Appendix:
YKY43_WINEP Enhancement Case

YKY43_WINEP Enhancement Case

YorkshireWater

Navigating this document

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

Links outside of this report

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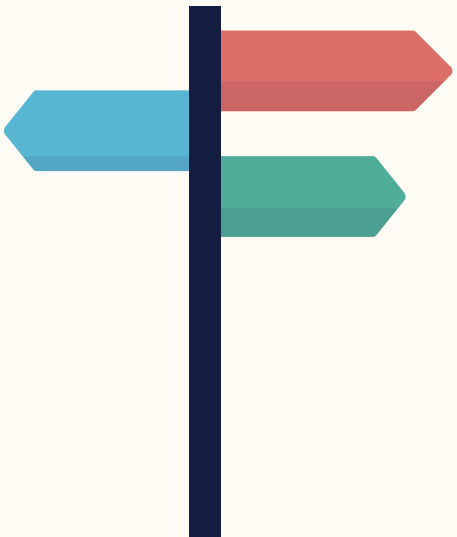
Read more about this at **Introduction to Enhancement Cases**

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

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



Contents

1. WINEP Enhancement Case

1.1 WINEP drivers

This section relates to all WINEP investment, covering reporting lines CW3.1 to CW3.40 and CWW3.1 to CWW3.152.

Lines with no planned expenditure are summarised in Annex: Lines with no proposed expenditure at the bottom of this document.

All other annexes to this document can be found in the Annex to the WINEP Enhancement Case.

Read more about this at
Annex to the WINEP Enhancement Case

1.2 WINEP overview

The Water Industry National Environment Programme (WINEP) is the programme of actions water companies need to take to meet statutory environmental obligations, non-statutory environmental requirements or delivery against a water company's statutory functions. Our WINEP applies to our entire region, incorporating clean and wastewater activities and several of our land-based programmes. Taking a 'source to sea' approach, it covers the management of:

- Our land
- The sources of our clean water
- The environmental impacts of our reservoirs and abstractions
- The impacts of the wastewater we release.

The WINEP is developed and agreed with the Environment Agency (EA) and Natural England (NE) following the principles and requirements set out in the following policy documents issues by the government:

- **SPS: The Government's Strategic Policy Statement for Ofwat.**

  The Government's strategic policy statement to Ofwat (SPS) set out the priorities for the water industry in PR19. In response, the Environment Agency and Natural England published the obligations and expectations for the water industry for PR19 in the Water Industry Strategic Environmental Requirements (WISER) document.

Read more about this at
Strategic policy statement to Ofwat incorporating social and environmental guidance

- **WISER : Water Industry Strategic Environmental Requirements**.

  The Water Industry Strategic Environmental Requirements (WISER) document provides water companies with strategic steer on the environment, resilience and flood risk. Written by the EA and Natural England, it sets out obligations and expectations for the water industry during the price review period 2025-2030 (PR24). It describes the environmental, resilience and flood risk obligations for companies to take into account when developing business plans.

Read more about this at
Developing the environmental resilience and flood risk actions for the price review 2024/water industry strategic environmental requirements WISER

We have addressed the statutory obligations, statutory obligations-plus, and non-statutory action expectations (S, S+ and NS), as described in the WISER document.

Related programmes:

The activities that we undertake in the WINEP programme are integrated with other programmes of work across our business plan. There are interconnections with the following programmes:

- DWI water quality programme – catchment activity delivered through the WINEP programme is integral to protecting the quality of raw water.
- WRMP – understanding and mitigating the environmental impact of our abstractions.
- DWMP – the WINEP programme informs the development of the DWMP.
- LTDS – the requirements of 2025-2030 WINEP are reflected in the LTDS core pathway. Longer term a forecast of the future WINEP requirements is made.
- Other enhancement cases such as coastal bathing waters and net zero.

Read more about our DWI submission at
Water Quality Improvements Enhancement Case

Read more about the draft WRMP at
Water Resources Management Plan

1.2.1 WINEP in AMP8

While other parts of our business plan deal with maintaining and improving our performance against existing environmental obligations, the WINEP focuses on new or enhanced environmental obligations. Similarly, there are other parts of our business plan that deal specifically with ensuring that population changes within the region do not increase the overall environmental impact of our activities.

Our WINEP is the most extensive and ambitious programme we have proposed and forms the core of our business plan. The range of solutions varies from conventional engineering approaches to our largest ever programme of catchment interventions. We have worked with the Environment Agency and Natural England to interpret and apply the strategic environmental requirements to Yorkshire Water. The final WINEP, agreed with the Environment Agency and Natural England, explains how we have met the extensive regulatory requirements and ambition set out in the WISER document.

1.2.2 The environment is a strategic priority

In early 2022, the government set their strategic priorities for Ofwat[1]. This statement set the policy direction for PR24, and in contrast to the statement five years previously, where the focus was on “long-term resilience” and “protecting customers”[2], the first strategic priority outlined this time was to “protect and enhance the environment”. Improvement to the environment, rivers and streams were specifically mentioned as priorities throughout the document, reflecting the government’s and society’s increasing expectations.

[1] https://www.gov.uk/government/publications/strategic-policy-statement-to-ofwat-incorporating-social-and-environmental-guidance/february-2022-the-governments-strategic-priorities-for-ofwat

[2] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/661803/sps-ofwat-2017.pdf

Mid-2022 saw the Environment Agency and Natural England publish the Water Industry Strategic Environmental Requirements (WISER)[3], which detailed how they expected water companies to "step-up their level of ambition" in AMP8 and beyond. This document reflected the increased expectations of society around improvements to the environment and rivers, including this statement in the first section:

"People want more from the environment, including the opportunity to swim outdoors and spend more time near their local river. Therefore, going beyond damage limitation and creating a water environment that benefits people as well as nature is important."

Published in December 2022, Ofwat's final methodology for PR24 "Creating tomorrow together, Our final methodology for PR24"[4] outlined how the water sector needs to transform by improving performance, rebuilding trust, moving rapidly and stepping up further with stretching targets.

Environmental protection and improvement are at the heart of the final methodology, with delivery of "greater environmental and social value" one of Ofwat's key ambitions. Improvements to our blue spaces is a key focus of the methodology too – improvements to river water quality and health are detailed throughout and bolstered by the new biodiversity and river water quality performance commitments outlined in Appendix 7 of the methodology[5] which emphasise the duties of water companies to "further the general biodiversity objective'. The "general biodiversity objective" is 'the conservation and enhancement of biodiversity in England through the exercise of functions in relation to England'.

Throughout 2022 and early 2023, the EA published specific driver guidance documents to aid water companies define their PR24 WINEP schemes.

In 2023, the Government published the first revision of their 25-year Environment Plan, the 'Environmental Improvement Plan' This document has a huge focus on the water environment and notes the key role that the water industry will need to play in achieving the goals. With regards to fish passage, the document specifically states that "Defra will ensure that physical modifications that no longer serve a wider purpose and may cause harm to the water environment are mitigated or removed".

1.2.3 Collaborations and partnerships

The Yorkshire Forum for Water Customers (the Forum) and the Forum's environmental sub group, have contributed to the evolution of our approaches, and we thank the Forum and the sub group for their valued contribution. The sub group includes representation from the Environment Agency, Natural England and other third parties with environmental interests. The strategic environmental requirements were subject to considerable challenge by the sub group and helped us ensure our plan reflect the ambition and needs of customers and the environment.

Our close working relationship with the Environment Agency and Natural England through the PR19 Joint Management Group established reasonable timescales. The WINEP3 dates have been assimilated into our business plan and are reflected in our performance commitments.

Relevant areas of our WINEP plan have been co-developed with multiple partner organisations through the Biodiversity Action Group (BAG) and the Biodiversity Steering Group (BSG). These groups have been instrumental in the development and refining of our programme and we would like to thank all members for their support and challenge.

1.2.4 Our AMP8 Subcases

[3] https://www.gov.uk/government/publications/developing-the-environmental-resilience-and-flood-risk-actions-for-the-price-review-2024/water-industry-strategic-environmental-requirements-wiser

[4] https://www.ofwat.gov.uk/wp-content/uploads/2022/12/PR24_final_methodology_main_document.pdf

[5] PR24_final_methodology_Appendix_7_Performance_commitments.pdf (ofwat.gov.uk)

Table 1.1: WINEP Water Subcases

Subcase Name	Description
Fish passage & river restoration	Investigations and actions to address Water Framework Directive and Biodiversity driven fish passage and river restoration issues. Issues were identified in collaboration with a number of partner organisations by following EA guidance.
Fish screening: fish & eels protection	Methods to protect eels and other relevant fish species (e.g. Salmon):- • Screening measures installed at river intakes to prevent entrainment of eels and salmon; • Investigations to ascertain whether eels or salmon are at risk through the operation of our assets
Surface Water catchment management programme	This programme builds on previous AMPs' catchment management programme, which seeks to stabilise or reduce colour, pesticides, nutrients and sediments. This ranges from peatland restoration (raising the hydrology of the peat mass, thereby reducing the aerobic conditions which allows peat to oxidise and degrade) to landscape scale collaboration with farmers and the food and drink supply chain to promote and support the roll out of more sustainable, resilient and profitable agricultural methods, often referred to as regenerative farming.
Water resources	Yorkshire Water must deliver the relevant regulatory actions to ensure that our surface and groundwater abstractions do not cause environmental harm or deterioration under the Water Framework, Habitats Regulations and associated legislation. In addition, we must consider the longer-term changes that we may need to make in the future beyond existing statutory requirements in support of our regional Environmental Destination. Our programme comprises a combination of investigations (to identify the relevant measures to deliver the statutory obligations) and actions (where previous investigations or other drivers have identified the need for implementation through the WINEP). Together these actions support the delivery of our Long-Term Delivery Strategy, developing the evidence based and determining the pace and profile of investment in our water resources management plans. It is aligned with our programme of long-term supply-side expenditure that enhances the supply-demand balance (e.g., delivery of supply-side enhancements).
Biodiversity & Invasive species	Investigations and delivery projects to abide by our legal duties under the Water Framework Directive, the Environment Act and the Natural Environment and Rural Communities Act. Work is particularly focused on undertaking activity to mitigate our impact on endangered species and habitats, delivering conservation work such as chalk stream river restoration alongside Catchment Partnerships, reducing new pressures on Sites of Special Scientific Interest that we own and putting in place mechanisms to ensure we do not recklessly spread invasive non-native species, particularly through our transfers of raw water and also sewage sludge.

Table 1.2: WINEP Wastewater Subcases

Subcase Name	Description
River water quality investigations	The Water Framework Directive (WFD) requires Yorkshire Water to investigate potential impact of their assets on the environment which may result in a failure of the WFD standards. We will investigate 2 catchments to assess whether storm discharges are causing a failure of the WFD intermittent standards, where the Environment Agency have data which suggests there may be an issue relating to our permitted discharges.
River Water Quality Improvements	The drivers will deliver improvements to continuous wastewater discharges from our WwTWs for ammonia, biochemical oxygen demand and phosphorus to reduce our impact on the receiving waterbody and improve river water quality. All obligations are identified to achieve targets in accordance with UK environmental legislation such as Urban Wastewater Treatment Regulations, Water Framework Directive, Habitats Directive and the new Environment Act.
Water quality investigations and monitoring: Chemicals and microplastics	These drivers will investigate the performance of treatment, presence in the environment and impact on the environment of hazardous substances and microplastics. Some of these drivers deliver enhanced monitoring of cypermethrin at wastewater treatment works identified as potential significant impacts on the environment.

Investigation into Nitrogen Removal Technically Achievable Limit	This investigation will be undertaken in collaboration with other UK water companies and regulators to understand the effectiveness of wastewater treatment types for removing total nitrogen from continuous wastewater discharges; and inform whether the current 10 mg/l total nitrogen technical limit can be tightened.
Schemes to meet the 25 Year Environment Plan	The 25YEP driver supports investigations and actions contributing to the government's 25 Year Environment Plan goals. The driver will help achieve the government's 25YEP ambition to leave the environment in a better condition for future generations as set out in the draft Water Industry Strategic Environmental Requirements (WISER).
Bathing Water Quality – Inland Bathing	Improve the quality of three inland waters: • One designated riverine bathing water (River Wharfe at Cromwheel, Ilkley) • Two non-designated, but popular recreational sites (River Wharfe at Wetherby and River Nidd at Knaresborough)
Storm Overflow Reduction Plan	Improvements to reduce storm overflow spills in line with the targets of the Storm Overflow Reduction Plan so that they do not discharge above an average of 10 rainfall events per year by 2050. To carry out investigations in line with the requirements for no local adverse ecological impact and to reduce aesthetic impacts by installation of screens.
Monitoring of discharges	Installing new equipment to monitor WwTW intermittent discharges and WTW discharge flows.
River Water Quality Monitoring	There is a requirement for water companies to install continuous water quality monitoring of all discharges to the environment and to carry out investigations to determine the best way to install monitoring where there is currently no defined methodology.
Septic Tank Removal and Replacement	Septic tanks are used to treat wastewater from very small settlements where there is low environmental impact from treated wastewater discharges. Improving discharge quality involves replacing or upgrading septic tanks that discharge into surface water with secondary treatment.
Schemes driven by population numbers	The Urban Wastewater Treatment Directive has requirements that apply to all WwTWs that serve a given population size or greater. Where WwTWs population are forecast to cross a threshold, new standards must be met.
Improve the resilience of recycling sludge to land	These drivers will deliver increased resilience through additional storage sludge storage, to support the continuation of biosolids recycling to agriculture.

You can read all the detail on each of our subcases in sections 2 – 18. Section 1 sets out our high-level approaches that apply to the subcases.

1.2.5 Delivering Our AMP8 Programme

Our AMP8 WINEP enhancement programme is the largest we have ever proposed and is needed to meet our statutory obligations.

The overall programme is £1,809m [6] - £83m for water, £1,726m for wastewater (including £44m for Bioresources). We have been working hard with our supply chain and service partners to ensure they understand the scale of the proposed programme to ensure that we have confidence in the delivery mechanisms for such a significant programme of work, we discuss this in more detail in section 8.16 in Chapter 8 of our main business plan.

More detail on this subject can be found in
Chapter 8: Our Plan

1.2.5.1 Water WINEP Expenditure

Table 1.3: Water Enhancement Subcase Expenditure

[6] This does not include the expenditure on schemes that are currently assessed as suitable for DPC

Subcase	Driver	Reporting Lines	AMP8 Enhancement Expenditure (£m)
Fish passage & river restoration	Fish Passage	CW3.7-8 CW3.16-17 CW3.28 CW3.32	12.4
	River Restoration	CW3.17 CW3.32	1.1
	Total		**13.5**
Surface Water	**Total**	CW3.14 CW3.32	**16.1**
Water resources	Groundwater	CW3.14 CW3.17 CW3.32	9.1
	Surface Water	CW3.2 CW3.16 CW3.29 CW3.32	6.8
	Total		**15.8**
Biodiversity & Invasive species	Biodiversity	CW3.1-2 CW3.29 CW3.32	20.5
	Invasive Species	CW3.10-11 CW3.29 CW3.32	6.1
	Total		**26.6**
Fish Screening - Eels SAFFA	Fish Screening	CW3.32	9.9
	Eels SAFFA	CW3.4 CW3.32	0.1
	Total		**10.0**
Water WINEP			82.1[7]

1.2.5.2 Wastewater WINEP Expenditure

Table 1.4: Wastewater Enhancement Case Expenditure

Case	Driver (where appropriate)	Reporting Lines	AMP8 Enhancement Expenditure (£m)
River water quality investigations		CWW3.109-110	2.0
River Water Quality Improvements (Sanitary and Nutrients)	Phosphorus	CWW3.64-65 CWW3.70-71	350.5
	Ammonia and BOD	CWW3.73-74	60.3
Water quality investigations and monitoring: Chemicals and microplastics		CWW3.52-53	5.6

[7] Variance is due to rounding and £0.3m which is accounted for in the wastewater Monitoring of discharges Case

Investigation into Nitrogen Removal Technically Achievable Limit		CWW3.61-62	0.0[8]
Schemes to meet the 25-Year Environment Plan		CWW3.100-101	4.8
Bathing Water Quality – Inland Bathing		CWW3.13-14 CWW3.16-17 CWW3.22-23 CWW3.46-47 CWW3.88-89 CWW3.109-110	178.7
Storm overflows reduction	Storm overflows reduction	CWW3.13-15 CWW3.16-17 CWW3.22-24 CWW3.25-28 CWW3.34-36 CWW3.37-39 CWW3.46-48 CWW3.109-111	705.7
	IMP Storage	CWW3.19-20 CWW3.22-24 CWW3.46-48	115.1
	Coastal Bathing Water Overflows[9]	CWW3.13-15 CWW3.16-17 CWW3.22-24 CWW3.25-28 CWW3.34-36 CWW3.37-39 CWW3.46-48 CWW3.109-111	[265.6] not included in WINEP total
	Total		820.8
Monitoring of discharges		CWW3.4-6 CWW3.10-12	85.1[10]
Upstream and downstream monitoring of outfalls		CWW3.7-8 CWW3.106-107	157.5
Septic Tank Removal and Replacement		CWW3.91-92 CWW3.94-95	18.3
Schemes driven by population numbers		CWW3.64-65	0.0[11]
Improve the resilience of recycling sludge to land		CWW3.137-138 CWW3.143-144 CWW3.169	43.8
Total			1727.4*

*numbers are rounded

1.2.6 Our approach to developing the enhancement cases

We have followed the guidance in Ofwat's methodology in Appendix 9, Annex 1 when writing our enhancement cases[12].

[8] Value is £47k, shows as £0.0m due to rounding in this table

[9] Cost is included in this case but this is not part of WINEP so has separate enhancement case

[10] £0.300m clean water expenditure included in this case

[11] Value is £3k, shows as £0.0m due to rounding in this table

[12] PR24_final_methodology_Appendix_9_Setting_Expenditure_Allowances.pdf (ofwat.gov.uk)

Where we have been able to answer sections of this methodology at a programme level, we have done so in section 1 of this document, where this is not the case we have answered those sections on a case by case basis in sections 2 to 18.

1.3 Need for the Proposed Investment

The primary role of the WINEP is to ensure water companies take the actions that are required to meet the environmental legislative requirements that apply to water companies in England.

Programmes of work covering land, water, wastewater and bioresources are agreed with the Environment Agency (EA) and Natural England (NE) to ensure that all statutory obligations are met. In doing so we consider the requirements of government policy, legislation, WINEP driver guidance, wider relevant guidance, and local strategies.

1.3.1 Long-Term Delivery Strategy Alignment Across our WINEP

Our Long-Term Delivery Strategy (LTDS) sets out our vision and ambition for the next 25 years, the outcomes we aim to achieve, and the actions and investments we intend to undertake to deliver them. It is a new requirement for this pricing period, and an integral, mandatory part of Yorkshire Water's PR24 plan.

Our long-term delivery strategy is structured around four primary enhancement investment areas, each of which is underpinned by one or more strategic planning areas. The table below demonstrates how each investment area will contribute to achieving our long-term outcomes for customers.

Table 1.5: LTDS Investment Areas

Investment area	Strategic planning area	Outcome: Secure, safe, clean water supplies	First-class customer service	Bills everyone can afford	Modern and resilient infrastructure	Net zero carbon emissions	A healthy, natural environment
Clean water	Water industry natural environment programme (clean)	■	■	■	■		■
	Water resources management plan						
	Drinking water quality						
Wastewater	Water industry natural environment programme (waste)		■	■	■	■	■
	Drainage and wastewater management plan						
	Bioresources						
Resilience	Clean water resilience	■	■		■		
	Clean water security						
	Wastewater resilience						
	Wastewater security						
	Living with Water						
Net zero	Carbon and energy					■	■

Our LTDS is underpinned by an adaptive planning approach, meaning we have identified both the activities that are needed now and the investments that may be required in the future. This approach accounts for future uncertainties – such as climate change, regional population growth, and changes in legislation – and helps us to make the right investment decisions to deliver our strategy efficiently.

We have incorporated WINEP plans for future AMPs into our LTDS to ensure we can fulfil our statutory obligations and meet customer needs and expectations in the long term. Our planned activities include, for example, conservation activities to protect sensitive habitats and species, removing phosphorus from treated wastewater (including through the use of nature-based solutions), and increasing our use of microbiological disinfection technologies to improve river and coastal water quality.

Read more about the LTDS at
Long Term Delivery Strategy

1.3.2 Factors Outside of Management Control

All WINEP drivers are driven by legislation with the vast majority being Statutory and Statutory Plus and therefore outside of management control. We have a well-established process for identifying schemes required under the various drivers.

There are a small number of approaches taken depending on the differences in the actual drivers. However, for most approaches we work in collaboration with the Environment Agency (EA) and/or Natural England (NE) to identify the Risks and thereby the Need.

The need is then challenge and tested against the guidance. E.g., the EA originally proposed that there were 15 sites that met the criteria for improvement schemes under U_IMP2. We reviewed these sites and initially agreed with the assessment. When we internally challenged the list against the EA guidance, we found that 5 of the sites were outside the criteria as they contributed less than 3% of the load and were therefor not needed. When we re-reviewed these with the EA, they agreed with our assessment and the 5 sites were removed from this driver. Once the list of needs is agreed we optioneer a range of solutions. This is internally challenged to ensure it is an efficient and robust solution.

1.4 Best Option for Customers

Consistent with the EA's WINEP methodology, we developed options to meet each of the WINEP drivers and assessed which of the options proved to be the best value for customers. For some WINEP drivers our statutory obligation was prescriptive, and we had little or no flexibility in developing alternative solutions.

Sections 1.4.1 and 1.4.2 explain how we developed our options and how we assessed which were best value for customers, and our approach to selecting our preferred solutions for AMP8.

1.4.1 Optioneering approach

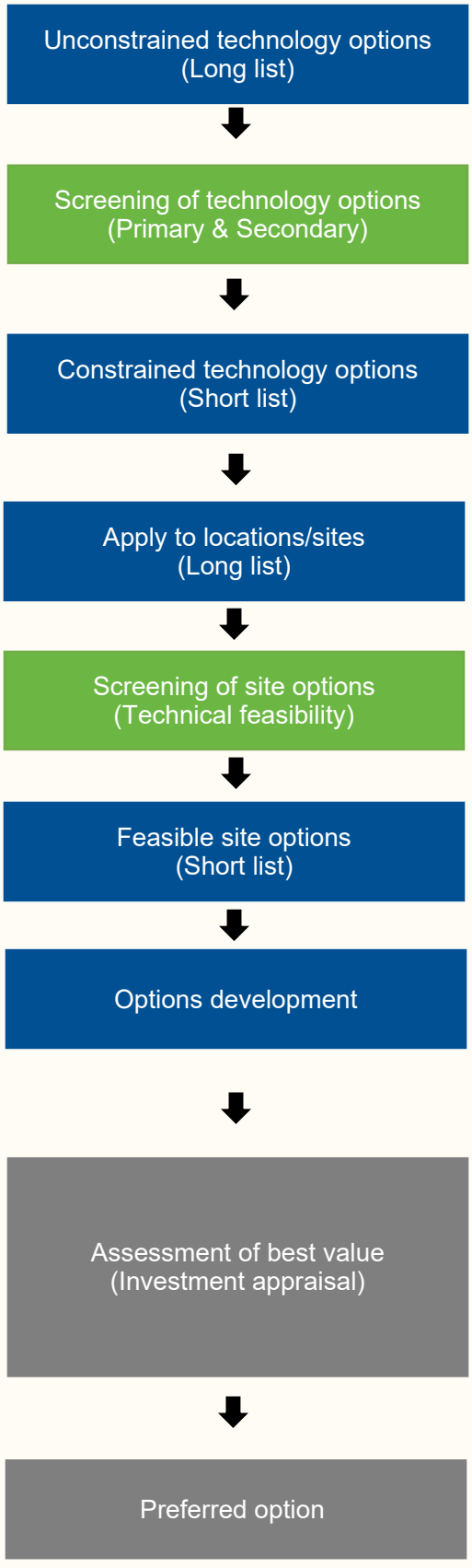
In this section, we set out the optioneering approach we have applied to develop all our WINEP PR24 programmes.

Figure 1.1 below sets out our process for identifying the best option for customers. This is based on the principles of the HM Treasury, The Green Book: Central Government Guidance on Appraisal and Evaluation [13] and the WINEP Options Development Guidance.

In addition to this process, Table 1.7 sets out our Options Development principles which we applied during our process for developing and filtering options.

[13] HM Treasury, The Green Book, Central Government Guidance on Appraisal and Evaluation 2022

Figure 1.1: Process for Developing and Filtering Options



Unconstrained list of technology options

We have developed a broad range of potential technology options in accordance with section 7.2.1 of the WINEP Options development guidance.

Constrained list of technology options

We have screened the unconstrained list of technology option against:
1) expected to meet statutory obligation, and
2) technically feasible in accordance with section 7.2.2 of the WINEP Options development guidance.

Where we have multiple options of a similar type, we have then used a proportional approach to screen out technology options which are obviously less natural capital benefits, higher costs, and higher carbon.

Unconstrained list of technology options for site options

We have applied the constrained list of technology options to each of the sites/locations and then screened this to ensure the technology is technically feasible to implement on a specific site (contributes towards the deliverability assessment).

For example, it is not possible to implement a gravity solution where the gradient does not allow it.

Options development

We have developed the scope to a level which contains a mixture of desktop assessments and a sample of on-site surveys. We have used information from the surveys to extrapolate to the sites which have had a desktop assessment. For Water and Wastewater Capex cost estimates, we have used a range of costing methods, viz: lump sums, bottom-up builds via our Sewage Treatment Works model Design and Value Engine (DAVE), and our in-house Unit Costing Database (UCD) cost models). For Opex cost estimates, we have used: historical costs, for UCD cost models the Opex was manually entered into the solution into our Enterprise Decision Analysis (EDA) tool, and for DAVE determined solutions the Opex was automatically calculated using a set of agreed assumptions.

Assessment of best value

We have undertaken an assessment of benefits and net present value for each of the options from the constrained list at each site using the guidance in section in section 7.3 of WINEP options development guidance. We have also assessed each option against the Wider Environmental Outcomes Metrics and a deliverability assessment as part of our benefits assessment in accordance with section 7.2 of WINEP Options Development guidance.

Preferred

We have selected the preferred option and where we have not selected the least cost option we have explained why.

Table 1.6: WINEP Options Development Principles

Expectation	How this has been met
Environmental Net Gain	We have undertaken an assessment of environmental net gain of the options by assessing the potential environmental impacts including the natural environment, net zero, catchment resilience, access, amenity and engagement of each option and monetised alongside the whole life cost, choosing the one that provides the greatest overall environmental benefit/cost ratio.
Natural Capital	We have assessed each of our options against the full range of natural capital metrics and wider environmental objectives as part of our WINEP assessment to the Environment Agency. These have been quantified through our benefits assessment.
Catchment and Nature-Based Solutions	All our solutions are taken through our TOTEX Hierarchy approach. This brings in catchments and systems-based thinking to develop a suite of interventions for each need or risk. We have considered a range of nature-based solutions, e.g., integrated constructed wetlands, reed beds, facultative lagoons and infiltration fields.
Proportionality	We have taken a proportional approach to options development based on green book principles. Where there are more than three traditional treatment options, we have screened out those which have obviously less natural capital benefits, higher costs and higher carbon without undertaking a full benefits and cost assessment, which would require a much more detailed optioneering scope.
Evidence	The evidence to our options is described within sections 2 to 18 of this enhancement case. We clearly record the reasons for discarding options. Further supporting evidence of our solutions development and our data sets is available in our Options Development Report and Options Assessment Report as submitted to the EA. Our WINEP submission has been independently audited by a third party (WS Atkins) and there are no outstanding actions.
Collaboration	We have collaborated with the Drinking Water Inspectorate, the Environment Agency, Rivers Trust, Natural England, and local Stakeholders to define the list of sites. Further collaboration with regulatory bodies, local stakeholders and planning authorities will occur as part of the WINEP delivery process.

1.4.1.1 Innovation

The nature and timescales of the WINEP process have meant that opportunity to explore innovative solutions in our optioneering approach has in some cases been limited. Where there is evidence that innovative solutions such as nature based solutions are appropriate, we have selected these as options. Where a more detailed evidence base may be required, or where there would need to be more detailed discussions with the EA on novel permitting approaches, we have opted for more certain solutions in our WINEP proposals. While some regulations limit our ability to be innovative in our approach, we will seek to apply innovate approaches to our obligations in the design and delivery phases of the programme where appropriate.

For more information on our approach to optioneering please see section 6 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

1.4.2 Cost benefit analysis

We set out our approach for Net Present Value analysis in Annex A1 – Economic Evaluation in the WINEP Enhancement Case Annexes document, which sets out our approach consistent with the WINEP Options Development Guidance.

Read more about this at
Annex to the WINEP Enhancement Case

For more information on our approach to Cost Benefit please see section 6 in Introduction to Enhancement Cases.

1.4.3 Carbon impact and best value

We discuss this in the individual subcases.

1.4.4 Performance Commitment Impact Quantification

There are four WINEP areas that have a direct impact on a Performance Commitment:

- Bathing Waters
- Storm Overflows
- River Quality (P-removal)
- Biodiversity

This is discussed in more detail in the individual cases.

1.4.5 Direct Procurement for Customers (DPC)

For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

Table 1.7 Water Subcases DPC Assessment

Subcase	Met DPC Criteria?	Element Assessed?	Suitable for DPC?
Fish passage & river restoration	No	N/A	N/A
Fish & eels protection	No	N/A	N/A
Surface Water catchment management programme	No	N/A	N/A
Water resources	No	N/A	N/A
Biodiversity & Invasive species	No	N/A	N/A

Table 1.8: Table 1.8 Wastewater Subcases DPC Assessment

Subcase	Met DPC Criteria?	Element Assessed?	Suitable for DPC?
River water quality investigations	Yes	N/A	No
River Water Quality Improvements	Yes	N/A	No
Water quality investigations and monitoring: Chemicals and microplastics	No	N/A	N/A
Investigation into Nitrogen Removal Technically Achievable Limit	No	N/A	N/A
Schemes to meet the 25-Year Environment Plan	No	N/A	N/A
Inland Bathing Water Quality	Yes	WINEP (Bathing Water Improvements)	Yes
	Yes	Ilkley Bathing Water	No

Storm overflows reduction	Yes	This is combined with the Coastal Overflows case	Yes
Monitoring of discharges	No	N/A	N/A
River Water Quality Monitoring	No	N/A	No
Septic Tank Removal and Replacement	No	N/A	N/A
Schemes driven by population numbers	Yes	N/A	No
Improve the resilience of recycling sludge to land	No	N/A	N/A

1.5 Cost Efficiency

We set out our approach to costing in Annex A1 in our Annex to the WINEP Enhancement Case which sets out our approach consistent with the WINEP Options Development Guidance. See section 'Cost assessment' for our options assessment purposes.

Section 7.3 in Introduction to Enhancement Cases outlines our overall approach to cost estimation and cost efficiency, we discuss how this has been applied in each of the subcases in sections 2 to 18.

1.6 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in the Introduction to Enhancement Cases.

We have not proposed any water WINEP PCDs as the subcases do not reach the materiality threshold.

We have proposed the following wastewater WINEP PCDs:

Table 1.9: WINEP PCDs

PCD	Enhancement case/subcase
Accelerated Infrastructure Delivery Project	
Inland bathing water improvement scheme - Wharfe Ilkley	WINEP - Bathing water quality and Storm Overflow Reduction Plan
Coastal bathing water improvement	WINEP - Storm Overflow Reduction Plan
Wastewater	
PCDWW2 Flow monitoring / River water quality monitoring	WINEP - Upstream and downstream monitoring of all YW outfalls
PCDWW4 Flow to full treatment	WINEP - Storm Overflow Reduction Plan and Bathing water quality
PCDWW5a Storm overflows (group)	WINEP - Storm Overflow Reduction Plan group, Bathing water quality and Coastal bathing water overflows
PCDWW18 Investigations	
PCDWW5b WFD_IMP Storm overflows (group)	WINEP - Storm Overflow Reduction Plan

PCDWW6 Storm overflow - new / upgraded screens	WINEP - Storm Overflow Reduction Plan group, Bathing water quality and Coastal bathing water overflows
PCDWW10 Treatment for phosphorus removal	WINEP - River water quality improvements (sanitaries and nutrients) and Schemes driven by population numbers under Urban Wastewater Directive
PCDWW12 Treatment for tightening of sanitary parameters	

1.7 Assurance

We employed Atkins to carry out external assurance of our WINEP approach to ensure that the defined process was followed.

For information on our assurance more generally please see section 7.4 in Introduction to Enhancement Cases.

2. Water: Fish Passage & River Restoration

2.1 Drivers:

Table 1.1: Drivers

Driver code	Brief description	Statutory status	Tier 1 outcome
WFD_IMP_PHYSHAB	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	Statutory Plus	Achieve water body objective status or prevent deterioration
WFD_INV_PHYSHAB	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	Statutory	
WFD_IMP_WRHMWB	Action to improve ecological status (surface water)	Statutory Plus	Implement mitigation measures in a catchment to meet water framework directive objectives in designated WR A/HMWBs
WFD_INV_WRHMWB	Investigation to determine impact of abstractions and appraisal of options for an effective solution to achieve good ecological status (surface water)	Statutory	
NERC_IMP	Changes to permits or licences, and/or other action that contributes towards biodiversity duties, requirements and priorities.	Statutory Plus	Conserve and enhance biodiversity

2.1.1 Requested Investment:

Table 1.2 Fish Passage & River Restoration AMP8 Expenditure

	£m	Table Line Ref.
Enhancement Expenditure Capex	5.456	CW3.7, CW3.16, CW3.27,
Enhancement Expenditure Opex	8.045	CW3.8, CW3.17, CW3.28, CW3.32
Base Expenditure Capex	0.000	
DPC value	0.000	
Total	**13.501**[14]	

[14] Excluding £10.4m of match funding referenced in Table 1.4: Fish Passage Schemes

2.1.2 Associated Reporting lines in Data Table:

Table 1.3: CW3 Reporting Lines

Line Number	Line Description
CW3.7	Eels/fish passes; (WINEP/NEP) water capex
CW3.8	Eels/fish passes; (WINEP/NEP) water opex
CW3.9	Eels/fish passes; (WINEP/NEP) water totex
CW3.16	Water Framework Directive; (WINEP/NEP) water capex
CW3.17	Water Framework Directive; (WINEP/NEP) water opex
CW3.18	Water Framework Directive; (WINEP/NEP) water totex
CW3.28	Investigations; (WINEP/NEP) - desk based study only water capex
CW3.29	Investigations; (WINEP/NEP) - desk based study only water opex
CW3.30	Investigations; (WINEP/NEP) - desk based study only water totex
CW3.31	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water capex
CW3.32	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water opex
CW3.33	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water totex

2.2 High Level Driver description:

This document outlines the PR24 Enhancement Cases for fish passage and river restoration investment under both the Environment Agency's (EA's) Water Framework Directive (WFD) and Natural Environment and Rural Communities (NERC) Statutory and Statutory Plus drivers.[15]

WFD drivers:

Under the WFD, the EA's drivers include all WFD water body biological failures relating to fish passage, fish entrainment and physical modification that relate to physical modification and/or ecological discontinuity caused by structures and associated infrastructure owned or utilised by water companies. The primary outcome for this driver is to achieve water body objective status or prevent deterioration, with the secondary outcomes of addressing the impacts of water company assets on habitats in catchments, fish passage and fish entrainment.

The NERC Act 2006 is primarily intended to implement key aspects of Defra's 2004 Rural Strategy; it also addresses a wider range of issues relating broadly to the natural environment. YW has a duty to conserve and enhance biodiversity as set out in Part 3 of the NERC Act.[16]

Further to this, under the Environment Act 2001, YW has a duty to contribute to key Government goals on habitat creation, preventing species extinction and improving species abundance. That should be done in a way that aligns with the still extant Biodiversity2020 Nature Strategy and developing Local Nature Recovery Strategies (as set out in the Environment Act).

[15] Refer to 'Section 3: WINEP obligations and drivers' of the WINEP methodology.
[16] Specifically, Section 41 of the Act requires the Secretary of State to publish a list of species and habitats that must be conserved and enhanced.

2.3 Need

2.3.1 The Need for the Proposed Investment

The Need for fish passage and river restoration enhancement spending in AMP7 is due to:

- New information about YWs asset base and impact on the environment
- Increased Government expectations

New information

Following publication of the PR24 WFD driver guidance and confirmation of WFD drivers to apply in PR24, YW undertook a strategic approach to the identification of risks and issues across the Yorkshire operational area.

This process followed the EA WINEP methodology and involved combining potential risks and issues brought to our attention via any route (stakeholder, Customers, etc) since PR19 with potential risks and issues identified by a Geographical Information System search using the latest YW asset data, resulting in a 'long list' of new risks and issues.

These locations were visited with the EA to confirm if a WFD driver applied, alongside checks against YWs asset information and ownership/control data.

Increased expectations

In 2022 and 2023, several government bodies signalled an increase in expectations and requirements:

- The SPS required companies to 'protect and enhance the environment' through improvement to the environment and rivers and streams as priorities.
- WISER set out increased expectations for water company ambition and reflected the need to meet increasing societal expectations.[17]
- Ofwat's PR24 final methodology details the need for improvements to river water quality and health, bolstered by the new biodiversity and river water quality performance.
- First revision to 25-year Environment Plan sets out for fish passages that "Defra will ensure that physical modifications that no longer serve a wider purpose and may cause harm to the water environment are mitigated or removed".
- EA's driver guidance documents for Biodiversity, 25 Year Environment Plan, WFD Physical Habitat and fish passage and Water Resources Artificial and Heavily Modified Water Body.
- All the EA's driver guidance documents reflect the growing regulatory expectations on water companies to improve river health. For example, the Biodiversity driver guidance clearly states the greater requirement on water companies to not just 'have regard' to 'conserving biodiversity' as defined under the NERC Act, but now have a 'Duty to conserve and enhance biodiversity' as required under the Environment Act 2021. The driver guidance makes clear that this is an enhancement of expectations on water companies and that "The aim of this change is to provide for the enhancement or improvement of biodiversity, not just maintenance in its current state".

Read more about this at
25 Year Environment Plan

[17] For example, WISER stated: "People want more from the environment, including the opportunity to swim outdoors and spend more time near their local river. Therefore, going beyond damage limitation and creating a water environment that benefits people as well as nature is important."

2.3.2 The Scale and Timing of the Investment

We propose £12.4m totex for fish passage projects and £1.1m totex for river restoration projects. Improved fish passage is also a priority and driver for others; therefore our investment will contribute to a wider programme of works with a total value of £22.8m. Working as a key Partner of Great Yorkshire Rivers, we have developed a co-designed programme to ensure our investment is aligned to the work of others in the region. These locations were visited with the EA to confirm if a WFD driver applied, alongside checks against YW's asset information and ownership/control data before inclusion in our AMP8 WINEP programme. Refer to section 'Best Option for customers' for how we scoped the sites with the EA and identified partner contributions.

The completion dates of these schemes (noted in the table below) are set by the EA to align with regulatory constraints, including River Basin Management Planning and where applicable, deliver in time to inform future price reviews, for example where an investigation identifies a 'need' for a fish pass implementation scheme in AMP9.

For AMP8 the following fish passage schemes were agreed with the EA:

Table 1.4: Fish Passage Schemes

Action name	Action description	AMP8 totex (£m)	Completion date
Townhead weir	Removal of weir to provide fish passage and improve river habitat	1.471	31/03/2030
Springhead weir	Need to provide fish passage. Removal of weir expected.	0.796	31/03/2030
Wharfe pipes	Removal of 5 no. large diameter raw water mains that span River Wharfe	1.609	31/03/2030
River Holme pipes INVESTIGATION	Investigation to identify options for fish passage over this and multiple barriers caused by sewer pipes in the River Holme	0.104	30/04/2027
River Ryburn pipes INVESTIGATION	Need to investigate fish passage options across length of Ryburn lined/crossed by YW sewer pipes	0.104	30/04/2027
Staithes Beck INVESTIGATION	Need to investigate fish passage options across length of Staithes Beck lined/crossed by YW sewer pipes	0.104	30/04/2027
Derwent Swallow holes INVESTIGATION	Need to investigate options to improve fish passage around decommissioned YW swallow hole flow control structures.	0.104	30/04/2027
Yorkshire sewer pipe crossing Investigation	Yorkshire wide investigation of need for fish passage projects in AMP9 across 295 sewer pipe crossings and 575 clean water pipe crossings	0.104	30/04/2027
Bradford Beck sewer pipe INVESTIGATION	Investigation into options for fish passage over weir associated with YW siphon	0.104	30/04/2027
River Rother sewer pipe weir INVESTIGATION	Investigation into options for fish passage over weir associated with YW sewer pipe crossing	0.104	30/04/2027
Thickwoods Brook weir fish passage INVESTIGATION	Scheme to investigate fish passage solution at Thickwoods Brook weir	0.104	31/12/2026
Great Yorkshire Rivers Partnership	Partnership with EA and Rivers Trust to support the Great Yorkshire Rivers Project. Great Yorkshire Rivers Project to deliver fish passage solutions, our YW contribution will fulfil our NERC	18.096	31/03/2030

	Act duties whilst leveraging additional funding to expand the scale of the project.		
	Total with Match Funding	**22.801**	
	Total without Match Funding	**12.401**	

For WFD driven fish passage schemes, options appraisals either undertaken in previous AMPs, or planned to be undertaken to inform solutions in AMP8 are used to ensure both statutory compliance with the WFD, but also maximise environmental outcome and value for money for Customers.

WFD projects are driven by statutory needs and therefore the 'do nothing' option is discounted and value for money is ensured via cost-benefit assessment of all option types prior to delivery.

For AMP8, the following river restoration schemes were agreed with the EA:

Table 1.5: River Restoration Schemes

Scheme name/site	Short description of solution	AMP8 totex (£m)	Completion date
Guiseley Beck & Yeadon Gill river restoration	Scheme to investigate and deliver river restoration on Guiseley Beck & Yeadon Gill within the grounds of Esholt Hall	0.813	31/03/2030
River restoration investigation	Investigation to identify options and feasibility across several sites flagged by the EA and eNGO's	0.287	30/04/2027
	Total:	**1.100**	

2.3.3 Interactions with Base Expenditure

We confirm this enhancement case does not overlap with base funding.

2.3.4 Activities Funded in Previous Price Reviews

Fish passage projects and partnerships have been delivered since AMP5 and the proposed investment in AMP8 builds on the shared learning and established capabilities (YW and catchment Partners) across the Yorkshire Area.

The sites identified for fish passage and river restoration projects in AMP8 are new compared to those funded in previous price reviews:

- AMP7: £4m on fish passage capital projects, £0.7m on investigations and £2m on Partnership projects via seven catchment Partners (excluding partner match funding contributions of >£2m).
- AMP7: £0.3m on river restoration capital projects £0.1m on investigations and £0.05m partnership projects.
- AMPs 5 and 6: £12m on 16 fish passage projects, £0.5m on Partnership projects, attracting an additional £1m in match funding.

2.3.5 Long-term Delivery Strategy Alignment

The values within our AMP8 submission have formed the basis of our Long-Term Delivery Strategy (LTDS) response, taking into account the rapidly changing policy landscape around Water Framework Directive, biodiversity, and the Government's 25-year plan targets for the Environment.

The LTDS considers resilience risks and interventions, and Yorkshire Water's LTDS has been influential in directing this submission. The LTDS is a new requirement for this regulatory period, and an integral, mandatory part of Yorkshire Water's PR24 plan.

The strategic planning frameworks (Water Resource Management Plan (WRMP), Drainage and Wastewater Management Plan (DWMP) and Water Industry National Environment Programme (WINEP) all feed into the LTDS. It is chiefly concerned with future enhancement investment, and the coming price period and future DWI water quality submission components will be included. The LTDS will also include future risks for the next three regulatory periods.

Our LTDS is structured around four primary enhancement investment areas, each of which is underpinned by one or more strategic planning areas. The table below demonstrates how each investment area will contribute to achieving our long-term outcomes for customers.

Figure 2.1: LTDS Investment Areas

Investment area	Strategic planning area	Outcome: Secure, safe, clean water supplies	First-class customer service	Bills everyone can afford	Modern and resilient infrastructure	Net zero carbon emissions	A healthy, natural environment
Clean water	Water industry natural environment programme (clean)						
	Water resources management plan						
	Drinking water quality						
Wastewater	Water industry natural environment programme (waste)						
	Drainage and wastewater management plan						
	Bioresources						
Resilience	Clean water resilience						
	Clean water security						
	Wastewater resilience						
	Wastewater security						
	Living with Water						
Net zero	Carbon and energy						

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about this at
Long-Term Delivery Strategy

2.3.6 Customer Support

We know from the wide range of research we have undertaken that the natural environment and improving this is high on our customers agenda. In our own affordability and acceptability testing we presented our customers with the improvements we plan to make in the natural environment including enhancing biodiversity, improving rivers and reconnecting 400km of river throughout Yorkshire to allow fish passage, our customers were very impressed with this.

> *"I'm actually quite surprised that Yorkshire water is involved so much in nature, like when they were talking about removing the barriers for the fish and improving biodiversity... anything that helps nature to thrive is always going to be great" Female, 18-44, YW Affordability and Acceptability Testing, Sept 2023*

> *I also feel positive about the chalk stream project and the removal of fish movement barriers." Female, East Riding, 25-34, YW Affordability and Acceptability Testing, Sept 2023*

In addition, our own Valuing Water customer priorities study and our engagement with customers in the Defra storm overflows consultation highlights that actions to reduce our impact on rivers and actions which improve rivers overall are of the highest priority. Our customers support our approach to improving and reconnecting Yorkshire's rivers, 79% of customers found our plan to be acceptable in our own affordability and acceptability testing meaning we are

delivering on areas which are important to our customers. To learn more about our customer and stakeholder engagement, please visit Chapter 6 of our main business plan.

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

2.3.7 Factors Outside of Management Control

Please refer to section 1.3.2.

2.4 Best Option for Customers

2.4.1 Options Considered

This process followed the EA WINEP methodology[18] and involved combining potential risks and issues brought to our attention via any route (stakeholder, customers, etc) since PR19 with potential risks and issues identified by a Geographical Information System (GIS) search using the latest YW asset data, resulting in a 'long list' of 98 risks and issues.

For investigations, there is only one option for undertaking these with the appropriate level of rigour. However, the investigations will consider the potential for wider benefits to customers. For example, where options could enhance wider biodiversity, such as creating a natural bypass channel, or provide recreational benefits e.g., canoe access, we will consider this within the investigation and optioneering process.

For the improvement schemes, we can typically choose from four options to provide solutions which are dependent on site conditions and constraints. The options are removal of the obstacle, an easement (typically minor alterations to the weir, such as baffles), a bypass channel, or a technical fish pass. Similar to the investigations, the potential for wider benefits to customers will be considered during optioneering.

Fish passage:

Through consultation with the Environment Agency and Natural England, risks and issues associated with the relevant drivers were first identified. Yorkshire Water undertook assessments of YW owned assets and consulted with catchment stakeholders to confirm the applicability of drivers to the risks and issues identified.

This process resulted in the following projects being entering the WINEP:

- 2 no. WFD_IMP_WRHMWB
- 1 no. WFD_IMP_PHYSHAB
- 7 no. WFD_INV_PHYSHAB
- 1 no. WFD_INV_WRHMWB
- 1 no. NERC_IMP

Similar consultation with the Environment agency was carried out for River Restoration which resulted in the need for two projects as below:

River Restoration:

- 1 no. WFD_IMP_PHYSHAB
- 1 no. WFD_INV_PHYSHAB

For the NERC_IMP Partnership scheme ('Great Yorkshire Rivers'), the table below outlines the process followed in development of the scale of the YW funding and match funding available. Through co-design with the relevant regulators and catchment delivery partners, the scale of

[18] https://www.gov.uk/government/publications/developing-the-environmental-resilience-and-flood-risk-actions-for-the-price-review-2024/water-industry-national-environment-programme-winep-methodology

investment is considered to be proportionate to the Need and represent the best option for customers.

Table 1.6: NERC Funding Process

Date	Details
PR19	Development of S41 NERC Act fish passage Partnership project concept
AMP7	Delivery of S41 NERC Act fish passage Partnerships across 6 Partners and 4 catchments. Mix of project delivery and capability building via support for fish passage specific roles within 3rd parties.
December 2021	Anticipating PR24, YW approached potential fish passage catchment Partners for project concepts
Jan 2022	Long list of projects shortlisted with EA to align with joint ambitions and follow on from AMP7 fish passage Partnerships. Recognition of requirement for enabling framework to ensure delivery of shortlist
Jan – June 2022	High level discussions with EA and The Rivers Trust (RT) around enabling Framework. Agreement on mutual ambition and need for enabling framework – "Great Yorkshire Rivers Partnership". Memorandum of Understanding developed, circulated and supported at EA Yorkshire Board level and TRT Director level.
June 2022	Finalised project list transposed into PR24 planning. Level of ambition set.
June 2022	Director level commitment to YW – RT Strategic Partnership, further strengthening relations and ambitions
October 2022	AMP7 funded fish passage Partnership with RT entered to generate runway into AMP8
November 2022	YW Presentation of GYR project to EA Yorkshire Fish Passage Board. EA National issued letter of support.
December 2022 – March 2023	YW, RT and EA workshops to conceptualise and agree AMP8 Partnership Terms of Reference, Activity plan and identify match funding opportunities.
March 2023	YW-EA Match funded role to support GYR development and implementation recruited.
May and June 2023	Letters of support for scheme issued by EA and RT senior leaders (see embedded documents below)
June 2023	First Board meeting of Great Yorkshire Rivers
10th July 2023	23 representatives from 12 potential delivery Partners met for face-to-face workshop in Leeds to learn about GYRs and be invited to form GYRs Steering Group
14th July 2023	GYRs formally launched at opening event for recent fish pass scheme. Attended by Nicola Shaw (YW CEO), Mike Dugher (EA Area Director), Mark Lloyd (RT CEO).

Our preferred solutions are set out under 'the scale and timing of investment' section.

2.4.2 Cost-Benefit Appraisal

We have not undertaken a detailed CBA. Limited solutions are available to meet the distinct need and specifications for each site.

2.4.3 Carbon impact and best value

Given the narrow scope of solutions available for investigations or improvements, carbon impact or nature-based solutions have not been key factors in our option selection.

2.4.4 Impact Quantification

There is no impact on performance commitments resulting from this enhancement totex.

2.4.5 Third Party Funding

In response to our query regarding partnership contributions Ofwat stated that: “Benchmarking will only take into account contributions made by third parties to enhancement schemes proposed by companies which are consistent with the proper carrying out of statutory functions. These third-party contributions would pay for costs that customers would otherwise have to pay for.”

£10.4m has been identified as potential match funding for fish passage Partnership programme. See Table 1.4 above outlining how match funding was identified. This investment is focussed on the aims and outcomes of third parties and will contribute to work beyond YW statutory duties therefore we have not accounted for this funding within our reporting.

During both AMPs 6 and 7, we have demonstrated that YW funding directed via Partnership projects attracts significant match funding and delivers significantly improved environmental outcomes than would have been able to be delivered by YW alone.

2.4.6 Customer Views

For information on how we consulted with our customers on this enhancement case, see the section on customer support above.

2.4.7 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

2.5 Cost Efficiency

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in section 7.3 in Introduction to Enhancement Cases, has been applied to this enhancement case. Table 1.2 at the beginning of this document summarises the costs associated with this enhancement case:

2.5.1 Cost estimate for our preferred option

Our costing estimate has been developed bottom up, using engineering judgement based on our past experience. The assumptions used to develop our fish passage and river restoration costs are discussed in turn below.

2.5.1.1 Fish passage cost development

As outlined earlier in this document, we have proposed an investment of £22.8m totex during AMP8 for fish passage projects, £10.4m of which is partner matched funding contribution. The table below outlines the approach taken for actions covered by this investment.

Table 1.7: Cost Estimate Approaches

Scheme	Approach
Townhead weir	Implementation solutions at these sites were costed using internal cost models for similar projects, which have captured outturn cost data since AMP5.

Springhead weir	Previous schemes were reviewed to inform the scope of solutions proposed for AMP8, with site specific factors accounted in the design of options. With the scope of each solution determined, historic cost data of related activities was used to develop an overall solution cost.
Wharfe pipes	
Investigations	Our proposed investigation cost for AMP8 fish passage projects is based on an average cost across the 8 sites to be assessed during the period. The submitted cost is based on our experience of similar investigations during the current price control.
Great Yorkshire Rivers Partnership	The project list captured by the Great Yorkshire Rivers Partnership has been co-designed with a range of stakeholders, including the Rivers Trust and Environment Agency. Both organisations have endorsed the investment requested within this enhancement case. Formal CBAs and associated documentation have been submitted to the Environment Agency as part of the WINEP process. Cost estimates were also developed through engagement with stakeholders, who were involved in identifying candidate schemes, required budgets to deliver and potential for match funding to be secured. The overall funding estimate therefore represents the cost of the final projects put forward for investment through the partnership. This includes internal on cost estimates associated with enabling the formal start up and administration of the partnership, and to manage the delivery of projects. Crucially, the £7.7m cost estimate to support the core delivery of the partnership and its proposed projects is associated with unlocking up to £10.4m of Partner match funding

2.5.1.2 River restoration cost development

We propose a total investment of £1.1m totex during AMP8 for our two river restoration projects. The cost for each project is set out earlier in this document in Table 1.5.

We have costed the schemes using the outturn costs of our current AMP7 schemes. We believe the AMP7 schemes provide a reasonable basis to estimate our future costs, as they are similar schemes which we have scaled up to provide forward looking cost estimate of our AMP8 schemes.

Table 1.8: Cost Estimate Approaches

Scheme	Approach
Guiseley Beck & Yeadon Gill river restoration	Implementation solutions at this site was costed using internal cost models for similar projects, which have captured outturn cost data from AMP7. Previous schemes were reviewed to inform the scope of solutions proposed for AMP8, with site specific factors accounted in the design of options. With the scope of each solution determined, historic cost data of related activities was used to develop an overall solution cost. This project is similar to an AMP7 project, so the previous costs were scaled up by a factor of two based on a larger geographic coverage of the site. Funds have also been included to address a fish passage issue caused by a wastewater pipe, the value was determined by a similar AMP7 scheme.
River restoration investigation	Our proposed investigation cost for AMP8 fish passage projects is based on an average cost of AMP7 investigations across the 2 sites to be assessed during the period. The submitted cost is based on our experience of similar investigations during the current price control. Cost build up also includes costs for an intensive desked based review.

2.5.2 Efficiency of our cost estimate

Section 7.3 in Introduction to Enhancement Cases outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

In developing our implementation cost estimates for fish passage projects, we have applied a detailed bottom-up approach to determine the scope of solutions, building on our experience of delivering similar projects. Our cost estimates have been informed by historic cost information from similar projects.

In developing our investigations cost estimates, we have agreed the scope of investigations in AMP8 with the Environment Agency. We have considered historic costs of delivered related activities within the scopes of the investigations in determining our final estimates.

Our proposals for the Great Yorkshire Rivers Partnership have been co-developed with a wide range of stakeholders, who have brought their expertise to inform the overall scope and cost estimate of the project. We have ensured value for money for our customers through our partnership work in this area to unlock significant match funding opportunities to deliver solutions efficiently.

2.5.3 Need for enhancement model adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging. However, for this driver we anticipate (based on PR19) that Ofwat will not produce a cost model and would assess this expenditure through a shallow or deep dive dependent on materiality.

2.6 External assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

2.7 Customer Protection

Our enhancement totex for this case does not meet the materiality threshold for any PCD groupings. There is sufficient regulatory oversight for our activities under the WINEP, therefore we do not propose any customer protection mechanisms for this case.

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

2.7.1 Third Party Funding or Delivery Arrangements

For the Great Yorkshire Rivers partnership, the potential to attract £10.4m in partner funding has been identified and the risk of not achieving this is considered low based on similar initiatives in AMP6/7. If this target is not achieved GYR will still have £7.4m which will deliver benefits to customers albeit at a lesser level and will deliver the activities identified in this enhancement case.

3. Water: Fish Screening & Eels Protection

3.1 Driver:

There are two drivers for fish screening in AMP8:

- Eel Regulations (Driver Codes EE-INV and EE-IMP)
- Salmon and Sea Trout Entrainment (Driver Codes SAFFA-INV and SAFFA-IMP)

3.1.1 Requested Investment:

Table 1.1: Costs for Fish Screening Case

	£m	Table Line Ref.
Enhancement Expenditure Capex	9.698	CW3.3, CW3.31
Enhancement Expenditure Opex	0.289	CW3.4, CW3.32
Base Expenditure Capex		
DPC value	0.000	
Total	**9.987**	

3.1.2 Associated Reporting lines in Data Table:

Table 1.2: CW3 Reporting Lines

Line Number	Line Description
CW3.4	Eels/fish entrainment screens; (WINEP/NEP) water capex
CW3.5	Eels/fish entrainment screens; (WINEP/NEP) water opex
CW3.6	Eels/fish entrainment screens; (WINEP/NEP) water totex
CW3.31	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water capex
CW3.32	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water opex
CW3.33	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water totex

3.2 High Level Driver description

3.2.1 Eels Regulations

The Eels Regulations (2009) came into force on 15 January 2010 to identify and address 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. To be legally compliant with the Eels Regulations, all intakes (capable of abstracting at least 20 m^3 per day), obstructions (including weirs) and all outfalls must be screened for eel unless considered exempt.

The Environment Agency (EA) has been working across all relevant sectors that own and/or operate water intakes and weirs, to identify how they can protect eel and help restore the stock to a sustainable level. For example, as both owners and operators of river intakes that abstract raw water for treatment and distribution, Yorkshire Water has been identified as one of the organisations that needs to either modify some of its existing river abstraction infrastructure (intake screens) where an impact on eels is confirmed/likely or undertake investigations to understand any potential impact.

The risk to eels was prioritised as high, medium, or low and this was based on a model output which factored in distance from the sea, the size of the abstraction and the presence of eel. For barriers, the distance from the sea, the number of preceding barriers downstream of the asset and the length of river that would be made available by barrier removal/installation of a pass were used to produce the prioritisation.

There are two categories of work under this Driver:

- EE-IMP - Schemes to improve 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).
- EE-INV - Investigation required to confirm presence of eels/risk of eel entrainment/identify that a structure is a barrier to eel passage and to determine appropriate action.

For AMP8 there is one implementation scheme (IMP) and two investigations (INV) required under this driver.

3.2.2 Salmon and Sea Trout Entrainment

Effective intake screens minimise the risk of juvenile and post-spawning adult salmon or sea trout being lost or delayed as they migrate downstream. With many salmon stocks at critically low levels any losses or reduction in the amount of spawning that takes place is likely to affect the numbers of fish in future generations.

The Salmon and Freshwater Fisheries Act 1975 (SAFFA) requires us to:

- install physical fish screens at river intakes to prevent the entrainment and impingement of salmon and sea trout.
- investigate to determine the screening requirements or risk of entrainment, should waters that are not yet frequented by salmon or sea trout, be frequented by them at some point in the future.

In AMP8, we propose one investigation across five upland freshwater intakes and their potential for being frequented by salmon and sea trout, as presently there is an absence of fisheries data in these areas. The habitat suitability and water quality will also be assessed.

3.3 Need

3.3.1 The Need for the Proposed Investment

3.3.1.1 Eels Regulations

In line with the recently published Driver Guidance, in PR24, water companies are expected to complete improvements at all remaining high priority intakes and high and medium priority barriers to eels. In addition, the remaining medium priority intakes have been reviewed and water companies are expected to deliver screens for eels at sites that have an original prioritisation score of 50 or higher in PR24. All other medium and low priority abstractions (with a score of 49 or less) and low priority barriers should be addressed if capital/maintenance works at a site are planned during the PR24 delivery window.

The EA has identified three medium or high priority sites for Yorkshire Water to address in AMP8. As agreed with the EA, we will upgrade the existing bandscreens with a fish screen of smaller mesh size at Elvington WTW river intake (River Derwent). We are also required to investigate the Moor Monkton intake on the river Ouse and the Stoneferry Bridge intake on the river Hull to determine if any improvement works are required.

3.3.1.2 Salmon and Sea Trout Entrainment

Consultation with the Environment Agency together with site visits during 2022 resulted in a requirement for a single investigation. We will investigate and quantify the risk of entrainment to salmon at the following intakes:

- River Burn
- Birk Gill
- River Laver
- Stock Beck
- Carlesmoor Beck

3.3.2 The Scale and Timing of the Investment

3.3.2.1 Eels regulations

We propose to undertake:

Table 1.3 Summary of solutions related to eels regulations

Site	Solution	Description	AMP8 totex (£m)
Elvington WTW river intake on the river Derwent	Improvement (high priority)	Installation of bandscreens with smaller mesh	9.698
Moor Monkton river intake on the river Ouse	Investigation (high priority)	Investigate whether bandscreen with smaller mesh is required	0.115
Stoneferry Bridge intake on the river Hull	Investigation (medium priority)	Investigate whether risks to migrating elvers	0.058

One large scheme will be delivered (Elvington) and two smaller investigations (Moor Monkton and Stoneferry Bridge) during AMP8. In addition to the cost of the physical fish screens, significant civils works will need to be undertaken at Elvington to accommodate the new screens such as modifications to the pump house (containing bandscreens) and intake. The regulatory output date for the Eels Regulations work is March 2030, therefore this scheme must be delivered and signed off by the Environment Agency during AMP8.

The preferred solution has been agreed with the Regulator and is considered the best practise solution for fish screening at river intakes. The existing solution, installed in AMP4 to meet another regulatory driver, does not meet the requirements of the Eels Regulations, which came into force later and are more stringent.

Refer to the section ‘Best options for customers’ for our approach to determining the preferred solution.

3.3.2.2 Salmon and Sea Trout Entrainment

We propose to undertake:

Table 1.4 Summary of solutions related to salmon and sea trout entrainment

Site	Solution	Description	AMP8 totex (£m)
Intakes on the River Burn, Birk Gill, River Laver, Stock Beck and Carlesmoor Beck	Investigation (high priority)	Investigate whether risk of entrainment of Salmon	0.115

We propose £115.5k (c£23k per site) to undertake studies comprising site walkovers, electrofishing surveys, habitat suitability assessments, water quality analysis and associated reporting and recommendations. This cost has been developed through a bottom-up approach and based on similar studies (under different drivers) undertaken in previous AMPs. No previous works have been undertaken specifically for salmon or under the SAFFA.

3.3.3 Interactions with base or previous funding

We confirm this enhancement case does not overlap with base funding or any allowances in previous price reviews.

As the initial compliance date for the Eels Regulations was from 1st January 2015, Yorkshire Water was required to undertake some works to achieve compliance during AMP6. Between 2015 and 2020, intakes classed by the Environment Agency as "high priority" for screening under this driver had to be screened for the protection of Eels. For this driver the Environment Agency specified the sites / locations that water companies were required to address by undertaking a risk-based approach. For both the AMP6 and AMP8 work, sites that are in low-risk locations (>150 m in altitude and >100 km above the tidal limit) and abstract less than $20m^3$ per day, will not require eel passage or screening measures unless there is robust evidence of a naturally occurring population of eels at that location.

Previously funded schemes under the Eels regulations in AMP6 were undertaken at different sites to those identified for AMP8. For reference, AMP6 schemes included:

- Installation of Johnson's passive wedgewire cylinder screens at Loftsome Bridge intake on the River Derwent.
- Minor modifications to the outfall at Ruswarp WTW.
- Installation of fish pass Hempholme weir on the River Hull.

In PR19 (AMP7) water companies were asked to focus on outstanding high priority eel structures. YW did not have any remaining high priority structures, so no work pertaining to the Eels Regulations driver was required in this AMP.

3.3.4 Long-term Delivery Strategy Alignment

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about our LTDS at
Long Term Delivery Strategy

3.3.5 Customer Support

We have not carried out specific customer engagement related to this enhancement case given that it is a statutory requirement.

3.3.6 Factors Outside of Management Control

Please refer to section 1.3.2.

3.4 Best Option for Customers

3.4.1 Options Considered

Only "Best practice" screening solutions have been considered as they offer the best possible protection for migrating fish. No alternatives were reviewed as they do not offer the appropriate level of fish protection.

We set out our solution development across the three sites identified by the EA.

1. **EE_IMP: Elvington WTW intake on the river Derwent (High priority site)**

Back in AMP4, a scheme to install a fish return and recover system was implemented at Elvington's river intake, to comply with a piece of European legislation called the Habitats Directive. Elvington abstracts from the River Derwent, which sits in a European designated site called a Special Area of Conservation (SAC). One of the interesting features to be conserved at this site are lamprey; a small eel-like fish. To help prevent entrainment and impingement of lamprey the intake screen was modified so that any eels entering the screens could then be caught on ledges within the existing bandscreens, washed off into a channel and returned to the river.

However, because this set up does not meet the screening requirements for Eels, consultation with the Environment Agency together with site visits during 2022 have confirmed that the intake now needs further modification. Elvington river intake is classed as a high priority site under the Regulations, which therefore must be addressed during AMP8, and the existing bandscreens with a mesh size of 5mm, are 3mm too wide for the prevention of entrainment of eels. The bandscreens must be upgraded so they are suitable for the protection of the European Eel.

2. **EE_INV: Moor Monkton intake on the river Ouse (High priority site)**

Under a previous driver several AMPs ago, a Johnson's Passive wedgewire cylinder screen was installed at this intake. However, in order to meet the requirements of the Eels regulations, the screen, which currently has a mesh size of 3mm, needs to be under 2mm. However, despite being within 30km of the tidal limit, which is considered the upstream threshold for juvenile eels, it is thought that the presence of juvenile eels in this area is unlikely, as whilst the intake is within this threshold, it is towards the top limit. However, because the screens are technically not compliant with the Regulations given its position within this threshold, consultation with the Environment Agency has led to the agreement that will undertake an investigation during AMP8 to ascertain the presence of eels and therefore confirm a likely impact, which can then be addressed (if required) via a scheme in AMP9.

3. **EE_INV: Stoneferry Bridge intake on the river Hull (Medium priority site)**

This site has been identified by the Environment Agency as a medium priority site for eels. YW and the EA have agreed that a small investigation is necessary during AMP8 to find out more about this asset and whether it could pose a risk to migrating elvers. Then if the investigation concludes there is a potential impact, a scheme may be put forward to address this for delivery in AMP9.

3.4.2 Cost-Benefit Appraisal

We have not undertaken a CBA for Elvington WTW as we must replace the bandscreens to be compliant. CBAs are not a WINEP requirement for investigations.

3.4.3 Carbon impact and best value

As above, meeting the statutory requirements is the driver of this investment.

3.4.4 Impact Quantification

There is no impact on performance commitments resulting from this enhancement totex.

3.4.5 Third Party Funding

There is no third party funding for this case.

3.4.6 Customer Views

We have not carried out specific customer engagement related to this enhancement case given that it is a statutory requirement.

3.4.7 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

3.5 Cost Efficiency

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in Section 7.3 in Introduction to Enhancement Cases, has been applied to this enhancement case. Table 2.1 at the beginning of this document summarises the costs associated with this enhancement case.

3.5.1 Cost development for our preferred option

Our costing estimate has been developed using a combination of bottom-up estimates and cost estimates from external providers. Key assumptions are discussed in turn below.

3.5.1.1 Salmon and Sea Trout related cost estimate

Our cost estimate for this item was developed through a bottom-up approach. As outlined in the need for the proposed investment section of this enhancement case, consultation with the Environment Agency and site visits determined the need for a single investigation during AMP8, which is proposed to take place at 5 sites. An estimate of £23,000 per site has been included based on our previous experience of similar activities, such as; electrofishing surveys, site walkovers and habitat assessments, water quality analysis and associated reporting and recommendations.

3.5.1.2 Eels related cost development

Our cost estimates related to Eel Regulation drivers were developed using a bottom-up approach, using engineering judgement and our experience. The table below summarises our estimation approach for the three sites identified by the Environment Agency.

Table 1.5: Approach by Site

Site	Approach
Implementation – Elvington	As outlined in our identification of the best option for Customers, intervention is required during AMP8 at Elvington to replace ageing assets and to meet screening requirements for Eels. We have been working with external costing engineers to develop a detailed scope of work required for the solution, which has been approved by the Environment Agency. This scope was then tested with the market, and quotes were received from two delivery partners. As part of our costing approach, we compared this cost to related schemes delivered in AMP6, whilst noting the site-specific differences for our scheme at Elvington (including presence of a conservation area, greater complexity of civils works required and work at higher altitude). Our final proposed investment of £9.698m results from this costing exercise.
Investigation – Moor Monkton	As outlined in our identification of the best option for Customers, an investigation at Moor Monkton has been agreed with the Environment Agency during AMP8 to ascertain the presence of eels. This investigation will require fish surveys and entrainment studies to determine this. To determine whether a 1.75mm fish screen will need to be installed in AMP9, we need to confirm the presence or absence of elvers in the River Wharfe, in the vicinity of the river intake. Should elvers be found, then an entrainment study will need to be conducted to measure the likelihood that these will be entrained or impinged into the works at the current mesh size of 3mm. We have estimated this investigation will cost £115.5k, based on our experience of undertaking such activities at previous price controls and the fact that Moor Monkton is one of our biggest abstractions.
Investigation – Stoneferry Bridge	As outlined in our identification of the best option for Customers, a small investigation at Stoneferry Bridge has been agreed with the Environment Agency during AMP8 to understand the impact of the asset on eels. This is a new requirement at AMP8; since it has been assessed by the EA as a medium priority

	site with a score of 50 or more. (Conversely sites with a score below 50 do not need to be investigated). This investigation will determine the potential impact of the site on the local eel population. It will consider the amount of water abstracted, the frequency of abstraction, eel swimming speeds and approach velocities. We have estimated this investigation will cost £58k, based on our experience of undertaking such activities at previous price controls.

3.5.2 Efficiency of our cost estimate

Section 7.3 in Introduction to Enhancement Cases outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

In developing our improvement cost estimate at Elvington, we have applied a detailed bottom-up approach, working with external costing engineers to determine an appropriate solution which has been consulted on with the Environment Agency. We received quotes from two potential suppliers before determining the final investment to include within our engagement case. We have also compared the solution to outturn costs for related projects at AMP6, whilst noting the site-specific differences that drive expected differences in cost.

In developing our investigations cost estimates, we have agreed the scope of investigations in AMP8 with the Environment Agency. We have considered historic costs of delivered related activities within the scopes of the investigations in determining our final estimates.

3.5.3 Need for Enhancement Model Adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging. However, for this driver we anticipate (based on PR19) that Ofwat will not produce a cost model and would assess this expenditure through a shallow or deep dive dependent on materiality.

3.5.4 External Assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

3.6 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

Our enhancement totex for this case does not meet the materiality threshold for any PCD groupings. There is sufficient regulatory oversight for our activities under the WINEP, therefore we do not propose any customer protection mechanisms for this case.

3.6.1 Third Party Funding or Delivery Arrangements

We have no third party funding associated with the delivery of this case.

4. Water: Surface Water Catchment Management Programme

4.1 Drivers:

WFD_DrWPA_ND; WFD_DrWPA_INV; WFD_DrWPA_IMP

4.1.1 Requested Investment:

Table 1.1: Surface Water AMP8 Expenditure

	£m	Table Line Ref.
Enhancement Expenditure Capex	0.000	CW3.13, CW3.31
Enhancement Expenditure Opex	16.095	CW3.14, CW3.32
Base Expenditure Capex		
DPC value	0.000	
Total	**16.095**	

4.1.2 Associated Reporting lines in Data Table:

Table 1.2: CW3 Reporting Lines

Line Number	Line Description
CW3.13	Drinking Water Protected Areas; (WINEP/NEP) water capex
CW3.14	Drinking Water Protected Areas; (WINEP/NEP) water opex
CW3.15	Drinking Water Protected Areas; (WINEP/NEP) water totex
CW3.31	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water capex
CW3.32	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water opex
CW3.33	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water totex

4.2 High Level Driver description:

Yorkshire Water must deliver the relevant regulatory actions to ensure that the water quality of our surface water abstractions does not further deteriorate and in doing so support the health of the catchment. This is delivered through a series of catchment management actions. The overall aim of catchment management (CM) is to improve the biological and hydrological functionality of soils and keep them where they belong. Re-vegetating bare peat and blocking drainage networks helps to reduce the erosion and raise the water table. In turn this slows the runoff which not only helps the peat forming sphagnum mosses to grow, but also helps to mitigate flooding downstream by storing more water in the catchment. Raising the water table reduces the aerobic conditions that allow colour (dissolved organic carbon (DOC)) to be released from the peat. We have been undertaking peatland restoration since AMP5 and our delivery partners have had considerable effect in obtaining external funding leveraged from our committed

funding. The most recent example is the Yorkshire Peat Partnership (YPP) who have successfully obtained two grants from Defra's Nature for Climate fund to the value of £8m.

In the lowlands, our catchment approach is to engage with the agricultural sector to promote less intensive forms of farming, such as regular ploughing, and try to farm in harmony with the soil biology, rather than chemicals and horsepower. Through the integration of multi-species cover crops we can improve the soil organic matter (SOM), which enables the soil to hold up to 200 tonnes of additional water for each 1% increase in SOM. This water retention helps build resilience in the soil and mitigates extreme weather events, such as drought or floods.

These cover crops also help improve nitrogen use efficiency, by holding on to nutrients that might otherwise be lost through erosion or leaching. This in turn reduces the carbon footprint of the arable crops grown, which has seen a significant interest from the food and drink supply chain; this collaboration continues to develop temporally and spatially, including activity beyond the UK.

A further benefit of cover crops is that they provide food for pollinators and natural predator control, such as parasitic wasps or ladybirds which consume aphids, reducing reliance on insecticides. Again, this is a further saving in cost of production, making this type of farming more profitable, and therefore more likely to be sustainable in the long-term. The food and drink supply chain are willing to pay farmers in their supply chain to undertake some or all of these activities, which effectively means they are investing in catchment management interventions for their own reasons, but also helping to improve water quality, which offsets some of the need for water company activities.

4.3 Need

4.3.1 The Need for the Proposed Investment

All proposed actions and investigations are in line with Environment Agency (EA) Water Industry National Environment Plan (WINEP) driver guidance (and supplementary guidance, where relevant). The proposed investment allows Yorkshire Water (YW) to deliver against these statutory obligations.

The main driver for catchment schemes lies under Article 7 of the water framework which seeks to see no further deterioration of raw waters used for public water supplies. This remains unchanged into AMP8. Through agreement with the EA, we have developed our WINEP to address the following driver codes:

Figure 4.1: WFD_DrWPA_ND Guidance Extract

DrWPA_ND	Catchment scheme actions and measures recommended by either previous investigations; or, actions for water companies identified in safeguard zone action plans to prevent WQ deterioration to avoid the need for additional treatment (WFD 'must do'): subject to cost effectiveness, sustainability and measurement of effectiveness. Some limited post-scheme appraisal can be included in the catchment management driver. Ongoing surveillance monitoring does not form part of the WINEP and falls into the company's ongoing, business as usual operations, such as catchment monitoring for water safety plans.

Figure 4.2: WFD_DrWPA_INV Guidance Extract

DrWPA_INV	Catchment investigations by water companies to fully characterise groundwater and surface water SgZs, undertake an options appraisal and identify and recommend measures for catchment schemes to include in the next AMP period and carry out a cost benefit/cost effectiveness analysis. Monitoring as part of the investigation to understand the issue and identify the action can be included.

Figure 4.3: WFD_DrWPA_IMP Guidance Extract

DrWPA_IMP	Catchment scheme actions and measures recommended by either previous investigations; or, actions for water companies identified in safeguard zone action plans; or actions identified through other water company work, to improve WQ to reduce the level of existing treatment: subject to cost benefit and sustainability including monitoring of effectiveness of the measures. Some limited post-scheme appraisal can be included in the catchment management driver. Ongoing surveillance monitoring does not form part of the WINEP and falls into the company's ongoing, business as usual operations, such as catchment monitoring for water safety plans.

Since AMP5, our catchment management programmes have successfully delivered significant improvements to the internationally important blanket bog habitats that dominate our Pennine reservoir catchments. Peatland restoration takes time to implement, from initial engagement with landowners to the development and implementation of the restoration plan.

There are at least two phases to restoring these habitats, with re-vegetation of bare peat and blocking of drainage networks being the first. This aims to reduce erosion but also to stabilise the peat mass and raise the water table. Once this is done, then excess heather cover – which dries the peat out – can be tackled, and peat forming sphagnum mosses planted. The scale of works is ongoing as we seek to build resilience to changing weather patterns into our catchment land.

Our catchment management programme in the Lowlands has had considerable impact over the last five years, both in terms of area influenced in Yorkshire, but also our ambition to drive cultural and behavioural change in the agricultural sector. A University of Leeds paper summarises this change.[19]

By focussing on the importance of soil health, we can optimise the nitrogen use efficiency; reduce pesticide inputs through more natural processes and improve water quality. At the same time this delivers more resilient and nutritious food; low carbon raw materials; improved biodiversity and pollinator numbers and mitigates flooding by storing more water in the soil profile.

Our Sustainable Landscapes Programme and the associated Good Soils Guide (currently being used in 43 countries around the world), have demonstrated a collaborative approach that works for all. This approach is also being rolled out in other areas of the UK, and the world.

As an example of how effective usage of a cover crop can be, as part of the Sustainable Landscapes River Hull project an assessment of nitrogen content of soil was made following cover crop usage (vining peas). This cover crop intercepted up to 400kgs of nitrogen per Ha. This is a significant saving to the farmer, as the nitrogen is available to the following crop, but, more importantly from a raw water quality perspective, it prevented this nitrogen entering the underlying aquifer.

Read more about the Sustainable Landscapes Programme at **www.sustainablelandscapes.uk.com**

Read more about the Good Soils Guide at **www.soilguide.co.uk**

4.3.2 The Scale and Timing of the Investment

We propose to spend £16.1m in AMP8 to meet our obligations, including:

Table 1.3: Proposed Costs

Site	Action	Totex (£m)*	Completion date
30 upland catchments for continued peatland restoration	Catchment mgmt.	13.6	Dec 2029
6 river abstractions, spatially expanding our existing agricultural engagement initiatives	Catchment mgmt.	1.9	Dec 2029
1 investigation covering main river abstractions to	Investigation	0.5	March 2027

[19] https://spotlight.leeds.ac.uk/evaluation-of-yorkshire-sustainable-landscapes-programme/

assess the use of weather station data, and whether it can forewarn of increases in agro chemicals and sediments			
Total		16.1	

*numbers are rounded

The scale and timing of the investment has been agreed with the EA, allowing YW to deliver its' statutory obligations under the Water Framework Directive (WFD) and further aligns with previous AMPs. Our peatland restoration will continue into AMP8 to protect and enhance previous investment in these catchments. They have been degraded over decades for a variety of reasons, including government policy, and we believe they could take a significant time to get back to full health.

Our Lowland programme of works builds on our learning and relationships with farmers and the food and drink supply chain over the last seven years, and we have been able to demonstrate the benefits of investing in the landscapes where raw materials are sources. We have also helped develop what we believe were the world's first verified arable soil carbon credits through Future Food Solutions, and the BCarbon team in Houston, USA. The first 10,000 were verified on a Yorkshire Wolds Farm and sold last year.[20]

4.3.3 Interactions with base or previous funding

We confirm this enhancement case does not overlap with base funding or any allowances in previous price reviews.

Our CM programme has been supported by various regulators since we started in AMP5. AMP5 was delivered outside of base funding through Undertakings with the DWI; AMP6 was delivered through the NE/EA National Environment Programme (NEP), and AMP7 and AMP8 are being delivered with the support from the EA through WINEP.

We have agreed with the EA that there are four elements to CM activity, three of which meet the eligibility criteria for WINEP, and one that does not. Activities that do not meet the eligibility criteria are carrying out the same activities that have been completed previously in the same location. For peatland restoration this means that we may continue successive but different restoration techniques in the same catchment. In the Lowlands, this also allows us to develop more innovative farming practices with the same – and expanding – groups of farmers, with whom we have built trusted relationships over the last two AMPs.

This investment builds on the successful implementation of catchment management schemes over the last three AMPs and is delivered through partnerships such as Moors for the Future and the Yorkshire Peat partnership who both have significant experience of using our funding to access other funding, such as EU LIFE or Nature for Climate.

We also plan to expand our farmer engagement initiative working with the food and drink supply chain. Over the course of the last 5 years, we have expanded the area impacted by the sustainable landscapes farming approach from the original 16,000 Ha in three pilot areas to over 50,000 Ha. There is an appetite within the agricultural sector and the food and drink supply chain to produce raw materials with a low carbon footprint, which can be achieved through optimising nitrogen use; planting cover crops to protect, enhance and intercept these nutrients and other agrochemicals; improve soil organic matter and soil health, and sequester carbon from the atmosphere into the soil.

Peatland restoration is an ongoing process, and whilst we might be working in the same catchment over various AMPs, the implementation of measures may be different or in different areas of that catchment. This proposed investment will allow us to continue our efforts to stabilise the hydrology of these catchments, thereby building resilience to changing weather patterns.

[20] Refer to https://sustainablefutures.uk.com/carbon-bank

In the Lowlands, our influence builds over the years, growing in terms of the area of land covered and the maturity of the activities and partnerships. Whilst some of the land affected might be the same, we trial different interventions, such as cover crop seed trials, or assessing the impact that functional field margins have on natural predator control (e.g. lady birds or parasitic wasps to reduce or eliminate insecticide use) on those farms. The programme of work is structured such that techniques are tested and used as 'demonstrators' with peer-to-peer best practice sharing sessions. Farmers take a lead in demonstrating to other farmers what works, and how to implement the measures on their own farms.

4.3.4 Long-Term Delivery Strategy Alignment

Our long-term strategy for our catchment management programme is to work with key stakeholders in changing perceptions and behavioural approaches to managing land, by identifying outcomes whereby all stakeholders benefit. An example of this is the role YW played in breaking down conflict between moorland managers and environmental regulators (Bogathon) which ultimately led to a consensus that underpinned the Government's Blanket Bog restoration strategy.

This strategy both protects and enhances internationally important habitats from Exmoor to the Scottish Borders, thereby ensuring upland catchments that the company does not own would be prioritised for restoration within Countryside Stewardship schemes, and more significantly this restoration cost would not fall on our customers. In some instances, our funding, together with stewardship schemes and the government's Nature for Climate Funding has allowed us to increase the size and accelerate the scale of restoration of our upland catchments.

By concentrating on promoting a more integrated and holistic way to manage land, we have demonstrated that peatland restoration can deliver more widespread social and environmental benefits, be that flood mitigation; carbon storage, or less visibly, yet equally important, support for rural communities.

We have taken a similar ethos to our approach in the Lowlands; looking at the benefits that a regenerative approach to agriculture can deliver. These include soil protection; improvements to soil health and biology; flood mitigation through increasing soil organic matter which holds more water in the soil profile; increased biodiversity and pollinators; more resilient supply chains; low or zero carbon cereal crops; improved farm profitability; reduced input costs, and not least, improved water quality.

We have shown that the sustainable landscapes approach delivers for all stakeholders and through the development of The Carbon Bank, we have provided a platform where the food and drink supply chain can buy these carbon credits which reduces their liabilities whilst specifically supporting the regenerative agriculture approach that delivers the aforementioned benefits. This approach is also being replicated in other areas of the UK, and worldwide in some cases.

Over and above this we are partnering with another wheat supply chain, whereby they will pay for farmers to implement regenerative agriculture techniques that will have benefits to raw water quality at no cost to our customers. As there are minimal downsides to this approach, the aspiration is that it will become business as usual, and our direct investment should tail off, leaving the food and drink supply chain to invest back in the landscape that they source their raw materials from.

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

Read more about this at
Long-Term Delivery Strategy

4.3.5 Customer Support

We have worked with the NFU and the Moorland Association (MA) since 2005, through shared participation in research groups like the Upland Hydrology Group, and Catchment Sensitive Farming Steering Groups. More recently, other stakeholder groups have emerged through the EA's Catchment Based Approach, whereby catchment partnerships across England help to coordinate and deliver the various River Basin Management plans. These are mostly hosted by Rivers' Trusts and Wildlife Trusts and include members from the NFU and MA, where relevant,

along with many other interested parties. These partnerships meet regularly and allow us to share our work with others that may not be familiar with it.

We seek to manage the YW rural estate in an open and inclusive way to support our tenants' livelihoods and aspirations. In turn we hope to influence practices on land that we do not own. Examples of where behaviours have changed include a recognition that wetter moors with less heather and more sphagnum moss can provide a more resilient habitat for breeding birds – not just grouse – due to a changing climate. Again, Lowland farmers who engaged with the Sustainable Landscapes (SL) programme were initially sceptical of the programme, but as it has become clear that the partnership works in a way that aims to benefit all members and supports successful, profitable methods of farming, the enthusiasm for participating in one of the SL Innovation Groups is ever growing.

Finally, the approach and markets we have developed within arable farming has matured the thinking of supply chains, as they see the more holistic benefits of supporting regenerative farming, rather than just demanding cheaper prices from their suppliers. All these examples, and more, demonstrate that this approach works for all, and it has been extremely rewarding to see this being replicated in other areas of the world.

4.3.6 Factors Outside of Management Control

Please refer to section 1.3.2.

4.4 Best Option for Customers

4.4.1 Options Considered

Catchment management is a sustainable way to mitigate raw water quality deterioration, whist building resilience to changing weather conditions. This approach is fully supported by the EA and includes peatland restoration, such as grip blocking and revegetating bare peat, but also farmer engagement to optimise agro-chemical use and a focus on improving soil management. The latter can also deliver flood management and biodiversity benefits, along with the ability to store and sequester carbon, through the growth of cover crops.

A key theme across our CM programme is identifying opportunities to work in collaboration with other interested parties. Examples include grouping together the various peatland restoration programmes in the north of the country, under the banner of the Great North Bog. This allows us to share our respective programmes of work with others, which allows coordinated approaches to identifying external funding opportunities, or indeed the phasing of work to ensure there is sufficient contractor availability, which in turn provides more competition between contractors, and thereby improved value for money for our customers.

An example of collaboration in our Lowland programme is a coordinated approach to sourcing cover crop seeds for our various SL initiatives. This bulk buying reduces the overall cost to YW, but also allows farmers to buy additional cover crop seeds over and above the 10Ha we offer each farmer. There are other SL programmes outside Yorkshire which are not funded by Yorkshire Water, but those farmers can also benefit from reduced prices for cover crop seeds, and soil/ data analysis The various partnerships and collaborative projects we have developed since AMP5 have delivered more than our customers have funded, through access to EU LIFE funding; Nature for Climate, or more recently investment coming from the food and drink supply chains.

Whilst our customers should not pay for the associated benefits, such as flood mitigation, or improved biodiversity, we consider it appropriate to invest in solutions which address raw water quality issues that can also protect these assets from a changing climate. The alternative would be to invest in very expensive water treatment processes, which would not have these wider environmental and societal benefits, nor would the attract third party funding. Projects included in PR24 involve continued and expanded plans to restore peat habitat in our upland catchments and continued expansion of our SL agriculture programme.

4.4.2 Cost-Benefit Appraisal

The catchment solutions outlined in this enhancement case have been assessed against YWs Service Measure Framework. Benefits have been attributed to Compliance Risk Index (CRI) and improvement to land use. The CRI benefits are based on forecast improvements to raw water quality entering the Water Treatment Works across the region, therefore reducing the likelihood of water quality failures. See the CW15 data tables and commentary for further details.

4.4.3 Carbon impact and best value

Peatland restoration delivers carbon storage and sequestration so delivers a carbon benefit. This benefit is captured against YWs Service Measure Framework through the improvement in land use in comparison to end of pipe treatment and construction of new water production and treatment facilities which is carbon costly requiring significant construction and use of high carbon materials such as concrete and steel.

4.4.4 Impact Quantification

In addition to carbon storage, peatland restoration also delivers wider environmental and societal benefits, such as flood mitigation; biodiversity enhancement and supports the rural economy.

Working with the agricultural community and the food and drink supply chain improves water quality but has a significant environmental and societal impact. Improving and enhancing soil organic matter allows fields to hold more water – flood mitigation; sequester carbon which can now be traded to provide zero carbon raw materials; provide significant biodiversity benefits (cover crops provide habitat for pollinators and natural predation, such as parasitic wasps); improves nitrogen use efficiency (and cost); improves resilience to changing weather patterns, and is more profitable, thus more likely to become business as usual.

Read more about this at
https://sustainablefutures.uk.com/carbon-bank/

4.4.5 Third Party Funding

There is no expected third party funding to contribute to our programmes, but any that does arise that we can access will help deliver more activity in our plans. That may be third party investment to protect our internationally important peatland habitats or further expansion of Landscape Enterprise Networks (LENs), where the food and drink supply chain are able to financially support payments to farmers for implementing regenerative farming measures e.g., minimum tillage; improve nitrogen use efficiency or cover crops to enhance and protect our agricultural soils.

4.4.6 Customer Views

We have not carried out specific customer engagement on solution options related to this enhancement case given that it is a statutory requirement.

4.4.7 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in the Introduction to Enhancement Cases appendix.

Read more about this at
Introduction to Enhancement Cases

4.5 Cost Efficiency

This section outlines how our overall approach to cost estimation and cost efficiency, as described in section 7.3 in the Introduction to Enhancement Cases appendix, has been applied

to this enhancement case. Table 1.1 at the beginning of this document summarises the costs associated with this enhancement case:

4.5.1 Cost estimate for our preferred option

Our costing estimate has been developed bottom up, using expert judgment based on our experience of delivering similar schemes. The assumptions used to develop our peatland restoration, catchment management and investigation costs are discussed in turn below. The values discussed have been reviewed and agreed with the Environment Agency through the WINEP process.

4.5.1.1 Peatland restoration cost development

We have worked closely with the Yorkshire Peat Partnership to develop detailed scopes and cost estimates for the proposed solutions to continue peatland restoration at 30 upland catchments during AMP8. Scopes have been developed on a site-by-site basis, based on the specific measures that are required to improve their health.

Yorkshire Peat Partnership is part of the Great North Bog initiative, which brings together the expertise of organisations including the North Pennines AONB Partnership and the Moors for the Future Partnership. The board of the Great North Bog meets regularly to share knowledge and best practice, to consider the phasing of peatland restorations work with consideration of capacity within the supply chain, and to ensure adequate checks and balances are present in tendering processes.

Bottom-up cost estimates have been developed for each site, using the expertise of these organisations and historic cost information gathered through our work together for over ten years on similar projects.

4.5.1.2 Catchment management cost development

We have developed cost estimates for 6 sites to expand our existing agricultural engagement initiatives in the Lowlands. Cost estimates have been developed based on our experience of delivering current and previous initiatives similar in scope and using historical cost information.

4.5.1.3 Investigation cost development

We have agreed the scope of our proposed investigation with the Environment Agency as part of the WINEP process. We have considered historic costs of delivering similar activities in determining our final estimates.

4.5.2 Efficiency of our cost estimate

Section 7.3 in the Introduction to Enhancement Cases appendix, outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case. our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

In developing our peatland restoration cost estimates, we have leveraged the expertise of external organisations to develop detailed scopes of work and associated costs. Estimates have been based on historical costs and the delivery of similar solutions in the current and previous AMPs. We have benefitted from the initiatives of the Great North Bog, using collaborative approaches to knowledge sharing in determining scopes of work, and in approaches to tendering and procurement.

In developing our catchment management and investigation cost estimates. we have compared the scope of work proposed to previous projects delivered and historic costs to determine an efficient cost estimate.

The measures outlined in this case involve significant collaboration with a range of stakeholders in our catchment areas, which unlock a wide range of benefits through innovative solutions. Whilst no formal third-party funding is associated with the investment outlined in this investment case, our past experience of delivering similar solutions demonstrates the ability of organisations such as Yorkshire Peat Partnership to leverage our investment in securing additional funding sources.

4.5.3 Need for enhancement model adjustment (modelled adjustment only)

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging.

We note that the variety of interventions and drivers being addressed in this area will make identification of appropriate cost drivers difficult and therefore we anticipate (based on PR19) that Ofwat will not produce a cost model and would assess this expenditure through a shallow or deep dive dependent on materiality.

4.6 External assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

4.7 Customer Protection

Our enhancement totex for this case does not meet the materiality threshold for any PCD groupings. There is sufficient regulatory oversight for our activities under the WINEP, therefore we do not propose any customer protection mechanisms for this case.

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

4.7.1 Third Party Funding or Delivery Arrangements

We have no third party funding associated with the delivery of this case.

5. Water: Water Resources

5.1 Drivers

WFD_IMP_WRHMWB, WFD_ND_WRHMWB, WFD_NDINV_WRHMWB, WFD_ND_WRFlow, EDWRMP_INV, HD_IMP, HD_INV, DrWPA_ND

5.1.1 Requested Investment:

Table 1.1: AMP Expenditure for the Total Water Resources Case

	£m	Table Line Ref.
Enhancement Expenditure Capex	1.728	CW3.16
Enhancement Expenditure Opex	14.115	CW3.2, CW3.14, CW3.17, CW3.29, CW3.32
Base Expenditure Capex		
DPC value	0.000	
Total	**15.843**	

Table 1.2: AMP Expenditure for the Surface Water Element Only

	£m	Table Line Ref.
Enhancement Expenditure Capex	1.728	CW3.16
Enhancement Expenditure Opex	5.018	CW3.2, CW3.29, CW3.32
Base Expenditure Capex		
DPC value	0.000	
Total	**6.746**	

Table 1.3: AMP Expenditure for the Groundwater Element Only

	£m	Table Line Ref.
Enhancement Expenditure Capex	0.000	
Enhancement Expenditure Opex	9.097	CW3.14, CW3.17, CW3.32
Base Expenditure Capex		
DPC value	0.000	
Total	**9.097**	

5.1.2 Associated Reporting lines in Data Tables (and APR if appropriate):

Table 1.4: CW3 Reporting Lines

Line Number	Line Description
CW3.1	Biodiversity and conservation; (WINEP/NEP) water capex
CW3.2	Biodiversity and conservation; (WINEP/NEP) water opex
CW3.3	Biodiversity and conservation; (WINEP/NEP) water totex
CW3.13	Drinking Water Protected Areas; (WINEP/NEP) water capex
CW3.14	Drinking Water Protected Areas; (WINEP/NEP) water opex
CW3.15	Drinking Water Protected Areas; (WINEP/NEP) water totex
CW3.16	Water Framework Directive; (WINEP/NEP) water capex
CW3.17	Water Framework Directive; (WINEP/NEP) water opex
CW3.18	Water Framework Directive; (WINEP/NEP) water totex
CW3.28	Investigations; (WINEP/NEP) - desk based study only water capex
CW3.29	Investigations; (WINEP/NEP) - desk based study only water opex
CW3.30	Investigations; (WINEP/NEP) - desk based study only water totex
CW3.31	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water capex
CW3.32	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water opex
CW3.33	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water totex

5.2 High Level Driver description:

Yorkshire Water must deliver the relevant regulatory actions to ensure that our surface and groundwater abstractions continue not to cause environmental damage or deterioration. The two main statutory drivers governing this are:

- (Water Framework Directive) (England & Wales) Regulations 2017 (also referred to as the WFD Regulations)
- Conservation of Habitats and Species Regulations 2017 (commonly referred to as the Habitats Regulations).

This includes investigating under these drivers whether our abstractions are having adverse environmental impacts and, where necessary, introducing mitigation measures (e.g. licence capping, changing the location, volume and timing of abstraction, or introducing nature-based solutions).

In addition, we must consider the longer-term changes that we may need to make in the future beyond existing statutory requirements in support of our regional Environmental Destination and through our adaptive, best value water resources plans.

5.3 Need

5.3.1 The Need for the Proposed Investment

This investment programme is driven by Yorkshire Water's WINEP obligations as defined by the Environment Agency (and, in the case of the Habitats Regulations, Natural England). All proposed actions and investigations are in line with Environment Agency WINEP driver guidance and associated Water Resources Planning Guidelines (and supplementary guidance, where relevant). The proposed investment allows Yorkshire Water to deliver against these statutory obligations:

1. The Water Environment (Water Framework Directive) (England & Wales) Regulations 2017 (also referred to as the WFD Regulations) provide a framework for managing the water environment in England. Under the WFD Regulations, the Environment Agency must prepare a river basin management plan for each river basin district. The plan includes environmental objectives and a summary of the programmes of measures required to achieve those objectives.

2. Yorkshire Water also has a duty to help protect, conserve and restore European sites. European sites comprise special areas of conservation (SACs) for specific natural habitats and species, and special protection areas (SPAs) for birds. These sites receive legal protection to help conserve the internationally important habitats and species for which they are designated, under the Conservation of Habitats and Species Regulations 2017 (commonly referred to as the Habitats Regulations).

The WFD and Habitats regulations are the main statutory obligation which our Water Resources WINEP delivers against. It requires us to improve the environment where necessary and additionally to prevent any further deterioration in the status as defined by the WFD. Our programme comprises a combination of investigations (to identify the relevant measures to deliver against the statutory obligations) and implementation schemes (where previous investigations or other drivers have identified the need for implementation through the WINEP). Through agreement with the Environment Agency, we have developed our WINEP to investigate/address the following drivers:

- WFD_NDINV_WRHMWB – **Investigating** the requirement for mitigation measures to meet WFD objectives in Artificial or Heavily Modified Waterbodies, for example in catchments impounded by reservoirs used for water supply.
- WFD_IMP_WRHMWB / WFD_ND_WRHMWB - **Implementing** mitigation measures to meet WFD objectives in Artificial or Heavily Modified Waterbodies (e.g. in catchments which are impounded by water supply reservoirs).
- WFD_ND_WRFlow – **Implementing** measures to prevent WFD deterioration from current status within a catchment.
- EDWRMP_INV - **Investigating** water environment risks and opportunities to meet outcome of regional plan.
- HD_IMP - **Investigating** impacts of water company activities, or permit / licence conditions/standards on a European site to determine the costs and technical feasibility of meeting targets.
- HD_INV **Implementing** actions to contribute to restoration of a European site to move towards meeting the conservation objectives.
- DrWPA_Inv - **Investigations** for ‘at risk’ DrWPAs or groundwater safeguard zone to identify actions investigations for ‘at risk’ DrWPAs or groundwater safeguard zone to identify actions to prevent deterioration and/or to reduce treatment. to prevent deterioration and/or to reduce treatment.
- DrWPA_ND - **Implementation** of actions through a catchment scheme, or 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.

All of the above drivers are categorised as ‘Statutory’ WINEP drivers which together support the delivery of our Long Term Delivery Strategy, developing the evidence base and determining the pace and profile of investment in our water resources management plans.

5.3.2 The Scale and Timing of the Investment

The scale and timing of the investment is consistent with the above guidance, allowing Yorkshire Water to deliver its statutory obligations under the WFD / Habitats Regulations and to meet future water needs as set out in the National Framework for Water Resources. A summary of the number of schemes by driver and associated Totex (**total £15.8m**) is summarised in the table below. All schemes must be completed within AMP8 as required by the Environment Agency WINEP guidelines / informed by the relevant statutory drivers.

Table 1.5: Costs by Driver

Scheme Type	Driver	No. of schemes	Totex (£m)
Investigation	EDWRMP_INV	2	1.28
	WFD_NDINV_WRFlow	2	0.88
	WFD_NDINV_WRHMWB	1	0.69
	HD_INV	1	2.15
Implementation	WFD_IMP_WRHMWB	3	0.68
	WFD_ND_WRFlow	6	2.71
	WFD_ND_WRHMWB	4	0.55
	HD_IMP	1	0.21
	DrWPA_ND	16	6.38
Investigation	DrWPA_INV	1	0.31
Total			**15.84**

Where implementation schemes are included, these have been subject to the relevant optioneering and cost-benefit assessment consistent with WINEP methodologies. All identified implementation solutions have been assessed as cost beneficial. Benefits have been assessed in line with the relevant EA guidance. Costs were derived based on benchmarked outturn costs for similar schemes.

Investigation schemes have not been subject to cost-benefit assessment or optioneering, rather the scope of these schemes has been agreed with regulators through the WINEP approval process and in support of the relevant statutory drivers.

The table below summaries the action types by water resources WINEP scheme:

Table 1.6: Driver Code Actions

Driver code	Asset	Action
WFD_IMP_WRHMWB	Underbank Reservoir compensation flow rules review	Review and licence variation of the compensation control curve rules for Underbank Reservoir
WFD_IMP_WRHMWB	Scout Dike Reservoir compensation flow rules review	Review and licence variation of the compensation control curve rules for Scout Dike Reservoir
WFD_IMP_WRHMWB	Worth Valley flow trial	Flow trial and licence variation to support environmental improvement in the Worth Valley
WFD_ND_WRFlow	West Beck Licence formalisation	Formalisation of licences conditions following AMP7 investigations at West Beck
EDWRMP_INV	Reservoir adaptive management	Adaptive management for long term environmental resilience in HMWBs
WFD_NDINV_WRHMWB	Heavily Modified Waterbodies No Deterioration Investigations	Investigations to support formalisation of environmental conditions not currently contained within abstraction or impoundment licences
WFD_ND_WRHMWB	Heavily Modified Waterbodies No Deterioration Licence change: Eldwick Reservoir	Formalisation of environmental conditions not currently contained within abstraction or impoundment licences

Driver code	Asset	Action
WFD_ND_WRHMWB	Heavily Modified Waterbodies No Deterioration Licence change: Embsay Reservoir	Formalisation of environmental conditions not currently contained within abstraction or impoundment licences
WFD_ND_WRHMWB	Heavily Modified Waterbodies No Deterioration Licence change: Lumley Moor Reservoir	Formalisation of environmental conditions not currently contained within abstraction or impoundment licences
WFD_ND_WRHMWB	Heavily Modified Waterbodies No Deterioration Licence change: Weecher Reservoir	Formalisation of environmental conditions not currently contained within abstraction or impoundment licences
HD_INV	River Derwent Environmental Destination	Feasibility study of meeting rCSMG in the Lower Derwent.
EDWRMP_INV	Regional Environmental Destination	Regional options appraisal for Environmental Destination
WFD_ND_WRFlow	River Ouse Abstraction	Holding Line pending completion of AMP7 investigation
HD_IMP	Mitigation measures	Mitigation measures pending outcome of HD_INV
WFD_NDINV_WRFlow	How Stean Catchwaters	Investigations into sustainability of the How Stean catchwaters abstraction licence
WFD_NDINV_WRFlow	West Beck Upper - WR Investigation	Investigation to assess possible impact of increased groundwater abstraction up to fully licenced on flows in West Beck Upper.
WFD_ND_WRFlow	Hull Wellfield - WR options appraisal.	Options appraisal and scheme planning based on AMP7 investigations
WFD_ND_WRFlow	Wolds Wellfield - WR options appraisal.	Options appraisal and scheme planning based on AMP7 investigations
WFD_ND_WRFlow	Selby Wellfield - WR options appraisal.	Options appraisal and scheme planning based on AMP7 investigations
WFD_ND_WRFlow	Doncaster - WR options appraisal.	Options appraisal and scheme planning based on AMP7 investigations
DrWPA_ND	CML - Pesticide catchment management	Implementation of targeted catchment management following recommendations of pesticide investigations undertaken in AMP7
DrWPA_ND	Nutwell - Pesticide catchment management	Implementation of targeted catchment management following recommendations of pesticide investigations undertaken in AMP7
DrWPA_ND	Highfield Lane - Pesticide Catchment Management	Implementation of targeted catchment management following recommendations of pesticide investigations undertaken in AMP7
DrWPA_ND	Goosehouse - Pesticide Catchment Management.	Implementation of targeted catchment management following recommendations of pesticide investigations undertaken in AMP7
DrWPA_ND	Hull Wellfield - Nitrate catchment management and characterisation (Springhead, Cottingham, Dunswell, Keldgate).	Catchment characterisation and initiation of catchment management with land users, primarily those in agricultural sector. Key assumptions - engage with suitable landowners.
DrWPA_INV	Irton - Nitrate catchment management and characterisation	Nitrate Catchment Management and Characterisation

Driver code	Asset	Action
DrWPA_ND	Bridlington - Nitrate Catchment Management	Revised catchment management - changes to cover crop types, cover crop application and area, application of carbon credits, review of nitrogen usage, implementation and increased monitoring of crop, soil nitrate, groundwater nitrate including data analysis and modelling/prediction of changes to groundwater nitrate concentration.
DrWPA_ND	Haisthorpe - Nitrate Catchment Management	Revised catchment management - changes to cover crop types, cover crop application and area, application of carbon credits, review of nitrogen usage, implementation and increased monitoring of crop, soil nitrate, groundwater nitrate including data analysis and modelling/prediction of changes to groundwater nitrate concentration.
DrWPA_ND	Burton Agnes - Nitrate Catchment Management	Revised catchment management - changes to cover crop types, cover crop application and area, application of carbon credits, review of nitrogen usage, implementation and increased monitoring of crop, soil nitrate, groundwater nitrate including data analysis and modelling/prediction of changes to groundwater nitrate concentration.
DrWPA_ND	Kilham - Nitrate Catchment Management	Revised catchment management - changes to cover crop types, cover crop application and area, application of carbon credits, review of nitrogen usage, implementation and increased monitoring of crop, soil nitrate, groundwater nitrate including data analysis and modelling/prediction of changes to groundwater nitrate concentration.
DrWPA_ND	Elmswell - Nitrate Catchment Management	Revised catchment management - changes to cover crop types, cover crop application and area, application of carbon credits, review of nitrogen usage, implementation and increased monitoring of crop, soil nitrate, groundwater nitrate including data analysis and modelling/prediction of changes to groundwater nitrate concentration.
DrWPA_ND	Hutton Cranswick - Nitrate Catchment Management	Revised catchment management - changes to cover crop types, cover crop application and area, application of carbon credits, review of nitrogen usage, implementation and increased monitoring of crop, soil nitrate, groundwater nitrate including data analysis and modelling/prediction of changes to groundwater nitrate concentration.
DrWPA_ND	Etton - Nitrate Catchment Management	Revised catchment management - changes to cover crop types, cover crop application and area, application of carbon credits, review of nitrogen usage, implementation and increased monitoring of crop, soil nitrate, groundwater nitrate including data analysis and modelling/prediction of changes to groundwater nitrate concentration.
DrWPA_ND	Heck - Nitrate Catchment Management	Revised catchment management - changes to cover crop types, cover crop application and area, application of carbon credits, review of nitrogen usage, implementation and increased monitoring of crop, soil nitrate, groundwater nitrate including data analysis and modelling/prediction of changes to groundwater nitrate concentration.
DrWPA_ND	Carlton Mill Lane - Nitrate Catchment Management	Revised catchment management - changes to cover crop types, cover crop application and area, application of carbon credits, review of nitrogen usage, implementation and increased monitoring of crop, soil nitrate, groundwater nitrate including data analysis and modelling/prediction of changes to groundwater nitrate concentration.
DrWPA_ND	Pollington - Nitrate Catchment Management	Revised catchment management - changes to cover crop types, cover crop application and area, application of carbon credits, review of nitrogen usage, implementation and increased monitoring of crop, soil nitrate, groundwater nitrate including data analysis and modelling/prediction of changes to groundwater nitrate concentration.

5.3.3 Interactions with Base Expenditure

There is no overlap with base expenditure.

5.3.4 Activities Funded in Previous Price Reviews

None of the investments duplicate activities funded in previous Price Reviews. Where AMP8 **implementation** schemes have been included following AMP7 **investigation** schemes, the AMP8 investment is funding the action identified in AMP7. This means that the same assets/catchments have been included where an AMP8 scheme succeeds an AMP7 investigation, but there is no duplication of investment, rather the delivery of an action following options appraisal.

For some implementation schemes which address catchment scale water pollution, activities are in the same area as previous activities but in these cases the scale and/or type of activity is significantly different. It must also be recognised (as is stated in EA Drinking Water Protected Area Guidance) that effecting change at a catchment scale will usually require decades of investment. This investment will deliver wide benefits beyond just protection of water but also benefits in terms of carbon, sediment loss, habitat creation, flood management and improved productivity.

5.3.5 Long-term Delivery Strategy Alignment

The WINEP collates the actions that water companies are required to deliver as part of their environmental obligations. Water resources focussed WINEP drivers have an ongoing, cyclical role in determining the extent and pace of changes to abstraction and the resulting impact on WRMP supply forecasts.

Our Water Resources WINEP programme for AMP8 supports Yorkshire Water's long-term delivery strategy and is aligned with our programme of long-term supply-side expenditure that enhances the supply-demand balance (e.g. delivery of supply-side enhancements).

The strategic planning frameworks WRMP, Drainage and Wastewater Management Plan (DWMP) and WINEP all feed into the LTDS. It is chiefly concerned with future enhancement investment, and the coming price period and future DWI water quality submission components will be included. The LTDS will also include future risks for the next three regulatory periods.

Our long-term delivery strategy is structured around four primary enhancement investment areas, each of which is underpinned by one or more strategic planning areas. The table below demonstrates how each investment area will contribute to achieving our long-term outcomes for customers.

Figure 5.1: Extract from LTDS

Investment area	Strategic planning area	Outcome: Secure, safe, clean water supplies	First-class customer service	Bills everyone can afford	Modern and resilient infrastructure	Net zero carbon emissions	A healthy, natural environment
Clean water	Water industry natural environment programme (clean)	■	■	■	■		■
	Water resources management plan	■	■	■	■		■
	Drinking water quality	■	■	■	■		■
Wastewater	Water industry natural environment programme (waste)		■	■	■	■	■
	Drainage and wastewater management plan		■	■	■	■	■
	Bioresources		■	■	■	■	■
Resilience	Clean water resilience	■	■		■		
	Clean water security	■	■		■		
	Wastewater resilience	■	■		■		
	Wastewater security	■	■		■		
	Living with Water	■	■		■		
Net zero	Carbon and energy					■	■

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

Read more about this at
Long-Term Delivery Strategy

5.3.6 Customer Support

While this is a statutory requirement and there has not been customer engagement carried out at a scheme level, we do know that the continuous supply of safe, clean drinking water to our customers is considered a top priority according to our Valuing Water priorities research. However, we also know from our Water Resources North customer engagement that customers often take water for granted so balancing the priority against this challenge is imperative. We also know from this research that customers are becoming more mindful of the environmental impact businesses are having, and there is an expectation that water companies must look after the environment, particularly with regards to managing our water resources.

The research also found that there was 'widespread approval' of the environmental ambition and that most wanted water companies to be ambitious and deliver enhanced protection for the environment, to support nature recovery and achieve sustainable abstraction. We saw this come out in discussions with customers during the research, with increased abstraction seen as a last resort when considering options to improve the water resources position and a clear desire for water companies to implement options that improved the efficiency of the current system instead.

To learn more about our customer and stakeholder engagement, please visit Chapter 6 of our main business plan.

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

5.3.7 Factors Outside of Management Control

Please refer to section 1.3.2.

5.4 Best Option for Customers

5.4.1 Options Considered

The water resources WINEP considers the impact of Yorkshire Water's abstraction (e.g. direct from rivers and groundwaters) or impoundment (e.g. for water supply reservoirs) licences and the measures required to ensure environmental protection whilst maintaining reliable water supplies.

All implementation schemes under these drivers have been subject to the relevant Options Appraisal approaches set out in the WINEP guidance[21] and though agreement with the Environment Agency. Where appropriate, this has included economic analysis (following EA guidance) to identify cost-beneficial solutions. This is consistent with Yorkshire Water's 6-capitals approach.

Investigation schemes were not subject to economic analysis but the estimated costs and basis for inclusion in the WINEP was agreed through consultation with the Environment Agency.

5.4.1.1 Implementation cost development

The costs associated with the implementation of the catchment interventions were considered, including operational and capital expenditures, loss of production, cost savings, and output gains. The outcome is presented in Figure 1.2.

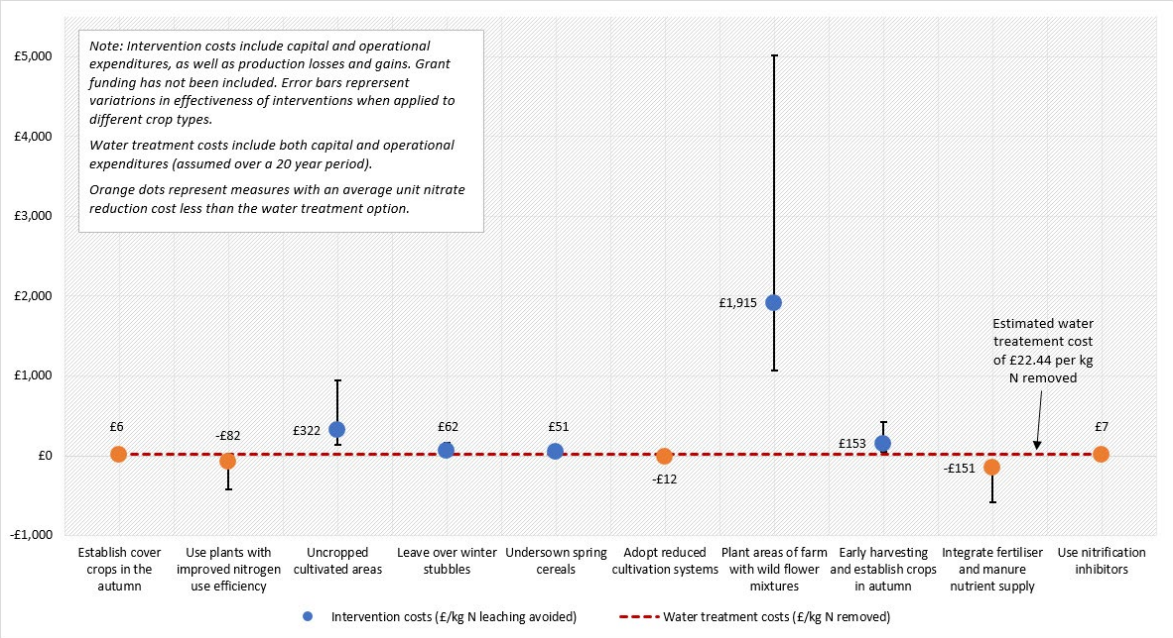
The cost implications of different interventions vary significantly from net cost savings of over £100 per hectare (use plants with improved nitrogen use efficiency; integrate fertiliser and

[21] Environment Agency (2022) Water Industry National Environment Programme: Options Assessment Guidance (Final, March 2022)

manure nutrient supply), to net costs of over £1,000 per hectare (early harvest in autumn; plant wild flower mix). Seven out of the ten shortlisted interventions would incur a net cost for the farmers, and costs associated with loss in output tend to be more significant compared with additional operational or capital expenditures.

The implementation costs of interventions have been analysed in the context of their nitrate reduction potentials to provide a directly comparable indicator to the water treatment option, as presented in Figure 1.2. The net costs (in £) per kg of nitrate avoided from different interventions vary from -£151 (win-win scenarios for both farmers and YW) to £1,915 (the high cost is mainly due to production loss). Compared with the estimated water treatment cost of £22.44 per kg N removed, a number of interventions would provide cost savings, including cover crops, nitrate efficient plant varieties, adopting reduced cultivation, fertiliser and manure integration, and nitrification inhibitors.

Figure 5.2: Comparison between intervention costs and water treatment costs (£/kg N avoided/removed)



5.4.2 Cost-Benefit Appraisal

Applying for consent for, then constructing and commissioning new raw water sources and associated treatment/distribution infrastructure is a long term and costly exercise. The investigation of impacts from existing sources followed by improved monitoring and control, or introduction of mitigation measures, is in contrast a shorter and less costly activity. The result is also greater confidence in the sustainability of our operations and a stronger evidence base for the long-term management of water resources.

As described previously, all schemes have been subject to the relevant optioneering and cost-benefit assessment consistent with WINEP methodologies There are no cost models for water resources investigations or monitoring; however, we have developed good information from previous work and current spend in AMP7 is in line with expectation. We therefore have good evidence to show that our costings based on existing work are a good measure of future cost.

5.4.3 Carbon impact and best value

Schemes and investigations have a very low carbon impact. There is little infrastructure to build – usually small observation boreholes, small temporary river flow gauges and installation of monitors. For catchment schemes there is likely to be a carbon benefit as cover crops are shown to remove and store carbon in the soil with an approved carbon credit scheme available. In comparison, end of pipe treatment and construction of new water production and treatment facilities is carbon costly requiring significant construction and use of high carbon materials such as concrete and steel.

5.4.4 Impact Quantification

There is no impact on performance commitments from this enhancement totex. As mentioned previously, it can take several AMPs for benefits from this type of expenditure to materialise.

5.4.5 Third Party Funding

There is no planned third-party funding for these drivers as the schemes largely relate to investigating abstraction operations or implementing measures to mitigate adverse impacts through licence changes. However, we are working with a number of partners and landowners and are receiving in-kind benefits from additional work they are carrying out. Farmers may expand cover cropping beyond that supported by our schemes and the Environment Agency are supporting use of existing monitoring points and data provision. For example, we provide cover crop seeds, support geological mapping, and assist/attend events with contractors so that we gain increased land area which has been positively affected and get additional data and influence with other bodies.

5.4.6 Customer Views

We have not carried out specific customer engagement on solution options related to this enhancement case given that it is a statutory requirement, but a summary of customer views of this area more generally can be found in our customer support section above.

5.4.7 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

5.5 Cost Efficiency

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in Section 7.3 in Introduction to Enhancement Cases, has been applied to this enhancement case. Table 1.1 at the beginning of this document summarises the costs associated with this enhancement case.

5.5.1 Cost development for our preferred option

Our costing estimate has been developed bottom up, using engineering judgement based on our past experience and the delivery of similar schemes in AMP7. The assumptions used to develop our surface water and groundwater related costs are discussed in turn below.

Surface water and groundwater cost development

As outlined earlier in this document, we have proposed an investment of £15.84m totex during AMP8 in our water resources enhancement case, £6.75m of which relates to surface water abstractions and £9.10m relates to groundwater schemes. The table below summarises the cost estimate for each scheme.

Table 1.7: Costs by Scheme

Scheme Type	Scheme Name	Cost (£m)
Surface Water Schemes	Worth Valley Flow Trial	0.22
	West Beck Licence Formalisation	0.38
	Scout Dike Control Rules Review	0.32
	Underbank Control Rules Review	0.13
	Reservoir Adaptive Management	0.96
	HMWB No Deterioration (Investigations)	0.69
	HMWB No Deterioration Implementation	0.55
	Regional Environmental Destination Investigations	0.32
	River Derwent CSMG Investigations	2.15
	How Stean Catchwaters	0.68
	Holding line for River CSMG complimentary measures	0.21
	River Ouse WFD No Deterioration Holding Line	0.13
	Surface Water Schemes Total	**6.75**
Groundwater Schemes	Hull Wellfield - Nitrate catchment management and characterisation	0.49
	Irton - Nitrate catchment management and characterisation	0.31
	Bridlington - Nitrate Catchment Management	0.31
	Haisthorpe - Nitrate Catchment Management	0.31
	Burton Agnes - Nitrate Catchment Management	0.31
	Kilham - Nitrate Catchment Management	0.31
	Elmswell - Nitrate Catchment Management	0.31
	Hutton Cranswick - Nitrate Catchment Management	0.31
	Etton - Nitrate Catchment Management	0.31
	Heck - Nitrate Catchment Management	0.31
	Carlton Mill Lane - Nitrate Catchment Management	0.31
	Pollington - Nitrate Catchment Management	0.31
	Hatfield - Nitrate Catchment Management	0.31
	Armthorpe - Nitrate Catchment Management	0.31
	Nutwell - Nitrate Catchment Management	0.31
	Littleworth - Nitrate Catchment Management	0.31
	Highfield Lane - Nitrate Catchment Management	0.31
	CML - Pesticide catchment management	0.31
	Nutwell - Pesticide catchment management	0.31

Scheme Type	Scheme Name	Cost (£m)
	Highfield Lane - Pesticide Catchment Management	0.31
	Goosehouse - Pesticide Catchment Management.	0.31
	Hull Wellfield - WR options appraisal	0.55
	Wolds Wellfield - WR options appraisal	0.55
	Selby Wellfield - WR options appraisal	0.55
	Doncaster - WR options appraisal	0.55
	West Beck Upper - WR Investigation	0.20
	Groundwater Schemes Total	**9.10**

Below, we outline the approaches taken to develop cost estimates for investigation and implementation solutions.

Table 1.8: Approaches

Investigation costing	**The scope of investigations under the drivers in this enhancement case have not been subject to formal cost-benefit analysis or optioneering. Instead, they have been developed and approved in conjunction with the Environment Agency through the WINEP process.** **We have developed our cost estimates by comparing the scope of these agreed investigations to those we have previously delivered and used historic cost information from similar activities to build bottom-up estimates.**
Implementation costing	As discussed earlier in this document, implementation schemes have been designed through a detailed optioneering process in line with WINEP methodologies. The proposed solutions have been developed collaboratively and agreed with the Environment Agency. We have applied a bottom-up approach to develop cost estimates for these solutions, benchmarking against historic costs for similar schemes in the current and previous AMPs. Our estimates have subsequently been optimised as part of a broader portfolio of work using our Enterprise Data Analytics tools.

5.5.2 Efficiency of our cost estimate

Section 7.3 in Introduction to Enhancement Cases outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

In developing our investigation cost estimates, we have agreed the scope of investigations in AMP8 with the Environment Agency. We have considered historic costs of related activities we have previous delivered in past investigations in determining our final estimates. In developing our implementation cost estimates, we have applied a detailed bottom-up approach to determine the scope of solutions, building on our experience of delivering similar projects and in line with WINEP guidance. Our cost estimates have been developed by benchmarking against historic cost information from similar project we have delivered.

Where external support is anticipated in the delivery of solutions, we have consulted framework rates agreed as part of our existing environmental assessment agreement to inform estimates.

5.5.3 Need for enhancement model adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging. For this driver we anticipate that Ofwat will

maintain its PR19 approach to water investigations and not produce a cost model due to the lack of relevant drivers (using No. Of Investigations as a driver would not capture the scale or scope of different investigative drivers).

We believe it would be appropriated to assess this expenditure through a shallow dive given its relative immateriality.

5.6 External Assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

5.7 Customer Protection

Our enhancement totex for this case does not meet the materiality threshold for any PCD groupings. There is sufficient regulatory oversight for our activities under the WINEP, therefore we do not propose any customer protection mechanisms for this case.

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

5.7.1 Third Party Funding or Delivery Arrangements

We have no third party funding associated with the delivery of this case.

6. Water: Biodiversity and Invasive Species

6.1 Associated WINEP Drivers:

NERC_IMP, SSSI_INV, SSSI_IMP, INNS_INV, INNS_Mon, INNS_ND

6.1.1 Requested Investment:

Table 1.1: Biodiversity Expenditure in AMP8

	£m	Table Line Ref.
Enhancement Expenditure Capex	11.842	CW3.1, CW3.10
Enhancement Expenditure Opex	14.773	CW3.2, CW3.11, CW3.29, CW3.32
Base Expenditure Capex		
DPC value	0.000	
Total	**26.615**	

6.1.2 Reporting lines in Data Tables:

Table 1.2: CWW3 Reporting Lines

Line Number	Line Description
CW3.1	Biodiversity and conservation; (WINEP/NEP) water capex
CW3.2	Biodiversity and conservation; (WINEP/NEP) water opex
CW3.3	Biodiversity and conservation; (WINEP/NEP) water totex
CW3.10	Invasive Non Native Species; (WINEP/NEP) water capex
CW3.11	Invasive Non Native Species; (WINEP/NEP) water opex
CW3.12	Invasive Non Native Species; (WINEP/NEP) water totex
CW3.28	Investigations; (WINEP/NEP) - desk based study only water capex
CW3.29	Investigations; (WINEP/NEP) - desk based study only water opex
CW3.30	Investigations; (WINEP/NEP) - desk based study only water totex
CW3.31	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water capex
CW3.32	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water opex
CW3.33	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water totex

6.2 High Level description of Drivers:

- **EA's PR24 Biodiversity Driver Guidance** – The EA's PR24 Biodiversity Driver states '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.

- **EA's PR24 Invasive Non-Native Species (INNS) Driver Guidance –** EA guidance states the *'*UK has specific international and national obligations and laws to control the spread of INNS. The retained EU Invasive Alien Species Regulations (IAS Regulations) aim to limit spread, implement controls and prevent risks from INNS. The Wildlife and Countryside Act 1981 (as amended) and the Invasive Alien Species (Enforcement and Permitting) Order 2019 provide a comprehensive regulatory regime to tackle species of special concern in Great Britain.
- **Sites of Special Scientific Interest (SSSIs) –** water companies have duties to take reasonable steps to conserve and enhance SSSIs and water companies should contribute to maintaining or meeting 'favourable condition' for sites of special scientific interest. '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.

6.3 Need

6.3.1 The Need for the Proposed Investment

6.3.1.1 Biodiversity

This investment programme is driven by Yorkshire Water's WINEP obligations as defined by the Environment Agency and Natural England. Investment delivers a step change in outcome above general base funded duties and mitigates specific impacts on biodiversity occurring by Yorkshire Water fulfilling its statutory duties.

YW have a duty to conserve and enhance biodiversity as set out in the NERC Act 2006 as strengthened by the Environment Act 2021.

Further to this, under the Environment Act, YW has a duty to contribute to key Government goals on habitat creation, preventing species extinction and improving species abundance. This should be done in a way that aligns with the still extant Biodiversity 2020 Nature Strategy and developing Local Nature Recovery Strategies (as set out in the Environment Act).

From the OFWAT PR24 methodology, it is noted that:

"We propose that all companies should have rolling programmes to assess biodiversity in order to establish comprehensive and consistent biodiversity baselines so that all of their land is assessed over a four-year period. This should also give companies and regulators a better understanding of the state of the natural capital value and associated potential on company-owned land."

And in reference to species extinction and abundance targets:
"We consider that the most appropriate way for water companies to support this third target would be through the WINEP programme as the actions may need to be specified at a detailed level, with specific deliverables."

YW relies on healthy rivers to abstract water and discharge wastewater and we recognise we have both acute and diffuse impacts on them. Rivers should be a thriving functional ecosystem, embedded within their surrounding catchment and landscape, and visited and enjoyed by the people around them.

A healthy river needs a diverse biological assemblage, with macrophytes, invertebrates, fish and mammals all as important as water quality statistics. It is not enough to focus on the river in isolation, and wetland habitats in particular all interconnect with the river ecosystem as well as provide supporting services like water quality remediation or carbon sequestration.

YW wants to invest to help build the resilience of these systems in a way that achieves a net gain to biodiversity as well as supporting the resilience of the groups and partnerships with similar agendas. We want to make sure the value we gain from biodiversity is included in how

we make decisions as a company and that we are making the right level of investment given the impacts we have and the benefits we accrue.

This programme is agreed with regulators as allowing us to fulfil the above through activities relevant to local nature strategies and ecological context and in mitigating our operational impacts on biodiversity or undertaking actions to conserve and enhance biodiversity through our operations.

6.3.1.2 Invasive species

Non-native species are organisms introduced by human activities to a geographical area in which they would not normally be found. In many cases these species do not establish a viable population or have minimal impact on the ecological function of the habitat. However, in some instances non-native species can have detrimental impacts to the ecosystem, economy or human health – thereby becoming 'invasive' non-native species (INNS). Impacts can be wide-reaching but some examples are: resource competition with native species; transmission of disease to native species, livestock, etc.; altering the abiotic conditions of the habitat; damage to industrial (including water company) infrastructure or operations from biofouling; or erosion of riverbanks and flood defence.

It has been previously estimated that INNS cost the UK economy nearly £2 billion/yr (Williams et al, 2010). Although the cost to the water industry was included in this figure (£4.7m/yr across the entire industry, including brown rat control), it is considered to have been a considerable underestimate. The report produced by UK Water Industry Research (Aldous et al, 2016) updated this estimate with an increased understanding of the water industry's INNS management activities, particularly regarding the costs levied against water-supply operations. For example, Aldous et al (2016) gave the yearly management costs of Signal Crayfish and Zebra Mussel as £150k/eradication programme and £800k/yr/company in maintenance cost, respectively. The estimated management costs to an individual water company for INN plant species (aquatic and terrestrial) control ranged from £4k-75k/species/yr. In the absence of effective biosecurity measures to reduce the INNS introductions, these figures clearly represent a potentially significant and ongoing cost to the industry. There are also legislative drivers for the water industry to effectively mitigate the transfer of INNS within their networks. Non-adherence to the legislation carries a potential for liability and reputational damage to the industry.

The PR24 guidance for INNS drivers notes:

"*Company-wide plans for managing and controlling the effects of INNS on assets and for preventing the spread of INNS should be developed and implemented where these do not already exist. These plans should include site-based risk reduction actions. These should take account of any additional threats or challenge posed by invasive species as a result of climate change. We expect to see action to support and promote good biosecurity at water company assets with public access*."

Also noted are the general principles:

- All actions to reduce the risk of introduction and spread of INNS are reducing the risk of deterioration for WFD and can be applied at any water body.
- Actions developed within the WINEP for INNS should align within the Great Britain Invasive Non-Native Species Strategy and INNS local/regional strategies.
- Investigations should use the WINEP options development guidance to help ensure the best value action is identified for PR29.
- We expect that Water Companies seek to support volunteer action and partnership working in delivering the WINEP.
- Many actions to address INNS will work best at the catchment scale.
- It might be appropriate to consider risk reduction actions for pathogens in addition to INNS when considering solutions.
- All water companies are to consider:
    - Pathways of spread - understanding and reducing the risk from pathways of spread.
    - Preventing spread - controlling, eradicating or managing INNS to prevent spread (where this will contribute to the tier 1 outcome).

- Action on INNS and biosecurity to achieve and maintain conservation objectives of SSSI and Habitats Directive sites.
- Surveillance programmes for INNS at locations of high risk of introduction.

Raw Water Transfers (RWT) (AMP7 INNS_INV) – overview

The investigations completed during APM7 identified and assessed measures and technologies that have potential utility for the reduction of INNS movement via the RWT pathway. This investigation followed a process of an initial, large scale literature review to develop an unconstrained list of biosecurity options. The unconstrained list was then sifted further through a more detailed optioneering process to produce a constrained list of options. Using defined categories and a risk assessment-based prioritisation process, the constrained options were then recommended, based on the transfer-specific technical information available at the time, at a RWT level. Individual RWTs were prioritised within the context of YW Water Resource Allocation Planning (WRAP) zone level.

Raw Water Transfers Risk Assessment tool

The Yorkshire Water RWT Risk Assessment Tool was designed to aid in the assessment of YW's raw water transfers in relation to their potential risk of transferring aquatic and riparian INNS. Developed under the scope of AMP7 WINEP measure specification forms 7YW200046 to 7YW200056, the tool followed the PR19 guidance provided by the Environment Agency for assessing RWTs, utilising a source-pathway-receptor model approach, providing a means of quantifying the relative risk of transferring INNS. The tool was designed to accommodate the diverse and complex nature of the YW RWT network and was aligned with the RWT module of the Strategic Resource Options risk assessment tool developed by the Environment Agency to future proof this process.

Raw Water Transfers (AMP7 INNS_INV) – development of unconstrained list of actions

The development of the unconstrained list was informed through a large-scale review of biosecurity methods within peer-reviewed and grey literature; knowledge of water industry processes and related industries (e.g., aquaculture, maritime technology); awareness of biosecurity best practice; and a review of more general equipment with a perceived applicability to RWT biosecurity. This resulted in the consideration of a wide range of potential measures which could in theory be implemented on RWTs. Throughout the optioneering process best data was gathered to support / inform decisions and recommendations; however, expert judgment was an important factor in the review process, as was the use of a precautionary approach to address the uncertainties of this complex biosecurity problem.

The outcomes from these AMP7 investigations, together with other guidance issued by the Environment Agency, has led to the identified AMP8 WINEP programme.

6.3.1.3 SSSIs

During late AMP6 and early AMP7, YW invested in a Natural England Discretionary Advice Programme of assessment for a total of 56 SSSI units, 22 of which were then downgraded. The outcome of these assessments led to a drop on YW meeting target condition from 99.97% to the current figure of 81.3% meeting Unfavourable Recovering or better (only (3.03% in favourable).

Table 1.3: SSSI Assessments

SSSI	No of units assessed	No of units downgraded
South Pennine Moors	39	14
Dark Peak	12	4
West Nidderdale – Barden and Blubberhouses	2	1

East Niddderdale (Flamstone Pin- High Ruckles	2	2
Withens Clough	1	1
	56	**22**

At first sight, this looks as though the sites have degraded despite investment over previous AMPs. This isn't the case over the majority of the units and an explanation has been provided by NE which includes the following:

- Different monitoring methodology used in the past –less quantitative data gathering previously, and some past assessments were done from a walk-over survey, rather than using the full CSM methodology. In an ideal situation, we would be comparing 'like for like' data and change could be directly related to management.

- Different features monitored – sometimes in the past only one feature of the unit was monitored. This survey has been rigorous about assessing all of the priority habitats present on a unit. The lowest condition status of multiple features on a unit (e.g., dry heath and blanket bog) is the status of the unit overall.

- On units with multiple habitats, the focus has been on the restoration of the Blanket Bog and these interventions have had a positive impact on the condition of these habitats and they are heading towards more Favourable condition. However, the adjacent habitats such as Dry Heath and Wet Heath are tending to 'pull down' the overall condition of the unit.

- A change in management is leading to an actual decline in condition.

Blanket bogs are sensitive habitats and can take a long time to recover from the effects of drainage, erosion, burning and overgrazing. Time is necessary to allow restoration measures or changes in management to establish and have an impact on the habitat. However, the assessments have produced recommendations where an intervention seems necessary for progress including:

- Blocking of grips to increase the water table and restore hydrology.
- Inoculation of species where there is a lack of positive indicator species (if species are introduced before the conditions are ideal, then this may not be successful e.g., inoculating peat with Sphagnum before the water table has been raised and the peat sufficiently wet).
- Bracken control.
- Non-capital works including cessation of burning (or an agreed burning rotation plan – Burning is not required for the conservation management of the habitat).
- Reviewing grazing levels, particularly in winter when grazing can switch from grass to dwarf shrubs and burning rotations.
- Molinia Management plans (purple moor grass, a plant that can change the habitat type of an area of moorland and move it out of favourable status as defined by Natural England).

In order for a unit to change back to 'Unfavourable Recovering' or progress towards 'Favourable', there needs to be evidence of progress and that all management measures are in place to address the recovery process. This will mean liaising with NE throughout the AMP to discuss how each point of failure is being addressed. This will also involve:

- Close collaboration with the stakeholders over each unit including tenants, commoners, sporting rights owners and external stakeholders.
- Assent for all capital works and a plan to carry out the necessary interventions.
- Molinia management plans may be needed – these may require development and actions over multiple AMPs to deliver benefits.

-

Molinia

Molina is a type of invasive purple moor grass which can harm blanket bog restoration, reduce biodiversity and damage ecosystem health. Molina management plans will have to be agreed with all relevant parties but there is no clear steer from Natural England on how to fully tackle this area.

Molina dominance is a challenging ecological problem to solve from a restoration point of view. There are several questions which arise, including;

- What did the ecosystem look like prior to the impact of invasive Molina and to what extent can it be restored?
- What types of measures are needed to restore the ecosystem to a healthier state?
- What are the costs and benefits involved when the outcome for attempted restoration is uncertain?

Some Molinia habitats could be restored as Wet Heath or a mire system. Both would improve species richness and ecosystem diversity. In smaller areas it may be worth piloting specific measures prior to embarking on moorland-wide work.

Restoring natural processes could be a start, so re-instating the hydrology on a site by blocking any drains and wetting the peat, may reduce Molinia vigour. Following this, cutting or cattle grazing in spring and autumn could be useful. A third phase could involve re-seeding with dwarf shrubs and Sphagnum if conditions allow.

Yorkshire Water has proposed a Molinia trial involving several types of intervention under the SSSI_INV driver. The proposed research title is ‘Impacts of bunding, repeated cutting, and Sphagnum plug planting on water tables and the cover of Molinia on Molinia-dominated blanket bog in the South Pennines’.

6.3.2 The Scale and Timing of the Investment

The timing of the WINEP investment is determined by the Environment Agency, who require us to complete all investigations by March 2027 and implementation and No Deterioration projects by 2030.

Table 1.4: Costs by Scheme Type and Driver

Scheme Type	Driver	No. of schemes	Enhancement totex (22/23 £m)	Regulatory completion date
Investigation	INNS_INV	5	1.88	March 2027
	SSSI_INV	2	0.26	March 2027
Implementation	INNS_ND	4	3.63	March 2030
	NERC_IMP (excluding fish passage)	6	11.93	March 2030
	SSSI_IMP	1	8.28	March 2030
Monitoring	INNS_MON	1	0.62	March 2027

Note: Numbers may not add to total due to rounding

NERC biodiversity programme:

- Delivering a chalk stream flagship restoration project.

- Conserving and enhancing wetland habitats, including chalk streams and priority wetland habitat along river corridors subject to Yorkshire Water abstraction pressures and discharges. This is linked to the recent Yorkshire Wildlife Trust research showing that wetland habitats are the most important habitat of concern across Yorkshire to mitigate species extinction and restore lost biodiversity.
- Species conservation work where Yorkshire Water has a disproportionate ability to make a difference to regional populations, for example with native white-clawed crayfish or freshwater pearl mussel (as agreed with Stakeholders and Regulators).
- Working with external partners to improve the status of biodiversity across Yorkshire Water's land and operations by increasing the biodiversity value of our land and rivers.
- Working with Local Authorities to play our appropriate part in delivering the new Local Nature Recovery Strategies.
- Working with Catchment Partnership citizen scientists to restore priority river habitat impacted by our operations.

INNS programme:

- Working as an industry to investigate how to mitigate the impacts of raw water transfers as vectors for the spread of INNS.
- Investigating how to mitigate INNS spread via temporary drought transfers
- Working with DEFRA agency groups to develop sustainable and efficient controls on invasive non native aquatic macrophytes.
- Investigating measures to mitigate the impact of invasive signal crayfish on YW assets.
- Attempting eradication of the only population of invasive narrow-clawed crayfish in north Yorkshire (found in a YW asset) prior to their wider spread.
- Implementing the biosecurity actions identified by AMP7 investigations into raw water transfers and bioresource movements.
- Supporting catchment scale biosecurity programmes and working with third party recreational users on our assets.
- Working as an industry to support the Environment Agency INNS monitoring programme.

SSSI programme:

- Restoring SSSI Moorland in Yorkshire Water ownership.
- Investigating how to manage and remove purple moor grass from moorland habitats.
- Investigating the status of the Tophill Low SSSI site and potential actions to improve the resilience of the site.

The financial values have been reviewed by the Environment Agency through the WINEP process and they have indicated we should proceed with all submitted actions as being best value for customers and the environment, against our statutory obligations.

6.3.3 Interactions with base or previous funding

We confirm this enhancement case does not overlap with base funding or any allowances in previous price reviews.

This investment is distinct and separate from our general duties under legislation and is required to deliver a step change in outcome from general maintenance duties. For example, under our general NERC Act duties, we are required to ensure we consider biodiversity within our decision making (e.g. within the assessment process conducted to develop WRMP or DWMP options), our development projects (e.g. in ensuring that our capital scheme delivery projects deliver 10% BNG and undertake sufficient ecology surveys and screening to abide by wildlife law) and our land management (e.g. routine clearance of invasive species, or ensuring biodiversity outcomes are included in our rural tenancies). This investment has been specifically identified by the Environment Agency and Natural England as being required through the WINEP process to

allow us to make a step change in our outcomes for biodiversity and the Government policies and metrics which underpin this (e.g., creating new wildlife rich habitat, preventing species extinction etc).

Due to the long-term nature of ecosystem restoration, the WINEP NERC and SSSI investment planned for AMP8 will build on but not repeat prior activities. For example, in extending the SSSI moorland management programme under Natural England guidance where work will occur on the same sites but mitigating different pressures. There is no direct replication of already funded work being undertaken and no overlap with other enhancement investment on our land.

Previously funded work included:

- AMP7: Habitat mapping programme, freshwater pearl mussel project, biodiversity programme, river resilience project, Local Wildlife Site conservation management, Gouthwaite SSSI investigation, SSSI moorland management.
- AMP6: Ancient Woodland continuity, veteran trees project, INNS management, fish passage, crayfish investigation, biodiversity enhancement fund, SSSI moorland management.
- AMP5: Ancient Woodland restoration programme, river restoration programme, SSSI moorland management.
- AMP4: Rodley Weir bypass fish channel, corporate Biodiversity Action Plan.
- AMP3: Red kite reintroduction, Twite preservation programme.

6.3.4 Long-term Delivery Strategy Alignment

The values within our AMP8 submission have formed the basis of our LTDS response, taking into account the rapidly changing policy landscape around biodiversity, and the Government's 25-year plan targets for the Environment.

Figure 6.1: Extract from LTDS

Investment area	Strategic planning area	Outcome: Secure, safe, clean water supplies	First-class customer service	Bills everyone can afford	Modern and resilient infrastructure	Net zero carbon emissions	A healthy, natural environment
Clean water	Water industry natural environment programme (clean)	■	■	■	■		■
	Water resources management plan	■	■	■	■		■
	Drinking water quality	■	■	■	■		■
Wastewater	Water industry natural environment programme (waste)		■	■	■	■	■
	Drainage and wastewater management plan		■	■	■	■	■
	Bioresources		■	■	■	■	■
Resilience	Clean water resilience	■	■		■		
	Clean water security	■	■		■		
	Wastewater resilience	■	■		■		
	Wastewater security	■	■		■		
	Living with Water	■	■		■		
Net zero	Carbon and energy					■	■

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

Read more about this at
Long-Term Delivery Strategy

6.3.5 Customer Support

The environment has never been as high on the agenda of our customers. Our research throughout and post covid has identified that our customers' appreciation for the environment has increased, especially the local environment surrounding their homes, so improving this is always welcomed.

In testing our plan with customers via affordability and acceptability (AAT) research (outside of Ofwat guidelines), we presented the outcome 'A Healthy Natural Environment' as part of achieving our overall vision. The biodiversity PC and target sit within this outcome. Our AAT results show exceptionally high support at 85% - not only for this outcome, but also the targets to 2030 that sit within it. In addition, our overall plan is acceptable by 79% of customers.

> *"I like that it covers the needs of all stakeholders addressing pollution, sustainability, affordability, customer services, biodiversity etc. I think the targets are very specific and measurable too." Yorkshire Water Affordability & Acceptability Testing Research, Sept 2023.*
>
> *"I like the commitment to the environment and biodiversity." Yorkshire Water Affordability & Acceptability Testing Research, Sept 2023.*
>
> *"Like that it had a stated target to increase/ protect biodiversity as this is sometimes overlooked." Yorkshire Water Affordability & Acceptability Testing Research, Sept 2023*

To learn more about our customer and stakeholder engagement, please visit Chapter 6 of our main business plan.

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

Optioneering against our NERC and INNS programmes was predominately completed in collaboration with our external Biodiversity Advisory Group (BAG). This comprises of representatives of the Rivers Trusts, Wildlife Trusts and CaBA Catchment Partnerships within our operational area (Yorkshire Wildlife Trust, Sheffield & Rotherham Wildlife Trust, Don Catchment Rivers Trust, East Yorkshire Rivers Trust, Yorkshire Dales Rivers Trust, Aire Rivers Trust, Calder Rivers Trust, Esk & Coastal Streams Catchment Partnership, Derwent Catchment Partnership, Dales to Vales Rivers Network, Aire Catchment Partnership, Calder Catchment Partnership, Don, Dearne & Rother Catchment Partnership – all of whom represent thousands and tens of thousands of customers).

Additional consultation took place with other key stakeholders such as the four lead authorities for Local Nature Recovery Strategies in the Yorkshire area, representatives of the National Parks within our operational area and national NGO groups such as the RSPB and Freshwater Habitats Trusts. The programme was co-developed in iteration with Yorkshire Water specialists, the BAG and technical specialists from the Environment Agency and Natural England through a pre-existing YW/EA/NE Biodiversity Steering Group (BSG). INNS specific consultation was run with the Yorkshire Invasive Species forum and key focused stakeholders such as British Canoeing, the Angling Trust and the Canal and Rivers Trust.

Consultation process:

Stage 1, setting the framework
In October 2021, the BAG was briefed on the WISER and WINEP consultations, PR24 timeline and the likely ask of the group to help collaboratively design the YW Biodiversity Programme. In October and November, the Biodiversity Steering Group (BSG) met to review the developing guidance through the WISER and WINEP documentation and draft Options Development Report guidance as well as discussing initial expectations around likely content under the NERC driver.

Stage 2, collaboratively identifying risks and issues
In January 2022, the BAG was updated on the new WINEP guidance and options development information was shared to enable the groups to consult with internal staff and key partners, leading to a workshop in February 2022 where there was a general discussion of 'risks' and 'issues' relating to biodiversity. This workshop produced a longlist of potential solutions for inclusion in the AMP8 programme and YW encouraged additional thoughts during a consultation phase that also included external partners like Local Authorities or national NGO groups.
In February 2022, the BSG met to produce a similar longlist of risks and issues based on prior investigations, policy changes and professional judgement.

The BSG met again in March to refine the longlist into a likely shortlist for presentation to the BAG. This BAG meeting took place in March where YW summarised the feedback received and reflected what elements aligned with policy drivers and YW's corporate aspirations for biodiversity, and which elements were not likely to be taken forwards at this stage and why not.

Stage 3, proposing solutions
In May the BSG met to discuss learning from AMP7 that could feed into the AMP8 programme, updated each other on the expected PR24 timeline and compared feedback received from other national and industry colleagues.

In June 2022, the BAG met to discuss the shortlist that had been created from the longlist which pinned down the risks and issues being met by the programme. A second meeting in June discussed the potential solutions to meet these 'risks' and a further meeting in July then defined the solutions and the scale of the solution required.

A BSG meeting in July allowed YW to update on the recommendations of the BAG to ensure regulator acceptance in principle. To help define the solution, the content of the WINEP draft Action Specification Forms (ASFs) was discussed and YW undertook the action of drafting these for the NERC programme to allow the regulatory outcomes of the programme to be defined to give sense to the WINEP Options Development Report (ODR) and Options Appraisal Report (OAR).

The programme as a whole, the ASFs and ODRs were then reviewed and refined at meetings of the BSG between July and October as well as general discussions to share intelligence on good practice across the water industry, and guidance from regulators (for example the outcomes of a Water UK Conservation Network meeting or the Natural England Nature Recovery List).

Overall, the process of co-designing the programme took over a year, involved six iterations of the plan with 26 major stakeholders and many minor ones, as well as Environment Agency and Natural England staff. This gives confidence the programme is robust, appropriate and meets both legislative needs and also stakeholder priorities.

6.3.6 Factors Outside of Management Control

Please refer to section 1.3.2.

6.4 Best Option for Customers

Throughout the WINEP Options development process, there has been close engagement and co-creation with a number of key stakeholders. YW has worked closely with the EA (Fisheries, biodiversity, and environmental planning officers) and NE steering group, as well as hosting an external Biodiversity Advisory Group (BAG). The BAG comprises of representatives from all 9 Catchment and Coastal Partnership's across Yorkshire, as well as the 5 Rivers Trusts and 2 Wildlife Trusts covering Yorkshire.

Both groups have an existing relationship with us over several AMP cycles, but the intensity of meetings has increased since October 2021 during the build-up of our PR24 programme, feeding into identifying risks & issues, which were developed to generate a constrained list of options, and in helping cost and define outcomes for the programme.

Yorkshire Water have also consulted with representatives of the various Local Authority and Combined Authorities leading on the development of the four Local Nature Recovery Strategies across Yorkshire, as well as other key stakeholders such as the RSPB and National Trust. YW has also advertised widely via Catchment Partnerships for suggestions and inclusions within elements of its PR24 fish pass programme.

6.4.1.1 Process to confirm risks and issues

On publication of the Draft WISER and WINEP guidance, a series of meetings were held with the external BAG to help collate a specific response to the biodiversity elements that represented a beneficial outcome for biodiversity across Yorkshire. Catchment Partnership hosts were encouraged by YW to also submit their own response, representative of the conditions and long-term strategies within their own specific catchment.

Following publication of the driver guidance, a series of meetings were held involving both the YW/EA/NE steering group as well as the BAG. Initial stakeholder feedback was received from biodiversity technical specialists at the EA and NE as well as via the BAG, to develop a long list of pressures impacting on biodiversity across Yorkshire as well as an understanding of the bespoke regional pathways to respond to Government strategy on biodiversity. Using the guidance, YW was able to work with partners to sense check these pressures and desired outcomes against the impacts of its operations and its ability to make a disproportionate impact against their delivery. This process was iterative and involved meetings of the BAG as well as bespoke focused meetings around key habitats, species or spatial areas (For example with Catchment Partnership subgroups or species focused NGO specialists).

YW also used high level DEFRA information such as Priority habitat layers for wetland, headwater stream and other key habitats as well as liaising with Local Ecological Records Offices to ensure a good understanding of the biodiversity baseline against which work was required. Additional information was provided by Natural England through the Nature Recovery List.

In identifying risks and issues, YW have also built on the findings of AMP7 investigations and implementation plans. For example, the current ongoing AMP7 Investigation into Freshwater Pearl Mussels on the River Esk, currently ongoing AMP7 Implementation work on White-clawed crayfish and particularly, the AMP7 programme to map and value our landholdings for biodiversity.

Unlike a typical WINEP investment programme, the biodiversity programme is driven by helping conserve and enhance biodiversity, a topic that is hard to define in relation to specific assets or modelling outputs. It is clear from the multiple Local Authorities declaring a climate and biodiversity emergency as well as the well-respected State of Nature reports, that the wider risk to Biodiversity is immense, with the majority of key species and habitats having declined markedly over the past century. As such, the role of developing the constrained list is not to ‘fix’ biodiversity, but to understand through an unconstrained list the key pressures and desired outcomes to help restore and conserve Yorkshire’s habitats and species, before developing a constrained list representing what could be considered to be YW’s proportionate fair share in playing its role in this.

A large list of stakeholder suggestions was received either through direct discussion, email or through working groups of the BAG or others (e.g., the North Yorkshire Crayfish Forum or the Yorkshire Invasive Species Forum). One key theme running through the majority of suggestions as well as aligning with YW’s corporate aspirations, was recognising that in our role as a water company, we have a disproportionate ability to impact on certain key habitats and species, particularly wetland and aquatic ones. The Environment Agency amongst others note that as well as over 90% already being lost, over 10% of our freshwater and wetland species are threatened with extinction, with two thirds of our existing wetland species being in decline and note that wetlands make up only 3 percent of the UK but are home to at least 10 percent of our species.

Through YW’s own data reviews we recognise that there are key wetland habitats such as chalk streams, protected sites such as the Derwent SAC, or key aquatic species such as Freshwater Pearl Mussel that, whilst we would address any acute issues via using permitting and licensing processes, our participation alongside partners is key to help drive positive biodiversity outcomes.

The unconstrained list was reviewed internally by YW to identify broad themes and outcomes, and then with specialists from the EA and NE to refine it into a constrained list for further consideration. This was presented back to the BAG and key stakeholders for further discussion and refinement.

6.4.1.2 Robustness of our plan

The multiple plan iterations, the cost-efficient method by which solutions have been identified and costed, and the close oversight from regulators and environmental stakeholders has helped ensure the process of development and costing of this investment is appropriate and transparent.

The process is overseen by the regulatory WINEP process with project sign off only being achieved subject to approval from the Environment Agency and Natural England, with failure to achieve sign off being reflected within the composition of the company's Environment Performance Assessment rating.

6.4.2 Cost-Benefit Appraisal

We have not undertaken a Yorkshire Water specific CBA, as all actions are demonstrated to be cost beneficial via the defined Environment Agency cost-benefit assessment process. This was a criteria for the inclusion of Statutory+ drivers in the WINEP.

We have attributed benefits from this enhancement case to the biodiversity performance commitment in CW15. See data tables and commentary for further details.

6.4.3 Carbon impact and best value

The programme comprises of nature based solutions where we currently have no existing carbon model to determine impact. This will be created and reported on during AMP8 delivery through the associated carbon Performance Commitments.

6.4.4 Impact Quantification

The new Biodiversity performance commitment means we will be accountable for our planned biodiversity outcomes across this and other programmes over a long-term horizon. Whilst not all WINEP lines under these drivers directly contribute towards the Biodiversity Performance Commitment (for example, projects focused on species conservation have no direct overlap with the DEFRA habitat unit calculations), all the forecast biodiversity outcomes under the Performance Commitment are delivered against this programme, reaching an estimated outcome of 0.85 biodiversity units per 100 km^2 of our operational areas by the end of AMP8.

6.4.5 Third Party Funding

There is no third party funding against delivery of these statutory duties. Historically Yorkshire Water has been successful in identifying opportunities and working with Partners to access third party funding to deliver greater outcomes for customers, and we believe it likely this will contribute around £15m towards biodiversity outcomes between 2025 and 2030 (for example accessing Governmental or EU grants for moorland restoration, Natural Environmental Research Council grants for PhD student support and Heritage Lottery Fund and Esmée Fairbairn Foundation funding for river habitat improvements).

6.4.6 Customer Views

For information on how we consulted with our customers on this enhancement case, see the section on customer support above.

6.4.7 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases

Read more about this at
Introduction to Enhancement Cases

6.5 Cost Efficiency

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in our introduction to enhancement cases, has been applied to this enhancement case. Table 1.1 at the beginning of this document summarises the costs associated with this enhancement case.

6.5.1 Cost development for our preferred option

Our costing estimate has been developed bottom up, using professional judgement and cost models based on our past experience. The assumptions used to develop our biodiversity, SSSI and invasive species costs are discussed in turn below. The financial values discussed have been reviewed by the Environment Agency through the WINEP process, who indicated we should proceed with all submitted actions as being cost beneficial, as well as best value for customers and the environment, against our statutory obligations.

6.5.1.1 Biodiversity cost estimate

The biodiversity programme includes a range of schemes. The costs for the schemes are based on existing cost models refined by engagement with our supply chain and stakeholders. Once the constrained programme list was organised into outcome focused projects, to help cost and define benefits, the methods and feasibility of project delivery was reviewed via the BAG and in house at Yorkshire Water. This was done against existing cost models using historic programme delivery costs, as well as through discussion with other water companies, NGO groups, Local Authorities and Regulators. We were able to develop appropriate, partnership-based cost models by working with stakeholders such as the Yorkshire Wildlife Trust and National Trust, to understand the benefits and costs of working with eNGO partners rather than 'typical' consultancy and contractor supply chains.

As an example, existing cost models from previous AMPs have shown outcomes that can be achieved by YW employing Tier 1 contractors to create habitat on our land, by funding Partners such as NGOs to do similar against specific outputs, and by funding Partners to do similar against outcomes. Whilst there will always be a requirement for directly delivered work (e.g. due to H&S constraints), cost models have shown that generally, working in partnership with NGOs and Local Authorities has led to reduced costs for similar outputs, as well as wider 6 capitals benefits (e.g. whilst not like for like, river restoration on a similar length of the River Washburn cost £600k during AMP5 when led by our Tier 1 partners, and a similar length was delivered in AMP7 by working with eNGO groups and their volunteers (at c.£80k for a similar restoration project on a chalk stream with the Yorkshire Wildlife Trust and at c.£20k for a similar length with the Wild Trout Trust). Further, working with these groups generated additional social benefits through volunteer input, as well as improving sustainability through volunteer led long term management and monitoring. The third option of working with Partners focused on outcomes generates even higher 6 capitals benefits, as well as reduced financial costs where Partnership Agreements rather than Contracts have allowed the Partner to access third party funding such as Heritage Lottery Fund and European Regional Development Fund grants across recent AMP7 projects.

6.5.1.2 Invasive species cost estimate

We have included an investigation cost estimate for this work, following engagement with a supplier to determine investigation scope and proposed costs as well as benchmarking against similar existing AMP7 investigations.

The costs for the implementation scheme are based on indicative quotes from suppliers and costing provided by our internal costings teams, as well as the findings from present AMP WINEP investigations that drove the AMP8 no deterioration programme.

6.5.1.3 SSSI cost development

As outlined earlier in this document, we have proposed an investment of £0.25m totex during AMP8 for two SSSI related investigations, and £7.9m restoring SSSI Moorland in Yorkshire Water ownership. The table below outlines the approach taken for actions covered by this investment.

Table 1.5: Approach taken to SSSI Moorland

Scheme	Approach to cost development

Investigation - purple moor grass	We have proposed a Molina trial under the SSSI_INV driver. We have included an investigation cost estimate of £0.1m for this work, following engagement with a supplier to determine investigation scope and proposed costs.
Investigation – Tophill Low SSSI	We have proposed an investigation at the Tophill Low SSSI site to determine its status and any potential actions required to improve resilience. We have included an investigation cost estimate of £0.15m for this work. This is based on an estimate of £15,000 for survey and reporting work, based on historic experience of undertaking similar activity in AMP7. The remainder of the investment relates to the solution required on the site, estimated by considering previously delivered measures and additional costs driven by the specific characteristics of the Tophill Low site.
Restoring SSSI Moorland in Yorkshire Water ownership	As outlined earlier in this document, we have invested in a Natural England Discretionary Advice Programme, which highlighted opportunities to improve the status of several SSSI sites in our region. We have worked closely with the Moors for the Future Partnership to develop detailed scopes of work across our SSSI sites to achieve this objective. Costs were developed with Moors for the Future utilising historic cost information from the delivery of previous schemes for Yorkshire Water over the past ten years. Costs were based on historic costs of comparable activities.

6.5.2 Efficiency of our cost estimate

Section 7.3 in Introduction to Enhancement Cases outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

In developing our SSSI investigation cost estimates, we have compared the scope of work proposed to previous projects delivered and historic costs to determine an efficient cost estimate. In the case of Molina, we have also engaged with a supplier to inform our estimate. In developing our Moorland SSSI restoration cost estimates, we have worked closely with the Moors for the Future Partnership to develop detailed scopes of works, and to develop cost estimates based on the delivery of similar schemes and historic cost information from work over the last ten years. We have also challenged the scope of work proposed to identify efficiencies. For example, we have removed over £1m of investment from the scope of this work related to bracken and tree planting and are engaging with stakeholders for this work to be funded as part of moor management activities undertaken and funded elsewhere.

In developing our biodiversity programme, we have engaged with a range of providers in the market to obtain quotes for delivery. We also considered alternative delivery models.

As an example, existing cost models from previous AMPs have shown outcomes that can be achieved by employing Tier 1 contractors to create habitat on our land, by funding Partners such as NGOs to do similar against specific outputs, and by funding Partners to do similar against outcomes.

Whilst there will always be a requirement for directly delivered work (e.g. due to H&S constraints), cost models have shown that generally, working in partnership with NGOs and Local Authorities has led to reduced costs for similar outputs, as well as wider 6 capitals benefits (e.g. whilst not like for like, river restoration on a similar length of the River Washburn cost £600k during AMP5 when led by our Tier 1 partners, and a similar length was were delivered this AMP by working with eNGO groups and their volunteers (at c.£80k for a similar restoration project on a chalk stream with the Yorkshire Wildlife Trust and at c.£20k for a similar length with the Wild Trout Trust.)). Further, working with these groups generated additional social benefits through volunteer input, as well as improving sustainability through volunteer led long term management and monitoring. The third option of working with Partners, focused on outcomes, generates even higher 6 capitals benefits, as well as reduced financial costs where Partnership Agreements rather than Contracts allow the Partner to access third party funding such as HLF Heritage Lottery Fund and ERDF European Regional Development Fund grants across recent AMP7 projects.

6.5.3 Need for enhancement model adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging.

We note that the variety of interventions and drivers being addressed in this area will make identification of appropriate cost drivers difficult and therefore we anticipate (based on PR19) that Ofwat will not produce a cost model and would assess this expenditure through a shallow or deep dive dependent on materiality.

6.6 Third party assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

6.7 Customer Protection

Our enhancement totex for this case does not meet the materiality threshold for any PCD groupings. There is sufficient regulatory oversight for our activities under the WINEP, therefore we do not propose any customer protection mechanisms for this case.

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

6.7.1 Third Party Funding or Delivery Arrangements

We have no third party funding associated with the delivery of this case.

7. Wastewater: River Water Quality Investigations

7.1 Drivers:

WFD_INV and WFD_INV_MOD

7.1.1 Requested Investment:

Table 1.1: River Water Quality Investigations AMP8 Expenditure

	£m	Table Line Ref.
Enhancement Expenditure Capex	0.000	CWW3.109
Enhancement Expenditure Opex	1.970	CWW3.110
Base Expenditure Capex		
DPC value		
Total	**1.970**	

7.1.2 Associated Reporting lines in Data Table:

Table 1.2: CWW3 Reporting Lines

Line Number	Line Description
CWW3.109	Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling wastewater capex
CWW3.110	Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling wastewater opex
CWW3.111	Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling wastewater totex

7.2 High Level Driver description:

Intermittent discharges

Under WINEP, the Water Framework Directive (WFD) requires companies to investigate the potential impact of our assets on the environment which may result in a failure of the WFD standards. We undertake our investigations by following the principles set out in the Urban Pollution Management (UPM3) Manual v3, unless there are site-specific exceptions. These modelling studies aim to replicate the catchment so that we can assess long term compliance with the required standards and work with the EA on any actions/improvements.

The Environment Agency (EA) have identified possible issues with our intermittent discharges in two of our catchments. The intermittent discharges occur in the Batley Beck and Oak Beck catchments. To understand the issues and if required, develop a resolution, we propose to undertake investigations under the WINEP driver WFD_INV. Following these AMP8 investigations, we will identify improvements (if any) for funding through PR29.

Continuous discharges

Investigations into potential water quality impact from wastewater discharges can also be identified under the WFD_INV_MOD driver. This driver is specifically aimed at waterbodies that are in poor or bad ecological class, with an aim of understanding if the waterbody's classification is brought about by wastewater discharges, either intermittent or continuous. The investigations should review potential impact from wastewater discharges identified in collaboration with the environment agency, with the aim of understanding if and what improvements are necessary in AMP9. Two WFD_INV_MOD investigations have been agreed with the Environment Agency at Brompton Beck and Tunstall Beck.

7.3 Need for investment

7.3.1 The Need for the Proposed Investment

Intermittent discharges

The EA has identified two waterbodies that require investigation into the impact of our intermittent discharges under WFD_INV in AMP8:

Table 1.3: Investigation locations

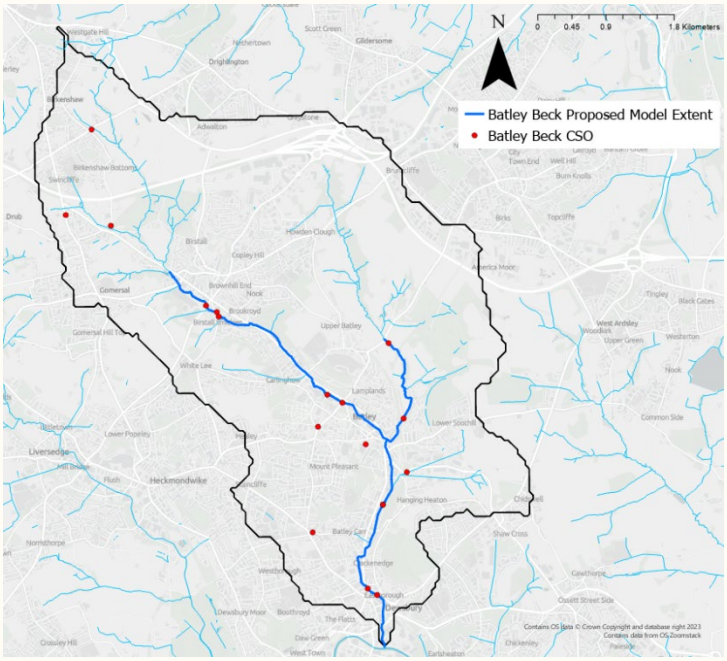
Locations	Waterbody ID
Batley Beck from Source to River Calder	GB104027062670
Oak Beck	GB104027063760

For the Batley Beck catchment the EA produced an investigation report "A&R Investigation - PR24 investigation to provide evidence on the presence of intermittent discharges in GB104027062670 Batley Beck from Source to River Calder" which concluded:

- "The invertebrate community of the Batley Beck is failing to meet Good Ecological status and is dominated by taxa tolerant of organic pollution.
- Elevated levels of ammonia have been recorded intermittently. Continuous water quality loggers have demonstrated that intermittent inputs of ammonium are occurring, although at low levels.
- It is likely that the cause of failure for invertebrates can in some part be attributed to intermittent organic discharges over a long period of time but the true extent may be masked by the heavy modification of the channel.
- It is not possible to apportion the cause to one point source in particular given the highly modified urbanised nature of the watercourse and difficulty in collecting samples at specific points."

17 permitted storm discharges flow into Batley Beck as shown below; there are no Yorkshire Water treated continuous discharges. The source of the beck is in the Gomersal and Gildersome areas, it then flows in a southerly direction though the urban areas of Birstall and Batley before joining the River Calder in the centre of Dewsbury.

Figure 1.1: Batley Beck Permitted Storm Discharges

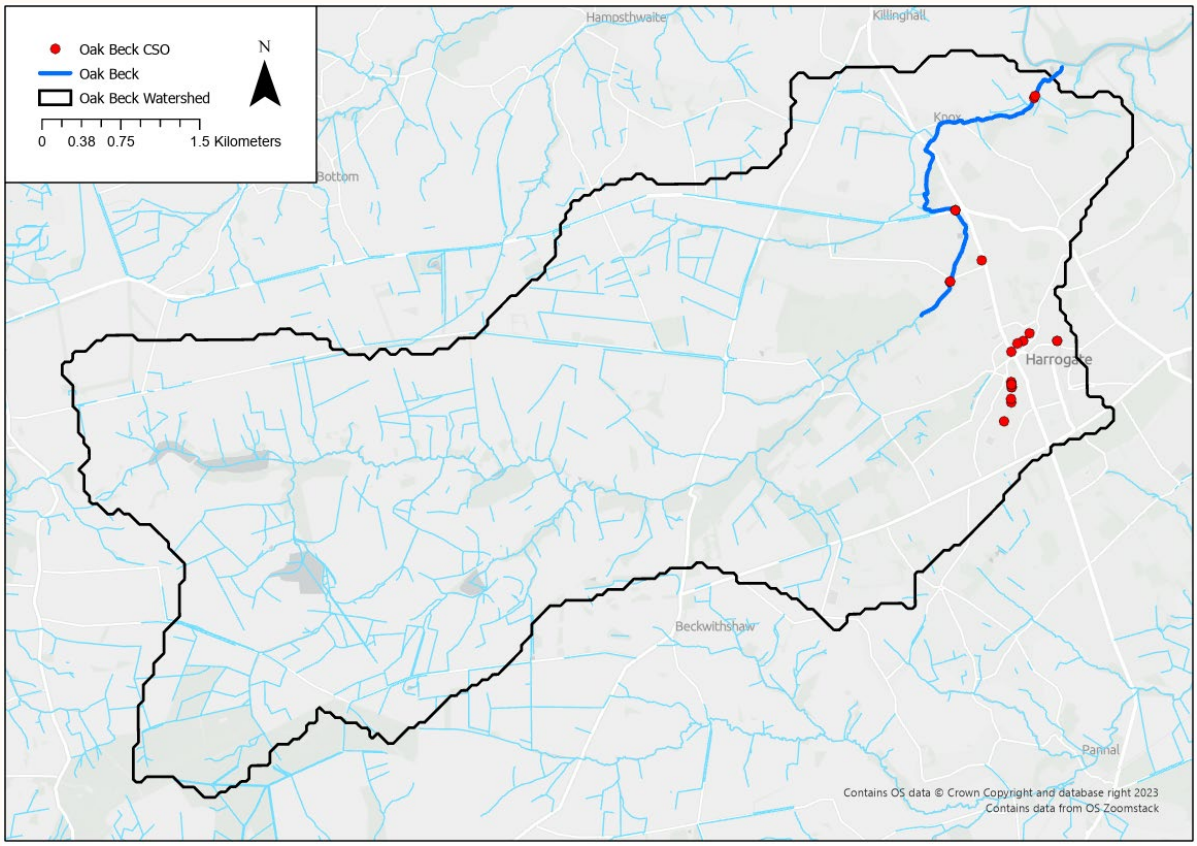


For the Oak Beck catchment the EA produced an investigation report “A&R Investigation - Investigation to assess the impact of intermittent discharges in GB104027063760 Oak Beck” which concluded:

- “Routine invertebrate samples taken on Oak Beck classify the waterbody as Good overall. However Site 231 which is downstream of various CSOs classifies as Moderate.
- A further investigation following investigatory samples taken in October 2018 showed an extremely severe impact on the invertebrate community downstream of Harrogate Hydro CSO compared to upstream. This effect was not evident from routine sampling due to the location of routine sampling points.
- Routine phys-chem spot sampling from one site further downstream classifies the waterbody as High for ammonia and Moderate for phosphate and DO.
- More detailed phys-chem data collected using sondes immediately downstream of Harrogate Hydro CSO reveals regular ammonium spikes and evidence of sewage effluent affecting water quality.
- This evidence suggests that there is an intermittent organic pollution issue on Oak Beck which was not able to be detected by routine biology or phys-chem sampling alone.
- The evidence also suggests that some organic pollution events did not coincide with rainfall.”

The Oak Beck drains a catchment area of around 37km^2 rising in the west with Scargill and Beever Dyke reservoirs in the upper reaches. It then flows in an easterly direction through the rural catchment to the west of Harrogate before following the north westerly perimeter of Harrogate and discharging to the River Nidd. There are 24 permitted storm overflow discharges and the treated effluent of Harrogate North wastewater treatment works (WwTW) discharging immediately upstream of Oak Becks discharge to the River Nidd.

Figure 1.2: Oak Beck Permitted Storm Discharges



Following the completion of the above reports the EA supplied these to Yorkshire Water and requested that these investigations be included in the WINEP. We have considered the evidence provided in the reports and agree that they require further investigations. There is clear evidence of a water quality response to rainfall which could be attributed to intermittent discharges.

We will undertake modelling to investigate the EA findings within the two catchments, which will be used to quantify the impact of Yorkshire Water intermittent assets on compliance with the WFD standards. The outcome of these studies informs any future investment which may be required to mitigate this impact.

Continuous discharges

We have proposed two WwTW continuous discharge investigations under the WFD_INV_MOD driver. The aim of this driver is to collect local samples to update the SIMCAT-SAGIS model. The model can then be used to understand if any investment is required for the continuous discharge(s) in the catchment to improve phosphorus water quality. Updating the model in this way will provide certainty as to any potential investment required in future periods.

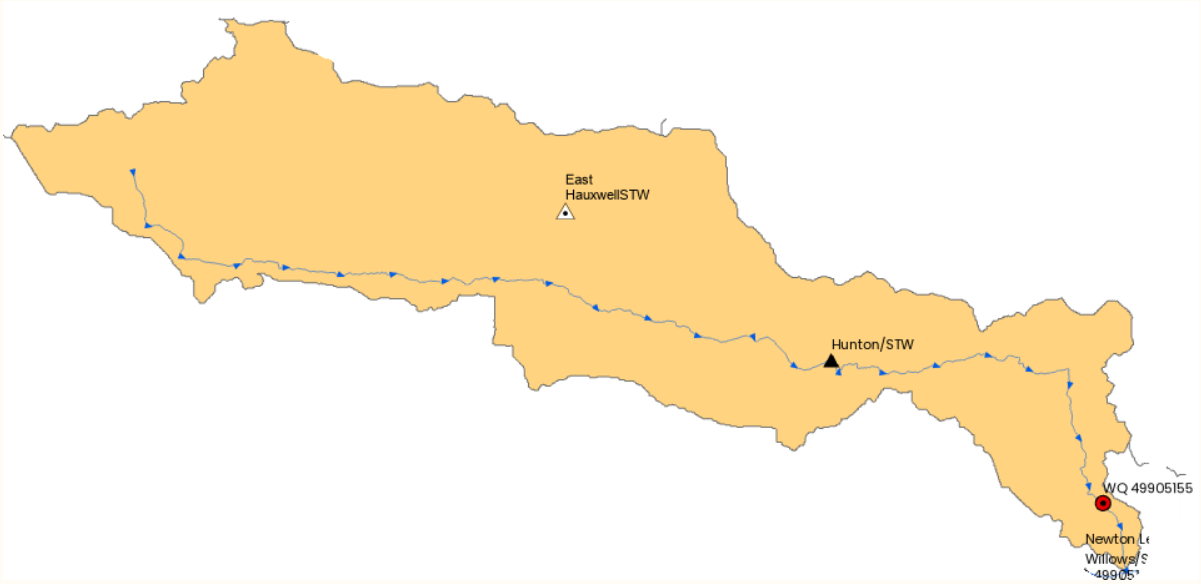
Table 1.4: Investigation Locations

Locations	Waterbody ID
Brompton Beck	GB104027068960
Tunstall Beck	GB104027068990

Brompton Beck is currently determined to be ‘quite certain’ weight of evidence (WoE) on the Environment Agency database and is at WFD Poor status for phytobenthos and macrophytes in 2019, which are indicators of phosphorus. Howeve,r phosphorus in 2019 is at WFD Moderate status. The Environment Agency suspect this is due to point source discharge(s) from the water industry. The waterbody receives wastewater discharges from East Hauxwell WwTW (Population Equivalent of 36 by 2030) and Hunton WwTWs (Population Equivalent of 378 at 2030). East Hauxwell is located on an unmodelled reach and for the purposes of the SIMCAT-

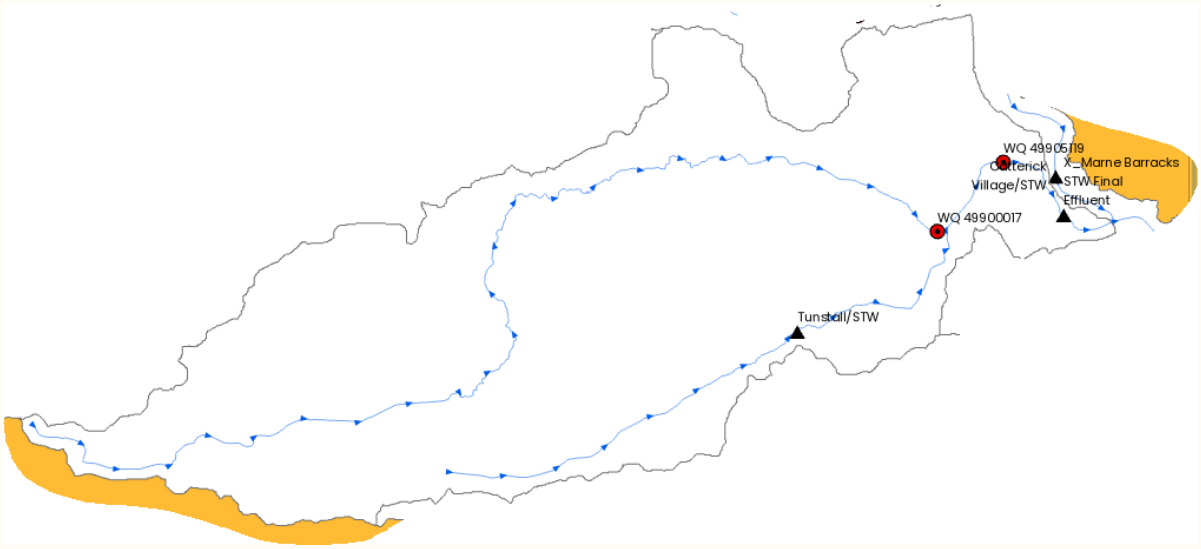
SAGIS model is assumed to be a direct discharge to the modelled reach. However, the catchment is primarily rural land use and the only WFD water quality sample point is approximately 1.2 km downstream of Hunton WwTW. The aim of this investigation is to obtain phosphorus samples from upstream and downstream of the WwTWs to provide greater certainty as to any potential investment required in future periods.

Figure 1.3: Brompton Beck waterbody GB104027068960



Tunstall Beck is currently determined as 'uncertain' WoE for eutrophication, the Environment Agency's 2019 WFD class for macrophytes and phytobenthos is WFD Poor status, and the 2019 WFD Class for phosphorus is at High status. The WFD_INV_MOD dataset states there is confirmed evidence that the pressure for WFD Poor ecological status for the macrophytes and phytobenthos is due to water industry point source continuous discharge(s). Following a discussion with the Environment Agency around inconsistency in datasets, it was agreed an investigation with local sampling would benefit the confidence of any potential phosphorus scheme needed at Tunstall WwTW, which has a predicted population of 229 by 2030. There is a third party sewage discharge at the end of the waterbody, Marne Barracks STW but this is downstream of both WFD water quality sample points. There is also a significant agricultural input to the waterbody. Catterick Village WwTW does not discharge to Tunstall Beck.

Figure 1.4: Tunstall Beck waterbody GB104027068990.



7.3.2 The Scale and Timing of the Investment

Although the requirement to undertake the studies is outside of management control, we have

worked with local EA representatives to agree the level of the study and required outputs. This helps ensure we do not do too much or too little but gives us and the EA confidence that any conclusions are robust. We must complete our investigations by the end of April 2027, as required by the EA in order that the outcomes can inform PR29. Refer to the EA's "Water Industry Planning: PR24 Profiling of WINEP actions" guidance shown below:

Water Framework Directive (surface waters)		
Driver code	**Driver description**	**Completion date**
WFD_INV	Investigations of actions to improve water quality in terms of relevant WFDR status objectives	30/04/2027
WFD_INV_MOD	Investigations to ensure no river, lake or estuary is in poor or bad ecological status due to the water industry	30/04/2027

Intermittent discharges

We propose to spend approximately £572k on Oak Beck and Batley Beck £1,188k. The funding will allow us to conduct the required modelling across the two catchments consistent with standard practice (I.e. the UPM manual). Both studies require several activities including:

- construction/upgrade of hydraulic sewer models.
- data collection across both sewerage assets and within river monitoring.
- construction and calibration of hydraulic river models.

Continuous discharges

Unlike the Oak Beck and Batley Beck UPM investigations, there is no requirement for construction or upgrade of hydraulic sewer models for the Brompton Beck and Tunstall Beck studies. The studies will require the following activities:

- Collection of river samples and analysis for phosphorus.
- River flow monitoring, where sufficient volume of flow allows.
- Collection of WwTW final effluent samples and analysis for phosphorus.
- Flow monitoring of final effluent, where no MCert flow meter is currently present.
- Update of SIMCAT-SAGIS water quality model.
- Potential source apportionment calculations using collected data.
- Analysis of river water quality model results to determine 90th percentile WFD target compliance.
- Identification of potential FairShare phosphorus permit limits where necessary and supported by the SIMCAT-SAGIS model outputs.

We propose to spend £0.105m on Brompton Beck and £0.105m on Tunstall Beck to complete the studies.

7.3.3 Interactions with base or previous funding

We confirm this enhancement case does not overlap with base funding or any allowances in previous price reviews. We have undertaken investigations and been allocated funding in previous AMPs, however, none have been completed on these catchments and as such there has been no previous funding.

7.3.4 Long-term Delivery Strategy Alignment

This case focuses on short term investigations and whilst it does not have an impact on our long-term delivery strategy, it aligns with our strategy of a 'Thriving Yorkshire – right for customers, right for the environment'.

7.3.5 Customer Support

Through wider engagement we understand that river water/sea water and bathing waters have grown in importance in recent years – spurred on by covid and lockdowns forcing customers to take more interest in their local environment and related to this is the surge in 'wild swimming'.

Each of these factors have meant there is a growing interest in the water environment and more of an understanding of the impact of water companies on bathing water specifically.

In the Ofwat/CCWater customer preferences research, we understand that river water quality is ranked as a mid-tier priority to customers when considered across the range of performance commitments. However, in contrast, in our own Valuing Water customer priorities research found that treating wastewater to a high standard to ensure good quality water in Yorkshire's rivers and beaches and other factors which impact river water quality such as pollution incidents and storm overflows all sit in the top tier priority service areas for both household and non-household customers when considered alongside 27 other priorities.

In addition to this, and more specifically, we undertook some research exploring customers thoughts on enhanced expenditure on investigations and improvements to two rivers in Yorkshire – Wyke Beck and River Wiske. The findings concluded that at an overall level, the research suggests that customers are supportive of the investigations/ improvements to Wyke Beck and the River Wiske, and that there is some willingness to pay towards this.

> *"This seems like a great thing to do as it is always good to help improve the river and its habitat as this will be beneficial to the area, the environment and animals that live in the area and for people, both locally and anyone who visits the area" Online Community Member, Your Water, WINEP Evaluating customer support for investigations and improvements to Wyke Beck and River Wiske, April 2023*

We also undertook some research on Defra's consultation on storm overflows. This research cemented the importance of river water quality to our customers. Customers view river and sea health as being important, 98% of customers agreed that river/sea health was important to them. River health was important to customers primarily to support wildlife and so that they look clean. 3 in 4 felt it's important for river/sea health to be improved to provide healthy habitats as opposed to being improved for personal use such as swimming. Yorkshire Water were clear that addressing storm overflows would have an impact on bills, even still river/sea health was seen to be a high priority and around three-quarters feel just as supportive or more so after learning that it is likely going to increase costs. In our own independent affordability and acceptability testing study (outside of Ofwat guidelines), we showcased our extensive plan to customers and 79% found our plan to be acceptable.

More about our wider engagement and acceptability testing can be found in Chapter 6.

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

7.3.6 Factors Outside Management Control

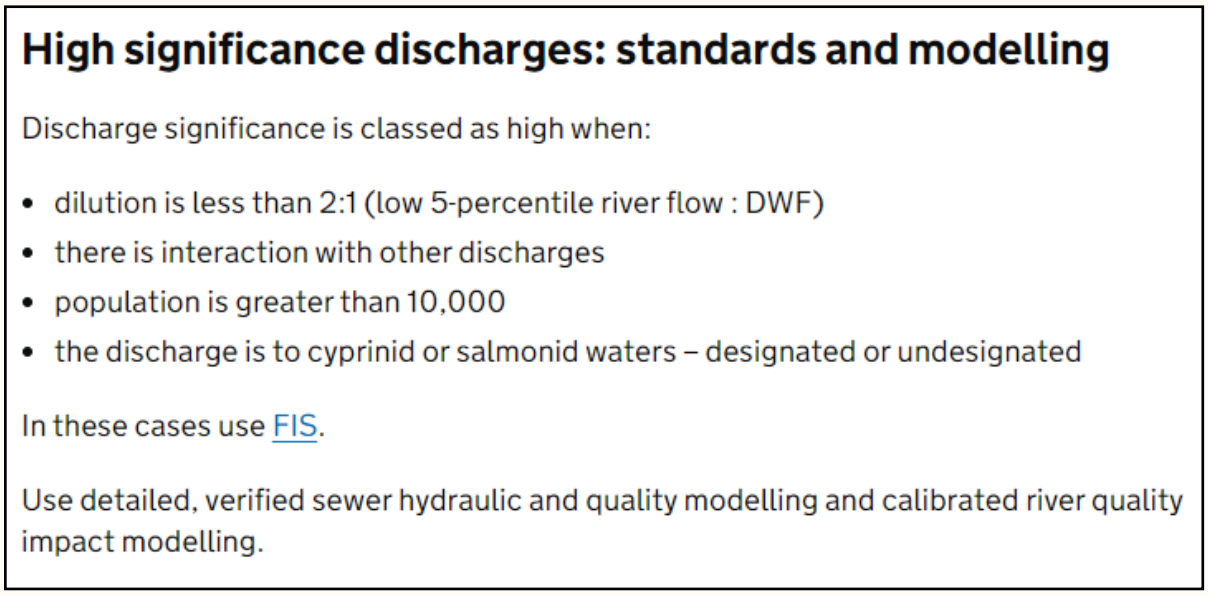
Please refer to section 1.3.2.

7.4 Best Option for Customers

7.4.1 Options Considered

Investigation scope follows standard guidance as set out in the UPM3 as required by the EA and defined in the WINEP line, given this there is limited scope for optioneering. The UPM3 manual does allow for different complexities of models to be applied to each catchment. The EA and YW have reviewed these catchments and agreed that discharges to these catchments are of high significance as they meet one or more of the criteria set out on the gov.uk website and an extract is shown below.

Figure 1.5: High Significance Discharges Criteria



High significance discharges: standards and modelling

Discharge significance is classed as high when:

- dilution is less than 2:1 (low 5-percentile river flow : DWF)
- there is interaction with other discharges
- population is greater than 10,000
- the discharge is to cyprinid or salmonid waters – designated or undesignated

In these cases use FIS.

Use detailed, verified sewer hydraulic and quality modelling and calibrated river quality impact modelling.

The high significance of the discharges mean that calibrated river modelling is required, which is reflected in the developed cost.

See section 'scale and timing' for the planned activities for each investigation, and the 'need' section for the extent of modelling planned.

7.4.2 Cost-Benefit Appraisal

We are not required to undertake cost benefit analyses as part of the development of an investigation programme with the EA. We are required to follow the establish approach to develop the scope of each investigation.

7.4.3 Carbon impact and best value

As stated above, there is no opportunity to consider wider benefits in the development of investigation programmes.

7.4.4 Impact Quantification

There is no impact on our performance commitments. We will use data from the investigations inform our business decisions on where and how to prioritise investments in future periods.

7.4.5 Cost and Benefit Uncertainties

The investigations do contain some uncertainty which cannot be fully defined at this stage. There is sometimes the need to extend the programme as a result of delays in data collection, for example data collection is related to certain weather conditions which may or may not occur in the time defined for the investigation. We have used previous experience to allow what we believe to be an appropriate time allowance, but unusually wet or dry years or other external factors may result in programme extensions.

7.4.6 Third Party Funding

No planned third party funding for this driver.

7.4.7 Customer Views

A review of research to support this enhancement case is in section 1.3.5 above.

7.4.8 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

7.5 Cost Efficiency

This section outlines how our overall approach to cost estimation and cost efficiency.

7.5.1 Cost development for our preferred option

As outlined earlier in this case, schemes were identified through the PR24 WINEP process through consultation with the Environment Agency.

We are currently undertaking eight river water quality investigations in AMP7 through three contracting partners, we have costed our proposed AMP8 investigations by using our agreed contractor framework rates for the contractors. We present the rate for each investigation in the table below.

Table 1.5: Proposed Costs

Discharge Type	Locations	Cost of studies (£m)
Intermittent Discharge	Batley Beck from Source to River Calder	£1.188m
	Oak Beck	£0.572m
Continuous Discharge	Brompton Beck	£0.105m
	Tunstall Beck	£0.105m

The total cost of the investigations is £1.97m.

7.5.2 Efficiency of our cost estimate

In developing our investigation cost estimates, we have agreed the scope of investigations in AMP8 with the Environment Agency. We have considered historic costs of related activities we have previous delivered in past investigations in determining our final estimates.

7.5.3 Need for enhancement model adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging.

We don't believe that investigations can be modelled effectively as their scope can vary by site and by the approach taken by the local environment agency. We anticipate that Ofwat will retain the PR19 shallow or deep dive approach to investigations allowances depending on materiality.

7.6 External Assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

7.7 Customer Protection

Our combined investigation programme meets the materiality threshold for PCDWW18. Please refer to the Storm Overflow Reduction Plan customer protection section for the proposed PCD and time delivery incentive, and supporting rationale.

7.7.1 Third Party Funding or Delivery Arrangements

We have no third party funding associated with the delivery of this case.

8. Wastewater: River Water Quality Improvements

8.1 Driver:

WFD_ND, WFD_IMP, WFD_IMP_MOD, HD_IMP and EnvAct_IMP1

8.1.1 Requested Investment:

Table 1.1: Nutrient Determinands Expenditure (Phosphorus)

	£m	Table Line Ref.
Enhancement Expenditure Capex	339.520	CWW3.64 (chemical), CWW3.70 (green solution)
Enhancement Expenditure Opex	9.970	CWW3.65, CWW3.71
Base Expenditure Capex	0.978	CWW2.16
DPC value		
Total	**350.468**	

Table 1.2: Sanitary Determinands Expenditure (Ammonia and BOD)

	£m	Table Line Ref.
Enhancement Expenditure Capex	57.851	CWW3.73
Enhancement Expenditure Opex	2.413	CWW3.74
Base Expenditure Capex		
DPC value		
Total	**60.264**	

8.1.2 Associated Reporting lines in Data Table:

Table 1.3: CWW3 Reporting Lines

Line Number	Line Description
CWW3.64	Treatment for phosphorus removal (chemical) (WINEP/NEP) wastewater capex
CWW3.65	Treatment for phosphorus removal (chemical) (WINEP/NEP) wastewater opex
CWW3.66	Treatment for phosphorus removal (chemical) (WINEP/NEP) wastewater totex
CWW3.70	Treatment for nutrients (N or P) and / or sanitary determinands, nature based solution (WINEP/NEP) wastewater capex
CWW3.71	Treatment for nutrients (N or P) and / or sanitary determinands, nature based solution (WINEP/NEP) wastewater opex
CWW3.72	Treatment for nutrients (N or P) and / or sanitary determinands, nature based solution (WINEP/NEP) wastewater totex
CWW3.73	Treatment for tightening of sanitary parameters (WINEP/NEP) wastewater capex
CWW3.74	Treatment for tightening of sanitary parameters (WINEP/NEP) wastewater opex
CWW3.75	Treatment for tightening of sanitary parameters (WINEP/NEP) wastewater totex

8.2 High Level Driver description:

The driver codes and descriptions shown below are extracts from the Environment Agency's (EA) relevant PR24 driver guidance. An 'S' legal obligation is Statutory and an 'S+' legal obligation is subject to the Environment Agency's cost-benefit analysis process. All these drivers apply to multiple determinands, namely Phosphorus, Ammonia and Biochemical Oxygen Demand/Dissolved Oxygen (BOD/DO) discharged from continuous wastewater discharges to inland surface waters (river waterbodies).

Figure 1.1: EA PR24 WINEP Driver Guidance – Nutrients and Sanitary Determinands (Surface Waters)

Driver code	Description	Legal obligation	Tier 1 outcome
WFD_INV	Investigations of actions to improve water quality in terms of relevant WFDR status objectives.	S	Water company contribution to achieve improvement objectives for water quality or prevent deterioration
WFD_IMP	Implementation of actions to improve water quality in terms of relevant WFDR status objectives	S+	
EnvAct_IMP1	Actions to reduce phosphorus loading from treated wastewater by 80% by 2037 against a 2020 baseline	S	Water company contribution to achieve improved water quality.

Figure 1.2: EA PR24 WINEP Driver Guidance – Water Body Ecological Status (Poor and Bad Ecological Status Waterbodies)

Driver code	Description	Legal obligation	Completion date	Tier 1 outcome
WFD_INV_MOD	Investigations to ensure no river, lake or estuary is in poor or bad ecological status due to the water industry	S+	30/04/2027	Water company actions contributing to poor or bad ecological status
WFD_IMP_MOD	Actions to ensure no river, lake or estuary is in poor or bad ecological status due to the water industry	S+	31/03/2030	

Figure 1.3: EA PR24 WINEP Driver Guidance – Prevent Deterioration

Driver code	Description	Legal obligation	Tier 1 outcome
WFD_ND	Actions to meet requirements to prevent deterioration	S	Water company contribution to achieve improvement objectives for water quality or prevent deterioration

- There is an actual deterioration of status of a water quality element within a water body at the 2021 baseline, when compared to the 2015 baseline. This is where deterioration has been identified and attributed to the permit, or to growth at a water company discharge location. The water body must be restored back to the 2015 baseline, or;
- There is growth prediction that is certain or probable[1] by 2035 and the associated discharge load increase (within permit headroom) is certain to cause a failure or unacceptable further deterioration in either the 2015 or 2021 baseline status[2], or;
- Elements that comprise ecological status are in the lowest status class; actions should be identified to prevent any further deterioration of that element.

Figure 1.4: EA PR24 WINEP Driver Guidance – European Sites

Driver code	Description	Legal obligation	Tier 1 outcome
HD_IMP	Action to contribute to restoration of a European site or Ramsar site to move towards meeting the conservation objectives.	S	Maintain or restore favourable conservation status at European sites
HD_ND	Action to contribute to maintenance of (prevent	S	

Assessment is made of Yorkshire Water's (YW) compliance against in-river targets set under the Water Framework Directive (WFD) and in accordance with the EA's relevant PR24 driver Guidance. For WFD_IMP (including WFD_IMP_MOD) where YW's wastewater discharges will impact the quality of the receiving waterbody, an improvement scheme will be identified by way of a new permit limit for the relevant determinand. The primary objective is to achieve WFD FairShare Good status.

For Prevent Deterioration WFD_ND drivers the permit limit applied will be to prevent deterioration of water quality under three scenarios. Where current evidence is uncertain or

suspected a WFD_INV or WFD_INV_MOD driver can be applied to investigate the receiving waterbody in collaboration with the EA. An investigation will gather data and evidence to inform potential future investment in AMP9 with greater certainty where a wastewater discharge is found to exceed the relevant WFD target(s).

YW's assessment of these drivers uses multiple EA and YW data sources together with water quality modelling tools, which have been calibrated and provided by the EA for this purpose. The assessments have been undertaken in collaboration with the EA and the outcomes agreed and entered onto the PR24 WINEP spreadsheet.

Previous rounds of investment for continuous wastewater treatment work (WwTW) discharges delivered in AMP6 and currently being delivered in AMP7 have been accounted for in the baseline scenario(s) prior to identifying any new improvement schemes required for AMP8.

Further information on the U_IMP2 drivers is found in Schemes Driven by Population Numbers under Urban Wastewater Directive. The description of the need and breakdown of costs for the U_IMP schemes is provided in the aforementioned enhancement case. The costs for U_IMP2 are included in this enhancement case ,River water quality (sanitaries and nutrients), and are covered by the grouped PCD.

8.3 Need

8.3.1 The Need for the Proposed Investment

WFD_ND Prevent Deterioration

The prevent deterioration (WFD_ND) driver applies to phosphorus, ammonia and BOD/DO and requires three assessments for each determinand:

- Deterioration between the 2015 and 2021 baseline WFD classification
- Within permit headroom predicted growth by 2035
- Elements that comprise the lowest class

Deterioration between the 2015 and 2021 baseline WFD classification

The EA confirmed that no waterbodies have deteriorated between the 2015 and 2021 baselines for phosphorus, ammonia or BOD/DO in the YW operational region. Therefore, no investment is required under this part of the prevent deterioration driver.

Within permit headroom predicted growth by 2035

The second assessment under the WFD_ND driver for phosphorus, ammonia and BOD/DO is to understand the potential water quality deterioration that may occur by the predicted 2035 population growth. A within permit headroom increased flow (Figure 1) is modelled to predict any potential deterioration associated with the future growth. Where the predicted 2035 DWF increase exceeds the current permitted DWF (Figure 2), DWF is capped at the current permitted DWF. This is because flow exceeding current permitted DWF is not eligible for investment under the WFD prevent deterioration driver.

Figure 1.5: Diagram of Within Permit Headroom Growth.

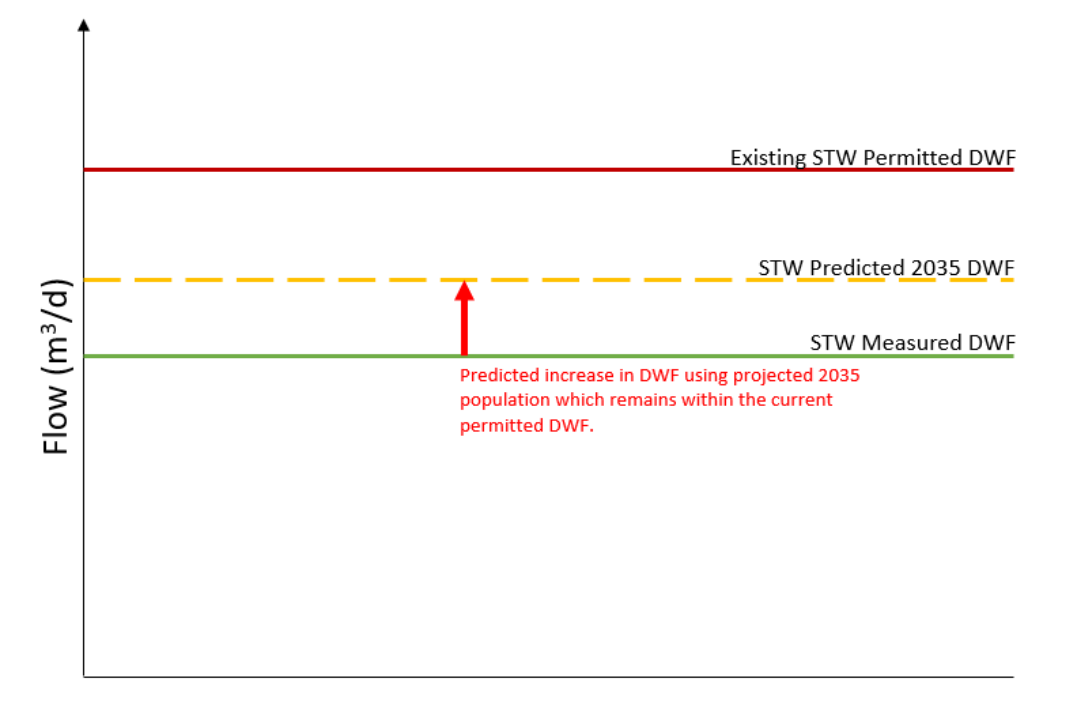
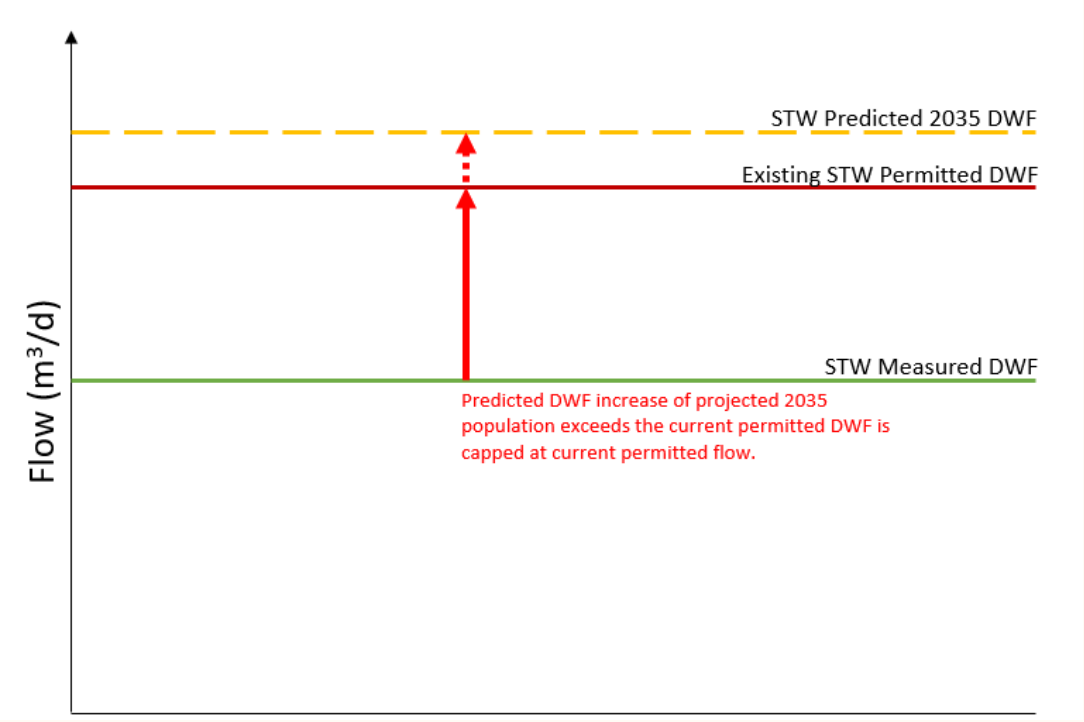


Figure 1.6: Diagram of Above Permitted DWF Growth Being Capped at the Existing Permitted DWF



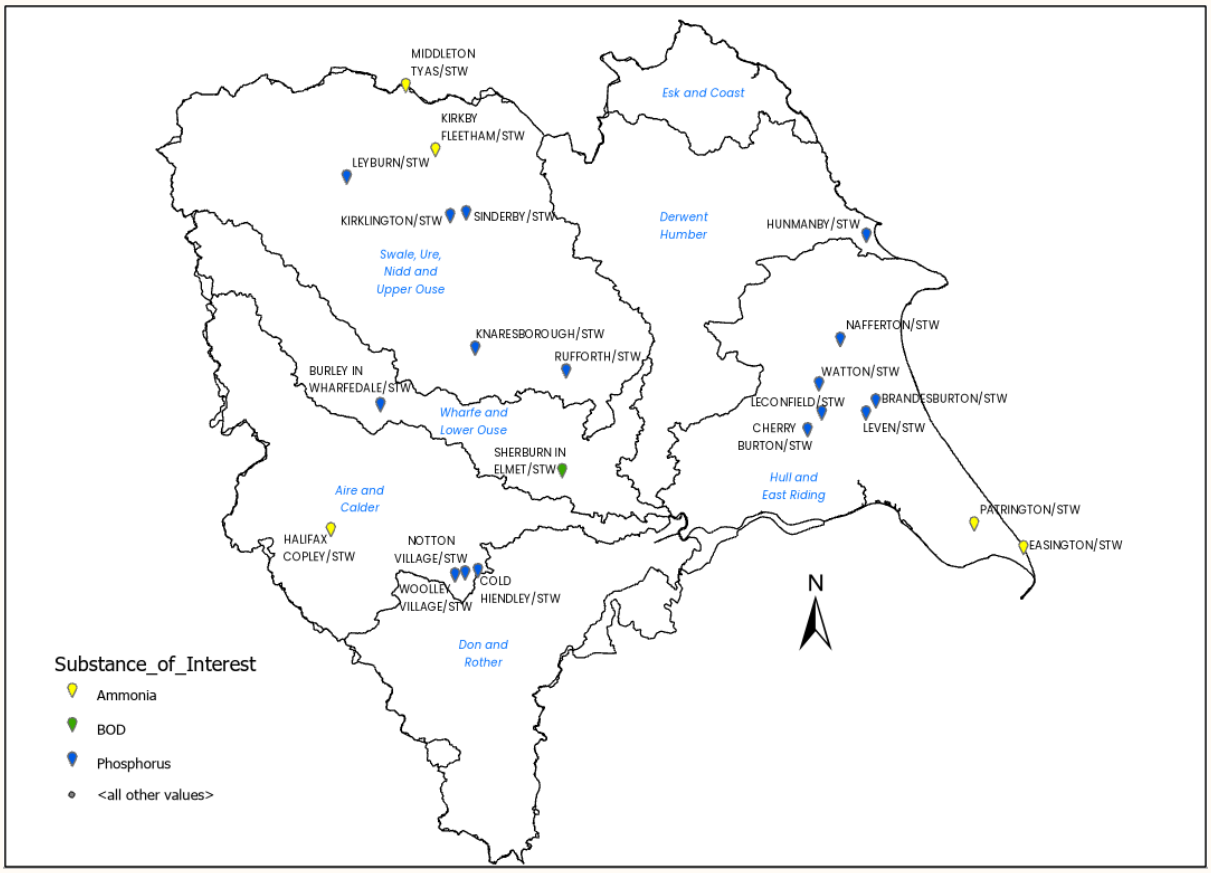
The river water quality is then compared from the observed baseline to the increased discharge volume to identify potential impact on the receiving waterbody. Where an impact greater than 3% deterioration of in-river concentration is predicted, a new permit limit is identified to maintain the observed baseline to prevent the deterioration that may occur from the predicted 2035 growth. The following schemes have been identified using the PR24 SIMCAT-SAGIS Calibrated model:

Table 1.4: List of WFD_ND Phosphorus, Ammonia and BOD/DO Obligations Identified for AMP8 Delivery.

Asset	Baseline in-river concentration (mg/l)	2035 Growth in-river concentration (mg/l)	Percentage in-river change Baseline to 2035 Growth >3% (%)	Proposed AMP8 WFD_ND STW Final Effluent Permit Limit (mg/l)	Post WFD_ND In-river Concentration (mg/l)
Total Phosphorus (Annual Average)					
KIRKLINGTON/STW	0.0408	0.0439	7.56	4.0	0.0391
SINDERBY/STW	1.2650	1.3531	6.96	8.0	1.26
LEYBURN/STW	0.0331	0.0380	14.69	2.0	0.0309
KNARESBOROUGH/STW	0.1585	0.1674	5.63	4.0	0.1457
RUFFORTH/STW	1.7592	1.8360	4.37	6.0	1.7343
BURLEY IN WHARFEDALE/STW	0.0619	0.0655	5.90	3.0	0.065
HUNMANBY/STW	1.2637	1.4078	11.40	5.0	1.26
WOOLLEY VILLAGE/STW	0.2478	0.2582	4.19	0.25	TBC*
COLD HIENDLEY/STW	3.3716	3.4786	3.17	0.25	TBC*
NOTTON VILLAGE/STW	1.2605	1.3718	8.83	0.25	TBC*
EASINGTON/STW	0.9460	1.0311	9.00	4.0	0.8349
BRANDESBURTON/STW	1.4008	1.4452	3.17	5.0	1.2574
LEVEN/STW	0.7738	1.0247	32.42	5.0	0.9096
WATTON/STW	0.1711	0.1893	10.63	3.5	0.171
NAFFERTON/STW	1.7641	1.9704	11.69	6.0	1.7468
CHERRY BURTON/STW	1.8957	1.9808	4.49	6.0	1.8939
LECONFIELD/STW	1.7397	1.8252	4.91	4.0	1.6673
Total Ammonia (95th Percentile)					
MIDDLETON TYAS/STW	0.2841	0.3331	17.25	2.0	0.2511
KIRKBY FLEETHAM/STW	0.2460	0.3410	38.60	8.0	0.2432
HALIFAX COPLEY/STW	0.2835	0.3178	12.12	2.0	0.2051
EASINGTON/STW	3.9668	4.2755	7.78	21.0	3.9
PATRINGTON/STW	0.8615	1.2582	46.05	8.0	1.1
BOD/DO (95th Percentile)					
SHERBURN IN ELMET/STW	BOD: 9.0734 DO: 3.9854	BOD: 10.208 DO: 3.5011	BOD: 12.5 DO: 12.15	BOD 9.0	BOD: 10.21 DO: 3.501

*Three sites do not yet have post-intervention concentration confirmed.

Figure 1.7: Location of WFD_ND 2035 Within Permit Headroom Growth Obligations.



*N.B. EASINGTON/STW has two obligations for ammonia and phosphorus but is only displayed once on the map.

Elements that comprise the lowest class

This assessment reviewed waterbodies that were in the lowest ecological class. The EA have reviewed the classifications together with supporting data and have not identified any schemes for investment under this section of the WFD_ND driver.

WFD_IMP, WFD_IMP_MOD, HD_IMP and EnvAct_IMP1

Phosphorus

There are several drivers available to bring about improvements in phosphorus:

- WFD_IMP
- WFD_IMP_MOD
- HD_IMP
- EnvAct_IMP1

The WFD_IMP driver is to bring about water quality improvements required to achieve WFD Good status where there is very certain weight of evidence linking the river water quality issue with continuous wastewater discharges from YW's WwTWs. Assessments were completed for inland surface waters where the WFD target standards apply.

Schemes were identified using the EA's optimiser spreadsheet in order to apply the EA's Polluter Pays Principle and FairShare approach. Schemes were identified at WwTWs located in, or upstream of, waterbodies where the EA's ecological impact weight of evidence database (WoE) was 'very certain' of eutrophication. The WoE database scores evidence such as the presence of macrophyte and phytobenthos species in waterbodies which are key indicators of eutrophication taking place. For waterbodies in the WoE database that were categorised as 'quite certain' further evidence was sought from the EA to support whether investment was required, or not

.

All schemes under WFD are subject to cost-benefit analysis. Those schemes that pass CBA will be delivered in AMP8. Where schemes failed CBA, these will be referred to the Minister for inclusion, or not.

The WFD_IMP_MOD driver is to bring about phosphorus improvement where a waterbody is at Poor or Bad WFD class status. This driver coincides with WFD_IMP schemes and are applied as a secondary driver to WFD_IMP.

The EA have applied another Statutory driver, EnvAct_IMP1, for any schemes with a priority phosphorus driver, namely WFD_IMP, HD_IMP, WFD_ND or WFD_IMP_MOD. Where a scheme only achieves FairShare Moderate status, the limit must be tightened to the 0.25 mg/l total phosphorus technical limit. The EnvAct_IMP1 driver overrides WFD_IMP cost benefit analysis ensuring any schemes that fail the cost-benefit assessment are still implemented.

The River Derwent (Humber catchment) is a designated Site of Special Scientific Interest (SSSI) and has been assessed against the relevant CSMG targets from Natural England. Three schemes have been identified to achieve the CSMG phosphorus targets at Wheldrake WwTW. Phosphorus removal can also be prescribed under the Urban Waste Water Directive where population thresholds are exceeded. These schemes are reported in the U_IMP2 enhancement case.

The following schemes have been identified on the PR24 WINEP:

Table 1.5: List of WFD_IMP, WFD_IMP_MOD, HD_IMP and EnvAct_IMP1 phosphorus obligations identified for AMP8 delivery.

Site	Previous AMP Investment for Phosphorus	AMP8 Proposed WFD_IMP P (mg/l)	WFD_IMP Target Class	WFD_IMP_MOD P limit (mg/l)	HD_IMP CSMG Proposed P limit (mg/l)	EnvAct_IMP1 Proposed P limit (mg/l)
ABERFORD/STW	N/A	1.5	FS Good	1.5	N/A	1.5
ALDBROUGH/STW	N/A	0.3	FS Good	N/A	N/A	0.3
AMPLEFORTH VILLAGE/STW	N/A	0.7	FS Good	N/A	N/A	0.7
APPLETON WISKE/STW	N/A	0.25	FS Good	0.25	N/A	0.25
ASKHAM BRYAN/STW	N/A	3	FS Good	N/A	N/A	3
ATWICK/NO 2 STW	N/A	4	FS Good	N/A	N/A	4
BALDERSBY/STW	N/A	1.5	FS Good	N/A	N/A	1.5
BARWICK IN ELMET/STW	N/A	0.7	FS Good	0.7	N/A	0.7
BECKWITHSHAW/STW	N/A	0.25	FS Good	N/A	N/A	0.25
BOLTON ON DEARNE/STW	UWW 2 mg/l	0.25	FS Moderate	N/A	N/A	0.25
BRANDESBURTON/STW	N/A	0.25	FS Good	N/A	N/A	0.25
CARLTON HUSTHWAITE/STW	N/A	1.0	FS Good	N/A	N/A	1.0
CAWTHORNE/STW	N/A	0.3	FS Good	0.3	N/A	0.3
CHERRY BURTON/STW	N/A	0.25	FS Good	N/A	N/A	0.25

Site	Previous AMP Investment for Phosphorus	AMP8 Proposed WFD_IMP P (mg/l)	WFD_IMP Target Class	WFD_IMP_MOD P limit (mg/l)	HD_IMP CSMG Proposed P limit (mg/l)	EnvAct_IMP1 Proposed P limit (mg/l)
CLAXTON/STW	N/A	0.8	FS Good	N/A	N/A	0.8
COLD HIENDLEY/STW	N/A	0.25	TBC	N/A	N/A	0.25
CRANE MOOR/STW	N/A	0.25	FS Good	N/A	N/A	0.25
CUDWORTH/NO 2 STW	N/A	0.7	FS Moderate	N/A	N/A	0.25
DANBY WISKE/STW	N/A	0.25	FS Good	N/A	N/A	0.25
DARFIELD/NO 2 STW	N/A	0.25	FS Moderate	N/A	N/A	0.25
DARTON/STW	UWW 2 mg/l	0.7	FS Moderate	N/A	N/A	0.25
EAST COWTON/STW	N/A	0.25	FS Good	N/A	N/A	0.25
ELVINGTON/STW	N/A	N/A	N/A	N/A	2.0	2.0
ESCRICK/STW	N/A	1.5	FS Good	N/A	N/A	1.5
FARLINGTON/STW	N/A	1.0	FS Good	N/A	N/A	1.0
FLAXTON/STW	N/A	0.25	FS Moderate	N/A	N/A	0.25
GREAT SMEATON/NO 1 STW	N/A	0.25	FS Good	N/A	N/A	0.25
HAMBLETON/STW	N/A	0.7	FS Moderate	N/A	N/A	0.25
HARLEY/STW	N/A	0.7	FS Good	N/A	N/A	0.7
HARLINGTON/STW	N/A	1.5	FS Moderate	N/A	N/A	0.25
HARROGATE NORTH/STW	N/A	0.25	FS Good	N/A	N/A	0.25
HAXBY WALBUTTS/STW	N/A	0.25	FS Moderate	N/A	N/A	0.25
HOLTBY/STW	N/A	0.25	FS Good	N/A	N/A	0.25
INGLEBY ARNCLIFFE/STW	N/A	0.25	FS Good	N/A	N/A	0.25
KIRKBYMOORSIDE/STW	N/A	N/A	N/A	N/A	0.7	0.7
KIRK HAMMERTON/STW	N/A	2.5	FS Good	N/A	N/A	2.5
KNARESBOROUGH/STW	N/A	0.25	FS Good	N/A	N/A	0.25
LECONFIELD/STW	N/A	0.25	FS Moderate	N/A	N/A	0.25
LEVEN/STW	N/A	0.25	FS Good	N/A	N/A	0.25

Site	Previous AMP Investment for Phosphorus	AMP8 Proposed WFD_IMP P (mg/l)	WFD_IMP Target Class	WFD_IMP_MOD P limit (mg/l)	HD_IMP CSMG Proposed P limit (mg/l)	EnvAct_IMP1 Proposed P limit (mg/l)
LONG MARSTON/STW	N/A	1.0	FS Good	1.0	N/A	1.0
LONG RISTON NORTH/STW	N/A	4.0	FS Good	N/A	N/A	4.0
LUNDWOOD/STW	UWW 2 mg/l	0.25	FS Moderate	N/A	N/A	0.25
MAUNBY/STW	N/A	4.0	FS Good	N/A	N/A	4.0
MICKLEFIELD/NO 2 STW	N/A	0.25	FS Good	N/A	N/A	0.25
NORTH COWTON/STW	N/A	0.25	FS Good	N/A	N/A	0.25
NORTH DEIGTON/STW	N/A	4.0	FS Good	N/A	N/A	4.0
NORTHALLERTON/STW	HD 2 mg/l	0.25	FS Moderate	N/A	N/A	0.25
NOTTON VILLAGE/STW	N/A	0.25	TBC	N/A	N/A	0.25
PATELEY BRIDGE/STW	N/A	0.25	FS Good	N/A	N/A	0.25
RAWCLIFFE YORK/STW	N/A	0.7	FS Good	N/A	N/A	0.7
RUFFORTH/STW	N/A	1.0	FS Good	N/A	N/A	1.0
SAND HUTTON/STW	N/A	1.5	FS Good	N/A	N/A	1.5
SHIPTON/NO 2 STW	N/A	0.3	FS Good	N/A	N/A	0.3
SILKSTONE/STW	N/A	0.4	FS Good	N/A	N/A	0.4
SINDERBY/STW	N/A	0.25	FS Good	N/A	N/A	0.25
SKIPSEA/STW	N/A	0.25	FS Good	N/A	N/A	0.25
STAPLETON PARK/STW	N/A	0.5	FS Good	N/A	N/A	0.5
SUTTON WHITESTONECLF/STW	N/A	0.5	FS Good	N/A	N/A	0.5
TANKERSLEY/STW	N/A	0.25	FS Good	N/A	N/A	0.25
TEMPLE NORMANTON/STW	N/A	0.25	FS Moderate	N/A	N/A	0.25
TOCKWITH/STW	N/A	0.25	FS Good	N/A	N/A	0.25
WARTHILL/STW	N/A	0.4	FS Good	N/A	N/A	0.4
WATH ON DEARNE/STW	UWW 2 mg/l	0.4	FS Moderate	N/A	N/A	0.25
WENTWORTH/STW	N/A	0.25	FS Good	N/A	N/A	0.25
WEST ROUNTON/STW	N/A	0.25	FS Good	0.25	N/A	0.25

Site	Previous AMP Investment for Phosphorus	AMP8 Proposed WFD_IMP P (mg/l)	WFD_IMP Target Class	WFD_IMP_MOD P limit (mg/l)	HD_IMP CSMG Proposed P limit (mg/l)	EnvAct_IMP1 Proposed P limit (mg/l)
WHELDRAKE/STW	N/A	N/A	N/A	N/A	0.7	0.7
WILLIAMTHORPE/STW	N/A	0.25	FS Moderate	N/A	N/A	0.25
WITHERNWICK/STW	N/A	1.0	FS Good	N/A	N/A	1.0
WOMBWELL/STW	UWW 2 mg/l	0.25	FS Moderate	N/A	N/A	0.25
WOODALL/STW	N/A	3.0	FS Good	N/A	N/A	1.5
WOOLLEY VILLAGE/STW	N/A	0.25	TBC	N/A	N/A	0.25
WORSBROUGH/STW	UWW 2 mg/l	0.25	FS Moderate	N/A	N/A	0.25
YEARSLEY/STW	N/A	0.3	FS Good	N/A	N/A	0.3
YORK NABURN/STW	N/A	0.25	FS Good	N/A	N/A	0.25

Figure 1.8: Location of HD_IMP Phosphorus Obligations.

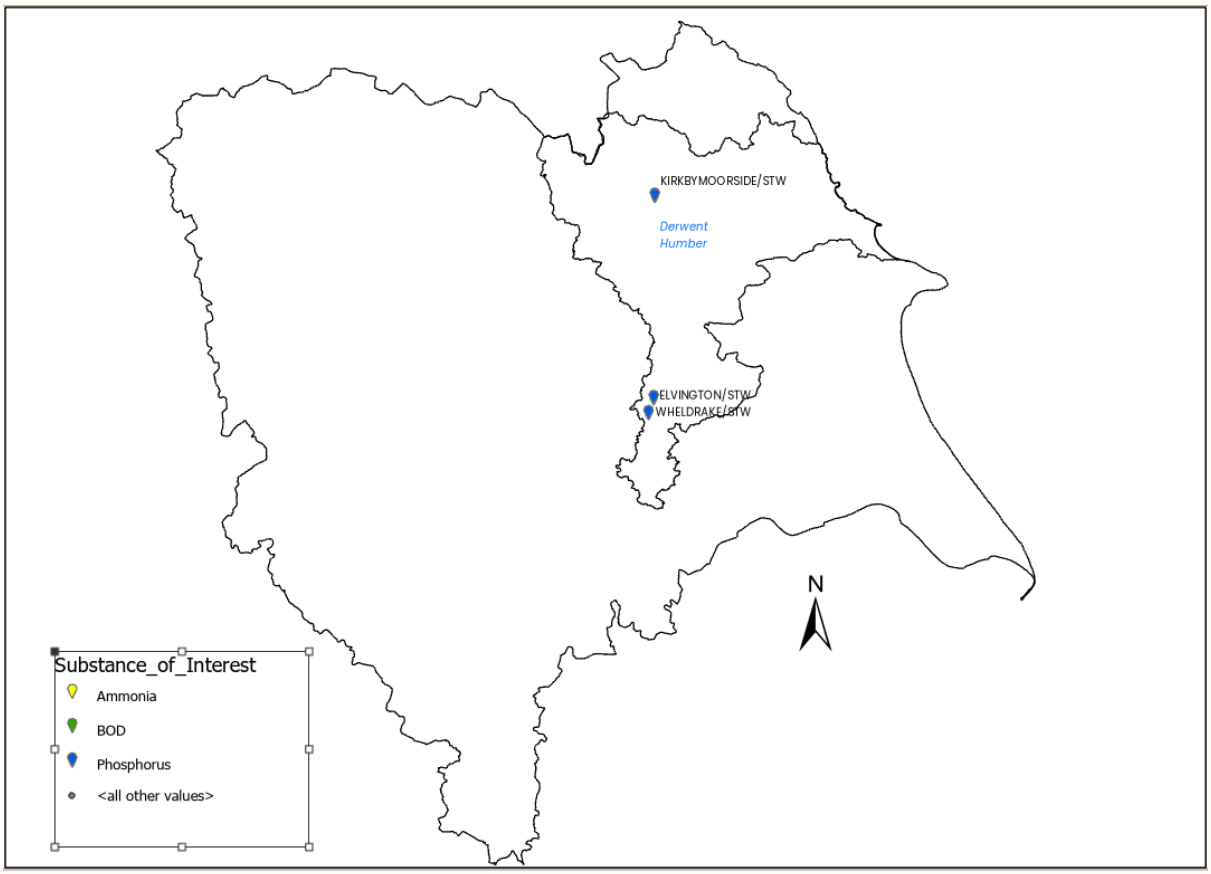
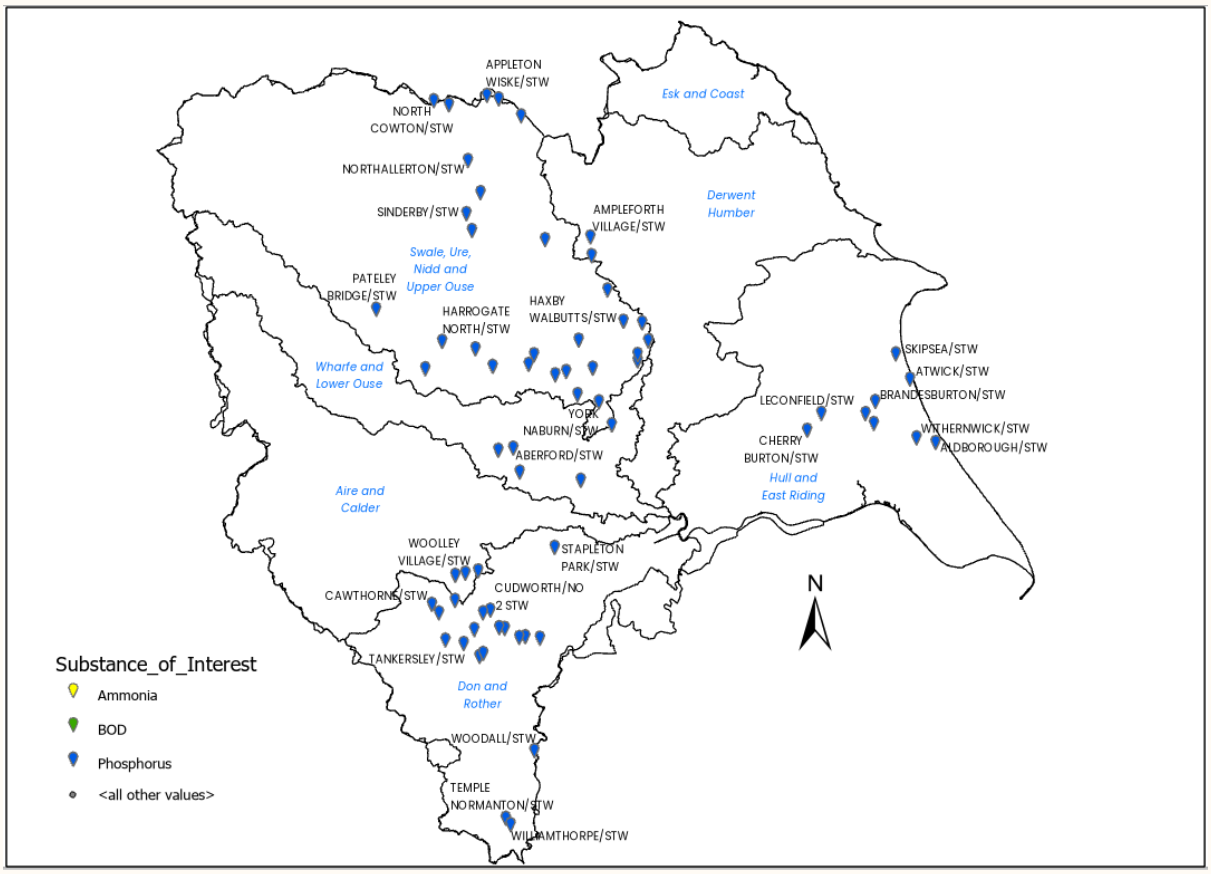


Figure 1.9: Location of WFD_IMP and EnvAct_IMP1 Phosphorus Obligations



Ammonia

Schemes were identified using the EA's SIMCAT-SAGIS At Permit model. The FairShare approach used to identify phosphorus schemes does not apply to ammonia schemes. Any scheme identified is predicted to achieve the full WFD predicted class at the modelled point of mixing (point of discharge).

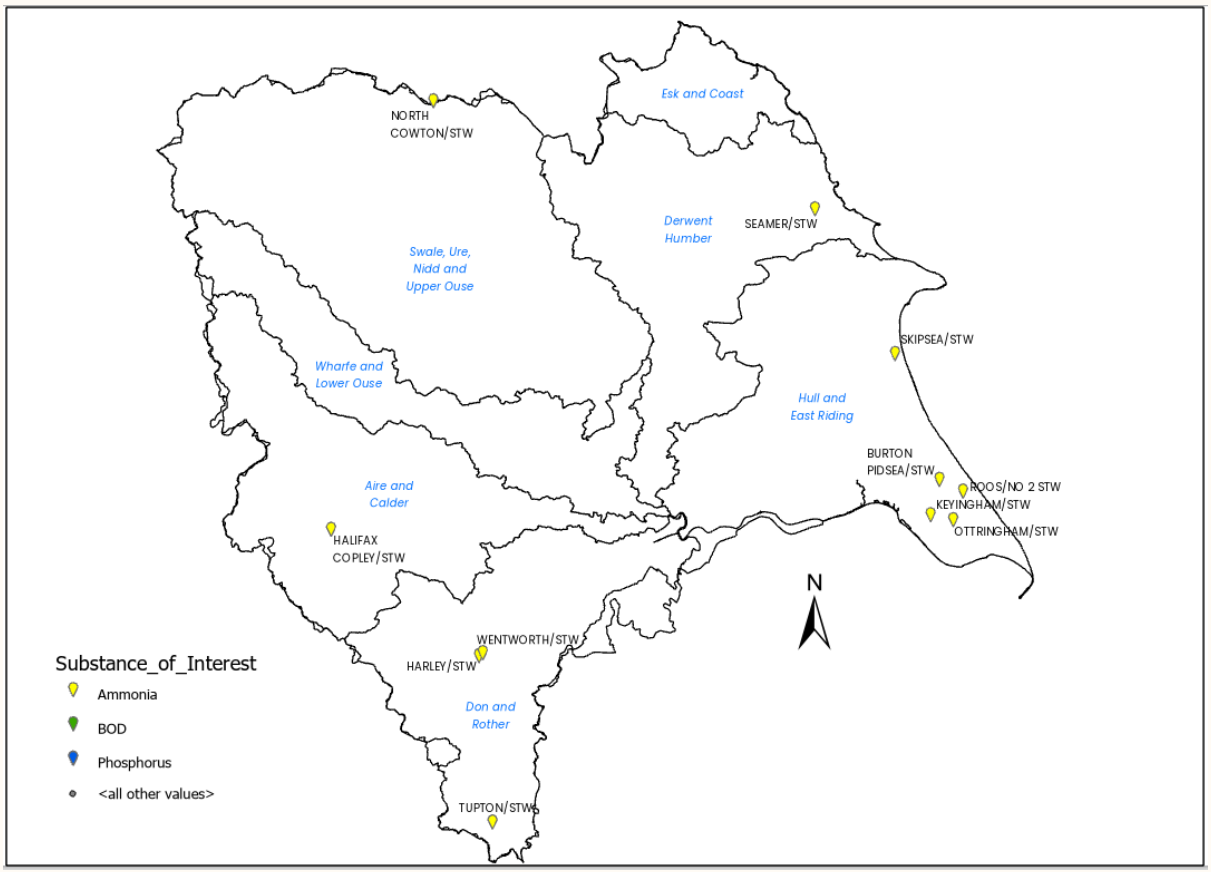
The River Derwent (Humber) is designated as a Site of Special Scientific Interest (SSSI) and has been assessed against the relevant ammonia CSMG targets from Natural England. The River Derwent already achieves the ammonia CSMG targets so no HD_IMP ammonia schemes have been identified for AMP8.

EnvAct_IMP1 does not apply to ammonia.

Table 1.6: List of WFD_IMP and WFD_IMP_MOD ammonia obligations identified for AMP8 delivery.

Site	AMP8 Proposed WFD_IMP Ammonia (mg/l)	WFD_IMP Ammonia Target Class	AMP8 proposed WFD_IMP_MOD ammonia (mg/l)	AMP8 Proposed HD_IMP Ammonia
BURTON PIDSEA/STW	3	Good	N/A	N/A
EAST COWTON/STW	9	Moderate	9	N/A
HALIFAX COPLEY/STW	3	Good	N/A	N/A
HARLEY/STW	5	Good	N/A	N/A
KEYINGHAM/STW	1	Good	N/A	N/A
NORTH COWTON/STW	5	Moderate	5	N/A
OTTRINGHAM/STW	4	Moderate	N/A	N/A
ROOS/NO 2 STW	4	Moderate	N/A	N/A
SEAMER/STW	2	Good	2	N/A
SKIPSEA/STW	6	Moderate	N/A	N/A
TUPTON/STW	2	Good	N/A	N/A
WENTWORTH/STW	3	Good	N/A	N/A

Figure 1.10: Location of WFD_IMP Ammonia Obligations.



Biochemical Oxygen Demand/Dissolved Oxygen (BOD/DO)

Schemes were identified using the EA's SIMCAT-SAGIS At Permit model. The FairShare approach used to identify phosphorus schemes does not apply to BOD/DO schemes. Any scheme identified is predicted to achieve the full WFD predicted class at the modelled point of mixing (point of discharge).

The River Derwent (Humber) is designated as a Site of Special Scientific Interest (SSSI) and has been assessed against the relevant BOD/DO CSMG targets from Natural England. The River Derwent does not meet the BOD/DO CSMG targets. The EA have determined that no interventions brought about by YW would allow the River Derwent to achieve the CSMG dissolved oxygen target, as the exceedance is likely brought about by flow regimes rather than continuous WwTW discharge water quality impacts.

Therefore, no HD_IMP BOD/DO water quality schemes have been identified for AMP8. There is an investigation into the impacts of flow regimes on the River Derwent included under the HD_INV driver. More detail can be found in the HD_INV chapter.

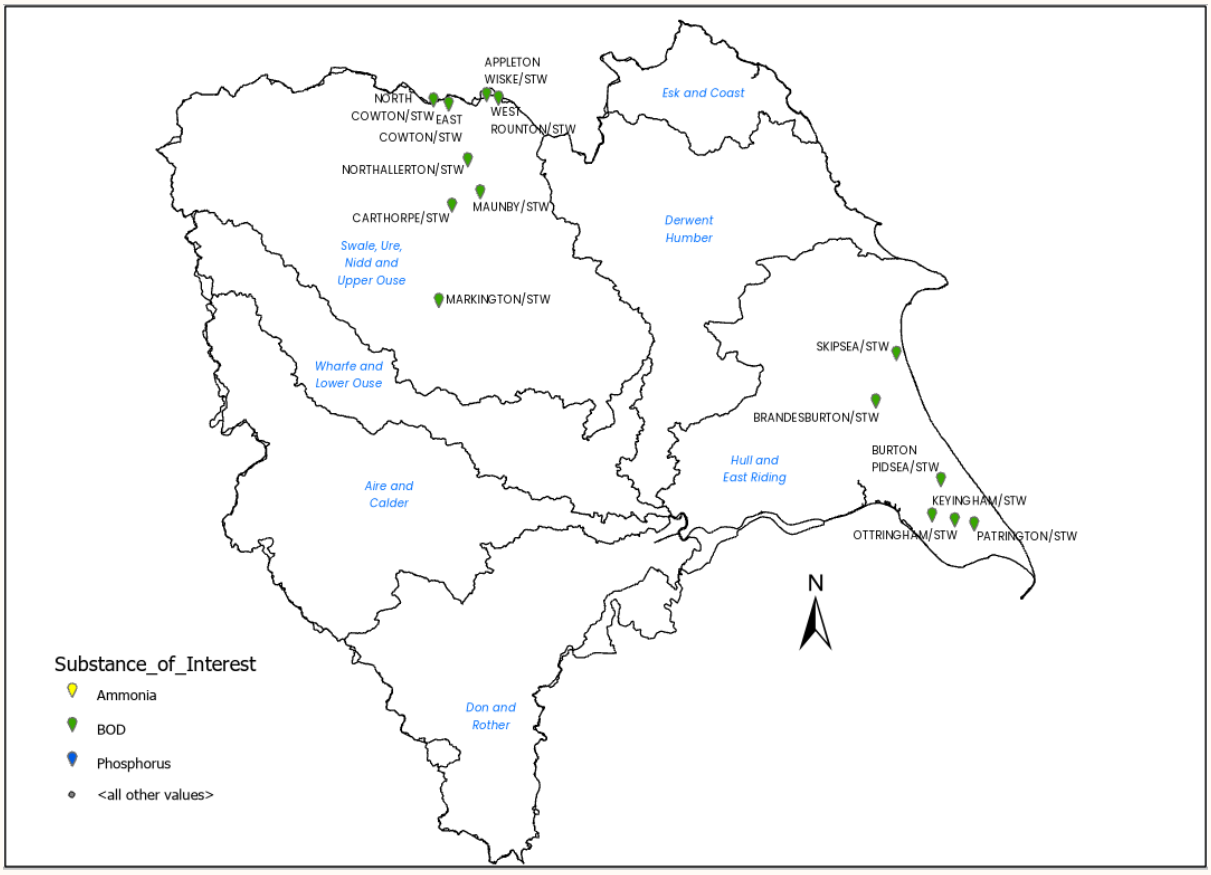
EnvAct_IMP1 does not apply to BOD/DO.

Table 1.7: List of WFD_IMP and WFD_IMP_MOD BOD obligations identified for AMP8 delivery.

Site	AMP8 Proposed WFD_IMP BOD (mg/l)	WFD_IMP BOD Target Class	AMP8 Proposed WFD_IMP_MOD BOD (mg/l)	AMP8 Proposed HD_IMP BOD (mg/l)
BURTON PIDSEA/STW	10	Good	N/A	N/A
BRANDESBURTON/STW	10	Good	N/A	N/A

EAST COWTON/STW	10	Good	N/A	N/A
NORTH COWTON/STW	10	Good	N/A	N/A
APPLETON WISKE/STW	10	Good	N/A	N/A
WEST ROUNTON/STW	10	Good	N/A	N/A
NORTHALLERTON/STW	10	Good	N/A	N/A
MAUNBY/STW	10	Good	N/A	N/A
PATRINGTON/STW	10	Good	N/A	N/A
OTTRINGHAM/STW	10	Good	N/A	N/A
KEYINGHAM/STW	10	Good	N/A	N/A
CARTHORPE/STW	10	Good	N/A	N/A
MARKINGTON/STW	10	Good	N/A	N/A
SKIPSEA/STW	10	Good	N/A	N/A

Figure 1.11: Location of WFD_IMP BOD Obligations



8.3.2 The Scale and Timing of the Investment

The regulatory completion dates for each of the sites above are set by the EA in their PR24 Profiling Guidance, as shown below:

Figure 1.12: EA PR24 Profiling Guidance

Water Framework Directive (surface waters)		
Driver code	**Driver description**	**Completion date**
WFD_INV	Investigations of actions to improve water quality in terms of relevant WFDR status objectives	30/04/2027
WFD_IMP	Implementation of actions to improve water quality in terms of relevant WFDR status objectives	31/03/2030
WFD_ND	Actions to meet requirements to prevent deterioration	31/03/2026 (Note 16) 31/03/2030 (Note 17)
WFD_INV_MOD	Investigations to ensure no river, lake or estuary is in poor or bad ecological status due to the water industry	30/04/2027
WFD_IMP_MOD	Actions to ensure no river, lake or estuary is in poor or bad ecological status due to the water industry	31/03/2030

Environment Act		
Driver code	**Driver description**	**Completion date**
Environment Act wastewater target		
EnvAct_IMP1	Actions to reduce phosphorus loading from treated wastewater by 80% by 31 December 2038 against a 2020 baseline	31/12/2038 (Note 9)

Habitat Regulations		
Driver code	**Driver description**	**Completion date**
HD_IMP	Action to contribute to restoration of a European site or Ramsar site to move towards meeting the conservation objectives	31/03/2030

Note 9 - Planning to meet the Environment Act 2021 wastewater phosphorus reduction target by 2038 will span two Asset Management Planning (AMP) periods from 2025 to 2035. Work will be prioritised in PR24 to action in catchments with WFDR phosphorus failures and identified eutrophication problems and/or catchments where the phosphorus targets for European Sites or SSSIs are exceeded. All other wastewater treatment works which fall outside of these requirements can be planned for PR29 delivery. They should be entered into the PR24 WINEP with a delivery date of AMP9.

Note 16 - Early delivery where deterioration has occurred since the 2015 RBMP and identified in 2021 plan (published late 2022)

Note 17 - the action must be in place in soon as possible before the class deteriorates. If deterioration is known to occur in the future, or the action cannot be delivered by the completion date due to engineering constraints, the Environment Agency will consider extending the date to 31 March 2030 on a site by site basis using evidence provided by the water company.

8.3.3 Interactions with Base Expenditure

We confirm this enhancement case does not duplicate base funding. We have identified £0.978m of works for five sites that are more akin to maintenance, which we will fund through base. We request enhancement investment for the extent the works are required to achieve our new permit levels for phosphorus, ammonia and/or BOD.

8.3.4 Activities Funded in Previous Price Reviews

There are seven WwTWs identified for WFD_IMP and EnvAct_IMP1 phosphorus removal schemes in AMP8, which have existing 2 mg/l phosphorus permit limits that received funding in AMP7 under a different statutory driver, either Urban Waste Water Directive or Habitats

Directive. The AMP8 schemes tighten the existing permit limit and represent a step change in the level of treatment required. Additional treatment is required on site to comply with the new tighter phosphorus permit limit. The tighter AMP8 permit limit cannot be met without additional, new treatment processes being installed that were not funded under the previous obligation.

A WwTW with single-point ferric dosing treatment can only treat to a permit limit of 0.7 mg/l total phosphorus. Beyond 0.7 mg/l to the technical limit of 0.25 mg/l, second point dosing is required as well as additional solids capture. For example, WOMBWELL/STW has an AMP7 2 mg/l Urban Waste Water Sensitive Area designation. In AMP8 WOMBWELL/STW will have a new 0.25 mg/l phosphorus limit under WFD_IMP and EnvAct_IMP1. The 0.25 mg/l scheme was proposed in PR19 but failed WFD cost-benefit analysis, so only the statutory UWW 2 mg/l scheme progressed. Applying the statutory driver EnvAct_IMP1 of 0.25 mg/l in AMP8 supersedes the need for CBA but the 0.25 mg/l limit cannot be complied with without additional treatment, of a second ferric dosing unit and additional solids capture.

8.3.5 Long-term Delivery Strategy Alignment

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about this at
Long-Term Delivery Strategy

8.3.6 Customer Support

While there has not been any specific customer research related to this enhancement case, more generally we know that river water quality is of medium to high importance to our customers, through the research carried out on behalf of Ofwat and CCWater and our own Valuing Water customer priorities research, where our research showed that customers prioritised water quality in rivers, streams and the sea in their Top 6 service areas.

An example of a specific piece of customer engagement carried out on phosphorus removal in our rivers was the WINEP research evaluating customer support for investigations and improvements to Wyke Beck and River Wiske. 82% of our customers supported investigations into reductions in phosphorus.

For more information on our customer engagement across river water quality, see our Performance Commitment appendix or visit Chapter 6 of our main business plan to view our wider engagement.

Read more about this at
Detailed Performance Commitments appendix

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

8.3.7 Factors Outside Management Control

Please refer to section 1.3.2.

8.4 Best Option for Customers

8.4.1 Options Considered

An unconstrained list of options was created with stakeholder input, see Figure 1.13. This ranges from conventional treatment options through to novel untested processes and supply side interventions. The table in Figure 1.14 shows reasons for discounting options to achieve the constrained list.

Figure 1.13: Unconstrained List of Options Considered for WwTW Quality Improvement

Approach	Constrained	Comments
Biological Nutrient Removal	✓	
Sewer modelling	✗	Outcome not delivered
Built catchment flow reduction	✗	Outcome not delivered
Ozone	✗	Outcome not delivered
Membrane filtration	✗	Outcome not delivered
Chemical disinfection	✗	Outcome not delivered
Chemical dosing	✓	
CSO Spill mitigation	✗	Outcome not delivered
Dilution assessment	✗	Outcome not delivered
Increase treatment capacity	✓	
Use of clean water sludges for P removal	✓	
Industry collaboration	✗	Outcome not delivered
Joint sampling programme	✗	Outcome not delivered
Trade effluent management	✗	Outcome not delivered
Nature Based Solutions	✓	
Network storage	✗	Outcome not delivered
Permit trading	✗	Outcome not delivered
Rationalise assets	✓	
Sidestream excess flows through passive systems	✓	
SuDS	✗	Outcome not delivered
Ultra Violet Disinfection	✗	Outcome not delivered
Wetland	✓	
Work with other WASCS	✗	Outcome not delivered
Accelerated rollout of IOT / Smart monitors	✗	Outcome not delivered
Cross sector planning	✗	Outcome not delivered
Capture storm water, treat and use as sub-potable	✗	
Citizen science	✗	Outcome not delivered
Catchment Nutrient Balancing	✓	
Geographical synergies	✗	Outcome not delivered
Innovative treatment processes	✓	
Catchment Partnership support	✓	
Payment for ecosystem services	✗	Outcome not delivered
Political engagement	✗	Outcome not delivered
Removal at source	✗	Outcome not delivered
rtRIVERi	✗	Outcome not delivered
Storm storage only applies to combined network population	✗	Outcome not delivered
Full surface water separation	✗	Outcome not delivered
Infiltration reduction	✗	Outcome not delivered
Customer education	✗	Outcome not delivered
Misconnections	✓	
Impermeable area surface water management	✗	Outcome not delivered
Property level surface water management	✗	Outcome not delivered
Per capita consumption reduction	✗	Outcome not delivered
Catchment fencing	✗	Outcome not delivered
Buffer strips	✗	Outcome not delivered
Work with agriculture	✗	Outcome not delivered
Localised MSP dosing	✗	Outcome not delivered
Smart Water Networks	✗	Outcome not delivered
System operator	✗	Outcome not delivered
Urine separation	✗	Outcome not delivered

The unconstrained list was reviewed in a workshop with YW colleagues from across the business and with external stakeholders, to create a constrained list. The matrix in Figure 1.14 shows reasons for discounting options to achieve the constrained list.

Figure 1.14: Constrained List of Options Considered for WwTW Quality Improvement

Approach	Feasible	Comments
Biological Nutrient Removal	✔	Only applies to current ASP sites
Chemical dosing	✔	Single or Two Point Dosing
Increase treatment capacity	✔	Various
Use of clean water sludges for P removal	✘	Lack of control makes this unreliable
Nature Based Solutions	✔	Wetland
Rationalise assets	✔	Pump out to different STW
Sidestream excess flows through passive systems	✔	Wetland
Wetland	✔	See NBS
Catchment Nutrient Balancing	✘	Short timescales preclude this option at this stage
Innovative treatment processes	✘	Unidentified processes
Catchment Partnership support	✘	Short timescales preclude this option at this stage
Misconnections	!	Investigation required. Possible once scheme in delivery phase

Following the development of the constrained list, YW held a second workshop including colleagues from asset planning and local service delivery teams. This was to discuss site specific options. This workshop reviewed the options in the constrained list and how they might be employed on each specific location. For phosphorus removal schemes, a matrix of options was created (Figure 1.15 and Table 1.8). This matrix is used as a guide and not hard set of rules. Local knowledge and/or engineering judgment may have been used to flex the options where appropriate. For BOD and ammonia schemes, additional primary and secondary treatment options are considered.

Figure 1.15: List of Potential Solutions Available Dependent on the Phosphorus Permit Limit Proposed.

Approach	Feasible	Comments
Biological Nutrient Removal	✔	Only applies to current ASP sites
Chemical dosing	✔	Single or Two Point Dosing
Increase treatment capacity	✔	Various
Nature Based Solutions	✔	Wetland
Rationalise assets	✔	Pump out to different STW
Sidestream excess flows through passive systems	✔	Wetland
Wetland	✔	See NBS
Misconnections	!	Investigation required. Possible once scheme in delivery phase

Table 1.8: Solution availability identified by phosphorus permit limit. Green is available, Red is unavailable.

Total Phosphorus Permit Limit (mg/l)	1 Point chemical dosing	2 Point chemical dosing	Wetland	Electro Coagulation	EBPR	Transfer or Relocation
>=1			2k PE Limit	5k PE Limit		
>=0.7						
<=0.6						

However, application of the EnvAct_IMP1 driver on all phosphorus removal obligations (WFD_IMP, WFD_IMP_MOD or HD_IMP) specifies that onsite treatment only can be implemented in order to achieve the treated load reduction required at the WwTWs. There are restrictions (Table 1.5) where onsite wetland solutions will only be possible dependent on the proposed total phosphorus permit limit. Other restrictions such as land availability and ground conditions may prevent an onsite wetland from being possible.

All other phosphorus removal obligations will need to be achieved by traditional solutions. YW would welcome greater opportunities to promote more low carbon, environmentally sustainable solutions.

In general, we expect to see improvement in levels of ammonia and BOD from phosphorus reduction solutions. However, solutions for ammonia and BOD will not improve Phosphorus levels. As shown in Figure 1.15, we have a range of constrained options. For example, by increasing treatment capacity, we can address BOD and ammonia levels, but without any impact on phosphorus.

The extent we can apply each option depends on the existing assets and the level of change in our permit requirements. We require sufficient space on site to be able to implement a nature-based solution for ammonia, however this will not be a feasible option for BOD. When selecting our site solutions, we have considered the characteristics of each site and applied the relevant option from Figure 1.15 and Table 1.8.

8.4.2 Cost-Benefit Appraisal

WFD_ND is a statutory driver and does not require Cost-benefit appraisal. WFD_IMP schemes are statutory plus and CBA was developed in line with the EA's method, as defined in 01 Introduction to Enhancement Cases linked below. However, EnvAct_IMP1 has been placed on all WFD_IMP drivers. EnvAct_IMP1 is a statutory driver and does not require CBA.

For more information on our approach to CBA please see section 6 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

8.4.3 Carbon impact and best value

Where possible we will aim to implement low carbon solutions, pending EA approval. Phosphorus limits below approximately 2 mg/l are likely to be traditional solutions with a higher carbon footprint. We will aim to deliver the best value solution possible for each WwTW. The benefits associated with delivery of these solution are avoidance of legal non-compliance and improved river water quality. These benefits are described in Table CWW15.

8.4.4 Impact Quantification

We have set out the expected improvement in performance from this enhancement case in section 'Customer Protection' under annualised outcome delivery incentive.

Our investment in reducing ammonia and BOD levels do not impact any performance commitments.

8.4.5 Third Party Funding

There is no planned third party funding for river water quality drivers listed in this document.

8.4.6 Customer Views

We have not carried out specific customer engagement on solution options related to this enhancement case given that it is a statutory requirement, but a summary of customer views of this area more generally can be found in our customer support section above.

8.4.7 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

8.5 Cost Efficiency

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in section 7.3 in Introduction to Enhancement Cases has been applied to this enhancement case. Table 1.1 and Table 1.2 at the beginning of this document summarise the costs associated with this enhancement case:

8.5.1 Cost estimate for our preferred option

Our costing estimate has been developed using our Unit Cost Database (UCD) and our Enterprise Data Analytics processes. Further details on how we have applied these tools to develop cost estimates are provided in section 7.3. Key assumptions used to create cost estimates for this enhancement case are discussed below.

As outlined earlier in this case, schemes were identified through the PR24 WINEP process through consultation with the EA. We then worked through a detailed optioneering process to identify solutions available.

As part of our central approach to costing, information was collected regarding the characteristics of existing assets at identified sites and future permitted limits. Using decision tools, additional assets are then generated with measures to meet the specified permit limit. Design measures are subject to verification by a technical consultant before cost models from our Unit Cost Database are applied to the scope specified.

In some instances, a site-specific solution was designed in conjunction with our Strategic Planning Partner, and subsequently costed using information held within our Unit Cost Database. Where no suitable cost models were identified in our Unit Cost Database, we utilised information held in the national water industry costing database where applicable (TR61 v14). Adjustments are required to this data to account for differences in methodology and to account for YW design costs.

Please refer to Annex D1 in the WINEP Enhancement Case Annexes document.

Read more about this at
Annex to the WINEP Enhancement Case

8.5.2 Efficiency of our cost estimate

Section 7.3 of the Introduction to Enhancement Cases outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

For our proposed implementation costs, estimates were developed using the expertise of our Strategic Planning Partner to determine scope and using UCD models to create efficient cost estimates. Our UCD approach involves building detailed cost estimates that are developed using historic cost information on individual components of an overall solution.

8.5.3 Need for enhancement model adjustment

Phosphorus Removal Costs

We support Ofwat's approach of making use of benchmarking models to set efficient allowances where appropriate. The use of benchmarking models is based on company evidence-based data, and less regulatory judgment is involved when opting for deep dives and shallow dives assessments where companies' costs are comparable. However, without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging.

For Phosphorus removal costs we believe Ofwat can build on its PR19 modelling approach which underwent significant iterations throughout the PR19 process and the CMA appeals. We believe Ofwat should weight any analysis to forward looking data as there will be diminishing returns to benefits being driven under these drivers as less beneficial Phosphorus removal schemes (£/PE) become statutory compared to the AMP7 programme.

In order to fully reflect efficient costs, a variety of key drivers need to be considered. The key variables impacting on the relative efficient cost of meeting P removal obligations set by environmental legislation included the following:

- **Number and size of sites**. The scale of STWs that are affected by obligations. Companies with more affected sites, or larger sites, will – all else being equal – face greater costs of meeting their obligations. The size of sites is typically measured by load or by a site's Population Equivalent (PE)
- **Permit level**. The lower the absolute level of permit, the more costly it is to achieve. For example, it is more costly to achieve a permit level of 0.5mg/l than it is to achieve a permit level of 1mg/l. This is because lower limits require additional treatment units and additional chemicals leading to increased capital and operating costs.
- **Change in permit level**. Enhancement costs reflect step changes from current levels of service. The extent to which permit levels change can vary between companies, and therefore this drives differences in costs between companies. Companies that have received enhancement cost allowances in the past to achieve the UWWTD driver (typically a set 1 or 2 mg/l limit), may have less of a change to meet the WFD standard (set based on the output of river modelling) than a company that currently has no permit and has to achieve both standards.
- **Type of obligation / Availability of blue/green solutions.** The type of obligation affects what solutions can be applied to achieve the required permit levels. The UWWTD is clear in that permit levels must be achieved by treating wastewater before it is discharged from the treatment works. At WINEP3 we noted that the WFD applied no such restrictions and that therefore, less costly technologies (e.g. catchment-based solutions) can be used to meet WFD obligations compared to UWWTD obligations. This is no longer fully the case as all WFD_IMP schemes now have a EnvAct_IMP1 driver as well. The availability of solution options such as catchment permitting and wetland treatments are still relevant drivers of cost however.

We note that as more evidence was provided to both Ofwat and the CMA related to these variables, improved models were introduced throughout the PR19 process. However these new models, were triangulated with the original models that did not capture all relevant cost drivers, thus only partially funding the efficient allowance required. We urge Ofwat to develop models that incorporate all of the valid variables in the first pass at PR24.

We welcome Ofwat's capturing of additional drivers and a breakdown by intervention types in its data tables. We would like to understand further how Ofwat's modelling will incentivise the best value solution to be delivered rather than the least cost in-AMP.

Sanitary Parameters

It is not clear how Ofwat will assess Sanitary Parameter costs and therefore we cannot assess whether an adjustment is required. At PR19 Ofwat was unable to find appropriate models to drive Sanitary Parameter costs at FD so simply applied the WINEP in-the-round efficiency to all companies' costs.

We support Ofwat continuing to consider whether a modelling approach is appropriate and identify the key drivers of cost as being:

1 – Flow through the sites (Population Equivalent) - Scale
2- The number of sites - scale / economies of scale
3 – Stringency of consent – complexity (there are significant step changes in complexity as Ammonia consent moves below <3mg/l and below <1mg/l.

8.6 External assurance

For information on Assurance please see section 7.4 in Enhancement Cases – Introduction.

8.7 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

We reviewed our forecast enhancement totex and found we met the 1% materiality threshold for PCDWW10 and PCDWW12. Accordingly, we propose to implement a PCD to safeguard customers from non-delivery of our proposed phosphorous, ammonia and BOD/DO improvement investments.

We also considered whether additional customer protection mechanisms were in existence or should be introduced to complement the PCD.

8.7.1 Price Control Deliverable – Nutrient removal

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

Table 1.9: PCD Parameters

PCD Delivery Expectation	
Description	Enhancing the quality of treated wastewater by removing greater levels of nutrients before discharging to the environment in accordance with the new regulations. Biochemical oxygen demand (BDO)/ dissolved oxygen (DO) is a measure of the biological pollution of wastewater. The company will improve 134 sites to reduce the phosphorus, ammonia and BOD/DO concentration in treated wastewater to new compliance levels. The new levels for compliance are set out in [WINEP spreadsheet].
Output measurement and reporting	The number of compliant sites, reported to zero decimal places. The company will report on its progress in parallel with the APR.
Assurance	The company must commission an independent, third-party assurer, with a duty of care to Ofwat, to assure, to our satisfaction, that the conditions below have been met and the outputs of the scheme set out below have been delivered.
Conditions on Scheme	Sites that are found to no longer require upgrades for nutrient removal may be swapped with alternative sites requiring nutrient removal approved by the EA through an amended WINEP. Sites will be completed by the regulatory dates specified under the WINEP.

We have set our delivery profile to meet our obligations to the EA and the required completion dates for each type of site. We note some timings are still to be finalised with the EA and Defra, and we will provide an update once available.

8.7.1.1 Forecast deliverables

Sites are based on the primary driver regulatory dates and the sites in the tables under the first need section where you have sites grouped by driver.

Table 1.10: Forecast Deliverables

Deliverable	Unit	Forecast Deliverables				
		2025/26	2026/27	2027/28	2028/29	2029/30
Sites compliant with phosphorus standard	Number	17*	0	0	0	85**
Sites compliant with ammonia standard	Number	5*	0	0	0	12
Sites compliant with BOD standard	Number	1*	0	0	0	14

*Includes WFD_ND 31st March 2026 regulatory date.

**Includes U_IMP2, 25YEP_IMP, WFD_IMPg, WFD_IMPm and HD_IMP 31st March 2030 regulatory date. Does not include EnvAct_IMP1 secondary drivers.
We have a reasonable level of certainty around the solutions required to meet the new compliance levels for each site. We note there is variation in costs required depending on various site factors, and therefore we consider the PCD payment should reflect each named schemes costs.

8.7.1.2 Proposed payment rate

Table 1.11: Payment Rate

Deliverable	Unit payment (£m)
£m per phosphorus site	Refer to Annex D1 in the Annex to the WINEP Enhancement Case
£m per ammonia site	
£m per BOD site	

8.7.2 Annualised Outcome Delivery Incentive

We identified one common performance commitment that is impacted enhancement case, which reflects the improvements for phosphorus removal. We have only included the forecast performance from enhancement totex to calculate the ODI impact for this case.

There are no PC and ODI impacts from the Ammonia and BOD removal investments.

The expected performance is 76.11% increase in phosphorus load removed from a 2020 baseline by 2029/30 which aligns with table OUT5.71.

8.7.2.1 Forecast benefits

Table 1.12 Forecast PC Benefit

PC	Unit	Forecast Benefits				
		2025/26	2026/27	2027/28	2028/29	2029/30
River water quality	% reduction	72	76	76	76	76

The Ofwat performance commitment method for phosphorus load removed includes reductions only from the next whole calendar year after implementation. As the AMP8 phosphorus limits will be delivered by the regulatory WINEP date of 31st March 2030, these reductions will not be included in the AMP8 forecast, but will be included from January 2031, the first year of AMP9. The 72% and 76% are forecast to be delivered from AMP7 WINEP phosphorus removal obligations.

The Ofwat performance commitment method also applies measured flow and measured water quality. As future years have not yet been measured the figures forecast in Table 1.12 are based on the Ofwat method of permitted DWF*1.2 for flow and the AMP8 WINEP obligation permitted phosphorous limit. When flow and quality are measured in years to come, they are unlikely to completely match the forecast. Factors such as weather and asset performance will likely affect the measured values.

8.7.2.2 Forecast ODI impacts

Table 1.13: Forecast ODI Impact

PC	ODI rate (£m / unit)	Total ODI exposure (£m)
River water quality	£0.000661m per kg P removal	20.68

8.7.3 Annualised time delivery incentive

We consider the River Water Quality PC and ODI associated with this enhancement case provides sufficient protection for customers for the phosphorus programme. However the ODI exposure is less than 3.5% of the enhancement totex across all nutrient removal programmes. We propose to a time delivery incentive for each ammonia and BOD/DO site delivered late.

8.7.3.1 Time incentive payment rate

Table 1.14: Proposed Payment Rate

Deliverable	Unit payment (£m)
£m per ammonia/BOD site	Scale of time delay incentive = totex for enhancement x 3.5% = £63.87 x 3.5% = £2.24m Incentive per scheme per year = £2.24m ÷ 36 ÷ 5 years = £0.012m

We propose that the time delivery incentive does not apply where we have not completed sites in accordance with directions from the EA, such as an agreed revised WINEP programme for AMP8.

8.7.4 Third Party Funding or Delivery Arrangements

This is not applicable for this case.

9. Wastewater: River Water Quality Monitoring

9.1 Drivers:

EnvAct_INV1,2 & 3, EnvAct_MON1, 2, 3, 4 & 5

9.1.1 Requested Investment:

Table 1.1: River Water Quality Monitoring AMP8 Expenditure

	£m	Table Line Ref.
Enhancement Expenditure Capex	116.135	CWW3.7, CWW3.106
Enhancement Expenditure Opex	41.315	CWW3.8, CWW3.107
Base Expenditure Capex		
DPC value		
Total	157.450	

9.1.2 Associated Reporting lines in Data Table:

Table 1.2: CWW3 Reporting Lines

Line Number	Line Description
CWW3.7	Continuous river water quality monitoring (WINEP/NEP) wastewater capex
CWW3.8	Continuous river water quality monitoring (WINEP/NEP) wastewater opex
CWW3.9	Continuous river water quality monitoring (WINEP/NEP) wastewater totex
CWW3.106	Investigations, other (WINEP/NEP) - survey, monitoring or simple modelling wastewater capex
CWW3.107	Investigations, other (WINEP/NEP) - survey, monitoring or simple modelling wastewater opex
CWW3.108	Investigations, other (WINEP/NEP) - survey, monitoring or simple modelling wastewater totex

9.2 High Level Driver description:

As part of the Environment Act 2021 there is a requirement for water companies to install continuous water quality monitoring of all discharges to the environment. These are covered by a number of drivers depending on the type of environment to be monitored, installation or where there is no defined methodology for monitoring, investigation to understand the best approach to installation and monitoring. These are summarised below.

- EnvAct_INV1 – Investigation - Estuarine
- EnvAct_INV2 – Investigation Inland Complex (canals, groundwater and lakes)
- EnvAct_INV3 – Investigation Coastal
- EnvAct_MON1 – Installation Estuarine
- EnvAct_MON4 – Installation Inland watercourse

- EnvAct_MON5 – Near real time reporting

The installation of the monitors will be over AMP8 and 9 as set out in the EA's guidance.

In August 2023 DEFRA issued revised technical guidance which in turn resulted in the EA providing revised driver guidance. Due to the timing of this additional guidance it has not been possible to update the costs and delivery profiles associated with this driver/enhancement case to fully comply with the latest guidance. Further work is ongoing to revise the number of monitors required to meet the revised guidance and as such the number of monitors are likely to change. This will impact EnvAct_MON1 and EnvAct_MON4.

9.3 Need for investment

9.3.1 The Need for the Proposed Investment

The Environment Act 2021 sets out the requirement to install continuous water quality monitors up and downstream of all discharges for a number of parameters.

This is a new requirement and as such we have never installed monitoring or received funding to undertake work of this nature.

The data will be collected and reported in near real time to the public via an online portal. This will lead to an enhanced service to our customers as it will allow them to see the health of their rivers.

The driver guidance provided by the environment Agency summarises the need and benefits as *"…water quality (WQ) monitoring data will further improve the understanding of any impact from storm overflows and WwTW discharges on the receiving environment, and help identify necessary improvement actions. Providing these data in near real time (NRT) to the public will continue to improve the transparency of storm overflow operation."*

9.3.2 The Scale and Timing of the Investment

We propose to invest under a number of the EA's WINEP drivers supplied, this investment is summarised below.

Table 1.3: Investment by Driver

Driver	Description	Investment£m*
EnvAct_INV1	Estuarine: Investigation/pilots to assess site suitability for continuous water quality monitoring of the receiving environment.	£1.05m
EnvAct_INV2	Inland complex: Investigation/pilots to assess site suitability for continuous water quality monitoring of the receiving environment.	£0.82m
EnvAct_INV3	Coastal: Investigation/pilots to assess site suitability for continuous water quality monitoring of the receiving environment.	£0.525m
EnvAct_MON1	Estuarine: Installation of continuous water quality monitoring of the receiving watercourse upstream and downstream of storm overflows and wastewater treatment works discharge outlets.	£4.99m
EnvAct_MON4	Inland watercourses: Installation of continuous water quality monitoring of the receiving watercourse upstream and downstream of storm overflows and wastewater treatment works discharge outlets.	£144.8m
EnvAct_MON5	Develop and implement the ability to publish continuous water quality monitoring data in near-real time in a standardised format	£5.25m
	Total	**£157.45m**

*numbers are rounded

The outputs of the investigations (EnvAct_INV codes) will be used to inform the investment requirement under the associated monitoring drivers either within AMP8 or 9. These investigations will be a combination of local site-specific studies and a national collaborative study with input and investments from all water companies to ensure we are consistent. EnvAct_MON4 and 5 investments will result in the installation of monitoring in riverine environments with the ability to report in near real time.

The EA's guidance sets out when each driver is required to be completed by these have been summarised below:

- EnvAct_INV1, 2 and 3 – 30th April 2027
- EnvAct_MON1 - 31st March 2030
- EnvAct_MON4 – All priority and a total of 40% of sites by 31st March 2030
- EnvAct_MON5 – 31st March 2027

Further investment will be required as part of PR29 and AMP9 to complete the rollout of monitors at sites.

In August 2023 DEFRA issued revised technical guidance which in turn resulted in the EA providing revised driver guidance. Due to the timing of this additional guidance it has not been possible to update the costs and delivery profiles associated with this driver/enhancement case to fully comply with the latest guidance. Further work is ongoing to revise the number of monitors required to meet the revised guidance and as such the number of monitors are likely to change. This will impact EnvAct_MON1 and EnvAct_MON4.

9.3.3 Interactions with Base Expenditure

As this is a new requirement under the Environment Act 2021, there is no overlap with base expenditure and falls solely under WINEP investment.

9.3.4 Activities Funded in Previous Price Reviews

There is no overlap with funding from previous price reviews as this is a new requirement of the Environment Act 2021.

9.3.5 Long-term Delivery Strategy Alignment

The driver guidance received from the Environment Agency sets out the delivery timescales for this work with it being phased over AMP8 and AMP9, therefore this sets the timelines and this is followed within our long-term delivery strategy.

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about our LTDS at
Long Term Delivery Strategy

9.3.6 Customer Support

While this enhancement case has been developed to meet statutory requirements, we know that quality of water within the natural environment is important to our customers..

Through wider engagement we understand that river water/sea water and bathing waters have grown in importance in recent years – spurred on by covid and lockdowns forcing customers to take more interest in their local environment and related to this is the surge in 'wild swimming'. Each of these factors have meant there is a growing interest in the water environment and more of an understanding of the impact of water companies on bathing water specifically.

In the Ofwat/CCWater customer preferences research, we understand that river water quality is ranked as a mid-tier priority to customers when considered across the range of performance commitments. However, in contrast, in our own Valuing Water customer priorities research found that treating wastewater to a high standard to ensure good quality water in Yorkshire's rivers and

beaches and other factors which impact river water quality such as pollution incidents and storm overflows all sit in the top tier priority service areas for both household and non-household customers when considered alongside 27 other priorities.

Our research on Defra's consultation on storm overflows cemented the importance of river water quality to our customers. Customers view river and sea health as being important, 98% of customers agreed that river/sea health was important to them. River health was important to customers primarily to support wildlife and so that they look clean. 3 in 4 felt it's important for river/sea health to be improved to provide healthy habitats as opposed to being improved for personal use such as swimming. Yorkshire Water were clear that addressing storm overflows would have an impact on bills, even still river/sea health was seen to be a high priority and around three-quarters feel just as supportive or more so after learning that it is likely going to increase costs.

Wider monitoring can only bring benefits to water quality and the water environment overall, meeting our customers' expectations that the water environment should improve. In our own independent affordability and acceptability testing study (outside of Ofwat guidelines), we showcased our extensive plan to customers and 79% found our plan to be acceptable.

More about our wider engagement and acceptability testing can be found in Chapter 6 of our main business plan.

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

9.3.7 Factors Outside of Management Control

Please refer to section 1.3.2.

9.4 Best Option for Customers

9.4.1 Options Considered

The number of options is limited as prescribed by the guidance, so optioneering and cost variation is limited, (see below from EA guidance).

Monitor type

For PR24 planning pumped kiosk-based systems are recommended as the primary method of monitoring. In-situ suitcase systems should be the option where it is known that a pumped kiosk installation is infeasible and will remain infeasible in future. Further detail is included in the technical guidance and implementing legislation.

The costs which have been developed assuming that a kiosk-based system will be possible in all locations but as noted by the guidance this may not be possible in all cases. Where in-situ installation is required, it is envisaged the overall costs will be comparable. The install costs will reduce as there is no need for the kiosk, but the annual maintenance will increase as it is demonstrated that this type of installation require more frequent visits. The decision about whether a kiosk is infeasible will take place on a site-by-site basis and will form part of the design process.

The type of monitor and sensors to be installed has been determined based on both our current experience of monitoring within rivers on a smaller temporary scale (approx. 30-50/AMP) and the experience of the Environment Agency who have also deployed at a slightly larger scale. Experience by both show that although there are cheaper monitors available, they do not reliably return good data which is what is required and expected by the public.

The number of monitors required will be dictated by the rules around monitor siting including exceptions and clustering. We have taken this guidance and applied GIS routines specifically developed for this to calculate the number of monitors required once the exclusions, considerations and clustering has been applied (as mentioned in other sections of the enhancement case revised guidance was received in August 2023 which will influence the

number of monitors required. It is not envisaged that this will result in a material change to costs).

9.4.2 Cost-Benefit Appraisal

Due to the prescriptive approach taken to these monitors by the Environment Agency there was no opportunity for cost benefit appraisal. There is typically only one option for each installation and where there is more than one there are no wider benefits, and the least cost option is selected.

9.4.3 Carbon impact and best value

Further detail of our benefits assessment can be found in Table CWW15. The installation of river water quality monitoring does not drive benefits in its own right.

9.4.4 Impact Quantification

There is no impact on our performance commitments. We will use data from the newly installed meters to inform our business decisions on where and how to prioritise investments.

9.4.5 Cost and Benefit Uncertainties

As stated previously, we had little scope for optioneering and selection of technology to deliver these prescriptive requirements. The uncertainty lies in the scope of the programme, where our proposed PCD protects customers in the event we agree with the EA a reduced scope for our WINEP.

We are also open to any opportunities for river water quality monitoring requirements to be delivered through a national programme of work.

9.4.6 Customer Views

Wider research highlighting the importance of river water quality and overall improvements to this are covered in Section 1.3.6.

9.4.7 Third Party Funding

There is no third party funding.

9.4.8 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

9.5 Cost Efficiency

9.5.1 Option Costs

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in section 7.3, has been applied to this enhancement case. The table below summarises the costs associated with this enhancement case:

Table 1.4: Costs by Driver

Driver	Description	Investment £m*
EnvAct_INV1	Estuarine: Investigation/pilots to assess site suitability for continuous water quality monitoring of the receiving environment.	£1.05m

EnvAct_INV2	Inland complex: Investigation/pilots to assess site suitability for continuous water quality monitoring of the receiving environment.	£0.82m
EnvAct_INV3	Coastal: Investigation/pilots to assess site suitability for continuous water quality monitoring of the receiving environment.	£0.525m
EnvAct_MON1	Estuarine: Installation of continuous water quality monitoring of the receiving watercourse upstream and downstream of storm overflows and wastewater treatment works discharge outlets.	£4.99m
EnvAct_MON4	Inland watercourses: Installation of continuous water quality monitoring of the receiving watercourse upstream and downstream of storm overflows and wastewater treatment works discharge outlets.	£144.8m
EnvAct_MON5	Develop and implement the ability to publish continuous water quality monitoring data in near-real time in a standardised format	£5.25m
	Total	**£157.45m**

*numbers are rounded

This business case includes costs for both monitoring and investigations. The investment costs have been developed based on historical costs of national investigations involving collaboration and data collection as well as considering the requirements of the investigation to inform PR29.

9.5.2 Cost estimate for our preferred option

As noted earlier in this case, the drivers for investment in continuous water quality monitoring relate to new requirements introduced in the Environment Act 2021. Consequently, our approach to costing has focused on developing a bottom-up estimate, rather than formal benchmarking against our historic actual costs or external data sources.

Whilst some minor monitoring requirements have previously been invested in under previous WINEP programmes, the scale of investment required under this new driver is significantly higher. Our approach to development considers the volume of installations required, and the associated unit cost. We discuss our assumptions for each of these below:

Volume of work used in our cost estimate

Driver guidance from the Environment Agency specifies criteria that determine where monitor installations are required across our area and which discharges are excluded from requiring monitoring. Exceptions include:

• Any watercourse with a year-round, permanent depth of 4cm or shallower throughout the permissible distance from the optimum monitoring point
• Descriptive only permitted treatment works
• Storm overflows that spill fewer than 10 times per year over a 5-year average.

The guidance also sets out a range of clustering rules which determine situations where it is more appropriate to monitor groups of discharges as a cluster rather than individually. This in most instances is where due to proximity it would not be possible to monitor the impact of the discharges individually as multiple discharges impact the same length of watercourse. We have developed routines within GIS that capture these criteria and analyse our network information to determine where installations are required to comply with the driver guidance. This approach has accounted for exceptions and clustering when determining the number of monitors.

This process identified 1803 monitors will be required during AMP8, as informed by the updated draft guidance from the Environment Agency in June 2023. The table below provides the profile of installations over the period:

Table 1.5: EnvAct_MON4 Installation Profile

	AMP8 (years ending 31st March)					
	2026	2027	2028	2029	2030	Total
Number of monitor installations	53	100	350	650	650	1803

Our proposed profile of monitoring installations recognises that the level of installations required during AMP8 represent a step change relative to historic workloads. For example, in AMP7 we have had temporary installations at approximately 30 sites, equivalent to less than 2% of the installations required in AMP8. Further, these installations were temporary in nature, whilst permanent fixtures will be required to address future requirements. Consequently, our proposed profile recognises deliverability constraints and the likely need for installations to ramp up over time.

Unit costs used in our cost estimate

The table below summarises the unit cost assumptions that have informed our cost estimate.

Table 1.6: Unit Cost Assumptions

	Unit cost rates per monitor (£)
Installation costs	£63,000
Operations and Maintenance costs (annual)	£16,800

In developing our installation unit cost estimate, we have considered:

- Costs associated with groundworks preparations and associated civils work.
- Costs associated with the purchase of monitoring equipment, including kiosks, sondes and associated telemetry. These are estimated to be £30-40k, based on an indicative quote received from our existing framework provider for Water Quality and River Monitoring services.
- Costs associated with land access and planning permission required to secure access and consents to install equipment. These costs will be site specific and vary depending on specific access requirements and agreements in place. To develop a unit rate assumption, we have used an average site figure of £10,000 for purchase of easement rights, fees and associated legal costs. We have also used an average cost of £10,000 for associated planning work. These figures are based on engineering judgement, based on our existing cost experience.

In developing our operations and maintenance cost assumption, we have considered:

- Costs associated with monitoring, scheduling required visits, maintenance, calibration and data hosting. These are estimated to be £16k, based again on an indicative quote received from the previously mentioned provider and costs shared from the Environment Agency on their current maintenance costs.
- In relation to data hosting, this cost includes an allowance for developing algorithms to manage the data and push it, based on agreed protocols, to the main web-based platform.

Total cost estimate

As summarised at the table at the beginning of this section, our total cost estimate derived through the approach outlined above is £157.45m over AMP8.

In August 2023 DEFRA issued revised technical guidance which in turn resulted in the EA providing revised driver guidance, due to the fact this additional guidance arrived late it has not been possible to update the costs and delivery profiles associated with this driver/enhancement case to fully comply with the latest guidance. Further work is ongoing to revise the number of monitors required to meet the revised guidance and as such the number of monitors are likely to change. The scale and timeline will also be

revised to meet revised phasing between AMP8 and AMP9. This will impact EnvAct_MON1 and EnvAct_MON4.

9.5.3 Efficiency of our cost estimate

Section 7.3 outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

Given investment under this driver represents a significant increase in activity, in an area where there is limited historical cost information, we have relied on cross checking against other available sources to demonstrate the efficiency of our estimate. The lack of sector wide information available at present to us has not enabled formal modelling, however as we note later in this section, we expect a simple unit cost model may be achievable by Ofwat through evaluating companies forecast costs for PR24.

In developing our cost estimate, we have considered market costs, having obtained an indicative quote from our existing framework provider of Water Quality and River Monitoring services to develop unit cost estimates. These quotes have informed the costs underpinning our submission.

We have also considered costing information provided by the Environment Agency, who currently undertake comparable modelling at approximately 250 sites. Once accounting for additional land and planning costs that will be incurred by Yorkshire Water when installing such equipment, our proposed estimates are broadly in line with the estimates provided by the Environment Agency.

9.5.4 Need for enhancement model adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging.

Whilst some minor monitoring requirements have previously been invested in under other drivers in previous WINEP programmes, this driver is new to PR24 and is at a much larger scale of investment.

We would anticipate that Ofwat could make a simple cost model based on the number of monitors to be installed and companies' forecast costs.

9.6 External assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

9.7 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

We reviewed our forecast enhancement totex and found we met the 1% materiality threshold for PCDWW2. We propose to protect customers from the under or non-delivery of river water quality monitors, which is driven by EnvAct_MON4.

We also considered whether additional customer protection mechanisms were in existence or should be introduced to complement the PCD.

9.7.1 Price Control Deliverable (PCD)

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

Table 1.7: PCD Parameters

PCD Delivery Expectation	
Description	Installation of 1803 meters to specification required by WINEP EnvAct_MON4 driver. The company will install 1803 continuous river water quality monitors over AMP8 to measure river water quality parameters (dissolved oxygen, temperature, pH values, turbidity and ammonia). The meters will be installed on the receiving watercourse, both upstream and downstream of storm overflows and wastewater treatment works discharge outlets.
Output measurement and reporting	Number of meters installed, reported to zero decimal places. Delivery of each meter is to be verified through the WINEP process.
Assurance	The company must commission an independent, third-party assurer, with a duty of care to Ofwat, to assure, to our satisfaction, that the conditions below have been met and the outputs of the scheme set out below have been delivered.
Conditions on Scheme	The monitors will be installed and reporting data by 31 March 2030.

We have set our delivery profile to recognise that the level of installations required during AMP8 represent a step change relative to historic workloads. (Note this number will change in line with revised August 2023 Guidance).

The time delivery incentive will be calculated yearly based on the delivery profile. PCD payment will only be calculated on the cumulative end of AMP8 number of meters.

Table 1.8: EnvAct_MON4 Forecast Deliverables

Deliverable	Unit	Forecast Deliverables				
		2025/26	2026/27	2027/28	2028/29	2029/30
EnvAct_MON4 meter installation	Number (cumul)	53	153	503	1153	1803

We propose an average cost PCD payment rate for each meter.

Table 1.9: PCD Payment Rate

Deliverable	Unit payment (£m)
£m per meter	= totex for meter installation ÷ no. of deliverables = £144.85m ÷ 1803 = £0.0803m

9.7.2 Annualised Outcome Delivery Incentives

There is no performance commitment or ODI impact for this enhancement totex. The rollout of monitoring will provide data to inform future investments.

9.7.3 Annualised time delivery incentive

We consider a time delivery incentive is appropriate as the enhancement spend is material and there is no ODI protection for customers.

Table 1.10: Time Incentive Payment Rate

Deliverable	Unit payment (£)
£ per meter	Scale of time delay incentive = £144.85m enhancement x 3.5% = £5.07m Incentive per meter per year = £5.07m ÷ 1803 meters ÷ 5 years = £562

We propose that the time delivery incentive does not apply where we have not installed meters in accordance with directions from the EA, such as an agreed revised WINEP programme for AMP8.

9.7.4 Third Party Funding or Delivery Arrangements

We have no third party funding associated with the delivery of this case.

10. Wastewater: Water Quality Investigations and Monitoring: Chemicals and Microplastics

10.1 Drivers:

WFD_IMP_CHEM, WFD_INV_CHEM, WFD_INV_MP, WFD_MON_CHEM, WFD_ND_CHEM3, WFD_ND_CHEM4, WFD_NDLS_Chem1, WFD_NDLS_Chem2

10.1.1 Requested Investment:

Table 1.1: Expenditure Required

	£m[22]	Table Line Ref.
Enhancement Expenditure Capex	3.259	CWW3.52
Enhancement Expenditure Opex	2.313	CWW3.53
Base Expenditure Capex		
DPC value		
Total	**5.572**	

10.1.2 Associated Reporting lines in Data Tables (and APR if appropriate):

Table 1.2: CWW3 Reporting Lines

Line Number	Line Description
CWW3.52	Chemicals and emerging contaminants monitoring, investigations, options appraisals; (WINEP/NEP) wastewater capex
CWW3.53	Chemicals and emerging contaminants monitoring, investigations, options appraisals; (WINEP/NEP) wastewater opex
CWW3.54	Chemicals and emerging contaminants monitoring, investigations, options appraisals; (WINEP/NEP) wastewater totex

10.2 High Level Driver description

The 25 Year Environment Plan includes the government action on p101, 'Minimising the risk of chemical contamination in our water". This action states, '*We want to tackle risks from chemical contaminants in English waters, including groundwater, and make sure that levels of contaminants entering fresh water bodies (which may be transported to coasts and seas) neither increase nor give rise to pollution.*', and, '*Decisions on managing risks will be proportionate and based on the weight of evidence, so that for example a high level of certainty will be needed before a decision is made to invest in expensive treatment technology to reduce chemicals from treated wastewater effluents*.'

[22] Costs are in 22/23 price base

Read more about the 25 Year Environment Plan at
25-year-environment-plan.pdf (publishing.service.gov.uk)

This identifies the need for the investigations into chemicals emitted into the environment from water industry activity. These investigations will provide the evidence of where the risks from water industry emissions of chemicals to the environment are from, whether they pose an unacceptable risk, and what investment would be needed to mitigate that risk.

The Water Framework Directive (WFD) Regulations' environmental objectives, as set out in regulation 13, include: protect, enhance and restore each body of surface water with the aim of achieving good status for all water bodies by 2021. Where this is not possible and subject to the criteria set out in the WFD Regulations, aim to achieve good status by 2027 or set an objective less stringent than good status.

On 13th January 2022 the Environment Audit Committee reported that, 'Not a single river in England has received a clean bill of health for chemical contamination.'

Since its inception in 2010, the Chemical Investigations Programme (CIP) has become a significant tool for the water industry to identify and quantify risk to the environment from non-sanitary determinands (*i.e.,* not biochemical oxygen demand, ammonia or suspended solids). Each year thousands of new chemicals are created, and hundreds brought to market in the UK. Regulation is struggling to enforce bans on chemicals and new chemicals are not being assessed for environmental impact before they hit the market and are subsequently disposed of via wastewater treatment into the water or soil environment.

10.3 Need for investment

10.3.1 The Need for the Proposed Investment

This enhancement case looks at investment to investigate and reduce the presence of cypermethrin in our wastewater to be compliant with new environmental quality standards (EQSs) for cypermethrin applied since December 2018[23].

Cypermethrin is a synthetic pyrethroid insecticide. It is used in the UK to control a range of pests in both arable and livestock farming, in homes and gardens, and in public and commercial buildings. Cypermethrin is not very persistent in the environment nor is it likely to bioaccumulate in aquatic organisms, but it is highly toxic to some species of aquatic life, particularly aquatic invertebrates such as insects and crustaceans.

Cypermethrin has been designated as a Priority Substance under the Environmental Quality Standards Directive (2013/39/EU), a daughter Directive of the Water Framework Directive (WFD) (2000/60/EC) and a new Environmental Quality Standard (EQS) has been applied since December 2018. Prior to this it was identified as a Specific Pollutant in the UK under the WFD. The high toxicity of cypermethrin, which is reflected in the very low annual average EQS value of 0.00008µg/l for freshwaters, means that relatively small inputs can potentially be a cause for concern.

The wide range of uses of cypermethrin means there are several routes by which it can enter the water environment. These include surface run-off following application to arable crops and loss from hard standings on farms following treatment of sheep and cattle or washing of pesticide equipment. Environmental inputs can also arise from industrial processes such as wool processing or from domestic sources because of home and garden use. Cypermethrin has been detected in the effluents of all the wastewater treatment works sampled to date in the Chemical Investigation Programme (CIP). It can arise from several sources including industrial discharges and from homes due to use of home and garden pest control products.[24]

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[23] Cypermethrin: Sources, pathways and environmental data – Environment Agency October 2019

[24] Cypermethrin: challenges for the water environment

Date: October 2021 (Environment Agency)

The Environment Agency (EA) works with companies through the Water Industry National Environment Programme (WINEP) to identify and set obligations for specific improvements for wastewater treatment works (WwTWs) and associated water bodies through river needs or standstill limits. Where the need for improvement cannot be determined or attributted directly to a water company asset, companies must undertake investigations.

In AMP8, Yorkshire Water with the EA, using results from the latest CIP, must deliver works across five WINEP drivers:

- **WFD_IMP_CHEM,** To meet either good ecological status or good chemical status. This is needed where an EQS is exceeded downstream of a WwTW discharge. The Environment Agency has instructed Yorkshire Water to monitor final effluent and the watercourse upstream and downstream of each final effluent discharge for cypermethrin in the eight WwTWs within scope by the regulatory deadline. This will determine whether further investment in treatment at those WwTWs is necessary in AMP9 or beyond.
- **WFD_INV_CHEM,** Investigations demanded by the Environment Agency into chemicals where research has indicated there may be a significant impact on chemical or ecological quality because of emissions from WwTWs. Emissions of final effluent and sewage sludge are within the scope of this driver. Chemicals within scope have been identified as needing urgent investigation because of findings from previous chemical investigations programmes and the latest peer-reviewed published scientific research or have been identified as needing urgent investigation by the Environment Agency's Prioritisation and Early Warning System (PEWS) for substances of emerging concern.
- **WFD_INV_MP,** Investigations required by the Environment Agency into microplastics where research has indicated there may be a significant impact on microplastic quantities because of emissions from WwTWs. Emissions of final effluent and sewage sludge are within the scope of this driver. Microplastics within scope have been identified as needing urgent investigation due to findings from previous chemical investigations programmes and the latest peer-reviewed published scientific research.
- **WFD_NDLS_Chem1,** Measures related to load standstill requirements for chemicals (where EQS exceedance is predicted, but measures fail economic assessments associated with EQS). This is where an EQS is exceeded downstream of a wastewater treatment works (WwTW) discharge, but the Environment Agency decides the cost benefit analysis of that investment indicates the benefit of the improvement in watercourse quality does not exceed the cost of that improvement. Chemicals and limits within scope have been identified as needing standstill limits to prevent deterioration of watercourses because of findings from previous chemical investigations programmes.
- **WFD_NDLS_Chem2,** Measures related to load standstill requirements for chemicals (below EQS). These are set where a wastewater treatment works is discharging concentrations of a chemical, but the EQS is not threatened immediately downstream. Targets are set to ensure that current effluent quality does not deteriorate and to contribute to broader aims to cease and phase out emissions and discharges of priority hazardous substances and prevent pollution swapping. Chemicals and limits within scope have been identified as needing standstill limits to prevent deterioration of watercourses because of findings from previous chemical investigations programmes.

10.3.2 The Scale and Timing of the Investment

We need to spend £5.3m[25] over AMP to meet the EA's requirements:

- £4.3m on investigations across emissions from WwTWs for microplastics and for any significant impact to wastewater quality (WFD_INV_CHEM and WFD_INV_MP).
- £1.0m on meeting new standstill limits at 28 sites (WFD_NDLS_Chem1 and WFD_NDLS_Chem2).

For WFD_IMP_CHEM, we will monitor cypermethrin in the final effluent, and in the watercourse upstream and downstream of the final effluent discharge point, for Adwick Le Street, Blackburn Meadows, Cawthorne, Cudworth, Dronfield, Meltham, Ripponden Wood and South Elmsall

[25] All costs in the section are quoted in 21/22 price base

WwTWs. This activity is already costed in WFD_NDLS_Chem1, so the additional cost of flexible permitting approach 4, specified by the Environment Agency, is zero against the WFD_IMP_CHEM driver.

For WFD_INV_CHEM, the following investigations will inform Chemical Investigations Programme Phase 4 (CIP4):

- **Perfluorooctane sulfonic acid (PFOS) sources** – The null hypothesis is that significant PFOS loads will be prevented from entering the sewer network by trade consents. The investigation will be within six WwTW networks where CIP3 identified the need for investigation due to the amount of PFOS in final effluent and its impact on the receiving watercourse. The six WwTWs are Balby, Blackburn Meadows, Knostrop, Pocklington, Renishaw and Rawcliffe York WwTWs. At each WwTW the crude sewage at up to fifteen locations within the sewer catchment (covering potential trade inputs), the WwTW influent, effluent and the receiving watercourse upstream and downstream of the WwTW will be monitored for PFOS once a month for two years. The results will indicate whether prevention of PFOS reaching each WwTW by using trade effluent discharge consents will significantly reduce the amount of PFOS within the receiving watercourse.
- **The impact of final effluent chemicals on protected sites in the Humber Estuary** – The null hypothesis is that chemicals and/or nutrients from WwTWs >25,000 PE do not threaten protected sites in the estuary. Yorkshire Water will work in partnership with Anglian Water and Severn Trent Water, the other water companies whose discharges influence chemical and nutrient concentrations in the Humber Estuary, to deliver a model of the estuary that will determine whether six chemicals from WwTWs with a PE greater than 25,000 threaten the good ecological status of protected sites (Special Areas of Conservation, and Special Protected Areas and Ramsar Sites). We will also monitor four other chemicals' levels in the estuary as specified by Natural England, who are working in partnership with the Environment Agency on this investigation's steering group. Twenty samples over 12 months will be taken at representative sites across the estuary, and the results from these samples used to create the model.
- **The action of integrated constructed wetlands (ICWs) on chemicals –** The null hypothesis is that ICWs do not remove 25 substances from sewage effluent. In partnership with the English and Welsh water and sewerage companies (WaSCs), Yorkshire Water will steer and fund the sampling and analysis of chemicals in the influent, effluent, bed sediment and plants at three ICWs from around the country. Each ICW will have 8 influent, 8 effluent, one sediment and four plant samples taken and analysed for 25 chemicals.
- **The impact of sewage sludge applications to land on soil and groundwater chemical content –** The null hypothesis is that sewage sludge applications to agricultural land do not increase concentrations of chemicals in the soil or groundwater. In partnership with the English and Welsh WaSCs, Yorkshire Water will steer and fund the sampling and analysis of chemicals in the soil in and groundwater around agricultural fields that have, and have not, had sewage sludge applied to their surface.
- **The influence of sludge treatment on the chemicals in the sludge –** The null hypothesis is that sludge treatment does not affect chemical content of the sludge. In partnership with the English and Welsh WaSCs, Yorkshire Water will steer and fund the sampling and analysis of chemicals at sludge treatment facilities nationwide to determine whether different sludge treatment processes such as anaerobic digestion, advanced anaerobic digestion and lime stabilisation influence the concentration of chemicals.
- **The impact of WwTW final effluent discharges to land on chemicals in groundwater –** The null hypothesis is that WwTW final effluent discharges to land do not increase groundwater concentrations of monitored substances. Yorkshire Water will analyse for chemicals in 12 samples over a year for each of effluent, up-gradient groundwater and down-gradient groundwater fort 7 WwTWs that discharge to land.
- **The impact of WwTWs on Antimicrobial Resistance (AMR) in sewage and the environment –** The null hypothesis is that wastewater treatment has no impact on antimicrobial resistance in the environment. In partnership with the English and Welsh

WaSCs, Yorkshire Water will steer and fund the sampling and analysis of chemicals, antimicrobial resistant bacteria and antimicrobial resistant genes at 10 sites nationwide. Samples are likely to be taken of influent, effluent, upstream and downstream, sewage sludge, tankered domestic septic waste, environmental sediment, soil and groundwater over twelve months.

- **The scale of the problem of emerging substances of concern at WwTWs –** The null hypothesis is that there is no significant risk in emerging substances of concern's loads or concentrations. In partnership with the English and Welsh WaSCs, Yorkshire Water will steer and fund the sampling and analysis of emerging substances of concern such as those identified by the Environment Agency's Prioritisation and Early Warning System (PEWS). Two WwTWs at each of the 10 WaSCs in CIP4 will have samples analysed for emerging substances of concern. CIP4 will have samples analysed for emerging substances of concern.
- **The scale of the problem of per- and poly-fluorinated alkyl substances (PFAS) at WwTWs –** The null hypothesis is that there is no significant risk in PFAS loads or concentrations. In partnership with the English and Welsh WaSCs, Yorkshire Water will steer and fund the sampling and analysis of PFAS. Two WwTWs at each of the 10 WaSCs in CIP4 will have samples analysed for PFAS.
- **The impact of emerging substances of concern identified in CIP3 at WwTWs** - The null hypothesis is that there is no significant risk in Decabromodiphenyl ether, fipronil or imidacloprid loads or concentrations. In partnership with the English and Welsh WaSCs, Yorkshire Water will steer and fund the sampling and analysis of these three chemicals. Two WwTWs at each of the 10 WaSCs in CIP4 will have samples analysed for Decabromodiphenyl ether, fipronil and imidacloprid
- **Non-target screening (mass spectrometry scans) at selected WwTWs** - The null hypothesis is that there is no significant risk in a wide range of emerging substances' loads or concentrations. In partnership with the English and Welsh WaSCs, Yorkshire Water will steer and fund the sampling and analysis of emerging substances. Two WwTWs at each of the 10 WaSCs in CIP4 will have samples analysed for a wide range of emerging substances using non-targeted mass spectroscopy.
- **Trends over time in concentrations and loads of emerging substances of concern at WwTWs** – The null hypothesis is that there is no change over time in emerging substances' loads or concentrations. In partnership with the English and Welsh WaSCs, Yorkshire Water will steer and fund the sampling and analysis of emerging substances. Five WwTWs that were monitored throughout CIP3 will have samples analysed for emerging substances of concern.
- **The impact of emerging substances of concern that are endocrine disruptors leaving WwTWs in final effluent** - The null hypothesis is that there is no significant risk from endocrine disrupting emerging substances' loads or concentrations leaving WwTWs. In partnership with the English and Welsh WaSCs, Yorkshire Water will steer and fund the sampling and analysis of endocrine disrupting emerging substances. Two WwTWs at each of the 10 WaSCs in CIP4 will have samples analysed for endocrine disrupting emerging substances.
- **A local investigation into sources of silver in the Knostrop WwTW sewer network** - The null hypothesis is that significant silver loads will not be prevented from entering the sewer network by trade consents. The investigation will be within Knostrop WwTW network where the Environment Agency CIP3 identified the need for investigation due to the amount of silver in final effluent and its impact on the receiving watercourse. At Knostrop WwTW the crude sewage at up to eleven locations within the sewer catchment (covering potential trade inputs), the WwTW influent, effluent and the receiving watercourse upstream and downstream of the WwTW will be monitored for silver once a month for a year. The results will indicate whether prevention of silver reaching each WwTW by using trade effluent discharge consents will significantly reduce the amount of silver within the receiving watercourse.

WFD_INV_MP, Investigations required by the Environment Agency into microplastics where research indicates there may be a significant impact on microplastic quantities because of

emissions from WwTWs. Emissions of final effluent and sewage sludge are within the scope of this driver. The investigations delivering this driver include investigations into:

- **The impact of sewage sludge applications to land on soil and groundwater microplastic content** - The null hypothesis is that sewage sludge applications to agricultural land do not increase concentrations of microplastics in the soil or groundwater. In partnership with the English and Welsh WaSCs, Yorkshire Water will steer and fund the sampling and analysis of microplastics in the soil in and groundwater around agricultural fields that have, and have not had, sewage sludge applied to their surface.
- **The impact of WwTW processes on the quantity of microplastics in the final effluent** – The null hypothesis is that wastewater treatment does not change the number or mass of microplastic particles in sewage effluent. In partnership with the English and Welsh WaSCs, Yorkshire Water will steer and fund the sampling and analysis of microplastics at different stages of wastewater treatment. One WwTW at each of the 10 WaSCs in CIP4 will have samples analysed for microplastics numbers, masses and type.
- **The impact of advanced thermal conversion of sewage sludge on its microplastic content** – The null hypothesis is that advanced thermal treatment of sewage sludge does not alter the form, number or mass of microplastics. If microplastics in sewage sludge prevent recycling to land, then the most effective method of destroying microplastics in sludge will need to be employed. In partnership with the English and Welsh WaSCs, Yorkshire Water will steer and fund the sampling and analysis of microplastics in organic wastes subject to advanced thermal conversion processes such as gasification or pyrolysis.

For WFD_NDLS_Chem1, the EA has set new standstill limits for cypermethrin in final effluent due to its impact on the receiving watercourse. Using the results of the CIP3 investigations[26] limits apply at specific WwTWs for specific chemicals within the PR24 WINEP, covering WwTWs at Adwick Le Street, Blackburn Meadows, Cawthorne, Cudworth, Dronfield, Meltham, Ripponden Wood and South Elmsall.

For WFD_NDLS_Chem2, the EA has set new standstill limits due to the amount of non-sanitary chemicals in final effluent and their impact on the receiving watercourse at the following WwTWs: Balby (PFOS), Barwick In Elmet (cypermethrin), Blackburn Meadows (cadmium (total), PFOS, zinc (dissolved)), Carleton (cypermethrin), Cawthorne, Clayton West (cypermethrin), Dronfield (zinc (dissolved)), Easingwold (cypermethrin), Eggborough (cypermethrin), Goole Rawcliffe (cypermethrin), Huddersfield Colne Bridge (cypermethrin), Huddersfield Cooper Bridge (cypermethrin, nonylphenol), Knostrop (PFOS), Lundwood (cypermethrin), Mill Lane (cypermethrin), Pocklington (PFOS), Rawcliffe York (PFOS), Renishaw (PFOS), Sandall (cypermethrin), Smalley Bight (cypermethrin), Sutton (cypermethrin), Wath On Dearne (cypermethrin) and Wombwell (zinc (dissolved)).

For both types of new standstill limits (_CHEM1 and _CHEM2), the cost of varying the environmental permits for these WwTWs is set by the EA. The cost of monitoring required by WFD_NDLS_Chem2 is the best value Yorkshire Water has been able to negotiate with the market through the setup of its framework contract for sampling and analysis.

10.3.3 Customer Support

While this enhancement case is to meet our statutory requirements, we know that quality of water within the environment is important to our customers.

We know, using the Ofwat/CCWater customer preferences research and our own Valuing Water research that river water quality is of medium to high importance to customers.

10.3.4 Interactions with base or previous funding

There is no overlap with base expenditure. The improvements identified for AMP8 are to meet new standards, and as such, require new monitoring in addition to existing WwTW operations.

[26] UK Water Research Industry Limited The National Chemical Investigations Programme 2015-2020 Volume 3 Wastewater Treatment Technology Trials.

The need for proposed enhancement investment does not overlap or duplicate with activities already funded at previous price reviews. All actions are new and defined by the Environment Agency for delivery in AMP8 within the Price Review 2024 Water Industry National Environment Plan (PR24 WINEP). None of the actions have been included in previous WINEPs.

10.3.5 Long-term Delivery Strategy Alignment

The enhancement case is part of the core adaptive pathway for the long-term delivery strategy. Within LS4 Waste enhancement expenditure, this enhancement case covers the following lines:

- **Chemicals and emerging contaminants monitoring/investigations/options appraisals**
  The CIP will continue to play a significant role in the next five asset management periods and probably beyond that given the ongoing introduction of new chemicals into wastewater.

- **Catchment management – chemicals source control**

  For AMP8 there is no catchment scheme for chemical source control. For subsequent schemes, investment is likely to increase in communication programmes across the region to prevent cypermethrin entering the sewer network from domestic, commercial and agricultural sources. Future costs are included on the basis that source control programmes will be required.

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about this at
Long-Term Delivery Strategy

10.3.6 Factors Outside of Management Control

The widespread presence of ubiquitous persistent bioaccumulative and toxic (uPBT) substances has created the need for this enhanced investment and is outside of management control.

For more information, please refer to section 1.3.2.

10.4 Best Option for Customers

10.4.1 Options Considered

Each Asset Management Period since 2010-2015, has included a chemical investigations programme (CIP) comprising actions in the WINEP driven by DEFRA, defined by the EA in negotiation with the Water and Sewerage Companies and monitored by Ofwat. The process of defining these actions has been delivered by the CIP steering group, comprising Ofwat, DEFRA, EA and WaSCs who develop in regular quarterly meetings leading up to each AMP, the scope of the WFD_INV_CHEM driver. Within the steering group, both traditional and non-traditional options are discussed and minuted to arrive at the most effective best value solution to the need for investigation.

This AMP the same role for the WFD_INV_MP driver has been delivered by members of the Water UK Strategic Water Quality and Waste Planning Group Microplastics sub-group comprising the Environment Agency and WaSCs. Yorkshire Water will undertake investigations consistent with the directions from the 'UKWIR Chemical Investigations Programme 4 (CIP4) Pre-Scoping Technical Note'. A Technical Specification will be issued on a routine basis as the details of each WINEP driver are developed. This document forms the basis for water companies to procure services to undertake the monitoring and analysis for each driver.

The following extract *(in italics)* from Pre-scoping Technical Note explains the differences of CIP4 from previous CIPs: *Many of the CIP4 investigations will be informed by and will build on the previous investigations. Several elements of this programme have been scoped to further*

study and assess finding from CIP3. Therefore, the programme needs to recognise that there has been significant analysis of the CIP3 data, beyond the published project reports, and these outputs need to be effectively collated. Furthermore, it is possible that while the programme is progressing, third parties who are not associated with CIP4 might publish findings from their analysis of the CIP3 data.

CIP4 goes beyond previous monitoring programmes as it includes new elements dealing with fish, plant and sediment sampling. Therefore, there is the need to involve research or academic organisations in addition to commercial laboratories. This is akin to the investigation research studies delivered in the CIP3 programme and will require the participation of subject matter experts for, for example, microplastics and AMR. The efficient integration of a diverse capability base is critical for the successful delivery of the programme. The success criteria for these new elements will therefore be met by working with specialist contractors and providing a coordinating overview and flexibility in the delivery of the element, potentially in both scope and timing.

The optioneering process was for the Environment Agency to review the performance of all 53 of the YW WwTWs monitored in CIP2 for removal of a wide range of chemicals identified by the EA.

As an example, nine WwTWs were identified by the Environment Agency as needing performance improvements to meet river needs limits that would preserve environmental quality standards for cypermethrin. The next step in the optioneering process was to review the performance of all available phosphorus-removing technologies being assessed at full scale in CIP2 for their performance in removing cypermethrin from sewage effluent. This produced a table of performance in cypermethrin removal of different technologies as part of, 'The national chemical investigations programme 2015-2020 volume 3 wastewater treatment technology trials[27]'. Capital and operational costs of installation and operation of each technology at different population equivalent capacities were also assessed and tabulated in the same report. The twenty different technologies were compared, and the best single option selected for the performance needed at each of the nine WwTWs within scope.

Read more about this at
The national chemical investigations programme 2015-2020 volume 3 wastewater treatment technology trials

Costs were then calculated using the outputs from the wastewater treatment technologies trials, Then the Environment Agency estimated the value of the length of river improved (LORI) by the investment at each WwTW and used these values to run a cost benefit analysis (CBA) for each of the nine WwTWs. Eggborough WwTW failed the CBA, so was then subject only to WFD_NDLS_CHEM2 standstill limits, ensuring no deterioration of environmental quality in the watercourse receiving the final effluent. Yorkshire Water has no access to the Environment Agency's cost benefit analysis methodology. Guidance on using the tool is available in, 'Environment Agency Economic Appraisal for Chemicals at Sewage Treatment Works Guidance document September 2017 reference number 39294', but the specific CBA tool outputs for the wastewater treatment works within scope has not been shared.

One investigation in CIP3 was, 'The national chemical investigations programme 2020/2022, volume 10, substances removal by installed technologies[28]'. The investigation results became available during the AMP8 business planning process and demonstrated the performance of the selected cypermethrin removal technologies when run by water company operations staff as part of the WwTW, subject to all the constraints normally present. This was more of a 'real world' test of the technologies than the CIP2 investigations, where each technology was run as a separate process under the control of the technology providers, with specific focus on optimisation of energy and chemical use. The CIP3 investigation demonstrated that performance of the selected technologies was much less effective when run within the constraints of a WwTW. This suggested the significant risk that the proposed improvements would not deliver the improvement needed and would become a 'regretful' investment. Consequently, the Environment Agency converted all eight of the original improvement actions

[27] Source: UKWIR

[28] Source: UKWIR

under driver WFD_IMP_CHEM to flexible permitting option 4, requiring only monitoring and reporting in AMP8.

Read more about this at
The national chemical investigations programme 2020/2022, volume 10, substances removal by installed technologies

Flexible permitting is monitoring and reporting of cypermethrin in the final effluent and in the receiving watercourse upstream and downstream of the final effluent discharge. For subsequent AMPs the joint Ofwat/EA/water industry Water UK Strategic Steering Group Task and Finish Group on chemicals strategy is likely to focus environmental protection on action other than end-of-pipe treatment. Technologies with a higher likelihood of meeting river needs limits for chemicals, such as granular activated carbon and membrane filtration would cost so much that any chance of meeting proposed river needs limits within customers' willingness to pay thresholds will not be delivered. A greater understanding of chemicals may lead to a re-assessment of end of pipe solutions. For example, another option used by Government is the ban of specific chemicals.

We have set out the agreed investigations for each of the WINEP drivers under the earlier heading ‘The Scale and Timing of the Investment’.

10.4.2 Cost-Benefit Appraisal

We are not required to undertake cost benefit analyses as part of the development of an investigation programme with the EA. As stated above, the EA develops their own analysis.

10.4.3 Carbon impact and best value

As stated above, there is no opportunity to consider wider benefits in the development of investigation programmes.

10.4.4 Impact Quantification

There is no impact on our performance commitments. We will use data from the investigations to inform our business decisions on where and how to prioritise investments.

10.4.5 Cost and Benefit Uncertainties

We have undertaken these investigations during several previous AMPs. We consider we can mitigate uncertainty through our established delivery approach. This includes quarterly meetings of the Chemical Investigations Programme Steering Group, with other water companies, Ofwat, DEFRA and the Environment Agency as members.

10.4.6 Customer Views

We have not carried out specific customer engagement on solution options related to this enhancement case given that it is a statutory requirement, but a summary of customer views of this area more generally can be found in our customer support section above.

10.4.7 Third Party Funding

There is no third party funding.

10.4.8 Direct Procurement for Customers (DPC)

For information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in the Introduction to Enhancement Cases appendix.

Read more about this at
Introduction to Enhancement Cases

10.5 Cost Efficiency

This section outlines how our overall approach to cost estimation and cost efficiency, as described in Section 7.3 in the Introduction to Enhancement Cases appendix, has been applied

to this enhancement case. Table 1.1 at the beginning of this document summarises the costs associated with this enhancement case:

10.5.1 Cost development for our preferred option

Our costing estimate has been developed using a combination of bottom-up techniques and allocating agreed external costs to required activities. This estimation process has been undertaken in the context of an agreed scope of work with our Regulators. Key assumptions are discussed in turn below.

10.5.1.1 Scope of work

The scope of work for this enhancement case has been agreed in negotiation with the Environment Agency, Ofwat and DEFRA at steering group meetings of the chemical investigations programme (CIP) for actions in chemical drivers, and in negotiation with the Environment Agency and DEFRA at Water UK Strategic Steering Group microplastics sub-group for actions in microplastics drivers. Each quarter, the Chemical Investigations Programme Steering Group (CIPSG) meets to ensure effective planning and delivery of the WINEP chemical actions, including budget negotiations.

10.5.1.2 Cost development

Two overall approaches were followed to develop a cost estimate from this defined scope of work:

Table 1.3: Costing Methods

Method	Approach
Detailed bottom-up costing (method A)	For certain actions, a detailed scope of the number of samples, sample media, determinands to be analysed for, and limits of detection for each determinand in each medium was defined in negotiation with our Regulators. In these cases, we worked with our current framework providers for sampling and analytical services to estimate the cost required to deliver Yorkshire Water's component of the overall project scope. Such estimates were developed using existing framework rates for such activity. Where applicable, the cost of varying environmental permits was also included, which is a cost specified by the Environment Agency. The agreed project scope also identified where a summary report is required. In these cases, the UK Water Industry Research framework provider for consultancy services, Atkins (SNC Lavalin), provided a quote for delivery of the report. Our estimates include the Yorkshire Water proportion of these costs, as determined by the splits agreed at the CIP steering group (with costs split either equally by company or by number of wastewater customers). Yorkshire Water cost estimates were also included to account for time and effort required for project lead and programme and project management activities.
Allocation of agreed external costs (method B)	For other actions, such as the antimicrobial resistance investigation, where a detailed scope has not yet been worked up, a project cost was negotiated with our Regulators at the steering group. We have allocated our proportion of this cost across relevant actions on a top-down basis, and as above added costs for Yorkshire Water project lead and programme and project management activities.

Table 1.4 below provides a breakdown of our cost estimate by action.

Table 1.4: Cost Estimate by Action

Driver		Name	Total number of samples	Cost method (A or B)	Site names	Total cost per action inc. YW resource costs (£m)
WFD_INV_CHEM	WFD_INV_CHEM4a	Proposed permitting approach and investigations PFOS	2736	A	Balby Knostrop Pocklington Renishaw Rawcliffe York Blackburn Meadows	0.443
	WFD_INV_CHEM4a	TraC Waters	120	B	Humber Estuary	0.600
	WFD_INV_CHEM4a	Integrated Constructed Wetlands (ICWs)	189	B	Clifton	0.097
	WFD_INV_CHEM4a	Sludge to soil to groundwater field trials	unknown	B	WwTWs determined by field selection	0.194
	WFD_INV_CHEM4b	Sludge	144	B	Naburn	0.105
	WFD_INV_CHEM4c	Groundwater (chemicals monitoring)	336	A	Burton Fleming Middleton on The Wolds North Dalton Tibthorpe Weaverthorpe West Lutton Wetwang	0.583
	WFD_INV_CHEM4d	Antimicrobial Resistance (AMR)	60	B	WwTWs to be determined	0.263
	WFD_INV_CHEM4e	Emerging Substances	248	A	Knostrop Middleton On the Wolds	0.411
	WFD_INV_CHEM4e	Emerging Substances (PFAS)	224	B	Knostrop Middleton On the Wolds	0.082
	WFD_INV_CHEM4e	Emerging Substances (CIP3 substances of concern)	224	A	Knostrop Middleton On the Wolds	0.094
	WFD_INV_CHEM4e	Emerging Substances (non-target screening)	64	A	Knostrop Middleton On the Wolds	0.084
	WFD_INV_CHEM4e	Emerging Substances (trends)	600	A	Bridlington Cherry Burton Harrogate North Hull Naburn	0.345
	WFD_INV_CHEM4e	Emerging Substances (endocrine disruptors)	8	A	WwTWs to be determined	0.079

	WFD_INV_CHEM4g	Local investigation (actual - issue raised by the EA on 19th December 2022)	180	A	Knostrop	0.063
	WFD_INV_CHEM4h	Ancillary costs	none	B	all sites	0.126
	Total WFD_INV_CHEM cost					**3.568**
WFD_NDLS_CHEM1		No Deterioration Load Standstill (NDLS) limits for substances in WwTW final effluent	5040	A	Adwick Balby Barwick in Elmet Blackburn Meadows Carleton Cawthorne Clayton West Cudworth Dronfield Easingwold Eggborough Goole Rawcliffe Huddersfield Colne Bridge Huddersfield Cooper Bridge Knostrop Lundwood Meltham Mill Lane Pocklington Rawcliffe Yorks Renishaw Ripponden Sandall Smalley Bight South Elmsall Sutton Wath on Dearne Wombwell.	**1.006**
WFD_INV_MP	WFD_INV_MPa	impact of biosolids spreading on microplastics in soil and groundwater	195	B	WwTWs to be determined	0.105
	WFD_INV_MPb	Is microplastic created in wastewater treatment?	30	B	WwTWs to be determined	0.105
	WFD_INV_MPc	Sludge thermal conversation review & trials		B	WwTWs to be determined	0.525
	Total WFD_INV_MP cost					**0.735**

NOTE: The total cost in table 1.4: Cost Estimate by Action is £5.31M, £0.262M less than the total in table 1.1 Expenditure Required. This difference is because the values in table 1.4: Cost Estimate by Action are in 2021/22 price base.

10.5.2 Efficiency of our cost estimate

Section 7.3 in the Introduction to Enhancement Cases appendix outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

In developing our cost estimates, where we have applied a detailed bottom-up approach for negotiated investigations, we have considered historic costs for the delivery of earlier phases of the chemical investigation programme in AMP7. The scope of these actions has been subject to negotiation with our Regulators and benefited from collaborative input across water companies. We have also developed cost estimates in conjunction with existing framework providers, which represent the most efficient rates we have negotiated with the market.

Several of the costs included within our estimates, such as Environment Agency permit variation costs, are determined by third parties and are outside of our control. Atkins are also contracted through UKWIR to provide consulting services to all companies, removing duplication of effort.

Finally, where a top-down approach has been applied, this has involved allocating a budget which has been subject to negotiation with the Environment Agency, ensuring value for money.

10.5.3 Need for enhancement model adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging. However, for this driver we anticipate (based on PR19) that Ofwat will not produce a cost model and would assess this expenditure through a shallow dive approach.

The costs are broadly agreed by the CIPSG as described above and so any benchmark modelling approach would not be appropriate.

10.6 External assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

10.7 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

Our enhancement totex for this case does not meet the materiality threshold for any PCD groupings. There is sufficient regulatory oversight for our activities under the WINEP, therefore we do not propose any customer protection mechanisms for this case.

10.7.1 Third Party Funding or Delivery Arrangements

This is not applicable for this case.

11. Wastewater: Investigation into Nitrogen Removal Technically Achievable Limit

11.1 Driver:

WFD_INV_N-Tal

11.1.1 Requested Investment:

Table 1.1: Investigation into Nitrogen Removal Technically Achievable Limit AMP8 Expenditure

	£m	Table Line Ref.
Enhancement Expenditure Capex	0.000	CWW3.61
Enhancement Expenditure Opex	0.047	CWW3.62
Base Expenditure Capex		
DPC value		
Total	**0.047**	

11.1.2 Associated Reporting lines in Data Table:

Table 1.2: CWW3 Reporting Lines

Line Number	Line Description
CWW3.61	Nitrogen technically achievable limit monitoring, investigation or options appraisal; (WINEP/NEP) wastewater capex
CWW3.62	Nitrogen technically achievable limit monitoring, investigation or options appraisal; (WINEP/NEP) wastewater opex
CWW3.63	Nitrogen technically achievable limit monitoring, investigation or options appraisal; (WINEP/NEP) wastewater totex

11.2 High Level Driver description:

Figure 1.1: Extract from PR24 WINEP Driver Guidance – Nitrogen Technically Achievable Limit.

Driver code	Description	Legal obligation	Tier 1 outcome
WFD_INV_N-Tal	Investigations to assess treatment options for nitrogen.	NS – Defra approved must do	Water companies action to develop and test nitrogen treatment options.

The WFD_INV_N-TAL driver is a Department for the Environment, Food and Rural Affairs (DEFRA) approved national study which will be facilitated by UK Water Industry Research (UKWIR) in collaboration with UK Water and Sewerage Companies (WaSCs) and regulators to review if the current wastewater treatment technical limit of 10 mg/l is still appropriate with today's available wastewater treatment technologies. Total nitrogen reduction is not a targeted determinand in the standard wastewater treatment process. Removing total nitrogen usually requires tertiary treatment as an additional process.

The Environment Agency (EA) have communicated through the WFD_INV_N-TAL project steering group (PSG) that although this is a Non-Statutory driver, it is "DEFRA approved must do" (Figure 1.1) and is therefore compulsory for all WaSCs to participate in the investigation.

The investigation is exclusively driven by the Environment Agency through the Water Industry National Environment Plan (WINEP) and therefore should be fully enhancement funded.

11.3 Need

11.3.1 The Need for the Proposed Investment

The PR24 driver guidance from the EA states this driver is "Non-Statutory, DEFRA approved must do".

During a collaborative workshop with the EA, all water companies were instructed to take part in the joint investigation regardless of whether the company had any nitrogen removal obligations for Nutrient Neutrality, or not. The driver is similar in nature to the AMP6 UKWIR national phosphorus removal technology trials, whereby technologies were designed and installed at wastewater treatment works (WwTWs),and sampled and analysed to understand the effectiveness of phosphorus removal.

With multiple companies contributing to the AMP6 phosphorus trials it allowed a range of different technologies and varying sizes of WwTW to be included. This resulted in statistically significant data, providing a wider understanding of phosphorus removal technologies available to the water industry. The AMP6 national UKWIR phosphorus trials led to the technical limit to be reduced from 0.5 mg/l to 0.25 mg/l, and has since informed the UK's AMP7 phosphorus removal programmes with further investment programmes set to continue until 2038 to achieve the national Environment Act 80% phosphorus removal target.

The aim of WFD_INV_N-TAL is to study the efficacy of existing and new wastewater treatment technologies to establish the level of treatment that can be achieved, and if the existing total nitrogen technical treatment limit can be reduced from the current 10 mg/l. The current technical limit is equal to the total nitrogen removal limit contained in the Urban Waste Water Treatment Regulations 1991 (UWWTR).

Wastewater treatment has improved over the last 20 years, since the introduction of the UWWTR, especially with the advancement of phosphorus removal treatment since the AMP6

national UKWIR phosphorus removal trials. The aim of WFD_INV_N-TAL is to review the 10 mg/l total nitrogen technical limit in order to apply the best protection possible for nitrate sensitive surface waters, and where nutrient neutrality is required.

The investigation is required as sampling and analysis for total nitrogen is not undertaken routinely under operator self-monitoring permit clauses, unless there is an existing total nitrogen limit included in an environmental permit. Yorkshire Water (YW) currently have no WwTWs with a total nitrogen limit on the permit.

For this driver, one option is to build new infrastructure to investigate treatment performance for the removal of total nitrogen. YW are not proposing to construct new treatment works, rather to utilise three technologies installed at three WwTWs through the AMP7 WFD_IMP phosphorus removal programme. YW are not requesting funding to install any new equipment or treatment technologies under the WFD_INV_N-TAL driver. The three sites chosen will offer unique technologies, at varying scales to the national study to understand their performance and reliability for total nitrogen removal and the degree to which removal can be achieved.

The UKWIR project will be a collaborative investigation with the EA where the results from sampling programmes across the country will be shared and reported in a single report. This will have benefits for the water industry to share a collective understanding of the types of treatment available and to what scale they are able to deliver total nitrate removal.

The three WwTWs proposed and accepted by the EA from YW are:

1. CLIFTON WwTW

Clifton WwTW, located in the Don and Rother catchment, is an operational wetland designed and built in AMP7 to achieve 4 mg/l phosphorus permit limit (see Figure 1.2). It is a multi-award-winning site which treats wastewater for a population of approximately 180 people. The works was put forward for the WFD_INV_N-TAL investigation as it is a low carbon solution which minimises the use of power and chemicals needed to operate the works making it a resilient and sustainable type of wastewater treatment. This is a unique opportunity to understand how effective the process is at removing total nitrogen with advantages for the net zero carbon emission commitment at the forefront of water industry focus.

Figure 1.2: CLIFTON WwTW wetland nature-based solution. Photos 1 and 2 c.May 2022 shortly after planting; Photo 3 c.July 2023 after one-year's vegetation growth (photo credit: P.Dimbleby, 2023).

2. HOLLYM MYERS LANE WwTW

Hollym Myers Lane WwTW, located in the Hull and East Riding area, has been constructed in AMP7 to replace Withernsea WwTW and serves a residential population of approximately 6,620 which doubles during the summer months to a population of approximately 15,000 and is a sustainable Aero-Fac® facultative pond by Gurney Environmental (see Figure 1.3). The works has a low carbon footprint, can incorporate renewable energy and is capable of disinfection due to its exposure to natural UV light which is important for Hollym Myers Lane WwTW to reduce any potential impact on local bathing waters.

The facultative pond is capable of quickly adapting to large changes in volume, which is important given the large holiday population served by Hollym Myers Lane WwTW. While the site does not contain vegetation like Clifton WwTW, it is still considered to be a nature-based solution for the reasons above. Including this site in the WFD_INV_N-TAL study will inform the water industry as to how well this treatment type can remove total nitrogen. There are few installations of this type in the UK at this scale so will provide an interesting case study into its ability and resilience at removing total nitrogen.

Figure 1.3: The HOLLYM MYERS LANE WwTW facultative pond. (Photo credit: C. Fell)

3. KNOSTROP WwTW

Knostrop WwTW is YW's largest wastewater treatment works, treating the wastewater for a population of approximately 638,000 and discharges to the Aire and Calder catchment. In AMP7, Knostrop WwTW will have an Enhanced Biological Phosphorus Removal (EBPR) plant constructed to achieve an AMP7-funded obligation of 0.4 mg/l total phosphorus permit limit by 22nd of December 2024. This work has been nominated for the WFD_INV_N-TAL study due to its large population scale and phosphorus removal EBPR technology. Once installed, EBPR requires little to no ferric dosing unlike a traditional phosphorus removal plant. For this reason, the site was put forward to the EA to understand EBPR's effectiveness for total nitrogen removal on a large scale WwTW with a smaller carbon contribution.

Through engagement with the EA, our proposal for WFD_INV_N-TAL is to undertake site specific sampling and analysis of the three different processes described above. The EA were supportive of the inclusion of these three technologies within the investigation to maximise the size, scale and type of technologies included across the country in the investigation. The EA have approved YW's proposed sites Clifton WwTW, Hollym Myers Lane WwTW and Knostrop WwTW.

The sites proposed do not require any further design, purchase, or installation of new treatment processes for this investigation, the utilisation of technologies installed in AMP7 minimises the cost of the trials whilst providing unique treatment technologies for the total nitrogen technical limit research. The three technologies included by us have not been utilised for the removal of total nitrogen before. The WFD_INV_N-TAL investigation allows us to obtain data as to the total nitrogen removal rate that is possible with these technologies from the influent to the effluent of each WwTWs.

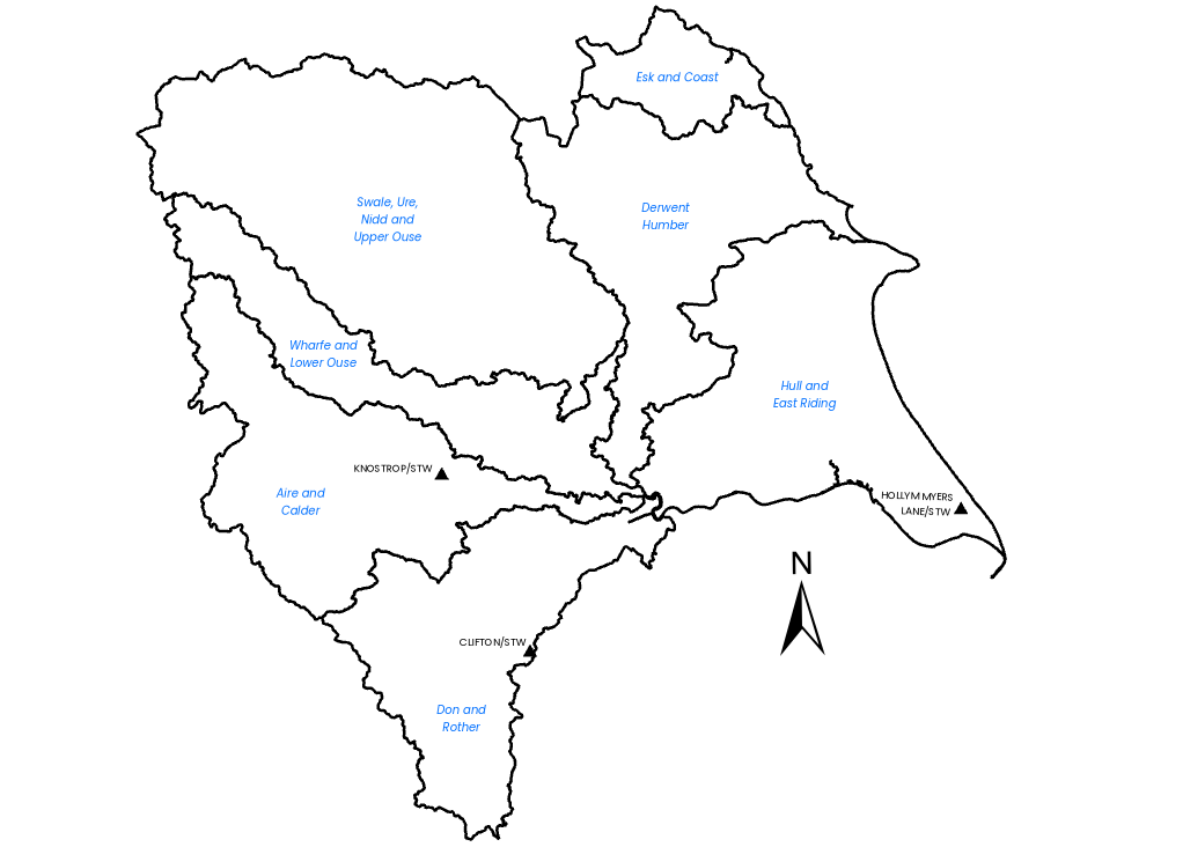
Moving forward, if it is demonstrable that these technologies remove total nitrogen, they become key nature-based solutions in nitrate sensitive areas that will provide wastewater treatment resilience and help companies achieve lower carbon and net-zero commitments. EBPR uses little to no chemical dosing of ferric salts so is lower carbon than traditional phosphorus removal techniques and has a better long-term sustainability to more traditional ferric dosing treatment

for phosphorus removal. So, if the investigation can understand EBPR's effectiveness at total nitrogen removal this will be valuable information for the water industry.

11.3.2 The Scale and Timing of the Investment

We have chosen schemes with a good geographical spread (see Figure 1.4) with varying population size and different technology types, two of which encompass nature-based solutions (Clifton WwTW and Hollym Myers Lane WwTW) as resilient and sustainable technologies to inform futureproofing of wastewater treatment for the water industry.

Figure 1.4: Location of the three WwTWs to be sampled for the WFD_INV_N-TAL investigation



The regulatory compliance date is 30th April 2027. YW are proposing a sampling-only programme utilising technologies installed during AMP7. Sampling will occur weekly for 12-months at the influent, mid-process, and effluent sample points for each of three WwTWs. The national investigation will provide information that will inform future investment across the industry in AMP9 and beyond.

11.3.3 Interactions with Base Expenditure

There are no overlaps with base expenditure. The three WwTW to be sampled are not currently sampled for total nitrogen as they do not have limits for total nitrogen within their environmental permits.

11.3.4 Activities Funded in Previous Price Reviews

There have been no activities funded previously for reviewing the wastewater treatment technical limit for total nitrogen.

11.3.5 Long-Term Delivery Strategy (LTDS) Alignment

The LTDS considers resilience risks and interventions. It is a new requirement for this regulatory period, and an integral, mandatory part of Yorkshire Water's PR24 plan.

Ofwat's guidance has placed adaptive planning at the heart of the LTDS, and this approach is an opportunity to demonstrate how decisions can be made under different plausible future circumstances, setting out all key enhancement activities in terms of adaptive pathways. Specifically, we will present a Core Pathway of 'no and/or low regret' enhancement investments, alongside alternative pathways which could be triggered depending on how future uncertainties develop.

The long view to 2050 is adaptable, with pathways that can be modified in pursuit of long-term aims. Whilst we have a preferred best value plan, our long-term plans are adaptive with defined triggers and actions for diverting to an alternative pathway in the future. We may divert to an alternative plan once the risks are certain and we are able to identify with confidence the pathway we are following. This might be if one or more of our preferred options is unsuccessful or if new information on one of the key risks shows we are following a different scenario pathway. So, this work is not simply part of a five-year plan, but rooted in the future ambitions of Yorkshire Water, its customers and stakeholders and the broader water industry.

Currently Yorkshire Water has no continuous wastewater discharges into designated nitrate sensitive areas. There are no nitrogen removal obligations identified for YW's WwTW discharges in AMP8 and currently none are forecast for AMP9. There would need to be new nitrate sensitive area designations for surface waters receiving YW's continuous discharges before any nitrate removal investment is required.

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about our LTDS at
Long Term Delivery Strategy

11.3.6 Customer Support

While we have not carried out specific customer engagement on nitrogen removal, we know that our customers place significant importance on the environment. According to our research on understanding the impact of covid and wider events, we learned that during the Covid-19 pandemic, customers became more invested in looking after the environment, borne from a renewed appreciation for the local environment and associated improvements seen while the world was under lockdown. Despite the cost-of-living crisis, we have seen from our research that people still expect businesses to take action to ensure the environment remains a priority.

We also know that water quality in the environment is of medium to high importance to our customers, through the research carried out on behalf of Ofwat and CCWater and our own Valuing Water customer priorities research, where our research showed that customers prioritised water quality in rivers, streams and the sea in their Top 6 service areas.

Given the extent of support for improvements in environmental water quality, we were confident to include this enhancement case in our plan. This will, in part, address river water quality issues in certain areas which is supported by our customers. In our own independent affordability and acceptability testing study (outside of Ofwat guidelines), we highlighted our extensive plan to customers and 79% found our plan to be acceptable.

More about our wider engagement and acceptability testing can be found in Chapter 6 of our main business plan.

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

11.3.7 Factors Outside of Management Control

Please refer to section 1.3.2.

11.4 Best Option for Customers

11.4.1 Options Considered

YW are in a unique position relative to other companies; we have had three new technologies funded and constructed during AMP7 for phosphorus removal obligations. So we are not requesting funding towards the construction of these technologies. Nor are we requesting funding to deliver new treatment processes for the purpose of this study. This minimises the cost to the customer whilst providing data from three low carbon technologies to inform nitrate removal rates to the water industry.

This driver is an investigation only into the efficacy of technologies installed during AMP7 to understand the reliability of total nitrogen removal by sampling and analysing the wastewater at the inlet, mid-process and outlet of each site agreed with the EA. This keeps the costs associated with the WFD_INV_N-TAL driver very low.

The continued use of technologies installed in AMP7 minimises the cost of the trials, as the wastewater treatment types are already operational (Clifton WwTW and Hollym Myers Lane WwTW) or are being constructed by their end of AMP7 regulatory date (Knostrop WwTW), whilst providing unique treatment technologies for the total nitrogen technical limit research.

For the sampling and analysis programme, we will utilise YW's sampling team and the existing laboratory analysis contract to undertake the sample analysis. The laboratory sampling method and limit of detection have been shared with the EA and other water companies to ensure consistency across all samples.

11.4.2 Cost-Benefit Appraisal

We have not undertaken a detailed cost benefit analyses as part of developing our sampling programme, given the single type and small scale of activities under consideration. In line with the EA's PR24 Guidance, a CBA is not required for the development of investigations under WINEP.

11.4.3 Carbon impact and best value

As stated above, there is no opportunity to consider wider benefits in the development of sampling programmes.

11.4.4 Impact Quantification

This driver does not link to any current performance commitments.

11.4.5 Third Party Funding

There is no third party funding associated with this driver for the completion of YW's sampling programme and contribution to UKWIR's project management fee.

11.4.6 Customer Views

We have not carried out specific customer engagement on solution options related to this enhancement case, but a summary of customer views of this area more generally can be found in our customer support section above.

11.4.7 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in the Introduction to Enhancement Cases appendix.

Read more about this at
Introduction to Enhancement Cases

11.5 Cost Efficiency

11.5.1 Option Costs

This section outlines how our overall approach to cost estimation and cost efficiency, as described in section 7.3 in the Introduction to Enhancement Cases appendix, has been applied to this enhancement case. Table 1.1 at the beginning of this document summarises the costs associated with this enhancement case:

11.5.1.1 Cost estimate for our preferred option

Our costing estimate has been developed bottom up, considering volumes of work and unit rates. Assumptions for each are discussed in turn below.

Volume of work used in our cost estimate

As noted earlier, this enhancement case is driven by sampling activity at three WwTW sites approved by the Environment Agency. The table below summarises the number of samples required in AMP8.

Table 1.3: Samples Required by Site

Site	Sample Point location	Frequency of samples	Number of samples
Clifton STW	Influent	Weekly for 12 months	52
	Mid-process	Weekly for 12 months	52
	Effluent	Weekly for 12 months	52
Hollym Myers lane STW	Influent	Weekly for 12 months	52
	Mid-process	Weekly for 12 months	52
	Effluent	Weekly for 12 months	52
Knostrop STW	Influent	Weekly for 12 months	52
	Mid-process	Weekly for 12 months	52
	Effluent	Weekly for 12 months	52

Table 1.4: Costs by site

As summarised at the table at the beginning of this section, our total cost estimate derived through the approach outlined above is £0.047m over AMP8. The table below provides a breakdown of this cost across sites, and includes sampling, analysis, UKWIR data management fees and YW project management.

Site	Sample Point location	Site Total (£k)
Clifton STW	Influent	£15.509
	Mid-process	
	Effluent	
Hollym Myers lane STW	Influent	£15.509
	Mid-process	
	Effluent	
Knostrop STW	Influent	£15.509
	Mid-process	
	Effluent	
		£46.528

11.5.2 Efficient Cost Estimates

Section 7.3 in the Introduction to Enhancement Cases appendix, outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

As outlined in the previous section ‘Best Option for Customers’, we have proposed a solution that does not request funding towards the construction of new technologies, but instead focuses on undertaking sampling at three new technologies already funded and constructed at AMP7. This minimises the cost associated with the WFD_INV_N-TAL driver. We will not need to design, purchase and install new treatment processes for this investigation alone, which would then require decommissioning (and associated costs) at the end of the trial.

In designing our sampling and analysis programme, we propose to utilise our in-house sampling team and our existing laboratory analysis contract provider to ensure costs are efficient.

11.5.3 Need for enhancement model adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging. However, for this driver we anticipate that Ofwat will not produce a cost model and would assess this expenditure through a shallow or deep dive dependent on materiality.

11.6 External Assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

11.7 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

Our enhancement totex for this case does not meet the materiality threshold for any PCD groupings. There is sufficient regulatory oversight for our activities under the WINEP, therefore we do not propose any customer protection mechanisms for this case.

11.7.1 Third Party Funding or Delivery Arrangements

This is not applicable for this case.

12. Wastewater: Schemes to Meet the 25 Year Environment Plan

12.1 Driver:

25 YEP_IMP and 25YEP_INV

12.1.1 Requested Investment:

Table 1.1: Expenditure for Schemes to Meet the 25 Year Environment Plan

	£m	Table Line Ref.
Enhancement Expenditure Capex	4.796	CWW3.100
Enhancement Expenditure Opex	0.046	CWW3.101
Base Expenditure Capex		
DPC value		
Total	**4.842**	

12.1.2 Associated Reporting lines in Data Table:

Table 1.2 CWW3 Reporting Lines

Line Number	Line Description
CWW3.100	25 year environment plan; (WINEP/NEP) wastewater capex
CWW3.101	25 year environment plan; (WINEP/NEP) wastewater opex
CWW3.102	25 year environment plan; (WINEP/NEP) wastewater totex

12.2 High Level Driver description:

There are two drivers under this WINEP enhancement case:

- 25YEP_IMP: Locally significant environmental measures not eligible under any other driver, but with clear evidence of customer support and contributing to meeting 25 Year Environment Plan goals.
- 25YEP_INV: Investigations into a locally significant environmental issue not eligible under any other driver, but with clear evidence of customer support and contributing to meeting 25 Year Environment Plan goals.

The 25YEP driver supports investigations and actions contributing to the government's 25 Year Environment Plan goals. The driver will help achieve the government's 25YEP ambition to leave the environment in a better condition for future generations as set out in the draft Water Industry Strategic Environmental Requirements (WISER). Through WINEP actions, water companies can contribute to the 25YEP goals of:

- Clean air
- Clean and plentiful water
- Thriving plants and wildlife
- Reduced risk of harm from environmental hazards such as flooding and drought

- Using resources from nature more sustainably and efficiently
- Enhanced beauty, heritage and engagement with the natural environment
- Mitigating and adapting to climate change
- Minimising waste
- Managing exposure to chemicals
- Enhancing biosecurity.

12.3 Need

12.3.1 The Need for the Proposed Investment

Under the broad outcomes defined by the 25 Year Environment Plan, two are of particular relevance to a water company: 'Clean and plentiful water' and 'Thriving plants and wildlife.'

Clean and plentiful water

We will achieve clean and plentiful water by improving at least three quarters of our waters to be close to their natural state as soon as is practicable by:

- reaching or exceeding objectives for rivers, lakes, coastal and ground waters that are specially protected, whether for biodiversity or drinking water as per our River Basin Management Plans.

Thriving plants and wildlife

We will achieve a growing and resilient network of land, water and sea that is richer in plants and wildlife.
On land and in freshwaters, we will do this by:

- Creating or restoring 500,000 hectares of wildlife-rich habitat outside the protected site network, focusing on priority habitats as part of a wider set of land management changes providing extensive benefits.
- Taking action to recover threatened, iconic or economically important species of animals, plants and fungi, and where possible to prevent human induced extinction or loss of known threatened species in England and the Overseas Territories.

The 25 Year Plan Driver Guidance notes that:
Where water companies have customer support for non-statutory actions that go above and beyond their statutory obligations these can be included in the Water Industry National Environment Programme (WINEP) under the 25 Year Environment Plan (25YEP) driver, where they are not covered by other PR24 driver guidance.

The 25YEP driver supports investigations and actions contributing to the government's 25 Year Environment Plan goals. The driver will help achieve the government's 25YEP ambition to leave the environment in a better condition for future generations as set out in the draft Water Industry Strategic Environmental Requirements (WISER).

- Actions should be outcome focussed, innovative, integrated across the catchment, and delivering multiple benefits.

Improving aquatic biodiversity

Under a developing corporate Biodiversity Strategy, YW holds the following four long-term aspirations for biodiversity:

- Aspiration 1: To achieve a net gain to biodiversity through our operations
- Aspiration 2: To improve the ecological resilience of our rivers and catchments
- Aspiration 3: To give a strong voice to nature in our decision making
- Aspiration 4: To help customers engage with their river and surrounding natural ecosystems

Yorkshire Water relies on healthy rivers to abstract water and discharge wastewater, and we recognise we have both acute and diffuse impacts on them. Rivers should be a thriving

functional ecosystem, embedded within their surrounding catchment and landscape, and visited and enjoyed by the people around them.

A healthy river needs a diverse biological assemblage, with macrophytes, invertebrates, fish and mammals all as important as water quality statistics. It is not enough to focus on the river in isolation, and wetland habitats in particular all interconnect with the river ecosystem as well as providing supporting services like water quality remediation or carbon sequestration.

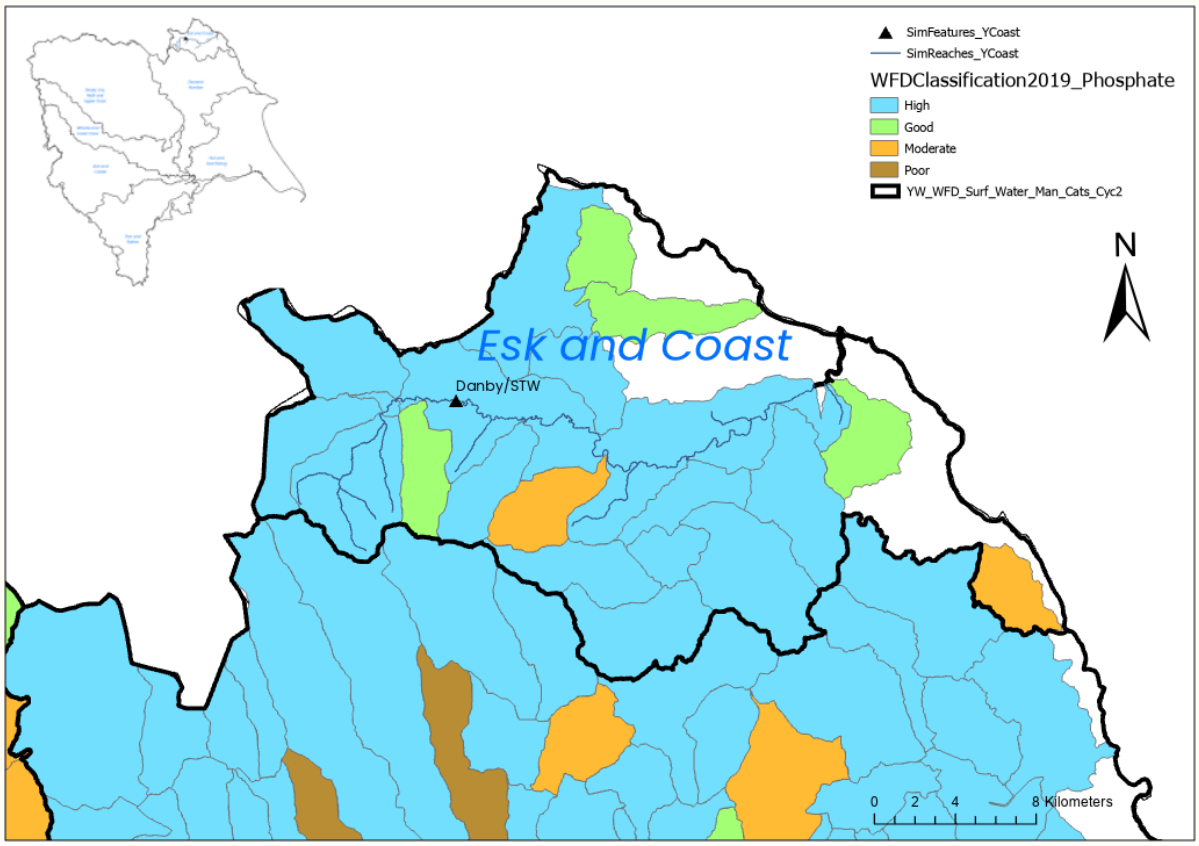
Yorkshire Water wants to invest to help build the resilience of these systems in a way that achieves a net gain to biodiversity as well as supporting the resilience of the groups and partnerships with similar agendas. We want to make sure the value we gain from biodiversity is included in how we make decisions as a company and we are making the right level of investment given the impacts we have and the benefits we accrue.

In AMP8 we will further protect the Freshwater Pearl Mussel (FwPM)

Following driver guidance, the 25 Year Environment Plan driver has been used to support action not required by primary or secondary legislation. Stakeholder engagement was not a standalone activity, but took place in conjunction with other statutory driver processes. When reviewed by Yorkshire Water topic specialists who in turn liaised with discipline specific specialist EA and NE staff, the only implementation action evidencing stakeholder support but not aligned with an existing driver is in respect to a wastewater treatment works upgrade to benefit freshwater pearl mussels (FWPMs) on the River Esk. This action aligns with the provisional outcomes of an ongoing AMP7 WINEP investigation focused on a widespread monitoring and optioneering programme to enable Yorkshire Water to understand its impacts on the FwPM population and their scale with respect to other catchment impacts.

The River Esk waterbody that receives the continuous discharge from Danby WwTW is already classified as WFD ‘Good’, or better nutrient status (see Figure 1) and so this investment cannot be included in the business plan under the traditional WFD_IMP or EnvAct_IMP1 phosphorus drivers, where Environment Agency guidelines state schemes can only be included at WwTW that do not already meet WFD Good status. Our wastewater discharges include phosphorus levels and solids within permitted limits, but the river conditions are not sufficiently pristine for the freshwater pearl mussels. However, research has shown that the FWPMs require significantly better water quality than WFD High status, and with an ageing population it is time critical that this work must proceed in AMP8 if the FwPM are to be effectively protected.

Figure 1.1: Location of Danby WwTW in the river Esk operational catchment with associated 2019 waterbody WFD Classification status



The FwPMs are valuable filter feeders for their ecosystem and well as having a symbiotic relationship with salmon and sea trout, but the existing population has been in decline since the 1980s and with most mussels now in the 70s-90s there is only a short time left before they will reach an age where they can no longer viably sustain.

A population of captive bread muscles exists, but our monitoring has identified other diffuse pollution issues which would undermine the release of these captive bred animals. This has led to support from the Esk & Coastal Streams Catchment Partnership and the North York Moors National Park Authority, to launch a catchment wide water quality improvement programme including working with farmers, riparian rights owners and angling groups. In addition to this, we will be continuing to work with the Catchment Partnership and NYMNPA to support an ongoing widespread monitoring programme to allow catchment solutions such as the use of riparian buffer strips to be used on appropriate tributaries (funded via S.106 funding they are able to draw down from ongoing mining activities in the Park).

Read more about this at www.yorkshirewater.com/news-media/news-articles/2021/yorkshire-water-partners-with-fba-to-breed-rare-pearl-mussels/

25YEP_INV

The planned investigations will run through to April 2027. We will be working collaboratively with stakeholders and undertaking monitoring to inform the investigations. We will be undertaking two investigations: 1) Lower Wyke Beck, and 2) Wiske operational catchment.

Lower Wyke Beck Study

Wyke Beck is a tributary of the river Aire in Leeds which receives the discharges from Yorkshire Water's largest WwTW, Knostrop. The beck is heavily canalised at the lower end and is visible

from a local amenity route from the Skelton Lake service station with access to bridle paths along both the river Aire and the Aire-Calder canal. The section of Wyke Beck is fenced off from the public and as it Is canalised, it is not prime habitat for ecology with flat concrete bed and banks.

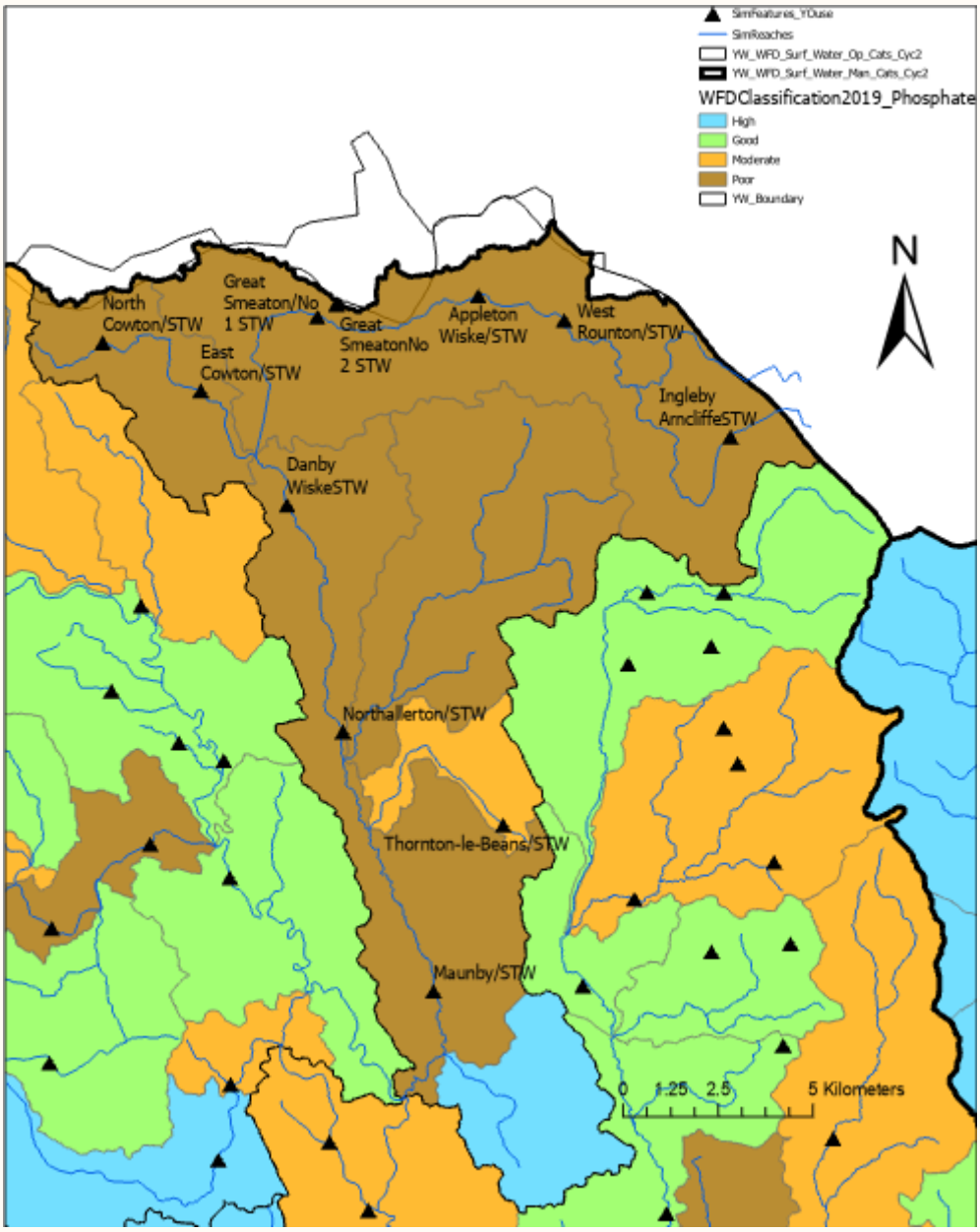
The investigation is to review if it is feasible to separate the discharge(s) from Knostrop WwTW from Wyke Beck and to undertake river restoration, if feasible, on Wyke Beck to promote healthy geomorphology and habitat to encourage a diverse range of species to thrive in the habitat. One aim of such work would also be to increase recreational amenity of the area.

Wiske Operational Catchment study

Modelling undertaken by both the Environment Agency and Yorkshire Water has not been able to improve the phosphorus load in the Wiske operational catchment to achieve WFD Good status. Whilst WFD_IMP and EnvAct_IMP1 WINEP obligations identified for AMP8 deliver Yorkshire Water's FairShare phosphorus reductions from WwTWs in the catchment, the aim of this study is to investigate what is needed to enable the Wiske operational catchment to improve beyond our FairShare to achieve WFD Good status in totality, if possible, using a variety of in-catchment improvements.

We aim to develop our knowledge of within catchment opportunities to further increase phosphorus load removal by working closely with key stakeholders such as the Yorkshire Dales Rivers Trust (YDRT) and the Environment Agency to understand what actions are needed to improve the operational catchment. The YDRT are already reinstating historical wetlands in the catchment to address historical issues from land management and drainage and through early conversations with them there are greater opportunities available. We would like to investigate this further and develop our relationship with the YDRT and other stakeholders to identify possible opportunities to improve phosphorus removal in this catchment. Any improvements identified will also aim to be low carbon, blue-green solutions to create or improve existing habitats and biodiversity net gain in AMP9.

Figure 1.2: Location of WwTWs in the river Wiske operational catchment with associated 2019 waterbody WFD Classification status



12.3.2 The Scale and Timing of the Investment

25YEP_IMP

The investment planned is to achieve the WINEP 25YEP_IMP obligation for 0.25 mg/l phosphorus removal by 31st March 2030. We will be installing tertiary solids removal and chemical dosing at Danby WwTW to reduce phosphorus in the wastewater discharge to appropriate levels.

During AMP7 we have been working with the Freshwater Biological Association (FBA) and the Environment Agency, to collect mussels from the river and artificially induce breeding in the FBA laboratories at Windermere. This has led to the collection of several thousand juvenile mussels (compared to the c.100 left in the river). However, we will not be able to return these to the river under a Natural England licence until water quality conditions are suitable. We are passionate

about protecting the FwPMs and believe this is the right action to take to improve the water quality habitat and support the future recruitment of FwPMs in AMP8.

25YEP_INV

The planned investigations will run through to April 2027. We will be working collaboratively with stakeholders and undertaking monitoring to inform the investigations. We will be undertaking two investigations: 1) Lower Wyke Beck, and 2) Wiske operational catchment. Any improvements will be considered for delivery in AMP9 or beyond.

12.3.3 Interactions with Base Expenditure

We confirm this enhancement case does not overlap with base funding.

12.3.4 Activities Funded in Previous Price Reviews

Yorkshire Water has not previously received enhancement investment through the YEP driver or prior local WINEP or NEP drivers.

Yorkshire Water has had a NERC_INV action during AMP7 to undertake a monitoring programme to help understand our impacts on the FwPM population, the results of which have led to this 25YEP_IMP action at Danby WwTW.

12.3.5 Long-term Delivery Strategy Alignment

Please refer to section 1.3.1 for information on our long-term delivery strategy.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about our LTDS at
Long Term Delivery Strategy

12.3.6 Customer and Stakeholder Support

With regards to setting out customer and stakeholder support for this enhancement case, we provide a summary of customer engagement research before addressing how we have engaged with our stakeholders more specifically.

Through our research we understand that environmental water quality has grown in importance in recent years – spurred on by covid and lockdowns - forcing customers to take more interest in their local environment.

We know, using the Ofwat/CCWater customer preferences research that river water quality is of medium importance to customers, when considering it within a wider list of performance commitment areas. It should be noted, however, that it is considered one of the most important environmental performance commitments and more relatable than others.

In our own Valuing Water customer priorities research, we tested 20 priorities with household and non-household customers, three of which were specifically related to water quality in rivers, streams and the sea. Both household and non-household customers prioritised all three of these priorities within their Top 6 service areas – highlighting the importance of environmental water quality to Yorkshire customers.

Given this insight and that collected through other studies we conducted such as our Drainage and Wastewater Management Plan research, Designated Bathing Water research and Customer Views on Storm Overflow consultation we understand environmental water

quality is a priority to our customers and something which requires additional investment to meet the expectations of our customers.

In testing our plan with customers in affordability and acceptability research conducted following Ofwat guidelines - 78% of customers found the plan to be acceptable and in our own independent affordability and acceptability testing research, 79% of customers found our overall plan to be acceptable.

> *"It's quite clear from seeing YW representatives facing up to the high profile issues on TV news channels and the printed media, that steps are being taken in both the short and long term, to rectify and improve all aspects of water supply and sewage treatment. I accept there have been problems nationally, particularly regarding storm overflows, however I do appreciate that it is a massive undertaking to provide water to millions of households and businesses, and to manage treatment of the sewage created by those households and businesses." Customer, Yorkshire Water Independent Affordability and Acceptability Testing Research, September 2023.*

To read more about our customer research, please visit Chapter 6 of our main plan.

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

12.3.6.1 Customer research for thriving plants and wildlife

In terms of biodiversity, we know, using the Ofwat/CCWater customer preferences research that biodiversity is of medium importance to customers, when considering it within a wider list of performance commitment areas. Essentially, people reported this area to be of some importance, but struggled to link biodiversity with impacts on their everyday lives. The research also found there was a lack of awareness of the concept of biodiversity as a performance area for water companies across household and non-household customers. This may be linked to the fact that biodiversity is a new performance commitment for water companies, and once this becomes more established, we are likely to see an increase in customer awareness, and therefore interest in improving this in the future.

12.3.6.2 Our stakeholder engagement

The 25 Year Plan driver is focused on principles and outcomes rather than specific assets or modelling options. As such, the role of developing the constrained list is not to 'fix' 25 Year plan targets, but to understand through an unconstrained list, the key pressures and desired outcomes to help deliver against them, before developing a constrained list representing what could be considered to be YW's proportionate fair share in playing its role in this.

A large list of stakeholder suggestions was received either through direct discussion, email or through working groups of our Biodiversity Advisory Group (BAG) or others (e.g., the Esk & Coastal Streams Catchment Partnership or the Yorkshire Invasive Species Forum). One key theme running through the majority of suggestions as well as aligning with YW's corporate aspirations, was recognising that in our role as a water company, we have a disproportionate ability to impact on certain key habitats and species, particularly aquatic ones. The Environment Agency amongst others note that as well as over 90% already being lost, over 10% of our freshwater and wetland species are threatened with extinction, with two thirds of our existing wetland species being in decline and note that wetlands make up only 3 percent of the UK but are home to at least 10 percent of our species.

Through YW's own engagement we recognise for key aquatic species such as FwPM we are in a unique position to make a positive difference in the catchment due to the impact of our permitted operations. An example of such engagement includes our discussions with the Esk & Coastal Streams Catchment Partnership regarding a project to improve water quality on the River Esk, with the intention of supporting a population of FwPM, which are under threat of

extinction in Yorkshire. Under existing guidance, this project to improve water quality may not have been prioritised, but after engagement with the Partnership we have included the project within our plan as an important example of how we should be promoting biodiversity across our region.

Our part in delivering the River Esk Freshwater Pearl Mussel Strategy 2022-2050

A sub-group of the Esk & Coastal Streams partnership has been set up to concentrate on the production and delivery of a strategy to return the population of FwPM on the Esk to a sustainable level.

In summary, due to the strategy being developed collaboratively by regulators, local authorities, eNGOs and YW and having wider review by the Catchment Partnership (including sporting groups and local landowners), it demonstrates strong alignment with the co-design principles embedded in the WINEP process.

The strategy identifies required action relating to the mussel population itself, water quality, habitats, host populations and other key factors. It notes it is essential for water quality conditions to improve and work will be required from farmers and water companies to ensure water quality is sufficient for natural recruitment and potential release sites. This together with the wider identified actions acts as a constrained list of potential solutions that could be supported and/or implemented by Yorkshire Water to help deliver its 25 Year Environment Plan obligations. Given the strategy has been supported by regulators, local authorities with large populations (e.g., NYMNPA with >25,000 residents) and eNGOs with similar (e.g., 50,000 Yorkshire Wildlife Trust members) YW are confident that it represents the best achievable outcome for FwPM in the Esk and helps deliver against the 25 Year Plan target of Thriving plants and wildlife and Clean and plentiful water.

The strategy contains 42 broad actions that are required between 2022 and 2050. It would not be proportionate or appropriate for YW to deliver against all 42 actions from this longer constrained list, however in consultation with the Steering Group, it was noted that YW are in a unique position to deliver against a subset of these actions (e.g., it is appropriate for YW to hold the action relating to water industry, water quality improvements) and actions where this is the case have progressed to the feasible list of actions.

The NYMNPA supports our planned investment in protecting the FwPM, recognising our critical role in their strategy to protect the critically endangered species. Click here for a copy of their correspondence.

To learn more about our customer and stakeholder engagement, see Chapter 6 of our main business plan.

12.3.7 Factors Outside of Management Control

Please refer to section 1.3.2.

12.4 Best Option for Customers

12.4.1 Options Considered

The WINEP optioneering process as defined by the Environment Agency, has led to a number of scenarios being developed across the programme, with cost benefit assessments undertaken against a broad range of environmental outcomes. As the Action Specification Forms for these WINEP actions are determined, these options will be further refined under scrutiny from the Environment Agency and through collaboration with relevant stakeholder groups such as Catchment Partnerships. Our approach to Optioneering is detailed in section 1.4.

Throughout the WINEP options development process, there has been close engagement and co-creation with a number of key stakeholders. Yorkshire Water has worked closely with an EA and NE steering group, as well as hosting an external Biodiversity Action Group (BAG). The BAG comprises of representatives from all nine Catchment and Coastal Partnerships across Yorkshire, as well as the five Rivers Trusts and two Wildlife Trusts covering Yorkshire. Both

groups have an existing relationship with us over several AMP cycles, but the intensity of meetings has increased since October 2021 during the build-up of our PR24 programme, feeding into identifying risks & issues, developing through to a constrained list of options, and in helping cost and define outcomes for the programme. Yorkshire Water have also consulted with representatives of the various Local Authority and Combined Authorities leading on the development of the likely four Local Nature Recovery Strategies across Yorkshire as well as other key stakeholders such as the RSPB and National Trust.

Following publication of the driver guidance a series of meetings were held involving both the YW/EA/NE steering group as well as the BAG. Initial stakeholder feedback was received from biodiversity technical specialists at the EA and NE as well as via the BAG to develop a long list of pressures impacting on biodiversity across Yorkshire as well as an understanding of the bespoke regional pathways to respond to Government strategy on biodiversity and relevant outcomes from the DEFRA 25 Year Environment Plan. Between them, these groups represent a significant proportion of our customers via their membership. Using the guidance, YW was able to work with partners to sense check these pressures and desired outcomes against the impacts of its operations and its ability to make a disproportionate impact against their delivery. This process was iterative and involved meetings of the BAG as well as bespoke focused meetings around key habitats, species or spatial areas. (For example, with Catchment Partnership subgroups or species focused NGO specialists.) Additional information was provided by Natural England through the Nature Recovery List.

Specifically, to inform this driver, further detailed stakeholder engagement and co-creation has been undertaken with the Esk & Coastal Streams Catchment Partnership with four specialist workshops taking place, alongside the Environment Agency, Natural England and the North York Moors National Park Authority.

To cost the phosphorus removal solution, we followed the same approach as for the WFD_IMP drivers in our enhancement case River Water Quality Improvements.

In summary the feasible options for phosphorus removal are typically:

Figure 1.3: List of potential solutions available.

Approach	Feasible	Comments
Biological Nutrient Removal	✓	Only applies to current ASP sites
Chemical dosing	✓	Single or Two Point Dosing
Increase treatment capacity	✓	Various
Nature Based Solutions	✓	Wetland
Rationalise assets	✓	Pump out to different STW
Sidestream excess flows through passive systems	✓	Wetland
Wetland	✓	See NBS
Misconnections	!	Investigation required. Possible once scheme in delivery phase

Only Chemical dosing is a suitable option for this site, due to permit limit requirements which is at the technically achievable limit (TAL). The existing assets are filter works meaning because it is not an activated sludge plan (ASP), biological nutrient removal is not a suitable appropriate option. Nature-based solutions, removal of misconnections or changes in capacity will change the levels of phosphorus and solids enough to achieve the required levels for mussel habitats.

12.4.2 Cost-Benefit Appraisal

The benefits associated with delivery of these solutions are avoidance of legal non-compliance and improved river water quality. These benefits are described in Table CWW15. However, we are unable to quantify the additional benefit of improving the river quality above the current ‘good’ quality condition. We do though, consider the non-monetisable value of protecting the FwPM habitat is a critical benefit for customers, community and the environment.

12.4.3 Carbon impact and best value

We considered nature-based solutions, but these were not suitable as noted previously.

12.4.4 Impact Quantification

This driver has an immaterial impact on our performance under the River Water Quality common performance commitment.

12.4.5 Cost and Benefit Uncertainties

We have addressed uncertainty by adopting known technologies into our solution so we can improve our wastewater discharges beyond our existing required levels.

12.4.6 Third Party Funding

The 25 year plan places responsibilities for achieving outcomes across a large number of organisations. As we have outlined in this document, we have worked closely with our key stakeholders to identify a programme for Yorkshire Water that is proportionate. Due to the nature of this work, we will work in partnership to deliver the identified outcomes, and this has the potential to leverage additional funding to support more diverse environmental and customer outcomes.

In response to our query regarding partnership contributions Ofwat stated that: “Benchmarking will only take into account contributions made by third parties to enhancement schemes proposed by companies which are consistent with the proper carrying out of statutory functions. These third-party contributions would pay for costs that customers would otherwise have to pay for.”

This enhancement case sets out Yorkshire Water’s investment need and any match funding received will support the partners share of project costs, rather than reducing our investment need.

There is no third-party funding committed to help deliver the action. However, in AMP7 there has been around £0.8m in third party funding, targeted at the present WINEP investigation outcomes of the Esk Freshwater pearl mussel action in particular, which is likely to grow during AMP8. To date there has been monitoring costs shared between at least four of the Catchment Partnerships, with coordinated fisheries, water quality, invertebrate and habitat monitoring taking place jointly by the EA, YW, the North York Moors NPA and Natural England. Habitat improvements have already been funded via ERDF and S.106 funding, which has been unlocked by the Yorkshire Water monitoring financial spend in AMP7.

12.4.7 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

12.4.8 Customer Views

Refer to the section ‘options considered’ for how we have worked with customers and stakeholders to develop our solutions.

12.5 Cost Efficiency

12.5.1 Option Costs

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in section 7.3 in Introduction to Enhancement Cases, has been applied to this enhancement case. Table 1.1 at the beginning of this document summarises the costs associated with this enhancement case:

12.5.1.1 Cost development for our preferred option

Our costing estimate for the 25YEP_IMP scheme at Danby WwTW has been developed bottom up, using expert judgement based on our past experience and the delivery of similar schemes. The assumptions used to develop our investigation and implementation costs are discussed in turn below.

Table 1.3 Costing Assumptions

	Detail of Assumptions
Investigation costing	The scope of the two investigations in this enhancement case have not been subject to formal cost-benefit analysis or optioneering. Instead, they have been developed and approved in conjunction with the Environment Agency through the WINEP process. We have developed our cost estimates by comparing the scope of these agreed investigations to those we have previously delivered and used historic cost information from similar activities to build bottom-up estimates. This has included considering the costs of undertaking desktop and fieldwork studies.
Implementation costing – Phosphorus removal	Our costing estimate has been developed using our Unit Cost Database (UCD) and our Decision-Making Framework processes. Further details on how we have applied these tools to develop cost estimates are provided in Section 7.3 in Introduction to Enhancement Cases. As part of our central approach to costing, information was collected regarding the characteristics of existing assets at identified sites and future permitted limits. Using decision tools, additional assets are then generated with measures to meet the specified permit limit. Design measures are subject to verification by a technical consultant before cost models from our Unit Cost Database are applied to the scope specified. In some instances, a site-specific solution was designed in conjunction with our Strategic Planning Partner, and subsequently costed using information held within our Unit Cost Database. Where no suitable cost models were identified in our Unit Cost Database, we utilised information held in the national water industry costing database where applicable (TR61 v14). Adjustments are required to this data to account for differences in methodology and to account for Yorkshire Water design costs.

12.5.1.2 Efficiency of our cost estimate

Section 7.3 in Introduction to Enhancement Cases outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

In developing our investigation cost estimates, we have agreed the scope of investigations in AMP8 with the Environment Agency. We have considered historic costs of related activities we have previously delivered in past investigations in determining our final estimates.

For our proposed implementation costs, estimates were developed by the YW Costing Team using the expertise of our Strategic Planning Partner to determine the scope required for costing and using UCD models to create efficient cost estimates. Our UCD approach involves building detailed cost estimates that are developed using historic cost information on individual components of an overall solution.

12.5.2 Need for enhancement model adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging. However, for this driver we anticipate that Ofwat will not be able to produce a meaningful cost model and would assess this expenditure through a shallow or deep dive dependent on materiality.

12.6 External assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

12.7 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

Our enhancement totex for this case does not meet the materiality threshold for any PCD groupings. There is sufficient regulatory oversight for our activities under the WINEP, therefore we do not propose any customer protection mechanisms for this case.

12.7.1 Third Party Funding or Delivery Arrangements

There are no third party funds identified to deliver the activities identified in this enhancement case. It is anticipated that the expenditure in this enhancement case will attract funding from other organisations to deliver greater benefits to customers.

13. Wastewater: Inland Bathing Water Quality

13.1 Drivers:

BW_IMP1, BW_IMP4 BW_INV1, BW_INV5

13.1.1 Requested Investment:

Table 1.1: Bathing Waters AMP8 Expenditure

	£m	Table Line Ref.
Enhancement Expenditure Capex	174.126	CWW3.13, CWW3.16, CWW3.22, CWW3.46, CWW3.88, CWW3.109
Enhancement Expenditure Opex	4.622	CWW3.14, CWW3.17, CWW3.23, CWW3.47, CWW3.89, CWW3.110
Base Expenditure Capex		
DPC value	28.196	SUP12
Total	**206.944**	

13.1.2 Associated Reporting lines in Data Table:

There is no single enhancement category for the delivery of Bathing Water improvements; the scope of investment is partitioned between 6 of the Enhancement Categories as listed in Table 1.2 below.

Table 1.2: CWW3 Reporting Lines

Line Number	Line Description
CWW3.13	Increase flow to full treatment; (WINEP/NEP) wastewater capex
CWW3.14	Increase flow to full treatment; (WINEP/NEP) wastewater opex
CWW3.15	Increase flow to full treatment; (WINEP/NEP) wastewater totex
CWW3.16	Increase storm tank capacity at STWs - grey solution; (WINEP/NEP) wastewater capex
CWW3.17	Increase storm tank capacity at STWs - grey solution; (WINEP/NEP) wastewater opex
CWW3.18	Increase storm tank capacity at STWs - grey solution; (WINEP/NEP) wastewater totex
CWW3.22	Storage schemes to reduce spill frequency at CSOs etc - grey solution; (WINEP/NEP) wastewater capex
CWW3.23	Storage schemes to reduce spill frequency at CSOs etc - grey solution; (WINEP/NEP) wastewater opex
CWW3.24	Storage schemes to reduce spill frequency at CSOs etc - grey solution; (WINEP/NEP) wastewater totex
CWW3.46	Storm overflow - new / upgraded screens (WINEP/NEP) wastewater capex

CWW3.47	Storm overflow - new / upgraded screens (WINEP/NEP) wastewater opex
CWW3.48	Storm overflow - new / upgraded screens (WINEP/NEP) wastewater totex
CWW3.88	Microbiological treatment - bathing waters, coastal and inland (WINEP/NEP) wastewater capex
CWW3.89	Microbiological treatment - bathing waters, coastal and inland (WINEP/NEP) wastewater opex
CWW3.90	Microbiological treatment - bathing waters, coastal and inland (WINEP/NEP) wastewater totex
CWW3.109	Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling wastewater capex
CWW3.110	Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling wastewater opex
CWW3.111	Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling wastewater totex

13.1.3 Phasing of PR24 Water Industry National Environment Programme:

The actions identified within this enhancement case are all associated with WINEP actions, both statutory and non-statutory, as detailed throughout the enhancement case. Following correspondence from the Environment Agency on 5th July 2023 regarding deliverability, financeability and customer affordability of PR24, all water companies were asked to review their WINEP in line with the provided Secretary of State's steer. This included a review of opportunities to phase all non-statutory commitments into future AMPs. We held subsequent conversations with Defra and the Environment Agency on our non-designated bathing water WINEP actions on 23rd August and following these conversations the below non-statutory actions have been phased into future price reviews.

- 08YW100147a - Wetherby
- 08YW100679i - River Nidd at Knaresborough Continuous (assets to be defined)

These were confirmed back to Yorkshire Water Services on 18th September 2023. As this was after the date at which we could make changes to our business plan, these activities remain within expenditure detailed in CWW3 and the enhancement case below. The actions phased relate to reporting lines:

Table 1.3: CWW reporting lines impacted through WINEP phasing

Line Number	Line Description
CWW3.88	Microbiological treatment - bathing waters, coastal and inland (WINEP/NEP) wastewater capex
CWW3.89	Microbiological treatment - bathing waters, coastal and inland (WINEP/NEP) wastewater opex
CWW3.90	Microbiological treatment - bathing waters, coastal and inland (WINEP/NEP) wastewater totex

The expenditure allowances and associated lines which will not be addressed through the PR24 business plan are as follows:

Table 1.4: Associated capex/opex/totex costs for PR24 WINEP phasing

Line Number	Line Description	Cost
CWW3.88	Microbiological treatment - bathing waters, coastal and inland (WINEP/NEP) wastewater capex	£53.924m
CWW3.89	Microbiological treatment - bathing waters, coastal and inland (WINEP/NEP) wastewater opex	£3.242m
CWW3.90	Microbiological treatment - bathing waters, coastal and inland (WINEP/NEP) wastewater totex	£57.166m

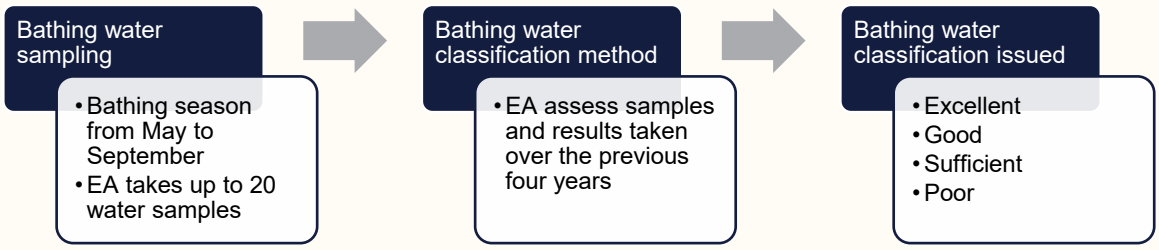
13.2 High Level Driver description:

The Bathing Water Regulations 2013[29] (the Regulations) aim to protect and improve bathing water quality to protect public health and improve the public information available at designated surface waters which are utilised for recreational purposes.

Under the Regulations, applications can be made to designate recreational waters as formal bathing waters. Where a designation exists, the Environment Agency (EA) must monitor the water for faecal indicator organisms (FIOs), specifically Escherichia coli (E. coli) and Intestinal enterococci (IE) throughout the duration of the bathing water season (May – September). These FIOs are used as an indicator of water quality and risk to public health and can originate from many sources, including sewage, agricultural livestock, wildlife, birds and run off or drainage.

Following the bathing water monitoring, an annual classification based on the previous four years data must be published to advise the public on the bathing water quality at each designated bathing water. Signage must then be displayed by the local authority to inform the public of this.
To summarise, the annual process for designated bathing waters is:

Figure 1.1: Summary of Bathing Water Process



We recognise that there is a growing public interest in improving waters for recreational purposes which has also been recognised through the Water Industry National Environment Programme (WINEP) guidance on bathing waters for PR24. This enhancement case therefore proposes to go beyond our statutory duties, and we propose to improve the quality of three inland waters under the WINEP:

- One designated bathing water (River Wharfe at Cromwheel, Ilkley)
- Two non-designated recreational sites (River Wharfe at Wetherby and River Nidd at Knaresborough)

[29] https://www.ofwat.gov.uk/wp-content/uploads/2022/12/data.pdf

These water quality improvements are proposed by reducing storm overflow discharges and upgrading wastewater treatment works. We also propose bathing water investigations to further understand impacts upstream of the three sites to inform any future investment requirements. Our investment is proposed under the following WINEP drivers:

Table 1.5: Summary of PR24 WINEP Bathing Water Drivers

Driver Code	Description	Legal Obligation
BW_IMP1	Actions to improve waters with a current planning class of Poor	Statutory
BW_IMP4	Actions to improve non-designated waters where there is evidence of customer support	Non-statutory
BW_INV1	Investigations for waters with a current planning class of Poor	Statutory
BW_INV5	Investigations at non-designated waters where there is evidence of customer support	Non-statutory

Our work on the River Wharfe at Cromwheel, Ilkley has already begun in AMP7 under Ofwat's Accelerated Infrastructure Delivery Project[30].

13.3 Need for investment

13.3.1 The Need for the Proposed Investment

Where the Department for Environment, Food and Rural Affairs (Defra) has designated recreational waters as formal bathing waters under the Regulations, new statutory obligations can be introduced for water companies, particularly where waters are classified as 'poor'.

The EA has introduced new drivers and guidance for water companies to reflect these obligations as part of its PR24 WINEP driver guidance for Bathing Waters. These new drivers include both statutory obligations as well as non-statutory improvements at waters which are utilised for recreation but have not been designated under the Regulations. This is to reflect the public interest in improvements at non-designated waters and is subject to customer support.

In AMP8, we propose to support improvements in water quality at three inland waters:

Table 1.6: Summary of PR24 Bathing Water Drivers and Locations

Bathing water sites	WINEP driver code	Description	Legal Obligation
River Wharfe at Cromwheel, Ilkley	BW_IMP1	Actions to improve waters with a current planning class of Poor	Statutory
	BW_INV1	Investigations for waters with a current planning class of Poor	Statutory
	BW_IMP4	Actions to improve non-designated waters where there is evidence of customer support	Non-statutory

[30] https://www.ofwat.gov.uk/consultation/accelerated-infrastructure-delivery-project-draft-decisions/#Outcome

The River Wharfe at Wetherby	BW_IMP4	Actions to improve non-designated waters where there is evidence of customer support	Non-statutory
The River Nidd at Knaresborough	BW_INV5	Investigations at non-designated waters where there is evidence of customer support	Non-statutory

We also must comply with Defra's Storm Overflows Discharge Reduction Plan[31], which requires water companies to significantly reduce harmful pathogens from any storm overflows that discharge into or near designated bathing waters. This plan introduces a new spill frequency target for designated inland bathing waters of one spill per bathing water season, on average, for storm overflows discharging within 5km upstream of the inland bathing water site.

The Regulations and the Storm Overflows Discharge Reduction Plan require us to make infrastructure improvements upstream of designated bathing waters, and we also propose to make improvements upstream of non-designated recreational sites where we know the community intend on applying for bathing water status.

13.3.1.1 Designated Inland Bathing Waters: River Wharfe at Cromwheel, Ilkley

In December 2020, Defra announced the River Wharfe at Cromwheel, Ilkley would become the UK's first designated riverine bathing water, following a successful application by the Ilkley Clean River Group (ICRG).

The ICRG formed as an environmental campaign group and applied for bathing water status with three key aims[32]:

1. To stop storm overflows of sewage into the river outside storm conditions;
2. To upgrade the sewage treatment works and infrastructure; and,
3. To ensure sewage spills don't leave solids on the riverbank

The bathing water has subsequently been classified as 'Poor' under the Regulations following the 2021 and 2022 bathing water season, with signage advising against bathing displayed at the bathing water.

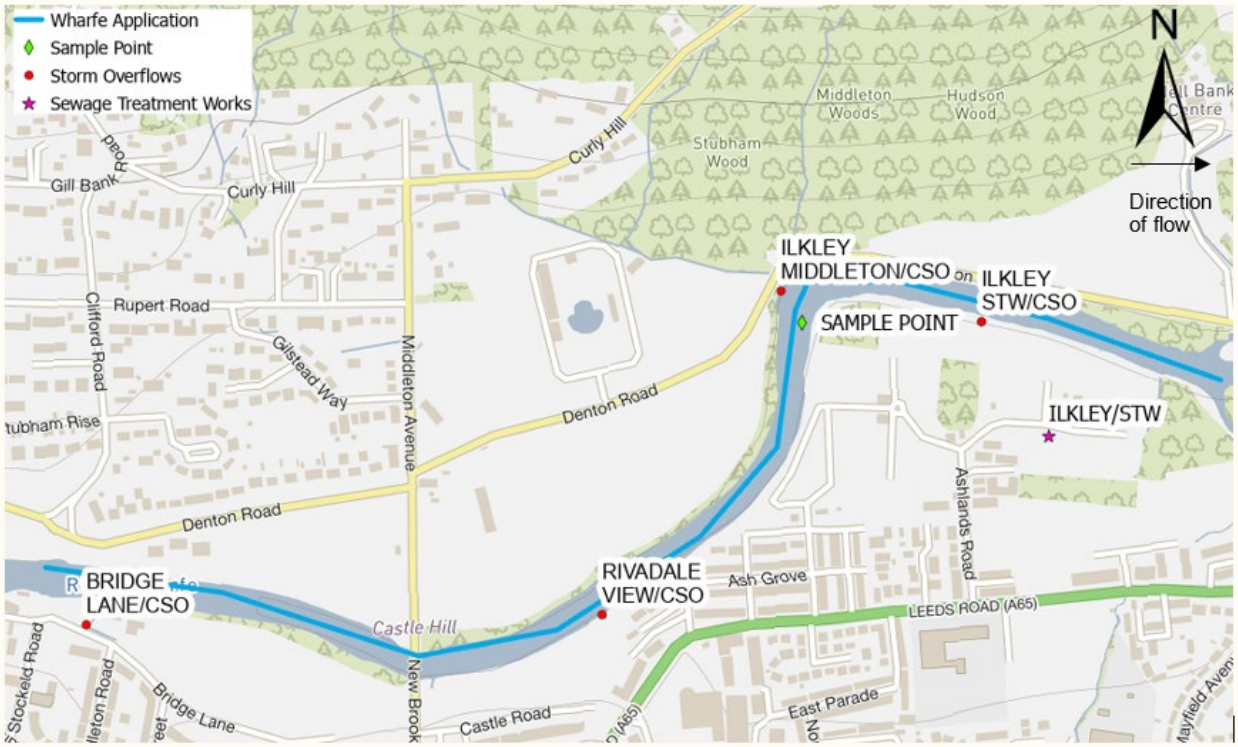
In the application for bathing water status[33], the ICRG applied for a one-mile stretch of the watercourse to be designated as a formal bathing water under the Regulations. This one-mile stretch includes a number of Yorkshire Water assets including storm overflows and Ilkley Sewage Treatment Works, as highlighted on Figure 1.2 below.

[31] Storm Overflow Discharge Reduction Plan, https://www.gov.uk/government/publications/storm-overflows-discharge-reduction-plan

[32] https://ilkleycleanriver.uk/

[33] Ilkley Clean River Group Bathing Water Application, https://ilkleycleanriver.uk/wp-content/uploads/2022/12/DesignatedBathingWaterApplication_Ilkley_2019.pdf

Figure 1.2: Map highlighting River Wharfe at Cromwheel application and immediate assets



The Environment Agency's designated sampling point for compliance monitoring is situated at the point of the most bathers, which is partway through the applied reach. Under the Storm Overflow Discharge Reduction Plan, assets within 5km upstream of the compliance point are required to meet the statutory spill targets. However, as the compliance point is within the applied reach, sewerage infrastructure downstream from the designated sample point is not covered under a statutory bathing water WINEP driver. We know from engaging with the local community and environmental campaign groups that downstream of the designated bathing water is also used for recreational purposes, and therefore to protect public health, we have proposed investment under the non-statutory bathing water driver.

13.3.1.2 Non-designated inland bathing waters: River Wharfe at Wetherby and River Nidd at Knaresborough

Engagement with our communities and stakeholders across Yorkshire has alerted us to two further recreational locations where communities have or intend to apply for bathing water status (see next section for customer engagement). These are:

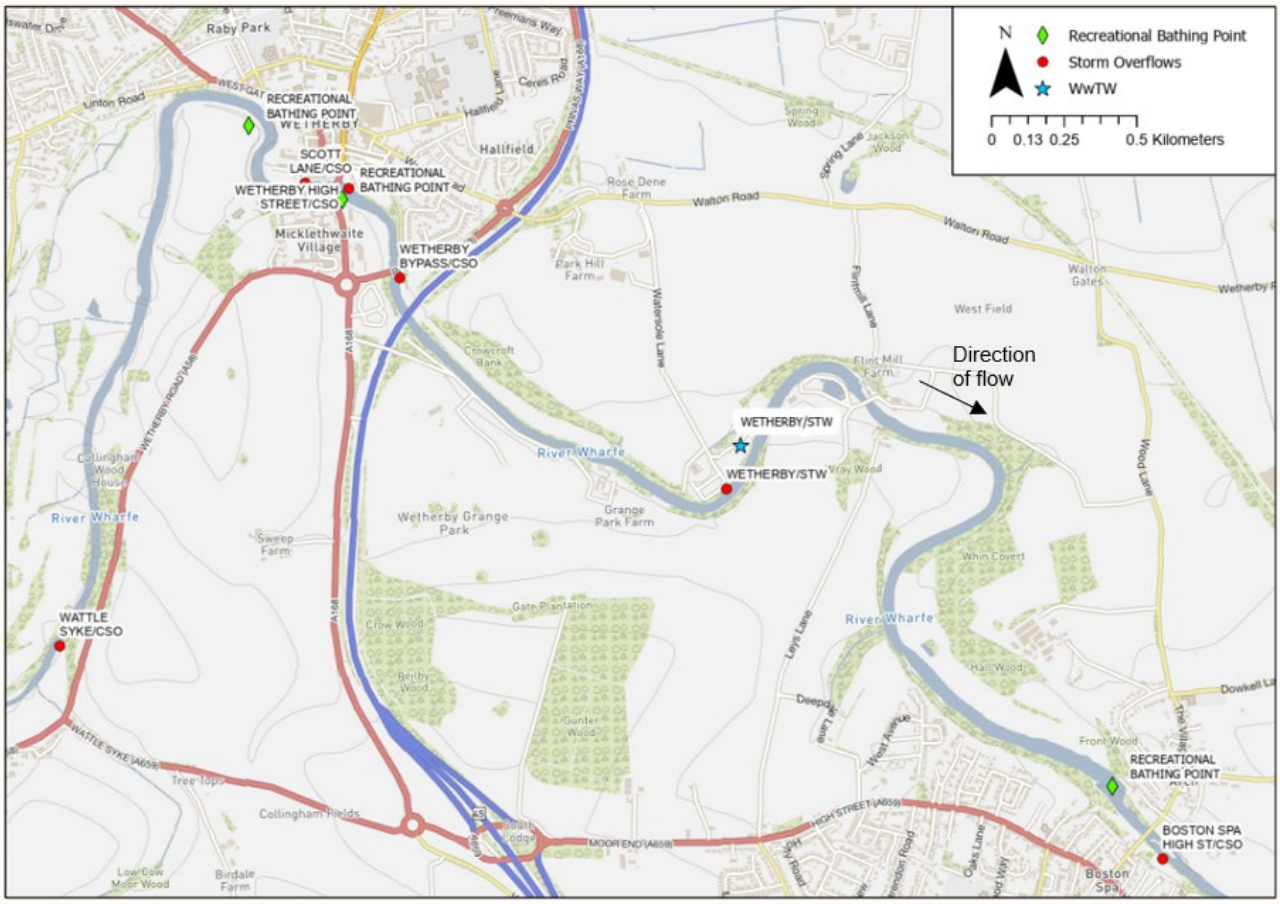
- The River Wharfe at Wetherby. An application was submitted in 2022, this was not approved, however, further applications are expected.
- The River Nidd at Knaresborough. An application for bathing water status is expected in 2023 here.

The Wetherby and Villages Clean River Group[34] formed in 2022 with the aim of achieving bathing water status by stopping storm overflow discharges and wastewater entering the Wharfe by engaging with the local community and working with Yorkshire Water.

[34] https://wetherbyandvillagescleanrivergroup.com/

In October 2022, the Wetherby and Villages Clean River Group submitted an application for bathing water status at three locations as highlighted by the 'Recreational Bathing Point' on Figure 1.3..

Figure 1.3: Map highlighting recreational bathing points and local sewerage infrastructure on the River Wharfe, Wetherby



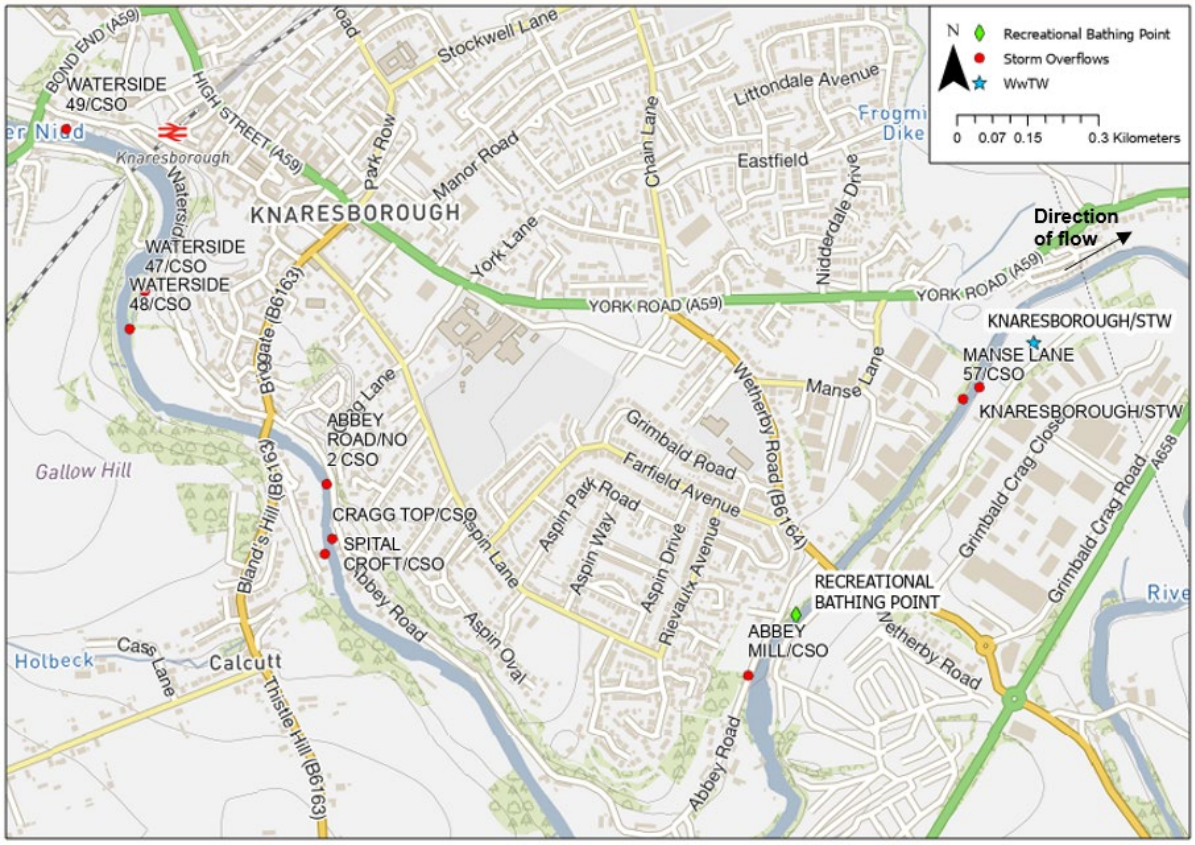
The Nidd Action Group[35] formed in 2023 with the aim of achieving a 'Cleaner Nidd, Fit for Life'. The group have three key aims:

1. Make rivers safe for all from invertebrates to fish, birds, animals and people
2. Stop sewage pollution of untreated sewage into the River Nidd
3. Raise the bar and improve standards so legally discharged waste doesn't harm the River Nidd.

Figure 1.4 highlights the recreational location on the River Nidd at Knaresborough, where the Nidd Action Group propose to apply for bathing water status.

[35] https://www.niddactiongroup.org/

Figure 1.4: Map highlighting recreational bathing points and local sewerage infrastructure on the River Nidd, Knaresborough



Although these are not currently designated bathing waters, our customers want us to improve the water quality across Yorkshire to support the recreational use of bathing waters. We are therefore proposing non-statutory investigations to understand further upstream asset impacts at Wetherby and Knaresborough and improvements to our storm overflows in line with the Storm Overflow Reduction Plan and at our continuous sewage treatment discharges where there is an expected impact to bathing water quality.

13.3.2 The Scale and Timing of the Investment

All of the investment proposed under this enhancement case has been submitted for inclusion within the WINEP. Following the Environment Agency's review, the below obligations have all been marked as to proceed as on the WINEP with a required compliance date:

13.3.2.1 River Wharfe at Cromwheel, Ilkley

For our infrastructure improvements for the River Wharfe at Cromwheel, Ilkley, we have considered both our statutory requirements as well as non-statutory opportunities as part of a holistic approach to improve bathing water quality.

We propose to invest £63.524m capex at Cromwheel across the statutory and non-statutory drivers for AMP8:

Table 1.7: Summary of River Wharfe at Cromwheel Capex Enhancement

WINEP driver	Bathing Reach	Output	Compliance Date	Cost (Capex £m)
BW_INV1	Upstream	Bathing Water Investigation	April 2027	1.939
BW_IMP1	Upstream	1 spill per bathing water season, on average, for 5 km upstream of the sample location	March 2026	48.539
BW_IMP4	Downstream	Tertiary treatment for Ilkley STW	March 2030	5.748
BW_IMP4	Downstream	1 spill per bathing water season, on average, for Ilkley STW 6X DWF	March 2030	7.297
Total				63.523[36]

Due to Ilkley's classification of 'Poor' following the 2021 and 2022 bathing water season, this investment must be carried out as soon as possible to protect the bathing water's status and avoid de-designation[37]. This investment was proposed under the Ofwat Accelerated Infrastructure Delivery Project and approved in the final decisions in June 2023.

We recognise that bathing waters are complex and need investigating fully to ensure all sources of faecal indicator organisms are addressed across the catchment. We also recognise the River Wharfe at Cromwheel, Ilkley is the UK's first designated riverine inland bathing water and as such understanding and guidance is continuing to evolve. Our AMP8 investigations may conclude that we require further enhancement investment through the PR29 process (for example, at upstream storm overflows beyond the 5km required within the Storm Overflow Reduction Plan).

Due to the regulatory compliance dates, and the need to make improvements to bathing water quality to protect public health, the spill reduction schemes are likely to be delivered through traditional grey infrastructure/storage solutions rather than blue/green infrastructure.

BW_INV1

As a newly designated bathing water where the cause of 'Poor' bathing water has not previously been investigated under any other WINEP driver, the River Wharfe at Cromwheel, Ilkley is proposed for a bathing water investigation under BW_INV1 We propose a bathing water quality model investigation which includes the catchment dynamics upstream of the bathing water. The catchment upstream from Ilkley is predominantly rural with over 180 km of watercourse and tributaries upstream of the bathing water. Much of the catchment is grassland and pastureland, with large areas of agriculture.

Although the Storm Overflow Discharge Reduction Plan introduces a new statutory spill target for storm overflows discharging up to 5km from inland bathing waters, we have 12 sewage treatment works and 16 storm overflows within the catchment which, along with diffuse sources have the ability to impact the bathing water quality.

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[36] Numbers rounded

[37] De-designation occurs after five consecutive years of Poor classification under the Bathing Water Regulations

Our bathing water investigation will require the following activities:

- Collection of river samples for analysis of faecal indicator organisms including both upstream and downstream of our assets
- Collection of asset samples for analysis of faecal indicator organisms
- Investigations into bacterial die off rates within the river
- River flow monitoring
- Construction or upgrade of hydraulic sewer models where applicable
- Construction and calibration of dynamic river model which supports transportation of faecal indicator organisms.

BW_IMP1

To align with the Storm Overflow Discharge Reduction Plan, we propose to reduce spills to 1 spill per bathing water season on average for assets discharging within 5 km upstream of the monitoring point. For the River Wharfe at Cromwheel, Ilkley, the EA's compliance point is set at the grid reference of 412167, 448432. We have assessed our assets within 5km upstream of this point and propose investment at the following assets:

- ILKLEY MIDDLETON/CSO
- RIVADALE VIEW/CSO
- BRIDGE LANE/CSO
- ADDINGHAM/NO 1 SPS (3XDWF & 6XDWF)
- LOW MILL LANE 179/CSO

To support the return of stored flows to treatment, further enhancement to increase the flow to full treatment capacity beyond existing consent levels will also be required at ILKLEY/STW to allow storm flows to be treated.

BW_IMP4

As detailed earlier in this enhancement case, the application for bathing water status extended downstream from the EA's compliance point. Ilkley Sewage Treatment Works and its associated storm overflows are located within this downstream reach. To protect public health, we are proposing tertiary disinfection on the final effluent at Ilkley STW as well as storm overflow reduction to 1 spill per bathing water season on average at ILKLEY/STW/3XDWF and ILKLEY/STW/6XDWF.

13.3.2.2 Non-designated bathing waters – Wetherby and Knaresborough

Taking into consideration our customers' views on non-designated bathing waters, we also propose to carry out bathing water investigations and improvements on the River Wharfe at Wetherby, and on the River Nidd at Knaresborough.

Our proposals for non-designated bathing waters use the same principles as our designated bathing waters for storm overflows by using the spill targets set out under the Storm Overflow Reduction Plan. For our continuous sewage discharges, we propose to invest following on from the outputs of our bathing water investigations and therefore only investing at assets where there is an evidenced impact on bathing water quality.

We propose to invest £138.798m (capex) in non-designated bathing locations for AMP8:

Table 1.8: Summary of Non-Designated Capex Enhancement (includes DPC)

Driver	Bathing Water	Output	Compliance Date	Cost (Capex £m)
BW_INV5	Wharfe at Wetherby	Bathing Water Investigation	April 2027	1.988
BW_INV5	Nidd at Knaresborough	Bathing Water Investigation	April 2027	1.939
BW_IMP4	Wharfe at Wetherby	Bathing Water Infrastructure Improvements (1 spill per bathing water season, on average, for 5 km upstream of assumed sample location and tertiary treatment based on outputs of BW_INV5)	March 2030	85.842
BW_IMP4	Nidd at Knaresborough	Bathing Water Infrastructure Improvements (1 spill per bathing water season, on average, for 5 km upstream of assumed sample location and tertiary treatment based on outputs of BW_INV5)	March 2030	49.029
Total				138.798

We recognise that bathing waters are complex and need investigating fully to ensure all sources of faecal indicator organisms are addressed across the catchment. Our AMP8 investigations may conclude that we require further enhancement investment through the PR29 process (for example, at upstream storm overflows beyond the 5km required within the Storm Overflow Reduction Plan).

To support the return of stored flows to treatment, further enhancement to increase the flow to full treatment capacity beyond existing consent levels will also be required at Wetherby/STW to allow storm flows to be treated.

Due to the regulatory compliance dates, and the need to make improvements to bathing water quality to protect public health, the spill reduction schemes are likely to be delivered through traditional grey infrastructure/storage solutions rather than blue/green infrastructure.

BW_INV5

As popular recreational waters in Yorkshire, where communities intend to apply for bathing water status but do not currently have designations, these locations have not previously been investigated under any other WINEP driver. We propose bathing water quality model investigations which includes understand the catchment dynamics upstream of the bathing water.
Our bathing water investigations will reflect the same requirements as the statutory investigations and will require the following activities:

- Collection of river samples for analysis of faecal indicator organisms including both upstream and downstream of our assets
- Collection of asset samples for analysis of faecal indicator organisms
- Investigations into bacterial die off rates within the river
- River flow monitoring
- Construction or upgrade of hydraulic sewer models where applicable
- Construction and calibration of dynamic river model which supports transportation of faecal indicator organisms

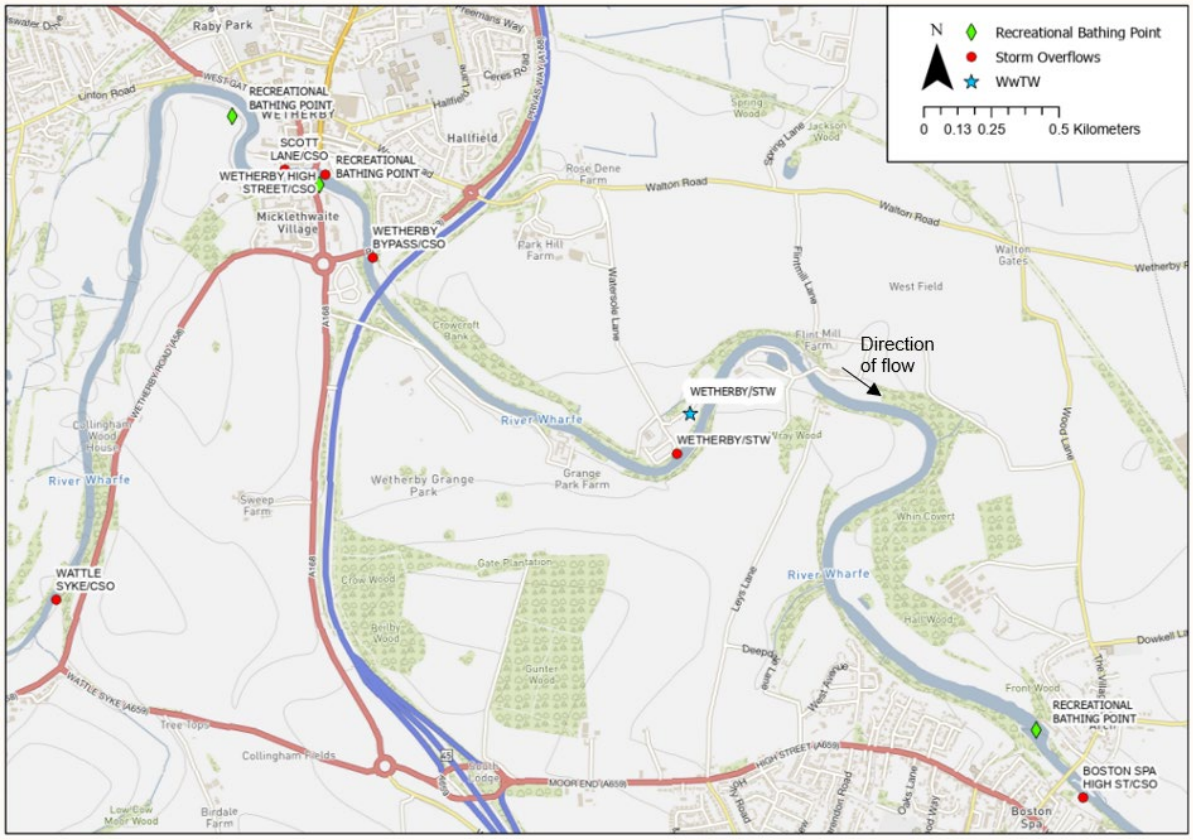
BW_IMP4

To align with the Storm Overflow Discharge Reduction Plan, we propose to reduce our spills to 1 spill per bathing water season on average for assets discharging within 5 km upstream of the recreational waters.

For the River Wharfe at Wetherby, there are three recreational locations, highlighted on Figure 1.5 below, utilised for recreation on the river with grid references of:

- Boston Spa 443019, 445967
- Wetherby Bridge: 440449, 447989
- Wetherby Playing Fields: 440187, 448181

Figure 1.5: Map highlighting recreational locations on River Wharfe at Wetherby

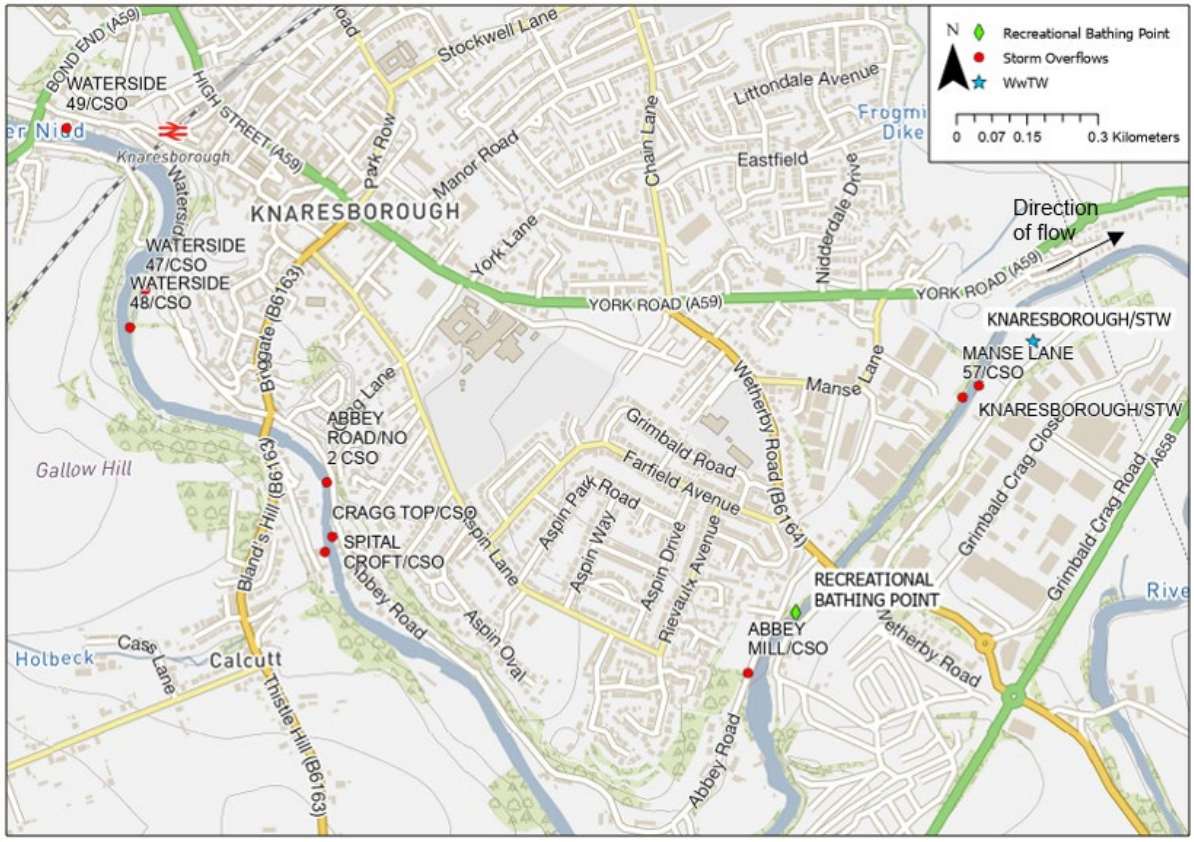


Using these points as boundaries for the recreational waters, storm overflows discharging within 5 km upstream, following the watercourse and tributaries, were identified. This exercise identified the below assets as discharging within 5km of the indicative sample points, which will require infrastructure improvements where the spill frequency target is not already met:

- WETHERBY BYPASS/CSO
- WETHERBY HIGH STREET/CSO
- WETHERBY/STW
- SCOTT LANE/CSO
- WATTLE SYKE/CSO
- COLLINGHAM LEEDS ROAD/CSO
- LANGWITH VALLEY/CSO

For the River Nidd at Knaresborough, one recreational location has been used on the river with grid references of 436040, 455917, as highlighted on Figure 1.6 below:

Figure 1.6: Map highlighting recreational locations on River Nidd at Knaresborough



Using these points as boundaries for the recreational waters, storm overflows discharging within 5 km upstream, following the watercourse and tributaries, were identified. This exercise identified the below assets as discharging within 5km of the indicative sample points, which will require infrastructure improvements where the spill frequency target is not already met:

- ABBEY ROAD/NO 2 CSO
- WATERSIDE 47/CSO
- WATERSIDE 48/CSO
- WATERSIDE 49/CSO
- BOROUGHBRIDGE ROAD/CSO
- CRAGG TOP/CSO
- ABBEY MILL/CSO
- SPITAL CROFT/CSO

Following on from the outputs of our BW_INV5 investigations, we also propose to include disinfection requirements at sewage treatment works where it is deemed necessary. We are working with our local Environment Agency colleagues to develop a mechanism which ensures tertiary disinfection treatment is only implemented where the outputs of BW_INV5 state this is required.

13.3.3 Interactions with base or previous funding

We confirm this enhancement case does not overlap with base funding or any allowances in previous price reviews.

The inland bathing water designation at the River Wharfe at Cromwheel is a new statutory obligation to improve the water quality since PR19. The infrastructure in this catchment has not previously been funded to support bathing water quality.

Similarly, additional drivers were added to the PR24 WINEP bathing water guidance to reflect the growing public interest in improvements at non-designated waters. As these are newly

introduced drivers, no previous investment has been made at other inland recreational locations for bathing water purposes.

We note, this enhancement case reflects the proposals submitted for the Accelerated Infrastructure Delivery Project in AMP7 for the River Wharfe at Cromwheel, Ilkley[38].

13.3.4 Long-term Delivery Strategy Alignment

Our long-term ambition is to continually improve bathing water quality at our existing designations as well as supporting new bathing water designations. This aligns to our company vision of a thriving Yorkshire, right for customers, right for the environment as well as the objective of the Yorkshire Bathing Water Partnership, which is to achieve excellent bathing water status at all of Yorkshire's designated bathing waters.

From our engagement with stakeholder groups across Yorkshire, we know there is an interest in applying for future bathing water designations. We also know from our customer engagement survey, 'Exploring customer views on Designated Bathing Water sites', that our customers want to see us to go beyond the statutory requirements at bathing waters.

In our Long-Term Delivery Strategy, we have accounted for three successful bathing water applications per AMP, which will require improvements to our wastewater assets. Based on our current understanding within Yorkshire and across the industry of monitoring of inland recreational locations for bathing water quality, we have assumed that these future designations will be classified as Poor, requiring both improvements across our asset base and in collaboration with our stakeholders to manage diffuse bathing water sources.

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about this at
Long-Term Delivery Strategy

13.3.5 Customer Support

Through wider engagement we understand that bathing waters have grown in importance in recent years – spurred on by covid and lockdowns forcing customers to take more interest in their local environment. Related to this is the surge in 'wild swimming' given the health benefits this brings. Each of these factors have meant there is a growing interest in the water environment and more of an understanding of the impact of water companies on bathing water specifically.

In the Ofwat/CCWater customer preferences research we understand that bathing water quality is ranked in the lowest group in terms of priority when considered across the range of performance commitments. However, in contrast, in our own Valuing Water priorities research found that treating wastewater to a high standard to ensure good quality water in Yorkshire's rivers and beaches, was considered in the top six priority service areas; alongside reducing storm overflows and pollution for both household and non-household customers when considered alongside 27 other priorities – all of which impact bathing water quality.

In August 2022, we carried out specific bathing water engagement with our customers via our online 'Your Water' community: exploring customer views on designated bathing water sites. We conducted a survey with 353 members of the community, and a discussion with 108 customers (20 of whom were Ilkley residents). The customer research aimed to understand:

[38] https://www.ofwat.gov.uk/consultation/accelerated-infrastructure-delivery-project-draft-decisions/#Outcome

- How do customers feel about the statutory requirements for designated bathing sites?
- If customers want Yorkshire Water to carry out investigations and improvements at/above the statutory level for inland and coastal designated bathing sites?
- If customers want Yorkshire Water to carry out these investigations/improvements at non-designated bathing sites?

In summary, the research found that the water quality at both coastal and inland bathing/recreational sites is important to our customers. This is particularly important for those who live nearby these areas. Customers felt as though meeting statutory duties was the bare minimum Yorkshire Water should work towards, and most customers supported investigations and improvements that go beyond – 86% of those surveyed supported investigations of inland designated bathing water sites and 84% agreed improvements should be made. Our customers recognised that there would be a bill impact to supporting improvements and the proposed costs felt reasonable, therefore the research found 7 out of 10 customers would be accepting of the increase, however, we acknowledge this research was undertaken in isolation and without the wider context of bill increases.

Given this support, we included this investment in the final plan we tested with customers through affordability and acceptability testing research both following Ofwat guidelines and in our own independent affordability and acceptability study. Both studies found that our plan was acceptable to the vast majority of customers – 78% of customers following Ofwat guidelines and 79% of customers in our own independent study. Also, the Yorkshire Leaders Board (a collective of the councils and Mayoral Combined Authorities within Yorkshire that work together to take a strategic approach to important issues affecting the Yorkshire and Humber area) have written a letter of support endorsing our plan. In addition, representing his constituents, Andrew Jones MP for Harrogate & Knaresborough also wrote a letter of support backing additional investment to improve the non-designated River Nidd to bathing water standards.

Learn more about our wider engagement in Chapter 6 of our main business plan.

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

13.3.6 Factors Outside Management Control

Please refer to section 1.3.2.

13.4 Best Option for Customers

13.4.1 Options Considered

Our approach to optioning follows the methodology set out in Section 1.4.

In summary for Inland Bathing Waters:

- Our unconstrained list of options ranged from conventional treatment and storage solutions through to surface water management and novel untested processes including smart wastewater networks. (See Figure 1.7)
- We reviewed the unconstrained list of options with subject matter experts (SMEs) against the Outcomes, Goals and Outputs for the PR24 Bathing Waters, Storm Overflow Reduction and Urban Wastewater Treatment Regulations Driver Guidance, with selected options discounted to achieve the constrained options list. (See Figure 1.8)
- We developed a feasible list of options by refining these against the Outcomes, Goals and Outputs for the PR24 Bathing Waters and Storm Overflow Reduction Driver Guidance. This included an asset specific review against the locations identified through the Risks and Issues process. (See Figure 1.9, Figure 1.10 and Figure 1.11)

The review of the constrained options list considered:

- PR24 driver guidance
- Current catchment evidence
- AMP 7 investment
- PR24 Profiling of WINEP actions
- YW's asset-specific understanding
- Feasibility and deliverability
- Other PR24 WINEP investment proposed outside these drivers

Where the comment is 'Outcome not delivered' this means the fundamental requirement to reduce spills to 1 spill per bathing season and 10 or fewer is not met.

Figure 1.7: Unconstrained list of options and evidence for removal

Approach	Constrained	Comments
Biological Nutrient Removal	✗	Outcome not delivered
Sewer modelling	✗	Outcome not delivered
Built catchment flow reduction	✗	Outcome not delivered
Ozone	✓	
Membrane filtration	✓	
Chemical disinfection	✓	
Chemical dosing	✗	Outcome not delivered
CSO Spill mitigation	✓	
Dilution assessment	✗	Outcome not delivered
Increase treatment capacity	✓	
Use of clean water sludges for P removal	✗	Outcome not delivered
Industry collaboration	✗	Outcome not delivered
Joint sampling programme	✓	
Trade effluent management	✗	Outcome not delivered
Nature Based Solutions	✓	
Network storage	✓	
Permit trading	✗	Outcome not delivered
Rationalise asstets	✓	
Sidestream excess flows through passive systems	✗	Outcome not delivered
SuDS	✓	
Ultra Violet Disinfection	✓	
Wetland	✓	
Work with other WASCS	✗	Outcome not delivered
Accelerated rollout of IOT / Smart monitors	✗	Outcome not delivered
Cross sector planning	✗	Outcome not delivered
Capture storm water, treat and use as sub-potable	✓	
Citizen science	✓	
Catchment Nutrient Balancing	✗	Outcome not delivered
Geographical synergies	✗	Outcome not delivered
Innovative treatment processes	✓	
Catchment Partnership support	✓	
Payment for ecosystem services	✗	Outcome not delivered
Political engagement	✗	Outcome not delivered
Removal at source	✗	Outcome not delivered
rtRIVERi	✗	Outcome not delivered
Storm storage only applies to combined network population	✓	
Full surface water seperation	✓	
Infiltration reduction	✓	
Customer education	✓	
Misconnections	✓	
Impermeable area surface water management	✓	
Property level surface water management	✓	
Per capita consumption reduction	✗	Outcome not delivered
Catchment fencing	✓	
Buffer strips	✓	
Work with agriculture	✓	
Localised MSP dosing	✗	Outcome not delivered
Smart Water Networks	✗	
System opperator	✗	Outcome not delivered
Urine seperation	✗	Outcome not delivered

Figure 1.8: Unconstrained list of options with assessment comments

Category	Approach	Feasible	Comments
Final Effluent Quality	Ultra Violet Disinfection	✓	Considered as part of PR24 Ilkley strategy
	Chemical Disinfection	!	Not preferred
	Ozone	!	Not preferred
	Membrane filtration	✓	Considered as part of PR24 Ilkley strategy
	Increase treatment capacity	✓	Considered as part of PR24 Ilkley strategy
	Rationalise assets	✓	Considered as part of PR24 Ilkley strategy
	Wetland	✗	Land availability
Storm Overflow Quality	Ultra Violet Disinfection	✗	Does not meet Storm Overflow Reduction Plan targets
	Chemical Disinfection	✗	Does not meet Storm Overflow Reduction Plan targets
	Ozone	✗	Does not meet Storm Overflow Reduction Plan targets
	Membrane filtration	✗	Does not meet Storm Overflow Reduction Plan targets
	Increase treatment capacity	✗	Does not meet Storm Overflow Reduction Plan targets
	Capture storm water, treat and use as sub-potable	✗	Not deliverable by 2026 regulatory compliance date
	Wetland	✗	Does not meet Storm Overflow Reduction Plan targets
Storm Overflow Reduction	Network storage	✓	Considered as part of PR24 Ilkley strategy
	Increase treatment capacity	✓	Considered as part of PR24 Ilkley strategy
	Infiltration removal	✓	Considered as part of PR24 Ilkley strategy
	Property level surface water management	✓	Considered as part of PR24 Ilkley strategy
	Impermeable area surface water management	✓	Considered as part of PR24 Ilkley strategy
	Full surface water separation	✗	Not deliverable by 2026 regulatory compliance date
Catchment Partnership and Customer Engagement	Catchment Partnership support	!	Catchment Partnership support for Dales to Vales River Network proposed under XXX (Ben Aston Driver)
	Catchment fencing	✗	Unknown catchment location impacts for March 2026 regulatory compliance date
	Buffer strips	✗	Unknown catchment location impacts for March 2026 regulatory compliance date
	Misconnections	!	Misconnections considered in AMP 7 approach to bathing water
	Citizen Science	!	Considered through all workstreams
	Joint sampling programme	!	Considered through all workstreams
	Customer education	!	Considered through all workstreams

Figure 1.10: Feasible list of options for the River Wharfe at Ilkley

Category	Approach	GRASSINGTON/STW	DRAUGHTON/STW	BEAMSLEY/STW	LOW MILL LANE 179/CSO	ADDINGHAM/NO 1 SPS/PRELIMINARY TREATMENT-STW/6XDWF OVERFLOW	ADDINGHAM/NO 1 SPS/PRELIMINARY TREATMENT-STW/3XDWF OVERFLOW	BRIDGE LANE/CSO	RIVADALE VIEW/CSO	ILKLEY MIDDLETON/CSO	ILKLEY/STW/6XDWF OVERFLOW	ILKLEY/STW/3XDWF OVERFLOW	ILKLEY/STW/6XDWF OVERFLOW
Final Effluent Quality	Ultra Violet Disinfection	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓
	Membrane filtration	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓
	Increase treatment capacity	✗	✗	✗	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓
	Rationalise assets	✗	✗	✗	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓
Storm Overflow Reduction	Network storage	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
	Increase treatment capacity	N/A	N/A	N/A	✗	✗	✗	✗	✗	✗	✗	✓	✗	N/A
	Infiltration removal	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
	Property level surface water management	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
	Impermeable area surface water management	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A

Figure 1.9: Feasible list of options for the River Wharfe at Wetherby

Category	Approach	WETHERBY BYPASS/CSO	WETHERBY HIGH STREET/CSO	WETHERBY/STW/STORM	SCOTT LANE/CSO	WATTLE SYKE/CSO	COLLINGHAM LEEDS ROAD/CSO	LANGWITH VALLEY/CSO	WETHERBY/STW	POOL/STW	OTLEY/STW	KEARBY/STW	BF
Final Effluent Quality	Ultra Violet Disinfection	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	
	Membrane filtration	✓	✓	✓	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	
	Increase treatment capacity	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	
	Rationalise assets	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✗	✗	✗	✗	✗	
Storm Overflow Reduction	Network storage	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	
	Increase treatment capacity	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	
	Infiltration removal	✗	✗	✗	✗	✗	✗	✗	N/A	N/A	N/A	N/A	N/A	
	Property level surface water management	✗	✗	✗	✗	✗	✗	✗	N/A	N/A	N/A	N/A	N/A	
	Impermeable area surface water management	✗	✗	✗	✗	✗	✗	✗	N/A	N/A	N/A	N/A	N/A	

Figure 1.11: Feasible list of options for the River Nidd at Knaresborough

Category	Approach	ABBEY ROAD/NO 2 CSO	WATERSIDE 47/CSO	WATERSIDE 48/CSO	WATERSIDE 49/CSO	BOROUGHBRIDGE ROAD/CSO	CRAGG TOP/CSO	ABBEY MILL/CSO	c
Storm Overflow Reduction	Network storage	✔	✔	✔	✔	✔	✔	✔	✔
	Increase treatment capacity	✖	✖	✖	✖	✖	✖	✖	✖
	Infiltration removal	✖	✖	✖	✖	✖	✖	✖	✖
	Property level surface water management	✖	✖	✖	✖	✖	✖	✖	✖
	Impermeable area surface water management	✖	✖	✖	✖	✖	✖	✖	✖

13.4.1.1 Solution Development and Costing

BW_INV1 & BW_INV5

To support in the development of our options considered for inland bathing water modelling, we held a collaborative workshop with a number of our framework modelling consultants. The collaborative workshop reviewed the study area(s) as well as the below requirements of the model:

- Required to understand and assess the bathing water quality impacts
- Used to understand the influencing boundary on bathing water
- Required to quantify the impacts of Yorkshire Water assets on the bathing water quality
- Required to assess impacts of solutions on the bathing water quality

The outputs of the workshop considered two different modelling approaches for the inland bathing water investigations:

- Standard approach based on a simplistic mass balance river model
- Enhanced approach based on using a simplistic mass balance river model in the upper catchments with the development of a 2D river transport model in the bathing reach and immediate drainage catchment.

Due to the complexity of bathing waters, with die off rates and river flow dynamics, the enhanced approach was considered the preferred option which would meet the required deliverables for the bathing water investigations.

13.4.1.2 River Wharfe at Cromwheel, Ilkley - BW_IMP1 & BW_IMP4

To support in the development of our options for inland bathing water improvements, we worked with our Strategic Planning Partner to undertake a high-level assessment and optioneering exercise which would support improvements in bathing water quality as well as meeting the storm overflow reduction plan. Ahead of this optioneering exercise, we had produced and reviewed an unconstrained and constrained list of options, following the WINEP guidance.

Throughout the feasible optioneering exercise, high level options were developed using our existing sewer models for the area, uplifted to a 2050 design horizon. The notional solution development considered buildability taking into account overall footprint, available space, practicality and location. All storage volumes developed through the optioneering exercise were incorporated into the hydraulic model and tested.

The below options were developed for all storm overflows throughout the optioneering exercise, see Figure 1.12 below:

- Option 1: Grey infrastructure traditional solution
- Option 2a: Blue green solutions with 75% removal/separation of ground infiltration, moorland runoff, paved and roof area
- Option 2b: as above with uplift of Ilkley STW to 200 l/s
- Option 3a: Blue green solutions with removal/separation of 75% paved and roof area
- Option 3b: as above with uplift of Ilkley STW to 200 l/s
- Option 4a: Blue green solutions with removal/separation of 75% roof area
- Option 4b: as above with uplift of Ilkley STW to 200 l/s

Figure 1.12: Extract of options development process

LOCATION	DESCRIPTION	EMBODIED CARBON (tCO2e)	OPERATIONAL CARBON (tCO2e/yr)	NPV (£) incl. monetised carbon
Ilkley STW	300l/s UV	4687.4	1258.8	40,537,224
Ilkley STW	200l/s UV	2254.5	1045.4	27,540,768
Ilkley STW	300l/s MBR	2578.7	941.4	31,481,254
Ilkley STW	6x 1 Spill	1927.4	18.1	5,750,996
Ilkley STW	6x 1 Spill (BG Scenario 1)	527.9	12.4	2,402,686
Ilkley STW	6x 1 Spill (BG Scenario 2)	1471.2	11.9	4,334,936
Ilkley STW	6x 1 Spill (BG Scenario 3)	2092.6	14.4	5,898,155
Ilkley STW	3x 1 Spill (BG Scenario 1)	2293.5	18.5	6,214,168
Ilkley STW	3x 1 Spill (BG Scenario 2)	3972.8	23.5	10,241,226
Ilkley STW	3x 1 Spill (BG Scenario 3)	5269.3	43.0	13,453,657
Ilkley STW	6x 3 Spills	701.5	10.3	2,424,299
Addingham	1 Spill	2035.2	13.5	6,107,947
Addingham	1 Spill (BG Scenario 1)	492.9	4.3	1,930,449
Addingham	1 Spill (BG Scenario 2)	1274.1	6.0	3,620,015
Addingham	1 Spill (BG Scenario 3)	1630.2	6.9	4,491,515
Addingham	3 Spills	737.9	7.8	2,635,111
Ilkley Middleton	1 Spill	877.4	4.8	2,715,648
Ilkley Middleton	1 Spill (BG Scenario 3)	527.0	4.2	1,991,465
Ilkley Middleton	UV	941.6	23.0	6,366,131
Low Mill Lane	1 Spill	261.0	0.5	873,286
Low Mill Lane	1 Spill (BG Scenario 3)	259.8	0.4	838,093
Rivadale	1 Spill	3659.8	29.6	11,016,110
Rivadale	1 Spill (BG Scenario 1)	1251.9	8.5	3,761,929
Rivadale	1 Spill (BG Scenario 2)	1591.9	9.1	4,625,153
Rivadale	1 Spill (BG Scenario 3)	2171.9	10.2	5,449,680
Rivadale	3 Spills	1483.5	17.6	5,425,231

The below options were considered for tertiary disinfection at Ilkley STW:

- Ultra violet (UV) disinfection
- Membrane bioreactor (MBR) disinfection

Following on from the development of the above high-level options, as well as optimisation through the Yorkshire Water Enterprise Decision Analytics tool (within the Decision-Making Framework (DMF)), the below considerations were also made:

- BW_IMP1 driver has a regulatory compliance date of March 2026 under the WINEP. We know from existing catchment partnerships that support the implementation of blue/green solutions across Yorkshire e.g., Living with Water and Connected by Water, that these partnerships take time to develop through to a stage of solution implementation and that blue/green solutions can be more complex to develop and implement. Due to the time constraints associated with the March 2026 delivery date, grey infrastructure was considered a more preferable delivery route, however, we will continue to explore how blue/green solutions can support the delivery of the outcomes.
- BW_IMP4 considered both UV and MBR as disinfection treatment options. However, due to the location of the final effluent discharge in comparison to the reach utilised by bathers and the lower levels of dilution and dispersion at inland environments compared to coastal, UV was discounted

from being a preferred solution. UV carries a significant risk of not being sufficient at virus removal at Ilkley STW and therefore leading to a risk to public health.

13.4.1.3 River Wharfe at Wetherby and River Nidd at Knaresborough – BW_IMP4

Due to the later interest expressed in applying for bathing water status at Wetherby and Knaresborough, our approach for storm overflow reduction here aligns to the work completed for the Drainage and Wastewater Management Plans (DWMP). Every storm overflow contained within a hydraulic model has been reviewed against the 2050 target spill performance to establish if there is an investment need against the targets set out under the Storm Overflow Discharge Reduction Plan. For this work, all overflows have been assessed independently.

Where possible, two generic approaches have been considered which align to the feasible options identified through the WINEP process:

- **Enhance/Grey network Storage:** increase the capacity of our network through traditional 'grey' solutions, i.e., building bigger pipes, storage tanks and upgrading our existing assets. This option approach considers network modification only.
- **Reduce and Enhance/Impermeable area surface water management (SuDS):** Adopt blue-green solutions to manage and reduce the amount of rainfall entering our network to reduce our levels of risk then utilise traditional grey solutions to meet the scenario target if necessary. This option approach considers a reduction in rainfall induced flow and network modification.

For the enhance option, the storage volume was calculated based upon baseline model predictions. For the Reduce and Enhance option, the calculation was conducted on a model with 50% of the connected impermeable area removed from the model.

An allowance for screening provision has been made at every storm overflow. Where intervention is required, as part of the SODRP, an allowance for a screen and screening chamber has been made within the solution cost for both enhance and reduce and enhance options. Where no intervention is required to achieve the SODRP target spill frequency, a standard allowance for a screen and screening chamber has been made.

Process: Enhance

This approach is common to both the development of the enhance process and reduce and enhance.

1. Hydraulic modelling completed for the DWMP predicted yearly spill counts and volumes for each overflow in 2050. Solutions were developed to limit spill frequencies to the required standard for the specific asset.
2. The tank storage volumes were approximated based on the spill volume of the frequency target+1 spill when spills are ranked by volume, for both the bathing season and annual target.
3. Storage volumes were translated to one of four standardised tank diameters, ranging from 3.05m to a maximum of 25m diameter.
4. High-level outline designs were created for the tank solutions to support the cost build up. An allowance for standard items such as: manholes, pumps, hydro ejectors, odour control units, MCC, power supply, screen and screen chamber were made.
5. Key metrics such as pipe size, length, pump return rate, tank size, screen size have been utilised to develop a high-level Bill of Quantities (BoQ) for each solution. The generated BoQ was supplied to our in-house costing team to allow company Unit Cost Database (UCD) cost models to be applied. This provided total CAPEX, OPEX, embodied carbon and operational carbon values for each storm overflow scheme.

Process: Reduce and Enhance

Full details of the 'Reduce' process can be found in Annex C2. The 'Enhance' is common to both approaches and can be found in Annex C1 in the Annex to the WINEP Enhancement Case document.

Read more about this at
Annex to the WINEP Enhancement Case

For the Reduce and Enhance option, the calculation was conducted on a model with 50% of the connected impermeable area removed from the model. Sub-catchments connected to each storm overflow were assessed based on hydraulic models to understand the difference in impermeable area between the baseline model and the impermeable area reduction model. This assessment provides the total impermeable area for removal per storm overflow, when considering the sub-catchments connected to each overflow.

Standard designs were created for the SuDS intervention types listed below to provide a notional £/m^2 or £/m^3 of intervention:

- Detention basins
- Pocket basin
- Geocellular storage
- Bio-retention (road and verge)
- Permeable paving
- Commercial water butt

Indicative solutions were generated characterising varying housing densities and available green space. In each solution a blend of the SuDS features above was assumed with the proportional split of each SuDS feature varying in each solution.

Solutions were sized for 30-year return period events. The makeup of the SuDS features was based on housing density and the proportion of green space available within the sub-catchment area. A costing model was developed by Stantec using their engineering expertise and experience gained throughout the industry and the Spon's price guides.

All discharges that have modelling information in the DWMP were included for assessment of costs and benefits for both the storage and impermeable area removal options.
The below options were considered for tertiary disinfection in the Wetherby and Knaresborough catchments:

- Ultra violet (UV) disinfection
- Membrane bioreactor (MBR) disinfection

All options considered were assessed using our Decision-Making Framework. Our approach to the benefits assessment is detailed under Section 6 within our Introduction to Enhancement Cases appendix. Our Decision-Making Framework (DMF) was utilised with the aim of delivering a best value and optimal programme against service levels, performance commitments and statutory requirements.

Read more about this at
Introduction to Enhancement Cases

13.4.1.4 Preferred Options

To conclude, after reviewing all options considered above, this enhancement case proposes:

- 3 bathing water investigations through complex modelling
- Storm overflow reduction to 1 spill per bathing water season at 19 storm overflows
- Screen only enhancements at 3 storm overflows
- Tertiary microbiological treatment at up to 10 sewage treatment works, pending outcome of bathing water investigations.

Solutions may evolve once further modelling is complete and through the ground investigation and detailed design phase. We will continue to review the below approaches through design:

- Increase in flows treated
- Catchment Partnership
- Impermeable area surface water management – removal at source
  Infiltration Reduction

We set out the specific assets for each bathing water under section 'The Scale and Timing of the Investment'.

13.4.2 Cost-Benefit Appraisal

Our approach to Cost-Benefit Appraisal is detailed in Section 1.4.2.

The benefits as derived by our investment planning system are quantified in Table CWW15 under 6 different Enhancement Categories according to the scope of the components of investment. The sums associated with Bathing Water improvement are apparent in each Enhancement Category by the prefix "Bathing Water".

The annual benefits of delivering improved inland Bathing Waters by the end of AMP 8 are significant (Table 1.9). This is because our risk and benefit metrics place a very high and regionalised value on maintaining and improving Yorkshire's bathing waters. We have also assumed that the bathing waters at Wetherby and Knaresborough will be formally designated by 2030.

Table 1.9: Projected Benefit of Bathing Water Schemes

Enhancement Category	Total Bathing Water Benefit For AMP8 (£m)	Annual Benefit Post 2030 (£m)
Increase flow to full treatment	30.436	7.609
Investigations, other - multiple surveys, and/or monitoring locations, and/or complex modelling	10.330	5.165
Microbiological treatment - bathing waters, coastal and inland	25.693	25.693
Storage schemes to reduce spill frequency at CSOs etc - grey solution	37.444	9.361
Storm overflow - new / upgraded screens	1.872	0.468
Total	**105.774**	**48.296**

13.4.3 Carbon impact and best value

Further detail of our benefits assessment can be found in Table CWW15. For our bathing water quality improvements, we have associated benefits linked to:

- Number of bathing water compliance failures
- Number of bathing water classifications deteriorations avoided
- Number of non-compliance events

Additionally, storm overflow reductions have the additional associated benefits:

- Reduction in spill frequency

- Reduction in spill volume
- Land use area restored or protected (bare ground/greenspace/wetland)
- Surface water separated from combined
- River water quality improved

13.4.4 Impact Quantification

Bathing waters are highly complex and can be impacted by numerous sources of faecal indicator bacteria. These influences can include sewerage infrastructure, meteorological conditions, surface run off, traders and agriculture, local wildlife and beach usage.

For AMP8 we are proposing the below forecast against our bathing water performance commitment:

Table 1.10: Forecast bathing water quality performance commitment performance

Year	2025-26	2026-27	2027-28	2028-29	2029-30
Forecast performance (%)	73.5	73.5	73.5	82.3	82.3

This forecast improvement in our bathing water quality performance is supported by this enhancement case, our WINEP Storm Overflow Reduction enhancement case and our non-WINEP coastal overflow enhancement case.

These enhancement cases address bathing water quality through focussing our infrastructure improvements around three key themes. These are discussed further in our Bathing Water Performance Commitment appendix:

- Investigate: where we have new designations, or popular recreational swimming locations, we will investigate to ensure we have a robust understanding of the factors impacting bathing water quality. For our existing designations, we will continue to develop our understanding of the complexities of these bathing waters.
- Enhance: we will increase the capacity of our networks and seek opportunities for surface water management to ensure we meet the new bathing water spill reduction standards set out in the Government's Storm Overflow Discharge Reduction Plan (SODRP). Under the SODRP, the following bathing water targets have been introduced:
    - For designated coastal storm overflows, there is a mandatory spill target of <2 spills per bathing water season
    - For designated inland storm overflows, there is a mandatory spill frequency target of 1 spill per bathing water season

  We will also use advanced treatment technologies for enhance the quality of our final effluent discharges where required.
- Collaborate: we will continue to work in partnership to ensure bathing water quality is managed collaboratively. We will explore where we can collaborate on our investment proposals to deliver additional benefits and good value for our customers and communities.

The expenditure detailed within this case also impacts upon our storm overflow performance. The table below shows the number of spills reduced on average in a typical year, from the proposed investment, which contributes to the performance commitment. Further details are contained within the Storm Overflow enhancement case.

Table 1.11: Proposed Spill Reduction

	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	Total

Bathing Water Storm Overflows (No.)	**0**	**0**	**0**	**3**	**111**	**81**	**195**
Bathing Water Storm Overflows - DPC (No.)	**0**	**0**	**0**	**0**	**0**	**26**	**26**
Bathing Water Storm Overflows - Accelerated expenditure (No.)	**0**	**396**	**132**	**0**	**0**	**0**	**528**

13.4.5 Cost and Benefit Uncertainties

Throughout the development of our storm overflow enhancement programme, the following assumptions/risks have been captured:

- Our modelling assessments have used a 2050 “typical year” rainfall adhering to UKCP09 standards.

During the detailed design phase, we will:

- Update our modelling assessments to align to UKCP18 climate change predictions and utilise a 25-year time series for our assessments. This will provide greater certainty in our solution development but may increase storage volumes and solution requirements.

For the River Nidd at Knaresborough, no assessment to WwTW compliance has been assessed due to the time constraints of intention to apply for bathing water status here. During the detailed design phase, we will assess the impact of emptying storage on the relevant WwTWs to ensure there is no adverse impact created downstream. This may also alter solution requirements.

13.4.6 Third Party Funding

Due to the nature of the proposals under this enhancement case, and the likely grey infrastructure delivery route, it is not expected to attract third party funding towards the delivery of these schemes.

13.4.7 Direct Procurement for Customers (DPC)

Following our review of investment suitability, the below asset has been identified within this enhancement case for consideration for Direct Procurement for Customers:

- WETHERBY/STW

For information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in the Introduction to Enhancement Cases appendix.

Read more about this at
Introduction to Enhancement Cases

13.5 Cost Efficiency

13.5.1 Option Costs

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in section 7.3 in Introduction to Enhancement Cases has been applied to this enhancement case. Table 1.1 at the beginning of this document summarises the costs associated with this enhancement case:

13.5.1.1 Cost estimate for our preferred option

As noted earlier in this case, elements of this enhancement case propose to go beyond our statutory duties, and we propose to improve the quality of three inland waters under WINEP, one designated and two non-designated. Our approach to cost estimation varies by site and WINEP driver and utilises a combination of estimation via central cost models alongside bottom-up cost estimates derived via engineering justification.

In this section, we outline our approach to developing cost estimates for investigation and improvement drivers separately, given the common approaches followed for each.

Investigation cost estimation: WINEP drivers BW_INV1 and BW_INV5

The table below summarises our proposed AMP8 capex in relation to investigations as outlined earlier in this enhancement case.

Table 1.12: Expenditure Summary

Driver	Bathing Water	Output	Capex cost (£m)
BW_INV1	Wharfe at Cromwheel, Ilkley	Bathing Water Investigation	1.939
BW_INV5	Wharfe at Wetherby	Bathing Water Investigation	1.988
BW_INV5	Nidd at Knaresborough	Bathing Water Investigation	1.939
Total Investigation Cost			**5.866**

As described in our options development approach, we held a collaborative workshop with a number of our framework modelling consultants to develop a modelling approach for inland bathing water investigations. The preferred option from this work was to utilise an enhanced modelling approach, based on using a simplistic mass balance river model in the upper catchments with the development of a 2D river transport model in the bathing reach and immediate drainage catchment.

This approach was used to derive site specific costs for investigations at Cromwheel and Wetherby, in conjunction with our modelling advisors. This approach was not possible for the River Nidd at Knaresborough investigation, given the site is earlier in its journey to a formal application for bathing water status, and thus less information is available to inform modelling. Our estimate for the Wharfe at Cromwheel is used as a proxy in the absence of further evidence.

Improvement cost estimation: WINEP drivers BW_IMP1 and BW_IMP4

The table below summarises our proposed AMP8 capex in relation to improvements as outlined earlier in this enhancement case.

Table 1.13: Capex Expenditure Summary(includes DPC)

Driver	Bathing Water	Output	Capex cost £m
BW_IMP1	Wharfe at Cromwheel, Ilkley	1 spill per bathing water season, on average, for 5km upstream of the sample location	48.539
BW_IMP4	Wharfe at Cromwheel, Ilkley	1 spill per bathing water season, on average, for Ilkley STW 6X DWF	7.297
BW_IMP4	Wharfe at Cromwheel, Ilkley	Tertiary treatment at Ilkley STW	5.748

BW_IMP4	Wharfe at Wetherby	Bathing Water Infrastructure Improvements (1 spill per bathing water season, on average, for 5 km upstream of assumed sample location and tertiary treatment based on outputs of BW_INV5)	85.841
BW_IMP4	Nidd at Knaresborough	Bathing Water Infrastructure Improvements (1 spill per bathing water season, on average, for 5 km upstream of assumed sample location and tertiary treatment based on outputs of BW_INV5)	49.029
Total Improvement Cost			196.454

As described in our approach to optioneering, a wide range of options were considered in identifying our preferred solutions. These options were developed by our Strategic Planning Partner and costed and captured in our Enterprise Decision Analytics (EDA) tool within the Decision-Making Framework (DMF). Unit Cost Database (UCD) cost models were applied within EDA using out-turn cost data from capital projects delivered by our main contract partners to derive cost estimates. Further details on UCD cost models are provided in section 7.3 in Introduction to Enhancement Cases.

For Bathing Water Quality, using EDA we considered various treatment and storage alternatives at wastewater treatment works and sewerage options (new pipework, detention tanks, pumping stations, storm storage, CSO structures) along the catchment area. Within those options, different scenarios (spill frequencies, storage volumes etc.) and treatment processes (for example with and without UV disinfection at STW) were costed. Different combinations of scenarios were looked at as part of the optioneering process, to ensure best whole life cost and statutory obligations are met. This optimisation informed our specific estimates for the solutions at Ilkley and Wetherby.

As outlined in our approach to investigation costs, the River Nidd at Knaresborough is earlier into its journey to a formal application for bathing water status. Therefore, to create a cost estimate for AMP8 we have utilised the detailed bottom-up estimate for Ilkley, developed with our Strategic Planning Partners, to account for the specific characteristics of the Knaresborough catchment.

13.5.1.2 Efficiency of our cost estimate

Section 7.3 in Introduction to Enhancement Cases outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

For our proposed investigation costs, as outlined earlier in our costing approach, we worked collaboratively with modelling consultants to develop an approach for inland bathing water investigation. In addition to these, we also sense checked cost estimates with those implied from existing models that utilise internal outturn data for similar purposes, for example in relation to urban pollution. These approaches give us confidence that our proposed costs are efficient and appropriately evidenced given the new nature of inland bathing water investigations.

For our proposed improvement costs, estimates were developed using the expertise of our Strategic Planning Partner to determine scope and using UCD models to create efficient cost estimates. Our UCD approach involves building detailed cost estimates that are developed using historic cost information on individual components of an overall solution. For our tertiary treatment costing, our Strategic Planning Partner also liaised with experienced industry contractors to develop costs provided.

As part our costing approach, a range of sites were selected for external benchmarking. This involved working with consultants to develop independent cost estimates using the same scoping information used to inform our own estimates through EDA. For Bathing Water Quality, this included the Ilkley scheme.

13.5.2 Need for enhancement model adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging.

For Bathing Water investment, we note that the variety of interventions and drivers being addressed in this area will make identification of appropriate cost drivers difficult and therefore we anticipate (based on PR19) that Ofwat will not produce a cost model and would assess this expenditure through a deep dive approach.

13.6 External assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

13.7 Customer Protection

Our initial review of our forecast enhancement totex found we met the 1% materiality threshold for PCDWW4, PCDWW5 and PCDWW18.

We propose to group the elements of this case under PCDWW4, PCDWW5 and PCDWW18 with the Storm Overflows enhancement case (section 14) customer protection. Given the overlap in measures and reporting, we have grouped the customer protection mechanisms.

Following a subsequent review for PCDWW14 and following on from the PR24 Water Industry National Environment Programme confirmation of phasing, as detailed in section 1.1.3 taking account of the impacted expenditure within Table 1.5 of this enhancement case, we will no longer meet the 1% materiality threshold and therefore do not propose a PCD for this item. During drafting we considered a PCD would measure both completion of our investigations and WwTW upgrades, because investigation findings may determine we no longer need to invest at certain sites, and we can return those funds to customers.

We have an existing Price Control Deliverable (PCD) under the Accelerated Infrastructure Delivery Project for “Scheme 6: Inland bathing water improvement scheme - Wharfe Ilkley” which covers microbiological treatment for ILKLEY/STW. We have excluded all assets covered under that existing PCD from our proposed AMP 8 PCDs.

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

13.7.1 Third Party Funding or Delivery Arrangements

We confirm that the PCD will exclude any investment delivered through DPC and that we have no third party funding associated with the delivery of this case.

14. Wastewater: Storm Overflow Reduction Plan

14.1 Driver:

Storm Overflow Reduction Plan Drivers EnvAct_IMP2, EnvAct_IMP3, EnvAct_IMP4, EnvAct_IMP5, EnvAct_INV4.

Also contains an element of WFD_IMP, relating to the solutions of 2 No. WFD_INV Urban Pollution Management intermittent discharge investigations from AMP7.

14.1.1 Requested Investment:

Table 1.1: Storm Overflows (please note, this table includes Scheme 9 (Wheatcroft CSO) of the Accelerated Infrastructure Delivery Project costs)

	£m	Table Line Ref.
Enhancement Expenditure Capex	702.820	CWW3.13, CWW3.16, CWW3.22, CWW3.25, CWW3.34, CWW3.37, CWW3.46, CWW3.109
Enhancement Expenditure Opex	2.839	CWW3.14, CWW3.17, CWW3.23, CWW3.26, CWW3.35, CWW3.38, CWW3.47, CWW3.110
Base Expenditure Capex		
DPC value	85.589[39]	SUP12
Total	**791.248**	

Table 1.2: WFD_IMP – Urban Pollution Management Solutions

	£m	Table Line Ref.
Enhancement Expenditure Capex	114.930	CWW3.19, CWW3.22,CWW3.46
Enhancement Expenditure Opex	0.180	CWW3.20, CWW3.23,CWW3.47
Base Expenditure Capex		
DPC value		
Total	**115.110**	

[39] The DPC value in SUP12 is combined with the element contained in the Coastal Bathing Waters Overflow Enhancement Case

14.1.2 Associated Reporting lines in Data Tables:

As described within our process below, our storm overflow assessments have been undertaken at a strategic level and therefore not all the lines descriptions have costs associated with them due to the granularity of the solution. This may be refined throughout the detailed design process as the schemes progress.

Table 1.3: CWW3 Reporting Lines

Line Number	Line Description
CWW3.13	Increase flow to full treatment; (WINEP/NEP) wastewater capex
CWW3.14	Increase flow to full treatment; (WINEP/NEP) wastewater opex
CWW3.15	Increase flow to full treatment; (WINEP/NEP) wastewater totex
CWW3.16	Increase storm tank capacity at STWs - grey solution; (WINEP/NEP) wastewater capex
CWW3.17	Increase storm tank capacity at STWs - grey solution; (WINEP/NEP) wastewater opex
CWW3.18	Increase storm tank capacity at STWs - grey solution; (WINEP/NEP) wastewater totex
CWW3.22	Storage schemes to reduce spill frequency at CSOs etc - grey solution; (WINEP/NEP) wastewater capex
CWW3.23	Storage schemes to reduce spill frequency at CSOs etc - grey solution; (WINEP/NEP) wastewater opex
CWW3.24	Storage schemes to reduce spill frequency at CSOs etc - grey solution; (WINEP/NEP) wastewater totex
CWW3.25	Storage to reduce spill frequency at CSOs etc - green solution; (WINEP/NEP) wastewater capex
CWW3.26	Storage to reduce spill frequency at CSOs etc - green solution; (WINEP/NEP) wastewater opex
CWW3.27	Storage to reduce spill frequency at CSOs etc - green solution; (WINEP/NEP) wastewater totex
CWW3.28[40]	Storm overflow - discharge relocation (WINEP/NEP) wastewater capex
CWW3.29	Storm overflow - discharge relocation (WINEP/NEP) wastewater opex
CWW3.30	Storm overflow - discharge relocation (WINEP/NEP) wastewater totex
CWW3.31	Storm overflow - increase in combined sewer / trunk sewer capacity; (WINEP/NEP) wastewater capex
CWW3.32	Storm overflow - increase in combined sewer / trunk sewer capacity; (WINEP/NEP) wastewater opex
CWW3.33	Storm overflow - increase in combined sewer / trunk sewer capacity; (WINEP/NEP) wastewater totex
CWW3.34	Storm overflow - sustainable drainage / attenuation in the network; (WINEP/NEP) wastewater capex

[40] Please note we are not currenty reporting any expenditure on lines CWW3.28-33 however as we move through detailed design this may change

Line Number	Line Description
CWW3.35	Storm overflow - sustainable drainage / attenuation in the network; (WINEP/NEP) wastewater opex
CWW3.36	Storm overflow - sustainable drainage / attenuation in the network; (WINEP/NEP) wastewater totex
CWW3.37	Storm overflow - source surface water separation; (WINEP/NEP) wastewater capex
CWW3.38	Storm overflow - source surface water separation; (WINEP/NEP) wastewater opex
CWW3.39	Storm overflow - source surface water separation; (WINEP/NEP) wastewater totex
CWW3.40[41]	Storm overflow - infiltration management: wastewater capex
CWW3.41	Storm overflow - infiltration management: wastewater opex
CWW3.42	Storm overflow - infiltration management: wastewater totex
CWW3.43	Storm overflow - sewer flow management and control; (WINEP/NEP) wastewater capex
CWW3.44	Storm overflow - sewer flow management and control; (WINEP/NEP) wastewater opex
CWW3.45	Storm overflow - sewer flow management and control; (WINEP/NEP) wastewater totex
CWW3.46	Storm overflow - new / upgraded screens (WINEP/NEP) wastewater capex
CWW3.47	Storm overflow - new / upgraded screens (WINEP/NEP) wastewater opex
CWW3.48	Storm overflow - new / upgraded screens (WINEP/NEP) wastewater totex
CWW3.109	Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling wastewater capex
CWW3.110	Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling wastewater opex
CWW3.111	Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling wastewater totex

14.2 High Level Driver description:

Storm Overflows

The Environment Act (2021)[42] and government's Storm Overflow Discharge Reduction Plan[43] introduces stringent new targets to protect people and the environment from the operation of storm overflows. The Storm Overflow Discharge Reduction Plan (SODRP) introduces the following new targets:

1. Protecting the environment: Water companies will only be permitted to discharge from a storm overflow where they can demonstrate that there is no local adverse ecological impact.

[41] Please note we are not currenty reporting any expenditure on lines CWW3.40-45 however as we move through detailed design this may change

[42] https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted

[43] https://www.gov.uk/government/publications/storm-overflows-discharge-reduction-plan

2. Protecting public health in designated bathing waters: Water companies must significantly reduce harmful pathogens from storm overflows discharging into and near designated bathing waters by either; applying disinfection; or reducing the frequency of discharges to meet Environment Agency spill standards by 2035.
3. Ensuring storm overflows operate only in usually heavy rainfall events: storm overflows will not be permitted to discharge above an average of 10 rainfall events per year by 2050.

This enhancement case relates to five Water Industry National Environment Programme (WINEP) drivers arising from new obligations from the Environment Act 2021. One driver relates to environmental investigations on the harm from storm discharges and four are to make improvements to storm discharges. Specifics for each driver are given in the table below.

Table 1.4: Driver Descriptions

Driver Code	Description	Legal Obligation	Tier 1 Outcome
EnvAct_IMP2	Improvements to reduce storm overflow spills to protect the environment so that they have no local adverse ecological impact.	Statutory	Water company actions to protect the environment from the effects of urban wastewater collection and discharges.
EnvAct_IMP3	Improvements to reduce storm overflows that spill to designated bathing waters to protect public health.	Statutory	
EnvAct_IMP4	Improvements to reduce storm overflows spills so that they do not discharge above an average of 10 rainfall events per year by 2050.	Statutory	
EnvAct_IMP5	Improvements to reduce storm overflow aesthetic impacts by installation of screens.	Statutory	
EnvAct_INV4	Investigations to reduce storm overflow spills to protect the environment so that they have no local adverse ecological impact.	Statutory	

Our work on one storm overflow covered within this enhancement case, Wheatcroft CSO, has already begun in AMP7 under Ofwat's Accelerated Infrastructure Delivery Project[44].

WFD_IMP – Urban Pollution Management Solutions

In AMP7, a number of investigations were carried out under WFD_INV to make an assessment of Yorkshire Water's compliance against in-river intermittent targets set under the Water Framework Directive (WFD). Where the AMP7 WFD_INV study has concluded that Yorkshire Water intermittent assets are the cause of failure of the WFD standards then a WFD_IMP scheme will be promoted under WFD_IMP.

The driver codes and descriptions shown below are extracts from the Environment Agency's relevant PR24 driver guidance. An 'S' legal obligation is Statutory and an 'S+' legal obligation is subject to the Environment Agency's cost-benefit analysis process. All these drivers apply to multiple determinands.

[44] https://www.ofwat.gov.uk/consultation/accelerated-infrastructure-delivery-project-draft-decisions/#Outcome

Figure 1.1: EA PR24 WINEP driver guidance – Nutrients and sanitary determinands (surface waters)

Driver code	Description	Legal obligation	Tier 1 outcome
WFD_INV	Investigations of actions to improve water quality in terms of relevant WFDR status objectives.	S	Water company contribution to achieve improvement objectives for water quality or prevent deterioration
WFD_IMP	Implementation of actions to improve water quality in terms of relevant WFDR status objectives	S+	

14.3 Need for Investment

14.3.1 The Need for the Proposed Investment – Storm Overflows

The Environment Act 2021 placed new obligations on the Government to make improvements to storm discharges, over and above the previous requirements. These obligations have been passed through to water companies via the Storm Overflow Discharge Reduction Plan (SODRP).

The SODRP requires the following actions to be undertaken by water companies:

1. By 2035, all overflows discharging into or near every designated bathing water to have been improved; and 75% of overflows discharging to high priority sites
2. By 2050, no storm overflows will be permitted to operate outside of unusually heavy rainfall or to cause any adverse ecological harm.

Table 1.5 below demonstrates an indicative trajectory of the required improvements and the spill reductions that should be achieved by the targets from a 2020 baseline.

Table 1.5: Indicative trajectory of storm overflow reductions from the SODRP.

Year	2030	2035	2040	2045	2050
% of high priority site storm overflows improved	38%	75%	87%	100%	100%
% of total storm overflows improved	14%	28%	52%	79%	100%

These new obligations apply to all permitted storm overflows including:

- Combined Sewer Overflows (CSOs)/Storm Overflows (SOs) on the sewer network.
- Storm discharges at pumping stations.
- Inlet CSOs at Wastewater Treatment Works (WwTW).
- Storm Tanks at WwTW.

We will investigate and develop schemes to deliver improvements up to 2050 as part of our enhancement programmes and Long Term Delivery Strategy for storm overflows. Our strategy aligns with the indicative trajectory of improvements outlined within the SODRP (Table 1.5). Through our PR24 proposals, we plan to undertake at least 20% of the storm overflow spill reduction schemes incorporating blue/green techniques in AMP 8. Our ambition is to increase this to at least 50% of schemes from AMP9 onwards, as we embed the learning that we will take from AMP8 and build on the partnerships that we will strengthen through our Drainage and Wastewater Management Plans and AMP8 interventions.

In addition to the direct storm overflow reduction investment proposed in this enhancement case via either grey infrastructure (storage solutions) or upstream surface water management and attenuation, we have also included an expenditure allowance for increasing the capacity of Scarborough Wastewater Treatment

Works. This capacity increase is required, due to the volumes of storage associated with the WINEP storm overflows in this catchment and the need to empty the storage tanks and to return any stored flows to treatment before the next storm event impacts upon the catchment. The timing of emptying the tanks and the treatment of the flows to safe discharge to the environment is key in making sure that we achieve the lower spill frequency target of 2 spills per bathing season for the targeted overflows in this catchment.

Due to time constraints, primarily caused by the late issuing of the specific WINEP storm overflow guidance, we have had to rapidly develop the storm overflow intervention programme. As a consequence, we have not been able to assess the impact of our proposed solutions on the receiving wastewater treatment works for the other wastewater catchments included in this enhancement case. Whilst, in the majority of catchments, we have sought to implement the solutions which have the least impact on the wastewater treatment works, due to the size of the interventions, the risk on wastewater treatment works capacity to treat the returned flows from the storm overflow storage tanks prior to further rainfall events impacting upon the catchment still remains. An element we will continue to assess during the design phases of the project.

Our business plan submission also includes further investment for storm overflows included under the following enhancement cases:

- Bathing Water Quality
- Coastal Storm Overflows (outside PR24 WINEP)

Read more about this at
Coastal Storm Overflows Enhancement Case

14.3.2 The Need for the Proposed Investment – WFD_IMP – Intermittent Discharges

Two AMP7 WFD_INV studies concluded that Yorkshire Water intermittent discharges were resulting in the waterbodies not meeting the required standard. These were:

Rother Upper

As a part of the AMP7 Water Industry National Environment Programme (WINEP Ref: 7YW200903), Yorkshire Water Services Ltd (YWS) undertook an Urban Pollution Management (UPM) study for the Rother Upper near Clay Cross, Derbyshire. The objective of this study was to assess the impact of YWS storm sewage discharges on the water quality within the agreed river reach, with a particular focus on understanding their contribution to failures of water quality standards.

Compliance was assessed with the Fundamental Intermittent Standards (FIS) for un-ionised ammonia and with the 99 percentile (99%ile) standards for total ammonia and un-ionised ammonia. The results show that water quality in the study reach is significantly impacted by YWS asset discharges, so that it does not comply with the FIS un-ionised ammonia standards or the total ammonia 99%ile standards.

As a result of the above non-compliance, solutions were developed to ensure compliance with the above standards. In total six solutions were identified:

- Option 1 – Storage
- Option 2 – Pass Forward Flow to treatment increase of 125 l/s (no storage required)
- Option 3 – Pass Forward Flow to treatment increase of 50 l/s with storage
- Option 4 – Pass Forward Flow to treatment increase of 75 l/s with storage
- Option 5 – Blue/green solution
- Option 6 – Constructed Wetlands

Option 6 has been selected to progress as it was the least cost and best value option but has a cost benefit ratio of less than 1.

Bradford Beck

As a part of the AMP7 Water Industry National Environment Programme (WINEP Ref: 7YW201457), Yorkshire Water Services Ltd (YWS) undertook an Urban Pollution Management (UPM) study for the GB104027062862 – Bradford Beck (Clayton Beck to River Aire). The objective of this study was to assess the impact of YWS storm sewage discharges on the water quality within the agreed river reach, with a particular focus on understanding their contribution to failures of water quality standards.

Compliance was assessed with the Fundamental Intermittent Standards (FIS) for un-ionised ammonia and dissolved oxygen. The results show that water quality in the study reach is significantly impacted by YWS asset discharges, so that it does not comply with the FIS un-ionised ammonia standards.

As a result of the above non-compliance solutions were developed to ensure compliance with the above standards. In total, 2 solutions were identified:

- Option 1 – Storage only solutions
- Option 2 – Blue/green and storage solutions

Option 1 has been selected to progress as it was the least cost and best value option but has a cost benefit ratio of less than 1.

For both Rother Upper and Bradford Beck, we found the cost benefit ratio failing to meet the criteria to progress and we initially did not include these solutions in our proposed WINEP. We have since discussed with the Environment Agency who marked the solutions as proceed to allow Defra the opportunity to review the cost benefit and decide if this should be included in the final plan. On the Environment Agency's 18th September PR24 WINEP publication, the actions remain as 'Proceed'.

14.3.3 The Scale and Timing of the Investment

In Yorkshire, we have 2203[45] storm overflows. To meet the Defra's Storm Overflow Discharge Reduction Plan, our investment will be phased through to 2050. For our programme in AMP8, we have prioritised our activities focussing on assets with least regret i.e. ones that do not restrict future catchment wide opportunities and assets which have the least impact on the wastewater treatment works. This allows us to improve our storm overflow performance whilst allowing time for us to build partnerships to deliver wider blue/green solutions in future AMPs.

Under this enhancement case, the primary WINEP drivers are as follows:

Table 1.6: Assets by Driver

Primary Driver	No. of Assets
EnvAct_INV4	691
EnvAct_IMP2*	1
EnvAct_IMP3*	5 (incl. 1 Accelerated and 3 DPC Route)
EnvAct_IMP4*	186

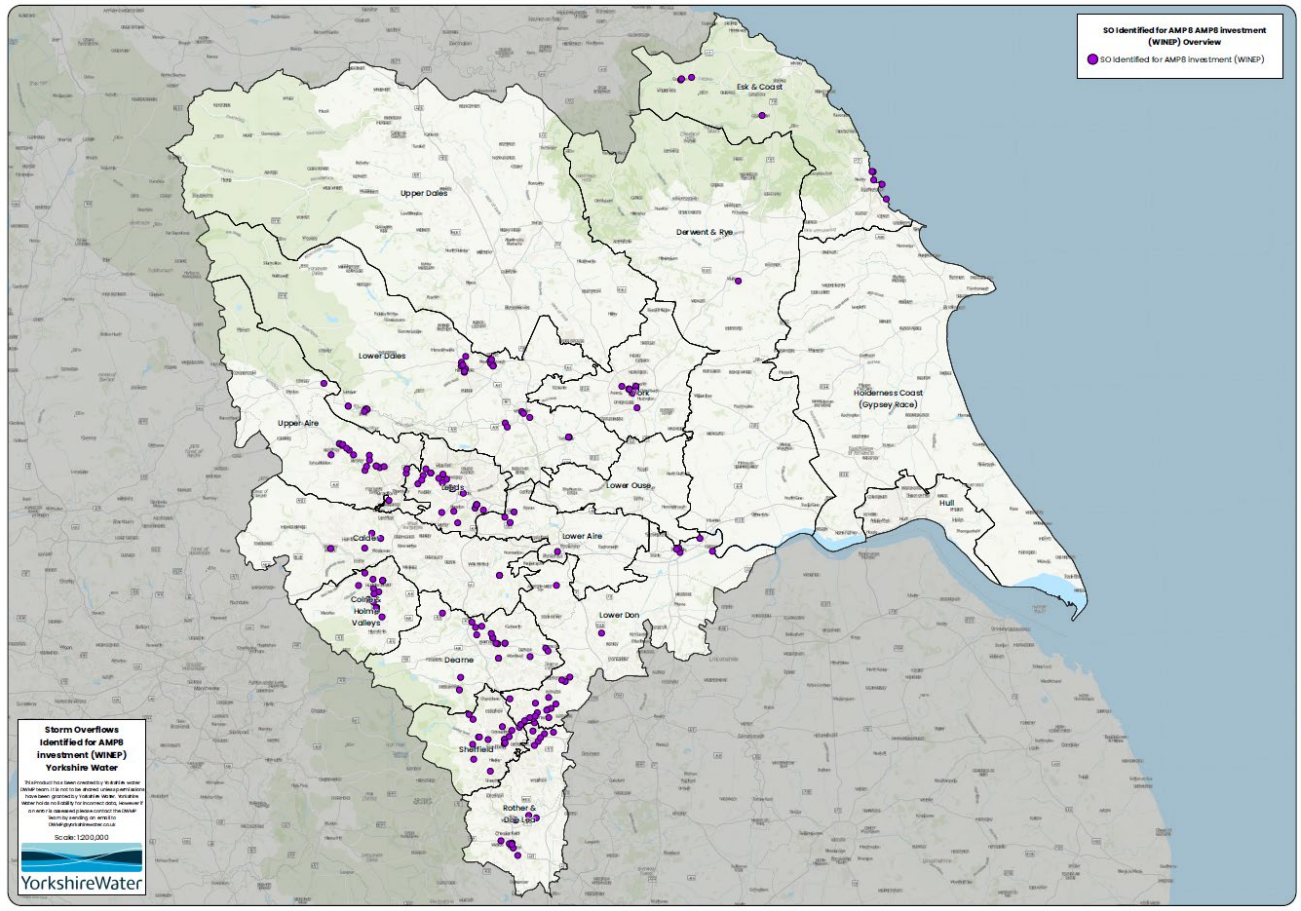
*where an EnvAct_IMP5 screen enhancement is required, these will be delivered at the same time as addressing the primary driver.

[45] OUT5.73 value, will vary from year to year as overflows are permitted or abandoned.

Through these drivers we will:

- Undertake investigations for 691 storm overflows under the EnvAct_INV4 driver. These investigations will assess whether a further reduction from the 10 spill criteria is required to ensure they have no local adverse ecological impact. We will prioritise these predominantly on high priority sites, to ensure our AMP9 and beyond programmes achieve the no local ecological harm targets. Costs submitted for EnvAct_INV4 investigations are forecast to be £76.62 million for AMP8.
- Improve a minimum of 211 overflows sites by the end of AMP8 to meet the Environment Act and SODRP requirements. It should be noted that this enhancement case contributes towards 192 of the storm overflow sites required (the remaining covered under the Bathing Water enhancement case detailed below). We propose to invest £709.456m (totex – including DPC and Accelerated) on a range of solutions, including £168.013m (totex) on solutions that comprise blue/green techniques, where we will adopt blue/green techniques to deliver improvements on 20% of the overflows. This investment also includes for the increase in flow to full treatment capacity for 1 wastewater treatment works, as described in the Need For Investment section of this document.

Figure 1.2: Map highlighting overflows within the Storm Overflow Reduction Plan and Inland Bathing Water Enhancement Cases:



Further storm overflow reduction schemes within our PR24 business plan are included within the following enhancement cases:

- Bathing Water Quality – 12 storm overflows (including one DPC scheme, where spill reduction schemes are proposed to meet the inland bathing water spill standard and an additional 2 sites

which will have screening improvements. Additional to these are a further 8 spill reduction schemes are included in an Accelerated Infrastructure Delivery Project).
- Coastal Storm Overflows (outside PR24 WINEP) - 22 storm overflows (which includes 2 DPC schemes)

Those included under the bathing water quality enhancement case ensure we are compliant with the targets under the Storm Overflow Discharge Reduction Plan. Our additional coastal storm overflow enhancement case addresses our customer priorities as detailed under Customer Support section of the enhancement case.

Overall, combining the enhancement cases noted above together, we propose to improve 234 sites to reduce number of spills.

Blue/Green Ambition

It is widely understood that blue/green solutions provide additional wider benefits to society than traditional grey solutions and are typically more resilient for the future. However, in the context of storm overflow spill reduction, these solutions are often more expensive to deliver meaning that without third party funding they may not be best value for customers.

Our AMP 7 programme has supported developing our understanding and ability to utilise blue/green solutions. We are embedding our learning from:

- Living with Water (LWW) in Hull and East Riding, is our flagship blue/green partnership. The aim of the LWW blue/green plan for Hull is to remove surface water from the sewer network using blue/green solutions. Please refer to the separate enhancement case for more details on this programme.
- Our bespoke AMP7 Surface Water Management performance commitment incentivises and encourages implementation of a greater number of blue/green solutions by reporting the number of hectares of surface water run-off removed or reduced from the public sewer network due to blue/green infrastructure or surface water disconnections. Social and human benefits include improvement of amenity values, property prices, biodiversity, health, wellbeing and recreation, as well as financial capital benefits to us in terms of the avoided energy (and associated carbon) use. Specifically, we looked at three intervention types:
    - Blue/green infrastructure (natural capital) options to mimic the natural water cycle
    - Blue/green infrastructure to slow the flow of surface water into our network to maximise the capacity of our network during storms
    - disconnection uses underground pipes (manufactured capital) to take surface water straight to receiving water courses.

Read more about this at
Living with Water Enhancement Case

Blue/Green Infrastructure Case Study: Roundhay Park Lane CSO

Below is an example of how we are utilising blue/green solutions to deliver outcomes relating to storm overflows and WwTW compliance issues and shows our commitment to deliver blue/green solutions, take on learnings and deliver more blue/green solutions like this over the coming AMPs. We propose to implement further SuDS schemes in AMP8.

Roundhay Park Lane CSO, in Leeds, has had a surface water separation and SuDS scheme constructed in AMP7. This was to deal with a river water quality issue identified from a UPM (Urban Pollution Management) study. Modelling revealed that the existing sewer had some capacity headroom. This was

maximised as part of the scheme, with a new throttle installed to hold flows back and reduce spills from the CSO in smaller, more frequent events. Infiltration strip SuDS and highways water separation were also constructed, to ensure flood risk was not increased from the sewer system. Compensatory flood defences were constructed along the receiving watercourse to ensure that flood risk did not increase from the stream. The street with the planted SuDS, seen below in Figure 1.3 saw an increase in green permeable area and local people have an increased amenity from the planting schemes. Local wildlife also benefited from the creation of this new habitat.

Figure 1.3: Rain gardens at Roundhay

14.3.4 Interactions with Base Expenditure

Storm overflow discharges can occur due to a combination of hydraulic capacity, operational/ maintenance issues and infiltration. The investment proposed under this enhancement case is limited to the hydraulic capacity element and base funding will be used to address other elements.

We anticipate across AMP8, base expenditure will allow a spill reduction of 16,775 spills, based on an average year across all our storm overflow assets. A significant proportion of which can be attributed to the additional £180 million of reinvestment, to address storm overflow reduction in AMP7[46]. The benefits in spill reduction from this additional investment will be realised at the start of AMP8. This accounts for 84% of the base expenditure spill reduction quoted and the investment is more akin to the proposed enhancement expenditure proposed.

14.3.5 Activities Funded in Previous Price Reviews

Previous improvement investment on storm discharge spill reduction has been driven by environmental need rather than spill counts; in many cases water quality modelling demonstrated that there was no need to reduce the spills to the spill targets in the new Environment Act 2021. This is the case for both inland waters and coastal bathing waters, which we previously demonstrated through Marine Impact Modelling. The funding for these changes in previous AMPs has come through water quality enhancement funding. Despite this, the Storm Overflow Discharge Reduction Plan introduces mandatory requirements for all water companies to meet the specified spill frequency targets, as addressed through this enhancement case, excluding the assessment of environmental impact on the marine environment.

[46] https://www.yorkshirewater.com/news-media/news-articles/2023/work-begins-on-yorkshire-water-s-180m-storm-overflow-reduction-plan/

The storm overflow screen policy has also changed as a result of the Environment Act which requires that all overflows are screened to remove matter larger than 6mm in two dimensions, the screens must also have a hydraulic capacity for up to five-year spill flows. Previous Environment Agency policy took a risk-based approach where low and non-amenity locations have no screen requirements and medium and high amenity sites need either 6mm or 10mm screens depending on the spill frequency. Previous funding was based on the old policy, screen improvements for these drivers are new requirements based on the new policy. The funding for screen improvements have previously been funded through enhancement quality drivers.

14.3.6 Long-term Delivery Strategy Alignment

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about this at
Long-Term Delivery Strategy

Our strategy for storm overflows is to meet the required targets set out in the Storm Overflow Discharge Reduction plan from 2025 to 2050. Our Long-term Delivery Strategy for storm overflows sets out proposed investment. This can be seen in reporting table LS4.

Our medium-term AMP9 investment plan for the regulatory period 2030-2035, prioritises high priority sites as well as looking to incorporate the outcomes of the no local ecological harm investigations. Our longer-term plan across AMPs 10-12 for the regulatory periods spanning 2035-2050 is to complete the priority sites and address all assets requiring intervention. By 2050, we will ensure all sites requiring a spill reduction and requiring a compliant screen will have been completed. Further details on this can be found in the Long-Term Delivery Strategy data tables. We will work to enhance our SODRP (Storm Overflow Discharge Reduction Plan) in future AMPs and through future cycles of the DWMP as we continue to build upon our learnings from delivering blue/green interventions and continue to grow and embed our partnerships, to allow optimal delivery of the plan.

To develop on these opportunities in future pricing periods, we have a significant investigation program under the EnvAct_INV4 driver, which we will use to develop our PR29 Storm Overflow improvement programme. These investigations look at the impact that our storm overflows have on the environment and determine whether we need to drive to a spill frequency less than 10 to cause no harm to the environment. The outcomes of which will be used to inform our future plans.

14.3.7 Customer Support

Despite this enhancement case being related to statutory requirements, we provide an overview of the customer support in this space following our comprehensive customer engagement programme.

Reducing spills from overflows has gained more prominence amongst campaigners, regulators and society in recent years. Awareness has increased surrounding overflows that spill linked to the publishing of event duration monitoring (EDM) data. However, according to the customer preference research, as published by Ofwat and CCWater, storm overflows are ranked within the least important group of service areas. Individuals did not spontaneously connect the use of storm overflows to other performance commitment areas, and rather ranked performance commitments as high priority if they had a direct and personal impact on them.

Our own customer priority research, Valuing Water found that out of 20 priority areas tested, household and non-household customers ranked reducing the release of untreated sewage mixed with rainwater into rivers and streams during times of heavy rainfall as the fifth highest priority area.

This does contrast with the Ofwat CCWater customer preferences research however, our Valuing Water research is more explicit on pollution as a potential result of the use of storm overflows, rather than the act itself. Our research also found relatively low awareness of storm overflows initially, and it was only after provision of information that views of priority were stronger.

We can see strong support for reducing the use of storm overflows during other customer engagement, as identified during a study conducted via our online community on storm overflows. There is an expectation that we should stop using them altogether and anything less than this may be considered insufficient, however there was also acceptance that this would require significant investment.

> *"If Storm Overflows have such a bad impact on the environment, they should be reduced by any means possible. Climate change and biodiversity should be our number one priority…I think the old sewage systems and the increase in population/floods etc will make it difficult to improve things without a huge input of finance."*
> Online Community Member, Your Water Online Community, Customer views on Storm Overflows Consultation

Finally, investment in storm overflows was mentioned in both the affordability and acceptability testing study we undertook following Ofwat guidelines and our own independent affordability and acceptability testing study, in both studies the vast majority of customers supported our plan, including this enhancement case – 78% and 79% respectively. To learn more about this, see Chapter 6 of our main business plan. In addition, the Yorkshire Leaders Board (a collective of the councils and Mayoral Combined Authorities within Yorkshire that work together to take a strategic approach to important issues affecting the Yorkshire and Humber area) have written a letter of support endorsing our plan, specifically mentioning the investment in Storm Overflows as an area of support.

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

14.3.8 Factors Outside Management Control

Please refer to section 1.3.2.

14.4 Best Option for Customers

14.4.1 Options Considered

Investigations

The storm overflow investigation programme has been included in this enhancement case to address the EnvAct_INV4 driver. The purpose of these investigations is to assess the harm to the environment from inland storm overflow discharges and to assess whether spill frequency should be reduced to a level below that specified by the EnvAct_IMP4 driver. Where the investigation results in a need to go beyond the spill frequency standard for the watercourse to ensure no local adverse ecological impact, an EnvAct_IMP2 driver will be raised in future AMPs.

We have developed our PR24 investigation programme to investigate a total of 691 sites. These are phased in 2 distinct batches, one for completion by 30th April 2027, to inform PR29 investment programmes and ensure that interventions in AMP9 deliver to both the spill frequency target and any additional requirements to ensure no local adverse ecological impact, and a second batch for completion by the 31st of March 2030 to inform future AMPs and smooth the delivery programme to deliver more efficiently. The 691 sites were selected, focusing on priority sites, so that we can meet requirements set out in the PR24 WINEP Driver Guidance, as summarised in the bullet points below:

- Water and Sewerage Companies should include this driver for PR24 as early contribution to building their programme to achieve the Defra consulted target dates to achieve no local adverse ecological impact of[47]:
    - 75%+ storm overflows discharging in or close to high priority sites by 2035.
    - 100% overflows discharging in or close to high priority sites by 2045.
    - All remaining storm overflow sites by 2050.

At the time of creating the WINEP, there was little detailed information around the scope and requirements for the investigation. We know that we will need to demonstrate that the discharges from our inland storm overflows meet the UPM (Urban Pollution Management) framework's FIS (Fundamental Intermittent Standards) and 99 percentile standards, in addition to the 10 spills per annum, but there are varying degrees of data collection and modelling required to demonstrate compliance. The selection of tools, data collection and level of UPM study is normally agreed with the Environment Agency prior to WINEP submission. Given that there was no opportunity to have these discussions in detail, we have based our costs for undertaking this programme of work on our AMP7 experiences of delivering SOAF (Storm Overflow Assessment Framework) investigations. These investigations contain a mix of levels of UPM and complexity in data collection and modelling. This approach was discussed and agreed with our local Environment Agency representatives.

Since the submission of the WINEP, we have been working collaboratively with the Environment Agency and the other Water and Sewerage Companies, in sharing our experience of undertaking SOAF and UPM investigations to develop the methodology in how to undertake these EnvAct_INV4 investigations. At the time of writing these discussions are still ongoing. Due to this uncertainty, we have only committed to 1 EnvAct_IMP2 driver in PR24, where we have developed a FIS and 99 percentile compliant intervention through our WFD Investigation programme undertaken this AMP. It should be noted that for the Bradford Beck and Danesmoor solutions, which have been included under the WFD_IMP driver, pending cost benefit assessment agreement by Defra, we did not have the opportunity to do the fully assess the solution requirements to meet the full requirements of the SODRP and the Environment Act.

Additional feasibility work and increases to the scope would be needed to be included in these schemes as EnvAct_IMP2 outputs, which would add to the costs that have been submitted to date. At a programme level we need greater time to plan effective catchment wide interventions to meet the wider requirements and provide the most cost-effective solutions for our customers. We will continue these investigations in AMP8.

As described above, we are still working with the on the scope of the programme, accordingly we consider the price control deliverable will protect customers where there is an agreed reduction scope.

Storm Overflow Discharge Reduction Improvements

It should be noted that the process outlined below was also followed for the WFD_IMP – Intermittent Discharges work. The subtle difference being that the targets are centred on meeting the WFD standards, in 2 specific stretches of watercourse, rather than the storm overflow drivers set out in the Environment Act.

An unconstrained list of 37 options was developed, options included conventional options such as treatment and storage solutions through to surface water management and novel untested processes including smart wastewater networks. The full list of options is given in the table below, the constrained column indicates where the options were taken forward to the constrained list. The comments column provides information on why options weren't taken forward and where they are taken forward additional information. Where the comment is 'Outcome not delivered' this means the fundamental requirement to reduce spills to 10 or fewer is not met.

47 Storm Overflows Discharge Reduction Plan, Defra 26 August 2022

Figure 1.4: Unconstrained list with assessment comments

Approach	Constrained	Comments
Built catchment flow reduction	✗	Outcome not delivered
Membrane filtration	✗	Outcome not delivered
Chemical disinfection	✗	Outcome not delivered
Chemical dosing	✗	Outcome not delivered
Dilution assessment	✗	Outcome not delivered
Increase treatment capacity	✓	Increase flow to full treatment
Industry collaboration	✗	Outcome not delivered
Trade effluent management	✗	Outcome not delivered
Nature Based Solutions - Wetlands	✓	e.g. Integrated Constructed Wetland to treat flows
Network storage	✓	Traditional concrete tanks
Permit trading	✗	Outcome not delivered
Rationalise assets	✓	Pump to network with available capacity
Side stream excess flows through passive systems (e.g. Reedbed to treat flows)	✓	
Work with other WASCS	✗	Outcome not delivered
Accelerated rollout of IOT / Smart monitors	✗	Outcome not delivered
Cross sector planning	✗	Outcome not delivered
Capture storm water, treat and use as sub-potable	✓	
Citizen science	✗	Outcome not delivered
Catchment Nutrient Balancing	✗	Outcome not delivered
Geographical synergies	✗	Outcome not delivered
Innovative treatment processes	!	Unidentified process
Catchment Partnership support	✓	Needs time to set up partnerships
Payment for ecosystem services	✗	Outcome not delivered
Political engagement	✗	Outcome not delivered
Removal at source	✓	
Full surface water separation	✓	
Infiltration reduction	✓	
Customer education	✓	Reduce spills due to blockages
Misconnections	✓	Surface water disconnecting from foul and combined
Impermeable area surface water management - SuDS	✓	
Property level surface water management	✓	
Per capita consumption reduction	✓	May not provide sufficient flow reduction
Smart Water Networks	✗	Outcome not delivered
System operator	✗	Outcome not delivered

Each option was tested to see if it delivered the outcome and could be delivered in the timescales required. Cost was not a consideration at this stage as it is dealt with later when all feasible options are subject to a cost benefit analysis which identified least cost and most beneficial options. The review of the constrained options list considered:

- PR24 driver guidance
- Current catchment evidence
- AMP 7 investment
- PR24 Profiling of WINEP actions
- YWS asset specific understanding
- Feasibility and deliverability
- Other PR24 WINEP investment proposed outside the drivers considered

The table below shows the assessment of each option on the constrained list and reason for not including in the feasible list.

Figure 1.5: Constrained list with feasibility assessment

Approach	Feasible	Comments
Increase treatment capacity	!	To be considered across all workstreams and during delivery
Nature Based Solutions - Wetlands	!	Not developed sufficiently to deliver in PR24
Network storage	✓	
Rationalise assets	✗	SMART techniques not developed sufficiently to deliver in PR24
Side stream excess flows through passive systems (e.g. Reedbed to treat flows)	✗	Not developed sufficiently to deliver in PR24
Impermeable area surface water management - SuDS	✓	
Capture storm water, treat and use as sub-potable	✗	Not deliverable by 2026 regulatory compliance date
Catchment Partnership support	!	To be considered across all workstreams and during delivery
Impermeable area surface water management - Removal at source	!	To be considered across all workstreams and during delivery
Full surface water separation	✗	Not feasible to delivery in time available for PR24
Infiltration reduction	!	To be considered across all workstreams during delivery where appropriate
Customer education	✗	Unlikely to meet Storm Overflow Reduction Plan targets
Misconnections	✗	Unlikely to meet Storm Overflow Reduction Plan targets
Property level surface water management	✗	Unlikely to meet Storm Overflow Reduction Plan targets
Per capita consumption reduction	✗	Unlikely to meet Storm Overflow Reduction Plan targets

The feasible options are;

- Enhance/Grey network Storage – traditional storage solution, typically a concrete tank designed to decrease discharges to 1 spill per bathing water season and 10 spills in 2050 epoch, based on a typical year, using the 12/24 counting methodology.

- Reduce and Enhance/Impermeable area surface water management utilising SuDS (Sustainable Drainage Systems) – This is a solution where 50% of impermeable contributing area has been removed from the combined system using a combination of blue/green techniques. Where this does not achieve the spill target additional grey storage has been included, following the method outlined above. Where possible the solution has been refined for the benefits of reduction of flood risks for properties.

Solution Development and Costing

The basis for our storm overflow assessment work aligns to the work completed for the Drainage and Wastewater Management Plans (DWMP). Every storm overflow contained within a hydraulic model has been reviewed against the 2050 target spill performance to establish if there is an investment need against the targets set out under the Storm Overflow Discharge Reduction Plan (SODRP). For this work, all overflows have been assessed independently.

Spill Targets

The storm overflows addressed in this enhancement case were assessed in line with the targets set out under the Storm Overflow Discharge Reduction Plan as follows:

- Storm overflows (including designated bathing water overflows) should spill on average no more than 10 times per year (over a 10-year period). All spills will be counted, including those that spilled less than 50 m^3. (EnvAct_IMP4)
- Storm overflows discharging directly into, or less than 1km upstream in hydraulic continuity of a designated bathing water must have no more than 2 spills per bathing water season on average, assessed over 10 years for Excellent status (EnvAct_IMP3)
- Where a storm overflow has been assessed for no local adverse ecological impact (EnvAct_IMP2), its assessment has utilised UPM FIS and 99 percentile standards

Feasible Option Development

Where possible, two generic approaches have been considered:

- **Enhance/grey network storage:** increase the capacity of our network through traditional 'grey' solutions, i.e., building bigger pipes, storage tanks and upgrading our existing assets. This option approach considers network modification only.
- **Reduce and Enhance/impermeable area surface water management utilising SuDS:** Adopt blue/green solutions to manage and reduce the amount of rainfall entering our network to reduce our levels of risk then utilise traditional grey solutions to meet the scenario target if necessary. This option approach considers a reduction in rainfall induced flow and network modification.

For the enhance option, the storage volume was calculated based upon baseline model predictions. For the Reduce + Enhance option, the calculation was conducted on a model with 50% of the connected impermeable area removed from the model. Where this does not achieve the spill target additional grey storage has been included, following the method outlined above.

An allowance for screening provision has been made at every storm overflow. Where intervention is required, as part of the SODRP, an allowance for a screen and screening chamber has been made within the solution cost for both enhance and reduce and enhance options. Where no intervention is required to achieve the SODRP target spill frequency, a standard allowance for a screen and screening chamber has been made.

Process: Enhance
This approach is common to both the development of the enhance process and reduce and enhance.

6. Hydraulic modelling completed for the DWMP predicted yearly spill counts and volumes for each overflow in 2050. Solutions were developed to limit spill frequencies to the required standard for the specific asset.
7. The tank storage volumes were approximated based on the spill volume of the frequency target+1 spill when spills are ranked by volume, for both the bathing season and annual target.
8. Storage volumes were translated to one of four standardised tank diameters, ranging from 3.05m to a maximum of 25m diameter.
9. High-level outline designs were created for the tank solutions to support the cost build up. An allowance for standard items such as: manholes, pumps, hydro ejectors, odour control units, MCC, power supply, screen and screen chamber were made.
10. Key metrics such as pipe size, length, pump return rate, tank size, screen size have been utilised to develop a high-level Bill of Quantities (BoQ) for each solution. The generated BoQ was supplied to our in-house costing team to allow company cost models to be applied. This provided total CAPEX, OPEX, embodied carbon and operational carbon values for each storm overflow scheme.

Full details of the 'Enhance' process followed can be found in Annex B1 in the Annex to the WINEP Enhancement Case document.

Process: Reduce and Enhance

Full details of the 'Reduce' process can be found in Annex B2. The 'Enhance' is common to both approaches and can be found in Annex B1 in the Annex to the WINEP Enhancement Case document.

Read more about this at
Annex to the WINEP Enhancement Case

For the Reduce + Enhance option, the calculation was conducted on a model with 50% of the connected impermeable area removed from the model. Sub-catchments connected to each storm overflow were assessed based on hydraulic models to understand the difference in impermeable area between the baseline model and the impermeable area reduction model. This assessment provides the total impermeable area for removal per storm overflow, when considering the sub-catchments connected to each overflow.

Standard designs were created for the SuDS intervention types listed below to provide a notional £/m^2 or £/m^3 of intervention:

- Detention basins
- Pocket basin
- Geocellular storage
- Bio-retention (road and verge)
- Permeable paving
- Commercial water butt

Indicative solutions were generated characterising varying housing densities and available green space. In each solution a blend of the SuDS features above was assumed with the proportional split of each SuDS feature varying in each solution.

Solutions were sized for 30-year return period events. The makeup of the SuDS features was based on housing density and the proportion of green space available within the sub-catchment area. A costing model was developed by Stantec using their engineering expertise and experience gained throughout the industry and the Spon's price guides.

Future Design Development

Due to the late availability of WINEP guidance and the limited time this gave for the detailed assessments required, four approaches will be considered throughout the detailed design stage:

- Increase in flows treated
- Catchment Partnership – working with other stakeholders to develop alternative solutions
- Impermeable area surface water management – removal at source
- Infiltration Reduction

During the detailed design phase, to allow the above assessments to take place, we will continue to:

- review and update sewer models where required,
- assess the capacity of the receiving wastewater treatment works to accept additional flows,
- review information on any planned works the relevant local authority or agency has planned in the area
- Identify specific surface water removal opportunities

14.4.2 Cost-Benefit Appraisal

All discharges that have modelling information in the DWMP were included for assessment of costs and benefits for both the storage and impermeable area removal options. Discharges with no sewer model could not be considered for AMP8; without a sewer model, solutions cannot be identified as the sewer models enable the volumetric assessments to be understood in order to design a scheme meet the relevant spill target. Accordingly, we identified and assessed the 192 overflows for AMP8 for inclusion in this storm overflow enhancement case.

Our approach to the benefits assessment is fully set out under Section 6 of the Enhancement Case appendix. Our Decision Making Framework (DMF) was utilised with the aim of delivering a best value and optimal programme against service levels, performance commitments and statutory requirements. Least cost and best value options for all sites within this driver were identified for individual discharges.

The Options Assessment Reports produced as part of WINEP have been shared with Ofwat previously.

We have overridden the preferred solution for 41 (20%) of the discharges selected in the program to incorporate blue/green techniques consistent with our ambition. Following the programme optimisation carried out using the DMF, no options incorporating blue/green techniques were selected as the preferred solution due to the costs outweighing the benefits.

Recognising the benefits solutions utilising blue green technologies can provide to the wider community and the environment, where the initial optioneering process identified alternative solutions a high-level screening check of the selected options was undertaken. This screening process was designed to identify sites where the storage volume or theoretical tank drain down may present the greatest risks. The adoption of blue/green solutions aide in the reduction of this risk.

Preferred Options:

To conclude, after reviewing all options above, this enhancement case proposes:

Table 1.7: Proposed Solutions

Solution	Sites
Grey storage	198 151+41+6 (41 additional storage needed above the blue/green interventions to meet the spill frequency standards +6 additional from the WFD_IMP driver)
Blue/green solutions	42 41+1 (additional 1 from the WFD_IMP driver)
Flow to full treatment	1
Screens	198 192+6 (additional from the WFD_IMP driver)

We have developed these solutions on the basis of our modelling processes described above. Solutions may evolve once further modelling is complete and through the ground investigation and detailed design phase. We will continue to review the below approaches through design:

- Increase in flows treated
- Catchment Partnership
- Impermeable area surface water management – removal at source
- Infiltration Reduction

To support the return of stored flows to treatment, further enhancement to increase the flow to full treatment capacity beyond existing permit levels will also be required at Scarborough/STW to allow flows collected in the grey storage tanks to be emptied and subsequently treated in time for the next storm event that hits the catchment. As discussed earlier, due to time constraints, we have had to rapidly develop the storm overflow intervention programme, primarily caused by the late issuing of the specific WINEP storm overflow guidance, meaning that we have not been able to assess the impact of our proposed solutions on the receiving wastewater treatment works for the other wastewater catchments included in this enhancement case. Whilst, in the majority of catchments, we have sought to implement the solutions which have the least impact on the wastewater treatment works, due to the size of the interventions, the risk on wastewater treatment works capacity to treat the returned flows from the storm overflow storage tanks prior to further rainfall events impacting upon the catchment still remains.

14.4.3 Carbon impact and best value

Further detail of our benefits assessment can be found in Table CWW15. For our storm overflow reduction improvements, we have associated benefits linked to:

- Reduction in spill frequency
- Reduction in spill volume
- Land use area restored or protected (bare ground/greenspace/wetland)
- Surface water separated from combined
- River water quality improved
- Number of bathing water compliance failures
- Number of bathing water classifications deteriorations avoided
- Number of non-compliance events
- Storm overflow – new / upgraded schemes

14.4.4 Impact Quantification

The table below shows the forecast benefits in terms of reduction in average number of spills per overflow (based on the company's total number storm overflows) from the investments included in this case. It should be noted that the primary driver for these investments is from the Environment Act and therefore the assets chosen to be invested in are not selected to maximise spill frequency changes. The benefits have been calculated following the same methodology used in the OUT5 tables. Due to the Event Duration Monitoring being reported by calendar year and the investments by financial year, we have accounted for 75% of the benefits occurring in the year of delivery and 25% in the following year against the 2020 spill frequency baseline.

Table 1.8: Forecast Benefits

Deliverable	Unit	Forecast Benefits					
		2025/26	2026/27	2027/28	2028/29	2029/30	2031/32
Storm Overflows - WINEP - Storm Overflows Enhancement Case drivers - Env_Act IMP2 ,3 and 4 drivers as primary (incl. DPC and Accelerated)	Reduction in average no. of spills/ overflow - Cumulative	0.034	0.194	0.402	0.651	0.945	0.945
WFD_IMP WINEP - Bradford Beck		0.000	0.000	0.000	0.010	0.042	0.042
Total		**0.034**	**0.194**	**0.402**	**0.661**	**0.988**	**0.988**

These reductions in average number of spills per overflow (based on the company's total number storm overflows) contribute to the storm overflow performance commitment.

The outcome of this investment, coupled with the bathing water enhancement case will enable us to deliver to Defra's indicative trajectory of improvements outlined in the SODRP.

14.4.5 Cost and Benefit Uncertainties

Throughout the development of our storm overflow enhancement programme, the following assumptions/risks have been captured:

- Our modelling assessments have used a 2050 "typical year" rainfall adhering to UKCP09 standards. It was not possible to perturb the rainfall to reflect UKCP18 climate change predictions during the development of our programme as the RedUp v3 tool was not complete at the time of assessment.
- No impact to WwTW compliance has been assessed (with the exception of Scarborough STW) currently due to time constraints, and therefore are not included within our cost allowances.

During the detailed design phase, we will:

- Update our modelling assessments to align to UKCP18 climate change predictions and utilise the RedUp v3 tool to develop a 25-year time series for our assessments. This will provide greater certainty in our solution development but may increase storage volumes and solution requirements.

- Assess the impact of emptying storage on each WwTW to ensure no adverse impact is created downstream. This may also alter solution requirements.

We have forecast our delivery timescales based on:

- We will drive predominantly grey solutions that will impact on our net zero ambitions and will be less resilient to long term growth and climate change.
- Resources to deliver these outputs in the timescales throughout our current and future supply chains will be in high demand across the industry
- Notional solutions and costs only consider spill frequency targets. There is currently a Defra consultation ongoing around assessing harm for coastal and estuarine assets, which may impact these solutions to deliver lower spill frequencies at increased costs and volumes.

We also anticipate some industry learning:

- How spills vary across England and where there are regional and/or company-specific factors that influence company performance. See our Outcomes section where we explain why an expectation of 20 average spills is not suitable for companies such as ourselves and United Utilities.
- How and why performance commitment calculations and results for spills can be different to Data records from Event Duration Monitors (EDMs) return data, and also numbers for the Env Act targets.

14.4.6 Third Party Funding

Partnerships with local authorities and other third parties typically take a number of years to deliver improvements. There has been limited opportunity for partnership opportunities to be included in the programme for AMP8 and meet the delivery timescales, opportunities will continue to be explored and the programme may change to incorporate any identified. Our key learning from our past and current work is that partnership working can deliver broader benefits for our customers and the environment. Strong partnerships require time and resource to build trust and common goals, most often partnership opportunities for delivery and co-funding present themselves in the near and short term. Match funding is available to fund the priorities of our partners and not to offset water industry costs.

There is currently no third party funding included in this enhancement case.

14.4.7 Customer Views

We have not carried out specific customer engagement on solutions for this enhancement case given that this has been developed in response to statutory requirements.

14.4.8 Direct Procurement for Customers (DPC)

Under this enhancement case, the following assets are being considered for delivery through the DPC route:

Table 1.9 Sites considered for DPC

YW Discharge URN	Asset Name
S00513	SCALBY MILLS/CSO
S00849	TOLL HOUSE/SPS
S01048	CORNER CAFE/NO 2 CSO

For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

14.5 Cost Efficiency

14.5.1 Option Costs

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in section 7.3 in Introduction to Enhancement Cases, has been applied to this enhancement case.

Table 1.1 and Table 1.2 at the beginning of this document summarise the costs associated with this enhancement case:

Cost estimate for our preferred option

We are proposing £1,128m of enhancement expenditure in AMP8 as part of our storm overflow reduction plan. This compromises our WINEP Storm overflow programme (including the overflows in our bathing waters enhancement case) and our coastal bathing waters programme.

The table below shows the split across the sub programmes (WINEP and Coastal Bathing Waters (non-WINEP)) programmes and the total for our storm overflow programme, excluding DPC. The costs are average Financial Year 22/23 CPIH (123.0).

Table 1.10: Programme Split

Scheme Type		WINEP Storm Overflow Programme (£m)	Coastal Bathing Waters (£m)	Total Storm Overflow Programme (£m)
Grey Schemes	Screen (all)	116.12	11.19	127.31
	Storage in network	510.38	88.50	598.88
	Storage at works	29.32	0.00	29.32
Blue/Green Schemes	Area in network	109.51	165.87	275.38
	Area at works	4.35	-	4.35
Flow to Full treatment	Flow to Full treatment increases	92.62	-	92.62
	Total	**862.29**	**265.56**	**1127.86**

The total storm overflow programme of £1127.86m is aligned to the totex value for storm overflows in Table 1.1 of c£705m. The c£705m in Table 1.1 is storm overflow investment with a WINEP Environment Act driver code as the primary driver, therefore it excludes storm overflow investment allocated to Inland Bathing Water drivers. Table 1.10 also includes the urban pollution management (WFD_IMP) investment (Table 1.2) and the Coastal bathing waters.

As outlined in our best option section, we are proposing a mixture of blue green and grey schemes for delivery in AMP8. We describe our costing approach for these schemes in detail below.

Grey solutions

These options were developed by our Strategic Planning Partner and costed and captured in our Enterprise Decision Analytics (EDA) tool. Unit Cost Database (UCD) cost models were applied within EDA using out-turn cost data from capital projects delivered by our main contract partners to derive cost estimates.

Blue Green solutions

Our UCD model has limited data on blue green solutions, we worked with Stantec to develop a SuDS costing tool to estimate the costs for our schemes. We used a weighted element to determine the amount of urbanisation, the proportion of urbanisation impacted the type and cost of the solution.

Storm Overflow Investigation (EnvAct_INV4)

At the time of creating the WINEP, there was little detailed information around the scope and requirements for the investigation. We know that we will need to demonstrate that the discharges from our inland storm overflows meet the UPM (Urban Pollution Management) framework's FIS (Fundamental Intermittent Standards) and 99 percentile standards, in addition to the 10 spills per annum, but there are varying degrees of data collection and modelling required to demonstrate compliance. The selection of tools, data collection and level of UPM study is normally agreed with the Environment Agency prior to WINEP submission. Given that there was no opportunity to have these discussions in detail, we have based our costs for undertaking this programme of work on our AMP7 experiences of delivering SOAF (Storm Overflow Assessment Framework) investigations. These investigations contain a mix of levels of UPM and complexity in data collection and modelling. This approach was discussed and agreed in principle with our local Environment Agency representatives.

The cost we have included for is:

Table 1.11: Proposed Unit Costs

	No. of storm overflow investigations	Unit cost (£)	Total cost (£m)
EnvAct_INV4 Investigation	691	110,883.94	76.621

14.5.2 Efficient Cost Estimates

Section 7.3 in Introduction to Enhancement Cases outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

We have assessed quotes from contractors to deliver solutions compared to the cost allowances developed from our models and outturn data described previously. This has demonstrated cost efficiency, through costs that are close to the market rate and in some instances, under the quotes from the contractors.

We assessed the efficiency of cost estimates by developing models using the DWMP data set. We discuss this modelling in more detail in the next section.

14.5.3 Need for enhancement model adjustment

We support Ofwat's approach to use benchmarking models to set efficient allowances where high quality models can be developed. The use of benchmarking models is based on company evidence-based data, and less regulatory judgment is involved than when relying on deep dive and shallow dive assessments where companies' costs are comparable. Our assumption is that Ofwat will use the PR19 benchmarking models as their basis to assess companies' proposed costs in a number of areas.

Nevertheless, we believe that Ofwat should not roll over its PR19 models for sewer overflows[48], in its current format for the following reasons:

- **The PR19 models did not differentiate between totex related to grey and green schemes**. The requirements of such schemes differ significantly, given their specific costs and requirements. Ofwat has already recognised this and has re-designed the business plan tables to differentiate between these costs categories. Hence, we strongly encourage Ofwat to assess in detail the disaggregated information on costs and costs drivers that will be provided by companies in their business plans.

- **The PR19 models in their current form do not adequately capture the new requirements set by Ofwat in the draft methodology**. The regulations around combined sewer overflows (CSOs) have changed from PR19 to PR24. They now focus on CSO discharges per location, whereas previously, the CSO spills reductions were counted on aggregate and were focused on specific environmental improvements. This has the effect of restricting the ability of companies to optimise their enhancement projects across all CSO locations and thus can increase costs.

Is there compelling evidence that the allowances would, in the round, be insufficient to account for evidenced special factors without an enhancement model adjustment?
We strongly encourage that Ofwat needs to conduct an in-depth revision of their PR19 econometric models. If Ofwat uses their updates their PR19 econometric modelling, allowances for Yorkshire Water would be significantly lower (less than a half) than the funding we require) to comply with new regulations.

If Ofwat considers our proposed models in their assessment, they will likely adequately account better for required funding. The special factors can be accounted for by differentiating between totex related to grey and green schemes, as explained in our previous answer. We are conscious that developing models that consider several drivers simultaneously can be challenging given the small dataset (around 10/11 data points). As shown in our answer to question "f", we have identified a set of models that Ofwat could consider for their assessment. It is worth noting that our models are based on preliminary data, as companies will submit their business plans at a later stage. We note that these models were also assessed prior to the inclusion of some of our Storm Overflow activity as DPC schemes.

Is there compelling econometric or engineering evidence that the factors identified would be a material driver for costs?

We have assessed the following data sources to form our recommendations to Ofwat:

- A benchmark analysis based on 2020-22 APR data: we found 2020-22 APR data is not suitable for modelling purposes, given the change in data definitions/reporting and insignificant reported values.

- A benchmark analysis based on the drainage and wastewater management plans (DWMPs) published in early June this year.

- A benchmark analysis based on Yorkshire Water's internal data on individual projects.

[48] The models for sewer overflows can be found here: **Spill frequency** and **Storm tank capacity**

Our recommended models

Across two of the data sources, we found statistically significant drivers:

- **In the DWMP data, the additional volume of required storage was a common driver for costs related to grey schemes in the network and in the wastewater treatment works. Another key driver was the number of individual schemes per company**. This is in line with Ofwat's modelling approach used in PR19, albeit without the separation of green and grey schemes.
- **With the Yorkshire Water's internal benchmarking dataset, we identified two other drivers that could be considered by Ofwat to assess costs related to grey schemes: the length of rising mains and the length of gravity sewer pipes laid**. We also found that the diameter of rising mains and the diameter of gravity sewer pipes are also relevant costs drivers. Nevertheless, it seems that these data will not be collected by Ofwat according to the PR24 business plan templates (see specifically table CWW20).

Table 1.12 below presents our recommended models for each of PR24 enhancement data table line. In the next section, we explain the rationale behind our recommendations by looking at the three data sources listed above. We also set out our proposed weights for triangulating our proposed models, rather than grouping drivers into a single model.

Table 1.12: Summary of proposed models for PR24

Benchmark on DWMP industry		Benchmark on YW's internal data	
Costs	Models and Drivers	Costs	Models and Drivers
Grey Network Storage	Model 1 - Additional grey storage / containment volume to be delivered in the network Model 2 - The number of individual schemes in the network for grey schemes	**Grey schemes**	Model 1 - Volume, Gravity Sewer Pipe Length Model 2 - Volume, Rising main length
Grey WwTW storage	Model 1 - Additional grey storage volume required at WwTW Model 2 - The number of individual schemes in WwTW for grey schemes		
Green Network Storage	Model 1 - Permeable area inflow removed from entering the network or stored in environment Model 2 - The number of individual schemes in the network for green schemes	**Green schemes**	N / A
Green WwTW Storage	Model 1 - The number of individual schemes in WwTW for green schemes		

14.5.3.1 Our detail assessment - A benchmark exercise based on the 2020-22 APR data

We looked at 2020-22 APR data as reported by companies. Ofwat has stated in the PR24 methodology that it would consider both the actual and companies' forecasts to benchmark enhancement costs. The advantage of using historical data is that it captures full investment cycles, and a larger sample is more representative of the population, which could produce more accurate results. Nevertheless, **we recommend Ofwat not to use actual data for the following reasons**.

- First, there has been a structural break on the data in 2020-21 where more disaggregated costs data has been requested to companies. This makes the historical data (2011-12 to 2021-22) not comparable across time, which could produce misleading results.
- Second, as previously explained in our answer to question “d”, pre-2020-21 expenditure is based on different requirements set by Ofwat and the EA. Hence, using this data will not adequately identify companies’ efficient costs.
- Third, most companies will start their sewer overflows projects in the middle of the AMP. Hence, most companies report close-to-zero costs in their 2020-22 APR data. This makes these data not suitable for econometric benchmarking analysis.

14.5.3.2 Our detailed assessment - A benchmark exercise based on the DWMP data

In early June, water companies shared their Drainage and Wastewater Management Plans (DWMP) data. Companies have provided, amongst other information, the expected expenditure on sewer overflows relating to both grey and green schemes alongside relevant costs drivers. The information is also disaggregated for storage required in the network, and in the wastewater treatment works (WwTW). Table 1.13 displays the 10 regression models that we tested.

Read more about this at
Drainage Water Management Plans

Table 1.13: DWMP dataset – Tested models

Regression id / drivers	Dependent variable (totex category assessed)	Additional grey storage / containment volume to be delivered in the network	Number of individual schemes network grey	Permeable area inflow removed from entering the network or stored in environment	Number of individual schemes network green	Additional grey storage volume required at WwTW	Number of individual schemes WwTW	Number of individual blue/green interventions (schemes) required at WwTW
Label	**Totex**	**Volume grey network**	**Schemes grey network**	**Inflow green network**	**Schemes green network**	**Volume grey WwTW**	**Schemes grey WwTW**	**Schemes green WwTW**
Regression 1	Grey network storage	x						
Regression 2	Grey network storage		x					
Regression 3	Grey network storage	x	x					
Regression 4	Green network schemes			x				
Regression 5	Green network schemes				x			
Regression 6	Green network schemes			x	x			
Regression 7	Grey WwTW storage					x		
Regression 8	Grey WwTW storage						x	
Regression 9	Grey WwTW storage					x	x	

Regression 10	Green WwTW interventions							x

Table 1.14: DWMP dataset – Model Results

Cost driver(s) / Model	Dependent variable: grey network storage (£m)			Dependent variable: green network schemes (£m)			Dependent variable: Grey WwTW storage (£m)			Dependent variable: green WwTW interventions (£m)
	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6	Regression 7	Regression 8	Regression 9	Regression 10
Volume grey network	**0.730****		0.238							
Schemes grey network		**0.710*****	0.476							
Inflow green network				**0.565**		0.248				
Schemes green network					**0.696****	0.638**				
Volume grey WwTW							**0.871*****		0.880**	
Schemes grey WwTW								**0.911***	-0.018	
Schemes green WwTW										1.246***

Cost driver(s) / Model	Dependent variable: grey network storage (£m)			Dependent variable: green network schemes (£m)			Dependent variable: Grey WwTW storage (£m)			Dependent variable: green WwTW interventions (£m)
	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6	Regression 7	Regression 8	Regression 9	Regression 10
No. of observations	8	7	7	8	7	7	7	7	7	5
R squared	0.56	0.83	0.81	0.14	0.69	0.67	0.80	0.35	0.76	0.97
Catch-up challenge	8.4%	8.8%	10.7%	46.7%	48.3%	41.3%	32.3%	50.8%	32.2%	20.2%
Model evaluation based on a) coefficients; b) R squared; c) efficiency scores range.	a) good b) medium c) good	a) high b) high c) high	a) low b) good c) good	a) medium b) low c) medium	a) high b) high c) medium	a) low b) medium c) medium	a) high b) high c) medium	a) high b) medium c) medium	a) low b) medium c) medium	a) high b) high c) medium
Weight assigned for each totex category	25%	75%	0%	25%	75%	0%	75%	25%	0%	100%

Notes: The *, ** and *** next to the coefficients denote statistical significance at 1%, 5% and 10% respectively

We selected our preferred models based on the following criteria, which are in line with Ofwat's econometric framework:

- **Coefficients**: We look at the magnitude/size of the coefficient, direction of effect and statistical significance of the coefficients. If a model reports a coefficient with a sign in the opposite direction of what it is expected from an economics and engineering reasoning, then the model is removed automatically from our list of recommended models.
- **R squared**: How much the drivers explain the variance of the specific costs assessed
- **The range of the efficiency scores** (the efficiency scores are defined as the ratio of actual costs to hypothetical modelled allowance).

Table 1.14 displays the results of each of the 10 regression models tested. In all regressions, we have transformed costs and costs drivers in natural logarithms. We also include information with respect to the three criteria described above. The penultimate row presents our summary, which is the basis of our proposed weights that could be assigned to each model to estimate triangulated allowances. A detailed assessment can be found in the complementary workbook.

Models 3, 6 and 9 are automatically removed from our lists as some coefficients report an opposite effect to what is expected. This is due to the multicollinearity between the drivers included in each regression. Based on our model evaluation, we recommend the following models, which are highlighted in bold font in table 3:

- For totex related to grey schemes in the networks, we recommend using regressions 1 and 2. We have assigned a relatively higher weight to model 2 given that this model reports a significantly higher R squared compared to model 1 (86% compared to 56%). We recommend that Ofwat use both model to set efficient allowances.
- For totex related to green schemes in the network, we propose using 4 and 5 with weights of 25% and 75% respectively for the same reason explained above.
- Similarly, we propose using different weights for models 7 and 8 for totex related to grey schemes in the WwTW.
- Regarding totex related to green schemes at WwTW, the DWMP data only includes the number of schemes. Therefore, we only assessed one model for this totex category. We found a suitable model that could be used, but Ofwat should be cautious that 3 companies in the sample did not report costs for this category, including ourselves.

In summary, we recommend the following models:

- ✓ **For totex related to grey schemes in the network and in WwTW, Ofwat could consider two univariate models using the volume and the number of schemes as drivers.**
- ✓ **For totex related to green schemes in the network, YW could also suggest using two univariate models using the area inflow and the number of schemes as drivers.**
- ✓ **For totex related to green schemes in WwTW, Ofwat should assess the number of schemes when data from all companies is available.**

14.5.3.3 Our detailed assessment - A benchmark exercise based on our internal data

We also conducted a benchmark analysis using our internal data, which comprises detailed information on 167 grey schemes and 47 green schemes. Aside from the volume required for additional storage, our internal data contains other drivers that could be considered by Ofwat in their assessment relating to the length and diameter of rising mains and gravity sewer pipes.

The data also contains pumping capacity and power related drivers. We opted not to propose such drivers since there is little variability in the data. Furthermore, power usage is under Yorkshire Water's management control.

We assessed 15 different regression models for each totex related to grey and green schemes, which are presented in Table 1.15. Our assessment is based on the same criteria described in the DWMP analysis section.

Table 1.15: Regression Models

Regression id / drivers	Volume	Gravity pipe length	Gravity pipe diameter	Rising main length	Rising main diameter	Screen chamber diameter
Regression 1	x					
Regression 2		x				
Regression 3			x			
Regression 4		x	x			
Regression 5				x		
Regression 6					x	
Regression 7				x	x	
Regression 8						x
Regression 9	x	x				
Regression 10	x		x			
Regression 11	x	x	x			
Regression 12	x			x		
Regression 13	x				x	
Regression 14	x			x	x	
Regression 15	x					x

Table 1.15 and Table 1.16 display the results of regression outputs for totex related to grey and green schemes, respectively.

Based on our models evaluation, we recommend the following models:

- Totex related to grey schemes:
  - ✓ We recommend models 9 and 12, where volume is used a primary driver with length of rising mains and length of gravity sewer pipes as additional drivers. The coefficients of

the drivers in these models are statistically significant. The catch-up challenge (which is based on the upper quartile) are amongst the lowest.

- ✓ We also found that the diameter of rising mains and gravity sewer pipes could also be used as alternative drivers. However, to our knowledge, Ofwat has not asked such information to companies in their PR24 business plan tables request.

- Totex related to green schemes:
  - ✓ The models seem to be less robust than those of grey totex due to extremely low R squared values. Nevertheless, similar drivers to grey schemes could be considered by Ofwat as part of its testing of different models.

In summary, we recommend the following models:

- ✓ **For totex related to grey schemes, the length of rising mains and the length of gravity sewer pipes could be considered as additional drivers.**
- ✓ **For totex related to green schemes, we did not find suitable additional drivers, but this may be due to the small sample of green schemes in our dataset. Ofwat should consider assessing the length of rising mains and the length of gravity sewer pipes for these costs.**

Table 1.16: Yorkshire Water's Internal Benchmarking Dataset – Totex Related to Grey Network Storage Schemes

	Dependent variable: grey network storage (£m)														
Project	**Reg 1**	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**	**Reg 6**	**Reg 7**	**Reg 8**	**Reg 9**	**Reg 10**	**Reg 11**	**Reg 12**	**Reg 13**	**Reg 14**	**Reg 15**
Volume	0.343***								**0.325*****	0.312***	0.310***	**0.325*****	0.185***	0.181***	0.307***
Gravity pipe length		0.246***		0.185***					**0.184*****		0.165***				
Gravity pipe diameter			0.543***	0.487***						0.223***	0.175***				
Rising main length					0.246***		0.184***					**0.184*****		0.177***	
Rising main diameter						1.520***	1.485***						0.837***	0.818***	
Screen chamber diameter								0.481***							0.269***
No. of observations	168	167	167	167	167	167	167	167	**167**	167	167	**167**	167	167	167
R squared	0.73	0.08	0.17	0.21	0.08	0.72	0.77	0.20	**0.77**	0.75	0.78	**0.77**	0.80	0.84	0.78
Catch-up challenge	23.4%	38.3%	33.7%	31.2%	38.3%	23.5%	22.8%	41.3%	**24.3%**	19.7%	21.9%	**24.3%**	16.6%	18.2%	19.2%
Evaluation coefficients	High	High	High	High	High	High	High	High	**High**	High	High	**High**	High	High	High

	Dependent variable: grey network storage (£m)														
Project	**Reg 1**	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**	**Reg 6**	**Reg 7**	**Reg 8**	**Reg 9**	**Reg 10**	**Reg 11**	**Reg 12**	**Reg 13**	**Reg 14**	**Reg 15**
Ranking R squared	9	14	13	11	14	10	7	12	**5**	8	3	**5**	2	1	4
Ranking on efficiency scores range	10	14	11	12	14	3	4	13	**7**	9	5	**7**	2	1	6
Recommended? If not, why?	Low R squared	Low R squared	Low R squared	Low R squared	Low R squared	Low R squared	Low R squared	Low R squared	**Yes**	Wide range of efficiency scores	Yes	**Yes**	Yes	Yes	Wide range of efficiency scores

Table 1.17: Yorkshire Water's Internal Benchmarking Dataset – Totex Related to Green Network Storage Schemes

	Dependent variable: green network storage (£m)														
Project	**Reg 1**	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**	**Reg 6**	**Reg 7**	**Reg 8**	**Reg 9**	**Reg 10**	**Reg 11**	**Reg 12**	**Reg 13**	**Reg 14**	**Reg 15**
Volume	0.075								-0.09	0.093*	0.116*	0.09	0.124	0.137	0.027
Gravity pipe length		0.024		0.019					-0.074		-0.111				
Gravity pipe diameter			-0.156	-0.155						-0.221	-0.242				
Rising main length					0.024		-0.035					-0.074		-0.072	

	Dependent variable: green network storage (£m)														
Project	**Reg 1**	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**	**Reg 6**	**Reg 7**	**Reg 8**	**Reg 9**	**Reg 10**	**Reg 11**	**Reg 12**	**Reg 13**	**Reg 14**	**Reg 15**
Rising main diameter						0.663	0.737						-0.683	-0.667	
Screen chamber diameter								0.331***							0.132**
No. of observations	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
R squared	0.03	-0.03	0.00	-0.03	-0.03	0.00	-0.03	0.21	0.01	0.05	0.04	0.01	0.01	-0.02	0.19
Catch-up challenge	27.6%	29.4%	25.0%	25.8%	29.4%	31.0%	28.3%	23.4%	26.4%	26.7%	25.7%	26.4%	26.6%	24.2%	26.8%
Evaluation coefficients	Medium	Low	Low	Low	Low	Low	Low	High	Low	Medium	Low	Low	Low	Low	Low
Ranking R squared	5	10	17	13	10	17	10	1	6	3	4	6	8	9	2
Ranking on efficiency scores range	6	12	10	11	12	9	8	15	3	2	1	3	7	5	14
Recommended? If not, why?	Low R squared	Coefficients not significant	Coefficient with wrong sign	Coefficient with wrong sign	Low R squared	Coefficients not significant	Coefficient with wrong sign	Coefficients not significant	Coefficient with wrong sign	Coefficient with wrong sign	Coefficient with wrong sign	Coefficient with wrong sign	Low R squared	Coefficient with wrong sign	Low R squared

14.6 Third Party Assurance

The costs used in these enhancement case come from the work used to create our Drainage and Wastewater Management Plan (DWMP). The costs and processes to generate these have undergone third-party independent assurance as part of our DWMP.

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

14.7 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

We reviewed our forecast enhancement totex for storm overflows and found we met the 1% materiality threshold as a result of activities under three enhancement cases: Storm overflow reduction plan (this case, including the 2 WFD_IMP schemes), Bathing water quality and Coastal bathing water overflows. We meet the materiality threshold for four PCD groupings:

- PCDWW4 – flow to full treatment
- PCDWW5 – storm tank capacity, storage, SuDS and other activities
- PCDWW6 – new / upgraded screens for storm overflows
- PCDWW18 – desktop studies, simple monitoring and multiple/complex monitoring

We propose to address these four groupings across three PCDs. Within PCDWW5, we have two sets of activities: 1) to meet spill targets and 2) to meet WFD targets in 2 watercourses, improvements which have arisen through the conclusion of our AMP7 Urban Pollution Management studies.

The PCD grouping for PCDWW18 includes non-storm overflow specific studies and monitoring activities. The total expenditure allowance for PCDWW18 is £87m, of this £76.6m is for the storm overflow investigation programme (EnvAct_INV4). The remaining expenditure is allocated to other investigation types. For simplicity and to reflect the acute difference in materiality across the various investigations, we propose to exclude these other investigations from this customer protection mechanism.

We also considered whether additional customer protection mechanisms were in existence or should be introduced to complement the PCD. Our solution for the Wheatcroft CSO and associated spend is already protected by an existing PCD under the Accelerated Infrastructure Delivery Project for “Coastal bathing water improvement”. We also have an existing PCD for “Scheme 6: Inland bathing water improvement scheme - Wharfe Ilkley”, which covers our investment across storm overflows related to the designated bathing water.

We have summarised the assets that are covered by the three enhancement cases and split out those that will be delivered through DPC and those that relate to our existing two PCDs under the Accelerated Infrastructure Delivery Project. Our investment covers storm overflows and wastewater treatment works (WwTW) assets.

Table 1.18: Assets Covered by Each Case

Enhancement Case	Asset Delivery Route	Number of Assets
WINEP Storm Overflows	Storm Overflows – Standard Delivery	188
	Storm Overflows - DPC Route	3
	Storm Overflows - Accelerated	1
	WwTW Improvements – Standard Delivery	1

Additional Coastal Storm Overflows	Storm Overflows – Standard Delivery	20
	Storm Overflows - DPC Route	2
Inland Bathing Water Quality	Storm Overflows – Standard Delivery	13
	WwTW Improvements – Standard Delivery	1
	Storm Overflows - DPC Route	1
	Storm Overflows - Accelerated	8
	WwTW Improvements – Accelerated	1
	Total	**239**

14.7.1 Price Control Deliverable - Storm overflows

The following breakdown of assets will be included in our PCDs relating to Storm Overflows. These assets exclude those sites which are incorporated in the Accelerated funding schemes, or to be considered in the DPC route.

Table 1.19: Delivery Routes

Enhancement Case	Asset Delivery Route	Number of Assets
WINEP Storm Overflows	Storm Overflows – Standard Delivery	188
	WwTW Improvements – Standard Delivery	1
Additional Coastal Storm Overflows	Storm Overflows – Standard Delivery	20
Inland Bathing Water Quality	Storm Overflows – Standard Delivery	13
	WwTW Improvements – Standard Delivery	1
Total		**223**

For ease of public messaging on this PCD, we propose to move the one EnvAct_IMP3 storm overflow from the WINEP category to Coastal, to align with the spill reduction target of this category. Therefore, under this customer protection we propose the following assets.

Table 1.20: Assets by Category

PCD Category	Number of Assets
Inland/WINEP	187
Coastal	21
Inland bathing water	13
Total	**221**

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

Table 1.21: PCD Parameters – Storm Overflows

PCD Delivery Expectation	
Description	Deliver enhancements to storm overflows and wastewater treatment works to ensure compliance with Storm Overflow Discharge Reduction Plan targets. To reduce storm overflow spill frequency to levels specified in the Environment Act 2021, the company will investigate 691 storm overflows to assess against the "no harm" criteria and undertake 221 improvement schemes at inland and coastal sites. The results of the investigations will inform the improvement work programme for AMP9 and AMP10. The company will improve storm overflows by: • installing or upgrading screens to prevent matter larger than 6mm in diameter in 2 dimensions from being discharged to the environment, consistent with new regulations • traditional, grey infrastructure solutions, and/or • blue/green infrastructure solutions. Typical grey solutions include providing additional storage, often in the form of storage tanks which store flows which would have been spilled to the environment, which will then be emptied after the storm flows reside, generally through pumps back to the sewerage system and on to treatment at the treatment works. Whereas blue/green infrastructure involves the separation of surface water flows from foul water flows and may include attenuating the separated surface water in SuDS features, such as ponds, swales and rain gardens. This replicates more natural catchment processes, before draining into watercourses, or back into the sewerage system when there is capacity to do so.
Output measurement and reporting	Company should report completed activities in parallel with the APR. This information should be split by: • Number of screens installed or upgraded – all required • Number of storm overflows that meet Environment Agency spill standards, split by those overflows that are inland, or near non-designated bathing waters and coastal bathing waters • Number of storm overflows investigated. For the completed storm overflow schemes, the company should also report the solution, such as the volume of storage provided or area of surface water separation. The company will assess whether storm overflows meet the Environment Act spill standards through modelling spill frequency before and after the interventions.
Assurance	The company must commission an independent, third-party assurer, with a duty of care to Ofwat, to assure, to our satisfaction, that the conditions below have been met and the outputs of the scheme set out below have been delivered.
Conditions on Scheme	Storm overflow improvement schemes that are found to be not required may be swapped with alternative sites that are approved by the EA through an amended WINEP. Environment Act Targets 1. Spill targets to reduce storm overflow spills to protect the environment so that they have no local adverse ecological impact. These are determined through environmental impact assessment modelling, and spill targets are site specific where required to be less than 10 spills per year on average. 2. Spill targets to reduce storm overflows that spill to designated bathing waters to protect public health. For the designated coastal bathing beaches in Yorkshire, this is 2 spills per bathing season on average. For designated inland bathing waters, this is 1 spill per bathing season on average. 3. Spill targets to reduce storm overflows spills so that they do not discharge above an average of 10 rainfall events per year by 2050. For the Crofton STW storm overflow, included in the WINEP, the company must meet both the spill reduction target and the no environmental harm requirement.

We have developed this enhancement case based on our modelling, rather than fully investigated and detailed design solutions. We may need to install alternative solutions for some storm overflows to reflect site constraints and/or further information gathered during the investigation and design process. Accordingly, we propose PCD deliverables at an output level rather than at a solution-type level to reflect this uncertainty.

We have set our delivery profile to reflect the establishing of the supply chain and contract partners to meet the EA's regulatory compliance dates across our WINEP storm overflows programme and based on our current delivery processes. We have excluded the storm overflow improvements that will be delivered and hence funded through DPC from the total number of sites and the PCD payment calculation.

The installation of the storm overflow screens follows the same delivery profile of the spill frequency reduction scheme for each storm overflow.

14.7.1.1 Forecast deliverables

Table 1.22: Forecast Deliverables – Storm Overflows

Deliverable	Unit	Forecast Deliverables				
		2025/26	2026/27	2027/28	2028/29	2029/30
Storm overflows	Number (cumul)	0	2	44	89	187
Coastal overflows	Number (cumul)	0	0	1	5	21
Non-designated bathing water overflows	Number (cumul)	0	0	0	1	11*
Storm overflow screens upgraded	Number (cumul)	0	2	45	95	221
Storm overflow sites investigated (EnvAct_INV4)	Number (cumul)	0	0	474	474	691

*Note: 2 of the 13 sites for non-designated bathing water overflows are for a storm overflow screen only.

We propose a range of PCD payment rates to reflect the activities for each type of deliverable.

- For screen installation or upgrades and for investigations, the cost for each site is reasonably homogenous, therefore we propose an average unit cost for the payment rate.
- For storm overflow investigations, again the investigation activity is expected to be similar to the Storm Overflow Assessment Framework, which we have undertaken this AMP. Although the costs can vary due to the complexity of investigation and specifically the level of modelling and data collection required, we have taken an average unit cost based on our programme of 158 studies in AMP7. Accordingly, we propose an average cost rate.
- For each storm overflow, we provide a schedule of costs as our proposed interventions range from £0.3m up to circa £85m per storm overflow.

Storm overflows

We have not progressed through the detailed design for our solutions and therefore do not have high confidence in the exact costs estimated for each storm overflow. We reviewed the distribution of our schemes costs and found we could group schemes into £1m bands. Within these bands we have calculated an average unit cost and considered the variance within each category.

We consider our proposed cost categories find the balance of enabling us some flexibility to manage our programme but are narrow enough to mitigate the risk for customers that we may seek to complete the cheapest schemes first. Our proposed cost categories per scheme are included in Annex B3 in the Annex to the WINEP Enhancement Case document.

For our more significant costs, we have named individual schemes and costs, as a cost category approach would not be appropriate for customers.

14.7.1.2 PCD payment rate:

Table 1.23: PCD Unit Rates – Storm Overflows

Deliverable	Unit payment (£m)
£m per scheme	See Annex B3 for scheme costs and allocations
£m per screen	= totex for enhancement for specified deliverable ÷ no. of deliverables = £119.303m ÷ 221 = £0.539m (rounded down)
£m per SO investigated	= totex for enhancement for specified deliverable ÷ no. of deliverables = £76.6 ÷ 691 = £0.110m (rounded down)

14.7.2 Price Control Deliverable – Flow to full treatment

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

Table 1.24: PCD Parameters - Flow to Full Treatment

PCD Delivery Expectation	
Description	To deliver enhancement to wastewater treatment capacity, to accommodate flows generated by the storm overflow storage schemes. By storing flows which would otherwise have been discharged to the environment, there is a need to return the flows to the sewerage system so that they can be treated. The emptying of the increased sewerage system storage increases peak flows to the wastewater treatment works and is needed to be emptied in a timely manner so that the overflows comply with their associated spill targets when the next rainfall events occur.
Output measurement and reporting	Company will report completed activities in parallel with the APR. This information should report the completed capacity improvements to the wastewater treatment works.
Assurance	The company must commission an independent, third-party assurer, with a duty of care to Ofwat, to assure, to our satisfaction, that the conditions below have been met and the outputs of the scheme set out below have been delivered.
Conditions on Scheme	The wastewater treatment works under this PCD are: • Wetherby WwTW – Flow to Full Treatment increase • Scarborough WwTW – Flow to Full Treatment increase.

We have set our delivery profile to reflect the establishing the supply chain and contract partners to meet the EA's regulatory compliance dates across our WINEP storm overflows programme and based on our current delivery processes. It should be noted that these inventions are significant on complex infrastructure and although they appear to be back end loaded, these will be stretching but we consider achievable targets to hit.

14.7.2.1 Forecast deliverables

Table 1.25: Forecast Deliverables - Flow to Full Treatment

Deliverable	Unit	Forecast Deliverables				
		2025/26	2026/27	2027/28	2028/29	2029/30
Flow to full treatment capacity increased to required level	Number (cumul)	0	0	0	0	2

Interim milestone

Consistent with Ofwat's guidance, we have considered where we can propose an interim milestone where we only have end-of-AMP delivery completion milestones. We propose the following interim milestone:

Table 1.26: Start on Site Milestone Description

Milestone	Description
Start on site	Completion of: • Planning approved • Design Accepted • Procurement contracts signed & ordered • All permits submitted • Start onsite letter issued by Project Manager • Partner takes over site • Delivery contract signed • Accurate spend forecast received for the construction phase This stage also includes significant surveys and ground investigations.

Once we reach the 'start on site' milestone, we are committed to the full cost of the project through signed contracts with obligations to our contract delivery partners. Based on our experience of undertaking projects of this size, we estimate that there will be between 2-3 years of construction work in order to deliver the beneficial completion of a project.

Given this lead time, we must reach this milestone by the mid-point of AMP8. If we reach this milestone later, we will not complete the project but will have incurred a significant amount of the allowed spend. Therefore, returning the whole scheme cost for non-delivery would not align with the completed activities.

We consider that if we are delayed in reaching our start on site milestone, by the end of the AMP we will still have incurred 70% of the costs. Therefore, we should return the 30% to customers and re-apply for the remainder of the funding in AMP9. As noted in Ofwat's IN23/05, where we are months from beneficial completion at the end of AMP8 we will provide evidence to Ofwat on why we should retain all funding to complete the scheme early in AMP9.

14.7.2.2 PCD payment rate:

Table 1.27: Payment Rate - Flow to Full Treatment

Milestone	Unit payment (£m)
Start on site milestone achieved but not beneficial completion	Return 30% of scheme value
No start on site milestone achieved	Return 100% of scheme value • Wetherby WwTW – Flow to Full Treatment increase: £26.913m • Scarborough WwTW – Flow to Full Treatment increase: £43.373m

14.7.3 Price Control Deliverable – WFD_IMP

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

Table 1.28: PCD Parameters - WFD_IMP

PCD Delivery Expectation	
Description	Deliver enhancement to storm overflows (named in the WINEP) in Bradford Beck and Upper Rother to ensure compliance assessed against the appropriate in-river Water Framework Directive (WFD) intermittent targets defined as part of the original studies. This investment results from completing the Bradford Beck and Lower Rother UPM (Urban Pollution Management) investigations into assessing the reasons that these watercourses were not achieving compliance against the appropriate in-river Water Framework Directive (WFD) intermittent targets defined as part of the original studies and proposing interventions to achieve compliance. The solutions for Bradford Beck currently include providing additional storage, often in the form of storage tanks which store flows which would have been spilled to the environment, which will then be emptied after the storm flows reside, generally through pumps back to the sewerage system and on to treatment at the treatment works. For the Upper Rother solution, the company will develop a wetland solution at Danesmoor sewage treatment works, to improve the quality of the flows discharged to the environment using nature-based solutions.
Output measurement and reporting	Number of schemes with completion of WFD interventions to meet the WFD intermittent targets for the waterbody, set out in the WINEP, reported to zero decimal places. The company will report completed activities in parallel with the APR. For the completed storm overflow schemes, the company should also report the solution, such as storage provided or area of surface water separation. The company will measure whether improvements meet the compliance assessed against the appropriate in-river Water Framework Directive (WFD) intermittent targets defined as part of the original studies through modelling spill frequency before and as a result of interventions.
Assurance	The company must commission an independent, third-party assurer, with a duty of care to Ofwat, to assure, to our satisfaction, that the conditions below have been met and the outputs of the scheme set out below have been delivered.
Conditions on Scheme	The works will be undertaken in two schemes covering one or more assets: • Bradford Beck scheme

	○ Frizley Gardens ○ North Avenue ○ Preston Street ○ Longside Lane ○ Little Horton Lane No 2 ○ George St Bradford • Oakenshaw Beck scheme ○ Danesmoor CSO For Bradford Beck, we have identified six assets that may require interventions, but as stated in the WINEP we have agreed to work collaboratively with the Environment Agency in the delivery of the outcome of improving the quality of the watercourse, so the assets and solutions may change because of this collaborative working.

We have set our delivery profile to reflect the establishing the supply chain and contract partners to meet the EA's regulatory compliance dates across our WINEP storm overflows programme and based on our current delivery processes. It should be noted that these interventions are significant on complex infrastructure and although they appear to be back end loaded, these will be stretching but we consider achievable targets to hit. The profiles also allow for time to work collaboratively with the EA on these solutions as noted in the WINEP.

14.7.3.1 Forecast deliverables

Table 1.29: Forecast Deliverables – WFD_IMP

Deliverable	Unit	Forecast Deliverables				
		2025/26	2026/27	2027/28	2028/29	2029/30
Bradford Beck UPM Solution	Number	0	0	0	0	1
Upper Rother UPM Solution	Number	0	0	0	1	0

14.7.3.2 Interim milestone

Consistent with Ofwat's guidance, we have considered where we can propose an interim milestone where we only have end-of-AMP delivery completion milestones. We propose the following interim milestone:

Table 1.30: Start on Site Milestone Description

Milestone	Description
Start on site	Completion of: • Planning approved • Design Accepted • Procurement contracts signed & ordered • All permits submitted • Start onsite letter issued by Project Manager • Partner takes over site • Delivery contract signed • Accurate spend forecast received for the construction phase This stage also includes significant surveys and ground investigations.

Once we reach the 'start on site' milestone, we are committed to the full cost of the project through signed contracts with obligations to our contract delivery partners. Based on our experience of undertaking projects of this size, we estimate that there will be between 2-3 years of construction work in order to deliver the beneficial completion of a project.

Given this lead time, we must reach this milestone by the mid-point of AMP8. If we reach this milestone later, we will not complete the project but will have incurred a significant amount of the allowed spend. Therefore, returning the whole scheme cost for non-delivery would not align with the completed activities.

We consider that if we are delayed in reaching our start on site milestone, by the end of the AMP we will still have incurred 70% of the costs. Therefore, we should return the 30% to customers and re-apply for the remainder of the funding in AMP9. As noted in Ofwat's IN23/05, where we are months from beneficial completion at the end of AMP8 we will provide evidence to Ofwat on why we should retain all funding to complete the scheme early in AMP9.

14.7.3.3 PCD payment rate:

Table 1.31: Payment Rate - WFD_IMP

Milestone	Unit payment (£m)
Start on site milestone achieved but not beneficial completion	Return 30% of scheme value
No start on site milestone achieved	Return 100% of scheme value • Bradford Beck £110.762m • Upper Rother £4.340m

14.7.4 Annualised Outcome Delivery Incentives

We identified one common performance commitment that is impacted by this enhancement case. We have only included the forecast performance from enhancement totex to calculate the ODI impact for this case. We have included the benefit from the sites that will be delivered through DPC, hence we are incentivised to achieve the best contract for customers.

Table 1.32 below shows the forecast average number of spills per overflow monitored, extracted from line OUT5.74 and the benefits from the enhancements noted within the cases mentioned. We note that this is not the line taken for the Performance Commitment report, but we feel that this gives a greater ability to compare the benefits, without accounting for any penalties associated with the amount of time that the Event Duration Monitor is operational for.

Table 1.32 below also shows the forecast benefits in terms of reduction in average number of spills per overflow (based on the company's total number storm overflows) from the investments included in these proposed PCDs. It should be noted that the primary driver for these investments is from the Environment Act and therefore the assets chosen to be invested in are not selected to maximise spill frequency changes. The benefits have been calculated following the same methodology used in the OUT5 tables. Due to the Event Duration Monitoring being reported by calendar year and the investments by financial year, we have accounted for 75% of the benefits occurring in the year of delivery and 25% in the following year against the 2020 spill frequency baseline.

The numbers in the table below contribute to the enhancement benefits, but not the whole of the benefits, as Accelerated and DPC schemes have been removed, along with contributions from other WINEP schemes which are not included within the drivers included in this PCD.

Table 1.32: Forecast Benefits (OUT5.74)

PC	Unit	Forecast Benefits					
		2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Storm overflows overall	OUT5.74 - Average number of spills per overflow - monitored	27.98	26.05	25.64	24.64	23.52	21.61
WINEP - Storm Overflows - Env_Act IMP2 and 4 drivers as primary (excl. DPC and Accelerated)	Reduction in average no. of spills/ overflow	0	0.034	0.161	0.208	0.245	0.280
WINEP + Additional Coastal (non WINEP) - Coastal Storm Overflows - Env_Act IMP3 drivers as primary (excl. DPC and Accelerated)	Reduction in average no. of spills/ overflow	0	0.000	0.002	0.006	0.020	0.053
WINEP inland Non-designated bathing water overflows (excl. DPC and Accelerated)	Reduction in average no. of spills/ overflow	0	0.000	0.000	0.005	0.019	0.007
WINEP - Bradford Beck WFD_IMP	Reduction in average no. of spills/ overflow	0	0.000	0.000	0.000	0.010	0.033
Total	Reduction in average no. of spills/ overflow	0	**0.034**	**0.162***	**0.219**	**0.293**	**0.373**
Cumulative benefits		0	**0.034**	**0.196**	**0.415**	**0.708**	**1.081**

*rounding

14.7.4.2 Forecast ODI impacts

The total exposure has been calculated based on the sum of the year-on-year cumulative benefits for the AMP8 period.

Table 1.33: Forecast ODI Impact

PC	ODI rate (£m / unit)	Total ODI exposure (£m)
Storm overflows	1.39	1.88

It should be noted that the performance against this ODI is highly dependent on the rainfall weather patterns in a year. The forecast benefits are based on a “typical” year. It can be seen from the installation of our EDMs the weather plays a significant part in the annual performance.

14.7.5 Annualised time delivery incentive

We considered the extent a timing incentive would appear to be appropriate to accompany the chosen PCD. We note the Storm Overflow PC and ODI associated with this enhancement case does not provide sufficient protection for customers, as the ODI exposure is less than 3.5% of the enhancement totex.

However, we think that having a time incentive would restrict our ability to select the best solutions for the catchment to ensure we meet each timing deadline.

We have set out that 20% of our interventions will incorporate blue/green techniques. We have a stretch target to achieve 40% of solutions incorporating blue/green techniques in the next AMP. In our experiences of delivering blue/green focused programmes such as our Living with Water partnership, we are aware that nature-based solutions take significantly longer to deliver than those of a traditional nature. This is due to the need to build relationships to work collaboratively through the planning and design processes with all stakeholders, including various departments in local authorities, the Environment Agency, Internal Drainage Boards, local interest groups and residents and businesses. For traditional solutions it is much simpler, water companies have powers to implement them where there is a need to and often the area post construction has minimal change compared to the original landscape.

We consider that the novelty of the programme also requires some flexibility in the scheduling. We are developing the scale of the programme and will seek the best value solution through negotiating contracts with delivery partners. Allowing flexibility in within AMP phasing means we can seek optimisation opportunities through our tender process and negotiate delivery incentives that achieve both our regulatory deadlines and our ambition to improve the extent of blue/green techniques implemented.

We also consider a time incentive would not be appropriate for our investigations programme that will inform PR29. We usually complete these investigations on time and to specification except for two scenarios: 1) we receive inconclusive evidence and need further investigation or 2) weather conditions prevent us from the required sampling and monitoring. In both instances, we will bear the cost of rescheduling or extending our investigations programmes and are therefore incentivised to keep to our programme schedule and hence regulatory deadlines. The PCD protects customers from the key uncertainty that we may agree a reduced scope with the EA during AMP8.

14.7.6 Third Party Funding or Delivery Arrangements

We confirm that investment proposed under DPC will be excluded from the PCD above and that we have no third-party funding associated with the delivery of this case.

15. Wastewater: Monitoring of Discharges

15.1 Driver:

U_MON3, U_MON4, U_MON6 and EPR_MON1

15.1.1 Requested Investment:

Table 1.1: Monitoring of WwTW Intermittent Discharges and WTW Discharge Flows Enhancement Case Requested Expenditure

	£m	Table Line Ref.
Enhancement Expenditure Capex	84.099	CWW3.1, CWW3.4, CWW3.10
Enhancement Expenditure Opex	0.780	CWW3.2, CWW3.5, CWW3.11
Base Expenditure Capex		
DPC value		
Total	**84.879**	

In addition, there is £0.24m Capex in table CW3.

15.1.2 Associated Reporting lines in Data Table

Table 1.2 CWW3 Reporting Lines

Line Number	Line Description
CWW3.4	Flow monitoring at sewage treatment works; (WINEP/NEP) wastewater capex
CWW3.5	Flow monitoring at sewage treatment works; (WINEP/NEP) wastewater opex
CWW3.6	Flow monitoring at sewage treatment works; (WINEP/NEP) wastewater totex
CWW3.10	MCERTs monitoring at emergency sewage pumping station overflows (WINEP/NEP) wastewater capex
CWW3.11	MCERTs monitoring at emergency sewage pumping station overflows (WINEP/NEP) wastewater opex
CWW3.12	MCERTs monitoring at emergency sewage pumping station overflows (WINEP/NEP) wastewater totex

There are some other tables linked to this case:

Table 1.3: CWW8 Reporting Lines

Line Number	Line Description
CWW8.4	Number of intermittent discharge sites with event duration monitoring

CWW8.5	Number of monitors for flow monitoring at STWs

Table 1.4: CWW20 Reporting Lines

Line Number	Line Description
CWW20.50	Number of new MCERTs event duration monitors installed at SPS emergency overflows
CWW20.51	Number of new MCERTs flow monitors (PFF) installed at SPSs with combined emergency and storm overflows.
CWW20.52	Number of event duration monitors installed (to include at STWs and in network)
CWW20.53	Number of event duration monitoring schemes requiring permit changes only (at STWs and in network)
CWW20.54	Number of event duration monitoring schemes requiring simple meter installations (at STWs and in network)
CWW20.55	Number of event duration monitoring schemes requiring complex civils installations (at STWs and in network)

15.1.3 Phasing of PR24 WINEP to AMP9

The actions identified within this enhancement case are all associated with WINEP actions, both statutory and non-statutory, as detailed throughout the enhancement case. Following correspondence from the Environment Agency on 5th July 2023 regarding deliverability, financeability and customer affordability of PR24, all water companies were asked to review their WINEP in line with the provided Secretary of State's steer. This included a review of exploring opportunities to phase all non-statutory commitments into future AMPs. We have proposed phasing of this driver in line with the guidance given by the Environment Agency.

- 75% (645 monitors) of the originally planned monitors for U_MON6 have been phased out to AMP9. 645 monitors will be installed in AMP9 at a cost of £57.380m.

Confirmation of this phasing was received by Yorkshire Water on 18th September 2023, and as such was too late to implement this phasing in PR24 data tables. The full expenditure therefore remains within Table CWW3 and the enhancement case below. The reporting lines and associated expenditure is included in the following sections of this enhancement case but is no longer required through the PR24 business plan:

Table 1.5: Associated capex/opex/totex costs for PR24 WINEP phasing

Line Reference	Detail	Cost
CWW3.10	MCERTs monitoring at emergency sewage pumping station overflows (WINEP/NEP) wastewater capex	£56.838m
CWW3.11	MCERTs monitoring at emergency sewage pumping station overflows (WINEP/NEP) wastewater opex	£0.542m
CWW3.12	MCERTs monitoring at emergency sewage pumping station overflows (WINEP/NEP) wastewater totex	£57.380m

Table 1.6: PR24 WINEP Phasing Effect on CWW20

Line Reference	Detail	Number
CWW20.50	Number of new MCERTs event duration monitors installed at SPS emergency overflows	645

CWW20.51	Number of new MCERTs flow monitors (PFF) installed at SPSs with combined emergency and storm overflows.	344

15.2 High Level Driver description:

The purpose of these monitoring drivers is to provide high quality information on the operation of wastewater overflows or for water treatment works discharge, accurate information on volume discharged to the environment. This data will be used by water companies to ensure assets are operating as expected and by the Environment Agency to check compliance with Environmental Permit conditions. The Environment Agency have determined where monitoring is required and the standard of the monitoring.

MCERTS is the Environment Agency's Monitoring Certification Scheme for environmental permit holders. MCERTS is used to approve people, instruments and laboratories. The MCERTS standard has recently been expanded to include event and duration monitors relating to storm overflows (i.e., monitors specified by Environment Agency driver U_MON3). All equipment and processes used by Yorkshire Water for these monitoring installations must be to MCERTS standard.[49]

15.3 Need for investment

15.3.1 The Need for the Proposed Investment

The Environment Agency (EA) have concerns that they cannot assess water companies' compliance to legal and permit requirements for storm discharges, emergency discharges and discharges of trade effluent from Water Treatment Works (WTW). Monitoring of storm discharges and trade effluent discharges are a continuation of work in previous AMPs and the monitoring of emergency discharges is new for PR24. To ensure that the monitoring is carried out to a consistent and high standard the EA have specified that for these drivers the installation must be to MCERTs standard.

We must install new monitoring equipment to meet each of the EA's drivers (references given are the EA driver codes):

- U_MON3 – Monitoring Certification Scheme (MCERTS) certified overflow operation monitoring at Wastewater treatment works (WwTW) or last in line Sewage Pumping Station (SPS) overflows. Measures when and for how long an overflow operates, this would typically be periods when excess flows are diverted to storm tanks. Typically, the monitor would be an ultrasonic level meter on an overflow weir.
- U_MON4 - MCERTS certified flow monitoring at WwTW or last in line SPS overflows. Monitors the rate of flows passed forward for treatment for comparison with the permit flows. Typical installations would be an electromagnetic flow meter on a pipe or flow measuring flume.
- EPR_MON1 - MCERTS certified WTW. Total daily volume flow/max flow rate monitoring. 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.

Details on the Environment Agency requirements for these monitors is included in their driver guidance 'PR24 WINEP driver guidance - Monitoring for flow compliance'. Below is an extract from this guidance.

[49] For further information refer to https://www.gov.uk/government/collections/monitoring-emissions-to-air-land-and-water-mcerts

Figure 2.1: Driver Guidance

Driver	Description
U_MON3	MCERTS certified FPF overflow operation monitoring at WwTW or last in line SPS overflows
U_MON4	MCERTS certified FPF flow monitoring at WwTW or last in line SPS overflows
EPR_MON1	MCERTS certified WTW Total daily volume flow/max flow rate monitoring

The final EA driver is:

- U_MON6 - MCERTS certified monitoring of emergency overflow operation on network sewage pumping stations. Monitors when an emergency overflow operates, where there is a related storm overflow the rate of pumped flows passed forward into the sewer network is also monitored.
- The U_MON6 driver to monitor the duration and frequency of emergency overflow operation to MCERTS standards aligns with Environment Act 2021 requirements to monitor and report on the operation of storm overflows.

Details on the Environment Agency requirements for these monitors is included in their driver guidance 'PR24 WINEP driver guidance –Emergency Overflows Monitoring'. Below is an extract from this guidance.

Figure 2.2: U_MON6 Driver Guidance

Driver	Description	Completion date
U_MON6	MCERTS certified monitoring of emergency overflow operation on network sewage pumping stations	31/03/2030

15.3.2 The Scale and Timing of the Investment

By the end of AMP8, the Environment Agency requires us to install a total of 1,118 devices across our sites. The table below sets out our proposed spend for each installation type.

Table 1.7: Expenditure by Installation Type

Driver	Number of devices	Totex £m
U_MON3	230 (Certification only)	£0.381
EPR_MON1	4	£0.239
U_MON4	24	£7.992
U_MON6	860	£76.506
Total	1118	£85.119[50]

Note: with the recent confirmation from DEFRA to phase 75% of U_MON6 into AMP9, we reduce our monitors from 860 to 215 and reduce associated costs by £57.38m. The total case value becomes £27.739m).

15.3.3 Interactions with Base Expenditure

We confirm this enhancement case does not overlap with base funding.

[50] This table varies to Table 1.1 as it includes the EPR_MON1 costs as well.

15.3.4 Activities Funded in Previous Price Reviews

U_MON3 monitoring is a driver in AMP7, the driver has increased in scope for AMP8 to include the MCERTS standard. The MCERTs standard has only recently been released, installations prior to the standard may not meet the standard and none of the installations have had the opportunity for MCERTs inspections. 230 monitors were installed in AMP7 that all need additional certification in AMP8. Monitors installed in AMP7 were chosen as they would likely meet the future MCERTS requirements and therefore funds for AMP8 are limited to minor changes and the certification costs.

U_MON4 monitoring and the related U_INV2 investigations into the installation of monitoring are AMP7 drivers. The majority of U_MON4 installations will have been completed in AMP7. For discharges where the U_INV2 investigations identified that significant works were required to install monitoring to U_MON4 standard then a U_MON4 driver has been included in AMP8.

U_MON6 monitoring is a new requirement and there have been no similar obligations in the past.

EPR_MON1 is a driver in AMP7 and there have been similar drivers in previous AMPs, none of the discharges included for AMP8 have had previous investment in previous AMPs.

15.3.5 Long-term Delivery Strategy Alignment

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about our LTDS at
Long Term Delivery Strategy

15.3.6 Customer Support

While this enhancement case is to meet our statutory requirements, we know that quality of water within the environment is important to our customers, and therefore monitoring wastewater discharges into the natural environment should be considered a priority area. We know, using the Ofwat/CCWater customer preferences research that river water quality is of medium importance to customers, when considering it within a wider list of performance commitment areas. It should be noted, however, that it is considered one of the most important environmental performance commitments and more relatable than others.

In our own Valuing Water customer priorities research, we tested 20 priorities with household and non-household customers, three of which were specifically related to water quality in rivers, streams and the sea. Both household and non-household customers prioritised all three of these priorities within their Top 6 service areas – highlighting the importance of environmental water quality to Yorkshire customers.

To read more about our wider engagement please see Chapter 6 of our main business plan.

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

15.3.7 Factors Outside of Management Control

Please refer to section 1.3.2.

15.4 Best Option for Customers

15.4.1 Options Considered

Options considered have been split into categories of Site Selection and Technology. The selection processes have been set by the Environment Agency with little or no scope for optioneering.

Site Selection

- U_MON3 – all overflows that meet the criteria will be delivered in AMP8, this is set by the Environment Agency and is the same as the list of installations in the AMP7 WINEP.
- U_MON4 – defined by the remaining sites that were not required to be delivered in AMP7 and have not had any funding to install in any previous AMPs. These are sites that could not be delivered by minor works on site and require significant civils works. The Environment Agency set a requirement to give 100% coverage of sites during AMP8.
- U_MON6 – 100% of sites that meet the criteria are required in AMP8.

Note: with the recent confirmation from DEFRA to phase 75% of U_MON6 into AMP9, we will need to determine which of the sites are to be phased.

Technology Selection

Technologies are those limited to devices and systems that have MCERTS accreditation. The selection from within the limited options is determined by the existing site conditions e.g., site layout and configuration.

- U_MON3 – we can only use MCERTS certified devices and need to certify the system. The choice of devices is therefore limited to those that the manufacturers have applied and received certification for. Whilst the certification was not known during the installation of the devices in AMP7, YW chose devices that are certified for use in other similar MCERTified installations in the expectation that the same devices will gain certification for use under U_MON3. We considered this choice should avoid the need to replace recently installed equipment before it has reached the end of its asset life. This has kept the costs down on this obligation to be mainly third party costs that are common to all companies. These are the costs associated with the external inspection and certificate issue and the cost charged by the EA to update the Environmental Permits.
- U_MON4 – the equipment requirements are nearly identical to those required for flow meters that have been in use for a number of years to measure volumes of treated sewage effluent to the environment and there is experience gained from installing monitoring for U_MON4 during AMP7. The choice of installation is determined by the existing site layout and there is no opportunity for innovation.
- U_MON6 – Monitors on emergency overflows are as a minimum similar to U_MON3 and in a number of cases additional flow monitoring similar to U_MON4 monitors.

15.4.2 Cost-Benefit Appraisal

Due to the prescriptive approach taken to these monitors by the Environment Agency there was no opportunity for cost benefit appraisal. There is typically only one option for each installation and where there is more than one there are no wider benefits and the least cost option is selected.

15.4.3 Carbon impact and best value

As stated above, we could not consider a wide range of benefits as part of our optioneering. The minimum expected benefits of this case, based on our best value analysis relate to the avoidance of compliance failures.

For information about this please see reporting table CWW15 and its associated table commentary.

15.4.4 Impact Quantification

There is no impact on our performance commitments. We will use data from the newly installed meters to inform our business decisions on where and how to prioritise investments.

15.4.5 Cost and Benefit Uncertainties

As stated previously, we had little scope for optioneering and selection of technology to install. We will manage uncertainty through our delivery, by using lessons learned from AMP7.

15.4.6 Third Party Funding

There are no opportunities for third party funding to deliver these drivers.

15.4.7 Customer Views

We have not carried out specific customer engagement on solution options related to this enhancement case given that it is a statutory requirement, but a summary of customer views can be found in our customer support section above.

15.4.8 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

15.5 Cost Efficiency

15.5.1 Option Costs

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in section 7.3 in Introduction to Enhancement Cases, has been applied to this enhancement case. Table 1.1 at the beginning of this document summarises the costs associated with this enhancement case.

Cost development for our preferred option

The total cost for monitoring in AMP8 is £85.119m. The table below sets out the cost for each driver:

Table 1.8: Costs by Driver

Driver	Cost (£m)
U_MON3	£0.381
EPR_MON1	£0.239
U_MON4	£7.992
U_MON6	£76.506
Total cost	**£**85.119[51]

Note: with the recent to confirmation from DEFRA to phase 75% of U_MON6 into AMP9, we reduce our monitors from 860 to 215 and reduce associated costs by £57.38m. The total case value becomes £27.739m).

We cover the costing approach we have taken for each of the investment drivers in turn.

U_MON3

[51] This table varies to Table 1.1 as it includes the EPR_MON1 costs as well.

As outlined earlier in this case, the installation for this driver has been undertaken in AMP7. The costs associated with this driver are costs for inspection and certification only.

EPR_MON1

Our costing estimate for this driver has been developed using our Unit Cost Database and our Decision-Making Framework (DMF) processes.

U_MON4

The equipment requirements are nearly identical to those required for flow meters that have been in use for a number of years to measure volumes of treated sewage effluent to the environment and there is experience gained from installing monitoring for U_MON4 during AMP7. We have taken a site-specific approach using our Unit Cost Database and our Decision-Making Framework (DMF) processes.

U_MON6

This driver is the largest component of our monitoring costs for AMP8. We have taken an assumption-based approach to estimating the costs at each site. We have used this approach due to the late timing of the guidance being issued.

Our approach involved assessing each site based on available data. We have then grouped the site into one of three categories. The categories provide a high-level indication of the expected works required to meet the requirements. We summarise the three categories and the components within them below:

- Category 1: Installation and certification of event monitoring – where the overflow is solely for use in an emergency. This covers MCERTS and EDM costs only.
- Category 2: Installation and certification for event monitoring and certification of existing flow meter – where the overflow is common to a storm discharge and there is an existing monitor(s). Covering MCERTS, EDM and MCERTS pass forward flow monitor costs.
- Category 3: installation and certification for event monitoring and Installation and certification of a flow meter – where the overflow is common to a storm discharge and there is no existing flow meter suitable for use. Covering the MCERTS, EDM and MCERTS pass forward flow monitor and civils costs.

Our approach to costing the components of the categories are as follows:

- MCERTS costs are set nationally. The certificate is issued by the EA. To obtain the certificate we undertake our own site inspection first. We use third party providers to undertake our site inspections, these are subject to a competitive tender process to ensure we are delivering cost efficiency.
- The civils costs use our Unit Cost Database (UCD) and our Decision-Making Framework (DMF) processes.

Efficiency of our cost estimate

Section 7.3 in Introduction to Enhancement Cases outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

Estimates were developed using the expertise of our Strategic Planning Partner to determine scope and using UCD models to create efficient cost estimates. Our UCD approach involves building detailed cost estimates that are developed using historic cost information on individual components of an overall solution.

15.5.2 Need for enhancement model adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging.

However, we would anticipate that Ofwat could recreate its modelling approach from PR19 for this activity. We previously identified that costs were driven by both the total number of sites but importantly by whether or not the site had an existing meter and whether any civils investment was required. We recommend that Ofwat considers these additional variables when creating a model to assess U_MON driver costs at PR24.

15.6 External assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

15.7 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

We reviewed our forecast enhancement totex and found we no longer meet the 1% materiality threshold for PCDWW3 with the change in phasing of our monitoring programme. During drafting we considered any PCD would measure the number of monitors installed and could be similar to our proposed mechanism for PCWW2.

15.7.1 Third Party Funding or Delivery Arrangements

This is not applicable for this case.

16. Wastewater: Septic Tank Removal and Replacement

16.1 Driver:

U_IMP7

16.1.1 Requested Investment:

Table 1.1: Proposed Septic Tank Expenditure

	£m	Table Line Ref.
Enhancement Expenditure Capex	17.373	CWW3.91, CWW3.94
Enhancement Expenditure Opex	0.898	CWW3.92, CWW3.95
Base Expenditure Capex		
DPC value		
Total	**18.271**	

16.1.2 Associated Reporting lines in Data Table:

Table 1.2: CCW3 Reporting Lines

Line Number	Line Description
CWW3.91	Septic tank replacements - treatment solution; (WINEP/NEP) wastewater capex
CWW3.92	Septic tank replacements - treatment solution; (WINEP/NEP) wastewater opex
CWW3.93	Septic tank replacements - treatment solution; (WINEP/NEP) wastewater totex
CWW3.94	Septic tank replacements - flow diversion; (WINEP/NEP) wastewater capex
CWW3.95	Septic tank replacements - flow diversion; (WINEP/NEP) wastewater opex
CWW3.96	Septic tank replacements - flow diversion; (WINEP/NEP) wastewater totex

16.2 High Level Driver description:

Septic tanks are used to treat wastewater from very small settlements where there is low environmental impact from treated wastewater discharges. Most septic tanks discharge to ground via a soakaway. A small number of Yorkshire Water's septic tanks discharge to watercourse. U_IMP7 is a statutory requirement applying to septic tanks that discharge to watercourse. The requirement is to remove the discharge from the watercourse and discharge to ground via a soakaway or to retain the discharge to watercourse and replace the septic tank with a more conventional treatment works capable of achieving a standard of 60mg/l suspended solids (SS) and 40mg/l Biochemical Oxygen Demand (BOD). The table below is from the EA Driver guidance.

Driver code	Description	Legal obligation	Tier 1 outcome
U_IMP7	Provide secondary treatment capable of achieving 40:60 BOD:suspended solids where a septic tank discharges to surface water.	S	Water company actions to protect the environment from the effects of urban wastewater collection and discharges

16.3 **Need**

The need for the proposed investment

The need for the proposed investment is to improve discharge quality by replacing or upgrading septic tanks that discharge into surface water with secondary treatment which will contribute to the delivery of Water Framework Directive (WFD) objectives of achieving Good Ecological Status (GES) in receiving surface water bodies. It will also contribute to the following 25 Year Environment Plan objectives, 'Chapter 4 – reducing the impact of wastewater'. Government Policy requires septic tank discharges to surface water to be upgraded to secondary treated sewage effluent discharges to surface water. This is aligned to the Urban Wastewater Treatment Regulations (UWWTR) 1994 requirements in relation to duties to provide and maintain wastewater collecting systems and operate treatment plants and provide "appropriate treatment". These requirements mean that septic tank discharges to surface water need to be upgraded to provide secondary treatment.

16.3.1 The Scale and Timing of the Investment

Following publication of the driver guidance a series of meetings were held involving both YW and EA colleagues. The first meeting was to achieve a mutual understanding to the requirements of the driver. Data was shared on specific assets where both parties had evidence to suggest that actions would be required under this driver. EA and YW lists of assets were collated into one longer list. Initially 58 specific sites were identified as potentially requiring action. YW carried out a desktop exercise interrogating its databases and systems. This resulted in several sites being suggested for removal from the list due to: -

- The site being found to already have secondary treatment
- The site found to be already discharging via a soakaway.

This data was shared with the EA for examination by local officers. This exercise reduced the number of assets that required action by 28. It was agreed that the remaining 30 assets require action under this driver.

The regulatory date for completion of the upgrading work is 31/03/2028.

The table below shows the individual sites. With associated WINEP action Identification numbers. It should be noted that there are 31 lines in this table. The solution at Reeth (Action ID 08YW100172a) is included to accommodate the flow from Grinton East and Grinton West (Action IDs 08YW100018a & 08YW100019a respectively). The only viable solution at Grinton East and Grinton West is to pump the sites away. This is due to local land availability restrictions. The nearest wastewater treatment works that can receive the flow is Reeth WwTW, hence it is included here as it will require an upgrade to accommodate the additional flow. This approach and the above solution have been discussed and agreed with the Environment Agency.

Following on from the agreed list of sites, we received further instruction from the Environment Agency on 5th July 2023 to phase the U_IMP7 driver across AMPs 8 and 9. Further detail provided by the Environment Agency by email on 17th August 2023, required an assessment to ensure any discharges into or upstream of a Site of Special Scientific Interest (SSSI), Special Protection Area (SPA) or Special Area for Conservation (SAC) were delivered in AMP8, whilst those that did not were phased into AMP9. Yorkshire Water have undertaken this assessment, and we propose to phase £14.4m Totex of the total £18.3m shown in Table 2.1 as follows:

- Treatment Solution Capex £8.3m (CWW3.91), Treatment Solution Opex £0.46m (CWW3.92).
- Flow Diversion Capex £5.3m (CWW3.94), Flow Diversion Opex £0.27m (CWW3.95).

Table 1.3: Proposed Phasing

			5th July 2023 EA Phasing	
WINEP Action ID	**Primary Driver**	**Action Name**	**SSSI/SAC/SPA**	**Proposed Phasing**
08YW100005a	U_IMP7	ALDWARK BOAT CLUB/STW	N/A	AMP9
08YW100006a	U_IMP7	ARRATHORNE/STW	N/A	AMP9
08YW100007a	U_IMP7	BALDERSBY ST JAMES/STW	N/A	AMP9
08YW100008a	U_IMP7	BARMBY BANKFIELD/STW	Permitted DWF:Q95 river flow ratio >1:8 (1:30,038)	AMP9
08YW100009a	U_IMP7	BELL BUSK/STW/	N/A	AMP9
08YW100010a	U_IMP7	BEVERLEY ROAD NORTON/STW	Discharges to tributary of river Derwent SSSI	**AMP8**
08YW100011a	U_IMP7	CB TERRACE/STW	N/A	AMP9
08YW100012a	U_IMP7	DUNKESWICK/STW	Discharges upstream of East Keswick Fitts SSSI	**AMP8**
08YW100013a	U_IMP7	EAST NESS/WTW STW	N/A	AMP9
08YW100014a	U_IMP7	ECCUP/STW	Discharges upstream of East Keswick Fitts SSSI	**AMP8**
08YW100015a	U_IMP7	ELLERBECK/STW	N/A	AMP9
08YW100017a	U_IMP7	ELVINGTON/WTW/STW	Discharges to river Derwent SSSI	**AMP8**
08YW100018a	U_IMP7	GRINTON EAST/STW	N/A	AMP9
08YW100019a	U_IMP7	GRINTON WEST/STW	N/A	AMP9
08YW100020a	U_IMP7	HEALAUGH REETH/STW	N/A	AMP9
08YW100021a	U_IMP7	HOLME ON THE WOLD STW	N/A	AMP9
08YW100022a	U_IMP7	KIRBY SIGSTON/STW	N/A	AMP9
08YW100023a	U_IMP7	LEIGHTON COTTAGES/STW	N/A	AMP9
08YW100024a	U_IMP7	LINDLEY LODGE/STW	Discharges upstream of East Keswick Fitts SSSI	**AMP8**

08YW100025a	U_IMP7	LOW COMMON/STW	N/A	AMP9
08YW100026a	U_IMP7	MIDDLETON QUERN/STW	Upstream of Ripon Parks SSSI	**AMP8**
08YW100027a	U_IMP7	ORNHAMS/STW	N/A	AMP9
08YW100028a	U_IMP7	PICKWOOD SCAR/STW	N/A	AMP9
08YW100029a	U_IMP7	REDMIRES/NO 2 STW	Discharges to Wyming Brook SSSI, SAC & SPA	**AMP8**
08YW100030a	U_IMP7	THIRKLEBY/STW	N/A	AMP9
08YW100031a	U_IMP7	THIRN/STW	N/A	AMP9
08YW100032a	U_IMP7	THORNTON STREET/STW	N/A	AMP9
08YW100033a	U_IMP7	UPSALL/STW	N/A	AMP9
08YW100034a	U_IMP7	WEARDLEY/STW	Discharges upstream of East Keswick Fitts SSSI	**AMP8**
08YW100035a	U_IMP7	WELWICK NO.2/STW	Discharges upstream of Humber Estuary	**AMP8**
08YW100172a	U_IMP7	REETH/STW	N/A	AMP9

16.3.2 Interactions with Base Expenditure

We confirm this enhancement case does not overlap with base funding.

16.3.3 Activities Funded in Previous Price Reviews

This is a new driver for PR24. Therefore, there has been no activity under this driver in previous AMPs.

16.3.4 Long-term Delivery Strategy Alignment

The investment identified here is contained within the LTDS core pathway for AMP8. However, following recent request from EA/Defra to phase investment into future periods, the LTDS will need to be reviewed to reflecte the impact of this phasing request. It is now envisaged that this driver will continue in future periods.

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about this at
Long-Term Delivery Strategy

16.3.5 Customer Support

We have not carried out specific customer engagement related to this enhancement case given that it is a statutory requirement.

16.3.6 Factors Outside of Management Control

Please refer to section 1.3.2.

16.4 Best Option for Customers

16.4.1 Options Considered

Yorkshire Water followed the Environment Agency guidance in the development of options. We developed an Unconstrained List of options. This was a wide-ranging list, some of which were not appropriate for the requirements. Therefore, this was reduced to a Constrained List and further reduced to a Feasible List.

Figure 2.1: Constrained options

Approach	Constrained	Comments
Increase treatment capacity	✓	Package Plant
Nature Based Solutions	✓	Reedbed or ICW
Rationalise asstets	✓	Pump to nearby STW
Sidestream excess flows through passive systems	✗	Reedbed or ICW
Wetland	✓	Reedbed or ICW
Innovative treatment processes	✗	Unidentified process
Soakaway	!	Suject to Ground Water Risk Assessment

The options on the feasible list were entered into the Yorkshire Water decision making framework, (DMF) and this provided costs and benefits for each solution.

Figure 2.2: Feasible options

Approach	Constrained	Comments
Increase treatment capacity	✓	Package Plant
Nature Based Solutions / Wetland	✓	Reedbed or ICW
Rationalise asstets	✓	Pump to nearby STW
Soakaway	!	Suject to Ground Water Risk Assessment

Across the sites we have been able to adopt one solution or a combination of solutions. We cannot yet plan for the soakaway solution until we have done our site investigations. We must undertake a groundwater risk assessment to determine whether this type of solution has the chance of contaminating the groundwater.

We have considered where we could adopt nature-based solutions, including an integrated constructed wetland (ICW). We had to exclude this option for the sites with land area constraints, such as housing or streams/rivers.

It is not possible to define site by site preferred solutions at this stage.

The preferred solutions are those successfully integrated onto the feasible list and will differ on a site-specific basis pending site investigations, as part of scheme delivery. Table 2.3 sets out all sites considered and those we propose to progress in AMP8.

16.4.2 Cost-Benefit Appraisal

Our solution development focused on how we could meet the need as specified within the WINEP driver guidance. As described above, we are still working through the detailed design to determine a preferred solution, which will be informed by each site's specific characteristics.

16.4.3 Carbon impact and best value

We sought to adopt nature-based solutions where possible. However, some sites were constrained in terms of available land area, as outlined previously. The benefits associated with delivery of these solutions are total area restored or protected and avoidance of legal non-compliance. These benefits are described in Table CWW15.

16.4.4 Impact Quantification

There is no impact on performance commitments from this enhancement case.

16.4.5 Third Party Funding

There is no third party funding planned for this driver.

16.4.6 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

16.4.7 Customer Views

We have not carried out specific customer engagement related to this enhancement case given that it is a statutory requirement.

16.5 Cost Efficiency

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in section 7.3 of Introduction to Enhancement Cases, has been applied to this enhancement case. Table 2.1 at the beginning of this document summarises the costs associated with this enhancement case:

16.5.1 Cost estimate for our preferred option

Our costing estimate has been developed using our Unit Cost Database and our Enterprise Data Analytics processes within the Decision-Making Framework (DMF). Further details on how we have applied these tools to develop cost estimates are provided in section 7.3. Key assumptions used to create cost estimates for this enhancement case are discussed below.

Scope of work

As outlined earlier in this case, 30 assets requiring intervention were identified through the PR24 WINEP process in consultation with the Environment Agency. We then followed Environment Agency guidance in the development of options, working from an unconstrained list to a constrained list before reducing to a feasible list that reflected site specific characteristics. Our costing approach was applied to these solutions, which broadly fell into three categories: grey, transfer and green.

Cost development

The table below outlines the costing approach applied for the three categories of solutions proposed in this case.

Table 1.4: Costing Approach by Category

Option	Approach
Grey options	The grey option solutions involve a Submerged Aerated Filter (SAF) package plant. Options were costed using a cost model within our Unit Cost Database. Given the relatively low levels of flow (m^3/d) associated with the proposed sites, the lower limit of this cost model was used to develop estimates covering civils and mechanical and electrical cost elements, plus rates and maintenance as part of associated opex costs. At some sites, a green option was not possible due to a range of location specific factors, including difficult access, proximity to agricultural land, steep slope, near a clean water treatment works (so a contamination risk); limited space available within site boundary due to existing assets or buildings and/or insufficient land available close to the site. Some sites also already had a power supply or pumping station, meaning that a grey option represented the most efficient solution from an installation and maintenance perspective.
Transfer options	In some cases, transfer to the nearest main sewer or wastewater treatment works was the most robust and viable option. Scopes for transfers to main sewers were developed in

	conjunction with our Strategic Planning Partner, including pumping stations, kiosk, odour control and power supply. Measures relating to the upsizing of wastewater treatment works were developed internally to treat the additional flow. Both scopes were costed using the latest version of the cost models within the Decision-Making Framework (DMF).
Green options	Green options considered included a bioretention system, reed bed, integrated constructed wetland (ICW) or French drain. Measures and site details for each green option were developed in conjunction with our Strategic Planning Partner to develop bottom-up cost estimates using SuDs costing tools. These tools were built using SPONs data, given a lack of historical data due to the new nature of such schemes. Estimates were also made for land purchase requirements, using assumptions of future population growth to inform assumptions.

16.5.2 Efficiency of our cost estimate

Section 7.3 of Introduction to Enhancement Cases, outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case. application of this approach to this specific enhancement case.

For our proposed implementation costs, estimates were developed using the expertise of our Strategic Planning Partner to determine scope and using UCD models to create efficient cost estimates. Our UCD approach involves building detailed cost estimates that are developed using historic cost information on individual components of an overall solution. Where historical cost estimates were not available (for example, in the case of green options), bespoke modelling was developing using external benchmarks in the form of SPONs data.

16.5.3 Need for enhancement model adjustment

Without a view of the Ofwat approach to assessing this driver it is not possible to estimate the need for an adjustment. If sufficient data is available from the industry, we believe this driver may be a suitable candidate for an econometric model, the key drivers affecting cost are:

- Nr of Sites – scale variable. These are typically small sites, so this is likely to be more appropriate than using a Nr / Population Equivalent.
- Solution type – In the majority of cases nature-based solutions such as soakaways and wetlands are cheaper solutions with additional biodiversity benefits than a standard package plant solution to achieve compliance. However, it is not always technically feasible.

We therefore encourage Ofwat to explore a modelling approach for this area but one that includes both of these key drivers.

If an appropriate model cannot be developed, then this area should be assessed using a shallow/deep dive approach dependent on materiality.

16.6 Third party assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

16.7 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

Our enhancement totex for this case does not meet the materiality threshold for any PCD groupings. There is sufficient regulatory oversight for our activities under the WINEP, therefore we do not propose any customer protection mechanisms for this case.

16.7.1 Third Party Funding or Delivery Arrangements

This is no third party funding proposed for this driver.

17. Wastewater: Schemes Driven by Population Numbers

17.1 Driver:

Driver: U_IMP1 and U_IMP2

17.1.1 Requested Investment:

Schemes under the Urban Waste Water Treatment Directive share Enhancement Categories with the much larger Water Framework Directive and the Environment Act investment programmes (refer Table 1.2). Please note that the schemes under U_IMP2 described in this document are covered by the PCD in the River Water Quality Improvements Enhancement Case. The costs to deliver the U_IMP2 schemes are also covered in the River Water Quality (Sanitaries and Nutrients) enhancement case but are referenced here for clarity. They should not be double counted. The U_IMP1 cost of £30k is exclusive to this case.

Table 1.1: Proposed Expenditure for Schemes Driven by Population Numbers Under the Urban Wastewater Directive (U_IMP1 and U_IMP2)

	£m	Table Line Ref.
Enhancement Expenditure Capex	7.168	CWW3.64
Enhancement Expenditure Opex	0.240	CWW3.65
Base Expenditure Capex	0.037	CWW2.16
DPC value	N/A	
Total	**7.445**	

17.1.2 Associated Reporting lines in Data Table:

Table 1.2: CWW3 Reporting Lines

Line Number	Line Description
CWW3.64	Treatment for phosphorus removal (chemical) (WINEP/NEP) wastewater capex
CWW3.65	Treatment for phosphorus removal (chemical) (WINEP/NEP) wastewater opex
CWW3.66	Treatment for phosphorus removal (chemical) (WINEP/NEP) wastewater totex

17.2 High Level Driver description:

The Urban Wastewater Treatment Directive (UWWTD) has many requirements that apply to all sewage treatment works that serve a given population size or greater. The requirements are many and varied. This enhancement case concerns the above drivers (U_IMP1 and U_IMP2) and how Yorkshire Water has applied these drivers to PR24.

U_IMP1 requires that any sewage treatment works (STW) that serves a population of greater that 2000 shall, as a minimum, treat to a standard of 25mg/ biochemical oxygen demand (BOD) and 125mg/l chemical oxygen demand (COD). These standards may be more or less stringent than other standards that apply at the same STW under different legislation.

U_IMP2 requires that any STW that serves a population of greater that 10,000 shall, as a minimum, treat to a standard of 2mg/ total phosphorus (TP) where it discharges to a waterbody that had been designated as a Sensitive Area for Eutrophication (SAe). Any STW that serves a population of greater that 100,000 shall, as a minimum, treat to a standard of 1mg/l TP where it discharges to a waterbody that had been designated as an SAe. These standards may be more or less stringent than other standards that apply at the same STW under different legislation. The table below is from the EA Driver Guidance document.

Figure 1.1: Extract from the EA Driver Guidance

Driver code	Description	Legal obligation	Tier 1 outcome
U_IMP1	Actions to improve discharges from agglomerations that, through population growth, have crossed the population thresholds in the UWWTR and therefore must achieve more stringent UWWTR requirements. This includes newly qualifying discharges (from agglomerations >10,000 population equivalent (PE)) within existing Sensitive Areas. This includes discharges of >2,000 PE to fresh waters and estuaries and discharges >10,000 PE to coastal waters, as well as discharges >10,000 PE and 100,000 PE to Sensitive Areas.	S	Water company actions to protect the environment from the effects of urban wastewater collection and discharges
U_IMP2	Actions to reduce total phosphorus and/or total nitrogen levels in qualifying discharges (from agglomerations >10,000 PE) associated with the next review of Sensitive Areas (Eutrophic).	S	

Source: Environment Agency's PR24 WINEP driver guidance – Urban Waste Water Treatment Regulations V0.3 (2022).

17.3 Need

17.3.1 The Need for the Proposed Investment

These drivers cover the requirements of the Urban Wastewater Treatment (England and Wales) Regulations (UWWTR) 1994 (as amended) in terms of the provision of treatment plants, treatment, and the requirements for discharges. For the purposes of PR24, this means any new actions required to: -

A) improve discharges that through population growth have crossed population thresholds in the UWWTR, or
B) reduce phosphorus levels in qualifying discharges (from agglomerations >10,000 PE) associated with the next review of Sensitive Areas (Eutrophic) (SA(E), anticipated to become effective in 2022/2023, or

The nutrient reduction requirements for new Sensitive Areas will need to be met within 7 years of the effective date of the next Urban Waste Water Treatment Identification of Sensitive Areas Notice which is anticipated to be no later than May 2023, so by 2030. This means that although

compliance with the additional obligations of regulations is not required until the subsequent AMP delivery period, funding for this AMP period will allow the measures to be planned and delivered by the required date. Please see the profiling guidance for further details.

17.3.2 The Scale and Timing of the Investment

We propose to invest £7.2m over AMP8 on two WINEP drivers. This figure does not include costs for Harrogate North, Knaresborough, Rawcliffe York, York Naburn and Burley in Wharfedale WwTW U_IMP2 obligations as the permit limit is superseded by the tighter phosphorus limit driven by WFD_IMP and EnvAct_IMP1. The EA driver guidance specifies the types of activities and when they need to be completed:

Figure 1.2: Extract from EA Driver Guidance

Urban Wastewater Treatment Regulations		
Driver code	**Driver description**	**Completion date**
U_IMP1	Actions to improve discharges from agglomerations that, through population growth, have crossed the population thresholds in the UWWTR and therefore must achieve more stringent UWWTR requirements	31/03/2030 (Note 5)
U_IMP2	Actions to reduce total phosphorus and/or total nitrogen levels in qualifying discharges (from agglomerations >10,000pe) associated with the next review of freshwater Sensitive Areas (Eutrophic)	TBC (Note 6 and 7)

U_IMP2 drivers are still awaiting DEFRA sign off for the designation. Treatment must be installed 7 years after Sensitive Area designation. If the Sensitive Area (Eutrophic) designation is not approved, schemes under this driver will be removed from the programme.

For U_IMP1

Following publication of the driver guidance YW and EA colleagues agreed that no sites were crossing the 250 population threshold boundary and only one site was identified as crossing the 2000 population threshold. This site was put forward for permit change only as the site already performs to the required standards.

WwTWs proposed under U_IMP1 are:

Table 1.3: U_IMP1 Proposed Sites

WINEP Action ID	WwTW SAI Name	Permit Number	UWWTR PE Threshold Exceeded by 2030
08YW100039	EMBSAY/STW	2583 A1	>2000

For U_IMP2

Following publication of the driver guidance the EA published a spreadsheet containing new and additional waterbodies where evidence exists for eutrophication. It also identifies 15 Yorkshire Water assets that are contributing to this eutrophication. YW and EA colleagues reviewed these sites and this was followed by YW colleagues carry out a more detailed examination of the data. Following this, it was agreed that 5 sites were removed in line with the driver guidance. Specifically, they were removed as they were indirect inputs and found to be contributing less than 5% of the load to the waterbody.

WwTWs proposed under U_IMP2 are:

Table 1.4: U_IMP2 Proposed Sites

WINEP Action ID	WwTW SAI Name	Permit Number	Proposed Total Phosphorus Limit (mg/l)
08YW100001	COLBURN/STW	27/23/0123 A1	2
08YW100002	HARROGATE NORTH/STW	QR.27/21/0047 A1	2
08YW100003	KNARESBOROUGH/STW	QR.27/21/0031 1	2
08YW100004	RAWCLIFFE YORK/STW	27/24/0129 1	2
08YW100042	YORK NABURN/STW	27/24/0124 1	1
08YW100446	ILKLEY/STW	27/19/0045 1	2
08YW100045	WETHERBY/STW	27/20/0054 A1	2
08YW100036	THORP ARCH/STW	27/20/0068 A1	2
08YW100037	LEEMING BAR/STW	WRA6832 A1	2
08YW100043	BURLEY IN WHARFEDALE/STW	E164 / 3/ 1	2

U_IMP2 driver costs are covered with other Phosphorus removal actions in the River Water Quality (Sanataries and Nutrients) enhancement case. This case includes the costs and the PCD associated with this driver. The costs should not be double counted.

17.3.3 Interactions with Base Expenditure

There is a small amount of base associated with this case as part of a quality to base allocation. Where we have identified that exiting capacity is replaced as part of a solution, that expenditure is allocated to base. The total base in this case is £0.037m.

17.3.4 Activities Funded in Previous Price Reviews

Embsay has received investment under U_IMP1 in previous periods. It subsequently dropped below the population threshold. The current permit does not include the relevant Urban Wastewater Regulation treatment clauses. The investment proposed for AMP8 is for administration only to revise the permit to include the clauses needed to comply with the UWWTR.

Three sites Wetherby, Thorp Arch and Leeming Bar WwTWs already have 0.5 mg/l total phosphorus limits delivered in AMP6 under a WFD_IMP driver to achieve WFD Good status. We are not requesting funding for any additional treatment processes on site. For these three sites, we will update the environmental permit to include the relevant clauses for the Urban Wastewater Regulation sensitive area designation, 2 mg/l permit limit (in addition to the AMP6 0.5 mg/l permit clause), with the appropriate UWWTR sampling regime.

17.3.5 Long-term Delivery Strategy Alignment

The investment identified here is part of the AMP8 core pathway identified in the LTDS.

Please refer to section 1.3.1 for more information on our long-term delivery strategy.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about this at
Long-Term Delivery Strategy

17.3.6 Customer Support

While we did not carry out specific customer engagement on this enhancement case given that it is a statutory requirement, we do know that our customers are mindful that an increase in population is a huge driver for investment across our network and infrastructure. In customer research regarding our Drainage and Wastewater Management plan, the concept of population growth was a topic of discussion. Customers felt that population growth is likely to put pressure on an 'already creaking' wastewater drainage system and an acknowledgement that Yorkshire Water would need to invest in infrastructure to maintain service levels in the future. While this is not direct engagement related to this enhancement case, it shows a level of customer understanding when considering the impact of population growth on Yorkshire Water, and acknowledgement of subsequent increased costs.

To learn more about this, see Chapter 6 of our main business plan.

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

17.3.7 Factors Outside Management Control

Please refer to section 1.3.2.

17.4 Best Option for Customers

17.4.1 Options Considered

U_IMP1
The activity is permit administration for Embsay WwTW, there are no options to consider.

U_IMP2
The feasible list of options for this driver is severely curtailed as the regulation requires end of pipe solutions only. The UWWTR is clear that wastewater must be treated at the WwTW prior to being discharged to the environment. The options on the feasible list were entered into the Yorkshire Water Decision Making Framework (DMF) and this provided costs and benefits for each solution.

17.4.2 Impact Quantification

Obligations under U_IMP2 driver for phosphorus removal are included in the phosphorus load removed performance commitment forecasts for 'River water quality'. We have set out the cumulative impact from all phosphorus schemes in the enhancement case for sanitary and nutrient improvements. Our solution development has been constrained by the WINEP statutory obligations and therefore, there has been no meaningful opportunity to consider wider benefits. The benefits associated with delivery of these solutions are avoidance of legal non-compliance and improved river water quality.

These benefits are described in Table CWW15 under the shared Enhancement categories. As these schemes arise from statutory drivers the only benefit articulated is of legal compliance after completion of the scheme. Legal compliance is not monetised in our investment planning system.

17.4.3 Third Party Funding

There is no third-party funding planned for this driver.

17.4.4 Customer Views

We have not carried out specific customer engagement related to solutions for this enhancement case given that it is a statutory requirement, but views on population growth can be found in the customer support section above.

17.4.5 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

17.5 Cost Efficiency

Cost estimate for our preferred option

This section outlines how our overall approach to cost estimation and cost efficiency has been applied to this enhancement case. Table 1.1 at the beginning of this document summarises the costs associated with this enhancement case:

Cost estimate for our preferred option

As outlined earlier in this case, schemes were identified through the PR24 WINEP process through consultation with the Environment Agency. Our costing estimate has been developed using our Unit Cost Database and our Decision-Making Framework processes.

As part of our central approach to costing, information was collected regarding the characteristics of existing assets at identified sites and future consenting limits. Using decision tools additional assets are then generated with measures to meet the specified consent limit. Design measures are subject to verification by a technical consultant before cost models from our Unit Cost Database are applied to the scope specified.

The table below summarises the costs across the two drivers:

Table 1.5: Costs by Driver

Driver	Type of Cost Incurred	Site Name	Enhancement Capex cost (£)
U_IMP1	Permitting only	Embsay	£2,924
U_IMP2	Build schemes	Colburn	£2,576,267
		Ilkley	£3,326,931
		Harrogate North*	These 5 Schemes are superseded by schemes under more stringent Water Framework drivers – Refer See the enhancement case for 'River Water quality improvements (nutrients & sanitaries)".
		Knaresborough*	
		Rawcliffe York*	
		Burley in Wharfedale*	
		York Naburn*	
	Permitting, sampling, and monitoring	Wetherby	£420,622
		Thorp Arch	£420,622
		Leeming bar	£420,622
Total Cost			**£7,167,991^**

*Driver delivery is superseded by the tighter phosphorus limit under the WFD_IMP and EnvAct_IMP1 drivers therefore the costs are included in the sanitary and nutrients enhancement case.
^Please note that all costs apart from UIMP1 are included in the River Water Quality (Sanitaries and Nutrients) Enhancement Case. The PCD described in that case also covers UIMP2 schemes.

We have categorised the costs into three categories:

- Permitting only costs, these costs are the costs of the EA permits for the site.
- Permitting, sampling and monitoring costs include the permit costs for EA permits, plus costs for monitoring of P-levels.
- Build schemes are the enhancement costs required to meet new permit levels and include the cost of a built solution on the site, the dosing costs and monitoring costs.

Efficiency of our cost estimate
These costs were developed using the expertise of our Strategic Planning Partner to determine scope and using UCD models to create efficient cost estimates. Our UCD approach involves building detailed cost estimates that are developed using historic cost information on individual components of an overall solution.

Third party assurance
For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

17.5.1 Need for enhancement model adjustment

Phosphorus Removal Costs

We support Ofwat's approach of making use of benchmarking models to set efficient allowances where appropriate. The use of benchmarking models is based on company evidence-based data, and less regulatory judgment is involved when opting for deep dives and shallow dives assessments where companies' costs are comparable. However, without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging.

For Phosphorus removal costs, we believe Ofwat can build on its PR19 modelling approach which underwent significant iterations throughout the PR19 process and the CMA appeals. We believe Ofwat should weight any analysis to forward looking data as there will be diminishing returns to benefits being driven under these drivers as less beneficial Phosphorus removal schemes (£/PE) become statutory compared to the AMP7 programme.

In order to fully reflect efficient costs, a variety of key drivers need to be considered. The key variables impacting on the relative efficient cost of meeting Phisphorus removal obligations set by environmental legislation included the following:

- **Number and size of sites.** The scale of STWs that are affected by obligations. Companies with more affected sites, or larger sites, will – all else being equal – face greater costs of meeting their obligations. The size of sites is typically measured by load or by a site's Population Equivalent (PE).
- **Permit level.** The lower the absolute level of permit, the more costly it is to achieve. For example, it is more costly to achieve a permit level of 0.5mg/l than it is to achieve a permit level of 1mg/l. This is because lower limits require additional treatment units and additional chemicals leading to increased capital and operating costs.
- **Change in permit level.** Enhancement costs reflect step changes from current levels of service. The extent to which permit levels change can vary between companies, and therefore this drives differences in costs between companies. Companies that have received enhancement cost allowances in the past to achieve the UWWTD driver (typically a set 1 or 2 mg/l limit), may have less of a change to meet the WFD standard (set based on the output of river modelling) than a company that currently has no permit and has to achieve both standards.
- **Type of obligation / Availability of blue/green solutions.** The type of designation affects what solutions can be applied to achieve the required permit levels. The UWWTD is clear in that permit levels must be achieved by treating wastewater before it is discharged from the treatment works.

We note that as more evidence was provided to both Ofwat and the CMA related to these variables, improved models were introduced throughout the PR19 process. However, these new models, were triangulated with the original models that did not capture all relevant cost drivers, thus only partially funding the efficient allowance required. We urge Ofwat to develop models that incorporate all the valid variables in the first pass at PR24.

We welcome Ofwat's capturing of additional drivers and a breakdown by intervention types in its data tables. We would like to understand further how Ofwat's modelling will incentivise the best value solution to be delivered rather than the least cost in-AMP.

17.6 External Assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

17.7 Customer Protection

Although this enhancement case is not material on its own, the phosphorus activities (U_IMP2) are grouped with our River Water Quality Improvements case. We set out our proposed price control deliverable and other customer protection under PCDWW10 in that enhancement case.

17.7.1 Third Party Funding or Delivery Arrangements

This is not applicable for this case.

18. Bioresources: Improve the Resilience of Recycling Sludge to Land

18.1 Drivers

This case covers investment in compliance with the following WINEP drivers:

- SUiAR_IMP
- SUiAR_ND

18.1.1 Requested Investment

Table 1.1: Required SUiAR Investment

	£m	Table Line Ref.
Enhancement Expenditure Capex	43.502	CWW3.137, CWW3.143,
Enhancement Expenditure Opex	0.340	CWW3.138, CWW3.144, CWW3.169[52]
Base Expenditure Capex		
DPC value		
Total	**43.842**	

18.1.2 Associated Reporting lines in Data Tables

Table 1.2: CWW3 data table lines impacted by this case

Line Number	Line Description
CWW3.137	Sludge storage - Cake pads / bays / other; (WINEP/NEP) bioresources capex
CWW3.138	Sludge storage - Cake pads / bays / other; (WINEP/NEP) bioresources opex
CWW3.139	Sludge storage - Cake pads / bays /other; (WINEP/NEP) bioresources totex
CWW3.143	Sludge treatment - Thickening and/or dewatering; (WINEP/NEP) capex
CWW3.144	Sludge treatment -Thickening and/or dewatering; (WINEP/NEP) opex
CWW3.145	Sludge treatment - Thickening and/or dewatering; (WINEP/NEP) totex

[52] There is £0.106m in this reporting line which should be mapped to line 138, we will correct this in future.

18.1.3 High Level Driver description:

There are two WINEP drivers under this enhancement case:

- **SUiAR_IMP**, Actions to improve resilience in the sludge supply chain to agriculture and other relevant use or disposal outlets.
- **SUiAR_ND**, Actions to meet requirements to prevent deterioration in soil quality or water

The EA driver guidance gives a summary of the objective. Within this enhancement case all text within a text box is EA driver guidance or EA communications.

'The sewage sludge (biosolids) drivers in this document are aimed at delivering improvements in the resilience of the sludge management chain. This can be achieved by improved sludge management practices and the creation of suitably robust contingency measures. Developing and utilising new and additional sludge treatment and management technologies and with better contingency plans to manage impacts of climate change and periods of supply chain disruption will better serve the continuous production of treated sludge (biosolids) that are beneficially supplied to farmers for spreading onto their agricultural land.
Investments through these drivers will also support requirements to prevent deterioration in soil quality or water quality, as well as helping the Government's and Water UK's net zero commitments to be realised.'

Sewage sludge is predominately treated via Anaerobic Digestion (AD) or Advanced Anaerobic Digestion (AAD) This process produces biogas which can be used to power combined heat and power (CHP) engines to produce green electricity or converted to biomethane for injection to grid. The AD process produces digestate and once fully treated this material is called biosolids.

The Biosolids needs to meet a range of standards to be suitable for recycling to agriculture. The most important considerations are:

- Sludge Use in Agriculture Regulations (SUiAR)
- Biosolids Assurance Scheme (BAS)

The SUiAR sets out the requirements for recycling sludge to agricultural land in the UK. BAS is an industry supported assurance scheme primarily designed to assure the agricultural sector and its supply chain as to the quality and safety of the products supplied. YW only recycles biosolids to agriculture that are 100% compliant with BAS. In order to achieve the pathogen standards of the BAS, digested sludge is either held for a period of weeks (typically up to 6-8 weeks) on a concrete, drained pad, or a small addition of lime is added and the material is stored in an open sided Dutch barn. Storage on Dutch barn sites is limited to less than a week, as the product quality is achieved following the pH change in the biosolids. In 2022/23, 93.7% of YW's biosolids were recycled to agriculture, as some "legacy stocks" were deemed unsuitable and were recycled to land reclamation. In a more typical year ~99% of material produced in the year is recycled to agriculture.

A small proportion of biosolids may fail the standards and cannot be reprocessed to achieve the standards. In these cases, biosolids are recycled to land reclamation.

YW has submitted actions under SUiAR_IMP driver as this driver seemed the most appropriate in terms of the actions that are required.

18.2 Need

18.2.1 The Need for the Proposed Investment

Introduction to the risks associated with biosolids recycling.

The need for this investment is due to complexities outside of the control of the water industry which are making it increasingly difficult to recycle biosolids to agriculture in a timely manner.

Recently there has been an increasing number of factors out of the control of water companies that threaten the resilience of the supply chain of sewage sludge to agricultural land. The EA driver guidance explains the need for the proposed investment:

'An increasing number of factors that are out of the control of Water and Sewage Companies (WaSCs) threaten the resilience of the supply chain of sewage sludge to agricultural land such as:

● exceptional weather events preventing access to agricultural land,

● disease causing farmers to change their cropping plans which has an effect on the requirement for sludge;

● HGV driver shortages due to the global pandemic affecting the ability to transport sludge;

● and EU Exit affecting the ability to move sludge to land;

● as well as other regulatory or market requirements affecting land managers that have the ability to impact the supply and demand of sludge to land.

DEFRA have expressed support for these new sludge drivers to develop contingency measures when business as usual is disrupted to improve the resilience of the supply chain of sewage sludge to agricultural land. Water companies should take opportunity to fund appropriate improvements through their PR24 WINEPs'.

'A lack of access to alternative outlets or treatment technologies for sludge or ability to store sewage sludge temporarily in a compliant manner during times when agricultural land is not available demonstrates that contingency measures and long-term planning for sludge management require investment.'

The Environment Agency (EA) has worked with the water industry and has needed to provide time limited agreements called Regulatory Position Statements (RPS's) to allow business as usual activities to account for the lack of resilience and challenges in these areas. The SUiAR drivers facilitate an increase in resilience as well as improvement to the quality of the digestate being recycled to agriculture.

Indications from the EA within their Sludge Strategy and through meetings and conversations is they want to see sludge recycling to land continue as they view it as the current Best Practicable Environmental Option. The EA have stated they want to support the recycling of key nutrients present in biosolids, namely nitrogen (N) and phosphorus (P). However, the EA have been concerned for several years about the security of supply of this material through the supply chain and key issues such as wet weather leading to waterlogged farmland. The EA driver guidance states:

'The sewage sludge (biosolids) drivers are aimed at delivering improvements in the resilience of the sludge management chain. This can be achieved by improved sludge management practices and the creation of suitably robust contingency measures. Developing and utilising new and additional sludge treatment and management technologies and with better contingency plans to manage impacts of climate change and periods of supply chain disruption will better serve the continuous production of treated sludge (biosolids) that are beneficially supplied to farmers for spreading onto their agricultural land.

Investments through these drivers will also support requirements to prevent deterioration in soil quality or water quality (surface water), as well as helping the Government's and Water UK's net zero commitments to be realised'.

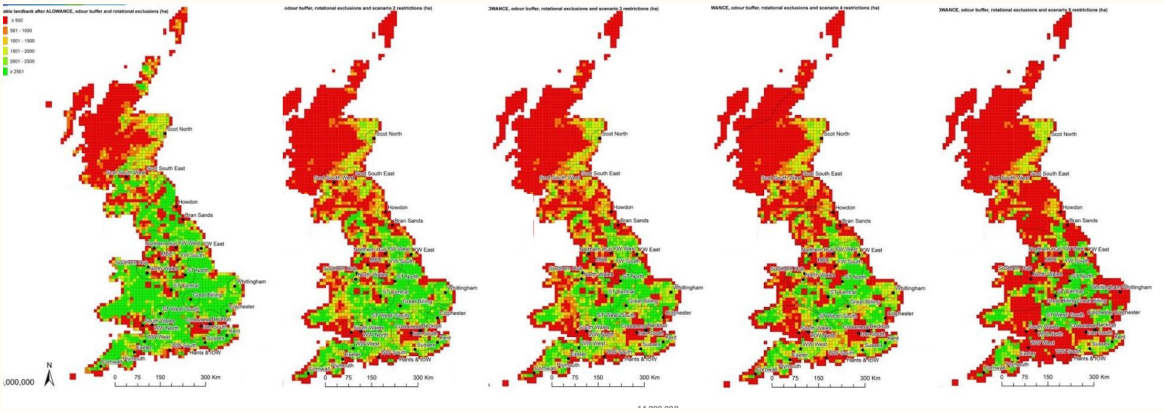
As well as the challenges outlined within the EA driver guidance, the industry is facing regulatory complexity, uncertainty, and more stringent requirements. For these reasons, YW welcomes the opportunity to improve resilience via the SUiAR drivers, however within this section YW wishes to also outline the wider complexities and explain why despite AMP8 improvements in resilience, the industry may face difficulties associated with the continuation of sludge recycling to agriculture. The current risks to landbank availability have been outlined by Grieve Strategic in their strategic modelling report into landbank availability. Grieve Strategic were commissioned by Water UK to review and model the landbank risk. In the report titled Grieve Strategic Landbank Modelling Report (Annex E1 in the Annex to the WINEP Enhancement Case document) they report that:

'In terms of pressure on landbank, there are a wide range of factors that could and do affect the amount of agricultural landbank available for biosolids recycling. The regulatory environment has and continues to be subject to change, which can create uncertainty and pressure on the landbank. The regulations governing the recycling of biosolids to agricultural land are under review and there has and continues to be significant discussion concerning the Farming Rules for Water (FRfW) regulations. Although the introduction of Statutory Guidance in relation to the FRfW appears to have abated concerns, there is still uncertainty around certain requirements and what may happen in the future. Phosphate management is likely to continue to come under renewed focus probably leading to a tightening of rules beyond what is currently allowed under the Biosolids Nutrient Management Matrix and even in terms of nitrogen management (e.g., autumn applications). Moreover, the exact form of the EA Sludge Strategy is still being decided, but it is likely to have a significant impact on the process, logistics and operations associated with the recycling of biosolids to agricultural land as well as other potential threats (including poly- and perfluoroalkyl substances (PFAS), microplastics and antimicrobial resistance)'.

Read more about this at
Annex to the WINEP Enhancement Case

Landbank modelling by Grieve Strategic modelled five scenarios, the figure below shows the results of the modelling side by side.

Figure 1.1: Grieve Strategic Landbank Modelling Scenarios



Findings were that for scenarios 1, 2 and 3 there is sufficient available agricultural land to recycle all GB biosolids via the modelled Sludge Treatment Centre (STC) configurations. For scenarios 4 and 5 there is insufficient available agricultural land to recycle all GB biosolids via the modelled STC configurations. The two key areas of sensitivity driving the change between scenarios 3 and 4 are no autumn applications before winter cereals and increased restrictions on P additions.

Risk to the environment

The timely removal of biosolids off site and recycling to agriculture is the only outlet available for this material.

If the lack of resilience continued into AMP8 or as a worst-case scenario the recycling outlet was not available, water companies would rapidly have a serious issue with sludges backing up through WwTW leading to non-compliance with the WwTW environmental discharge permit water quality limits.

Should a total collapse of the agricultural route for recycling materialise the most likely sequence of events would be biosolids storage on site at Sludge Treatment Facilities (STF) would begin to fill. Under currently existing storage, some YW sites would fill in less than five days, others over a period of several weeks to months. Four out of five of YW's five largest sites would be full of biosolids within a week. This would effectively leave two options:

a) Stop processing sludge.
b) Store sludge on unpermitted land, without suitable storage pads or drainage, potentially on other sites, without the requisite environmental permits for waste storage.

Option B would not be legally compliant. It would create large stocks of material which YW would have no outlet. These stocks would continue to grow until such a point as an outlet became available. If new technology is required (e.g., sludge destruction) this would take many years, possibly a decade, to deliver. This material would become an odour nuisance and result in high levels of complaints. Additionally, the biosolids would leach pollutants to land. Whenever any technological solution became available it would need to be oversized to cope with years of back-logs of stockpiles. Currently storing sludge without a permit does not impact on EPA assessments, but it is part of the EA's approach that inappropriate use of permits (or not having appropriate permits) would form part of EPA assessment by 2026. Whilst we do not know yet precisely how this would be calculated, in the event of the circumstances described above arising, YW would have multiple failures of permits, likely at a level that would produce an EPA assessment of 0 or 1 stars.

Option A would mean liquid sludge would back up in each WwTW. Sludge storage tanks would fill within a few days on larger WwTW, and within a few weeks on smaller WwTW. This would lead on to primary tanks being full of sludge, increasing loading to secondary treatment. Where activated sludge plants (ASP) are installed, mixed liquor suspended solids (MLSS) concentrations would increase, and within a week we would start to see loss of solids in final settlement tanks which would discharge to the river. There would be issues with providing aeration in the ASP lanes. This would lead to breaches of the permitted limits for suspended solids, Biochemical Oxygen Demand, Ammonia and Phosphate. In wet weather we would rapidly lose sludge blankets from the final settlement tanks which would cause widespread pollution events. Several of these events would have the potential to be category 1 or 2 pollution. This would cause significant damage to river water quality, affect the heath of the river and cause fish kills. YW would be assessed as a 1- or 0-star company on EPA assessment.

As Option A would rapidly become obviously unsustainable, and option B would require companies to operate outside of regulation, we believe companies would move to operating under option B as this would have the lower impact on the environment and increasing pressure on the government would mean that Regulatory Position Statements (RPS's) would be required to allow the least harmful environmental option at the time. This would likely require some recycling of biosolids to agriculture, perhaps under a RPS as occurred in 2022, whilst alternative solutions are developed.

The aim of these SUiAR drivers is to relieve the pressure of these bottlenecks in the process, and the provision of additional storage capacity reduces the speed of impact of the above issues. It also allows for better planning of applications to farmland, reworking or reprocessing material that is not compliant with farmer needs and will provide resilience to short term supply chain shocks. However, YW believes the coverage of these drivers and the solutions available are insufficient – and could not practically be made sufficient – to fully resolve the landbank issues should wholesale loss of agricultural land become an ongoing issue, where potentially years of storage would be required.

Environmental Protection

The five needs and solutions approved by the EA will provide an enhanced level of environmental protection and resilience to what YW has presently. This includes storage of biosolids in a safe and controlled manner before being removed and spread to farmland, protection against the inability to get the product to farmers, protection against the effects of re-wetting. Storage within a barn provides some protection against diffuse emissions to air such as odour or bioaerosols and it will ensure the material is stackable and will not slump on farmland.

Additional storage be that within barns or on pads will prevent leachate pollution to ground due to the provision of impermeable surfacing and captured drainage. It will facilitate the management of material that is out of specification with BAS and the measures introduced to comply with the FrFW measures introduced to meet the DEFRA guidance on FrfW. This will minimise the amount of material which needs to be sent to reclamation due to non-compliance. The enhanced dewatering at three sites will improve the quality of the biosolids in terms of reduced leachate run off and the reduced risk from slumping when stored on farmland. The provision of new robust dewatering systems at these sites will remain useful should the sludge strategy change to destruction technology in the future because incinerators can only accept feed with higher dry solids.

Pollutants

Whilst the EA's concerns are largely around N and P, investigations continue into the potential risks from persistent chemicals and microplastics. Although there is no scientific consensus in these areas as to appropriate solutions, these types of pollutants may be present and the public appetite for their presence in biosolids used in agriculture may mean the agricultural and food retail market moves at a faster pace than regulatory factors. This could produce greater rejection rates from farmers in order to protect their supply chains.

Overview of statutory and non-statutory requirements.

There are several complex, uncertain, interacting statutory and non-statutory requirements applicable to the storage, treatment, and recycling of biosolids.

- SUiAR (Statutory)
- BAS (Non-statutory)
- The EA's national Sludge Strategy - published in March 2020 (Non-statutory)
- The Industrial Emissions Directive (IED) Best Available Techniques (BAT) Reference Document for Waste Treatment – published August 2018 (Statutory)
- Appropriate Measures (EA guidance) Biological waste treatment - published in September 2022 (Non-statutory)
- The Farming Rules for Water Regulations (FrFW) - introduced in England in April 2018 (Statutory)

Out of this list only the EA's national Sludge Strategy was specifically referred to by the EA in the SUiAR driver guidance. However due to the interdependencies between the regulatory requirements and guidance relevant detail is provided below in terms of how they may affect sludge recycling to land.

EA Sludge Strategy

The cornerstone of this strategy is to bring sludge and septic tank sludge into EPR and for the SUiAR to be repealed. The EA's national Sludge Strategy will see the SUiAR regulations replaced with Environmental Permitting (England and Wales) Regulations (EPR). In March 2020 the EA published their Policy paper "Environment Agency strategy for safe and sustainable sludge use",

Read more about this at
www.gov.uk/government/publications/environment-agency-strategy-for-safe-and-sustainable-sludge-use/environment-agency-strategy-for-safe-and-sustainable-sludge-use

It supports Defra's 25-year environment plan in the areas of: using and managing land sustainably, increased resource efficiency and reducing pollution and waste. It seeks to improve regulation of sludge supply and use and importantly it continues to enable the option to recycle sludge to agricultural land as organic manure. The EA desires to "level the playing field" such that there are consistent rules and regulations across all the organic waste sectors. Within this strategy the EA reviewed the current regulatory regime for sludge treatment, storage, and use.

The EA's Sludge Strategy proposed 4 options for regulatory change. The EA are still in discussions with the water industry as to whether option 3 or 4 of the strategy will be adopted. Option 3 is the use of existing EPR regulatory tools which would necessitate deployments. Option 4 is to evolve EPR regulatory tools with the suggested use of an earned recognition scheme such as the existing Bioresources Assurance Scheme (BAS) with notifications rather than deployments. BAS is an independent earned recognition assurance scheme.

Why does this affect sludge recycling to land?

If the EA decide that deployments are required, this will introduce red tape and slow the recycling process down. Deployments are similar to environmental permits and once approved they allow companies to spread material to land, these need EA approval (which has taken up to 60 days previously) and would be a departure from the system currently in force (under the SUiAR) where prior EA approval before spreading is not required. A consequence of this could be that companies need larger storage pads to accommodate storing biosolids on site for longer because of delays caused by deployment approvals. Note YW has not accounted for delays attributable to deployment timescales because of the uncertainty, rather have outlined in the OAR and ODR's that YW's assumption is that deployment approvals would not cause delays.

With current storage levels, any delay due to deployments could not be managed, even if it were just 24 hours.

One way to streamline deployments that has been discussed has been through the use of a scheme such as BAS as an “earned recognition scheme”, where deployments under BAS certified operations would be given a light touch management from the EA. YW have planned on this basis, and with deployments requiring only 10 days under the EA strategy. However, the EA have not yet agreed on what basis the BAS standard could become an earned recognition scheme.

Farming Rules for Water Regulations

The FrFW were introduced in England in April 2018 to fulfil obligations on diffuse pollution under the Water Framework Directive. Rule 1 aims to ensure that all reasonable precautions are taken to prevent diffuse pollution following the application of organic manures and manufactured fertilisers. To comply with Rule 1, farmers must demonstrate they have planned nutrient applications to ensure they are applied in quantities that are sufficient to meet, and not exceed, the crop and soil requirements.

Recent clarification of the interpretation of Rule 1 by the EA has confirmed that farmers must demonstrate that the timing and quantity of organic manure applied is in accordance with crop and soil need at the time of application. The EA have narrowly defined this in terms of the immediate days following the application of the biosolids upfront of crops beginning to grow.

This applies to all types of organic manure containing readily available N, and effectively rules out autumn and winter applications except to a crop that has a nitrogen fertiliser requirement in those seasons (e.g., winter oilseeds and grass to support late season growth in August and September).

Why does this affect sludge recycling to land?

From the Grieve Strategic Landbank Modelling Report into landbank availability:

> *‘Organic manures particularly bulky solid manure like biosolids cake are spread with either, side or read discharge spreaders. Cereal crops are usually sown with tramlines, effectively roadways in fields where no crops are planted allowing sprays or fertiliser to be applied from. However, these are on average 24 metres apart (or even more), which makes spreading biosolids cake to growing crops more difficult. Modern spreading equipment does enable biosolids (and other solid organic manures) to be top dressed from tramlines in the spring, although the risk of crop damage is increased, particularly given the width of tyres required to minimise compaction, meaning many landowners may be unwilling to accept this practice. It would also result in increased ammonia volatilisation, odour nuisance and P loss (through run-off), as incorporation is not possible where a growing crop is present. There would be a need to engage with food chain stakeholders as topdressing to a growing crop creates a different perception of food safety risk to applications before drilling, who have previously raised concerns. Conversely, the autumn is ideally suited to spreading of biosolids as the ground is drier enabling heavy machinery to access the land without a risk of compaction; this is particularly important when spreading on medium or heavy soils made up of clay. It is also possible to incorporate the biosolids ahead of planting the subsequent crop. Where there are lighter soils (e.g., sandy), it is more likely that they will drain quickly and are less impacted by the weather making topdressing, a more practical option, however, the lack of incorporation will still give rise to increased odour and other emissions’.*

There were concerns by the water industry that the EA’s interpretation of rule 1 would mean that sludge recycling to land would not be allowed in the autumn, because at this point the crops do not require the nutrients spread to land. This would have been unworkable because most sludge recycling takes place in the autumn. To provide the EA with assurance that sludge recycling to land is not causing pollution, water companies committed to 20 additional control measures to ensure the continued safe spreading of biosolids, rather than over the cropping cycle. An example of one of the measures is the requirement for sludge cake to be a minimum 20% dry solids. A drier sludge cake means there is less risk of leachate pollution to soil, ground water or surface water.

The 20 measures have been adopted by YW and the rest of the industry and are planned to be incorporated into BAS. However, the process on consulting on the BAS scheme has shown that

considerable differences in interpretation around both P and N applications continue to exist between the industry and the EA. Further discussions are ongoing to understand whether these can be resolved. Failure to resolve these may mean that BAS is not seen as suitable for an "earned recognition" scheme, leading to longer deployment timescales, reduced application rates, increased land-bank requirements, and potentially restrictions in autumn spreading. As discussed above, neither YW's existing storage, nor YW's proposed additional storage under this driver is sufficient to satisfy reasonable worse-case assumptions, nor have YW planned for any further BAS standard changes.

IED

In July 2019 the EA confirmed that AD plants treating > 100 tonnes of sludge per day required an IED permit for this activity. Water companies were given until August 2022 to apply for IED permits and have until December 2024 to comply with the permit conditions.

Why does this affect sludge recycling to land?

YW's AD plants provide sludge treatment and produce the digestate that is recycled under the SUiAR. AD plants require IED permits and IED introduces a requirement for Best Available Techniques (BAT) to be used. An example of this is for existing site tanks to have secondary containment / bunding retrofitted. IED introduces a complex, uncertain and costly set of new requirements. The water industry has not been funded to provide these upgrades and an independent review concluded costs for the industry in the region of £0.6bn for secondary containment alone (source SNC / Lavalin, Water UK Industrial Emissions Directive Supporting Document IED Supporting Document 31st May 2023, Annex E2 in the Annex to the WINEP Enhancement Case document). On the 1st of August 2023 Ofwat wrote to all companies clarifying their position on IED and setting out the requirements for a data request to inform a potential funding mechanism for PR24. YW have responded to this request, however it should be noted that YW is in a slightly different position to most companies having received a specific mechanism for the recovery of IED compliance costs granted by the Competition and Markets Authority.

YW are funding IED environmental improvements out of base monies in AMP7 because IED is an unfunded obligation. The significant costs which have a 75:25 (customer: company) cost sharing arrangement may lead YW to change our sludge strategy (away from recycling to disposal) due to affordability challenges and predicted landbank pressures. A potential consequence of this could be abortive investment via PR24 SUiAR drivers because new storage pads could become redundant by 2030 if sludge needs to be treated by incineration.

Appropriate Measures

The Biological Waste Treatment Appropriate Measures was published by the EA in September 2022. This guidance document outlines additional measures that must be provided on sites with environmental permits, including YW's STFs.

Appropriate Measures introduces a prescriptive set of new requirements. The water industry has not been funded to provide these upgrades and an independent review concluded costs for the industry in the region of £1.4bn for covering for sludge storage pads alone (source SNC / Lavalin, Water UK Industrial Emissions Directive Supporting Document IED Supporting Document 31st May 2023). This is relevant because all YW STFs have storage pads and one of the conditions within the Appropriate Measures is that all existing and new digestate stores must be covered. The majority of YW's storage pads are currently uncovered. YW have provided the cost of compliance with Appropriate Measures to Ofwat as part of the IED data request mentioned above. Please refer to our Appropriate Measures Enhancement Case on the required funding to deliver these new regulatory requirements.

Read more about this at
Appropriate Measures Enhancement Case

Why does this affect sludge recycling to land?

Unfunded obligations such as Appropriate Measures may lead YW to change our sludge strategy (away from recycling to disposal) due to affordability challenges and predicted landbank pressures. A potential consequence of this could be abortive investment via PR24 SUiAR drivers

because new uncovered storage pads could become redundant by 2030 if sludge needs to be disposed to incinerator rather than recycled to agriculture.

Summary

This section illustrates the need for investment under the WINEP SUiAR drivers and outlines the risk around the industry having no other outlet for recycling or disposal of sludge at present. Whilst non-agricultural routes for biosolids recycling exist, for example land reclamation, they are very limited in capacity. Therefore, they are used only where agricultural routes cannot be used. Nationally 3.6 million tonnes (c. 90%) of sewage sludge per annum is recycled to agricultural land (source: Grieve Strategic Landbank Modelling Report).

Expanding non-agricultural use of biosolids, for example through sludge destruction (advanced thermal conversion or traditional incineration) and energy recovery, cannot be quickly turned on, as new assets would be required to be planned, funded, designed, permitted, and built. This leaves the sector heavily dependent on the agricultural market.

For context, incineration was as an outlet for 50% of YW's sludge in previous AMPs but YWs sludge strategy evolved away from sludge disposal to sludge recycling in line with the Waste Framework Directive waste hierarchy. It should be noted that YW faced several challenges with sludge incineration in terms of high costs, reliability of assets and breaches of permit emission limits to air.

In summary, YW and the wider industry are facing increasingly stringent and uncertain regulatory requirements and risk from changes in public perception over the acceptability of recycling biosolids to agriculture. If these risks were to materialise, the only viable alternative is sludge destruction. We discuss the land bank risk further in our Bioresources Strategy Appendix and set out a proposed uncertainty mechanism for the risk not addressed by the SUiAR drivers in our Uncertainty Mechanisms and RoRE Risk Analysis Appendix.

Read more about this at
Bioresources Sludge Strategy Appendix

Read more about this at
Uncertainty Mechanisms and RoRE Risk Appendix

18.3 The Scale and Timing of the Investment

In AMP8, following EA approval for 5 out of 10 needs and solutions proposed by YW, YW must invest £43m in enhanced storage and dewatering at key identified STFs. The five needs and solutions are provided below.

- Need 1 is to extend the existing covered sludge barns to hold 18 days of storage at 4 major sites. This will provide YW with 18 days of covered barn storage at Esholt, Hull, Huddersfield and Knostrop. These sites were chosen because they are YW's largest STFs, they already have environmental permits for the waste activity and because they already have a high standard of environmental protection due to the provision of existing barns.

YW has open sided Dutch barns at 4 out of 14 of our STF sites. At Hull, Knostrop and Huddersfield where lime treatment takes place, and at Esholt where thermal hydrolysis treatment takes place storage within Dutch barns is appropriate because storage is limited to less than one week i.e., the size of the barn is relatively small because there is no requirement to store sludge for a long period. Digestate produced by these treatment processes are ready to go to agriculture much sooner than digestate produced at YW's other STFs which require storage time on an open pad (typically up to 6-8 weeks) in order to achieve the pathogen standards of the BAS.

It should be noted that Appropriate Measures Section 9.4, Outputs from anaerobic processes – digestate. 4. States "You must effectively minimise fugitive emissions from dewatered digestate fibre and digested sewage sludge cake. This applies to all stored material. For example, you must store it:

- under a suitable cover
- in an enclosed building fitted with an air ventilation and extraction system"

YW has not proposed the provision of new covers or barns, or enclosed buildings with ventilation systems at the other STF sites where digestate must be stored for between 6-8 weeks. YW has not proposed enclosed building with air ventilation and extraction at any site. These requirements are addressed in the YW Appropriate Measures enhancement case.

- Need 2 is to provide additional 30 days storage on pads at 5 sites. Investment supported under the WINEP will provide YW with, the provision of 30 days additional storage. This provides YW with more resilience should the supply chain be adversely affected for short periods or issues arise with the quality of the material produced.
- Need 3 is to provide short term pad storage at Caldervale. Investment under the WINEP provides new pad storage at Calder Vale STF
- Need 4 is to provide extra pad storage on YW land to mitigate loss of storage on areas of high flood risk. It is likely that this new storage will be constructed on STFs in East Yorkshire, where it will be necessary to provide resilience against the reduction in ability to store biosolids on farmland at risk of flooding over winter.

The provision of storage in all cases provides YW with more resilience should the supply chain be adversely affected for short periods or issues arise with the quality of the material produced.

- Need 5 is to provide enhanced dewatering performance. Investment under the WINEP will provide Under the 20 measures associated with compliance with the FrFW, measure 3 states ‘Biosolids cake to be applied to land in England must achieve a minimum of 20% dry solids at the point of production from 1st July 2022’. YW has 3 sites which require upgrades to the dewatering systems to reliably guarantee >20% dry solids. These sites are Dewsbury, Calder Vale and Sandall.

The scale and timing of investment is important for the effective management of sludge and biosolids. YW assumed that in AMP8, YW’s sludge strategy will remain 100% recycling to land. This was the basis for the 10 needs and solutions submitted to the EA. Upon review, the EA agreed with 5 out of 10 of YWs needs and solutions under these drivers. For detail, please refer to EA Options Assessment Outcome part of Section 1.4.1.

If all of the 10 needs and solutions proposed had been accepted by the EA this would have allowed YW to plan for an adaptive pathway of a continuation of 100% sludge recycling to land, improved resilience, but with an eye to the future via the investigation into destruction technology during AMP8. On that basis at the time of submission of the 10 OARs to the EA, YW were confident that the proposed programme of investment was well considered and if approved by the EA it would make YW resilient for the future without the need to pour unnecessary concrete.

YW based needs and solutions 1-9 broadly on landbank scenario 3. We believed this to be a pragmatic and measured approach which offered the best value to customers given the uncertainties faced in the short term and to avoid building stranded assets. This was also based on the confirmation from the EA that they want to see continued recycling of nutrients to land, and the knowledge that new destruction technology could not be constructed by 2030. There is a risk that YW has not asked for enough storage in light of the ongoing debates with the EA regarding the need for deployments under the EA’s Sludge Strategy negotiations.

YW based needs and solutions 1-9 on landbank scenario 3 (10-year minimal change) where there is sufficient available agricultural land to recycle all GB produced biosolids. With the impact of landbank scenario 4 (10-year most likely change) predicted to occur from 2025 onwards YW created option 10 which is future planning of destruction technology, i.e., AMP8 planning and design for investment in AMP9. This was a feasibility study for future planning of destruction technology to determine suitable locations, obtain planning permission, obtain suitable environmental permits, technology selection and detailed design of required plants. YW planned for this work to involve collaboration with stakeholders locally, regionally, and nationally in line with the findings of the national treatment capacity work and the CIWEM long term sludge strategy outputs.

It is YW’s view that need and solution 10 is required to enable YW to be ready for the changes predicted in landbank scenario 4 from 2025 onwards. At this point in the AMP YW believes that due to the constraints on the landbank identified for the future, it is likely that a significant proportion of biosolids will no longer be recycled to agriculture.

YW also submitted a AMP9 forward need and solution for major transitional funding in AMP8 to build two destruction plants to be commissioned in AMP9 to treat approximately 60% of YWs sludge by 2035, assuming some degree of treatment commencing in 2032. 2040 sludge growth and quality numbers with 10% headroom equates to 202,369 tds/annum. On this basis YW selected 60% of 200,000 tds/annum as the basis for sizing the destruction plants. Costings were based on information from the PR24 Sludge to Land Strategy Report – Final 22nd September 2022 which is a report for YW produced by Mott Macdonald (Annex E3 in the Annex to the WINEP Enhancement Case document).

Because of the critical nature of the scope, scale, and timing of investment YW and the wider industry attempted to agree the scope of the needs and solutions and the timing of the investment with the EA. Over a period of several months there was a significant amount of engagement with the EA at a national and local level. The water industry national WINEP and Long-Term Strategy group provided three pieces of evidence to support the WINEP submissions. These were presented to and agreed by the EA and are explained below:

18.3.1 Evidence 1 - WINEP issues log

The aim of this spreadsheet was to collaboratively agree what is the issue and evidence for the issue. It contains a list of statutory and non-statutory drivers which the water industry considered could be in scope for consideration under the SUiAR drivers. The EA reviewed and agreed the contents of this list. Figure 1.2 shows the introductory text and Figure 1.3 shows the format of the spreadsheet.

Figure 1.2: WINEP Issues Log Introductory Text

1 Development of WINEP Evidence Log:

The environmental risks and issues allow water companies and regulators to identify where action is required to deliver compliance with statutory and statutory plus obligations, and will also identify where the environment is not meeting stakeholder expectations and so where non-statutory actions may be proposed.

The link between a water company's activity and a failure to meet its environmental obligation should be confirmed by robust data and supported by modelling (where appropriate).

This spreadsheet has been developed collaboratively between the water industry and EA to identify risks and issues, and itemise them on individual rows. Risks and issues cited within the sludge driver guidance were identified, and further risks and issues have been identified by a water industry group. This spreadsheet was collaboratively reviewed at meeting on 14/4/2022.

Further assessment has then been made of available evidence for the risks and issues, assumptions over these risks and issues, whether or not the requirements are sufficiently clear to support AMP8 WINEP planning. For requirements that are unclear, further work has also been suggested:

1) Risk and Issues to be included within national landbank modelling to make an assessment of the materiality of its impact on landbank resilience under common future scenarios
2) Via sprint work, led by Atkins, to review or generate evidence quickly to provide better definition of the risk or issue
3) This is an issue to be picked up through national sludge strategy where further research or innovation is required, or more compex issues, that cannot be addressed quickly in time for WINEP submission

The WINEP guidance states: The evidence required for each risk and issue, and where that can be found, is set out within the relevant WINEP driver guidance. Water companies may wish to supplement this with evidence from other sources including their own monitoring and third-party data. Where evidence isn't available to confirm the extent of the impact of the water company's activity then an investigation and or monitoring may be an appropriate action.

The approach set out above in developing an evidence log for the WINEP guidance, the national landbank modelling and sprint work to provide further evidence for risks and issues is fully aligned with the WINEP methodology.

A table summarising the columns in the WINEP evidence log is provided in the tab (column explanation)

Figure 1.3: WINEP Issues Log Spreadsheet Format

Aim: collaboratively agree what is the issue and evidence for the issue.

Line Ref	WINEP Driver	Generic Risk	Risk / Issue	Referenced in WINEP Driver Guidance?	Commentary (EA driver guidance text in *italics*)	Water Industry Assumptions	Supporting Evidence	In / Out of Scope
1	WINEP_IMP	Statutory Obligation	Sludge (use in Agriculture) Regulations (SUiAR) 1989	Yes	*The Regulations introduce requirements and precautions on the supply and use of sludge in agriculture. Recycling to land of sewage sludge must take account of the nutrient needs of plants grown by a farmer and it must not impair soil or water quality.* *The Sludge (Use in Agriculture) Regulations 1989 set out the rules around how sludge can be re-used and are also statutory obligations.* *We expect WaSCs to manage their sewage sludge in a sustainable way and follow circular economy principles in line with the Urban Waste Water Treatment Regulations.*	Regulatory Compliance. No direct new requirement. It is known that it is intended for SUiAR to be revoked. The replacement is yet to be defined. Minimum standard for AMP8 is compliance with SUiAR. See Line 8 - with withdrawal of SUiAR more activities will fall under EPR	Sludge (use in Agriculture) Regulations (SUiAR) 1989 (legislation.gov.uk)	In Scope
2	WINEP_IMP	Statutory Obligation	Urban Waste Water Treatment Regulations	Yes	*Article 14 of the Urban Waste Water Treatment Directive states "sludge arising from waste water treatment shall be re-used whenever appropriate. Disposal routes shall minimize the adverse effects on the environment." These are the statutory obligations that WaSCs must follow and are not subject to cost benefit tests. The Sludge (Use in Agriculture) Regulations 1989 set out the rules around how sludge can be re-used and are also statutory obligations.*	Regulatory Compliance. No direct new requirement. Current obligations under UWWTD are understood and there are no known planned regulatory changes. However, individual WwTW final effluent consent drivers are unknown. These present an AMP8 risk in changes to the quality and quantity of sludges produced. Cumulative impact of these changes may lead to a change outlet direction. Issues will be site and company specific and evidence generation to be led by individual companies.	The Urban Waste Water Treatment (England and Wales) Regulations 1994 (legislation.gov.uk)	In Scope
5	WINEP_IMP	Statutory Obligation	Appropriate Measures for the Biological Treatment of Waste	No	Draft for consultation available only.	Assumed this will be published in 2022. Assumed three years compliance date for capital works will make this an AMP8 deliverable. Assumed that most standards will be covered through IED permitting and there will not be extra over requirements. However, this will capture sites below IED threshold or sites operating under T21 exemptions. Water companies to review individual need and requirements.	Environmental Agency; Appropriate measures for the biological treatment of waste (Consultation draft,July 2020)	In Scope
6	WINEP_IMP	Statutory Obligation	Waste Framework Directive	No		Existing regulatory obligation. There is a need to demonstrate compliance with the overarching objectives of the waste framework directive. Need to demonstrate sludge storage and recycling 'WITHOUT RISK' to the environment.	S3 warning letter(**internal link**)	In Scope
7	WINEP_IMP	Statutory Obligation	Environment Agency national Sludge Strategy	Yes	*This will move controls of sludge use from the Sludge (Use in Agriculture) Regulations (SUiAR) into the Environmental Permitting Regulations (EPR). This change is required as the supply chain of sludge for use is no longer short or linear and the chemical complexity of sewage sludge has evolved so the Regulations need to reflect this.*	New regulatory requirement will follow implementation of EA sludge strategy and it is assumed that this will be an AMP8 driver. Withdrawal of SUiAR has a 'late 2023' regulatory window. Definition of requirements will be too late for WINEP and therefore we cannot assume adoption of an assurance scheme and must assume compliance with EPR standard rules permits as minimum requirements. Final EA report to Defra with recommendations will be used to inform the Defra impact assessment and consultation.	Environment Agency; Strategy for safe and sustainable sludge use (Updated 15 July 2020)	In Scope

18.3.2 Evidence 2 - National landbank assessment

The national landbank assessment in the Grieve Strategic Landbank Modelling Report showed by the end of AMP8 under landbank scenario 4, there will be insufficient landbank for biosolids recycling both locally and nationally.

18.3.3 Evidence 3 - Storage review

The water industry employed Atkins (SNC / Lavalin) to conduct an independent review of the regulatory requirements for storage of biosolids. This was to enable a baseline and common understanding for all water companies. One of the key recommendations was that some additional storage is required now to manage current levels of risk around the changing recycling regime with further storage provided to address ongoing resilience needs. The suggestion would be nominally:

- 1-month additional storage (short term, for immediate implementation) to allow changes in current practice, (best case) deployment application.
- 3 months (mid-term, to address in AMP8) to allow for extended over-winter storage, move to EPR and mean deployment periods.
- up to 6 months (long term, AMP8 and beyond) to address risks around loss of spring spreading due to climate change, resilience around epidemics and unforeseeable restrictions.

The reference for this report is WINEP Sludge Driver Evidence Support, Biosolids Storage 12th August 2022 by SNC / Lavalin (Annex E4 in the Annex to the WINEP Enhancement Case document).

18.3.4 Interactions with Base Expenditure

There is no overlap with base expenditure.

18.3.5 Activities Funded in Previous Price Reviews

The need or proposed enhancement investment does not overlap or duplicate with activities already funded at previous price reviews. All actions are new and defined by the EA for delivery in AMP8 within the Price Review 2024 Water Industry National Environment Plan (PR24 WINEP). None of the actions have been included in previous WINEPs.

18.3.6 Long-term Delivery Strategy Alignment

This enhancement case is part of the core adaptive pathway for the long-term delivery strategy.

The LTDS considers resilience risks and interventions. It is a new requirement for this pricing period, and an integral, mandatory part of YW's PR24 plan.

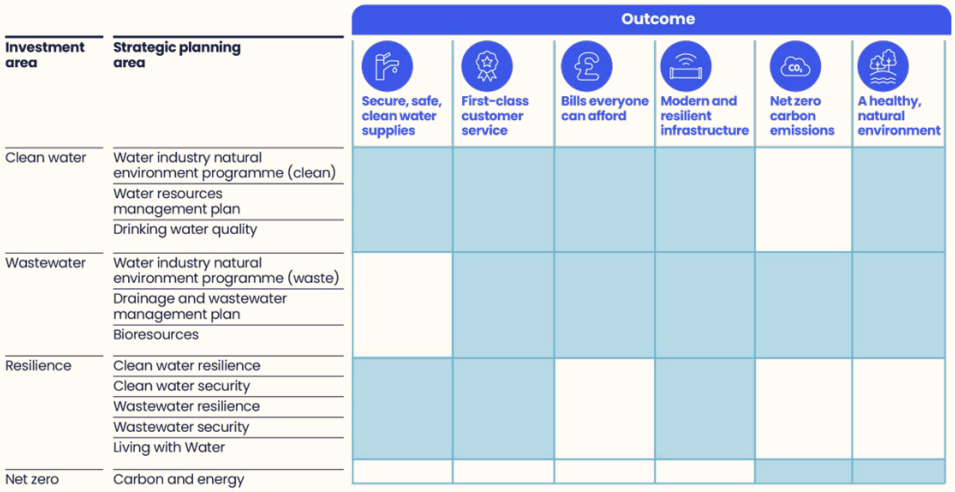
Ofwat's guidance has placed adaptive planning at the heart of the Long-Term Delivery Strategy, and these appendices are an opportunity to demonstrate how decisions can be made under different plausible future circumstances, setting out all key enhancement activities in terms of adaptive pathways. Specifically, we will present a Core Pathway of 'no and/or low regret' enhancement investments, alongside alternative pathways which could be triggered depending on how future uncertainties develop.

The long view to 2050 is adaptable, with pathways that can be modified in pursuit of long-term aims. Whilst we have a preferred best value plan, our long-term plans are adaptive with defined triggers and actions for diverting to an alternative pathway in the future. We may divert to an alternative plan once the risks are certain and we are able to identify with confidence the pathway we are following. This might be if one or more of our preferred options is unsuccessful or if new information on one of the key risks shows we are following a different scenario pathway. So, this work is not simply part of a five-year plan, but rooted in the future ambitions of Yorkshire Water, its customers and stakeholders.

The strategic planning frameworks Water Resource Management Plan (WRMP), Drainage and Wastewater Management Plan (DWMP) and Water Industry National Environment Programme (WINEP) all feed into the LTDS. It is chiefly concerned with future enhancement investment, and the coming price period and future DWI water quality submission components will be included. The LTDS will also include future risks for the next three pricing periods.

Our long-term delivery strategy is structured around four primary enhancement investment areas, each of which is underpinned by one or more strategic planning areas. Figure 1.4 below demonstrates how each investment area will contribute to achieving our long-term outcomes for customers.

Figure 1.4: Contribution of investment to long term outcomes



Please refer to section 1.3.1 for more information on our long-term delivery strategy.

Read more about this at
Long-Term Delivery Strategy

18.3.7 Customer Support

We have not carried out specific customer engagement related to this enhancement case given that it is a statutory requirement.

18.3.8 Factors Outside of Management Control

As explained within the need and scale and timing of investment sections there is a great deal of regulatory uncertainty as well as uncertainty around public perception associated with the continued recycling of biosolids to agriculture. These uncertainties were not known at PR19 and could not be planned for. These uncertainties are outside of management control, however, to seek clarity and manage risk, YW is working with the wider industry to contribute to the CIWEM national Long-Term Sludge Strategy as well as influencing the EA, Ofwat and Defra.

Read more about this at **CIWEM long-term strategy**
www.water.org.uk/news-views-publications/publications/strategy-bioresources

For more information, please refer to section 1.3.2.

18.4 Best Option for Customers

The PR24 WINEP is the first to include sludge drivers. The process of defining the options followed the publication of the driver guidance. The EA held a meeting to present the SUiAR driver guidance to the industry. Following this water companies set up a national group known as the WINEP and Long-Term Strategy group to identify the risks and issues, this group regularly met with the EA to ensure buy in to the approach taken. In parallel YW set up an internal working group of subject matter experts (SME) from across the business. This internal working group met frequently to develop a baseline understanding of the risks and issues, a list of unconstrained option and a list of constrained options. YW has had several meetings with the EA to discuss our approach at a national and local level.

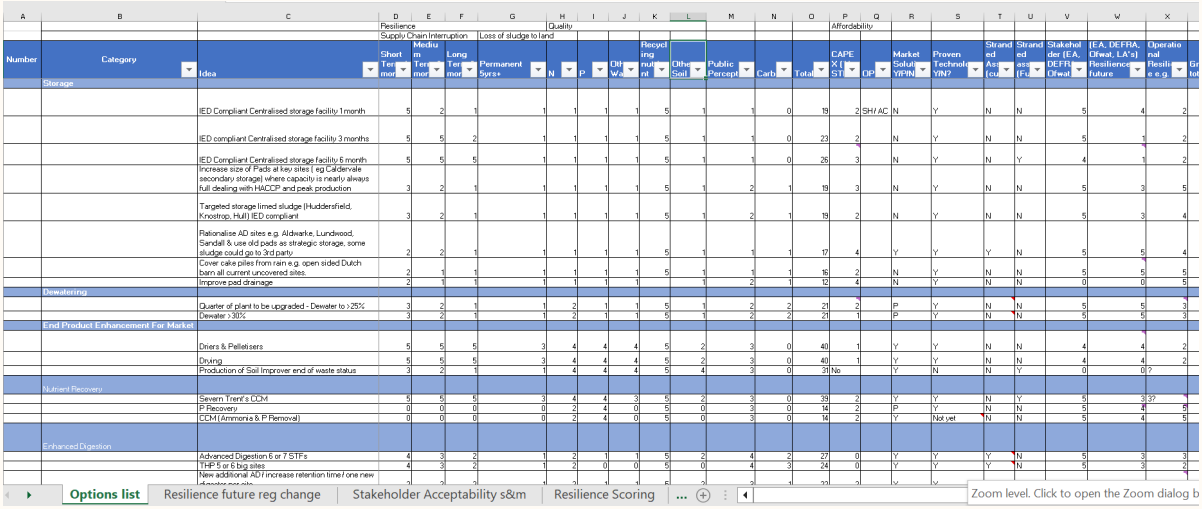
18.4.1 Options Considered

This section outlines the WINEP optioneering process and steps undertaken by YW.

Step 1. Internal working group PR24 Sludge Driver Scoring.

The YW internal working group generated an unconstrained list of options ranging from conventional AD treatment and sludge storage solutions through to treatment technologies including dryers and destruction technologies and novel untested processes. The group assessed these options against the SUiAR driver requirements of resilience and quality with a scoring system. The reasons for discounting and screening out options included whether the option used a proven technology, capex and opex costs, risks around stranded assets, risks around public perception about a particular option etc.

Figure 1.5: Screenshot of scoring matrix



Number	Category	Idea	Resilience: Supply Chain Interruption – Short term	Resilience: Supply Chain Interruption – Medium Term	Resilience: Supply Chain Interruption – Long term	Quality: Loss of sludge to land – Permanent 5yrs+	Quality: Loss of sludge to land – N	Quality: Loss of sludge to land – P	Quality: Loss of sludge to land – Other Waste	Quality: Loss of sludge to land – Recycling nutrient	Quality: Loss of sludge to land – Other Soil	Quality: Loss of sludge to land – Public Percept	Quality: Loss of sludge to land – Carbon	Quality: Loss of sludge to land – Total	Affordability – CAPEX (£ STT)	Affordability – OPEX	Market Solution YP/N	Proven Technology YP/N?	Stranded Asset (cust)	Stranded asset (Fut)	Stakeholder (EA, DEFRA, Dfwat, LA's)	(EA, DEFRA, Dfwat, LA's) Resilience future	Operational Resilience e.g.
	Storage																						
		IED Compliant Centralised storage facility 1 month	5	2	1	1	1	1	1	5	1	1	0	19	2	SH/ AC	N	Y	N	N	5	4	2
		IED compliant Centralised storage facility 3 months	5	5	2	1	1	1	1	5	1	1	0	23	2		N	Y	N	N	5	1	2
		IED Compliant Centralised storage facility 6 month	5	5	5	1	1	1	1	5	1	1	0	26	3		N	Y	N	Y	4	1	2
		Increase size of Pads at key sites (eg Caldervale secondary storage) where capacity is nearly always full dealing with HACCP and peak production	3	2	1	1	1	1	1	5	1	2	1	19	3		N	Y	N	N	5	3	5
		Targeted storage limed sludge (Huddersfield, Knostrop, Hull) IED compliant	3	2	1	1	1	1	1	5	1	2	1	19	2		N	Y	N	N	5	3	4
		Rationalise AD sites e.g. Aldwarke, Lundwood, Sandall & use old pads as strategic storage, some sludge could go to 3rd party	2	2	1	1	1	1	1	5	1	1	1	17	4		Y	Y	Y	N	5	5	4
		Cover cake piles from rain e.g. open sided Dutch barn all current uncovered sites.	2	1	1	1	1	1	1	5	1	1	1	16	2		N	Y	N	N	5	5	5
		Improve pad drainage	2	1	1	1	1	1	1		1	2	1	12	4		N	Y	N	N	0	0	5
	Dewatering																						
		Quarter of plant to be upgraded - Dewater to >25%	3	2	1	1	2	1	1	5	1	2	2	21	2		P	Y	N	N	5	5	3
		Dewater >30%	3	2	1	1	2	1	1	5	1	2	2	21	1		P	Y	N	N	5	5	3
	End Product Enhancement For Market																						
		Driers & Pelletisers	5	5	5	3	4	4	4	5	2	3	0	40	1		Y	Y	N	N	4	4	2
		Drying	5	5	5	3	4	4	4	5	2	3	0	40	1		Y	Y	N	N	4	4	2
		Production of Soil Improver end of waste status	3	2	1	1	4	4	4	5	4	3	0	31	No		Y	N	N	Y	0	0	?
	Nutrient Recovery																						
		Severn Trent's CCM	5	5	5	3	4	4	3	5	2	3	0	39	2		Y	Y	N	Y	5	3	3?
		P Recovery	0	0	0	0	2	4	0	5	0	3	0	14	2		P	Y	N	N	5	4	5
		CCM (Ammonia & P Removal)	0	0	0	0	2	4	0	5	0	3	0	14	2		Y	Not yet	N	N	5	4	5
	Enhanced Digestion																						
		Advanced Digestion 6 or 7 STFs	4	3	2	1	2	1	1	5	2	4	2	27	0		Y	Y	Y	N	5	3	3
		THP 5 or 6 big sites	4	3	2	1	2	0	0	5	0	4	3	24	0		Y	Y	Y	N	5	3	2
		New additional AD / increase retention time / one new																					

Within the working group sessions there was knowledge sharing about existing and novel technologies, traditional and non-traditional intervention types used by YW or other water companies. Options were then discounted using the scoring matrix as well as judgement based on expertise within the group to produce the constrained options list.

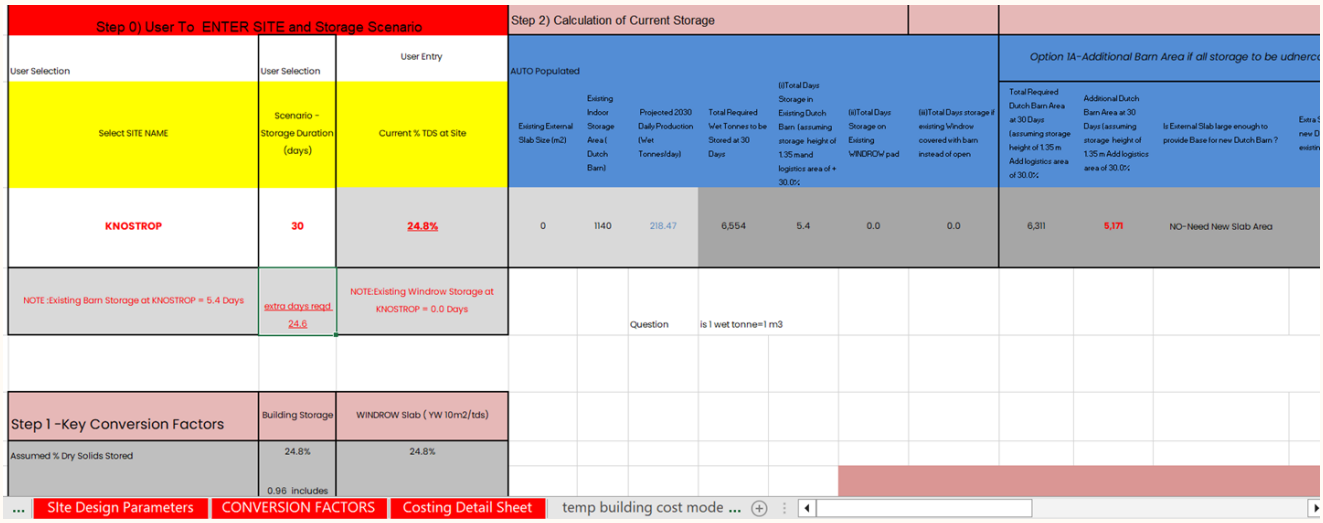
Step 2. Cost of Additional Storage ready reckoner.

Figure 1.7 below shows the storage ready reckoner template:

The increase in storage capacity is calculated from the number of days storage, the capacity of existing pads and barns and the % dry solids. YW have a set of costing models which calculate pad, building and ventilation costs based on the design area and volume. At the time of costing the options for the duration of storage were still subject to change and optimisation; a flexible and repeatable method of costing was required.

A simple ready reckoner was developed. The corporate cost models for the 3 options of pad, portal frame or ventilated enclosed building were collated in an options spreadsheet and approved by the corporate costing team. The user defines the total storage duration required and the reckoner calculates the additional size parameters from the specific site characteristics of existing storage, the % dry solids, windrow, or storage volumes.

Figure 1.6: Screenshot of Storage Cost Ready Reckoner



Step 0) User To ENTER SITE and Storage Scenario			Step 2) Calculation of Current Storage									
User Selection	User Selection	User Entry	AUTO Populated							*Option 1A-Additional Barn Area if all storage to be udnerc*		
Select SITE NAME	Scenario - Storage Duration (days)	Current % TDS at Site	Existing External Slab Size (m2)	Existing Indoor Storage Area (Dutch Barn)	Projected 2030 Daily Production (Wet Tonnes/day)	Total Required Wet Tonnes to be Stored at 30 Days	(i)Total Days Storage in Existing Dutch Barn (assuming storage height of 1.35 m and logistics area of + 30.0%)	(ii)Total Days Storage on Existing WINDROW pad	(iii)Total Days storage if existing Windrow covered with barn instead of open	Total Required Dutch Barn Area at 30 Days (assuming storage height of 1.35 m Add logistics area of 30.0%	Additional Dutch Barn Area at 30 Days (assuming storage height of 1.35 m Add logistics area of 30.0%	Is External Slab large enough to provide Base for new Dutch Barn ?	Extra
KNOSTROP	30	24.8%	0	1140	218.47	6,554	5.4	0.0	0.0	6,311	5,171	NO-Need New Slab Area	
NOTE :Existing Barn Storage at KNOSTROP = 5.4 Days	extra days reqd 24.6	NOTE:Existing Windrow Storage at KNOSTROP = 0.0 Days			Question	is 1 wet tonne=1 m3							
Step 1 -Key Conversion Factors	Building Storage	WINDROW Slab (YW 10m2/tds)											
Assumed % Dry Solids Stored	24.8%	24.8%											
	0.96 includes												

Site Design Parameters | CONVERSION FACTORS | Costing Detail Sheet | temp building cost mode ...

Step 3. Sludge storage costing scenarios.

Figure 1.8 below shows an extract of the sludge storage costing scenarios spreadsheet. These costs and storage parameters were collated by successive use of the storage cost ready reckoner described above. Each row represents the costing options for a specific site at a specific storage duration.

Figure 1.7: Sludge Storage Costing Scenarios Spreadsheet

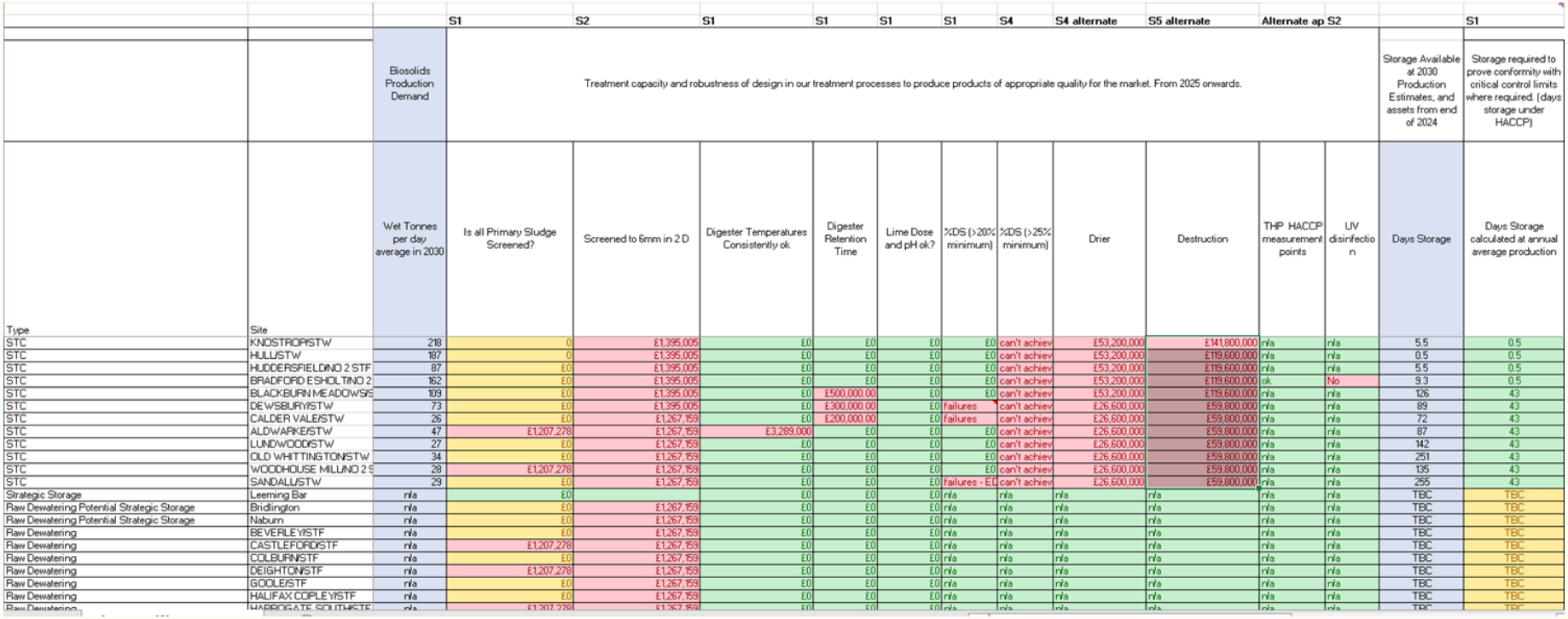
Site	% TDS	Total No of Days Storage In Scenario	Existing Barn Provision (calc by Reckoner)-Days	Existing WINDROW Provision (calc by Reckoner)-Days	Additonal Days Storage Required	Option 0 Additional Windrow Slab Required	Option 2A - Open Dutch Barn with Extension Slab as required
KNOSTROP	24.8%	10.5	5.4	0.0	5	£594,556	£3,333,723
KNOSTROP	24.8%	14.2	5.4	0.0	9	£860,974	£4,751,033
KNOSTROP	24.8%	18.7	5.4	0.0	13	£1,139,197	£6,530,810
KNOSTROP	24.8%	48.7	5.4	0.0	43	£2,534,182	£20,564,244
KNOSTROP	24.8%	90	5.4	0.0	85	£4,156,380	£39,599,154
KNOSTROP	24.8%	365	5.4	0.0	360	£17,670,061	£166,517,486
HULL	25.5%	10.5	9.2	0.0	1	£208,454	£1,174,977
HULL	25.5%	14.2	9.2	0.0	5	£526,793	£2,969,252
HULL	25.5%	18.7	9.2	0.0	9	£815,451	£4,510,381
HULL	25.5%	48.7	9.2	0.0	39	£2,143,753	£16,160,551
HULL	25.5%	90	9.2	0.0	81	£3,480,832	£32,521,495
HULL	25.5%	365	9.2	0.0	356	£14,975,131	£141,121,256
HUDDERSFIELD	27.3%	10.5	5.6	0.0	5	£311,546	£1,685,412
HUDDERSFIELD	27.3%	14.2	5.6	0.0	9	£456,094	£2,586,826
HUDDERSFIELD	27.3%	18.7	5.6	0.0	13	£606,513	£3,397,842
HUDDERSFIELD	27.3%	48.7	5.6	0.0	43	£1,358,310	£8,396,788
HUDDERSFIELD	27.3%	90	5.6	0.0	84	£2,140,709	£16,127,537
HUDDERSFIELD	27.3%	365	5.6	0.0	359	£7,058,800	£66,601,661

Step 4. Option Development Spreadsheet.

A range of risks were identified, with solutions identified for varying levels of resilience grouped into two main areas: “treatment”, which included improved dewatering, improved screening; improved digester retention time; Improved solids destruction through advanced digestion; resilience to UV disinfection for enhanced product quality.

These were assessed for fitness with the driver and cost, two screenshots are provided in Figure 1.9 and Figure 1.10 below:

Figure 1.8: Options Development Spreadsheet Screenshot 1



			S1	S2	S1	S1	S1	S1	S4	S4 alternate	S5 alternate	Alternate ap	S2		S1
		Biosolids Production Demand	Treatment capacity and robustness of design in our treatment processes to produce products of appropriate quality for the market. From 2025 onwards.											Storage Available at 2030 Production Estimates, and assets from end of 2024	Storage required to prove conformity with critical control limits where required. (days storage under HACCP)
Type	Site	Wet Tonnes per day average in 2030	Is all Primary Sludge Screened?	Screened to 6mm in 2 D	Digester Temperatures Consistently ok	Digester Retention Time	Lime Dose and pH ok?	%DS (>20% minimum)	%DS (>25% minimum)	Drier	Destruction	THP HACCP measurement points	UV disinfection	Days Storage	Days Storage calculated at annual average production
STC	KNOSTROPISTW	218	0	£1,395,005	£0	£0	£0	£0	can't achiev	£53,200,000	£141,800,000	n/a	n/a	5.5	0.5
STC	HULLISTW	187	0	£1,395,005	£0	£0	£0	£0	can't achiev	£53,200,000	£119,600,000	n/a	n/a	0.5	0.5
STC	HUDDERSFIELDNO 2 STF	87	£0	£1,395,005	£0	£0	£0	£0	can't achiev	£53,200,000	£119,600,000	n/a	n/a	5.5	0.5
STC	BRADFORD ESHOLTNO 2	162	£0	£1,395,005	£0	£0	£0	£0	can't achiev	£53,200,000	£119,600,000	ok	No	9.3	0.5
STC	BLACKBURN MEADOWSIS	109	£0	£1,395,005	£0	£500,000.00	£0	£0	can't achiev	£53,200,000	£119,600,000	n/a	n/a	126	43
STC	DEWSBURYISTW	73	£0	£1,395,005	£0	£300,000.00	£0	failures	can't achiev	£26,600,000	£59,800,000	n/a	n/a	89	43
STC	CALDER VALEISTW	26	£0	£1,267,159	£0	£200,000.00	£0	failures	can't achiev	£26,600,000	£59,800,000	n/a	n/a	72	43
STC	ALDWARKEISTW	47	£1,207,278	£1,267,159	£3,289,000	£0	£0	£0	can't achiev	£26,600,000	£59,800,000	n/a	n/a	87	43
STC	LUNDWOODISTW	27	£0	£1,267,159	£0	£0	£0	£0	can't achiev	£26,600,000	£59,800,000	n/a	n/a	142	43
STC	OLD WHITTINGTONISTW	34	£0	£1,267,159	£0	£0	£0	£0	can't achiev	£26,600,000	£59,800,000	n/a	n/a	251	43
STC	WOODHOUSE MILLNO 2 S	28	£1,207,278	£1,267,159	£0	£0	£0	£0	can't achiev	£26,600,000	£59,800,000	n/a	n/a	135	43
STC	SANDALLISTW	29	£0	£1,267,159	£0	£0	£0	failures - E	can't achiev	£26,600,000	£59,800,000	n/a	n/a	255	43
Strategic Storage	Leeming Bar	n/a	£0		£0	£0	£0	n/a	n/a	n/a	n/a	n/a	n/a	TBC	TBC
Raw Dewatering Potential Strategic Storage	Bridlington	n/a	£0	£1,267,159	£0	£0	£0	n/a	n/a	n/a	n/a	n/a	n/a	TBC	TBC
Raw Dewatering Potential Strategic Storage	Naburn	n/a	£0	£1,267,159	£0	£0	£0	n/a	n/a	n/a	n/a	n/a	n/a	TBC	TBC
Raw Dewatering	BEVERLEYISTF	n/a	£0	£1,267,159	£0	£0	£0	n/a	n/a	n/a	n/a	n/a	n/a	TBC	TBC
Raw Dewatering	CASTLEFORDISTF	n/a	£1,207,278	£1,267,159	£0	£0	£0	n/a	n/a	n/a	n/a	n/a	n/a	TBC	TBC
Raw Dewatering	COLBURNISTF	n/a	£0	£1,267,159	£0	£0	£0	n/a	n/a	n/a	n/a	n/a	n/a	TBC	TBC
Raw Dewatering	DEIGHTONISTF	n/a	£1,207,278	£1,267,159	£0	£0	£0	n/a	n/a	n/a	n/a	n/a	n/a	TBC	TBC
Raw Dewatering	GOOLEISTF	n/a	£0	£1,267,159	£0	£0	£0	n/a	n/a	n/a	n/a	n/a	n/a	TBC	TBC
Raw Dewatering	HALIFAX COPLEYISTF	n/a	£0	£1,267,159	£0	£0	£0	n/a	n/a	n/a	n/a	n/a	n/a	TBC	TBC
Raw Dewatering	HARROGATE SOUTHSTF	n/a	£1,207,278	£1,267,159	£0	£0	£0	n/a	n/a	n/a	n/a	n/a	n/a	TBC	TBC

Figure 1.9: Options Development Spreadsheet Screenshot 2

				2030					2035			
Scenario	Brief Description	Opex	Notes	Physical Storage Risk	Permit Compliance	Landbank Risk	Treatment Capacity Risk	Product Quality Risk	Physical Storage Risk	Permit Compliance	Landbank Risk	T C
0	Do nothing	?	no use of drivers for WINEP	VH	VH	M	VH	H	VH	VH	VH	V
1	Variations on investment on storage and process resilience, with lowest cost storage solutions proposed where possible	neutral?	screenings in 1 D; essential storage risks resolved; aldwarke heating; improved capital maintenance for sites with lower retention times, all sites to >20% DS; storage for over winter for 1:100 year flood farmers. Sufficient storage for day to day operations if no change to landbank for usage, plus to manage landbank in 1 in 100 years flood risk; insufficient to manage deployments, Not resilient to tightening up of BAS rules under ER. Some risk of odour, barns not fully enclosed, use of pads on sites with lower risks	H	H	M	H	M	H	H	H	V
2		neutral?	As 1 but with prudent additional storage for operational mitigation	M	H	M	H	M	H	H	H	V
3a		neutral?	As 2 plus: Screenings in 2D Plus Scenario2; **One month** emergency supply chain storage on pads	L	H	M	H	L	M	h	H	V
3b	As per 3 with pads converted to barns	?	Screenings in 2D Plus Scenario2; Convert pads in dutch barns	L	M	M	H	VL	M	M	H	V
3c	As per 3 but with all storage as odour controlled sealed barns	?	Screenings in 2D Plus Scenario2; Convert pads in covered odour controlled buildings	L	L	M	H	VL	M	L	H	V
4	As per 3a but 1 year of supply chain interuption protection on pads	?	1 year supply chain interuption. Doesn't include opex (significant in year we need it). Assumes we already own the land and storage is on pads	VL	H	L	H	L	VL	H	H	V
5a	As per 3a plus BBM THP	?	Full end to end cost needs modelling; savings on rationalising sites might be possible * Needs strategic modelling	L	H	L	L	L	M	H	M	H
5b	As per 3a plus 100 TDS/day drying	?	Assumed to be at Knostrop * Needs strategic modelling	L	M	L	H	L	M	M	M	H
5c	As per 3a but 100 TDS/day Incineration	?	Assume to be at BBM; could allow some rationalisation of other south sites *Needs strategic modelling. Unlikley to be able to deliver this by 2030	L	M	L	L	L	M	M	L	H

Options were assessed against whether they directly contributed to the landbank risk; improved resilience to permit compliance; directly provided additional storage; provided additional treatment capacity or improved the product quality in some way which may make the product more satisfactory for the agricultural market. The assessment was undertaken by the internal working group of SMEs.

Increasing resilience was often only available at increasing cost. Given the uncertainty in much of the requirements and how these would be interpreted by the EA, finding the balance between customer affordability and increased resilience was difficult, particularly as some assets risk becoming “stranded investments” if YW ultimately change sludge strategy from recycling to destruction technologies.

Following an assessment of overall affordability within the programme, a shortlist was produced of scenarios which could be adopted under the WINEP driver. Scenario 3a was selected by the internal PR24 Performance and Investment task and finish group.

Step 5. Sludge WINEP drivers - outline of the residual risk.

The internal working group SMEs highlighted two residual risks associated with progressing with scenario 3a.

1. Compliance with the requirements of the Appropriate Measures guidance

The EA have very recently published their final version of Appropriate Measures on 22nd September 2022. Within this guidance there are regulatory requirements which will require additional investment from water companies. One of the largest risks is the requirement to provide a “suitable cover” for digestate stores and where possible contain, treat, and abate odorous emissions. Scenario 3a allows for some covered storage but there are other sites where uncovered storage is proposed. At any new site where YW constructs uncovered storage the EA are unlikely to issue a suitable permit. In this case, YW would not be permitted to store digestate on the new uncovered storage pads.

2. Deployments under the Environmental Permitting Regulations (EPR)

In 2023 the EA intended to replace the SUiAR with EPR (note in August 2023 the EA removed reference to 2023 from their published sludge Strategy). It is normal practice for deployments to be required before material is spread to land under EPR. Before the biosolids can be recycled to land, deployment applications must be made to the EA and written approval granted. Deployment applications detail the waste types, the land it will be spread to and a benefits statement. On average deployment approvals take 60 days. YW’s scenario 3a only provides 30 days of additional storage therefore once EPR is enforced there is a risk the new storage pads may become full before deployments are approved.

Step 6. Sludge WINEP drivers update approach for landbank scenario 4.

The internal working group SMEs raised awareness with senior managers that other water companies were planning for landbank scenario 4 rather than landbank scenario 3. This was because Defra could withdraw existing guidance on FrFW after 2 years meaning a significant amount of extra landbank would be required. To combat any risks from this, the internal working group decided to create a 10th need and solution (to add to the 9 original needs and solutions for scenario 3a). This is entitled need and solution 10 ‘future planning of destruction technology, AMP8 planning and design investment for AMP9’.

Following the 6 steps outlined above, YW generated scenario 3a 9 WINEP needs and solutions:

- Extend covered sludge barn storage to 18 days at 4 sites.
- Provide additional 30 days storage on pads at 5 sites.
- Provide short term pad storage at Caldervale.
- Provide extra pad storage on YW land to mitigate loss of storage on areas of high flood risk.
- Enhance heating process at Aldwarke.
- Enhance dewatering performance.
- Provide standby UV at Esholt.
- Provide enhanced sludge screening to 6mm 2d.
- Provision of proactive maintenance systems to mitigate plant downtime.

The 10th WINEP need, and solution generated was:

- Future planning of destruction technology.

Additionally, YW submitted a AMP9 forward need for major transitional funding in AMP8 to build two destruction plants to be commissioned in AMP9 to treat 60% of YWs sludge by 2035, assuming some degree of treatment commencing in 2032. 2040 sludge growth and quality numbers with 10% headroom equates to 202,369 tds/annum. On this basis YW selected 60% of 200,000 tds/annum as the basis for sizing the destruction plants. Costings were based on information within the "*PR24 Sludge to Land Strategy Report – Final 22nd September 2022*" which is a report for YW produced by Mott Macdonald.

Further details about the 10 needs and solutions are provided in 10 OAR's and 3 ODR's submitted to the EA.

EA Options Assessment Outcome

As of May 2023, the EA provided feedback to YW and has confirmed which needs and solutions have the status proceed or remove:

- Extend covered sludge barn storage to 18 days at 4 sites – Proceed.
- Provide additional 30 days storage on pads at 5 sites – Proceed.
- Provide short term pad storage at Caldervale – Proceed.
- Provide extra pad storage on YW land to mitigate loss of storage on areas of high flood risk – Proceed.
- Enhance heating process at Aldwarke – Remove.
- Enhance dewatering performance – Proceed.
- Provide standby UV at Esholt – Remove.
- Provide enhanced sludge screening to 6mm 2d – Remove.
- Provision of proactive maintenance systems to mitigate plant downtime – Remove.
- Future planning of destruction technology – Remove.

The EA wrote to all water companies on 19th May 2023 to confirm their endorsement of "storage +" options. Key extract from the letter included below:

Figure 1.10: Extract from EA letter 19/5/23

Water Industry National Environment Programme - Sludge (Use in Agriculture) update

This information letter is to be read in conjunction with the decisions made on sludge (use in agriculture) options contained within the second draft release of the WINEP, that was shared with all water companies on 2 May 2023. These decisions were made following the release of information letter EA/09/2023 and subsequent meetings with all the water and sewage companies (WaSCs). The decisions are referred to as the 'Storage +' assessment.

Based on our current understanding of the WaSCs and their supply of sludge to agriculture we consider that proceeding with proposals for Storage + is sufficient in the short to medium term to develop contingency measures when business as usual is disrupted. This will deliver an improved supply chain resilience for the WaSCs.

Principles for assessment

The sludge (use in agriculture) driver seeks environmental enhancements in sewage sludge (biosolids) to deliver contingency measures (such as storage) when business as usual is disrupted. An objective of the sludge (use in agriculture) driver is to deliver improvements in the resilience of the sludge management chain; a supply chain that is almost totally reliant on agricultural outlets. The sludge (use in agriculture) driver supports actions to bring change to the way sludge is managed to ensure its soil conditioning and fertiliser value meets its full potential.

Storage + is a hybrid assessment in the sewage sludge (biosolids) supply chain. It includes both storage and other actions which deliver environmental improvements of sludge quality and handling prior to storage and before supply to agriculture, such as enhanced dewatering and pelletisation. The assessment also supports in principle the options associated with future EPR requirements for the agricultural use of sludge. The Storage + assessment does not support actions associated with addressing growth or volume of sludge. This means there is an in principle presumption against options such as thermal destruction technologies and optimisation of sludge treatment processes.

YW submitted a PR24 WINEP Options Assessment Decision Challenge Form on 12th June 2023. This was for 2 needs and solutions 1) Provide standby UV at Esholt and 2) Future planning of destruction technology. The EA provided feedback on 22nd June 2023 confirming that these two needs were still marked "remove".

18.4.2 Cost-Benefit Appraisal

The benefits as derived by our investment planning system are quantified in Table CWW15 under two Enhancement Categories according to the scope of the components of investment (refer Table 1.3). The sums associated with SUiAR improvement are apparent in Table CWW15 in each benefit type by the prefix "Sludge Treatment".

The annual benefits of delivering improved resilience by the end of AMP8 are relatively low as the investment is principally addressing new and emerging legislative requirements which are not monetised within our valuation system. We do not anticipate significant benefit within AMP8

Table 1.3: Projected Benefit (£m) of Sludge Enhancement under SUiAR

Enhancement Category	Total SUiAR Benefit For AMP8	Annual Benefit Post 2030
Sludge storage - Cake pads / bays	£0	£2.130
Sludge treatment - Thickening and/or dewatering	£0	£0.249
Total	£0	£2.379

18.4.3 Carbon Impact and Best Value

The investment involves a significant amount of embodied carbon, totalling 45,900 tonnes with 55.5 tonnes per annum of operational carbon, with a monetised impact of £17.123m and £0.021m/annum respectively. This is due to requirement for large areas of storage pad construction in concrete. We will innovate where possible to reduce this overall effect as far as possible.

18.4.4 Impact Quantification

There is no impact on our performance commitments from this enhancement investment.

18.4.5 Third Party Funding

There is no planned third party funding for this case/driver.

18.4.6 Customer Views

We have not carried out specific customer engagement related to this enhancement case given that it is a statutory requirement.

18.4.7 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

18.5 Cost Efficiency

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in section 7.3 in Introduction to Enhancement Cases, has been applied to this enhancement case. Table 1.1 at the beginning of this document summarises the costs associated with this enhancement case.

18.5.1 Cost estimate for our preferred option

Our costing estimate has been developed by constructing bottom-up models based on information from our Unit Cost Database and our Enterprise Data Analytics processes. Further details on how we have applied these tools to develop cost estimates are provided in section 7.3 of Introduction to Enhancement Cases. Key assumptions used to create cost estimates for this enhancement case are discussed below.

18.5.2 Scope of work

As outlined earlier in this document, we have followed a detailed optioneering process to identify the best options for customers. This has involved:

- Utilising central cost models on options of pad, portal frame or ventilated enclosed building to develop a calculation tool to estimate the cost of additional storage.
- Undertaking scenario analysis across options to understand storage requirements and associated costs.
- Assessing options with SME input against a range of factors including whether they directly contributed to the landbank risk; improved resilience to permit compliance; directly provided additional storage; provided additional treatment capacity or improved the product quality in some way which may make the product more satisfactory for the agricultural market.

Following this process, we received agreement from the Environment Agency through the WINEP process to proceed with 5 of 10 proposed needs and solutions, as described in detailed earlier in this document.

18.5.3 Cost estimation

As described in our option development section, we developed a tool to estimate the cost of additional storage across a range of options and scenarios. This tool was constructed using three cost models for options of pad, portal frame or ventilated enclosed buildings solutions. For a total storage duration required, this model calculated the additional size parameters from the specific site characteristics of existing storage, the % of dry solids, windrow, or storage volumes.

The models underpinning this estimation tool are from our Unit Cost Database and Enterprise Data Analytics processes, utilising detailed cost information gathered from the delivery of similar projects.

18.5.4 Efficiency of our cost estimate

Section 7.3 of Introduction to Enhancement Cases outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. This section outlines the application of this approach to this specific enhancement case.

For our proposed costs, estimates were developed using scopes defined through a detailed internal optioneering exercise with subject matter experts. In parallel, YW and the wider industry attempted to agree the scope of the solutions and the timing of the investment with the EA. Over a period of several months there was a significant amount of engagement with the EA at a national and local level.

The water industry national WINEP and Long-Term Strategy group provided three pieces of evidence to support the WINEP submissions. These were presented to and agreed by the EA.

Our estimates utilise an offline costing spreadsheet aligned with models from our Unit Cost Database. The offline spreadsheet considered the existing storage at each site, both pad and barn and then calculated the additional storage under a variety of scenarios. At a late stage in the process, the corporate cost model database was updated and the impact of this was fully assessed. This delivered a new portal frame model which further refined the cost estimates.

18.5.5 Need for enhancement model adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging.

For this driver we anticipate that the range of interventions (wide ranging and company specific) will make identification of appropriate cost drivers difficult and therefore we anticipate that Ofwat will not produce a cost model and would assess this expenditure through a deep dive approach.

18.6 External assurance

For information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

18.7 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

Our enhancement totex for this case does not meet the materiality threshold for any PCD groupings (PCDWW24 or PCDWW25). There is sufficient regulatory oversight for our activities under the WINEP, therefore we do not propose any customer protection mechanisms for this case.

18.7.1 Third Party Funding or Delivery Arrangements

We have no third party funding associated with the delivery of this case.

Annex: Lines with no proposed expenditure

We have no planned expenditure for the following reporting lines:

Table A.1: Water – Reporting Lines with No Planned Expenditure

Reporting Line	Name	Comment
CW3.5	Eels/fish entrainment screens; (WINEP/NEP) water opex	No opex requested for this driver
CW3.13	Drinking Water Protected Areas; (WINEP/NEP) water capex	No capex requested for this driver
CW3.19	Wetland creation; (WINEP/NEP) water capex	No planned enhancement expenditure for this driver
CW3.20	Wetland creation; (WINEP/NEP) water opex	
CW3.21	Wetland creation; (WINEP/NEP) water totex	
CW3.22	Trade effluent discharge flow monitoring; (WINEP/NEP) water capex	No planned enhancement expenditure for this driver
CW3.23	Trade effluent discharge flow monitoring; (WINEP/NEP) water opex	
CW3.24	Trade effluent discharge flow monitoring; (WINEP/NEP) water totex	
CW3.25	25 year environment plan; (WINEP/NEP) water capex	No planned enhancement expenditure for this driver
CW3.26	25 year environment plan; (WINEP/NEP) water opex	
CW3.27	25 year environment plan; (WINEP/NEP) water totex	
CW3.28	Investigations; (WINEP/NEP) - desk based study only water capex	No capex requested for this driver
CW3.31	Investigations; (WINEP/NEP) - survey, monitoring or simple modelling water capex	No capex requested for this driver
CW3.34	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water capex	No planned enhancement expenditure for this driver
CW3.35	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water opex	
CW3.36	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water totex	
CW3.37	Investigations total; (WINEP/NEP) water capex	No capex requested for this driver

Table 0.2: Wastewater – Reporting Lines with No Planned Expenditure

Reporting Line	Name	Comment
CWW3.1	Event duration monitoring at intermittent discharges (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.2	Event duration monitoring at intermittent discharges (WINEP/NEP) wastewater opex	

CWW3.3	Event duration monitoring at intermittent discharges (WINEP/NEP) wastewater totex	
CWW3.5	Flow monitoring at sewage treatment works; (WINEP/NEP) wastewater opex	No opex requested for this driver
CWW3.25	Storage to reduce spill frequency at CSOs etc - green solution; (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.26	Storage to reduce spill frequency at CSOs etc - green solution; (WINEP/NEP) wastewater opex	
CWW3.27	Storage to reduce spill frequency at CSOs etc - green solution; (WINEP/NEP) wastewater totex	
CWW3.28	Storm overflow - discharge relocation (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.29	Storm overflow - discharge relocation (WINEP/NEP) wastewater opex	
CWW3.30	Storm overflow - discharge relocation (WINEP/NEP) wastewater totex	
CWW3.31	Storm overflow - increase in combined sewer / trunk sewer capacity; (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.32	Storm overflow - increase in combined sewer / trunk sewer capacity; (WINEP/NEP) wastewater opex	
CWW3.33	Storm overflow - increase in combined sewer / trunk sewer capacity; (WINEP/NEP) wastewater totex	
CWW3.35	Storm overflow - sustainable drainage / attenuation in the network; (WINEP/NEP) wastewater opex	No opex requested for this driver
CWW3.38	Storm overflow - source surface water separation; (WINEP/NEP) wastewater opex	No opex requested for this driver
CWW3.40	Storm overflow - infiltration management: wastewater capex	No planned enhancement expenditure for this driver
CWW3.41	Storm overflow - infiltration management: wastewater opex	
CWW3.42	Storm overflow - infiltration management: wastewater totex	
CWW3.43	Storm overflow - sewer flow management and control; (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.44	Storm overflow - sewer flow management and control; (WINEP/NEP) wastewater opex	
CWW3.45	Storm overflow - sewer flow management and control; (WINEP/NEP) wastewater totex	
CWW3.49	Treatment for chemical removal (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.50	Treatment for chemical removal (WINEP/NEP) wastewater opex	
CWW3.51	Treatment for chemical removal (WINEP/NEP) wastewater totex	

CWW3.55	Treatment for total nitrogen removal (chemical) (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.56	Treatment for total nitrogen removal (chemical) (WINEP/NEP) wastewater opex	
CWW3.57	Treatment for total nitrogen removal (chemical) (WINEP/NEP) wastewater totex	
CWW3.58	Treatment for total nitrogen removal (biological) (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.59	Treatment for total nitrogen removal (biological) (WINEP/NEP) wastewater opex	
CWW3.60	Treatment for total nitrogen removal (biological) (WINEP/NEP) wastewater totex	
CWW3.61	Nitrogen technically achievable limit monitoring, investigation or options appraisal; (WINEP/NEP) wastewater capex	No capex requested for this driver
CWW3.67	Treatment for phosphorus removal (biological) (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.68	Treatment for phosphorus removal (biological) (WINEP/NEP) wastewater opex	
CWW3.69	Treatment for phosphorus removal (biological) (WINEP/NEP) wastewater totex	
CWW3.71	Treatment for nutrients (N or P) and / or sanitary determinands, nature based solution (WINEP/NEP) wastewater opex	No opex requested for this driver
CWW3.76	Catchment management - chemicals source control; (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.77	Catchment management - chemicals source control; (WINEP/NEP) wastewater opex	
CWW3.78	Catchment management - chemicals source control; (WINEP/NEP) wastewater totex	
CWW3.79	Catchment management - nutrient balancing; (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.80	Catchment management - nutrient balancing; (WINEP/NEP) wastewater opex	
CWW3.81	Catchment management - nutrient balancing; (WINEP/NEP) wastewater totex	
CWW3.82	Catchment management - catchment permitting; (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.83	Catchment management - catchment permitting; (WINEP/NEP) wastewater opex	
CWW3.84	Catchment management - catchment permitting; (WINEP/NEP) wastewater totex	
CWW3.85	Catchment management - habitat restoration; (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.86	Catchment management - habitat restoration; (WINEP/NEP) wastewater opex	
CWW3.87	Catchment management - habitat restoration; (WINEP/NEP) wastewater totex	

CWW3.92	Septic tank replacements - treatment solution; (WINEP/NEP) wastewater opex	No opex requested for this driver
CWW3.95	Septic tank replacements - flow diversion; (WINEP/NEP) wastewater opex	No opex requested for this driver
CWW3.97	Fish outfall screens; (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.98	Fish outfall screens; (WINEP/NEP) wastewater opex	
CWW3.99	Fish outfall screens; (WINEP/NEP) wastewater totex	
CWW3.104	Investigations, other (WINEP/NEP) - desk-based studies only wastewater opex	No opex requested for this driver
CWW3.115	Contribution to third party schemes under WINEP/NEP only (not covered elsewhere) wastewater capex	No planned enhancement expenditure for this driver
CWW3.116	Contribution to third party schemes under WINEP/NEP only (not covered elsewhere) wastewater opex	
CWW3.117	Contribution to third party schemes under WINEP/NEP only (not covered elsewhere) wastewater totex	
CWW3.118	River connectivity (e.g. for fish passage); (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.119	River connectivity (e.g. for fish passage); (WINEP/NEP) wastewater opex	
CWW3.120	River connectivity (e.g. for fish passage); (WINEP/NEP) wastewater totex	
CWW3.121	Restoration management (marine conservation zones etc) (WINEP/NEP) wastewater capex	No planned enhancement expenditure for this driver
CWW3.122	Restoration management (marine conservation zones etc) (WINEP/NEP) wastewater opex	
CWW3.123	Restoration management (marine conservation zones etc) (WINEP/NEP) wastewater totex	
CWW3.124	Access and amenity for WINEP/NEP only (not covered elsewhere) wastewater capex	No planned enhancement expenditure for this driver
CWW3.125	Access and amenity for WINEP/NEP only (not covered elsewhere) wastewater opex	
CWW3.126	Access and amenity for WINEP/NEP only (not covered elsewhere) wastewater totex	
CWW3.127	Advanced WINEP (not covered elsewhere) wastewater capex	No planned enhancement expenditure for this driver
CWW3.128	Advanced WINEP (not covered elsewhere) wastewater opex	
CWW3.129	Advanced WINEP (not covered elsewhere) wastewater totex	
CWW3.131	Sludge storage -Tanks (pre-thickening, pre-dewatering or untreated) (WINEP/NEP) capex	No planned enhancement expenditure for this driver
CWW3.132	Sludge storage -Tanks (pre-thickening, pre-dewatering or untreated); (WINEP/NEP) opex	
CWW3.133	Sludge storage -Tanks (pre-thickening, pre-dewatering or untreated); (WINEP/NEP) totex	

CWW3.134	Sludge storage -Tanks (thickened/dewatered or treated); (WINEP/NEP) capex	No planned enhancement expenditure for this driver
CWW3.135	Sludge storage - Tanks (thickened/dewatered or treated); (WINEP/NEP) opex	
CWW3.136	Sludge storage - Tanks (thickened/dewatered or treated); (WINEP/NEP) totex	
CWW3.140	Sludge treatment - Anaerobic digestion and/or advanced anaerobic digestion; (WINEP/NEP) bioresources capex	No planned enhancement expenditure for this driver
CWW3.141	Sludge treatment - Anaerobic digestion and/or advanced anaerobic digestion; (WINEP/NEP) bioresources opex	
CWW3.142	Sludge treatment - Anaerobic digestion and/or advanced anaerobic digestion; (WINEP/NEP) bioresources totex	
CWW3.146	Sludge treatment - Other; (WINEP/NEP) bioresources capex	No planned enhancement expenditure for this driver
CWW3.147	Sludge treatment - Other; (WINEP/NEP) bioresources opex	
CWW3.148	Sludge treatment -Other; (WINEP/NEP) bioresources totex	
CWW3.149	Sludge investigations and monitoring (NEP only) bioresources capex	No planned enhancement expenditure for this driver
CWW3.150	Sludge investigations and monitoring (NEP only) bioresources opex	
CWW3.151	Sludge investigations and monitoring (NEP only) bioresources totex	