions had been put forward under these drivers.

4.3.7 All actions identified through the driver guidance review prompted a requirements statement to be produced that clearly set out the requirements and evidence for the need, as per step 2 in Figure 2. At this point UUW's internal Risk and Value (RV) process was triggered, as per step 3 in Figure 2. This process is a well-established three stage process that all proposed needs must go through to ensure risks are appropriately treated to gain best value outcomes.

4.3.8 The requirements statements were submitted to the RV0 gateway. RV0 comprises a holistic team of specialists that challenge the requirements and evidence for the need. Identified WINEP/NEP actions only progressed through RV0 to the next stage if the RV team were satisfied that the evidence provided validated the need.

4.3.9 All actions included within the scope of this enhancement claim, have been reviewed and endorsed through UUW's internal RV process as well as by the relevant external parties (the EA, NRW, NE).

4.4 Scale and timing of investment

4.4.1 UUW's proposed AMP8 WINEP/NEP programme comprises statutory and statutory plus WINEP/NEP obligations, which have dictated the scale and timing of the WINEP/NEP enhancement investment required.

4.4.2 The EA's PR24 profiling of WINEP actions[11] document sets out the required deadline dates that actions must be delivered by. All deadlines for the statutory and statutory plus water drivers are within AMP8.

4.4.3 As stated in the WINEP methodology, statutory obligations arise from legal requirements and therefore water companies must complete statutory WINEP actions, by the timescales dictated.

4.4.4 Statutory plus obligations are also set out in legislation and are therefore required to be completed, by the timescales set out in the driver guidance. However, unlike statutory obligations, they can include an assessment of benefits versus cost. If an action is deemed disproportionately expensive alternative objectives or extended timescales may be set at the discretion of the EA/NRW. Disproportionality of cost was not applicable to any schemes UUW put forward and therefore we are obliged to deliver in line with driver guidance timescales, all of which are within AMP8.

4.4.5 WINEP/NEP programmes can include non-statutory requirements that go above and beyond the minimum legal requirements if there is sufficient customer support to validate the need. UUW has not proposed any non-statutory actions as we did not find any prospective schemes to be cost-beneficial so we sought to minimise our investment in this area.

4.4.6 Multiple pieces of customer research point to the importance of balancing the need to improve the environment with affordability of customer bills. As such, we have set out to include largely statutory requirements in the plan, drive innovation and utilise partnerships where possible.

4.5 Base Maintenance & Enhancement Expenditure

4.5.1 A number of AMP7 WINEP/NEP investigation schemes, funded through enhancement spend, have led to the proposal of AMP8 WINEP/NEP implementation schemes or continued investigation schemes. This process ensures we are investing in the right area and in the right way.

4.5.2 An internal assurance, sample based review, of the cost build-ups has been undertaken, as per Appendix E. This was to identify if any base maintenance requirements had been included, and therefore would

[11] DEFRA (2022) *Water Industry Planning PR24 profiling of WINEP actions*. Available on EA internal sharepoint shared with UUW.

count towards the implicit allowance. We can confirm that there is no overlap of the proposed WINEP/NEP enhancement projects with any activities we are undertaking through base in AMP7 nor AMP8. This is because our proposals are incremental and therefore do not replace or improve existing assets in any material way.

4.5.3 We are submitting an enhancement claim to Ofwat with the support of the Drinking Water Inspectorate (DWI) to undertake improvements at our Water Treatment Works (WTW) where we have been impacted by changing raw water quality. This is in relation to taste and odour compounds, which have deteriorated beyond design parameters of the WTW. As a twin-track approach we have proposed WINEP/NEP investigations under the DrWPA investigation driver into source and pathway of algae and geosmin on four of our catchments that feed the affected WTWs, these are: Hurleston WTW catchment, Ridgegate WTW catchment, Lamaload WTW catchment, and Cowpe WTW catchment. Catchment solutions such as this minimise the need for further, more expensive work at WTWs in the future.

4.6 Integration with Other Planning Frameworks

4.6.1 We have worked to ensure that our Water WINEP/NEP development has integrated with other planning frameworks. This includes:

- *River basin management plans* – A number of activities on the AMP8 WINEP/NEP e.g. changes to abstraction support the achievement of environment quality objectives and contribute to preventing deterioration in water bodies.
- *Water Resources Management Plans (WRMP)* – AMP7 WINEP/NEP investigations and option appraisals have informed our WRMP and defined the prevent deterioration actions for PR24. Through the AMP8 WINEP/NEP we will carry out further investigations into sustainable abstraction as part of the Environmental Destination set out for Water Resources West. These investigations are to assess current licences within the aquifer to understand if additional licence capping is required in the long term considering different climate change scenarios. Outputs will feed into WRMP29 and next round of regional planning.
- *Drinking water safety plan* - Outputs of our WINEP/NEP investigations, analysis of raw water quality and the Drinking Water Safety Plan have been used to inform the development of our AMP8 Drinking Water Protected Area WINEP/NEP actions.
- *Local Nature Recovery Strategies* – Some of our catchment land is likely to be integral to Local Nature Recovery Strategies as it forms part of Nature Recovery Networks. This includes WINEP schemes to improve catchment land at Thirlmere, Haweswater, Bowland, West Pennines, South Pennines, Poaka Beck and Upper Duddon.
- *Biodiversity PR24 performance commitment* – Biodiversity is an Ofwat performance commitment for PR24. Biodiversity improvements associated with WINEP/NEP actions will be included in the delivery of this performance commitment.
- *Long Term Delivery Strategy* (LTDS) - The LTDS is a new requirement for the 2024 price review which requires companies to define a 2050 ambition and develop a strategy to deliver that ambition under a range of scenarios. Four common reference scenarios (CRSs) have been defined by Ofwat (climate change, technology, demand, abstraction reductions) and companies are also expected to develop wider scenarios (see *UUW12 - Long Term Delivery Strategy* document for more details). Ofwat expects companies to consider a wide range of possible impacts of the scenarios, see 4.7.1- 4.7.2 for further details.

4.7 Long Term Delivery Strategy (LTDS)

4.7.1 We have built our Water WINEP enhancement case around the AMP8 WINEP programme, consequently there is a statutory need for these investments during AMP8. In order to ensure this reflects low regrets

investment we have challenged drivers and worked with regulators to prioritise needs. Additionally we have considered phasing of solutions into AMP9.

4.7.2 The enhancement case includes 56 investigations (including Pennington investigation, under a secondary driver, as part of the overall implementation scheme), these will help us to understand the needs, reduce uncertainty and prioritise the timing of solutions in the context of the long term plan. In our LTDS we have considered the likely need for future WINEP drivers, the assumptions and associated costs are outlined in the core pathway. Additionally we have considered the impact of different scenarios on future WINEP need, including climate change, demand, technology, abstraction reductions and changing expectations. Our core pathway comprises low regrets solutions that deliver our ambition under most scenarios. An adverse climate change scenario may require that we move to an alternative pathway, with a trigger point in AMP9.

4.8 Customer Support

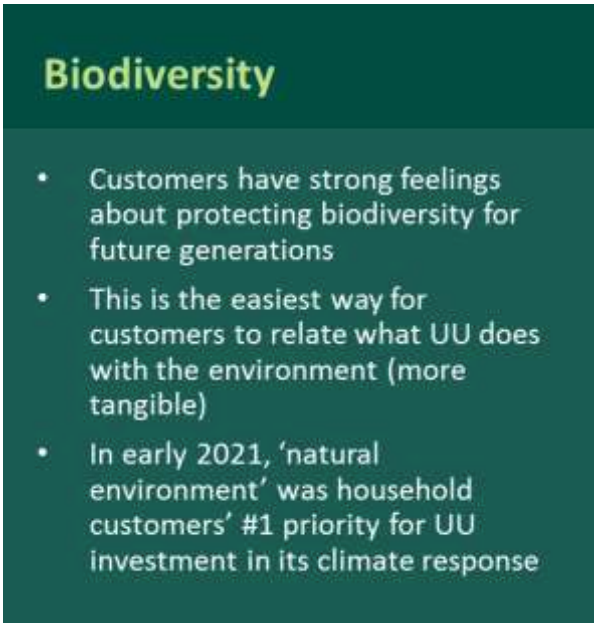
4.8.1 UUW has not undertaken specific customer research into the Water WINEP/NEP as the service improvement to be delivered through WINEP/NEP drivers is mandated by regulations or law.

4.8.2 However, the Water WINEP will deliver improvements to ensure we can continue to manage the interdependency that our water abstraction requirements have on the natural environment thereby protecting and enhancing biodiversity.

4.8.3 As part of the Price Review and development of other plans, UUW has been undertaking customer research that gives us an insight into how customers view and prioritise environmental outcomes and spend.

4.8.4 At PR24, water companies are required to set out their five-year business plans in the context of a 25-year Long-Term Delivery Strategy (LTDS). Customer input is vital for building a successful LTDS. Customer research undertaken, in 2023, as part of developing the LTDS has shown that customers do regard the environment as a high priority. Figure 3 indicates current insight from customers with regard to biodiversity.

Figure 3: Customers insight into biodiversity

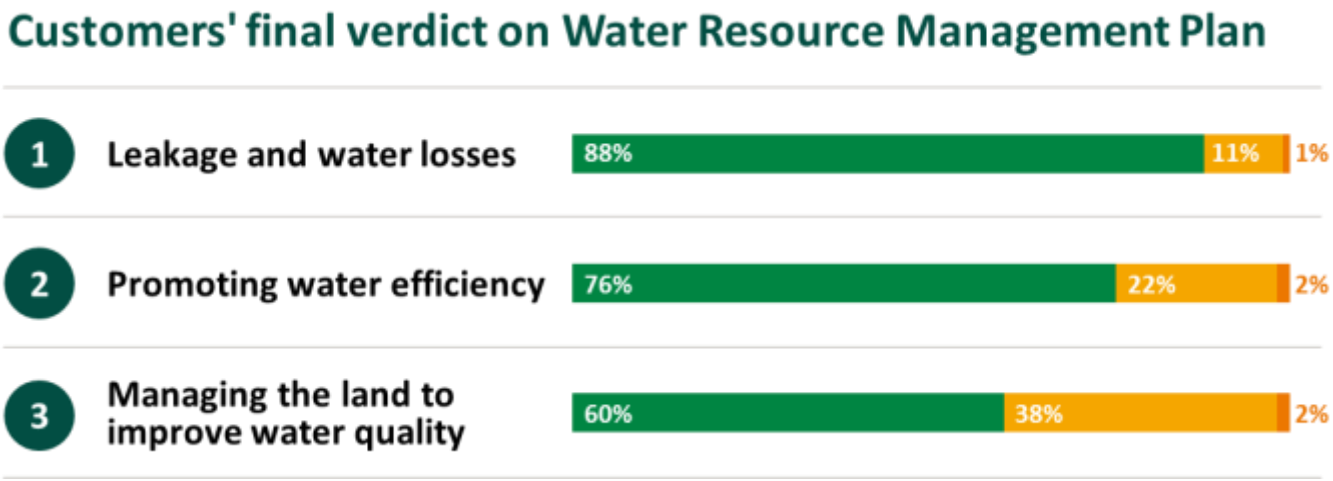


Source: LTDS Synthesis Report Final, slide 16

4.8.5 Customer research undertaken, in 2021, as part of developing the WRMP has indicated that land management to improve water quality came out as third most acceptable option, see Figure 4, this demonstrates a high level of support for this approach. UUW has proposed four implementation

schemes to undertake land management where raw water quality is deteriorating: Huntington and Sutton Hall (River Dee) for turbidity; Errwood and Fernilee and Wybersley for colour; Hodder/Stocks for colour; and Franklaw for ammonia. We also have twenty one drinking water protected area investigations put forward for AMP8 that may deliver land management activities to improve water quality in AMP9.

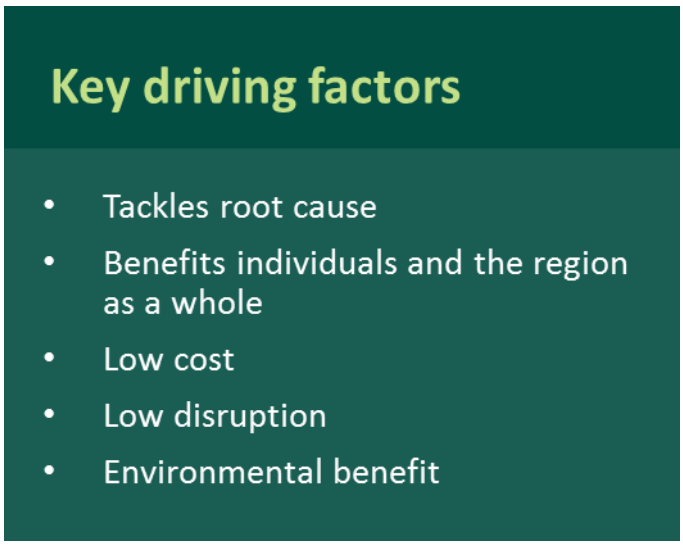
Figure 4: WRMP research into customer priorities



(Source: DWMP/ WRMP Immersive options overview, slide 25)

4.8.6 Customers' key driving factors for this ranking are shown in Figure 5. These driving factors align with the cost and benefits of undertaking a catchment based approach as advocated through the WINEP/NEP process.

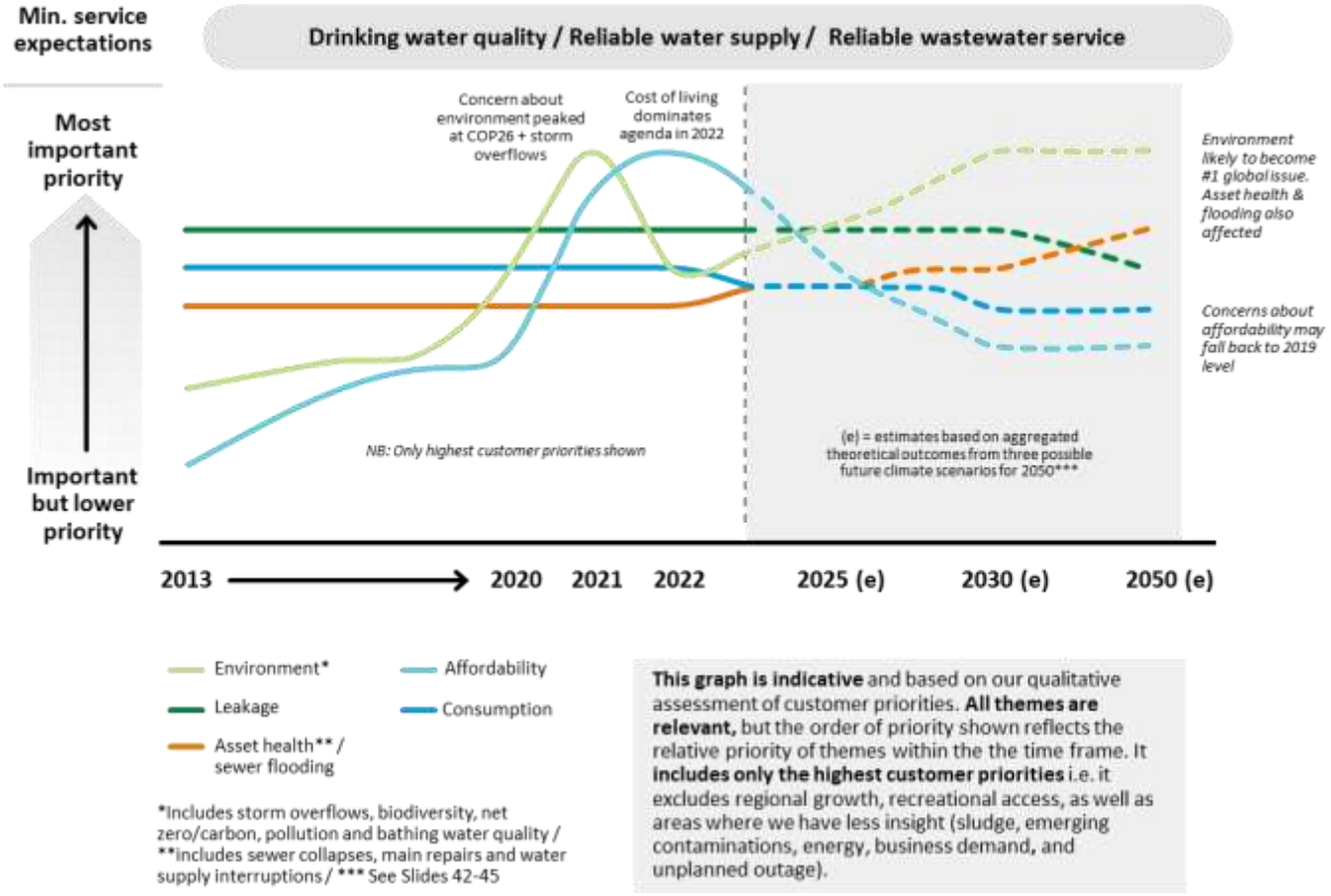
Figure 5: WRMP research - driving factors for ranking of land management to improve water quality



(Source: DWMP/ WRMP Immersive options overview, slide 71)

4.8.7 Figure 6, taken from the LTDS research, indicates that future trends predict that the environment will become customers highest priority from 2025/2026 onwards.

Figure 6: Future trends of customer priorities



Source: LTDS Synthesis Report Final, slide 7

4.8.8 One of the five key messages that came out of undertaking customer research in 2023 was that the environment is likely to rise to the fore by 2050 – either as a reaction to negative climate events or after global efforts to tackle adverse effects in the intervening decades.

4.8.9 As part of WRMP research, undertaken in April 2021, answers received when asked what people themselves feel is important were; 'the impact on the environment is a constant concern' and customers 'love living in an area with lots of countryside and green space (perhaps heightened by COVID-19 pandemic) and want this to be preserved'. We consider this to be evidence that customers support UUW's continued compliance with its environmental obligations.

4.9 Management Control

4.9.1 The obligation to deliver the Water WINEP/NEP is driven by factors outside of management control, as legislation dictates high level outcomes water companies must achieve.

4.9.2 Therefore to ensure the best value for customers UUW has fully engaged with the EA and other relevant stakeholders in building up the WINEP/NEP programme. This includes following and enhancing the WINEP/NEP methodology and aligning to our internal Risk and Value process, as described in sections 4.3.7 to 4.3.8. This ensures robust cost-benefit appraisals and best value analysis has been undertaken when considering which options to take forward. This process will be described in detail in 5.2. This approach minimises the risk of factors outside of management control.

4.9.3 Much of our risk and issue identification also utilised evidence gathered through our AMP7 WINEP/NEP investigation programme. The WINEP/NEP investigations programme supports the robust identification of the need for future environmental improvement schemes such that we are playing our fair share in delivering environmental improvements and they are based on sound evidence. Where evidence of environmental impact is uncertain, we have proposed further investigations in AMP8 to ensure that any

interventions are based on robust evidence. For example in AMP7 we undertook seven catchment investigations into the source of algae, these were at our Ashworth Moor, Haslingden Grane, Laneshaw, Mitchells, Ridgegate and Rivington catchments. It was expected that the investigations would provide clear conclusions with which we could then propose AMP8 implementation schemes to deal with the algae issues. However, the investigations deemed that investment in the catchment would not have a tangible impact on algae or geosmin. Instead, further investigations have been recommended. This recommendation was reviewed with the EA and agreed that a further round of investigations would be undertaken in AMP8 in order to ensure the best value outcome for customer's money.

4.9.4 We have also reviewed and influenced the requirements to ensure the investigations programme only includes investigations which are relevant to our duties as a water company and have a realistic possibility of leading to environmental improvements in future AMPs. Half (55no. based on primary drivers) of the AMP8 Water WINEP/NEP programme is made up of investigations.

4.9.5 This collaborative risk and issue identification process has ensured that we are prioritising and investing in areas which have a well evidenced environmental need, and that we are meeting those needs in the most efficient way. We have also sought to identify opportunities for partnership working, such that the best value for customers and the environment is secured, see 5.7.1 to 5.7.6.

4.9.6 Section 6 on cost efficiency will discuss details as to what steps have been taken to control costs.

5. Best option for customers

5.1 Overview

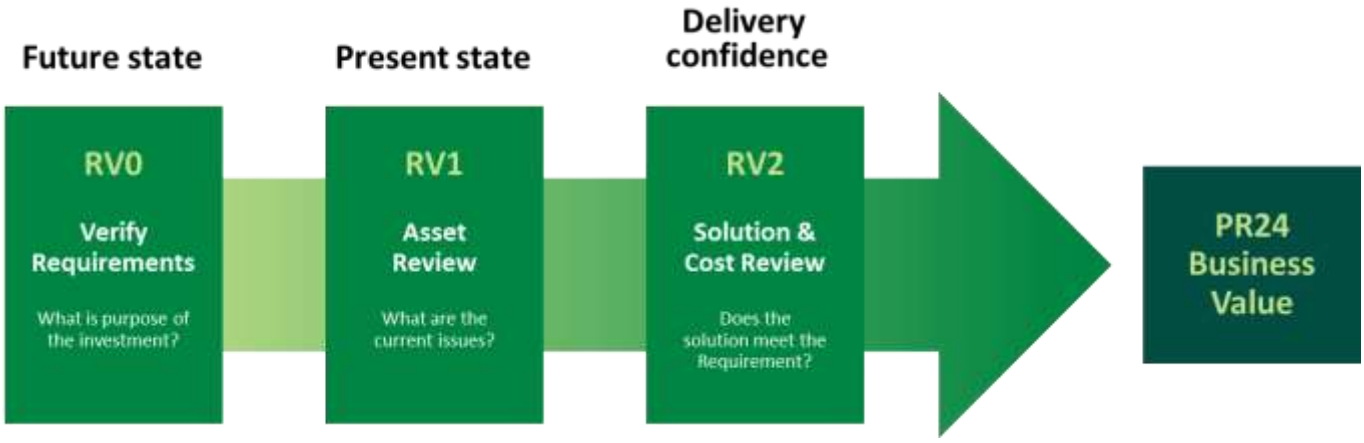
5.1.1 UUW wants to ensure the Water WINEP/NEP programme represents the best value for customers whilst also delivering its statutory environmental obligations. The EA/NRW also have a requirement to demonstrate how WINEP/NEP will deliver benefits to the environment for the money invested by water companies.

Following on from a robust needs identification phase, the options development and selection phase (Figure 2, step 4) also followed a robust methodology.

5.2 Options development

5.2.1 Our options development and assessment process has been undertaken in line with the EA's WINEP/NEP guidance and we have aligned this with the fundamental principles of UUW's defined value management process. Risk and Value for PR24 (RV) is a three stage process (shown in Figure 7), aimed at positively challenging our projects to ensure we have sufficient evidence behind decisions. It provides UUW with confidence that we are proposing the right projects for the AMP8 programme and therefore managing and maximising the value for customers from our investments. It also ensures that the organisation adopts a robust approach to options identification, development and selection to maximise the realisation of benefits associated with these investments.

Figure 7: UUW's Risk and Value process



5.2.2 Figure 8 portrays the options development process stages, which sit under step 4 of Figure 2 and also details further the RV1 and RV2 phases as shown in Figure 7. Table 3 describes the activity at each step in the options development process.

5.2.3 For schemes where there is uncertainty over the issue, solution or benefits UUW has proposed a programme of investigations ahead of action to ensure that any future investment in interventions is based on sound evidence and can therefore ensure best value.

Figure 8: Options development process stages

Table 3: Description of activity at each step in options development process

Process stage	Key activity
Risk and Value 1	Baseline performance and condition of assets is understood based on data from UUW corporate systems and models.
Unconstrained options	Unconstrained options are identified through use of the Generic High Level Solution (GHLS) categories (see Table 4), options from PR19 investigations and the process decision matrix.
Constrained options	A series of coarse filter tools are used to filter the constrained options. These tools consider a range of factors including high level costing, high level deliverability, technical feasibility, land constraints, catchment opportunities, potential for nature-based solutions, headroom in existing assets/processes and carbon opportunities.
Risk and Value 2	Each constrained option is reviewed to confirm it will meet the WINEP/NEP requirement and, therefore, it can proceed to consideration as part of the best value assessment.
Best value assessment	Cost, carbon, benefits, biodiversity net gain assessed for each option.
Preferred option selection	The output of the carbon, cost, benefit and best value assessments is reviewed at a programme level as part of our internal governance for WINEP/NEP development to ensure that decisions around options selection are fully justified.

5.2.4 As per Figure 8 each WINEP/NEP requirement passes through a series of stages before the agreed solution is confirmed. The process follows a staged approach which moves from unconstrained options to constrained options and then to feasible options with an audit trail as to why options are discounted at each step.

5.2.5 For each requirement, as part of the Options Development process, un-constrained options were identified against a list of Generic High Level Solution (GHLS) categories. The GHLS categories are set out in Table 4.

5.2.6 To ensure a truly best value approach it is important to have a broad range of innovative, value-adding solutions to choose from. At the options development phase we used pre-defined GHLS' to provide a starting point for our Engineering team. This list of solutions includes a partnerships option, an operational optimisation option, and a nature-based option, which means that we have value-adding options flowing into the optioneering process.

Table 4: Generic High Level Solutions

GHLS	Description
Monitor & Respond	Accept risk with agreed contingency plan
Operational Intervention	Solve need by identifying targeted maintenance to restore performance
Optimise Asset	Solve need by improving performance of existing equipment
Partnership	Solving need by assistance of third parties, i.e. assisting farmers reduce pollution of watercourses
Refurbish Asset	Major asset refurbishment to restore asset life and performance
Replacement	Replace asset(s) on like for like basis
New Asset	Build new asset when all other options are not possible (this could be a NBS)
Integrated Approach	Integrated solution across asset boundaries e.g. network, process, bio-resources or catchment level solutions. An integrated solution is a systems thinking response and could be a combination of the above solution types.
Combination of generic high level solutions	Example - Licence modification and Low flow support from Manley Common to Ashton Brook

5.3 Co-creating solutions and maximising partnerships

5.3.1 A large proportion of the water WINEP/NEP programme is based around catchment interventions and nature based solutions and therefore options development was largely bespoke for each requirement. Solutions were in the main based on previous investigation reports, site specific requirements, expert judgement based on past experience of similar schemes, and in conjunction with other partners.

5.3.2 Catchment management is important as it deals with the source of the issue and provides a first line of defence at the WTW. This helps to minimise asset interventions required at the WTWs as well as providing other benefits such as resilience in our catchments and efficient customer bills. UUW recognise that there is significant value in co-creating solutions with partners who have shared or aligned interests as this leads to opportunities for co-funding. In several areas we have co-created solutions with others.

5.3.3 As part of the Natural Course collaborative project, individuals from the partner organisations (Rivers Trust and NE) were seconded into UUW for a three month period to co-develop options for the WINEP/NEP. Workshops were held with UUW's water catchment and property teams along with the Responsible Officers and area teams from NE, EA and Rivers Trusts to identify risks, opportunities and solutions related to designated sites and biodiversity in general. These were shared with UU and combined with the WINEP/NEP driver guidance to agree the sites that could be included for enhancement as part of the WINEP/NEP.

5.3.4 Also for designated sites and biodiversity schemes the Designated Sites portal[12] provides a comprehensive list of threats and remedies required to achieve favourable condition for each unit of a SSSI. This was reviewed, along with up to date survey data to agree a reasonable programme for delivery in AMP8. Innovative practices were also proposed, such as the use of conservation grazing to achieve multiple benefits (e.g. increased biodiversity and reduced wildfire risk). It was agreed that whole-farm plans would be the best approach to manage the activity and the use of partnership resources such as project officers and farm advisers would be an important part of co-delivery for the schemes.

5.3.5 Where a potential partnership opportunity was identified a partnership-based option was developed using the UU partnership framework. The framework signposts tools that can be used to support the assessment of suitable potential partnerships and formation of successful partnerships. This was developed in collaboration with the strategy managers to identify relevant partners, seek opportunities for co-funding and assess technical feasibility.

5.4 Options selection

5.4.1 All of the water WINEP/NEP requirements came out as single options. In the main this was to do with the fact that the majority of the proposed AMP8 schemes had already gone through an options development phase as part of a previous investigation project. Therefore the preferred solutions had either already been detailed out or are part of an on-going multi-AMP approach.

5.4.2 Table 5 details out why schemes under each driver code came out as single option.

[12] Natural England. Designated Sites Portal. Link here: https://designatedsites.naturalengland.org.uk/

Table 5: Optioneering - single option reasons

Driver Code	No. of Schemes	Schemes	Reason for single option
WFD – Hydrological Regime: WFD_ND_WRFlow & WFD_IMP_WRFlow	28	28 implementation schemes (as detailed in Appendix B) either licence revocations or variations, some with associated stream support (providing water to the watercourse)	Optioneering phase already undertaken in AMP7 as part of the associated projects, which have determined the preferred solutions
WFD - Heavily Modified Water Bodies: WFD_ND_WRHMWB; WFD_IMP_WRHMWB; W_WFD_WRHMWB_IMP1	4	Pennington reservoir – provision of compensation flow	An investigation and implementation scheme in AMP8. The investigation scheme will undertake options appraisal and development
		Vyrnwy reservoir – re-gravelling the downstream watercourse	
		Calder weir – allow fish passage upstream of the weir	Optioneering phase already undertaken in AMP7 as part of the associated projects, which have determined the preferred solutions
		Stocks reservoir mitigation – improving downstream river morphology	
WFD – Physical Habitat: WFD_IMP_PHYSHAB	2	Hug Bridge weir	Optioneering phase already undertaken in AMP7 as part of the associated projects, which have determined the preferred solution
		Taxal gauging weir	
Drinking Water Protected Areas: DrWPA_ND; DrWPA_IMP; W_DrWPA_NDIMP1	4	Huntington and Sutton Hall (River Dee turbidity)	Optioneering phase already undertaken in AMP7 as part of the associated projects, which have determined the preferred solutions
		Errwood & Fernilee & Wybersley colour	
		Hodder/Stocks colour phase 2	
		Franklaw ammonia	On-going AMP7 green recovery project has informed AMP8 solution and scope
Habitat Regulations (European Sites): HD_IMP; HD_ND; W_HR_NDIMP1	5	Ennerdale infrastructure removal design phase	The River Ehen compensatory measures package of works has decided the appropriate solution for Ennerdale, Crummock, Overwater & Chapel House – ongoing AMP7 design phase schemes (multiple AMP delivery)
		Crummock infrastructure removal	
		Overwater infrastructure removal	
		Chapel House infrastructure removal	
		South Pennines	On-going AMP7 green recovery project has informed AMP8 solution and scope
Eels: EE_IMP; W_EEL_IMP1	3	Horseshoe Falls abstraction – eel screening	AMP7 stakeholder discussions has informed AMP8 solution
		Haweswater reservoir – AMbOM	Solution based on previous AMP6 investigation report and EA guidance
		Stocks reservoir – AMbOM	
Invasive Non Native Species (INNS): INNS_ND INNS_MON	3	INNS mitigation actions	Optioneering phase already undertaken in AMP7 as part of the associated projects, which have determined the preferred solutions
		INNS surveillance development	Solution based on EA guidance and requirements.
		INNS surveillance programmes	
Sites of Special Scientific Interest (SSSI):	3	Bowland SSSI	Optioneering phase already undertaken in AMP7 as part of the associated

Driver Code	No. of Schemes	Schemes	Reason for single option
SSSI_IMP: SSSI_ND		Haweswater SSSI	projects, which have determined the preferred solutions under a partnership approach
		West Pennines SSSI	On-going AMP7 WINEP and green recovery project has informed AMP8 solution and scope under a partnership approach
Natural Environment and Rural Communities (NERC) biodiversity priority: NERC_IMP	4	River Eden	On-going AMP7 WINEP and green recovery projects have informed AMP8 solution and scope under a partnership approach
		Poaka Beck	
		Upper Duddon	
		Thirlmere	
All investigations under all drivers	56	Investigations under all drivers (Pennington and Vyrnwy have both an investigation and implementation driver under the same action ID)	Where a new or known issue requires investigation in order to be able to determine the most effective solution

5.4.3 Despite all the water WINEP/NEP requirements coming out as single options the proposed solutions still followed the options development process, as detailed in Figure 8. This was to ensure the options were assessed to ensure they would deliver the need and allow projects to progress to detailed scope development and cost estimating.

5.4.4 The options were costed and assessed for deliverability, feasibility, and opportunities. A review was undertaken by the Planning, Land & Environmental Team and UUW's Construction Services which allowed identification of risks and potential mitigation measures. This improved the cost accuracy associated with implementing the PR24 solution, it also allowed elimination of options which are not deliverable thereby confirming feasibility.

5.4.5 A detailed assessment of the options ensured all the appropriate information was fed into the RV2 meeting to allow a robust verification that the solution was fit for purpose and could proceed to the best value assessment phase.

5.5 Best value analysis

5.5.1 Best value analysis allows different options for a deliverable to be judged against each other in a consistent way to allow decision makers to select a preferred solution based on outcomes that are most important.

5.5.2 In the context of the Water WINEP/NEP all actions were single option with no alternative to be judged against. Equally statutory WINEP/NEP driver requirements are statutory obligations with water companies required to complete WINEP/NEP actions to fulfil these duties regardless of cost-benefit analysis. Only the statutory plus drivers require an assessment of costs and benefits to ensure the most appropriate solution is taken forward. Where a statutory plus action is considered disproportionately expensive to meet, alternative objectives, or extended timescales to meet the objectives, may be set.

5.5.3 Despite being single options UUW put all schemes through the best value analysis process in order to ensure the single options being put forward represent value for customers and if not provided evidence in order to challenge back on the requirement where appropriate (only relevant to statutory plus drivers).

5.5.4 UUW has developed the "PR24 Value Tool" which allows us to quantify the economic value of a wide range of priorities to assess a whole life calculation of best value over thirty years, see *UUW45 – our approach to deliver best value totex* for further information.

5.5.5 The tool has been developed by internal SMEs and aligns with Ofwat's guidance (appendix 9 section 6.1)[13] and the EA's WINEP/NEP Options Development Guidance[14]. The tool and process have been assured by a qualified and experienced third party to give confidence on the robustness of value estimates and the overall process.

5.5.6 The tool is used to quantify both the 'risk' of not meeting a requirement and the 'value' of implementing the solution. The tool focusses primarily on environmental value and utilises the EA's WEO metrics to quantify value, as requested in the EA WINEP Options Development Guidance. Using the WEOs supports consistency of value assessment between different companies for the WINEP/NEP. Risk is determined based on UUW's risk breakdown structure. See Figure 9 and Figure 10.

5.5.7 The inputs to the value tool included costs (CAPEX, OPEX and whole life), carbon (embedded, operation and whole life), data on biodiversity plus risks and benefits.

Figure 9: Risk-based metrics in the PR24 Value Tool

[13] Ofwat (2022) *Appendix 9 setting expenditure allowances*. Available here: https://www.ofwat.gov.uk/wp-content/uploads/2022/12/PR24_final_methodology_Appendix_9_Setting_Expenditure_Allowances.pdf

[14] DEFRA (2022) *Options Development Guidance*. Available on EA internal sharepoint shared with UUW.

Figure 10: Natural capital-based metrics in the PR24 Value Tool

5.5.8 In addition to the metrics above, carbon emissions are also a prominent metric in our decision making. Carbon is accounted for as a negative benefit (or dis-benefit) in our cost benefit analysis, monetised through the UK Government's cost of carbon. The carbon figures stated in Figure 11 are aligned to the EA WINEP methodology and not the Ofwat performance commitment methodology. For more information on how the management of greenhouse gas emissions and the goal for Net Zero 2050 has been embedded in our decision making, see *Chapter 6 – Delivering social and environmental value*, and the supplementary document *UUW37 - Our strategy to net zero 2050*. This metric is different to the climate regulation metric in the above diagram, which represents carbon sequestration by habitats.

5.5.9 The value tool itself leads SMEs, involved in estimating value, through the relevant questionnaires for the intervention being assessed to quantify performance in terms of consequence, severity and quantity. It then uses agreed valuations to monetise the predicted performance. This gives a consistent unit that can be used in decision making process.

5.6 Best value outputs

5.6.1 All eleven of the AMP8 WINEP/NEP drivers included in the water programme are statutory environmental obligations. Six of these drivers are classed as statutory plus (biodiversity schemes, heavily modified water bodies improvement schemes, eel schemes, INNS surveillance, SSSI schemes and fish passage schemes), which means they can include an assessment of benefits and, in some cases, an additional step of affordability testing. The remaining five drivers are classed as statutory, with water companies required to complete WINEP/NEP actions to fulfil these statutory obligations regardless of cost benefit.

5.6.2 Based on the inputs provided, to the PR24 Value Tool, on each solution against the risk and value metrics the tool calculates the 'cost-benefit' ratio of each solution. Anything with a cost-benefit ratio above 1 means the benefits outweigh the costs of the scheme over thirty years and therefore provides good value to customers.

5.6.3 All statutory plus water WINEP/NEP schemes came out with a 'cost-benefit' ratio above 1 and therefore, despite the schemes being single option, we are confident that they are providing good value to the customer and have therefore been taken forward as our preferred least cost best value options.

5.6.4 Outputs from the options development process and the best value analysis are all recorded within the Options Development Report (ODR) and Options Assessment Report (OAR) documentation, as per the WINEP/NEP methodology, that has been sent to the EA.

5.6.5 Through our WINEP/NEP development process and acceptance by the EA we are forecasting we will deliver Wider Environmental Outcomes (WEOs) over 30 years valued at £651.394 million (FY23 price base) with a whole life carbon reduction of 480, 252.84 tonnes of CO2 equivalent, as detailed in Figure 11.

Figure 11: Benefits to be delivered through the Water WINEP enhancement

	Present Value of Benefits (30 year) £M	Ofwat Driver Total Present Value of all WEO benefits (30 year) £M	Ofwat Driver Total (WEO & risk based metrics) Present Value of all benefits (30 year) £M	Carbon Total (Whole Life Carbon) E + (O*30) - (S*30) (30 year) tC02e*
Overall Total (all Ofwat drivers)		**£651.394**	**£728.342**	**-480,252.84**
Biodiversity and conservation		**£468.870**	**£468.990**	**-248,292.94**
WEO 1: Amenity, Access and Engagement (£M, dp3)	£95.090			
WEO 2: Catchment Resilience (£M, dp3)	£330.280			
WEO 4: Net Zero (£M, dp3)	£43.500			
Other 3: Finance (£M, dp3)	£0.120			
Other 1: Trust and reputation (£M, dp3)	£0.000			
Eels/fish entrainment screens		**£0.370**	**£46.040**	**582.55**
WEO 1: Amenity, Access and Engagement (£M, dp3)	£0.370			
Other 3: Finance (£M, dp3)	£4.570			
Other 1: Trust and reputation (£M, dp3)	41.100			
Eels/fish passes		**£0.123**	**£0.123**	**15.41**
WEO 1: Amenity, Access and Engagement (£M, dp3)	£0.123			
Invasive Non Native Species		**£0.000**	**£0.930**	**0.00**
Other 3: Finance (£M, dp3)	£0.930			
Drinking Water Protected Areas		**£255.731**	**£256.193**	**-235,633.85**
WEO 1: Amenity, Access and Engagement (£M, dp3)	£87.220			
WEO 2: Catchment Resilience (£M, dp3)	£127.991			
WEO 4: Net Zero (£M, dp3)	£40.520			
Other 3: Finance (£M, dp3)	£0.419			
Other 1: Trust and reputation (£M, dp3)	£0.043			
Water Framework Directive		**-£73.700**	**-£43.934**	**3075.99**
WEO 1: Amenity, Access and Engagement (£M, dp3)	£0.140			
WEO 2: Catchment Resilience (£M, dp3)	-£73.840			
WEO 4: Net Zero (£M, dp3)	£0.000			
Other 3: Finance (£M, dp3)	£29.550			
Other 1: Trust and reputation (£M, dp3)	£0.216			

* The carbon figures stated in Figure 11 are aligned to the EA WINEP methodology and not the Ofwat performance commitment methodology

5.6.6 Alongside the benefits detailed in Figure 11 the direct benefits of the proposed schemes and their proposed solutions are:

- Improvements to 10,667 hectares of SSSIs, supporting our overall target to achieve 100% of our owned SSSIs in 'favourable' or 'unfavourable recovering' condition by 2030;
- Restoration of 500 hectares of peatland to improve raw water quality and a sequestration of 16,064.4 tCO2e/hectare/year in carbon emissions;
- Three barriers to fish passage addressed and three risks of eel entrainment mitigated
- Three infrastructure removal projects in order to improve the conservation status at the designated European sites
- Five schemes to contribute to conserving and enhancing biodiversity
- Thirty four schemes to contribute to meeting WFD objectives for improving the environment
- Interventions to contribute to reducing the risk of spread and impact of INNS

5.7 Co-funding and utilising partnerships

5.7.1 As part of the water WINEP/NEP we have sought to identify opportunities for partnership working and obtaining grant funding, such that the best value for customers and the environment is secured. We will be targeting circa £5.3M of partnership contributions to allow us to deliver greater benefit to customers without increasing costs.

5.7.2 As an example, the Huntington and Sutton Hall AMP8 turbidity scheme demonstrates working in partnership. Since 1999 the Dee pollution group has brought together UUW, Hafren Dyfrdwy, Severn Trent, Welsh Water, NRW and the EA to ensure close partnership work to protect water quality. These arrangements have already provided the mechanisms by which the four water companies can work together and have shown that they do so for mutual benefit. All four water companies experience water quality issues at their WTW with turbidity. UUW funded an AMP7 WINEP/NEP investigation into turbidity that identified a large proportion of the sources being runoff from livestock activities. This scheme will deliver the recommendations from that investigation. By having a combined AMP8 catchment scheme we can share knowledge and resources to ensure a more effective and efficient catchment improvement project is delivered. This approach of joint water company working to deliver improved and protected water quality and quantity in the River Dee catchment is a long term ambition covering the next three AMP periods until 2040. We are forecasting partner contribution of circa 30%.

5.7.3 We also anticipate that there will be opportunities under a number of the Water WINEP/NEP drivers to utilise partnerships and obtain grant funding as we progress schemes to implementation phases, see Table 6:

- Some schemes under the Water Environment (WFD) Regulations 2017 driver – working with partners to improve the natural environment in mitigation for our assets and activities
- Drinking Water Protected Area Driver – working with partners to deliver catchment restoration and resilience initiatives for raw water quality
- Habitat Drivers – Habitat Regulations (European Sites), SSSI and NERC drivers – working with partners to deliver habitat improvement initiatives on catchment
- Some schemes under the Eels Driver – working with partners to improve eel habitat and passage.

5.7.4 We have confidence in securing partnership funding having operated in this way for multiple AMPs where we have demonstrated leveraged funding which has risen from a ratio of UUW to partnership funding of 1:2.5 in 2014/15 to 1:6.9 in 2019/20.

5.7.5 There are a number of schemes in which we are confident that we will be able to work in partnership and obtain grant funding, see Table 6.

Table 6: Partnership funding opportunities AMP8 WINEP/NEP

Scheme	Partner (s)	Total cost (UUW AMP8 & TI Totex (post frontier shift and RPE assumptions) plus partnership contribution)	UUW (Totex) AMP8 & TI Totex (post frontier shift and RPE assumptions)	Estimated partner contribution	Rationale
Errwood and Fernilee & Wybersley Colour – Goyt – DrWPA driver	National Trust	£5,186,944.53	£4,186,944.53	£1,000,000.00	Estimate. Potential co-funding from peatland restoration grants and National Trust funding in-kind We have a successful history of undertaking peatland restoration on our catchments and obtaining grant funding to help do this.
Franklaw – colour and ammonia – DrWPA driver	Wyre Rivers Trust	£344,062.84	£344,062.84	To be confirmed	No defined route as yet but complimentary funding will be sought. Potential co-funding from a blend of catchment sensitive farming/woodland planting grants, ELMs. On owned land our tenants are able to obtain stewardship grants that align with our land management objectives. We have a successful history of obtaining and delivering benefits under stewardship grants.
Huntington and Sutton Hall turbidity – DrWPA driver	WaSCs	£2,522,766.54	£1,687,766.54	£835,000.00	£835,000 co-funding from Severn Trent, Welsh Water and Hafren Dyfrdwy. Potential further co-funding from catchment sensitive farming/woodland planting grants, ELMs. On owned land our tenants are able to obtain stewardship grants that align with our land management objectives. We have a successful history of obtaining and delivering benefits under stewardship grants.
River Eden – NERC driver	Eden Rivers Trust	£193,513.63	£193,513.63	To be confirmed	No defined route as yet but complimentary funding will be sought. Potential co-funding from nutrient neutrality, catchment sensitive farming/woodland planting grants, ELMs On land we own our tenants are able to obtain stewardship grants that align with our land management objectives. We have a successful history of obtaining and delivering benefits under stewardship grants.

Scheme	Partner (s)	Total cost (UUW AMP8 & TI Totex (post frontier shift and RPE assumptions) plus partnership contribution)	UUW (Totex) AMP8 & TI Totex (post frontier shift and RPE assumptions)	Estimated partner contribution	Rationale
South Pennines – Habitats driver	Moors for the Future	£6,560,063.75	£5,060,063.75	£1,500,000.00	Estimate. Assumed 75% matched funding from peatland restoration and Natural Flood Management (NFM) grants. We have a successful history of undertaking peatland restoration on our catchments and obtaining grant funding to help do this.
Thirlmere resilience – NERC driver	John Muir Trust, Cumbria Wildlife Trust, West Cumbria Rivers Trust	£3,630,288.15	£3,130,228.15	£500,000.00	Estimate. Potential co-funding from Countryside Stewardship/ELMs, woodland planting grants. On land we own our tenants are able to obtain stewardship grants that align with our land management objectives. We have a successful history of obtaining and delivering benefits under stewardship grants.
Bowland – SSSI driver	Forest of Bowland Area of Outstanding Natural Beauty (AONB)	£2,554,130.72	£2,054,130.72	£500,000.00	Estimate. Assumed 40% matched funding from peatland restoration grants. We have a successful history of undertaking peatland restoration on our catchments and obtaining grant funding to help do this.
West Pennines – SSSI driver	Lancashire Peat Partnership, Woodland Trust, Moors for the Future	£2,717,380.72	£1,717,380.72	£1,000,000.00	Estimate. Potential co-funding from a blend of catchment sensitive farming/woodland planting grants, ELMs. On land we own our tenants are able to obtain stewardship grants that align with our land management objectives. We have a successful history of obtaining and delivering benefits under stewardship grants.
Total		**£23,709,150.88**	**£18,374,090.88**	**£ 5,335,000.00**	

5.7.6 Table 7 indicates some of the grant funding we have previously secured for delivery schemes that give us confidence in the levels of grant funding we feel we will be able to achieve as part of the AMP8 WINEP/NEP. There is some uncertainty this far in advance as to what specific grants and totals will be available. However we have taken this into account when developing the expected grant funding income. Document *UUW38 - Working in Partnership* sets out further details as to our partnership approach.

Table 7: Historic grant funding

Location	AMP	Source of funding	Purpose	Area covered (hectares)	Amount
Cumbria and Bowland catchments	AMP7	Nature for climate grant	Improve moorland habitat	1,063 hectares	£2.4 million
Various UU moorland catchments in the South Pennine Moors	AMP6	MoorLife 2020 grant	Improve moorland habitat	9,500 hectares total (not all funding was spent on UUW catchment land as grant was a joint bid with a focus on improving peatland in the wider South Pennine Moors) c3,167 hectares of UUW catchment land benefitted	€16million (euros) total – split three ways between UUW, Yorkshire Water and Severn Trent. c€5.3million spent on UUW catchment land
Lostock / Franklaw catchments	AMP6	Pennine Peatlife grant	Improve moorland habitat	1,353 hectares total (not all funding was spent on UUW catchment land as grant was a joint bid with a focus on improving peatland in the wider North Pennine Moors)	€3.8 million (euros) total UUW paid 10% leverage and therefore got 10% of benefit
Poaka Beck catchment	AMP7	South Cumbria Rivers Trust	Reduce risks to raw water quality parameters in the catchment	Contribution in time of an assistant project officer	£20,000 per year
Cheshire boreholes groundwater catchments	AMP6& 7	Countryside Stewardship grant	Reduce risks to raw water quality parameters in the catchment	6,592 hectares	£275,000
Watchgate catchments	AMP7	RSPB - Government green recovery grant	Improve biodiversity and tree habitat	3,000 hectares	£250,000

Source: UUW analysis of historic grant funding

6. Cost efficiency

6.1 Overview

6.1.1 This section will detail out how UUW has arrived at its option costs and provide supporting evidence as to how these cost estimates are efficient. Further details of cost efficiency are given in document: *UUW45 - our approach to deliver best value Totex*.

6.1.2 The use of the Risk and Value (R&V) process, as discussed in 5.1.1 to 5.7.6, across all our major projects has supported challenge of our expenditure requirements, including enhancements. This ensures that when we decide projects are necessary, we only do what we need to do, that our decisions are based on strong evidence, and the value to both the business and customers is clear. The process ensures that we keep challenging and validating both the need for our projects and the way we deliver them.

6.1.3 We have delivered environmental enhancement projects on the WINEP/NEP since AMP3. During this period we have developed a comprehensive understanding of the costs of delivering environmental enhancement projects, and the challenges and opportunities that these projects can present.

6.1.4 The AMP8 water WINEP/NEP programme comprises of 55 implementation schemes and 55 investigations (as per primary driver).

6.1.5 The implementation schemes are largely bespoke projects based on very site specific circumstances. Costs for each solution were developed internally, using a bottom-up estimating approach, by collaboration across our SMEs, Engineering and Estimating functions, and with input where appropriate from consultants and external parties.

6.1.6 A bottom-up estimating approach ensured bespoke cost build-ups with itemised elements for each scheme based on site specific information. Item elements were costed based on a combination of contractor framework rates, estimator judgement, historical outturn costs from previous projects, and cost curves where available.

6.1.7 UUW's PR24 capital cost estimating approach has been based on data collected over a number of AMPs (AMP3 to AMP7) updated to reflect the present market conditions under which UUW and the UK Water Industry are operating. Mott Macdonald (MM) have provided an estimating service to UUW over AMP6 and AMP7. MM also provide an estimating service to a number of other UK Water Companies, which allows them to provide a benchmarked approach to UUW's PR24 capital cost estimates.

6.1.8 Our Engineering teams developed an estimating brief and all solutions underwent a deliverability assessment. UUW's Planning, Land & Environmental Team, Ground Engineering and Construction Services undertook a review to challenge the scheme design and eliminate any options that were not deemed feasible, thereby improving cost accuracy. This also included an assessment of the likely delivery route (including Direct Procurement for Customers) which was then used as the basis for the Contractor add-ons in the cost estimate. This cost build-up process follows the PR24 estimating process.

6.1.9 Indirect costs including UUWs cost to deliver the projects including project management are added on top of the direct costs build-up.

6.1.10 A third party was engaged to carry out a bottom-up benchmarking exercise by comparing our cost build ups against similar companies. This resulted in an additional internal challenge on costs. As a result, the third party considers our costs to be efficient.

6.1.11 Cost estimate build-ups and cost efficiency is discussed in more detail below in groupings of similar schemes (not necessarily by driver codes). Please note that cost estimate build-ups given as evidence throughout this section may not show costs in FY23 price base as the WINEP/NEP was submitted to the EA/NRW in FY21 price base. All cost estimates have been uplifted to price base FY23 for Price Review submission to Ofwat. Therefore there will be some discrepancies between cost build-up evidence

presented and final costs being put forward as part of the price review. It will be made clear throughout the document which price base costs are being shown in.

6.1.12 The remainder of this section sets out how we have costed each element of the Water WINEP programme:

- Section 6.2 discusses catchment land management schemes;
- Section 6.3 discusses water resource flow schemes;
- Section 6.4 discusses fish passage schemes;
- Section 6.5 discusses the West Cumbria compensatory measures schemes;
- Section 6.6 discusses eel schemes;
- Section 6.7 discusses invasive non-native species schemes;
- Section 6.8 discusses water resource – heavily modified water body schemes; and
- Section 6.9 discusses the investigation programme

6.2 Catchment land management schemes

6.2.1 This grouping of schemes refers to actions were we are undertaking a catchment based solution to either improve the raw water quality (under the DrWPA WINEP/NEP driver) or improve the biodiversity and habitat of a catchment (under a WINEP/NEP biodiversity (NERC), SSSI, or European sites (HD) driver) under the Ofwat categories: Drinking Water Protected Areas; (WINEP/NEP) water and Biodiversity and conservation; (WINEP/NEP) water.

6.2.2 Schemes in this grouping are detailed in Table 8 along with further relevant details as to how their cost estimates were built up. The table indicates that the costs are robust as they have either been developed by consultants undertaking an AMP7 investigation, which provided a detailed costed plan, or they were built from internal SMEs based on site specific knowledge and historical outturn costs of similar projects.

Table 8: Catchment land management schemes - cost build up

Unique ID	Ofwat Category	WINEP/NEP Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
UU100003	Drinking Water Protected Areas; (WINEP/NEP) water	W_DrWPA_NDIMP1	Huntington and Sutton Hall Turbidity	AMP7 investigation findings (costed plan from consultants)	£1.688
08UU100164	Biodiversity and conservation; (WINEP/NEP) water	NERC_IMP	Thirlmere Resilience	SME bottom up build based on an on-going AMP7 project and outturn project costs for similar schemes	£3.130
08UU100163	Biodiversity and conservation; (WINEP/NEP) water	NERC_IMP	Upper Duddon	SME bottom up build based on an on-going AMP7 project and outturn project costs for similar schemes	£0.838

Unique ID	Ofwat Category	WINEP/NEP Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100146	Drinking Water Protected Areas; (WINEP/NEP) water	DrWPA_ND	Errwood and Fernilee & Wybersley Colour - Goyt	AMP7 investigation findings (costed plan from consultants)	£4.187
08UU100158	Biodiversity and conservation; (WINEP/NEP) water	SSSI_IMP	Bowland	SME bottom up build based on an on-going AMP7 project and outturn project costs for similar schemes	£2.054
08UU100159	Biodiversity and conservation; (WINEP/NEP) water	SSSI_IMP	Haweswater Resilience	SME bottom up build based on an on-going AMP7 project and outturn project costs for similar schemes	£0.906
08UU100161	Biodiversity and conservation; (WINEP/NEP) water	SSSI_IMP	West Pennines	SME bottom up build based on an on-going AMP7 project and outturn project costs for similar schemes	£1.717
08UU100157	Drinking Water Protected Areas; (WINEP/NEP) water	DrWPA_ND	Hodder/Stocks colour phase 2	AMP7 investigation findings and SME bottom up build based on outturn project costs for similar schemes	£0.784
08UU102343	Drinking Water Protected Areas; (WINEP/NEP) water	DrWPA_IMP	Franklaw ammonia	SME bottom up build based on an on-going AMP7 project and outturn project costs for similar schemes	£0.344
08UU100145	Biodiversity and conservation; (WINEP/NEP) water	NERC_IMP	River Eden	SME bottom up build based on an on-going AMP7 project and outturn project costs for similar schemes	£0.194
08UU100162	Biodiversity and conservation; (WINEP/NEP) water	NERC_IMP	Poaka Beck	SME bottom up build based on an on-going AMP7 project and outturn project costs for similar schemes	£0.838
08UU100160	Biodiversity and conservation; (WINEP/NEP) water	HD_IMP	South Pennines	SME bottom up build based on an on-going AMP7 project and outturn project costs for similar schemes	£5.060

6.2.3 Paragraphs 6.2.4 to 6.2.12 below provide further evidence as to the robustness of the costs as detailed in Table 8.

6.2.4 UUW has a successful history of delivering catchment schemes for drinking water protected areas and biodiversity:

- The EA has always signed off our completed catchment schemes
- The Sustainable Catchment Management Programme (SCaMP) that UUW commenced in AMP4 was the first water company catchment enhancement programme and has been widely recognised as industry leading and subsequently adopted by other water companies
- UUW has successfully gained the IUCN (International Union for the Conservation of Nature) Nature Based solutions accreditation for our work in partnership with The Royal Society for the Protection of Birds (RSPB) in the Haweswater catchment, which is international recognition of our work towards a more environmentally sustainable future for farming and land management.

6.2.5 The schemes to be delivered in AMP8 follow and build-on similar schemes we have done previously for similar drinking water quality parameters (namely colour) and on similar habitats. Our AMP8 programme is mainly focusing on habitats consisting of upland peat and woodland, with which we have a successful track record of interventions spanning from AMP4 undertaken through our SCaMP programme. This has delivered environmental improvements to catchment land moving it from 48% of land in 2004 (pre-SCaMP) in favourable or unfavourable recovering condition to 91% in 2023 as a result of decades of investment by UUW.

6.2.6 The majority of schemes also include a requirement to engage with farmers and tenants – usually done through a Trust (Rivers Trust / Wildlife Trust) on our behalf and again we have a successful history of farmer and tenant engagement over the past few AMPs.

6.2.7 The scheme cost build-ups were built based on historical similar scheme outturn data from projects undertaken at Longdendale for peatland restoration, at Thirlmere for forestry and peatland restoration, and the River Wyre for agricultural and farmer engagement projects. Alongside these, costs were also built through either detailed scope items based on AMP7 investigation conclusions and/or SME input to build scope based on site specific knowledge and continuation of works already undertaken at the sites.

6.2.8 Catchment based schemes for biodiversity and raw water quality improvements, regardless of driver, have similar project outputs. Costings have therefore been derived around key outputs and based on a number of parameters: unit cost per item; unit cost per area to be improved; complexity and scale of sampling / monitoring; and/or length of scheme (in years). The key outputs that these schemes have been costed against are (based on relevance to the scheme in question):

- Owned or non-owned catchment land of what type (peatland / farmland / woodland) and what scale (area);
- Requirement for a Catchment Officer on the ground to deliver the scheme over what duration and working hours per week (e.g. 1 Catchment Officer, 3x days per week for 5 years);
- Woodland planting and maintenance costs;
- Peatland restoration costs;
- Peatland management costs (including: wildfire reduction measures, rush management, sphagnum planting, grip/gully blocking, cattle grazing etc.);
- Farming interventions (education, farm plans and audits, asset interventions (fencing out feeder streams, improving farm assets etc.); and
- Survey costs and complexity (raw water quality and/or habitat surveys).

6.2.9 Appendix D indicates a cost build-up example for the Errwood and Fernilee – Goyt catchment part of the Errwood and Fernilee & Wybersley Colour – Goyt – scheme. Costs are shown in price base FY21, this has been uplifted to price base FY23 for final inclusion into the Ofwat data tables.

6.2.10 Appendix D indicates the targeted level of detail the consultants and UUW estimating have used to build-up direct costs and the unit rates they have applied.

6.2.11 External benchmarking of costs for these schemes against other water companies has been difficult for a number of reasons:

- the nature of catchment schemes being dependent on habitat type and condition and this varying between and within companies
- the area (hectares) of catchment scheme interventions and this information not being available
- the specific interventions required e.g. gully blocking (benchmarked by how many/what length), fencing (benchmarked by what length), Catchment Officer (benchmarked by the time of employment required) etc. and again this information not being readily available.

6.2.12 Despite this we believe our cost estimates are efficient due to our successful history of undertaking interventions of this kind, with cost build-ups based on historic outturn unit costs, and having built up successful partnerships within which we undertake delivery and maximise grant funding opportunities where available as detailed in 5.3.15.7.1 to 5.7.6. Also, a third party was engaged to carry out a bottom-up benchmarking exercise by comparing our cost build ups against similar companies. This resulted in an additional internal challenge on costs. As a result, the third party considers our costs to be efficient.

6.3 Water resource flow schemes

6.3.1 This grouping of schemes refers to schemes under the Ofwat Water Framework Directive; (WINEP/NEP) water category that have a WINEP/NEP WFD_ND_WRFlow driver. These actions consist of schemes where either:

- A licence revocation and works to ensure the site is made safe and that contamination risk to the aquifer is removed, is required; or
- A licence modification is required and in some cases construction of new assets is necessary in order to enable the flow change or instream flow support to the watercourse.

6.3.2 Schemes in this grouping are detailed in Table 11 along with further relevant details as to how their cost estimates were built up. The table indicates that the costs are efficient as they are all based on an AMP7 investigation and have:

- Accurate known costs for licence variation fees as provided by the EA in their Environmental Permitting and Abstraction Licensing charging scheme document[15] as outlined in Table 9;
- Costs to prevent pollution to the aquifer and surveying costs based on historical outturn costs for a similar project at a group of boreholes and associated assets at Greetby Hill in 2015, shown in Table 10; and/or,
- New asset requirements that have been built up from consultant scope and costs as well as through a bottom up internal engineering and estimating review based on site specifics.

[15] The Environment Agency (2022) *The Environment Agency (Environmental Permitting and Abstraction Licensing) (England) Charging Scheme 2022*. Available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1098117/Environment_Agency_EPR_and_Abstraction_Licensing_Charging_Scheme_2022.pdf

Table 9: Direct cost build-up for abstraction licence variations

Direct cost build-up for abstraction licence variations (FY23 price base):	
Base charge (amount based on level of abstraction and licence change required as set out in the guidance)	£32,954
Water undertaker charge	£2,000
Consultation to other statutory bodies e.g. NE	£300
Advertising charge	£500
Habitats assessment	£779
UUW direct costs – administration, engineering drawings, consultation with EA and other relevant parties, preparation of documentation	£10,000
Total abstraction licence variation cost (direct costs)	£46,533

Table 10: Borehole modification costs based on Greetby Hill project 2015

Item	Based on Greetby Hill project (FY16 price base)
Remove borehole pump and rising main - crane required. If borehole is over 150m then crane hire for 2 days will be required	£5k per day
CCTV survey and geophysics survey for each borehole due to be backfilled	Borehole under 150m deep = £3.5k; borehole over 150m deep = £5k
Prepare borehole modification proposal	£490 per borehole
Backfill borehole to make safe and prevent contamination of the aquifer	£165 per meter depth
Provide post project report including as built information and photographs	£490 per borehole
Other modifications of associated assets and other project costs (e.g. reinstatement etc.) on top based on site specifics	Based on site specifics

Table 11: Water resource flow schemes - cost build-up

Unique ID	Ofwat Category	WINEP/NEP Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Type of scheme	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100026	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Prenton boreholes	AMP7 investigation	Licence modification	Current EA licence modification fee + admin costs	£0.056
08UU100018	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Newton/Grange borehole	AMP7 investigation	Licence modification	Current EA licence modification fee + admin costs	£0.113
08UU100016	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Eddisbury borehole	AMP7 investigation	Licence modification	Current EA licence modification fee + admin costs	£0.056
08UU100013	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Cotebrook no.1 borehole	AMP7 investigation	Licence modification	Current EA licence modification fee + admin costs	£0.056
08UU100014	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Cotebrook no.2 borehole	AMP7 investigation	Licence modification	Current EA licence modification fee + admin costs	£0.056
08UU100027	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Sandyford borehole	AMP7 investigation	Licence modification	Current EA licence modification fee + admin costs	£0.056
08UU100025	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Organsdale borehole	AMP7 investigation	Licence modification	Current EA licence modification fee + admin costs	£0.056
08UU100012	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Delamere boreholes	AMP7 investigation	Licence modification	Current EA licence modification fee + admin costs	£0.056
08UU100017	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Foxhill boreholes	AMP7 investigation	Licence modification	Current EA licence modification fee + admin costs	£0.056

Unique ID	Ofwat Category	WINEP/NEP Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Type of scheme	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100003	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Bearstone boreholes	AMP7 investigation	Licence modification	Current EA licence modification fee + admin costs	£0.056
08UU100011	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Five Crosses borehole	AMP7 investigation	Licence modification	Current EA licence modification fee + admin costs	£0.056
08UU100006	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Eccleston Hill borehole	AMP7 investigation	Licence modification	Current EA licence modification fee + admin costs	£0.056
08UU100008	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Rivington gathering grounds	AMP7 investigation	Licence revocation	Admin costs to administer licence revocation	£0.001
08UU100010	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Ullswater freshet abstraction	AMP7 investigation	Licence revocation	Admin costs to administer licence revocation	£0.001
08UU100022	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Manley Quarry (Low Farm) boreholes	AMP7 investigation	Licence modification and low flow stream support scheme from Manley Quarry/Low Farm to Peckmill Brook	Based on AMP7 investigation report scope items and site specifics bottom-up build through estimating. The direct costs are built up of: • licence modification fee • low flow stream support scope (assets required to release water to the watercourse)	£0.483
08UU100021	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Manley Common (Four Lane Ends) boreholes	AMP7 investigation	Licence modification and low flow support from Manley Common to Ashton Brook (1.5Ml/day)		£1.196

Unique ID	Ofwat Category	WINEP/NEP Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Type of scheme	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100023	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Mouldsworth boreholes	AMP7 investigation	Licence modification and low flow stream support scheme from Mouldsworth to Ashton Brook (1.5Ml/day) and low flow stream support scheme from Mouldsworth to Salters Bk (1.5Ml/day)	• surveys and investigations including sinking a borehole to allow ground investigation works • groundwater modelling • water quality and temperature sampling • new pipework and valves • new flow meter • new chamber building to house new assets • electrical installation work to allow a communication link back to headquarters • fees to obtain a discharge of water to watercourse consent • site set-up, demobilisation, and reinstatement.	£2.340
08UU100028	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Springhill borehole	AMP7 investigation	Licence revocation and safeguarding the aquifer against pollution risk	Based on AMP7 investigation report scope items and site specifics. Costs for safeguarding the site are based on a 2015 project of borehole and site safeguarding at Greetby Hill boreholes (as shown in Table 10). The direct costs are built up of: • construction costs:	£2.464
08UU100020	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Hooton borehole	AMP7 investigation	Licence revocation and safeguarding the aquifer against pollution risk		£0.450
08UU100015	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Eaton borehole	AMP7 investigation	Licence revocation and safeguarding the aquifer against pollution risk		£0.908

Unique ID	Ofwat Category	WINEP/NEP Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Type of scheme	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100024	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Newton Hollows boreholes	AMP7 investigation	Licence revocation and safeguarding the aquifer against pollution risk	• remove borehole pumps and pipework (crane required) • undertake cctv and geophysical surveys to understand condition of borehole asset • undertake cctv survey of horizontal shafts (adits) between boreholes to understand condition • back fill with grout and cap borehole/adit system • post project report with updated asset drawings/information • Safeguard assets in order reduce risk of contamination to the aquifer.	£0.694
08UU100019	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Helsby borehole	AMP7 investigation	Licence revocation and safeguarding the aquifer against pollution risk		£0.451
08UU100133	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Ashton borehole	AMP7 investigation	Licence revocation and safeguarding the aquifer against pollution risk		£0.492
08UU100007	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Lees Lane borehole	AMP7 investigation	Licence revocation and safeguarding the aquifer against pollution risk		£0.709
08UU100001	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Gorstons borehole	AMP7 investigation	Licence revocation and safeguarding the aquifer against pollution risk		£0.383

Unique ID	Ofwat Category	WINEP/NEP Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Type of scheme	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100002	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Laneshaw/Corn Close boreholes	AMP7 investigation	Licence modification and borehole investigations	Based on AMP7 investigation report scope items and site specifics. Costs include: • licence modification fee • borehole investigation work – cctv and geophysical logging • installation of new assets due to change in borehole operation • pump test (to prove new flows can be achieved) • Regulatory 15 sampling (ensure water is compliant with the Drinking Water regulations)	£0.110
08UU100004	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Schneider Road boreholes	AMP7 investigation	Licence modification and installation of new assets to enable new flow regime	Based on AMP7 investigation report scope items and site specifics. Costs include: • licence modification fee • Implement the required control system changes to allow new flow regime • Install radio link to allow communication of assets back to the central systems • Install automatic level monitoring on the 4 boreholes	£0.146

Unique ID	Ofwat Category	WINEP/NEP Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Type of scheme	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100005	Water Framework Directive; (WINEP/NEP) water	WFD_ND_WRFlow	Thorncliffe Road borehole	AMP7 investigation	Licence modification and installation of new assets to enable new flow regime	Based on AMP7 investigation report scope items and site specifics. Costs include: • licence modification fee • Implement the required control system changes to allow new flow regime • Install radio link to allow communication of assets back to the central systems • Install automatic level monitoring on the borehole	£0.146

6.3.3 Table 11 outlines the detailed cost build for UUW's AMP8 water resources flow programme. We consider these costs to be efficient. Largely this is due to the fact that half the projects (24) under this sub-category are made up purely of licence modification fees or are licence revocations and therefore the majority of the costs are stipulated in the EA guidance. The remaining project costs are based on historical outturn rates, uplifted to FY23 price base, and a bottom-up cost build. Also, a third party was engaged to carry out a bottom-up benchmarking exercise by comparing our cost build ups against similar companies. This resulted in an additional internal challenge on costs. As a result, the third party considers our costs to be efficient.

6.4 Fish passage schemes

6.4.1 This grouping of schemes refers to schemes under the Ofwat Eels/fish passes; (WINEP/NEP) water category with the associated WINEP/NEP drivers of WFD_ND_WRHMWB and WFD_IMP_PHYSHAB. These actions consist of schemes to allow fish passage upstream of UUW owned weirs at Taxal, Hug Bridge, and Calder.

6.4.2 The schemes all have a site specific solution based on detailed investigations and optioneering that was undertaken as part of AMP7 WINEP investigation schemes.

6.4.3 Costs have therefore been developed as a hybrid from external consultants based on detailed scope, outturn costs from similar schemes and build-up using current labour, plant and material rates with expert judgement from experienced senior estimator on productivities. We therefore consider these cost estimates efficient. More detail can be found in Table 12.

Table 12: Fish passage cost build-up

Unique ID	Primary driver code	Scheme name	Source of AMP8 cost estimates	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100139	WFD_ND_WRHMWB	Fish passage improvements at Calder river intake - new bypass channel on left bank	AMP7 investigation findings (costed scope from consultants, reviewed by UUW engineering and estimating)	Based on investigation report scope items and site specifics bottom-up build through estimating. The direct costs are built up of: Pre-construction activities: Temporary works design to allow in river working Flood risk assessment Ground investigations (2x boreholes required – one upstream of weir and one downstream of weir) Mobilisation and temporary work compound set up Access track creation including a ford (river) crossing Construction activities: Construction of natural bypass channel, resting pools, riffle structure and associated inlet/outlet structures that all aid fish in moving upstream Construction of a vehicle bridge Post-construction activities: Reinstatement of compound area / working areas Demobilisation from site.	£1.534

Unique ID	Primary driver code	Scheme name	Source of AMP8 cost estimates	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100140	WFD_IMP_PHYSHAB	Fish passage improvements at Hug Bridge weir - low cost baffles	AMP7 investigation findings (costed scope from consultants, reviewed by UUW engineering and estimating)	Based on investigation report scope items and site specifics bottom-up build through estimating. The direct costs are built up of: Pre-construction activities: Temporary works design to allow in river working Flood risk assessment Ground investigations (2xboreholes required – one upstream of weir and one downstream of weir) Mobilisation and temporary work compound set up Temporary access track creation Construction activities: Temporary cofferdam construction to provide a safe and dry in-river working area around existing weir in order to allow work to be undertaken Fish pass works: placement of boulder rock and concrete, fixing low cost baffles to weir face using anchors Post-construction activities: Removal of cofferdam Reinstatement of compound area / working areas Demobilisation from site.	£0.667

Unique ID	Primary driver code	Scheme name	Source of AMP8 cost estimates	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100141	WFD_IMP_PHYSHAB	Fish passage improvements at Taxal gauging weir - removal of weir and associated assets	AMP7 investigation findings (costed scope from consultants, reviewed by UUW engineering and estimating)	Based on investigation report scope items and site specifics bottom-up build through estimating. The direct costs are built up of: Pre-construction activities: Temporary works design to allow in river working Flood risk assessment Ground investigations (2x boreholes required – one upstream of weir and one downstream of weir) Mobilisation and temporary work compound set up Creation of access track Vegetation removal Construction activities: Cofferdam construction to provide a safe and dry in-river working area around existing weir in order to allow work to be undertaken Construction of temporary diversion channel (20m long x 1.5m wide x 1m deep) to divert river flows around the cofferdam and weir in order to allow work to be undertaken Removal of weir (breakout concrete retaining wall, remove debris screen, remove wing walls) Remove assets and demolish kiosk building in order to make safe Post-construction activities: Reinstatement of compound area / working areas Demobilisation from site.	£1.309

6.4.4 As detailed in Table 12 we believe our costs are efficient as they are based on detailed costed scopes from specialist consultants. To back this up we have benchmarked our costs against similar schemes, with an eel/fish passage objective, undertaken in AMP7 by Northumbrian Water[16], the EA[17], and Yorkshire Water[18]. These benchmarked unit costs, uplifted to price base FY23, were ranging between circa £190,000 to £10million. In contrast, our unit cost across the schemes are £1.17 million on average.

6.4.5 There is a large range between costs due to the solution, scale and complexity that different eel/fish passage schemes can have i.e. low cost baffle installation versus full weir removal. However, this level of detail was not available in order to further refine the benchmarking. Also as some of the other water company costs are rolled up by driver they include investigation schemes as well as implementation schemes, which brings the average cost down. Our unit cost just includes implementation schemes. Our costs are closer to the lower end of the benchmarked scale than the upper and this does include two major schemes – one full weir removal and one natural bypass channel.

6.4.6 In addition to this benchmarking exercise, a third party was engaged to carry out a bottom-up benchmarking exercise by comparing our cost build ups against similar companies. This resulted in an additional internal challenge on costs. As a result, the third party considers our costs to be efficient.

6.5 West Cumbria compensatory measures schemes

6.5.1 This grouping of schemes refers to schemes under the Ofwat biodiversity and conservation; (WINEP/NEP) water category with the associated WINEP/NEP HD_IMP driver.

6.5.2 The actions relate to a wider compensatory measures package, brought about in 2014, under the Habitats Directive 'review of consents' process. This was due to the impact of abstraction from Ennerdale on the River Ehen downstream of Ennerdale at which UUW abstracts water for public water supply.

6.5.3 The River Ehen is a designated Special Area of Conservation (SAC), currently in 'unfavourable declining' condition and therefore UUW have committed to cease abstraction from Ennerdale. However, due to Ennerdale being a key source for the supply of drinking water to West Cumbria, and the need to find and build alternative sources, UUW were given two AMPs to achieve the requirement on the basis that we would undertake further mitigating actions (compensatory measures) to offset the timeframe given for delivery. Since 2014 we have designed, constructed and commissioned a new water treatment works and the associated assets required to provide West Cumbria with water from our integrated water supply zone and we ceased abstracting from Ennerdale in March 2023.

6.5.4 The infrastructure removals schemes, being undertaken for the purpose of improving the natural environment, at Ennerdale, Crummock, Overwater and Chapel House are agreed physical mitigation measures under the compensatory measures package and are part of a multi-AMP phased delivery approach. Overwater, Chapel House and Crummock are all infrastructure removals schemes in AMP8 with Ennerdale in the planning and design phase in AMP8 and a removals stage in AMP9, this is due to the complexity and sensitivity of the habitat and ecology at Ennerdale.

6.5.5 Removing the infrastructure and re-naturalising these sites will achieve the required environmental benefits as well as having financial benefits associated with removal of ongoing responsibility and liability for maintenance of compensation flows, fish passes, dams, and all associated infrastructure at these sites.

[16] Northumbrian Water (2018*) Appendix 3.2 Enhancement Business Cases*. Page 20. Available here.

[17] EA (2022) *Colwick (Holme Sluices) Fish Pass Project – Frequently Asked Questions*. Available here.

[18] Yorkshire Water (2018) *Appendix 8G PR19 WINEP Technical Appendix*. Page 98. Available here.

6.5.6 The sites and schemes are all complex and unique in nature with added constraints as they are all in designated areas and/or have designated species associated with them. Crummock Water is a designated SAC and SSSI; Overwater is a designated SSSI and the downstream River Ellen from Chapel House contains salmon, which is a species of conservation concern.

6.5.7 Due to the complexity and uniqueness of each scheme investigations and optioneering[19] was undertaken in AMP6 and AMP7 for Crummock, Overwater and Chapel House. This has therefore allowed a robust and site specific solution to be developed at each site. Costs have been developed as a hybrid from the investigation scope, external consultants, internal engineering disciplines and estimator build-up using current labour, plant and material rates with expert judgement from experienced senior estimator on productivities. Table 13 details the cost build-ups for each scheme.

[19] Jacobs (2020) *Ehen Compensatory Measures – Crummock Water/Overwater/Chapel House Abstraction Infrastructure Removal – Full Technical Report*. UUW internal document.

Table 13: West Cumbria infrastructure removals schemes cost build-ups

Unique ID	Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100150	HD_IMP	Crummock infrastructure removal	AMP6&7 implementation - design phase works and scope development by Jacobs consultants and UUW	The direct costs are built up of: • Pre-construction activities: • Mobilisation and temporary work compound set up • Temporary works to facilitate weir removal • Vegetation and tree clearance • Stakeholder / customer engagement • Construction activities: • Demolition of Park Beck channel • Disposal of materials (masonry and concrete) from Park Beck channel • Bridge removal and disposal x6 • Excavation of new channel and disposal of materials • Removal of penstocks (valves) and associated metal work • Demolition and disposal of weir on the River Cocker • Demolition and disposal of fish pass and associated in-filling (using imported and existing material) following removal • Re-naturalisation and infilling of area where assets have been demolished • Demolition and disposal of concrete wave wall on the River Cocker • Demolition and disposal of concrete wave wall along left flank of reservoir • Re-profiling of shoreline • Plugging of existing pipework to make safe • Removal of fish screen by a diver • Stone pitching removal at Park Beck pump house • Reconnection of watercourses (17no. small and 8no. large) • Demolition and disposal of raw water intake screen • Reinstatement to Crummock Water eastern and western bank • New footpath creation	£12.146

Unique ID	Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
				• Bridge installation x3 Post-construction activities: • Reinstatement of compound area / working areas • Landscaping scheme (tree and vegetation planting) • Demobilisation from site.	
08UU100149	HD_IMP	Chapel House infrastructure removal	AMP6&7 implementation - design phase works and scope development by Jacobs consultants and UUW	The direct costs are built up of: • Pre-construction activities: • Mobilisation and temporary work compound set up • Creation of temporary access track and footpath • Temporary works to facilitate weir removal with over-pumping of watercourse for twenty six weeks • Vegetation and tree clearance • Stakeholder / customer engagement • Construction activities: • Removal of Chapel House dam: • Removal of spillway, wavewall, roadway/steps, valve house, fish pass, pipework • Disposal of material • Re-profiling of area where dam removed • Installation of fencing and bridge • Realignment and re-naturalisation of the River Ellen: • Excavation • Removal of material	£13.276

Unique ID	Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
				• Stone protection • Construction of offline flood storage area requiring concrete headwalls and pipework • Creation of new access tracks and footpaths to properties and farms at the site • Removal of all redundant infrastructure Post-construction activities: • Reinstatement of compound area / working areas • Removal of temporary access tracks and footpaths • Landscaping scheme (tree and vegetation planting) • Demobilisation from site.	
08UU100152	HD_IMP	Overwater infrastructure removal scheme	AMP6&7 implementation - design phase works and scope development by Jacobs consultants and UUW	The direct costs are built up of: • Pre-construction activities: • Mobilisation and temporary work compound set up • Creation of temporary access tracks and bridges • Temporary works (sand bagging) to facilitate weir removal • Vegetation and tree clearance • Stakeholder / customer engagement • Construction activities: • Demolition and disposal of weir • Excavation to form outlet channel • Re-profiling of shoreline using excavated material • Demolition of redundant assets (compensation pipework, valves and controls)	£5.063

Unique ID	Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
				• Realign Overwater Beck with the River Ellen Post-construction activities: • Reinstatement of compound area / working areas • Removal of temporary access tracks and bridges • Landscaping scheme (tree and vegetation planting) • Demobilisation from site.	
08UU100151	HD_IMP	Ennerdale infrastructure removal design phase	AMP6&7 implementation - design phase works and scope development by Jacobs consultants and UUW	The direct costs are built up of: Design phase activities: • Production of an Environmental Impact Assessment (detailed planning application) including pre-application advice and planning application fees • River restoration design works • Costs for liaison with a qualified reservoir engineer for weir removal advice • Stakeholder liaison and public management and meetings • Public rights of way diversions (footpaths etc.) • Design phase surveys: • Ground investigations, topography and bathymetry surveys (to provide landform profiles and information) • Flood risk assessment • Habitat surveys (trees, vegetation, hedgerow, breeding bird, macrophytes, wetland habitat, fish, invasive non-native species, otter, protected species) • Archaeological heritage surveys • Photo-visual surveys	£2.210

6.5.8 Top-down benchmarking has not been possible on these schemes due to the very unique nature and complexity of each scheme. However cost build-ups are deemed to be efficient as:

- These are complex schemes in environmentally sensitive areas;
- A detailed planning phase has been undertaken in AMP6 and AMP7 including regulator and stakeholder engagement;
- Consultants and SMEs have produced costs;
- A bottom-up estimating approach has been taken to factor in the site specifics of each scheme;
- UUW has significant experience of delivering major capital projects and producing Environmental Impact Assessments, planning applications and the associated surveys and activities that feed into them and therefore understand the time, resources and costs required for these activities; and,
- A third party was engaged to carry out a bottom-up benchmarking exercise by comparing our cost build ups against similar companies. This resulted in an additional internal challenge on costs. As a result, the third party considers our costs to be efficient.

6.6 Eels schemes

6.6.1 This grouping of schemes refers to actions under the Ofwat Eels/fish entrainment screens; (WINEP/NEP) water driver with the associated WINEP/NEP driver codes W_EEL_IMP1 and EE_IMP. Table 14 indicates how the direct costs have been built up.

Table 14: Eel schemes cost build-ups

Unique ID	Primary Driver Code	Scheme name and description	Source of AMP8 cost estimates	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
UU100001	W_EEL_IMP1	Eel implementation scheme at Horseshoe Falls, Llangollen - implement eel screen on abstraction point at Horseshoe Falls to prevent entrainment of eels into the system and removal from the River Dee to meet requirements of eel legislation. Delivery sat with Canal and River's Trust (C&RT) as they own the asset. Costs will be split between UUW and C&RT.	Design undertaken by APEM consultants with a costed scope document based on outturn costs from similar schemes undertaken and unit rates and allowances applied through estimating.	Direct cost build-up includes: Development of legal agreement with C&RT due to co-funding Fee to amend current licences Vegetation clearance Construction of new valves, flow meter, chambers to house assets, head-wall (supporting structure), electrical assets, new screens, walkways, penstocks (valves), backwash system (to clean the screens of debris) Compensation to council for loss of parking area Survey costs Reinstatement of areas impacted by construction activities Site set-up and demobilisation.	£2.404
08UU100167	EE_IMP	Stocks Reservoir Eel "alternative measures by other means" (AMbOM) implementation scheme – mitigation not feasible at source therefore money is allocated to provide eel passage, habitat, and/or monitoring at another feasible location	EA guidance indicates amount required to be spent based on outcome of the APEM investigation undertaken in 2017.	AMP6 investigations concluded that solutions at source are not technically feasible and so an AMbOM scheme is proposed. The EA guidance document[20] sets out the costs that have to be spent based on abstraction volume and distance from tidal limit, see Figure 12.	£0.066

[20] Environment Agency (2017) *Safe passage for eel: alternative measures (where best practice screening is not cost beneficial for existing sites)*. Available from the EA.

Unique ID	Primary Driver Code	Scheme name and description	Source of AMP8 cost estimates	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100168	EE_IMP	Haweswater Reservoir Eel "alternative measures by other means" (AMbOM) implementation scheme – mitigation not feasible at source therefore money is allocated to provide eel passage, habitat, and/or monitoring at another feasible location			£0.077

Figure 12: AMbOM cost table (taken from guidance document in footnote 20)

Expected cost (£k)		Distance from tidal limit (km)		
		>50	30 to 50	<30
Abstraction volume (m3/day) as per the abstraction licence	Low (<30,000)	£10k	£20k	£30k
	Medium (>30,000 to 100,000)	£20k	£30k	£40k
	High (>100,000)	£30k	£40k	£50k

6.6.2 As Table 14 indicates there is high confidence in the costs associated with these schemes due to the fact that they are all based on previous investigations undertaken by specialist consultants, which has provided a detailed scope in the case of Horseshoe Falls and the information required to be able to utilise EA guidance for costs for the AMbOM schemes as shown in Figure 12. Additionally, a third party was engaged to carry out a bottom-up benchmarking exercise by comparing our cost build ups against similar companies. This resulted in an additional internal challenge on costs. As a result, the third party considers our costs to be efficient.

6.7 Invasive non-native species

6.7.1 This grouping of schemes refers to schemes under the Ofwat Invasive Non Native Species; (WINEP/NEP) water driver and associated WINEP/NEP INNS_MON and INNS_ND driver codes.

6.7.2 Table 15 details out the direct cost build-ups for the INNS schemes.

Table 15: INNS cost build-up

Unique ID	Primary Driver Code	Scheme name and description	Source of AMP8 cost estimates	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100166	INNS_MON	INNS Surveillance Programmes - setting up of a surveillance programme to monitor INNS	Costs specified by the EA and confirmed through the INNS workshops	Cost details include: • Consultant and internal SME time • Surveying and monitoring INNS	£0.077
08UU100165	INNS_ND	INNS mitigation actions	AMP7 investigation and scope development. Costs produced by AECOM consultants who undertook the investigation and are SMEs.	Cost details include: biosecurity management planning based on different areas of risk in the business, biosecurity implementation measures - surveys, signage, wash-down stations, costs for a biosecurity team	£3.984
08UU100169	INNS_MON	INNS Surveillance Development - setting up of cross company development of surveillance techniques and approaches for relevant horizon, alarm and alert invasive non-native species	EA WINEP discussions and Water UK formula based on company size (10.5% based on UUW size)	EA indicated that all water companies will be required to contribute to a UK Water Industry Research (UKWIR) led project costing £300k and the cost contribution is determined by the Water UK formula based on company size.	£0.182

6.7.3 As Table 15 indicates there is high confidence in the costs associated with these schemes due to the fact that they are either based on previous investigations undertaken by specialist consultants, which has provided a detailed scope or the costs are contribution amounts to cross company research schemes for which amounts have been dictated in EA guidance based on company size.

6.8 Water resource – heavily modified water body schemes

6.8.1 This grouping of schemes refers to schemes under the Ofwat Water Framework Directive; (WINEP/NEP) water driver and associated WINEP/NEP WFD_IMP_WRHMWB & W_WFD_WRHMWB_INV1 drivers. The schemes all related to waterbody health however they are very different schemes.

6.8.2 Table 16 provides more detail as to the direct cost build-up for the schemes.

Table 16: Water resource heavily modified waterbody cost build-up

Unique ID	Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Cost build-up	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100153	WFD_IMP_WRHMWB	Pennington reservoir compensation flow - provision of a compensation flow from the reservoir system to the downstream watercourse. There is an investigation phase also for Pennington in AMP8 to inform this implementation scheme. Costs for the investigation scheme are sat under the investigations line.	Bottom-up build by a senior estimator based on unit rates, allowances and site specific information based on required scope.	The direct costs are built up of: Pre-construction activities: Mobilisation and temporary work compound set up Creation of temporary access track and footpath Fee for obtaining required reservoir licence Construction activities: Construct new access paths to new assets Installation of a pedestrian access bridge Installation of new gate valves, pipework and housing chamber Installation of a new V notch to measure reservoir flows Installation of flow measurement devices Purchase land to build a new control kiosk Build new control kiosk Post-construction activities: Reinstatement of compound area / working areas Demobilisation from site.	Implementation cost of this scheme is £1.690 against full value of scheme of £2.640, which includes an investigation element (cost detailed under investigation driver)

Unique ID	Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Cost build-up	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
08UU100154	WFD_IMP_WRHMWB	River Hodder mitigation for Stocks reservoir impact - develop an option for implementation to improve river morphology and minimise the impact of Stocks Reservoir on the River Hodder	The AMP7 investigation, undertaken by APEM consultants, produced a detailed cost schedule detailing out all the required activities and associated unit cost rates split down into eleven sections of the watercourse. APEM consultants are specialists in this type of work and therefore are well placed to produce robust cost estimates. APEM's cost estimates were also reviewed by UUW estimating.	APEM consultants produced a detailed cost schedule, which details out all required works / activities and associated costs for each eleven sections of the watercourse. Direct costs are built up of: Planning application fees Required surveys Stakeholder engagement Design fees Required permit fees – flood risk assessment; public rights of way changes; vegetation management and heritage and archaeological discussions with the Local Planning Authority fees Creation of temporary access tracks at numerous points along the watercourse Fencing (based on rates per metre) Vegetation planting Wood deflectors and berms in the river to provide varying flows and habitats Weir removal Land purchase costs in order to undertake the habitat improvements required Removal of temporary access tracks and reinstatement of working areas.	£1.030

Unique ID	Primary Driver Code	Scheme name	Source of AMP8 cost estimates	Cost build-up	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
UU100002	W_WFD_WRHMWB_INV1	Assessment and mitigation of gravel starvation downstream of Vyrnwy reservoir - to understand gravel reinstatement requirements to mitigate for effect of Vyrnwy Reservoir and work in partnership with Hafren Dyfrdwy (HDD) to re-gravel the Afron Vyrnwy to improve ecological and riverine processes	HDD own Vyrnwy reservoir and UUW have abstraction rights and therefore this project is being undertaken jointly with an 80 (HDD) / 20 (UUW) split of costs. Costs are deemed efficient as they have been produced based on a very similar scheme undertaken by Dwr Cymru (Welsh Water), Cyfoeth Naturiol Cymru Natural Resources Wales, Elan Valley and the Wye & Usk Foundation to investigate and re-gravel the Elan system. Costs estimates were based on the project finances reported in April 2019 (uplifted to FY23 price base). This provided a cost for investigation and a unit cost per km of river to re-gravel. UUW estimating reviewed the cost build-up.	The direct costs are built up of: Investigation phase costs based on unit costs for resources and surveys required per discipline e.g. habitat staff, consultants etc. Implementation phase costs - a unit cost per km reach of river for re-gravelling based on a graveling project on the Elan system in 2019 undertaken by Dwr Cymru (Welsh Water).	Implementation cost of this scheme is £0.0027 against full value of scheme of £0.0042, which includes an investigation element (cost detailed under investigation line)

6.8.3 Table 16 explains how the costs for each scheme have been built up. The costs are deemed to be efficient for these reasons:

- Pennington – this is an efficient estimate as it was produced using a detailed bottom up build approach by a senior estimator with SME input and, as the scheme is an asset driven solution, costs were available from the internal estimating systems, cost curves, and unit rates.

- River Hodder – this is an efficient cost build-up as it is based on the outcome of an AMP7 investigation in which the consultants have produced detailed scope items and a detailed cost schedule based on a breakdown of eleven sections of the waterbody. The consultants used for the investigation are specialist consultants in this field and therefore undertake similar work as this regularly, which informs their cost build-ups.
- Vyrnwy gravel starvation – this is a robust cost build-up as it is based on outturn costs from a similar sediment management scheme in a relatively similar location in 2019.
- A third party was engaged to carry out a bottom-up benchmarking exercise by comparing our cost build ups against similar companies. This resulted in an additional internal challenge on costs. As a result, the third party considers our costs to be efficient.

6.9 Investigations programme

6.9.1 56 investigations (includes Pennington investigation, under a secondary driver, preceding the implementation scheme) have been put forward as part of the AMP8 water WINEP programme under the Ofwat Investigation driver codes across the range of specific drivers WINEP/NEP drivers. Of the 56 investigations, 52 investigations fall under the Ofwat Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water driver and 4 investigations fall under the Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water driver.

6.9.2 Investigations have been proposed where there is uncertainty over the issue and/or required solution. This ensures we will be investing in the right areas in AMP9.

6.9.3 In the majority of cases the investigations put forward are looking at the same issues that we have already looked at in other areas in AMP6&7 and therefore we have been able to produce cost estimates for the investigations based on historical outturn costs and subject matter expert guidance. Table 17 shows the cost build-up for the investigation programme.

Table 17: Investigations cost build-ups

Driver code / sub category	No. of investigations	Source of AMP8 cost estimate	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
Drinking Water Protected Areas				
Taste and Odour	7 (Ashworth Moor, Haslingden Grane, Laneshaw, Mitchells, Piethorne, Ridgegate, Rivington)	Scope and costs based on the AMP7 algae investigations at these same seven sites	Direct costs include: • 12 months' worth of sampling at multiple locations within the reservoir and feeder streams • Sampling and analysis for the following parameters: Chlorophyll, Blue green algal chlorophyll, Total phosphorus, Orthophosphate, Ammoniacal nitrogen, Total oxidised nitrogen, Total nitrogen, Nitrate, Nitrite, Suspended solids, Dissolved Organic N, Organic Phosphorus, Temperature, pH, Geosmin intra cellular, Geosmin extra cellular, 2MIB, Algal counts, Secchi depth transparency • Use of a boat to undertake sampling • Consultant's time for analysis, research and report writing	£0.484 per scheme
Gesomin (and ammonia)	3 (Cowpe – geosmin; Hurleston – geosmin and ammonia; Lamaload – geosmin)	Scope and costs based on the AMP7 algae investigation outturn costs.	Direct costs include: • 12 months' worth of sampling at multiple locations within the reservoir and feeder streams • Sampling and analysis for the following parameters: Chlorophyll, Blue green algal chlorophyll, Total phosphorus, Orthophosphate, Ammoniacal nitrogen, Total oxidised nitrogen, Total nitrogen, Nitrate, Nitrite, Suspended solids, Dissolved Organic N, Organic Phosphorus, Temperature, pH, Geosmin intra cellular, Geosmin extra cellular, 2MIB, Algal counts, Secchi depth transparency • Use of a boat to undertake sampling • Consultant's time for site visits, analysis, research and report writing	Cowpe: £0.403 Hurleston: £0.410 Lamaload: £0.403

Driver code / sub category	No. of investigations	Source of AMP8 cost estimate	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
Colour	7 (Fishmoor, Franklaw, Lancaster, Laneshaw, Ridgling, Rivington, Worsthorne)	Scope and costs used from the AMP7 colour investigations for Wybersley in the Goyt (Errwood and Fernilee) and Lyme (Horsecoppice and Bollinhurst) catchments	Direct costs include: • 12 months' worth of sampling at multiple locations within the catchments and feeder streams into the reservoirs • Sampling and analysis for colour, DOC, turbidity and other associated parameters • Monitoring of water flows in the catchment • Deployment of auto-samplers in the catchments to allow sampling at desired frequency • Consultant's time for site visits, analysis, research and report writing	Fishmoor: £0.311 Franklaw: £0.294 Lancaster: £0.311 Laneshaw: £0.311 Ridgling: £0.311 Rivington: £0.311 Worsthorne: £0.311
Nitrates (and bacteria)	4 (Cliburn (nitrates), Fairhill (nitrates), Widnes boreholes (nitrates and bacteria), Wirral boreholes (nitrates))	Scope and costs used from the AMP7 borehole and groundwater projects and groundwater WINEP investigations	Direct costs include: • 12 months' worth of nitrate sampling at all boreholes associated with the site in question • Sampling and analysis for nitrate and other associated parameters e.g. bacteria where relevant • Analysis of spatial model outputs • Recommendations on the likely effectiveness of nature based / catchment interventions in AMP9. • Consultant's time for site visits, analysis, research and report writing	Cliburn: £0.709 Fairhill: £0.577 Widnes: £0.577 Wirral: £0.973

Driver code / sub category	No. of investigations	Source of AMP8 cost estimate	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
Invasive Non-Native Species	2 (Raw water transfer mitigation trials, Phase 2: INNS raw water transfer investigation and options appraisal)	Mitigation trial costs: the EA have proposed £5million across the water industry in AMP8 split using the Water UK formula based on company size (UUW will have to contribute 10.5%). Phase 2: INNS raw water transfer investigation and options appraisal: scope and costs based on the AMP7 phase 1 investigation	Direct costs include: <u>Raw water transfer mitigation trials</u> This will be an EA/Water UK led national collaborative pilot investigation that all water companies will contribute to. The investigation will be to see how best companies can mitigate for transfers of raw water through technology and retrofitting onto existing assets. Trials of different technology will be proposed. The EA have proposed £5million across the industry in AMP8 split using the Water UK formula based on company size (UUW will have to contribute 10.5%). <u>Phase 2: INNS raw water transfer investigation and options appraisal</u> The purpose of the phase 2 investigation is to complete a gap analysis of the raw water transfer system not covered by the AMP7 phase 1 study and complete a mop up risk assessment and options appraisal. The assessment should include any raw water assets or infrastructure such as washouts or discharges that have the potential to discharge raw water into different catchments. The investigation should identify and rank (in respect of risk) any raw water assets or infrastructure that could be significantly impacted by INNS or act as a potential pathway to the spread of INNS. The options appraisal should identify any additional opportunities & measures to reduce risk within the water transfer network, not covered by phase 1. Majority of the cost is for consultant's time to undertake the research and analysis.	Raw water transfer mitigation trials: £0.729 Phase 2: INNS raw water transfer investigation and options appraisal: £1.384
Biodiversity	1 (Skerton Weir – fish passage investigation)	Scope and costs based on the five AMP7 fish passage investigations undertaken, which are exactly what is required for this action.	Direct costs include: • Fish surveys in multiple locations up and down stream of the weir • River water quality and other habitat parameter surveys in the location of the weir • Options appraisal and development for effective fish passage – potentially looking at full weir removal • Consultation with stakeholders • Consultant's time for site visits, analysis, research and report writing	Skerton Weir: £0.210

Driver code / sub category	No. of investigations	Source of AMP8 cost estimate	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
Water Resources Artificial and Heavily Modified Water Bodies	4 (Pennington compensation flow, gravel starvation downstream of Vyrnwy reservoir, gravel starvation downstream of Stocks reservoir, Longdendale (Etherow -Woodhead Res. to Glossop Bk.)	Pennington, Stocks and Vyrnwy are all an investigation and implementation scheme in AMP8. Cost build-up of the investigation element is based on similar investigations undertaken in AMP6&7. Longdendale cost is based on a similar investigation undertaken in the same valley in AMP6	The direct costs for the investigations are built up of: • Vyrnwy: investigation phase costs based on unit costs for resources and surveys required per discipline e.g. habitat staff, consultants etc. • The direct costs for Pennington are based on similar investigations undertaken in AMP6 and modelling will be required to understand what flow rate the compensation should be set at. • Stocks costs are built up of surveys based on AMP7 investigation findings at Stocks for flow and habitat related matters. Costs include survey and monitoring work and consultant time to assess and provide a report. • Longdendale costs are also built up of survey and monitoring work and consultant time to assess and provide a report.	Pennington: Investigation cost of this scheme is £0.950 against full value of scheme of £2.640, which includes an implementation element (cost detailed under WFD_IMP_WRHMWB driver) Vyrnwy: Investigation cost of this scheme is £0.0015 against full value of scheme of £0.0042, which includes an implementation element (cost detailed under W_WFD_WRHMWB_INV1 driver) Stocks: £0.110 Longdendale: £0.040

Driver code / sub category	No. of investigations	Source of AMP8 cost estimate	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
Eel Regulations	6 (Levers Water, Langden Brook and Hareden system, Dean Clough, Whitendale and Brennand system, Thirlmere, Pickup Bank)	Costs based on historical outturn costs for investigating similar schemes in AMP6 on the River Dee abstractions. UUW Estimating updated costs to bring in line with PR24 cost base	Direct cost build-up includes: • Consultant costs to investigate eel entrainment / barriers to passage at all the abstraction assets associated with the specific site • Consultants to develop a costed solution for implementation in AMP9 • Consultants to undertake a cost benefit assessment of the proposed scheme • Report writing and review	£0.156 per scheme
Water Resources Regional Long-term Environmental Destination	11 (Furness aquifer, Fylde aquifer, Wyre habitat/sediment improvements, Grizedale Brook instream habitat improvements, Lune-Wyre, Manchester and Cheshire East permo-triassic sandstone aquifer, Manchester and Cheshire east carboniferous aquifer, Mersey Basin Lower and Merseyside North Permo-Triassic sandstone aquifer, Tarnbrook Wyre sediment management, Wirral and West Cheshire aquifer, company contribution to regional plan (ED)	All investigations are similar to investigations undertaken in AMP6&AMP7 and therefore scope and outturn costs from these projects have been used to inform the AMP8 cost build. It is acknowledged however that the AMP8 investigations with options appraisals considering climate change and wider catchment interventions will be more complex than the AMP7 schemes. In particular the Fylde region will be particularly complex due to the multiple competing pressures being investigated in the area.	Direct costs include: • Sampling, monitoring and analysis based on length required and number of locations • Consultant's time for site visits, analysis, research and report writing • Stakeholder engagement	Furness: £0.202 Fylde: £0.472 Wyre: £0.515 Grizedale Brook: £0.478 Lune-Wyre: £0.614 Manchester and Cheshire East permo-triassic sandstone aquifer: £0.301 Manchester and Cheshire East carboniferous aquifer: £0.301 Mersey Basin Lower and Merseyside North: £0.301 Tarnbrook Wyre: £0.515 Wirral and West Cheshire: £0.189 Regional Plan: £0.690

Driver code / sub category	No. of investigations	Source of AMP8 cost estimate	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
Groundwater	1 (Fylde aquifer recharge)	This scheme is a pilot trial of aquifer recharge. Costs have been built up from various sources as UUW has not undertaken an aquifer recharge scheme before. Groundwater modelling costs have come from consultant costs (Wood and Mott Macdonald) based on work undertaken through groundwater investigations in AMP7. EA permitting fees of £40k have come from their charges guidance. Installation of new asset costs have been generated from scope for constructing a new borehole and pumps etc. based on cost curves and SME input.	Direct cost build-up includes: • Groundwater modelling • Sampling and monitoring of the aquifer and watercourses • EA permitting fees for discharging to the environment • Consultant fees for analysing information and providing recommendations • Public consultation costs • Installation of new assets to enable aquifer recharge	Fylde: £4.904

Driver code / sub category	No. of investigations	Source of AMP8 cost estimate	Cost build-up (direct costs)	Totex (£M) (post frontier shift & RPE assumptions) (price base FY23)
Water Resources (hydrological regime)	10 (Trawden Springs, Aughertree/ Longlands, River Dane, Langden/ Hareden, Downholland Brook, Wheelock, Millingford Brook, Manley Common boreholes, Manley Quarry boreholes, Mouldsworth boreholes)	All investigations are similar to investigations undertaken in AMP6&AMP7 and therefore scope and outturn costs from these projects have been used to inform the AMP8 cost build.	Direct cost build-up consists of: • Either aquifer modelling or flow monitoring depending on whether the site is surface water or groundwater • Consultant's time for site visits, analysis, research and report writing	Trawden Springs: £0.504 Aughertree/ Longlands: £0.420 River Dane: £0.420 Langden/ Hareden: £0.420 Downholland Brook: £0.189 Wheelock: £0.490 Millingford Brook: £0.189 Manley Common: £0.087 Manley Quarry: £0.069 Mouldsworth: £0.096

6.9.4 As Table 17 identifies the majority of cost build-ups are based on previous investigations we have undertaken and therefore we have a good idea of costs.

6.9.5 We have benchmarked our costs against similar investigations undertaken in AMP7 by Northumbrian Water[21], Welsh Water[22], Wessex Water[23] and Yorkshire Water[24]. From the information available unit costs, in price base FY23, for investigations were ranging between circa £175,000 to £1.2million, with Welsh coming out at a unit cost of £637,740 per investigation and Yorkshire Water coming out at unit cost of c£700k, in price base FY23, for groundwater resource assessments, which will be similar to our environmental destination and WFD flow investigations. Our unit cost across the investigations is £461,513.

6.9.6 The range of costs for investigations is large and this is due to the broad remit of investigation topics, scope of investigations, and complexity. As mentioned in 6.9.1 fifty two of the fifty six investigations on the Water WINEP for AMP8 are tagged as: multiple surveys, and/or monitoring locations, and/or complex modelling. We know from AMP7 experience that the AMP8 investigations programme will be complex and time and resource intensive based on the type of investigations we have. We therefore believe our unit cost per investigation, although higher than the lower end of the range of benchmarked costs, is justified and is below the costs Welsh Water and Yorkshire Water put forward in PR19.

6.9.7 To add to this, a third party was engaged to carry out a bottom-up benchmarking exercise by comparing our cost build ups against similar companies. This resulted in an additional internal challenge on costs. As a result, the third party considers our costs to be efficient.

6.10 Third party assurance of our cost estimates

Bottom-up benchmarking (Faithful and Gould)

6.10.1 Faithful and Gould undertook a bottom-up deep dive into the cost efficiency of our enhancement cases. This involved a close examination of our cost base relating to a sample of our enhancement programme, with comparisons made to similar activity carried out by third party companies across a variety of sectors.

6.10.2 F&G looked at our direct costs across each of the following categories:

(a) Staff including site supervision

(b) Mobilisation and site set up, running and removal of site offices and welfare

(c) Temporary services for general site use, such as water to wash out concrete skips

(d) Attendant plant and equipment, such as cranes, forklift for unloading deliveries etc

(e) Attendant labour, defined as hourly paid operatives not involved in productive works

(f) Site consumables, such as waste skips

(g) Set-up site compounds, erecting hoardings etc

(h) O&M manuals

(i) Health and safety

6.10.3 It also looked at the contractor's indirect costs (e.g. overhead and design costs) and UUW's indirect costs (e.g. land acquisition costs). Due to the size of the programme, F&G examined a sample of our enhancement cases. However, this sample included projects from each of our enhancement categories

[21] Northumbrian Water (2018*) Appendix 3.2 Enhancement Business Cases*. Page 20. Available here.

[22] Dwr Cymru / Welsh Water (2018) *Water Resources Ref 5.8A*. Page 23. Available here.

[23] Wessex Water (2018) *Supporting document 5.1 – Protecting and enhancing the environment*. Pages 135-141. Available here.

[24] Yorkshire Water (2018) *Appendix 8G PR19 WINEP Technical Appendix*. Page 112 & 116. Available here.

and covered £1.246bn of expenditure. Therefore, we consider this sample to representative of our overall enhancement programme.

6.10.4 F&G noted the effectiveness of UUW's cost estimation process:

"In addition to the benchmarking data held by Faithful+Gould we understand that UUW has applied multiple internal and external challenges to progressively refine the cost estimation undertaken to date. In particular we note UUW's use of its Investment Programme Estimating System (IPES) which is a bespoke parametric estimating tool containing data from AMP3 to AMP7, to provide historical cost curves alongside estimated data from third party organisations."

6.10.5 F&G found that our proposed costs are in line with rates typically seen across the industry:

"Overall, UUW's approach of utilising historic cost curves, market testing and obtaining specialist third party quotations demonstrates a sound proactive approach to cost planning. In total £1.2bn of schemes underwent targeted cost assessment with £573m making up the construction works element.

After presenting our initial findings it was encouraging to see UUW's commitment to addressing our findings and applying these to the wider enhancement estimates, charting a strategic route towards greater efficiency and scope clarification.

In light of this Cost Assurance work and evidence of UUW's responsive actions we have concluded that the data we have benchmarked is within a reasonable alignment with anticipated market rates."

7. Customer protection

7.1 Introduction

7.1.1 It is important that customers have confidence that we will deliver the enhancement schemes that get reflected in our PR24 final determinations and they are suitably protected in the event of non-delivery, or if there are material changes to deliverables (including changes to dates), which leads to a change in cost (including changes in the timing of required expenditure). Ofwat proposes that, if companies fail to deliver or are late delivering improvements to customers, then price control deliverables (PCDs) should, where appropriate, be used to compensate customers. In our PR24 *Chapter 8 –Delivering at Efficient Cost, section 8.8.9* we have proposed an approach to PCDs that aims to provide customer protection, such that customers are fairly compensated for non-delivery (such as due to a change in regulatory requirements) or late delivery (including as a result of a change to a regulatory date), between PCDs, any related ODI underperformance payments, and cost sharing arrangements.

7.2 Water WINEP enhancement price control deliverable

7.2.1 We have considered PCDs in two areas (£105.495m).

(a) Biodiversity (£47.437m AMP8 totex)

(b) Other Water WINEP drivers (£58.058m AMP8 totex)

(a) Biodiversity

Table 18: PCD summary

Scheme delivery expectations	
Description of deliverable	Deliver biodiversity improvements to restore or prevent deterioration of Sites of Special Scientific Interest (SSSI) and/or ensure European sites are in favourable condition (this relates to schemes under a NERC, SSSI or HD driver code).
Output measurement and reporting	We have calculated the cumulative PCD deliverables based on the area (hectares) of the catchment of each location involved that is benefitting from this environmental improvement. To account for work required to achieve each of the milestones, we have proportioned the associated hectarage as 20% for Contract Award, 40% Start on Site and 40% Project in Use. The projects at Overwater, Crummock Water and Chapel House also include significant construction costs, and the costs per hectare of those projects are therefore disproportionaly higher than the other schemes in the programme. For these three projects we have applied a surrogate measure of 'equivalent hectarage' based on the number of hectares that relate to the cost of each of those schemes, if one applies the average £ / hectare of the other schemes in the programme. This ensures that PCD rates are broadly proportionate to all schemes in the programme, number of actions completed under the NERC, SSSI and HD driver codes in line with project milestones, as set out in the Tables 22. Equivalent hectarage of catchment benefitting from actions completed under the NERC, SSSI and HD driver codes in line with project milestones, as set out in the Table 221. This is used to calculate the weighted milestone value used in this PCD as shown in Table 233. We propose the completion of site schemes will be reported through the APR process through table 5a (new line or additional commentary). Whilst this table does not currently allow for project milestone delivery, this additional detail could be set out in table commentary. No delivery completion is forecast in years 1 and 2 as these years will be spent in design and definition project phase, and securing 3rd party partnerships, and tendering contracts. This phase will also involve extensive negotiation and agreement with the Environment Agency, National Parks Authority, Natural England, and land owners concerning detailed method statements and success criteria.
Assurance	In line with EA guidance completion of an action will require the live WINEP/NEP to have been signed off by UUW with the relevant Output in Use evidence pack uploaded to the EA WINEP SharePoint. The EA will then also need to sign the live WINEP/NEP to confirm they are happy that the scheme has been completed in line with the Action Specification Form. For schemes with a regulatory date of 31st March the EA have until 15th May in order to review the evidence and sign-off. EA sign-off provides third party assurance.
Conditions on scheme	None
Impact on PCs	None

7.2.2 In our PCD template *UUW32-PCD Excel Sheet* we have assumed a wholesale WACC of 3.23%, in line with Ofwat's guidance. We have assumed a 50% totex cost sharing rate, which is applied before calculating PCDs. We have applied a further 50% for Bioresources (where applicable), to ensure that only 25% of Bioresources totex is at risk from PCDs, given the lack of RCV guarantee, and general uncertainty in cost recovery from future Bioresources price controls. For late delivery we have applied a proportionate value of annual opex, and assumed 3.5% of capex, which provides a fair reflection of the time value of money of any related deferred capital spend.

Table 19: PCD delivery profile

	Unit	AMP8	2024	2025	2026	2027	2028	2029	2030	Ultimate delivery
Cumulative delivery target for PCD	**hectares**		**-**	**-**	**-**	**-**	**10,635**	**31,905**	**53,175**	**53,175**
AMP8 Capex (22/23 pb)	£	14,736,227	-	-	1,722,706	1,354,340	7,411,447	3,877,842	369,893	
AMP8 Opex (22/23 pb)	£	32,695,119	-	-	6,143,983	3,621,241	8,395,673	11,614,192	2,920,030	
ODI impact per unit of PCD volume	£/hectares	0.00								

Table 20: Price Control Allocation

Price Control	Unit	Price Control Allocation
Water resources	%	100.00%
Water network+	%	0.00%
Wastewater Network+	%	0.00%
Bioresources	%	0.00%

Table 21: PCD Incentive rates

	Unit	WR	WN+	WwN+	BR
Overall delivery	£/hectares	446	0	0	0
Time value rate	£/hectares	14	0	0	0
Late delivery	£/hectares	201	0	0	0

7.3 Supporting information

Table 22: Project Milestones

Site	HA	Contract award (20%)	Start on site (40%)	Project in use (40%)
Poaka Beck	102	01/08/2027	01/04/2028	31/03/2030
Thirlmere	2,084	01/08/2027	01/08/2028	31/03/2030
Upper Duddon	1,715	01/08/2027	01/04/2028	31/03/2030
River Eden	40	01/08/2027	01/04/2028	31/03/2030
Ennerdale	4,390	01/08/2027	01/07/2028	31/03/2030
Bowland	1,549	01/08/2027	01/07/2028	31/03/2030
Haweswater	1,085	01/08/2027	01/04/2028	31/03/2030
South Pennines	5,814	01/08/2027	01/08/2028	31/03/2030
West Pennines	2,219	01/08/2027	01/07/2028	31/03/2030
Crummock Water	13,617	01/09/2027	01/09/2028	31/03/2030
Chapel House	14,884	01/09/2027	01/09/2028	31/03/2030
Overwater	5,676	01/08/2027	01/08/2028	31/03/2030

Table 23: Forecast deliverables

Deliverable and weighting	Unit	Forecast deliverables				
		2025-26	2026-27	2027-28	2028-29	2029-30
Contract Award (20%)	hectares	0	0	10635	10635	10635
Start on Site (40%)	hectares	0	0	0	21670	21670
Project in Use (40%)	hectares	0	0	0	0	21670
Total (PCD deliverable)	**hectares**	**0**	**0**	**10635**	**31905**	**53175**

(b) Other Water WINEP drivers

7.3.1 We have not included a PCD for this area as each individual driver is small in size, and below Ofwat's indicated threshold.

Appendix A Overview of WINEP drivers

Table 24: Overview of WINEP drivers

PR24 WINEP/NEP drivers	Underpinning legislative requirements	Driver codes (S = statutory obligations) (S+ = statutory plus obligations)	High level driver description	Number of actions
Water Resources (Hydrological Regime)	Water Environment (Water Framework Directive) Regulations 2017	WFD_INV_WRFlow (S) (investigation to determine impact of abstractions and appraisal of options for an effective solution to achieve good ecological status (surface water). Completion date 31/12/2026). WFD_NDINV_WRFlow (S) (investigation to determine the likelihood that future abstraction will cause deterioration in any element affecting the ecological status of a water body and identify effective solutions. Completion date 31/12/2026). WFD_ND_WRFlow (S) (action to protect / ensure no deterioration in status (surface water). Completion date 31/03/2030). WFD_IMP_WRFlow (S+) (action to improve ecological status (surface water). Completion date 31/03/2030).	The hydrological regime driver relates to actions to protect and improve the hydrological regime of water bodies to meet objectives as set out in accordance with Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. The hydrological regime is a supporting element for a water body to achieve good ecological status. The impact of abstraction pressures on the hydrological regime can mean that the flow in a water body is not sufficient to be supporting good ecological status. The hydrological regime in surface waters is an essential factor determining the creation, function and health of habitats and the protection of the ecology they support.	WFD_INV_WRFlow = 1 investigation WFD_NDINV_WRFlow = 9 investigations WFD_ND_WRFlow = 28 schemes WFD_IMP_WRFlow = no schemes

PR24 WINEP/NEP drivers	Underpinning legislative requirements	Driver codes (S = statutory obligations) (S+ = statutory plus obligations)	High level driver description	Number of actions
Water Resources Artificial and Heavily Modified Water Bodies	Water Environment (Water Framework Directive) Regulations 2017	WFD_INV_WRHMWB (S) (investigation and appraisal of options to determine the impact of abstraction and/or water storage infrastructure on achievement of good ecological potential in an Artificial or Heavily Modified Water Body (water resources use. Completion date 31/12/2026). WFD_NDINV_WRHMWB (S) (investigation to determine the likelihood that abstraction and/or water storage infrastructure will cause deterioration in ecological potential of an Artificial or Heavily Modified Water Body (water resources use) and identify effective solutions. Completion date 31/12/2026). WFD_ND_WRHMWB (S) (action to protect / ensure no deterioration in ecological potential. Completion date 31/03/2030). WFD_IMP_WRHMWB (S+) (action to achieve good ecological potential. Completion date 31/03/2030).	The Water Resources Artificial and Heavily Modified Water body (A/HMWB) driver relates to the actions to protect and achieve objectives as set out in accordance with Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. The WFD objective for A/HMWB is to achieve and maintain Good Ecological Potential (GEP). A/HMWBs are designated to recognise the activities within them. Some A/HMWBs are designated for the activities of water storage (such as drinking water supply, power generation or irrigation) or water regulation (abstraction and discharges). To achieve GEP a defined set of mitigation measures for the designated use need to be in place.	WFD_INV_WRHMWB = 3 investigations* WFD_NDINV_WRHMWB = no investigations W_WFD_WRHMWB_INV1 = 1 NEP investigation* WFD_IMP_WRHMWB = 2 schemes* W_WFD_WRHMWB_IMP1 = 1 NEP scheme* WFD_ND_WRHMWB = 1 scheme. *Pennington and Vyrnwy are both single actions on the WINEP yet they both have an investigation and implementation scheme driver in AMP8.

PR24 WINEP/NEP drivers	Underpinning legislative requirements	Driver codes (S = statutory obligations) (S+ = statutory plus obligations)	High level driver description	Number of actions
WFD Physical Habitat and Fish Passage	Water Environment (Water Framework Directive) Regulations 2017	WFD_INV_PHYSHAB (S) (investigation to determine: impacts from water company owned/utilised physical modification on fish passage or physical habitat and Impact to WFD water body status/potential objectives – e.g. is the physical modification a reason for not achieving good status/potential? Completion date 30/04/2027). WFD_IMP_PHYSHAB (S+) (actions to address barriers to passage of fish or impacted physical habitat in WFD failing waterbodies not designated artificial or heavily modified for water resources uses. Completion date 31/03/2030).	In PR19 a new driver (WFD-IMP-FISH) to tackle fish failures as a result of fish passage issues at water company structures was established under the Water Environment (Water Framework Directive) Regulations 2017. For PR24 this driver is being expanded to include all WFD biological quality element failures that relate to physical modification/ecological discontinuity caused by structures and associated physical infrastructure owned or utilised by water companies. These WFD biological quality element failures would include those caused by: Fish passage Fish entrainment Physical Modification As in PR19, this driver applies to all water bodies except those designated as artificial or heavily modified for water resources purposes.	WFD_INV_PHYSHAB = no investigations. WFD_IMP_PHYSHAB = 2 schemes.

PR24 WINEP/NEP drivers	Underpinning legislative requirements	Driver codes (S = statutory obligations) (S+ = statutory plus obligations)	High level driver description	Number of actions
Groundwater	Water Environment (Water Framework Directive) Regulations 2017	WFDGW_INV (S) (Groundwater good status investigation relating to water resource or water quality. Completion date 30/04/2027). WFDGW_NDINV (S) (Groundwater prevent deterioration investigation relating to water resource or water quality. Completion date 30/04/2027). WFDGW_ND (S) (Groundwater prevent deterioration action relating to water resource or water quality. Completion date 31/03/2026 or 31/03/2030 depending on deterioration status). WFDGW_IMP (S+) (Groundwater good status improvement action relating to water resource or water quality. Completion date 31/03/2030).	Groundwater is vulnerable to the impacts of pollution and abstraction, so this driver objective is to investigate and implement actions to protect and improve groundwater. It should be used where water company assets are affecting, or being affected by, anthropogenic groundwater quality or quantity issues, here companies should develop schemes to protect and improve groundwater. Schemes should be location specific, have clear measurable outcomes and delivery timescales. This driver can be used on its own or with other drivers.	WFDGW_INV = no investigations. WFDGW_NDINV = 1 investigation. WFDGW_ND = no schemes. WFDGW_IMP = no schemes.

PR24 WINEP/NEP drivers	Underpinning legislative requirements	Driver codes (S = statutory obligations) (S+ = statutory plus obligations)	High level driver description	Number of actions
Drinking Water Protected Areas	Schedule 1 of the Water Supply (Water Quality) Regulations 2016	DrWPA_INV (S) (Investigations for 'at risk' DrWPAs or groundwater safeguard zone to identify actions to prevent deterioration and/or to reduce treatment. Completion date 30/04/2027). DrWPA_IMP (S+) (Implementation of actions through a scheme to improve water quality so the level of purification treatment can be reduced over time. Completion date 31/03/2030). DrWPA_ND (S) - Implementation of actions through a catchment scheme, or at a wastewater treatment works, to prevent deterioration (or improve following a deterioration) in water quality to avoid an increase in the level of water purification treatment. Completion date 31/03/2030).	Water companies develop DrWPA actions using a weight of evidence approach to: ● prevent deterioration in water quality to avoid an increase in the level of water purification treatment; or ● improve water quality so the level of purification treatment can be reduced over time. Actions can be aimed at surface water quality and/or groundwater quality and should address substances with the potential to impact drinking water treatment including wholesomeness. Schedule 1 of the Water Supply (Water Quality) Regulations 2016 lists the parameters, and the concentration of those parameters, which would constitute a potential danger to human health.	DrWPA_INV = 21 investigations. DrWPA_IMP = 1 scheme. DrWPA ND = 2 schemes. W_DrWPA_NDIMP1 = 1 NEP scheme.

PR24 WINEP/NEP drivers	Underpinning legislative requirements	Driver codes (S = statutory obligations) (S+ = statutory plus obligations)	High level driver description	Number of actions
European Sites	Conservation of Habitats and Species Regulations 2017 Water Environment (Water Framework Directive) Regulations 2017 Water Industry Act 1991 Biodiversity 2020: A strategy for England's wildlife and ecosystem services	HD_IMP (S) (action to contribute to restoration of a European site or Ramsar site to move towards meeting the conservation objectives. Completion date 31/03/2030). HD_ND (S) (action to contribute to maintenance of (prevent deterioration of) a European site or Ramsar site at favourable conservation status. Completion date 31/03/2030). HD_INV (S) (investigation and or options appraisal to determine impacts of water company activities, or permit / licence conditions/standards on a European site or Ramsar site or to determine the costs and technical feasibility of meeting targets. Completion date 30/04/2027).	Water companies have a duty to help protect, conserve and restore European sites. This is a statutory driver in the WINEP and water companies are expected to contribute to maintaining or restoring the habitats and species of European sites at favourable conservation status across their natural range in the UK. European sites comprise special areas of conservation (SAC) for specific natural habitats and species, and special protection areas (SPA) for birds. These sites receive legal protection to help conserve the internationally important habitats and species for which they are designated. The individual sites, supported by features of the landscape which help connect them with each other and improve their coherence, collectively make up a 'national site network' of European sites. Natural England periodically monitor and assess the condition of SSSIs which underpin European sites.	HD_IMP = 5 schemes. HD_ND = no schemes. HD_INV = no investigations.

PR24 WINEP/NEP drivers	Underpinning legislative requirements	Driver codes (S = statutory obligations) (S+ = statutory plus obligations)	High level driver description	Number of actions
Eels	The Eels (England and Wales) Regulations 2009	EE_INV (S) (investigation required to confirm eel entrainment/identify that a structure is a barrier to eel passage and to determine appropriate action. Completion date 30/04/2027). EE_IMP (S+) (schemes to improve diversion structures to prevent the entrainment of eel (for example screening intakes) and to address barriers to the passage of eel (for example building and maintaining eel passes). Completion date 31/03/2030).	These drivers are to comply with the Eels Regulations 2009 by identifying and addressing actions to halt and reverse the decline in the European eel stock, aiming to meet a target set for the number of mature adult eels leaving each river basin to return to spawn at sea. The UK must consider eel passage as part of the solution and this need is reflected within the provisions contained within Part 4 of the Eels Regulations. The Environment Agency has been working across all sectors with operators of water intakes and owners of other eel barriers, such as weirs, to identify how they can protect eel to help to restore the stock to a sustainable level. From 1st January 2015, to be legally compliant with the Eels Regulations, all intakes (capable of abstracting at least 20 m3 per day) and all outfalls must be screened for eel unless the requirement is exempt.	EE_INV = 6 investigations. EE_IMP = 2 schemes. W_EEL_IMP1 = 1 NEP scheme.

PR24 WINEP/NEP drivers	Underpinning legislative requirements	Driver codes (S = statutory obligations) (S+ = statutory plus obligations)	High level driver description	Number of actions
Invasive non-native species (INNS)	Invasive Alien Species Regulations (IAS Regulations) The Wildlife and Countryside Act 1981 Invasive Alien Species (Enforcement and Permitting) Order 2019	INNS_INV (S) (investigations – includes pathway analysis, prevention of deterioration and actions to achieve conservation objectives. Completion by 31/03/2027). INNS_ND (S) (Delivery - Actions to prevent deterioration by reducing the risks of spread of INNS and reducing the impacts of INNS. Completion by 31/03/2030). INNS_IMP (S, S+) (Delivery - Improvement schemes to reduce the impacts of INNS, where INNS is a reason for not achieving conservation objectives or good status. Completion date by 31/03/2030). INNS_MON (S+) (Surveillance - Set up of surveillance programmes. Completion date by 31/03/2030).	Invasive non-native species of flora and fauna are considered the second biggest threat after habitat loss and destruction to biodiversity worldwide. The annual cost of invasive non-native species to the GB economy was estimated in 2010 to be £1.7 billion per year. It is estimated INNS are a contributing pressure in over a quarter of water bodies not achieving good status, and over 70 per cent of water bodies are at risk of deterioration due to the impacts of INNS. The UK has specific international and national obligations and laws to control the spread of INNS. INNS actions within the WINEP also contribute to the 25-year plan goals of Clean and Plentiful Water, Thriving Plants and Wildlife, and Enhancing Biosecurity, and reduce Water Company future risks to cost and infrastructure that INNS may present.	INNS_INV = 2 investigations INNS_ND = 1 schemes INNS_MON = 2 monitoring actions INNS_IMP = no schemes.

PR24 WINEP/NEP drivers	Underpinning legislative requirements	Driver codes (S = statutory obligations) (S+ = statutory plus obligations)	High level driver description	Number of actions
Sites of Special Scientific Interest (SSSI)	Wildlife and Countryside Act 1981 Water Industry Act 1991 Biodiversity 2020: A strategy for England's wildlife and ecosystem services	SSSI_IMP (S+) (action to contribute to restoration of a SSSI to favourable condition. Completion date 31/03/2030). SSSI_ND (S+) (action to contribute to maintenance of (prevent deterioration of) the condition of a SSSI. Completion date 31/03/2030) SSSI_INV (S+) (investigation and/or options appraisal to determine impacts of water company activities, or permit or licence conditions/standards on a SSSI or to determine the costs and technical feasibility of meeting targets. Completion date 30/04/2027).	Water companies have duties to take reasonable steps to conserve and enhance SSSIs. This means this is a Statutory+ driver in the WINEP and water companies should contribute to maintaining or meeting 'favourable condition' SSSIs. 'Favourable condition' is achieved when appropriate management actions are in place and the notified habitats and features of a SSSI are judged to be in a healthy state and conserved for the future.	SSSI_IMP = 3 schemes SSSI_ND = no schemes SSSI_INV = no investigations
Biodiversity	Natural Environment and Rural Communities Act 2006 (Environmental Act 2021 strengthens Section 40 of NERC Act) 25 Year Environment Plan Biodiversity 2020: A strategy for England's wildlife and ecosystem services	NERC_INV (S+) (investigations and/or options appraisal for changes to permits or licences, and/or other action that contributes towards biodiversity duties, requirements and priorities. Completion date 30/04/2027). NERC_IMP (S+) (Changes to permits or licences, and/or other action that contributes towards biodiversity duties, requirements and priorities. Completion date 31/03/2030)	Water companies have an existing duty to have regard to conserving biodiversity and this will be strengthened further as a result of the Environment Act 2021. This driver can be used as a Statutory+ driver in the WINEP to deliver actions to respond to risks and issues for biodiversity related to water company operations, including to address their fair share of pressures that are impacting biodiversity.	NERC_INV = 1 investigation NERC_IMP = 4 schemes

PR24 WINEP/NEP drivers	Underpinning legislative requirements	Driver codes (S = statutory obligations) (S+ = statutory plus obligations)	High level driver description	Number of actions
Environmental Destination/Water Resources Management Plans (WRMPs)	National framework for water resources sets out the need for regional plans (includes long-term environmental destination). Statutory element of these plans is through the delivery of Water Resource Management Plans (WRMPs)	EDWRMP_INV (S) (investigations, options appraisals or feasibility studies for actions identified within the WRMP to meet regional planning requirements that do not fit with WFD driver requirements. Completion date 31/12/2026). EDWRMP_IMP (S+) (actions identified within the WRMP to meet regional planning requirements that do not fit with WFD driver requirements. Completion date 31/03/2030).	In March 2020, the Environment Agency published the National Framework for Water Resources which outlines potential water resources scenarios to 2050 and beyond. The National Framework set that an overall reduction in abstraction of between 1,200 million litres per day and 2,200 million litres per day may be needed by 2050. The National Framework set out the need for regional plans, to identify how the security of public water supply and the protection of the environment will be managed. The statutory element of these plans is through the delivery of individual company WRMPs. The new regional plans will put the environment at the heart of the decisions. Abstractions today may not be sustainable in the future due to climate change and changes in land use. By forecasting the need to change abstractions, we can avoid the current issue of trying to fix problems after they happen. Regional plans will include a long-term environmental destination that shows how they will protect and enhance the environment over the life of the plan. The environmental destination represents the outcome for the environment that the regional plan is aiming to deliver.	EDWRMP_INV = 11 investigations. EDWRMP_IMP = no schemes.

PR24 WINEP/NEP drivers	Underpinning legislative requirements	Driver codes (S = statutory obligations) (S+ = statutory plus obligations)	High level driver description	Number of actions
Salmon and Sea Trout entrainment	Salmon and Freshwater Fisheries Act 1975.	SAFFA_IMP (S) (Schemes to prevent entrainment of salmon or migratory trout in existing intakes and outfalls. Completion date 31/03/2030). SAFFA_INV (S) (Investigations to confirm level of entrainment or impediment to fish passage or devise an appropriate solution in waters that are becoming frequented by salmon or migratory trout. Completion date 30/04/2027).	This driver is to ensure a water company's existing surface water intakes and outfalls are screened to prevent the entrainment of salmon or sea trout. This screening requirement is set out in Section 14 of the Salmon and Freshwater Fisheries Act 1975 and applies to all waters which are frequented by salmon or sea trout. With improvements in water quality and resolution of barriers to fish passage salmon and sea trout are returning to rivers or parts of rivers where they have previously been absent.	SAFFA_IMP = no schemes SAFFA_INV = no investigations
Monitoring for flow compliance		EPR_MON1 (S) (MCERTS certified WTW Total daily volume flow/max flow rate monitoring. Completion date 31/12/2026).	The EPR_MON1 driver requires Water Treatment Works (WTW) trade effluent discharges to have MCERTS certified flow monitoring to allow their performance against permit conditions to be better regulated.	EPR_MON1 = no schemes

Appendix B AMP8 WINEP/NEP Schemes

Table 25: WINEP/NEP implementation schemes

Action ID	Action name	Description	Ofwat category	WINEP/ NEP driver	Primary driver	Secondary driver	Tertiary driver	Reg date
08UU100146	Errwood and Fernilee & Wybersley colour	Undertake targeted interventions within the Lyme & Goyt Catchment to minimise or prevent deterioration of raw water quality in relation to colour	Drinking Water Protected Areas; (WINEP/NEP) water	Drinking Water Protected Areas	DrWPA_ND			31/03/2030
08UU100157	Hodder/Stocks colour phase 2	Undertake targeted interventions within the Stocks to minimise or prevent deterioration of raw water quality in relation to colour	Drinking Water Protected Areas; (WINEP/NEP) water	Drinking Water Protected Areas	DrWPA_ND			31/03/2030
UU100003	Huntington and Sutton Hall (River Dee Turbidity)	Collaborative funding from multiple Water Companies/organisations to deliver catchment interventions to reduce turbidity in the raw water	Drinking Water Protected Areas; (WINEP/NEP) water	Drinking Water Protected Areas	W_DrWPA_NDIMP1			31/03/2030
08UU102343	Franklaw ammonia	Implementation of actions and sampling to reduce ammonia in the raw water so the level of purification treatment can be reduced over time	Drinking Water Protected Areas; (WINEP/NEP) water	Drinking Water Protected Areas	DrWPA_IMP			31/03/2030
08UU100151	Ennerdale infrastructure removal	Preparation and submission of an EIA to support the planning application for the removal of Ennerdale infrastructure in AMP9	Biodiversity and conservation; (WINEP/NEP) water	European Sites	HD_IMP	WFD_IMP_ WRHMWB		31/03/2030

Action ID	Action name	Description	Ofwat category	WINEP/ NEP driver	Primary driver	Secondary driver	Tertiary driver	Reg date
08UU100150	Crummock infrastructure removal	Infrastructure removal and return environment to a natural state	Biodiversity and conservation; (WINEP/NEP) water	European Sites	HD_IMP	WFD_IMP_ WRHMWB		31/03/2030
08UU100149	Chapel House infrastructure removal	Infrastructure removal and return environment to a natural state	Biodiversity and conservation; (WINEP/NEP) water	European Sites	HD_IMP	WFD_IMP_ WRHMWB		31/03/2030
08UU100152	Overwater infrastructure removal scheme	Infrastructure removal and return environment to a natural state	Biodiversity and conservation; (WINEP/NEP) water	European Sites	HD_IMP	WFD_IMP_ WRHMWB		31/03/2030
08UU100160	South Pennines	Manchester Uplands resilience, working in partnership to enable nature recovery, meet conservation objectives and deliver natural flood management	Biodiversity and conservation; (WINEP/NEP) water	European Sites	HD_IMP	SSSI_IMP	NERC_IMP	31/03/2030
08UU100162	Poaka Beck	Working in partnership with the South Cumbria Rivers Trust to engage with farmers and encourage take-up of measures to improve habitats	Biodiversity and conservation; (WINEP/NEP) water	Biodiversity	NERC_IMP			31/03/2030
08UU100164	Thirlmere	Phase two Thirlmere Resilience scheme, working in partnership to enable nature recovery	Biodiversity and conservation; (WINEP/NEP) water	Biodiversity	NERC_IMP			31/03/2030
08UU100163	Upper Duddon	Working in partnership with the South Cumbria Rivers Trust to engage with farmers and land owners and encourage measures to improve habitats, including natural flood management	Biodiversity and conservation; (WINEP/NEP) water	Biodiversity	NERC_IMP			31/03/2030

Action ID	Action name	Description	Ofwat category	WINEP/ NEP driver	Primary driver	Secondary driver	Tertiary driver	Reg date
08UU100145	River Eden	Provide a Catchment Advisor to work with the Eden Rivers Trust to implement a programme of measures within the River Eden catchment	Biodiversity and conservation; (WINEP/NEP) water	Biodiversity	NERC_IMP			31/03/2030
08UU100153	Pennington Reservoir	Provide compensation and variable flows from Pennington Reservoir into Pennington Beck. Install equipment to provide and measure all flows (including compensation flow, overflow spills and bypass flows)	Water Framework Directive; (WINEP/NEP) water	Water Resources Artificial and Heavily Modified Water Bodies	WFD_IMP_WRHMWB	WFD_INV_ WRHMWB		31/12/2026
08UU100154	Stocks Reservoir	Improve river morphology and minimise the impact of Stocks Reservoir on the River Hodder	Water Framework Directive; (WINEP/NEP) water	Water Resources Artificial and Heavily Modified Water Bodies	WFD_IMP_WRHMWB			31/03/2030
UU100002	Assessment and mitigation of gravel starvation downstream of Vyrnwy Reservoir	Work in partnership to re-gravel the Afron Vyrnwy to improve ecological and riverine processes	Water Framework Directive; (WINEP/NEP) water (64%)	Water Resources Artificial and Heavily Modified Water Bodies	W_WFD_WRHMWB_INV1	W_WFD_WRHMWB_IMP1		31/03/2030
08UU100139	Calder river intake	Install a naturalised bypass channel on the left bank to allow fish and eels to bypass the existing weir	Water Framework Directive; (WINEP/NEP) water	Water Resources Artificial and Heavily Modified Water Bodies	WFD_ND_WRHMWB	WFD_IMP_PHYSHAB		31/03/2030
08UU100167	Stocks Reservoir	Improve habitat and passage for eels by undertaking an “Alternative measures by other means” (AMbOM) scheme	Eels/fish entrainment screens; (WINEP/NEP) water	Eel Regulations	EE_IMP			31/03/2030

Action ID	Action name	Description	Ofwat category	WINEP/ NEP driver	Primary driver	Secondary driver	Tertiary driver	Reg date
08UU100168	Haweswater Reservoir	Improve habitat and passage for eels by undertaking an "Alternative measures by other means" (AMbOM) scheme	Eels/fish entrainment screens; (WINEP/NEP) water	Eel Regulations	EE_IMP			31/03/2030
UU100001	Horseshoe falls abstraction - eel screening	Install eel screens to prevent the entrainment of eels in the abstraction infrastructure	Eels/fish entrainment screens; (WINEP/NEP) water	Eel Regulations	W_EEL_IMP1			31/03/2030
08UU100169	INNS Surveillance Development	Undertake cross company development of surveillance techniques and approaches for relevant horizon, alarm and alert invasive non-native species	Invasive Non Native Species; (WINEP/NEP) water	Invasive Non-Native Species	INNS_MON			30/04/2027
08UU100166	INNS Surveillance Programmes	Undertake a surveillance programme to monitor Invasive Non-Native species	Invasive Non Native Species; (WINEP/NEP) water	Invasive Non-Native Species	INNS_MON			30/04/2027
08UU100165	INNS mitigation actions	Implement Invasive Non-Native species mitigation actions arising from risk assessments, option appraisal and companywide initiatives	Invasive Non Native Species; (WINEP/NEP) water	Invasive Non-Native Species	INNS_ND			31/03/2030
08UU100158	Bowland	Work in partnership to enable nature recovery and meet conservation objectives of the SSSI	Biodiversity and conservation; (WINEP/NEP) water	Sites of Special Scientific Interest	SSSI_IMP	NERC_IMP		31/03/2030
08UU100159	Haweswater	Work in partnership to enable nature recovery and meet conservation objectives of the SSSI	Biodiversity and conservation; (WINEP/NEP) water	Sites of Special Scientific Interest	SSSI_IMP	NERC_IMP		31/03/2030

Action ID	Action name	Description	Ofwat category	WINEP/ NEP driver	Primary driver	Secondary driver	Tertiary driver	Reg date
08UU100161	West Pennines	Work in partnership to enable nature recovery and meet conservation objectives of the SSSI	Biodiversity and conservation; (WINEP/NEP) water	Sites of Special Scientific Interest	SSSI_IMP	NERC_IMP		31/03/2030
08UU100140	Hug Bridge weir	Install low cost baffles to allow fish and eels to traverse the Hug Bridge weir	Eels/fish passes; (WINEP/NEP) water	WFD physical habitat and fish passage	WFD_IMP_PHYSHAB			31/03/2030
08UU100141	Taxal gauging weir	Undertake weir removal to allow passage of fish and eels	Eels/fish passes; (WINEP/NEP) water	WFD physical habitat and fish passage	WFD_IMP_PHYSHAB	WFD_IMP_ WRHMWB		31/03/2030
08UU100001	Gorstons borehole	Revocation of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow			31/03/2030
08UU100002	Laneshaw/Corn close boreholes	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100003	Bearstone boreholes	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100004	Schneider Road boreholes	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030

Action ID	Action name	Description	Ofwat category	WINEP/ NEP driver	Primary driver	Secondary driver	Tertiary driver	Reg date
08UU100005	Thorncliffe Road borehole	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100006	Eccleston Hill Borehole	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100007	Lees Lane borehole	Revocation of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow			31/03/2030
08UU100008	Rivington Gathering Grounds abstraction	Revocation of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow			31/03/2030
08UU100010	Ullswater freshet abstraction	Revocation of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow			31/03/2030
08UU100011	Five Crosses borehole	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030

Action ID	Action name	Description	Ofwat category	WINEP/ NEP driver	Primary driver	Secondary driver	Tertiary driver	Reg date
08UU100012	Delamere boreholes	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100013	Cotebrook1 borehole	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100014	Cotebrook2 borehole	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100015	Eaton borehole	Revocation of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100016	Eddisbury borehole	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030

Action ID	Action name	Description	Ofwat category	WINEP/ NEP driver	Primary driver	Secondary driver	Tertiary driver	Reg date
08UU100017	Foxhill boreholes	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100018	Newton/ Grange borehole	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100019	Helsby boreholes	Revocation of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100020	Hooton boreholes	Revocation of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100021	Manley Common (Four Lane Ends) boreholes	Modification of the abstraction licence and low flow stream support to ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation and AMP8 stream support feasibility study*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030

Action ID	Action name	Description	Ofwat category	WINEP/ NEP driver	Primary driver	Secondary driver	Tertiary driver	Reg date
08UU100022	Manley Quarry (Low Farm) boreholes	Modification of the abstraction licence and low flow stream support to ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation and AMP8 stream support feasibility study*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100023	Mouldsworth boreholes	Modification of the abstraction licence and low flow stream support to ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation and AMP8 stream support feasibility study*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100024	Newton Hollow boreholes	Revocation of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100025	Organsdale borehole	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100026	Prenton boreholes	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030

Action ID	Action name	Description	Ofwat category	WINEP/ NEP driver	Primary driver	Secondary driver	Tertiary driver	Reg date
08UU100027	Sandyford borehole	Modification of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100028	Springhill borehole	Revocation of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030
08UU100133	Ashton borehole	Revocation of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer. *Awaiting outcome from AMP7 investigation*	Water Framework Directive; (WINEP/NEP) water	Water Resources (hydrological regime)	WFD_ND_WRFlow	WFDGW_ND		31/03/2030

Table 26: WINEP/NEP investigation schemes

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100194	Ashworth Moor taste and odour	Re-investigation to understand deterioration of raw water quality concentrations of geosmin to remove 'at risk' status for that substance in the drinking water protected area	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100205	Cliburn nitrates	Investigation to understand deterioration of raw water concentrations of Nitrate in Cliburn boreholes	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100206	Cowpe geosmin	Investigation to understand deterioration of raw water quality concentrations of geosmin to remove 'at risk' status for that substance in the drinking water protected area	Drinking Water Protected Areas; (WINEP/NEP) water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100207	Fairhill nitrates	Investigation to understand deterioration of raw water concentrations of Nitrate in Fairhill boreholes	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100208	Fishmoor colour	Investigation to understand deterioration of raw water quality concentrations of colour to remove 'at risk' status for that substance in the drinking water protected area	Drinking Water Protected Areas; (WINEP/NEP) water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100156	Franklaw colour	Investigation to determine actions required to prevent deterioration to raw water quality concentrations of colour in Franklaw safeguard zone to remove 'at risk' status for that substance in the drinking water protected area	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100195	Haslingden Grane taste and odour	Re-investigation to understand deterioration of raw water quality concentrations of geosmin to remove 'at risk' status for that substance in the drinking water protected area	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100209	Hurleston geosmin and ammonia	Investigation to understand deterioration of raw water quality concentrations of geosmin and ammonia to remove 'at risk' status for that substance in the drinking water protected area	Drinking Water Protected Areas; (WINEP/NEP) water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100210	Lamaload geosmin	Investigation to understand deterioration of raw water quality concentrations of geosmin in Lamaload Reservoir to remove 'at risk' status for that substance in the drinking water protected area	Drinking Water Protected Areas; (WINEP/NEP) water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100211	Lancaster colour	Investigation to understand deterioration of raw water quality concentrations of colour to remove 'at risk' status for that substance in the drinking water protected area	Drinking Water Protected Areas; (WINEP/NEP) water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100212	Laneshaw colour	Investigation to understand deterioration of raw water quality concentrations of colour to remove 'at risk' status for that substance in the drinking water protected area	Drinking Water Protected Areas; (WINEP/NEP) water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100196	Laneshaw taste and odour	Re-investigation to understand deterioration of raw water quality concentrations of geosmin to remove 'at risk' status for that substance in the drinking water protected are	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100197	Mitchells taste and odour	Re-investigation to understand deterioration of raw water quality concentrations of geosmin to remove 'at risk' status for that substance in the drinking water protected area	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100198	Piethorne taste and odour	Re-investigation to understand deterioration of raw water quality concentrations of geosmin to remove 'at risk' status for that substance in the drinking water protected area	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100213	Ridgaling colour	Investigation to understand deterioration of raw water quality concentrations of colour to remove 'at risk' status for that substance in the drinking water protected area	Drinking Water Protected Areas; (WINEP/NEP) water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100199	Ridgegate taste and odour	Re-investigation to understand deterioration of raw water quality concentrations of geosmin to remove 'at risk' status for that substance in the drinking water protected area	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100214	Rivington colour	Investigation to understand deterioration of raw water quality concentrations of colour to remove 'at risk' status for that substance in the drinking water protected area	Drinking Water Protected Areas; (WINEP/NEP) water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100200	Rivington taste and odour	Re-investigation to understand deterioration of raw water quality concentrations of geosmin to remove 'at risk' status for that substance in the drinking water protected area	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100215	Widnes Boreholes (Stockswell) nitrates and bacteria	Investigation to understand deterioration of raw water quality concentrations of Nitrate and bacteria to remove 'at risk' status for that substance in the drinking water protected area	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100216	Wirral boreholes nitrates	Investigation to understand deterioration of raw water quality concentrations of Nitrate to remove 'at risk' status for that substance in the drinking water protected area	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027
08UU100218	Worsthorne colour	Investigation to understand deterioration of raw water quality concentrations of colour to remove 'at risk' status for that substance in the drinking water protected area	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Drinking Water Protected Areas	DrWPA_INV		30/04/2027

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU102344	Skerton Weir	Investigation into the impact of Skerton Weir upon fish productivity and sustainability.	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Biodiversity	NERC_INV	WFD_INV_PHYSHAB	30/04/2027
08UU100231	Longdendale (Etherow - Woodhead Res. to Glossop Bk.) investigation	Investigation at Longdendale (Etherow - Woodhead Res. to Glossop Bk.) to determine the impact of abstractions and appraisal of options (including variable compensation flow) for an effective solution to contribute to meeting WFD objectives in designated A/HMWBs	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources Artificial and Heavily Modified Water Bodies	WFD_INV_WRHMWB		31/12/2026
08UU100242	Gravel starvation downstream of Stocks Reservoir	Investigation into the feasibility of undertaking sediment management measures to help mitigate against sediment starvation from Stocks Reservoir and contribute to meeting WFD objectives in designated A/HMWBs	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources Artificial and Heavily Modified Water Bodies	WFD_INV_WRHMWB		31/12/2026
UU100002	Assessment and mitigation of gravel starvation downstream of Vyrnwy Reservoir	Investigation to determine the gravel reinstatement requirements downstream of Vyrnwy reservoir to mitigate for the effect of impoundment	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water (36%)	Water Resources Artificial and Heavily Modified Water Bodies	W_WFD_WRHMWB_INV1		31/12/2026

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100153	Pennington Reservoir	Need to undertake the investigation element as part of the implementation scheme in AMP 8 to determine what, compensation flow and, if appropriate an adaptive management approach and options appraisal about the hands off flow, is required and how to deliver it from the reservoir to contribute towards meeting WFD objectives in designated A/HMWBs	Water Framework Directive; (WINEP/NEP) water	Water Resources Artificial and Heavily Modified Water Bodies	WFD_INV_WRH MWB		31/12/2026
08UU100236	Levers Water	Investigation to assess the impacts to eel entrainment at Levers Water to ensure structures meet requirements of eel legislation	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Eel Regulations	EE_INV		30/04/2027
08UU100237	Langden Brook and Hareden System	Investigation to assess the impacts to eel entrainment at Langden Brook and Hareden System to ensure structures meet requirements of eel legislation	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Eel Regulations	EE_INV		30/04/2027
08UU100238	Dean Clough	Investigation to assess the impacts to eel entrainment at Dean Clough to ensure structures meet requirements of eel legislation	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Eel Regulations	EE_INV		30/04/2027

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100239	Whitendale and Brennand System	Investigation to assess the impacts to eel entrainment at Whitendale and Brennand System to ensure structures meet requirements of eel legislation	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Eel Regulations	EE_INV		30/04/2027
08UU100240	Thirlmere Reservoir	Investigation to assess the impacts to eel entrainment at Thirlmere Reservoir to ensure structures meet requirements of eel legislation	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Eel Regulations	EE_INV		30/04/2027
08UU100241	Pickup Bank	Investigation to assess the impacts to eel entrainment at Pickup Bank to ensure structures meet requirements of eel legislation	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Eel Regulations	EE_INV		30/04/2027
08UU100201	Grizedale Brook holistic study on instream habitat improvements	Grizedale Brook holistic study on instream habitat improvements to contribute to enhancing the water environment to meet outcome of the regional plan	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water	Water Resources Regional Long-term Environmental Destination	EDWRMP_INV		31/12/2026
08UU100202	Lune-Wyre transfer investigation	Investigation to assess the environmental (hydroecological) impact of the Lune-Wyre transfer to improve understanding of the impact and contribute to enhancing the water environment to meet outcome of the regional plan	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water	Water Resources Regional Long-term Environmental Destination	EDWRMP_INV		31/12/2026

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100203	Tarnbrook Wyre sediment management plan development	Tarnbrook Wyre sediment management plan development to contribute to enhancing the water environment to meet outcome of the regional plan	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water	Water Resources Regional Long-term Environmental Destination	EDWRMP_INV		31/12/2026
08UU100204	Wyre habitat/sediment improvements investigation	Wyre habitat/sediment improvements investigation to contribute to enhancing the water environment to meet outcome of the regional plan	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water	Water Resources Regional Long-term Environmental Destination	EDWRMP_INV		31/12/2026
08UU100222	Wirral and West Cheshire aquifer	Investigation to assess current licences within the aquifer to understand if additional licence capping is required in the long term considering different climate change scenarios and when to contribute to meeting the outcome of the regional plan. Investigation will look at the timing of potential licence changes and the spatial impact on groundwater and surface water bodies. Outputs from this investigation will feed into WRMP 29.	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources Regional Long-term Environmental Destination	EDWRMP_INV		31/12/2026

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100223	Furness aquifer	Investigation to assess current licences within the aquifer to understand if additional licence capping is required in the long term considering different climate change scenarios and when to contribute to meeting the outcome of the regional plan. Investigation will look at the timing of potential licence changes and the spatial impact on groundwater and surface water bodies. Outputs from this investigation will feed into WRMP 29.	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources Regional Long-term Environmental Destination	EDWRMP_INV		31/12/2026
08UU100224	Fylde aquifer	Investigation to assess current licences within the aquifer to understand if additional licence capping is required in the long term considering different climate change scenarios and when to contribute to meeting the outcome of the regional plan. Investigation will look at the timing of potential licence changes and the spatial impact on groundwater and surface water bodies. Outputs from this investigation will feed into WRMP 29.	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources Regional Long-term Environmental Destination	EDWRMP_INV		31/12/2026

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100225	Manchester and Cheshire East Permo-Triassic Sandstone Aquifer	Investigation to assess current licences within the aquifer to understand if additional licence capping is required in the long term considering different climate change scenarios and when to contribute to meeting the outcome of the regional plan. Investigation will look at the timing of potential licence changes and the spatial impact on groundwater and surface water bodies. Outputs from this investigation will feed into WRMP 29.	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources Regional Long-term Environmental Destination	EDWRMP_INV		31/12/2026
08UU100226	Mersey Basin Lower and Merseyside North Permo-Triassic Sandstone Aquifer	Investigation to assess current licences within the aquifer to understand if additional licence capping is required in the long term considering different climate change scenarios and when to contribute to meeting the outcome of the regional plan. Investigation will look at the timing of potential licence changes and the spatial impact on groundwater and surface water bodies. Outputs from this investigation will feed into WRMP 29.	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources Regional Long-term Environmental Destination	EDWRMP_INV		31/12/2026

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100227	Manchester and Cheshire East Carboniferous Aquifer	Investigation to assess current licences within the aquifer to understand if additional licence capping is required in the long term considering different climate change scenarios and when to contribute to meeting the outcome of the regional plan. Investigation will look at the timing of potential licence changes and the spatial impact on groundwater and surface water bodies. Outputs from this investigation will feed into WRMP 29.	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources Regional Long-term Environmental Destination	EDWRMP_INV		31/12/2026
08UU100857	Company contribution to Regional Plan environmental destination	Company level environmental destination feasibility and options appraisal to contribute to the environmental destination of regional plans.	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources Regional Long-term Environmental Destination	EDWRMP_INV		31/12/2026
08UU100220	Raw water transfer mitigation trials	National investigation on raw water transfer treatment technologies to contribute to preventing deterioration by reducing the risks of spread of INNS and reducing the impacts of INNS	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Invasive Non-Native Species	INNS_INV		31/03/2027

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100221	Phase 2: INNS Raw water transfer investigation and options appraisal	Phase 2 investigation to complete a gap analysis of the raw water transfer system not covered by the phase 1 investigation and complete a mop up risk assessment and options appraisal. The expectation is that both the phase 1 and 2 investigations will be combined into a single risk assessment and options appraisal report to reduce the risk of spread of INNS within new and existing water transfer networks	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Invasive Non-Native Species	INNS_INV		31/03/2027
08UU100219	Fylde aquifer recharge investigation - stage 2	Investigation to assess the impact of abstraction on groundwater resources. Aquifer storage and recovery (ASR)/Managed aquifer recharge (MAR) feasibility assessment and development of a trial scheme	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Groundwater	WFDGW_NDINV	WFD_NDINV_WRFlow	30/04/2027
08UU100228	Wheelock (Source to Kidsgrove Stream) investigation	Investigation to assess waterbody deterioration risk from abstraction to inform any mitigation measures and contribute to preventing deterioration from current status within a catchment	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources (hydrological regime)	WFD_NDINV_WRFlow	WFDGW_NDINV	31/12/2026
08UU100229	Millingford (Newton) Brook investigation	Investigation to assess waterbody deterioration risk from abstraction to inform any mitigation measures and contribute to preventing deterioration from current status within a catchment	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources (hydrological regime)	WFD_NDINV_WRFlow	WFDGW_NDINV	31/12/2026

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100232	Trawden Springs	Investigation to assess waterbody deterioration risk from Trawdern Spring abstraction to inform any mitigation measures and contribute to preventing deterioration from current status within a catchment	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water (50%); Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water (50%)	Water Resources (hydrological regime)	WFD_NDINV_WRFlow	WFDGW_NDINV	31/12/2026
08UU100233	Aughertree/Longlands	Investigation to assess waterbody deterioration risk from Aughertree/Longlands abstraction to inform any mitigation measures and contribute to preventing deterioration from current status within a catchment	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources (hydrological regime)	WFD_NDINV_WRFlow		31/12/2026
08UU100234	River Dane (Clough Brook to Cow Brook)/Dane (Cow Brook to Wheelock)/Dane (Wheelock to Weaver) investigation	Investigation to assess waterbody deterioration risk from abstraction to inform any mitigation measures and contribute to preventing deterioration from current status within a catchment	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources (hydrological regime)	WFD_NDINV_WRFlow	WFDGW_NDINV	31/12/2026
08UU100235	Langden/Hareden investigation	Investigation to assess waterbody deterioration risk from Langden/Hareden system abstraction to inform any mitigation measures and contribute to preventing deterioration from current status within a catchment	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources (hydrological regime)	WFD_NDINV_WRFlow		31/12/2026

Action ID	Action name	Description	Ofwat category	WINEP/NEP overarching driver	Primary driver	Secondary driver	Reg date
08UU100858	Mouldsworth boreholes	Investigation (low flow support feasibility study) at Mouldsworth boreholes to contribute to preventing deterioration from current status within a catchment	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources (hydrological regime)	WFD_NDINV_WRFlow		31/12/2026
08UU100859	Manley Common boreholes	Investigation (low flow support feasibility study) at Manley Common (Four Lane Ends) borehole to contribute to preventing deterioration from current status within a catchment	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources (hydrological regime)	WFD_NDINV_WRFlow		31/12/2026
08UU100860	Manley Quarry boreholes	Investigation (low flow support feasibility study) at Manley Quarry (Low Farm) borehole to contribute to preventing deterioration from current status within a catchment	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water	Water Resources (hydrological regime)	WFD_NDINV_WRFlow		31/12/2026
08UU100230	Downholland (Lydiate/Cheshire Lines) Brook investigation	Investigation to assess waterbody deterioration risk from abstraction to inform any mitigation measures and contribute to preventing deterioration from current status within a catchment	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water	Water Resources (hydrological regime)	WFD_INV_WRFlow		31/12/2026

Appendix C WINEP/NEP Costs (AMP8 & Transitional Investment)

Action ID	Action name	CAPEX (£M)	OPEX (£M)	TOTEX (£M)
Schemes		(post frontier shift & RPE assumptions)		(price base FY23)
08UU100146	Errwood and Fernilee & Wybersley colour	£4.187	£0.000	£4.187
08UU100157	Hodder/Stocks colour phase 2	£0.784	£0.000	£0.784
UU100003	Huntington and Sutton Hall (River Dee Turbidity)	£1.688	£0.000	£1.688
08UU102343	Franklaw ammonia	£0.344	£0.000	£0.344
08UU100151	Ennerdale infrastructure removal	£0.000	£2.210	£2.210
08UU100150	Crummock infrastructure removal	£0.000	£12.146	£12.146
08UU100149	Chapel House infrastructure removal	£0.000	£13.276	£13.276
08UU100152	Overwater infrastructure removal scheme	£0.000	£5.063	£5.063
08UU100160	South Pennines	£5.060	£0.000	£5.060
08UU100162	Poaka Beck	£0.838	£0.000	£0.838
08UU100164	Thirlmere	£3.130	£0.000	£3.130
08UU100163	Upper Duddon	£0.838	£0.000	£0.838
08UU100145	River Eden	£0.194	£0.000	£0.194
08UU100153	Pennington Reservoir (do not double count. Also listed under investigations. However only one action on the WINEP for the investigation and implementation aspects combined)	£2.640	£0.000	£2.640 (costs split between WFD implementation driver (£1.690) and investigation driver (£0.950))
08UU100154	Stocks Reservoir	£1.030	£0.000	£1.030
UU100002	Assessment and mitigation of gravel starvation downstream of Vyrnwy Reservoir (do not double count. Also listed under investigations. However only one action on the WINEP for the investigation and implementation aspects combined)	£0.0042	£0.000	£0.0042 (costs split between WFD implementation driver (£0.0027) and investigation driver (£0.0015))
08UU100139	Calder river intake	£1.534	£0.000	£1.534
08UU100167	Stocks Reservoir	£0.000	£0.066	£0.066
08UU100168	Haweswater Reservoir	£0.000	£0.077	£0.077
UU100001	Horseshoe falls abstraction - eel screening	£2.404	£0.000	£2.404
08UU100169	INNS Surveillance Development	£0.182	£0.000	£0.182
08UU100166	INNS Surveillance Programmes	£0.000	£0.077	£0.077
08UU100165	INNS mitigation actions	£3.984	£0.000	£3.984
08UU100158	Bowland	£2.054	£0.000	£2.054
08UU100159	Haweswater	£0.906	£0.000	£0.906
08UU100161	West Pennines	£1.717	£0.000	£1.717
08UU100140	Hug Bridge weir	£0.667	£0.000	£0.667

Action ID	Action name	CAPEX (£M)	OPEX (£M)	TOTEX (£M)
08UU100141	Taxal gauging weir	£1.309	£0.000	£1.309
08UU100001	Gorstons borehole	£0.382	£0.001	£0.383
08UU100002	Laneshaw/Corn close boreholes	£0.110	£0.000	£0.110
08UU100003	Bearstone boreholes	£0.000	£0.056	£0.056
08UU100004	Schneider Road boreholes	£0.146	£0.000	£0.146
08UU100005	Thorncliffe Road borehole	£0.146	£0.000	£0.146
08UU100006	Eccleston Hill Borehole	£0.000	£0.056	£0.056
08UU100007	Lees Lane borehole	£0.708	£0.001	£0.709
08UU100008	Rivington Gathering Grounds abstraction	£0.000	£0.001	£0.001
08UU100010	Ullswater freshet abstraction	£0.000	£0.001	£0.001
08UU100011	Five Crosses borehole	£0.000	£0.056	£0.056
08UU100012	Delamere boreholes	£0.000	£0.056	£0.056
08UU100013	Cotebrook1 borehole	£0.000	£0.056	£0.056
08UU100014	Cotebrook2 borehole	£0.000	£0.056	£0.056
08UU100015	Eaton borehole	£0.906	£0.001	£0.908
08UU100016	Eddisbury borehole	£0.000	£0.056	£0.056
08UU100017	Foxhill boreholes	£0.000	£0.056	£0.056
08UU100018	Newton/Grange borehole	£0.000	£0.113	£0.113
08UU100019	Helsby boreholes	£0.449	£0.001	£0.451
08UU100020	Hooton boreholes	£0.449	£0.001	£0.450
08UU100021	Manley Common (Four Lane Ends) boreholes	£1.196	£0.000	£1.196
08UU100022	Manley Quarry (Low Farm) boreholes	£0.483	£0.000	£0.483
08UU100023	Mouldsworth boreholes	£2.340	£0.000	£2.340
08UU100024	Newton Hollow boreholes	£0.692	£0.001	£0.694
08UU100025	Organsdale borehole	£0.000	£0.056	£0.056
08UU100026	Prenton boreholes	£0.000	£0.056	£0.056
08UU100027	Sandyford borehole	£0.000	£0.056	£0.056
08UU100028	Springhill borehole	£2.463	£0.001	£2.464
08UU100133	Ashton borehole	£0.491	£0.001	£0.492
Investigations				
08UU100194	Ashworth Moor taste and odour	£0.484	£0.000	£0.484
08UU100205	Cliburn nitrates	£0.709	£0.000	£0.709
08UU100206	Cowpe geosmin	£0.403	£0.000	£0.403
08UU100207	Fairhill nitrates	£0.577	£0.000	£0.577
08UU100208	Fishmoor colour	£0.311	£0.000	£0.311
08UU100156	Franklaw colour	£0.294	£0.000	£0.294
08UU100195	Haslingden Grane taste and odour	£0.484	£0.000	£0.484
08UU100209	Hurleston geosmin and ammonia	£0.410	£0.000	£0.410
08UU100210	Lamaload geosmin	£0.403	£0.000	£0.403
08UU100211	Lancaster colour	£0.311	£0.000	£0.311
08UU100212	Laneshaw colour	£0.311	£0.000	£0.311
08UU100196	Laneshaw taste and odour	£0.484	£0.000	£0.484

Action ID	Action name	CAPEX (£M)	OPEX (£M)	TOTEX (£M)
08UU100197	Mitchells taste and odour	£0.484	£0.000	£0.484
08UU100198	Piethorne taste and odour	£0.484	£0.000	£0.484
08UU100213	Ridgaling colour	£0.311	£0.000	£0.311
08UU100199	Ridgegate taste and odour	£0.484	£0.000	£0.484
08UU100214	Rivington colour	£0.311	£0.000	£0.311
08UU100200	Rivington taste and odour	£0.484	£0.000	£0.484
08UU100215	Widnes Boreholes (Stockswell) nitrates and bacteria	£0.577	£0.000	£0.577
08UU100216	Wirral boreholes nitrates	£0.973	£0.000	£0.973
08UU100218	Worsthorne colour	£0.311	£0.000	£0.311
08UU102344	Skerton Weir	£0.210	£0.000	£0.210
08UU100231	Longdendale (Etherow -Woodhead Res. to Glossop Bk.) investigation	£0.040	£0.000	£0.040
08UU100242	Gravel starvation downstream of Stocks Reservoir	£0.110	£0.000	£0.110
UU100002	Assessment and mitigation of gravel starvation downstream of Vyrnwy Reservoir (do not double count. Also listed under investigations. However only one action on the WINEP for the investigation and implementation aspects combined)	£0.0042	£0.000	£0.0042 (costs split between WFD implementation driver (£0.0027) and investigation driver (£0.0015))
08UU100153	Pennington Reservoir (do not double count. Also listed under investigations. However only one action on the WINEP for the investigation and implementation aspects combined)	£2.640	£0.000	£2.640 (costs split between WFD implementation driver (£1.690) and investigation driver (£0.950))
08UU100236	Levers Water	£0.156	£0.000	£0.156
08UU100237	Langden Brook and Hareden System	£0.156	£0.000	£0.156
08UU100238	Dean Clough	£0.156	£0.000	£0.156
08UU100239	Whitendale and Brennand System	£0.156	£0.000	£0.156
08UU100240	Thirlmere Reservoir	£0.156	£0.000	£0.156
08UU100241	Pickup Bank	£0.156	£0.000	£0.156
08UU100201	Grizedale Brook holistic study on instream habitat improvements	£0.478	£0.000	£0.478
08UU100202	Lune-Wyre transfer investigation	£0.614	£0.000	£0.614
08UU100203	Tarnbrook Wyre sediment management plan development	£0.515	£0.000	£0.515
08UU100204	Wyre habitat/sediment improvements investigation	£0.515	£0.000	£0.515
08UU100222	Wirral and West Cheshire aquifer	£0.189	£0.000	£0.189
08UU100223	Furness aquifer	£0.202	£0.000	£0.202
08UU100224	Fylde aquifer	£0.472	£0.000	£0.472
08UU100225	Manchester and Cheshire East Permo-Triassic Sandstone Aquifer	£0.301	£0.000	£0.301

Action ID	Action name	CAPEX (£M)	OPEX (£M)	TOTEX (£M)
08UU100226	Mersey Basin Lower and Merseyside North Permo-Triassic Sandstone Aquifer	£0.301	£0.000	£0.301
08UU100227	Manchester and Cheshire East Carboniferous Aquifer	£0.301	£0.000	£0.301
08UU100857	Company contribution to Regional Plan environmental destination	£0.690	£0.000	£0.690
08UU100220	Raw water transfer mitigation trials	£0.729	£0.000	£0.729
08UU100221	Phase 2: INNS Raw water transfer investigation and options appraisal	£1.384	£0.000	£1.384
08UU100219	Fylde aquifer recharge investigation - stage 2	£4.904	£0.000	£4.904
08UU100228	Wheelock (Source to Kidsgrove Stream) investigation	£0.490	£0.000	£0.490
08UU100229	Millingford (Newton) Brook investigation	£0.189	£0.000	£0.189
08UU100232	Trawden Springs	£0.504	£0.000	£0.504
08UU100233	Aughertree/Longlands	£0.420	£0.000	£0.420
08UU100234	River Dane (Clough Brook to Cow Brook)/Dane (Cow Brook to Wheelock)/Dane (Wheelock to Weaver) investigation	£0.420	£0.000	£0.420
08UU100235	Langden/Hareden investigation	£0.420	£0.000	£0.420
08UU100858	Mouldsworth boreholes	£0.094	£0.001	£0.096
08UU100859	Manley Common boreholes	£0.085	£0.001	£0.087
08UU100860	Manley Quarry boreholes	£0.066	£0.004	£0.069
08UU100230	Downholland (Lydiate/Cheshire Lines) Brook investigation	£0.189	£0.000	£0.189

Appendix D Example direct cost build-up of the Errwood and Fernilee colour scheme (costs shown in FY21 price base)

PR24 WATER WINEP

PROJECT ID	D000000415
PROJECT NAME	ERRWO_DrWPA_HD Wybersley, Errwood and Fernilee (SWSGZ3202 / SWSGZ3201) Safeguard Zones Raw Water Colour Investigation of Errwood, Fernilee, Horse Coppice and Bollinhurst Reservoirs
Clean Water/Wastewater	Clean Water
UU Diversion Reference Number/s	PR24 WINEP

DESCRIPTION OF WORKS

G1	Survey	Detailed field reconnaissance, comprising a field walkover survey with GPS assisted mapping and in-field assessment to determine spatial metrics and quantities for the development of land management and restoration works. Features such as degraded, bare and eroding peat, peat pipes and macro void structure, natural gullying and artifical gripping or a combination of several of these features at any given location which contribute to in-situ production of colour in the peat body should be identified, as well as providing more prescriptive management maps which allow the targeting of works in the catchment.
G2	Implementation	Implementation of the techniques identified below and figure contained in the Goyt Information worksheet

ITEM	CATCHMENT	SCOPE	AREA AFFECTED (ha)	LENGTH AFFECTED (m)	REQUIRED UNITS		COST PER UNIT	UNIT TYPE	REPORT COST (£)	ADDITIONAL COST (£)	REVISED COST (£)	VOLUME / WEIGHT OF MATERIALS
SURVEY												
G1-1	**Goyt Catchment**	Errwood Upper Goyt, Errwood Wildmoorstone Clough, Errwood Shooters	1335	N/A	54	days	£ 400	£ /day	**£ 21,600**	£ -		

		Clough North, Errwood Shooters Clough South and Fernilee Deep Clough survey									
		SURVEY TOTAL							**£ 21,600**	£ -	**£ 21,600**
IMPLEMENTATION											
G1-2	**Goyt Catchment**	Grip blocking using peat turves	N/A	17050	Upto 170	No. blocks	£ 10	per block	**£ 170,500**	£ -	17,050m of locally sourced peat blocking
G1-3	**Goyt Catchment**	Gully blocking using stone dams	N/A	39232	Upto 392	No. dams	£ 250	per dam	**£ 98,000**	£ -	39,232m of imported random sized gritstone (between 75 - 200mm in size)
G1-4	**Goyt Catchment**	Peat drip edge reprofiling	N/A	10000	10000	m	£ 5	per m	**£ 10,000**	£ -	10,000m of excavator machine reprofiling of exposed edges to form slopes that can be re-vegetated to bring stability to the substrate and halt erosion

G1-5	**Goyt Catchment**	Bare peat stabilisation using Geojute	N/A	7846.4	N/A	m²	£ 4	per m²	**£ 31,386**	£ -	7,846m of imported of 3cm pore diameter fibrous mesh geojute combines with a nurse species seed mix
G1-6	**Goyt Catchment**	Bare peat restoration - lime seed and fertiliser	0.25	N/A	N/A	ha	£ 2,500	per ha	**£ 625**	£ -	2,500m² of imported lime, seed and fertiliser mix
G1-7	**Goyt Catchment**	Grassland reversion	76.13	N/A	N/A	ha	£ 5,000	per ha	**£ 380,650**	£ -	761,300m² of provision of moorland vegetation types
G1-8	**Goyt Catchment**	High priority sphagnum and blanket bog species planting	96.65	N/A	N/A	ha	£ 2,500	per ha	**£ 241,625**	£ -	Planting of 966,500m² of Sphagnum and other mosses
G1-9	**Goyt Catchment**	Low priority sphagnum and blanket bog species planting	195.41	N/A	N/A	ha	£ 2,500	per ha	**£ 488,525**	£ -	Planting of 1,954,100m² of Sphagnum and other mosses
G1-10	**Goyt Catchment**	Fire Warning / Education signage	N/A	N/A	39	No.	£ 100	per sign	**£ 3,900**	£ -	Provision of 39 signs fixed to wooden post

		TOTAL			**£ 1,425,211**	**£ -**	**£ 1,425,211**
CONTRACTOR ADD-ONS							
G1-11	**Goyt Catchment**	Management, Design, Implementation and Control	40%		**£ 570,084**	£ -	
		IMPLEMENTATION TOTAL			**£ 1,995,295**	**£ -**	**£ 1,995,295**

Appendix E Second line internal assurance on cost build-ups

E.1 Purpose of the assurance

E.1.1 To ensure no material elements of base maintenance have been included in the cost build-ups.

E.2 Process Description

Table 27: Methodology

Process Step	Description
Step 1	Scope and requirements of assurance were defined. See E.3 for scope.
Step 2	6 cost build-ups to be reviewed were chosen at random using a random number generator
Step 3	Our internal risk assessment process triaged the level of risk in order to understand the level of assurance required.
Step 4	Assurance piece was progressed – reviewer was provided with the scope of the assurance and the 6 cost build-ups in order for them to review
Step 5	Reviewer fed back on findings

E.3 Scope of assurance

E.3.1 To review a representative sample (10%) of the Water WINEP implementation schemes cost build-ups to determine any base maintenance costs.

E.3.2 Materiality to be classed as 1% of the value of the project in question.

E.3.3 To be reviewed by an internal independent party with a financial background.

E.4 Outcomes

E.4.1 Our internal risk assessment process triaged the level of risk associated with base maintenance expenditure being present in the enhancement cost build as medium risk. Our internal process mandates that all medium risks must be subject to an internal review from an independent internal party. As such, we carried out an internal review of the cost build ups. This section sets out the structure and outcome of that review.

E.4.2 There are 55 schemes in total therefore 6 cost build-ups were reviewed, as per scope in section E.3.1. The cost build-ups reviewed were:

- 08UU100153 Pennington Reservoir (implementation of equipment to provide and measure compensation flows (including overflow spills and bypass flows) around and from Pennington Reservoir into Pennington Beck)
- 08UU10015 – Eaton borehole (revocation of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer)
- 08UU100165 – INNS mitigation actions (implement Invasive Non-Native species mitigation actions arising from risk assessments, option appraisal and company-wide initiatives)
- 08UU100007 – Lees Lane borehole (revocation of the abstraction licence to reduce abstraction and ensure no deterioration of the river and the aquifer)
- UU100002 – Vyrnwy gravel starvation (working in partnership to re-gravel the Afron Vyrnwy to improve ecological and riverine processes)

- 08UU100021 – Manley Common (Four Lane Ends) borehole (modification of the abstraction licence and low flow stream support to ensure no deterioration of the river and the aquifer)

E.4.3 An internal subject matter expert (SME) undertook the review. The SME has been independent of the WINEP AMP8 programme build.

E.4.4 The findings of the internal review were:

- Pennington – no maintenance items included in cost build-up
- Eaton – no maintenance items included in cost build-up
- INNS – no maintenance items included in cost build-up
- Lees Lane – no maintenance items included in cost build-up
- Vyrnwy gravel starvation – no maintenance items included in cost build-up
- Manley Common – one element of maintenance found: *B1: Replace section of existing 250mm Diameter Ductile Iron Raw Water Rising Main with 150mm Tee Section to allow new main to be connected* at a cost of £3,665.03 against a project cost of £1.196M (price base FY23)), which is non material. £3665.03 is 0.3% of £1.196M.

E.4.5 Based on a 10% sample of the programme the internal second line assurance review found no elements of materiality and therefore based on likelihood of probability there are no material maintenance costs included in the programme and we consider the risk is minimal.

E.4.6 This is further backed up with the knowledge that in many cases the schemes included are catchment interventions with no work being undertaken on physical assets and half the Water WINEP programme is made up of investigations.

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United Utilities

Water for the North West

UUW60

Vyrnwy

October 2023

Enhancement Case 2

United Utilities

Water for the North West

Contents

1. Enhancement submission

<table>
<tr><th colspan="2">Enhancement submission</th></tr>
<tr><td>Title:</td><td>Vyrnwy Treated Water Aqueduct Modernisation</td></tr>
<tr><td>Price Control:</td><td>Water Network Plus</td></tr>
<tr><td>Enhancement headline:</td><td>The Vyrnwy treated water aqueduct comprises three parallel 42” diameter pipelines made from a combination of steel and cast iron. The aqueduct is an integral part of the UUW regional supply network, transporting water which originates from Lake Vyrnwy in North Wales to supply over 1.38 million customers in Cheshire and Merseyside. Constructed between 1881 and 1938, at circa. 240km combined length, the aqueduct was the longest in the world on its completion.

Enhancement investment is required in order to complete the final phase of the Vyrnwy aqueduct relining programme which will improve downstream water quality for customers through improved compliance with the iron standard and reduced risk of discolouration (water appearing black/brown/orange). To date, a significant portion of the steel sections of the aqueduct have been refurbished through the employment of various cleaning techniques. The final phases of the project involve slip-lining the cast iron sections of the pipeline – a proven technique for reducing discolouration which involves inserting a plastic pipe into the existing cast iron pipe.</td></tr>
<tr><td>Enhancement expenditure

(FY23 prices)</td><td>
<table>
<tr><th></th><th>AMP8 Capex inc TI (£m)</th><th>AMP8 Opex (£m)</th><th>AMP8 Totex (£m)</th></tr>
<tr><td>Pre RPE and Frontier Shift</td><td>154.043</td><td>0.000</td><td>154.043</td></tr>
<tr><td>Post RPE and Frontier Shift</td><td>151.128</td><td>0.000</td><td>151.128</td></tr>
</table>

The table above shows the total expenditure, inclusive of accelerated programme and transitional investment, on both a pre-efficiency (i.e. pre frontier shift and real price effects basis, consistent with the cost data tables), and a post efficiency and RPE basis (i.e. consistent with the value we propose to be recovered from price controls). All numbers referenced hereafter in this enhancement case are on a post efficiency and RPE basis.</td></tr>
<tr><td>This case aligns to :</td><td>Long-Term Drinking Water Quality Strategy. For full reconciliation between enhancement costs and data table lines, see enhancement mapping tabs in UUW117 – Project allocations CW3 and CWW3</td></tr>
<tr><td>PCD</td><td>Yes</td></tr>
</table>

2. Enhancement case summary

Gate	Summary	Location reference
Need for enhancement investment	• The AMP8 programme of work will be the final instalment of a multi-AMP commitment to improving water quality downstream of the Vyrnwy aqueduct. • The size and scale of the work required to renovate aqueducts and achieve the step change in performance required for customers is beyond the capacity of routine maintenance activity. • Our approach to the prioritisation and sequencing of relining work has been determined through the utilisation of a hydraulic modelling tool and consideration of other statutory projects within the system and associated systems to ensure the best outcome for customers with respect to lowest risk to supplies and most efficient project outcomes. • The completion of this work is essential to us achieving our long-term ambitions with respect to customer contacts about water quality, thus the project is referenced in our Long Term Drinking Water Quality strategy. • Customer research consistently identifies drinking water quality as one of the highest priorities for customers. The most recent research indicates that customers are keen for UUW to invest now in core service offerings, such as drinking water quality. • The Vyrnwy aqueduct has been in service for over 130 years - in this time, customer and regulator expectations have increased significantly in the case of drinking water quality. While the aqueduct fulfils its duty of conveying water to customers in Cheshire and Merseyside, it is not able to meet higher water quality standards that we must adhere to.	*4.2* *4.2* *4.3* *4.5* *4.6* *0*
Best option for customers	• Throughout the duration of the Vyrnwy aqueduct project, we have undertaken trials to determine the best techniques that will deliver improved performance for customers at the optimal cost. • We considered an assortment of solutions to mitigate the risks to drinking water quality associated with the condition of the aqueduct and have selected the solutions which are cost-beneficial for customers. • We are confident that the solutions identified represent the best value for customers due to the techniques to be employed being proven to improve water quality with respect to occurrences of discolouration and compliance with the iron standard. • By improving water quality in the areas supplied by the Vyrnwy aqueduct, we anticipate improved performance with respect to water quality customer contacts and CRI following completion of this work. • We have worked with delivery partners to undertake workshops aiming to reduce carbon, time and costs associated with this work. The utilisation rate of the Vyrnwy aqueduct will remain high and this work will allow the aqueduct to be of service for generations to come.	*5.2* *5.2* *5.3* *5.5* *5.6*

Cost efficiency	• At PR19, we submitted a high-level cost estimate to complete the remainder of work on the Vyrnwy aqueduct, spanning AMPs 7 and 8, based on the cost to deliver work in AMP5. The scope of the project in both AMP7 and AMP8 has since been developed at a much more detailed level and the cost estimate has been updated to reflect this. • We have used bottom-up principles to create the cost estimate, using estimating tools equipped with the most up-to-date market intelligence to give a line-by-line estimate for individual items to create a robust and efficient estimate. • Unforeseen cost increases as a direct consequence of high inflation rates and the conflict in Ukraine causing the price of crude oil to spike have been challenging throughout AMP7. However, we have made use of cost saving initiatives, such as free issuing the pipe to the contractor to avoid unnecessary overheads applied by the contractor and early procurement of plastic pipework to escape cost increases. • Third party assistance has been sought to validate cost estimates to ensure a level of accuracy and identify areas for potential efficiencies. We have worked in collaboration with industry experts to ensure cost estimates were accurate with respect to historical outputs and expected norms in relation to slip-lining pipes of this size.	*6.2* *6.2* *6.3* *6.4*
Customer protection	• To ensure that customers are protected from the event of under, late or non-delivery of this project, a price control deliverable has been developed which provides a mechanism for customer pay-back should any of these circumstances arise.	*7.1*

3. Introduction

3.1 Section Summary

3.1.1 This document sets out an enhancement case of £151.128 million to deliver the final phases, 65.6km, of relining the Vyrnwy aqueduct in order to improve water quality for over 1.38 million customers in the areas supplied by the aqueduct. The completion of this work will improve water quality compliance with respect to the iron parameter, which is known to cause discolouration to potable water, and therefore customers in these areas will experience fewer occurrences of discolouration.

3.2 Background of the Vyrnwy Aqueduct

3.2.1 [✂

]

3.2.2 The aqueduct gains its title from Lake Vyrnwy, a reservoir located in North Wales which was built in the 1880s with the purpose of supplying water to Liverpool. Lake Vyrnwy along with the Vyrnwy aqueduct, is [✂].

3.2.3 The raw water supplied from Lake Vyrnwy is low alkalinity water, when compared to other UUW surface water sources such as Haweswater in the Lake District. Low alkalinity water is known to be corrosive, a condition which means the water dissolves metals at an excessive rate. This is of particular relevance when we consider the material of the Vyrnwy aqueduct and how this water has interacted with the internal surface of the pipe throughout its life span.

3.2.4 Water treatment works (WTW) performance prior to improvements made in AMP3 has resulted in legacy iron deposits within our fleet of aqueducts. These deposits, which are brown/orange in colour, can discolour the water being supplied to customers. This project is intended to prevent discolouration from reaching customers. In the steel sections of the aqueduct, cleaning the interior surface of the aqueduct is a technically feasible approach. The cast iron sections of the aqueduct have a higher level of deposition within them due to reactions between the aqueduct and the low alkalinity water leading to corrosion of the internal pipe wall. . The first phases of cleaning the Vyrnwy aqueduct saw the removal of approximately 1 tonne of iron deposits per 100m cleaned, Figure 1.

3.2.5 Cleaning alone will not rectify the problem in the final sections. To improve service to customers we plan to insert an inert plastic liner into the aqueduct, which will act as a physical barrier between the water and the iron aqueduct walls. This technique is known as slip-lining.

Figure 1: Iron deposits removed from phase 1 of the Vyrnwy aqueduct project

3.2.6 The aqueduct consists of four discreet hydraulic (Siphon) sections from [✂]and finally residual water arriving at [ ]. Each discreet hydraulic section can be separately isolated, forming a convenient way in which the programme can be split up for delivery phases. A map showing the location of the Vyrnwy aqueduct and its route from [✂]is included at Figure 2.

Figure 2: [✂]

-]

Source: UUW Vyrnwy project delivery

3.2.7 The programme has been split along the three linear pipelines into three siphons:

- [✂]
- [✂]
- [✂]

Figure 3: -]

-]

Source: UUW Vyrnwy project delivery

Figure 4: -]

[ ]

Source: UUW Vyrnwy project delivery

Figure 5: -]

[ ]

Source: UUW Vyrnwy project delivery

3.3 Relining Project

3.3.1 The primary aim of the Vyrnwy aqueduct relining project is to improve water quality for customers supplied by the pipeline, through reducing the risk of discolouration and non-compliance with the iron parameter. The project comprises a combination of cleaning (through the employment of jetting and air-pigging) the steel sections in AMP7 and slip lining the cast iron sections of the aqueduct. Relining the cast iron sections of the pipe with a plastic alternative will significantly reduce the amount of iron deposition within the aqueduct, which, when disturbed, can lead to drinking water appearing yellow or brown in colour, which customers would, rightly, reject. Visual representations of each technique are shown in Figure 6, Figure 7 and *Figure 8*.

3.3.2 Pigging refers to the use of a Pipe Integrity Gauge or PIG, a device which can be pulled through the pipe. Typically a PIG will mechanically scrape the interior of a pipe, but PIGs can be equipped with compressed air jets, or water jets, to blast corroded particles away from the interior of the pipe, leaving a clean pipe wall surface.

Figure 6: Slip lining technique

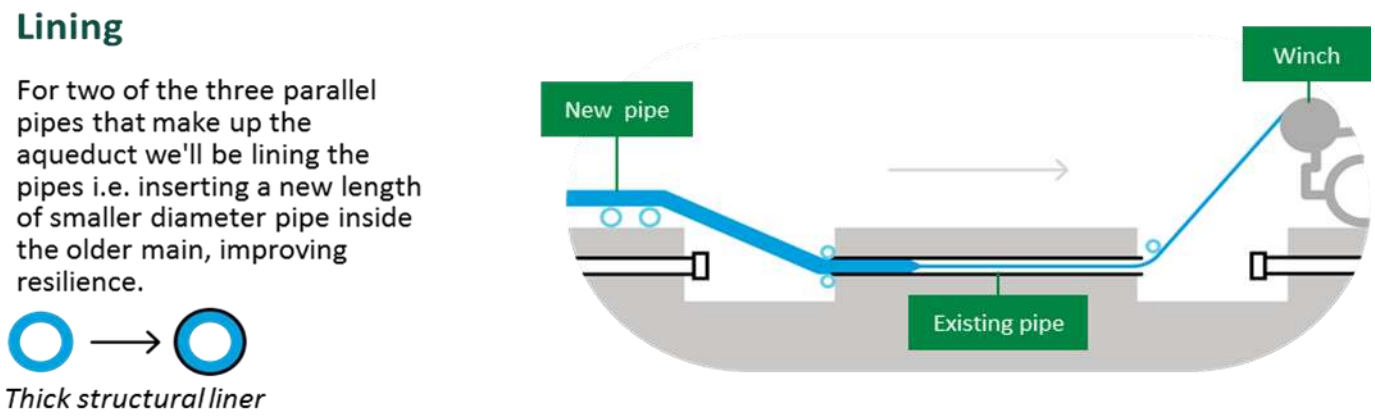


Figure 7: Jetting technique

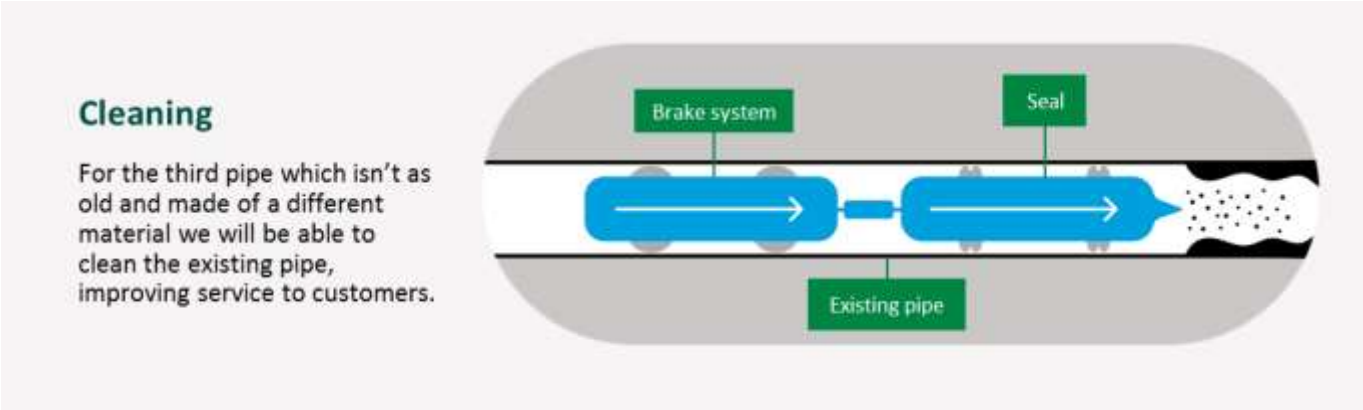


Figure 8: [✂]

Source: UUW Vyrnwy project delivery

3.3.3 The project has been phased over multiple AMPs with the first portion completed during AMP5 when the section of pipe between [✂

]

3.3.4 During AMP6 we agreed with the Drinking Water Inspectorate (DWI) to deliver an innovative enhanced treatment process at [✂]and completed work to enhance the control of the Vyrnwy aqueduct to improve the quality and aesthetics of the water supplied by [✂]. The innovative treatment process was designed to address multiple water quality drivers at [✂]and ensure the water entering the aqueduct contains the lowest residual manganese concentration possible. While the improvements at -]will improve water quality for customers, measures at the treatment works alone will be insufficient to address all of the discolouration issues associated with the aqueduct.

3.3.5 Concurrently, we developed an alternative plan to clean and reline sections of the Vyrnwy aqueduct in the event this innovative technology failed to deliver the required outcome. Our PR19 business plan was based on the expectation we would not have to clean or reline the Vyrnwy aqueduct in AMP7 therefore no costs were included for this work. However, given the innovative approach with the enhanced treatment process, an AMP7 Outcome Delivery Incentive (ODI) was agreed should the Vyrnwy aqueduct need to be cleaned to meet the target for reduction in water discolouration. This AMP7 ODI allows UUW to recover £548k per km of the aqueduct cleaned or relined.

3.3.6 In AMP7 we launched the Vyrnwy Aqueduct Modernisation Programme (VAMP) which included 73.4km of cleaning or relining of the aqueduct. We are proposing that the remaining lengths to be relined is delivered as part of enhancement investment in AMP8 with a Price Control Deliverable (PCD) metric proposed for protection for customers. We propose a new PCD that would be a similar to the current Vyrnwy aqueduct AMP7 output ODI based on km delivered metric, but that the incentive rate may differ

based on the price of work to complete in AMP8. An outline of the aqueduct siphons and the delivery programme is included at Figure 9.

3.3.7 The Drinking Water Inspectorate (DWI) has issued an Enforcement Order to reduce the number of discolouration contacts from customers and improve the quality and appearance of drinking water, in the water supply zones served by the Vyrnwy aqueduct.

3.3.8 As part of this order, UUW is required to produce and implement a specific action plan, based on previous commitments to clean and reline the Vyrnwy aqueduct, identifying short and medium-term mitigating steps and identifying the long-term solutions necessary, to address the risk of contravening the requirements of regulation 4 of the Water Supply (Water Quality) Regulations.

3.3.9 This project is specifically focused on addressing the risk of water discolouration associated with the Vyrnwy aqueduct and not any of the downstream water supply zones, and is focused on cleaning and/or lining of all three lines of the Vyrnwy aqueduct [✂
]. The Enforcement Order has stipulated that UUW must complete the programme of work by 31 December 2028.

Figure 9: Vyrnwy aqueduct siphons and associated project delivery timeframe

[ ]

Source: UUW Vyrnwy project delivery

4. Need for enhancement investment

4.1 Section Summary

4.1.1 Due to the legacy deposits within the pipeline coupled with the high utilisation of the Vyrnwy aqueduct, customers in the areas supplied by the aqueduct experience higher than average instances of discolouration and water quality non-compliance with the iron parameter in comparison to other areas of the North West. Relining the Vyrnwy aqueduct will enable us to deliver a step change in performance and improve the overall customer experience.

4.2 Evidence enhancement is required

4.2.1 At PR19, we proposed a bespoke ODI to allow UUW to recover the costs associated with cleaning or re-lining of the Vyrnwy aqueduct, as required by the DWI Enforcement Order. In our proposal, we indicated that the incentive would need to continue into AMP8 until the scheme was fully delivered. We have opted to alter the method for funding this investment from continuation of the bespoke ODI to an enhancement claim as a result of our continued research and information collection in AMP7. This has enabled us to better define the scope of the work required and determine the most appropriate method necessary to address the discolouration risk and abide by our legal duties. Consequently, we have used this knowledge to produce a robust cost estimate for the remainder of the project of which the unit rate per km differs from the ODI incentive rate.

4.2.2 The size and scale of aqueducts and the extensive course of enabling work required to complete aqueduct relining means that this work is separate to the ongoing maintenance of aqueducts, which includes activities such as valve maintenance, inspections and air valve flushing. Additionally, the Vyrnwy aqueduct pipelines were constructed over 130 years ago, indicating that this is a once-in-over-100-years activity.

4.2.3 Throughout the life span of the Vyrnwy aqueduct, we have invested maintenance expenditure to preserve the performance the aqueduct was built to deliver. However, in order to achieve a step change in performance that will meet regulator and customer expectations that have heightened since the aqueduct was constructed, additional investment is now necessary.

4.2.4 The step change in performance required could not be delivered through an alternative route to relining and it is not possible to complete relining work through operational activity alone.

4.2.5 In AMP7 we aim to complete 73.4 km of cleaning and relining of the Vyrnwy aqueduct.

4.2.6 Enhancement investment in AMP8 will allow the continuation of progress made to date on the cleaning and lining of the Vyrnwy aqueduct through the execution of the programme in AMP8 and will ensure successful resolution of the risk associated with the pipeline. Furthermore, enhancement investment to complete the remaining sections of relining work will allow us to fulfil our statutory requirements detailed in the DWI Enforcement Order.

4.3 Scale and timing of investment

4.3.1 In order for the water quality risks to be fully resolved and the terms of the Enforcement Order to be satisfied, the entire length of the Vyrnwy aqueduct must be cleaned or lined. Furthermore, this work must be completed in a continuous sequence to remove the possibility of iron deposits from an unlined section making their way into a newly lined section.

4.3.2 Our plan is to reline the remaining 65.6km in AMP8 to improve the service to customers while addressing the provisions of the DWI Enforcement Order before 31 December 2028.

4.3.3 We have employed resource allocation modelling (MISER) to set the boundary conditions for the various staged outages required to facilitate the project. This focused on the production sources at -]]-][✂

]and the restrictions on the production capacity during any Vyrnwy aqueduct outage. Any potential loss or reduction in supplies must be balanced by an increase from other sources.

4.3.4 Our approach to management of supplies and production capability during all relining scenarios allows an acceptable level of contingency to be maintained to ensure our standards for supply-demand balance are not compromised, recognising the integrated water system that we operate.

4.3.5 The change in flow balance to facilitate the required outages of the relining project dictates the sequencing of outages. Significant flow increases in aqueducts above their normal operating levels are deemed too high risk due to the potential for widespread discolouration.

4.3.6 The hydraulic modelling results determined that a staged cleaning approach to the project is required to maintain water supplies to customers and minimise any potential supply risks. In addition, the modelling identified that any lining installed could not reduce the internal diameter of the pipe considerably in order to retain the maximum flow required to maintain supplies.

4.3.7 It is imperative that the work is completed while managing separate outages on associated assets for other regulatory notices in AMP7. We therefore deemed it prudent to prioritise cleaning of the aqueduct in AMP7 as this was less invasive than relining.

4.3.8 Given these factors, our approach to the project was to complete the project in phases, starting at [✂]reservoirs were cleaned initially. The cleaning of line three will continue throughout AMP7 as this line is all steel. We now have to line the remaining cast iron sections.

4.4 Activities funded at previous price reviews

4.4.1 At PR04, a programme of work was agreed with the DWI to clean/line six named Large Diameter Trunk Mains (LDTM) across the UUW supply area to reduce the risk of both iron and manganese non-compliance, following completion of significant improvements in water quality leaving the upstream WTWs. At that time, [✂]. This enhancement work was completed as outlined in Table 1.

Table 1: LDTM cleaning and relining activity completed in previous AMPs

LDTM	Activities	Completion date
Dee LDTM South (1)	Cleaned 50km Relined 0km	19 March 2008
Hodder LDTM	Cleaned 43.7km Relined 44.7km	13 April 2010
LCUS LDTM	Cleaned 22.4km Relined 0km	16 June 2011
Rivington LDTM	Cleaned 12km Relined 0.33km	30 April 2014
Dee LDTM North (2)	Cleaned 16.5km Relined 0km	16 May 2014
Manchester Ring Main	Cleaned 176km Relined 0km	27 June 2014
Vyrnwy LDTM	Clean/Relining	Ongoing

4.4.2 As sated previously, work on the Vyrnwy aqueduct has been phased over multiple AMPs, a summary of the activities completed through enhancement expenditure is displayed at Table 2.

Table 2: Vyrnwy aqueduct historic expenditure

Activity	AMP4	AMP5	AMP6	AMP7	Total AMP4-7
-]	£0	£28,894,702	£782,156	£0	£29,676,858
-]	£3,733,182	£18,960,585	£41,638	£0	£22,735,405
Vyrnwy LDTM Control and Automation	£0	£0	£5,625,190	£89,535	£5,714,725
[✂]	£1,517,078	£3,452,550	£549	£0	£4,970,176
[✂]	£172,792	£4,297,186	£0	£0	£4,469,978
Water quality monitoring	£0	£308,360	£500,531	£0	£808,891
Water quality engineering study	£0	£0	£134,621	£841	£135,462
AMP7 refurbishment work	£0	£0	£0	£114,500,000	£114,500,000
Total	**£5,423,052**	**£55,913,382**	**£7,084,684**	**£114,590,36**	**£183,011,44**

Source: UUW data.

4.4.3 Following the work completed in AMP5, a review of the water quality and consumer complaint data showed that there had been significant improvements in both iron compliance and a reduction in discolouration contacts across the area supplied.

4.4.4 At this time, latest research provided new insights into the potential root causes of elevated iron concentrations and discoloured water in the distribution network including the potential adverse influence of elevated manganese concentrations on iron compliance and discolouration, even when manganese was significantly below the current water quality standard.

4.4.5 As a result, we simultaneously developed a new innovative treatment process that could realise a significant reduction in manganese concentration at [✂]to ensure the quality of water entering the Vyrnwy aqueduct would not have an adverse effect on the pipe in future. This lower concentration had been shown to deliver improvements in discolouration contact rates downstream of WTWs where it could be achieved in 80% of samples. In AMP6 we commenced the delivery of two interventions at [✂]to improve the water quality at source.

4.4.6 Nonetheless, the innovative solution for manganese removal proved to be less effective than originally planned. In order to honour our commitment to customers and the regulator, we were required to continue planning for the cleaning and/or relining of the Vyrnwy aqueduct to deliver the expected benefits to customers regarding discolouration. A revised solution for work at [✂]is being delivered to improve bacteriological compliance and address the long-term deterioration in raw water colour and dissolved organic carbon.

4.4.7 Both the work at [✂]and the Vyrnwy LDTM are together intended to complement each other to ensure that the original outcomes for customers (a 50% reduction in water quality consumer contacts from the 2001 baseline) are realised.

4.5 Overlap with long-term delivery strategy

4.5.1 The Vyrnwy aqueduct is a [✂]asset, a [✂], enhancement expenditure is required to remove the legacy deposits and ensure that the water travelling through the pipeline does not deteriorate in quality.

4.5.2 The completion of this work is referenced in our long term drinking water quality strategy. We anticipate that this work, alongside targeted water network interventions, will significantly reduce the number of customers contacting us to report discolouration as well as improving resilience and reducing unacceptable risks.

4.5.3 The level of performance we are aiming to achieve in our long-term ambition is an 80% reduction in water quality contacts by 2050 (compared to the 2017/18 baseline) – this work will play a vital role in achieving this goal.

4.6 Customer Support

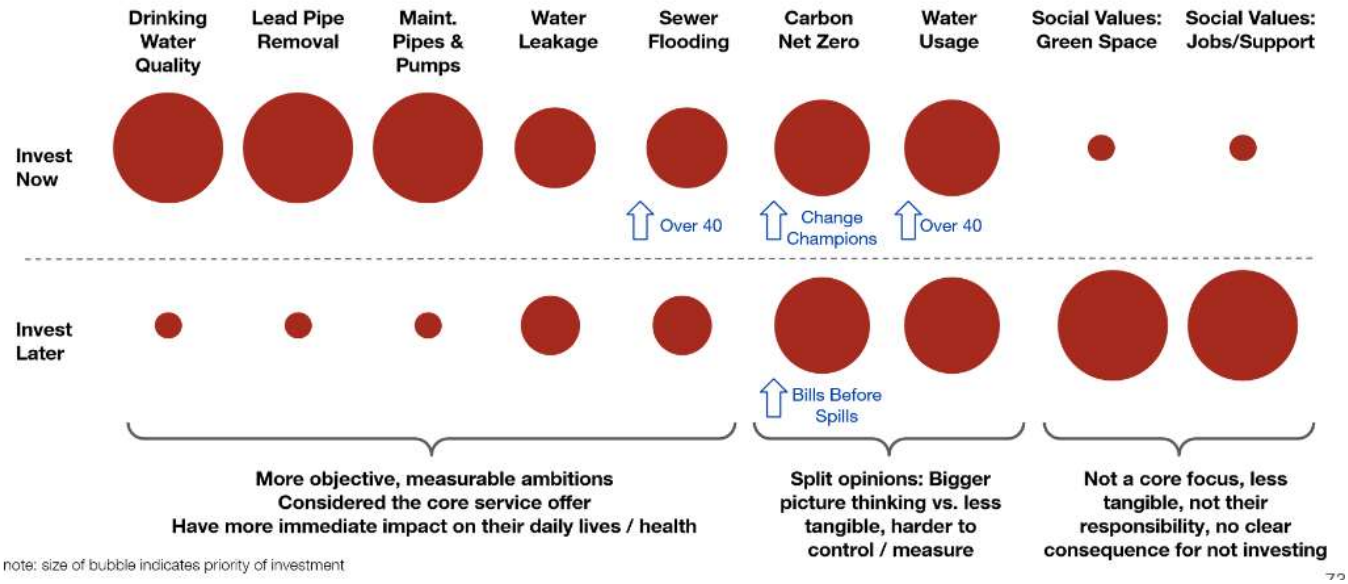
4.6.1 As part of the development of the historical and current regulatory business plans, UUW commissioned Price Waterhouse Coopers LLC (PwC) to carry out research into customer priorities.

4.6.2 The customer research identified drinking water quality as a priority ambition for most customers, with many seeing it as a core service offer and basic human need. Additionally, customer research prepared by Impact for UUW's customer priorities has shown safe clean drinking water to be ranked highest, while taste, smell and appearance is ranked third, out of all our priorities for AMP8 and beyond. A sufficient and reliable supply of safe clean drinking water is intrinsically linked to good public health and customer confidence in water supplies.

4.6.3 In the PwC facilitated research, customers were shown UUW plans in different thematic areas, and were then asked to comment on those plans, and were given a range of spend and delivery profiles to choose from.

4.6.4 Customers were offered three spend profile options, from deferred investment resulting in ageing assets, to moderate investment focussing on long life asset replacement/maintenance, to accelerated investment. Customers indicated that they want to see more urgent investment in 'core services' that have more immediate impact on lives/health. Customers consistently identified critical asset maintenance as a core, high priority. This is shown in Figure 10.

Figure 10: Customer preference for timeliness of investments[1]



Source: PWC report 2021

4.7 Factors outside of management control

4.7.1 Since the Vyrnwy LDTM was originally constructed in the 1880s the original design of the aqueduct did not take into consideration the water quality implications of long term use of the pipes and could not foresee the increased regulator and customer expectations surrounding water quality. While the aqueduct fulfils its duty of supplying water to residents of Cheshire and Merseyside, it is unable to meet the higher water quality standards that we must adhere to.

[1] https://www.unitedutilities.com/globalassets/z_corporate-site/about-us-pdfs/p143-customer-priorities-2021/final-report.pdf

4.7.2 The timeframe stipulated within the Enforcement Order means that we are obliged to complete this work within AMP8. Nonetheless, customer research has indicated that customers are in full support of investments in relation to water quality being made now. It is clear that customers prioritise excellent water quality and this enhancement takes us closer to achieving this for all customers and improving their overall experience.

4.7.3 We have taken steps to improve the quality of water at the source through WTW interventions and targeted catchment activity. Nonetheless, the interactions between the low alkalinity water and cast iron pipes remain and the only way to resolve this issue is to line the aqueduct with a robust material that will not adversely affect the quality of water as is passes through the pipe.

5. Best option for customers

5.1 Section Summary

5.1.1 The terms of the Enforcement Order clearly set out the DWI's requirement that UUW will clean and reline the Vyrnwy aqueduct. The methods in which this is carried out is the company's decision and therefore in order to ensure that the chosen solution represents the best value for customers, communities and the environment over the long-term, we undertook trials on the Vyrnwy aqueduct and reported outcomes to the DWI.

5.2 Options review

5.2.1 The outcome of the aforementioned trials provided detailed information on the cleaning and relining techniques available for the Vyrnwy aqueduct project. The report contained the results from the research and development lining trial and formed the basis of the approach Vyrnwy aqueduct in subsequent AMPs.

5.2.2 The trials identified the need to select the correct solution dependent on the environment, while considering the following key matters:

- The continuity of supplies to all water supply zones (WSZ) served by the aqueduct during delivery of individual projects;
- Risks to water supply and drinking water quality during the works, including discoloured water and loss of supply;
- The interface between this programme and other projects ([✂]the Severn Trent Transfer solution);
- Environmental and ecological factors;
- Land access and highways issues;
- Constructability challenges;
- Liaison with local and national authorities and other interested parties, including the Environment Agency and Local Authorities;
- Disposal of water used for cleaning; and,
- Schedule for delivery.

5.2.3 It was assumed that slip-lining would be significantly more cost effective than the alternative "thin-wall" lining as a lining technique due to the ability to install increased lengths thus reducing the number of excavations and access requirements. Jet Wash cleaning likely offers the most economical approach to addressing the water quality issues associated with line three, assuming that the existing lining is in a satisfactory condition and the steel main is structurally sound.

5.2.4 A full options report was produced, including hydraulic modelling, which explored a range of techniques and the impact each would have on the overall flow capacity of the system. The modelling highlighted that any lining installed could not reduce the internal diameter of the pipe considerably in order to maintain supplies.

5.2.5 The hydraulic modelling was used to determine the project delivery schedule, the results of which determined that a staged approach to relining is required to maintain water supplies to customers and minimise any potential supply risks.

5.2.6 We considered the complete abandonment of the Vyrnwy aqueduct and replacing supplies with groundwater sources. Groundwater sources are of higher alkalinity and therefore have a much less

corrosive effect on cast iron pipes and therefore lead to fewer instances of discolouration within the water network. Groundwater is considered to have a more stable water chemistry.

5.2.7 The cheapest groundwater option available within the Water Resources Management Plan (WRMP) comes at cost of £3.1m/Ml/d, resulting in a total cost of £641.2m to meet the 210 Ml/d required from Oswestry WTW in our WRMP24.

5.2.8 In reality, within our WRMP24, there is only 151Ml/d licence headroom available from feasible groundwater sources and the average cost to deliver this additional capacity is in the region of £9m/Ml/d, giving a total cost of £1357.8m for 151.1Ml, leaving a shortfall of 59Ml/d.

5.2.9 Another option explored was the installation of manganese removal treatment on all bulk supply take offs in place of work at [✂]or on the Vyrnwy aqueduct. This option was dismissed on account of the excessive cost associated.

5.2.10 The delivery solutions have been shared with the DWI throughout the overall lifecycle of the project across numerous AMPs.

5.3 Cost-benefit appraisal

5.3.1 Our options review enabled us to determine the most appropriate solution for addressing the requirements detailed in the Enforcement Order that represents the best value for customers.

5.3.2 The techniques to be employed on the aqueduct are proven to improve water quality with respect to occurrences of discolouration and compliance with the iron standard, therefore we are confident that customers will have an overall improved experience as a result of the relining.

5.3.3 We anticipate that the following benefits will be realised by both UUW and consumers by completing this series of investments:

- Maintained public confidence in water supplies by avoiding discolouration events;
- Reduced discoloured water customer contacts. Customers judge safe clean drinking water by what they taste, smell and see;
- Reduced risk of non-compliance with the Regulatory Standard for iron and therefore adverse impact on compliance risk index; and
- Continued provision of safe, clean drinking water that meets customer standards.

5.3.4 We have remained in regular communication with the DWI both prior to and post the issuing of the Enforcement Order, informing them of our intentions throughout its duration during regular liaison meetings. The delivery solution has been formally assessed and agreed with DWI and they expect us to deliver the specific solution as well as the outcomes of the project stipulated in the Enforcement Order.

5.4 Best Value Analysis

5.4.1 Our approach to delivering best value is robust and consistent across all of our enhancement cases. Our approach uses a rich mix of metrics to help us drive value and efficiency in developing our business plan. Consistency of the approach is driven through our PR24 Value Tool which allows us to quantify and value environmental and social benefits, costs and risks. For more detail on this approach please see ‘Our approach to deliver best value totex’.

5.4.2 In the case of the Vyrnwy aqueduct relining, the best value plan is the least cost and therefore we did not find it necessary to conduct carbon and natural capital assessments of alternative solutions that were discounted on account of their high costs. Our expert knowledge informs us that the solution identified has a lower carbon impact than a full replacement programme given the size and scale of the relining project.

5.5 Quantified benefit of the proposed options

5.5.1 The following performance commitments will be impacted by this enhancement:

Customer contacts about water quality

5.5.2 In AMP7, we had a bespoke performance commitment associated with reducing customer contacts about taste, smell and appearance. This will continue to be measured in AMP8 as a common ODI. Renovating the Vyrnwy aqueduct will result in fewer occurrences of discoloured water for customers owing to the removal of deposits within the pipeline which are a direct cause of discolouration. We have a target of 50% reduction of the number of customer contacts reporting discoloured water in the WSZ receiving more than a 50% supply from Lake Vyrnwy when compared to the 2001 baseline, as defined in the Enforcement Order. We envisage that the relining work included in this enhancement case will enable us to achieve this target.

5.5.3 In achieving the target defined in the Enforcement Order, this would result in a customer contact rate per 1,000 population benefit of 0.05.

Compliance Risk Index (CRI)

5.5.4 This measure relates to the quality of water supplied to customers and is calculated by the DWI. Our commitment remains to having zero water quality failures. Relining the Vyrnwy LDTM will lead to improved water quality compliance with respect to the iron parameter in the downstream Water Supply Zones. By completing this work, we expect to see an avoidance of CRI points in AMP8 as a result of the removal of water supply zones included in the Regulation 28 Discolouration Notice.

5.6 Cost and benefit delivery uncertainty mitigation

5.6.1 In order to support the decision-making of the preferred solution, trials were completed to explore the techniques available for the project, the outcome of the trials and the chosen solution has been shared with the DWI.

5.6.2 The design followed the formal UUW asset standards process for the selection of pipe materials and hydraulic requirements which includes asset design and materials to be used, the hydraulic design (including the margin of safety we employ), standards for laying mains, and Civil Engineering Specification for the Water Industry (CESWI).

5.6.3 We have undertaken innovation workshops with the contractors to reduce carbon, time and cost, and adopted a collaborative approach to driving additional benefit from their experience and knowledge.

5.6.4 The utilisation rate of the Vyrnwy aqueduct will remain high and this work will allow the aqueduct to continue to operate for generations to come, delivering a sufficient supply of high quality water to customers. Due to the essential nature of the aqueduct within UUW's supply network, it is imperative that the relining is dependable and to a high standard.

6. Cost efficiency

6.1 Section Summary

6.1.1 We recognise that the value of this enhancement is higher than the original estimate submitted at PR19. We have made use of previous project out turn costs, market intelligence and consultation with third party experts to create a robust cost estimate for this work. A multitude of unforeseen factors have led to this point, namely the significant price increases of materials, beyond that of recent inflation rates. We have taken steps to validate costs with industry experts to ensure that our estimates are efficient.

6.2 Approach to cost build

6.2.1 As detailed in section 4.2, the relining of the final sections of lines 1 and 2 of the Vyrnwy aqueduct was identified as the most appropriate solution – this decision was driven largely by the cost to deliver this work to achieve the desired outcomes when compared to other, more expensive, options.

6.2.2 At PR19, high level cost estimates were created for the completion of the work based on AMP5 project costs to clean and reline sections of the Vyrnwy aqueduct from [✂]to -]). At the time this estimate was produced, we were pursuing the innovative solution to lower manganese concentration and address [✂]], therefore it was not in our best interests to develop a detailed project scope and cost estimate due to the time and resource required to do this.

6.2.3 To date, work on the Vyrnwy aqueduct in AMP5 and AMP7 has been through mostly rural areas of Shropshire and South-West Cheshire. As we progress to the North sections of the aqueduct located in North-Cheshire and the outskirts of Merseyside, the areas in which we are working in become more urbanised, this presents additional logistical challenges that were not present in the AMP5 project and therefore not accounted for in the PR19 high level estimate.

6.2.4 Hydraulic modelling had not been completed when the original estimate was produced, and therefore assumptions on the scale and scope of the slip-lining were made including the techniques to be employed and the pipe pressure rating to be used. During AMP7, we have undertaken hydraulic modelling to refine the scope of the project which has identified that higher pipe pressure ratings are required, which are more costly than the previously scoped lower rated pipes. The unit cost difference between the two pipes is approximately £156/meter (68% higher).

6.2.5 There are additional challenges associated with the final stages of relining due to locations of significance within Cheshire that the aqueduct passes through. The first of which being Delamere Forest (Figure 11) located [✂], which is a logistically difficult section that could require long duration road closures and extensive diversion routes. In order to mitigate these risks and minimise disruption to road users, loss of trade to local business owns and maintain access to private housing, multiple options have been scoped which include adapting ways of working to reduce the time required on site. The option selected for this section of work must balance the aforementioned factors with the cost to deliver the work and therefore we have developed specific bottom-up cost estimates for each of the possibilities considered.

Figure 11: Pipe-bridge located within Delamere Forest

-]

6.2.6 Fiddlers Ferry is a decommissioned power station and is located -]of the aqueduct and is scheduled to be demolished late summer/autumn 2023 (Figure 12). The Vyrnwy treated water aqueduct runs underneath the site. Due to the long-term industrial use of the power station site and surrounding land, it is prudent to take additional precautions when slip lining these sections of the aqueduct. We are appraising different pipe materials that will provide an additional layer of water quality protection from

the contaminated ground surrounding the pipe while balancing this with the cost associated with each material type.

Figure 12: Fiddlers Ferry power station

Source: Warrington Worldwide News Article published 22/09/23

6.2.7 Bottom-up principles were used to derive the AMP8 direct cost estimate. We made use of an estimating software (*Candy)*, updated with the most recent market intelligence with respect to unit rates for individual items, to create the estimate on a line-by-line approach to create the most accurate and efficient estimate.

6.2.8 [✂] with a further 6% applied for UUW Risk. This is an appropriate level of risk applied when we consider the size and scale of the projects and the multitude of components involved. We have experience from our work to date on this project of sharp, unexpected price increases to factors outside of our control. 20% uplift is then applied for UUW Cost to Serve and a final 7% for UUW Corporate Overhead. A third party was engaged to carry out a bottom-up benchmarking exercise by comparing our cost build ups against similar companies. This resulted in an additional internal challenge on costs of 2.5% reduction. This is illustrated in Table 3.

6.2.9 We are committed to working with our supply chain and contractors to identify areas for cost saving and efficiency throughout the duration of the project. An example of this is through free issuing the pipe to the contractor and working with the supply chain to procure pipework at the most cost effective time to avoid price increases. Additional detail is included in section 6.3.

Table 3: AMP8 project cost build-up

Estimate Summary		-]	-]	Total
Direct Cost		£33,389,773.53	£37,788,975.64	£71,178,749.17
Contractor Indirects	60%	£20,033,864.12	£22,673,385.38	£42,707,249.50
Sub-Total		£53,423,637.65	£60,462,361.02	£113,885,998.67
UUW Risk	6%	£3,205,418.26	£3,627,741.66	£6,833,159.92

Estimate Summary		-]	-]	Total
Sub-Total		£56,629,055.91	£64,090,102.69	£120,719,158.59
UUW Cost to Serve	20%	£11,325,811.18	£12,818,020.54	£24,143,831.72
Sub-Total		£67,954,867.09	£76,908,123.22	£144,862,990.31
UUW Corporate Overhead	7%	£4,756,840.70	£5,383,568.63	£10,140,409.32
Sub-Total		£72,711,707.78	£82,291,691.85	£155,003,399.63
UUW Efficiency Target	-2.5%	-£1,817,792.69	-£2,057,292.30	-£3,875,084.99
TOTAL PROJECT COST		**£70,893,915.09**	**£80,234,399.55**	**£151,128,314.64**

Source: UUW cost estimate.

6.3 Evidence that cost estimates are efficient

6.3.1 At PR19, cost estimates were made based on the out turn of the AMP5 project. Throughout the duration of the Vyrnwy aqueduct project, our knowledge and understanding of the pipe and its condition have evolved which has allowed us to develop a detailed, final scope of work required for the final phases of the project. We have utilised a number of innovative tools and techniques to determine which sections of the pipe must be relined in order to control the amount of relining work being carried out and ultimately minimise costs.

6.3.2 Cost estimates were calculated as the methods to be utilised on the aqueduct, with the environmental considerations along its length, were determined. Due to the volatility of polymer prices for the production of the polyethylene (PE) pipe used for relining, the pipe is free issued by UUW to the contractor in AMP7, enabling us to realise a 2.7% saving. We plan to continue this procurement structure in AMP8 to ensure the pipe costs are efficient.

6.3.3 The current unpredictability of materials markets mean that it is not appropriate to apply inflation factors alone to previous projects, especially in the case of PE pipes as these are made from oil and therefore the cost to produce PE pipes is driven by the price of crude oil. In 2022, the price of crude oil rose to that of 2014 as a direct consequence of inflation and the conflict in Ukraine, **Figure 13**. Estimating materials costs in this manner would be irresponsible and could lead to large discrepancies between the estimate and actual cost.

Figure 13: Crude oil price 10 year trend [2]

Source: Trading economics website.

6.3.4 In June 2022, we were made aware of a 17% increase in the cost of PE pipe to come into effect on 01 July 2022 – at this time, prices had already risen by 30%. In response to this, we opted to complete early purchase of 39km of PE pipe to seize the opportunity to save £2.44m (less storage costs of £15,000) on pipe costs.

6.3.5 There is limited industry data available on the cost of similar projects due to the expenditure associated with aqueduct improvements not being shared at an industry level. Slip-lining aqueducts of this size and length is far beyond any business as usual activity we have undertaken on our regular water mains and thus it is not appropriate to scale up the unit rate for slip-lining smaller diameter pipes and apply to the Vyrnwy aqueduct.

6.4 Third party assurance

Bottom-up benchmarking (Faithful and Gould)

6.4.1 Faithful and Gould undertook a bottom-up deep dive into the cost efficiency of our enhancement cases. This involved a close examination of our cost base relating to a sample of our plan, with comparisons made to similar activity carried out by third party companies across a variety of sectors.

6.4.2 F&G looked at our direct costs across each of the following categories:

(a) Staff including site supervision

(b) Mobilisation and site set up, running and removal of site offices and welfare

(c) Temporary services for general site use, such as water to wash out concrete skips

(d) Attendant plant and equipment, such as cranes, forklift for unloading deliveries etc

[2] https://tradingeconomics.com/commodity/crude-oil (accessed 26.07.2023).

(e) Attendant labour, defined as hourly paid operatives not involved in productive works

(f) Site consumables, such as waste skips

(g) Set-up site compounds, erecting hoardings etc

(h) O&M manuals

(i) Health and safety

6.4.3 It also looked at the contractor's indirect costs (e.g. overhead and design costs) and UUW's indirect costs (e.g. land acquisition costs). Due to the size of the programme, F&G examined a sample of our enhancement cases. However, this sample included projects from each of our enhancement categories and covered £1.246bn of expenditure.

6.4.4 F&G noted the effectiveness of UUW's cost estimation process:

"In addition to the benchmarking data held by Faithful+Gould we understand that UUW has applied multiple internal and external challenges to progressively refine the cost estimation undertaken to date. In particular we note UUW's use of its Investment Programme Estimating System (IPES) which is a bespoke parametric estimating tool containing data from AMP3 to AMP7, to provide historical cost curves alongside estimated data from third party organisations."

6.4.5 F&G found that our proposed costs are in line with rates typically seen across the industry:

"Overall, UUW's approach of utilising historic cost curves, market testing and obtaining specialist third party quotations demonstrates a sound proactive approach to cost planning. In total £1.2bn of schemes underwent targeted cost assessment with £573m making up the construction works element.

After presenting our initial findings it was encouraging to see UUW's commitment to addressing our findings and applying these to the wider enhancement estimates, charting a strategic route towards greater efficiency and scope clarification.

In light of this Cost Assurance work and evidence of UUW's responsive actions we have concluded that the data we have benchmarked is within a reasonable alignment with anticipated market rates."

7. Customer protection

7.1 Introduction

7.1.1 It is important that customers have confidence that we will deliver the enhancement schemes that get reflected in our PR24 final determinations and they are suitably protected in the event of non-delivery, or if there are material changes to deliverables (including changes to dates), which leads to a change in cost (including changes in the timing of required expenditure). Ofwat proposes that, if companies fail to deliver or are late delivering improvements to customers, then price control deliverables (PCDs) should, where appropriate, be used to compensate customers. In our PR24 *Chapter 8 –Delivering at Efficient Cost, section 8.8.9* we have proposed an approach to PCDs that aims to provide customer protection, such that customers are fairly compensated for non-delivery (such as due to a change in regulatory requirements) or late delivery (including as a result of a change to a regulatory date), between PCDs, any related ODI underperformance payments, and cost sharing arrangements.

7.2 Price control deliverable

Table 4: PCD summary

Scheme delivery expectations	
Description of deliverable	Relining 65.6km of the Vyrnwy [✂]in line with the terms of the DWI Enforcement Order.
Output measurement and reporting	Company should deliver the number of km re-lined and thus water quality benefits for customers in line with the terms of the DWI Enforcement Order. The km re-lined will be reported and monitored through the APR process, making use of the existing reporting mechanism in place for the Vyrnwy aqueduct AMP7 bespoke Performance Commitment which monitors the same output, however this will require a new reporting line.
Assurance	DWI assessment of completed milestones as per the terms of the Enforcement Order, in line with agreed Enforcement Order Audit Strategy Independent third-party assessment of completed milestones and forecast of likely outturn position, through APR audit process.
Conditions on scheme	The work is subject to an Enforcement Order by the DWI (Ref UUT 2020 – 00002). The work must be completed by 31 December 2028 with a satisfactory completion report demonstrating successful completion and delivery of the outcomes by 31 January 2030. Therefore, we propose that this PCD should be conditional upon UUW completing the report by the 31*st* January 2030.
Impact on PCs	Impact likely on WQC PCL, given the nature of the Enforcement Order, we do not consider it appropriate to reflect that in this PCD.

7.2.1 In our PCD template *UUW32-PCD Excel Sheet* we have assumed a wholesale WACC of 3.23%, in line with Ofwat's guidance. We have assumed a 50% totex cost sharing rate, which is applied before calculating PCDs. We have applied a further 50% for Bioresources (where applicable), to ensure that only 25% of Bioresources totex is at risk from PCDs, given the lack of RCV guarantee, and general uncertainty in cost recovery from future Bioresources price controls. For late delivery we have applied a proportionate value of annual opex, and assumed 3.5% of capex, which provides a fair reflection of the time value of money of any related deferred capital spend.

Table 5: PCD delivery profile

	Unit	AMP8	2024	2025	2026	2027	2028	2029	2030	Ultimate delivery
Cumulative delivery target for PCD	**km**		**-**	**-**	**9.84**	**32.80**	**55.76**	**65.60**	**65.60**	**65.60**
AMP8 Capex (22/23 pb)	£	151,128,317	-	-	41,861,402	37,710,984	57,661,014	12,392,826	1,502,091	
AMP8 Opex (22/23 pb)	£	0	-	-	-	-	-	-	-	
ODI impact per unit of PCD volume	£/km	0.00								

Table 6: Price Control Allocation

Price Control	Unit	Price Control Allocation
Water resources	%	0.00%
Water network+	%	100.00%
Wastewater Network+	%	0.00%
Bioresources	%	0.00%

Table 7: PCD Incentive rates

	Unit	WR	WN+	WwN+	BR
Overall delivery	£/km	0	1,151,893	0	0
Time value rate	£/km	0	37,206	0	0
Late delivery	£/km	0	77,522	0	0

United Utilities Water Limited
Haweswater House
Lingley Mere Business Park
Lingley Green Avenue
Great Sankey
Warrington
WA5 3LP

unitedutilities.com

United Utilities

Water for the North West

UUW60

Lead

October 2023

Enhancement Case 3

United Utilities

Water for the North West

Contents

1. Enhancement submission

<table>
<tr><th colspan="2">Enhancement submission</th></tr>
<tr><td>Title:</td><td>Lead pipe replacement</td></tr>
<tr><td>Price Control:</td><td>Water Network Plus</td></tr>
<tr><td>Enhancement headline:</td><td>Replacement of 30,000 lead pipes from the water main to the compliance point at the first customer tap to reduce the risk of customer exposure to lead.</td></tr>
<tr><td>Enhancement expenditure
(FY23 prices)</td><td>
<table>
<tr><th></th><th>AMP8 Capex inc TI (£m)</th><th>AMP8 Opex (£m)</th><th>AMP8 Totex (£m)</th></tr>
<tr><td>Pre RPE and Frontier Shift</td><td>75.263</td><td>16.896</td><td>92.159</td></tr>
<tr><td>Post RPE and Frontier Shift</td><td>73.500</td><td>16.500</td><td>90.000</td></tr>
</table>

The table above shows the total expenditure, inclusive of accelerated programme and transitional investment, on both a pre-efficiency (i.e. pre frontier shift and real price effects basis, consistent with the cost data tables), and a post efficiency and RPE basis (i.e. consistent with the value we propose to be recovered from price controls). All numbers referenced hereafter in this enhancement case are on a post efficiency and RPE basis.
</td></tr>
<tr><td>This case aligns to:</td><td>Long Term Drinking Water Quality Plan 2023 (DWI)

Lead Strategy March 2023 (DWI)

For full reconciliation between enhancement costs and data table lines, see enhancement mapping tabs in UUW117 – Project allocations CW3 and CWW3.</td></tr>
<tr><td>PCD</td><td>Yes</td></tr>
</table>

2. Enhancement case summary

Gate	Summary	Location reference
Need for enhancement investment	Properties build prior to 1973 may have a lead communication and supply pipe. The removal of this full pipe to the compliance point is required in order to reduce exposure to lead and comply with regulatory standards and DWI expectations. The DWI expect water companies to make a step change in lead risk reduction during AMP8. Replacement of lead communication pipes is forecast to be 35,000 replacements during AMP8. Of this, 30,000 will be covered by this enhancement case. Those covered by the enhancement case are where full replacement from the water main to the compliance point has been completed in order to remove lead risk and improve compliance at this point. We have a residual risk based on age and volume of housing stock in the North West, with high levels of lead service pipes and high levels of economic deprivation. This will be facilitated through the continuation and expansion of our grant model for lead replacement in terms of scale and accessibility to facilitate and incentivise replacement of private lead pipes within the customer property. This will include dedicated support to customers in areas where there is very high levels of lead service pipes and economic deprivation, which inhibits customers' ability to afford service pipe replacements.	*3.1.4* *3.1.5* *3.1.4* *4.2.4* *3.1.8* *3.1.8, 3.1.9*
Best option for customers	There is a clear public health driver to remove lead pipework to properties in order to reduce exposure to lead. A wide range of options for lead pipe replacement have been considered taking into account all factors affecting lead including mitigation through long-term phosphate dosing and alternative techniques such as re-lining of lead pipes. DWI state that full replacement of the pipe is the only long-term solution to reducing lead risk. Pipe lining is only a short-medium term mitigation option and full replacement of the lead pipes is the only long-term solution. We are aligning to this full replacement approach.	*3.1.6* *Table 2* *5.4.2*
Cost efficiency	This case is based on an average cost of £3,000 per lead pipe replaced. This is an average cost and allows for a proportion of simple and more complex replacements (e.g. common supply pipes and supply pipes in rural areas that require additional main laying). We will maximise opportunities for efficiencies such as where there are multiple pipes in proximity or where mains replacement or metering activities are taking place. We will work in partnership with 3rd party housing providers to establish the most cost-effective approach to targeted pipe replacement. Third party assurance has been completed.	6.1 6.1.5 6.3
Customer protection	UUW propose a PCD for lead replacement based on number of lead pipes replaced.	7

3. Introduction

3.1.1 This document sets out an enhancement case of £90 million to allow UUW to reduce the number of lead pipes during AMP8, and support the ambition of removing the risk of lead exposure in drinking water across the North West by 2070.

3.1.2 Following the submission of a bespoke ODI to target lead removal at properties with the greatest needs and additional health benefits, Ofwat have recommended that this initiative forms part of an enhancement case with Price Control Deliverable (PCD) rather than a bespoke ODI.

3.1.3 Our long-term ambition is to eliminate the risk of lead exposure from potable water by 2070. This will be achieved through the removal of all lead pipework to the compliance point at the first customer tap, as the most effective way to reduce lead risk.

3.1.4 We have an estimated 506,421 lead pipe stock across the North West. This claim covers the replacement of 30,000 lead pipes (communication and supply) during AMP8, aligned with DWI expectation as set out in our AMP8 lead strategy submitted to the DWI in March 2023, and in line with our long-term ambition to remove all lead by 2070 as set out in our long-term water quality plan submitted to the DWI in January 2023.

3.1.5 We have liaised with the DWI regarding our lead ambition, they have set out their expectation for a step change in scale and pace moving into AMP8. The DWI annual report 2022 states that companies should be increasing their strategies to eliminate lead and this approach is aligned with this. DWI were also supportive of UUW's proposed uplift on the AMP7 ODI reward cap. The in-year cap has now been lifted to allow AMP7 target delivery to be expedited where required.

3.1.6 Long-term exposure to lead can be harmful to health especially for more vulnerable groups and 'there is no level of exposure to lead that is known to be without harmful effects'[1]. The reduction of lead in water reduces the risk to public health, especially for vulnerable customers (e.g. children and elderly). There is an acknowledged public health concern with widespread support for lead removal as the best and most effective long-term solution.

3.1.7 DWI have acknowledged that replacement of the service pipe to the compliance point at the first customer tap is the only acceptable long-term approach to removal of lead and that other technologies, such as lining of pipes, are not a suitable or equivalent alternative in the long-term. Experience to date, together with the latest research and guidance, supports the view that lead pipe removal is the most effective long-term approach to reducing risk.

3.1.8 In areas that suffer from high levels of economic deprivation, households are less able to access UUW's existing lead pipe replacement scheme, so the grant scheme will be expanded to include targeted replacement linked to lead risk and vulnerable areas as highlighted by our revised lead risk assessment.

3.1.9 This targeted replacement will help to remove the risk of lead in drinking water in areas where there are very high levels of lead service pipes and economic deprivation which inhibits customers' ability to afford service pipe replacements. This will also support vulnerable customer groups where lead removal is a higher priority.

3.1.10 We work collaboratively with wider industry to carry out research and benchmarking to ensure we have an aligned approach to customer supply pipes. It is recognised that water companies should have an aligned strategy for customer supply pipes including an integrated approach to lead, leakage etc. We are already industry leading in this field, completing many trials to establish the most effective way forward, and have removed comparatively high numbers of lead communication pipes in industry data shares (Further details in section 4.3).

[1] World Health Organisation: https://www.who.int/news-room/fact-sheets

3.1.11 Research has shown that providing water that is safe to drink is customers' highest priority. Customer research reveals that customers value safe water supply and are supportive of the removal of lead. Research completed in 2023 as part of the Long-term Delivery Strategy has shown lead pipe removal is a high priority (Further details in section 5.3)

3.1.12 As part of our Lead strategy submitted to the DWI in 2023, we are undertaking an end-to-end system review to assess the most effective short-term mitigation techniques for lead exposure alongside a circular economy review of phosphate (a finite resource used to manage plumbosolvency in drinking water and then removed from final effluent at wastewater treatment works). This will ensure that we are considering all elements of the system when planning interventions to reduce lead risk.

3.1.13 We have developed an adaptive plan to show how our approach to lead will evolve in response to external factors over multiple AMPs. Our long-term adaptive plan sets out the best value approach to reducing consumer exposure to lead in drinking water (included in section 5.4.5).

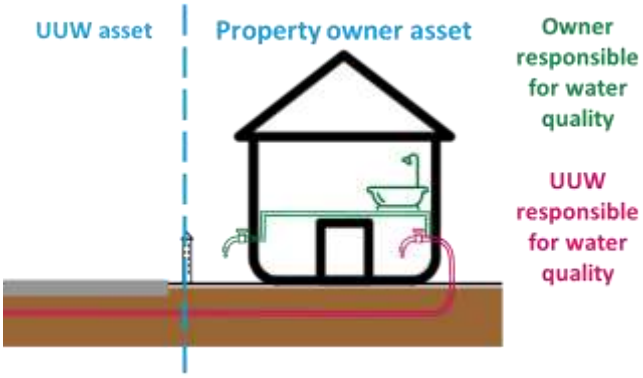
4. Need for enhancement investment

There is a clear public health driver to remove lead from properties in order to reduce exposure to lead. The DWI expect water companies to make a step change in lead risk reduction.

4.1 Lead pipe risk

4.1.1 We have an estimated 506,421 lead pipe stock across the North West, and this enhancement will support a programme to reduce this number during AMP8 and a continued programme over the long-term. This is a complex scheme as the communication pipe is owned by the water company to the property boundary and then the property owner to the first tap (Figure 1). The lead replacement investment will remove both the owned and non-owned parts of the service pipe in order to remove the lead risk.

Figure 1: Responsibility for pipework



***Compliance point at customer tap**

4.1.2 The DWI is clear on the view that lead replacement is the only long-term option to remove lead exposure risk as alternatives such as re-lining of pipes and dosing of phosphate are seen as short-medium term options. We will continue to mitigate lead risk through phosphate dosing until all lead is removed from the network.

4.1.3 DWI has set clear expectations that water companies need to make a step change in bringing down the level of risk by replacing more lead service pipes than in AMP7 and provided a letter of support for the ambition to increase the lead ODI cap for AMP7. The in-year cap has now been removed.

4.1.4 Our long-term ambition is to eliminate the risk of lead exposure from potable water by 2070 by replacing lead pipes to the compliance point at the first customer tap. This case for lead pipe replacement in AMP8 will:

- Expland our grant model for lead replacement providing customers with financial incentive to replace their supply pipe.
- Provide a targeted lead replacement scheme to support customers who cannot remove their own lead pipe were there are reduced levels of home ownership and less disposable income to enable people to pay for works. This will focus on working collaboratively in partnership with third parties such as social housing landlords.

4.1.5 This scheme will build on the successful grant model introduced in AMP7 and continue to build momentum, and increase accessibility of the uptake and delivery of this scheme and support the most vulnerable.

4.1.6 Replacement of lead communication pipes is forecast to be 35,000 replacements during AMP8. Of this, 30,000 will be covered by this enhancement case. Those covered by the enhancement case are where **full replacement from the water main to the compliance point at the first customer tap** has been

completed in order to remove lead risk and improve compliance at this point. We forecast 5,000 communication pipe only replacements, these will be covered by base expenditure as the full risk reduction is not completed.

Table 1: Summary of proposed (pipe replacement) activities

AMP8 Activities	Included in enhancement case	Scale
Communication pipe only Replacement of UUW owned communication pipe following water quality trigger at 5µg/l (reactive) (non-grant)	No	5,000 properties
Full replacement to compliance point Grant Scheme – Replacement of full service pipe to first customer tap. Customer side by customer, UUW side by UUW. Targeted replacement of full service pipe to customer tap based on social/economic vulnerability	Yes	30,000 properties

Lead pipe risk assessment

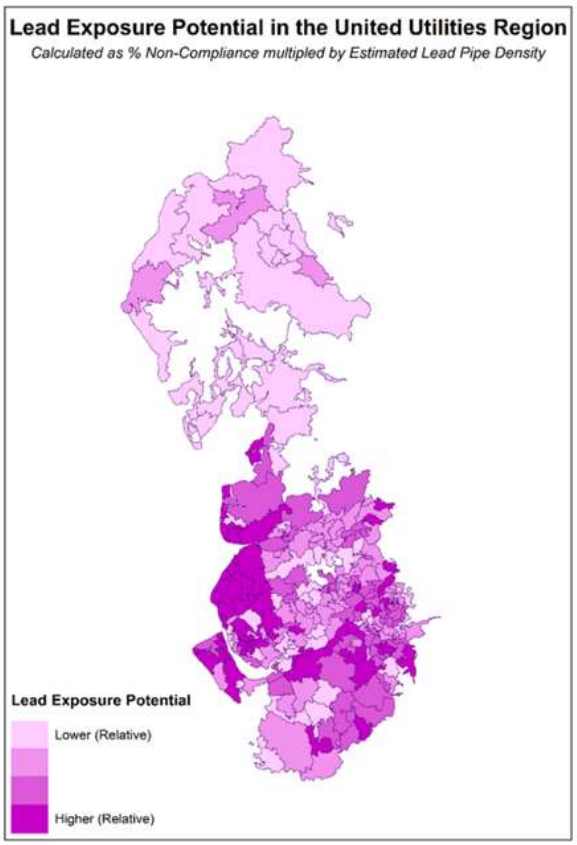
4.1.7 We have updated our lead risk assessment to highlight areas with the highest risk of having a lead pipe and estimate the number of lead communication pipes, based on:

- Lead non-compliance: Up to date sample results (2011-2022), including information from customer compliance samples alongside regulatory and routine monitoring sampling programmes; and
- Lead pipe density: Empirical data on lead prevalence (e.g. gathered during meter replacements or mains rehabilitation work).

4.1.8 This risk assessment has been mapped against CACI ACORN Consumer Classification data[2]. The consumer classification tool segments the population into 62 different categories, with those indicative of high levels of economic deprivation ("financially stretched" and "urban adversity") utilised in the identification of target areas for the measure. The maps in Figure 2 and Figure 3 show the areas where the highest levels of property level lead risk and economic deprivation are located across the North West. This dataset will be used to identify and engage with social housing providers and equivalent in the area to allow for targeted lead communication and supply pipe replacement to the first tap of the property.

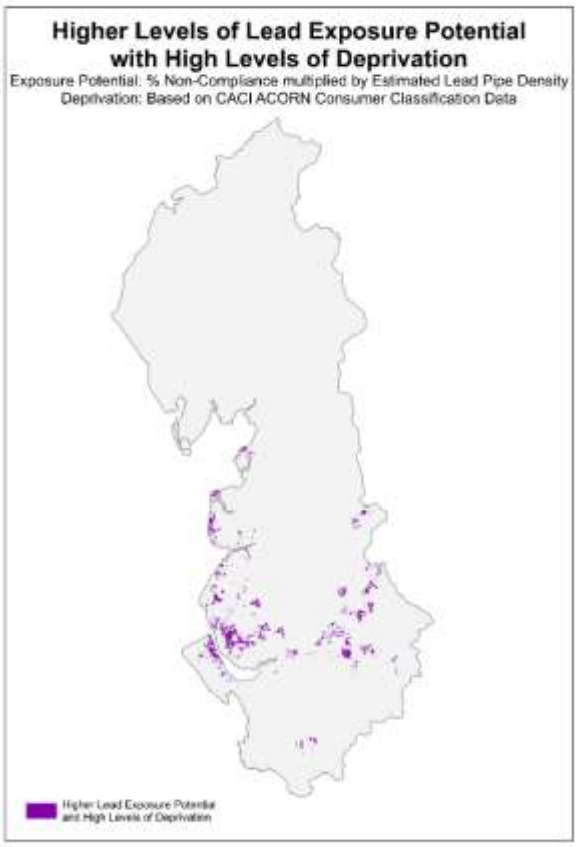
[2] https://www.caci.co.uk/wp-content/uploads/2022/03/Acorn-User-Guide-NEW.pdf

Figure 2: Map of relative lead exposure risk (based on lead risk assessment and water quality sample results)



Source: UUW lead analysis and CACI ACORN Consumer Classification data

Figure 3: Map showing high levels of lead risk overlaid with high levels of deprivation (based on CACI ACORN consumer classification data)



Source: UUW lead analysis and CACI ACORN Consumer Classification data

4.1.9 Areas with a relative higher lead risk can also be targeted for tailored communications to help consumers mitigate lead risk within their properties.

4.1.10 We are carrying out trials within AMP7 to help develop the targeted replacement process ready for expansion in AMP8.

Grant Model

4.1.11 In AMP7 we introduced a grant model to support full lead replacement to the first customer tap. This has had strong uptake - we are on track to fully remove 14,100 customer-side lead pipes. The in-year cap on the associated Outcome Delivery Incentive for the remainder of AMP7 has been removed, so we can build further momentum going into AMP8 and protect more customers sooner from exposure to lead.

4.1.12 During AMP8, we will expand this grant model and introduce additional activity where the grant scheme is unaffordable or inaccessible, such as to social housing groups, to target the replacement of up to 30,000 customer-side lead communication pipes. In AMP8 and beyond, we will continue developing our lead replacement approach to sustain high uptake. This is the most sustainable long-term solution to reducing exposure to lead for consumers across the North West.

4.2 Need for the enhancement

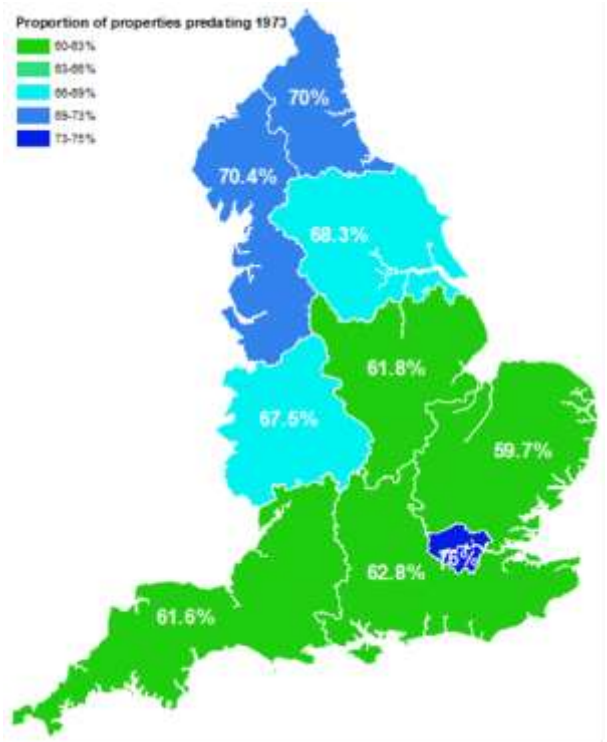
4.2.1 There is no level of exposure to lead that is known to be without harmful effects'[3]. Our strategy to reduce lead exposure is guided by our assessment of lead risk across the North West. We recognise that exposure and vulnerability are not uniform and by identifying high risk areas we can be more effective, efficient and equitable.

4.2.2 An individual's risk is affected by both economic and physical factors. Replacing a privately owned lead pipe, seeking a properly qualified plumber or selecting a low lead fitting may be simply unaffordable for customers in financial hardship. Physical exposure and vulnerability to lead also overlap with multiple dimensions of deprivation. For example, by increased exposure to lead sources, exacerbating existing poor health, limiting people's ability to change their circumstances, and reinforcing cycles between generations.

4.2.3 This case is driven by the historic housing stock in the North West and our commitment to reducing lead exposure in order to reduce public health risk.

4.2.4 The North West has high lead service pipe density due to the age of the housing stock and pace of development in the region. The map in Figure 4 below illustrates how this can present a challenge in the North West[4].

Figure 4: Proportion of properties pre-dating 1973



Source: Consumer data research centre

4.2.5 There is a higher level of deprivation within our customer base, which means that customers are less likely to be able to afford lead pipe replacement, compared to other regions. The four most deprived local authorities based on rank are in the North West[5]. This can mean that replacement of lead pipes is

[3] World Health Organisation: https://www.who.int/news-room/fact-sheets

[4] Consumer data research centre: https://data.cdrc.ac.uk/dataset/dwelling-ages-and-prices/resource/dwelling-age-band-counts-lsoa-2015.

[5] ONS data: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/835115/IoD2019_Statistical_Release.pdf

often financially inaccessible to those that could benefit most from it. The targeted replacement scheme will help these customers to replace lead pipes.

4.2.6 Lead health monitoring data (Lead exposure in children surveillance system LEICSS) links the most deprived areas to lead exposure in children (from multiple environmental sources). Seventy-five per cent of cases in 2021 lived in areas in the two most deprived quintiles of IMD (Index of Multiple Deprivation).[6] This means that the North West has both more lead pipes and, in some areas, population more susceptible to lead-related health risks.

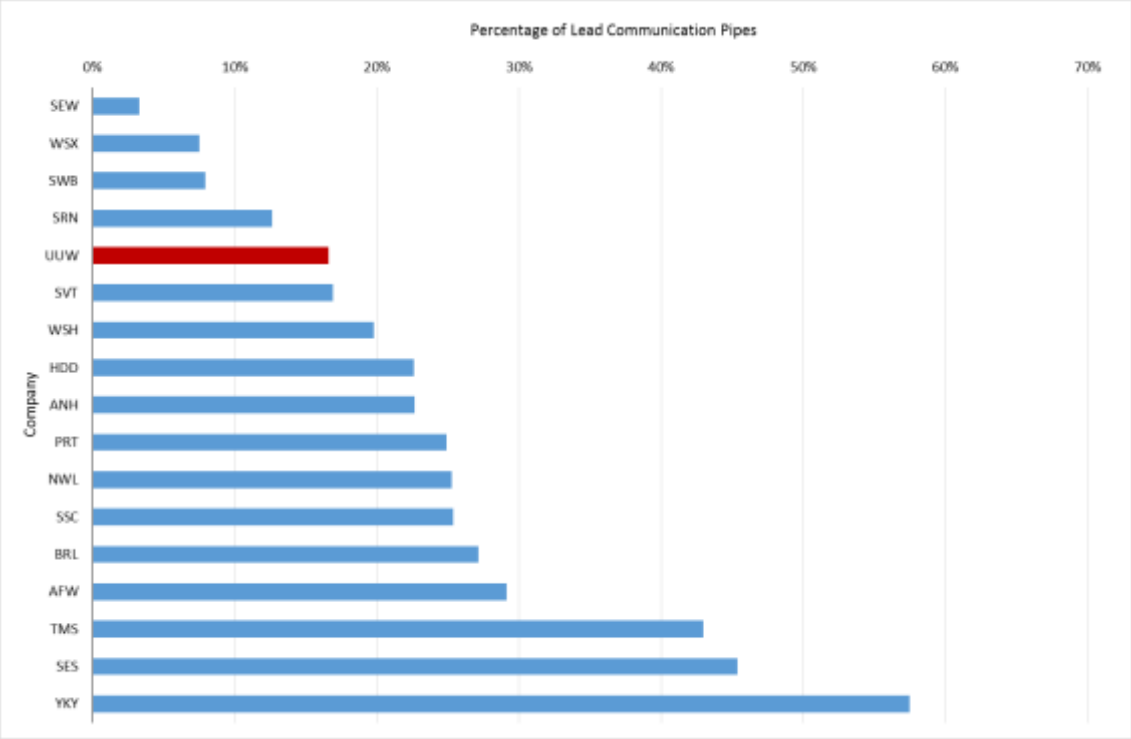
4.2.7 Research has shown that 'lead consumption from drinking water is generally low and is unlikely to have a significant impact on human health when considered in isolation', however, 'it is prudent to reduce lead intakes by as much as possible where feasible'.[7]

4.2.8 The potential health effects of lead in the water supply will be more prevalent in the North West due to the low alkalinity and upland peaty waters that are predominant in UUW's catchment area. These water types are more aggressive towards lead, resulting in greater potential for exposure to lead in potable water. Consequently, UUW employs a rigorous phosphate dosing approach for water supplies to mitigate this risk for the area. This mitigation will continue as part of the overall lead strategy.

4.3 Comparative position

4.3.1 It is estimated that 17% of communication pipes are lead (Figure 5), and from this an assumption that where there is a lead communication pipe, there is also a lead supply pipe. There will be anomalies where the communication pipe was replaced either reactively or proactively during Section 19 undertakings for mains replacement.

Figure 5: Estimate of lead communication pipes across water companies (as a percentage of total communication pipes)

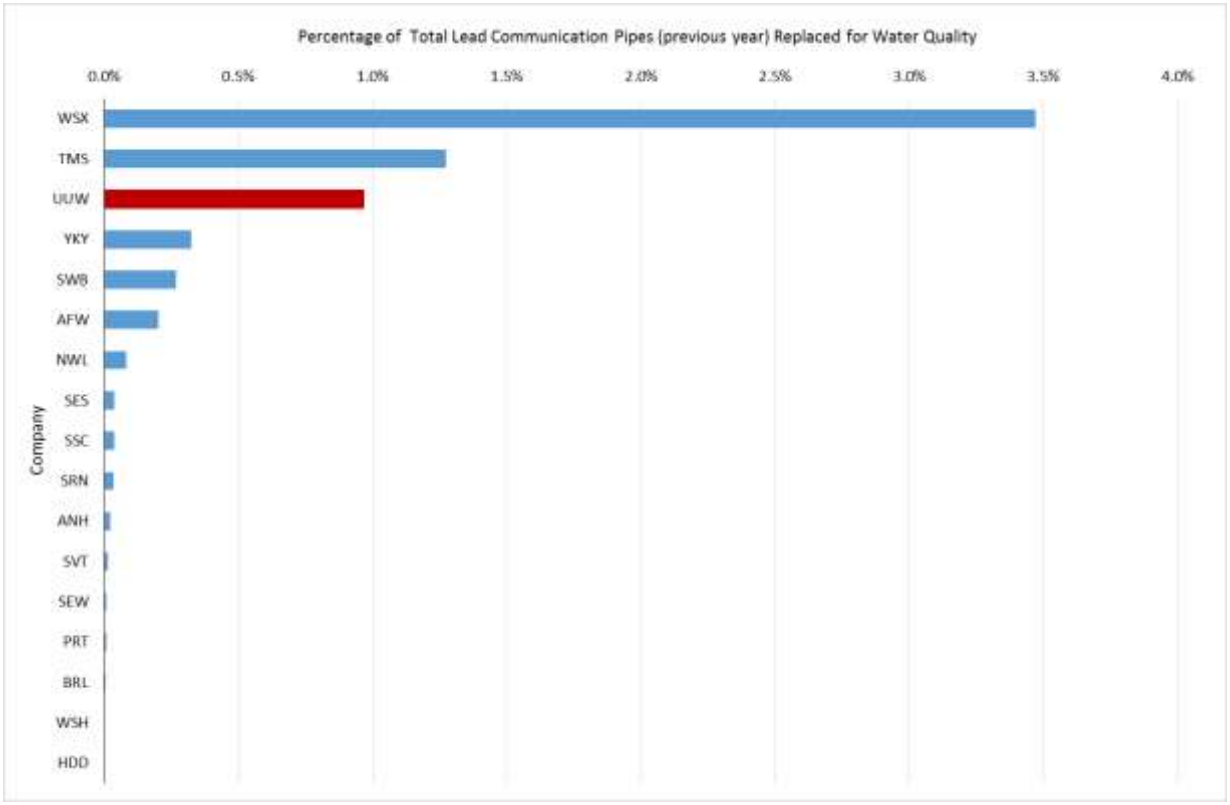


Source: APR data 2022

[6] Lead Exposure in Children Surveillance System (LEICSS) annual report 2022, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1128326/hpr0123_LEICSS_2021.pdf

[7] Review of the latest evidence on lead and estimation of intake via drinking water: https://dwi-content.s3.eu-west-2.amazonaws.com/wp-content/uploads/2020/10/27111218/DWI70-2-277.pdf

Figure 6: Industry comparison of lead communication pipe replacements



Source: APR data 2022

4.3.2 Figure 5 and Figure 6 illustrates the scale of the challenge. Although we have made progress during AMP7, a step change and continued replacement programme is required to deliver our long-term ambition.

4.4 Scale and timing of investment

4.4.1 In AMP8, in line with DWI expectations, we will make a step change in the scale and pace of lead pipe replacement as part of our long-term ambition to remove all lead by 2070. This ambition will build on our industry leading history of trials and interventions related to lead and phosphate that provide a firm grounding for the delivery of our lead removal strategy.

4.4.2 This increase in the scale of the programme is a step change from AMP7 investment and is in line with DWI expectations.

4.4.3 This is part of the long-term journey to be lead free by 2070 with opportunities to accelerate linked to the adaptive plan.

4.5 Management control

4.5.1 There are aspects to eliminating lead exposure that are outside of management control as listed below. This is further explored in the adaptive plan in Figure 7.

- External influence from government linked to future ownership of supply pipe, responsibilities of landlords etc. (No mandate)
- Regulatory influence from DWI in terms of legal notices that could determine replacement volumes. The lead strategy submitted to DWI in March 2023 is subject to the funding provided by this enhancement case.
- The lead supply pipe is owned by the customer who may require motivation and financial support to be encouraged to replace the lead pipe. The 'grant' element is customer driven so demand may

vary. The proactive element will be subject to the customer allowing access to the property to complete the work.

- Availability of resource (plumber/repair/maintenance resource) to complete the number of replacements. UUW has contract partners on long-term contracts to mitigate risk related to UUW owned assets. We work closely with supply chain to overcome any material risks. We will engage early with third parties to maximise opportunities and support to complete this work. We have also engaged with other companies completing this work to discuss and share approaches to overcoming these challenges.

5. Best option for customers

This section sets out why this enhancement is the best option for customers. A wide range of options for lead pipe replacement have been considered taking into account multiple factors affecting lead including mitigation through long-term phosphate dosing and alternative techniques such as re-lining of lead pipes.

5.1 Our approach

5.1.1 Our approach to delivering best value is robust and consistent across all of our enhancement cases. Our approach uses a rich mix of metrics to help us drive value and efficiency in developing our business plan. Consistency of the approach is driven through our PR24 Value Tool which allows us to quantify and value environmental and social benefits, costs and risks. For more detail on this approach please see 'Our approach to deliver best value totex'.

5.2 Options development

5.2.1 We have an industry leading track record of trials and studies related to lead risk. We actively engage with other water companies, suppliers and researchers to collaborate and share best practice such as active participation in the recent industry lead workshop with collaborative sessions on opportunities and challenges associated with lead risk. We have also held workshops with other water companies to share learning and good practice related to on-going schemes.

5.2.2 We are active contributors to current UKWIR projects including:

- UKWIR lead trial co-ordination: to understand the scope of lead trials and undertake a gap analysis based on literature and questionnaires and interviews completed by water companies. We are working with the contributing water companies to complete a knowledge sharing framework to maximise learning from trials and projects within AMP8; and
- UKWIR phosphate dose optimisation research: this will undertake further research into optimising dosing including understanding how water chemistry affects the required dose, and understanding variables that impact on lead solubility. This will help water companies to optimise dosing while lead service pipe replacements are progressed.

5.2.3 We have trialled numerous technologies to reduce lead risk and continue to research alternatives. Although we are currently pursuing lead pipe replacement we are aware of, and have trialled, alternative techniques such as lead pipe lining and no dig techniques such as 'pipe-pulling'. These techniques will remain part of the toolkit of options and will be used as appropriate where pipe replacement is not possible. It is recognised by the DWI that options such as re-lining should be considered in some circumstances, although as this is a short-term mitigation, there may be a need to re-line or remove in the future.

5.2.4 We have previously completed a study into the feasibility of adopting ownership of lead pipes. The purpose of this report was to understand the benefits and dis-benefits of adoption for both the customer and UUW including the boundaries of responsibility and the impact of current legislation. The report recommended that supply pipes should remain under the customers' private ownership. The findings concluded that widespread adoption would require changes to current legislation to operate efficiently. Without these changes to current legislation, water companies would require individual legal agreements with all customers and any requirement to carry out maintenance on these supply pipes would require agreement to access private land.

Table 2: Table to show options considered (aligned to our lead strategy)

Option	Rationale	Select/reject	Reason
Do nothing	Supply pipe is not a UUW asset. Very low number of infringements for lead standard at the customer tap (assuming continued phosphate dosing).	Rejected	Not in public health interest. Not aligned to DWI or customer expectations. Likely to lead to DWI notice/enforcement.
Deferment to future AMP	No immediate regulatory need or risk major number of infringements.	Rejected	Need to continue journey to lead free network aligned to long-term water quality plan.
Adopt supply pipe	Ownership and control to replace/repair supply pipe.	Rejected	Legal report completed 2021[8] Not recommending progression. No government support.
Dosing of Phosphate	Plumbosolvency protection for protection of lead entering water supply.	Selected	Will continue as mitigation until all lead pipes removed in an area.
Re-lining of lead pipes	Lead pipe is coated so lead not in contact with water.	Rejected	DWI do not see this a feasible long-term option. Will be considered as on case by case basis if appropriate.
Replacement of UUW owned side of communication pipe (Reactive)	Owned by UUW, reduce length of lead pipe supplying customer.	Selected	Committed to replacing UUW side following lead PCV infringement of 5µg/l.
Replacement of UUW owned side of communication pipe only (Proactive)	Owned by UUW, reduce length of lead pipe supplying customer. Previously completed as part of schemes in early AMPs.	Rejected	Does not remove lead risk to customer. Cost of replacement without benefit.
Grant Scheme - Replacement of full service pipe to customer tap. Customer side by customer, UUW side by UUW	Customer ownership and responsibility continues, financial incentive to complete work. Lead removed to compliance point (first customer tap).	Selected	Uptake popular - removal of full lead pipe. Expectation by DWI to continue and provide step change in scale.
Targeted replacement of full service pipe to customer tap. Customer side by landlord/3rd party, UUW side by UUW	Targeted replacement to make grant scheme more accessible to tenanted properties or those where work is cost prohibitive.	Selected	Link to vulnerability and accessibility.
Full system review	End to end review of circular economy benefits of phosphate through the system.	Selected	Circular economy benefits and efficiencies.

[8] UUW Lead Pipe Adoption – Feasibility Study July 2021

5.2.5 Based on the selected options, our strategy for AMP8 is to focus on the removal of lead to the compliance point (first customer tap) through:

- Operation of a **lead grant scheme** to incentivise customers to remove the customer owned section of the lead pipe to the first tap. This has been a successful incentive during AMP7 and has proven an effective method of supporting customers to remove their lead pipes. The UUW owned section is also replaced; and
- Expansion of the lead grant scheme to support **targeted lead replacement** where the grant scheme is currently unaffordable or inaccessible such as to social housing groups. This will also support the more vulnerable groups such as young families where lead removal is a higher priority.

5.2.6 In addition to pipe replacement, our AMP8 strategy will continue to focus on mitigation activities. This includes:

- Continued optimised phosphate dosing (removal of lead pipes will help move towards a chemical-free solution in the long-term);
- Improved data collection and mapping to further inform our comprehensive risk assessment; and
- Providing information to support customers to reduce lead risk from lead pipework and other potential sources such as lead solder and plumbing fittings.

5.2.7 Of the selected options, the service pipe replacement elements covered by the enhancement case shown in Table 3 below.

Table 3: Elements of enhancement case

Option	Reason	Scale
Grant Scheme - Replacement of full service pipe to customer tap. Customer side by customer, UUW side by UUW.	Build on successful and popular AMP7 scheme - removal of full lead pipe. Expectation by DWI to continue and provide step change in scale.	up to 30,000
Targeted replacement of full service pipe to customer tap. Customer side by landlord/3rd party, UUW side by UUW.	Link to deprivation and accessibility.	Proportion of 30,000 total (based on area identification)

5.2.8 These options represent the best long-term option based on long-term sustained protection against lead risk by removal of lead pipe.

5.2.9 This selection has additional benefits linked to other performance commitments and supply pipe initiatives including:

- Leakage (reduction in supply pipe leakage). Supply pipe replacement is a key component of the UKWIR/Water UK Leakage Road Map to 2050 which states that the industry as a whole needs to better understand risk associated with the deterioration of supply pipes, including interaction with lead supply pipe replacement programmes[9]. We are working with customers to reduce supply pipe leakage.
- Compliance Risk Index (CRI) (lead infringements measured at the customer's tap). Improving water quality at the compliance point will minimise potential lead infringements. Although lead infringements have a neglible impact on CRI, individual risk at a particular property with lead removed will be reduced.
- Low pressure (improved flow and pressure to customer tap, potential for C-MEX customer experience benefits).

[9] https://www.water.org.uk/publication/a-leakage-routemap-to-2050/

5.2.10 Other opportunities linked to this case include:

- Metering programme: Working collaboratively with other schemes, such as the installation of smart meter and replacement of distribution mains, will bring potential efficiencies to each of the proposed programmes.
- Potential opportunities for collaboration with utilities working on property driveways (for example fibre optics, gas).
- Potential efficiencies where work is completed alongside mains replacement activities (asset health/leakage enhancement) for UUW owned communication pipe elements.

5.3 Customer support

5.3.1 Research completed has shown that providing water that is safe to drink is customers' highest priority. Recently completed customer research by PwC on behalf of United Utilities 'Long-term delivery strategy ambitions testing' showed lead removal was a high priority for 'invest now'. Joint research between CCW and Ofwat shows that focus groups are highly engaged where health is seemingly at risk, such as with lead in pipes[10].

5.4 Options selection

5.4.1 Full lead replacement from the water main to the compliance point (first customer tap) is our preferred solution because it:

- Is the most effective way to reduce lead risk as it removes lead from the supply system;
- Offers a lower whole life cost; and
- Creates opportunities to achieve multiple benefits through one intervention.

This approach is supported by research outlined in the next points:

5.4.2 DWI have been very clear that lining is only a short-medium term mitigation option and full replacement of the lead pipes is the only long-term solution, 'The design life of lining materials may be a few decades and therefore further regular, though infrequent, interventions would be required to ensure lead exposure was minimised. Each intervention risks further exposure to lead from the host pipe and is therefore undesirable as a long-term solution'[11].

Partial replacement of the service pipe has been discounted as there is evidence to suggest that this is not effective in reducing lead levels as the communication pipe is often a minor component of the whole service pipe by length. There is also evidence that interventions on the pipe, such as for new connections, can further disturb lead in the pipe. 'There is evidence that demonstrates that the replacement of the communication pipe *only* will not necessarily lower water lead concentrations at the point of compliance and can result in greatly elevated lead concentrations for weeks or even months following completion of the communication pipe remediation', 'it is essential to include the remediation of **all lead pipework** into the property **up to the compliance point** as an implementation option.'[12]

5.4.3 We are consequently aligning to this full replacement approach to meet the regulatory expectations for long-term solution delivery and to minimise the requirement for multiple investments in future AMPs.

Adaptive planning

5.4.4 UUW has been at the forefront of reducing lead risk for over 20 years, from optimising plumbosolvency control to piloting full lead pipe removal. Our plans have progressed in response to the latest

[10] https://www.ccw.org.uk/publication/understanding-customers-preferences/

[11] Drinking Water Inspectorate 2021, Report Reference: DWI14372.2/16866-0 26 January 2021

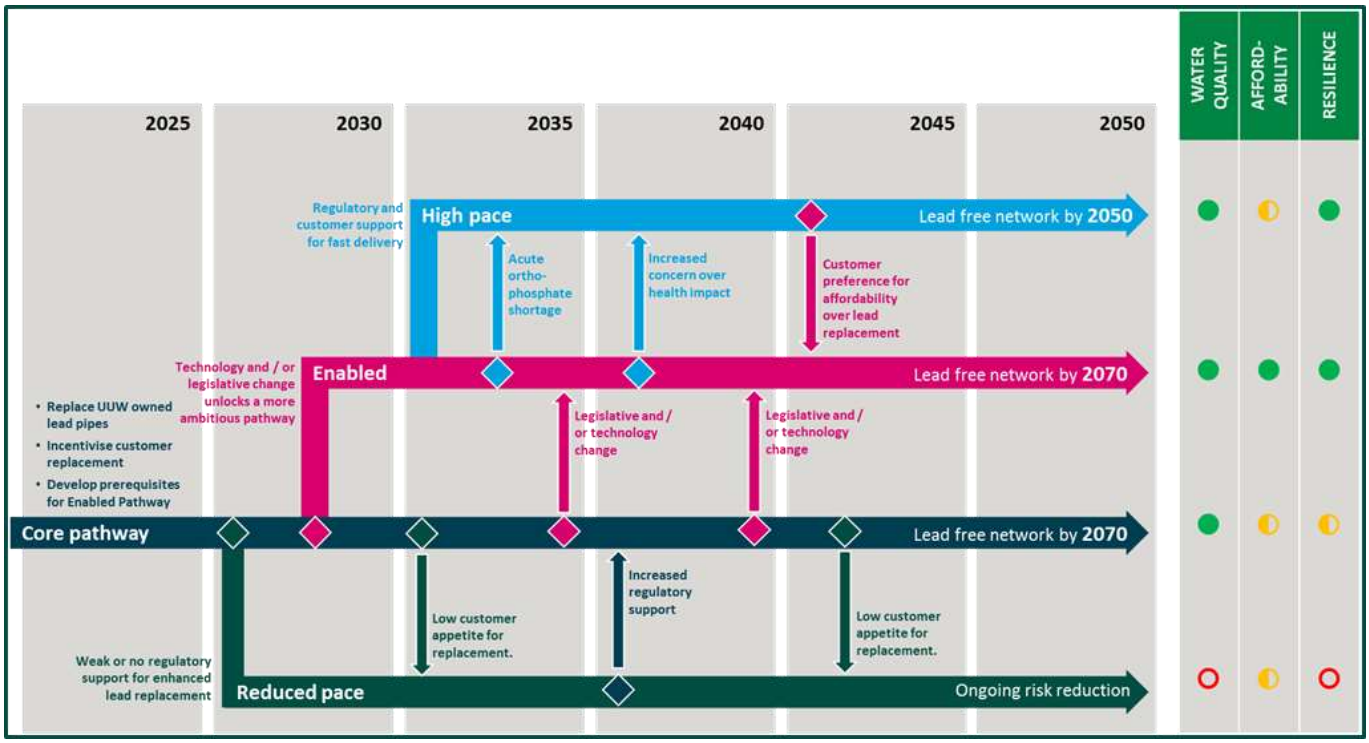
[12] Drinking Water Inspectorate 2021, Report Reference: DWI14372.2/16866-0 26 January 2021

understanding, and we will continue updating them in the future as we strive for effective and efficient risk reduction.

5.4.5 To support this evolution we have developed an adaptive long-term plan, as shown in Figure 7, to:

- Embrace technological, regulatory or legislative change;
- Be resilient to external challenges, such as disruption to the orthophosphate supply chain or unfavourable regulatory funding decisions; and
- Positively influence industry, regional and national policy.

Figure 7: Our adaptive plan for lead



Source: UUW adaptive plan for lead

5.4.6 Descriptions can be found below on our pathways.

Core pathway:

- This pathway expands our successful AMP7 approach by continuing to remove UUW owned lead pipes and incentivising customers to replace their lead plumbing, alongside business as usual activities such as plumbosolvency control and customer communications.
- It also includes enabling work to facilitate a shift to the Enabled pathway (e.g. supporting innovative solutions through our supply chain, engaging with regulators and policy makers on supply pipe ownership etc.).
- It achieves our ambition to remove lead pipes from our network by 2070 and performs satisfactorily – but not highly – against affordability and resilience. The cost of replacing lead pipes will impact bills and there is a risk from disruption to the orthophosphate supply chain.

Enabled pathway:

- This pathway anticipates a significant change in technology (e.g. enhanced trenchless technology) and/or legislation (e.g. change in supply pipe ownership) which enables lead pipes to be removed faster, or with less cost and disruption.

- It is desirable to transfer to this pathway early but the transition could take place at any point within the planning horizon. Changes, especially with regards to legislation, will be most effective if they align with business planning cycles.
- This pathway achieves our 2070 ambition with a lower bill impact and creates resilience through the opportunity to shift to the High Pace pathway.

High Pace pathway:

- This pathway accelerates to a 2050 target date by capitalising on regulatory support and the opportunities in the Enabled pathway.
- Transitions onto this pathway could be triggered by supply chain disruption or increased concern over the health impacts of lead. It would need to be selected early to allow delivery before 2050. This pathway could also be exited if customers express a strong preference for later delivery.
- This pathway outperforms on water quality and is resilient, but the medium-term bill impact is higher.

Reduced pace pathway:

- This is not a desired pathway but must be accounted for in our decision making.
- It is possible to transition off this pathway but delayed decisions place the 2070 ambition at increasing risk, and it will not be possible to accelerate to a 2050 target date from this pathway.
- This pathway performs poorly against all measures. The benefit of spending less on lead pipe replacement is offset by continued operational spending on orthophosphate.

6. Cost efficiency

This section demonstrates how UUW has ensured the costs put forward in this enhancement case are efficient and represent best value for money.

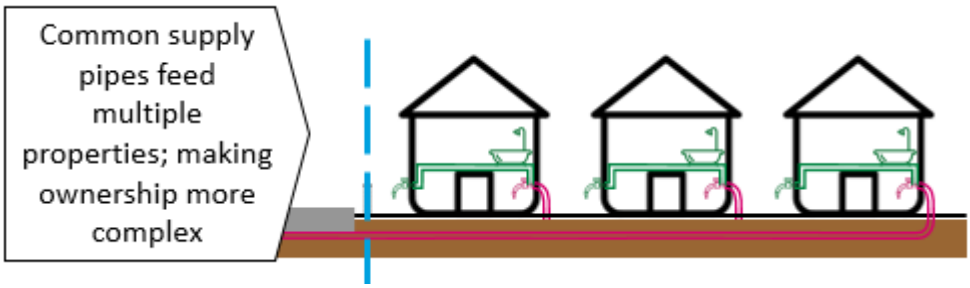
6.1 Approach to cost build

6.1.1 The cost build is based on an average of £3,000 per pipe replacement. This is built up of the estimated cost of replacement of the pipe, allowance for a customer grant plus additional associated delivery costs such as traffic management and road closures. This is an average cost and allows for the completion of more complex cases such as common supply pipes (CSP) and those that may require some main laying.

6.1.2 There is a risk that certain replacements will cost significantly more than this (e.g. common supply pipes and supply pipes in rural areas that require additional main laying that lead to significant additional costs). This is an assumed average cost considering more complex and less complex schemes. Common/shared supplies (shown in Figure 8) present significant challenges and make up around 30-40% of applications for lead pipe replacement.

6.1.3 We plan to continue the lead pipe replacement grant scheme into AMP8 and as part of this will need to build up methods for addressing the more complex cases particularly where common supply pipes feed multiple properties.

Figure 8: Illustration of common supply pipes (CSPs)



Source: UUW common supply pipe definition

6.1.4 As part of this, we are developing our framework for delivery to accommodate and adapt to support customers with more complex schemes. This will support customers with more complex arrangements to remove their lead supply pipes.

6.1.5 As part of the targeted replacement, the intention is to work with partners such as social housing landlords in order to replace lead supply pipes to the first customer tap in non-owned properties. As part of this, we will work with the partner to establish the most cost-effective model, looking at potential efficiencies for large numbers of replacements, potentially as part of other works being completed at the property.

6.1.6 Traffic management and road permits contribute to the costs significantly but efficiencies can be made where multiple connections are made in the same street as part of the targeted approach.

6.1.7 We have a robust process in place to ensure that the Developer Services and lead contract is cost-effective with key performance indicators to incentivise both efficiency and performance.

6.2 Approach to challenging our assumptions

6.2.1 As part of our lead strategy and aim to reduce the risk of lead exposure from potable water, we will actively look to embrace new technologies and look for synergies with other projects and interventions to make the removal of lead from the network as efficient and disruption free as possible.

6.2.2 Different options have been, and will continue to be, explored as appropriate including techniques and technical options for pipe replacement including e.g. moling trials and replacement innovations.

6.2.3 We actively engage with other water companies, suppliers and researchers to collaborate and share good practice such as active participation in the recent industry lead workshop (December 2022) with collaborative sessions on opportunities and challenges associated with lead risk. We have completed industry benchmarking to compare costs/constraints of different techniques. We have engaged with Severn Trent Water on AMP7 lead Green Recovery replacements to discuss good practice.

6.3 Third party assurance of our cost estimates

6.3.1 We commissioned two specific pieces of third party work to assure the cost efficiency of our enhancement cases:

- A bottom-up benchmarking exercise (Faithful and Gould); and
- Assurance on top-down benchmarking carried out by UUW (Deloitte).

6.3.2 We consider that the complementary and independent output of these pieces of work demonstrates that our cost estimates are efficient and represent excellent value for money for our customers.

Assurance on top-down benchmarking (Deloitte)

6.3.3 As part of our business plan submission, UUW carried out top-down benchmarking, which took two distinct forms:

- Unit cost analysis using recent data from the industry's APR datashare and other publications (e.g. Drainage and Wastewater Management Plans); and
- Where possible and feasible, econometric analysis based upon Ofwat's PR19 model suite.

6.3.4 As we discuss in *Chapter 8 – Delivering at efficient cost* and supplementary document *UUW46 – Cost Assessment Proposal,* recent supply-side shocks mean that the relationship between cost and cost driver reflected within the econometric models used to assess enhancement expenditure at PR19 is no longer appropriate. As such, we consider benchmarking carried out using more recent data to be more effective at assessing AMP8 enhancement costs. As such, we do not consider comparisons to cost estimates derived using the coefficients estimated at PR19 to be relevant.

6.3.5 In general, where recent and comparable data was available, our benchmarking analysis found our business plan costs align to similar comparator companies. This is reflected in Deloitte's findings:

"Overall, UUW has performed econometric benchmarking on programmes totalling £3,908m in enhancement case costs. We did not find any material errors in this econometric benchmarking…UUW's other top-down benchmarking based on more recent data submitted by peer companies indicates that UUW PR24 costs are generally in line with expected costs."

6.3.6 Details about the specific benchmarking relating to the lead enhancement case are set out in section 6.4.

6.4 Industry comparison

6.4.1 We have benchmarked our approach and costs with the wider industry using data comparison and collaborative forums such as Water UK. However, it is difficult to draw direct comparisons as the UUW grant (to customer) model was unique during AMP7.

6.4.2 A benchmarking exercise has been completed reviewing PR19 deep dive information, outcomes of Green Recovery awards and, notably, reviewing the key points from the WRc/DWI 'Long-term Strategies

to Reduce Lead Exposure from Drinking Water'[13] which includes cost estimates used for the economic model.

6.4.3 In the economic model (DWI/WRc report 2021)[14], the unit pipe replacement costs used for replacement to the compliance point were: £2,000 (lower estimate), £2,750 (central estimate) and £3,500 (higher estimate). This range illustrates the varying complexities associated with the work. Our estimate is an average to accommodate the varying complexities of each case.

[13] https://dwi-content.s3.eu-west-2.amazonaws.com/wp-content/uploads/2021/02/08150815/DWI70-2-320.pdf

[14] Long-term strategegies to reduce lead exposure in drinking water https://dwi-content.s3.eu-west-2.amazonaws.com/wp-content/uploads/2021/02/08150815/DWI70-2-320.pdf

7. Customer protection

7.1 Introduction

7.1.1 It is important that customers have confidence that we will deliver the enhancement schemes that get reflected in our PR24 final determinations and they are suitably protected in the event of non-delivery, or if there are material changes to deliverables (including changes to dates), which leads to a change in cost (including changes in the timing of required expenditure). Ofwat proposes that, if companies fail to deliver or are late delivering improvements to customers, then price control deliverables (PCDs) should, where appropriate, be used to compensate customers. In our PR24 plan *Chapter 8 –Delivering at Efficient Cost, section 8.8.9* we have proposed an approach to PCDs that aims to provide customer protection, such that customers are fairly compensated for non-delivery (such as due to a change in regulatory requirements) or late delivery (including as a result of a change to a regulatory date), between PCDs, any related ODI underperformance payments, and cost sharing arrangements.

We propose a PCD for the lead replacement enhancement. This will be on lead risk reduced measured by number of lead pipes replaced.

7.1.2 This case will deliver the replacement of customer communication pipes and financial support to assist the customer replace their owned part of the service pipe. Only full replacement to the compliance point will be part of the enhancement case.

7.1.3 The PCD will be based on number of pipes removed from the water main to the compliance point at the customer first tap. This number is made up of the communication pipe and customer supply pipe.

7.1.4 The key driver is that the 'outcome' risk of exposure to lead is reduced, but this 'risk' reduction is very difficult to measure due to multiple confounding factors such as lead in the environment from other sources. The number of pipes replaced will be used monitor the completion of this investment.

7.1.5 This case has a relatively small impact on other performance commitments. Lead infringements have a neglible impact on Compliance Risk Index (CRI). Water quality samples for lead do not provide an accurate reflection of risk and is not an appropriate measure for this case. There is a small associated benefit for the leakage with the replacement of the communication and supply pipe.

7.1.6 There is a link to customer contacts for water quality (lead particles/bits in water, query on lead analysis). We receive around 200 number of these per year. However, there is a risk this number could increase due to increased work/promotion of lead, again the number of contacts is not reflective of lead risk.

7.1.7 There is likely to be a DWI notice associated with the output (lead pipe removed) and associated audit strategy, aligned to the Lead Strategy submitted to the DWI in March 2023.

7.1.8 The delivery profile will be profiled as uniform across the AMP, building on the grant delivery model of AMP7. There will be peaks and troughs linked to the customer driven nature of the output, and dependencies on contract/plumber resources and materials.

7.1.9 Delay to delivery within AMP8 will likely lead to a negative relationship with the DWI and possible enforcement associated with a legal notice. In the long-term, delays to delivery profile/scale will likely delay the overall journey to meet our ambition to be lead free by 2070.

7.1.10 The supply pipe is a non-owned asset, and work to replace it can be disruptive and inconvenient for customers. The grant scheme is based on customer request, however the targeted scheme may be co-ordinated by a third party such as the landlord. There is a risk to delivery if the customer does not agree to work taking place, or refuses access for element of the work to be completed.

7.2 Lead enhancement price control deliverable

Table 4: PCD summary

Scheme delivery expectations	
Description of deliverable	Customers removed from having lead supplies; replacement of lead pipe from water main to compliance point. This may be completed as 2 interventions: communication pipe (UUW owned) and supply pipe (customer owned).
Output measurement and reporting	A customer will have been deemed to have been removed from lead supply by removal of both communication pipe and supply pipe. For shared supplies, each customer will be counted as an individual output. Reported each year at financial year end.
Assurance	Where the custmer replaces the supply pipe under our grant scheme, the grant is only paid to the customer following confirmation of completion of the work. Assurance that this work is completed and met the standards is verified by a Water Safe plumber providing photo or video evidence or UUW customer technician pipe-out inspection. The evidence is stored, reviewed and checked prior to the grant being paid and communication pipe being replaced by UUW. Further verification and photos are taken at the time of connection. All volumes reported as part of Annual Performance Reporting (APR). Established reporting requirements, assurance and governance processes for the APR will be followed.
Conditions on scheme	None
Impact on PCs	Assume zero. Minor/negligible impacts on CRI and on leakage (associated with improved asset health of supply pipe)

7.2.1 In our PCD template *UUW32-PCD Excel Sheet* we have assumed a wholesale WACC of 3.23%, in line with Ofwat's guidance. We have assumed a 50% totex cost sharing rate, which is applied before calculating PCDs. We have applied a further 50% for Bioresources (where applicable), to ensure that only 25% of Bioresources totex is at risk from PCDs, given the lack of RCV guarantee, and general uncertainty in cost recovery from future Bioresources price controls. For late delivery we have applied a proportionate value of annual opex, and assumed 3.5% of capex, which provides a fair reflection of the time value of money of any related deferred capital spend.

Table 5: PCD delivery profile

	Unit	AMP8	2024	2025	2026	2027	2028	2029	2030	Ultimate delivery
Cumulative delivery target for PCD	**customers**		**0**	**0**	**6,000**	**12,000**	**18,000**	**24,000**	**30,000**	**30,000**
AMP8 Capex (22/23 pb)	£	73,500,000	0	0	14,700,000	14,700,000	14,700,000	14,700,000	14,700,000	
AMP8 Opex (22/23 pb)	£	16,500,000	0	0	3,300,000	3,300,000	3,300,000	3,300,000	3,300,000	
ODI impact per unit of PCD volume	£/customers	0.00								

Table 6: Price Control Allocation

Price Control	Unit	Price Control Allocation
Water resources	%	0.00%
Water network+	%	100.00%
Wastewater Network+	%	0.00%
Bioresources	%	0.00%

Table 7: PCD Incentive rates

	Unit	WR	WN+	WwN+	BR
Overall delivery	£/customers	0	1,500	0	0
Time value rate	£/customers	0	48	0	0
Late delivery	£/customers	0	193	0	0

United Utilities Water Limited
Haweswater House
Lingley Mere Business Park
Lingley Green Avenue
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United Utilities

Water for the North West

UUW60

Network and Information Systems and Security and Emergency Measures Direction (NIS and SEMD)

October 2023

Enhancement Case 4

United Utilities

Water for the North West

Contents

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Water for the North West

UUW60

Raw Water Quality Deterioration

October 2023

Enhancement Case 5

United Utilities

Water for the North West

Contents

1. Enhancement submission

<table>
<tr><th colspan="2">Enhancement submission</th></tr>
<tr><td>Title:</td><td>Raw Water Quality Deterioration</td></tr>
<tr><td>Price Control:</td><td>Water Network Plus</td></tr>
<tr><td>Enhancement headline:</td><td>Climate change has resulted in the quality of the raw water in a number of our impounding reservoirs to deteriorate beyond the treatable designed capabilities of the Water Treatment Works (WTW) they feed. This has led to the need to reduce output and peak week production capacity at these sites in order to be able to manage the risk of supplying water with an unpleasant taste and smell to customers.

We have undertaken significant research into the formation of the taste and odour causing compounds geosmin and 2-MIB in raw water sources, but despite this work, no trigger has been identified and an increasing number of our sources are impacted year on year.

The alleviation of the risks posed by the presence of geosmin and 2-MIB is presently through reducing production output, however this is not a long-term sustainable solution due to the strain already put on the system by sudden increases in demand caused by events such as dry weather and freeze thaw.</td></tr>
<tr><td>Enhancement expenditure

(FY23 prices)</td><td>
<table>
<tr><th></th><th>AMP8 Capex inc TI (£m)</th><th>AMP8 Opex (£m)</th><th>AMP8 Totex (£m)</th></tr>
<tr><td>Pre RPE and Frontier Shift</td><td>42.255</td><td>0.420</td><td>42.675</td></tr>
<tr><td>Post RPE and Frontier Shift</td><td>41.179</td><td>0.407</td><td>41.586</td></tr>
</table>

The table above shows the total expenditure, inclusive of accelerated programme and transitional investment, on both a pre-efficiency (i.e. pre frontier shift and real price effects basis, consistent with the cost data tables), and a post efficiency and RPE basis (i.e. consistent with the value we propose to be recovered from price controls). All numbers referenced hereafter in this enhancement case are on a post efficiency and RPE basis.</td></tr>
<tr><td>This case aligns to :</td><td>Long-Term Drinking Water Quality Strategy

For full reconciliation between enhancement costs and data table lines, see enhancement mapping tabs in UUW117 – Project allocations CW3 and CWW3.</td></tr>
<tr><td>PCD</td><td>Yes</td></tr>
</table>

2. Enhancement case summary

Gate	Summary	Location reference
Need for enhancement investment	• Investment is needed to enhance removal processes of the secondary metabolites geosmin and 2-methylisoborneol (2-MIB) at five water treatment works (WTW), where current treatment processes are insufficient as a result of increased concentrations and frequency of geosmin and 2-MIB.	*4.2*
	• Geosmin and 2-MIB are compounds found in surface waters, while safe to drink, they are known to cause an unpalatable taste and smell to water if they should find their way into drinking water supplies without specific treatment or blending.	*4.2.2*
	• Water quality sample data has demonstrated that there is a deteriorating trend at the raw water sources of the named treatment works which is showing no sign of levelling or improving.	*0*
	• It is crucial that the required investment is made in AMP8 as supplies are being put at increasing risk through the need to reduce output or shut water treatment works down entirely to mitigate against increasing concentrations of geosmin and 2MIB. In addition, the cost of materials and labour associated with projects such as this have increased due to high inflation and are predicted to increase further at rates higher than CPIH inflation into AMP8. It is therefore not possible for this work to be deferred to AMP9 when the costs will likely increase further and thus become unaffordable for customers.	*Figures 1-7* *4.4*
	• This investment is the start of our long-term drinking water quality strategy which includes an adaptive plan for securing water quality for the future while taking into account climate change and contaminants of emerging concern.	*4.6*
	• Customers ranked *drinking water that looks and smells good* third highest of our priorities for AMP8, indicating that customers will support this investment.	*4.7*
	• Alongside this investment, we plan to continue research into the factors affecting the production of geosmin and 2-MIB which exclusively affect surface waters to enable the development of green solutions in future. The outcome of our most recent investigation has signalled that benefits from catchment management to reduce nutrient input might be limited on account of the presence of geosmin and 2-MIB in very low nutrient systems.	*4.7*
Best option for customers	• Our options review has identified the need for additional treatment processes to effectively remove taste and odour compounds from raw water. The most appropriate technologies identified for the WTW included, are installation of granular activated carbon (GAC) either as filter media or contactors and the installation of an advanced oxidation process. The options assessment has considered the challenges faced at each water treatment works to	*5.2*

	ensure a robust solution is implemented, that will give the best value for customers. • The estimated cost to deliver (capex and opex) per annum for each named project is outlined in table 1. We made a technical submission to the DWI in March 2023 detailing the need to develop the current treatment processes at these locations and the anticipated benefits our consumers will realise by making these upgrades. • We envisage that customer contact rate for taste, smell and appearance will improve following the completion of these enhancements. Nevertheless, the avoided ODI penalty is insufficient to meet the cost of the projects. • The anticipated utilisation rate of the named schemes is high, due to the recurring nature of geosmin and 2-MIB and the risks that they pose. We have previously employed temporary, deployable technology to manage the risk. However, due to the rapid nature at which the concentration of the metabolites can increase and the essential conditions for temporary treatment solutions, they are not robust enough to meet customer's needs long-term.	*5.3* Table 21 *5.4* *5.5* *5.6*
Cost efficiency	• The options development period followed a three stage risk and value process, designed to positively challenge our projects and decisions. • We have taken learning from our AMP6 innovation roll out to implement a new Technology Approval Process which aims to identify opportunities for innovative technologies and nature based solutions. We have incorporated technologies discovered through this route into our Process Decision Support Tool to identify opportunities that present the best value solutions. • The option selected for each site seeks to achieve the best value for the environment, society and UUW over the long-term. We used our value assessment tool to allow for the selection of the preferred solution based on the comparison of value between various options.	*6.2* *6.3* *6.4*
Customer protection	• We have developed a Price Control Deliverable (PCD) in order to protect customers' investment from delayed delivery, non-delivery or a reduction in programme scope. • Repayment for non-delivery would be made based on defined project milestones, adjusted for the size and scale of the project by the maximum capacity in Ml/d of the associated WTW.	*7.2* *7.2*

3. Introduction

3.1.1 This document sets out an enhancement claim of £41.586 million to allow UUW to install new treatment processes at five water treatment works to mitigate the effects of deteriorating raw water quality in the associated source waters.

3.1.2 Our consumers have told us that their top 3 priorities are: water that is safe to drink; reliable water supply now and in the future; water that tastes, smells and looks good. Drinking water quality is measured not only by compliance with regulatory standards, but through customers' perception. Historically, company performance related to regulatory standards has been exceptional at around 99.9% compliance. Despite this, we still experience water quality related incidents and customers still feel the need to contact us to share their concerns on water quality.

3.1.3 Our long-term drinking water quality strategy is aligned to this requirement as a sufficient and reliable supply of safe, clean drinking water is intrinsically linked to good public health and customer confidence in water supplies. Our 2050 ambitions are therefore to:

(1) Provide a service that is 100% compliant with regulatory, quality and environmental requirements;

(2) Provide a service which is resilient to challenges such as new water quality standards, climate change, asset health and potential risks from emerging contaminants;

(3) Ensure customers are confident and trusting of their drinking water quality; and

(4) Deliver for future generations by embedding sustainability, innovation and partnership working in our plans.

3.1.4 Geosmin and 2-methylisoborneol (2MIB) are metabolites, found in surface water sources, which are produced by cyanobacteria which lead to an earthy or musty taste and odour in drinking water. Conventional water treatment processes alone are incapable of removing these metabolites.[1]

3.1.5 To effectively remove geosmin and 2MIB from raw water an additional treatment step such as the addition of powdered activated carbon, filtration through granular activated carbon (GAC) or advanced oxidation with ozone is required. The selection of the most appropriate technology takes into consideration the concentration at which geosmin and/or 2MIB is present in the raw water source. Our recent experience has informed us that particularly high levels of 2MIB cannot be effectively removed with GAC in the long term, due to the 2MIB saturating the filtration media and significantly limiting its performance and lifespan.

3.1.6 Research into environmental triggers of geosmin and 2-MIB identified an ample supply of nutrients, such as phosphorus, is essential for cyanobacteria growth.[2] Therefore, in AMP4, we established and implemented long-term, catchment management solutions to respond to the risk posed by increasing nutrient inputs and while these schemes were effective for a period of time, further investment is now needed in our treatment processes at chosen WTW to ensure we achieve our short and long-term ambitions.

3.1.7 Despite our well established catchment management strategy to reduce nutrient inputs into raw water, there are still occurrences of elevated concentrations of geosmin and 2-MIB in raw water sources supplying a number of WTW. It is widely understood that the presence of these compounds in drinking water, while safe to drink, results in an unpleasant, earthy or musty taste and smell to the water. The presence of geosmin and 2-MIB in impounding reservoirs presents a risk not only to the taste and smell

[1] Alexandra Cerón-Vivas, Maryory Patricia Villamizar León, Álvaro Andrés Cajigas, Geosmin and 2-methylisoborneol removal in drinking water treatment, Water Practice and Technology (2023) 18 (1): 159-167.

[2] R.G. Perkins, E.I. Slavin, T.M.C. Andrade, C. Blenkinsopp, P. Pearson, T. Froggatt, G. Godwin, J. Parslow, S. Hurley, R. Luckwell, D.J. Wain, Managing taste and odour metabolite production in drinking water reservoirs: The importance of ammonium as a key nutrient trigger, Journal of Environmental Management (2019) 244: 276-284.

of water supplied to consumers, but a risk to water sufficiency as without a treatment solution, the affected water sources are unable to remain in supply.

3.1.8 We have undertaken research in AMP7 into the relationship between algal biomass and the presence of geosmin and 2-MIB in impounding reservoirs. The outcome of this research indicates that there is no link between the two.

3.1.9 We have identified the need for additional control measures to be implemented at five WTW (Table 1) to minimise the risk from production of geosmin and 2-MIB in the raw water in the form of additional permanent treatment solutions. Investigations are continuing to identify the environmental conditions that trigger the formation of geosmin and 2-MIB in the raw water.

Table 1: Proposed scheme and associated cost at selected WTW

Water Treatment Works	Technology Summary	Estimated Cost to Deliver (Capex)	AMP8 Opex	Estimated Opex per Annum (AMP9 onwards)
Cowpe	GAC filter refurbishment	£5,299k	£45.375k	£91k
Fishmoor	Advanced oxidation process	£11,794k	£131.178k	£532k
Hurleston	GAC filter refurbishment	£9,691k	£94.740k	£190k
Lamaload	GAC contactor installation	£7,199k	£83.770	£168k
Ridgegate	GAC contactor installation	£7,196k	£51.858k	£104k

3.1.10 To improve our performance and enable us to supply a consistent water supply of reliable quality, we have identified five WTW impacted by changing raw water quality which has deteriorated beyond design parameters of the WTW. In order to mitigate the risk posed by elevated concentrations of geosmin and 2-MIB in raw water at present, we have imposed reduced production flows through the WTW alongside targeted catchment management to control nutrient inflows to raw water sources. Despite this, the raw water quality has continued to deteriorate and recent prolonged periods of dry weather has meant we have been unable to reduce flows further. In some cases, the challenge presented by the raw water quality has led to us turning off the WTW completely for extended periods.

3.1.11 Under the AMP8 methodology for calculating unplanned outages, the requirement to include outages on account of poor raw water quality, where this has previously been an exclusion, it is no longer possible to turn off the WTW without incurring a penalty.

3.1.12 In recent years UUW has experienced a higher than industry average number of customer contacts for taste, smell and appearance and our performance has been in line with the industry average for CRI. A contributing factor to this elevated rate of customer contacts about water quality is due to the fact that a very large percentage of our raw water is from surface water, which is subject to a multitude of external factors, particularly changing weather conditions. We anticipate that by investing in these five WTW and enhancing their treatment capabilities, customers in the areas supplied from the WTW will benefit from a consistent supply of water of dependable quality. Customers will benefit not only by receiving a water supply that tastes and smells good, but receive a supply from the same water source all year round, reducing the need for blend changes.

3.1.13 Our anticipated performance with respect to the Water Quality Customer Contacts performance commitment has been calculated by estimating the benefits derived from enhancement expenditure and adding this to the performance from base, thereby creating a counterfactual for if that expenditure had not occurred.

4. Need for enhancement investment

4.1 Introduction

4.1.1 Deteriorating raw water quality as a consequence of climate change has led to a number of our water treatment works assets being unable to robustly treat the incoming raw water to a standard that is accepted by our consumers. The presence of geosmin and 2-MIB in raw water impounding reservoirs, in increasing concentrations, poses a risk to the taste and smell of water being supplied if action is not taken to remove these compounds during treatment.

4.2 Evidence Enhancement is required

4.2.1 We have allocated enhancement expenditure to nominated WTW where the quality of the raw water has deteriorated beyond its designed treatment capability. Our selection process involved reviewing water quality sample data, the drinking water safety plan (DWSP) risk assessment and the validated peak week production capacity of WTW as stated in our Water Resources Management Plan (WRMP) PR14 to PR24.

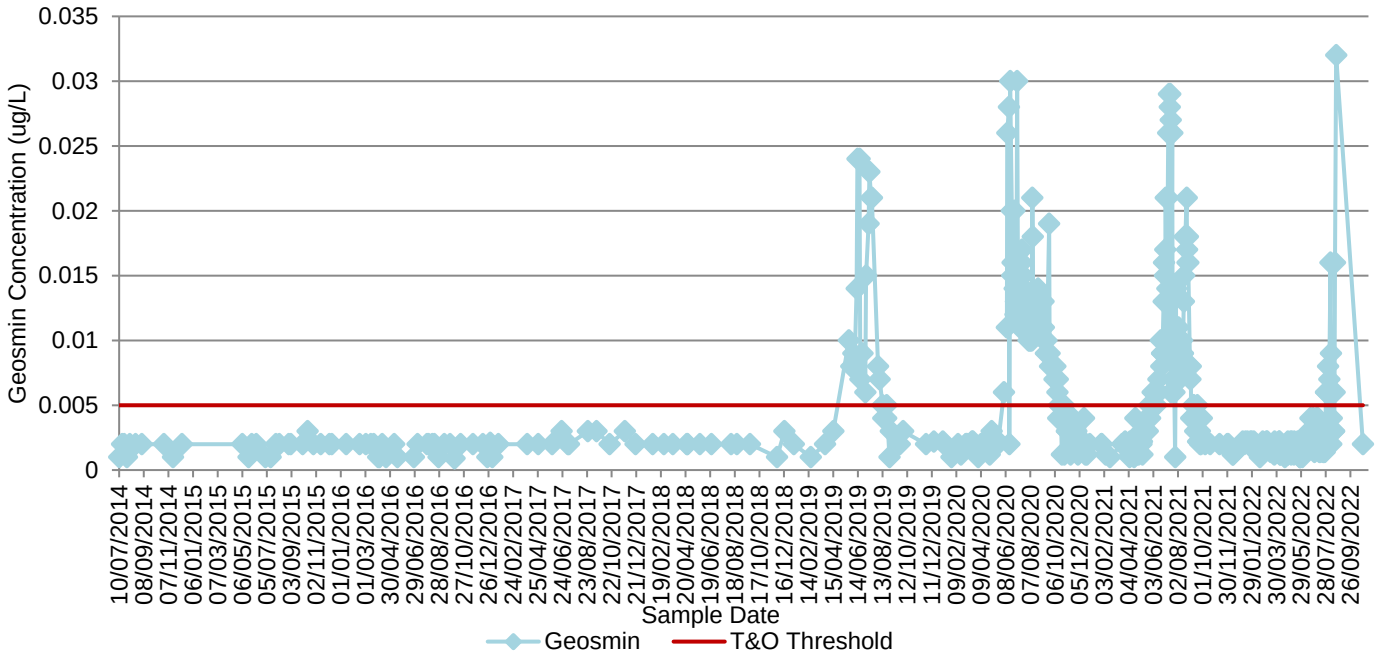
4.2.2 Geosmin and 2-MIB are secondary metabolites formed in surface water sources by species known as actinomycetes bacteria and cyanobacteria. While safe to drink, the compounds are a prominent cause of earthy or musty taste and odours in drinking water, even at extremely low concentrations. The reported taste and odour detection threshold concentrations vary widely in literature, we have adopted a threshold of 5 ng/L for our approach to taste and odour management based on a combination of available literature and experience. Although the triggers for production of geosmin and 2-MIB are uncertain, our experience informs us that once these compounds are detected in a raw water source we will continue to detect it in subsequent years and at higher concentrations.

4.2.3 Should the concentration of geosmin or 2-MIB in the raw water exceed the taste and odour threshold for detection, the water at consumers' taps is likely to possess an unpalatable taste and smell, causing consumers to reject the water on account of this. This leads to customers contacting us to report an earthy or musty taste and smell to their water supply and is a breach of the Water Supply (Water Quality) Regulations owing to the taste and smell being unacceptable to consumers.

4.2.4 The existing, conventional, water treatment processes are not capable of removing the geosmin and 2-MIB that is present in the raw water. These compounds are able to pass through the WTW, affecting the aesthetic quality of the water supplied to consumers. Moreover, the presence of these compounds in raw water frequently induces the need to temporarily reduce production output at these locations or, in more severe cases, halt output entirely from the WTW until the raw water quality has returned to a treatable state. These deficiencies in production capacity present a significant challenge during the warm and dry months when concentrations of these compounds and demand for water are simultaneously at their highest.

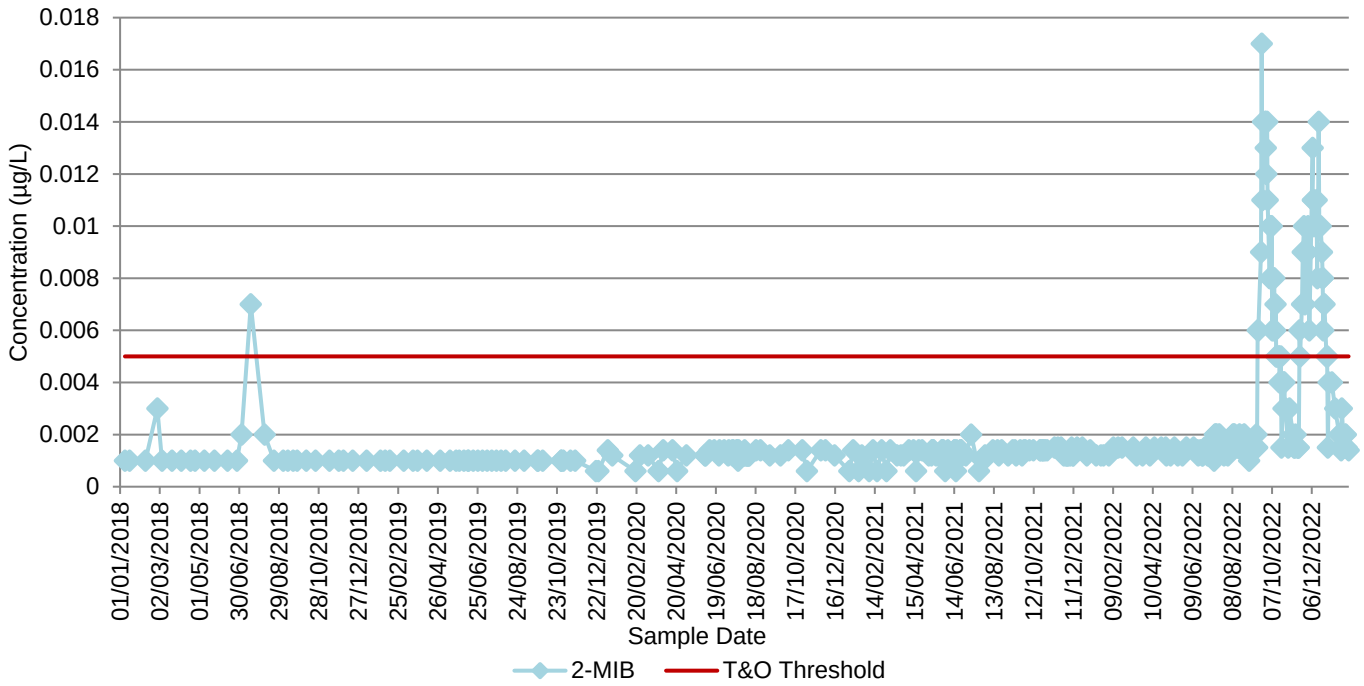
4.2.5 Water quality sample data displayed in Figures 1 – 7 demonstrates that there is a deteriorating trend at the nominated WTW and we anticipate that this will only decline further in consequence of the effects of climate change. Research undertaken as part of our AMP7 WINEP programme has observed that there is no obvious link between algal biomass and the concentration of geosmin and 2-MIB present in impounding reservoirs. This is a significant finding as it denotes that catchment interventions alone are insufficient at managing the risk presented by these compounds and treatment solutions are essential. Investigations are continuing in order to identify the environmental conditions that trigger the formation of geosmin in the raw water.

Figure 1: Cowpe WTW raw water geosmin concentration



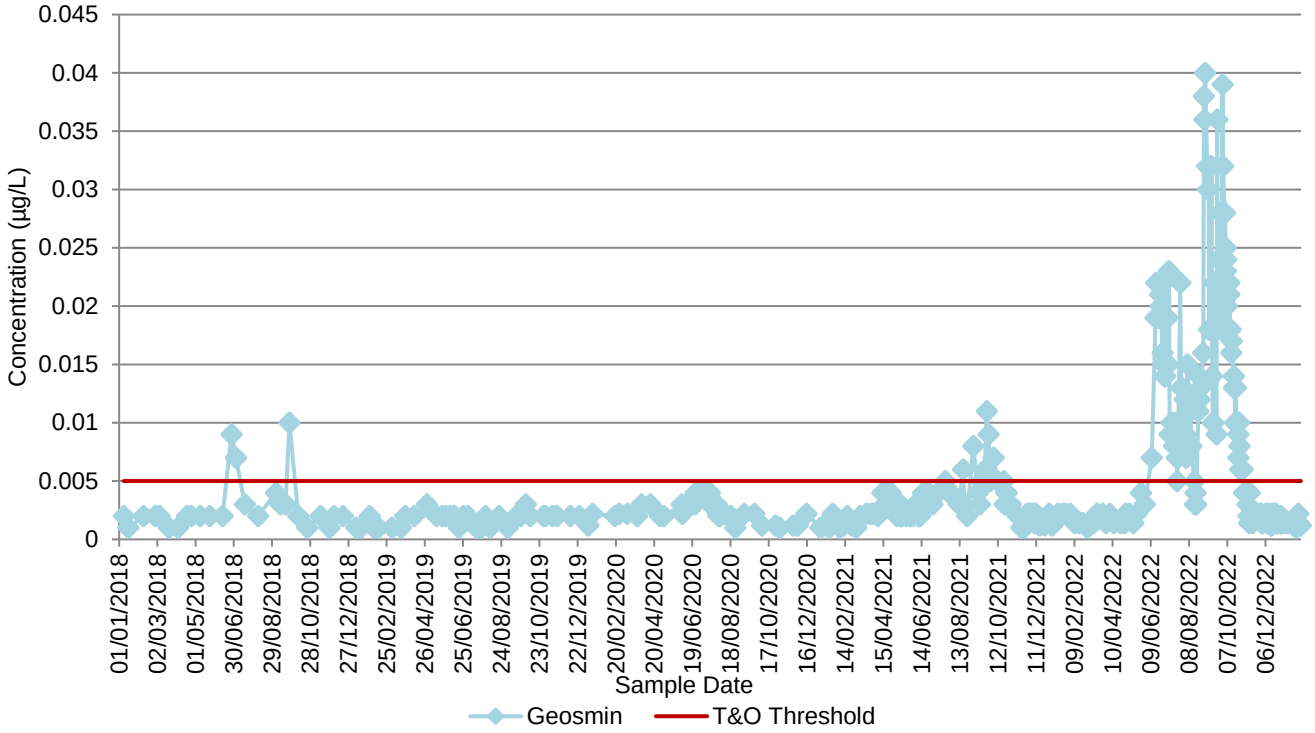
Source: UUW analysis of internal monitoring data

Figure 2: Fishmoor WTW raw water 2-MIB concentration



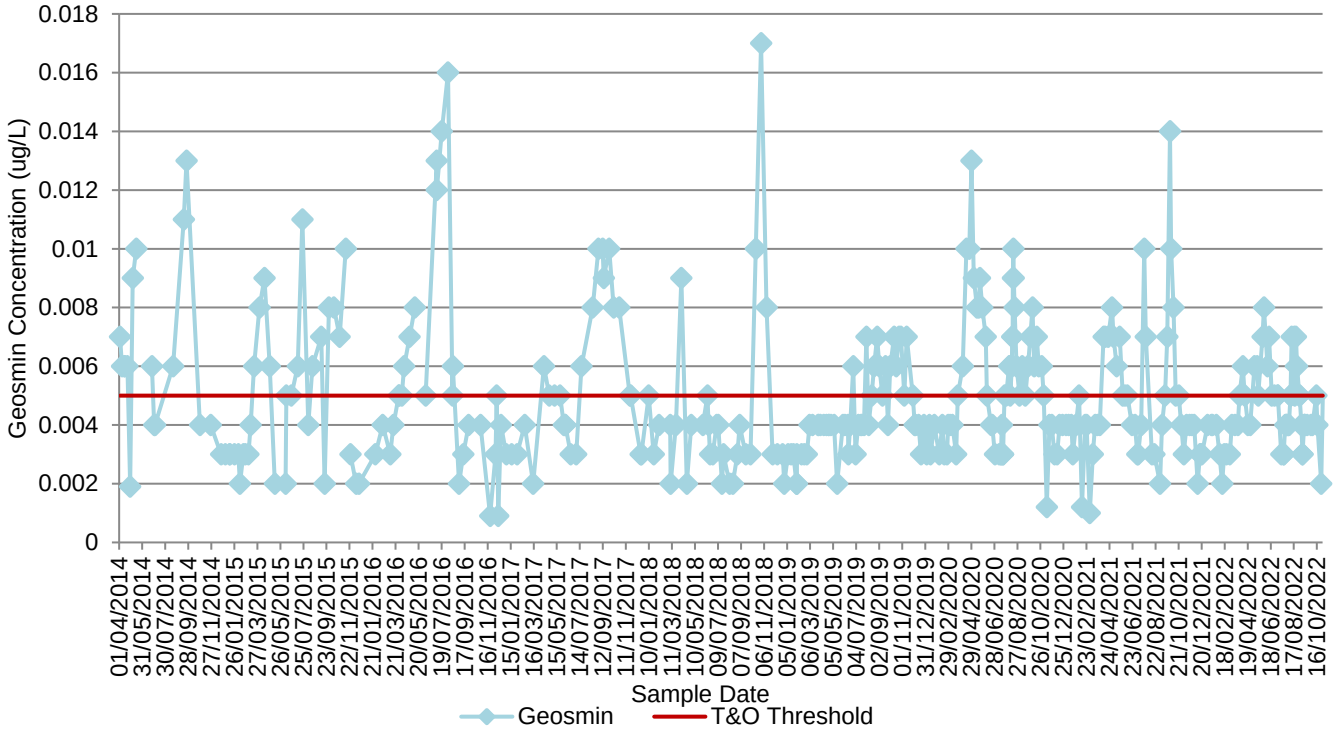
Source: UUW analysis of internal monitoring data

Figure 3: Fishmoor WTW raw water geosmin concentration



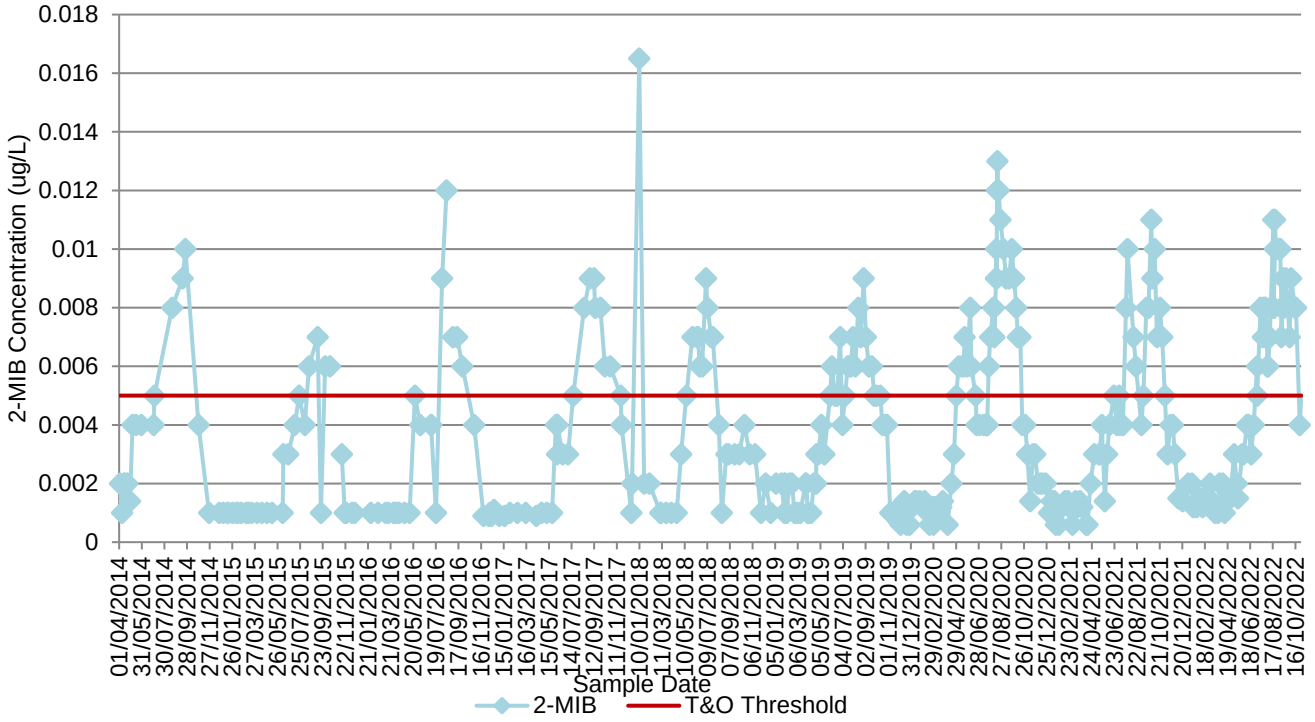
Source: UUW analysis of internal monitoring data

Figure 4: Hurleston WTW raw water geosmin concentration



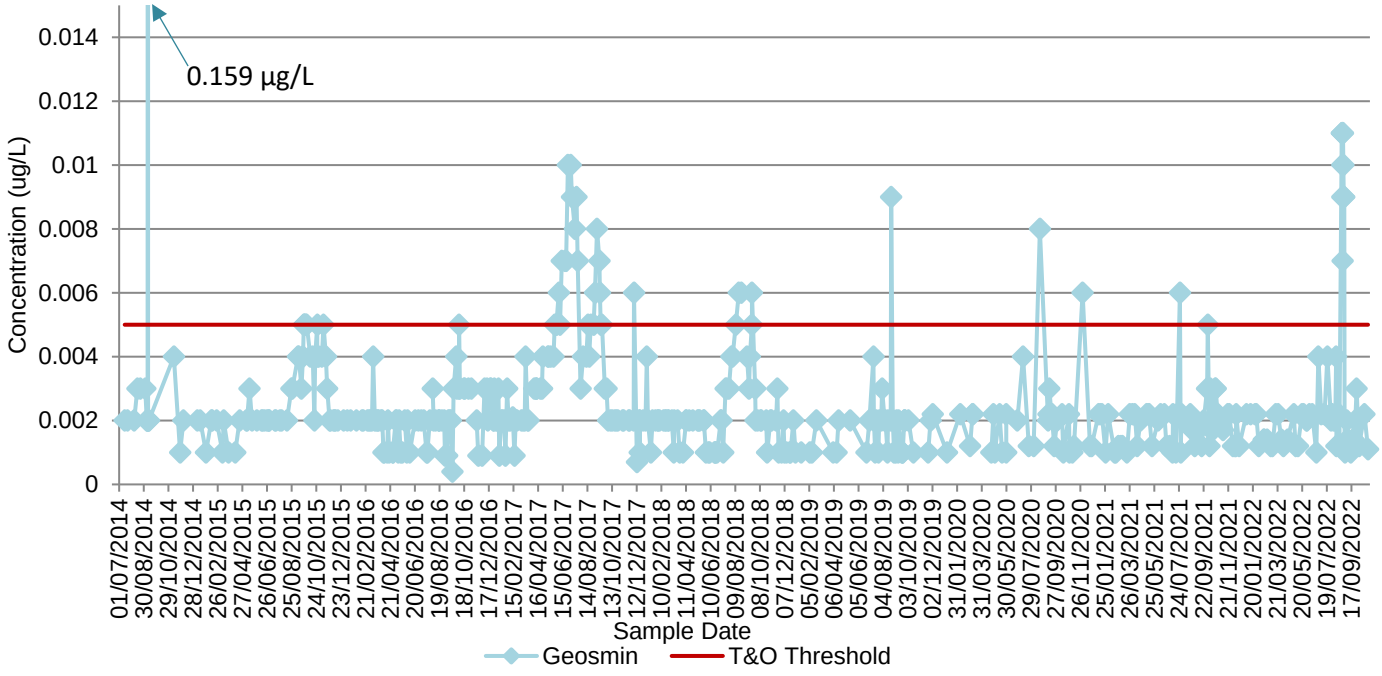
Source: UUW analysis of internal monitoring data

Figure 5: Hurleston WTW raw water 2-MIB concentration



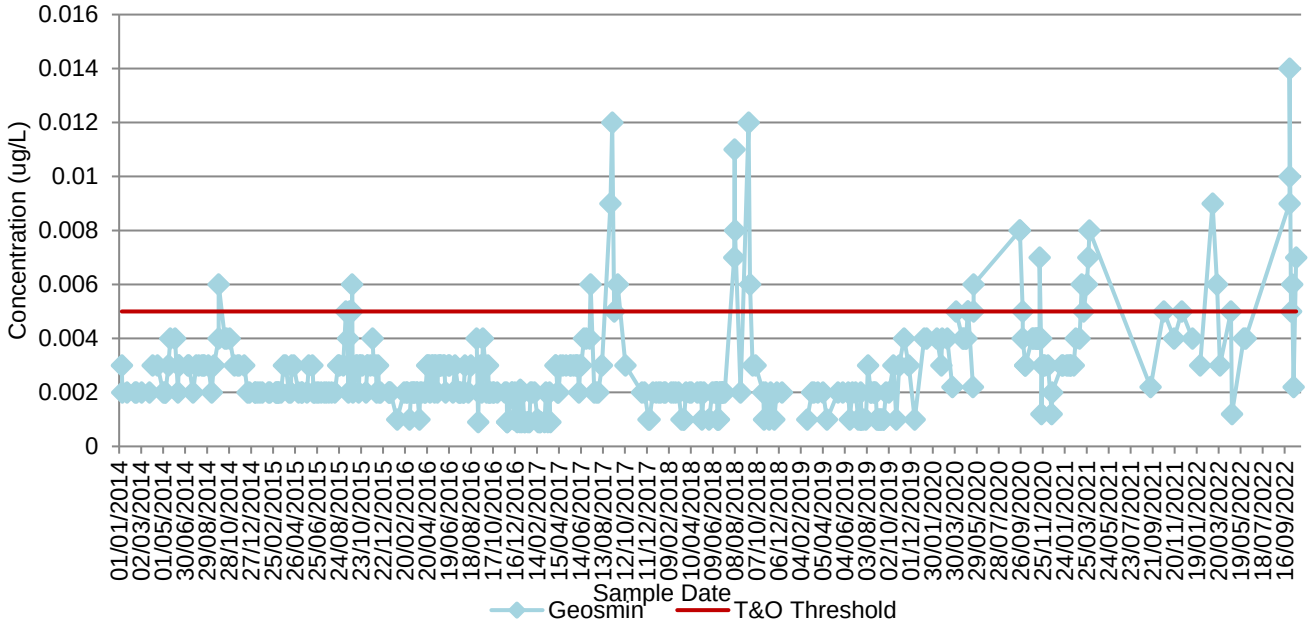
Source: UUW analysis of internal monitoring data

Figure 6: Lamaload WTW raw water geosmin concentration



Source: UUW analysis of internal monitoring data

Figure 7: Ridgegate WTW raw water geosmin concentration



Source: UUW analysis of internal monitoring data

4.3 Scale and Timing of the Investment, including Validation from Appropriate Sources

4.3.1 UUW operates 86 WTW of which 53 are supplied from surface water sources. Currently 13 of UUW's WTW have permanent geosmin and 2-MIB removal installed in the form of GAC filters. At PR19, we allocated enhancement expenditure to four WTW which had experienced a deterioration in raw water quality with respect to geosmin and/or 2-MIB concentration in the years preceding PR19. At each periodic review, we have prioritised the WTW with the greatest need for intervention to allow us to distribute investments appropriately.

4.3.2 To prevent water from entering supply with an unpalatable taste or smell, we have previously had to reduce output from affected water treatment works considerably, or entirely in some cases, and/or employ a temporary powdered activated carbon (PAC) dosing rig at the WTW to reduce the concentration of the refractory compounds. While the latter option is relatively successful at removing geosmin from raw water, the timeliness of PAC dosing is impeded by the unpredictability of geosmin production. Additionally, there are constraints at the WTW in relation to the maximum PAC dose and maximum WTW flow in order to ensure critical treatment parameters are not compromised. Furthermore, PAC dosing is not technically feasible at every WTW. Where PAC dosing is in operation, plant throughput reductions are recurrently required which in turn have an impact on supply availability in the regional supply system.

4.3.3 A more robust solution is the permanent installation of granular activated carbon (GAC) filters at the WTW. Current market conditions, including the cost of raw materials, has resulted in the comparative unit cost to complete similar schemes of this nature in AMP8 compared to AMP7 is approximately 4x higher. Should this investment be delayed until AMP9, it is likely that these costs will increase further and become too costly for customers.

4.3.4 We have sought support from the Drinking Water Inspectorate (DWI) on our intentions through a technical submission and have consequently received letters of support for our plan. We anticipate that Notices to complete this work by the end of AMP8 will be in place by February 2024.

4.4 Activities to be delivered through Base

4.4.1 This enhancement case reflects activity that will deliver a step-change in service levels. As such, it is unequivocally enhancement expenditure. To promote efficiency, where appropriate, we will make use of existing structures that would be otherwise redundant with the new technology. We have included allowance for enabling works to these structures within the enhancement claim.

4.4.2 However, we have not included any related maintenance expenditure within this claim.

4.4.3 Advanced oxidation with ozone is a separate, additional, tertiary treatment process to the existing operation.

4.4.4 The installation of GAC contactors will require the acquisition of brand new assets to be inserted into the treatment process as a new stage.

4.4.5 Where first stage filter media is to be replaced with GAC, the current first stage filter tanks must undergo modifications, including adjusting weir heights and the installation of a new programmable logic controller (PLC) and its software to allow for a new backwash cycle. GAC media is lighter than traditional sand or anthracite media, therefore these modifications are necessary for the new treatment process to operate properly as the media would be blown out on the first backwash with the existing cycle and weir heights.

4.4.6 The enabling work that is to be carried out to existing assets does not come within the remit of maintenance through base expenditure as it is exclusively intended for the installation of GAC and therefore would not be carried out if GAC was not being installed. This work would not benefit the current operating processes.

4.5 Overlap with Long-Term Delivery Strategy

4.5.1 This intervention reflects the first five years of our long-term drinking water quality strategy. We have developed an adaptive plan which assesses the potential impacts of a range of drivers under differing scenarios. This includes consideration of the impact of climate change and our developing understanding of these metabolites that cause water quality issues.

4.5.2 The investment we have outlined is low regrets, since the raw water quality has deteriorated beyond the design capability of the identified WTW. Additional investment is therefore crucial to achieve the level of service customers expect, alongside the level of performance we are aiming for in our long-term ambitions of an 80% reduction in water quality contacts by 2050 (compared to the 2017/18 baseline).

4.6 Customer Support

4.6.1 As part of the development of the historical and current regulatory business plans, UUW commissioned Price Waterhouse Coopers LLC (PwC) to carry out research into customer priorities.

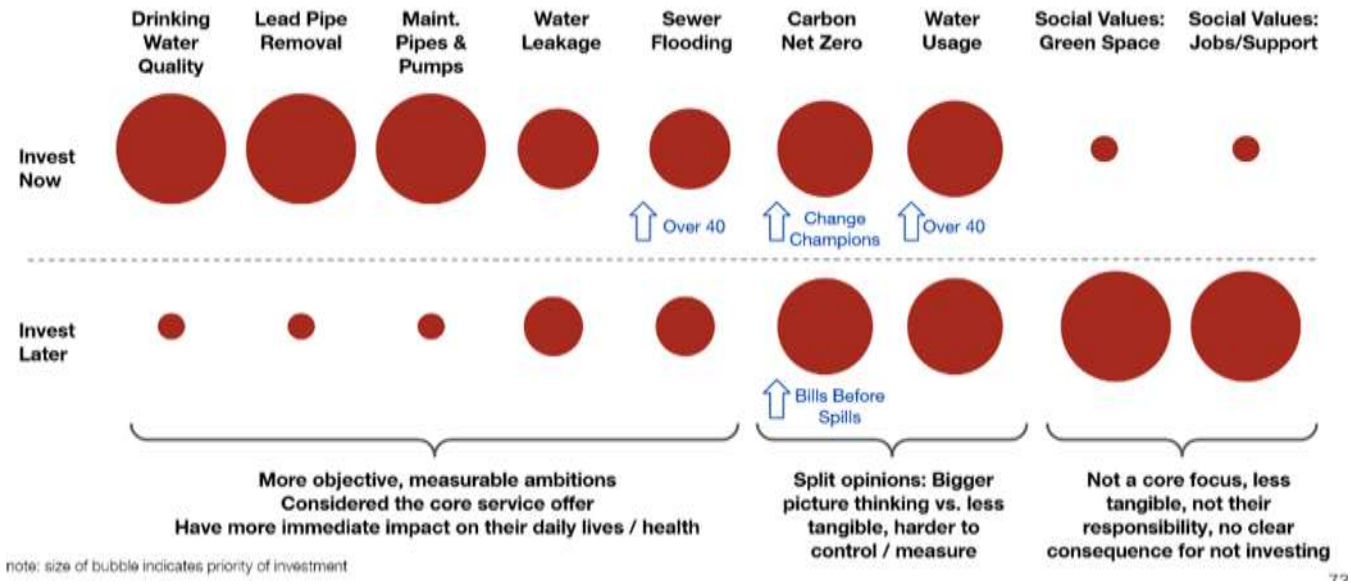
4.6.2 The customer research identified drinking water quality as a priority ambition for most customers, with many seeing it as a core service offer and basic human need. Additionally, customer research prepared by Impact for UUW's customer priorities has shown safe clean drinking water to be ranked highest, while taste, smell and appearance is ranked third, out of all our priorities for AMP8 and beyond[3]. A sufficient and reliable supply of safe clean drinking water is intrinsically linked to good public health and customer confidence in water supplies.

4.6.3 In the PwC facilitated research, customers were shown UUW plans in different thematic areas, and were then asked to comment on those plans, and were given a range of spend and delivery profiles to choose from. Customers were offered three spend profile options, from deferred investment resulting in ageing assets, to moderate investment focussing on long life asset replacement/maintenance, to accelerated

[3] https://www.unitedutilities.com/globalassets/z_corporate-site/about-us-pdfs/p143-customer-priorities-2021/final-report.pdf

investment. Customers indicated that they want to see more urgent investment in 'core services' that have more immediate impact on lives/health (Figure 8).

Figure 8: Customer preference for timeliness of investments



Source: Long Term Delivery Strategy Ambition Testing report[4]

4.6.4 We consider it is appropriate for customers to fund this enhancement as it is intrinsically aligned to two of their top three priorities of safe clean drinking water and water that tastes and smells great ranked highest and third respectively, out of all our priorities for AMP8 and beyond. This work will enable an enhanced level of treatment which will protect supplies against the accumulating consequences of climate change.

4.7 Factors Outside of Management Control

4.7.1 The multitude of factors contributing to geosmin and 2-MIB syntheses mean that is it not possible to accurately predict when the geosmin or 2-MIB concentration will increase in the raw water sources. There is limited data to suggest that geosmin and 2-MIB are biodegradable in the environment and it is well understood that the metabolites cannot be removed with conventional treatment processes. There is strong substantive evidence to suggest that it can be removed through treatment with activated carbon, as demonstrated by the improved geosmin removal capability of our Mitchells WTW which underwent the installation of GAC filters in AMP7.

4.7.2 The outcome of our AMP7 WINEP investigation into algal biomass and associated taste and odour issues in seven of our reservoir systems indicated that, while a catchment may be very low in nutrient input and algal growth, elevated levels of geosmin and 2-MIB are still witnessed in the associated impounding reservoir(s). The research signalled that benefits from catchment management to reduce nutrient inputs may be limited and hard to achieve. The advantages of reduced nutrient input to prevent filter blinding at the WTW and thus promote overall better asset health remain and therefore we will continue with our robust catchment management approach. There is evidence available which demonstrates that geosmin and 2-MIB synthesis is stimulated by higher temperatures. As indicated in the DWI's *Long-term planning guidance for drinking water quality*, the UK Meteorological Office projects hotter and drier summers on account of climate change, thus signifying that we can expect to see continued growth of this issue for the foreseeable future.

[4] unitedutilities.com/globalassets/z_corporate-site/about-us-pdfs/long-term-delivery-strategy-ambitions-testing/long-term-delivery-strategy-ambitions-testing-full-report.pdf

4.7.3 Additionally, our records show that the number of reservoirs within our fleet with geosmin or 2-MIB present in them has almost doubled in the years from 2010 – 2022, (Table 2). Despite the employment of targeted catchment management, the picture of geosmin and 2-MIB in reservoirs has not improved.

Table 2: Number of UUW reservoirs with geosmin and/or 2-MIB

	No. IRs (geosmin)	No. IRs (2MIB)	No. IRs (geosmin OR 2MIB)
2010	25	22	25
2022	47	13	48

Source: UUW analysis

4.7.4 The occurrence of geosmin and 2-MIB in raw water sources exclusively affects surface waters and therefore water companies with a greater proportion of upland water are more susceptible to the taste and odour challenges posed by these metabolites. Additionally, surface water sources are more vulnerable to extreme weather patterns. This denotes that water companies which are predominantly surface water fed are met with the further challenge of managing available resources during warmer, drier months before the added challenge of taste and odour metabolites is considered. The inability to treat the raw water at these five WTW that is available to an acceptable standard for customers would be allayed by this investment.

5. Best option for customers

5.1 Introduction

5.1.1 Geosmin and 2-MIB at the concentrations detected cannot be effectively removed with conventional treatment, therefore it is imperative that the necessary treatment solutions are installed at the affected WTW. We are committed to finding the most robust, no regrets solution to this problem and are conducting pilot trials of two new technologies in AMP7 to help inform our assessment of the best investment for customers in AMP8.

5.2 Options Review

5.2.1 We have made use of our knowledge and experience of geosmin and 2-MIB occurrences in raw water sources to develop the most appropriate suite of options to address this risk. These include interventions and investigations at the source to expand our understanding of these compounds further which have been incorporated into our AMP8 WINEP (Table 3).

5.2.2 There is still no known solution to eliminate geosmin and 2-MIB from the raw water at the source, nor are the conditions in which their production is triggered fully understood. It is therefore necessary to upgrade the treatment capability at the relevant WTW where geosmin and 2-MIB pose the largest risk to water quality and water sufficiency to ensure that UUW can continue the provision of wholesome water.

Table 3: Options considered to address deteriorating raw water quality

Option	Rationale	Select/Reject	Reason
Continue with current practice	Least cost option for customers.	Reject	The current practice results in significantly reduced flows from the WTW which is not acceptable to be able to sustain demand especially as temperatures increase. In addition, there is a risk of supplying unpalatable water to consumers under the current practice.
Catchment interventions to reduce nutrient input	Our catchment strategy has been to reduce nutrient input into reservoir sources to prevent algal growth.	Select (WINEP)	While this activity has positive impacts on overall asset health at the WTW due to less filter blinding, recent WINEP investigations have suggested that there is a limited relationship between algal biomass and geosmin/2-MIB production.
Grey solutions	Robust, permanent, solutions to effectively treat taste and odour compounds.	Select	Long-term, high-utilisation solutions that are proven to resolve the issue.

Option	Rationale	Select/Reject	Reason
Investigations and studies into the root cause of geosmin and 2-MIB formation	By understanding the conditions in which geosmin and 2-MIB formation is triggered, this could enable us to introduce targeted catchment interventions to prevent the compounds from forming in the raw water source.	Select (WINEP)	Our AMP7 WINEP investigation provided good insight into the relationship between algal biomass and geosmin and 2-MIB formation, however the industry is still yet to identify the trigger of their production.
Introduce or build new sources	Creating new sources or introducing new groundwater sources could ensure that there is no geosmin or 2-MIB present in the raw water sources.	Reject	The cost associated with this would be extremely high and is not guaranteed to work as there is still instances of geosmin and 2-MIB in non-impounding reservoirs.
Delay investment until AMP9	Continue to manage the risk using current practices until AMP9 so as to not contribute towards large AMP8 investment programme.	Reject	The cost of materials has already increased in recent years and therefore could increase beyond customer affordability in AMP9. In addition, climate change is causing our water resources to be stretched already so we must be in a position to utilise all available water to meet demand.

Source: UUW options development report

5.2.3 Without enhancement investment, we are unable to make the crucial upgrades to the necessary WTW which will allow us to continue the provision of good quality water that customer's value. Additional treatment processes are required to remove taste and odour compounds from raw water that conventional treatment is not equipped to do. The occurrence of these compounds in raw water has intensified owing to factors outside of management control and therefore the investment is beyond that expected of base expenditure.

5.2.4 As stated previously, activated carbon is known to be successful at removing geosmin during treatment. Activated carbon can be utilised in two forms – PAC or granular activated carbon (GAC). In our experience, despite deploying temporary PAC dosing, there has been detections of geosmin at concentrations above the taste and odour threshold in the treated water. Furthermore, geosmin concentrations can increase rapidly in impounding reservoirs and therefore the delay caused by waiting for sample analysis can significantly shorten the time to respond and commence PAC dosing. Where geosmin occurs in the raw water for prolonged periods or on a much more regular basis, such as annually, PAC dosing is no longer cost effective and has a damaging impact on water supplies being able to meet demand due to the requirement to reduce WTW output.

5.2.5 A more robust solution, such as installing GAC filter media, is required which does not have an adverse impact on the downstream process, or require any further reductions in plant throughput, so that the resilience of the supply system is retained. A GAC filter provides a permanent and continual solution for the removal of geosmin and ensures treatment is in place immediately, should a sudden increase occur.

5.2.6 Where large spikes of 2-MIB are experienced in the impounding reservoir, advanced oxidation using ozone as the oxidant is deemed a more robust solution due to the persistent nature of 2-MIB. Additionally, 2-MIB exists in surface waters with a considerable amount of other natural organic matter that competes for GAC adsorption sites meaning that the efficacy of removal declines dramatically after

a short period of time. Advanced treatment processes comprising oxidation with ozone followed by GAC filters to polish any by-products from the oxidation process has therefore been identified as the best option under these circumstances.

5.2.7 To further our understanding of the efficacy of different technologies on 2-MIB removal, we are conducting trials in AMP7 on hollow fibre membrane technology and ozone advanced oxidation at Rivington WTW. The outcome of the trials will be used to inform our scope for the solution required at Fishmoor WTW and to aid future treatment technology optioneering in the event of new 2-MIB spikes in our reservoirs.

5.2.8 We plan to continue catchment management activities to reduce the risk of geosmin and 2-MIB occurring in our source waters as well as carefully managing surface water resources to limit the impact of the metabolites on the WTW. As part of our PR24 WINEP submission, we are proposing further investigations into better understanding the sources and pathways of taste and odour metabolites. We aim to build on the AMP7 work and carry out an options appraisal with a view to including actions in the catchment in the PR29 WINEP submission. We are part of an ongoing collaborative research project with UK Centre of Ecology and Hydrology (UKCEH), Cardiff University and a number of other Water Companies. The project aims to understand what the contributory factors are to taste and odour metabolite production in order to plan mitigation measures. This is being undertaken *via* a large scale mesocosm experiment at the UKCEH mesocosm facility to understand and define factors affecting taste and odour metabolites. The outcome of this experiment will be used to better predict taste and odour metabolite production and provide evidence for intervention management to prevent a taste and odour risk.

5.2.9 By advancing our understanding of the pathways of taste and odour metabolites, we will be able to apply targeted and potentially innovative ways of working on our catchment land to improve, or at least stabilise, the quality of the raw water.

5.3 Cost-Benefit Appraisal

5.3.1 Our balanced options review enabled us to determine that engineered, grey solutions was the most robust and reliable option. Following this, a desktop assessment of plausible solutions was undertaken which resulted in two options for each WTW being scoped and cost estimated (more detail on the cost estimating process is found in section 6). Brief details of the options put forward and the rationale for which was chosen is included in Table 4.

5.3.2 Our claim is valued at £41.586m; this includes installation of GAC contactors and supporting assets at two WTW, conversion of existing sand or anthracite filters with GAC at two WTW and installation of an advanced oxidation treatment process at one WTW.

Table 4: Solutions identified by WTW

Location	Option 1	Option 1 Capex	Option 2	Option 2 Capex	Preferred Solution	Rationale
Cowpe WTW	Permanent PAC dosing unit	£2,398k	Filter media conversion to GAC	£5,299k	2	More robust solution which negates the need to reduce plant flows
Fishmoor WTW	Filter media conversion to GAC	£5,794k	Advanced oxidation treatment process	£11,794k	2	More robust solution for treating large spikes of 2-MIB

Location	Option 1	Option 1 Capex	Option 2	Option 2 Capex	Preferred Solution	Rationale
Hurleston WTW	Filter media conversion to GAC	£9,691k	Advanced oxidation treatment process	£15,929k	1	Least cost solution
Lamaload WTW	Pressure filter conversion to GAC	£3,460k	New GAC pressure filters	£7,199k	2	Option 1 is not technically robust to achieve the required outcome
Ridgegate WTW	Pressure filter conversion to GAC	£2,301k	New GAC pressure filters	£7,196k	2	Option 1 is not technically robust to achieve the required outcome

Source: UUW options development report

5.3.3 We anticipate that the following benefits will be realised by both UUW and consumers by completing this series of investments:

- Maintained public confidence in water supplies by avoiding taste and odour events;
- Reduced taste and odour customer contacts. Customers judge safe clean drinking water by what they taste, smell and see;
- Reduced risk of non-compliance with the Regulatory Standard for taste and odour and therefore adverse impact on compliance risk index; and
- Continued provision of safe, clean drinking water that meets customer standards.

5.3.4 A technical submission was made to the DWI in March 2023, illustrating the factors that have led to our decision and the rationale for the proposed upgrades at each of the named sites. The submission demonstrates that despite extensive catchment management, the raw water quality has continued to deteriorate and the most appropriate next course of action is to install robust, permanent, treatment solutions.

5.4 Best Value Analysis

5.4.1 Our approach to delivering best value is robust and consistent across all of our enhancement cases. Our approach uses a rich mix of metrics to help us drive value and efficiency in developing our business plan. Consistency of the approach is driven through our PR24 Value Tool which allows us to quantify and value environmental and social benefits, costs and risks. For more detail on this approach please see 'Our approach to deliver best value totex'.

5.5 Quantified Impact of the Proposed Options

5.5.1 The following performance commitment will be impacted by this enhancement:

Water Quality Customer Contacts

5.5.2 In AMP7, we had a bespoke performance commitment associated with reducing customer contacts about taste, smell and appearance. This will continue to be measured in AMP8 as a common ODI. Through enhancing the treatment capabilities of the selected WTW and allowing them to remain in supply continuously, customers will benefit from a consistent supply of reliable water quality that they can depend on. The removal of taste and odour compounds from drinking water, coupled with the

ability to supply customers with the same source of water year-round, will result in fewer customer contacts about the taste and smell of their water. We envisage that customer contact rate for taste, smell and appearance will improve following the completion of these enhancements. Nevertheless, the avoided ODI penalty is insufficient to meet the cost of the projects.

5.6 Cost and Benefit Delivery Uncertainty Mitigation

5.6.1 The proposed solutions will all have a high utilisation rate due to the recurring risk posed by geosmin and 2-MIB in the surface water sources. Concentrations of these metabolites have been shown to accelerate rapidly in raw water which presents a challenge when managing raw water sources due to the delays encountered between sampling and results of analysis becoming available. It is because of this reason that deployable solutions, such as temporary PAC dosing rigs, are not robust enough.

5.6.2 There is limited data to suggest that geosmin is biodegradable in the environment and strong substantive evidence to suggest that it can be removed during treatment by activated carbon, as demonstrated by the improved geosmin removal capability of our Mitchells WTW which underwent scheduled asset refurbishment in AMP7. The use of GAC to remove organic compounds during water treatment, such as geosmin and 2-MIB, is a well-researched and proven method for tackling these taste and odour compounds.

5.6.3 Where we are proposing a new (to UUW) technology for geosmin and 2-MIB removal, we have made a transitional investment to undertake a trial in AMP7 of the technology at a pilot scale to support our understanding of the technology and its operating parameters. We have made contact with colleagues within the Water Industry with experience of installing and utilising this technology, including conducting Q & A sessions and site visits with relevant personnel in attendance to maximise our comprehension of the new technology.

6. Cost efficiency

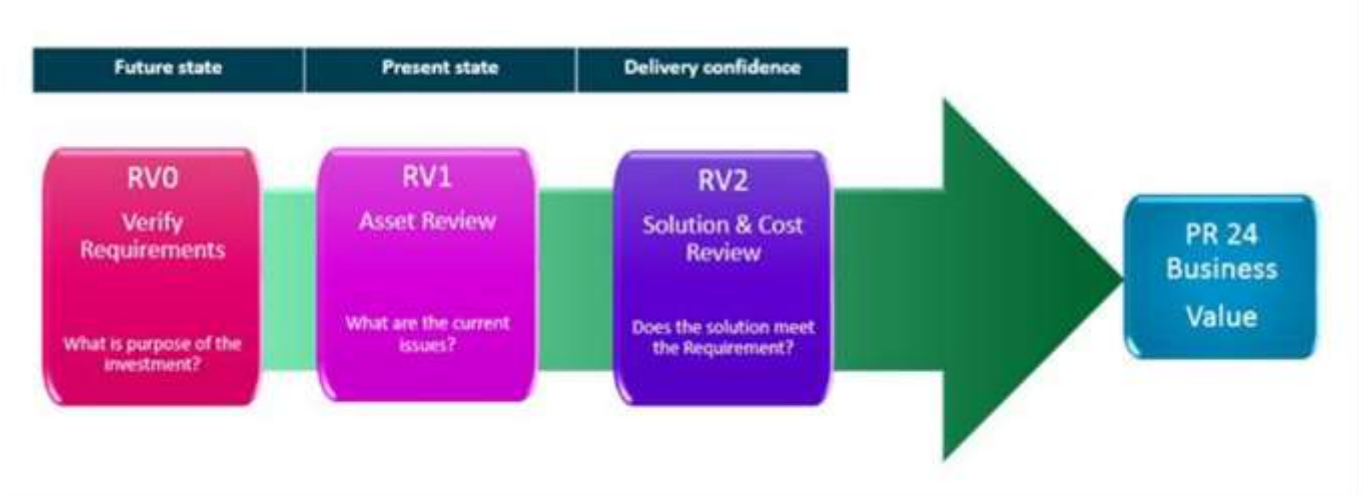
6.1 Introduction

6.1.1 To ensure robust and efficient costs in our programme we have used an estimating approach based on data collected over a number of AMPs (AMP3 to AMP7) updated to reflect present market conditions under which we and the UK Water Industry are operating. Mott Macdonald provide us and other UK water and sewerage companies with an estimating service, which allows them to provide a benchmarked approach to our PR24 capital cost estimates.

6.2 Options Development

6.2.1 PR24 options development followed the fundamental principles of UUW defined value management process. Risk and Value for PR24 (RV) was a three stage process (Figure 9), aimed at positively challenging our projects to ensure we have sufficient evidence behind decisions. It provides United Utilities with confidence that they are proposing the right projects for the AMP8 Programme and therefore managing and maximising the value for their customers from their investments. It ensures that the organisation adopts the correct approach to option identification, development and selection to maximise the realisation of benefits associated with these investments.

Figure 9: PR24 Risk and Value process



6.2.2 Once the requirements had been clearly verified RV1 was completed in order to understand the current asset condition and performance. Without this understanding there is significant risk that proposed solutions will fail to deliver the value intended and may even fail to satisfy the requirements. This initial baselining was essential in order to allow identification of possible options against the generic high level solutions (GHLS).

6.2.3 Options to address PR24 requirements passed through a series of stages before the agreed solution was confirmed, from an initial 'un-constrained' list of options through to confirmation of the defined and estimated scope associated with a preferred solution.

6.2.4 Within the options development process, un-constrained options were identified against a list of GHLS categories (Table 5). If un-constrained options were deemed viable then additional screening was carried out to identify 'constrained' options, with further screening taking place to refine the feasible solutions and determine those to be progressed to detailed scope development and estimating. In developing feasible options the engineer will always have taken which solution could represent the best value to the customer into consideration.

Table 5: Generic High Level Solutions

GHLS	Description
Monitor & Respond	Accept risk with agreed contingency plan
Operational Intervention	Solve need by identifying targeted maintenance to restore performance
Optimise Asset	Solve need by improving performance of existing equipment
Partnership	Solving need by assistance of third parties, i.e. assisting farmers reduce pollution of watercourses
Refurbish Asset	Major asset refurbishment to restore asset life and performance
Replacement	Replace asset(s) on like for like basis
New Asset	Build new asset when all other options are not possible (this could be a NBS)
Integrated Approach	Integrated solution across asset boundaries e.g. network, process, bio-resources or catchment level solutions. An integrated solution is a systems thinking response and could be a combination of the above solution types.
Combination of generic high level solutions	Example - SuDS and a storage tank to address CSOs

6.2.5 Should a refurbishment, replacement or new asset solution be identified, a number of design tools were used to develop the requirement through to an estimated solution. Base design data was gathered from United Utilities' corporate systems to inform the design, including flow, quality and treatment performance data. In the majority of cases a 2050 design forecast was used, the exception being when there was a high level of uncertainty in the design forecast thus ensuring the most efficient design for the future.

6.2.6 For each requirement, options were identified and screened using the GHLS approach. Identification of options was more bespoke for water projects and was based on use of expert judgement based on past experience of similar schemes.

6.2.7 A detailed engineered design was then developed for all the feasible solutions identified during this screening process in order to provide comprehensive cost and carbon data.

6.2.8 It was at this stage that the options were assessed for deliverability. A review was undertaken by the Planning, Land and Environmental Team, Ground Engineering and United Utilities' Construction Services which allowed identification of risks and potential mitigation measures. This will have improved the cost accuracy associated with implementing the PR24 solution, it allowed elimination of options which are not deliverable thereby confirming feasibility. This included an assessment of the likely delivery route (including Direct Procurement for Customers) which was then used as the basis for the Contractor add-ons in the cost estimate.

6.3 Innovation

6.3.1 Throughout AMP7 United Utilities' has taken learning from AMP6 innovation roll out (such as that demonstrated with Nereda and Typhon) to deliver a new Technology Approval Process. This process identifies opportunities for innovative technologies and nature based solutions and provides a methodical approach to due diligence, innovation risk identification and mitigation planning. The approved technologies/solutions include:

- Those we have identified ourselves;
- Those suggested by our construction partners;
- Those identified by other WASCs but not yet progressed by United Utilities in AMP7 i.e. I-PHYC Algal bioreactors; and

- Global innovation insights such as that secured through our engineering service provider Jacobs and other consultants such as Stantec.

6.3.2 Our Technology Approval Process has allowed us to progress technologies into approval without the need to trial, for example the Mobile Organic Biofilm technology approved and now in detailed design and construction for our Macclesfield AMP7 scheme. This approach highlights United Utilities' credentials as a fast adopter of new technology but with deeper awareness of the inevitable innovation risks that need to be managed.

6.3.3 To develop our PR24 submission we have incorporated the technologies that have now secured 'Approved' status into our Process Decision Support Tool which was used to identify innovation opportunities by driver and site details. Where these innovation opportunities present the best value solutions they have been selected to be taken forward as the preferred solution. If the value of these novel and less well understood solutions cannot be determined with sufficient certainty they have been identified as an opportunity for United Utilities to pursue in the period between submission and delivery. Alongside this we will continue to review those innovations/solutions not yet approved but relevant to AMP8 drivers and progress these through our Technology Approval Process and, where truly necessary, deliver specific Innovation trials deemed. We believe this sets United Utilities in good standing in terms of understanding the key opportunities that innovation can deliver within our PR24 submission and will allow for further efficiency driven by our Innovation programme.

6.4 Options selection

6.4.1 The water sector is moving towards a 'best value' approach, promoted by the regulators, with a best value option being one which drives the best outcomes for the environment, society, customers and United Utilities over the long-term.

6.4.2 The value associated with the various options was assessed using the value assessment tool developed by United Utilities specifically for this purpose. This tool lists intervention type and pulls through the associated benefits and value. It assesses value against a number of benefits including all the wider environmental outcomes. The benefits were drawn from the MyRisk Risk Breakdown Structure (RBS), currently widely used in United Utilities.

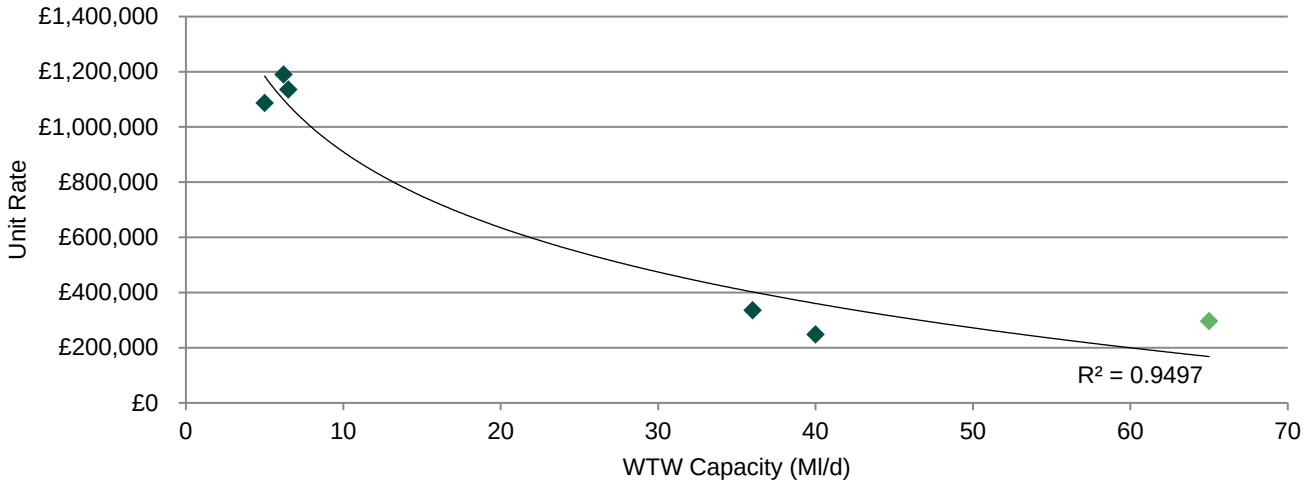
6.4.3 The inputs to the value tool included costs (capex, opex and whole life), carbon (embedded, operation and whole life), data on biodiversity plus risks and benefits as described above. The outputs from the tool included a cost benefit analysis and allowed the selection of the preferred solution based on the comparison of value between the various options (RV2). The option selected was therefore that which provides the best value to customers.

6.5 Industry Comparison

6.5.1 We have reviewed other water companies' business plans for similar schemes proposed at PR19. From this activity, we have identified that Yorkshire Water submitted an enhancement claim to install an Advanced Oxidation with Ozone Process at their Tophill Low WTW to address taste and odour issues caused by geosmin and 2-MIB in the raw water source. According to the PR19 submission, Tophill Low WTW produces 65 Ml/d treated water and the claim was valued at £16.3m. We have benchmarked our estimated costs for the installation of an Advanced Oxidation with Ozone Process at Fishmoor WTW, a site which produces 36 Ml/d.

6.5.2 We applied an inflation factor to reflect 2023 price base and found that the unit rate per Ml/d for Yorkshire water was £296,158 per Ml/d and our estimated cost unit rate for Fishmoor WTW is £336,000 per Ml/d, We have utilised other schemes within this enhancement claim to account for economies of scale and we have found that this unit rate is efficient when compared to Yorkshire Water (Figure 10).

Figure 10: Economies of scale affecting unit rate per Ml/d



Source: UUW data and Yorkshire Water PR19 Business Plan Submission Appendix 14a Drinking Water Quality DWI Submission

6.6 GAC Market Conditions

6.6.1 A significant driver of cost for each of the schemes named within this enhancement case is the price of carbon which is related to specifics such as coal, energy and exchange rates. Coal prices are dependent on the world demand and trade in coal which in turn depends on the availability and supply of oil and gas (Figure 11). Recent volatility in the global energy market due to factors such as the conflict in the Ukraine resulted in a sharp increase in coal prices in 2022.

6.6.2 Between 01 February 2022 and 01 January 2023, the cost of virgin carbon increased by 11%. While we have worked with suppliers to mitigate these increasing prices, global factors have a significant impact on the cost which are not possible to control locally.

Figure 11: 10 year global coal prices trend[5]

Source: Trading

6.7 Third Party Assurance

Pre-DWI submission assurance

6.7.1 Prior to the DWI Technical Submission in March 2023, UUW engaged Price Waterhouse Coopers (PwC) to undertake assurance for the submission, which included a deep dive assessment on the costing section focused on estimating, engineering and construction costs.

6.7.2 The approach to the review focused on the engineering estimation process applied for each of the options and the extent to which this had been correctly followed and assumptions had been input and applied consistently and correctly.

6.7.3 The outcome of this assurance activity found that the process methodologies being followed by UUW are satisfactorily robust and in line with our documented methodologies and recognisable industry practice.

6.7.4 The only area highlighted for consideration is in the treatment of Risk, where the cost estimate process/methodology assigns a % mark up to the overall cost estimate (based on previous data) specific to the delivery model being deployed. This appears to bypass the Risk and Opportunities evaluation process conducted separately. The merging of the two approaches could provide further refinement to the allocation of Risk to the cost estimates.

[5] https://tradingeconomics.com/commodity/coal (accessed 22/08/2023)

Assurance of our Cost estimates

6.7.5 Faithful and Gould undertook a bottom-up deep dive into the cost efficiency of our enhancement cases. This involved a close examination of our cost base relating to a sample of our plan, with comparisons made to similar activity carried out by third party companies across a variety of sectors.

6.7.6 F&G looked at our direct costs across each of the following categories:

(a) Staff including site supervision

(b) Mobilisation and site set up, running and removal of site offices and welfare

(c) Temporary services for general site use, such as water to wash out concrete skips

(d) Attendant plant and equipment, such as cranes, forklift for unloading deliveries etc

(e) Attendant labour, defined as hourly paid operatives not involved in productive works

(f) Site consumables, such as waste skips

(g) Set-up site compounds, erecting hoardings etc

(h) O&M manuals

(i) Health and safety

6.7.7 It also looked at the contractor's indirect costs (e.g. overhead and design costs) and UUW's indirect costs (e.g. land acquisition costs). Due to the size of the programme, F&G examined a sample of our enhancement cases. However, this sample included projects from each of our enhancement categories and covered £1.246bn of expenditure.

6.7.8 F&G noted the effectiveness of UUW's cost estimation process:

"In addition to the benchmarking data held by Faithful+Gould we understand that UUW has applied multiple internal and external challenges to progressively refine the cost estimation undertaken to date. In particular we note UUW's use of its Investment Programme Estimating System (IPES) which is a bespoke parametric estimating tool containing data from AMP3 to AMP7, to provide historical cost curves alongside estimated data from third party organisations."

6.7.9 F&G found that our proposed costs are in line with rates typically seen across the industry:

"Overall, UUW's approach of utilising historic cost curves, market testing and obtaining specialist third party quotations demonstrates a sound proactive approach to cost planning. In total £1.2bn of schemes underwent targeted cost assessment with £573m making up the construction works element.

After presenting our initial findings it was encouraging to see UUW's commitment to addressing our findings and applying these to the wider enhancement estimates, charting a strategic route towards greater efficiency and scope clarification.

In light of this Cost Assurance work and evidence of UUW's responsive actions we have concluded that the data we have benchmarked is within a reasonable alignment with anticipated market rates."

7. Customer protection

7.1 Introduction

7.1.1 It is important that customers have confidence that we will deliver the enhancement schemes that get reflected in our PR24 final determinations and they are suitably protected in the event of non-delivery, or if there are material changes to deliverables (including changes to dates), which leads to a change in cost (including changes in the timing of required expenditure). Ofwat proposes that, if companies fail to deliver or are late delivering improvements to customers, then price control deliverables (PCDs) should, where appropriate, be used to compensate customers. In our PR24 *Chapter 8 – Delivering at Efficient Cost, section 8.8.9* we have proposed an approach to PCDs that aims to provide customer protection, such that customers are fairly compensated for non-delivery (such as due to a change in regulatory requirements) or late delivery (including as a result of a change to a regulatory date), between PCDs, any related ODI underperformance payments, and cost sharing arrangements.

7.2 Price Control Deliverable

Table 6: PCD summary

Scheme delivery expectations	
Description of deliverable	Installation of permanent treatment solutions for the taste and odour causing metabolites, geosmin and 2-MIB, at five water treatment works under notice by the DWI.
Output measurement and reporting	PCD deliverables are set to reflect delivery of the additional treatment processes , meeting the milestones set out in the Project Milestones Table 7, with each milestone weighted by the scale of each project (by reference to the Ml/d of peak weak capacity of each treatment works). This is used to calculate the weighted milestone value used in this PCD as shown in Table 7 We propose the completion of site schemes will be reported through the APR process through table 6A, line 6A.29 Number of treatment works requiring remedial action because of raw water deterioration. Whilst this table does not currently allow for project milestone delivery, this additional detail could be set out in table commentary.
Assurance	DWI assessment of completed milestones as per the terms of the relevant Notices, in line with agreed Notice Audit Strategy Independent third-party assessment of completed milestones and forecast of likely outturn position, through APR audit process.
Conditions on scheme	None
Impact on PCs	Assume zero. We anticipate a small benefit through improved performance with respect to customer contacts about water quality through the completion of this programme of work. However, this risk is currently managed through significantly reducing flows at the affected WTW so as not to impact customers downstream. Therefore the driver of this project is not to improve performance with respect to PCs, but to ensure there is sufficient water of acceptable quality available to meet peak demand.

7.2.1 In our PCD template *UUW32-PCD Excel Sheet* we have assumed a wholesale WACC of 3.23%, in line with Ofwat's guidance. We have assumed a 50% totex cost sharing rate, which is applied before calculating PCDs. We have applied a further 50% for Bioresources (where applicable), to ensure that only 25% of Bioresources totex is at risk from PCDs, given the lack of RCV guarantee, and general uncertainty in cost recovery from future Bioresources price controls. For late delivery we have applied a proportionate value of annual opex, and assumed 3.5% of capex, which provides a fair reflection of the time value of money of any related deferred capital spend.

Table 7: PCD delivery profile

	Units	AMP8	2024	2025	2026	2027	2028	2029	2030	Ultimate delivery
Cumulative delivery target for PCD	**Ml/d (weighted milestones)**		-	-	**-**	**18.74**	**56.22**	**56.22**	**93.70**	**93.70**
AMP8 Capex (22/23 pb)	£	41,179,126	-	-	3,224,271	2,505,229	14,913,022	17,742,809	2,793,794	
AMP8 Opex (22/23 pb)	£	406,921	-	-	-	-	-	-	406,921	
ODI impact per unit of PCD volume	£/Ml/d (weighted milestones)	0.00								

Table 8: Price Control Allocation

Price Control	Unit	Price Control Allocation
Water resources	%	0.00%
Water network+	%	100.00%
Wastewater Network+	%	0.00%
Bioresources	%	0.00%

Table 9: PCD Incentive rates

	Unit	WR	WN+	WwN+	BR
Overall delivery	£/Ml/d (weighted milestones)	0	221,911	0	0
Time value rate	£/Ml/d (weighted milestones)	0	7,168	0	0
Late delivery	£/Ml/d (weighted milestones)	0	15,839	0	0

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Water for the North West