Our PR24 Enhancement Strategies

Part 2: Work with others to achieve significant improvements in ecological quality of catchments

October 2023

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Work with others to achieve significant improvements in ecological quality of catchments

1 Overview

1.1 Overview

This document sets out the enhancement investments that we propose to make to help us achieve the ambitions set out in our Strategic Direction Statement. Specifically, these investments related our ambition to work with others to achieve significant improvements in ecological quality across our catchments.We've looked at how our whole business, across both water and water recycling, can contribute to this ambition. Our enhancement proposals help to achieve this ambition through:

- Delivering an Advanced WINEP (section 2) which maximises environmental and social value through the identification of partnership working opportunities
- Improving river water quality by reducing the level of phosphorus, nitrogen and other nutrients that reach our rivers (section 3)
- Monitoring, treating and removing harmful chemicals from rivers (section 4)
- Delivering river restoration, catchment management and other actions as part of our water resources WINEP (section 5)
- Delivering monitoring (section 6) and investigations (section 7) investments to better understand our impact on the environment
- Installing public sewers at villages which are currently not connected to oursewer network (section 8) providing a more environmentally sustainable way of treating and recycling used water.

1.1.1 Guide to our enhancement strategies

Each of the enhancement strategies aligns to costs presented in our data table submissions. The table below sets out how each section of our enhancement proposals presented in this document maps to enhancement cost tables.

Table 1 Our PR24 'Work with others to achieve significant improvements in ecological quality of catchments' Enhancement Strategies

Enhancement strategy	Costs data table references
A-WINEP (section 2)	CWW3.127-CWW3.129 (Advanced WINEP)
Nutrient removal and sanitary parameters (section 3)	CWW3.55-CWW3.57 (Treatment for total nitrogen removal (chemical) (WINEP/NEP)) CWW3.64-CWW3.66 (Treatment for phosphorus removal (chemical) (WINEP/NEP)) CWW3.70-CWW3.72 (Treatment for nutrients (N or P) and / or sanitary determinands, nature based solution (WINEP/NEP)) CWW3.73-CWW3.75 (Treatment for tightening of sanitary parameters (WINEP/NEP))
Chemicals removal and investigations (section 4)	CWW3.49-CWW3.51 (Treatment for chemical removal (WINEP/NEP)) CWW3.52-CWW3.54 (Chemicals and emerging contaminants monitoring, investigations, options appraisals; (WINEP/NEP) CWW3.61-CWW3.63 (Nitrogen technically achievable limit monitoring, investigation or options appraisal; (WINEP/NEP))
Water WINEP (section 5)	CW3.1-CW3.3 (Biodiversity and conservation) CW3.4-CW3.6 (Eels/fish entrainment screens) CW3.7-CW3.9 (Eels/fish passes) CW3.10-CW3.12 (Invasive Non Native Species) CW3.13-CW3.15 (Drinking Water Protected Areas) CW3.16-CW3.18 (Water Framework Directive) CW12.10-CW12.12 (Invasive Non Native Species) CW12.16-CW12.18 (Water Framework Directive)
Monitoring (section 6)	CWW3.1-CWW3.3 (Event duration monitoring at intermittent discharges (WINEP/NEP)) CWW3.4-CWW3.6 (Flow monitoring at sewage treatment works; (WINEP/NEP)) CWW3.7-CWW3.9 (Continuous river water quality monitoring (WINEP/NEP)) CWW3.10-CWW.12 (MCERTs monitoring at emergency sewage pumping station overflows (WINEP/NEP))

Enhancement strategy	Costs data table references
Investigations (section 7)	CWW3.106-CWW3.108 (Investigations, other (WINEP/NEP) - survey, monitoring or simple modelling) CWW3.109-CWW3.111 (Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling)
First time sewerage (section 8)	CWW3.159-CWW3.161 (First time sewerage)

The structure of each individual enhancement strategy is aligned to Ofwat's enhancement criteria set out in chapter A1 of appendix 9 of the Final Methodology (Setting expenditure allowances). The table below sets out how each sub-heading maps across to the enhancement criteria. Our enhancement strategies should should be read alongside chapter 7.3 of our business plan which sets out an overview of how we have approached our enhancement investment plan overall.

Table 2 Enhancement strategy structure

Enhancement strategy sub-section heading	Enhancement assessment criteria
Delivering for the long term	**A1.1.1 Need for enhancement investment**
Investment context	a) Is there evidence that the proposed enhancement investment is required (ie there is a quantified problem requiring a step change in service levels)? This includes alignment agreed strategic planning framework or environmental programme where relevant.
Scale and timing	b) Is the scale and timing of the investment fully justified, and for statutory deliverables is this validated by appropriate sources (for example in an agreed strategic planning framework)?
Interaction with base expenditure	c) Does the proposed enhancement investment or any part of it overlap with activities to be delivered through base, and where applicable does the company identify the scale of any implicit allowance from base cost models?
Long term context (historic)	d) Does the need and/or proposed enhancement investment overlap or duplicate with activities or service levels already funded at previous price reviews (either base or enhancement)?
Long term context (future)	e) Is the need clearly identified in the context of a robust long-term delivery strategy within a defined core adaptive pathway?
Customer support	f) Where appropriate, is there evidence that customers support the need for investment (including both the scale and timing)?
Cost control	g) Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings (eg spend to save) beenaccounted for?
Unlocking greater value for customers, communities and the environment	**A1.1.2 Best option for customers**
Option consideration	a) Has the company considered an appropriate number of options over a range of intervention types (both traditional and non-traditional) to meet the identified need?
Cost-benefit analysis	b) Has a robust cost-benefit appraisal been undertaken to select the proposed option? Is there evidence that the proposed solution represents best value for customers, communities and the environment over the long term? Is third-party technical assurance of the analysis provided?

Enhancement strategy sub-section heading	Enhancement assessment criteria
Environmental and social value	c) In the best value analysis, has the company fully considered the carbon impact (operational and embedded), natural capital and other benefits that the options can deliver? Has it relied on robustly calculated and trackable benefits when proposing a best value option over a least cost one?
Investment benefit	d) Has the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?
Managing uncertainty	e) Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed - including where forecast option utilisation will be low?
External funding	f) Has the scale of forecast third party funding to be secured (where appropriate) been shown to be reliable and appropriate to the activity and outcomes being proposed?
Direct procurement	g) Has the company appropriately considered the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?
Customer view	h) Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views?
Cost efficiency	**A1.1.3 Cost efficiency**
Developing costs	a) Is it clear how the company has arrived at its option costs? Is there supporting evidence on the calculations and key assumptions used and why these are appropriate?
Benchmarking	b) Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)? d) Is there compelling evidence that the additional costs identified are not included in our enhancement model approach? e) Is there compelling evidence that the allowances would, in the round, be insufficient to account for evidenced special factors without an enhancement model adjustment? f) Is there compelling econometric or engineering evidence that the factor(s) identified would be a material driver of costs?
Assurance	c) Does the company provide third party assurance for the robustness of the cost estimates?
Customer protection	**A1.1.4 Customer protection**
	a) Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope? b) Does the protection cover all the benefits proposed to be delivered and funded (eg primary and wider benefits)? c) Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including how customers are protected against third-party funding risks?

Naturally, some of the information we highlight is relevant to more than one of these enhancement criteria, and so each enhancement investment should be read as a whole. In some sub-sections we go beyond the specific enhancement assessment criteria to provide additional relevant context where needed. For example, in some 'Long-term context (historic)' sections, we highlight not just the funding from previous price reviews, but also the activities and performance delivered in previous AMPs.

2 Advanced WINEP

Overview

- A-WINEP is our opportunity to deliver long-term environmental and social benefits above and beyond a traditional WINEP approach. We plan to do this by demonstrating an approach that maximises value by going even further for the environment through partnership working, a focus on the use of nature-based solutions, improved multi-stakeholder governance and innovative funding models
- We will invest £26.2m to unlock wider environmental and social outcomes through two workstreams:
  - The creation of a Partnership Centre of Excellence that brings together stakeholders to deliver improvements in river and coastal waters through nature first solutions
  - A Partnership Grant Fund, supporting emerging partnership opportunities within target catchments.
- Our requested funding represents around 1% of Anglian Water's current forecast cost of WINEP in PR24 and we believe it will be fundamental in piloting and facilitating better outcomes-based delivery in AMP8 and AMP9.
- A-WINEP was approved for progression to business plan submission (with a potential expenditure for AMP8 of £26.2m) after review by the EA, Ofwat, and members of the Advisory Group on 6th September 2023. The progression letter stated "Your A-WINEP has the potential to achieve more for the environment and customers - and provide valuable learnings for the wider industry - than your standard WINEP programme would otherwise be able to do. Thank you for your positive approach and embracing the spirit of collaboration."
- Our A-WINEP has been designed over a ten-year time horizon, and there is potential to scale up the A-WINEP to create a more outcomes-based WINEP at PR29.

Table 3 Cost dashboard

PR24 costs (£m)	
Capex	19.8
Opex	6.5
Totex	**26.2**
Benchmarking	
Method	
Costs removed	Specific benchmarking was not available so supplier quotes and historic costs of similar work have been built in to our costs.
Customer Protection	
Price Control Deliverable	A-WINEP: grants A-WINEP: Creation of Centre of Excellence
Ofwat data table	
CWW3.127-CWW3.129	Advanced WINEP

2.1 Delivering for the long term

2.1.1 Investment context

This investment is required to support the delivery of long-term environmental and social benefits above and beyond a traditional WINEP approach through our Advanced WINEP (A-WINEP) programme. Our vision for the A-WINEP is to achieve the highest level of ambition for the environment whilst ensuring that costs and risk remain acceptable to our customers. We plan to do this by demonstrating an approach to maximises value by going even further for the environment through:

- Partnership working (including leveraging significant partnership funding)
- A focus on the use of nature-based solutions
- Implementing solutions to water management challenges at scale
- Improved multi-stakeholder governance

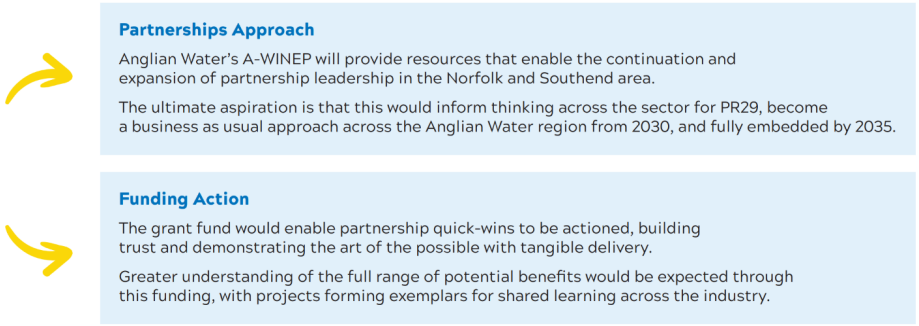
We submitted our initial concept of an 'Advanced WINEP' to the Environment Agency in November 2022 which would enable a more holistic approach to the delivery of WINEP obligations in target catchments. This was followed by the formal submission of our Stage 1 A-WINEP proposal 'Partnership for regeneration and resilience' on the 7th August 2023. We envisage the A-WINEP approach becoming our business as usual approach to developing the WINEP programme at PR29 and beyond.

A-WINEP was approved for progression to business plan submission (with a potential expenditure for AMP8 of £26.2m) after review by the EA, Ofwat, and members of the Advisory Group on 6th September 2023.

Why do we need an A-WINEP?

We support the ambition of both Ofwat and the EA to embrace all opportunities to deliver improvements through a long-term, flexible approach to outcomes-based regulation, including opting for 'green' over 'grey' options by default, and working in partnership with our stakeholders to deliver these benefits. Experience shows that setting up and maintaining strategic partnerships can be challenging without a consistent resource to support the development of projects and alignment of funding streams. Often partnerships lose momentum or become reactive to short-term funding opportunities, limiting the full benefits that could be achieved. Taking a longer-term approach will help to navigate this challenge, whilst providing a natural transition between PR24 and PR29. The existing regulatory framework limits this type of approach. Short term obligation deadlines encourage the use of traditional grey solutions. However, allowing more time to shape partnerships and encourage more sustainable approaches can lead to more nature-based solutions being delivered, with the associated greater range of benefits. As such, we propose to address this through our partnerships approach and through funding action (detailed in the image below).

Figure 1 Our A-WINEP partnerships approach and funding action



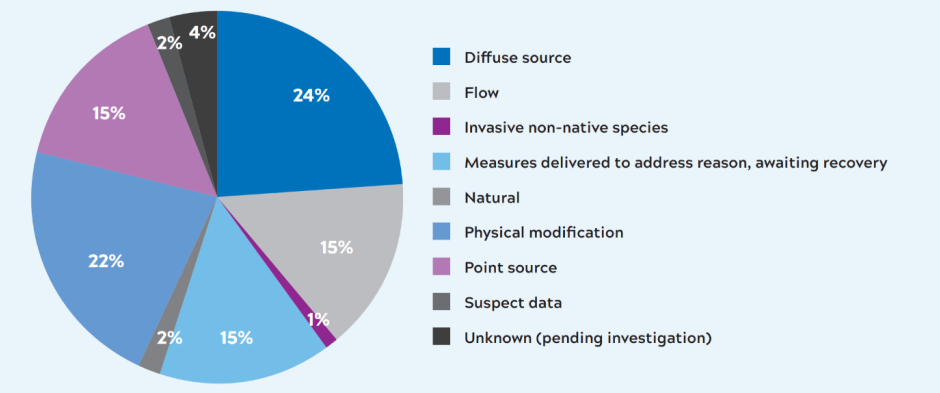
The table below provides an example of how the A-WINEP approach to catchment regeneration and urban regeneration can deliver additional environmental and social benefits beyond the traditional approach:

Table 4 A-WINEP - Wider benefits

	Traditional approach	A-WINEP	Wider benefits	Additional cost	Additional benefit
Catchment Regeneration Action to restore and enhance river catchment through nature-based solutions and land management	Nutrient removal only at numeric WRCs to achieve Anglian Water's fair share of the Environment Act target River restoration delivered through standard contractors on target river stretches	Nutrient removal across the whole catchment, supporting all sectors to achieve environmental targets through existing and emerging nutrient markets Wider catchment improvement through increased efficiency and partnership funding, delivering wider biodiversity and social benefit	Increased km enhanced. Local waterbodies improved. Good ecological status. Reduced soil loss. Biodiversity gain. Recreation Amenity.	£26.2m	£15-30m - water quality benefit from expansion of river restoration delivery (based on 50%-100% increase of traditional WINEP) £18m - water quality benefit from land-use interventions (based on 5% uptake across catchments) £10m - biodiversity net gain (based on 70% contribution to existing net gain expectations)
Urban Regeneration Surface Water Management Action to retrofit green infrastructure, such as sustainable drainage systems, to reduce the impact of storm overflows and reduce flood risk across two urban catchments - Great Yarmouth and Southend.	Grey, end of pipe solutions primarily benefiting Anglian Water infrastructure and delivering specific outputs at target storm overflows. No additional benefits to the wider community or environment.	Catchment - wide green solutions delivering overflow reduction target delivered through partnership funded approaches. Delivered over 10 years we will meet our storm overflow targets whilst delivering a wide range of benefits for the community	Wider air quality biodiversity recreation amenity and education benefit as well as additional downstream flood risk reduction Additional benefits to be measured - e.g. using the BEST tool.		£5 - 10m - water quality benefit (based on additional overflow spill reduction) £13.5m - biodiversity net gain (based on additional biodiversity units from SuDS) £1-50m - wider amenity, recreation and flood risk (range due to benefit uncertainty)

In our A-WINEP target area, there are common challenges that are driving Reasons for Not Achieving Good status (RNAGs). These include Point Source, Diffuse Source, Physical Modification, and Flow, making up 75% of the cause. Through the significant WINEP investment forecast in AMP8 and AMP9, we anticipate that a large proportion of Point Source and Flow challenges will be resolved; however there is currently no coordinated action to resolve Diffuse Source and Physical Modification challenges at a catchment scale.

Figure 2 Reasons for not achieving Good in A-WINEP target area



To achieve an outcome of healthy functioning and connected ecosystems, a holistic approach to all environmental challenges is required. We risk investing significantly in the environment through WINEP to resolve only part of the problem (e.g. nutrient fair share removal). Although this will undoubtedly deliver environmental gain, it won't achieve our overarching ambition. Furthermore, regulatory reporting of ecological status is not always representative of the needs of the local environments within a catchment (e.g. headwaters or smaller tributaries), meaning that the traditional WINEP approach can disincentivise investment in these areas. A-WINEP will allow us to build on traditional WINEP delivery and develop a programme of work targeting wider environmental gain around point and diffuse source challenges alongside morphological and habitat enhancements that deliver value to local communities. We also maintain the desire to translate ecological status into meaningful outcomes for catchment stakeholders and financial markets.

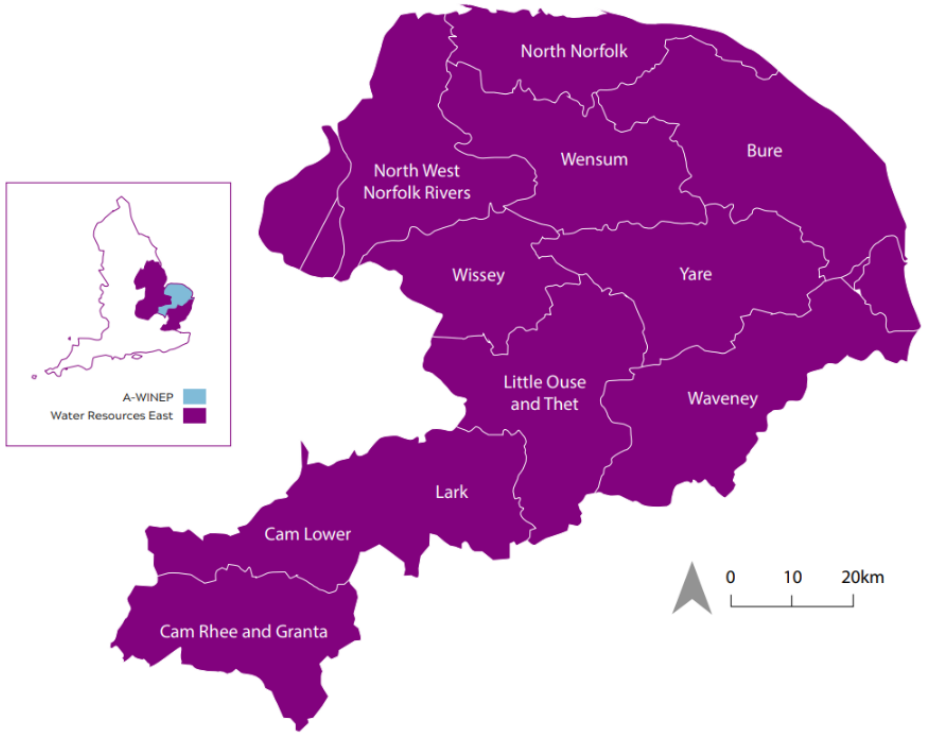
Our A-WINEP vision

A-WINEP is our opportunity to provide consistency to collaborative environmental delivery, facilitating a long-term partnership approach to enable the delivery of wider environmental gain and social prosperity in our catchments - natural and urban. As a 10-year investment in partnership development and delivery, it will provide the template for a different way of working for the sector, becoming the standard approach to WINEP investment planning from PR29 and beyond.

This proposal aims to be truly outcomes-focused, asking how we can push delivery of environmental outcomes beyond investments at our assets in an affordable and best-value way for our customers.

Ultimately, we want to create natural and urban catchments that enable environmental and social prosperity for our customers, aligned with the strategic ambitions of nature recovery strategies and national environmental objectives. This includes achieving good ecological status and creating thriving ecosystems in our most valuable habitats (e.g. chalk streams). A-WINEP will allow us to explore land management change across catchments, delivering water quality, flood, natural processes, biodiversity, recreation, amenity benefits (and many more) at a scale relevant to our customers and stakeholders. Our target will be to better quantify these and understand the market-readiness for such benefits generation.

Figure 3 Anglian Water A-WINEP region of interest



Through A-WINEP, we are building on existing strategic relationships that have been developed as part of Water Resources East and the Norfolk Water Hub Strategy, with an extended geography to integrate with Get River Positive delivery

on the Norfolk coast, the River Lark Chalk Flagship, and other priority chalk stream areas in and around Cambridge. This geography will allow us to explore how to deliver partnership working at scale, providing further experience to support a region-wide roll-out of the approach in PR29.

2.1.2 Scale and timing

The PR24 WINEP has a substantial focus on the delivery of statutory obligations to enable delivery of the government's 25-Year Environment Plan, including programmes around the reduction of nutrients, the achievement of nutrient neutrality, together with large statutory programmes around sewage sludge and storm overflows. Much of this will be focussed on the delivery of schemes for which there is a statutory obligation to deliver and output within a five-year period, for example improvements at specific water recycling centres or overflow locations. This can limit the opportunity for delivery of wider environmental outcomes and exploration of partnership projects that do not directly contribute towards resolving specific water company impacts on the environment.

Our A-WINEP programme goes beyond our statutory commitments: focussing on delivering additional environmental value in a way that is affordable for customers, through leveraging in diverse but complimentary funding streams and delivering wider environmental outcomes at scale through effective governance. Our requested funding represents around 1% of Anglian Water's current forecast cost of WINEP in PR24 and we believe it will be fundamental in piloting and facilitating better outcomes-based delivery in AMP8 and AMP9.

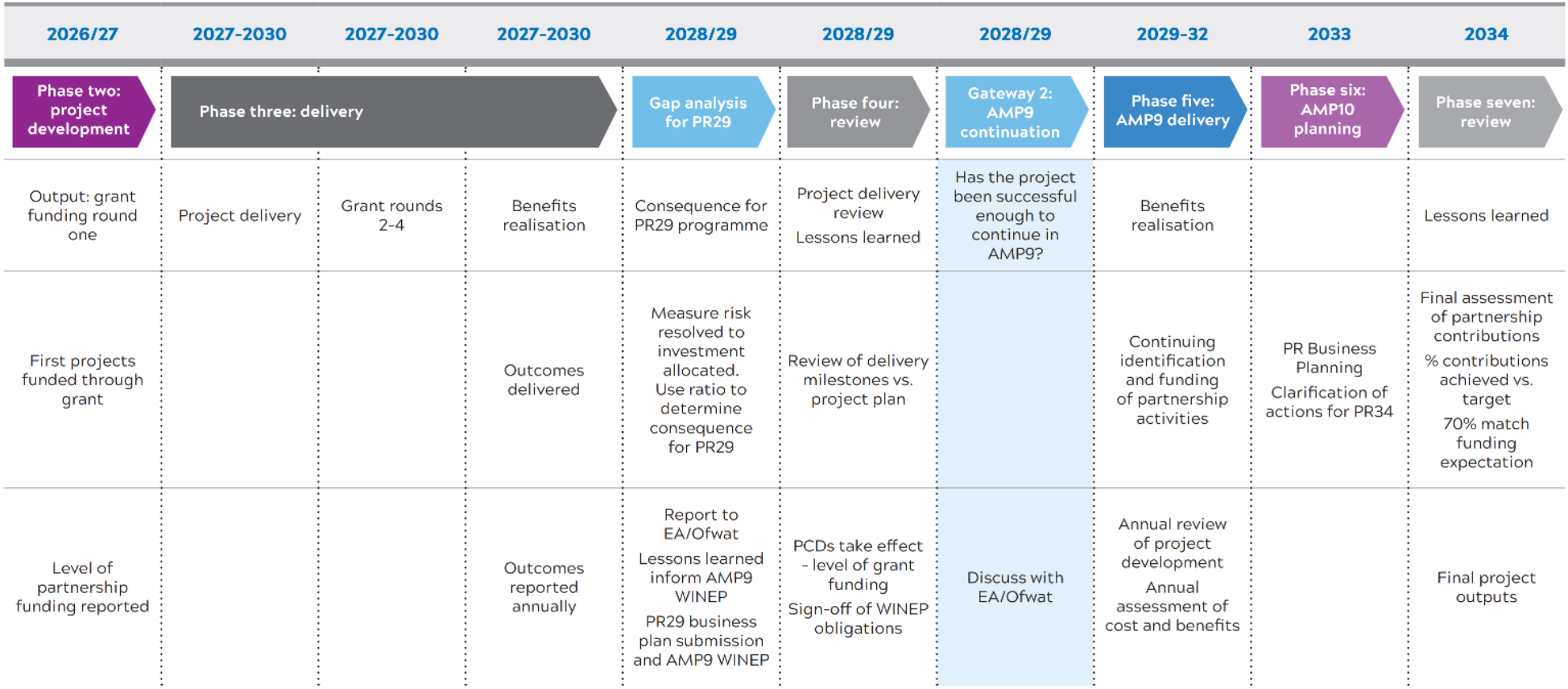
Our A-WINEP has been designed over a ten-year time horizon, because a longer time period is needed to establish strategic partnerships and run these successfully. Given the potential of scaling up the A-WINEP to create a more outcomes-based WINEP at PR29, a trial of this approach in catchments is required in PR24 to enable this. Deferring this trial to later AMPs would significantly reduce the scope for the delivery of additional benefits whilst meeting target dates outlined in the Environment Act.

More detail about the scale and timing can be found in our A-WINEP Stage 1 submission. Details of the anticipate A-WINEP timeline, outlining expected delivery dates and milestones for outcomes and reporting requirements, are outlined below:

Figure 4 A-WINEP timeline

Date	Pre 2025	2025/26	2025/26	May 2026	May 2026	May 2026	2026/27	2026/27	2026/27
A-WINEP phase	Phase zero	Phase one: establishing		Gateway 1 (centre of excellence)	Gateway 1 (urban regeneration)	Gateway 1 (grant)	Phase two: project development		
Outcome/ output		Governance established and partnerships in place	Urban regeneration plans agreed in outline	Has enough progress been made on establishing the centre of excellence to proceed?	High confidence that the urban regeneration plans will meet statutory deadlines for storm overflows by 2035	Has enough progress been made on establishing the grant to proceed?	Catchment outcomes agreed with partners (may be iterative, at different paces in different catchments)		Quick start projects begin
Measure/ milestone	Generate A-WINEP interest and enthusiasm within target catchments. Early commitment assessment Explore best vehicle/legal structure for centre of excellence	Baseline partnership assessment, structures and governance established	Clear plan of what actions will be taken to deliver our statutory WINEP obligations for storm overflows	Measure: MOU with strategic partners, aim for legal entity to be established Vision and Principles agreed Project review Board established Core Staff recruited	Funding Partners sign up	Is the grant scheme open to applicants with appropriate governance in place?	Catchment strategies established Outcomes and metrics agreed	Urban regeneration plans established Outcomes and metrics agreed	Where investment-ready projects are identified in phase zero, aim to begin work by 2026/2027
Reporting/ accountability	Informal Share with A-WINEP steering group Discuss with EA/ Ofwat AWS Board and strategic partner boards	Report to EA/ Ofwat EA/Ofwat invited to be members/ observers as appropriate	Agree with EA	Report to EA/Ofwat	For urban catchments, if target catchments are not agreed by the end of year 1, we will revert to traditional WINEP for the storm overflow programme	Report to EA/Ofwat	Report to EA/Ofwat	Report to EA/Ofwat	A-WINEP annual report to partners (shared publically)

Figure 5 A-WINEP timeline



Proposed Stage 2 activities and outcomes

In Stage 2 (2027-30), we propose to:

- Lay the groundwork for the Centre of Excellence. We will continue to engage with potential strategic partners to develop a shared vision and principles. With our partners, we will explore the most appropriate governance for the Centre to ensure that control, risks and responsibilities are shared fairly.
- Ensure clear visibility between A-WINEP, our Environment Strategy, and current internal structures around WINEP, outlining internal accountability for A-WINEP delivery and reporting.
- Continue to map opportunities for nature-based solutions and surface water separation. We have mapped our AMP8 investment to identify hotspots and challenges are working with the Norfolk Water Fund and the Rivers Trust to map opportunities for nature-based solutions. We're keeping an open mind. We don't anticipate being ready to set out a project pipeline before the start

of AMP8, but we will look to identify some 'quick-start projects' to begin early in AMP8. The kinds of NbS we expect to deliver will depend on what our partners need and what landowners are willing to do, but include establishing new wetland areas, habitat restoration, regenerative agriculture (where additional to requirements of Farming Rules for Water, diffuse pollution plans etc).

Nature-based solutions (NbS) can take time to deliver their full outcomes. At the project assessment stage, we'll set out what the expected outcomes are, with the proviso that catchment and partnership solutions will only be agreed where they are expected to offer better wholelife value and greater environmental outcomes than a water company-only solution. We will monitor the delivery of those outcomes, as we are doing at our Ingoldisthorpe treatment wetland, from the start of each project until at least the end of AMP9, when we expect the majority of outcomes will be delivered.

2.2 Interaction with base expenditure

There is no additional allowance for Advanced WINEP within Ofwat's base models. This is a new approach which has not been carried out by companies within base in previous AMPs and provides additional value to customers through new approaches to WINEP which will add additional wider value to customers beyond the statutory WINEP. Therefore, all of the costs associated with Advanced WINEP are assumed to be enhancement

2.3 Long term context (historic)

We have not previously received any base or enhancement allowance to take forward the A-WINEP approach and so there is no overlap with historic allowances either within base or enhancement.

2.4 Long term context (future)

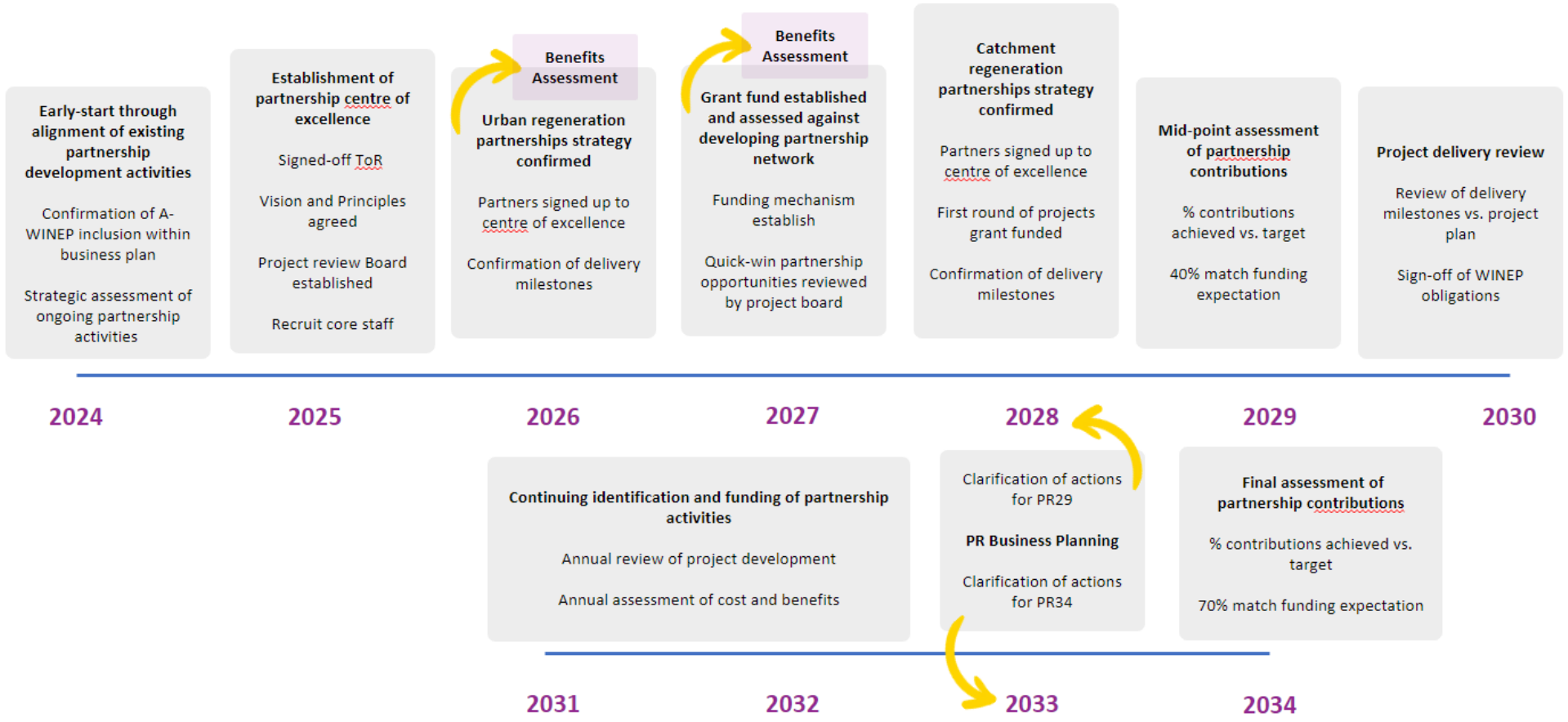
Our A-WINEP is reflected in our Long-Term Delivery Strategy (LTDS). It supports an adaptive approach by trialling a new way of delivering environmental objectives that spreads the cost to customers over ten years instead of five and aims to reduce the need for investment in future AMPs. It includes trigger points for switching to more traditional delivery if a catchment and partnership approach is not successful. We see significant opportunities from technology scenarios (e.g. catchment digital twin; concept in development in A-WINEP area).

LTDS projections reflect our belief that the A-WINEP approach will allow us to achieve our environmental ambition, without putting disproportionate cost pressure on customers. This is presented as avoidance of significant additional costs in the core pathway by working in partnership to co-finance environmental solutions that delivery wider benefits for our customers and the environment. [1]

Staged assurance has been proposed over a 10-year period within the A-WINEP submission, as part of a long-term view of environmental delivery and partnership development.

1 For more detail, please refer to section 2.2.1 'Environmental enhancement' in our LTDS

Figure 6 A-WINEP Staged Assurance Plan



We anticipate the further development of catchment strategies through the approach, aligning the ambitions of local partners with the needs of the environment and the maturity of markets to pay for these outcomes at scale.

We have embedded a place-based and outcomes approach into A-WINEP thinking. Our A-WINEP builds upon our current work with Norfolk County Council, The Nature Conservancy and Water Resources East (WRE) to develop and implement a Water Hub and associated Water Fund. A progress report for this project is available[2].

In order to understand where is best to invest to achieve the optimise environmental outcomes, WRE worked with a specialist conservation consultancy Biodiversify to develop a natural capital plan for the East of England using Systematic Conservation Planning. This plan outlines a shared vision for the restoration of nature across the East of England, with input from 37 stakeholder organisations and 945 discrete objectives reviewed. From this process, four priority areas for natural capital actions across the region where identified:

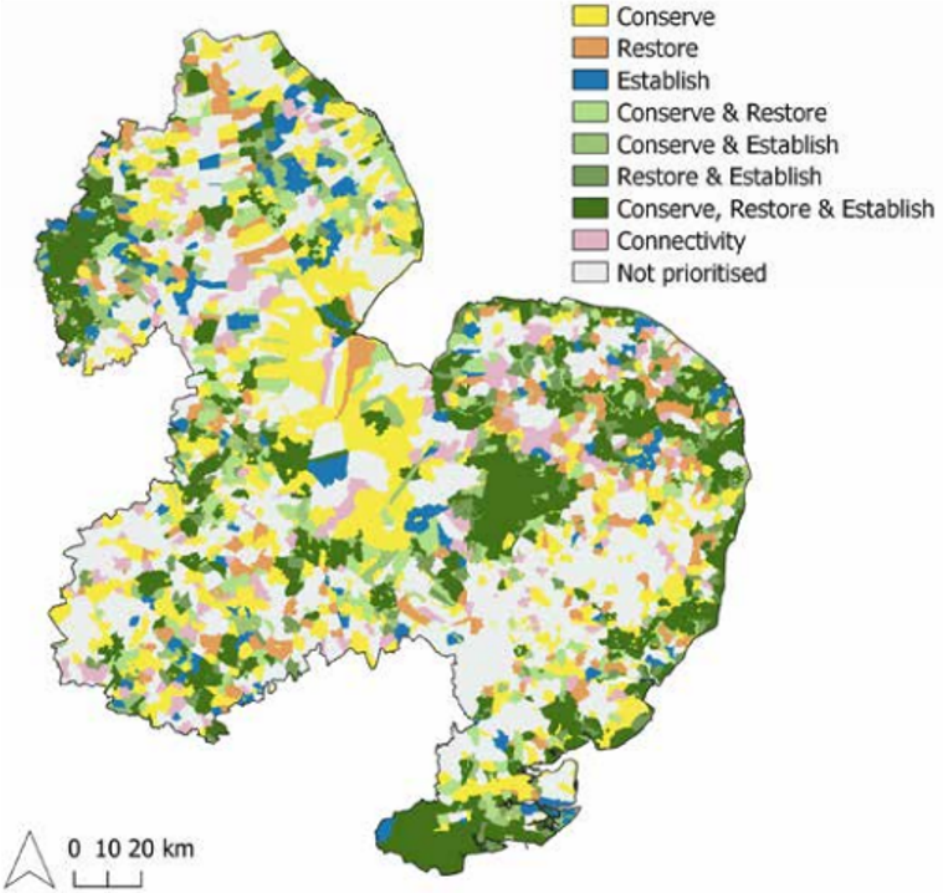
Table 5 Four priority areas for natural capital actions

Zone[a]	Meaning
Conserve	The areas of good quality habitat which should be **Conserved**
Restore	Area of degraded habitat which should be **Restored**
Establish	Areas where new habitat should be **Established**
Manage	Areas of farmland which should be **Managed** in a biodiversity friendly manner

a Source: The WRe Natural Capital Plan, October 2021

This supported the development of the map below which shows investment opportunities across the Anglian region, i.e., where the greatest environmental outcomes could be realised at the least cost to environmental investors.

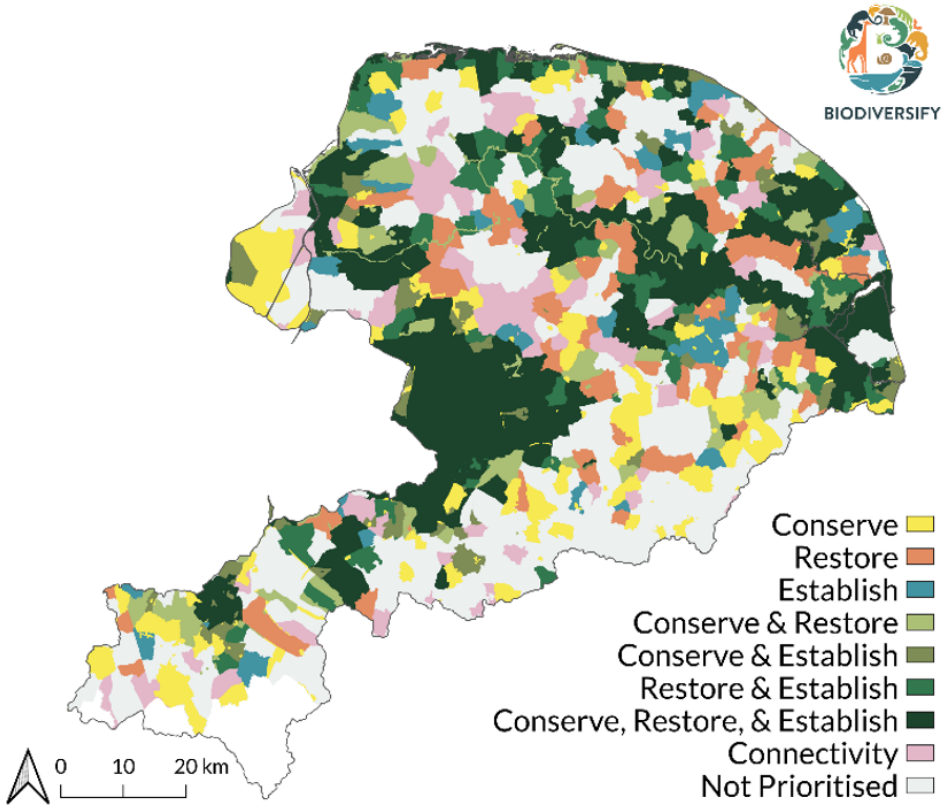
Figure 7 The WRe Natural Capital Plan, October 2021



We are currently working with Biodiversify directly to further refine this work for the county of Norfolk, which we will use as the basis for the A-WINEP programme.

2 https://wre.org.uk/wp-content/uploads/2022/11/v14-S_2594-NWSP-Stakeholder-Consultation.pdf

Figure 8 Norfolk natural capital opportunities



Source: The WRe Natural Capital Plan. October 2021

2.4.1 Customer support

Customers

We explored priorities for our A-WINEP plans with an in-depth focus group (n=5) and our online community (n=149 for this activity). Please refer to our Customer Synthesis Report for more detail[3]. When presented with a summary of our A-WINEP proposal and asked the open question, "What do you think of Anglian Water's plans to create this "partnership of excellence"? Tell us any initial questions or concerns you may have", our online community supported our overall A-WINEP approach. Provided stakeholders involved in the partnerships are properly motivated and managed, customers feel there is much to be gained from a 'partnership of excellence' including: greater improvements to the environment, water quality and infrastructure; less costs to pay in the future; and better strategies through viewing the project from different perspectives and expertise. 66% of 149 customers were in favour of us implementing our A-WINEP proposal.

Customers approve of a trial approach, starting with Norfolk and Southend, but would prefer to see wider implementation sooner than 10 years. When asked, "Do you agree with the approach to first focus the partnerships on Norfolk and Southend, before being rolled out for wider implementation in the rest of the region?" 27% agreed, 52% neither agreed nor disagreed, and 21% disagreed. N=149

Customers support the use of natural solutions that deliver wider benefits, even if they come at a higher cost. When asked, "To what extent do you support the use of natural solutions that deliver wider benefits, even if this costs more?", 74% were supportive or extremely supportive (n=149).

Customers are willing to pay the small increase in bills associated with the cost of our A-WINEP programme in AMP8, especially if that means costs would rise less in AMP9.The bill impact of the proposed A-WINEP investment alone was calculated to be 31p. We asked customers, "We'd like to get your thoughts on 3 payment scenarios to help fund the A-WINEP programme, which of the following would you prefer and why?

1. Keep bills lower to 2030, but higher costs after that
2. A small increase in customer AMP8 bills of 31p a year to 2030, but savings after 2030
3. A smaller A-WINEP programme, so smaller bill increase to 2030 but fewer benefits"

72% selected option 1, 19% option 2 and 9% option 3.

This insight will be used alongside our broader PR24 customer engagement to ensure we have a granular understanding of customers' willingness to pay for more-than-statutory environmental improvements, and that our A-WINEP targets the environmental outcomes customers care about most.

Stakeholders

We are building on established relationships with local and national Rivers Trusts, Water Resources East, the Norfolk Water Fund, Local Planning Authorities, Lead Local Flood Authorities and Highways Authorities , as well as our strategic engagement with catchment partnerships across the region. In addition, we have received positive feedback from both the A-WINEP Advisory Group and Get River

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Positive External Scrutiny Panel, and taken on-board their feedback within this proposal. We will continue to positively engage with these groups throughout A-WINEP delivery, whilst maintaining regulatory engagement through formal reporting and anticipated steering group meetings.

2.5 Cost control

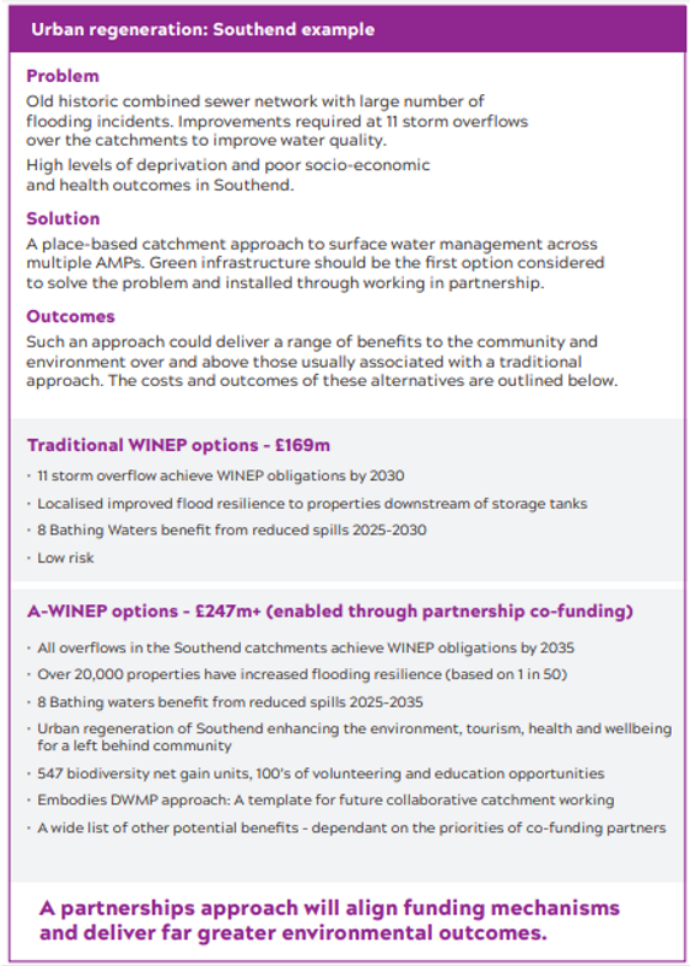
Recognising the uncertainty surrounding the delivery of benefits, for the grant element we would commit to returning funding to customers if we are not able to find partnership funding opportunities to the level that we expect. Our ambition in this area is to target 70% partnership funding, so we would initially expect to identify a reasonable percentage per scheme (50%), as a minimum to ensure we are making good-value grants. This will be monitored across the AMP and measured to ensure an increasing level of partner contribution is achieved (providing the necessary independent assurance on our performance against these criteria). Please refer to the A-WINEP proposed staged assurance plan for more details.

A-WINEP funding will only be utilised to deliver wider environmental outcomes that could not otherwise be achieved through our standard WINEP approach. WINEP is a statutory requirement specified by the Environment Agency, therefore some aspects of timing and scale of improvements are underpinned by the traditional obligation approach.

Traditional WINEP includes several elements that individually contribute to catchment regeneration but are not designed around a single outcome. Nutrient improvement, flow improvement, and biodiversity enhancement predominantly focus on actions at Anglian Water assets, and whilst nature-based solutions are recognised for their potential added value (including water quality improvement, habitat enhancement, flood relief, and water resource management), their inclusion in standard WINEP optioneering is often limited by confidence in these outcomes. We will deliver Environment Act targets for nutrients and storm overflows through traditional WINEP, and where possible, we will deliver additional benefits to these schemes through the A-WINEP partnerships. We provide examples of this approach in the image below:

Figure 9 Catchment regeneration: River Lark example

Figure 10 Urban regeneration: Southend example



We are recognising the impact that the inclusion of additional non-statutory investment will have for the affordability and deliverability of the PR24 plan. We have therefore sought to carefully balance the need for investment and the long-term benefits to the environment that it will deliver against these affordability and deliverability challenges. We have done this by taking steps to ensure we have controlled costs by benchmarking our costs based on the roles identified. We have built on our experience of developing a partnership approach through the Norfolk Water Hub, alongside our investment in strategic relationships with key partner organisations.

2.6 Unlocking greater value for customers, communities and the environment

2.6.1 Option consideration

A-WINEP will allow the exploration of nature-based solutions (NBS) as part of wider catchment regeneration, increasing the flexibility of opportunity realisation through a partnerships approach. In addition, we will promote a programme of entirely green solutions in urban regeneration catchments, whilst learning from complementary innovation projects aiming to understand the barriers to mainstreaming NBS solutions, and integrate outcomes into our A-WINEP approach.

It is too early to have a full suite of partnerships, tools, solutions and outcomes of the A-WINEP programme, and this will be progressed iteratively during AMP8. This investment is to enable us to seek out these possibilities and identify potential interventions that we could not do through the traditional WINEP. We will consider as wide a range of options as possible, including both traditional and non-traditional options as the A-WINEP programme develops.

Our aim is to develop a catchment restoration plan for each of the 11-priority catchment in the A-WINEP area, outlining a strategic long-term approach to collaborative environmental delivery. We will adopt tools such as systematic conservation planning (for which a baseline assessment has already been undertaken) to develop and deliver effective engagement and project development planning with partner organisations, developing ways of working, governance structures, and finance mechanisms in the process. Local nature recovery strategies will be aligned with other strategic catchment objectives at the very start of the process, so that all projects are aligned with an overarching vision and outcome in mind. The A-WINEP grant fund will be used to facilitate early delivery of identified projects and demonstrate the wider benefits that can be achieved. Whilst the specific projects have not been identified at this stage (as project development will be part of the catchment-wide approach), early engagement with catchment partnerships through our strategic relationship with The Rivers Trust and East of England Planning Hub has identified a substantial amount of interest and opportunity. Typical project interest includes working with landowners to promote land-use change to reduce diffuse pollution pressure and enhance/restore habitat, connectivity, and natural functions within rivers and adjacent riparian area.

By taking this approach, the A-WINEP option ensures that place-based thinking is done as standard, with prioritised detailed project design being developed in a systematic way with partners across a catchment. We are promoting nature-based solutions that deliver wider environmental outcomes and therefore deliver for multiple stakeholders and financial markets, ensuring that the approach delivers best value for our customers.

2.6.2 Cost-benefit appraisal

Partnership Centre of Excellence

We are still in the process of selecting projects to be delivered by the Partnership Centre of Excellence within the A-WINEP catchments. The Rivers Trust across our whole region which has developed an East of England Hub to bring together projects and partners. Within this partnership, we are working to conduct workshops around the target catchments with groups and organisations to identify potential projects. Our next step is to screen these opportunities to produce a shortlist linked to Anglian Water investment drivers. This work will continue through the rest of AMP7 and beyond to inform A-WINEP project selection.

We have co-funded the Norfolk Water Strategy Programme, which has identified the specific challenges in Norfolk, the role for nature-based solutions in addressing them, and the funding challenges and opportunities involved. By September 2023, the Programme will deliver a Norfolk Water Fund to facilitate markets in NbS for water resources and nutrient neutrality. This will inform development of A-WINEP nutrient and habitat projects, through:

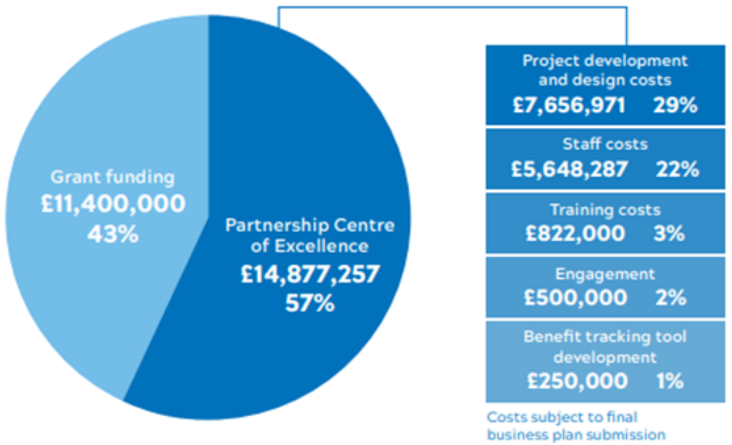
- NbS modelling and portfolio building – Demonstrating the benefits of investable NbS interventions for Nutrient Neutrality and Water Resources and co-benefits, most notably Biodiversity Net Gain.
- Business case for NbS – Demonstrating costs and benefits (monetised where possible) for a portfolio of NbS interventions at scheme and portfolio scale.
- Understanding the nutrient credit market in the Norfolk Broads, where project readiness (project development) has been identified as a significant limiting factor in accessing emerging markets for ecosystem services/environmental outcomes.

Through A-WINEP, our ambition is to leverage 70% partnership funding against a 30% contribution from Anglian Water. Experience and evidence show us that our ambition is stretching but achievable; for instance, our previous Norfolk Water Strategy received 95% partnership funding, and our Great River Positive programme at time of writing has 70% of partnership funding confirmed.

There is general acceptance that there is inherent value in working in partnership, and that co-delivery provides an opportunity to deliver more efficiently and achieve wider outcomes. Despite this, it remains difficult to assign a financial value and therefore demonstrate the cost-benefit of facilitating partnership structures.

Noting the difficulties in establishing a financial value for the benefits of this measure, we present the costs below

Figure 11 Financial benefits of partnership working



The Opportunity

Recent insight from the Norfolk Water Strategy suggests that partnership delivery of nature-based solutions has a potential market value of £12-24m per year, in Norfolk alone, with an additional £4m of biodiversity net gain, and wider water resource value from 5-12% potential gains in base river flows. Alongside other private, public and philanthropic interest, this suggests that there is a strong opportunity for co-funded A-WINEP delivery of wider outcomes in AMP8 (2025-30).

Grant funding

The A-WINEP Partnership Grant Fund will build on our experience of delivering similar grant schemes, such as the Get River Positive grant, Flood Partnership fund, Flourishing Environment fund, and Catchment Management grant. On average, these schemes leverage 60-65% partnership contributions, within a wide

range depending on the scheme, circumstances, and risk. With this in mind, we have set an ambitious target of leveraging on average 70% partnership funding towards schemes delivered as part of our A-WINEP.

We will establish a project review board and establish the criteria for assessment. This will include an expectation of at least 50% match funding and delivery of wider environmental benefit. With partners, we will develop a common methodology for benefits assessment, based on Wider Environment Outcome (WEO) metrics, water company value metrics, and other assessment tools (e.g. BEST). The A-WINEP Grant will allocate £1 million per target catchment in Norfolk, Lark and Cam, and a further £200,000 for the surface water catchments of Southend and Great Yarmouth.

The outcomes of the A-WINEP grant scheme will be:

- Funded delivery of partnership projects
- Quantified assessment of wider benefits
- Detailed understanding of financial markets for NbS
- Applicability assessment of project within PR29 landscape.

Applications to the grant will go to an expert review panel, whose role it is to assess the wider value of the partnership project proposal and ensure value for money.

2.6.3 Environmental and social value

As noted above, it remains difficult to assign a financial value to the benefits created by partnership working and therefore demonstrate the cost- benefit of facilitating partnership structures. Nonetheless, there is general acceptance that there is inherent value in working in partnership, and that co-delivery provides an opportunity to deliver more efficiently and achieve wider outcomes.

Our experience of delivering flood risk management in partnership with a range of stakeholders, demonstrates that savings can be achieved by working collaboratively, delivering more for less. We have been able achieve wider benefits for the environment and communities, whilst investing less than would otherwise be needed. For example, during Year 3 of AMP7, we contributed £1.46m towards co-funded schemes that reduce the risk of flooding to our customers, whilst our partners contributed £3.10m. Through this collaborative approach we were able to deliver £5.29m of benefits, as measured through our six capitals approach.

2.6.4 Investment benefits

Our A-WINEP approach will enable a programme of urban regeneration and catchment regeneration to be delivered in the target catchments. Where possible, benefits have been quantified using Wider Environmental Outcome metrics for both approaches, with estimates provided below. We remain committed to additional quantification of benefits throughout the A-WINEP delivery to better quantify the value that projects are providing, and expect this to be a primary outcome of the approach.

Table 6 A-WINEP wider benefits

	Traditional approach	A-WINEP	Wider benefits	Additional cost	Anticipated additional benefit value
Catchment Regeneration Action to restore and enhance river catchment through nature-based solutions and land management.	Nutrient removal only at numeric WRCs to achieve Anglian Water's fair share of the Environment Act target. River restoration delivered through standard contractors on target river stretches.	Nutrient removal across the whole catchment, supporting all sectors to achieve environmental targets through existing and emerging nutrient markets. Wider catchment improvement through increased efficiency and partnership funding, delivering wider biodiversity and social benefit.	Increased km enhanced. Local waterbodies improved. Good ecological status. Reduced soil loss. Biodiversity gain. Recreation. Amenity	£26.2m	From expansion of river restoration delivery (based on 50%-100% increase of traditional WINEP) £18m – water quality benefit from land-use interventions (based on 5% uptake across catchments) £10m – biodiversity net gain (based on 70% contribution to existing net gain expectations)
Urban Regeneration Surface Water Management. Action to retrofit green infrastructure, such as sustainable	Grey, end of pipe solutions primarily benefiting Anglian Water infrastructure and delivering	Catchment-wide green solutions delivering overflow reduction target delivered through partnership funded	Wider air quality, biodiversity, recreation, amenity and education benefit, as well as		£5-10m – water quality benefit (based on additional overflow spill reduction) £13.5m – biodiversity net gain (based on additional biodiversity units from SuDS)

	Traditional approach	A-WINEP	Wider benefits	Additional cost	Anticipated additional benefit value
drainage systems, to reduce the impact of storm overflows and reduce flood risk across two urban catchments – Great Yarmouth and Southend.	specific outputs at target storm overflows. No additional benefits to the wider community or environment.	approaches. Delivered over 10 years we will meet our storm overflow targets whilst delivering a wide range of benefits for the community	additional downstream flood risk reduction. Additional benefits to be measured – e.g. using the BEST tool.		£1-50m – wider amenity, recreation and flood risk (range due to benefit uncertainty)

An example catchment for each of these approaches is presented below, showing the comparison between traditional and A-WINEP approaches.

Table 7 Traditional versus A-WINEP comparison

	Catchment regeneration: River Lark example	Urban regeneration: Southend example
Problem	End-of-pipe solutions to remove Anglian Water's fair-share of nutrients is often high cost and high carbon, without delivering the ultimate environmental outcomes (good ecological status). Small waterbodies, like headwaters, can experience environmental damage that is diluted downstream, in the main waterbody, and so does not trigger investment.	Old historic combined sewer network with large number of flooding incidents. Improvements required at 11 storm overflows over the catchments to improve water quality. High levels of deprivation and poor socio-economic and health outcomes in Southend.
Solution	A combination of traditional investment on Anglian Water assets and multi-sector catchment approach that leverages private, public and philanthropic finance to deliver NbS with multiple benefits. Better strategic alignment of multi-sector approach over multi-AMP timeframe.	A place-based catchment approach to surface water management across multiple AMPs. Green infrastructure should be the first option considered to solve the problem and installed through working in partnership.
Outcomes	Such an approach could deliver a range of benefits to the community and environment over and above those usually associated with a traditional approach. It could also build capacity and raise confidence in delivering NbS and understanding their benefits and costs as a pathfinder for AMP9.	Such an approach could deliver a range of benefits to the community and environment over and above those usually associated with a traditional approach. The costs and outcomes of these alternatives are outlined below.
Traditional WINEP options	£24.4m (nutrient) + £5.4m (restoration) · Technically feasible levels of nutrient removal · River length improved through Water Quality improvement and habitat restoration · Increased low flow resilience	£169m · 11 storm overflow achieve WINEP obligations by 2030 · Localised improved flood resilience to properties downstream of storage tanks · 8 Bathing Waters benefit from reduced spills 2025-2030 · Low risk
A-WINEP options	£Traditional + £Grant (£30+m) · Identify opportunities to deliver greater nutrient reduction through catchment approaches - to reach Environment Act target and support sustainable development · Deliver non-statutory improvements in small waterbodies of most value to customers · Address more Reasons for Not Achieving Good (RNAGs) to get more waterbodies to Good Ecological Status · Incentivise NbS that are substantially funded by other sectors in a way that will deliver greatest risk reduction for drinking water protection, habitats and nutrients.	£247m+ (enabled through partnership co-funding) · All overflows in the Southend catchments achieve WINEP obligations by 2035 · Over 20,000 properties have increased flooding resilience (based on 1 in 50) · 8 Bathing waters benefit from reduced spills 2025-2035 · Urban regeneration of Southend enhancing the environment, tourism, health and wellbeing for a left behind community · 547 biodiversity net gain units, 100's of volunteering and education opportunities

	Catchment regeneration: River Lark example	Urban regeneration: Southend example
	· Opportunity for biodiversity net gain units, volunteering and education benefit · Wider delivery of environmental improvements through natural alignment of restoration ambition.	· Embodies DWMP approach: A template for future collaborative catchment working · A wide list of other potential benefits - dependant on the priorities of co-funding partners

2.6.5 Managing uncertainty

By its nature, Advanced WINEP has low solution certainty as the purpose of the investment is to deliver obligations in ways that we have not previously applied at a large scale. The allowance for A-WINEP specifically seeks to enable these alternative approaches to be delivered with a greater degree of certainty in future AMPs.

We also face uncertainty in delivery of A-WINEP as it is focussed on maximising delivery through partnership funding. This inherently places some of the outputs delivered through A-WINEP funding outside of our control, but we will minimise this risk through close collaborative working with our partners.

We outline the identified risks to each A-WINEP deliverable below, and the proposed mitigation for each:

Table 8 Risks to A-WINEP deliverables and proposed mitigations

A-WINEP deliverable	Risk	Impact on project objectives	Mitigation proposed
Centre of Excellence	Insufficient strategic partners willing to be involved. Reputational risks of failure may inhibit development or collaboration with Anglian Water.	Partnership development will be more piecemeal and reactive, rather than strategic and proactive.	Engagement and early discussions already happening and will continue throughout remainder of AMP7.
Project Delivery	Financial risk: Increase in costs due to higher-than-expected tender prices and / or macro-economic pressures such as inflation, the war in Ukraine and a prolonging of the Covid pandemic.	Results in fewer measures being installed across the project area, impacting on the learning and innovation benefits of the project.	Early engagement with procurement teams to ensure appropriate quotes are obtained.
Project Delivery	Financial risk: risk allocation for budget over-spend and under-spend across partners. Complexity of sharing financial risks across partners may prevent dome organisations from getting involved or place unfair burden on Anglian Water as lead organisation for outcomes benefiting multiple organisations.	Hinder partnership work through unfair distribution of cost risk compared to distribution of benefits.	Use best practice from other partnership arrangements and engagement with identified partners to explore options for risk allocation.
Project Delivery	Human resources risk: insufficient skilled staff resource available to deliver the project satisfactorily due to difficulties in both recruiting and retaining adequately skilled personnel.	Results in a risk to delivery of the strategic objectives and outcomes due to lack of capacity and continuity in the delivery of the Partnership Centre and grants to potential schemes.	Produce a recruitment plan identifying potential internal resources at Anglian Water and identified partners for the roles as well as a strategy for external recruitment and secondment options with clear job descriptions and skill requirements. Maintain regular Project Team updates and ensure resource constraints are captured early so that appropriate action can be taken.

A-WINEP deliverable	Risk	Impact on project objectives	Mitigation proposed
			Build the necessary skills into any SPV that is responsible for the delivery of ecosystem services from catchment solutions to multiple stakeholders - so not just water but transport, carbon, energy, food etc. The skills in NFM, Nat Cap, farm liaison, agri finance etc can be utilised across a wider base of projects and funding streams to provide greater scale and stability.
Project Delivery	Accessing both private and public funding to support and enhance the project.	Results in fewer measure being installed across the project area, reducing the positive impact of the A-WINEP programme impacting on the learning and innovation benefits of the project.	Develop robust business cases to support funding applications as early as possible.
Project Delivery	Reaching agreements on how to measure and share benefits in an equitable way across partners that avoids double-counting, ensures Anglian Water's statutory obligations are met and secures commitment from all partners.	Unintended consequences which skew projects towards certain outcomes, under or over-estimating outcomes from A-WINEP, fosters lack of trust or commitment amongst the partnership.	Develop a clear plan for outcomes identification, measurement and sharing to be agreed by all partners. The plan will map the potential outcomes, differentiating between Anglian Water's statutory requirements and additional co-benefits, define and quantify indicators to be used, and set out how these benefits will be shared across partners based on a transparent method of allocation. Auditing and certification of the processes used will also be needed.
Project Delivery	Lack of or poorly defined assurance processes to allocate funding, define roles and responsibilities, and monitor project delivery.	Poorly designed projects are selected, lack of accountability and transparency, poor financial management, loss of trust in the project leads to lower outcomes, inability to demonstrate values of the schemes.	Build on best practice from other projects to develop a robust and clear project assurance framework setting out clear roles and responsibilities, eligibility criteria for funding, processes for financial and quality monitoring. Ensure that the bidding process checks compliance with guidelines while also allowing for innovation and best value; monitoring and evaluation ensures delivery in accordance with guidance and submitted designs. Incorporate independent auditing of entire process.
Surface Water Management Catchments	Significant flood events	Diverts attention away from the project deliverables among the Project Team	Project management resources in place to manage the project deliverables
Surface Water Management Catchments	Unforeseen obstructions to key proposed locations of SuDS	Results in the relocation of SuDS features which could significantly change the effectiveness of the hydraulic performance of the SuDS proposed	Gather as much data as possible before commencing detailed design work, in particular ground penetrating radar
Nutrient Reduction	Failure to identify catchment interventions that deliver sufficient benefits to water customers	Catchment and nature-based solutions cannot replace traditional WINEP solutions in the A-WINEP period	Project design focusses on identifying projects that deliver additional nutrient benefit over Anglian Water statutory requirement, and paid for by markets e.g. nutrient neutrality credits

A-WINEP deliverable	Risk	Impact on project objectives	Mitigation proposed
Nutrient Reduction	Landowners unwilling to enter agreements to deliver nature-based solutions	Results in fewer measures being installed across the project area, reducing the positive impact of the A-WINEP programme impacting on the learning and innovation benefits of the project.	Continue work with Norfolk Water Fund and Rivers Trust to understand governance, finance and feasibility to help landowners understand options and implications.
Chalk Stream Restoration	Individual interventions do not tackle the core problems of over abstraction from aquifers and streams	Requires long-term planning of major investment in downstream reservoirs, treatment systems and pumped conveyance infrastructure.	Solutions should identify that abstracting downstream will support high quality chalk aquifer supplies in the upper catchment. This may be more expensive than abstracting from the upper chalk stream but will provide sustainable supplies to meet rising demand long into the future with ecosystem restoration.

2.6.6 External funding

By working together with others we could help to deliver not only improvements to our sewerage networks - reducing storm overflow spills, flooding, energy and carbon use from pumping and treatment - but we would also deliver wider benefits through the provision of nature-based solutions.

It is important to note that identifying strategic partners and agreeing the amount, timing and conditions of their contribution is part of the A-WINEP work we are proposing, rather than pre-work we could deliver at this stage. Given the timeframes involved and the work needed to identify the preferred green solutions, partners are not yet ready to enter funding agreements. Accurate understanding and assurance around partnership contributions is required for consideration with the current WINEP planning process.

Recent insight from the Norfolk Water Strategy suggests that partnership delivery of nature-based solutions has a potential market value of £12-24m per year, in Norfolk alone, with an additional £4m of biodiversity net gain, and wider water resource value from 5-12% potential gains in base river flows. Alongside other private, public and philanthropic interest, this suggests that there is a strong opportunity for co-funded A-WINEP delivery of wider outcomes in AMP8 (2025-30).

For this funding to be realised, market development and governance structures around the management of partnership funding will need to be explored and agreed through the A-WINEP approach. Specific criteria for the grant fund will be developed in collaboration with an external review panel, which will be established for AMP8 in-line with our current Get River Positive approach.

2.6.7 Direct procurement

Given the scale and uncertain nature of this investment area, we have considered that A-WINEP is not suitable for delivery through DPC, though it is suitable for delivery and funding through third-parties.

2.6.8 Customer view

Our customer engagement for this Price Review, as well day-to-day customer interactions and PR19 customer views, show that environmental protection is considered an important aspect of our work. Customers prioritise improvements that have a wider impact across the region (including river water quality) and they have strong preferences for avoiding deterioration. Improving river quality was ranked third in Anglian consumers' PR24 priorities and substantially above average. [4]

In our A-WINEP engagement, customers saw clear advantages to nature-first solutions and were happy pay a little extra to facilitate this, but this must be viewed in the context of customers' core desire for bills to be fair and affordable.

Our A-WINEP responds to these preferences by looking for ways to deliver wider environmental benefits through nature-first approaches while keeping costs down through partnership funding.

The location of the A-WINEP area was selected to build on existing partnerships and so to maximise the deliverability of the proposal. Some customers wanted to see the approach applied to a wider area. To ensure that the benefits can be realized in other areas as soon as possible, we have a developed a shared approach to capturing and disseminating the lessons learned from A-WINEP with Thames Water and United Utilities.

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Customers' preferences will help target the kinds of wider benefits we will seek to deliver. Customers want the A-WINEP to target environmental issues and public health. When customers ranked potential benefits, the top three were improved river quality beyond statutory requirements; reduced storm overflow discharges; and improved coastal waters beyond statutory requirements. We will build these preferences into the assessment criteria for the A-WINEP grant.

Customers want us to be transparent about how the money is spent and what it delivers. They want to know how we will be held accountable. The governance of both the centre of excellence and the grant will be shared publicly, as will the reporting and lessons learned.

2.7 Cost efficiency

2.7.1 Developing costs

The development of the A-WINEP costs in our plan follows our cost efficiency 'double lock' approach set out in chapter 7 Driving cost efficiency of our business plan. Through this approach we have ensured that are costs are efficient in their bottom-up build up, and this is cross-checked through external benchmark approaches. This section sets out how we have ensured cost efficiency of our A-WINEP investments through step one of our double lock approach. Step 2 is explored in section 7.1 of chapter 7 of our business plan.

We have taken a robust approach to developing our A-WINEP costs. The detail of the cost development approach is set out below, along with a breakdown of costs we provide in table CWW3.

Cost Estimation Methodology

This A-WINEP investment has been scoped to enable work as part of the advanced WINEP programme through developing partnership structures and enabling contributions. This includes catchment nutrient removal, overflow reductions, and environmental flow improvements.The costs for our A-WINEP proposal has been developed using a number of sources, including

- Business expertise from previous schemes and experiences
- Supplier Quotes
- The historic costs of similar previous work

"Linked partnership schemes" costs have been based on current experience of expenditure levels for specific action on sewers locations and to enable partnership delivery per river catchment.

The following table show our cost breakdown per activities proposed

Table 9 AMP8 A-WINEP investment summary

Investment ID	Scope	Capital Cost AMP8 £m	OPEX Cost (25-30) £m
I040315	Media and engagement campaign	0.500	
	Linked partnership schemes	11.400	
	CAS surveys & GIS layer creation	0.106	
	Benefits tracking tool	0.250	
	Detailed project development	2.051	
	Detailed project design	5.500	
	Agricultural advisors, project managers, catchment leader , external engagement managers , supporting upskilling SUDs training , Supporting upskilling of NGOs		6.470
	Total Cost	**19.807**	**6.470**

2.7.2 Benchmarking

In stage 2 of our cost efficiency 'double-lock' on A-WINEP, we sought variety of methods to assess, benchmark and challenge the costs in our plan.

The nature of the A-WINEP investments means there are no directly comparable reliable benchmarks that we are able to use to assess our costs. We have therefore sought alternative methods to ensure the efficiency of our costs and considered that building market testing of our costs into the plan to be the most reliable way to do this. Through this process, we have ensured that the unit rates used on the quotes provided are comparable to similar works delivery by our framework partners, and when possible (for instance where more than one specialist is available) we have sought for at least three quotes to inform our cost estimation approach. This builds external challenge directly into the cost estimation process, providing assurance that our proposed costs are efficient.

2.7.3 Assurance

Our A-WINEP proposal costs have been assured through external assurance by our third-party assurance providers, Jacobs.

2.8 Customer protection

Customers will be protected through the WINEP price control deliverable which will ensure that we deliver all of our obligations, and if we do not that funding will be returned to customers. For the A-WINEP component of the WINEP this will reflect the partnership fund and delivery of the centre of excellence. For more detail, please refer to the appendix 'Price Control Deliverables' [5]

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3 Nutrient removal and sanitary parameters

Overview

- Since privatisation the water industry has made great strides in nutrient removal, with concentrations of phosphorus 80% lower in 2020 than 1990. The AMP8 Water Industry National Environment Programme (WINEP) programme is set to be the most ambitious in the history of Anglian Water, aligned with Government mandatory targets to:
  - Reduce phosphorus loadings from treated wastewater by 80% by 2038 against a 2020 baseline, with an interim target of 50% by 31 January 2028.
  - Restore 75% of our water bodies to good ecological status.
- The PR24 plan has been calibrated to meet the above targets. These statutory targets align well with our SDS ambition of significant improvement in ecological quality, and our Get River Positive commitments. The portfolios covered by this enhancement case support commitment 1:

Figure 12 Our Get River Positive commitments

- This enhancement case covers a major programme of 270 investments to improve the environment by removing nutrients such as phosphorous and nitrogen, and through the tightening of sanitary determinands such as ammonia and BOD:
- Our nutrient removal and sanitary parameters enhancement covers a major programme of investments including a range of nutrients such as phosphorous, nitrogen, ammonia, BOD:
  - **14** Investments in sites which have crossed an UWWTD PE threshold and need to comply with a new sampling regime.
  - **19** Phosphorous, BOD and Ammonia removal schemes linked to preventing deterioration in water courses, of which 11 will be deferred to AMP9 at draft determination following recent regulatory confirmation.
  - **38** Schemes for Phosphorous and Nitrogen removal in designated Nutrient Neutrality catchments.
  - **59** additional Phosphorous removal schemes linked to habitats directive, which will target achieving environmental quality standards und the Common Standards and Monitoring Guidelines (CSMG).
  - **1** SSSI improvement investment explicitly linked to achieving environmental objectives within Pitsford reservoir.
  - **69** Phosphorous,Ammonia, or BOD improvement schemes, including 35 investments to improve waterbodies with poor ecological classifications, 13 high-priority schemes achieving good ecological status, and 21 wetland obligations which have had feasibility and detailed design undertaken in AMP7. These deliverables all contribute to achieving good ecological status in priority waterbodies under the WFD_IMP driver.

  The number of improvement investments has increased following a recent phasing decision by the Environment Agency, which requires additional Statutory+ requirements to be delivered in AMP8, as described below.
  - **70** additional investments under WFD_IMP driver, linked to achieving good ecological status in wider waterbodies where environmental need (eutrophication) is very certain across the region.

Wider investigation into impact of our assets on nitrogen and phosphorus levels in the downstream environment are included within the investigations enhancement case.

We partnered with Oxera and the COCE Alliance to benchmark the phosphorus removal and WINEP nutrient neutrality schemes within this investment

Table 10 Investment Summary

PR24 costs (£m)	
Capex	700.1
Opex	59.3
Totex	759.3
Benchmarking	
Method	Scheme outturn costs. Ofwat cost data and models. Industry cost models from TR61. Asset level cost comparison with other companies.
Costs removed	In the process of our cost benchmarking activity, we identified opportunities to reduce the costs included in our plan. £95 million has therefore been removed by reducing costs of interstage pumping station, inlet works and Mecana filter tank cost models. The costs includes in our plan are efficient compared to the benchmarks.
Customer Protection	
Price Control Deliverable	WINEP obligations
Ofwat data table	

CWW3.55-CWW3.57	Treatment for total nitrogen removal (chemical) (WINEP/NEP)
CWW3.64-CWW3.66 & CWW17.64-66	Treatment for phosphorus removal (chemical) (WINEP/NEP)
CWW3.70-CWW3.72	Treatment for nutrients (N or P) and / or sanitary determinands, nature based solution (WINEP/NEP)
CWW3.73-CWW3.75	Treatment for tightening of sanitary parameters (WINEP/NEP)

3.1 Delivering for the long term

3.1.1 Investment context

Enhancement investment is required for nutrient removal to ensure no deterioration of environmental water quality due to operation ofour Water Recycling Centres (WRCs), or where watercourses are not at Good Ecological Status and we are able to make a positive impact to the receiving environment by improving the quality of our final effluent. It also includes catchments designated by Natural England as covered by nutrient neutrality requirements. Where there are new or tightened permit conditions for phosphorus, nitrates or other sanitary determinants (such as ammonia) under the WINEP, the proposed investment is to meet these new conditions through a combination of nature-based and traditional solutions.

Following amendments to the Levelling Up and Regeneration Bill, as communicated with water companies on 7th September 2023, we will be looking to increase the flexibility around the delivery of nutrient neutrality WINEP obligations through the exploration of catchment permitting, catchment nutrient balancing, and nature-based solutions, post business plan submission on 2nd October. Our current business plan ensures that we will be able to comply with regulations by 1st April 2030 through a series of tradition tertiary treatment investments. We have explored opportunities for catchment permitting within the Norfolk Broads and found there to be some opportunity for flexible delivery, which will now be explored further. This approach aligns well with the wider aspirations of our A-WINEP proposal, which will consider how wider environmental gain can be achieved through the facilitation of a partnerships approach to environmental delivery. Catchment solutions have been explored a standard across all nutrient investment optioneering in PR24; however there remains a significant opportunity for greater

inclusion of these options within preferred options, both through A-WINEP and wider AMP8 delivery. This will require continuing engagement with regulators from business planning through to delivery.

Phosphorus and nitrogen are the main nutrients involved in eutrophication, where an excess of nutrients in water courses causes excessive growth of algae and plants which adversely affects water quality and local ecology (such as other plant species and wildlife). Addressing eutrophication is required to achieve good ecological status under the Water Framework Directive (WFD) and meet obligations under the Urban Wastewater Treatment Directive (UWWTD) and the Habitats Directive. The primary sources of phosphorus and nitrogen are effluent from wastewater and agricultural losses, with an increasing concentration driven by an increase in population growth as well as the availability of P-based fertilisers.

The need for investment stems from statutory and statutory-plus WINEP scheme obligations which are underpinned by Environment Act targets, including targets to:

- Reduce phosphorus loadings from treated wastewater by 80% by 2038 against a 2020 baseline, with an interim target of 50% by 31 January 2028.
- Restore 75% of our water bodies to good ecological status.

Listed below are the relevant driver codes as determined by the Environment Agency:

Table 11 Environment Agency driver codes

Investment driver	EA code
Treatment for phosphorus removal & treatment for nutrients and/or sanitary determinants	• U_IMP1 • WFD_ND • WFD_IMP • WFD_IMP_MOD • HD_IMP • HD_IMP_NN • EnvAct_IMP1 • SSSI_IMP
Treatment for tightening of sanitary parameters	• WFD_IMP • WFD_IMP_MOD • WFD_ND

Failure to deliver an obligation can result in apoor Environmental Performance Assessment score and increase risk of enforcement action from the Environment Agency (EA). We have obligations under the WINEP to deliver the following for each nutrient driver:

- **WFD_ND:** 19 phosphorous, biological oxygen demand (BOD) or ammonia removal schemes linked to preventing deterioration in water courses.
- **HD_IMP:** 59 Phosphorous removal schemes linked to the Habitats Directive and achieving Common Standards Monitoring Guidelines (CMSG) standards in the Norfolk Broads, Ouse and Nene washes.
- **HD_IMP_NN:** 38 Schemes for phosphorous and nitrogen removal in designated Nutrient Neutrality catchments.
- **WFD_IMP/WFD_IMP_MOD:** 139 Phosphorous, Ammonia and BOD schemes aimed at getting water courses to good ecological status, including 35 high priority investments contributing to improving waterbodies with poor ecological classifications.
- **SSSI_IMP:** 1 investment explicitly linked to achieving environmental objectives within Pitsford reservoir.
- **U_IMP:** 14 investments at sites which have crossed an UWWTD population equivalent (PE) threshold and need to comply with a new sampling regime.

Nutrient neutrality

Natural England advises that for sites protected under the Habitats Regulations 2017, local planning authorities can only approve developments if they are certain this will have no adverse impact on local ecology due to excess nutrients. As such, new residential developments must achieve 'nutrient neutrality' for planning to be granted. Therefore, as reflected in our Strategic Direction Statement ambition to enable sustainable economic and housing growth, the need to increase headroom for treating nutrients has wider implications for our ambitions beyond statutory obligations.

We have around 19 WRCs which will serve a population equivalent >2000PE by 31 March 2030, which drain to a nutrient neutral catchment. Our nutrient neutral areas are the River Wensum Special Area of Conservation (SAC) and the Broads SAC/Ramsar (Bure Broads and Marshes SSSI, Trinity Broads SSSI, Yare Broads and Marshes SSSI, Ant Broads and Marshes SSSI, Upper Thurne Broads and Marshes SSSI).

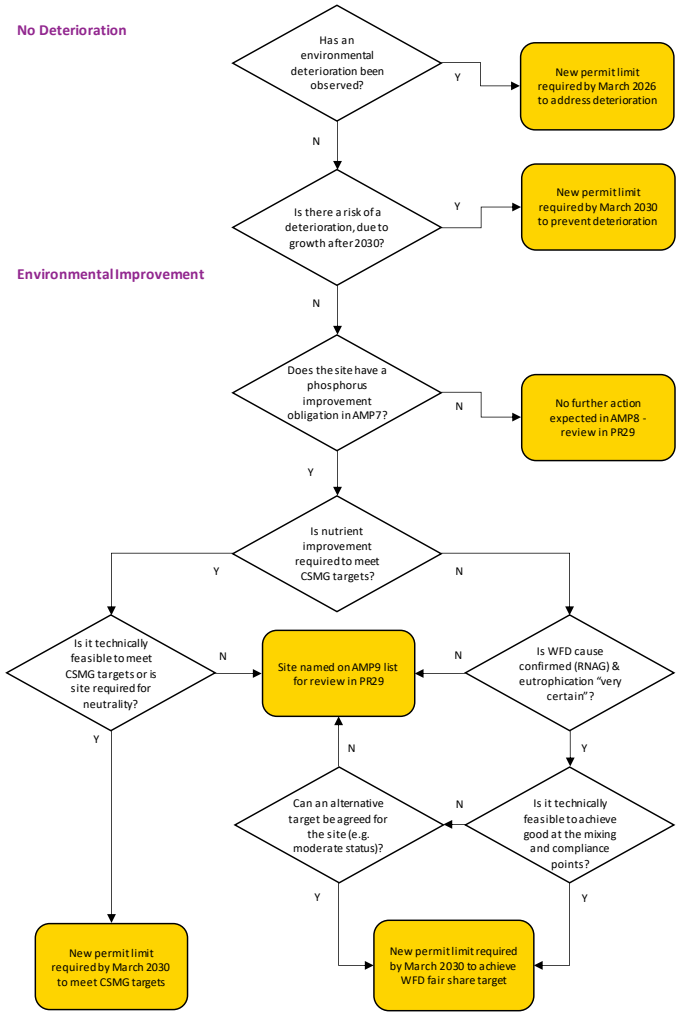
These sites are all included for traditional tertiary investment in this enhancement case; however, following the amendments to the Levelling Up and Regeneration Bill, as communicated with water companies on 7th September 2023, we will be looking to explore how catchment solutions can be applied to these investments post business plan submission on 2 October.

3.1.2 Scale and timing

The scale and timing of this investment is driven by the need to align with our WINEP obligations as specified by the Environment Agency. All obligations specified within this portfolio are statutory with AMP8 deadlines (summarised in the decision tree seen below). The need to deliver a programme of this significant size and challenging deadlines means there are minimal opportunities to identify alternatives. AMP9 investments have been identified but not included in PR24.

Within the EA WINEP guidance, the only expenditure that could be deferred are the statutory plus elements of the investment. We requested to phase all statutory plus investments linked to the WFD_IMP driver, however our request was rejected so we have included all statutory plus investments. In our phasing request to the EA we also requested removal of £146m of low cost benefit No Deterioration schemes for phosphorus removal and agreed that these should be removed from our plan, helping manage deliverability and affordability.

Figure 13 Nutrient Removal Decision Making Tree



3.1.3 Interaction with base expenditure

This investment is driven by the need to meet additional WINEP obligations and enhance water quality through nutrient removal programmes. Consistent with the approach of PR19, no implicit allowance is made within the base models for these WINEP obligations. This investment constitutes an improvement to our asset base.

We note that the installation of technologies to address phosphorus will result in an increase in the production of sludge at the relevant WRCs. The increase in sludge production due to P treatment has been factored in to our separate enhancement strategy for sludge.

3.1.4 Long term context (historic)

Nutrient schemes to address phosphorus loading builds upon investment during AMP7, which has included over 160 new or upgraded phosphorus removal plants at WRCs under the Good Ecological Status obligation or UWWTD obligation, and further removal investments under the No Deterioration and SSSI obligation.At present, the number WRCs with permitted nitrogen limits is much smaller than those with sanitary or phosphorus limits, with 19 assets specifically optimised for nitrogen removal. Our understanding of achievable levels of nitrogen removal is currently centred around these assets, with addition investigations into N-TAL proposed for AMP8.

Under the Accelerated Infrastructure Delivery (AID) programme, we have accelerated three WINEP schemes at Dereham, Fakenham and Whitlingham WRCs to deliver phosphorous removal under the nutrient neutrality driver, unlocking housing schemes that are currently stalled in the planning process because of nutrient levels in the Wensum and Broads. This is pending enactment of the proposed government changes to the Levelling Up and Regeneration Bill which will introduce mandatory achievement of Technically Achievable Limits (TAL) in Nutrient Neutral catchments. Recent amendments to the bill will allow further exploration of how these limits are achieved in AMP8, and will be further exploring catchment permitting, catchment nutrient balancing, and nature-based solutions options post business plan submission on 2nd October.

There are £62m of AMP7 nutrient schemes that were phased into early AMP8 as a measure to address affordability at PR19 (these schemes were removed from our PR19 plan before submission in September 2018). There are also some sites where an enhancement allowance was permitted for nutrient and sanitary parameters at PR19 and limits have since been tightened during AMP8. Where this is the case we have only sought an allowance at PR24 for the cost to reach the new permit from the AMP7 baseline. For sites where tightened permit conditions to be implemented during AMP9 are known with high confidence, we have proposed investment to meet the AMP9 permit condition during AMP8 to avoid duplication

of activities across AMP8 and AMP9. In terms of a unit rate, we expect that AMP8 solutions will have higher costs than those delivered in previous AMPs due to increasing complexity of treatment and an increase in tertiary treatment required.

3.1.5 Long term context (future)

This investment in the long term is driven by the requirement to meet the Environment Act target to reduce phosphorus loadings from treated wastewater by 80% by 2038 against a 2020 baseline, and the interim target of 50% by 31 January 2028.

A list of phosphorus improvements for AMP9/10 has been agreed with the Environment Agency to ensure that we achieve our fair share of nutrient removal to achieve good ecological status. This is equivalent to the 80% reduction target set in the Environment Act.Wider environmental improvements with respect to ammonia and BOD have largely been achieved; however, we will continue to work with regulators to ensure environmental deterioration is avoided through long-term environmental planning and increased understanding of the pressures of global climate change. We have also considered where growth forecasts will result in sites exceeding population thresholds and require investment under the Urban Waste Water Treatment Directive. This is aligned with DWMP forecasts to ensure a level of consistency between our enhancement strategies.

Beyond 2038, we anticipate enhancement investments being predominantly focussed on preventing deterioration as a result of growth and climate change, with a significant ramp down of WINEP investment in nutrients.

Our ambition remains to achieve wider environmental outcomes by influencing wider sources of nutrient enrichment in rivers across our region. We have proposed an A-WINEP approach that would allow the collaborative exploration of this goal, through partnerships and nature-based solutions delivery. We anticipate the A-WINEP approach becoming business as usually within the long-term context of WINEP delivery in future AMPs.

Our LTDS outlines our ambition to utilise innovative technologies to address nutrients over the short and long term. These include technologies currently in trial (I.e. algal fuel cells), and those that will emerge over the next 25 years. Our AMP8 enhancement expenditure is low regret at keeps open the opportunities to rollout these technologies when available and proven. [6]

As part of the Asset Management Maturity Assessment 2021, we explained in our response that we have introduced a post investment benefits review process. This process first identifies in the design phase the expected benefits of the scheme and documents how they will be measured once the investment is complete, then once the change has been implemented, revisits the site to collect actual data on benefits delivered. In their report[7]

Ofwat subsequently highlighted this as good practice, and included a sector-wide recommendation:

"Companies should systematically consider wider aspects of social and environmental value in decision-making and monitor whether delivered interventions provide the benefits expected in their planning".

We have thought carefully about our ability to measure the benefits of this substantial investment in nutrient removal in the post completion phase, and have included £22m within our proposed costs to install final effluent monitors at each site that is being enhanced. These monitors will provide far more granular insight of the performance of our new assets and allow improved understanding of each technology selected allowing learning to be fed into future nutrient programmes and optimisation of existing schemes. Without these monitors we would be concerned that this major investment programme may not deliver all the intended benefits.

3.1.6 Customer support

The need for investment is driven by a need to meet statutory obligations as set out by the EA, rather than being driven by customer preference.

3.1.7 Cost control

The concentration of P, N, BOD and ammonia received at WRCs from domestic sources is primarily driven by customer behaviour (including use of P-concentrated detergents or consuming high-nutrient foods). Failure to address nutrient concentrations discharged into water courses will lead to eutrophication, as such we have statutory obligations to deliver improvements to address nutrient loading under the WINEP where legal action can be taken if we fail to comply. In addition, under an amendment to the Levelling Up & Regeneration Bill, nutrient neutrality schemes are required to achieve Technically Achievable Levels of nutrient reduction by 1st April 2030. To support in ensuring that costs to customers are managed, we will be exploring catchment opportunities to delivery this government requirement in AMP8.

Sources of P, N, BOD and ammonia from trade effluent are managed under the requirements of the Water Industry Act and UWWTD. We take a proactive approach to managing upstream activities through the consenting of discharges into our network to protect people, processes, plant and the environment. Anglian Water

6 Please refer to Section 2.2.1 'Environmental enhancement' in our LTDS for more detail.
7 AMMA_Insights_And_Reccomendations_Report.pdf (ofwat.gov.uk)

are leading in this field and will be hosting the Maltese DPU (Discharge Permit Unit) in November to demonstrate our policies and procedures surrounding consenting, monitoring and regulating these activities in our region.

To ensure that delivery of the programme strikes the right balance between affordability and deliverability, we have worked extensively with the EA to make sure the scale of the programme is feasible by agreeing to optimise permit limits where possible.

3.2 Unlocking greater value for customers, communities and the environment

We discuss how we have unlocked greater value for our customers for the following in turn:

- Phosphorus
- Ammonia and BOD
- Nitrogen

3.2.1 Phosphorus

Option consideration

Innovation has played a key role in our optioneering process. We have worked and co-funded with Cranfield University to understand the recent developments in nature based solutions which supported our optioneering process. We have also worked with suppliers of innovative nutrient removal technologies to assess the feasibility of these for AMP8 rollout (such as algal bio-reactors for phosphorus removal). We have worked with the EA and Atkins to run different modelling scenarios to optimise where we need to invest within a catchment across different nutrient parameters.

The following table sets out all the options we considered throughout the optioneering process, regardless of if they were later selected as a feasible option.

Table 12 Phosphorus option consideration

No.	Option	Unconstrained?	Constrained?	Feasible?
1	Eliminate / Reduce the domestic P load coming into the Water Recycling Centres for Treatment	Yes		
2	Eliminate / Reduce the Trade P load coming into the Water Recycling Centres for Treatment	Yes		
3	Catchment Permitting[a]	Yes		
4	Catchment Nutrient Balancing[b]	Yes	Yes	
5	Single Stretch Permit targets	Yes	Yes	
6	Nature Based Solution - Media Reed Bed	Yes		
7	Nature Based Solution - Integrated Constructed Wetland	Yes	Yes	Yes
8	Biological Solution - Biological Phosphate Removal	Yes	Yes	
9	Biological Solution - Algal Biological Reactor	Yes	Yes	Yes
10	No Chemical Solution - Electrocoagulation	Yes	Yes	Yes
11	No Chemical Solution - Pump Away to another WRC in the same or other Catchment	Yes	Yes	Yes
12	AMP6 WRC Trial Solution - Comag	Yes		

No.	Option	Unconstrained?	Constrained?	Feasible?
13	AMP6 - WRC Trial Solution - Dose iron salts into Dynasand Sandfilter	Yes	Yes	Dosing approach to be used at site dependent on P limit
14	AMP6 - WRC Trial Solution - Dose iron salts into Bluepro Sandfilter	Yes	Yes	
15	Chemical Solution - Dose iron salts with Integrated Constructed Wetland	Yes	Yes	
16	Chemical Solution - Dose Iron Salts and Optimise the Solids performance of the Works	Yes	Yes	
17	Chemical Solution - Dose Iron Salts with Tertiary Solids Removal	Yes	Yes	
18	Chemical Solution - Dose Iron Salts	Yes	Yes	
19	Chemical Solution - Dose Aluminium Salts	Yes		
20	Chemical Solution - Optimisation of Existing Dosing WRCs	Yes		
21	Ofwat Innovation fund - Alternative Approaches to P removal on Rural WRC	Yes		

a Following amendments to the LURB in September 2023 we will now investigate opportunities in these areas with a view to moving into the feasible column in certain catchments.
b Following amendments to the LURB in September 2023 we will now investigate opportunities in these areas with a view to moving into the feasible column in certain catchments.

In line with the preference of our customers and regulators to implement more nature-based solutions where possible, we made sure to include a broad range of traditional and 'green' solutions to consider feasibility. We have worked extensively with Cranfield University to investigate innovative nature-based solutions and we are trialling an algal biological reactor . Although this is not feasible at all WRCs, we wish to further trial this technology in AMP8 to determine feasible for future AMPs.

Options to explore catchment permitting/catchment nutrient balancing are currently limited for AMP8, however these will be explored further following recent amendments to the Levelling Up and Regeneration Bill. There are significant opportunities to manage nitrogen through such an approach, and will intent to explore this within the Blackwater catchment in PR29, using approaches developed through the AMP8 A-WINEP to inform partnership working across the wider catchment.

3.2.2 Cost-benefit appraisal

Following the identification of the options set out in section 8, we have undertaken a cost-benefit analysis to reach the best value option for our plan. This takes into account a wide range of factors including customer views, uncertainty, and environmental and social outcomes.

The following table is taken from the relevant WINEP Option Development Report. Unconstrained options were assessed a standardised list of criteria to determine whether options were suitable to be progressed to the constrained options list of the ODR process. More detail on the EA's criteria for the unconstrained options (as summarised in the top row of this chart) can be found in section 7.3 of our main business plan. The colour coding used denotes if options fully met, partial met, or failed to meet the associated criteria to inform this optioneering process.

Table 13 Phosphorus: Unconstrained option assessment

No.	Option	Required outcome	Technical feasibility	Wider environmental outcomes	Customer support	Risk and uncertainty	Environmental risks
1	Eliminate / Reduce the domestic P load coming into the Water Recycling Centres for Treatment						
2	Eliminate / Reduce the Trade P load coming into the Water Recycling Centres for Treatment						
3	Catchment Permitting						
4	Catchment Nutrient Balancing						
5	Single Stretch Permit targets						
6	Nature Based Solution - Media Reed Bed						
7	Nature Based Solution - Integrated Constructed Wetland						
8	Biological Solution - Biological Phosphate Removal						
9	Biological Solution - Algal Biological Reactor						
10	No Chemical Solution - Electrocoagulation						
11	No Chemical Solution - Pump Away to another WRC in the same or other Catchment						
12	AMP6 WRC Trial Solution - Comag						
13	AMP6 - WRC Trial Solution - Dose iron salts into Dynasand Sandfilter						
14	AMP6 - WRC Trial Solution - Dose iron salts into Bluepro Sandfilter						
15	Chemical Solution - Dose iron salts with Integrated Constructed Wetland						
16	Chemical Solution - Dose Iron Salts and Optimise the Solids performance of the Works						
17	Chemical Solution - Dose Iron Salts with Tertiary Solids Removal						
18	Chemical Solution - Dose Iron Salts						
19	Chemical Solution - Dose Aluminium Salts						

No.	Option	Required outcome	Technical feasibility	Wider environmental outcomes	Customer support	Risk and uncertainty	Environmental risks
20	Chemical Solution - Optimisation of Existing Dosing WRC's						
21	Ofwat Innovation fund - Alternative Approaches to P removal on Rural WRC						

Examples of options ruled out and the reasons why include:

- Eliminating/ reducing domestic P load is impractical as it requires us to address factors broadly outside management control. Eg. Encouraging a reduction in meat consumption and reducing P concentration in detergents.
- Comag is an unproven solution with limited success within AMP6 trials.
- Dosing into sandfilters or bluepro was considered high risk as the last line of the process considering output of NEP trial data.
- Dosing with wetland attached was deemed currently to be too costly to implement both solutions whilst meeting tightening P limits, however, we remain interested in innovation around NBS and the opportunities that this will bring.
- We are waiting on more detail for the Ofwat Innovation Fund project.

The remaining options were then assessed against the following criteria to form a list of feasible options:

Table 14 Phosphorus Constrained option assessment

No.	Option	Feasibility and risk		Performance	Engineering	Cost and benefit	Environmental
4	Catchment Nutrient Balancing	Meets statutory obligations for some drivers	Have considered residual risk. This is high risk as the other sectors apportionment would be out of AW control without strict contractual terms.	Meets required outcome for some drivers	Not complex	Not assessed as different for each Catchment approach and not considered a feasable option	WINEP Wider Environmental and Social Assessment undertaken
5	Single Stretch Permit targets		Have considered residual risk. The residual risk is low as would not consider a stretch target unless we know it could meet it.		Not a complex build in terms of engineering but identifying the right land and Purchasing it is the complexitiy. Only suitable for relaxed P levels and small sites <1000 p.e	Not assessed as not considered a feasable option	
7	Nature Based Solution - Integrated Constructed Wetland		Have considered residual risk. Wetland would run under an OTA for three years where if it did not meet the permit level then mitigating actions would need to be taken. Risk that the Wetland becomes a stranded asset providing Environmental benefits only		Complex Process that needs a Carbon Source	Site specific and therefore detailed on each OAR	

No.	Option	Feasibility and risk		Performance	Engineering	Cost and benefit	Environmental
8	Biological Solution - Biological Phosphate Removal	Meets statutory obligations	Have considered residual risk.	Meets required need	Complex process and build and only suitable for smaller sites <2000P.E	Not Assessed as not considered a feasable option	
9	Biological Solution - Algal Biological Reactor		Have considered residual risk. Trialling in AMP7 to understand further risks in a real works environment		Only suitable for smaller sites	Not assessed as will know more as the technology ,Costs and benefits develop in AMP7	
10	No Chemical Solution - Electrocoagulation		Risks are not understood until the technology is proven within other water companies		Only suitable for smaller sites	Not assessed as will know more as the technology ,Costs and benefits develop in AMP7	
11	No Chemical Solution - Pump Away to another WRC in the same or other Catchment		Have considered residual risk. Risk eliminated in the right situations		Complex with Pipe runs etc	Not assessed as site specific and option only feasible for Small Problematic sites	
13-18	Dose Iron Salts		Have considered residual risk. Risks are well know and understood		Not complex unless tertiary treatment is required. Solution can be modulised and phased over AMP periods to get to the Permit limit required.	Site specific and therefore detailed on each OAR	

Table 15 Phosphorus feasible option assessment

No.	Option	Feasible solution (Y/N)	Justification
4	Catchment nutrient balancing	N	Previous attempts using Farmscoper to offset investment have been unsuccessful High level of risk as other sectors apportionment would be out of AW control without strict contractual terms. We will now investigate opportunities in this area based on the amendments to the LURB. We are hopeful that the opportunity to implement catchment nutrient balancing will be available irrespective of EPA rating.
5	Single stretch targets	N	Rejected on adaptability and resilience grounds
7	Integrated constructed wetlands	Y	Meets AW long term strategy and customers requirements for NBS
8	Bio P	N	AW only has experience of one Bio P site which is unreliable at low P levels. Strategic decision to not implement anymore.
9	Algal Biological Reactor	Y	Potential opportunity in AMP8. Meets AW ambition for no chemical solutions

No.	Option	Feasible solution (Y/N)	Justification
10	Electrocoagulation	Y	Will be assessed for trial in AMP8 - currently cannot be scaled to the size required but could develop further in the next few years. Meets AW ambition for no chemical solutions
11	Pump away	Y	To be considered during option development by delivery route and agreed by the EA in AMP9
13-18	Iron dosing	Y	Proven technology, experienced in delivering this solution
	Iron dosing with tertiary		
	Optimise existing dosing		

Iron dosing using Ferric or Ferrous is the selected solution in most cases unless there is an opportunity to use a Nature Based Solution Wetland. These have been prioritised as per the EA guidance for sites with a Phosphorous permit limit of 1mg/l or above and a Population equivalent of less than a 1000. Outside of these parameters, Nature based opportunities currently hold too much risk due to land requirements and construction costs. We will continue to seek alternative ways to work with landowners including the use of environment markets to further the implementation of nature-based solutions. We have an agreement with the EA to utilise an Operating Techniques agreement (OTA) so that permitting does not prevent us from delivering environmental benefits as the traditional method of issuing permits for this innovative opportunity would others become a blocker. We have a strategic objective to promote Nature based solutions as per Get River Positive, customer feedback and chemical free ambition.

We are working with Cranfield to keep up to date with the latest developments in wetland feasibility and constructing our own wetlands in AMP7, as our understanding increases we may be able to broaden the criteria for selecting suitable sites for Nature Based Solutions. Our strategy for PR24 was to consider nature-first when considering options for environmental enhancement, and whilst this has currently been limited by technical/regulatory restrictions, we will continue to explore how NBS can be applied to our WINEP delivery, particularly in light of recent amendments to the Levelling Up and Regeneration Bill, which put additional emphasis on the consideration of catchment options and NBS.

Where it is currently infeasible to deliver a treatment wetland, chemical dosing and tertiary treatment options have been explored. A second dose point and Tertiary treatment to remove the Solids related Phosphorous is considered for all P limits of below 0.5mg/l or where the solids performance is more than 20 x the P Limit (0.5mg/l = >10 TSS, 0.7mg/l = >14 TSS). There are a limited amount of opportunities on sites with existing chemical dosing to optimise the site by implementing two stage dosing and these have been selected where the tightening of consent / performance of the works has allowed.

All Solutions have been assessed using not only cost but Carbon, operational Carbon, Biodiversity impact and other suitable metrics such as Educational and Wellbeing opportunities for the Nature based solutions.

Breakdown of investments:

- Chemical dosing only - 35 investments
- Chemical dosing with tertiary treatment - 164 investments
- Wetlands - 25 investments (15 phased from AMP7 by agreement with the EA)

A wetland has been selected at Hail Weston WRC due to it being a first time P installation where the site has a PE less than 1000 and a P limit of 1mg/l or greater.

Great Barford WRC also requires a first time P limit of 1mg/l or greater but due to having a PE of over 1000 PE a wetland would be too large to be cost beneficial so a chemical dosing solution has been selected.In order to increase the likelihood of nature based solutions being a viable option for larger sites in future we will continue to further our learning from our AMP7 wetlands programme and explore innovations in this space.

3.2.3 Ammonia and BOD

Option consideration:

Innovation has played a key role in our optioneering process. We have worked and co-funded with Cranfield university to understand the recent developments in nature based solutions which supported our optioneering process. We have also worked with suppliers of innovative nutrient removal technologies to assess the feasibility of these for AMP8 rollout (ie algal bio reactor for phosphorus removal).

We have worked with the EA and Atkins to run different modelling scenarios to optimise where we need to invest within a catchment across different nutrient parameters.

The following table sets out all the options we considered to address Ammonia and BOD, including those discounted throughout the optioneering process.

Table 16 Ammonia and BOD: Option consideration

No.	Option	Unconstrained	Constrained	Feasible
1	Increased biological capacity	Yes	Yes	Yes
2	Increased biological and hydraulic capacity	Yes	Yes	Yes
3	Tertiary Filtration	Yes	Yes	Yes
4	Treatment Wetlands	Yes	Yes	Yes
5	Pump flow away to a different catchment	Yes		
6	Maintenance and Optimisation	Yes	Yes	Yes
7	Carbonaceous MBBR (Moving Bed Bio Reactor)	Yes	Yes	Yes
8	Additional Recirculation to Trickling Filter Works	Yes	Yes	Yes
9	Sequenced Batch Reactor (SBR)	Yes		
10	Roughing Filter	Yes		

3.2.4 Cost-benefit appraisal

Following the identification of the options set out in the table above, we have undertaken a cost-benefit analysis to reach the best value option for our plan. This takes into account a wide range of factors including customer views, uncertainty, and environmental and social outcomes.

The following table is taken from the relevant WINEP Option Development Report. Unconstrained options were assessed a standardised list of criteria to determine whether options were suitable to be progressed to the constrained options list of the ODR process. More detail on the EA's criteria for the unconstrained options (as summarised in the top row of this chart) can be found in section 7.3 of our main business plan. The colour coding used denotes if options fully met, partial met, or failed to meet the associated criteria to inform this optioneering process.

Table 17 Ammonia and BOD unconstrained option assessment

No.	Option	Required outcome	Technical feasibility	Wider environmental outcomes	Customer support	Risk and uncertainty	Environmental risks
1	Increased biological capacity						
2	Increased biological and hydraulic capacity						

No.	Option	Required outcome	Technical feasibility	Wider environmental outcomes	Customer support	Risk and uncertainty	Environmental risks
3	Tertiary Filtration						
4	Treatment Wetlands						
5	Pump flow away to a different catchment						
6	Maintenance and Optimisation						
7	Carbonaceous MBBR (Moving Bed Bio Reactor)						
8	Additional Recirculation to Trickling Filter Works						
9	Sequenced Batch Reactor (SBR)						
10	Roughing Filter						

The remaining options were then assessed against the following criteria to form a list of feasible options:

Table 18 Ammonia and BOD: constrained option assessment

No.	Option	Feasibility and risk		Performance	Engineering	Cost and benefit	Environmental
1	Increased biological capacity	Meets statutory requirements	Suitable on a site by site basis	Meets required outcome	High complexity		WINEP Wider Environmental and Social Assessment undertaken
2	Increased biological and hydraulic capacity						
3	Tertiary Filtration						
4	Treatment Wetlands						
6	Maintenance and Optimisation				Low complexity		
7	Carbonaceous MBBR (Moving Bed Bio Reactor)		Meets AW process design guide				
8	Additional Recirculation to Trickling Filter Works						

The following table sets out following the final stage of optioneering which options we considered feasible to be selected to address the required challenge:

Table 19 Ammonia and BOD feasible option assessment

No.	Option	Feasible (Y/N)	Justification
1	Increased biological capacity	Y	Suitable on site-by-site basis for sites with solids issues relating to BOD & NH3
2	Increased biological and hydraulic capacity	Y	Suitable on site-by-site for sites with solids issues relating BOD & NH3
3	Tertiary Filtration	Y	Suitable on site-by-site for sites with solids issues relating to BOD & NH3
4	Treatment Wetlands	Y	Suitable on site-by-site for sites with solids issues relating BOD & NH3
5	Pump flow away to a different catchment	N	To be considered during option development by delivery route and agreed by the EA in AMP8
6	Maintenance and Optimisation	Y	Suitable on site-by-site for sites with solids issues relating BOD & NH3 where the consent is being achieved or can be achieved
7	Carbonaceous MBBR (Moving Bed Bio Reactor)	Y	Suitable, selected on a site-by-site basis
8	Additional Recirculation to Trickling Filter Works	Y	Suitable, selected on a site-by-site basis
9	Sequenced Batch Reactor (SBR)	N	To be considered during in AMP detailed development on a site by site basis.
10	Roughing Filter	N	Risk and uncertainty around the solution deemed too high

We have used the expertise of our Environmental Science and Operational Treatment teams to carry out an assessment of current WRC performance and if there were opportunities to treat to a tighter standard. The knowledge and experience from these teams enabled us to identify suitable solutions and carry out a cost benefit analysis to progress these schemes.

A number of WRCs have no current ammonia limit and therefore we worked closely with the EA to select a suitable permit limit that would protect the watercourse but require no investment.

3.2.5 Nitrogen

Option consideration

Innovation has played a key role in our optioneering process. We have worked and co-funded with Cranfield University to understand the recent developments in nature based solutions which supported our optioneering process. We have also worked with suppliers of innovative nutrient removal technologies to assess the feasibility of these for AMP8 rollout (ie algal bio reactor for phosphorus removal). We have worked with the EA and Atkins to run different modelling scenarios to optimise where we need to invest within a catchment across different nutrient parameters.

The following table sets out all options considered throughout the optioneering process, regardless of it they were discounted through this process:

Table 20 Nitrogen option consideration

No.	Option	Unconstrained	Constrained	Feasible
1	Replace the Existing works with a New Activated Sludge plant complete with Anoxic tank and Recirculation pump system	Yes	Yes	Yes
2	New Tertiary De-nitrifying Sandfilter with Methanol Dosing	Yes	Yes	Yes
3	Additional Tertiary De-nitrifying Sandfilter with Methanol Dosing	Yes	Yes	Yes
4	Additional Anoxic tank and recirculation system retrofitted to existing Activated Sludge plant	Yes	Yes	Yes
5	Additional Anoxic tank and recirculation system retrofitted to a modified enhanced Activated Sludge plant	Yes	Yes	
6	Additional Balance tanks and control system for existing Biobubble sites	Yes		
7	Nature Based Solution - Integrated Constructed Wetland	Yes		
8	Biological Solution - Algal Biological Reactor	Yes		
9	Pump flows away from the works	Yes		
10	Optimise Existing Site with N consent	Yes		

3.2.6 Cost-benefit appraisal

Following the identification of the options set out above we have undertaken a cost-benefit analysis to reach the best value option for our plan. This takes into account a wide range of factors including customer views, uncertainty, and environmental and social outcomes.

The following table is taken from the relevant WINEP Option Development Report. Unconstrained options were assessed a standardised list of criteria to determine whether options were suitable to be progressed to the constrained options list of the ODR process. More detail on the EA's criteria for the unconstrained options (as summarised in the top row of this chart) can be found in section 7.3 of our main business plan. The colour coding used denotes if options fully met, partial met, or failed to meet the associated criteria to inform this optioneering process.

Table 21 Nitrogen unconstrained option assessment

No.	Option	Required outcome	Technical feasibility	Wider environmental outcomes	Customer support	Risk and uncertainty	Environmental risks
1	Replace the Existing works with a New Activated Sludge plant complete with Anoxic tank and Recirculation pump system			*N/A*	*N/A*		
2	New Tertiary De-nitrifying Sandfilter with Methanol Dosing			*N/A*	*N/A*		
3	Additional Tertiary De-nitrifying Sandfilter with Methanol Dosing			*N/A*	*N/A*		
4	Additional Anoxic tank and recirculation system retrofitted to existing Activated Sludge plant			*N/A*	*N/A*		
5	Additional Anoxic tank and recirculation system retrofitted to a modified enhanced Activated Sludge plant			*N/A*	*N/A*		
6	Additional Balance tanks and control system for existing Biobubble sites			*N/A*	*N/A*		
7	Nature Based Solution - Integrated Constructed Wetland			*N/A*	*N/A*		
8	Biological Solution - Algal Biological Reactor			*N/A*	*N/A*		
9	Pump flows away from the works			*N/A*	*N/A*		
10	Optimise Existing Site with N consent			*N/A*	*N/A*		

The constrained options were then assessed against the following criteria to form a list of feasible options:

Table 22 Nitrogen constrained option assessment

No.	Option	Feasibility and risk		Performance	Engineering	Cost and benefit	Environmental
1	Replace the Existing works with a New Activated Sludge plant complete with Anoxic tank and Recirculation pump system	Meets statutory obligations - NN is government legislation assisting with the Housing Market. This Option offers the best opportunity to meet TAL and help with this.	Low risk	Meets required outcome for some drivers	Complex	Site specific, detailed on OARs	WINEP Wider Environmental and Social Assessment undertaken
2	New Tertiary De-nitrifying Sandfilter with methanol Dosing		Medium risk as could be a reliance on providing a Carbon source probably Methanol which has H&S implications				

No.	Option	Feasibility and risk		Performance	Engineering	Cost and benefit	Environmental
3	Additional Tertiary De-nitrifying Sandfilter with Methanol Dosing		Medium risk as could be a reliance on providing a Carbon source probably Methanol which has H&S implications				
4	Additional Anoxic tank and recirculation system retrofitted to existing Activated Sludge plant		Medium risk as retrofitting to existing sites may not be able to get down to TAL	Partially addresses required outcome if cannot get to TAL	Not complex		
5	Additional Anoxic tank and recirculation system retrofitted to a modified enhanced Activated Sludge plant		Medium risk as retrofitting to existing sites may not be able to get down to TAL				

The following table sets out the options we deemed as feasible following this optioneering process:

Table 23 Nitrogen feasible option assessment

No	Option	Feasible	Justification
1	Replace the Existing works with a New Activated Sludge plant complete with Anoxic tank and Recirculation pump system	Y	Suitable on site-by-site basis for filter works with high Ammonia performance
2	New Tertiary De-nitrifying Sandfilter with Methanol Dosing	Y	Proven technology. Suitable on site-by-site basis for sites with good ammonia performance which do not have tertiary nutrifying sandfilters
3	Additional Tertiary De-nitrifying Sandfilter with Methanol Dosing	Y	Proven technology. Suitable on site-by-site basis for sites with good ammonia performance which do not have tertiary nutrifying sandfilters
4	Additional Anoxic tank and recirculation system retrofitted to existing Activated Sludge plant	Y	Suitable for ASP sites with good ammonia performance
5	Additional Anoxic tank and recirculation system retrofitted to a modified enhanced Activated Sludge plant.	N	Anglian Water does not have any sites requiring this solution in the nutrient neutrality areas
6	Additional Balance tanks and control system for existing Biobubble sites	N	Not suitable in nutrient neutrality area
7	Nature Based Solution - Integrated Constructed Wetland	N	Unknown until more investigation is done to see if Wetlands remove the Nitrogen Nutrient
8	Biological Solution - Algal Biological Reactor	N	Consider instead for AMP8 trial
9	Pump flows away from the works	N	Impractical in the Broads due to constraints on Pipe laying. To pump out of catchment would be expensive as it would require a daisy chain of pump stations and rising mains effectively creating a new network
10	Optimise Existing Site with N consent	N	AW does not have any relevant sites

Whilst we have filtered the constrained list of options to four feasible solutions these cannot be assessed against one another as it is solely dependant upon the type of site and its nitrifying capability. The site types above the 2000 PE at 2030 criteria in the Nutrient Neutral identified areas are mainly biological filter works with or without some form of tertiary treatment or they are activated sludge plants.

Our Environmental Science team recommend that biological filter works performing to a =<5mg/l ammonia have the opportunity to denitrify by installing another process stage and through the addition of a Carbon source (Methonal Dosing, in this case)

For biological filter works, where the performance does not facilitate the above option, the replacement to an activated sludge plant is the solution. As denitrification can be undertaken within a controlled anoxic zone with recirculation flows.

There are two WRCs with activated sludge plants which have good ammonia performance where it may be possible to retrofit an anoxic zone and recirculation flows.

We will seek to further consult professionals and suppliers to select the best technology to deliver nitrogen removal whilst also considering capital and operational carbon

Nature Based Solutions have not been considered due to the industry wide lack of proven examples or evidence that these can remove nitrogen. However, we will continue to monitor the wetlands we are installing for a range of parameters with a view to building the evidence base. Algae technology is being installed on a site for P removal in AMP7 and will be trialled for N removal in AMP8.

Breakdown of investments:

- 15 - Tertiary Denitrifying sand filter with methanol dosing
- 2 - Replace with ASP (Activated Sludge Plant)
- 2 - Additional Anoxic tank

3.2.7 Environmental and social value (Phosphorus, Ammonia & BOD, Nitrogen)

We have considered the environmental and social value of our nutrient removal and sanitary parameters investments as part of our options consideration process and this is reflected in the options consideration tables in the previous sections.

We have developed a Value Framework, structured by the Six Capitals, which allows us to express benefits and disbenefits in a common language (£) for use in cost-benefit analysis and to inform our investment decisions. [8]

The impact value within our Value Framework are made up of both private costs (e.g. costs to resolve an incident) and societal costs. Societal costs are derived through a robust Societal Valuation Programme considering a broad range of sources where customers views, preferences and priorities are canvassed, analysed and incorporated into the values through a triangulation process. [9]

A baseline position is established that captures any current or expected impacts to service, customers, the environment, safety etc (and their respected likelihoods).

Each alternative (i.e. option) is appraised to establish a residual position, with updated impacts and likelihoods. This residual position also considers any additional benefits and disbenefits that may apply as a result of the intervention.

These could be permanent (e.g. visual impact) or temporary (traffic disruption during construction) and consider a range of environmental and social measures including both capital and operational carbon.

This nutrient removal and sanitary parameters investment area primarily provides benefits in the following categories within our Value Framework:

- *Pollution*
- *Permit Failure - Quality Compliance*

In addition we have assessed these investments to consider further impacts on society including:

- *Traffic Disruption*
- *Construction Noise*
- *Visual impact*
- *Biodiversity*

The PR24 Final Methodology encourages the use of nature-based solutions as a first option where possible before considering other technologies. We have looked at this in detail and have selected NBS on a site-by-site basis based on the tightness of the consent and the land available in proximity to WRCs. From analysis, we conclude approximately 18 of our sites are suitable for wetlands as the preferred option, however will seek to increase this number through reconsidering options at the delivery phase.

8 For more information on our value framework see Chapter 7 Driving Cost Efficiency in Our Plan 2025-2030.
9 For more information on customer insight see Chapter 3 Customer Engagement in Our Plan 2025-2030.

For instance, for P removal the option selection matrix below sets out the preferred option to be proposed for sites depending on the P limit and population equivalent it caters:

Table 24 Phosphorus removal option selection matrix

P Limit	0-250 p.e		251-1000 p.e		1001-10000 p.e				10001-50000+ p.e				P Limit
	No permit limit		Existing Permit limit	First time P	Existing Permit limit >1mg/l		No permit limit		Existing Permit limit		No permit limit		
					No Tertiary	Existing Tertiary	Existing Tertiary	No Tertiary	No Tertiary	Existing Tertiary	Existing Tertiary	No Tertiary	
0.3	N/A	Avoid	Enhanced dosing plus cloth filter	Dosing and Tertiary Cloth filter	New Tertiary Cloth Filter	Supplement Existing Tertiary	Dosing and Supplement Tertiary	Dosing and Tertiary Cloth filter	New Tertiary Cloth Filter	Supplement Existing Tertiary	Dosing and Supplement Tertiary	Dosing and Tertiary Cloth filter	0.3
0.3													0.3
0.4												Dosing if ASP otherwise Cloth filter	0.4
0.5				Dosing if TSS is good otherwise Dosing and Cloth Filter	Optimise if ASP	Optimise Existing	Dosing	Dosing (if ASP otherwise Cloth)	Optimise if ASP otherwise New Tertiary Cloth Filter or 2nd dose point	Optimise existing if ASP othewise supplement or 2nd dose point			0.5
0.6			Wetland		Wetland			Dosing			Dosing	Dosing if ASP otherwise 2nd dose point	0.6
0.7													0.7
0.8				Dosing					Optimise existing	Optimise existing dosing		Dosing	0.8
0.9													0.9
1.0 +		New works or Wetland		Wetland									1.0 +

The figure demonstrates how the nature-based solutions (eg wetland) up to a certain consent beyond which the technology is not proven. For sites with consents greater than 1mg/l where a nature based solution may be suitable the limiting factor is the PE, for sites above 10,000 PE the physical size of the wetland becomes too large for it to be a viable solution.

3.2.8 Investment benefits

The primary benefit of each solution included in our plan is the reduction in level of nutrients, ammonia or BOD entering watercourses. Our proposed solutions have been chosen to meet the need of each obligation set out in the WINEP.

We expect phosphorus reduction delivered as part of this investment will deliver significant benefit for the River Water Quality (phosphorus) Performance Commitment. We anticipate that both traditional and nature-based solutions (ie wetlands) to address phosphorus will drive the majority of our improvement against this performance commitment, and therefore have calibrated the PCL accordingly.

3.2.9 Managing uncertainty

We note the industry P removal schemes in AMP8 are at risk of outstripping production capacity in the UK for iron salts such as Ferric Sulphate. This remains a live issue that we are seeking to address through conversations with WaterUK and directly with suppliers at a senior level.

The main benefit (overall improvement in river water quality status) is uncertain as it is based on modelling which itself has a level of uncertainty. We have worked with Atkins and the EA to use an agreed modelling approach but recovery of the natural environment may not happen in the way we expect due to other external factors.

We are certain that the solutions we have selected will meet the required permit levels as we have based our solutions on previous experience, the outcomes of the AMP6 P trials and advice from experts (I.e. Cranfield University research on wetlands and our own experience from our Ingoldisthorpe wetland).

3.2.10 External funding

We do not consider third-party funding to be a possibility for the traditional solutions included within this investment. Where wetlands and other nature-based solutions form the preferred options, we will work with stakeholders, where possible, to deliver these schemes but do not currently have third-party funding secured. There is a strong inter-play with our A-WINEP proposals here where we will be seeking to work with partners on achieving shared outcomes via shared funding.

3.2.11 Direct Procurement

We have considered each of our investments for their suitability for delivery through DPC. The investment involves works on existing assets which are likely to give rise to commercial and operational complexities that negatively affect the investment's discreteness. Therefore, we do not consider it feasible for this programme to be delivered through DPC.

3.2.12 Customer view

Where possible we have sought to consider nature based solutions and have selected these where they were feasible. As investment we are making is designed to meet obligations in the WINEP and are based on Anglian Water sites, there are no different alternatives for customers to inform the selection of, we have not undertaken specific customer engagement on options selection in this area.

3.3 Cost efficiency

3.3.1 Developing costs

The development of the nutrient removal and sanitary parameters costs in our plan follows our cost efficiency 'double lock' approach set out in chapter 7 Driving cost efficiencyof our business plan. Through this approach we have ensured that are costs are efficient in their bottom-up build up, and this is cross-checked through external benchmark approaches. This section sets out how we have ensured cost efficiency of our nutrient removal and sanitary parameters investments through step one of our double lock approach. Step 2 is explored in section 7.1 of Chapter 7 of our business plan.

We have taken a robust approach to developing our nutrient removal and sanitary parameters costs, building on our experience from delivering similar schemes into the bottom-up development of costs (before external cost benchmarking challenges are applied in step 2 of our 'double-lock' approach). The detail of the cost development approach is set out below, along with a breakdown of costs we provide in table CWW3.

As explained earlier in this enhancement evidence, we have included £22m additional cost to install monitors enabling post investment benefits review as recommended by the AMMA. We are concerned that other companies may not have taken a similar approach and our costs may therefore appear inefficient with the monitors included within the total. For this reason we recommend they are kept separate and assessed as an individual shallow or deep dive cost assessment methodology.

Cost Estimation Methodology

Where project construction elements can be broken down into major work elements such pumps, pile cloth filter, pipes, with high level design parameters, these costs are estimated individually by using the cost models and the on-site design information and then aggregated to inform our cost estimation for PR24.

We follow a common cost development methodology across our enhancement investments in a three phase process:

1. Establish cost and carbon models
2. Input the cost drivers into the model (including location specific factors)
3. Data validation, internal challenge and assurance.

In phase 2, we derived our total cost estimation for each scheme by gathering location based data which influences the cost estimates for each scheme. This included data relating to

- Flows;
- water quality;
- nutrient targets;
- site capacity/performance;
- presence of existing/planned treatment assets;
- site population equivalent;
- asset/treatment designed standards.
- aerial photos and sample data

The key cost assumptions and estimations have been built using both the cost models applicable to each asset and the on-site design information to inform our cost estimation for PR24.

The table below provides a breakdown of the nutrient and sanitary parameters costs provided in data table. The schemes in this table have been grouped by their scope and the WINEP driver code is provided to each of the group section and schemes.

Table 25 Natural capital options

WINEP driver codes	Investment ID	Investment name	Scope	Capital cost (£000s) AMP7	Capital cost (£000s) AMP8	OPEX Cost 000's (£) (25-30)
WFD_ND - Phosphorus HD_IMP WFD_IMP - AMP7 deferal WFD_IMP - Phosphorus WFD_IMP_MOD - Phosphorus	Various	25 Site locations	*Natural Capital Wetland *pumps *Site Ancillaries (Telemetry, Hardstanding, footpath, kiosk landscaping)	700	48,755	3,840
HD_IMP_NN - Phosphorus WFD_ND - Phosphorus WFD_IMP WFD_IMP_MOD - Phosphorus HD_IMP SSSI_IMP WFD_IMP - Phosphorus	Various	168 Site locations	*Pile Cloth Filter *Ferric Dosing *Pumps *Inlet works *Auto desludge system *Sludge tanks *Site Ancillaries (Telemetry, Hardstanding, footpath, kiosk landscaping)	14,399	515,763	43,092
U_IMP	Various	13 Site locations	*Pumps *Hardstanding *Chamber *pipework	-	1,107	50.64

WINEP driver codes	Investment ID	Investment name	Scope	Capital cost (£000s) AMP7	Capital cost (£000s) AMP8	OPEX Cost 000's (£) (25-30)
			*Site Ancillaries (Telemetry, Hardstanding, footpath, kiosk landscaping)			
HD_IMP WFD_IMP - AMP7 deferal WFD_IMP_MOD - Phosphorus WFD_ND - Phosphorus WFD_IMP - Phosphorus	Various	31 Site locations	*Ferric Dosing *Auto desludge *Inlet works *Sludge tanks *Site Ancillaries (Telemetry, Hardstanding, footpath, kiosk landscaping)	1,241	27,631	3,698
WFD_ND - Ammonia & BOD U_IMP WFD_IMP_MOD - Ammonia & BOD	Various	11 Site locations	*SAF Plant *Continuous Sand Filtration *Pumps *Site Ancillaries (Telemetry, Hardstanding, footpath, kiosk landscaping)	-	19,998	1,424
HD_IMP_NN - Nitrogen	Various	15 Site locations	*Sand Filtration *Upgrade existing Filters to be denitrifying *Methonal Dosing *Monitors *Pumps *Site Ancillaries (Telemetry, Hardstanding, footpath, kiosk landscaping)	-	46,050	4,569
HD_IMP_NN - Nitrogen	I033539	Bylaugh WRC NN N filter site high ammonia	*Aeration tanks *Methonal Dosing	-	4,391	67
HD_IMP_NN - Nitrogen	I033543	Reepham WRC NN N filter site high ammonia	*Monitors *Pumps *Site Ancillaries (Telemetry, Hardstanding, footpath, kiosk landscaping)	-	4,874	80

WINEP driver codes	Investment ID	Investment name	Scope	Capital cost (£000s) AMP7	Capital cost (£000s) AMP8	OPEX Cost 000's (£) (25-30)
HD_IMP_NN - Nitrogen	I033553	Whittlingham WRC - HD_IMP_ NN Nitrogen 10mg/l	*Anoxic tank with mixers *Recirculation PS	-	6,819	368
HD_IMP_NN - Nitrogen	I033557	Mattishall WRC - HD_IMP_ NN Nitrogen 10mg/l	*Pipework & valves *PLC to regulate recirculation rate *Lifting equipment *Site Ancillaries (Telemetry, Hardstanding, footpath, kiosk landscaping)	-	1,136	133
WFD_ND - Ammonia & BOD	I039653	WRC WINEP No Det BOD NH3 OPEX	Permit variations	-	77	41
WFD_IMP - BOD	I039640	Dorrington WRC	*Biofilter *Sinal Settlement Tank *Site Ancillaries (Telemetry, Roads, Footpath, Pipework)	-	1,738	25
	I041628	PR24 Final Effluent monitor (WRC's)	Install final effluent monitoring at every site where a Quality obligation is to be delivered under WINEP	-	21,729	1,881
			Total Programme	16,339	700,069	59,267

3.3.2 Benchmarking

In stage 2 of our cost efficiency 'double-lock' on nutrient removal and sanitary parameters, we used a variety of methods to assess, benchmark and challenge the costs in our plan. We applied cost benchmarking through the use of:

- Scheme outturn costs;
- Ofwat cost data and models;
- Industry models from TR61 and;
- Asset level cost comparison with other companies

Scheme outturn costs

We have continuously captured outturn costs data of all projects delivered in our capital investments including granular cost components such pumps, continuous sand filtration, clothes filters, etc. These outturn costs have been the inputs to the parametric models to each specific assets. Building outturn costs into our cost assumptions in this way builds cost efficiency into the build up of costs.

AMP7 has seen a significant increase in the number of nutrient removal schemes requiring investment compared to previous AMPs. In the rollout of this programme we have worked to identify efficient approaches are applied and that these are embedded in our cost models for PR24.

Wetlands projects costs have been estimated using a bottom up approach, and when possible components such as pipework and pumping station have been estimated using our cost models which incorporate scheme outturn costs, ensuring that the economies of scale achieved through the delivery of these assets in other

programmes are embedded in these cost estimations. Wetland direct construction costs have been estimated based on optimising the use of soils from within the site for construction of embankments, soil liner and access road; our average direct cost unit rate (excl land purchase, PS and fences) is of £75/m^2. We compared this with the experience of the Norfolk Rivers Trust who have more experience than we do of wetland delivery in our region.

Ofwat cost data and models

As a top-down benchmark for our phosphorus removal costs, we ran the two PR19 Final Determination P removal enhancement cost models with our P removal data for AMP8. The models require just three cost drivers: the aggregate p.e. of enhanced sites; the number of enhanced sites and the number of tight (<0.5mg) sites.

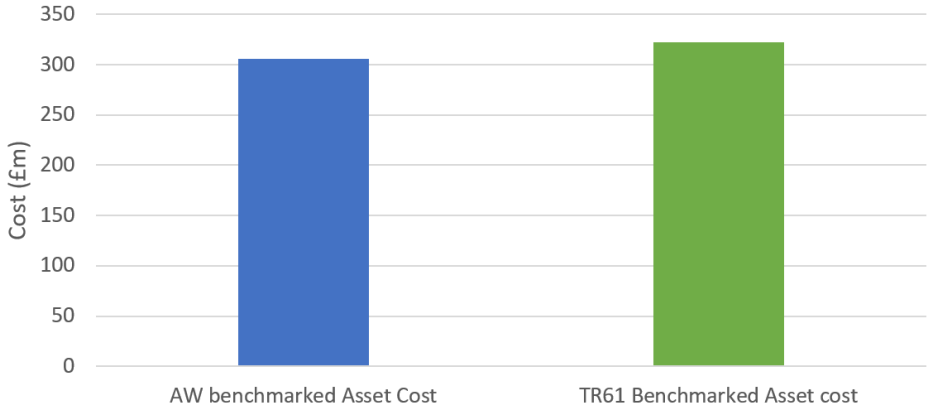
Having completed the benchmarking exercise highlighted above we are confident that that the costs submitted as part of this plan are efficient according to external benchmarks. Whereas at PR19, our proposed costs were assessed as being 5% inefficient, our PR24 proposed costs are assessed as being 12% efficient against the same models.

Industry cost models from TR61

We have sought assurance on the efficiency on the costs of the tertiary Pile Cloth Media Filtration, ferric dosing and pumping station by benchmarking to the parametric model build by WRC's TR61, WRc. These assets cover 86% of the total direct asset costs of the P-removal programme.

The graph below shows how our costs for these components compare with those from TR61. This shows that our cost estimations are in line with the TR61 industry benchmark, providing assurance that these costs are efficient.

Figure 14 Phosphorus Removal benchmarking



We have sought to benchmark our wetland project unit cost rate to WRcs TR61. Where the most update data available is for the construction of Reedbeds with a range of £90-300m^2 (2021 prices), compared to our unit cost of £75/m^2

Figure 15 Reedbed and Wetland range cost as per WRcs TR61 Draft NBS report 1.2

Nature based solution	To solve...	Funding source	Main manufacturers	Lifetime	Costs [a]	Cost year
Reedbeds	Improve water quality (3)	Government grant funded by Rural Payments agency, Natural England	Numerous manufacturers approved by the construction wetland association (e.g. ARM reed beds) (4)	Horizontal reed bed: 5-15 years Vertical reed bed: 25 years (5)	£90-£300/m^2 (6)	2021
					capex £15,950; opex £2,512/year (7)	2021
					capex £3000- £7000; opex £100/year (8)	2021

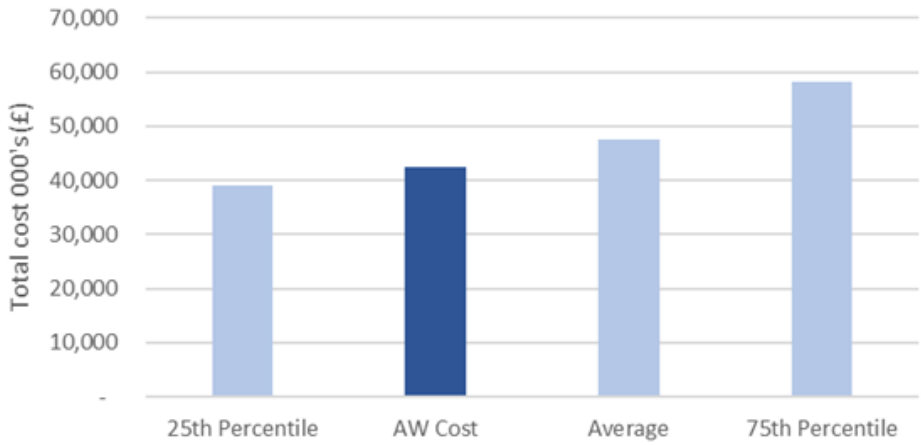
In light of this evidence presented above we have confidence that the costs we have estimated for our programme present an efficient rate.

Asset level cost comparison with other companies

The use of historic scheme outturn data and the TR61 benchmarking gives us high confidence that efficient cost estimations have informed the costs included in our plan. To further cross-check this, we have taken a sample of seven investments from the programme, which represent 40% of the total Nutrient Neutrality programme to be benchmarked. This benchmarking was carried out by Mott McDonald and AECOM, and consisted of bottom up detailed benchmarks of the individual components of the sample schemes selected of our nutrient neutrality costs.

The findings of this benchmarking are shown in graph below. This demonstrates that the benchmarked cost are lower than the average benchmark and close to the upper quartile. We have therefore considered that our nutrient neutrality investment costs are efficient.

Figure 16 Neutrient Neutrality - Direct asset cost benchmarking



Collectively, this benchmarking evidence has shown the costs of our nutrient removal and sanitary parameters costs to be efficient. In the process of conducting this benchmarking activity we identified opportunities In the process of our cost benchmarking activity, we identified opportunities to reduce the costs included in our plan. £95 million has therefore been removed by reducing costs of interstage pumping station, inlet works and Mecana filter tank cost models.

3.3.3 Assurance

Our cost estimation approach has been assured by an independent third party (Jacobs) and the cost benchmarking we have used to validate our costs has been carried out independently by Oxera (Ofwat cost data and models), and Mott Macdonald and Aecom (asset level cost comparison with other companies).

3.4 Customer protection

In the event that any of this enhancement investment is cancelled, delayed or reduced in scope, customers are protected through two principle means:

- As our investment fully aligns with statutory drivers. If we do not meet an obligation or they are delivered after their obligation date, we will face enforcement action from the Environment Agency.
- Our WINEP price control deliverable returns has been designed to return allowances to customer if any WINEP investment which are included in our plan are not delivered.

As both our enhancement investments and these customer protection mechanisms are fully aligned to the WINEP statutory drivers, this protection covers all the benefits that are proposed to be delivered.

For more detail on the WINEP PCD, please refer to the appendix 'Price Control Deliverables'[10]

10 ANX ANH37

4 Chemicals removal and investigations

Overview

- Chemicals investigations are statutory. They are required to improve our understanding of the risk that emerging chemicals may present and inform subsequent interventions to protect the environment. Following investigations between 2015-2023, there is a new statutory requirement to meet chemical limits for cypermethrin at designated sites. This is an insecticide found in sheep dip and pet flea collars that can harm ecology in rivers and is not removed by some water recycling centres.
  - We will invest £55m to improve river water quality by monitoring, investigating and delivering treatment to remove cypermethrin and other chemicals from water which is returned to the environment at 16 sites
  - There are currently a limited number of methods to remove cypermethrin. We have selected deep-bed sand filters as the preferred option for the 6 sites identified for treatment. 10 sites require advanced monitoring to understand the treatment efficacy under an Operating Technique Agreement on the permit.
- We sought assurance on the efficiency of our costs through benchmarking to available parametric models build by WRCs TR61, which showed our costs are below the industry average.

Table 26 Investment Summary

PR24 costs (£m)	
Capex	60.6
Opex	1.9
Totex	62.5
Benchmarking	
Method	Scheme outturn costs. Industry cost models from TR61.
Findings	Our costs were found to be significantly below the industry benchmark.
Customer Protection	
Price Control Deliverable	WINEP obligations
Ofwat data table	
CWW3.49-CWW3.51	Treatment for chemical removal (WINEP/NEP)
CWW3.52-CWW3.54 CWW3.61-CWW3.63	Chemicals and emerging contaminants monitoring, investigations, options appraisals; (WINEP/NEP) Nitrogen technically achievable limit monitoring, investigation or options appraisal; (WINEP/NEP)

4.1 Delivering for the long term

4.1.1 Investment context

This investment is required to meet WINEP obligations on the monitoring, investigations and options appraisal of chemicals and emerging containments, including microplastics and other CIP Programme 4 contaminants. These are listed under the following WINEP driver codes:

- WFD_INV_CHEM

- WFD_INV_MP
- WFD_INV_N-Tal

Investigations improve our understanding of the risk that emerging chemicals may present and inform subsequent interventions to protect the environment through investigation where chemicals present 'sufficient concern' and do not have Environmental Quality Standards (EQSs).

This includes investigations into:

- 4a: PFOS, TraC, ICW - PFOS loading through water recycling centres and future permitting approach, chemical fate within transitional and coastal (TraC) waterbodies, including priority substances and nutrients, and integrated constructed wetlands (ICW).
- 4b: Sludge - chemical fate within process sludge.
- 4c: Groundwater - chemical fate within groundwater where water recycling discharges to ground.
- 4d: AMR - Anti-microbial resistance (AMR) within water recycling process and immediate downstream environment.
- 4e: Emerging substances - covering more than 100 chemicals, including emerging substances list, PFAS compounds, substances of regulatory concern, trending chemicals, and endocrine disruptors, as well as microplastics.
- 4f: Innovative pathway controls - contributions to industry-wide trials of chemical source control.
- 4g: Local investigations - named chemicals in priority areas across the region, including PFOS and PBDE at Duxford, Tributyltin in Marley Gap Brook, and Iron in New Inn Brook.
- N-TAL: Investigations into technically achievable limits (TAL) for Nitrogen. This is a cross-sector programme managed centrally by UKWIR, with AWS contributing investigations into 5 treatment works through hard 'grey' solutions, run to capacity. Due to being investigative, and mandated by DEFRA, cost-benefit analysis was not utilised..

All schemes listed under these drivers are statutory, or statutory by expectation of DEFRA (INV_MP: Microplastic investigations, for which there is DEFRA approval for all companies to ensure they contribute to microplastic investigations in AMP8, as outlined within Environment Agency PR24 guidance.

In addition, investment is required for schemes to meet statutory WINEP obligations to achieve good chemical status, to prevent deterioration in chemical status, or to achieve standstill limits for chemicals. These are under the following drivers:

- WFD_NDLS_CHEM1
- WFD_NDLS_CHEM2
- WFD_ND_CHEM3
- WFD_IMP_CHEM

Investment is required through WINEP obligations under the Water Framework Directive, to enable a step change in investment in addressing chemicals based on the findings of investigations . This enhancement investment aims to improve our ability to undertake these functions, through a combination of intelligence gathering through related investigations, to inform future investment planning, and direct Water Recycling Centre enhancements, to reduce or restrict the presence of chemicals and other substances within the environment. This includes action to prevent deterioration associated with growth (including implementation of standstill permits), and direct environmental improvement where an in-river need has been identified.

There is a new statutory requirement in PR24 to meet chemical limits for Cypermethrin at designated sites, following results of the AMP6 and AMP7 Chemicals Investigation Programmes (CIP2 and CIP3), demonstrating adverse environmental impact above certain concentrations. This enhancement investment delivers the step change in investment required to respond to this.

4.1.2 Scale and timing

The scale and timing of this investment is determined by the requirement to deliver statutory WINEP obligations at named sites, previously identified through chemicals investigations. All load standstill and no deterioration permit changes are expected by end March 2027, with wider in-river improvements enhancements required by end March 2030.

There is no option to defer any of this investment to later AMPs, and solution options are limited by process certainty. Where possible enhancement efficiencies have been made between the chemical and nutrients programmes, with tertiary treatment being proposed under a flexible permitting arrangement to achieve both sets of requirements.

For sites subject to WFD_IMP_CHEM drivers only, cost-benefit analysis considering ecological benefit was undertaken. This was done using cost figures we generated in our internal cost estimation system C55, which were externally audited and approved, compared with benefit as measured using the EA outcome measures. Where schemes did not prove cost-beneficial, we requested to the EA to exclude those sites from our PR24 plan. OTA approaches were put forward for sites which already had suitable investment (see section 4.2). Through these changes we were able to remove £56.7 million of investment requirements, helping with affordability and deliverability of our plan.

CIP4 has an obligation of 31/03/ 2027, with some elements pulled forward to achieve this deadline.

All improvement schemes in this programme have an obligation date 31/03/2030.

Failure to meet these obligation deadlines may result in enforcement action being taken, with permit compliance performance being monitored through the Environmental Performance Assessment. Operating Techniques Agreements have been agreed with the Environment Agency, where control of chemical levels is limited by source understanding or process certainty.

4.1.3 Interaction with base expenditure

This investment is enhancement expenditure as it enhances the quality of water downstream of the final effluent discharge locations at Water Recycling Centres (WRCs). There is a base expenditure associated with the ongoing sampling and analysis of new permit parameters, however this is expected to be minimal compared with existing base sampling requirements.

This investment is also distinct from the investment for nutrient removal (which includes P, N, ammonia and BOD), and other non-chemical investigations, which can be found in a separate business cases. Efficiencies have been found between chemicals and nutrients programme as far as practicable, but this does not affect base expenditure.

Long term context (historic)

There have been equivalent drivers in PR14 and PR19 for Chemical Investigation Programmes. During AMP7, we have invested to meet 57 obligations which covered a combination of investigations and monitoring, addressing multiple parameters under the WINEP WFD_INV_CHEM drivers. There is no overlap between AMP7 and AMP8 enhancement investment for chemical improvements, although CIP rounds have and will continue to inform improvement requirements, across AMP periods.

The consecutive rounds of WINEP chemical investigation programmes have identified 20 sites requiring new chemical 'No Deterioration and/or Load Standstill' limits in AMP8.

Long term context (future)

It is expected that investigations into environmental chemical challenges will continue over the short, medium, and long-term, with, at minimum, an equal level of investment anticipated in future AMP rounds, demonstrating the sustained regulatory significance of chemicals. Whilst it is not possible to say exactly which emerging substances will be of interest in future AMPs, it is highly likely that greater emphasis will be given to catchment (source) control, which aligns well with Anglian Water's A-WINEP approach that has been proposed for PR24. Chemicals enhancement spend is intrinsically linked with growing public interest in the quality of the water environment, therefore we remain committed to the current industry-wide approach to chemical investigation programmes.

We are committed to our SDS ambition to work with others to improve the ecological quality of our catchments. Our LTDS sets out how will deliver on this long-term ambition. Our AMP8 investment for chemicals investigations is low regret as enables us to meet our ambition in all scenarios, and it will inform our response to addressing chemicals and microplastics in future AMPs, identifying the scale and location of potential challenges.[11]

4.1.4 Customer support

The need for investment is primarily driven by a need to meet statutory obligations as set out by our environmental regulator. Nonetheless, our Customer Synthesis Report found that customers are increasingly concerned by emerging substances and microplastics, and support the need for investigation. [12]. From our 'Get River Positive' customer engagement conducted by Incling, 94% of customers surveyed thought Anglian Water should carry out trials on new and emerging chemicals and microplastics to see if they can be prevented and/or removed from entering the sewage network during treatment processes although only 59% were happy to support a bill increase associated with this. More broadly, our customers have a strong preference for avoiding deterioration in service levels especially in relation to environmental outcomes. For new infrastructure schemes our customers value both environmental and economic benefits and support the introduction of nature-based solutions where appropriate to create a 'win-win' in terms of compliance, cost and environmental protection.

4.1.5 Cost control

As detailed further in the following sections, in line with our 'Place based thinking' LTDS cross cutting theme, we are exploring options to control costs through flexible permitting, subject to approval by the EA. Significant tertiary treatment is already planned as part of our nutrient programme, which is detailed further in the associated investment case. To understand the potential to generate efficiencies and synergies between nutrient tertiary treatment and cypermethrin removal at the same location, we are exploring a "maximising benefits" flexible approach to avoid the need for multiple investments. Table 29 below details those sites where we have not included investment for chemical removal and instead negotiated an OTA as there is already a nutrient removal driver at the same site. This is supported

11 Please refer to Section 2.2.1 'Environmental enhancement' in our LTDS for more detail.
12 Annex ANH55

by the EA and will establish if existing or proposed nutrient removal schemes are also effective for cypermethrin, nonylphenol and aluminium removal, ideally removing or reducing the need for further investment at PR29.

4.2 Unlocking greater value for customers, communities and the environment

4.2.1 Option consideration

Investigations

Where there are obligations to monitor, investigate, or appraise options for chemicals, this action is prescriptive and there are no alternative options how these activities can be carried out.

Improvements

Options appraisal was based upon the CIP 2 'P trials', which had some NBS inclusion. However, it was not deemed any of the assessed NBS will be sufficient to meet the treatment requirements in AMP8. Notably, CIP4 will be investigating in more detail the role treatment wetlands can play in treating a range of determinants (including cypermethrin and nonylphenol).

The full CIP2 'P trials' synthesis report can be provided upon request. With all enhancement investments, our strategy for PR24 has been to take a nature-first approach to solution optioneering. Treatment wetlands are yet to be designed or tested specifically for the removal of emerging chemicals, although PR24 does include investigations to understand the fate of these chemicals within existing wetland systems. A full review of available treatment technologies, and the efficacy of chemical removal that they provide, was concluded in CIP3 (AMP7) to inform options for consideration in PR24. Presently, there are limited proven or trialled options available to address cypermethrin, with no process guarantee from any of the assessed technologies. Following the findings of the report, the following tertiary treatment options were considered for cypermethrin removal at our water recycling centres:

- Deep-bed sand filters
- Pile Cloth Filter
- Do nothing

The 16 sites selected for investment were identified as requiring new chemical Improvement and/or No Deterioration limits in AMP8, with load standstill limits being managed without enhancement investment. The following sites were identified through this process as requiring investment within AMP8 to meet obligations:

Table 27 Chemical improvement sites

Site Name	Driver	Chemical
BRAINTREE STW	No Deterioration	Cypermethrin
BRIGG STW	No Deterioration	Cypermethrin
CAYTHORPE STW	Improvement, No Deterioration	Cypermethrin
COTTESMORE STW	Improvement	Cypermethrin
ELMSWELL WRC	Improvement	Cypermethrin
FRAMLINGHAM STW	No Deterioration	Cypermethrin
KEELBY STW	Improvement	Cypermethrin, Nonylphenol
LACEBY STW	No Deterioration	Cypermethrin
LEADENHAM STW	Improvement	Cypermethrin
LOUTH STW	Improvement, No Deterioration	Cypermethrin
MARKET RASEN STW	Improvement	Cypermethrin
NEWMARKET STW	Improvement	Cypermethrin
PAPWORTH EVERARD STW	Improvement	Cypermethrin
RAUNDS STW	Improvement	Cypermethrin
SHILLINGTON STW	Improvement	Cypermethrin, Aluminium
ULCEBY STW	Improvement, No Deterioration	Cypermethrin, Nonylphenol

Additional chemical limits for PFOS in AMP8 do not require enhancement investment, having been agreed with the Environment Agency to manage through an operating techniques agreement (OTA), to enable additional monitoring of WRC performance without the risk of numeric permit non-compliance.

4.2.2 Cost-benefit appraisal

Improvements

We have selected the following options for the 16 sites requiring investment for cypermethrin:

Table 28

Options	List of sites	Justification
Deep-Bed Sand Filters	Braintree STW Brigg STW Framlingham STW Caythorpe STW Newmarket STW Keelby STW	We have experience of delivering this option, therefore have more certainty on the solution cost and delivery of benefits. These schemes were chosen where a statutory driver applied, and an OTA was not applicable.
Operating Technique Agreement : Pile Cloths Filter	Louth STW Ulceby STW Papworth Everard STW Elmswell STW Raunds STW[a] Laceby STW Leadenham STW Market Rasen STW Shillington STW	We negotiated with the EA a 'Maximising Benefit' operating technique agreement (OTA). This OTA approach is used for sites with existing phosphorus (P) limits, or new limits planned in AMP8, that treat to a limit of 0.25mg/L., using a Mecanna filter. The CIP3 P trials confirmed the suitability of this set-up to also treat Cypermethrin and Nonylphenol. As there is an existing scheme at these, no additional investment is required.
Do Nothing	Great Totham STW	Where schemes were not either required under a statutory driver, suitable for an OTA, or cost-beneficial, we chose to not progress with limits.

a Please note that the Raunds STW nutrient removal scheme has been phased to AMP9 as part of recent correspondence with the Environment Agency, therefore we will review after the Draft Determination any requirement to reintroduce the chemical removal scheme in AMP8. The Nutrient removal scheme has a capex of £3.446m in 22/23 prices.

From our approach to place-based thinking, we have identified there is significant opportunities for delivery of the Chemicals and Nutrient Removal programmes planned for PR24, with tertiary treatment required in many cases to achieve Environment Act phosphorus targets (e.g. Mecana). CIP2 investigations suggested that Mecana may be a viable solution for cypermethrin, however confidence in the data was limited. Where tertiary treatment is already planned as part of the nutrient programme, we have agreed with the EA an Operating Technique Agreement (OTA) to maximise benefits, and gain a better understanding of the treatment effectiveness on cypermethrin/ nonylphenol. In these cases, we have not included costs specifically for chemical improvement where enhancement expenditure is already planned under the nutrient removal programme.

An original list of 20 sites was identified for chemical improvements from CIP3. These have been cross-referenced with the nutrient programme, with costs and benefits scrutinised with the Environment Agency (using regulator-derived benefit values). This process concluded the following approaches to managing compliance risk from each of the 20 sites:

- 6 sites identified for bespoke treatment investment for chemicals - new enhancement need, with Deep-Bed Sand Filters selected as the preferred PR24 option.
- 10 sites identified for Maximising Benefits Operating Technique Agreement (OTAs)- where tertiary treatment investment is already planned within the nutrient programme, advanced monitoring will be undertaken to understand treatment efficacy under an Operating Technique Agreement on the permit.
- 4 sites with no new limits (not cost-beneficial) - these sites did not meet the PR24 cost-benefit test and were therefore excluded from the business plan. Sites will retain a load standstill obligation but do not require enhancement expenditure in AMP8.

4.2.3 Environmental and social value

We have considered the environmental and social value of our chemical removal and investigations options as part of our options consideration process. We have developed a Value Framework, structured by the Six Capitals, which allows us to express benefits and disbenefits in a common language (£) for use in cost-benefit analysis and to inform our investment decisions[13].

The impact values within our Value Framework are made up of both private costs (e.g. costs to resolve an incident) and societal costs. Societal costs are derived through a robust Societal Valuation Programme considering a broad range of sources where customers views, preferences and priorities are canvassed, analysed and incorporated into the values through a triangulation process[14].

4.2.4 Investment benefits

Each option is assessed from a benefits perspective using Anglian Water's Value Framework. A baseline position is established that captures any current or expected impacts to service, customers, the environment, safety etc (and their respected likelihoods).

Each alternative (i.e. option) is appraised to establish a residual position, with updated impacts and likelihoods. This residual position also considers any additional benefits and disbenefits that may apply as a result of the intervention. These could be permanent (e.g. visual impact) or temporary (traffic disruption during construction) and consider a range of environmental and social measures including both capital and operational carbon.

This investment area primarily provides benefits in the following categories within our Value Framework:

- Environment

In addition to AWS's internal assessment of investment benefit, for improvement schemes the EA completed an independent benefit assessment for each potential scheme, based on the same benefit metrics as AWS. These figures were the final ones used for investment decisions, where cost-benefit was a consideration. Investigations were not subject to cost-benefit analysis, so were not included for this stage

4.2.5 Managing uncertainty

We identified a potential deliverability risk for the investigation component of this investment, due to the capacity of our laboratories to process the scale of work required. To mitigate this risk, our laboratories are undertaking a full strategic review to ensure that they have the capacity for the AMP8 programme to ensure its deliverability. We are also engaging with third-party analytical services to address the capacity shortfall if required.

We have limited experience of delivering deep-bed sand filters for cypermethrin removal as an emerging chemical. During CIP2, an industry review of cypermethrin removal was undertaken across a suit of treatment processes, with deep-bed sand filters demonstrating 88% removal efficiency. However, this trial had a relatively low sample size. Therefore, although this technology forms the basis for our PR24 investments, we do not currently have a process guarantee this approach will ensure compliance. To mitigate this risk, we have agree to operate all chemical improvement schemes under an operating techniques agreement as part of planned permit changes, removing numeric permit condition non-compliance risk.

4.2.6 External funding

We do not consider third-party funding to be a possibility for this investment.

4.2.7 Direct procurement

We have considered Ofwat's guidance on the consideration of enhancement investments for DPC. On several criteria, this investment falls short of the requirements for schemes to be delivered through DPC, including the £5m threshold for the cost of individual assets to be bundled. This investment also falls short of the £200m DPC by default threshold. Accordingly, this investment has been discounted from further consideration for DPC.

4.2.8 Customer view

Our customer insight as captured with our Customer Synthesis Report found that customers are supportive of our trails into emerging chemicals and microplastics to establish if they can be prevented.

4.3 Cost efficiency

4.3.1 Developing costs

The development of the chemicals removal and investigations costs in our plan follows our cost efficiency 'double lock' approach set out in Chapter 7 Driving cost efficiency of our business plan. Through this approach we have ensured that are costs are efficient in their bottom-up build up, and this is cross-checked through external benchmark approaches. This section sets out how we have ensured cost efficiency of our chemicals removal and investigations investments through step one of our double lock approach. Step 2 is explored in section 7.1 of chapter 7 of our business plan.

13 For more information on our value framework see Chapter 7 Driving Cost Efficiency in Our Plan 2025-2030.
14 For more information on customer insight see Chapter 3 Customer Engagement in Our Plan 2025-2030.

We have taken a robust approach to developing our chemicals removal and investigations costs, building on our experience from delivering similar schemes into the bottom-up development of costs (before external cost benchmarking challenges are applied in step 2 of our 'double-lock' approach). The detail of the cost development approach is set out below, along with a breakdown of costs we provide in table CWW3.

Cost estimation methodology

Where project construction elements can be broken down into major work elements such pumps, continuous sand filtration, SAF, with high level design parameters, these costs are estimated individually by using cost models and the on-site design information and then aggregated to inform our cost estimation for PR24.

We follow a common cost development methodology across our enhancement investments in a three phase process:

1. Establish cost and carbon models
2. Input the cost drivers into the model (including location specific factors)
3. Data validation, internal challenge and assurance.

In phase 2, We derived our total cost estimation for each scheme by gathering location based data which influences the cost estimates for each scheme.

We derived our costs for each scheme through considering:

- Scheme size
- the flow going through the site.
- current site assets configuration, operability and connection to existing assets
- number of samples and cost per sample
- UKWIR club contributions

The key cost assumptions and estimations have been built using both cost models applicable to each asset and the on-site design information to inform our cost estimation for PR24.

The table below provides a breakdown of the chemicals costs provided in data table lines.

Table 29 AMP8 investment overview

Investment ID	Investment name	Scope	Capital Cost (£k) AMP7	Capital Cost (£k) AMP8	OPEX Cost (£k) AMP8
I034711	BRAINTREE STW ND_CHEM3	*continuous sand filtration-10200 (m3/d) *Interprocess pump *SAF *Ancillaries(Footpaths, landscaping, telemetry, road)	-	9,830	137
I034712	BRIGG STW ND_CHEM3	*continuous sand filtration-8730 (m3/d) *Interconnecting Pumps/ Pipework *SAF *Ancillaries(Footpaths, landscaping, telemetry, road)	-	5,211	66
I034713	FRAMLINGHAM STW ND_CHEM3	*continuous sand filtration-3024 (m3/d) *Interconnecting Pumps/ Pipework *SAF *Ancillaries(Footpaths, landscaping, telemetry, road)	-	3,370	139
I034716	CAYTHORPE STW ND_CHEM3	*continuous sand filtration-2088 (m3/d) *Interconnecting Pumps/ Pipework *SAF *Ancillaries(Footpaths, landscaping, telemetry, road)	-	2,832	115
I034723	Newmarket STW WFD_IMP_CHEM	*continuous sand filtration-15552 (m3/d) *Interconnecting Pumps/ Pipework *SAF *Ancillaries(Footpaths, landscaping, telemetry, road)	-	6,943	105
I034730	KEELBY STW WFD_IMP_CHEM	*continuous sand filtration flow-2678 (m3/d) *Interconnecting Pumps/ Pipework *SAF *Ancillaries(Footpaths, landscaping, telemetry, road)	-	3,028	127
I034403	WFD_INV_MP _B	investigations to look into Microplastics in Final effluent and Biosolids from WRC's	-	100	-
I034406	WFD_INV_MP_C	WINEP investigations to look into Microplastics fate in thermal conversion sludge treatment technologies. The work will look at trial technologies as part of a collaborative WASC approach. SUiAR INV is included in this investment for enhanced biosolids microplastics investigations.	-	540	-

Investment ID	Investment name	Scope	Capital Cost (£k) AMP7	Capital Cost (£k) AMP8	OPEX Cost (£k) AMP8
I034659	CIP4 PFOS investigations WFD_INV_CHEM	*Cost includes sampling collection and analysis by AW labs	-	430	-
I034911	CIP4 (4a) TraC investigations WFD_INV_CHEM		528	19,782	-
I034916	CIP4 (4a) ICW investigations WFD_INV_CHEM		-	100	-
I034918	CIP4 (4b) Sludge investigations WFD_INV_CHEM		-	100	-
I034920	CIP4 (4c) GW investigations WFD_INV_CHEM		-	478	-
I034921	CIP4 (4c) Sludge-GW investigations WFD_INV_CHEM		-	2	-
I034922	CIP4 (4d) AMR investigations WFD_INV_CHEM		-	250	-
I034923	CIP4 (4g) Local investigations WFD_INV_CHEM		-	54	-
I034926	CIP4 Ancillary costs WFD_INV_CHEM		-	128	-
I034927	CIP4 (4e) Emerging substances investigations WFD_INV_CHEM		-	1,426	-
I033967	Wyton WRC N TAL	*Ferric Dosing *Pumps *Sand Filtration *Site Ancillaries	-	2,633	283.29
I034029	Oakham WRC N TAL		-	3,336	884.58
I034803	Eye-Hoxne Rd WRC N TAL	*Monitoring and Sampling	81.65	-	39.42
I034805	Thurleigh WRC N TAL		-	-	13.08
I034806	Red Barns / Turves WRC N TAL		-	-	13.08
		Total	**610**	**60,573**	**1,923**

4.3.2 Benchmarking

In stage 2 of our cost efficiency 'double-lock' on chemicals removal and investigations, we used a variety of methods to assess, benchmark and challenge the costs in our plan. We applied benchmarking through the use of:

- Scheme outturn costs
- Industry cost models from TR61

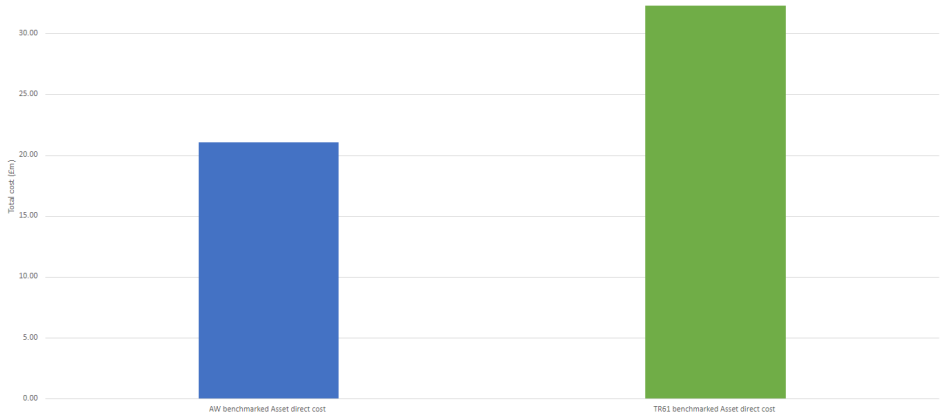
Scheme outturn costs

We have continuously captured outturn costs data of all projects delivered in our capital investments including granular cost components such pumps, continuous sand filtration, SAF, on costs, etc. These outturn costs have been the inputs to the cost models to each specific asset. Building outturn costs into our cost assumptions in this way builds cost efficiency into the build up of costs.

Industry cost models from TR61

We have sought assurance on the efficiency on the costs through by benchmarking to the available cost models built by WRCs TR61. From total capital costs (£60.57m) we benchmarked a sample of assets for which TR61 had comparable benchmarks. This data showed our costs to be more than 30% more efficient than the industry benchmark (£21m versus £32m). This is demonstrated in the graph below.

Figure 17 Chemical removal and investigation direct cost of asset only benchmarked to industry data WRC TR61



In light of stage 1 (scheme outturn costs) and stage 2 (Industry cost models) of our cost efficiency double-lock approach, we consider that this evidence shows the costs included in our plan are efficient.

4.3.3 Assurance

The development of our chemicals removal and investigations costs within our cost estimation system (C55) have been assured by Jacobs. The assurance sessions went through the findings made from CIP3 results, and their implementation in developing the selected options. The assurance then assessed the cost build-up of this option, including benchmarking (see 4.3.2 'Benchmarking')

4.4 Customer protection

The chemical removal and investigations investments are part of our WINEP Price control deliverable covering forecast delivery of WINEP obligations. As our investment is fully linked to the statutory obligations within the WINEP and the PCD is directly driven by WINEP obligations, we are confident that the PCD covers all the benefits that we intend to deliver through the chemcials removal and investigation programmes.

5 Water WINEP

Overview

- This enhancement strategy comprises of statutory WINEP investments related to the Water price control. This includes obligations for Water Framework Directive river restoration, invasive species, and drinking water protected areas.

Table 30 Investment Summary

PR24 costs (£m)	
Capex	35.6
Opex	15.5
Totex	51.1
Benchmarking	
Method	Scheme outturn costs. Market testing of costs.
Costs removed	Competitive quotes from suppliers have been used to inform our cost estimations.
Customer Protection	
Price Control Deliverable	WINEP obligations
Ofwat data table	
CW3.1-CW3.3	Biodiversity and conservation
CW3.4-CW3.6	Eels/fish entrainment screens
CW3.7-CW3.9	Eels/fish passes
CW3.10-CW3.12	Invasive Non Native Species
CW3.13-CW3.15	Drinking Water Protected Areas
CW3.16-CW3.18	Water Framework Directive
CW12.10-CW12.12	Invasive Non Native Species
CW12.16-CW12.18	Water Framework Directive

5.1 Delivering for the long term

5.1.1 Investment context

These investments relate to those parts of the Water Industry National Environment Programme which relate to the water price controls. They provide improvements which are required by legislation through the WINEP. The table below summarises the additional enhancement investments which are required in this area under WINEP.

Table 31 Investment drivers

Enhancement	Requirement for investment
Water Framework Directive (WFD), river restoration and river support schemes	AMP7 investigations and options appraisals were completed across several sites to investigate the impact of abstraction on river flow and identify mitigation options to address abstraction-related low flows to improve ecological status and reduce the need for supply side options. The investigations identified investments to implement in AMP8, in agreement with the Environment Agency.
Water Resources Management Plan Environmental Destination	AMP8 investigations are required to understand the phased implementation of abstraction reductions to achieve environmental destination objectives for sustainable abstraction. This is intrinsically linked with both WRMP strategic resource options and WINEP enhancement spend under the above drivers.
Eels Improvements	AMP7 investigations were completed to identify feasible options for access and egress at Alton Water and Ardleigh Reservoirs in AMP8. Investigation at Bucklesham raw water intake on the Mill River also identified need to install an eel and fish pass.

Enhancement	Requirement for investment
	Eel barrier investigations in AMP8 are focused on reviewing barriers we have in place and are responsible for which could impact Eels. Options will then be reviewed as to the suitable solutions required.
Invasive non-native species	AMP7 investigations were completed to investigate the risk of spread and introduction of invasive species along raw water transfers and at Anglian Water sites. The investigations identified options to implement in AMP8, in agreement with the Environment Agency. In addition, further investigations are required in AMP8 to understand mitigation options for raw water transfers.
Drinking water protected areas	Statutory schemes listed in the WINEP to implement catchment schemes to prevent deterioration or make improvements following a deterioration in water quality to avoid an increase in the level of water treatment. In order to reduce the amount of pesticides and phosphate being lost from the agricultural landscape into surface waters upstream of public water supply abstractions. Investment is required to implement an expanded programme of farmer engagement (including 1-2-1 farm visits, workshops and newsletters), sub catchment monitoring (pesticides, nutrients), and targeted interventions in high-risk sub-catchments which use catchment-based solutions to reduce the number of pesticides and agricultural phosphates lost to surface water. To be completed by 21st December 2029.
Biodiversity and conservation	Investments to improve habitats, comply with our obligations for protected sites and our Biodiversity Duty, which was strengthened by the Environment Act 2021

5.1.2 Scale and timing

The scale and timing of our water WINEP investment is driven by the need to align with our WINEP obligations as specified by the Environment Agency following AMP7 investigation investments. The investments included in this area are fully driven by the statutory WINEP programme and the need to meet the obligations within this programme within AMP8. There is no opportunity to phase schemes into later AMPs.

5.1.3 Interaction with base expenditure

This investment is enhancement as it enhances water quality, ecological status of water bodies and wider biodiversity, with no base expenditure permitted through the base models.

5.1.4 Long term context (historic)

Invasive species

The AMP7 investigations assessed the risk of introduction and spread of invasive species at AW sites and at raw water transfers. This assessment was then used to prioritise sites most at risk to identify mitigation options for AMP8 obligations, such as our recreational water parks. The investigation identified mitigation options to help reduce the risk of introduction and spread of invasive species. These options were prioritised in terms of their effectiveness and applied to specific sites. The options were reviewed, confirmed with the Environment Agency and agreed in proformas signed by the EA and AWS to confirm completion of the WINEP obligation.

Eels and fish

AMP7 obligations focused on investigations and the delivery of eel screens in line with our AMP7 WINEP. Our AMP8 programme does not overlap with these investments.

Drinking Water Protected Areas

In AMP7 the DWPA catchment programme focused primarily on the management and mitigation of the pesticide Metaldehyde. A small part of the programme trialled the effectiveness of a range of other catchment management interventions in small targeted sub-catchments.

In conversation with the Environment Agency, it was agreed that the AMP8 programme would build on these learnings significantly upscaling the areas of delivery. Aiming to address diffuse pollution at a catchment scale rather than trial approaches at a small or local catchment scale. Approaches considered included

those used by other water companies, government and non-governmental organisations to ensure catchment measures used represented the most effective and efficient options to deliver the DWPA targets.

The approach proposed is unique and seeks to "place farmers as the solution" to our DWPA challenges - working in partnership with farmers, groups and supply chain leaders to scale up awareness and actions. We are also focused on building resilience into the farmed environment by highlighting the value of external markets for carbon, biodiversity and regenerative farming practices.

Biodiversity and conservation

Our planned AMP8 investments for improving biodiversity do not overlap with, nor duplicate, AMP7 investments. Most are standalone investments linked to bringing more land into good ecological condition. These investments have been identified through our ongoing work to understand the biodiversity value and potential of our land, and have been agreed with the Environment Agency and Natural England.

Two schemes are follow-on schemes from AMP7. These are at Market Harborough in Leicestershire and Taverham in Norfolk. These schemes are not funding the same investment activity as in AMP7 but rather expanding the expected benefits of those schemes. The obligation for investment at Market Harborough states '...and carry out a necessary ground investigation of the sewage farm area, approx. 27 hectares, to inform future PR24 delivery option for creation of the adjacent wetland.' At Taverham, as well as undertaking river restoration, the obligation requires AW to explore floodplain restoration. The results of this will be the subject of investment at in AMP8.

5.1.5 Long term context (future)

Our AMP8 investment into the water WINEP obligations are low regret (being driven by statutory requirements) and are important in the delivery of our long-term LTDS environmental enhancement core pathway. Our Environmental enhancement sub strategy forecasts that investment will be require to deliver statutory obligations in this area between AMP9-AMP12. Future investment need is predicted in all programme areas in this investment case, but we also anticipate this being reactive to regulatory priorities that we cannot predict at this time (e.g. conservation status of chalk streams).

Our LTDS assumes that the roll-out of collaborative approaches tested through our AMP8 A-WINEP programme is extended to the broader WINEP from AMP9 onwards. If this does not occur, this will trigger our alternative pathway 'WINEP Approach Sensitivity Pathway', which assumes that we will need to provide additional investment for Biodiversity, eels programmes, and other areas captured within this portfolio in later AMPs. Our AMP8 investment remains low regret as it places us on the right track to deliver on our ambition all scenarios.[15]

5.1.6 Customer support

Our customers are keen to see us meet our statutory obligations, and where possible use nature-based solutions where feasible and at an acceptable cost. This preference has informed the selection of our preferred solution where possible as long as the obligation can still be met (such as the natural bypass solution option scoped at Bucklesham instead of a traditional solution).

5.1.7 Cost control

This investment is driven by obligations set out in the WINEP and is therefore a statutory driver outside of management control. Failure to comply may result in the Environment Agency taking legal enforcement action.

5.2 Unlocking greater value for customers, communities and the environment

5.2.1 Option consideration

WFD River Restoration

We have considered a range of options for WFD river restoration investments including:

- Capping of abstraction license quantities
- Abstraction reduction
- Relocation of abstraction sources
- River support
- River restoration

The potential long list was consulted on with the EA and the final long list was subject to Multi-Criteria Assessment to generate the options short list taken forward to Cost Benefit Analysis.

In addition, 'no deterioration' assessments were carried out across several sites as part of the AMP7 WINEP. This assessment included initial analysis of modelled abstraction scenarios and abstraction rates, to understand the current deterioration risk. Future modelled scenarios were then assessed to review any change in deterioration risk. Any mitigation required associated with no deterioration investigations will be addressed as part of future licence reductions, AWS no deterioration capping strategy and time-limited licence renewals.

15 Please refer to Section 2.2.1 'Environmental enhancement' in our LTDS for more detail

Invasive species

The AMP7 investigation identified mitigation options which were prioritised in terms of their effectiveness and applied to specific sites. The options were reviewed, confirmed with the Environment Agency and agreed in proformas signed by the EA and AWS to confirm completion of the WINEP obligation.

The following table sets out all options considered throughout the optioneering process, regardless of if they were discounted at any stage of the process:

Table 32 Options assessment appraisal - Invasive species

Option	Description	Unconstrained	Constrained	Feasible
Wensum balsam removal				
Control Himalayan Balsam on AW sites on the Wensum	Removal of Himalayan Balsam for Anglian Water-owned land in the Wensum catchment	Yes	Yes	Yes
Control Himalayan Balsam in the Wensum Catchment in partnership with others	Collaborative working at the catchment level to eradicate Himalayan Balsam from the whole of the Wensum, including Anglian-Water owned land	Yes	Yes	Yes
Rapid INNS removal				
Manage a fund for rapid removal of invasive species.	This fund would need be carefully managed to ensure it is used in only appropriate circumstances, to be agreed with the EA in the forthcoming ASF. In particular it will be deployed to protect Anglian Water's resilience to INNS, thereby providing a benefit to the customer by reducing the financial impact of newly established invasive species.	Yes	Yes	Yes
Hall WTW Biosecurity				
Catch GAC roughing filter	Catch GAC roughing filter water that is being drained from tankers collecting the GAC for regeneration, and prevent it from being lost to the river Trent by ensuring a diversion into the process water that is returned to the reservoir	Yes	Yes	Yes

Eels and fish

Options considered for our eels and fish investments included the following traditional and non-traditional solutions:

- A programme of trap and transport
- Installation of an engineered eel pass connecting the reservoirs with the downstream watercourse.

- Natural bypass solutions
- Installation of a mechanical fish/eel pass at the raw water intake.

Drinking Water Protected Areas

Our unconstrained list of options was compiled in consultation with a wide range of parties including the Environment Agency, Natural England, supply chain bodies, academic institutions and farmer groups. The table below sets out the principle options we have considered with specific options being chosen at each site based on site specific circumstances.

Table 33 Options assessment appraisal - Drinking water protected areas

Option	Description	Unconstrained	Constrained	Feasible
Monitor and engage	• Catchment monitoring of pesticides and phosphate. • Engage agriculture sector to communicate risk and best practice advice • Advise on external funding opportunities	Yes		
Monitor, engage and interventions (least cost)	• Targeted catchment monitoring of pesticides and phosphate. • Engage agriculture sector to communicate risk and best practice advice. • Deliver minimum effective level of field interventions, funded solely by AW in limited annually funded measures in priority sub catchments	Yes	Yes	Yes
Monitor, engage and interventions	• Catchment monitoring of pesticides and phosphate by AW and a number of local catchment partners. • Engage agriculture sector to communicate risk and best practice advice. • Use of funded interventions in partnership with co-funding and multiyear funding streams to deliver the widest range of long-term environmental benefits	Yes	Yes	Yes

Biodiversity and conservation

We are required to bring Sites of Special Scientific Interest into Favourable Condition and maintain them in such condition. We are also bound by the Biodiversity Duty which was strengthened by the Environment Act 2021. Investments that were promoted for WINEP investment were done so because they are consistent with these duties and are at sites that are a high priority for Anglian Water. Those sites are:

- Market Harborough WRC
- Broadholme WRC
- Grafham Water
- Marham Fen
- Taverham Mill
- Newbourne Springs

The following table sets out all options considered to meet our obligations on these sites:

Table 34 Options assessment appraisal - Biodiversity and conservation

No.	Option	Unconstrained	Constrained	Feasible
Taverham Mill				
1	Complete work on Wensum river enhancement started in AMP7, and enhance associated floodplain habitat	Yes	Yes	Yes
Newbourne Springs				
1	Fence NewbourneSprings and replace boardwalk	Yes	Yes	Yes
2	Fence NewbourneSprings	Yes	Yes	Yes
Marham Fen				
1	Restoration of Marham Fen as per the recommended management prescriptions	Yes	Yes	Yes
2	Tree felling only to restore fen habitat	Yes	Yes	Yes
Grafham Water				
1	Grassland restoration and fencing for woodland creation	Yes	Yes	Yes
2	Allow arable land to revert and mow each year, plus fencing for woodland creation	Yes	Yes	Yes
Broadholme WRC				
1	Site fencing to enable grazing to restore grassland condition of a habitat patch which is part owned by AW and part owned by the Wildlife Trust	Yes	Yes	Yes
2	Manage AW's land separately by mowing	Yes	Yes	Yes

No.	Option	Unconstrained	Constrained	Feasible
Taverham Mill				
Market Harborough				
1	Small Wetland connected to river	Yes	Yes	Yes
2	Small ponds, woodland and river restoration	Yes	Yes	Yes
3	Large wetland connected to river	Yes	Yes	No

WFD River Restoration

Each of the short-listed options was costed and the environmental benefits assessed in accordance with the EA Water Appraisal Guidance (2016) to generate a Benefit-Cost ratio and inform selection of the Preferred Option. Only cost-beneficial options were taken forward into PR24 business planning. The preferred option for each site was discussed with the EA and agreed in proformas signed by the EA and AWS to confirm completion of the WINEP obligation. The preferred options are captured in the table below, with more detail available in the relevant Option Appraisal Reports and Cost Benefit Assessments for each site.

Table 35 Preferred options - WFD river restoration

Site or scheme name	Preferred option no.	Preferred option description	Secondary option no.	Secondary/alternative option description
River Stiffkey	Stiffkey #09	River Support	Stiffkey #20	Combined River Support and River restoration
River Gipping	Gipping #15	River Restoration	Gipping #20	Combined River Support and River restoration
River Colne (North Essex Chalk)	Colne #14	Combined River Support and River restoration	Colne #07	River Support
River Pant (North Essex Chalk)	Pant #17	River Support	Pant #18	Combined River Support and River restoration

Invasive species

The following table sets out the options we considered throughout our optioneering process, and if these were feasible in meeting the required improvements:

Table 36 Feasible option descriptions - Invasive species

Option	Feasible option (Y/N)	Justification
Wensum balsam removal		
Control Himalayan Balsam on AW sites on the Wensum	Y	For Wensum balsam removal, both options were deemed feasible to address the spread of INNS from Anglian Water land and taken to OAR. However, anything less than the catchment approach promoted in the WINEP would result in AW assets being continuously reinfected with Himalayan Balsam. It is therefore more cost effective in the long term.
Control Himalayan Balsam in the Wensum Catchment in partnership with others	Y (preferred option)	
Rapid INNS removal		
Manage a fund for rapid removal of invasive species.	Y	Only one option was considered during the unconstrained, constrained and feasible optioneering stages as there was only one reasonable option available. The fund for the rapid removal of INNS was agreed with the EA during the WINEP process to improve the collective response to the threat of INNS in the East of England.

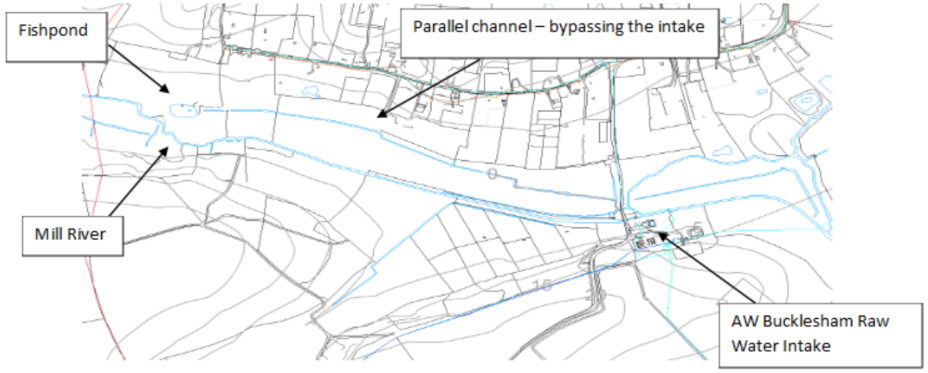
Option	Feasible option (Y/N)	Justification
Wensum balsam removal		
Hall WTW Biosecurity		
Catch GAC roughing filter	Y	Only one option was considered during the unconstrained, constrained and feasible optioneering stages as there was only one reasonable option available.

For Wensum balsam removal, both options were deemed feasible to address the spread of INNS from Anglian Water land and taken to OAR. However, anything less than the catchment approach promoted in the WINEP would result in AW assets being continuously reinfected with Himalayan Balsam. It is therefore more cost effective in the long term.

Eels and fish

For the installation of an eel and fish pass at Bucklesham Mill River, the mechanical fish/eel pass was discounted due to requirements around the water usage of the pass, where the water quantity required for the operation of the pass would make the raw water intake unusable at key times. Installation of a natural bypass was selected as the preferred option.

Figure 18 Bucklesham natural bypass



Drinking water protection areas

We considered the following options through our optioneering process. We deemed that two of the three options were suitable to meet our required outcomes in relation to DWPAs.

Table 37 Feasible option description - Drinking water protected areas

No.	Option	Feasible (Y/N)	Justification
1	Monitor and engage	N	Ruled out as lack of direct intervention reduce the change of delivering measurable change or improvement to meet statutory requirements
2	Monitor, engage and interventions (least cost)	Y	Deemed feasible as meets statutory requirements, delivers significant improvement to local environment priorities using nature-based solutions.
3	Monitor, engage and interventions	Y	Deemed feasible as meets statutory requirements, delivers significant improvement to local environment priorities using nature-based solutions.

Options for each sites where then selected in the relevant OAR.

Biodiversity and conservation

Options for each site where subject to the same criteria at the constrained and feasible stages of the optioneering process for drinking water protected areas. The final feasible options for each site where:

The following table sets out the options considered through our optioneering process to meet our obligations on biodiversity and conservation:

Table 38 Feasible option description - Biodiversity and conservation

No.	Option	Feasible option (Y/N)	Justification
Taverham Mill			
1	Complete work on Wensum river enhancement started in AMP7, and enhance associated floodplain habitat	Y	Only feasible option to bring Wensum SSSI into feasible condition
NewbourneSprings			
1	Fence Newbourne Springs and replace boardwalk	Y	Both ensure SSSI can continue to be managed and enhanced for biodiversity
2	Fence Newbourne Springs	Y	Both ensure SSSI can continue to be managed and enhanced for biodiversity
Marham Fen			
1	Restoration of Marham Fen as per the recommended management prescriptions	Y	Both have a direct link to meeting Environment Act responsibilities and will be supported by NGOs
2	Tree felling only to restore fen habitat	Y	Both have a direct link to meeting Environment Act responsibilities and will be supported by NGOs
Grafham Water			
1	Grassland restoration and fencing for woodland creation	Y	Both enhance Grafham Water SSSI and support targets set out in 25YEP
2	Allow arable land to revert and mow each year, plus fencing for woodland creation	Y	Both enhance Grafham Water SSSI and support targets set out in 25YEP
Broadholme WRC			
Taverham Mill			
1	Site fencing to enable grazing to restore grassland condition of a habitat patch which is part owned by AW and part owned by the Wildlife Trust	Y	Both options taken to OAR as supports improvement of SSSI
2	Manage AW's land separately by mowing	Y	Both options taken to OAR as supports improvement of SSSI
Market Harborough			
1	Small Wetland connected to river	Y	It will enable the restoration of AW land to something of much better value for biodiversity.
2	Small ponds, woodland and river restoration	Y	It will enable the restoration of AW land to something of much better value for biodiversity.
3	Large wetland connected to river	N	Not a feasible option as more complex engineering complexity (more earth moving required)

5.2.2 Environmental and social value

The methodology for the development of WINEP options requested that Environment Agency Wider Environmental Outcome (WEO) metrics were used where possible to inform the benefits provided by each option. These metrics were incorporated into corporate investment tools to ensure that they were appropriately evaluated during PR24 development. Particularly emphasis was placed on biodiversity net gain and water quality metrics, which were most relevant to these investments.

5.2.3 Investment benefits

This investment will deliver the following benefits:

- Ensuring compliance with protected sites legislation by moving sites towards favourable condition or keeping sites in favourable condition

- Compliance with the strengthened biodiversity duty by enhancing priority habitats
- Reducing the risk of invasive non-native species on the environment and on our business

This investment will not deliver any benefits to our performance on the Biodiversity PC, as the sites we propose for improvement through our AMP8 enhancement programme and the three sites we have currently opted in for the Biodiversity PC (Heigham WTW, Elsham WTW, and Grafham (Offord intake)) are mutually exclusive. All performance improvements for the Biodiversity PC will be delivered from expenditure derived from base allowances. We have currently not opted in the sites covered by this enhancement expenditure for the following reasons:

- Several sites may be managed in the long-term through agri-environment schemes (Broadholme, Grafham, Taverham). Units created as a result of other regulatory obligations cannot be included in the PC
- The PC has to be applied on land that AW has a long-term interest in. One scheme, at Market Harborough, will have a significant element of work on 3rd party land that we don't have an interest in
- One site at Newbourne Springs SSSI is unlikely to result in any additional units, as it is a SSSI already in Favourable Condition

However, we will keep this under review and work with our independent panel to decide if these sites may be suitable to be included within the PC in the future. If we do choose to opt sites into the scope of the PC during AMP8, this will need to be reflected within the PCL.

5.2.4 Managing uncertainty

All options proposed within this investment case are subject to scrutiny from the Environment Agency to ensure that they deliver desired environmental outcomes. Robust assurance is required where there is an expectation of partner contributions to achieve outcomes, therefore all options presented are fully funded and delivered by Anglian Water. This provides certainty that outcomes will be achieved, whilst maintaining the opportunity to explore wider partnership deliverables above and beyond the expectations of the WINEP delivery.

An example of this is through our catchment management delivery, where we retain the desire to co-fund solutions with landowners, but have ensured that funding will enable adequate engagement and grant funding to achieve the desired level of environmental outcome. Additionally, we will be working over a broad geography that does not require 100% engagement to be effective. This ensures that should there be a lack of landowner interest in delivery in a specific location, there is wider scope for environmental gain.

The investment covered by this enhancement is tightly constrained by regulation and so there is limited capacity to manage uncertainty.

5.2.5 External funding

For elements of this investment, where appropriate we will explore opportunities for the programme to be developed and delivered by appropriately skilled third parties (ie for delivery of engagement to farmers as part of DWPA investment, or biodiversity activities at Grafham Water Grasslands). These opportunities will be scoped at the delivery stage or will continue to utilise existing partnerships.

5.2.6 Direct procurement

As the scale of investment for this area falls well below the materiality threshold for DPC schemes, and the individual investments within them are relatively small we have considered that these scheme are not suitable for delivery through DPC and have discounted them from further consideration.

5.2.7 Customer view

Where possible to meet an obligation, we have sought to consider nature-based solutions and have selected these where they provided the best cost-beneficial option. An example is the selection of a natural bypass at Bucklesham following agreement with the EA in AMP7 to turn this obligation into an investigation to assess this possibility.

5.3 Cost efficiency

5.3.1 Developing costs

The development of the Water WINEP costs in our plan follows our cost efficiency 'double lock' approach set out in chapter 7 Driving cost efficiency of our business plan. Through this approach we have ensured that are costs are efficient in their bottom-up build up, and this is cross-checked through external benchmark approaches. This section sets out how we have ensured cost efficiency of our Water WINEP investments through step one of our double lock approach. Step 2 is explored in section 70.1 of Chapter 7 of our business plan.

We have taken a robust approach to developing our Water WINEP costs, building on our experience from delivering similar schemes into the bottom-up development of costs (before external cost benchmarking challenges are applied in step 2 of our 'double-lock' approach). The detail of the cost development approach is set out below, along with a breakdown of costs we provide in table CW3.

Cost estimation methodology

Where the projects construction elements are broken down into major work elements such channels, pipelines, with high levels design parameters; these are estimated individually by using the parametric cost models and the on-site design information and then aggregated it to inform our cost estimation for PR24.

We derived our costs for each water resources scheme through identifying similar investments from previous AMP investigations, with environmental improvement options (river restoration, river support, abstraction reduction) agreed with the EA and costed based on existing delivery experience/cost models

The table below provides a breakdown of schemes costs provided in CW3

Table 39 AMP8 investment overview = WFD and Eel improvements

Investment ID	Investment name	Scope	Capital Cost (£k) AMP7	Capital Cost (£k) AMP8	OPEX Cost (£k) AMP8
I034350	Alton Water Eel Migration	*Eel Trap and Transport * Allowance for a senior scientist liaising with an external consultant *Inlet channel and manual flow control *Fish and Eel channel linking *Channel clearance *Management and supervision	-	-	233
I034355	Ardleigh Reservoir Eel Migration		-	-	233
I034357	Bucklesham Mill River Eel Migration		-	286	-
I034360	Regional Barriers Eel Investigation	*Identify and describe the barriers * Classification and risk prioritisation *Appraisal and cost benefit analysis	-	337	-
I034362	Regional Invasive Species Investigation	Invasive Species Investigation	-	536	-
I010670	Raw Water Cloves Bridge **Multidriver scheme 50% allocated in Resilience Water** NOTE: Total value £20,121k is expected to be start design at the end of AMP8	*UV unit 63MLD *5.5 km water main 900mm NB *Pumps, pipes, valves upgrades *Building *Standby generator	-	971	-
I034363	Lark Catchment WFD Flow	*Channel enhancement measures *Enhanced natural recovery measures *Channel restoration measures	610	6,510	-
I034365	Wissey Catchment WFD Flow		-	6,408	-
I034366	Heacham Gaywood Broughton Brook WFD Flow		-	4,391	-
I034369	River Gipping WFD Flow	*river measures-Hydromorphology	-	1,667	-
I034367	River Stiffkey WFD Flow	*Water Main/pipewrork *Multistage Pump *Magflow	-	318	56
I034381	River Colne WFD Flow River Support		-	224	32
I034383	River Pant WFD Flow		-	565	98
I034395	Kennett Lee Brook River Support	*Water Main/pipewrork *Borehole pump	-	2,176	24

Investment ID	Investment name	Scope	Capital Cost (£k) AMP7	Capital Cost (£k) AMP8	OPEX Cost (£k) AMP8
		*Borehole shaft *Kiosk *Boundary fencing *Telemetry *Ancillaries(roads , landscaping)			
I040898	River Colne WFD Flow Restoration	Measures include: *Backwater / in-channel wetland *Channel dredging *Reduced tree shading *Narrowing structures (includes flow deflectors / groynes, LWD, side bars, re-grading, slope mattress and narrowing with aquatic ledges) *Tree planting, Buffer Strips,Gravel augment/ riffles *Structures to control flow split into bypass/ old channel, ensure fish passage	-	1,227	-
I034393	Regional Env Destination Investigation	*Hydroecology modelling *Groundwater and surface water modelling *Catchment collaboration and investigation *Sampling *WRE Simulator *Flood risk modelling *Estuarine modelling *Catchment-level simulator (WfT)	2,100	4,985	-
I034394	Regional No Det WFD Investigations	Investigation and modelling	-	333	-
I034396	Skerne WFD Investigation		-	290	-
I034407	AW Region national invasive species monitoring	surveillance techniques for high priority invasive species (INNS_MON)	-	-	35
		Total	**2,710**	**31,224**	**711**

Biodiversity investments have been identified on a site-by-site basis, and agreed with EA and NE, based on our detailed understanding of the biodiversity value of our assets and their place in the wider landscape. Investments have been identified where biodiversity enhancement is required on one of our sites or the wider landscape to comply with environmental regulations. Site by site assessments have been undertaken to identify suitable actions to improve the site's conservation status. Investigations have been selected to ensure compliance with WISER guidance.

The table below provides a breakdown of schemes costs.

Table 40 AMP8 investment overview - Invasive species

Investment ID	Investment name	Scope	Capital Cost (£k) AMP7	Capital Cost (£k) AMP8	OPEX Cost (£k) AMP8
I034468	Regional invasive species removal fund	Work to counter any invasive species as and when they occur.(To carry out the control of Pennywort using manual removal and herbicide treatment)	-	-	149
I034473	River Wensum River Water Quality	*Himalayan Balm removal *Project management	-	-	54
I034471	Taverham Mill biodiversity compliance	*SUDs *Outfall pipework *enabling work for access installation *Reinstatement	1,495	190	-
I034654	EA Biodiversity Compliance - Pollinator Strategy	*site visit (informal invertebrate survey, *assessing habitats for pollinators, *identifying opportunities for enhancement and/or improved management for pollinators) *2 days write up and creation of GIS outputs	-	-	108
Various	14 specific locations	Comprehensive programme of farmer engagement and catchment investment. Scaled to achieve maximum targeted benefit across the catchment	-	-	205
		Total	**1,495**	**190**	**516**

Catchment Management schemes have been identified based on the need to protect a source of drinking water from the influences of adjacent land management. These areas are defined as safeguard zones by the EA, with actions based around engaging landowners and influencing land management practices through advice/grant funding.

The table below provides a breakdown of schemes costs.

Table 41 AMP8 investment overview - Catchment management schemes

Investment ID	Investment name	Scope	Capital Cost (£k) AMP7	Capital Cost (£k) AMP8	OPEX Cost (£k) AMP8
I034649	Regional Catchment Turbidity Investigation	*Modelling *GIS + Remote sensing data *75 x monthly (75x24) *Partner with Wessex Water *Interventions	-	-	405
I034883	WINEP River Monitoring	*monitoring cost for 7 rivers includes: -Enhanced natural recovery measures -Channel enhancement measures -Channel restoration measure	-	-	2,041
Various	12 specific locations	*Catchment Scientist *Technical Training (FACTs / BASIS) *Media & Communications training *Algae Programme *Total Pesticide Programme *Engagement materials *Trade shows *Grant management programme *Modelling/Study	-	-	11,793
		Total	-	-	**14,239**

Table 42 Overall AMP8 Investment

	Capital cost 000's (£) AMP7	Capital Cost 000's (£) AMP8	OPEX Cost 000's (£) (25-30)
Total programme	4,205	31,414	15,466

5.3.2 Benchmarking

In stage 2 of our cost efficiency 'double-lock' on Water WINEP, we used a variety of methods to assess, benchmark and challenge the costs in our plan.We applied benchmarking through the use of:

- Scheme outturn costs
- Market testing of costs

Scheme outturn costs

There is mixture of activities to be carried out as part of our Water WINEP investments. We have used our cost models for assets that we have installed before to ensure that the economies of scale achieved through the delivery of these assets in other programmes are embedded in our cost estimations.

Market testing of costs

We have ensured that for activities that require specialist contractors, the unit rates used on the quotes are compared to similar works delivered by our framework partners, allowing us to challenge unit cost assumptions. Wherever possible, quotes have been sought from at least three specialists to inform the basis of our cost estimation.

On the basis of the activities we have undertaken to build efficient costs into our plan through vendor quotes and building in scheme outturn costs, we consider that the costs included in our plan are efficient.

5.3.3 Assurance

The development of our costs within our cost estimation system (C55) have been assured by a third-party (Jacobs).

5.4 Customer protection

Customers are protected against the non-delivery of this investment by enforcement action from the EA and the WINEP price control deliverable.

6 Monitoring

Overview

- Four programmes of monitoring are required by statutory WINEP obligations.
- The EA requires the installation of upstream and downstream Continuous River Water Quality Monitors to gather and report real time data on the impact of wastewater dischargers on receiving watercourses.
  - We will invest £166m to install and run continuous river water quality monitors between 2025-2030
  - Through the optioneering process, we selected the 'permanent solution' monitor for CRWQM, given the security risks or overengineering of the other potential options.
- We will also install Event Duration Monitors, Flow Monitors at WRCs, and Emergency Overflow Monitors where required by the Environment Agency.
- The cost estimates for our monitoring programme have been developed using similar scheme outturn costs based on our AMP7 programme. The exception to this is the CRWQM programme for which we do not have experience in delivery from previous AMPs as this is a brand new obligation at PR24, therefore for this we have market tested our costs.

Table 43 Investment Summary

PR24 costs (£m)	
Capex	227.8
Opex	21.9
Totex	249.7
Benchmarking	
Method	Scheme outturn costs. Market testing of costs.
Costs removed	In the process of market testing of our costs, £57 million of costs were removed. Market testing has been built into our cost assumptions.
Customer Protection	
Price Control Deliverable	WINEP obligations
Ofwat data table	
CWW3.1-CWW3.3 CWW3.4-CWW3.6 CWW3.7-CWW3.9 CWW3.10-CWW.12	Event duration monitoring at intermittent discharges (WINEP/NEP) Flow monitoring at sewage treatment works; (WINEP/NEP) Continuous river water quality monitoring (WINEP/NEP) MCERTs monitoring at emergency sewage pumping station overflows (WINEP/NEP)

6.1 Delivery for the long term

6.1.1 Investment context

Our proposed enhancement investments for monitoring are fully driven by the WINEP programme. Specifically, these monitoring investments cover four areas, each with a specific statutory driver from the Urban Wastewater Treatment

Directive (UWWTD), or Environment Act. These four areas are set out in the table below and how they are expressed within the WINEP statutory framework is also set out in the table .

Table 44 WINEP drivers

Monitor	Description	Statutory driver	WINEP driver code	PR24 enhancement expenditure lines (CWW table)
Event Duration Monitors	New discharge operation monitoring at water recycling centre storm tanks	UWWTD	U_MON3	3.1 - 3.3
Flow monitors	MCERTs flow monitoring at water recycling centres	UWWTD	U_MON4	3.4 - 3.6
Continuous River Water Quality Monitors	Provision of continuous near real-time water quality data upstream and downstream of discharges	Environment Act	EnvAct_MON1 to MON5	3.7 - 3.9
Emergency Overflow Monitors	MCERTs monitoring at emergency sewage pumping station overflows	UWWTD	U_MON6	3.10 - 3.12

A summary of each of these investment areas is set out below.

Event Duration Monitors

The PR24 driver requires that all U_MON3 overflow operation monitoring must be MCERTS certified. In addition to this monitoring is also required on storm tanks and overflows at Last in Line Pumping Stations (LILOS) that either overflow to a storm tank on a gravity system or overflow from a terminal pumping station with a dry weather flow of greater than 50m3/day.

Flow monitors

UMON4 monitors measure the flow to full treatment (FFT) at a WRC site.

The PR24 UMON4 driver is split into UMON 4a-e:

- UMON 4a/b - move a UMON 4 monitor installed in AMP7 to 2 minute rather than 15 minute monitoring frequency.
- UMON 4c - installation of a pass forward Flow meter at a site where a previous UINV2 investigation has been carried out. Where required divert storm and liquor returns.
- UMON 4d - N/A (not included in our plan)
- UMON 4e - installation of a pass forward flow monitor at a last in line overflow
- U_MON3 monitors for PR24 record the flow into storm tanks (or direct to environment where there is no storm tank). The UMON3 monitors installed in PR19 record flow to the environment from these tanks. UMON4 monitors installed in PR19 and PR24 record the pass forward flow to the treatment process. The information from these monitors can be used to determine whether storm tanks are being used outside the conditions stated in the discharge permit.

Continuous River Water Quality Monitors

The purpose of this investment programme is to gather and report real time data on the impact of waste water discharges (including Intermittent, storm overflows and continuous, treated final effluent) on receiving watercourses to support the identification of, and evidence for, future improvement actions in order to protect the environment. The updated technical guidance received on the 9th August includes statutory requirements for the installation of upstream and downstream monitors at 25% of all non-exempt assets by March 2030 (Within this envelope 50% should be sites classified as high priority), the real time reporting of this data alongside EDM data and pilot studies to investigate the suitability of continuous water quality monitoring at estuarine locations.

This monitoring will continuously measure a minimum of four water quality parameters with the scope to add a two additional parameters in the future. The costed solution involves installation of fixed kiosks upstream and downstream of discharges with a pumped feed from the watercourse to the monitoring instrumentation, associated power supplies and telemetry. The technical guidance includes details of how to determine the location of the downstream monitor, taking into account the distance downstream to achieve mixing in the river as well as grouping of any neighbouring discharges. For this reason we have not been able to select exact known locations at this stage and have made assumptions on the enabling costs, for example distance to nearest access route or power source.

Emergency Overflow Monitors

The purpose of this investment programme is to gather and report real time data on the duration and frequency of all permitted emergency overflow operations from wastewater network pumping stations and inlet pumping stations at wastewater treatment works (1419 sites in total). Monitoring will be required to meet MCERTS standard, and will inform future improvement schemes. Where pumping stations also have a storm overflow, pass forward flow monitoring must also be installed to allow emergency discharges to be distinguished from storm

overflows. In our APR23 we reported 889 emergency overflows in table 7C. The reason we require 1,419 monitors for emergency overflows is that many of our emergency overflows share an outfall with combined sewer overflows, in other words more than one overflow feed a common discharge point. The additional monitors are therefore required to ensure that the reason for the discharge can be attributed to the correct source.

6.1.2 Scale and timing

As our plan is fully aligned with the statutory requirements set out in the WINEP and we have included no non-statutory investments within our investments, the scale and timing of our monitoring enhancement investments is completely driven by the obligation dates set out in WINEP.

Our EDM and flow monitoring investments all have obligation dates by end of 2026. Emergency overflows obligations have a requirement to be delivered by 31st March 2030.

On CRWQM we have worked closely with Defra to phase investments, due to the substantial impact on deliverability and affordability that such a large programme would have. Recent agreements with the Secretary of State have allowed us to phase 744 monitor investments into future AMPs, reducing the scale of our CRWQM PR24 plan by circa £78m. As with other monitoring investments, the remaining enhancement investments included within our plan align with what is required within the WINEP to be delivered by 2030 as per updated guidance.

There is a peak in the spend at the start and end of AMP8 due to the need to invest in preparatory work at the start of the AMP. This will include modelling to determine the optimum point to locate the monitors correctly and surveys to identify the land and access required to install and maintain kiosks and monitors. Following this period there will be a length of time where lower spend will occur when easements, tendering for the project framework and setting up power supplies will be carried out. The spend then increases again at the end of the AMP to cover the cost of the physical delivery of the water quality monitors and kiosks.

6.1.3 Interaction with base expenditure

All of the investment that we are including in our plan as a proposed enhancement allowance is driven by the additional requirements placed upon us by the WINEP. We have separated out any related expenditure which we consider to be implicitly included within the base models. This is summarised in the table below. Those activities within base are not reflected in this enhancement proposal.

Table 45 Base and enhancement activities

Base activities	Enhancement activities
Maintenance of monitors installed before 2025	Installation of new monitors at storm tanks, water recycling centres, emergency overflows and river water quality monitors.
Inter-process monitors or monitors measuring parameters other than flow.	Associated civil engineering required to allow the installation of the above monitors.
Monitors on 356 assets not covered by WINEP guidance, that are now required to meet 100% storm overflow coverage by December 2023.	Upgrading of monitors to meet MCERT requirements where monitors do not do this already. This provides additional value by ensuring that all monitors are recording to the same standard with the same degree of accuracy.
Where monitors identify any previously unknown unpermitted operation of emergency overflows (ie during storm events) the work required to prevent this operation will be funded through base maintenance activities	Obtaining MCERT certification for each new monitor
Increased battery replacement needs as a result of increased real time monitoring requirements for UMON schemes which is now required by December 2023.	
Additional asset maintenance requirements as a result of delivering our AMP7 WINEP programme early in order to meet the December 2023 100% storm overflow coverage commitments	

6.1.4 Long term context (historic)

Monitoring investment consists of a mix of types of investments that we have delivered in previous AMPs which now required enhanced capabilities) and those which are new types of activity. The major component of our monitoring programme is that of CRWQM and EO monitoring, which we have not delivered in previous AMPs as it has not previously formed part of the WINEP.

For EDMs, and flow monitors, although we have delivered these previously there is no overlap or duplication of activities already funded at previous price reviews because we have delivered all of our previous monitoring investments on time. Therefore we are confident that all the monitors included within our PR24 plan deliver on new obligations within enhanced requirements, which we have not had funding for in the past. For example, there is a new requirement in PR24 for UMON3 installations to meet MCERTS monitoring standards. This means that previously installed UMON monitors that do not meet this new standard will require new installations.

6.1.5 Long term context (future)

We are committed to our SDS ambition of working with others to improve the ecological quality of our catchments. Our LTDS sets out how we will meet the ambitions outlined in our SDS. The AMP8 investment is low regret as it underpins our LTDS Environmental Enhancement (WINEP) sub strategy. It will deliver our LTDS ambition to continue meeting our WINEP obligations in all scenarios, and would also put us on the right path if an alternative pathway was triggered. We also consider the Storm Overflow Discharge Reduction Plan which requires that all overflows must have screening installed by 2050. Investing now therefore to bring power supplies to these locations is low regret as in future it will reduce the cost of installation of other powered assets at the same locations. [16]

6.1.6 Customer support

This investment is driven purely by the statutory WINEP programme. We have not included non-statutory investments that would require customer support.

6.1.7 Cost control

These investments are driven by the WINEP which is a statutory driver and therefore outside of company control. We have worked with the EA and Defra to control costs. We have been able to take steps to control costs within the plan by highlighting the benefits of phasing of the CRWQM programme which at its full scope in the development of the plan had the potential to add over £451m capex to the plan with significant implications for the affordability and deliverability of the overall PR24 plan.

6.2 Unlocking greater value for customers, communities and the environment

6.2.1 Option consideration

Across our monitoring investments we have considered a range of options where possible (and in all cases we have considered at least two options). Given the nature of the investment and the requirements of the WINEP, it is not an area where non-traditional or nature based solutions are available.

U_MON3

For U_MON3 investments there are more limited options available due to the technical prescriptiveness of the WINEP. We have considered the following potential options as reflected in our WINEP Options Development Report. We set out where we deemed these options to be feasible to meet the required need:

Table 46 U_MON3 options

No.	Option	Description	Unconstrained	Feasible
1	MCERT'd Class 1 non contact instrument to +/- 2mm accuracy, with data logging.		Yes	Yes
2	MCERT'd Class 1 non contact instrument to +/- 2mm accuracy and MCERT'd volumetric discharge from storm tanks		Yes	
3	MCERT'd ST overflow via a Radar monitor	We reviewed the WINEP requirement against our cost models and included a further option	Yes	Yes

16 Please refer to Section 2.2.1 'Environmental enhancement' in our LTDS for more detail

U_MON4

For U_MON4 investments, as with U_MON3, the relatively prescriptive requirement of the obligation to install a monitor limits the potential scope to consider a wide range of options. We have identified five potential options as presented in our WINEP Options Development Report:

Table 47 U_MON4 options

No.	Option	Description	Unconstrained	Feasible
1	Telemetry change on inlet FFT flow meter to measure 2 min flow data	Suitable for UMON4a/b only	Yes	Yes
2	Installation of an inline flow device	An inline flow device is suitable for sites where the flow enters the site through a closed pipe and a flume and ultrasonic device is suitable for sites where the flow enters through an open channel. The selection of the solution depends on the unique configuration of the inlet structure on each site.	Yes	Yes
3	Installation of an inline flow device and divert of Storm/ Liquors were required		Yes	Yes
4	Installation of Flume and Ultrasonic		Yes	Yes
5	Installation of Flume and Ultrasonic and divert of Storm/ Liquors were required		Yes	Yes

Continuous river water quality monitoring

For continuous river water quality monitoring we have considered the range options highlighted below as part of our EnvAct_MON1 to MON5 options consideration. We set out where we have identified feasible options to meet the required need.

Table 48 Continuous river water quality monitoring (CRWQM) solutions

No.	Description	Image	Rough order of magnitude unit cost estimate	Unconstrained	Feasible
1	Data buoy style solution (optical and no ammonia measured) - Option 1	 	£50k	Yes	
2	Temporary solution (optical) - Option 2		£100k	Yes	

No.	Description	Image	Rough order of magnitude unit cost estimate	Unconstrained	Feasible
3	Semi-permanent solution - Option 3		£150k	Yes	
4	Permanent solution - Option 4	 	£250k	Yes	Yes

No.	Description	Image	Rough order of magnitude unit cost estimate	Unconstrained	Feasible
5	Robust style solution - option 5		£350k	Yes	

Emergency overflows (EOs)

For monitoring at emergency overflows we have considered the following unconstrained options:

For emergency overflows without storm overflows present we have considered a single solution of a new monitor including access to that monitor. We also considered the option of revoking the EO permit and blocking off the overflow, but discounted this option when we constrained options due to the consequential risk to customer flooding if the overflow did not exist.

Table 49 Emergency Overflow options

No.	Option	Description	Unconstrained	Feasible
1	New monitor		Yes	Yes
2	Revoke EO permit and block off overflow		Yes	

6.2.2 Cost-benefit appraisal

The unconstrained options were assessed against the following criteria:

- ***Required outcome:*** *does the option meet statutory obligations/ non-statutory requirements?*
- ***Technical feasibility:*** *is the option technically feasible given site, operational (e.g. energy requirement, waste management etc.) or non-option specific circumstances?*
- ***WINEP wider environmental outcomes:*** *does this option contribute to the wider WINEP environmental outcomes?*
- ***Customer support:****will the option likely be supported by customers?*
- ***Risk and uncertainty:*** *does this option provide resilience against future uncertainties?*
- ***Environmental risks:*** *does this option provide resilience against future uncertainties?*

Following this assessment all of the U_MON3, UMON4, investments were shortlisted for the constrained options stage.

Each of the constrained options were then assessed against the following criteria:

Table 50

Feasibility & risk	Feasibility & risk	Performance	Engineering	Cost & benefit	Environmental
Statutory acceptability - does the option meet statutory obligations/ non-statutory requirements?	Planning and regulation - are there site specific issues that would need to be addressed with the option e.g., planning permission?	Outcomes - does the option deliver the required outcome?	Engineering complexity	Cost - what is the whole life cost of the option over 30 years	Environmental Assessment
Dependencies - does the option rely on or create an opportunity for co-design and implementation?	Customer acceptability	Adaptability - does the option provide a mechanism to change path should a risk materialize?		Benefits - what is the whole life benefit of the option over 30 years	
Implementation schedule - does the option require a significant amount of work and time to deliver?	Operational risk - has the residual risk (after implementation of option) been considered as a result of future likelihood of failure?	Resilience - does the option increase resilience in the system above and beyond meeting desired outcomes?		Cost-Benefit Ratio - what is the whole life benefit-cost ratio of the option over 30 years	
Third party benefits					

UMON_3 and U_MON4

Based on these criteria, most of the UMON_3, UMON_4, options were carried forward as feasible options. The preferred scope for UMON_3 was then used to support the creation of the UMON_6 scope

Table 51 U_MON 3 options

No.	Option	Feasible option (Y/N)	Justification
1	MCERT'd Class 1 non contact instrument to +/- 2mm accuracy, with data logging.	Y	Meets required need
2	MCERT'd Class 1 non contact instrument to +/- 2mm accuracy and MCERT'd volumetric discharge from storm tanks	N	the upgrade of an existing back end monitor to a volumetric monitor is not required as part of the WINEP driver and would be a maintenance activity.
3	MCERT'd ST overflow via a Radar monitor	Y	Meets required need
No.	**Option**	**Feasible option (Y/N)**	**Justification**
1	Telemetry change on inlet FFT flow meter to measure 2 min flow data	Y	Meets required need Suitable for UMON4a/b only
2	Installation of an inline flow device	Y	Meets required need The selection of the solution depends on the unique configuration of the inlet structure on each site.
3	Installation of an inline flow device and divert of Storm/ Liquors were required	Y	Meets required need
4	Installation of Flume and Ultrasonic	Y	Meets required need
5	Installation of Flume and Ultrasonic and divert of Storm/ Liquors were required	Y	Meets required need

This cost-benefit appraisal process has given us options to choose from at a site level depending on the needs and/ or location factors at that site.

For EDMs we have selected to use a radar monitor for all installations. Volumetric measurement is above the required standard specified by the EA so we have not included this option at any sites.

For flow monitoring the type of monitor and the requirement to divert storm or return liquor flows has been assessed on a site by site basis. The solution has been selected based on the unique layout of the site.

Continuous river water quality monitoring

For CRWQM we did exclude some options as set out in the table below.

Table 53 CRWQM feasible options assessment

	Option	Feasible solution	Justification
1	Data buoy style solution (optical and no ammonia measured)	N	Significant risk of buoy style solution dis-attaching from shore and being lost downstream. Security risk, non-compliant with EA guidance as unable to monitor all parameters, unreliable power supply relying on small solar panel for 15min observations 24/7/365. Serious concerns over safety for staff accessing the monitors.
2	Temporary solution (optical)	N	Secuity risk. Assets will be by river bank and therefore not on Anglian Water owned land. Risk of theft of non permanent assets. A permanent electricity will be required due to the frequency of monitoring 24/7 all through winter months including periods of snow. Also creates safety risk for staff
3	Semi-permanent solution	N	Secuity risk. Assets will be by river bank and therefore not on Anglian Water owned land. Risk of theft of non permanent assets. A permanent electricity will be required due to the frequency of monitoring.
4	Permanent solution	Y	Taken forward as least risk option without being overengineered. It also can be adapted to meet future requirements of the assurance and accreditation scheme and additional monitoring parameters and thereby presents the least-regret option. It is also the Defra preferred solution
5	Robust style solution	N	Whilst this may be required for specific high risk sites, these locations are currently unknown. Including this solution as the preferred one would risk over engineering the solution for lower risk sites as it includes land purchase, fencing and other permanent arrangements.

Emergency overflows

For emergency overflows without storm overflows present, the scope is based on the preferred solution for UMON_3 but includes the addition of access installation as no existing monitor exists (where in UMON_3 a non Mcerts standard monitor exists).

For emergency overflows where storm overflows are also present, the scope includes additional monitoring to allow pass forward flow to be calculated to determine whether the operation is as a result of a storm or an emergency.

It is recognised that some emergency overflows may require additional telemetry and access installations, for example if the overflow is a significant distance from the pumping stations. However, due to the volume of investments individual site surveys have not been carried out so as a result no allowance has been made for this circumstance.

Table 54 Emergency overflows feasibility assessment

	Option	Feasible solution	Justification
1	New monitor	Y	Only feasible solution
2	Revoke EO permit and block off overflow	N	We also considered the option of revoking the EO permit and blocking off the overflow, but discounted this option when we constrained options due to the consequential risk to customer flooding if the overflow did not exist.

6.2.3 Environmental and social value

As all monitors are relatively uniform in wider environmental and social impact, whilst carbon and other impacts have informed the overall impact of our plan, these have not been factors that have distinguished one monitoring option from another.

6.2.4 Investment benefits

The identified need for these investments is ultimately meeting the WINEP monitoring obligations. All of the investments that we are proposing in our plan meet this identified need. Network monitoring will create a benefit for the internal and external sewer flooding performance commitments through helping us to identify where there are potential pollutions earlier.

We assume for total pollution incidents that monitoring of the network and emergency overflows will reduce the risk of pollution incidents by 25% where monitors are present. These investments may also identify previously uncaptured pollutions incidents (for example where we have previously assessed an incident to have causes 'no impact' to the environment, continuous water quality monitoring provides increased opportunity to identify an impact). Whilst this would increase total pollution incidents reported under the performance commitment, the overall benefit on the environment would be of reduced impact. We have calculated a benefit in pollution numbers of 0.005 fewer incidents per year from 2027 as a result of UMON_3 and UMON_4 monitoring. As the obligations for CRWQM and UMON6 are for March 2030, no impact has been assumed for the AMP8 period.

For the relevant performance commitments, the PCLs have been set to reflect the benefit from enhancement expenditure. The quantified benefits of investment into monitoring against the performance commitments can be found in table CWW15.

6.2.5 Managing uncertainty

The largest component of our monitoring investments is CRWQM and this is also the investment area which comes with the most uncertainty, both in terms of costs and benefit delivery.

CRWQM presents significant cost uncertainty as a result of the significant increase in the size of the CRWQM programme -for all companies- compared to previous AMPs when there was no obligation for their installation. Because of this, there are both a limited number of suppliers and there will be high demand for these monitors in AMP8, exposing companies to increased cost uncertainty and exposure to delivery risks of these monitors, particularly as companies compete for the limited pool of materials and people required to install these monitors. There will also be a significant ongoing operating cost for the energy required to continuously run these monitors (we estimate 4.6mill kWh/yr).

We have sought to manage these uncertainties principally through engagement with government to phase the need for these monitors to be installed in AMP8. Without this we estimate that the energy requirement would have been 11.9m kWh/yr.

There is also regulatory uncertainty associated with CRWQM, particularly in relation to what scope of investment will be required within AMP8 and beyond. For example, any further changes to the number of monitors to be installed will change the level of investment required. Customers are protected from this through our WINEP Price Control Deliverable which will return funding to customers should the number of WINEP obligations be reduced. There is also regulatory uncertainty in the requirements on what additional parameters may need to be monitored in future AMPs, the technical guidance states that two additional parameters must be able to be added, but doesn't specify which. We have mitigated this risk by having systems which are designed to be modular allowing us to add to, rather than replace assets.

The siting of the monitors is a significant driver of cost. The technical guidance provided includes detailed site specific guidance for the siting of downstream monitors, taking into account flow characteristics of the receiving waterbody to define when mixing has occurred, as well as guidance on bundling of neighbouring discharge points. This is a complex issue that will require detailed investigation of all locations. Depending on the outcome the costs of the installation will vary significantly, especially for factors such as safe access to the watercourse bank, access to nearby power supply connection to a transformer (power supply provided by external District Network Operator DNO), and land availability both wayleaves for the power supply routes and for permanent siting of the kiosk. Power supply costs are a large component of the cost build up, so we have made assumptions about the distance to the nearest transformer on average per site.

Operational costs for continuous river water quality monitors are highly uncertain. These costs include not only the power to run the pumps that abstract water for sampling, but also the communications system to transfer data, and air scour system to prevent fouling in the abstraction pipes (which in the absence of regular air scour will fill with weeds, silt etc), but also replacement sensor heads based on a frequency experienced by the Environment Agency at their own river water monitoring stations, the costs of data collation and transfer via mobile networks, management and reporting via open data platforms, labour costs of calibrating monitors, transport costs for vehicles for the maintenance staff, and importantly the costs of investigations. The technical guidance is vague about the extent of responsibility on the water company for investigations into spikes in data captured, which may or may not be attributable to water company activities (may be due to other discharges between the upstream and downstream monitors).

For EDMs and flow monitors we have more experience of delivery and so have a higher degree of cost and benefit certainty.

6.2.6 External funding

The EDM and flow monitoring investments are all focussed on monitoring at our assets and so we have considered that securing third-party funding is unfeasible for these investments. For CRWQM, whilst these monitors will be installed within water bodies (which are not owned by Anglian) and so provide broader benefits to organisations beyond Anglian - as these are a statutory investments, there is no incentive for third-parties to support the funding of these assets (as we are required to deliver these investments anyway, with or without third party funding) unless we were to go beyond the statutory minimum number of monitors, which we are not proposing to do as part of this plan.

Whilst direct third-party funding for monitors is not proposed as part of this plan, we will work closely with relevant third-parties as part of the working with others cross-cutting theme we are delivering. This will include working with stakeholders across catchments, using the data from our monitors to inform actions which limit the impact of stakeholders' activities on watercourses.

6.2.7 Direct procurement

We considered each of our investments for their suitability for delivery through DPC. In particular we recognised the potential for the delivery of CRWQMs through DPC to support the affordability and deliverability of our plan. However, we have noted the technical discreteness guidance issued by Ofwat and in particular the guidance individual asset values. This stated:

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"where a company is proposing to bundle a large number of the same (or similar) type of assets for a DPC project, we would expect the cost of each discrete asset to be at least £5m-£10m"

As none of our monitors reach the minimum £5m asset costs, we have considered that following this guidance, none of our monitoring schemes (including bundled schemes) are suitable for delivery through DPC.

6.2.8 Customer view

As the monitoring investments that we propose to make are designed to meet obligations in the WINEP and there are no different alternatives for customers to inform the selection of, we have not undertaken specific customer engagement on options selection in this area.

6.3 Cost efficiency

6.3.1 Developing costs

The development of the monitoring costs in our plan follows our cost efficiency 'double lock' approach set out in chapter 7 Driving cost efficiency ofour business plan. Through this approach we have ensured that are costs are efficient in their bottom-up build up, and this is cross-checked through external benchmark approaches. This section sets out how we have ensured cost efficiency of our monitoring investments through step one of our double lock approach. Step 2 is explored in section 7.1 of chapter 7 of our business plan.

We have taken a robust approach to developing our monitoring costs, building on our experience from delivering similar schemes into the bottom-up development of costs (before external cost benchmarking challenges are applied in step 2 of our 'double-lock' approach). The detail of the cost development approach is set out below, along with a breakdown of costs we provide in table CWW3.

Cost estimation methodology

Where the project construction elements are broken down into major work elements such pumps, meters, chamber, interconnecting pipes, etc with high levels design parameters; these are estimated individually by using cost models and the on-site design information and then aggregated it to inform our cost estimation for PR24.

We follow a common cost development methodology across our enhancement investments in a three phase process:

1. Establish cost and carbon models
2. Input the cost drivers into the model (including location specific factors)
3. Data validation, internal challenge and assurance

In Phase 2 , We derived our costs for each scheme by gathering on site data which influence the cost estimates for each site, including:

- current operability
- current flow licences (max, min, peak)
- INOV survey results
- site specific requirements and
- assessment of construction constraints.

17 Technical Discreteness Guidance letter issued to Regulatory Directors, 3 July 2023

The tables below set out the breakdown of costs for event duration monitoring (CWW3.1-CWW3.3), flow monitoring at water recycling centres (CWW3.4-CWW3.6), continuous river water quality monitoring (CWW3.7-CWW3.9) and emergency overflow monitor (CWW3.10-CWW3.12) investments respectively.

Table 55 AMP8 Investment overview

	Type	Scope	Number of sites/locations	Capital Costs (£k) AMP7	Capital Costs (£k) AMP8	OPEX costs (£k) AMP8	Average Unit costs £m/location
Event Duration Monitors	Permit changes only						
	Simple meter installations	Radar monitor, inc data logger and MCERT inspection	409		3,904		10
	More complex civils installations/ works **half of the scope is covered UMON4**	Rigid Pipework, Radar Monitor, Platform, Magflow, Ladder, Inspection Chamber, Gate Valve and Data Logger and MCERT inspection	59	-	1,725	32	29
Flow monitors	Permit changes only	Telemetry reprogramming to change the data 15min to 2min on the from AMP7 UMON4 obligations	283	5,805	107	-	21
	Permit changes only	WINEP Reporting tool for the data visualization and reporting tool (for all UMON3/4/6)				861	
	Simple meter installations						
	More complex civils installations/ works	Inlet Works, Supernatant Pumping Stations, Pipework, Landscaping, Road, Telemetry, Footpath and Data Logger and MCERT inspection	23	7,995	10,195	2,487	791
	More complex civils installations/ works	Supernatant Pumping Station, Cabling Ducting/Tray, Data Logger, Flume, Ultrasonic Open and Pipework and MCERT inspection	45	-	12,526	1,273	278
	More complex civils installations/ works	Cabling Ducting/Tray, Data Logger, Gate Valve, Inspection Chamber, Magflow and Pipework and MCERT inspection	42	-	3,426	31	82
	More complex civils installations/ works	Cabling Ducting/Tray, Data Logger, Rigid Pipework, Ultrasonic Open and MCERT inspection ** incl 59 that half of scope is covered UMON3**	78	-	2,498	36	32
Continuous River Water Quality Monitors	Providing near real-time data	-	-	-	-	-	-
	Simple monitor installations	-	-	-	-	-	-

	Type	Scope	Number of sites/locations	Capital Costs (£k) AMP7	Capital Costs (£k) AMP8	OPEX costs (£k) AMP8	Average Unit costs £m/location
	More complex civils installations/ works	Cabling Ducting, Electricity Meter, Handrail, Hardstanding Area, Kiosk, Telemetry and WR Integrated Continuous Water Quality Monitor (ISE Chem)	484	-	149,619	16,846	309
Emergency overflow monitors	Permit change only						
	MCERTS EDM only	Rising mains pressure monitors with SIM card telemetry connection. As part of UMON4 and UMON6 investigations to determine pass forward flows	1,359		5,048	-	4
	MCERTS EDM only	Ladder, Platform and Radar Monitor and MCERT inspection	911		12,172	-	13
	MCERTS EDM and civils						
	MCERTS EDM and pass forward flow monitor	Rigid Pipework, Radar Monitor, Platform, Magflow, Ladder, Inspection Chamber, Gate Valve and Data Logger and MCERT inspection	499		26,628	295	53
	MCERTS EDM and pass forward flow monitor and civils						
		Total		**13,800**	**227,846**	**21,861**	

6.3.2 Benchmarking

In stage 2 of our cost efficiency 'double-lock' on monitoring , we considered a range of approaches which could be used to benchmark our monitoring costs. For this we considered that the most appropriate methods of cost benchmarking to be:

- Scheme outturn costs
- Market testing of costs

Scheme outturn costs

The cost estimates for our monitoring programme have been developed using our cost models for these assets. These models ensure that the economies of scale achieved through the large scale delivery of these assets in other programmes are embedded in the estimations.

Market testing of costs

The direct construction costs of monitors have also been informed by market testing through vendor quotation.

6.3.3 Assurance

The bottom-up build up of our costs has been assured externally by Jacobs.

6.4 Customer Protection

Monitoring and CRWQM are part of our WINEP Price Control Deliverable covering forecast delivery of WINEP obligations. As our investment is fully linked to the statutory obligations within the WINEP and the PCD is directly driven by WINEP obligations, we are confident that the PCD covers all the benefits that we intend to deliver through the monitoring and CRWQM programmes.

For more detail on the WINEP PCD, please refer to the appendix 'Price Control Deliverables'[18]

18 ANX ANH37

7 Investigations

Overview

- Investigations are statutory. We will invest £24m to carry out investigations to identify the future actions needed, costs and feasibility of meeting required environmental outcomes in rivers in future AMPs

Table 56 Investment Summary

PR24 costs (£m)	
Capex	23.7
Opex	0.0
Totex	23.7
Benchmarking	
Method	Market testing of costs
Costs removed	Market testing of costs have been built into our cost estimations.
Customer Protection	
Price Control Deliverable	WINEP obligations
Ofwat data table	
CWW3.106-CWW3.108 CWW3.109-CWW3.111	Investigations, other (WINEP/NEP) - survey, monitoring or simple modelling Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling

7.1 Delivering for the long term

7.1.1 Investment context

This investment in this area is required to meet statutory WINEP obligations for investigations and monitoring. These are listed under the following driver codes:

- WFD_INV
- HD_INV
- BW_INV/ND_INV
- SW_INV
- MCZ_INV
- EnvAct_INV

This includes investigations into the following:

- Nitrogen Source Apportionment in Lakes - Whilst there is good understanding of the apportionment of phosphorus into river systems and lakes, there are limitations to this from a nitrogen perspective. This investigation will monitor the loading of nitrogen from Anglian Water assets across the region and model the apportioned impact of these assets on lakes and their ability to meet environmental standards. There are currently only few Water Recycling Centres that have nitrogen removal stipulated within the permit, so this investigation will inform potential investment needs for PR29.
- Related to the nitrogen source apportionment investigation, Nitrogen(N)-TAL investigations will be undertaken across five Water Recycling Centres. This action is included with the chemicals investment case.
- Also, originally discussed as part of the Chemicals Investigation Programme, investigations into the fate of nutrients within priority estuaries is planned in AMP8. This will consider the very downstream effects of Anglian Water operations on estuarine conservation objectives and propose any additional enhancement action required to allow environment standards to be met.
- Yare Broads and Marshes Nutrient Investigation - AMP7 investigations and PR24 modelling has demonstrated that environmental standards are currently unachievable in the River Yare catchment due to the limitations of phosphorus removal TAL. Despite this, nutrient neutrality rules dictate that TAL investment is required at all Water Recycling Centres over 2000 population equivalent. This investigation will therefore monitor the positive impact of these investments and better understand the connectivity between the Yare Broads and Marshes SSSI and the river environment. Information attained will inform future potential

land management options and levels of nutrient removal (beyond TAL) to achieve environmental standards.Following amendments to the Levelling Up and Regeneration Bill, as communicated with water companies on 7th September 2023, we will be looking to increase the flexibility around the delivery of nutrient neutrality WINEP obligations through the exploration of catchment permitting, catchment nutrient balancing, and nature-based solutions, post business plan submission on 2nd October. This approach aligns well with the wider aspirations of our A-WINEP proposal, and will be applied to the scope of the Yare, Broads and Marshes investigation when delivered in AMP8. Catchment solutions have been explored a standard across all nutrient investment optioneering in PR24; however there remains a significant opportunity for greater inclusion of these options within preferred options, both through A-WINEP and wider AMP8 delivery. This will require continuing engagement with regulators from business planning through to delivery.

- Shellfish and Bathing Water investigations - AMP8 will see an extension of our shellfish and bathing water investigations into additional priority areas and inland bathing waters. These studies will inform the apportioned impacts of Anglian Water assets to determine if additional capital investment is required in PR29. We will also be investigating the interaction of Anglian Water operations with environmental standards for the Marine Conservation Zone at the Blackwater estuary, which will inform catchment-based action for PR29.
- Storm Overflow Investigations - All storm overflows will be investigated in AMP8 to inform a programme of improvements under the Environment Act. Storm overflows require investigation to determine whether they are adversely impacting the environment, with screening and UPM modelling used to determine the frequency of storm discharge that can occur without causing adverse ecological impact.

This investment excludes investigations listed under driver codes WFD_INV_CHEM, WFD_INV_N-Tal and WFD_INV_MP. Please refer to the investment case for Chemical Removals and Investigations. 4 Chemicals removal and investigations

Investigations and monitoring build a greater understanding of impact of our operations on the environment. Where environmental need has been identified through collaborative working with regulators, investigations and monitoring are used to identify interventions for further iterations of the WINEP.

7.1.2 Scale and timing

The scale and timing of this investment is determined by the requirement to deliver statutory WINEP obligations, with an expectation that all investigation will be concluded by March 2027 in order to inform PR29. There is no option to defer any of this investment to later AMPs.

19 Please refer to Section 2.2.1 in our LTDS for more detail.

Failure to meet these obligation deadlines may result in legal action being taken by the EA.

7.1.3 Interaction with base expenditure

This investment is enhancement expenditure as it relates to investigations and monitoring activities which are part of the WINEP and are used to identify interventions which enhance water quality in the environment. There is no overlap with base expenditure

7.1.4 Long term context (historic)

PR24 investigations build on series of investigations through PR14 and PR19, which have led to improvement action in subsequent AMP cycles. An example of this is the implementation of phosphorus (P)-TAL investigations in AMP6, which informed P limits in PR19, and continues to be used when considering options for meeting the Environment Act nutrient removal targets. Investigations into specific high-risk habitats/catchments (e.g. Pix Brook, Norfolk Broads, Blackwater Estuary) have both enabled programmes of work to meet environmental standards in AMP8, and also informed future strategic areas for whole catchment management approaches. Our delivery in coastal environments is informed by a rich history of investigations into the impacts of Anglian Water assets on bathing and shellfish waters, with linkages to the performance of overflow assets connected to these environments. This history provides continuity in understanding, and ensures that investigatory actions are not repeated, but rather they are developed further to provide a greater understanding of pressures on the environment.

7.1.5 Long term context (future)

Although our AMP8 investigations are statutory, we consider them to be low regret as they will support us in the delivery of our LTDS environmental enhancement ambitions over the long term by providing more information where our efforts need to be targeted. This investment case aligns with the water investment case and the chemicals investment case, to provide a full overview of investigations planned for AMP8. These will provide strategic direction around achieving long-term goals under the Environment Act, including nutrient improvements, overflow reductions, and sustainable abstraction environmental destination, whilst also informing emerging challenges that will require adaptive investment in future AMPs. [19]

7.1.6 Customer support

This investment is driven entirely by the statutory WINEP programme. We have not included non-statutory investments that would require customer support.

7.1.7 Cost control

The investigations and monitoring activities included within this investment case are specified by the Environment Agency (EA) and are statutory WINEP obligations, therefore are out of management control.

Although investigations are statutory, we have taken all possible steps to deliver this in the most cost effective way possible. Investigation costs have been provided through a combination of consultancy quotes and internal cost build-up, based on similar cost models and scopes of work. Outline scopes of work has been discussed and agreed with environmental regulators throughout PR24 development, in an attempt to manage expectations and improve cost accuracy.

7.2 Unlocking greater value for customers, communities and the environment

7.2.1 Option consideration

For investigations and monitoring, the action is prescriptive and there are no alternative options for how activities can be carried out, beyond site selection. In all cases, the investigation need was robustly challenged with environmental regulators, with the complexity of scope being reviewed in comparison to the quality of output provided. Across the investigations within this business case, the approach to monitoring and modelling was based on similar previous experience. For example, the Yare, Broads and Marshes SSSI investigation was based on a very similar project undertaken by consultants elsewhere in the country, and nitrogen source apportionment follows the modelling approach taken for phosphorus. This ensures consistency across approaches.

Throughout PR24, there were active discussions with regulators on the use of modelling alone, compared with the use of monitoring and tracer studies. The quality of previous investigations was an important consideration in picking a preferred option. Equally, a balance was struck with affordability and deliverability of the investigations tabled, with approaches to overflow investigations including a screening step in order to focus efforts on environmental priority areas.

7.2.2 Cost-benefit appraisal

As specified in the WINEP methodology, a cost benefit analysis is not required for investigations or monitoring actions. All investigations included in this enhancement are statutory and since there is no scope for different options for implementation there is no practical role for a cost-benefit appraisal.

7.2.3 Environmental and social value

As highlighted above, where there is an investigations obligation, there are no alternative delivery routes. The investigation itself may lead to future investments where we have a choice of options which will deliver different social and environmental benefits, but the investigations in themselves do not have alternatives which can have a greater/ lesser impact on wider value.

7.2.4 Investment benefits

The main impact of this investment is the deliverability of investigations as set out in the WINEP. The numbers of each can be found in table 1 below. The direct benefit of this to customers and the environment is expected to be seen in future AMPs where investigations lead to the identification of the need for environmental improvements. This investment does not have an impact on performance commitments.

Table 57 Number of investigations to carried out against each WINEP driver

Driver	Number of schemes
BW_INV/ BW_NDINV	15
MCZ_INV	1
SW_INV	14
WFD_INV	1
EnvAct_INVs (1-4)	1,531

7.2.5 Managing uncertainty

Our central laboratory is currently undergoing a review to understand and respond to the demands being placed upon them in AMP8. This review will cover some of the needs of the investigations in this portfolio.

The main delivery risk is in the storm overflow investigations, as the model scopes and specifications are variable. This will manifest in time to run models, and staff time requirements to do so.

7.2.6 External funding

Third-party funding is not feasible for this investment given the obligation falls upon the company to deliver.

7.2.7 Direct procurement

We have considered Ofwat's guidance on the consideration of enhancement investments for DPC. On several criteria, this investment falls short of the requirements for schemes to be delivered through DPC, including the £5m threshold for the cost of individual assets to be bundled. This investment also falls short of the £200m DPC by default threshold. We have therefore assumed that that this investment will not be delivered through DPC.

7.2.8 Customer view

As there are no alternative options for the delivery of investigations, we have not sought to build customer views on the selection of the proposed solution into our decision making on this investment area.

7.3 Cost efficiency

7.3.1 Developing costs

The development of the investigations costs in our plan follows our cost efficiency 'double lock' approach set out in chapter 7 Driving cost efficiency of our business plan. Through this approach we have ensured that are costs are efficient in their bottom-up build up, and this is cross-checked through external benchmark approaches. This section sets out how we have ensured cost efficiency of our investigations investments through step one of our double lock approach. Step 2 is explored in section 7.1 of chapter 7 of our plan.

We have taken a robust approach to developing our investigations costs, building on our experience from delivering similar schemes into the bottom-up development of costs (before external cost benchmarking challenges are applied in step 2 of our 'double-lock' approach). The detail of the cost development approach is set out below, along with a breakdown of costs we provide in table CWW3.

The cost developed for investigations are based on the framework based on the number of hours estimated and activities to carried on the data gathering , analysis and recommendation, incorporating:

- list of lakes of interest agreed with regulators
- area of influence / list of AW assets identified from existing WQ model
- quote and scope provided from specialist contractors to undertake investigation

The table below sets out the breakdown of costs provided in data table lines CWW3.106-CWW3.111.

Table 58

Investment ID	Project Name	Scope	Capital Cost (£k)AMP8	OPEX Cost (£k) AMP8
I034757	Regional Lakes Nitrogen Investigation	A modelling investigation (+ monitoring) is required to understand the proportional impact of Anglian Water Water Recycling Centres on lake nutrient loading and their associated status.	285	-
I041223	Yare Broads and Marshes Phosphorous Investigation	Scope of work to include: -Review flood durations and Levels of impacted sites. -Review Hydrological connectivity from existing information -Develop Conceptual Hydrological and nutrient transport model -Review Water quality data and nutrient source apportionment -Gap analysis and implications of permit setting	75	-
Various	7 sites Shellfish investigation	Thornham Harbour, Norton Creek, Butley River, Walton Backwaters, Osea Island, Dengie Flats , Foulness	7,577	-
Various	4 Sites Coastal Bathing Water Investigation	Great Yarmouth/Caister Point, Clacton , Wells, East Runton	1,185	-
I033592	Blackwater Marine Conservation Investigation	Marine Conservation Investigation	548	-
I034199	Investigate WRN Storm Overflows EnvAct_INV4	These investigations will inform the scope required for the delivery of EnvAct_IMP2Anglian Water has 1090 overflows in the Water Recycling Network (including PSs)	9,702	-
I034202	Investigate WRC Storm Overflows EnvAct_INV4	These investigations will inform the scope required for the delivery of EnvAct_IMP2Anglian Water has 462 overflows at Water Recycling Centres (including STCs)	4,317	-
		Total	**23,689**	-

7.3.2 Benchmarking

In stage 2 of our cost efficiency 'double-lock' on investigations, we have made use of market testing to ensure that the cost in our plan are efficient.

We have ensured that for activities that require specialist contractors, the unit rates used on the quotes are compared to similar works delivered by our framework partners, allowing us to challenge unit cost assumptions. Wherever possible, quotes have been sought from at least three specialists to inform the basis of our cost estimation in this plan.

7.3.3 Assurance

The development of our costs within our cost estimation system (C55) have been assured by Jacobs and our cost estimation process was assured by Arup.

7.4 Customer protection

Customers are protected against any cancellation, delay or reduction in scope via the WINEP price control deliverable that we are including as part of our plan. This protection covers all of the benefits that the investment will deliver because it is directly tied to the number of WINEP obligations that we deliver, and this

investment is fully aligned to the investigations required under the WINEP. Therefore, if any obligations are removed, or remain an obligation but are not delivered, we will return the funding for these investigations back to customers.

8 First time sewerage

Overview

- Private sewerage systems such as septic tanks in rural communities can cause environmental harm. Section 101A of the Water Industry Act places a statutory obligation on Anglian Water to provide a public sewer if evidence shows that the private systems are causing harm and a cost benefit analysis shows that a new public sewer is viable.
    - We will invest £59m to deliver 17 schemes for communities who are not currently connected with access to the sewerage system through the installation of new sewage treatment and sewerage assets. Where duty to serve has been confirmed, the Environment Agency requires schemes to begin within 5 years, which means all 17 schemes must be completed within the period 2025-2030.
- As a top-down benchmark for these costs we ran the PR19 first-time sewerage enhancement cost models updated with data for PR24. To demonstrate that we have listened to Ofwat's cost efficiency challenge from PR19, we have matched our requested costs to the modelled allowance and are therefore confident that that the costs submitted as part of this plan are efficient, and additionally that the costs we have put forward are particularly challenging as our current bottom up cost estimates for the actual delivery of these schemes are around £110m, significantly greater than the costs requested in the plan.

Table 59 Investment Summary

PR24 costs (£m)	
Capex	58.1
Opex	1.1
Totex	59.2
Benchmarking	
Method	Scheme outturn costs. Industry cost models from TR61 Ofwat data and cost models.
Findings	Our costs were initially higher than the benchmark and so we have applied a £49m cost reduction challenge to this area. Our costs are now efficient compared to the benchmark.
Customer Protection	
Price Control Deliverable	First time sewerage schemes
Ofwat data table	
CWW3.159-CWW3.161	First time sewerage

8.1 Delivering for the long term

8.1.1 Investment context

Section 101A of the Water Industry Act (as amended by Schedule 22 to the Environment Act 1995 and Section 94 of the Water Act 2003), places a statutory obligation on Anglian Water to provide a public sewer if three conditions are met:

1. There is an existing domestic sewerage system which is not connected to the public sewer (directly or indirectly)
2. The existing domestic sewerage system is creating problems affecting the environment or amenity
3. Provision of a public sewer is the most appropriate solution.

All first time sewerage applications are assessed in accordance with the official guidance notes issued by the Department of the Environment, Food and Rural Affairs (Defra). The relevant section in Defra's Statement of Obligations is reproduced below:

> "6.4 First time sewerage
>
> 6.4.2 Section 101A does not provide an automatic right of connection for properties not connected to mains drainage. Certain conditions need to be met and mains connection has to be the most satisfactory and best value solution to resolving the difficulties. Ministerial Guidance published by Defra and the Welsh Government provides further guidance on how applications are to be assessed and the criteria that need to be considered. The assessment should consider comparative practicability and cost of alternative solutions.
>
> 6.4.3 The Government expects sewerage undertakers to continue to examine all applications that are submitted to them under section 101A and to give their response within a reasonable time. Where schemes fall within the criteria and are approved, sewerage undertakers are required to give a realistic date for the sewer to be provided. The Government expects schemes to be carried out by that date and the sewerage undertakers to avoid delay.
>
> 6.4.4 Schemes relating to successfully determined applications made under Section 101A of the WIA 1991 and not already funded will be eligible for PR24 funding if engineering work is scheduled for the period (2025 - 2030). Schemes relating to potentially successful applications in relation to Section 101A of the WIA 1991, i.e. applications received but not yet determined, should be identified in order to indicate the likely scale of obligations for PR24."

This enhancement investment is needed to provide new sewerage systems to villages which are currently not connected to our sewerage network and are therefore reliant upon private treatment and disposal solutions such as septic tanks. The driver of this investment is the requirement to provide first time sewerage to unconnected villages in accordance with section 101A of the Water Industry Act 1991.

8.1.2 Scale and timing

The scale and timing of this investment has been driven by the number of applications we have received for new sewerage connections under s101A of the Water Industry Act. On this basis we have included 17 named schemes in our plan, 7 of which have been assessed and accepted as duty to serve areas under s101A. Where duty to serve has been confirmed, the Environment Agency requires schemes to begin within 5 years, which means all 17 schemes must be completed within the period 2025-2030. Ten detailed assessments will be completed by December 2023. These assessments will either confirm a Duty to provide public sewerage or not for these villages.

8.1.3 Interaction with base expenditure

This investment fully represents enhancement expenditure as it:

- increases the size of our sewer network
- increases the number of customers we provide sewerage services to
- delivers environmental improvements.

Whilst maintenance of previously delivered s101A schemes is implicitly included within the base cost models, this enhancement investment only includes additional schemes with new assets and therefore is not reflected in the base cost models.

8.1.4 Long term context (historic)

We have had a programme of first time sewerage connections for many years, with thousands of rural properties added to mains sewerage. Since S101A was added to the Water Industry Act in 1995, we have seen the larger un-served rural populations apply early for first time sewerage, due to the greater potential for environmental and amenity impacts from private treatment. Since 1995 the application rate remained high, averaging 40 per annum until 2002, when it dropped to nine per annum to 2015 and 4 per annum to 2019. Scheme acceptance trend is also downwards, meaning more applications are being rejected as they fail to meet cost benefit tests. This means that over time the cost of serving each property in the remaining communities that are applying is increasing. Our PR19 allowance was made using an assumption that 552 properties would be covered. This led to an Ofwat determined allowance of £19.2m after efficiency challenges. We expect to deliver all of these schemes in AMP7 and there is no overlap of funding with that requested in PR24. In delivery we are forecasting to overspend the PR19 Final Determination significantly, with our delivery teams expecting to complete the work for over £30m.

8.1.5 Long term context (future)

We will continue to monitor and respond to applications in future AMPs. We have projected forward first-time sewerage based upon historic scale of applications. We expect to continue to spend approximately £110m on first time connections during each AMP. This is predicated on the basis that the cost per property is increasing over time as the communities left to apply tend to be those that are harder to reach. Ofwat's PR19 econometric model used a triangulated approach to derive efficient allowances using historic costs dating back to 2011, meaning that many of the properties used to calibrate their allowance were from a period

when the cost per property was lower, purely as a function of the simpler communities to serve applying early. The model also suffered from a lack of data as the first time sewerage programmes were concentrated in two companies (Severn Trent and Anglian Water), making the calculation of an industry wide efficient benchmark difficult.

8.1.6 Customer support

We engage closely with the customers directly affected by first time sewerage investment but, as this investment is statutory, we have not sought customer support for the need, scale and timing of this investment.

8.1.7 Cost control

These investments are driven by customer applications under Section 101A of the Water Industry Act, therefore our ability to manage costs is limited. Under the Act we are required to connect un-serviced catchments of 2 or more properties where it is requested, causing environmental detriment and is cost beneficial to do so. For each investment we consider the cost and benefit of a private cess pool against providing sewerage connection. Once duty has been accepted the costs are further controlled by conducting a cost benefit analysis on a range of alternative options.

8.2 Unlocking greater value for customers, communities and the environment

8.2.1 Option consideration

We consider a range of options in delivering first time sewerage investments. These include :

Table 60 Option assessment appraisal

No.	Option	Description	Unconstrained	Feasible
1	Gravity Sewerage systems	Includes pumping stations and rising mains to keep sewers shallow - to meet CDM drivers and the future safe maintenance of the assets by Operators.	Yes	Yes
2	Vacuum Sewerage systems	Includes a Vacuum pumping station and rising main. The vacuum is designed to keep a shallow profile - which meets CDM drivers and the future safe maintenance of the assets by Operators.	Yes	Yes
3	Utilise the headroom in our local Wastewater Treatment Plants	Where possible	Yes	Yes
4	Provide new Wastewater Treatment Plants	Where no Treatment headroom is available.	Yes	Yes
5	Providing an individual treatment plant	For a property isolated from other Duty properties, we would consider providing an individual treatment plant, as long as this plant can be consented to discharge to a local watercourse.	Yes	Yes

8.2.2 Cost benefit appraisal

Out of the options outlined above, we established that all where feasible options:

Table 61 Feasible option assessment

	Option	Feasible solution	Justification
1	Gravity Sewerage systems	Yes	Feasible option (if existing wastewater treatment plant has headroom)

	Option	Feasible solution	Justification
2	Vacuum Sewerage systems	Yes	Feasible option (if existing wastewater treatment plant has headroom)
3	Utilise the headroom in our local Wastewater Treatment Plants	Yes	Feasible option (if existing wastewater treatment plant has headroom)
4	Provide new Wastewater Treatment Plants	Yes	Feasible option (if existing wastewater treatment plant has headroom)
5	Providing an individual treatment plant	Yes	The feasibility of installing an individual treatment plant is on a case-by-case basis and is only permitted by the Environment Agency if the treatment plant can discharge to a local ditch or watercourse.

We undertook cost-benefit analysis against each of the options identified above. This process was supported by permeability testing, hydraulic modelling and ground surveys, taking into account statutory designations and flood plains. All preferred options were chosen as the best whole life cost alternative over a 40 year life.

8.2.3 Environmental and social value

We accept duty on the majority of s101A schemes due to the existing environmental impact and risk that the inadequate private systems are posing in terms of watercourse, land and air pollution. In order to incentivise new customers to connect to these s101A schemes and minimise the financial burden of connection to the public system, we offer all customers with free public lateral drain connections if they connect within 6 months of being notified of the scheme. This offer is not provided by all water and sewerage providers and goes beyond our statutory s101A duties.

8.2.4 Investment benefits

The key incremental benefit of this investment is the number of villages with new mains sewerage systems. We expect his investment to connect an additional 17 villages to the sewer network, and this has been reflected in the Price Control Deliverable associated with this investment. We do not expect the investment to have an impact on our performance commitments, however the main benefit of the scheme it to improve ecological status of the watercourse by removing potential Reasons for Not Achieving Good Status (RNAGs).

8.2.5 Managing uncertainty

The enhancement investments we have included in our plan are based on the current view of villages that will be connected in AMP8. This is based on the number of applications received from villages to be connected and our cost-benefit assessment of these applications. In some instances, we have rejected applications due to there being insufficient benefit to justify the costs of the investments. However, villages have the right to appeal if they disagree with our decisions. If appeals are successful, this could increase the scope and costs of investments included in our plan, and (by nature of our rejection of these applications) we expect these investments to have relatively higher costs compared to their benefit. Should this risk materialise, we will have a degree of protection through cost sharing, but ultimately this will be an additional unfunded pressure on the plan.

The Environment Agency are currently considering an appeal for an assessment completed for Thurne Bungalow at Repps with Bastwick. If the Agency finds in favour of the appellant, then a project estimated at c£70million could be added to this s101A PR24 Portfolio. During the assessment, no pollution could be found in the area and Anglian Water decided that the cost benefit to our wider customer base for an initial £70million was not appropriate for c127 properties. We do not currently include this or an uncertainty mechanism in our plan and so are exposed to the risk of this being a required investment in AMP8 if successful at appeal. We would propose that the investment be included for PR29.

8.2.6 External funding

This investment is driven by a statutory driver placed on water companies. We do not expect any third-party funding to be secured for the scope of the investment that is delivered by our own teams. However, with each new community connected, our costs do not cover the pipe route from the roadside to the septic tank - this is paid for by customers and can cost several thousand pounds per house. In this way the total scheme is jointly delivered by ourselves and the community.

8.2.7 Direct procurement

We have considered the suitability of this investment for delivery through DPC in accordance with Ofwat's guidance.

The investment does not pass the size test. Each of the schemes averages around £3m of investment per village connected, which falls below the threshold of £5m for an individual asset to be bundled up into a larger scheme which could be considered for DPC.

Further, given that this investment is heavily integrated into the existing network (albeit an expansion of that network) we consider that there is not reasonable scope for a third party to own and operate the new assets.

Therefore we have not proposed that this investment should be delivered through DPC.

8.2.8 Customer view

We engage extensively with both customers and land owners to find the appropriate first time sewerage solution to be delivered on a site-by-site basis, this takes into account:

- land availability for the construction of pumping stations within the locality.
- land availability for the construction of wastewater treatment plants within the locality.
- the position of vacuum sewerage chambers in the boundary of residential properties - for the safe future maintenance of the chamber and internal vacuum valve.

These views form an important part of the options appraisal process we undertake at each site and help to ensure we implement a solution which takes into account engineering expertise and customer and stakeholder views.

8.3 Cost efficiency

8.3.1 Developing costs

The development of the first time sewerage costs in our plan follows our cost efficiency 'double lock' approach set out in chapter 7 Driving cost efficiency of our business plan. Through this approach we have ensured that are costs are efficient in their bottom-up build up, and this is cross-checked through external benchmark approaches. This section sets out how we have ensured cost efficiency of our first time sewerage investments through step one of our double lock approach. Step 2 is explored in section 7.1 of chapter 7 of our business plan.

We have taken a robust approach to developing our first time sewerage costs, building on our experience from delivering similar schemes into the bottom-up development of costs (before external cost benchmarking challenges are applied in step 2 of our 'double-lock' approach). The detail of the cost development approach is set out below, along with a breakdown of costs we provide in table CWW3.

Cost estimation methodology

Where project construction elements can be broken down into major work elements such pumps, and pipes, with high level design parameters, these costs are estimated individually by using cost models and the on-site design information and then aggregated it to inform our cost estimation for PR24.

We follow a common cost development methodology across our enhancement investments in a three phase process:

1. Establish cost and carbon models
2. Input the cost drivers into the model (including location specific factors)
3. Data validation, internal challenge and assurance.

We derived our costs for each scheme in this area through gathering relevant information of current infrastructure capabilities and area constraints by assessing :

- housing concentration - if the assessment area is a compact area of housing there will be a relatively low proportion of infrastructure required to serve them. And vice versa, small pockets of housing in an assessment area or ribbon developments will require a higher proportion of infrastructure to serve the properties.
- topography of the ground - if there is a suitable gradient from one end of a village to the other then a gravity system with a single pumping station could be the solution, however undulating ground will result in pumping stations to be situated at each low point within the catchment.
- proximity of the assessment area to an existing network with a WRC which has capacity to treat the additional flows
- ground conditions, assessment of soils type and high water table

The table below sets out the breakdown of first time sewerage costs as set out in cost data lines CWW3.159-CWW1.161. It should be note that following step one of our cost efficiency double-lock we undertook additional cost benchmarking of these costs in step 2 (this is set out in further detail in the 'Benchmarking' section below) which removed a further £49 million from the first time sewerage enhancement investment.

Table 62 AMP8 Section 101a First time sewerage investment overview

Investment ID	Investment Name	Scope	Total Length of Pipework	Properties connected	Pumping Stations		Capital Cost (£k) AMP8	OPEX cost (£k) AMP8	Cost per property connected (£k)
			km		Quantity	Total kW			
I023739	Gedney Hill S101a	* Pumping Stations *vacuum sewer, *Rising Main Pipes depth band 2.5-8 m	11.95	260	3	45	19,333	55	74
I024643	Barton Turf S101a		12.1	80	1	37	8,733	89	109
I024658	Runham S101a		5.75	69	1	29	6,255	54	91
I033827	Bessingham S101A		5.859	34	1	46	5,105	30	150
I034041	Aisby S101a		5.7	41	1	46	6,201	16	151
I034924	Crafton S101a		3.582	32	1	39	4,374	56	137
I038847	Hanworth S101A		5.45	44	1	39	5,301	89	120
I038794	Antingham S101A		8.6	87	2	63.5	8,970	-	103
I038762	Sutton St James, Jarvis Gate S101a	*vacuum sewer Pipes depth band 2.5-3m	0.9	17		0	1,100	3	65
I038842	Happisburgh S101A		2.26	20	1	17	3,448	79	172
I038837	Wendens Ambo s101a	*Pumping Stations *vacuum sewer, *Rising Main *Gravity Sewer Pipes depth band 2.5-10 m	8.35	119	3	69	10,227	-	86
I038854	Little Oakley S101A	*Gravity Sewer *Pumping Station	2.125	27	2	33	4,659	29	173
I038896	Bungay Staithe Rd S101A		0.155	11	1	13	1,051	13	96
I013497	Ludham S101a		0.26	12	1	15	882	5	73

Investment ID	Investment Name	Scope	Total Length of Pipework	Properties connected	Pumping Stations		Capital Cost (£k) AMP8	OPEX cost (£k) AMP8	Cost per property connected (£k)
			km		Quantity	Total kW			
I023612	Walpole Cross Keys S101a	Pipes depth band 2.5-4 m	9.1	163	2	30	10,015	105	61
I024765	Lincoln Road Lincoln S101a		0.395	20	1	15	1,716	12	86
I023609	Garvestone S101a	*Pumping Station *Gravity Sewer, *Rising Main Pipes depth band 2.5-6 m	6.98	108	4	60	9,722	43	90
I034928	S101a AMP8 Duty Appraisals						-	441	
Subtotal PR24 Investments				**1144**			**107,091**	**1,120**	
		AW adjustment to meet efficiency challenge					- 49,000		
						Total	**58,091**	**1,120**	

8.3.2 Benchmarking

In stage 2 of our cost efficiency 'double-lock' on first time sewerage, we utilised a range of benchmarking methods to ensure the costs in our plan are efficient. We used:

- Scheme outturn costs
- Industry cost models from TR61
- Ofwat's data and cost models

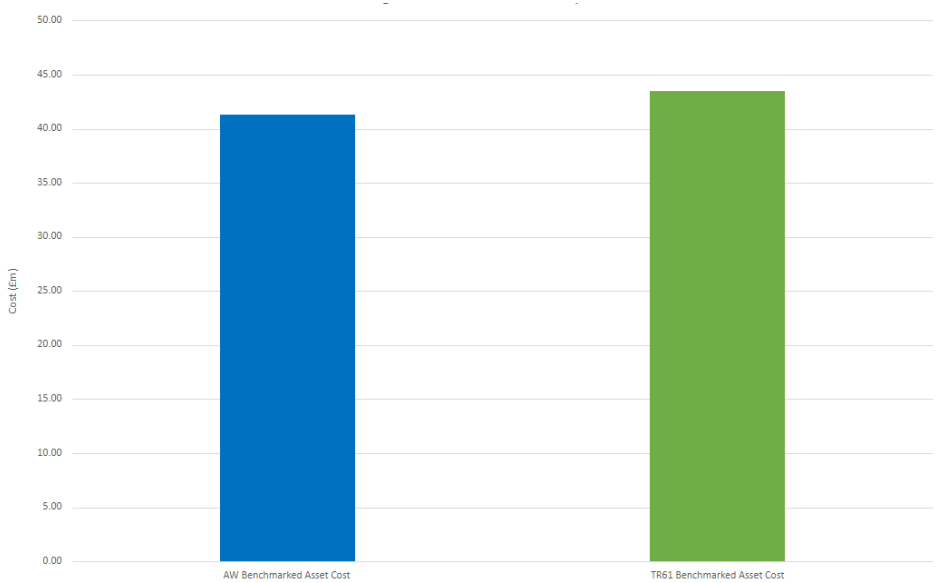
Scheme outturn costs

We have continuously captured outturn costs data of all projects delivered in our capital investments. These outturn costs have been the inputs to the cost models to each specific asset. Building outturn costs into our cost assumptions has been done in a way which ensures that any economies of scale achieved through the delivery of these assets in other programmes are embedded in the estimations.

TR61 Industry cost model comparison

We have compared our direct asset costs built bottom up from our delivery teams with the available benchmarks for the same scope from the TR61 database, showing that using a bottom-up engineering approach our costs are in line with industry averages (note this cost comparison was made before the £49m cost reduction was applied).

Figure 19 First time sewerage - direct cost of asset only benchmarked



Ofwat data and cost models

We utilised Ofwat's PR19 first time sewerage model with updated cost data. Both the historic and future looking models were recomputed using data up to and including 2023. The number of AMP8 first time sewage schemes and connections included in our business plan were then used to generate the benchmark costs.

Having completed this benchmarking exercise, we identified that our costs exceeded those of the benchmark set by running this model. We considered whether there were exogenous factors that could explain the difference between our costs and the benchmark for reasons other than cost efficiency, but found such factors could not reasonably explain the full cost gap. We have therefore aligned our costs with the econometric external benchmark to ensure the costs included in our plan are efficient. This is reflected as £49m reduction in the requested allowance for overall first time sewerage allowance.

The costs we have put forward as a result of this are particularly challenging as our current cost estimates for the actual delivery of these schemes are significantly greater than the costs included in the plan. This means that we have given ourselves a significant challenge in identifying how to deliver these schemes at a lower cost than has been seen in our historic outturns. Whilst this increases our exposure to the risk of overspending on these schemes against our allowance, we have considered it important to recognise that our external cost benchmarking has suggested that S101a schemes could be delivered at a lower unit cost and challenge ourselves to match this.

It should be noted that our cost benchmarking is based primarily on the econometric modelling approach taken at PR19, and we have yet to see companies forecast costs for PR24 which will influence and could change the modelling outputs. As such, should the PR24 first time sewerage cost model lead to a different efficient cost to that we have reached, there would need to be a change to our cost estimate as a result. We request that Ofwat use the bottom up costs provided above to build the PR24 econometric model as it will then be more representative of the types of schemes that are now being accepted under the legislation, which as explained above tend to increasingly be smaller rural communities that are more costly to serve per property.

Based on the cost benchmarking exercises we have carried out, we are confident that that the costs submitted as part of this plan are efficient.

8.3.3 Assurance

The cost estimates we have submitted for this enhancement investment have been set using the external benchmarking approach. This external benchmarking was carried out and assured by Oxera.

8.4 Customer protection

Section 101A of the Water Industry Act places a statutory obligation on us to provide a public sewer if evidence shows that the private systems are causing harm and a cost benefit analysis shows that a new public sewer is viable. If a duty to serve is confirmed, the EA can take enforcement action against companies who do not complete the required schemes within five years.

If these investments are delayed or reduced in scope to accommodate other schemes that have had an appeal upheld, customers will be protected by the First Time Sewerage schemes Price Control Deliverable. This is based on the number

of villages that have received new mains sewerage systems, and that these have been confirmed has complete by the Environment Agency. This PCD therefore allows for schemes to be replaced if appeals are successful and covers all of the benefits proposed to be delivered and funded through this enhancement investment.

For more detail on the First Time Sewerage PCD, please refer to the appendix 'Price Control Deliverables'[20]

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