Our Long-Term Delivery Strategy 2025–2050

Delivering our vision of
a thriving Yorkshire

YorkshireWater

Foreword

I am pleased to present our Long-Term Delivery Strategy for the 2025 to 2050 period. This strategy sets out our vision and ambition for the next 25 years, the outcomes we aim to achieve, and the actions and investments we intend to undertake to deliver them.

As a business, we face a series of long-term strategic challenges including climate change, affordability pressures, and rising customer expectations around service delivery and environmental protection. Responding to these challenges requires us to take a long-term view to ensure we make decisions that maximise the value we create for customers, society, and the wider environment.

Our Long-Term Delivery Strategy brings together strategic planning framework requirements, statutory obligations, existing commitments, and the priorities of our customers to outline the investment activities that are required over the next 25 years to meet our ambitions.

In developing our strategy, we have taken an adaptive approach to planning for the future. Adaptive planning means we have identified both the activities that are needed now and the investments that may be needed in future. This approach accounts for future uncertainties, helps us to make the right investment decisions to deliver our strategy efficiently, and promotes fairness between what customers pay now and what is paid for in the future.

Our strategy represents a step change in our approach to delivering more for our customers than ever before. Over the next 25 years, we will make an unprecedented level of investment across our region, leading to significant improvements in performance and long-term resilience. From delivering first-class customer service to creating healthy rivers teeming with biodiversity, our strategy will make sure we get things right for our customers and the environment – and help to create a thriving Yorkshire we can all be proud of.

Nicola Shaw

Nicola Shaw CBE
CEO

Long-term

This strategy sets out our vision and ambition for the next 25 years

Guide to this document

This document is structured as follows:

Vision

Outlines what we aim to achieve over the next 25 years.

Ambition

Defines how our vision will be delivered in terms of long-term performance outcomes for customers and the environment.

Strategy

Set out how we'll achieve our vision and ambition using adaptive planning techniques.

Rationale

Explains why our long-term delivery strategy represents the best possible approach to deliver our vision and ambition.

Foundation

Provides the key assumptions and uncertainties behind our long-term delivery strategy.

Board assurance statement

Explains how our Board has challenged and satisfied itself that our long-term delivery strategy is compliant with Ofwat's requirements.

About Yorkshire Water

Yorkshire Water provides some of life's most essential services to the people and businesses of Yorkshire, playing a key role in the region's health, wellbeing, and prosperity. We do this by supplying water and wastewater services to over 5 million people and 140,000 business properties, as well as being custodians of essential infrastructure and the natural environment.

We serve a diverse array of customers and communities with different needs, expectations, and circumstances across the region. We aim to tailor our services to align with customer priorities and ensure we meet their requirements, both now and in the future. For further details of our customer, communities and stakeholders across Yorkshire, see chapter 6 of our main business plan for 2025-2030.

1.3 billion
Litres of water we collect, treat and supply every day

1 billion
Litres of wastewater we collect, treat, and safely return to the environment every day

3,600 jobs
We provide for colleagues across Yorkshire

£1.5m
Amount we invest every day to maintain and enhance Yorkshire's pipes, pumps and networks

£950m
Amount we contribute to the wider economy, on goods and services from 1,200 suppliers each year

£1 billion
Amount of water bills we manage every year

Contents

Contents

1.0 Vision

Our vision is to create
‘A thriving Yorkshire: right for our customers, and right for the environment.’

‘A thriving Yorkshire’ means a region famous for its stunning beauty and natural environment, where communities can grow and prosper in a flourishing economy. It is where local institutions like Yorkshire Water invest in infrastructure, create jobs, and support skills development and education, and work in joined-up leadership with other organisations – such as councils, universities, and other utilities – across the region.

‘Right for our customers’ means that we will provide safe, clean, great tasting water and return wastewater safely to the environment. In providing these services we will make sure we deliver good value for money, which will mean bills that everyone can afford, both now and in the future. We also know that our customers have a diverse range of needs, so we will provide first-class customer service and make sure that we are easy to interact with.

‘Right for the environment’ means taking care of our precious natural resources and carefully managing our impact on the amazing natural environment of Yorkshire. We know that our priority is to keep wastewater in the pipes and prevent harm to the environment. We must also protect our water resources, reduce our carbon emissions to net zero, and invest in modern and sustainable infrastructure.

Our vision will be realised by achieving the following outcomes:

Figure 1: Our six customer outcomes

2.0 Ambition

2.1. Developing our ambition

Our ambition for 2050 defines how our vision will be delivered in terms of long-term performance outcomes for customers and the environment. In developing our ambition, we considered areas where we already have statutory or legal requirements, existing commitments that we have made in the past, and the long-term needs and expectations of our customers. We also considered our historic performance and projected future operational performance when setting our ambition, as well as opportunities we have to create further environmental and social value through our work in line with Ofwat's Public Value Principles.

In the course of developing our ambition, we undertook extensive engagement with customers and other stakeholders to understand their priorities, concerns, and feedback on our plans. This includes customer research undertaken to create our latest Water Resources Management Plan and Drainage and Wastewater Management Plan, along with an extensive study on understanding the priorities of our customers, business and future customers of Yorkshire through our ongoing customer insights work. We also considered external research carried out by Ofwat and the Consumer Council for Water, amongst others.

Taking a 25-year planning perspective helps us ensure we make effective decisions that provide long-term value for society and the environment. However, there is substantial uncertainty over such a long period due to, for example, future changes in climate, technology development, abstraction constraints and demand for water. As such, we recognise that statutory requirements, societal needs and customer expectations may change in future and will seek to review and evolve our ambition in future as required. Further information about our monitoring plan is provided in section 3.7.

2.2. Statutory requirements

As a private business providing an essential public service, we are naturally subject to stringent statutory requirements and an important part of our ambition is to make sure we deliver everything that is required of us by law. Many of our legal obligations are associated with long-term targets, which we have used to form the basis of our Long-Term Delivery Strategy (LTDS).

2.2.1. Water Resources Management Plan (WRMP)

Our WRMP sets out how we intend to maintain a safe and reliable water supply to customers over the long term. Our plan, which aligns with regional and national water resource planning objectives and Government strategies, aims to meet future water supply needs for Yorkshire while protecting the environment by ensuring we do not take more water than necessary. Our long-term water resources ambition aligns with the following targets set under the Government's 25 Year Environment Plan:

- provide a drought resilience level of service of 1 in 500 years for the most severe restrictions by 2039.
- reduce leakage by 50% by 2050 from a 2018 baseline.
- reduce household water use to 110 l/p/d by 2050.
- reduce non-household water use by 15% by 2050 from a 2020 baseline.

2.0 Ambition

2.2.2. Drainage and Wastewater Management Plan (DWMP)

Our DWMP is designed to help us to maintain a robust and resilient drainage and wastewater system for customers and communities into the future. It outlines the long-term needs and requirements of drainage, wastewater, and environmental water quality, and demonstrates how we will address priority areas such as sewer flooding, storm overflows and environmental protection. In particular, our DWMP meets the following requirements set under the Government's 25-Year Environment Plan to:

- improve drainage and the quality of our rivers and coasts.
- reduce surface water flooding risk.

It also aligns with the requirements of the Government's Storm Overflows Discharge Reduction Plan (SODRP) to:

- eliminate all adverse local ecological impacts from storm overflows by 2050.
- significantly reduce harmful pathogens from storm overflows discharging into and near designated bathing waters by 2035.
- ensure all storm overflows discharge fewer than an average of ten rainfall events per year by 2050.

2.2.3. Other statutory requirements and long-term obligations

In addition to the requirements listed above, we must also:

- Decarbonise our business to achieve the Government's net zero target by 2050.
- Deliver the Water Industry National Environment Programme (WINEP) every five years, which includes reducing the amount of phosphorus we discharge to water bodies, protecting land, river and coastal habitats, enhancing biodiversity, and addressing other priority areas (aligning to various targets in the Government's 25 Year Environment Plan).
- Participate in the UK National Adaptation programme and adapt our business to the challenges of climate change.
- Conserve and enhance protected habitat areas across our estate and ensure our developments result in a net gain in biodiversity.
- Ensure the resilience and security of our assets and sites.

2.3. Existing targets

We already have several ambitious targets that we set in 2018 in our long-term vision statement 'Not Just Water' and our PR19 business plan submission. We are on track to meet the majority of these targets given our progress to date. However, there are some target areas where improvements to our performance are needed and others where we have recently updated our targets. Further information about the specific revisions we have made is available in Section 4 – Rationale of this document.

We have also established other targets in recent years, such as those associated with our Public Interest Commitments that we made collectively with other water companies in 2019. However, as these are associated with timescales that do not extend to 2050, and in most cases align with other longer-term targets, we have not included them separately within our LTDS.

Finally, we have developed our own non-statutory targets that aim to deliver further social and environmental value to the communities we serve through the delivery of our core services in line with Principle 1 of Ofwat's Public Value Principles. These include, for example, providing support for vulnerable customers, and increasing the proportion of blue-green (nature-based) solutions we deliver through our work.

2.4. Addressing our current and future challenges and opportunities

As a business, we face a series of challenges to ensure we can provide our essential water and wastewater services to the people and businesses of Yorkshire both now and in the future. The expectations of our customers have risen substantially in recent years (particularly with respect to our environmental performance), we are experiencing significant financial pressures, and the ongoing rise in the cost-of-living underlines the need to avoid our bills adding an unnecessary burden to our customers' household budgets.

Compounding these challenges is the recognition that we need to strengthen our resilience to climate change, both through driving down emissions to mitigate our climate impact, and also through flexing our plans and infrastructure to adapt to future changes in the severity and frequency of extreme weather events.

2.0 Ambition

We also know there are emerging risks that may pose a threat to our business in future. Each year we carry out a strategic horizon scanning exercise to identify these issues and assess the likelihood of them impacting us, either directly or indirectly, in the long-term. Examples of emerging risks we have identified to date include possible changes in regulatory requirements associated with treating emerging environmental pollutants (e.g., microplastics or pharmaceuticals), the potential need for alternative sludge disposal solutions in the case of being unable to recycle sludge to farmland, and financeability risks relating to changes in investor confidence.

Conversely, our strategic horizon scan also helps us identify new opportunities that may help us improve efficiency or develop new ways of working to help improve the quality of service we deliver to our customers. For example, advances in innovative technology such as smart networks or artificial intelligence represent great potential for our business in future.

Some of these risks and opportunities are discussed in more detail under the Alternative Pathways section of this document.

Our LTDS is designed to build on our current areas of strength – such as enhancing biodiversity across Yorkshire, supporting vulnerable customers, and driving down carbon emissions – while also providing a focus on areas where we are working to improve our performance to meet the priorities, needs and expectations of our customers across the region (e.g., reducing leakage, supply interruptions, and sewer flooding).

2.5. Our ambition for 2050

Our ambitions for the key performance outcomes and metrics we aim to achieve for customers and the environment by 2050 are set out on page 12. We consider these to be stretching but achievable in the long-term. Some of these outcomes and metrics are new and reflect recent developments in customer and other stakeholder priorities, while others are a continuation of those we have set previously. Our ambition is aligned with our corporate strategy and outputs of strategic planning frameworks (e.g. our WRMP), which were informed by our customers through research and received scrutiny and challenge from our Board during their development.

2.6. Stakeholder and customer feedback

Our LTDS represents a culmination of our extensive customer, community and stakeholder engagement which has been ongoing since 2020 and builds on the work we carried out at PR19. Our engagement spans multiple bespoke research studies, testing of our statutory planning frameworks (e.g., our WRMP and DWMP) as well as specific testing of our LTDS to gain insight on customer views of our plans beyond 2025. This engagement has provided meaningful insight into our customers' expectations of us in the future and has been instrumental in the development of our LTDS. In this section, we focus on the recent customer and stakeholder feedback on our LTDS.

Our LTDS research aimed to understand:

- Customers' thoughts on our LTDS
- Whether customers believed performance commitment targets and enhancement investment would achieve the LTDS vision and ambition
- The levels of support for our LTDS
- How affordable customers felt the LTDS to be and subsequent preferences for bill phasing
- Whether our customers trust us to deliver the LTDS

We surveyed a representative sample of 793 of our customers, across our 'Your Water' online community, bolstered by an external boost of customers outside of our community to ensure a more representative view.

In general, attitudes towards our LTDS are positive, with 72% of customers expressing their support overall for our strategy. Four fifths of our customers told us they like our vision, and 75% agreed that it aligns with their overall priorities as a customer.

Similarly, our long-term outcomes are well-received overall, with 86% of our customers stating that they like the outcomes presented. Outcomes also scored highly on general appeal, as well as being seen as clear and beneficial to Yorkshire.

Customer quote: "I think the explanations of all 3 areas *[vision & outcomes, targets, and bill impact]* are defined really well; clear and easy to understand. It takes the needs of customers and the environment seriously and with compassion to make a difference that is suitable and achievable."

2.0 Ambition

In terms of our targets, our customers were supportive of most of the measures and targets presented, but with the view that we can go further in some areas, particularly leakage and the use of storm overflows. In Asset Management Period (AMP) 8, we are setting ourselves stretching but deliverable targets, with specific focus in areas that our customers tell us are priorities (e.g., reducing pollution, leakage, PCC and internal sewer flooding). Our investment will support this. For example, enhancement spend is planned to support our storm overflow reduction programme, which enables us to go beyond the minimum requirements set out in the Environment Act. We are also targeting reductions in our leakage levels and improvements to our internal sewer flooding performance.

Despite the overall positive feedback, our research did highlight some concerns about our LTDS vision, which tended to centre on costs, time frames, and achievability. We will take this feedback onboard as we work towards delivering our strategy and continue to engage with customers are we review and develop our strategy in future.

Our customers' perception of us following presentation of the LTDS and their trust in us to deliver against our strategy was lower than we would like it to be. In part, this seems to stem from an overall distrust of water companies at present with media scrutiny on storm overflows and other high-profile factors, as well as a perception that we have failed to meet performance targets and protect the environment in the past. We understand that past performance will have a significant impact on our customers' trust in us to deliver our LTDS and we are putting plans in place to improve our performance going forward.

Customer opinions are also more divided when it comes to bill impacts. While the majority understand why our statutory obligations mean that the cost of bills will increase, only 38% agree that the forecasted bills are affordable for them over the longer term, with a similar proportion disagreeing. We know that affordability is a key concern for Yorkshire Water customers. Therefore, we need to ensure that bills remain affordable now and in the future while at the same time continuing to accelerate performance improvements, improve resilience and respond to external considerations including climate change and other statutory obligations.

We have given careful consideration to the affordability of our plan and we have sought to protect those customers that are most impacted by increases in bills. To balance this affordability challenge we included a range of support measures to support our customers in AMP8 – our largest ever to be delivered. We will continue along this path across future AMPs, ensuring our customers are supported as our programmes of delivery increase in scale. We have also added an alternative pathway that would reduce most non-statutory elements of our planned future investment activities to address the risk of customer affordability concerns in future.

2.0 Ambition

Outcome	Goal	Performance metric	Unit	2050 target	Statutory and other requirements
Secure, safe clean water supplies	Consistently deliver high quality water	Compliance Risk Index	score	1	
		Customer contacts about water quality	no./10,000 population	0.4	
		Water supply interruptions	Average time for interruptions >3hrs	00:01:20	
		Drought resilience	Return period (years)	1 in 500 year event	
	Reduce household and non-household water consumption	Household per capita consumption	l/p/d	18.5%	
		Business demand	Ml/day	11.9%	
	Reduce leakage across our network	Leakage	Ml/day	48.8%	
First-class customer service	Deliver leading levels of customer service	CMeX	ranking	Upper quartile	
		DMeX	ranking	Upper quartile	
		BR-Mex	ranking	Upper quartile	
Bills everyone can afford	Reduce water poverty for economically deprived customers	Customers in water poverty	%	AMP-on-AMP reduction	
Modern & sustainable infrastructure	Reduce the occurrence of sewer flooding	Internal sewer flooding	No.	0	
		External sewer flooding	No.	8.61	
		Modelled hydraulic sewer flooding risk	Return period (years)	1 in 30 year event	
	Maintain reliable clean water and wastewater networks	Mains repairs	No/1,000km clean network	149.9	
		Sewer collapses	No/1,000km waste network	5.73	
	Maintain reliable clean water and wastewater treatment works	Unplanned outage	%	1.0	
		Discharge permit compliance	%	100	
Net zero carbon emissions	Reduce greenhouse gas emissions	Operational GHG - water (location based)	tCO_2e	66,264	
		Operational GHG - wastewater (location based)	tCO_2e	243,402	
A healthy natural environment	Eliminate pollution incidents (Category 1-3)	Serious pollution incidents	No.	0	
		Total pollution incidents	No.	0	
	Reduce discharges from storm overflows to rivers and coasts	Storm overflows	Avg no. spills / overflow	9.02	
	Reduce net phosphorous loading from treated wastewater	River water quality (phosphorus)	% reduction from 2020	85.8%	
	Achieve high quality bathing waters	Bathing water quality	%	69%	
	Enhance biodiversity across the region	Biodiversity	Units per 100km² operational area	8.35	
		Blue-green storm overflow solutions	% storm overflow solutions with blue-green component	50%	

Key for statutory and other requirements:

- Common PC
- DWMP
- 25 year environment plan
- WRMP
- Storm overflows discharge reduction plan
- Long-term obligations

Table 1: Our ambition for 2050

3.0 Our Strategy

3.1. Overview

This section outlines how we intend to achieve our vision and ambition for 2050 by setting out our delivery strategy over the next 25 years using adaptive planning techniques. Here, we describe the areas we are targeting for improvement to achieve our long-term ambition and the key enhancement activities that will be required to achieve these. We also provide information on other investment activities that may be required in future, explain how key elements of our LTDS will be monitored and reviewed, and summarise the impact of our strategy on customer bills.

Our LTDS represents a step change in our approach to delivering more for our customers than ever before. We know climate change and a growing population pose challenges to future water availability. That is why our LTDS includes provision to secure new water supplies and roll out smart metering to meet the needs of our customers in years to come, all of which is supported by our customers.

We are also embarking on our largest ever environmental improvement programme over the next 25 years, which will protect waterways from pollution and lead to cleaner, safer rivers and coasts that support biodiversity and recreation across the region. Furthermore, we are transitioning towards a more sustainable business model by introducing new nature-based solutions and investing to drive down our carbon emissions to reach net zero. By taking a long-term view and embracing new ways of working, we are confident that our strategy will deliver more value for our customers, society, and the environment than ever before.

The first five years of our LTDS form the basis for our business plan for 2025-2030 period, which is published in parallel to this document on our website.

3.2. Adaptive planning and future scenarios

3.2.1. Introduction to adaptive planning

Our LTDS is underpinned by an adaptive planning approach, which is a method used to support decision making in the face of a dynamic and uncertain future. Adaptive planning means we have identified both the activities that are needed now and the investments that may be needed in future under certain circumstances. This approach provides flexibility by accounting for future uncertainties and helps us to make the right investment decisions to deliver our strategy efficiently for our customers. Nonetheless, we recognise that there is inherent uncertainty in planning over a 25-year time period and therefore our strategy may be refined in future in response to changing legislative requirements, societal expectations, affordability challenges, or other drivers of change.

3.2.2. Scenario development

There are many potential future developments that are uncertain and pose risks to our decision-making in terms of potential underinvestment (leading to loss of service quality and/or unnecessarily high costs for future customers) or overinvestment (leading to stranded assets and/or customers paying more than they need to). These potential developments include changes in climate, technology, regional growth, water consumption patterns, and regulatory requirements.

To make sure our LTDS is robust in the face of these uncertainties, we have used a series of plausible future scenarios to inform our planning. These scenarios include a number of areas required by Ofwat, known as ‘common reference scenarios’, plus other areas that we have developed to test our strategy against further relevant factors, known as ‘wider reference scenarios’. Each scenario is based on ‘benign’ and ‘adverse’ assumptions of future trajectories, such that these represent plausible extremes across a spectrum of possible futures.

3.0 Our Strategy

Scenario summaries are provided in Table 2 and further details on each scenario can be found in Section 4 – Rationale of this document.

	Common reference scenarios				Wider reference scenarios			
Scenario	**Climate change**	**Technology**	**Demand**	**Abstraction reductions**	**Farming Rules for Water**	**Lead-free Yorkshire**	**Society-driven substance Intolerance**	**Customer affordability concerns**
Adverse	High: RCP8.5	Slow: slower development than expected	High: higher growth forecasts	High: 'Enhanced' scenario (in England)	Legislation introduced leading to loss of landbank	Legislation introduced requiring the removal of all lead pipework in the Yorkshire area within 25 years	Legislation introduced requiring the removal of forever chemicals from sludge and/or treated wastewater effluent	Customers face cost-of-living challenges and prioritise lower cost investment programmes to keep bills low.
Benign	Low: RCP2.6	Fast: faster development than expected	Low: lower growth forecasts and legislation on building regulations and product standards	Low: Current legal requirements (in England and Wales)	Continued access to landbank	Ongoing replacement of lead pipework in the Yorkshire area at current rates	Sludge and wastewater treatment as per current legislative requirements	Customers willing to accept higher bills in return for improved service delivery and long-term value creation.

Table 2: Common and wider reference scenarios used in our LTDS

3.2.3. Core and alternative pathways

Our LTDS consists of a core pathway and a series of alternative pathways. The core pathway contains the activities that need to be undertaken to be ready for all plausible future scenarios, both benign and adverse. These represent a combination of no- or low-regret investments, primarily to meet short-term requirements, coupled with investment required to keep future options open or minimise the cost of future options.

The alternative pathways in our strategy represent potential future investments focused on key areas of risk and uncertainty that may be needed in future under certain circumstances. We have limited our alternative pathways to include only those that would require a material change in enhancement investment. Each pathway contains a decision point, which indicates when a decision needs to be taken about the right option to efficiently deliver long-term outcomes, and a trigger point, which indicates the circumstances in which an alternative adaptive pathway would need to be followed.

3.3. Investment areas

Our LTDS is structured around four primary enhancement investment areas, each of which is underpinned by one or more strategic planning areas. Figure 2 demonstrates how each investment area will contribute to achieving the long-term outcomes for customers that we described in our Ambition section.

3.0 Our Strategy

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

Figure 2: Customer outcomes in relation to investment and strategic planning areas

These investment areas relate only to enhancement expenditure to deliver performance improvements. However, some long-term performance improvements will also be derived from base cost allowances. Further information on improvements we expect to achieve from base expenditure is provided in the Foundation section of this document. We also recognise that investment areas may contribute to different long-term outcomes in future regulatory periods due to, for example, technological developments or changes in government policy.

3.4. Core pathway summary

Figure 3 outlines the key outputs by investment area that will be achieved as part of our LTDS between 2025 and 2050. Further information on each investment area is provided in the following section of this document.

3.0 Our Strategy

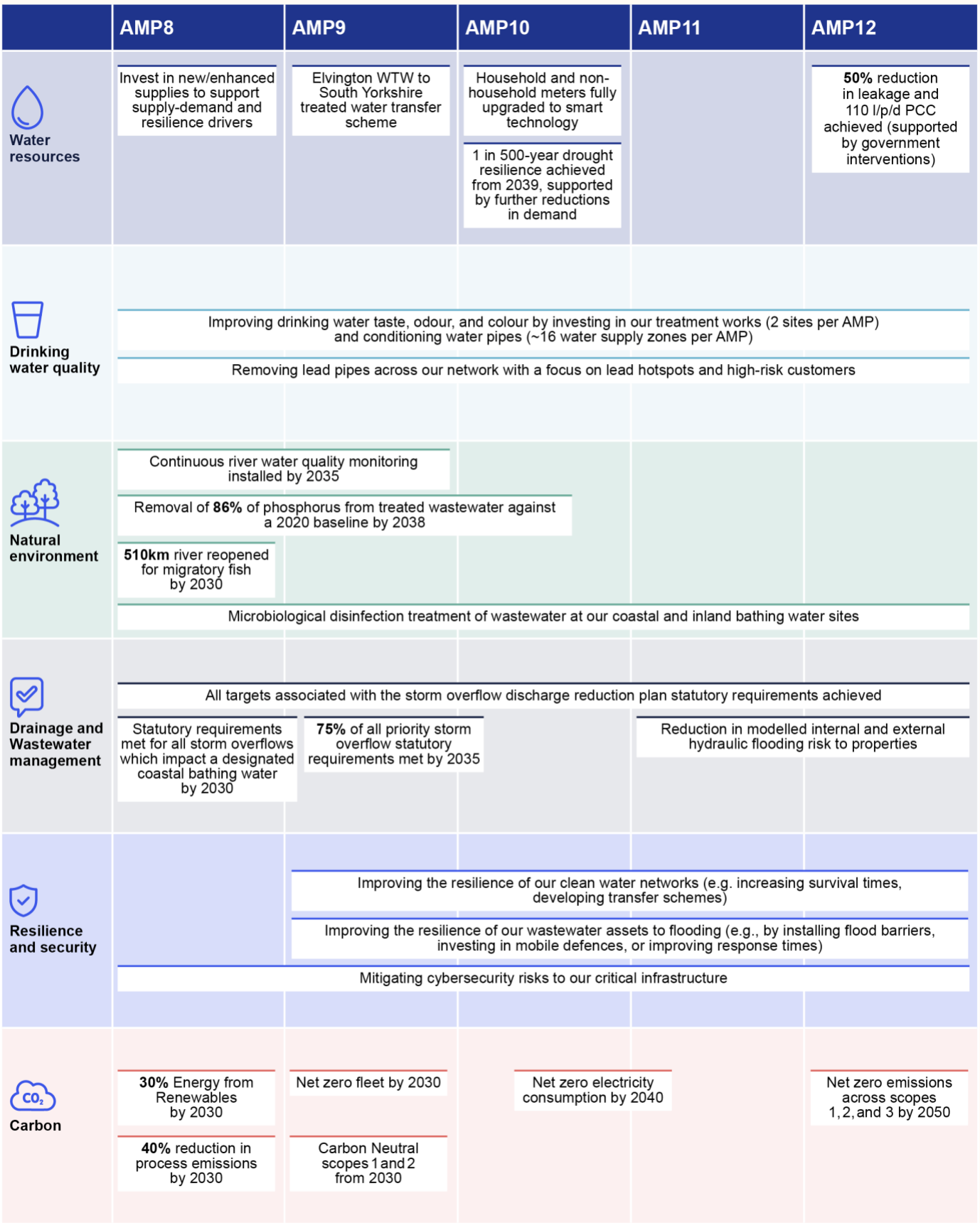


Figure 3: Customer outcomes in relation to investment and strategic planning areas

3.0 Our Strategy

3.5. Core pathway by investment area

3.5.1. Clean water

3.5.1.1. Water industry national environment programme (clean)

We recognise that in our role as a water company, we have a disproportionate ability to impact on sensitive habitats and species in or adjacent to waterways. Our core pathway includes a necessary level of enhancement expenditure to ensure we meet our conservation requirements under the Water Industry Act, the Environment Act, the Natural Environment and Rural Communities Act, and the Wildlife & Countryside Act. This includes activities covering chalk stream restoration, river restoration, conservation of habitats and species, and mitigating our operational impacts on protected sites and species. We will also invest in surveillance monitoring and treatment solutions to tackle the risk of invasive non-native species across the region, scaling up our activities in this area in future. These activities will have a marked benefit for biodiversity, helping stem future loss and safeguarding against regional species extinction.

We also propose investments to address risks to fish and eel populations in Yorkshire's rivers, such as removing artificial barriers and installing entrainment screens, to allow recovery of our native species and help rivers and their communities to thrive. We will deliver part of this work through our Great Yorkshire Rivers partnership between Yorkshire Water, the Environment Agency, and The Rivers Trust. We will reopen 510km of rivers across Yorkshire by 2030 – more than twice the length we are delivering in AMP7 – and also deliver community engagement, outreach, and education events through this partnership to further enhance the social and environmental value we bring to the region.

Our core pathway includes plans to invest in areas which are important to customers including catchment management activities to benefit drinking water protected areas and safeguard raw water supplies. These schemes include restoring peatlands, increasing soil organic matter in lowlands, and engaging with farmers to reduce the impact of agricultural operations on water quality. We will also invest in surface and groundwater flow-related schemes in line with Water Framework Directive requirements and the Environment Agency's environmental destination objectives to ensure long-term sustainable abstraction and compensation flows regimes that protect the environment and build resilience in the face of future pressures on water resources.

3.5.1.2. Water resources management plan

Our WRMP sets out how we will maintain safe and reliable water supplies for our customers while continuing to protect and enhance the environment over the long term. This plan is driven by the need to meet our baseline supply-demand deficit from early in our planning horizon, whilst striving to meet key government policy targets such as reducing leakage and PCC and increasing our resilience to drought.

Our plan has a twin-track approach to addressing supply-demand needs, across supply and demand options. Our core pathway is designed to meet the long-term demand policy targets, and the short-medium term deficit is met by these along with a set of AMP8 supply schemes (which also deliver supply resilience benefits). The plan also specifically addresses the risk to future water supplies caused by the cessation of an existing water transfer from Severn Trent (from the Derwent Valley reservoirs) in 2035.

We will reduce water demand across the region by investing in active leakage reduction and upgrading all household and non-household meters to smart meter technology (with relevant infrastructure) by 2040. We will also promote water efficiency measures to further reduce demand, supported by government policy interventions on water labelling and building regulations.

We plan to operate to a 1 in 200-year level of drought resilience for emergency drought measures until 2039. This will reduce the deficit in the short-term and allow demand reductions to take hold prior to moving to a better level of service, avoiding potentially unnecessary additional investment in the long-term. We will increase our resilience over time, such that from 2039 we will operate to a 1 in 500-year level of drought resilience.

Our core pathway also includes investment in supply side options, in particular new or enhanced groundwater supplies. These will help to meet our supply-demand deficit and also provide further supply resilience benefits. We have also included investment plans for a treated water internal transfer / interconnector from Elvington to meet customer supply needs in South Yorkshire caused by loss of the existing Derwent Valley transfer. Further investment in water treatment works capacity enhancements at Elvington will ultimately support this interconnector, but in the shorter-term will help to address the supply-demand deficit and supply resilience needs.

Note that our core pathway presented in our LTDS differs from that of our 'preferred' or 'most likely' WRMP. Our preferred WRMP includes additional expenditure to meet long-term environmental destination requirements by 2050, but these have not been included in our core pathway due to uncertainty around the solutions and abstraction reductions that will be required. However, we have presented these costs as an alternative pathway in our LTDS. See section 3.6 for further information.

3.0 Our Strategy

3.5.2. Drinking water quality

Providing safe, clean water supplies to our customers is a priority for us. Our core pathway proposes enhancement expenditure to make ongoing improvements to drinking water taste, odour, and colour through a combination of grey and green solutions. Grey solutions will focus on trunk main conditioning across the region combined with site-level schemes representing a combination of ozone, powdered/granular activated carbon filtration, and improvements to washwater systems. Green solutions comprise improvements to the management and selection of raw water sources, including installation of automated valves and turbidity and colour monitors to automate water flows.

We know addressing the issue of lead supply pipes is important to our more vulnerable customers due to the health risks associated with lead pipework. Therefore, we have proposed investment to continue the removal of lead from our network, focusing on high-risk and vulnerable customers such as those in communal buildings, schools, nurseries, and we will carry out full-service pipe replacement in identified local lead hotspot areas. This is in line with our Lead Strategy, which was recently shared with the Drinking Water Inspectorate (DWI). Our approach will help us target those most at risk from the issues associated with lead. In the longer term, we will also widen the scope of educational establishments to include other communal buildings such as sports and recreation halls and medical businesses. As part of our wider regional approach, we will focus on replacing our lead communication pipework, and any lead mains if these are identified, but do not propose any internal lead replacement activities in our core pathway. However, we have identified a potential alternative pathway for full removal of all lead pipework in our region, further details of which can be found in the 'Alternative pathways' section below.

We have proposed investments to address raw water quality deterioration in our core pathway. These include solutions to mitigate risks associated with trihalomethanes and nitrate in AMPs 8 and 9, followed by additional nitrate removal schemes in the longer-term. We also propose to invest in green solutions to tackle raw water quality deterioration by working with upland landowners, farmers and other stakeholders to raise awareness of their impacts on raw water quality and support them in their land management practices, such as by optimising fertiliser usage. Further investment will be used for river water quality monitoring across the region to better control raw water source selection.

3.5.3. Wastewater

3.5.3.1. Water industry national environment programme (waste)

Our core pathway includes some early enhancement expenditure in AMP8 to complete programmes of work that began in AMP7. This includes, for example, completing the installation of event duration monitoring equipment on storm tanks, flow monitoring equipment at sewage treatment works, and other monitoring equipment at emergency sewage pumping station overflows in line with the Environment Agency's Monitoring Certification Scheme (MCERTS).

We also plan to invest in continuous river water quality monitoring during AMP8 and AMP9 to meet the requirements of the government's Storm Overflow Discharge Reduction Plan and improve the health of our region's rivers. This includes costs associated with land, kiosks and flow monitors.

To ensure we can identify and quantify environmental risk associated with chemicals, microplastics and emerging contaminants, we propose to carry out monitoring, investigations, and options appraisals in AMP8 and future AMPs (most likely through the Chemical Investigations Programme coordinated by UK Water Industry Research), which will help to minimise the cost of options to address risks should they arise in future.

To achieve the national statutory target of an 80% reduction in net phosphorous loading from treated wastewater by 2038 (from a 2020 baseline) and mitigate our direct pressures on biodiversity, we propose to invest in a combination of chemical and biological treatment for phosphorus removal in AMP8, AMP9 and AMP10. We will also invest in nature-based solutions for nutrient removal, such as lagoons or wetlands, at our smaller wastewater sites and scale up our deployment of these solutions in future as we gain experience in their use.

3.0 Our Strategy

In order to comply with ongoing tightening of treatment requirements relating to sanitary parameters, and thereby achieve our discharge consent targets, we have included plans from AMP8 to AMP12 to invest further in our traditional filter works and activated sludge processes across a range of wastewater treatment works.

Our core pathway includes investment from AMP9 onwards in catchment management activities to control chemicals, such as cypermethrin, at source and prevent them entering our wastewater network from domestic, commercial, and agricultural sources. This activity will include raising awareness with farmers and other users such as veterinarians. We will also carry out catchment nutrient balancing and catchment permitting activities to improve river health. This will involve improvements at wastewater treatment works as well as 'in catchment' interventions where appropriate. This approach allows for greater environmental benefit to be realised whilst maintaining efficiency for our customers. In parallel to this, we will ensure that we have the appropriate skills to engage with stakeholders across water catchments. We intend to begin investigations in AMP8 and move into delivery activities from AMP9 onwards.

We know our customers and other regional stakeholders place a strong importance on the health of our region's rivers and coastlines as places to relax and exercise. At our coastal and inland bathing water sites, we have proposed ongoing investment in our core pathway for microbiological disinfection treatment to meet customer expectations for improved water quality standards. Following our WINEP plan, we have included investment for microbiological treatment to support three existing or proposed inland bathing waters in AMP8 (Ilkley, Wetherby and Knaresborough) and have included costs for three further bathing water designations per AMP thereafter.

We have proposed some smaller lines of expenditure relating to septic tank replacements in AMP8. In line with our Nature First commitment, we intend to install nature-based packages across 13 sites and divert flows from two further sites to the nearest available receiving treatment works.

We have also planned for enhancement expenditure for investigations to support future activities related to the government's 25-Year Environment Plan and the Water Industry National Environment Programme relating to the production of plans for phosphorus removal. In addition, we have planned for surveys, monitoring or complex modelling activities that would be required for new bathing water designations in the region.

3.5.3.2. Drainage and Wastewater Management Plan

We have used our preferred pathway from our recently published Drainage and Wastewater Management Plan (DWMP24) to inform our LTDS. Throughout the creation of our DWMP we engaged with customers and a number of key local stakeholders including Lead Local Flood Authorities, Rivers Trusts and the Environment Agency. Our DWMP is underpinned by customer and stakeholder expectations and requirements, particularly around priority areas linked to sewage flooding, sewage escapes, storm overflows and protecting the environment.

Our core pathway includes all the targets from the SODRP but currently not those relating to no local ecological harm, until suitable investigations have been carried out to inform this metric. Under our core pathway we will meet our statutory regulatory environmental targets. This will require extensive investment across the next 25 years.

Our expenditure on storm overflow assets, within our sewer network or at wastewater treatment works, to reduce spills is based around a reduce and enhance option or an enhance only option. We will look to reduce the amount of surface water and rainwater the enters our sewer network by removal of or attenuation using a blend of blue-green solutions (detention basins, swales) and any additional traditional grey storage requirements.

Our overall long-term plan will deliver the targets outlined in the SODRP and is a multi-AMP delivery profile to 2050. In line with our long-term ambition, we intend to deliver 20% of storm overflow solutions with blue-green components in AMP8, rising to 50% in each subsequent AMP. These investments are planned to take account of the modelled potential impacts of population growth, urbanisation, and climate change in 2050.

We plan to continually investigate and improve our designated bathing waters to support improvements in bathing water quality. We will meet the statutory requirements for designated coastal bathing water overflows by 2030, which is 5-years ahead of the 2035 government target. We are also looking to deliver regulatory improvements at our designated inland bathing water by 2026 and have included further work on two potential future designations to support improvements in bathing water quality by 2030.

We are also planning to install new or upgraded screens at all our storm overflows in line with the requirements of the SODRP, including storm overflows that require no other intervention. Screen upgrade work will commence

3.0 Our Strategy

in AMP8 where we deliver a spill reduction solution and continue onwards through AMPs 9-12.

Under our core pathway in the LTDS, we will begin to reduce the impact of modelled hydraulic flood risk in later AMPs which in turn will reduce the risk of internal and external flooding for our customers. Benefits will be seen from our blue-green storm overflow solutions and surface water removal from AMP8 onwards. This work will have some benefits and links to the existing Internal sewer flooding / External sewer flooding performance commitment measures relating to reducing the risk of hydraulic overloading and flooding of properties and will seek to reduce risk to those known to be already impacted.

3.5.3.3. Bioresources

Our core pathway includes expenditure for cake pads or bays to create additional sludge storage capacity in AMP8. We have also included a small amount of AMP8 expenditure to enhance dewatering at three sites to meet quality standards required to recycle treated sludge cake to land. In addition, we have included costs for growth at sewage treatment works to accommodate increases in treatment capacity that we forecast will be required in future.

3.5.4. Resilience

3.5.4.1. Clean water resilience

Our core pathway proposes investment to increase the survival time of water treatment works and the ability to supply customers with water in the event of a temporary outage of one or more treatment works. This work includes developing transfer schemes and linking networks across eight water supply systems. Our plan focuses on addressing the most urgent sites in AMP8, followed by further water supply systems from AMP9 onwards.

3.5.4.2. Clean water security

We have included enhancement expenditure in our core pathway in AMP8 for security upgrades at nine additional Critical National Infrastructure sites to comply with the Security and Emergency Measures Direction. No further investment in security is proposed from AMP9 onwards as assuming no change to statutory requirements, future costs will be funded from base expenditure.

We have proposed future investment to address cybersecurity risks from AMP8 to AMP12. This will focus on regulatory compliance and mitigating the risks of cyber targeting of physical assets in the future and improving our ability to predict and respond to the external threat landscape.

3.5.4.3. Wastewater resilience

In our core pathway we propose some relatively small amounts of investment from AMP9 onwards to improve the resilience of our wastewater assets to flooding. This includes installing flood barriers, raising sensitive mechanical and electrical equipment above likely water flooding levels, and relocating some assets to less flood-prone areas.

3.5.4.4. Wastewater security

No enhancement costs are proposed to comply with the Security and Emergency Measures Direction as assuming no change to statutory requirements, these will be funded from base expenditure.

We have proposed future investment to address cybersecurity risks from AMP8 to AMP12. This will focus on mitigating the risks of cyber targeting of physical assets in the future and improving our ability to predict and respond to the external threat landscape.

3.5.4.5. First time sewerage

Our core pathway includes a small amount of enhancement expenditure in each AMP to add first time sewerage infrastructure for new customers in line with our forecasts of population growth across the region.

3.5.4.6. Living with Water

We have proposed costs in our plan for our Living with Water Partnership to address flood risk in the Hull and Haltemprice catchment, a unique area within our region which relies upon pumped combined sewer infrastructure to drain over 88% of the area. Enhancement costs are based on the Living With Water Blue Green Plan, which is a long-term plan of investment, managed change, policy improvement, community engagement and other activities to deliver flood resilience for Hull and Haltemprice. The Blue Green Plan has been co-created with the partners to holistically manage surface water and sewer flood risk and the significant impacts of climate change. The Plan identifies the need for long term sustained investment to manage surface water. Note that contributions expected from other partners are excluded from our proposed costs.

3.0 Our Strategy

3.5.5. Net zero

3.5.5.1. Clean water carbon

Our customers tell us that net zero is really important to them, and while the cost-of-living crisis and concerns of future affordability impact customers' views of net zero, it is clear that they don't want us to push this aside. As part of our long-term emissions reduction plan, our core pathway includes enhancement expenditure for the expansion of renewable energy generation technologies at our clean water sites from AMP8 to AMP10. We have also proposed longer-term investment from AMP9 onwards for system upgrades to reduce chemical emissions, and also to reduce our wider emissions associated with purchased goods and services and capital goods. This investment will ensure we can align our emissions reduction pathway with science-based targets, which require a 90% reduction in emissions from a baseline year.

3.5.5.2. Wastewater carbon and energy

We propose enhancement investment in our core pathway to tackle methane (CH_4) process emissions at our wastewater treatment sites. This spend is focused mainly in AMP8 with some minor investment in future AMPs to achieve further incremental reductions in CH_4 emissions, which may also be driven by other compliance drivers such as the Industrial Emissions Directive. Similarly, we also include investment to tackle nitrous oxide (N_2O) process emissions at wastewater treatment sites. In AMP8 we will pilot monitoring and control of N_2O emissions at activated sludge plant (ASP) lanes at some of our larger sites, with a view to rolling this technology out more widely across our treatment sites in future AMPs. In the longer term, we will look to deploy solutions to further reduce N_2O emissions, such as covering ASP lanes or introducing other lower emission processes.

We have also included investment in renewables at our wastewater sites from AMP8 to AMP10. This will focus initially on rooftop solar installation schemes in AMP8 and subsequently progress to wider renewables – such as wind, heat recovery, and hydrogen – from AMP9 onwards.

Investment to reduce chemical-related emissions will come from base expenditure in AMP8, but we have included additional enhancement investment from AMP9 onwards to reduce overall chemical use, including mitigating additional consumption driven by future quality programmes. We have also proposed investment to decarbonise embedded emissions (scope 3) through measures such as investing in materials, products, or services and capital goods with lower embedded carbon relative to current selections.

3.6. Alternative pathways

Through our adaptive planning approach, we have identified a set of alternative investment pathways that we may take between 2025 and 2050 in response to plausible changes in future circumstances. These alternative pathways represent additional or alternative activities that would be undertaken under certain circumstances and would be likely to have a material impact on customers' bills. We have established decision points and trigger points for each alternative pathway in line with adaptive planning principles. In this section we provide an overview of each alternative pathway, and further details are available in the Rationale section of this document.

3.6.1. Alternative Pathway 1: Statutory investment programme

Our core pathway is based on best value planning principles that we are confident will deliver long-term benefits for our customers and the environment. However, we recognise that high energy bills, food costs, and other inflationary pressures faced by customers at present represent significant pressures on their household budgets. If the current cost-of-living crisis continues in future, there is a risk that our customers will prioritise lower cost bills over investment activities that would deliver better value in the long-term. This would require us to reduce the scope of our future investment programmes to minimise future costs to customers.

Under this alternative pathway, we would deliver our minimum statutory requirements but remove most non-statutory activities from our investment plans. We would also seek to reduce the cost of delivery by, for example, investing in grey solutions over blue-green solutions. These changes would produce an investment plan that would minimise customer bills in the shorter term.

3.0 Our Strategy

Our decision to move to this alternative pathway would be made at the next Price Review, with the pathway triggered at the start of AMP9. At present, we estimate the likelihood of triggering this alternative pathway at the start of AMP9 to be 60%. However, ahead of PR29, we will seek to review our investment activities with a view to delivering the benefits of our core pathway at a cost closer to that of our statutory investment programme alternative pathway.

3.6.2. Alternative Pathway 2: Our most likely WRMP pathway

Our 'most likely' pathway within our draft WRMP contains provision for improving the environment as part of the government's 25-year environment plan, achieved through specific reductions in abstraction. This would require the introduction of the Tees to York transfer – a transfer from Northumbrian Water to Yorkshire Water – coupled with a reduction in abstraction on the River Derwent to reduce abstraction and comply with Common Standards Monitoring Guidance (CSMG), which sets long-term flow targets for protected areas. Such a reduction in abstraction aligns with abstraction reductions under the BAU+ environmental destination scenario in the WRMP guidance, although we note that under a high Ofwat common reference scenario (Abstraction reductions) further investment also may potentially be required in the very long-term, outside the 25-year planning horizon.

Under this alternative pathway, we would require additional WRMP enhancement expenditure to deliver supply-side improvements in AMP12. Given the uncertainty associated with the abstraction reductions and solutions that will be required, we have presented these costs as an alternative pathway rather than as part of our core pathway as, at this point, we do not consider it to represent no- or low-regret expenditure.

Our decision to move to this alternative pathway would be made following completion of environmental investigation work on the River Derwent in collaboration with all relevant stakeholders and regulators to define the solution in more detail. These investigations would feed into a decision point in 2032 as part of the draft water resource management plan for that planning cycle. This will also allow Yorkshire Water further time to expand the feasible option portfolio to affirm the best-value solution to meet these longer-term drivers. The pathway would subsequently be triggered in 2049/50, which is the date at which we assume our abstraction licence will be reduced and the CSMG target will be applied. Note, however, that our trigger point may be amended following publication of our revised draft WRMP. At present, we estimate the likelihood of triggering this alternative pathway in 2049/50 to be 50%.

3.6.3. Alternative Pathway 3: Removal of all lead pipework across Yorkshire

Replacing lead pipework across Yorkshire is important for the long-term health of our customers. While our core pathway includes investment to renew lead communication pipes and external supply pipes, there is potential for future changes in legislation or regulation that would require us to accelerate our lead removal programme and achieve full removal of lead pipework across our clean water network within 25 years. Such changes would necessitate further drinking water quality investment to replace communication pipes, full-service pipes and internal plumbing to ensure compliance with relevant changes in legislation. This would increase the scope of lead-related activities in our core pathway.

Note that our Lead Strategy, which is currently undergoing review by the DWI at the time of submission, contains scenarios for full lead pipework removal within 25, 40 and 60 years. Given the uncertainty this presents, we have used the 25-year scenario to inform our alternative pathway on the basis that it aligns with the LTDS planning period (i.e., 2025-2050) and represents the highest potential cost to customers in terms of annual bill increases.

We currently forecast this alternative pathway could deviate from our core pathway at the start of AMP9 at the earliest. We would decide to move to this alternative pathway based on changes in legislation, which we assess regularly through our standard risk management processes and annual horizon scanning reviews. This decision would be made during the planning stage of our next Water Quality plan for submission to the DWI, following which the alternative pathway would be triggered if required. At present, we estimate a 20% likelihood of triggering this alternative pathway at the start of AMP9.

3.6.4. Alternative Pathway 4: Incineration of sludge to mitigate loss of landbank

We currently recycle all of our digested wastewater sludge to farmland where it can supply a large part of the nitrogen or phosphorus that most crops need and can also be a good source of organic matter that improves soils. However, there is uncertainty whether interpretation by the Environment Agency of Rule 1 of the Farming Rules for Water (Regulations 4 and 5 of the Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018), which aim to tackle diffuse water pollution, may prevent us from recycling all wastewater sludges to land. Under these circumstances, we would require additional Bioresources investment to create a different route for sludge disposal through the construction of two new incinerators. These costs would be spread across multiple AMPs due to the time required for planning, delivery and commissioning. We do not believe the

large-scale use of landfill is a viable alternative to recycling sludge to agricultural land.

We monitor changes in environmental regulations on a continuous basis through our standard risk management activities. Our decision to move to this alternative pathway would be taken at the price review prior to confirmed upcoming changes in regulation, with the pathway triggered upon changes in regulation. At present, we estimate a 30% likelihood of triggering this alternative pathway at the start of AMP9 but consider the likelihood of transitioning to this alternative pathway will increase over time.

Note, however, that we believe that there is lower but not insignificant chance (10% probability) that this landbank loss could occur within AMP8. As such, we have proposed an uncertainty mechanism to protect the company in the event that investment is required to address this risk ahead of AMP9. This is set out in our Risk & Return chapter 9.

3.6.5. Alternative Pathway 5: Incineration of sludge to remove forever chemicals

We treat all our digested sludge that we recycle to farmland to ensure it meets quality criteria as defined in the code of practice for the Sludge (Use in Agriculture) Regulations 1989. These quality criteria include limits on nutrients, chemicals, and micro-organism concentrations, but do not currently include a group of chemicals known as poly- and per-fluoroalkyl substances (PFAS), which are widely used in consumer items from waterproof clothing to personal care products.

Although few PFAS have been studied in detail, they are extremely persistent in the environment, resulting in their being known as forever chemicals. At present, the recycling of sewage sludge to land as a route for PFAS into soil is poorly understood. Under our core pathway, we assume that any future action to reduce PFAS concentrations would occur in the form of legislative restrictions of certain chemicals as opposed to sludge treatment solutions. However, if societal intolerance was to significantly increase in the future, then new legislation could be introduced that would require us to remove PFAS from sewage sludge recycled to land. Under these circumstances, we would require additional Bioresources investment to establish two new incinerators to create a different route for sludge disposal. These costs would be spread across multiple AMPs due to the time required for planning and delivery.

We carry out regular customer engagement work and analyse media coverage to assess and monitor customers' opinions on this subject. We also monitor changes in environmental legislation on a continuous basis through our standard risk management activities. Our decision to move to this alternative pathway would be made at the price review prior to confirmed upcoming changes in legislation, with the pathway triggered upon changes in legislation. At present, we estimate a 10% likelihood of triggering this alternative pathway at the start of AMP9 but consider the likelihood of transitioning to this alternative pathway will increase over time.

3.6.6. Alternative Pathway 6: Wastewater treatment to remove forever chemicals from final effluent

Treated effluent discharged to rivers from wastewater treatment works also represents a pathway for PFAS to enter the environment. As with the case for sewage sludge, PFAS in final effluent is not regulated currently (apart from the environmental quality standards in water bodies for perfluorooctane sulfonate) but we recognise that this may change and require us to remove PFAS from treated effluent in future. Under these circumstances, we would require additional WINEP (waste) investment to enhance chemical removal capacity at our wastewater treatment works using granular activated carbon treatment.

As mentioned in Alternative Pathway 4, we carry out regular customer engagement work and analyse media coverage to assess and monitor customers' opinions on this subject. We also review changes in environmental legislation on a continuous basis through our standard risk management activities, and are collaborating with the Environment Agency, Ofwat and Defra to monitor PFAS in wastewater effluent through the Chemicals Investigation Programme. Our decision to move to this alternative pathway would be made at the WINEP planning stage prior to confirmed upcoming changes in legislation, with the pathway triggered upon changes in legislation. Due to the differences in decision timing, we have represented this as a separate alternative pathway to alternative pathway 4. At present, we estimate the likelihood of triggering this alternative pathway at the start of AMP9 to be 10%.

3.0 Our Strategy

3.6.7. Alternative Pathway 7: Enhanced drainage and wastewater management capacity

Our modelling indicates that increased rainfall conditions under the high climate change (RCP8.5) common reference scenario would pose significant risks to the operation of storm overflows and the risk of hydraulic flooding. Mitigating these risks would require us to create additional wastewater network storage capacity, separate a greater volume of surface water runoff at source, and attenuate surface water runoff to slow the speed at which stormwater enters our sewer network. This would require additional expenditure under our DWMP investment area.

We currently forecast this alternative pathway could deviate from our core pathway at the start of AMP9 at the earliest. We would decide to move to this alternative pathway based on the most recent climate change projections (e.g., regional rainfall patterns and temperature trends) supplemented by climate adaptation planning guidance (e.g., from Defra), which we will assess, monitor and incorporate into our models as part of our ongoing business processes. This decision would be made during the planning stage of our next Drainage and Wastewater Management Plan, following which the alternative pathway would be triggered if required. We would look at a review of triggering the alternative pathway with every DWMP cycle and price review submission. At present, we estimate a 30% likelihood of triggering this alternative pathway at the start of AMP9.

3.6.7.1. Summary of alternative pathways

Alternative pathway	Description	Scenario type	Scenario	Investment area	Decision point	Trigger point
1	Statutory investment programme	Wider reference scenario	Customer affordability concerns – adverse	Resilience; DWMP; Living with Water	At PR29	Start of AMP9
2	Our most likely WRMP pathway	Common reference scenario	Abstraction reductions – high (adverse)	WRMP	2032 WRMP planning cycle	2049
3	Removal of all lead pipework across Yorkshire	Wider reference scenario	Lead-free Yorkshire – adverse	Drinking water quality	Price Review prior to change in legislation	Upon change in legislation
4	Incineration of sludge to mitigate loss of landbank	Wider reference scenario	Farming Rules for Water – adverse	Bioresources	Price Review prior to change in regulation	Upon change in regulation
5	Incineration of sludge to remove forever chemicals	Wider reference scenario	Society-driven substance intolerance – adverse	Bioresources	Price Review prior to change in legislation	Upon change in legislation
6	Wastewater treatment to remove forever chemicals from final effluent	Wider reference scenario	Society-driven substance intolerance – adverse	WINEP (waste)	WINEP planning round prior to change in legislation	Upon change in legislation
7	Enhanced drainage and wastewater management capacity to adapt to climate change	Common reference scenario	Climate change – high (adverse)	DWMP	Next DWMP planning round	Delivery of DWMP at start of AMP9

Table 3: Summary of alternative pathways showing scenarios, investment areas, decision points and trigger points.

3.0 Our Strategy

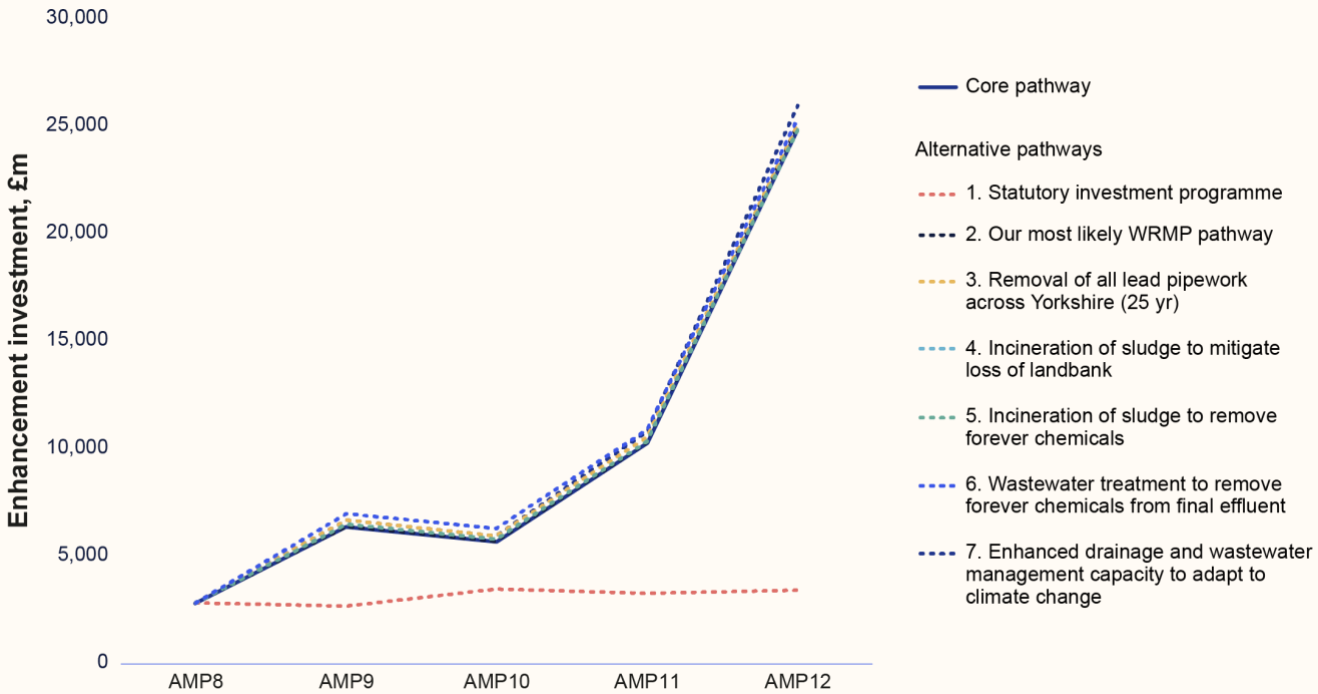


Figure 4: Overview of core and alternative pathway spend profiles from AMP8 to AMP12

3.7. Monitoring plan

In line with adaptive planning principles, we will establish a plan to monitor our LTDS and ensure we keep its implementation, metrics, trigger points and other key elements under review.

We will monitor the development of common reference scenarios, wider reference scenarios, and other developing risks at a high level through our existing business processes. For example, we conduct a strategic horizon scanning exercise each year to identify emerging risks that may impact our business in future, such as changes in societal expectations or government policy positions. Similarly, our Innovation team proactively assesses the technology landscape on an ongoing basis to understand the potential impact of new developments on our operations and processes. For each scenario we have identified strategic metrics that can be robustly quantified and monitored to allow us to continually assess the risk of an alternative pathway being triggered, as set out in Table 4.

At PR19 we developed a Resilience Framework for Yorkshire Water, and over the last year we have worked to update and evolve this from a qualitative maturity assessment to a more quantitative approach. Our updated Resilience Framework allows us to monitor our resilience by tracking strategic metrics against tolerance levels, forecast performance based on our core investment pathway, and evaluate future resilience under different operating conditions to support future planning.

We will incorporate our scenarios and associated strategic metrics into our Resilience Framework. This will enable ongoing monitoring of the risk of triggering an alternative pathway and facilitate reporting to Yorkshire Water Board, regulators, and other stakeholders. We intend to publish an update on our monitoring plan and progress against the LTDS each year, and carry out a more substantial review at PR29.

3.0 Our Strategy

Scenario type	Scenario	Strategic metric	Calculation	Data source	Monitoring frequency	Threshold for action	Action
Common reference scenario	Climate change	Forecasts of temperature, rainfall intensity and rainfall patterns	Various (e.g. rainfall time series perturbation using RED-Upv3 tool)	UKCP18 projections and future releases	Every five years at minimum	Forecasts exceed tolerances in strategic plans aligned with core pathway	Incorporate into strategic plans (e.g. WRMP, DWMP), leading potentially to triggering of alternative pathway or creation of new alternative pathway
	Technology	Various	Technology landscape review	YW Innovation team	Ongoing	Technological developments have potential to alter strategic plans under core pathway	Incorporate into strategic plans (e.g. WRMP, DWMP), leading potentially to creation of new alternative pathway
	Demand	Supply demand balance	Difference between water available for use (supply) and the demand for water	Internal data combined with population forecasts from Edge Analytics	At each WRMP planning round	Forecasted demand exceeds forecasted supply under core pathway	Incorporated into next WRMP, leading potentially to creation of new alternative pathway
	Abstraction reductions	Water resource availability	Key water resource measures as appropriate (e.g. naturally available resource at Q95 under EA's 'enhanced' scenario)	Environment Agency; Centre for Ecology and Hydrology; internal data	At each WRMP planning round	Forecasted demand exceeds supply availability under core pathway	Incorporated into next WRMP, leading potentially to creation of new alternative pathway

3.0 Our Strategy

Wider reference scenario	Lead-free Yorkshire		n/a	UK government policy; Stakeholder engagement research	Ongoing	Confirmed upcoming changes in regulation	Alternative pathway integrated into business plan at next price review
	Farming Rules for Water	Landbank availability	n/a	UK government policy	Ongoing	Confirmed upcoming changes in regulation	Alternative pathway integrated into business plan at next price review
	Society-driven substance Intolerance	Landbank availability	n/a	UK government policy	Ongoing	Confirmed upcoming changes in regulation	Alternative pathway integrated into business plan at next price review
		Discharge quality limits for PFAS	n/a	UK government policy	Ongoing	Confirmed upcoming changes in regulation	Alternative pathway integrated into next WINEP planning round
	Customer affordability concerns	Various	n/a	Customer engagement surveys	Ongoing	Customers express preference for lower cost bills	Incorporated into next Price Review

Table 4: Scenario monitoring plan overview

3.0 Our Strategy

3.8. Impacts on customer bills

The impacts of our core and alternative pathways on customers' bills are set out below. These impacts are based on the changes in bills forecasted for future enhancement expenditure, rather than the total bill amounts that customers will pay in future.

Pathway	Average change in annual bill over period, £				
	AMP8	AMP9	AMP10	AMP11	AMP12
Core pathway	75	138	67	146	352
Alternative pathway 1: Statutory investment programme	75	51	38	51	39
Alternative pathway 2: Our most likely WRMP pathway	75	138	67	146	356
Alternative pathway 3: Removal of all lead pipework across Yorkshire	75	145	71	151	356
Alternative pathway 4: Incineration of sludge to mitigate loss of landbank	75	141	69	147	352
Alternative pathway 5: Incineration of sludge to remove forever chemicals	75	145	70	154	370
Alternative pathway 6: Wastewater treatment to remove forever chemicals from final effluent	75	141	69	147	352
Alternative pathway 7: Enhanced drainage and wastewater management capacity to adapt to climate change	75	153	75	156	360

Table 5: Impacts on customer bills for our core and alternative pathways

3.9. Lessons learned

In developing our LTDS, we have built on our history of long-term planning to ensure we are able to provide high quality and resilient services to our customers both now and in the future. Following an adaptive planning methodology has provided valuable insights into our approach to developing plans for the future, helping us make the right decisions for our current and future customers. We intend to build on this strong foundation and review and refine our approach to long-term planning ahead of PR29.

4.0 Rationale

4.1. Overview

Our Rationale section details the methodology by which we developed our LTDS strategy to achieve our ambition considering adaptive planning and best value approaches. It includes the following elements:

- How we developed our core and alternative pathways and how we have ensured that they represent best value options for present and future customers.
- Scenario analysis detailing the sensitivity of adaptive pathways to various plausible futures across our strategic planning areas.
- Considerations in relation to previous long-term strategies.
- Consideration of the impact on affordability and fairness between current and future bill payers.
- The enhancement funding investments that are needed to keep plausible future options open.

4.2. Building on our history of long-term planning

We have been applying long term planning principles in our planning for previous price reviews and we published our long-term strategy 'Not Just Water' in 2018. The development of this LTDS uses these previous strategies and plans as a foundation, building on what we have learnt from the past.

The following section describes the development of this thinking including explaining variations from previous strategies and where learning has informed our LTDS approach.

Our key priorities within this LTDS include a continuation of ambitions that we set previously with the addition of some new outcomes to reflect recent developments in our operating context. These developments include those related to societal expectations and evolving regulatory regime. For example, we have in recent AMPs placed a stronger focus on preserving the natural environment of Yorkshire and on the phasing of investments such that we can support inter-generational fairness, which has become increasingly important within the backdrop of a challenging economic climate.

4.2.1. Development of the LTDS from PR19

Our PR19 plan set five ambitious objectives:

- Customers: 'We will develop the deepest possible understanding of our customers' needs and wants and ensure that we develop a service tailored and personalised to meet those needs.'
- Water supply: 'We will always provide you with enough safe water, we will not waste water and always protect the environment.'
- Environment: 'We will remove surface water from our sewers and recycle all wastewater, protecting the environment from sewer flooding and pollution.'
- Transparency: 'We will be a global benchmark for openness and transparency.'
- Bills: 'We will use innovation to improve service, eradicate waste and reduce costs so no one need worry about paying our bill. We will not waste money.'

As a response to evolving stakeholder needs, our LTDS develops our long-term strategy, building on the approaches set in PR19. This is particularly true for our environmental and water supply objectives where our current strategy places greater emphasis on net zero, wastewater management, increased smart metering, ensuring safe disposal of biosolids to land and increasing the quality of bathing waters.

4.0 Rationale

Focus to reach net zero commitments by 2050

The foremost change since 2018 has been a stronger focus on meeting our net zero commitments. In 2018, the focus was set on reducing leakage, mitigating carbon footprint, and reducing waste impact on the environment. Adaptation to new regulations has translated into more substantial expenditure required to reduce greenhouse emissions to zero. This stronger environmental focus can be reflected in net-zero expenditures and a higher proportion of blue/green solutions.

Investment in wastewater management to meet changing customer and regulatory expectations.

In 2018, we placed less emphasis on our approach to storm overflows than we do now. Due to customer-driven pressure coupled with increased media interest, current regulations around storm overflows have tightened. Accordingly, we must increase greater investment focus on minimising storm overflows to meet new standards.

Based on learning from our experiences since PR19, coupled with our improved knowledge of rainfall patterns and climate change and consideration of likely costs, we have revised ESF target upwards to achieve no more than 8.61 incidents per 10,000 sewer connections by 2050. We remain committed to achieving zero ESF incidents in future but recognise that the speed of the journey towards achieving this goal will be slower than initially anticipated.

In a similar vein, we have also revised our previous sewer collapses target upwards such that our 2050 target is now to achieve no more than 5.73 sewer collapses per 1000km wastewater network by 2050. This change comes in response to affordability challenges and the scale of investment required to reduce sewer collapses. We remain committed to improving the health of our wastewater assets but are prioritising investment in our clean water network because clean water asset failures have a more immediate and direct impact on service delivery than those on our wastewater network (i.e., not all sewer collapses lead to a service impact) and investing in our clean water network aligns with our current customer priorities. We will keep our target under review and seek to identify further opportunities for improvement in future.

Expansion of bathing water quality strategy to include in-land bathing water designation and prepare for potential future Designations.

The PR19 strategy was to strive to 'Good' and 'Excellent' bathing water quality on the East Coast of Yorkshire which we continue to work towards with the Yorkshire Bathing Water Partnership. Changes in public perception and increased media implication in recreational bathing has led to increased demand for in-land water to be acceptable for recreational bathing as well. This pressure has led to the first inland bathing water designation. Potential future designations will require investment to ensure water quality meets the requirements of the designation. On the east coast our goal is to continue to work in partnership towards Excellent bathing water quality.

Investment in modern technologies to reduce demand and leakage.

Reducing leakage by half was one of our aspirations at PR19 through to 2035. In preparation for PR24, new WRMP demands coinciding with the expiration of a connection with Severn Trent has provided an opportunity to switch to smart metering. As such, the business plans to place a stronger investment on smart metering technologies to deliver an excellent service to customers, reduce leakage and compensate for a supply/demand deficit. Tackling leakage is a priority issue for us and we plan to invest further in this area in future to address this challenge.

4.3. Identifying our core pathway

The following sections describe the steps we have taken to develop our core pathway and ensure that it will deliver our ambition in a wide range of future scenarios.

4.3.1. Step One

Our first step was to establish what investments we may need to meet our ambition in various future scenarios. We worked with many of our experts in areas such as wastewater, water quality and water resource planning to understand the pressures that have been identified over the next 25 years, and which could act as investment drivers. Once we understood the likely investment drivers, we considered the various types of solutions that could address the pressure identified. This created an initial view of possible 25-year enhancement investment profiles across water resources, water networks plus, wastewater networks plus and bioresource. The initial view of expenditure was developed by considering various solution options against both our long-term ambition and the challenges we know that we face as a business in achieving this ambition.

4.0 Rationale

In the development of this initial expenditure profile, we have, where appropriate, used our other long-term strategic planning documents to inform our LTDS initial enhancement investment profile. This approach capitalises on the strong history and experience we have in long term planning. For example, we have incorporated options and impact analysis and data from our DWMP as well as our WRMP to inform our initial enhancement investment profile, capturing key assumptions such that we could test our initial investment profiles to ensure they will deliver against future uncertainties.

4.3.2. Step Two

To develop our core pathway, we tested our initial solution options and therefore initial enhancement investment profile against Ofwat's Common Reference Scenarios and our own Wider Reference Scenarios. This ensures that our core pathway reflects 'no and/or low regrets' investments that can respond to a range of plausible futures. Scenario testing was carried out through a series of targeted workshops with our strategic planning area subject matter experts (SMEs).

4.3.3. Step Three

Following the outputs of our scenario testing we confirmed our core pathway such that we were confident it truly reflected 'no and/or low regrets' investments that keep options open to respond appropriately as the future develops. At this stage we also considered the alignment of our core pathway with our company ambition, considering our customers' preferences as well as affordability considerations and fairness between current and future customers.

4.3.4. Step Four

To ensure our 25-year enhancement investment plan is sequenced to deliver best value over the long-term we have validated our enhancement investment plans using our six capitals approach alongside Ofwat's best value guidance. Our six capitals model (Figure 5) informs decision making that incorporates broader public value ensuring the greatest net benefit to customers and wider society. It is one component of our decision-making framework and has been used to shape our sustainability accounting activities. In our LTDS we have used our framework in combination with Ofwat's best value guidance to assess whether the activities identified in our core pathway post scenario testing will maximise value for customers, communities, and the environment.

To apply Ofwat's best value guidance in conjunction with our six capitals model we first considered example valuations by strategic planning area according to each of the six capital categories. For example, under natural capital we considered how the activities in our core pathway might deliver benefits to crops, livestock, global climate, or recreational air quality. Having provided strategic planning area valuations, we then considered the value delivered by our core pathway regarding how the options in the pathway were identified and selected, why we have chosen these options and mix of approaches, and why the investments are sequenced to deliver in the short, medium, and long term. This helps us to demonstrate how our core pathway will provide value to our customers and ecosystem, as well as why the sequencing and choice of activities means we will be delivering best value. For further details on our six capitals assessment please see Appendix A.

4.0 Rationale

Figure 5: The six capitals framework

4.4. Our final core pathway

The following sub-sections document how we have identified our core pathway activities across all strategic areas, and why they represent the best mix of options and approaches to support our ambition over the next 25 years. We have considered a range of options and, after testing all scenarios, these investments remained from our initial options for 11 scenarios and therefore form our core pathway. For further detail on the activities in our core pathway please see Appendix B.

4.4.1. Clean water

We have grouped our clean water data according to our strategic planning areas. This includes our Water Industry National Environment Programme (WINEP), WRMP, Drinking Water Quality, Resilience, Security, and Net Zero.

4.4.1.1. WINEP

In our strategy we outlined that our core pathway includes the necessary level of enhancement expenditure to ensure we meet our conservation requirements under the Water Industry Act. We also want to encourage the recovery of our native species and build better resilience in our drinking water protected areas and raw water supplies.

How will this deliver best value for our customers?

To ensure that our core pathway maximises value for our customers, communities, and the environment we have considered how the options we have identified, selected, and sequenced represent best value.

Drinking water protected areas

Climate change predictions indicate that we will see warmer wetter winters and increasing frequency of summer storms. Changes in rainfall patterns impact on water quality. To help improve water quality and reduce carbon emissions and reduce river peak flows to limit flooding our core pathway will support Peatland restoration. We have selected peatland restoration as this provides long term benefits to the wider environment.

Peatland restoration is an iterative process taking several years to succeed. Initially the water level needs to be raised through gully and grip (drainage) blocking, along with the revegetation of bare peat. The activities in our core pathway look to reduce the amount of heather cover, as this dries the peat out, making it more vulnerable to changes in weather patterns and wildfires.

4.0 Rationale

Instead, we will plant peat forming species of sphagnum, which will help to intercept and store water. This will help keep the peat wetter for longer during the year.

We have identified our options through the development of catchment specific restoration plans, supported by water quality sampling to justify the actions under Article 7 of the Water Framework Directive, which are then implemented through WINEP. For lowland catchment management interventions, we will focus on measures to promote soil health, which includes supporting the growth of multi-variant cover crops and reducing tillage. This helps to build organic matter in the soil profile, which stimulates the biological functionality of the soil. This in turn will help to produce healthy, nutritious, and sustainable food, whilst delivering other benefits such as increasing pollinators, improving biodiversity, and providing flood mitigation. The carbon sequestered through this approach can also be traded through the newly launched Carbon Bank. The split between capital and operating solutions has been determined by financial regulations and all countryside management solutions are, by their very nature, nature-based solutions.

Our extensive partnership working will also ensure that our LTDS is delivering best value. Our partnership approach with United Utilities, Severn Trent Water and Northumbrian Water Limited means that our delivery partners have used our funding as match funding for two EULIFE (an independent research group) projects. This will deliver significantly more restoration than our respective budgets could deliver in isolation.

Our pioneering approach to regenerative agriculture in Yorkshire has seen the activity grow with external funding from the food and drink supply chain. To continue developing this sector our core pathway will invest in further programmes of partnership work. For example, Heineken has a worldwide programme of interventions as regenerative farming is key to producing low or zero carbon raw materials. In time, it is possible that the food and drink supply chain increase their activities and financial support for this approach, which should significantly reduce the amount of customers' monies allocated to this activity. The sequencing of our activities will therefore continue to develop our understanding of how regenerative agriculture can improve water and air quality as well as encourage more efficient water use.

Biodiversity and conversation

Our work to date focusing on biodiversity and conservation has improved our ecosystem resilience. To continue doing this our core pathway options have been identified and selected through stakeholder workshops led by our external Biodiversity Advisory Group (comprising of the Rivers Trusts, Wildlife Trusts and Catchment Partnerships within Yorkshire, and the Environment Agency (EA) and Natural England). This co-design approach has resulted in a programme that will maximise the biodiversity benefit and achieve wider benefits to our customers.

The programme has been co-designed to focus on the areas where maximum gains to biodiversity will be achieved and to meet wider aspirations including alignment with Local Nature Recovery Strategies and UK targets of reversing Biodiversity decline. By creating a more resilient ecosystem, there are additional benefits to society including contributions to improved water quality and flood mitigation. Partnership delivery has been designed into the programme, which brings additional benefits and better value to customers, through community engagement, creating jobs, and leveraging additional funding.

Eel schemes and fish passes

As part of how we deliver our services to customer we want to improve how we care for our fish population such as European eels and Atlantic salmon. Eel screens will be installed at high priority sites to prevent their entrainment and impacts on this highly protected species. Fish passes will be installed to remove obstacles to the movement of migratory species such as salmon.

To ensure that our eel schemes will deliver best value we have consulted best practice guidance. We have also sought consultation following WINEP driver guidance and agreed our options with our regulators (e.g., Environment Agency and Natural England). Fish passes represent excellent value for customers through addressing the immediate impact on fish populations, where obstructed migration can significantly impact on fish populations and overall river health. In addition, removing obstacles helps a river to achieve its full potential and fully realise the benefits of water quality investment.

Much of our fish pass programme will be delivered in partnership via the Great Yorkshire Rivers initiative. This delivers additional value to customers through leveraging additional funding and leveraging benefits such as increased resilience in the catchment partnerships, skills and job creation and community engagement.

Invasive non-native species

Our invasive non-native species (INNS) programme addresses numerous risks to our business, communities, and the wider environment. Our core pathway options have been identified and selected through stakeholder workshops led by our external Biodiversity Advisory Group. The programme is designed to target the risks

4.0 Rationale

that will bring the largest benefit to customers and deliver value through the efficiencies of working in a strategic and coordinated way.

By targeting the most important risks we reduce the likely impact on the environment, our operations, and other stakeholders. For example, mitigating the risks of transferring INNS via numerous pathways (raw water transfers, recreational users, construction) reduces the impacts across a wider area and on a wider range of landowners and stakeholders. There are wider benefits to controlling INNS including flood protection, increased biodiversity, and improved recreation.

The programme is built on coordinated delivery and partnership (e.g. Yorkshire Invasive Species Forum), which is fundamental to the successful control of INNS. This approach represents best value for our customers, as a fragmented uncoordinated approach is ineffective and far more expensive.

4.4.1.2. WRMP

Our Water Resource Strategy sets out how we intend to maintain a safe and reliable water supply to customers over the long term. Our plan is to meet future water supply needs for Yorkshire while protecting the environment by ensuring we do not take more water than necessary - aligning with regional and national water resource planning objectives and Government strategies. The Water Resource Strategy core pathway presented in this document aligns with the draft Ofwat core pathway presented in our Draft Water Resources Management Plan 2024.

How will this deliver best value for our customers?

Our approach to seeking to ensure that our LTDS core pathway maximises value for our customers, communities, and the environment is informed by the WRMP24 methodology and optioneering process detailed in the figure below

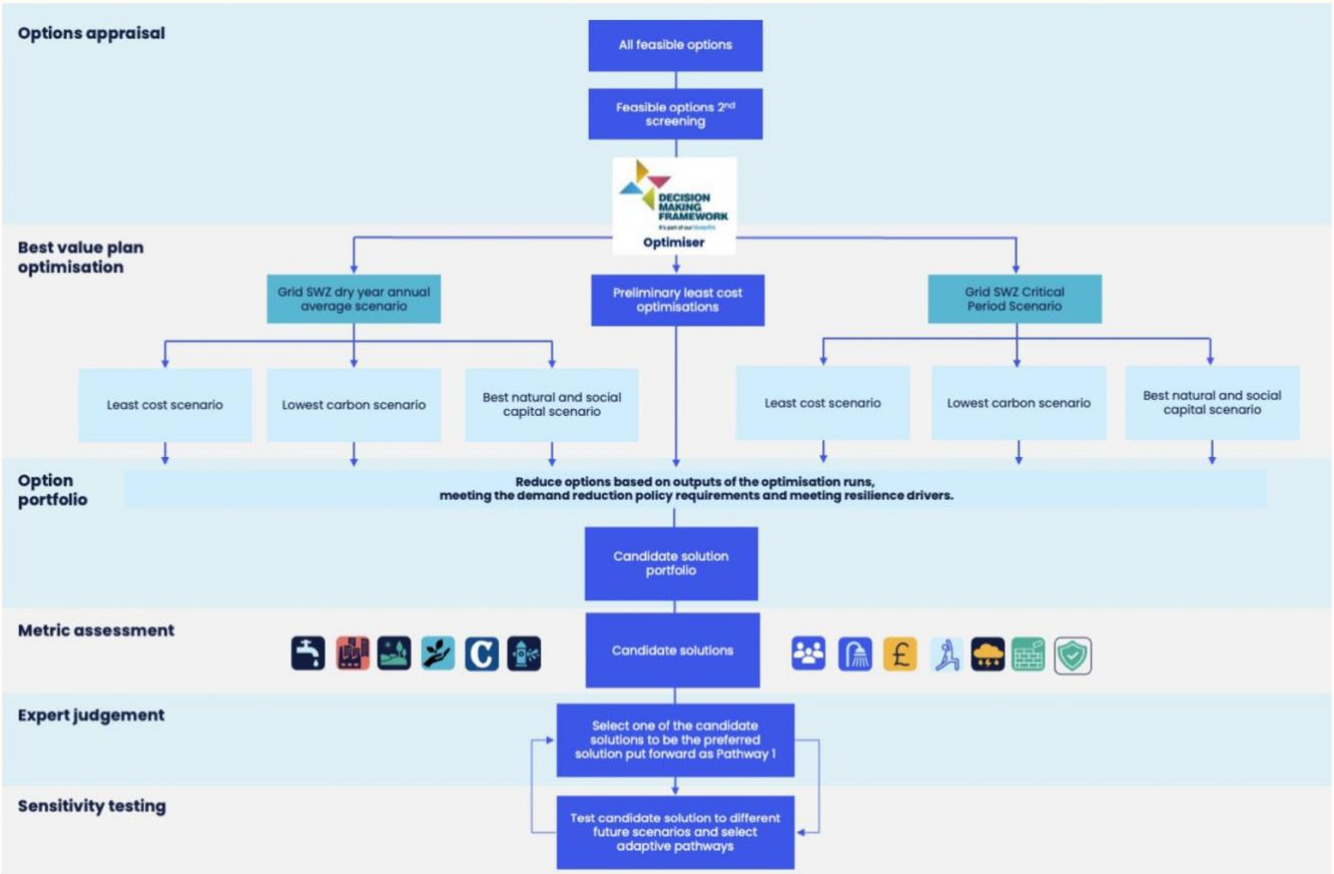


Figure 6: Our WRMP methodology and optioneering process

4.0 Rationale

The process outlined here assesses options against a variety of metrics as indicated in Step 4. These include public water supply drought resilience, biodiversity, natural capital, leakage reduction, per capita consumption reduction, flood risk management (non-drought resilience), multi-abstractor benefit, carbon, customer preferred option type, human and social well-being, financial cost, option deliverability and resilience. To ensure that our 25-year LTDS water resource strategy core pathway represents best value as defined in Ofwat's LTDS guidance, we have applied our LTDS methodology to the draft Ofwat core pathway presented in our Draft Water Resources Management Plan 2024 as described in section 2.3. The core pathway presented in this document therefore represents the minimum required interventions to ensure potential risks are mitigated and build resilience to future drought events. The sections below detail how our core pathway has been identified, selected, and sequenced to deliver best value. They have been grouped by the key strategic themes in our Water Resource Strategy.

Closing the supply-demand deficit

Our core pathway investments are sequenced so that we meet our short-term supply demand needs by 2030 and deliver supply resilience benefits in the long-term including new targeted supply sources to bolster vulnerable water treatment works currently at risk of supply outages during peak and critical demand periods. Our approach prevents large capital builds in the short-term as we will implement demand reduction schemes, allowing time to further investigate how best to meet the longer-term needs. The supply options we are proposing in our core pathway are only considered once demand options to meet policy targets have been applied. Our plan currently does not include nature-based solutions due to uncertainty about the distribution output benefits, which will be considered once further work has been conducted to understand the potential benefits.

Becoming resilient to a 1 in 500 drought (without drought measures)

To offset the public water supply drought resilience risk, we will plan to a lower level of service in the short term (a 1 in 200-year drought return period) and will be resilient to 1 in 500-year drought return period no later than 2039. Shorter term options include considering things such as balancing reservoir stocks, drought operation of sources, re-commissioning of unused sources, changes to abstraction licence agreements and reduction in reservoir compensation flows. To ensure best value and that our investments are low and no regrets, we have also reflected on the experiences of the drought in 2022. We expect to include any necessary adjustments to our revised draft WRMP. Our drought plan shows we should be resilient to a 1 in 500 level of service without the need for drought measures by 2039. We shall review the date for achieving the 1 in 500 level of service in our revised draft WRMP24. There would be benefit to customers in delivering these requirements earlier in the planning period as it would increase resilience and reduce risk. As part of the finalisation of our WRMP we will consider this in the round and assess the impact on customers' bills and affordability of the overall PR24 plan.

Meeting policy targets for demand management and leakage

As part of our appraisal process, we assessed our ability to exceed the statutory targets and considered customer, regulator, and stakeholder feedback. Following the assessment, we do not consider it to be cost effective to go beyond the statutory targets. Additionally, we are going to prioritise efforts to reduce demand whilst recognising that not all of this is in our direct control, but we want to do our utmost to play our part.

Our core pathway is designed with a linear profile of performance improvement and cost across the AMPs to provide intergenerational fairness and a trajectory towards the long-term policy targets. This approach allows us to ensure affordability in the short-term and explore innovative solutions which could make long-term delivery more cost-effective; one example of this approach is to upgrade our meters to smart technology in line with the asset life cycle. Many of our meters reach the end of their asset life in AMP8, resulting in an appropriate trigger to upgrade to smart technology which delivers additional benefits of consumption and leakage reduction. Our approach has been centred on striking the balance between the deployment of innovative solutions and known, reliable solutions to avoid unnecessary investment in technologies before we understand their impacts fully.

Increased supply resilience

As part of our long-term water resources planning, we have developed a Water Supply Systems resilience strategy (WSSS). Our WSSS project has reviewed the risk of extreme weather events and areas of our network where hydraulic constraints are challenging our ability to supply customers. During extreme weather events (summer and winter) we experience daily peaks in demand (greater than our Dry Year Annual Average or critical period demands), and when combined with network constraints, it can mean some areas, particularly if over reliant on a single Water Treatment Works, are at increased risk of outages. In our options appraisal, we have considered the risks identified in our WSSS and which of our water resources options could meet a supply-demand balance need and a WSSS need. The other aspect of this assessment is systems constraints, where the constraint is not water but rather

a function of the system itself. These options are classed as resilience options and we have included a best value metric in our decision-making process which assigns a value to options that meet resilience needs, including outage risks.

The total investment associated with supply resilience has been sequenced to deliver early in the strategy (AMP8) to maximise delivery synergies between dry year and non-drought resilience investments. Our approach to the investment profile means that we can meet supply resilience benefits at the same time as dry year investment solutions.

Meeting the needs of WINEP and environmental destination

Our options have been identified and selected by considering the timing of environmental destination, which is a component of the Government's 25-year environment plan focused on improving the environment for the next generation with specific targets for sustainable abstraction, to ensure best value and no regrets. Our groundwater Environmental Destination requirements, investigations will not be complete until 2025. For the surface water Environmental Destination, environmental and option development investigations will be concluded by the end of AMP8 to determine future solutions.

The loss of the Severn Trent Water supply (Derwent valley transfer)

The Derwent Valley transfer scheme means there will be a loss of water to our customers in a particular local area. Options have been considered to mitigate that loss and, in that process, we have identified that there are limited alternatives to deliver this need. We have explored a Strategic Resource Option with Severn Trent Water and considered enlarging an existing reservoir in their area. However, these options have now been discounted by Severn Trent Water under all scenarios and the option chosen is a treated water transfer option. To offset our loss, we must complete an internal transfer scheme which will be delivered by 2035; our profile of investment is sequenced to deliver this.

4.4.1.3. Drinking water quality

The quality of our drinking water is fundamental to our business. In our strategy we outlined that our core pathway will make ongoing improvements to drinking water taste, odour and colour as well as removing lead supply pipes from our network and addressing raw water quality deterioration.

How will this deliver best value for our customers?

To ensure our core pathway maximises value for our customers, communities, and the environment we have considered how the options we have identified, selected, and sequenced represent best value.

Taste and odour

Throughout our region we have seen continued increases in algal blooms in open waters across our region which pose risks to the quality of our drinking water. Our planned core pathway activities have been identified and selected in response to the risk of algal manifestations and their associated potential impacts on taste and odour. A range of solutions were identified and assessed to determine the best whole life value solution. In line with our long-term strategy, our approach is focused on identifying the source of the problem and applying nature-based solutions where possible. If these solutions cannot deliver the required benefits in a suitable time frame, then we will look to adopt grey solutions.

To derive a best value pathway, our approach delays capital solutions where the risk is not assessed as material. To make sure we are continually assessing the risk we are focusing on catchment management and monitoring as part of our forward look plan. Our solutions are therefore sequenced to target risks which are likely to manifest beyond acceptable thresholds in AMP8 and 9, and where nature-based solutions do not yield the necessary benefits in required timelines, grey solutions will be adopted.

Lead

Our planned core pathway activities have been identified and selected by adopting a risk-based approach. This has been informed by our water quality data and the ability to provide the best possible benefit from a public health perspective. The investment is sequenced based on this risk-based approach to give the widest benefit to customers within the bounds of available capital in line with historic expenditure.

Raw water quality

Our planned core pathway activities have been identified and selected by assessing risks to raw water quality. A range of solutions were subsequently identified and developed to determine the best whole life value solution. In line with our long-term strategy, our approach is focused on identifying the source of the problem and applying nature-based solutions as a priority. Our proposed core pathway investment delays capital solutions where continuous catchment management and monitoring are forecast to maintain the risks at tolerable levels. Our solutions are therefore sequenced to target risks that are likely to manifest beyond acceptable thresholds in AMP8 and 9, and where nature-based solutions do not yield the necessary benefits in required timelines, grey solutions will be adopted.

4.0 Rationale

Discolouration

Our planned core pathway activities have been identified by adopting a risk-based approach to prioritising interventions. This includes considering the most cost-beneficial solution to manage discolouration in our network at the points where we experience greatest risk. We have chosen to sequence our investment using a risk-based approach so that we can deliver the widest benefit to customers within the bounds of available capital in line with historic expenditure. Our core pathway therefore represents options and approaches that will deliver a best value mixture of solutions across the programme for addressing discolouration directly and indirectly.

4.4.1.4. Resilience

Embedding resilience in our business will be key to ensuring we can successfully deliver our services in an uncertain future. In our strategy we outlined that our core pathway will support initiatives that increase the survival time of water treatment works and the ability to supply customers with water in the event of a temporary outage of one or more treatment works.

How will this deliver best value for our customers?

To ensure our core pathway maximises value for our customers, communities, and the environment we have considered how the options we have identified, selected, and sequenced represent best value.

Over a two-year period, we held a series of workshops to identify how we can provide solutions that will continue developing our water supply system resilience. These were conducted with SMEs and our strategic planning partner. Water supply systems were prioritised based on resilience risk and known issues and a detailed holistic assessment of potential solutions was completed. We ensured that these solutions accounted for synergies or conflicts with other strategic planning frameworks.

Once a full list of possible solutions was identified, we completed a cost benefit analysis to identify the best value solution to meet our strategic goal of having no populations of greater than 34,000 properties connected to a single source of supply (1.5% of population based on the latest SEMD guidance). The solutions identified in the core pathway are the result of this work when tested against the scenarios and will therefore deliver the greatest benefit.

4.4.1.5. Security

In our strategy we outlined that our core pathway will support initiatives that keep our critical national infrastructure safe and compliant with the Security and Emergency Measures Directions and the NIS Directive.

How will this deliver best value for our customers?

Our planned core pathway activities have been identified following a risk assessment process that considers all our assets on an individual basis. This means that each asset (circa 5000 cyber physical assets) has a tailored safety approach. Our risk assessment identifies what investment will deliver the greatest mitigations in the short, medium, and long term by assessing the consequences of a breach and tailoring our solutions across our asset base, thereby ensuring our core pathway activities will deliver best value.

4.4.1.6. Net Zero

In our strategy we outlined that as part of our long-term emissions reduction plan our core pathway will support the expansion of renewable energy generation technologies, system upgrades to reduce chemical emissions and reduce our wider emissions associated with purchased goods as well as services and capital goods.

How will this deliver best value for our customers?

To ensure our core pathway maximises value for our customers, communities, and the environment we have considered how the options we have identified, selected, and sequenced represent best value. We aim to ensure we are aligned with government targets and achieve our own net zero ambitions. To attain and sustain this we need to undertake a programme of enhancement investment.

Renewables

To design and test our core pathway we have used the insight of our commercial team and their expertise in renewable markets and investments to build renewable energy investment models. This has helped us ensure that the investments we will make in renewable energy solutions are the right ones at the right time. Our focus on rooftop and ground mounted solar solutions in AMP8 means we will be able to substitute some of the energy from the national grid with our own solar power. Beyond further investments in solar, in the longer-term we plan to invest in other renewables. Therefore, in the short term our core pathway will align us with science-based targets to reduce scope 2 related emissions, through using lower carbon energy options and in the longer term will enhance resilience and energy cost security.

Purchased Chemicals

As a business we are reliant on a substantial volume of chemicals to deliver our core services of water and wastewater treatment but acknowledge that these are a significant source of our carbon footprint. As we make decisions about how to deliver our core services, we consider how the decisions we make will impact on our ongoing chemical usage and seek to identify solutions that will result in lower chemical usage and associated

4.0 Rationale

carbon emissions. At Yorkshire Water, we utilise the PAS2080 standard to assess and manage whole life carbon including the operational carbon impact of chemicals and selection of alternative solutions. Following optioneering, we have included nature-based and other alternative solutions to chemical dosing in our core pathway. In the core pathway, an upfront investment in AMP8 is required to align with the need to reduce reportable emissions in operational carbon performance commitments. Therefore, our plans to deliver solutions focused on purchased chemicals will be phased across later AMPs.

Embedded emissions in purchased goods, services and capital goods

Our planned core pathway activities have been identified following our optioneering for capital programme assessment. We have used this methodology to identify lower carbon solutions for purchased chemicals. At Yorkshire Water we utilise the PAS2080 standard to assess and manage whole life carbon including the operational carbon impact of chemicals and selection of alternative solutions. Following optioneering we have included nature-based and other alternatives to asset intensive solutions in line with our no build, build less, build smarter, build greener approach. The phasing of our investments allows for a tailwind in reduction from decarbonisation of energy and materials.

4.4.2. Wastewater

We have grouped our investment proposals for wastewater data table lines according to our strategic planning areas. This includes WINEP, DWMP, Bioresources, Resilience, Security, Net Zero and Living with Water. In the following section we will describe where we have planned enhancement investment and how this will help us achieve our strategy. Our approach will ultimately help us deliver on our commitments to our customers whilst supporting the local environment and ecosystem.

4.4.2.1. WINEP

In our strategy we outlined that our core pathway includes the necessary level of enhancement expenditure to ensure we meet the EA's Monitoring Certification Scheme and the government's SODRP, alongside our other statutory targets. We also want to encourage a move away from traditional solutions to treat and remove chemicals, as it is important that we move towards more sustainable options. This will be done by focusing on different treatment types such as source control and nature-based solutions as opposed end-of-pipe treatment. These solution choices will seek to deliver best value for our customers and the environment. At our coastal and inland bathing water sites, we are committed to meeting customer expectations for improved water quality standards.

How will this deliver best value for our customers?

To ensure our core pathway maximises value for our customers, communities, and the environment we have considered how the options we have identified and selected represent best value.

Storm overflow improvement

To make sure our core pathway options will deliver long-term sustainable solutions that will deliver best value for customers, we have sought to balance the additional benefits of delivering nature-based solutions, with the comparatively higher cost of deploying then in this application. We will focus on delivering outcomes using a blend of storage solutions, surface water removal and nature-based solutions. In the short term, we aim to deliver 20% of our interventions with blue green components, increasing this to 50% in future periods. We will always work to reduce the amount of traditional storage we need to deploy in the sewer network by working to reduce the amount of surface water that enters our sewer network alongside using nature-based options to store any excess flows. We will increase our costs and benefits certainty as we develop schemes in the short term and anticipate that this will result in a wider and efficient deployment of nature-based approaches in future AMPs.

Nature based solutions for final effluent treatment

Due to permitting regulations, there are limitations on the types of solutions that can be implemented to meet the requirements. For example, some Urban Wastewater Treatment Directive driven schemes specify end of pipe solutions. In other cases, nature-based solutions may only be suitable at sites with less stringent permit requirements. As a result, there can be a limited application for nature-based final effluent treatments. Current nature-based solutions also have a large physical footprint which limits viable sites further. We have identified any suitable sites based on these variables and are implementing nature-based solutions where possible. In the longer term we will work on

4.0 Rationale

gaining a better understanding and confidence in solutions with the aim of extending natured based solutions to larger population and permit limits.

Monitoring

Sites and locations for event duration monitoring, flow monitoring at sewage treatment works, river water quality monitoring and monitoring at emergency sewage pumping station overflows, will be selected based on Environment Agency guidance. The phasing of the investment is dictated by Defra requirements which is written into EA guidance.

Traditional biological wastewater treatment

Permit limits for a treatment works are set based on the needs of the receiving watercourse. We select appropriate wastewater treatments according to size of treatment works, permit limits, available land, cost, carbon and additional benefits. We monitor the market place for the emergence of new technologies and are aiming to move to more nature-based solutions, as our understanding and confidence in reliability improves.

Final Effluent treatment via chemical dosing

By 2038 we must achieve the national statutory target of an 80% reduction in net phosphorous loading from treated wastewater (from a 2020 baseline). Chemical dosing solutions have high-certainty and are cost-effective for the removal of phosphorus. To mitigate risk associated with chemicals such as the supply chain risk, environmental impact, and fluctuating costs, the core pathway considers how we could deploy different technologies such as nature-based solutions or enhanced biological phosphorus removal. We have taken a detailed bottom-up approach to developing site specific solutions. By tailoring solutions, we have ensured that investments are optimised to deliver best value. We share best practice with other water companies which supports our aim to move to more natured based solutions for treatment of final effluent.

Catchment management

Our future catchment management plans will be determined by forthcoming studies between us and the relevant strategic planning bodies, to identify the most appropriate locations to carry out our catchment management programmes across the region. We intend to adopt the learning from our catchment management activities for raw water protection and apply this to managing nutrients at source in raw water catchments rather than removing them through end-of-pipe treatment solutions.

4.4.2.2. DWMP

Our DWMP is a long-term strategic plan, designed to help us to maintain a robust and resilient drainage and wastewater system for customers and communities into the future. It outlines the long-term needs and requirements of drainage, wastewater, and environmental water quality, and demonstrates how we will address key issues such as sewer flooding, storm overflows and environmental protection. Our core LTDS pathway includes the required level of enhancement expenditure to ensure we meet all the targets from the SODRP (except for those relating to no local ecological harm) and our regulatory environmental targets. We also want to ensure that designated coastal and inland bathing waters will not be negatively impacted by our operations. We will begin to reduce the impact of modelled hydraulic flood risk, thereby reducing the risk of internal and external flooding to customers' homes and businesses.

How will this deliver best value for our customers?

To ensure our core pathway maximises value for our customers, communities, and the environment we have considered how the options we have identified and selected represent best value.

Storm overflow improvement

Society's acceptance of spills from storm overflows is changing. This has led to the government and our regulators requiring water companies to reduce the overall number of spills and any local ecological harm from our storm overflows into the river system in line with the targets in the 25-year storm overflow discharge reduction plan. Investment is required to reduce the number of spill events each year without increasing the risk of properties flooding during extreme rainfall events by reducing the amount of rainwater that enters our sewers or by storing the flows generated.

Our core pathway option has been identified by considering and balancing the need to move towards lower carbon solutions that benefit the wider environment, against the bill impacts that the phasing of this might have on customers whilst we trial innovative technologies to produce different solutions for our network that benefit our customers. The solutions that have been initially identified will be refined during delivery of these projects to meet our statutory regulatory requirements and the expected timelines and targets to allow us to deliver best value for customers and the environment.

We will focus on delivering outcomes using a blend of storage solutions, surface water removal and nature-based solutions. In the short term, new storage solutions will address AMP8 targets whilst ensuring best value for customers. We will always work to reduce the amount of traditional storage we need to deploy in the sewer network by working to increase the amount of surface water that enters our sewer network alongside using nature-based options to store any excess flows. We will increase our costs and benefits certainty as we

develop schemes across AMP8 and deploy these on a wider basis following catchment-based approaches in future AMPs.

Hydraulic flooding

Our core pathway addresses the need to reduce the impact of internal and external modelled hydraulic flooding to properties over time. In the short-term we will be reducing modelled hydraulic flood risk through our blue-green storm overflow solutions and working to maximise benefits through multi-scheme delivery. We will continue to work to optimise our hydraulic flood risk programme in line with our other activities and continue to work to undertake our business-as-usual activity in response to customer reports of flooding.

4.4.2.3. Bioresources

In our strategy we outlined that our core pathway includes the necessary level of enhancement expenditure to meet the quality standards required to recycle treated sludge to land. We also want to ensure that we create additional sludge storage capacity to increase our resilience.

How will this deliver best value for our customers?

To ensure our core pathway maximises value for our customers, communities, and the environment we have considered how the options we have identified and selected represent best value.

Biosolids recycling

We have identified and selected our options by reviewing the existing condition of our assets, and balancing the investment required to maintain them alongside alternative options to expand or build new facilities that would deliver increased benefits such as higher levels of treatment. Based on this, we have determined the optimal strategy for delivery of a reliable asset base with efficient operation. The mix of options and approaches represents the most efficient and optimal solutions. Our priority is on building less infrastructure and reducing energy consumption. The sequencing of the plan is designed to meet current and known future regulatory requirements, balancing the need for increased resilience and short-term impacts on customer affordability.

4.4.2.4. Resilience

In our strategy we outlined that our core pathway includes a relatively small amount of necessary enhancement expenditure to ensure we improve the resilience of our wastewater assets to flooding

How will this deliver best value for our customers?

To ensure our core pathway maximises value for our customers, communities, and the environment we have considered how the options we have identified and selected represent best value.

Resilience

In identifying and selecting our options we followed a risk-based approach. We used data from the Environment Agency and DEFRA's Evaluation of Risk of Coastal Erosion to help us identify where we needed solutions which were then prioritised within our affordability constraints. The options and mix of approaches have been driven by Totex hierarchy, this promotes options with the least carbon impact, that avoid operating risk, whilst still mitigating the risk of erosion and flooding on our wastewater assets. The investments are sequenced in terms of urgency and risk. In the short term, we will implement flood defences, fixed and mobile, and where possible for the longer term explore how nature based solutions could deliver increased flood resilience.

4.4.2.5. Security

In our strategy we outlined that our core pathway will support initiatives that keep our critical national infrastructure safe and compliant. We have identified investment required to address the risk of cybercrime being targeted of our physical assets. No enhancement costs are proposed to comply with the Security and Emergency Measures Direction as subject to any change in statutory requirements, these will be funded from base expenditure.

How will this deliver best value for our customers?

To ensure our core pathway maximises value for our customers, communities, and the environment we have considered how the options we have identified, selected, and sequenced represent best value.

Our planned core pathway activities have been identified following a risk assessment process that considers assets on an individual basis. This means that each asset (circa 5000 cyber physical assets) has a tailored safety approach. Our risk assessment identifies

4.0 Rationale

what investment will deliver the greatest mitigations in the short, medium, and long term, thereby ensuring our core pathway activities will deliver best value.

4.4.2.6. Net Zero

In our strategy we outlined that our core pathway will support our activity to tackle CH_4 and N_2O process emissions at our wastewater treatment sites. We are driven by compliance to government targets for net zero and have additional requirements to meet specific legislative requirements such as the Industrial Emissions Directive. We have also included investment in renewables at our wastewater sites.

How will this deliver best value for our customers?

To ensure our core pathway maximises value for our customers, communities, and the environment we have considered how the options we have identified and selected represent best value.

Process emissions

Our options have been identified and selected with the support of a specialist consultants. We have reviewed the options for process emission control and considered the whole life carbon benefit. A range of solutions were considered, and the selected solutions represent the most cost efficient. The Government Green Book investment case for carbon at £268/tCO_2e was used as a reference value for the point at which we decide what type of greenhouse gas reduction scheme is optimal in a particular situation. The investments have been sequenced so that process emissions are priority, with a focus to deliver early reduction of these emissions as part of science aligned targets to deliver net zero by 2050.

Renewables

To identify and select our options, renewable energy investment models have been built. Focus will be on rooftop solar installations for AMP8 as this presents the lower cost option and then ground-mounted installations to follow. We will be able to substitute some of the energy from the national grid with our own solar power. Investment in other renewables will follow where this is cost beneficial. The investment has been sequenced to align with grid decarbonisation between 2035 and 2040. The short-term aim is to align with science-based targets to reduce scope 2 related emissions, but also to enhance resilience and energy cost security.

4.4.2.7. Living with Water

In our strategy we outlined that our core pathway will support our Living with Water Partnership to address surface water flood risks in east Yorkshire, which is based on the Blue-Green Plan to deliver flood resilience for Hull and Haltemprice.

How will this deliver best value for our customers?

To ensure our core pathway maximises value for our customers, communities, and the environment we have considered how the options we have identified and selected represent best value.

The Blue Green Plan (BGP) was developed by the Living with Water Partnership and consultants Stantec through a jointly funded Yorkshire Water and Government study. The long-term, city-wide strategy looks to address frequent and extreme flooding from surface water. The plan recognises that water does not sit in isolation, but is an integral part of other services, sectors, growth and change within Hull and Haltemprice. It takes a system-based view and seeks to work with others to co-plan, co-create, co-fund and co-deliver schemes that create multiple benefits whilst reducing the cost to deliver. In creating the BGP, a group of stakeholders from across the organisations came together in two charettes, held across two days which were attended by over 50 stakeholders. The first stage of the plan was to understand the current position from a policy and performance perspective. A charrette was then held to form ideas and strategies, which were then shaped and tested to validate the art of the possible. Over the last nine years, we have developed tools to improve our understanding of flood risk in the area, including a 2D integrated hydraulic model which has provided a basis to develop and test multiple solutions in the plan.

The options and mix of approaches have been focused on increasing flood resilience whilst enhancing and improving spaces and places for our communities. The plan will help transform our urban areas to better utilise green spaces, store surface water locally, move surface water and reuse the surface water. This plan helps us combat climate change whilst enhances our city and the wellbeing of our communities.

4.0 Rationale

The BGP has six strategic layers:

People and culture

This underpins the plan including co-creation, education, awareness, jobs, skills.

Blue green corridors

A network of blue green channels to act as both receptors of surface water and a conveyor of surface water across the city that will remove floodwater from properties and living spaces.

Source control

Reducing the flow peak entering the drainage networks using sustainable drainage systems such as highway rain gardens, property planters and smart water butts.

Managed change

Repurposing and regeneration of certain parts of the city with a focus on blue-green infrastructure and flood resilience.

SMART technology

A smart approach will support and optimise the use of above and below ground spaces to provide flood alleviation in the right place at the right time.

Grey infrastructure

Infrastructure such as pumping stations, buried culverts and pipes will be required to help connect many of our blue green corridors and interventions.

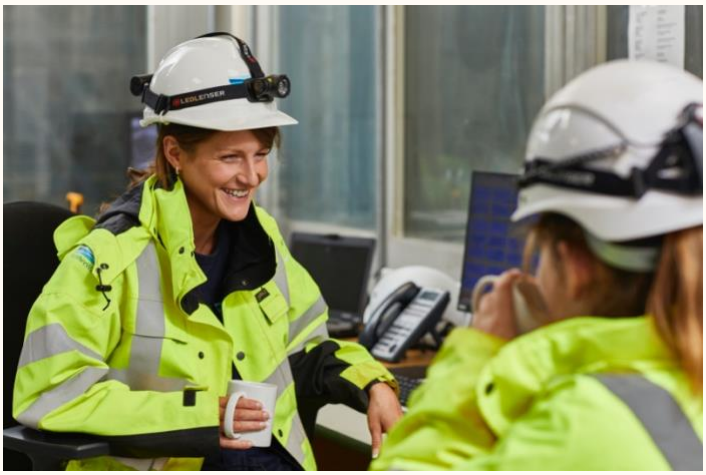
The investments are sequenced to ensure the Blue Green Plan is affordable and deliverable, a programme of activities has been developed over the short, medium, and long term. The significant culture and behaviour changes required to implement the plan will take time. The learnings and proof of concepts from the AMP7 schemes, combined with the short-term plan addressing policy, funding, co-creation, and education, will be key to delivering a successful BGP.

4.5. Identifying our alternative pathways

In this section we set out our alternative adaptive pathways which could be triggered depending on how future uncertainties develop

Step One

Following scenario testing as detailed in section 4.3 where we identified where our investment lines were affected by the plausible extremes presented by the scenarios, we then sought to identify those areas where the affect was material such that it should warrant an alternative pathway. As a business we defined the alternative pathway materiality threshold as LS3 or LS4 data lines that incurred >£100m per AMP increase in enhancement expenditure when needing to adapt to one of Ofwat's common reference scenario (CRS) or one of our wider reference scenarios (WRS). This materiality threshold approach aligns to the approach we take for our annual financial audits, and therefore provides consistency with our wider business activities.



Step Two

Having determined this materiality threshold assessment and applied it, we then conducted a series of workshops with our SMEs to ensure our alternative pathways had the following defined:

- the point in time at which the alternative pathway deviates from the core or another alternative pathway;
- when the decision would need to be taken about whether the alternative pathway is followed (decision point);
- the circumstances under which the alternative pathway would need to be followed (trigger point);
- how these circumstances will be assessed and monitored; and
- the relative likelihood of the alternative pathway.

To assess the relative likelihood of the alternative pathway, we drew on the advice of subject matter experts and management to reflect on how likely it was that we would reach the trigger point. If the circumstances of the trigger point arise, we will follow our adaptive pathway to ensure we can continue delivering for our customers and the environment.

4.0 Rationale

4.6. Our alternative pathways

The outputs of our stepped methodology for identifying potential alternative pathways are:

- We expect to follow two alternative pathways (one for Clean water and one for Wastewater) under the circumstances of the Customer Affordability Concerns (adverse) scenario for various investment areas
- We expect to follow an alternative pathway under the circumstances of the Abstraction Reductions (high) scenario for WRMP.
- We expect to follow an alternative pathway under the circumstances of the Lead-free Yorkshire scenario for Water Quality.
- We expect to follow an alternative pathway under the circumstances of the Society-driven Substance Intolerance scenario for Bioresources and WINEP wastewater.
- We expect to follow an alternative pathway under the circumstances of the Farming Rules for Water scenario for Bioresources.
- We expect to follow an alternative pathway under the circumstances of the Climate Change (high) scenario for DWMP.

4.0 Rationale

4.6.1. Clean Water

4.6.1.1. Most likely dWRMP24 pathway and Abstraction reduction scenario

WRMP

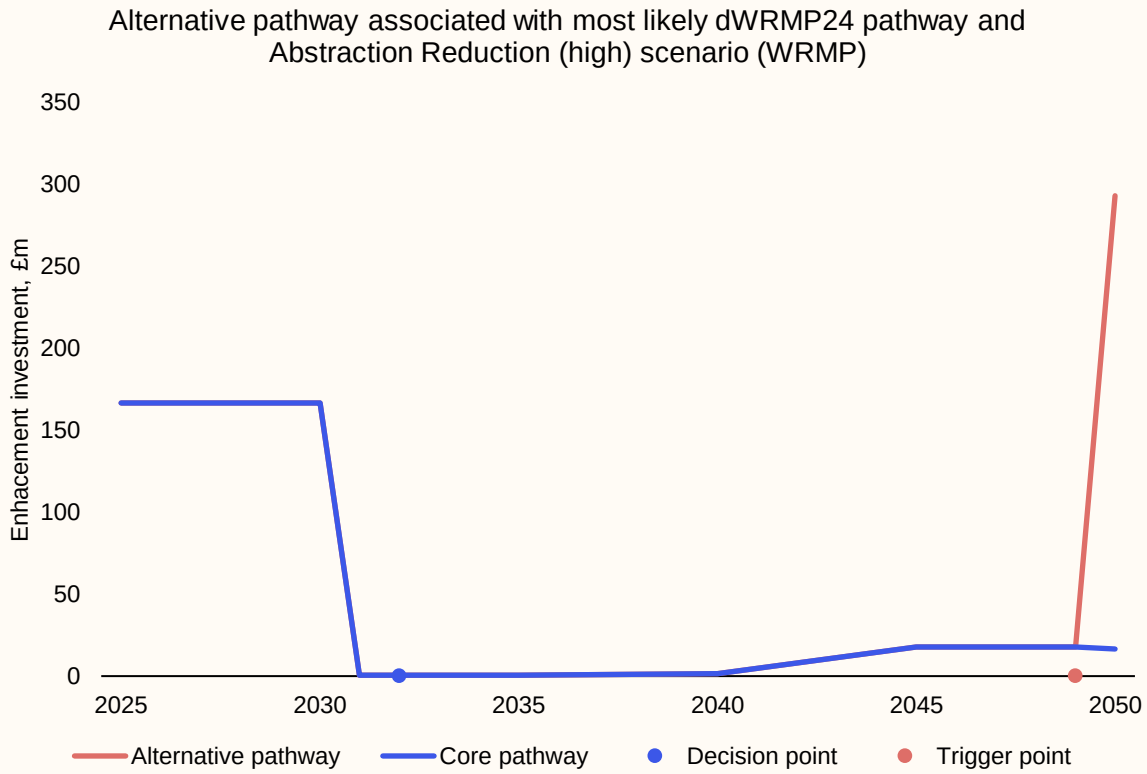


Figure 7: Alternative pathway associated with most likely dWRMP24 pathway and Abstraction Reduction (high) scenario (WRMP)

Within the LTDS, Ofwat expects companies to present their 'most likely' pathway from their WRMPs as an alternative pathway-where this is not the same as the core pathway. This is to show where the activities required to meet the dWRMP24 'most likely' scenarios diverge from the core pathway.

Alternative pathway foundations

Figure 7 illustrates the AMP-by-AMP anticipated enhancement expenditure of our draft WRMP 'most likely' pathway in comparison to the AMP-by-AMP LTDS core pathway for supply-side improvements.

This figure demonstrates that our WRMP most-likely pathway diverges from our LTDS core pathway at the start of AMP 12. The divergence reflects how the WRMP most-likely pathway brings in the Tees to Yorkshire transfer, a transfer from Northumbrian Water to Yorkshire Water. This is because to deliver the environmental destination plan, we will need to meet the Common Standards Monitoring Guidance (CSMG). This is government guidance that sets flow targets for European protected areas and impacts us because there will be a resultant licence reduction on the river Derwent by 2050. Through introducing a transfer from outside out region, we will be able to meet these requirements whilst continuing to deliver our services to our customers in the long-term.

The alternative pathway we expect to follow to respond to Ofwat's adverse abstraction scenario is the same as our 'most-likely' DWMP pathway. In addition, we have included the decision and trigger points specific to the abstraction scenario. We expect to decide on whether we will need to follow the most-likely pathway in 2032 following the completion of the environmental investigation work being conducted on the river Derwent to look at what is needed to meet legislative expectations. Having determined whether we need to prepare for the circumstances of Ofwat's adverse abstraction scenario, we anticipate the pathway will be triggered in in 2049, as this when is when CSMG will be introduced. At present we believe there is a 40% likelihood of this occurring. It is important to note that the trigger point might be revised following the revised

4.0 Rationale

draft WRMP as we are reviewing our environmental investigation plans.

4.6.1.1. Technology scenario WRMP

Following scenario testing we anticipate that our planned core pathway investment focused on metering will be impacted by Ofwat's benign technology scenario. Following the completion of the revised draft WRMP, we expect to be able to quantify this impact in more detail. Based on our current developing plans, we expect this alternative pathway will reprofile any planned enhancement investment in AMPs 10, 11 or 12 to be delivered in AMP 9 so that we can achieve the scenario goal of full smart water meter penetration by 2035.

4.0 Rationale

4.6.1.2. Lead-free Yorkshire Drinking Water Quality

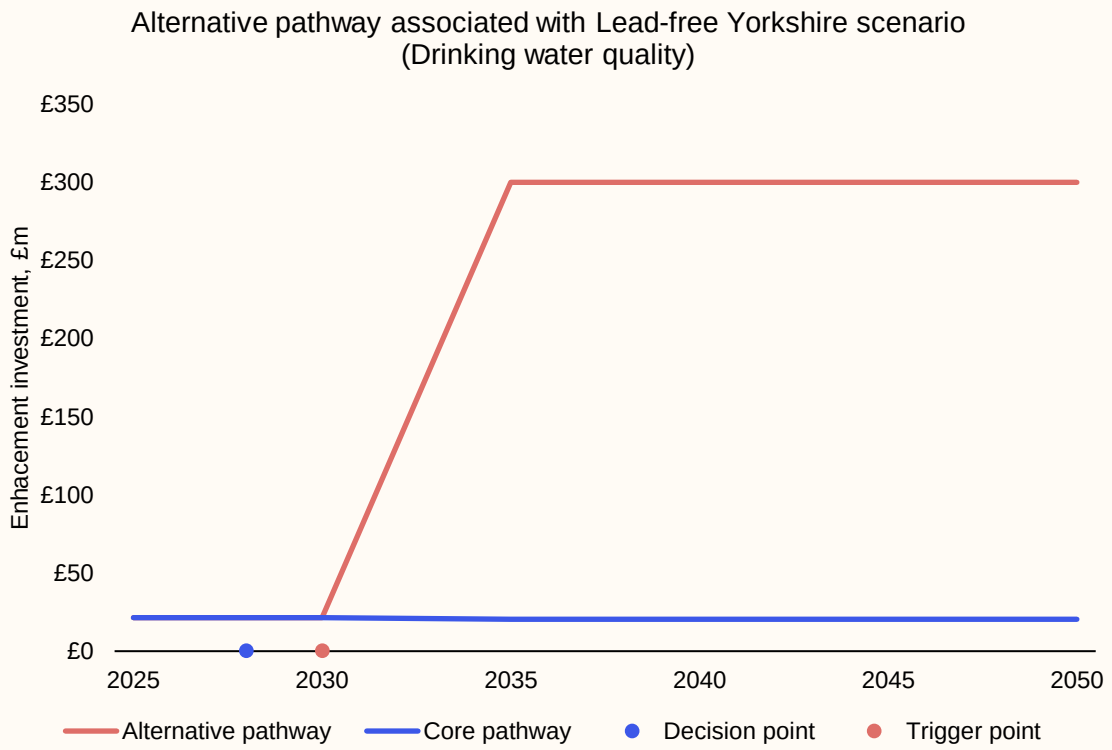


Figure 8: Alternative pathway associated with Lead-free Yorkshire scenario (Drinking water quality)

Our alternative pathway reflects the anticipated need to remove all lead from our network. Figure 8 illustrates the total anticipated enhancement expenditure in comparison to the total core pathway enhancement expenditure across all lines that are highly impacted by our Lead-free Yorkshire Wider Reference Scenario within the Water Quality strategic planning area. The decision point is expected in the latter years of AMP8 followed by a trigger point at the start of AMP9 for these data lines.

Alternative pathway foundations

Following scenario testing with our SMEs it seems possible we will need to follow an alternative investment pathway to deliver total lead removal from our network. We anticipate a societal driven change that would result in the DWI changing legislation or regulation, requiring full removal of lead pipes in water networks. We believe there is a 20% likelihood that these circumstances will arise, triggering the alternative pathway from AMP9 onwards. Our pathway reflects the removal and replacement activity being carried out over 25 years, although we note that our Lead Strategy also contains alternative plans for removal over 40- and 60-year periods. We have not included these as separate pathways on the basis that they are not independent (i.e., if one pathway materialised the others would become redundant) and the 25-year scenario aligns with the LTDS planning period (i.e., 2025-2050). The detail has been taken from the Lead Strategy submitted to the DWI which assumes at least a further 5 years post AMP12 to fully remove lead from our networks. The legislation will be assessed and monitored for any change.

4.0 Rationale

4.6.1.3. Customer affordability concerns
Resilience (clean water)

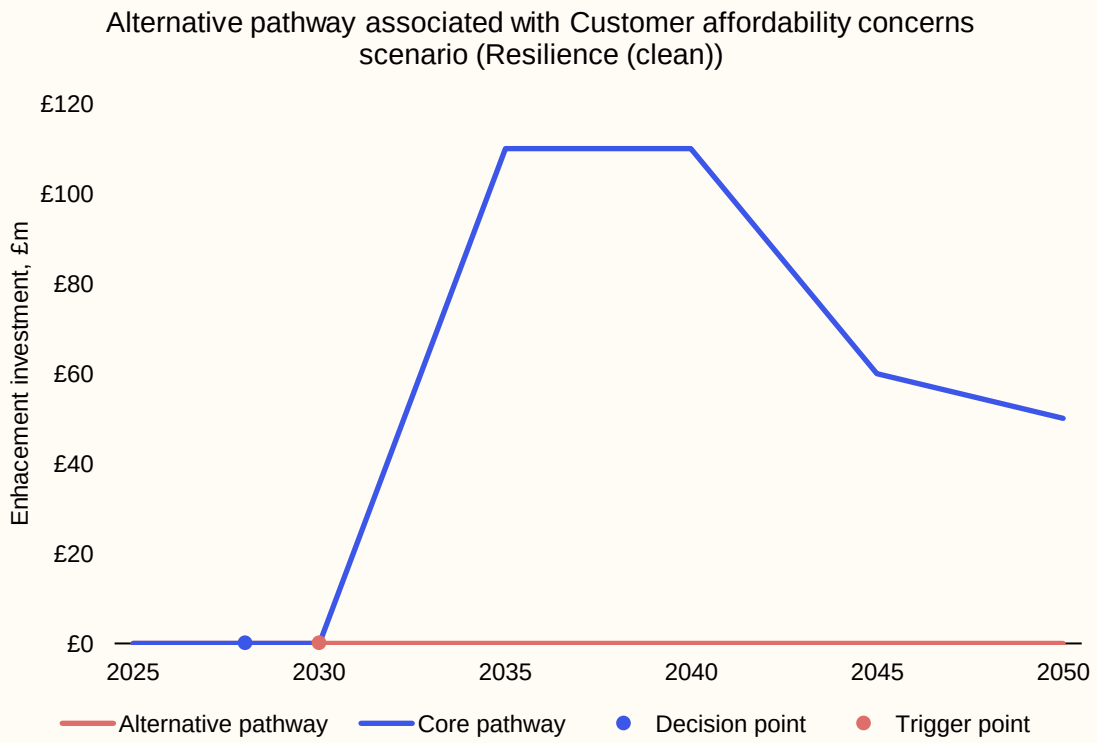


Figure 9: Alternative pathway associated with Customer affordability concerns scenario (Resilience (clean))

Our Statutory Investment Programme alternative pathway would deliver a programme to meet statutory requirements and minimise immediate costs for our customers. Figure 9 illustrates the reduction in total anticipated enhancement expenditure in comparison to the total core pathway enhancement expenditure across investment lines that are highly impacted by our Customer Affordability Concerns Wider Reference Scenario within the Resilience strategic planning area. The decision point is expected in the latter years of AMP8 followed by a trigger point at the start of AMP9 for these data lines.

Further information on wastewater investment areas that would be impacted by this alternative pathway is provided in section 4.7.1.3.

Alternative pathway foundations

Scenario testing with our SMEs indicates that our Resilience investment activities would be reduced under this alternative pathway as these are not underpinned by statutory obligations. We believe there is a 60% likelihood these circumstances will arise to trigger the alternative pathway at the start of AMP9.

4.0 Rationale

4.6.1.4. Wastewater

Society-drive Substance Intolerance

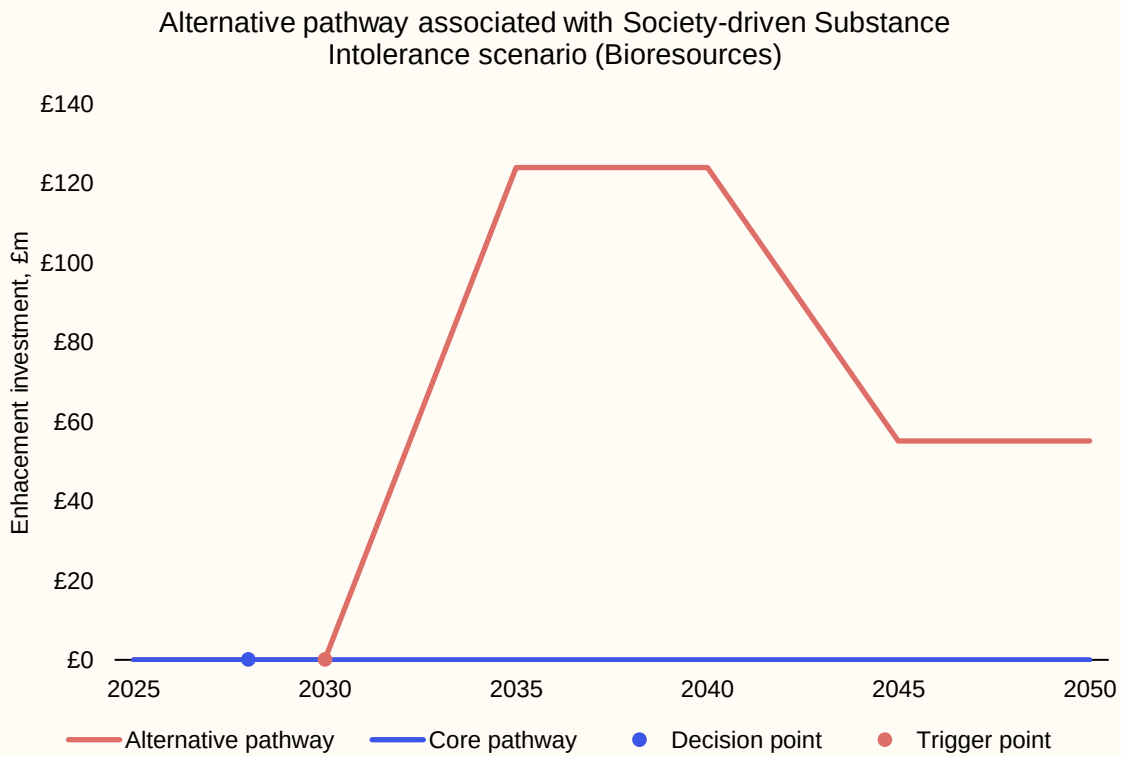


Figure 10: Alternative pathway associated with Society-driven Substance Intolerance scenario (Bioresources)

In the event that either the Society-driven Substance Intolerance scenario and/or the Farming Rules for Water scenario is triggered, the same course of action will be followed and only needs to be delivered once. We expect the decision point for whether we need to prepare for the Society-driven Substance Intolerance scenario to arrive after the decision point for the Farming Rules for Water scenario. Therefore, if the Farming Rules for Water scenario is planned to be delivered and later the Society-driven Substance Intolerance scenario is also triggered, then based on the technology currently available to us, we would not need to conduct the work twice.

Bioresources (wastewater)

Our alternative pathway reflects the anticipated need to build two new incineration facilities. Figure 10 illustrates the total anticipated enhancement expenditure in comparison to the total core pathway enhancement expenditure across all lines that are highly impacted by our Society-driven Substance Intolerance Wider Reference Scenario within the Bioresources (wastewater) strategic planning area.

The decision point is expected in the latter years of AMP8 as part of our bioresources planning for the PR29 Price Review, followed by a trigger point at the start of AMP9 when we have anticipated the legislative change might come into effect and impact these data lines.

Alternative pathway foundations

Following scenario testing with our SMEs it seems possible we will need to follow an alternative investment pathway to safely dispose of sludge. We anticipate a societal driven change in tolerance to forever chemicals in water and our final effluent, leading to legislation change could come to rigger this. We believe there is 10% likelihood that these circumstances will arise, triggering an alternative pathway from AMP9 onwards. The circumstances will be assessed and monitored by ongoing proactive customer engagement work and press coverage of the issue, to assess public opinion and monitor likelihood of change alongside monitoring changes in legislation.

4.0 Rationale

4.6.1.5. Farming Rules for Water Bioresources (wastewater)

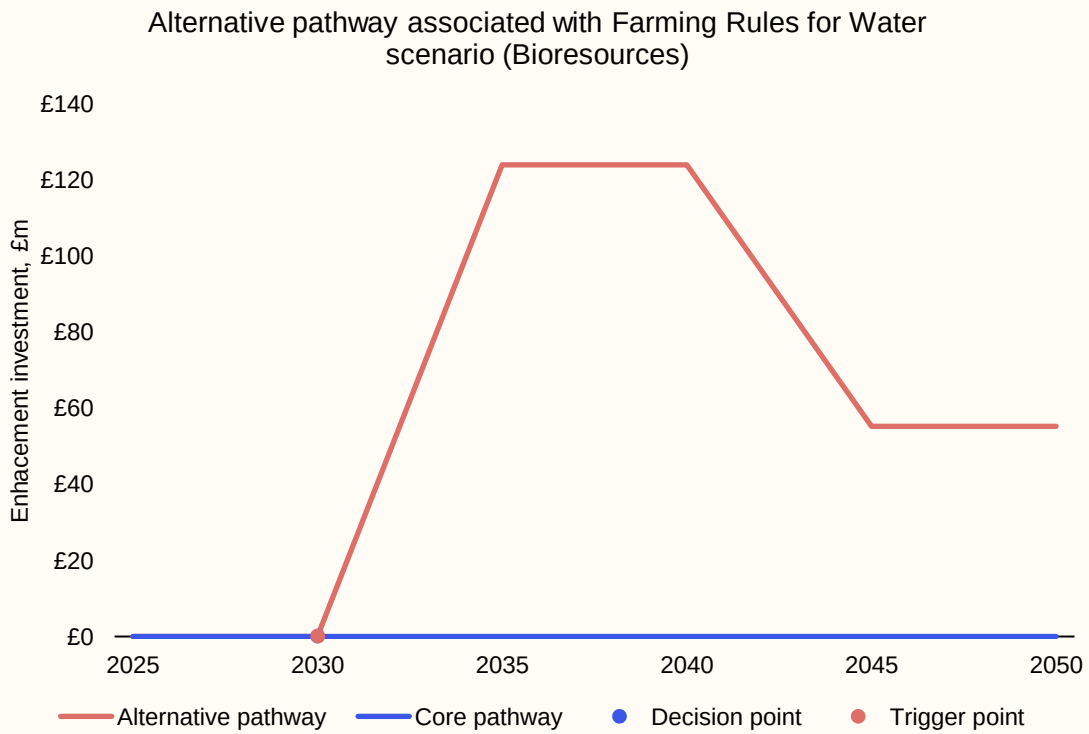


Figure 11: Alternative pathway associated with Farming Rules for Water scenario (Bioresources)

Our alternative pathway reflects the anticipated need to build two new incineration facilities. The figure above illustrates the total anticipated enhancement expenditure in comparison to the total core pathway enhancement expenditure across all lines that are highly impacted by our Farming Rules for Water Wider Reference Scenario within the Bioresources (wastewater) strategic planning area. The decision and trigger points for these data lines will be the same.

Alternative pathway foundations

Following scenario testing with our SMEs it seems possible we will need to follow an alternative investment pathway to safely dispose of sludge. We anticipate that a more stringent application of the Farming Rules for Water, could stop water companies from recycling sludge to agricultural land. We believe there is 30% likelihood that these circumstances will arise, triggering an alternative pathway from AMP9 onwards, but we expect the likely probability to increase over time to 50% in AMP10, 60% in AMP11 and 70% in AMP12. The circumstances will be assessed and monitored by cross-company working groups and annual reviews to assess the likelihood of change.

4.0 Rationale

4.6.1.6. Society-driven Substance Intolerance WINEP (wastewater)

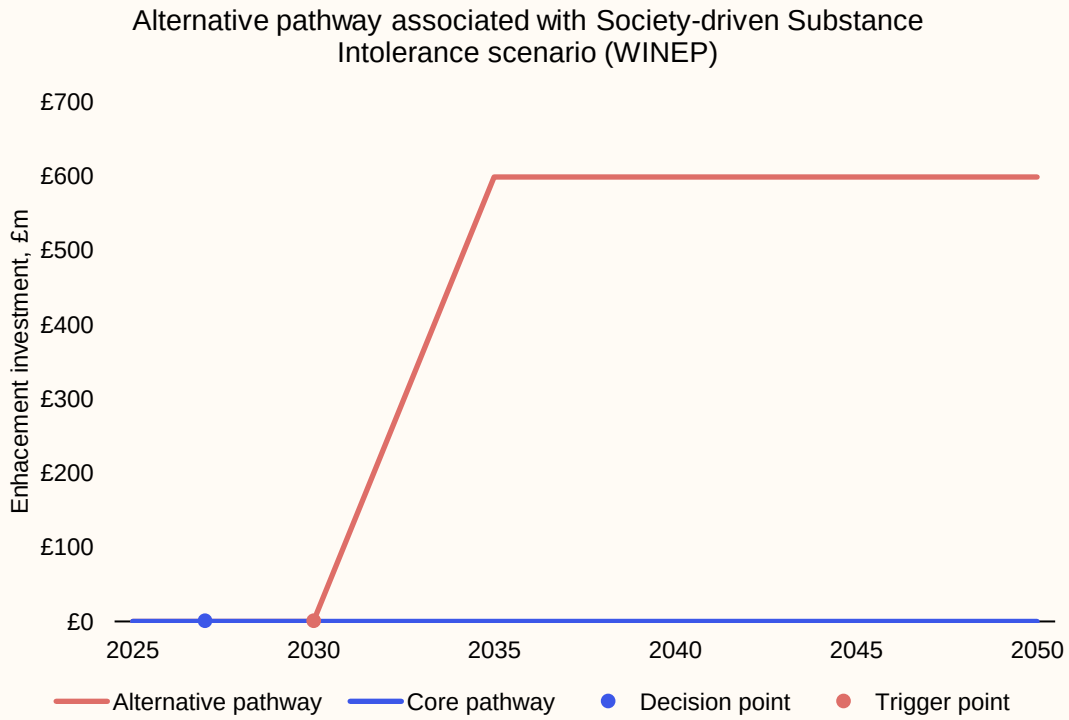


Figure 12: Alternative pathway associated with Society-driven Substance Intolerance scenario (WINEP)

Our alternative pathway reflects the anticipated need to treat final effluent for the removal of PFAS. The figure below illustrates the total anticipated enhancement expenditure in comparison to the total core pathway enhancement expenditure across all lines that are highly impacted by our Society-driven Substance Intolerance Wider Reference Scenario within the WINEP (wastewater) strategic planning area. The decision point is expected during the next WINEP planning round in the latter years of AMP8 followed by a trigger point at the start of AMP9 for these data lines.

Alternative pathway foundations

Following scenario testing with our SMEs it is possible we will need to follow an alternative investment pathway to treat our final effluent. We anticipate a possible societal driven change in tolerance to forever chemicals in water and the environment, leading to legislation change. We believe there is 10% likelihood that these circumstances will arise, triggering an alternative pathway from AMP9 onwards. The circumstances will be assessed and monitored against legislation and engaging the public and media on opinions and research on forever chemicals.

4.0 Rationale

4.6.1.7. Climate change (high) DWMP

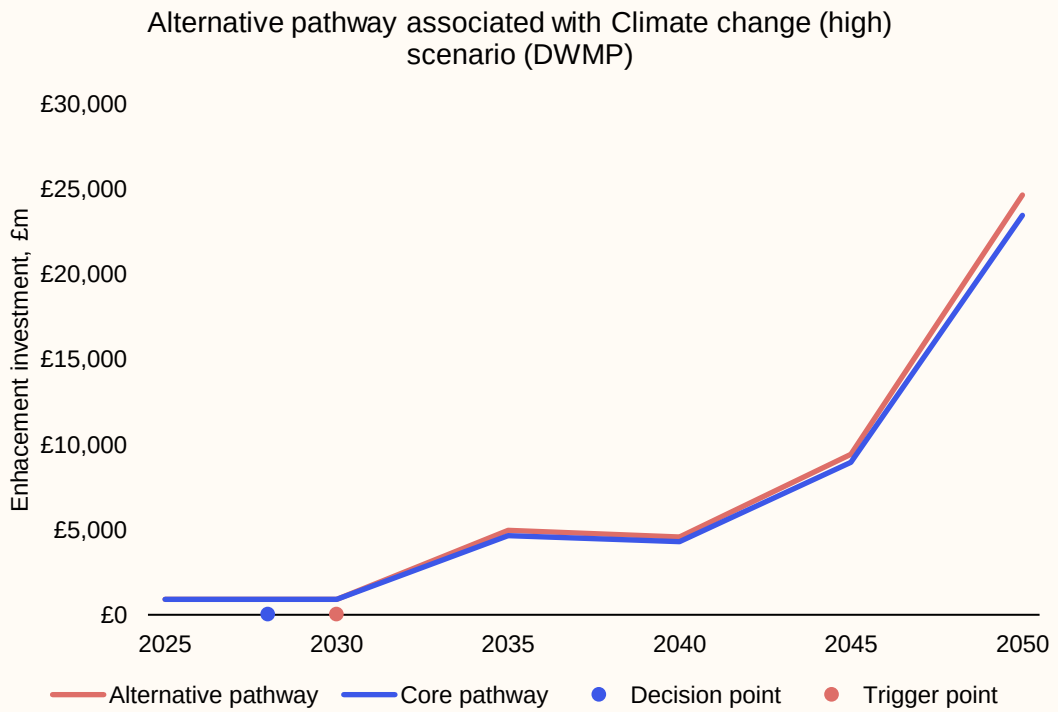


Figure 13: Alternative pathway associated with Climate change (high) scenario (DWMP)

Our alternative pathway reflects the additional needs for increased wastewater network storage or surface water removal under the adverse climate scenario. Sensitivity testing in the DWMP shows that to reduce the risk of the use of storm overflows under this adverse scenario, and also the risk of hydraulic flooding in the longer- term, additional investment would be required. Figure 13 illustrates the total anticipated enhancement expenditure in comparison to the total core pathway enhancement expenditure across all lines that are highly impacted by Ofwat's adverse climate change scenario within the DWMP strategic planning area.

Alternative pathway foundations

Following scenario testing with our SMEs it seems possible we will need to follow an alternative investment pathway to initially reduce the operation of storm overflows under Ofwat's adverse climate change scenario, and also the risk of the risk of hydraulic flooding in future AMPs. We anticipate that the decisions made at PR29 will trigger the adoption of the alternative pathway given that Ofwat's adverse climate change scenario comes to fruition. We believe that there is a 30% likelihood that these circumstances will arise, triggering an alternative pathway from AMP9 onwards. To make sure we are ready to adapt from AMP9, we anticipate that we will decide whether this alternative pathway is the right decision for us during the DWMP planning cycle in AMP8. So that we can continually assess when or whether adopting our alternative pathway is the right decision for our customers going forward we will continue to monitor national guidance and statistics on climate and any further insights from Ofwat, DEFRA or the Government that may influence our decisions.

4.0 Rationale

4.6.1.8. Customer affordability concerns
DWMP, Resilience (waste) and Living with Water

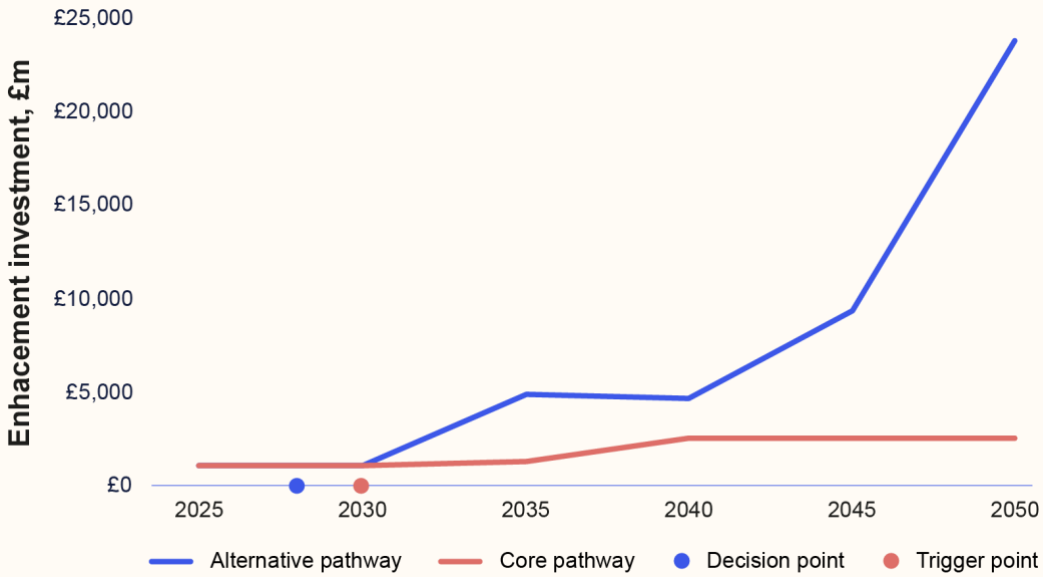


Figure 14: Alternative pathway associated with Customer affordability concerns scenario (DWMP, Resilience (waste) and Living with Water)

Our alternative pathway presents a reduction in enhancement expenditure across DWMP, Resilience (waste) and Living with Water investment areas. These changes relative to our core pathway are shown in Figure 14. We would decide to move to this pathway towards the end of AMP8 and, if needed, trigger the alternative pathway at the start of AMP9. At present, we believe there is a 60% likelihood of this occurring.

Alternative pathway foundations

Scenario testing with our SMEs indicates we may need to follow this alternative investment pathway to balance our future ambition for the Yorkshire region with the affordability concerns and constraints of our customers. The changes made to our investment lines under this alternative pathway reflect a change to our core pathway to remove most non-statutory activities and deliver our obligations at the lowest possible cost.

4.0 Rationale

4.7. Scenario testing

To help alleviate the risks associated with the challenges the water sector faces in the long-term and help offset future uncertainties, Ofwat expects companies to use scenario planning to inform their long-term delivery strategies.

Once our initial optioneering had determined the best value investments for each line in the LS3 and LS4 PR24 data tables we conducted scenario testing using the common reference scenarios (CRS) defined by Ofwat as well as our own wider reference scenarios (WRS) that we have developed. Testing these initial draft investments against a range of plausible futures has helped us confirm that our core pathway is comprised of low and no regrets investments, delivers against our ambition, and has also indicated to us where alternative investment sequences will likely deliver outcomes more efficiently. The outputs also informed the development of our alternative pathways.

To consistently test Ofwat's common reference scenarios and our wider reference scenarios we have taken a risk-based approach to understanding the impact of each scenario on our investments. To achieve this, we have followed a stepped approach. Figure 15 describes the sequential steps of our approach.

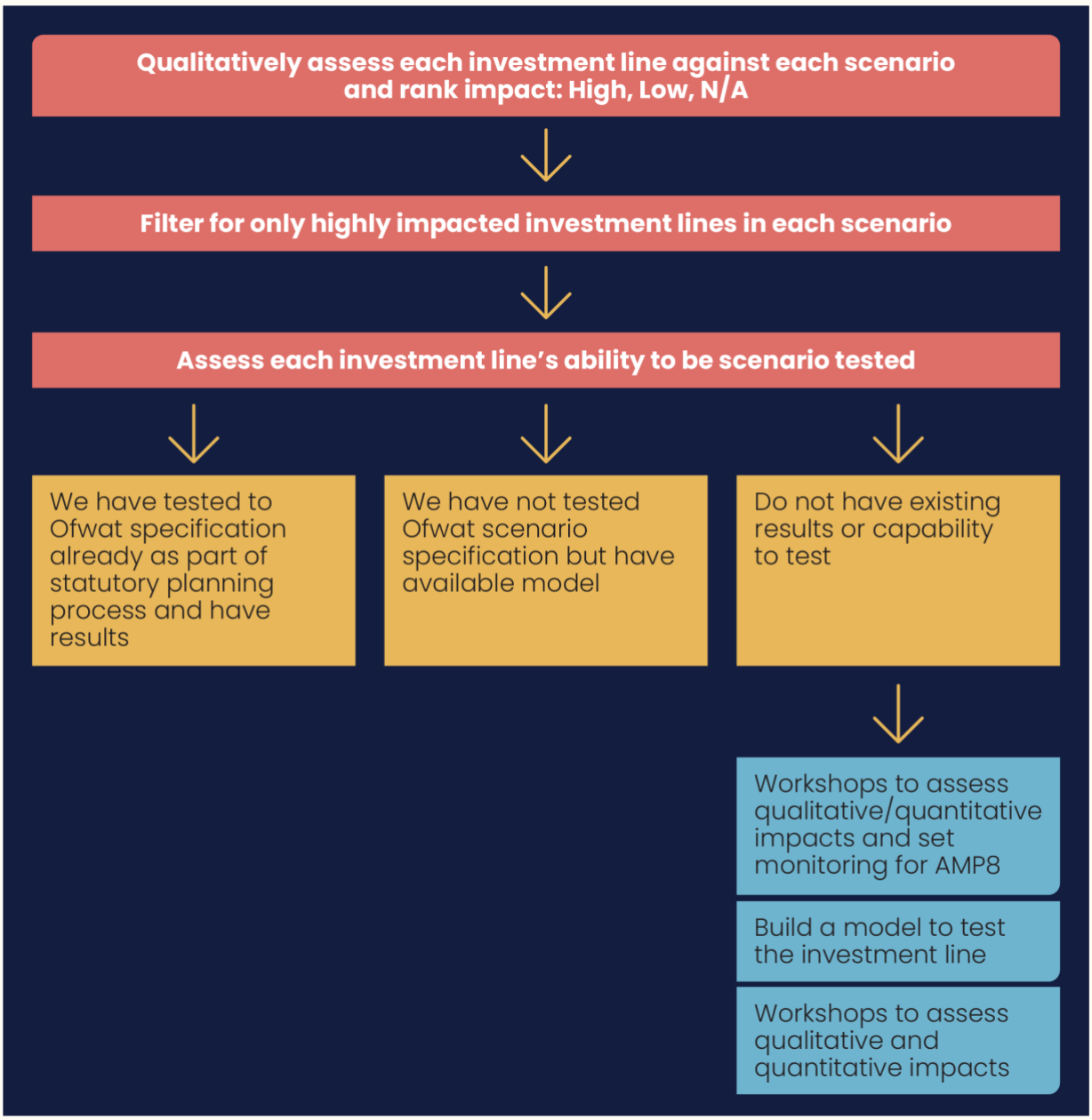


Figure 15: Summary of our scenario testing proces

4.0 Rationale

Stage 1 and 2 – impact assessment and filtering

To apply a risk-based approach to the scenario testing and to ensure that our CRS and WRS testing was conducted consistently across our different strategic planning areas we designed an impact assessment framework where we assessed the impact of each CRS and WRS against each data line in LS3 and LS4:

- Enhancement investment that may be materially impacted by the CRS were ranked 'high', where 'material impact' is defined as an impact that may cause an alternative investment plan to be followed.
- Enhancement investments that may be impacted by the CRS but seem unlikely to lead to material change were ranked 'low' impact, where low impact is defined as an impact that is unlikely to lead to a change in our investment plan.
- Enhancement investment that seem unlikely to be impacted by the CRS have been ranked 'none' i.e. no impact. No impact was defined as an impact that was highly unlikely or impossible to lead to a change in our investment plan.

All investment lines were then filtered for those highly impacted.

Stage 3

Having qualitatively assessed which investment lines may be highly impacted by Ofwat's common reference scenarios and our wider reference scenarios and filtered according to Stage 2 we conducted a series of workshops with SMEs. In these we assessed and captured how we could approach scenario testing each investment line so that we can understand how it might impact the value of investment required i.e., the method by which testing would be undertaken.

Stage 4

Where it was identified that we do not currently have an existing model to understand the impact on enhancement investment required to adapt for Ofwat's CRS and our WRS, we developed and agreed an approach on a line-by-line basis that could be applied by our SMEs so that we could complete detailed testing.

Stage 5

Having agreed an approach to testing our enhancement investment lines we conducted a series of workshops with our SMEs to capture what our investment profile might look like if we needed to adapt our services to meet the demands of the adverse and benign CRS and WRS. This stage was conducted with lines that were identified as highly impacted during our qualitative assessment as this is where we anticipate our investment lines to be materially impacted. Following this process means we understand and have data to support how we might need to consider different pathway options of enhancement investment to ensure we can adapt to different scenarios.

4.8. The scenarios we tested.

4.8.1. Ofwat's common reference scenarios

Following engagement with the sector and wider stakeholders, Ofwat has developed the common reference scenarios to support the industry develop their strategy and demonstrate that the strategy is of high quality. Figure 16 outlines the Ofwat testing parameters against which we have reviewed our planned enhancement investment to ensure that we will deliver a core pathway that is appropriate for meeting long-term objectives in a range of plausible futures.

	Climate Change	Technology	Demand	Abstraction reductions
'Adverse' scenarios	**High:** RCP8.5	**Slower:** slower development than expected	**Slower:** slower development than expected	**Slower:** slower development than expected
'Benign' scenarios	**Low:** RCP2.6	**Faster:** faster development than expected	**Low:** lower growth forecasts and legislation on building regulations and product standards	**Low:** Current legal requirements (in England and Wales)

Figure 16: Ofwat's common reference scenarios

4.0 Rationale

4.8.2. Our Yorkshire Water wider reference scenarios

To ensure our strategies are robust Ofwat expects companies to subject them to wider scenario testing including testing against material local or company-specific scenarios where appropriate. To demonstrate our strategy is resilient to a range of risks we have developed wider reference scenarios that consider risks to our investment planning to make sure we will be resilient in the face of a range of plausible futures.

Figure 17 below represents the sequential approach we have taken to developing our WRS. By following this approach, it allowed us to methodically refine our ideas ensuring the WRS we selected were distinct from Ofwat's CRS and reflect the reality of the challenges and circumstances we think we might face in future.

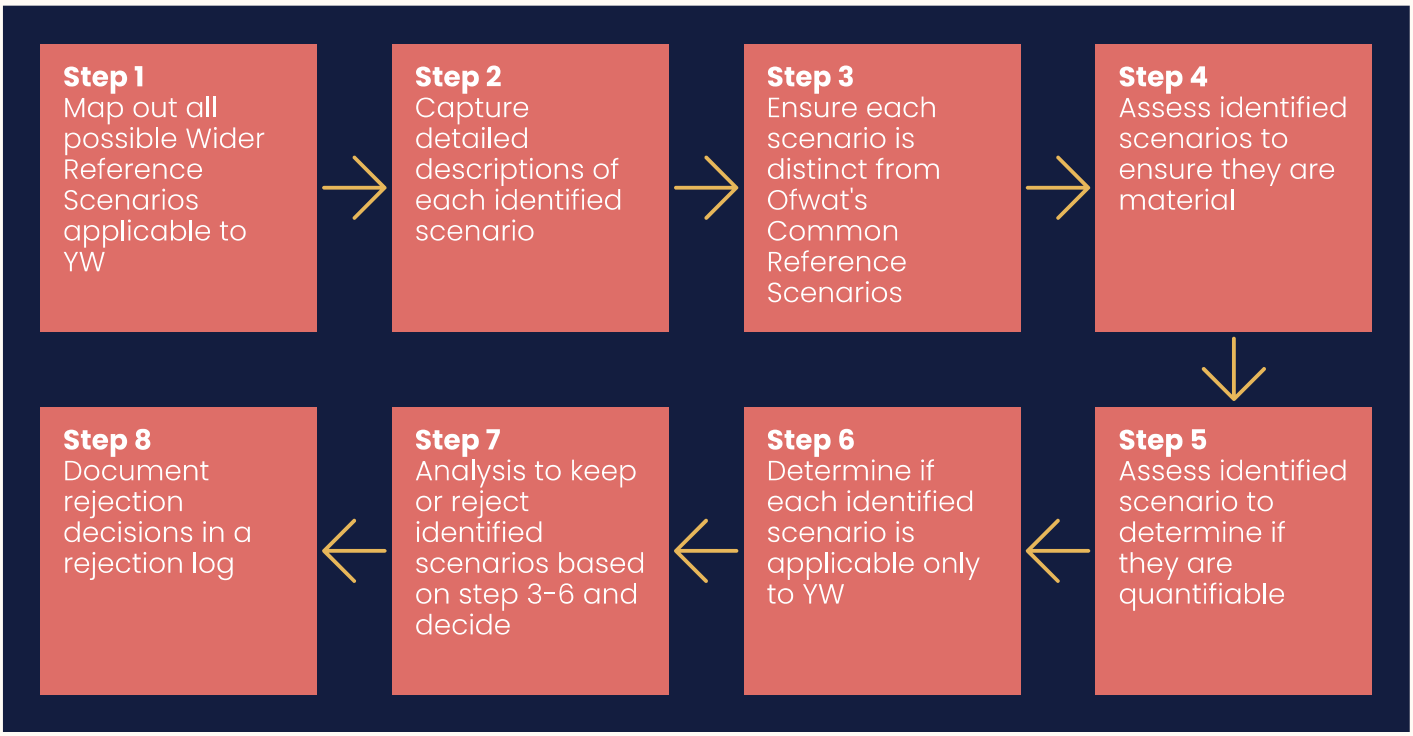


Figure 17: Our approach to developing our Wider Reference Scenarios

Having followed this process we identified the following as WRS that we would test our proposed investments against:

4.0 Rationale

4.8.1.1. Farming Rules for Water

There is currently uncertainty over interpretation by the Environment Agency of Rule 1 of the Farming Rules for Water (Regulations 4 and 5 of the Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018), which may prevent us from recycling all wastewater sludges to land. This means we will lose the landbank we currently use to recycle sludge. In our WRS these circumstances are our adverse scenario. Our benign scenario assumes that these regulations stay as they currently are, meaning there will be no loss of landbank.

4.8.1.2. Society-driven substance intolerance

This WRS considers the consequences of the release of PFAS and other forever chemicals to the environment being viewed with increasing intolerance by the public. Recent shifts in public expectation have created greater intolerance of PFAS and other forever chemicals in society and the environment which has led to an emphasis on addressing how we should remove these substances from clean and wastewater. Our adverse society-driven substance intolerance scenario reflects a future change in legislation that dictates the full removal of PFAS and other forever chemicals from wastewater. Our benign scenario reflects no change in legislation. We recognise that forever chemicals are an industry-wide issue, and this WRS explores how our adaptive planning might need to change to account for this risk.

4.8.1.3. Lead-free Yorkshire

This WRS reflects the increasing pressure to remove all lead in Yorkshire's pipe network. This scenario is driven by a legislative change in response to the growing public demand for a lead-free water network. To reflect this, we have created this scenario based on the Yorkshire-specific issues we face in achieving this. Our adverse scenario represents a policy change that instigates the need to remove all lead in the network by a given (near-future) date. The benign scenario implies no change to current legislation.

4.8.1.4. Customer Affordability Concerns

This WRS reflects the need to reduce the scope of our investment programmes by focusing on meeting statutory obligations but prioritising lower costs over best value activities. This scenario is driven by customer affordability concerns related to the future cost of living. Our adverse scenario represents a future where customer bill affordability, in the short term, becomes the dominant factor in our plans. The benign scenario implies that bills derived from a plan based on best value over the longer term are acceptable to customers.

4.9. The outputs of our testing

The following subsections describe how we conducted scenario testing with each strategic planning area and our identification of investment lines that we have assessed as being highly impacted by either Ofwat's CRS or our WRS. Investment line numbers refer to those in our core pathways (Tables LS3 and LS4). Further information on how each line is impacted is provided in our impact assessment in Appendix C.

4.9.1. Common reference scenario (CRS) testing

4.9.1.1. Clean Water

WINEP

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS3 WINEP investment lines we have consulted our subject matter experts. Below we have provided an overview of which investment lines we believe Ofwat's CRS will highly impact and how we anticipate we will need to adapt as a business.

Abstraction Reduction

Not highly impacted

Demand

Not highly impacted

Technology

Not highly impacted

Climate Change

Line LS3.4 which reflects our anticipated enhancement expenditure to address invasive non-native species in our water network has been identified as highly impacted by Ofwat's adverse Climate Change scenario. This is due to higher temperatures increasing the risk of invasive non-native species (INNS) population areas, potentially leading to new species colonising rivers and reservoirs. Consequently, we need to be ready to increase our monitoring activities and respond by increasing treatments or new management approaches.

4.0 Rationale

WRMP

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS3 Water Resource Strategy investment lines we have consulted our subject matter experts. Below we have provided an overview of which investment lines we believe Ofwat's CRS will highly impact and how we anticipate we will need to adapt as a business.

Abstraction Reduction

LS3.13, our predicted 25-year expenditure plan to enhance the supply-demand balance including expenditure associated with schemes delivering supply-side enhancements has been identified as highly impacted by Ofwat's adverse Abstraction Reduction scenario. This is because we will need to reduce our abstraction from the river Derwent following CSMG flow targets for European protected areas. As a result, we will need to bring in the Tees to York transfer option.

Demand

Not highly impacted

Technology

LS3.18 which reflects our predicted enhancement expenditure for the provision of new meters to our customers was identified as highly impacted under Ofwat's benign Technology scenario. This is because to deliver a smart water supply network by 2035 we would need to deliver our core pathway plan in earlier AMPs.

Climate Change

Not highly impacted

Drinking Water Quality

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS3 Drinking Water Quality investment lines we have consulted our subject matter experts. Below we have provided an overview of which investment lines we think Ofwat's CRS will highly impact and how we anticipate we will need to adapt as a business.

Abstraction Reduction

Not highly impacted

Demand

Lines LS3.27, LS3.28, LS3.29 and LS3.30 which reflect our anticipated enhancement expenditure to deliver improvements to taste, odour and colour as well as raw water quality deterioration in our water network using green and grey solutions have been identified as being highly impacted by Ofwat's adverse and benign demand scenario. This is because Ofwat's adverse demand CRS will put a higher demand on the network. We currently control the impact of taste or odour and raw water quality deterioration by reducing flow at reservoir sites. As the adverse demand scenario means we will need to supply more people with clean water we would be unable to reduce flow at our sites. To make sure we can provide a consistent standard in drinking water we would need to uprate our water treatment works. Without doing so, it may lead to an increase in discolouration incidents in the water supply network. However, when planning for Ofwat's benign demand CRS we would expect the treatment solution to reduce in cost as the reduced demand means we could run our works at a reduced design capacity.

Technology

Not highly impacted

Climate Change

Lines LS3.27 and LS3.29 which reflect our anticipated enhancement expenditure to deliver improvements to taste, odour and colour as well as raw water quality deterioration in our water network using grey solutions have been identified as highly impacted by Ofwat's adverse Climate Change scenario. This is because the adverse Climate Change CRS is likely to result in upland catchments becoming more vulnerable to extreme weather events. This will likely result in a higher volume of pesticides and nutrients being washed off arable land and polluting rivers resulting in additional treatment process requirements.

Resilience

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS3 Resilience investment lines we have consulted our subject matter experts, WMRP24 plans, and our existing models used to test our known scenarios. Following consultation, no lines have been identified as highly impacted.

Security

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS3 Security investment lines we have consulted our subject matter experts. Following consultation, no lines have been identified as highly impacted.

Carbon

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS3 investment lines we have consulted our subject matter experts. Below we have provided an overview of which investment lines we think Ofwat's CRS will highly impact and how we anticipate we will need to adapt as a business.

Abstraction

Not highly impacted

4.0 Rationale

Demand

Not highly impacted

Technology

Line LS3.39 which reflects our anticipated enhancement expenditure to achieve net zero has been identified as highly impacted by Ofwat's adverse technology scenario. This is because the development of technology will have a material impact on how we profile our investment in this area. This is because the investment we have profiled is based on technological development that sits in the middle of the dates outlined in Ofwat's adverse and benign technology CRS.

Climate change

Not highly impacted

4.9.1.2. Wastewater

WINEP

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS4 WINEP investment lines we have consulted our subject matter experts. Below we have provided an overview of which investment lines we think Ofwat's CRS will highly impact and how we anticipate we will need to adapt as a business.

Abstraction

Not highly impacted

Demand

Lines LS4.24 and LS4.25 which reflect our anticipated enhancement expenditure to treat nutrients and / or sanitary determinants as well as treatment for the tightening of sanitary parameters have been identified as highly impacted by Ofwat's adverse demand scenario. This is because higher demand creates an increased load at our treatment works which will yield a higher demand for intensive treatment schemes. We also expect a need for the treatment approach to need to change as nature-based solutions are likely to become less effective in the face of high demand. Therefore, the investment in line LS4.25 would be redirected to traditional grey solutions should the adverse demand impact materialise.

Technology

Not highly impacted

Climate Change

Lines LS4.24 and LS4.25 which reflect our anticipated enhancement expenditure to treat nutrients and / or sanitary determinants as well as treatment for the tightening of sanitary parameters have been identified as highly impacted by Ofwat's adverse climate change scenario. This is because more extreme droughts in the summer months will lead to lower river flows. This means there will be less dilution of nutrients or sanitary determinants in our water networks. As a result, we will have to increase treatment on our final effluent before we can release it to the environment. Based on our historic data we have assumed that if flows decrease by 10% or more, it will increase treatment costs by 30%.

DWMP

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS4 DWMP investment lines we have consulted our DWMP Core Plan alongside our subject matter experts. Below we have provided an overview of which investment lines we believe Ofwat's CRS will highly impact and how we anticipate we will need to adapt as a business.

Abstraction

Not highly impacted

Demand

Not highly impacted

Technology

Not highly impacted

Climate Change

Lines LS4.6, LS4.7, LS4.8, LS4.9, LS4.11, LS4.12, LS4.13, LS4.14, LS4.15, LS4.16 and LS4.60 which reflect our anticipated enhancement expenditure to reduce storm overflow spills and modelled hydraulic flood risk to customers have been identified as highly impacted by Ofwat's adverse climate change scenario (although we note these lines also capture other expenditure not related to our storm overflow plan). This is because weather changes associated with Ofwat's more extreme climate change CRS would create the need for additional storage, system capacity and management capability due to a greater volatility in flow rate. When considering the impact of Ofwat's benign climate change CRS, it is likely we would deliver smaller grey/green solutions and infrastructure programmes in alignment with the less extreme weather changes.

4.0 Rationale

Bioresources

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS4 bioresources investment lines we have consulted our subject matter experts. Below we have provided an overview of which investment lines we think Ofwat's CRS will highly impact and how we anticipate we will need to adapt as a business.

Abstraction

Not highly impacted

Demand

Not highly impacted

Technology

Not highly impacted

Climate Change

Line LS4.45 which reflects our anticipated enhancement expenditure for storage of sludge in cake pads, bays or other storage facilities has been identified as highly impacted by Ofwat's adverse climate change scenario. This is because climate change will increase storm frequency and severity. This will impact our sludge storage significantly as cake cannot be stored on flooded land. Currently some sites where this material is stored are next to rivers and are therefore at high risk to an increase in flooding.

Resilience

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS4 bioresources investment lines we have consulted our subject matter experts and conducted data testing. Below we have provided an overview of which investment lines we think Ofwat's CRS will highly impact and how we anticipate we will need to adapt as a business.

Abstraction

Not highly impacted

Demand

Not highly impacted

Technology

Not highly impacted

Climate Change

Line LS4.55 which reflects our anticipated enhancement expenditure to enhance resilience has been identified as highly impacted by Ofwat's adverse climate change scenario. This is because more frequent flooding events would require sites to be protected with temporary or permanent flood barriers. We might also need to raise sensitive mechanical and electrical equipment above likely water flooding levels or potentially relocate sites.

Security

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS4 Security investment lines we have consulted our subject matter experts. Following consultation, no lines have been identified as highly impacted.

Carbon & Energy

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS4 Carbon & Energy investment lines we have consulted our subject matter experts. Following consultation, no lines have been identified as highly impacted.

Living with water & other LS4 lines

To understand the impacts of Ofwat's CRS on the initial enhancement investment profiled in the LS4 Living with Water investment lines we have consulted our subject matter experts. Following consultation, no lines have been identified as highly impacted.

4.9.2. Wider reference scenario (WRS) testing

4.9.2.1. Clean Water

WINEP

Farming rules for water

Not highly impacted.

Society-driven substance intolerance

Not highly impacted

Lead-free Yorkshire

Not highly impacted

Customer affordability concerns

Not highly impacted

4.0 Rationale

WRMP

To understand the impact of Yorkshire Water's WRS on the initial enhancement investment profiled in the LS3 Water Resource Strategy investment lines we have consulted our subject matter experts. Following consultation, no lines have been identified as highly impacted.

Drinking Water Quality

Farming rules for water

Not highly impacted.

Society-driven substance intolerance

Not highly impacted.

Lead-free Yorkshire

Lines LS3.32, LS3.33 and LS3.34 which reflect our anticipated enhancement expenditure to replace lead in our water network have been identified as highly impacted by our adverse lead-free Yorkshire scenario. This is because if we were to remove all lead from the network then additional enhancement expenditure would be needed to achieve this. To achieve this, we have created our Lead-Free Yorkshire Strategy which is currently being reviewed by the DWI. This strategy describes how we anticipate needing to profile our investment to achieve a lead-free Yorkshire either over a 25-year, 40-year or 60-year time frame. The outcome of this will be removal of all lead from our networks, customer owned external pipework and customer owned internal pipework.

Customer affordability concerns

Not highly impacted

Resilience

Farming rules for water

Not highly impacted.

Society-driven substance intolerance

Not highly impacted

Lead-free Yorkshire

Not highly impacted

Customer affordability concerns

Line LS3.36 which reflects our reduced spending on resilience activities as these are not driven by statutory obligations.

Security

Farming rules for water

Not highly impacted.

Society-driven substance intolerance

Not highly impacted

Lead-free Yorkshire

Not highly impacted

Customer affordability concerns

Not highly impacted

Carbon & Energy

Farming rules for water

Not highly impacted.

Society-driven substance intolerance

Not highly impacted

Lead-free Yorkshire

Not highly impacted

Customer affordability concerns

Not highly impacted

4.0 Rationale

4.9.2.2. Wastewater
4.9.2.3. WINEP

Farming rules for water

Not highly impacted.

Society-driven substance intolerance

Lines LS4.17 and LS4.18 which reflect our anticipated enhancement expenditure to treat and monitor chemicals and emerging contaminants in our water network have been identified as highly impacted by our adverse society-driven substance intolerance scenario. This is because we would need to make significant changes to how we treat our wastewater to completely remove PFAS and other forever chemicals from all our wastewater works so that our final effluent contains no traces of these substances. To help us understand what technologies are currently available to make this transition we have used UK Water Industry Research (UKWIR) report, Ref. No. 22/WW/14/2. 'PFAS and wastewater prevalence, reduction options and costs' to inform our investment decisions.

Lead-free Yorkshire

Not highly impacted.

Customer affordability concerns

Not highly impacted

4.9.2.4. DWMP

Farming rules for water

Not highly impacted.

Society-driven substance intolerance

Not highly impacted

Lead-free Yorkshire

Not highly impacted

Customer affordability concerns

Lines LS4.6, LS4.7, LS4.8, LS4.12, LS4.13, and LS4.60 which reflects a reprofiling of investment activities to remove most non-statutory obligations and deliver schemes primarily using lower cost grey solutions.

4.9.2.5. Bioresources

Farming rules for water

Line LS4.48 which reflects our anticipated enhancement expenditure associated with the costs of disposing of sludge identified as highly impacted by our adverse Farming Rules for Water scenario. This is because the loss of our landbank will require us to introduce and use destruction treatment or technology to dispose of sludge through incineration.

Society-driven substance intolerance

Line LS4.48 which reflects our anticipated enhancement expenditure for sludge treatment identified as highly impacted by our adverse Society-driven Substance Intolerance scenario. This is because if we were not able to meet PFAS regulations through the sludge treatment process then we will need to invest in new incineration facilities to provide an alternative method of PFAS removal.

Lead-free Yorkshire

Not highly impacted.

Customer affordability concerns

Not highly impacted

4.9.2.6. Resilience

Farming rules for water

Not highly impacted.

Society-driven substance intolerance

Not highly impacted.

Lead-free Yorkshire

Not highly impacted.

Customer affordability concerns

Line LS4.55 which reflects the removal of most non-statutory resilience activity from our plan.

4.9.2.7. Security

Farming rules for water

Not highly impacted.

Society-driven substance intolerance

Not highly impacted

Lead-free Yorkshire

Not highly impacted

4.0 Rationale

Customer affordability concerns
Not highly impacted

4.9.2.8. Carbon & Energy

Farming rules for water
Not highly impacted.

Society-driven substance intolerance
Not highly impacted

Lead-free Yorkshire
Not highly impacted

Customer affordability concerns
Not highly impacted

4.9.2.9. Living with Water and other LS4 lines

Farming rules for water
Not highly impacted.

Society-driven substance intolerance
Not highly impacted

Lead-free Yorkshire
Not highly impacted

Customer affordability concerns
Line LS4.59 which reflects a reduction in scope for our Living with Water plans relative to our core pathway.

4.10. Impact on affordability and inter-generational fairness

Our LTDS describes how we plan to deliver our vision while keeping in mind how extraneous variables will impact our ability to deliver on our goals. As such, we aim to keep bills as low as possible while investing in new technologies to mitigate as much as is possible, the effects of climate change, rising demand and changes in legislation. This will future proof our activities and help us to keep bills affordable for future customers in the long-term.

Our vision of **"A thriving Yorkshire: right for our customers, and right for the environment"** reflects our drive to always deliver good value for money to present and future customers. Bills everyone can afford means a dual promise of both keeping bills as low as possible, both now and in future, while offering the right support to customers who struggle to pay.

4.11. Enhancement funding to keep future options open

To make sure that our adaptive planning approach supports keeping future options open, we have embedded an innovation research and development plan in our AMP8 core pathway. This is so that we can learn about and monitor the use of new techniques and technologies whilst investigating how they might benefit our customers or how they might lead us to deliver our services differently in the longer term.

4.11.1. Water Catchments and Treatment

SMART: Catchments & Abstractions

During AMP8 we will carry out targeted peatland restoration method trials to test innovative water quality improvement approaches. This will include a radical review of catchment restoration methods to determine the best techniques for delivering water quality benefit in the future. We will also develop industry best practice guidance to share with other companies based on the long-term monitoring data set that we have already built up for cutting vegetation on peatlands and heathlands. These initiatives will help us understand how we can tackle raw water quality challenges in a more sustainable way for our own business operations and the industry more broadly whilst remaining cost effective.

Further to this, we plan to apply a genomic technique to manipulate trophic cascade in drinking water reservoirs. We hope that in the long-term this will help us to reduce water quality risks associated with cyanobacteria, as the study will help us understand how dominance of algae or macrophytes relates to taste and odour risk and whether altering the trophic state can change this dominance. By applying high tech eDNA genomic methods to design a low carbon "catchment solution" we hope to develop solutions that will reduce the long-term impact of climate change.

Our core pathway additionally includes activities to develop our data platform and modelling. This is so we can incorporate both qualitative and quantitative data into our raw water source selection. To do this we will design a model or decision tree and data platform that will facilitate the expansion of our automated source selection technology. This will help keep options open for the future because we will be able to make more informed decisions that consider a broader range of source selection factors.

Our AMP8 plans also include exploring innovative solutions for indirect potable reuse and aquifer recharging. Specifically, we will carry out a review, feasibility assessment, and trial of innovative solutions to address predicted changes to where and how we abstract our raw water. This may include aquifer storage or indirect potable reuse.

4.0 Rationale

Finally, in the long-term we want to make more informed decisions on ecologically adaptive land management for mitigating fire risks. To do this we will determine the environmental costs and benefits of widely applied fuel management tools (burning, cutting, rewetting and managed succession) on habitat quality, biodiversity, and the carbon balance in fire prone UK landscapes.

SMART: Water Treatment

So that we can derive more appropriate solution options, we also want to better quantify the risk that climate change poses to water quality. This research programme focuses on understanding the impact that increased air temperature and changes in rainfall patterns on dissolved organic carbon, nitrate, and algal related risks will have, so that in the long term we can tailor solutions more appropriately thus mitigating the need for as many high capex and carbon intensive solutions as may have been traditionally deployed.

Further to this we are developing our phosphate disengagement strategy to improve water quality in the long-term. To do this, we need to understand the implication for water quality once all lead service pipes are removed and phosphate dosing is turned off. It is important for us to conduct this programme as we need to consider how we can cater for the geographical differences in our region and specifically, what implication this will have on our customers.

In the long-term we want to reduce the risk of compliance failures. We plan to achieve this by investigating how we can adopt an integrated approach to water treatment optimisation. As part of this we want to understand how multiple measures such as turbidity, particle counting, flow cytometry and zeta potential can be integrated and analysed in an automated way to give greater insight into operation performance. Further to this our AMP8 innovation plan looks to identify new sources of raw water. We expect this to include attenuated surface water, water recycling, non-potable supplies, raw water recharge with final effluent, advanced next generation reverse osmosis and ultrafiltration for seawater treatment.

Circular economy: managing water treatment process waste

We also want to make sure our long-term plans align with our wider sustainability goals. As part of this we will explore recycling nitrate waste from ion exchange and Electro Dialysis Reversal (EDR). To do this we will review the future nitrate risk in Yorkshire, consider the customer demand and associated climate change risks, and determine the feasibility of recycling nitrate rich waste into agricultural fertilisers through utilisation of processes such as EDR.

We will also explore techniques that can recycle dissolved organic carbon waste from ion exchange. This has been made possible by trial and evaluation of HUMVI which can recover humic acids from MIEX regenerant waste to convert waste stream that is taken off site in tankers for disposal, into a high value fertiliser product.

4.11.2. Water Distribution

Another key area of focus for our AMP8 innovation plan is to improve our understanding of our water distribution asset life. This will include developing a multi-faceted, multi-data approach to determining the remaining life of an asset. We also want to be able to better identify trends in our existing data. This will include exploring how we can use data in new ways to understand issues linking water treatment and networks. Additionally, we will explore new, different approaches to renewal rates. This will include looking at how we can optimise our asset investment models, and better understand what investigation processes and techniques we can use to verify leakage and bursts.

In the long-term we hope to provide the most cost-effective repair and rehabilitation solutions for our customers. A starting point for this will be to reflect on previous renewal and relining programmes, for example our Section 19 mains relining and replacement programme. Additionally, we want to understand more about the impact of road infrastructure and traffic volume on our water infrastructure and bursts by conducting new studies. Through understanding and quantifying the impact of traffic volume and road infrastructure on asset health, we can make more informed asset renewal models, as well as mains laying processes and standards.

Our AMP8 plans will further assess more cost-effective leakage repair solutions. This is so that we can improve our Economic Level of Leakage and Socially Acceptable Level of Leakage, such as through the use of internal pipe repair clamps, for example. We also want to improve how we identify and replace lead pipes in future AMPs. This includes developing a formal process for identifying and removing lead in the network, developing a cost/liability strategy to replace customer side lead pipes, conducting customer and stakeholder engagement to change perception of the issue and stimulate action and using ‘push’ devices to locate lead supply pipes and find leaks without impacting water quality.

Our AMP8 innovation plans will also investigate how we can mitigate new risks and implement new technologies. For example, we want to better understand the risk of summer breakouts on our network and the impact that they have. This functionality is not in our current leakage models. However, as we anticipate soil moisture deficit

and ground movement will increase with climate change, we need to plan for how we can adapt our infrastructure to be resilient to shrink, swell, thermal expansion and contraction. We also want to identify how we utilise next generation SMART Networks to also derive benefits to our customers. This includes smart pressure management, dynamic networks, virtual district meter areas (DMAs), virtual smart water systems, and smart DMA control. We also want to understand how we can integrate sensing devices in our smart meters e.g., pressure monitors, so that we can ensure we implement the optimum blend of devices in mains to get the most effective digital twin. By implementing these techniques, we expect to be able to better respond to and manage demand as well as leakage and bursts. Additionally, we want to reduce reports of discolouration. We want to achieve this through continuing our work with Sheffield University looking at how we can validate and expand our use of auto-mains conditioning pilots. As part of this we will carry out a sampling programme of service reservoirs, dead-ends and distribution mains to understand where the flushed sediment is ending up, and by developing sediment build up modelling and digital twins so that we can deploy intelligent tools to inform our flushing programme. Finally, we want to explore using smart tariffs. To do this we need to investigate the use of water tariffs, smart tariffs, and block tariffs for increased usage as a driver of PCC and non-household demand reduction using examples of water tariffing from around the world to incentivise reduced usage.

4.11.3. Wastewater Networks

Systemic approach to wastewater

Building on the Smart Networks project in AMP7, our AMP8 innovation plan will see us move into asset rationalisation, network control and process optimisation across an entire catchment. This will include identifying opportunities for asset rationalisation and taking control of a catchment using AI and machine learning combined with a series of actuated penstocks and pump controls. In the long-term we hope this will allow us to maximise the storage on our existing network whilst minimising spills from storm overflows and flooding to properties. Having extra control in the networks will also help our treatment process. This is because the controls will enable the delivery of a more consistent product and volume for treatment, enabling us to reduce energy costs and greenhouse gas emissions. Developing our full catchment approach will also present the opportunity to manage land differently, attenuating surface water and reducing run-off to improve river water quality. Our plans also include planting trees on flood planes to increase water uptake, increase biodiversity, and produce biomass for energy generation.

System separation

One of our biggest areas of focus over the next few AMP cycles is the reduction of storm overflow events. To enable us to reduce these events and operate our network in the most efficient way possible we need to prevent foul water from mixing with surface water in our combined sewers. To enable this, we need to understand the complex inputs into our network such as highways drainage. We will look at innovative ways to reduce the cost of separation by incentivising customers to do this at a property level or where we must install new foul or surface water systems reducing costs by laying broadband in the same trench or removing lead supply pipes. Our AMP8 innovation plan will lay the groundwork to deliver this over future AMPs.

Network mapping & asset health

A key enabling activity for both catchment control and system separation is network mapping. With the transfer of private to public in 2011 it was estimated we took on an additional 26,000km of sewer network. Recent studies by other water companies estimate that this could have been underestimated by 100-200%. This transferred network is where historically we have found the greater share of incidents associated with internal and external flooding. To get to the root cause of these issues we need to better understand our network and its location. Building on ideas explored in AMP7, our AMP8 plans will create the tools, systems and processes required to rapidly map, survey and condition grade our network at an affordable price.

Energy from sewers

Recognising our commitment to reach operational net zero by 2030 we need to explore how sewers and sewerage could play a part in achieving this. Heating buildings accounts for 19% of overall greenhouse gas emissions in the UK and most of these properties are connected to the sewer network. With advances in heat pump technology and the relatively high temperature of the liquid passing through the sewers, this combination could help reduce the carbon released by heating buildings. There is also an opportunity to harness some of the energy produced by large volumes of water passing through the gravity. We therefore want to look at how we could utilise the network as a large battery able to generate electricity when required.

4.0 Rationale

4.11.4. Wastewater Treatment and Bioresources

Treatment of emerging substances of concern will be given increasing focus as river health comes under increasing scrutiny. There is a growing public pressure to identify candidate technologies for removal of organic pollutants such as PFAS, pharmaceuticals, antibiotic microbial resistance, and other contaminants such as microplastics from wastewater. In AMP8 we want to assess the viability of potentially introducing new processes and any potential consequences of using these technologies (e.g., chemical destruction or accumulation in sludge), as well as the carbon impact and cost.

Net zero

A large part of achieving our net zero goals will be curtailing process emissions. Building on work in AMP7, we want to conduct further work to measure wastewater process and fugitive emissions. Particularly we want to focus on nitrous oxide and methane, characterising all treatment and sludge processes and developing tailored mitigation strategies when we have greater certainties over fugitive emissions (in part this certainty is related to growing understanding of emissions factors outside of our control). We also want to be able to better demonstrate our successful mitigations and enable accurate reporting of greenhouse gas emissions through the carbon accounting workbook. We will also setup auto-monitoring and plant control to optimise the balance between final effluent compliance, sludge quality, process emissions, carbon and energy and chemical use.

Ammonia recovery

Ammonia production to support agriculture consumes 3% of global energy, with its destruction to protect water health consuming another 2%. In AMP8 we want to explore the ways in which ammonia can be made more sustainable, such as piloting domestic and/or ‘commercial scale’ urine separation and source reuse, as well as technologies to recover ammonia from sludge liquors. We also want to investigate the carbon and energy balance of various alternative approaches and explore the market viability of each.

Sludge transformation and production

It is expected that sludge to land recycling will become non-viable and as a result, the current beneficial use of sludge could stall. To be ready to respond to this, we need to identify and assess technologies and approaches for extracting and recovering substances of value from sludge to support circular economy goals. We also need to carry out some additional work to ensure that markets to receive sludge products are available and sustainable.

Small works

Our AMP8 innovation plans also include assessing process and technology opportunities to deliver operationally efficient and compliant small, rural wastewater treatment works.

5.0 Foundation

5.1. Overview

This section outlines the key assumptions and uncertainties that sit behind our LTDS.

5.2. How base expenditure will underpin the delivery of our long-term performance

We have historically built up a robust understanding of our asset performance and the service it delivers from the investments that we have made. This has allowed us to understand the long-term performance improvements that we can expect from our base expenditure.

At an organisational level we have committed to several initiatives that will help continue to improve our performance from base including:

- A major modernisation programme to focus on improved planning and scheduling of our field teams, and to move us to proactive rather than reactive asset management.
- A Performance Excellence programme throughout the business ensuring that we are all pulling together every day, with a clear escalation route for ideas for improvement from every area of the business.

More specifically, in the development of each of our sub-strategies we have also assessed the base expenditure initiatives we have planned and the performance improvements they will deliver to confirm the validity of our core pathway activities. These base expenditure activities include:

Wastewater – trade effluent flow monitoring to help us build an accurate picture of discharge from premises which will help us pinpoint solutions particularly those delivered through Opex.

Carbon – we will deliver the transition of our fleet to low carbon alternatives through base. This will be achieved in line with our forecast asset replacement profile thus achieving a significant improvement in CO_2e reductions whilst minimising the impact on our customers' bills.

Security and Emergency Measures Direction (SEMD) – In our wastewater SEMD strategy we have robust SEMD measures already in place, and we will continue to incrementally improve these in line with our current understanding of the threat and risk landscape out to 2050.

Initiatives such as these (that are funded through base expenditure) will ensure that we are maximising the efficiency of our organisation and the way in which we manage our asset base.

However, base expenditure activities alone will not allow us to meet our ambitions and the expectations of our customers, meet the targets set by government and our regulators, and respond to the external pressures that we continue to face such as climate change. The delta between the performance levels that base expenditure will deliver and the performance levels required will require enhancement investments. These required enhancement investments underpin our LTDS.

5.0 Foundation

5.3. Wider assumptions

This section sets out the wider key assumptions underpinning the development of our LTDS using a PESTLE framework. Specific details of the uncertainties and assumptions associated with each investment line, and the basis on which these have been made, are provided in section 5.4.

Area	Wider assumptions (2025-2050)
Political	• Water industry continues to operate under a privatised regulated model with no material changes in structure or function. • No material changes to Yorkshire Water's operational service area. • No material changes in UK tax policy.
Economic	• Future economic shocks or stresses, such as inflation or access to capital markets, occur within the bounds of our existing risk scenarios. • Skills availability and supply chain capacity remain sufficient to meet the scale of future investment programmes.
Societal	• Customer trust and satisfaction remain sufficiently high to ensure customers do not refuse to pay their bills. • Regional population growth and water demand evolve in line with current forecasts. • No material changes in public vs private balance of social security expenditure and benefits provision. • Partnership plans receive an appropriate level of buy-in from community stakeholders.
Technological	• Water and sanitation services continue to be delivered using existing networks rather than decentralised (off-grid) systems. • Innovations, such as in process technology or AI, continue to be adopted and drive efficiencies across the business.
Legal	• No significant changes in government policy or legislative requirements beyond those identified for alternative pathways. • Trade import tariffs continue to allow for sourcing of key resources from international markets (e.g. chemicals). • Regulation adapts to societal expectations at a rate that does not result in unfunded cost pressures or new undertakings.
Environmental	• Changes in climate occur within the envelope of Ofwat's common reference scenario. • Policy, legal, market and reputational pressures to transition to a full net zero operating model continue to increase in future.

Table 6: Wider assumptions used in the development of our LTDS

5.0 Foundation

5.4. Uncertainties and assumptions

Throughout the development of our core pathway, we have documented the uncertainties that we believe are present and assumptions we have made to overcome these uncertainties. The below section describes these uncertainties and assumptions that underpin each investment line within our core pathway to enable us to achieve our ambition.

5.4.1. Clean Water

5.4.1.1. WINEP

Ofwat Line	Core Pathway Uncertainties	Core Pathway Assumptions
LS3.1 Biodiversity and conservation - Quality	There is significant uncertainty over the future programme as it depends on the Environment Agency's approach and Government policy with respect to halting biodiversity loss.	We have assumed that future ambition will be similar to that driven by current WINEP and policy requirements, therefore we have assumed that the core pathway will be similar in scale to AMP8 and will align to what has historically been delivered. We have low confidence in our costs and programme outputs due to rapid changes in Government policy on biodiversity and conservation, as well as rapid changes in the extent of endangered species and habitats.
LS3.2 Eels/fish entrainment screens	There is significant uncertainty over the future programme as we expect the Environment Agency approach to Eels/fish entrainment screens could change in the future.	We have assumed based on our current understanding of requirements that no further investment or investigations will be required beyond AMP10, as priority sites will have been identified and resolved by then. Our confidence levels on this remaining unchanged is low.
LS3.3 A. Eels/fish passes (YWS assets)	There is significant uncertainty over the future programme as it depends on the Environment Agency's approach.	We are assuming it is not necessary to include delivery of low priority sites, however, if this changes a much larger programme would be required than what is in the current core pathway to address Medium and High priority sites. We currently assume no further investment or investigations beyond AMP10. We have medium level confidence in our numbers.
LS3.3 B. Eels/fish passes (Partnerships initiatives)	No significant uncertainties.	If we continue the approach of tackling wider problems in partnership, then it is likely there will be several AMPs of similar investment, therefore we assume a similar scale of programme to AMP8. This work will be delivered under NERC_IMP driver. We have medium level confidence in our numbers.
LS3.4 Invasive Non-Native Species	The nature of the issue and the unpredictability is a major uncertainty. New technology is also being tried and tested across the sector so the most effective solutions out into the future are also unclear.	Historic costs have been used as basis for our long-term investment planning as we have no further data to base a plan on until trials and studies provide more certainty around effective solutions. As such, we have low confidence levels in these numbers.
LS3.5 Drinking Water Protected Areas	No significant uncertainties.	Assumed investment will continue at similar level to that done historically through the next 25 years. We have medium confidence levels.

5.0 Foundation

LS3.6 **A. Water Framework Directive**	No significant uncertainties.	We have assumed this investment Includes all flow related (non-ground water) schemes including the following drivers, Heavily Modified Water Body, No Deterioration and Environmental destination. Our confidence levels are low.
LS3.6 **B. Water Framework Directive - Groundwater**	No significant uncertainties.	We have assumed investment will continue at a similar level to how it has done historically through the next 25 years. We have medium confidence levels.
LS3.7 Wetland Creation	N/A	We have assumed wetlands are covered under the biodiversity driver so have included the spend there.
LS3.8 **Trade effluent discharge flow monitoring**	No significant uncertainties.	We assume that the work will be carried out in the first 2 AMPs with no further investment required, therefore because these costs are relatively near term and we have good historic data our confidence levels are high on the proposed expenditure levels.
LS3.9 25-year environment plan	N/A	We have detailed this investment in Wastewater WINEP.
LS3.10 **Investigations (WINEP/NEP) - desk based study only**	N/A	We have included investigations under each driver rather than put separately in these lines.
LS3.11 **Investigations (WINEP/NEP) - survey, monitoring or simple modelling**	N/A	We have included investigations under each driver rather than put separately in these lines.
LS3.12 **Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water totex**	N/A	We have included investigations under each driver rather than put separately in these lines.

5.4.1.2. WRMP

For clarity, our assumptions and uncertainties related to our water resources strategy are presented using strategic planning area themes rather than individual investment lines.

Strategic Planning Area Theme	Core Pathway Uncertainties	Core Pathway Assumptions
Close the supply-demand deficit	Inherent uncertainties exist in the supply-demand balance such as climate change, demand forecasts, meter optants etc. All of which are managed in our Water Resources Strategy with target headroom, pathways, and scenario processes to define the core pathway. Environmental legislation in the future is unknown and some options are dependent on WINEP investigations, e.g., for WFD compliance. Delivery Options: <u>Demand</u> Demand reductions have external dependencies that are not within our control. <u>Supply</u> The near-term supply solution risks were considered when forming the plan however, the success is still dependent on the outcome of investigations and there is still a risk the combined total benefit is less than predicted. In addition, any new supplies will need to consider the environmental and social impacts and how to mitigate the effects, such as achieving a 10% biodiversity net gain where planning permissions are required and reducing our operational carbon to align with carbon net zero targets. This creates a further risk that the time to implement could take longer than predicted, especially if the impacts and mitigation measures are complex. Licence applications and planning permission is uncertain.	There is a general assumption that climate change and demand forecasts hold true. In supply modelling we assume that long-term asset capability is maintained as per the modelling. It is generally assumed that there will be no new environmental legislation in future further impacting the plan. Delivery options: <u>Demand</u> Demand reductions targets over time are assumed to be met and we assume that government policy interventions for water labelling and building regulations are implemented and effective. <u>Supply</u> Supply options are assumed to be deliverable, will be licenced by Environment Agency and will yield the expected benefits. We assume all preliminary permissions are granted following additional scoping work to support submissions.
Become resilient to 1 in 500 droughts (without drought measures)	As detailed above, the supply-demand forecasts are subject to uncertainty that inherently impacts the need for the 1:500 drought. In addition to this there is an uncertainty that the current approach for stochastics and climate change could be subject to revision in the future. Future policy targets are not certain.	In addition to the assumptions detailed above regarding the supply-demand balance uncertainties, there is also an assumption that the current approach remains the same in the future for stochastics and climate change. We assume that any change in this would only impact long-term options excluded from the core pathway. We assume no change to policy targets.
Meeting policy targets for demand management and leakage	The success of this objective is partly dependent on the government's water labelling initiative. There will also be uncertainties on the number of meters optants, and the benefits from metering activities.	We assume that our options deliver the relevant benefits, and that government policy interventions are implemented and effective. We assume there is no change to policy targets. Under these circumstances, we would expect to deliver the most-likely pathway at the point in time which our monitoring plan indicates these circumstances. As a result of this testing, we

	Alongside our monitoring plan, to help us prepare for future uncertainty we have explored how we could adapt if the year-on-year combined efforts of leakage and PCC reduction only deliver half that assumed in our core pathway.	anticipate that we will adapt as a business by reviewing the timing of delivering our most-likely pathway.
Increased supply resilience	The uncertainties are the same as captured under closing the supply-demand balance deficit.	The assumptions are the same as captured under closing the supply-demand balance deficit.
Meeting the needs of WINEP and environmental destination	There is some uncertainty on what is required to define the environmental destination needs. The Environmental Destination BAU+ has a risk of reduced licence availability from groundwater sources by 2035 (11Ml/d in total) and a licence reduction on the river Derwent by 2050 to meet a CSMG target.	Where there is less certainty on required investment, a decision will be made on whether we follow the 'most likely' pathway following our planned investigations in AMP8, Environmental Destination solutions are therefore not included in the core pathway.
The loss of the Severn Trent Water supply (Derwent valley transfer)	There are no significant uncertainties regarding the need for the solution to offset our loss of supply, the only uncertainty will be relation to our ability to deliver a solution that has less of an environmental impact.	We are assuming that there will be some optimisation work on our solution carried out on our pipe routes to avoid the Peak District National Park.

5.4.1.3. Water Quality

Ofwat Line	Core Pathway Uncertainties	Core Pathway Assumptions
LS3.27 Improvements to taste, odour, and colour (grey solutions)	No significant uncertainties.	Optimisation 1.We have based our cost assumptions on the rollover of work completed in AMP8 (trunk main conditioning of 16WSZs). There are approximately 90 WSZs in Yorkshire so this would be a 6 AMP programme of work if we were to work through the whole the region based on our current level of resource. Treatment 2. We are assuming that the outcome of our planned AMP8 reservoir investigation will dictate that 3 out of 5 sites will have unacceptable risk. Therefore, in AMP9 we will partly address it with 2 grey solutions. It is expected that subsequent investigations will dictate the need for 1 grey solution to be completed. We have medium confidence levels on both.
LS3.28 Improvements to taste, odour, and colour (green solutions)	No significant uncertainties.	We are assuming that the outcome of our planned AMP8 reservoir investigation will dictate that 3 out of 5 sites will have unacceptable risk. Therefore, in AMP9 we will partly address it with one grey solution. It is expected that subsequent investigations will dictate the need for one green solution to be completed each AMP from AMP10 onwards. We have medium confidence levels.
LS3.29	No significant uncertainties.	We have assumed investment will continue based on historic submissions to the DWI for AMP5, 6 and 7. The THM removal

5.0 Foundation

Addressing raw water quality deterioration (grey solutions)		programme is almost complete and has some costs reflected in AMP8 for this but not in subsequent AMPs, therefore work reflects crypto and nitrate removal only. Our confidence levels are low.
LS3.30 Addressing raw water quality deterioration (green solutions)	No significant uncertainties.	All AMP8 investment in this area is covered by WINEP lines. We assumed investment for AMP9 onwards is based on source selection historic solution costs. Our confidence levels are medium.
LS3.31 Conditioning water to reduce plumbosolvency	No significant uncertainties.	We are assuming phosphate dosing will not be ceased as detailed in the Lead Strategy (2023). Total lead removal from the network would be required to do so and that will not be done in the next 25 years. We have medium confidence levels.
LS3.32 Communication pipes replaced or relined	No significant uncertainties.	We are assuming this refers to Lead, although it is not specified. No relining is included due to feedback from DWI that renewal is preferred. Our strategy is to continue lead removal from the network focusing on high-risk customers such as communal buildings, schools, and hotspot areas. Our confidence levels are medium.
LS3.33 External lead supply pipes replaced or relined	No significant uncertainties.	We are assuming no relining is included due to feedback from DWI that renewal is preferred. Our strategy is to continue lead removal from the network focusing on high-risk customers such as communal buildings, schools, and hotspot areas. Our confidence levels are medium.
LS3.34 Internal lead supply pipes replaced or relined	N/A	We do not propose to renew internal pipework. Our confidence levels are medium.
LS3.35 Other lead reduction related activity	N/A	All lead investment covered in LS3.32-33. Our confidence levels are medium.

5.0 Foundation

5.4.1.4. Resilience

Ofwat Line	Core Pathway Uncertainties	Core Pathway Assumptions
LS3.36 Resilience.	We are currently working out the cost benefit of this work post AMP 9 to understand if it outweighs the investment. If it is delivered it is also uncertain whether it will go down the route of DPC.	We have assumed investment is based on current scenarios for the Water Supply System Strategy and that AMP8 is delivered via DPC. Our confidence levels are low.

5.4.1.5. Security

Ofwat Line	Core Pathway Uncertainties	Core Pathway Assumptions
LS3.37 Security - SEMD	The risk, threats and vulnerabilities of the future are largely unknown looking this far into the future for security.	We have assumed no further enhancement expenditure is required unless there is change in legislative environmental or other external factors. We have assumed there is no enhancement funding required for emergency planning beyond AMP9 and that it will be funded through base allowances. Our confidence levels are low because of the very uncertain risk threat.
LS3.38 Security - Cyber	Considering the rapidly evolving technical and regulatory environment and threat landscape it is difficult predict cyber beyond AMP8.	We have assumed investment is based on greater targeting and risk to protect the business and its customers from. Our confidence levels are low because of the very uncertain threat landscape.

5.4.1.6. Carbon

Ofwat Line	Core Pathway Uncertainties	Core Pathway Assumptions
LS3.39 Greenhouse gas reduction (net zero)	Due to the volatile energy market, we have been unable to take the Opex Impact into account and we have therefore not profiled these costs.	We have assumed that fleet transition to electric vehicles, energy, and chemical efficiency will be funded through base allowances. Our confidence levels are low.

5.4.2. Wastewater

5.4.2.1. WINEP

Ofwat Line	Core Pathway Uncertainties	Core Pathway Assumptions
LS4.1 Event Duration Monitoring (EDM) at intermittent discharges	No significant uncertainties.	We have assumed the only WINEP driver included is U_MON3 and all monitors have been included whether related to storm tanks or not. The investment assumes installation of monitors completes in AMP7, and the overall programme will be complete by end of AMP8 and cost then converts to base. Our confidence levels are high.

5.0 Foundation

LS4.2 Flow monitoring at sewage treatment works	No significant uncertainties.	We have assumed the only WINEP driver included is U_MON4. The investment assumes this programme will be complete after AMP 8 and then converts to base. Our confidence levels are high.
LS4.3 **Continuous river water quality monitoring**	The finalised guidance from DEFRA is still to be released therefore the investment line is subject to change.	We have assumed the delivery profile is based on the government's Storm Overflows Discharge Reduction Programme. AMP8 current profile assumes a slower start in first two years to allow time to embed, purchase equipment and get agreements on monitor locations. AMP9 assumes a flatline profile continuing from work in AMP8. Our confidence levels are low (circa 20% across the AMPs) given the number of different scenarios that have been provided to Defra with costs and profile changes.
LS4.4 **MCERTs monitoring at emergency sewage pumping station overflows**	No significant uncertainties.	We have assumed that 25% of the MCERTS programme will be complete in AMP8 and the rest in AMP9 as per Environment Agency's phasing request. Our confidence levels are high.
LS4.17 **Treatment for chemical removal**	There is uncertainty around the level of chemical treatment that could become legislation. Uncertainty has been removed for AMP8 with no WWTWs requiring cypermethrin removal and 8 needing flexible chemical permitting approach 4. For subsequent AMPs there is uncertainty in the supply chain around guaranteeing cypermethrin removal with potential suppliers declining to undertake the work or stating they require significant trial work before being able to guarantee specific removal efficiencies.	We have assumed the only chemical we will be required to remove is cypermethrin under the driver WFD_IMP_CHEM. We have assumed that for later AMPs the emphasis will focus on environmental protection and on other action such an outright ban as opposed to end-of-pipe treatment. We have based this assumption on the joint Ofwat, Environment Agency, Water Industry, Water UK Strategic Steering Group Task and Finish Group's direction of travel. We assume that current technologies such as granular activated carbon and membrane filtration would cost so much that customers' willingness to pay thresholds will not be delivered. As we assume the cost of chemicals and energy will rise throughout the next 25 years, this will bring further pressure on regulators to manage risk to the environment through bans of specific chemicals rather than expensive, inefficient, end of pipe treatment. Our confidence levels are low.
LS4.18 **Chemicals and emerging contaminants monitoring/ investigations/ options appraisals**	Each year thousands of new chemicals are created, and hundreds brought to market in the UK. Regulation is failing to enforce bans on chemicals and new chemicals are not being assessed for environmental impact before they reach the market and are subsequently disposed of via wastewater treatment into the water or soil environment.	Since the inception of the Chemical Investigations Programme (CIP) in 2010 it has become a significant tool for the water industry to identify and quantify risk to the environment from non-sanitary determinants. Therefore, we assume the CIP will continue to play a significant role in the next five AMPs and probably beyond that. The scope of these investigations is being negotiated in steering group and technical working group meetings between water companies, Ofwat, DEFRA and the Environment Agency. It is unlikely that costs will vary significantly from the total already predicted. Confidence levels begin high in AMP 8 but drop lower for subsequent AMPs.

5.0 Foundation

LS4.19 **Treatment for total nitrogen removal (chemical)**	It is uncertain if nitrogen removal will be a requirement in the future.	We are assuming what we know under current legislation and there is no obligation to carry out nitrogen removal.
LS4.20 **Treatment for total nitrogen removal (biological)**	It is uncertain if nitrogen removal will be a requirement in the future.	We are assuming what we know under current legislation and there is no obligation to carry out nitrogen removal.
LS4.21 **Nitrogen Technically Achievable Limit monitoring, investigation, or options appraisal**	No significant uncertainties.	We are assuming that the nationwide trial of nitrogen removal technology takes place in year 1 of AMP8. Confidence levels are high.
LS4.22 **Treatment for phosphorus removal (chemical)**	No significant uncertainties.	We are assuming the requirement for nationwide 80% removal of phosphorus required by 2037 (EnvAct_IMP1) remains the legislation. Confidence levels are medium.
LS4.23 **Treatment for phosphorus removal (biological)**	No significant uncertainties.	We are assuming the requirement for nationwide 80% removal of phosphorus required by 2037 (EnvAct_IMP1) remains the legislation. Confidence levels are medium.
LS4.24 **Treatment for nutrients (N or P) and / or sanitary determinands, nature-based solution**	No significant uncertainties.	We have assumed Phosphorus removal schemes are covered in LS4.23 above. The investment in AMP 8 is for sanitaries under U_IMP7, however the assumption is that there will be more in following the following AMPS as more nature-based solutions is an ambition in this area. Confidence levels are high.
LS4.25 **Treatment for tightening of sanitary parameters**	The list of schemes is unstable as the Environment Agency have changed direction several times.	We have assumed that traditional filter works and activated sludge processes will remain the preferred way forward and the list of sites remains unchanged. The WFD_IMP BOD/DO schemes have been included at 10 mg/l technical limit as a worst-case scenario. The Environment Agency are undertaking some work to improve model calibration and give greater certainty to the permit limit required. Some of the WFD_IMP BOD/DO schemes may be removed from WINEP altogether. Confidence levels are medium.

5.0 Foundation

LS4.26 **Catchment management - chemicals source control**	We have not previously undertaken this work so costs are uncertain.	We have assumed that investment in communication programmes across the region to prevent cypermethrin entering the sewer network from domestic, commercial, and agricultural sources will be required. Confidence levels are low because we have low understanding of the intensity and breadth of required communications.
LS4.27 **Catchment management - nutrient balancing**	No significant uncertainties.	We assume investigation only in AMP8 to assess the requirements with delivery beginning in AMP9 and growing over the following AMPs.
LS4.28 **Catchment management - catchment permitting**	No significant uncertainties.	We assume investigation only in AMP8 to assess the requirements with delivery beginning in AMP9 and growing over the following AMPs.
LS4.29 **Catchment management - habitat restoration**	N/A	We have assumed that the investment is captured under NERC driver coded against LS3.1 instead so have profiled our investment there.
LS4.30 **Microbiological treatment - bathing waters, coastal and inland**	There remains uncertainty over the level of microbiological treatment required to protect inland bathing waters due to the lower dilution and dispersion levels when compared to coastal environments. Political uncertainty and customer willingness to pay in the future could become an issue.	We have assumed that Defra will issue further designations, with an assumed three designations per AMP. Confidence levels are low.
LS4.31 **Septic Tank Replacements - Treatment Solution**	No significant uncertainties.	We have assumed that under current legislation, there will be no further requirement for enhancement once the selected 15 sites are complete in AMP8.
LS4.32 **Septic Tank Replacements - Flow diversion**	No significant uncertainties.	We have assumed that this is not, or ever will be a preferred solution and is only to be deployed where an alternative is unfeasible. Confidence levels are high.
LS4.33 **Fish Outfall screens**	N/A	No planned investment.
LS4.34 **25-Year Environment Plan**	No significant uncertainties.	We have assumed this is for the removal of phosphorus only and is only reflective of investigative costs. Confidence levels are medium.

5.0 Foundation

LS4.35 **Investigations, other (WINEP/NEP) - desk-based studies only**	There is uncertainty on of the Environment Agency's guidance on no harm investigations (EnvActInv2) as it has not yet been released.	We assume we will continue as we currently operate and that we will not undertake any desktop only studies. Confidence levels are high.
LS4.36 **Investigations, other (WINEP/NEP) - survey, monitoring or simple modelling**	There is uncertainty on of the Environment Agency's guidance on no harm investigations (EnvActInv1) as it has not yet been released.	We have assumed that we will require investment in years 1 and 2 of AMP8 only based on draft requirements of the guidance (EnvAct_INV1). Confidence levels are medium.
LS4.37 **Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling**	There is uncertainty on the number of bathing water designations that will be issued by the Environment Agency.	We have assumed that for BW_INV1 - AMP8 investment is front end loaded and that monitoring is undertaken in Year 1, we have a high confidence level in the numbers. For this driver AMP9 costs are also assumed to be front end loaded, but will vary dependant on when investigations are raised, relating to bathing water designations. We have low confidence levels as we assume the number of designations could vary greatly from the assumption of 1 per year being designated. We have assumed that there will be no investment in AMP8 for BW_INV2, we assumed some investigations in AMP9 and that it will be most likely be front end loaded with monitoring skewing this and assuming a mid-AMP delivery requirement. We have low confidence in values. We have assumed that investment for BW_INV3 will be covered in BW_INV1 costs. We have low confidence levels in values. We have assumed that BW_INV5 will be covered by BW_INV1 costs. We have low confidence levels. We have assumed BW_NDINV will be covered by BW_INV2 costs. We have low confidence levels. We have assumed that EnvAct_INV4 AMP8 costs are front end loaded in the AMP, supported through transitional funding to assess the impact of "harm" from storm overflow discharges. The results of which will be used to inform PR29 and PR34 investment programmes. Numbers are based on initial guidance which is being revised and clarified. Therefore, there is a likelihood of change around these lines (circa 50% confidence). The costs and profiles were based on our experience of undertaking Storm Overflow Assessment Framework studies throughout AMP7. We have assumed a similar process for this driver from AMP9 costs, assuming a flat profile to aid with delivery. The remaining investigations to be completed before AMP12. Confidence from AMP9 onwards is 20%. We have assumed WFD_INV is for future Urban Pollution Management studies only. We have a high confidence in AMP8 expenditure for this driver, based on our experience in undertaking similar studies in previous AMPs. We have assumed that the average of the previous few AMPs of UPMs will be required. Total value less than previous AMPs to consider greater sewer

5.0 Foundation

		modelling stock. (Low confidence in AMP9 onwards, as may be impacted by the EnvAvt_INV4). We have assumed WFD_INV_MP has high confidence levels in AMP8 and that this is likely to be a growing area, so we have increased costs incrementally for future AMPs.
LS4.38 **Contribution to third party schemes under WINEP/NEP only (not covered elsewhere)**	N/A	There are no planned third-party schemes.
LS4.39 **River connectivity (e.g. for fish passage)**	N/A	This is covered under clean water.
LS4.40 **Restoration management (marine conservation zones etc)**	N/A	There are no marine conservation management zones in the YWS region.
LS4.41 **Access and amenity for WINEP/NEP only (not covered elsewhere)**	N/A	This driver is not being used.
LS4.42 **Advanced WINEP (not covered elsewhere)**	No significant uncertainties.	We have assumed investment will be for catchment management pilot schemes.
LS4.50 **Growth at sewage treatment works (excluding sludge treatment)**	Significant changes in regional population growth rates would impact future investment requirements.	We have assumed regional population growth occurs in line with current forecasts of c.2% per AMP.

5.0 Foundation

LS4.51 **Reduce flooding risk for properties (PC trajectory)**	N/A	This is base spending.

5.4.2.2. DWMP

Ofwat Line	Core Pathway Uncertainties	Core Pathway Assumptions
LS4.5 **Increase flow to full treatment (UIMP5)**	We have currently only included known investigated FFT increases linked to our SODRP so confidence in these is high but there remains significant uncertainty regarding the rest of the programme for FFT upgrades post AMP8.	Whilst UIMP5 has no investment beyond AMP7 we have included in here the FFT costs associated with SODRP activities for three sites.
LS4.6 **Increase storm tank capacity - grey solution (UIMP6)**	Uncertainties remain around the actual solution that will be installed versus the assumed costed solution. Uncertainties remain over the suitability of the solution, other options to deliver the solution needs and the opportunity to deliver this via blue-green strategies.	We have assumed a single asset storage tank for all traditional grey storage is required. All solutions have been built up in the same way, costed and audited as part of DWMP. Any hybrid solution grey storage has been included in this line for STW storm overflow interventions from line LS4.7.
LS4.7 **Increase storm system attenuation / treatment on a STW - green solution**	Uncertainties remain around the actual solution that will be installed versus the assumed costed solution. Uncertainties remain over the suitability of the solution, other options to deliver the solution needs and the opportunity to deliver this via blue-green strategies.	We have assumed that our 50% surface water removal will be achievable for the solution (based on a catchment approach) and that alternative wetland solutions will be appropriate to install to reduce spill volumes to the required targets. Any hybrid additional grey storage has been included in LS4.6
LS4.8 **Storage schemes to reduce spill frequency at CSOs etc - grey solution**	Uncertainties remain around the actual solution that will be installed versus the assumed costed solution. Uncertainties remain over the suitability of the solution, other options to deliver the solution needs and the opportunity to deliver this via blue-green strategies or in partnership.	We have assumed a single asset storage tank for all traditional grey storage is required. All solutions have been built up in the same way, costed and audited as part of DWMP. Any hybrid solution grey storage has been included in this line for STW storm overflow interventions from lines LS4.12 & LS4.13.
LS4.9 **Storage to reduce spill frequency at CSOs etc - green solution**	We are currently uncertain as to whether our core pathway will contain this element within it.	No current investment planned as our plan is a 25-year high-level strategic plan that does not contain this level of granularity currently but will be considered for all schemes upon further scheme investigation. We have assumed that this is related to post overflow green treatment solutions such as wetlands which we currently do not believe are viable solutions. Further development of technologies may allow this to become a viable alternative in the future.
LS4.10 **Storm overflow - discharge relocation**	We are currently uncertain as to whether our core pathway will contain this element within it.	No current investment planned as our plan is a 25-year high-level strategic plan that does not contain this level of granularity currently but will be considered for all schemes upon further scheme investigation.

5.0 Foundation

LS4.11 **Storm overflow - increase in combined sewer / trunk sewer capacity**	We are currently uncertain as to whether our core pathway will contain this element within it.	No current investment planned as our plan is a 25-year high-level strategic plan that does not contain this level of granularity currently but will be considered for all schemes upon further scheme investigation.
LS4.12 **Storm overflow - sustainable drainage / attenuation in the network**	Uncertainties remain over the actual solution delivery type and split between LS4.12 & LS4.13.	We have assumed that our 50% surface water removal will be achievable for the solution (based on a catchment approach) and that 50% of the work we carry out will be using sustainable drainage / attenuation in the network to resolve the need. Any hybrid additional grey storage has been included in LS4.8.
LS4.13 **Storm overflow - source surface water separation**	Uncertainties remain over the actual solution delivery type and split between LS4.12 & LS4.13.	We have assumed that our 50% surface water removal will be achievable for the solution (based on a catchment approach) and that 50% of the work we carry out will be using source surface water separation to resolve the need. Any hybrid additional grey storage has been included in LS4.8.
LS4.14 **Storm overflow - infiltration management**	We are currently uncertain as to whether our core pathway will contain this element within it.	No current investment planned as our plan is a 25-year high-level strategic plan that does not contain this level of granularity currently but will be considered for all schemes upon further scheme investigation.
LS4.15 **Storm overflow - sewer flow management and control**	We are currently uncertain as to whether our core pathway will contain this element within it.	No current investment planned as our plan is a 25-year high-level strategic plan that does not contain this level of granularity currently but will be considered for all schemes upon further scheme investigation and results from pilots will be used to establish any further sites for this type of intervention.
LS4.16 **Storm overflow - new / upgraded screens**	Uncertainties remain over the specific detail at each site and the screen intervention will be linked to the size and type of solution installed.	We have assumed that each site will require a new or upgraded screen and costed and profiled appropriately.
LS4.60 **Additional line 2 - Reduce modelled hydraulic flooding risk for properties (ISF & ESF)**	There remains significant uncertainty around the defined solution that will need to be reviewed, developed and installed to meet the need.	Modelled hydraulic flood clusters and costs were generated for the DWMP for internal and external flooding risk reduction and it has been assumed that a single solution option will resolve the need and this has been costed and audited as per the DWMP. LWW costs have been removed as they have their own line in LTDS.

5.0 Foundation

5.4.2.3. Bioresources

Ofwat Line	Core Pathway Uncertainties	Core Pathway Assumptions
LS4.43 **Sludge storage - Tanks (pre-thickening, pre-dewatering or untreated)**	Uncertainties remain around the actual solution that will be installed versus the assumed costed solution, along with the profile for delivery. Some of the tank covering required could ultimately be thickened / dewatered or treated and so some costs could move to LS4.44, although the total spend is expected to stay the same.	The 'Compliance with the EA's Appropriate Measures Enhancement Case' is approved.
LS4.44 **Sludge storage - Tanks (thickened/dewatered or treated)**	No costs have been included in our core assumption, however, once final solutions are confirmed some of the LS4.43 expenditure could occur on thickened, dewatered or treated tanks and therefore move under this header.	The 'Compliance with the EA's Appropriate Measures Enhancement Case' is approved.
LS4.45 **Sludge storage - Cake pads / bays /other**	Uncertainties remain around the actual solution that will be installed versus the assumed costed solution, along with the profile for delivery.	The 'Compliance with the EA's Appropriate Measures Enhancement Case' is approved.
LS4.46 **Sludge treatment - Anaerobic digestion and/or advanced anaerobic digestion**	n/a	This driver is not being used
LS4.47 **Sludge treatment - Thickening and/or dewatering**	Uncertainties remain around the actual solution that will be installed versus the assumed costed solution, along with the profile for delivery.	The 'Enhancement case for schemes to improve the resilience of recycling sludge to land' is approved.
LS4.48 **Sludge treatment - Other**	Uncertainties remain around the actual solution that will be installed versus the assumed costed solution, along with the profile for delivery.	The 'Compliance with the EA's Appropriate Measures Enhancement Case' is approved.
LS4.49 **Sludge investigations and monitoring**	n/a	The Environment Agency have not approved the proposed investment in this enhancement line. We therefore assume no investment
LS4.52	tbc	n/a

5.0 Foundation

First time sewerage		
LS4.53 **Sludge enhancement (growth)**	n/a	**n/a**
LS4.54 **Odour and other nuisance**	n/a	n/a

5.4.2.4. Living with Water

Ofwat Line	Core Pathway Uncertainties	Core Pathway Assumptions
LS4.59 **Living with Water**	Within the Hull and Haltemprice catchment sewer and surface water flood risk are entirely interlinked. The responsibility for surface water flood risk sits with the Lead Local Flood Authority whilst sewer flood risk is managed by Yorkshire Water. The plan is reliant upon funding streams coming together to manage flood resilience holistically and affordably. The current spend profile is reliant upon access to match funding.	We have assumed that we secure match funding to deliver the plan.

5.4.2.5. Resilience

Ofwat Line	Core Pathway Uncertainties	Core Pathway Assumptions
LS4.55 **Resilience**	No significant uncertainties.	The costs are based on SME judgement and historic activity, they are high level with low confidence, but it is relatively small-scale investment.

5.4.2.6. Security

Ofwat Line	Core Pathway Uncertainties	Core Pathway Assumptions
LS4.56 **Security - SEMD**	N/A	No further expenditure under enhanced is foreseen unless there is change in legislation, environmental or other external factors.
LS4.57 **Security - Cyber**	Considering the rapidly evolving technical and regulatory environment and threat landscape it is difficult predict cyber beyond AMP8.	We have assumed investment is based on greater targeting and risk to protect the business and its customers from. Our confidence levels are low.

5.4.2.7. Carbon

Ofwat Line	Core Pathway Descriptions	Core Pathway Assumptions
LS4.58 **Greenhouse gas reduction (net zero)**	No significant uncertainties.	We assume on fleet NZC transition that £30 million will be covered by base investment/delivered through Opex solutions and that any future fleet investment is assumed to be in base.

6.0 Board Assurance

Our vision is to create **'A thriving Yorkshire: right for our customers, right for the environment**.'

Our Long-Term Delivery Strategy to 2050 defines how our vision will be delivered in terms of long-term performance outcomes we aim to achieve, and the actions and investments we intend to undertake to deliver them for our current and future customers and the environment.

In developing our strategy, we considered areas where we already have statutory or legal requirements, existing commitments that we have made in the past, and the long-term needs and expectations of our customers. We also considered our historic performance and projected future operational performance, as well as the opportunities we have available to create further environmental and social value through our work in line with Ofwat's Public Value Principles.

As a business, we face a series of long-term challenges including climate change, affordability pressures, and rising customer expectations around service delivery and environmental protection. Responding to these challenges requires us to take a long-term view to ensure we make decisions that maximise the value we create for current and future customers, society, and the wider environment.

The Board has challenged and satisfied itself that the Long-Term Delivery Strategy:

- reflects a long-term vision and ambition that is shared by the Board and company management.
- is high quality, and represents our best overall possible strategy to efficiently deliver the stated long-term objectives, given future uncertainties.
- will enable the company to meet its statutory and licence obligations, now and in the future.
- is based on adaptive planning principles.

The Long-Term Delivery Strategy has been informed by customer engagement and the Board has taken steps to secure long-term affordability and fairness between current and future customers. Customer engagement is an integral part of day-to-day activity here at Yorkshire Water – understanding, assessing, shaping and supporting decisions continuously. Through our ongoing engagement activity, alongside external research undertaken by Ofwat and CCWater, we have learned what is important to customers and have formed our overall ambition and vision for the business plan and Long-Term Delivery Strategy based on this.

Customer engagement on the Long-Term Delivery Strategy maps back to all our other engagement research around delivering long-term, high quality, resilient water supplies and looking after our wastewater and keeping that in the pipes. However, we are also aware of the challenges in securing long-term affordability and fairness between current and future customers, especially with the uplift seen with storm overflow investment in the future. Our research shows that our customers want to spread the cost between current and future customers and we have taken this onboard within the plan.

The Board has challenged and satisfied itself that the 2025-2030 business plan implements the first five years of the Long-Term Delivery Strategy.

The Board is confident in the statements being made in this Board Assurance Statement as it has been a key party involved in the development of both the 10-year corporate strategy and the longer 25-year delivery strategy. The Board has challenged management on the development of both these strategies, including the scale of the future investment and the Board requested the inclusion of a statutory only pathway. This statutory only pathway would be triggered through constraints on either customer affordability or Company financeability. Development of the long-term strategy has required careful balance of the needs of our customers' and

6.0 Board Assurance

other stakeholders' interests now and in the future alongside the affordability of our ambitions.

To make sure our Long-Term Delivery Strategy is robust in the face of future uncertainties, we have used a series of plausible future scenarios to inform and challenge our planning. Each pathway contains a decision point, which indicates when a decision needs to be taken about the right option to efficiently deliver long-term outcomes, and a trigger point, which indicates the circumstances in which an alternative adaptive pathway would need to be followed.

It should be noted that we are yet to conclude our Water Resource Management Plan (WRMP) process for WRMP24. As required by Ofwat, we have included our best view of our WRMP24 within our business plan. This is based on our draft WRMP with revised demand reduction components included.

The Board have given careful consideration to Defra's request to rephase our AMP8 investment into AMP9 and recognise that any rephasing of activity into later AMP periods would inevitably increase the requirements in later AMPs and impact affordability in the future.

The Long-Term Delivery Strategy and this supporting Assurance Statement was approved collectively by the Board in September 2023.

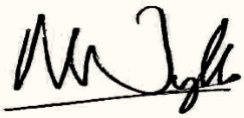
Signed by Yorkshire Water Services Limited Board of Directors

Signatures

Vanda Murray
Independent Non-Executive Chair

Nicola Shaw
Chief Executive Officer

Paul Inman
Chief Financial Officer



Andrew Wyllie
Senior Independent Director

Julia Unwin
Independent Non-Executive Director

Andrew Merrick
Independent Non-Executive Director

Wendy Barnes
Independent Non-Executive Director

Scott Auty
Non-Executive Director

Andrew Dench
Non-Executive Director

Russ Houlden
Non-Executive Director

7.0 Appendices

7.1. Appendix A. Six Capitals Assessment

The table below provides a detailed overview of our six capitals assessment where applicable to our core pathway.

7.1.1. Clean Water

7.1.1.1. WINEP

Table C1. LS3 Clean Water - WINEP Six Capitals Assessment

Six Capital	Example Valuations
Natural Capital	Drinking water protected areas • The YWS region has extensive sheep and cattle farming on the uplands and predominantly arable farming in lowlands. • Climate change mitigation is provided by the investment, as the work increases the organic matter in farming soils which builds resilience in peatland (by improving water retention in the soil profile), this attenuates flow in the rivers which in turn causes less erosion and carbon release. • Improvements are made to habitats that encourages biodiversity and pollination e.g., cover crops. • There is reduction in insecticides and fungicides being used due to natural predator control. Biodiversity and conservation • The investment contributes to flood mitigation, water quality improvements, carbon storage, air quality improvements, and ecosystem resilience. Eel schemes and fish passes • Improved fish populations throughout the YWS area, importantly aiding recovery and preventing further decline of threatened European eel and Atlantic salmon. • Associated improvements to wider ecology that rely on fish (e.g. predators such as heron, kingfisher, otter). • Fish passage schemes also improve the natural function of river flow and morphological processes. These benefit all aspects of the river and riparian environment. Invasive non-native species • Removal of existing riparian INNS helps improve flood deference and allows the transfer of raw water. Biosecurity prevents future costs from the arrival of new INNS via impacts on ecosystem services such as flood deference, water quality and pollination
Intellectual Capital	Drinking water protected areas • YWS have shared intellectual property sites that demonstrate the value of the interventions. • Through sharing insights with the government, confidence is given to the government to invest in schemes and inform better decision making. • Biodiversity and conservation

7.0 Appendices

	• Work in this area is supported by local PhD and MSc students, academic papers are published and BACI trials have been run. • Eel schemes and fish passes • Delivery of these schemes enhances the internal and external (contractor and partner) knowledge pool. Specific areas include: design and build of in river schemes, such as river intake screens and fish passes, health, safety and environmental risks and mitigation, procurement, contractual and legal. • Invasive non-native species • Work is supported by PhD and MSc students, academic papers published, BACI trials run
Social Capital	Drinking water protected areas • Improving habitat spaces for the public attracts more visitors and creates more desirable social spaces. • Improving trust with farmers and the relationship is now considered a partnership which helps farmers to make informed decisions. • Improved water retention in peatlands improves flooding resilience for communities. Biodiversity and conservation • Improves local amenity value and recreational value. Eel schemes and fish passes • Wider community benefits of fish passage schemes are directly targeted via fish passage partnerships such as Great Yorkshire Rivers. There is also improvement in enhanced recreational and economic opportunities associated with river improvement e.g. salmon returning to rivers attracts increased anglers to local community, with associated tourism benefits to local commercial and services sectors. Invasive non-native species • Amenity value, recreational value is improved.
Human Capital	Drinking water protected areas • Employment is created by increasing contractor work for peatland restoration in uplands and lowlands. • YWS have been able to use CDM regulations to dramatically improve the health and safety performance of the Yorkshire Peat Partnership. • Local economy has benefited from more awareness and a stronger focus on things like shopping locally grown meat and encouraging a circular economy. Improvements in local honey production have been seen because of improving habitats. Biodiversity and conservation • It provides societal wellbeing form volunteers taking part in the programme and improved quality of life for people visiting site. Eel schemes and fish passes • Delivery of these schemes enhances the internal and external supply chain and partner capacity, capability and expertise, both now and into the future. A specific objective of the Great Yorkshire Rivers Partnership is to enhance and embed resilience in partner capacity and capability, share learning via a Community of Practice and ensure long lasting benefits. Invasive non-native species • It provides societal wellbeing from volunteers taking part in the programme and improved quality of life for people visiting site.
Financial/Manufactured Capital	Drinking water protected areas • Through economies of scale YWS procures cover crop seeds at competitive prices, these prices are passed onto farmers to share the benefit.

7.0 Appendices

	• Funding has successfully been secured for peatland restoration e.g. AMP 6 through Yorkshire Peat Partnership and Moors for the Future secured £20m to support initiatives. An additional £9m in support from DEFRA has also been secured. • The lowlands have developed a carbon bank code which will provide an additional income for farmers implementing regenerative agricultural interventions which also benefits the food and drinks supply chain. Eel schemes and fish passes • For both eel and fish passage schemes, new manufactured capital assets are created and maintained for asset lives spanning decades, subject to future legislation changes. Partnerships such as Great Yorkshire Rivers will bring in at least £10m in match funding, enhancing financial capital. Invasive non-native species • The work avoids excessive management costs and diminution of value to neighbouring properties.

7.1.1.2. WRMP

Six Capital	Example Valuations
Natural Capital	Close the supply-demand deficit • As identified in YW Strategic Environmental Assessment for options relevant to the core pathway, some supply options present opportunities to enhance biodiversity as part of activities to replace habitats lost during the construction phase. Demand options reduce the pressure on waterbodies and their dependent habitats by reducing the amount of water taken from the environment. Become resilient to 1 in 500 droughts (without drought measures) • Becoming resilient to 1:500 without the need for use of drought measures has benefits for the water environment (including supported habitats and species) as there will be less pressure potential requirement for drought permits and orders during drought as detailed in the YW Drought Plan (NB. it does not mean that the need for drought permits will be eradicated). Relying less on such measures means the ecosystems that would otherwise be affected by these drought permits and orders can maintain their resilience under these conditions. It also reduces risks that reservoir storage depletion could impact on compensation / environmental flows d/s of reservoirs. Meeting policy targets for demand management and leakage • Demand reductions via leakage and PCC reductions translate to less water being taken from surface and groundwaters (and help offset upward pressures on demand like population growth). This is beneficial as it reduces impacts on flows, allowing aquatic flora and fauna to be better supported, particularly when flows are naturally lower during summer. Demand management and leakage reductions also allow for the supply-demand balance to be met, without reliance on supply options that may have an environmental impact. Increased supply resilience and meeting local growth NA Meeting the needs of WINEP and environmental destination • The core pathway is dependent upon further investigation work on the needs of environmental destination, so that effective long-term solutions can be identified and to avoid unnecessary offsetting supply options (which may themselves have env. impacts). Ultimately reducing abstractions to meet WINEP and environmental destination requirements helps maintain healthy flows and groundwater levels and give affected watercourses the change to recover from over abstraction. This could also help other abstractors, by ensuring they also have access to sufficient supply (e.g. to irrigate crops, etc). Offsetting loss of Severn Trent (Derwent valley transfer) NA

7.0 Appendices

Intellectual Capital	Close the supply-demand deficit • Development of options potentially creates or fosters intellectual capital through experience and expertise being retained to design, implement and commission new supply side schemes. This can also benefit future / later years should there be other options required to meet longer-term challenges. Become resilient to 1 in 500 droughts (without drought measures) NA Meeting policy targets for demand management and leakage • "Implementing smart metering as part of YW's demand management strategy will give YW the opportunity to gain new knowledge on customer behaviour and water needs and allow the company to leverage the use of big data. YW teams will have the opportunity to use this new information in novel ways to further their understanding of temporal and spatial patterns of water use and use that to further develop their future demand strategies and other process in future. • Meeting the level of aspiration in the policy targets will also require and/or utilise new innovations over time." Increased supply resilience and meeting local growth • There are opportunities for learning and further innovations in this area, to ensure options with multiple benefits can be included in future plans. The core pathway delivers the short-term no regrets solutions, whilst keeping the door open for longer-term solutions by continuing to explore and/or develop options to meet longer-term needs. Meeting the needs of WINEP and environmental destination • Environmental destination is a new area of work that although has synergies with the WINEP process, requires innovation with respect to the implementation if novel options and long-term planning. Thus, those involved in this work gain new knowledge and skills alongside the opportunity to identify innovative approaches to optioneering. The core pathway is relying upon further investigation work and exploring catchment level solutions particularly on the River Derwent. Offsetting loss of Severn Trent (Derwent valley transfer) • The process of identification and appraisal of options in itself contributes to the generation of new ideas. Moreover, investigations required to investigate the viability of large transfers of water generates new knowledge that can be leveraged in the future - this is being done as part of collaborative work as part of the RAPID Ofwat SRO project.
Social Capital	Close the supply-demand deficit • Supply schemes contribute to securing a resilient water supply and help mitigate climate change impacts on supply reliability for people (protecting from the economic and social impacts of loss of supply). YW customers might experience increased/renewed trust (or at least maintain it!) in the company's ability to ensure sufficient supply for the future. Furthermore, the delivery of some of the schemes will involve forging new/strengthening existing relationships and collaborating with the local community in which the scheme is delivered. Water efficiency initiatives can also deliver social capital via water efficiency education/communication between YW and its customers, which can translate to less demand for water. Become resilient to 1 in 500 droughts (without drought measures) • Decreased reliance on drought measures will increase the customer's trust in YW as the company will be seen as more reliable and less restrictive. Customers' views of YW could improve as a consequence. A higher level of resilience provides the public with greater confidence in YW's core service. Meeting policy targets for demand management and leakage • Realising YW's demand management ambitions requires collaboration both within the organisation as well as with key stakeholders (including other companies and regions) and regulators. Such interactions build social capital that can be harnessed to drive innovation and improvements in relation to the implementation of future demand management strategies. YW's demand management strategy includes educating customers on water efficiency and instigating behavioural change. This newly created social capital can help drive demand down in future

7.0 Appendices

	decades. Moreover, the delivery of ambitious leakage strategy can improve customer's perception of YW, as leakage is a highly sensitive issue for many. Increased supply resilience and meeting local growth • The necessity to include options that provide multiple benefits gives rise to the opportunity for collaboration with others and thus, creating social capital that can be harnessed in future planning rounds. Avoiding supply restrictions caused by supply interruptions increases trust in public water supply, and confidence for growth. Meeting the needs of WINEP and environmental destination • Co-creating options as part of environmental destination requires close work with a variety of stakeholders and regulators. This is the area of work that has the largest potential for creating social capital, due to the sheer amount of liaison required to identify and implement such options. YW will work closely with regulators and stakeholders as part of ongoing investigations work under the core pathway. Offsetting loss of Severn Trent (Derwent valley transfer) • The backfill options are designed to protect social wellbeing, otherwise caused by loss of water supplies to key areas. It protects trust in public water supply.
Human Capital	Close the supply-demand deficit • "The implementation of supply options (especially larger ones like DV8) will support the economy by providing new employment opportunities, maintaining existing employment, supporting existing and new businesses by ensuring security of supply into the future and supporting future housing growth. Moreover, the solutions required to plug deficits will maintain essential public water supplies and therefore help maintain public health and well-being. • Affordability / costs is an inherent part of the options appraisal process - the BVP was the lowest cost of the candidate dWRMP solutions. The BVP also had highest normalised score for five of the 13 best value metrics (customer preference, human and social wellbeing, biodiversity, multi abstractor benefit and flood risk management)." Become resilient to 1 in 500 droughts (without drought measures) • "Relying less on drought orders or permits will translate to better amenity value for the water environment, the continuation of recreational activities during dry spells and thus, positive impacts on human health and well-being. • A higher level of resilience to Level 4 emergency drought orders (standpipes, rota cuts etc.) reduces the likelihood of these draconian measures being implemented to protect public water supply, along with the high economic cost of their imposition (as outlined in a previous NIC report)." Meeting policy targets for demand management and leakage • YW's demand management strategy is designed to help customers maintain their health and well-being while decreasing their water use. For some customers, playing their part to help the water environment and keeping costs down boosts mental and financial well-being. Increased supply resilience and meeting local growth • "Supply and demand options in the plan collectively allow YW to meet local authority growth plans. • Options such as DV8, R8b and R8g are designed to provide customers with an additional resilience of water supply in case of outages, peak demands, and failures. In the absence of these options, supplies to the affected areas (i.e. York, North Yorkshire/Dales and Howardian Hills areas) would be interrupted by outages less than 24 hours. Hence, implementing these options would ensure customers' health and well-being is safeguarded, and local economy is protected. Moreover, some options (i.e. R8g) specifically targets support to public water and non-household demand growth planned in the North Yorkshire and South Eastern Grid area." Meeting the needs of WINEP and environmental destination • "The investigation of the best-value long-term solutions to meet ED / WINEP creates economic value. • By identifying the right solutions, on a now regrets basis, this protects customer bills and affordability."

7.0 Appendices

	Offsetting loss of Severn Trent (Derwent valley transfer) • The large scale options required to offset the loss of this key transfer (via WTW and internal interconnectors) create local economic value and employment from the development of infrastructure.
Financial/Manufactured Capital	Close the supply-demand deficit • Supply and demand options requiring upgrading existing infrastructure will contribute to maintaining manufactured capital. New infrastructure (i.e. construction of DV8, R8b, R8g etc - WTW and groundwater assets) will translate to new manufactured capital. The new assets (i.e. new treatment works and associated pipelines) will be used by YW to provide water to customers and therefore, fulfilling its purpose as a water company. Become resilient to 1 in 500 droughts (without drought measures) • Less reliance on NEUBs / EDOs will positively impact businesses and allow them to continue operating as normal and creating/maintaining their financial and manufactured capital. Meeting policy targets for demand management and leakage • Delivering leakage reductions leads to maintenance of existing manufactured capital for the future. For customers, reductions in demand could save money in the long run, thus creating financial capital. Increased supply resilience and meeting local growth • Supply resilience options led to the creation of new manufactured capital (i.e. via new assets such as WTW and pipelines being built). Meeting the needs of WINEP and environmental destination NA Offsetting loss of Severn Trent (Derwent valley transfer) • The transfer would protect and support planned growth in the YW area (i.e. businesses and housing developments), thus supporting the creation of manufactured and financial capital for other parties.

7.1.1.3. Water Quality

LS3 Clean Water – Water Quality Six Capitals Assessment

Six Capital	Example Valuations
Natural Capital	Tase and odour • The inclusion of green solutions will reduce the likelihood of algal blooms, which will improve the output of WTWs from existing storage options. This reduces the need to build new storage which reduces the carbon impact of the investment. Lead • There is no natural capital value until lead is fully removed from the network but once this has been achieved there would be significant carbon savings as the need to chemical dose the supply for lead would no longer be required, meaning not having to mine phosphate and import it from Russia. Raw water quality • Some of the catchment-based solutions from nitrate management schemes reduces nitrates and phosphates in surface water from fertilizers, this in turn reduces the extent of algal blooms. • The investment on the re-naturalisation of peatland bogs (which is endangered national habitat) has many benefits including improving natural habitats, ecosystems, and carbon capture. Discolouration • The investment means a reduced need for asset renewal which has significant carbon benefit.

7.0 Appendices

Intellectual Capital	Tase and odour • YWS are partnering with other water companies to undertake research to further understand the benefits of interventions in reservoirs. This is increasing the water industry's understanding of preventing algae-blooms in reservoirs. Lead • YWS have undertaken case study a programme (Rotherham Trial) which proactively addresses lead in the network using a risk-based approach. With a focus on vulnerable customers and targeted replacement, new techniques have been explored which can support decisions within the wider industry. Raw water quality • The investment is improving YWS and industry knowledge on how to treat taste and odour issues in response to climate change and increased pressure on water resource. Discolouration • There is a partnership underway with Sheffield University on gaining a better understanding of discolouration within water mains.
Social Capital	Tase and odour • It provides improved public amenities and ensuring health and safety for pets as algae is toxic for some animals. Lead • The investment would provide safer water with the removal of toxic metals from the water supply. • There are links to health benefits particularly for children as progressive removal of lead has been linked to improved brain development according to some studies. These studies have also linked lead removal from water supply to lower crime rates. • The investment therefore increases people's quality of living and builds trust with the customer. Raw water quality • The investment will allow increased customer confidence in YWS's reliability of water. Discolouration • Increased trust from customers by providing better quality water.
Human Capital	Tase and odour • These solutions create less risk exposure for employees as opposed to the need to operate and maintain additional assets associated with grey solutions. • Investing in a combination of green and grey solutions strikes a balance between employment and carbon benefits. Lead • The delivery of the trial has proven that the removal of lead from the network is challenging as the delivery team had to overcome issues such as health and safety within gardens, access to properties and local disruption, however many of our employees are customers and will benefit from safer water once work is complete. Raw water quality • The investment will create a balance between nature based and traditional capital-based solutions. The continuation of complex civil schemes provides employment and boosts the local economy, whereas nature-based solutions means that manual assets are not being installed with the associated risk of operation and maintenance. Discolouration • Conditioning as a opposed to renewing assets means a reduced risk of construction related health and safety issues for employees.
Financial/Manufactured Capital	Tase and odour

7.0 Appendices

	• Investment in assets provides robust resilience of supply against raw water quality changes, this improves the ability for treatment and reduces penalty exposure to the business. Lead • Investment in lead removal will remove the associated cost of phosphate dosing and the current ongoing costs of lead monitoring. The company will no longer have to be concerned about water quality sample failures on lead. Raw water quality • Investment in assets provides robust resilience (of supply) against raw water quality changes, improving the ability of treatment and reducing penalty exposure. Discolouration • Investment in assets provides robust resilience (of supply) against raw water quality changes, improving the ability of treatment and reducing penalty exposure. • There is a reduced need for asset renewal, conditioning a main is more beneficial than renewing it from cost perspective.

7.1.1.4. Security

LS3 Clean Water - Security Six Capitals Assessment

Six Capital	Example Valuations
Natural Capital	Cyber Security • Preventing cyber-attacks that could have significant environmental impacts e.g., Maroochy incident in 2000 where a cyber-attack caused the leakage if sewage around one of Australia's rural attraction areas. SEMD • If someone breaches physical or electronic security, they could interfere with equipment and or process and cause a pollution incident.
Intellectual Capital	Cyber Security • YWS are working with academia to shape what cyber physical security should look like. SEMD • Working with the National Security agencies looking at how all national infrastructure companies can enhance security across the estate.
Social Capital	Cyber Security • Preventing cyber-attacks that could have significant impact on quality water e.g., Maroochy incident. • Preventing pollution incidents through delivery of safe services. • Keeping customer information safe and ensuring YWs reputation and trust with customers. SEMD • As per above and insider threat, their impact and what they could get access to inside the business. It could potentially lead to a pollution incident which would affect quality of places, trust, and physical activity.
Human Capital	Cyber Security • Process safety measures in place to help foster a safe working environment e.g., a cyber-attack that could trigger the shutdown of systems to prevent potentially causing employees to be injured. SEMD • Process safety measures in place to help foster a safe working environment e.g., a physical attack that could trigger the shutdown of systems to prevent potentially causing employees to be injured.

7.0 Appendices

Financial/Manufactured Capital	Cyber Security • Risk that someone could break in and cause significant damage to a site, counter measures in investment plans to prevent and mitigate this. Risk assessments done by site to understand site specific vulnerabilities and required mitigating action to protect the business. SEMD • Risk that someone could break in and cause significant damage to a site, counter measures in investment plans to prevent and mitigate this. Risk assessments done by site to understand site specific vulnerabilities and required mitigating action to protect the business.

7.1.1.5. Resilience

LS3 Clean Water - Resilience Six Capitals Assessment

Six Capital	Example Valuations
Natural Capital	N/A
Intellectual Capital	Improving our understanding of our water supply system which will support better planning for future scenarios. YWS are focusing on developing strategies for the long-term water supply for customers.
Social Capital	Improving customer trust in YWS through serving our customer under all futures. Where customers only have single water sources, YWS are working to ensure that other sites can provide water to those customers, reducing/stopping water supply interruptions.
Human Capital	Solutions will be delivered through DPC in AMP8, this will provide local employment for contractors.
Financial/Manufactured Capital	If customer's water supply is interrupted, reactive supply has cost associated to it. If the need for this is alleviated, then YWS will not incur this cost. With more time to recover unplanned outage, then the less cost impact it will have for customers.

7.0 Appendices

7.1.1.6. Carbon

LS3 Clean Water - Carbon Six Capitals Assessment

Six Capital	Example Valuations
Natural Capital	Renewables • Use of renewables leads to reduction in use of fossil fuel based purchased electricity, and reduction in greenhouse gas emissions and air pollution and across the whole life taking into account the embedded carbon the natural capital associated with this investment is positive. Scope 3 – purchased chemicals • Optimising the use of purchased chemical is aligned with minimising use of natural resources, and minimising waste. Our approach follows a hierarchy of avoid, reduce, re-use, recycle to minimise demand for natural resources and give back to natural capital. Scope 3 – embedded emissions in purchased goods and service and capital goods • Optimising the use of purchased goods and services and capital goods is aligned with minimising use of natural resources, and minimising waste. Our approach follows a hierarchy of avoid, reduce, re-use, recycle to minimise demand for natural resources and give back to natural capital.
Intellectual Capital	Renewables • Potential to link to smart systems to balance demand for electricity - e.g. with battery storage in the short term, and grid export to support demand management at times of peak demand. Scope 3 – purchased chemicals • Strong potential to engage with industry and academic research on substitute chemicals and technologies to create new IP and skills. Scope 3 – embedded emissions in purchased goods and service and capital goods • Strong potential to engage with industry and academic research on substitute chemicals and technologies to create new IP and skills.
Social Capital	Renewables • Reduced demand on grid - helps make decarbonisation more deliverable and ensures others benefit from the decarbonisation - ability to feed into grid may also provide a social benefit. Financial savings will help control costs to customers in the medium to longer term. Reduced air pollution provides a benefit to health nationally. Scope 3 – purchased chemicals • Reducing chemicals, reduces cost helps maintain affordability of bills for customers. Scope 3 – embedded emissions in purchased goods and service and capital goods • Optimising the use of purchased goods and services and capital goods, reduces cost and helps maintain affordability of bills for customers.
Human Capital	Renewables • Significant solar programme - helps to stimulate the green economy and create jobs leading to wider value. Scope 3 – purchased chemicals • Reduced handling and use of chemicals has a positive health and safety benefit Scope 3 – embedded emissions in purchased goods and service and capital goods • Will stimulate green economy jobs
Financial/Manufactured Capital	Renewables • Cost savings over the asset life from avoided cost of purchased electrify (anticipated 7-8year payback is typical).

7.0 Appendices

	Scope 3 – purchased chemicals • There will be a balance of differential costs with some low chemical solutions saving costs and others requiring investment. Aim to reduce carbon emissions significantly will on balance require additional cost, but over time these costs will become normalised as low carbon chemicals become standard choice. Scope 3 – embedded emissions in purchased goods and services and capital goods • There will be a balance of differential costs with some saving and other additional cost. Aim to reduce carbon emissions significantly will on balance require additional cost, but over time these costs will become normalised as low carbon solutions become standard choice.

7.1.2. Wastewater

7.1.2.1. WINEP

LS4 Wastewater- WINEP Six Capitals Assessment

Six Capital	Example Valuations
Natural Capital	Storm overflow improvement via storage schemes • Rivers achieving good ecological status and therefore improving the aquatic environment. Storm overflow improvement via nature-based solutions • Rivers achieving good ecological status and therefore improving the aquatic environment with biodiversity net gain. Nature based solutions for final effluent treatment • Rivers achieving good ecological status and therefore improving the aquatic environment with biodiversity net gain. Catchment management • Rivers achieving good ecological status and therefore improving the aquatic environment with biodiversity net gain.
Intellectual Capital	Nature based solutions for final effluent treatment • Working with Rivers Trust and other water companies to improve understanding and upscale deployment of such schemes. Monitoring • Increasing our understanding of our assets and greater visibility of asset performance. Catchment management • Improved relationship with catchment partners and other sectors such as agriculture.
Social Capital	Storm overflow improvement via storage schemes • Rivers achieving good ecological status therefore increasing the amenity of the river. Storm overflow improvement via nature-based solutions • Rivers achieving good ecological status therefore increasing amenity of the river. Increased amenity in the environment where the nature-based solution has been created e.g., flower beds, ponds etc Nature based solutions for final effluent treatment • Rivers achieving good ecological status therefore increasing amenity of the river. Increased amenity in the environment where the nature-based solution has been created e.g. flower beds, ponds etc Monitoring • Additional data will foster trust with consumers. Traditional biological wastewater treatment

7.0 Appendices

	• Rivers achieving good ecological status therefore increasing the amenity of the river. Catchment management • Rivers achieving good ecological status therefore increasing amenity of the river. Increased amenity in the environment where the nature-based solution has been created e.g. flower beds, ponds etc
Human Capital	Storm overflow improvement via storage schemes • A safe asset base protecting employees. Storm overflow improvement via nature-based solutions • A safe asset base protecting employees. Nature based solutions for final effluent treatment • A safe asset base protecting employees. Monitoring • A safe asset base protecting employees. Traditional biological wastewater treatment • A safe asset base protecting employees. FE treatment via chemical dosing • A safe asset base protecting employees. Catchment management • A safe asset base protecting employees.
Financial/Manufactured Capital	Storm overflow improvement via storage schemes • Increasing the asset base and the RCV. Protection of the business from pollution and poor asset performance and the associated fines. Storm overflow improvement via nature-based solutions • Increasing the asset base and the RCV. Protection of the business from pollution and poor asset performance and the associated fines. Nature based solutions for final effluent treatment • Increasing the asset base and the RCV. Protection of the business from pollution and poor asset performance and the associated fines. Monitoring • Increasing the asset base and the RCV. Protection of the business from pollution and poor asset performance and the associated fines. Traditional biological wastewater treatment • Increasing the asset base and the RCV. Protection of the business from pollution and poor asset performance and the associated fines. FE treatment via chemical dosing • Increasing the asset base and the RCV. Protection of the business from pollution and poor asset performance and the associated fines. Catchment management • Protection of the business from pollution and poor asset performance and the associated fines.

7.0 Appendices

7.1.2.2. DWMP

LS4 Wastewater- DWMP Six Capitals Assessment

Six Capital	Example Valuations
Natural Capital	Storm overflow improvement via storage schemes • Natural capital value will be added through rivers achieving good ecological status, this improves the aquatic environment. Storm overflow improvement via nature based solutions • Natural capital value will be added through rivers achieving good ecological status, this improves the aquatic environment and also creates biodiversity net gain.
Intellectual Capital	Storm overflow improvement via nature based solutions • YWS are working in partnership with local authorities and the EA. Hydraulic flooding • YWS are working in partnership with local authorities and the EA.
Social Capital	Storm overflow improvement via storage schemes • Rivers achieving good ecological status means increased amenity and improved quality of the river which also results in increased trust from customer. Storm overflow improvement via nature based solutions • Rivers achieving good ecological status means increased amenity and improved quality of the river. In addition, there is an increased amenity in the environment where the nature based solution has been created e.g. flower beds, ponds etc. All of which increasing customer trust. Hydraulic flooding • Protecting housing and curtilage from the detrimental impact of sewer flooding. Therefore, increasing trust from customers due to protecting their health and safety.
Human Capital	Storm overflow improvement via storage schemes • Provision of a safe asset base protecting YWS employees. • The local economy is protected by ensuring tourism is not effected by keeping coastal water clean. Storm overflow improvement via nature based solutions • Provision of a safe asset base protecting YWS employees. • The local economy is protected by ensuring tourism is not effected by keeping coastal water clean. Hydraulic flooding • Creating work for the local economy in terms of traditional construction projects for local contractors. • Avoiding property blight in the local community.
Financial/Manufactured Capital	Storm overflow improvement via storage schemes • Creation of new assets increases YWS's RCV and protects the business from pollution incidents and fines. Storm overflow improvement via nature based solutions • Creation of new assets increases YWS's RCV and protects the business from pollution incidents and fines. Hydraulic flooding • Protecting the business from flooding penalties and increasing YWS's RCV.

7.0 Appendices

7.1.2.3. Bioresources

LS4 Wastewater- Bioresources Six Capitals Assessment

Six Capital	Example Valuations
Natural Capital	The investment is adding natural capital value by enabling nutrients to be recycled to agriculture where appropriate or where the agricultural need is there. This is also a much lower carbon option than incineration and provides a positive environmental benefit to soil health.
Intellectual Capital	YWS are actively engaging with York University on innovation trials to improve sludge digestion and information sharing with other WASCs to encourage and advance innovation.
Social Capital	Biosolids recycling will be managed responsibly to reduce any potential social impact e.g., taking measures to reduce odours and comply with the Biosolids Assurance Scheme. This will ensure the quality of social space.
Human Capital	Biosolids are a great non-chemical fertiliser which is supporting the local economy with a low cost, environmentally friendly fertiliser. By continuing to treat sludge we are maintaining a skilled workforce.
Financial/Manufactured Capital	The PR24 plan will deliver a more efficient return bioresources plan and will reduce cost for the business long term.

7.1.2.4. Living with water

LS4 Wastewater- Living with Water Six Capitals Assessment

Six Capital	Example Valuations
Natural Capital	Air Quality; scheme includes tree planting, attenuation basins, swales, green roofs in dense urban, populated areas and along transport corridors, which is expected to increase the air quality benefit value. They can absorb or remove certain pollutants, including nitrogen dioxide (NO2), Sulphur dioxide (SO2), particulates (PM10) and ozone (O3), providing a number of benefits to people that live, visit or pass through the area. Biodiversity & Ecology; Improvement is expected in the number and type of plant, animal, and insect species, resilience of biodiversity and range habitats with SuDS measures as well as through the connection of green space through the blue green corridors and (green) pathway measures. Carbon Sequestration; The main benefit will be derived through tree planting along the corridors, pathways and green open spaces. For this assessment, the 3 trees per 10m length of proposed Blue-Green corridor. The proposed number of trees have been distributed according to size: 65% small, 30% medium and 5% large. Water quality; A typical year simulation in the hydraulic drainage model has been used to assess the reduction in spills discharging to the receiving watercourses. Data is not yet available to quantify this. Pumping; The 1 year typical rainfall time series event simulated in the hydraulic drainage model provides an indication of the reduction in volumes. This has been compared with the volumes also pumped where necessary from the blue-green corridors. For this assessment, energy savings have been calculated based on the average pump flows, run times and estimated heads from the hydraulic model. Rainwater Harvesting (reduction in water usage); The total reduction in water usage through rainwater harvesting for both residential and non-residential (public, industrial and commercial) buildings is 6000 m3. This number is based on the proposed water butt size for non-residential and residential buildings and the assumed uptake of the total amount of non-residential and residential buildings in the study area.

7.0 Appendices

Intellectual Capital	Education; Hull will be an exemplar of turning into a flood-resilient region by using sustainable blue-green infrastructure. This provides the local community, schools and higher education; direct and easy access to BGI to educate students about climate resilience and sustainable water management. BGI may provide job opportunities and may great opportunities to learn new or enhance skills. Local community groups could also become involved with maintenance and monitoring of SuDS features. The Hull & Haltemprice region has 21 primary schools and 83 secondary/high schools with an average of 300-400 student. Based on these data, it has been assumed that a minimum of 500 students (equivalent to 15 classes) will be engaged in multiple school trips or activities related to the new blue green infrastructure per year. Hull university, LWW's academic partner potential expansion of their MSc offering and SuDS lab will lead to further skills and experiences in BGI.
Social Capital	Amenity; This scheme includes tree planting, attenuation basins, swales and bio retention areas across the study area. Many of the proposed measures will be visible and attractive, designed partly to improve appearance of green areas. These green areas (pre-construction) are assumed to not have a positive effect on the attractiveness and desirability of the study area due to their 'plain' setting. However, with the proposed 'improved' green space and newly introduced 'park' characteristics (e.g., bio retention areas or attenuation basins), the study area is expected to become more aesthetically pleasing to the local residents. Health; All SuDS measures will improve the existing green spaces (rain gardens, installing ponds for attenuation etc.), which may encourage residents or others to spend more time outdoors (e.g., walks around the area). With the proposed 'improved' green space and newly introduced 'park' characteristics (e.g., on green roofs or attenuation basins), the health care costs are expected to decrease as a result of increased physical activity, and the impact on emotional wellbeing associated with increased contact with nature. Noise; This scheme will include tree planting. When trees are densely planted over a width of at least 30m, they are able to provide enough acoustic attenuation to provide a 10db reduction and mitigate noise from vehicle movements on a road. Smaller pockets of trees or individual trees will have less quantifiable impacts on noise, but do contribute to acoustic attenuation. In this scheme tree planting is linked with an estimated 1db decrease. Recreation; Improved green space may encourage the local residents to go for more walks around the area. Besides that, the proposed detention basins could be designed to include a semi-permanent wet area, which could promote recreation such as bird watching, pond dipping, walking, eco-friendly playgrounds, etc. Traffic calming: Changes to the roads could result in decreased speeds, which could link with reduced accidents. A small reduction in accidents per year has been included in the benefits assessment.
Human Capital	Employment. New blue green infrastructure will require new roles to monitor, manage and maintain these assists. The BG plan may provide job opportunities including apprenticeships and great opportunities to learn new or enhance skills in this field. Working with Wilberforce College and their vision to be a Community Hub Employer leading the industry board towards green jobs for the future. Health and Safety; BGI and increase in green spaces and trees may provide a cooling effect during heatwaves. The education and engagement aspect of the plan will enable customers to be prepared in flooding events and to be able to recover more quickly, leading to a more resilient community. Traffic calming benefits also leading to reduced risk of road accidents. Local Economy: The local economy is enhanced by the greening of the environment and the increase in amenity provided. Confidence in investors in the area is increased due to the investment in flooding resilience. An expected increase in property values due to BGI.
Financial/Manufactured Capital	Flooding Damage costs avoided due to the BGP up to £1.266 Bn. Flood damage cost values are based on the Multi coloured handbook 2021 including residential and non-residential property damages in addition there are also costs avoided to emergency service responses and damages related to residential evacuation and emergency accommodation costs and privately owned vehicle damage. Rainwater harvesting leading to reduction in water usage, reduction in customers' bills and overall wastewater treatment costs.

7.0 Appendices

7.1.2.5. Resilience

LS4 Wastewater- Resilience Six Capitals Assessment

Six Capital	Example Valuations
Natural Capital	There is an opportunity to deploy nature-based solutions such as wetlands to manage natural flood defences, increasing biodiversity of the region.
Intellectual Capital	We are working with the Rivers Trust and the Environment Agency to form partnerships to implement green solutions. Improving our understanding the impacts of climate change on our assets, allowing better understanding of risks and methods to mitigate those risks.
Social Capital	Creating or improving green spaces though nature-based solutions.
Human Capital	Reduction of operational risk that is associated with traditional asset-based solutions
Financial/Manufactured Capital	Natural flood defences are more expensive to implement in the short term but will provide higher long-term value allowing for cost-savings into the future.

7.1.2.6. Carbon

LS4 Wastewater- Carbon Six Capitals Assessment

Six Capital	Example Valuations
Natural Capital	Process emissions (methane) • Reducing methane emissions is a direct mitigation measure for climate change, it also helps alleviates local air pollution/odour and reduces chemical (polymer) use for sludge processing thereby reducing material use. Improving digester capacity also alleviates need to build new assets and thereby reduces use of materials for construction. Self- generation of green energy displaces use of fossil fuels. Processes emissions (nitrous oxide) • Our approach has been to address the reduction of nitrous oxide using improved process control and optimisation of the conditions in are treatment plant. By doing this we have avoided chemical dosing solutions that would require energy intensive and or fossil fuel derived chemicals that would also create hard to manage by-products. Renewables • Use of renewables leads to reduction in use of fossil fuel based purchased electricity, and reduction in greenhouse gas emissions and air pollution and across the whole life taking into account the embedded carbon the natural capital associated with this investment is positive. Scope 3 – purchased chemicals • Optimising the use of purchased chemical is aligned with minimising use of natural resources, and minimising waste. Our approach follows a hierarchy of avoid, reduce, re-use, recycle to minimise demand for natural resources and give back to natural capital. Scope 3 - embedded emissions in purchased good and services and capital goods • Optimising the use of purchased goods and services and capital goods is aligned with minimising use of natural resources, and minimising waste. Our approach follows a hierarchy of avoid, reduce, re-use, recycle to minimise demand for natural resources and give back to natural capital.
Intellectual Capital	Process emissions (methane)

7.0 Appendices

	• Methane emission management in wastewater in an emerging area, and we are helping to progress understanding of the scale of emissions and their management. Leak detection and management will also lead to advances in approaches and understanding of solutions required - that will present opportunities for collaboration with peers, technology providers and academia. Processes emissions (nitrous oxide) • Process emission reduction - is an emerging area of science - we are working collaboratively with the industry, consultants and academia to refine the understanding of solutions and best solutions to mitigate N20, which has a high global warming potential. Renewables • Potential to link to smart systems to balance demand for electricity e.g. with battery storage in the short term, and grid export to support demand management at times of peak demand. Scope 3 – purchased chemicals • Strong potential to engage with industry and academic research on substitute chemicals and technologies to create new IP and skills. Scope 3 - embedded emissions in purchased good and services and capital goods • Strong potential to engage with industry and academic research on substitute chemicals and technologies to create new IP and skills.
Social Capital	Process emissions (methane) • Mitigating climate change. • Reduction of odour related to emissions from energy and recycling centres and impact to neighbours. Processes emissions (nitrous oxide) • Mitigating climate change. Renewables • Reduced demand on grid - helps make decarbonisation more deliverable and ensures others benefit from the decarbonisation ability to feed into grid may also provide a social benefit. • Financial savings will help control costs to customers in the medium to longer term. • Reduced air pollution provides a benefit to health nationally. Scope 3 – purchased chemicals • Reducing chemicals, reduces cost helps maintain affordability of bills for customers. Scope 3 - embedded emissions in purchased good and services and capital goods • Optimising the use of purchased goods and services and capital goods, reduces cost and helps maintain affordability of bills for customers.
Human Capital	Process emissions (methane) • Enhanced control of methane will improve safety of systems. Processes emissions (nitrous oxide) • Potential for new job creation for delivery of N2O control solutions/management and measurement etc. Renewables • Significant solar programme - helps to stimulate the green economy and create jobs leading to wider value. Scope 3 – purchased chemicals • Reduced handling and use of chemicals has a positive health and safety benefit Scope 3 - embedded emissions in purchased good and services and capital goods • Will stimulate green economy jobs

7.0 Appendices

Financial/Manufactured Capital	Process emissions (methane) • Investment will lead to increased biogas production with financial value of biogas. This is reflected in the opex savings. Reduction in polymer use also provides financial savings. Potential value to YW related to export of excess biogas to grid. Processes emissions (nitrous oxide) • Cost to delivering solution is high - but impact of N2O which has a global warming potential 200 time that of CO2 means values in other areas is significant and balances the cost. Renewables • Cost savings over the asset life from avoided cost of purchased electrify (anticipated 7-8year payback is typical). Scope 3 – purchased chemicals • There will be a balance of differential costs with some low chemical solutions saving costs and others requiring investment. Aim to reduce carbon emissions significantly will on balance require additional cost, but over time these costs will become normalised as low carbon chemicals become standard choice. Scope 3 - embedded emissions in purchased good and services and capital goods • There will be a balance of differential costs with some saving and other additional cost. Aim to reduce carbon emissions significantly will on balance require additional cost, but over time these costs will become normalised as low carbon solutions become standard choice.

7.1.2.7. Security

LS4 Wastewater- Security Six Capitals Assessment

Six Capital	Example Valuations
Natural Capital	Cyber security • Preventing cyber-attacks that could have significant water leakage incident. SEMD • If someone breaches physical or electronic security they could interfere with equipment and or process and cause a significant water leakage incident.
Intellectual Capital	Cyber security • YWS are working with academia to shape what cyber physical security should look like. SEMD • Working with the National Security agencies looking at how all national infrastructure companies can enhance security across the estate.
Social Capital	Cyber security • Preventing water safety incidents through delivery of safe services. • Keeping customer information safe and ensuring YWs reputation and trust with customers. SEMD • As per above and insider threat, their impact and what they could get access to inside the business. It could potentially lead to a water safety incident which would affect quality of places, trust and physical activity.
Human Capital	Cyber security • Process safety measures in place to help foster a safe working environment e.g., a cyber-attack that could trigger the shutdown of systems to prevent potentially causing employees to be injured.

7.0 Appendices

	SEMD • Process safety measures in place to help foster a safe working environment e.g., a physical attack that could trigger the shutdown of systems to prevent potentially causing employees to be injured.
Financial/Manufactured Capital	Cyber security • Risk that someone could break in and cause significant damage to a site, counter measures in investment plans to prevent and mitigate this. • Risk assessments done by site to understand site specific vulnerabilities and required mitigating action to protect the business. SEMD • Risk that someone could break in and cause significant damage to a site, counter measures in investment plans to prevent and mitigate this. • Risk assessments done by site to understand site specific vulnerabilities and required mitigating action to protect the business.

7.0 Appendices

7.2. Appendix B. Our Final Core Pathway

Here we summarise the data lines where we have planned enhancement investment and how this will help us achieve our strategy.

7.2.1. Clean Water

7.2.1.1. WINEP

This table outlines how each investment line will deliver our strategy over the next 25 years in accordance with expenditure on schemes listed in WINEP.

Ofwat Line	Core Pathway Descriptions
LS3.1 Biodiversity and conservation - Quality	This line picks up NERC driven WINEP investment. Costs reflect similar scale projects across the AMPs. Types of projects include chalk stream restoration, river restoration, species conservation, mitigating operational impacts on protected sites and species where it is not linked to WFD drivers and ensuring the company abides by its conservation commitments under the Water Industry Act, the Environment Act, the NERC Act, and the Wildlife & Countryside Act. Low confidence in numbers due to rapid changes in Government policy on biodiversity and conservation as well as rapid changes in the extent of endangered species and habitats.
LS3.2 Eels/fish entrainment screens	Expenditure is based on 2 Investigations of high, medium, and low priority sites and subsequent installation of 1 eel screen at a river intake at a medium/high priority site each AMP.
LS3.3 A. Eels/fish passes (YWS assets)	Expenditure is based on completing 3 fish passage schemes and completing 8 fish passage investigations each AMP. Numbers TBC.
LS3.3 B. Eels/fish passes (Partnerships initiatives)	Fish passage partnership: Great Yorkshire Rivers partnership between YWS, The Rivers Trust and The Environment Agency. YWS have agreed a terms of reference with a 20-year vision and objectives. YWS funding will reopen 510km of river by 2030, other qualitative outcomes for community engagement etc.
LS3.4 Invasive Non-Native Species	This includes surveillance and monitoring; its unpredictable nature makes forecast difficult. AMP 8 and 9 is mainly investigative costs to understand what can be done e.g., water transfer, new technology. AMP10 onwards costs reflect spend on treatment such as chlorination.
LS3.5 **Drinking Water Protected Areas**	The costs reflect the following: Year 1, Investigation and developing restoration plans and a programme of work. Year 2-4, delivery of restoration plans and programme of work such as. farmer engagement initiatives, restoring peatlands, increasing organic matter in lowlands. Year 5, completing the above schemes, contingency and reporting.
LS3.6 **A. Water Framework Directive**	Includes all flow related schemes. 8 implementation schemes (abstraction and compensation licence changes), 5 investigations/adaptive management schemes.
LS3.6 **B. Water Framework Directive - Groundwater**	Includes all flow related (non-ground water) schemes) including HMWB, No Deterioration, Env destination.
LS3.7 Wetland Creation	n/a as wetlands are covered under biodiversity driver.

7.0 Appendices

LS3.8 **Trade effluent discharge flow monitoring**	Includes installation of MCERTS and monitoring trade effluent discharge flow in the first 2 AMPS.
LS3.9 25 year environment plan	There is no investment on this driver. Investment is recorded in wastewater.
LS3.10 **Investigations (WINEP/NEP) - desk based study only**	There is no investment planned under this driver.
LS3.11 **Investigations (WINEP/NEP) - survey, monitoring or simple modelling**	There is no investment planned under this driver.
LS3.12 **Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water totex**	There is no investment planned under this driver.

7.2.1.2. WRMP

Ofwat Line	Core Pathway Descriptions
LS3.13 **Water enhancement totex (core pathway); Supply-side improvements**	Near term options to meet supply-demand needs, implemented pre-2030: R13 Brayton Bore Hole (BH) - new groundwater supply and Water Treatment Works (WTW); R37b(ii) R. Aire abstraction at Bingley; R3a Acomb Landing to Moor Monkton licence transfer; DV3 Magnesium Limestone new GW supply Doncaster; R8b Magnesium limestone new supply to Marton-cum-Grafton SRE; R8g Sherwood Sandstone support to grid (Wensleydale/Richmondshire); DV8(v) - Increase Elvington WTW capacity (mainly committed to South Yorkshire needs). Investment in the Dales (R8g), Howardian Hills (R8b), Bradford (R37b(ii)) and York (DV8(v)) areas will mitigate some of the risks identified by YW WSSS as well as closing the supply-demand balance gap.
LS3.14 **Water enhancement totex (core pathway); Demand-side improvements (excl leakage and metering)**	C5 Smart Metering and water efficiency - initiatives to be delivered in conjunction with smart meter roll out. Included in core to meet demand policy commitments.
LS3.15 **Water enhancement totex (core pathway); Leakage improvements**	L6 Active Leakage Control 95 Ml/d towards halving leakage by 2050 (included as policy commitments)
LS3.16 **Water enhancement totex (core pathway); Internal interconnectors**	DV8(iv) - Elvington WTW to south Yorkshire treated water transfer. Flexed into core pathway as change from draft WRMP given change in reconciliation position with WRW (loss of Derwent). Transfer ceases from STW under all pathways in line with Reconciliation 3, so included in core.

7.0 Appendices

LS3.17 **Water enhancement totex (core pathway); New meters requested by existing customers (optants)**	C1.3 New AMI meters requested by existing customers (optants) = in our preferred plan any optants from 2025 onwards will be provided with an AMI meter and the enhancement cost is included here (over the standard existing DMO cost). Included in core pathway as contributes to meeting demand policy targets. Linked to option C5
LS3.18 **New meters introduced by companies for existing customers; metering totex**	Selective metering - excluded.
LS3.19 **Water enhancement totex (core pathway); New meters for existing customers - business**	No programme of basic meter replacement. AMR to AMI upgrades covered below.
LS3.20 **Water enhancement totex (core pathway); Replacement of existing basic meters with AMR meters for residential customers**	No investment planned; all existing meters are at least AMR.
LS3.21 **Water enhancement totex (core pathway); Replacement of existing basic meters with AMI meters for residential customers**	No investment planned; all existing meters are at least AMR.
LS3.22 **Water enhancement totex (core pathway); Replacement of existing AMR meters with AMI meters for residential customers**	YWS plans to align the end of its current AMR assets life (battery life expiry), with an upgrade/ exchange to AMI technology. As such no AMRs are expected to be operational beyond AMP10. We do propose to replace all existing AMR meters with AMI. The costs presented in Table 8 are enhancement i.e. additional cost of retrofitting AMR meters with AMI. Included in core pathway as contributes to meeting demand policy targets. Based on Row C11a of post-submission (Ofwat Query) Table 8(c) - Linked to option C5 C11a definition: Replacement of existing AMR meters with AMI meters = replacement of existing household AMR meters with AMI meters
LS3.23 **Water enhancement totex (core pathway); Replacement of existing basic meters with AMR meters for business customers**	No investment planned; all existing meters are at least AMR.
LS3.24 **Water enhancement totex (core pathway); Replacement of existing basic meters with AMI meters for business customers**	No investment planned; all existing meters are at least AMR.

7.0 Appendices

LS3.25 **Water enhancement totex (core pathway); Replacement of existing AMR meters with AMI meters for business customers**	YWS plans to align the end of its current AMR assets life (battery life expiry), with an upgrade/ exchange to AMI technology. As such no AMRs are expected to be operational beyond AMP10. We do propose to replace all existing AMR meters with AMI. The costs presented in Table 8 are enhancement i.e. additional cost of retrofitting AMR meters with AMI. Included in core pathway as contributes to meeting demand policy targets. Based on Row C15 of post-submission (Ofwat Query) Table 8(c) - (we note that we think this line should probably have been labelled C14a in the post-WRMP table). Linked to option C5 C15 definition (as stated in YW Ofwat reply): Replacement of existing AMR meters with AMI meters = replacement of existing non-household AMR meters with AMI meters
LS3.26 **Water enhancement totex (core pathway); Smart meter infrastructure**	YWS will pay for data as a service in an Opex model for the transmission of logger customer flow data, over an IOT network and then integrated into YWS corporate systems for downstream business benefit realisation. The Network will be owned and operated by a third party. From Row C18 of Table 8(c) - Linked to option C5

7.2.1.3. Drinking Water Quality

This table outlines how each investment line will deliver our strategy over the next 25 years to deliver improvements in drinking water quality to our customers.

Ofwat Line	Core Pathway Descriptions
LS3.27 **Improvements to taste, odour, and colour (grey solutions)**	Treatment and Optimisation solution includes: Optimisation 1. Rollover of work to be completed in AMP8 (trunk main conditioning of 16WSZs). There are approximately 90 WSZs in Yorkshire so this would be a 6 AMP programme of work if YW were to work through the whole the region. Treatment 2. Completion of work at 2 sites at circa £20m each in AMP 9. In AMPs 10-12 completion of 1 grey solution per AMP at £20m. Solutions are a combo of ozone and PAC dosing, PAC OR GAC filtration and potential improvements to wash water systems. We would also consider MIEX as part of the evaluation of future schemes to address raw water colour.
LS3.28 **Improvements to taste, odour, and colour (green solutions)**	Costs reflect 1 green solution of £5m each AMP from AMP 9 onwards following reservoir investigation in AMP 8 (cost for this is covered in WINEP). The solution includes better management and selection/optimal usage of raw water sources, including installation of automated valves and monitoring, turbidity monitors and colour monitors to automate flows.
LS3.29 **Addressing raw water quality deterioration (grey solutions)**	In AMP 5, 6, 7 YW have submitted circa £50m to enhance WTW in DWI submission so future costs have been based on historic numbers. AMP 8 reflects the remaining THM removal programme and 2 nitrate removal schemes. AMP 9 onwards includes high nitrate removal schemes at Hutton Cranswick and Haisthorpe. From AMP 10 onwards the costs reflect circa 2-3 schemes each AMP to address deterioration. Each scheme is circa £20m. The works includes nitrate removal plant and UV treatment for crypto removal.
LS3.30 **Addressing raw water quality deterioration (green solutions)**	The investment includes costs of programmes to work with farmers and stakeholders to improve education and increase awareness and support them to optimise their fertiliser usage. Work also includes monitoring at mini dams on the region's rivers to control source selection.

7.0 Appendices

LS3.31 **Conditioning water to reduce plumbosolvency**	Due to the nature of YWs network phosphate dosing will not be ceased and as such no enhancement expenditure will be included in this line.
LS3.32 **Communication pipes replaced or relined**	YW's strategy is to continue lead removal from the network focusing on high-risk customers such as communal buildings, schools etc and hotspot areas. The work is all renewals. The DWI are sighted on the AMP8 programme.
LS3.33 **External lead supply pipes replaced or relined**	YW's strategy is to continue lead removal from the network focusing on high-risk customers such as communal buildings, schools etc and hotspot areas. The work is a renewal. The DWI are sighted on the AMP8 programme.
LS3.34 **Internal lead supply pipes replaced or relined**	YW are not proposing to carry out any internal lead replacement work.
LS3.35 **Other lead reduction related activity**	No further investment planned.

7.2.2. Wastewater

7.2.2.1. WINEP (Waste)

This table outlines how each investment line will deliver our strategy over the next 25 years in accordance with expenditure on schemes listed in WINEP.

Ofwat Line	Core Pathway Descriptions
LS4.1 **Event Duration Monitoring (EDM) at intermittent discharges**	The only WINEP driver included is U_MON3, all U_MON3 monitors have been included whether related to storm tanks or not. The Programme will be complete by end of AMP8. Expenditure is for MCERTs and permitting costs and with only minor works. All monitors will have been installed in AMP7. Converts to base at programme completion in AMP8.
LS4.2 Flow monitoring at sewage treatment works	The only WINEP driver included is U_MON4. This programme will be complete in AMP8. All expenditure is related to complex civils for the flow monitor chambers, all the simpler and existing monitor installations and certification will be completed in AMP7. Converts to base post AMP8.
LS4.3 **Continuous river water quality monitoring**	This is a result of the Environment Act (SODRP) requiring YW to install continuous water quality monitors to identify where there may be potential harm caused by YW's assets discharging. Costs include land ownership, kiosks, water quality sondes and their maintenance. Land ownership is a potential issue with this work as most installations will not be on YW owned land, it will need to be purchased to house the kiosks which need to be built by the side of the river . Costs also reflect the initial maintenance of these monitors during the AMP in which they are installed.
LS4.4 **MCERTs monitoring at emergency sewage pumping station overflows**	25% of MCERTS programme will be complete in AMP8, cost includes monitors and minor civils. 75% will be completed in AMP9.

7.0 Appendices

LS4.17 **Treatment for chemical removal**	We are not planning any enhancement in this area.
LS4.18 **Chemicals and emerging contaminants monitoring/ investigations/ options appraisals**	Since inception in 2010 the Chemical Investigations Programme (CIP) has become the primary tool in the water industry to identify and quantify environmental risk associated with non-sanitary determinants (i.e., excluding oxygen demand, ammonia, or suspended solids). Every year, thousands of new chemicals are created, and hundreds brought to market in the UK. Regulatory bodies have failed to enforce bans on chemicals and assess the environmental impact of new chemicals before market entry. Assuming continued lack of regulation, new chemicals will continue to be disposed via wastewater treatment and introduced into water and soil. Therefore, it is assumed that the CIP will play a growing role in the next five asset management periods and probably beyond that. Investigations will be required but scopes are yet to be determined.
LS4.19 **Treatment for total nitrogen removal (chemical)**	YW do not have a plan for any enhancement in this area under current legislation.
LS4.20 **Treatment for total nitrogen removal (biological)**	YW do not have a plan for any enhancement in this area under current legislation.
LS4.21 **Nitrogen Technically Achievable Limit monitoring, investigation, or options appraisal**	Expenditure in this line refers to a nationwide nitrogen trial testing different technologies and capability to remove nitrogen from final effluent. The trial will feed into a national report which will inform candidate technologies to remove 'total N' should any new permits be required in the future. The trial will be delivered in Year 2 AMP8.
LS4.22 **Treatment for phosphorus removal (chemical)**	The costs reflect chemical dosing to remove phosphorus which must meet the national target of 80% removal by 2038 against a 2020 baseline.
LS4.23 **Treatment for phosphorus removal (biological)**	The costs reflect rezoning of the secondary treatment process to precipitate out phosphorus, which could potentially include additional tank capacity.
LS4.24 **Treatment for nutrients (N or P) and / or sanitary determinands, nature based solution**	Where YW have small sites and the permit limit is not tight, we have opportunity to carry out nature-based solutions such as creating lagoons or ponds to treat nutrients. As nature-based solutions are less effective at nutrient removal then traditional solutions, only a few small-surfaced sites will use these solutions, hence costs are relatively low.
LS4.25 **Treatment for tightening of sanitary parameters**	The costs reflect traditional filter works and activated sludge processes across a range of sites.

7.0 Appendices

LS4.26 **Catchment management - chemicals source control**	AMP8 cost reflects lack of catchment scheme for chemical source control. For subsequent AMPs, expenditures include communication programmes across the region to prevent cypermethrin entering the sewer network from domestic, commercial, and agricultural sources. The costs assumes that these programmes could have a team of circa 6 people working with different sectors across Yorkshire regions.
LS4.27 **Catchment management - nutrient balancing**	AMP8 costs reflects investigation only. Delivery begins in AMP9 and grows continue over following AMPs. Catchment management (getting rivers to an acceptable eco status) involves assessing the length of the river and finding the optimal ways to manage nutrients in the river. It looks at flows, inputs and diverting where required. The costs reflect valves, monitors, employing catchment managers to engage stakeholders, and paying farmers to use fertilisers differently.
LS4.28 **Catchment management - catchment permitting**	AMP8 costs reflects investigation only. Delivery begins in AMP9 and grows continually over following AMPs. It involves selecting a point on the river and mandating that everything upstream of it (i.e., all contributions from YW in terms of load) should be mixed and matched. It allows YW to balance permits if they meet compliance. The costs reflect monitoring and enhancement at certain treatment works to allow balancing between works.
LS4.29 **Catchment management - habitat restoration**	There is no planned investment for this line as it falls under NERC driver and is aligned to LS3.1.
LS4.30 **Microbiological treatment - bathing waters, coastal and inland**	There is a growing customer expectation for improved bathing water standards. As such, expenditure reflects need for increased microbiological treatment as we anticipate further inland bathing water designations.
LS4.31 **Septic Tank Replacements - Treatment Solution**	The costs reflect a programme of work across 30 sites installing package plants, rotating biological contactors or similar. Work is due to be completed in AMP8.
LS4.32 **Septic Tank Replacements - Flow diversion**	This expenditure involves a pumping a site to the nearest available receiving works, including a pumping station and pipework. There is only one scheme where this solution works. It is not a preferred solution, but it is not possible to buy land at this site in order increase capacity.
LS4.33 **Fish Outfall screens**	There is no planned investment in this area.
LS4.34 **25 Year Environment Plan**	The cost reflects production of plans for phosphorus removal. There is currently a plan required to upgrade one sewage treatment works in AMP8. Subsequent AMPs require two additional investigations.
LS4.35 **Investigations, other (WINEP/NEP) - desk-based studies only**	YW do not currently or have plans to conduct desk-based studies.
LS4.36 **Investigations, other (WINEP/NEP) - survey, monitoring or simple modelling**	The costs reflect investigations in Year 1-2 AMP8.

7.0 Appendices

LS4.37 **Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling**	The costs included in this table encompass the selected schemes for the following drivers: • BW_INV1. • BW_INV2. • BW_INV3. • BW_INV5. • BW_NDINV. • EnvAct_INV4. • WFD_INV – This includes for Urban Pollution Management studies, highlighted for investigation by the EA. • WFD_INV_MP,
LS4.38 **Contribution to third party schemes under WINEP/NEP only (not covered elsewhere)**	There are no planned third-party schemes.
LS4.39 **River connectivity (e.g. for fish passage)**	Costs are covered under clean water enhancements.
LS4.40 **Restoration management (marine conservation zones etc)**	YW do not have any such zones or planned work in this area.
LS4.41 **Access and amenity for WINEP/NEP only (not covered elsewhere)**	This is not a driver being used currently, therefore there is no planned investment.
LS4.42 **Advanced WINEP (not covered elsewhere)**	These costs reflect investment in catchment management pilot schemes.
LS4.50 **Growth at sewage treatment works (excluding sludge treatment)**	Costs included costs for growth at sewage treatment works to accommodate increases in flow capacity that we forecast will be required in future. Includes design, civil and M&E costs.
LS4.51 **Reduce flooding risk for properties (PC trajectory)**	This is included in base spending

7.2.2.2. DWMP

This table outlines how each investment line will deliver our SODRP and hydraulic risk reduction strategy over the next 25 years in line with the fDWMP24. The DWMP data has formed the basis of these lines and has been reprofiled to the specific LTDS line guidance. Since production of the fDWMP24 some of the sites and costs have been reprofiled into different AMP's and some costs have been removed for an alternative procurement route via

7.0 Appendices

DPC. The data used is from the preferred plan from the DWMP which is based on modelled outputs. Where costs were not generated by modelling, we have used cost extrapolation and costs are as audited as per fDWMP24.

Ofwat Line	Core Pathway Descriptions
LS4.5 **Increase flow to full treatment (UIMP5)**	There is no planned programme of work post AMP7 for FFT UMP_IMP5. Any defined AMP8 FFT WINEP approved increases to FFT related to storm overflow interventions at Scarborough, Ilkley and Wetherby have been included in this line. This will evolve as scheme details are finalised.
LS4.6 **Increase storm tank capacity - grey solution (UIMP6)**	Costs have been included for any grey solution on overflows at WwTWs from the DWMP. This also includes any additional grey storage costs from our blue-green hybrid solutions. DPC scheme costs and screen costs have been removed.
LS4.7 **Increase storm system attenuation / treatment on a STW - green solution**	Costs have been included for any blue-green solutions on overflows at WwTWs from the DWMP. DPC scheme costs and screen costs have been removed. .
LS4.8 **Storage schemes to reduce spill frequency at CSOs etc - grey solution**	We have included the costs for storage at storm overflows in the network. This includes any extra grey storage elements from hybrid blue-green and grey schemes as well as grey only solutions. DPC scheme costs and screen costs have been removed.
LS4.9 **Storage to reduce spill frequency at CSOs etc - green solution**	This line is zero at present as our optioneering has not gone to this granular level of solution detail to provide a specific cost for this line. This is assumed to be reedbed style treatment and storage downstream of an overflow in the network and we do not believe this is currently a viable solution to take forward. We will continue to review options to develop these solutions as we progress with learning from other solution delivery and industry learnings.
LS4.10 **Storm overflow - discharge relocation**	This line is zero at present as this activity does not currently form part of our delivery plan but options to undertake this activity will be reviewed in line with further solution development.
LS4.11 **Storm overflow - increase in combined sewer / trunk sewer capacity**	This line is zero at present as our optioneering has not gone to this granular level of solution detail to provide a specific cost for this line. Our solutions are based on surface water removal or storage tanks at the assets. That is not to say that when the actual solution is designed and implemented that we would not look to upsize trunk/combined sewers.
LS4.12 **Storm overflow - sustainable drainage /**	Costs for area removed (surface water removed/attenuated) from the network have been taken from the DWMP and split across LS4.12 & LS4.13 lines as the detail and granularity of the solutions is not currently defined and solutions will be a blend of the options. Costs exclude any screening requirements. DPC scheme costs and screen costs have been removed.

7.0 Appendices

attenuation in the network	
LS4.13 **Storm overflow - source surface water separation**	Costs for area removed (surface water removed/attenuated) from the network have been taken from the DWMP and split across LS4.12 & LS4.13 lines as the detail and granularity of the solutions is not currently defined and solutions will be a blend of the options. DPC scheme costs and screen costs have been removed.
LS4.14 **Storm overflow - infiltration management**	This line is zero at present as our optioneering has not gone to this granular level of solution detail to provide a specific cost for this line. Our solutions are based on surface water removal or storage tanks at the assets. That is not to say that when the actual solution is designed and implemented that we would not look to take measures to reduce infiltration as part of the solutions.
LS4.15 **Storm overflow - sewer flow management and control**	This line is zero at present as our optioneering has not gone to this granular level of solution detail to provide a specific cost for this line. Our solutions are based on surface water removal or storage tanks at the assets. That is not to say that when the actual solution is designed and implemented that we would not look to use network controls and there are a number of innovation pilots ongoing which will provide further data and applicability for solution options, catchments and storm overflows going forward.
LS4.16 **Storm overflow - new / upgraded screens**	Screen enhancement totex provided as per DWMP. DPC scheme costs have been removed.
LS4.50 **Growth at sewage treatment works (excluding sludge treatment)**	Costs included costs for growth at sewage treatment works to accommodate increases in flow capacity that we forecast will be required in future. Includes design, civil and M&E costs.
LS4.60 **Additional line 2 - Reduce modelled hydraulic flooding risk for properties (ISF & ESF)**	This line represents our internal and external modelled flood risk reduction **costs** which **were generated for the DWMP**. Specific target definitions can be found within the DWMP. **Any costs associated with Living With Water have been removed** from this line **as they have their own line in LTDS**.

7.0 Appendices

7.2.2.3. Bioresources

This table outlines how each investment line will deliver our strategy over the next 25 years for Bioresources.

Ofwat Line	Core Pathway Descriptions
LS4.43 **Sludge storage - Tanks (pre-thickening, pre-dewatering or untreated)**	Costs are included for the costs of covering tanks as part of the Appropriate Measures enhancement case.
LS4.44 **Sludge storage - Tanks (thickened/dewatered or treated)**	This line is zero as no enhancement activity is planned for this area.
LS4.45 **Sludge storage - Cake pads / bays /other**	Costs included here cover the expansion of cake storage required under the WINEP SUiAR Enhancement Case and the covering of cake storage and conversion to lime sanitisation as required by the Appropriate Measures Enhancement case.
LS4.46 **Sludge treatment - Anaerobic digestion and/or advanced anaerobic digestion**	This line is zero as no enhancement activity is planned for this area.
LS4.47 **Sludge treatment - Thickening and/or dewatering**	This line is zero as no enhancement activity is planned for this area.
LS4.48 **Sludge treatment -Other**	Costs included here are to provide for the covering of lagoons as required by the Appropriate Measures Enhancement case.
LS4.49 **Sludge investigations and monitoring**	This line is zero as no enhancement activity is planned for this area.
LS4.52 **First time sewerage**	A small amount of expenditure is required each AMP under quality drivers to add first time sewerage infrastructure.
LS4.53 **Sludge enhancement (growth)**	This line is zero as no enhancement activity is planned for this area.
LS4.54 **Odour and other nuisance**	This line is zero as this activity is delivered through base expenditure.

7.0 Appendices

7.2.2.4. Living with water

This table outlines how each investment line will deliver our strategy over the next 25 years.

Ofwat Line	Core Pathway Descriptions
LS4.59 Living with Water	The Living with Water Partnership have worked collaboratively to develop the Blue Green Plan, which is a 25-year plan of investment, managed change, policy improvement, community engagement and other to deliver flood resilience for Hull and Haltemprice. Future spend is based upon the outputs of the Blue Green Plan which is very ambitious.; investment is profiled using the lowest cost estimate. Costs are for YW only and exclude costs for external partners.

7.2.2.5. Resilience

The following tables outline how each investment line will deliver our strategy over the next 25 years to enhance resilience, comply with SEMD 2022 requirements and NIS Regulation 2018.

Ofwat Line	Core Pathway Descriptions
LS3.36 Resilience.	The investment is the Water Supply System strategy project, which focuses on survival time of water treatment works and the ability to supply customers with water. Survival time is the amount of time YW can go without certain treatment works through the ability to supply customers from elsewhere. The work includes transfer schemes and linking networks (a suite of solutions developed in 8 supply systems). Long term plan is to invest in the most urgent sites in AMP8, in AMP9 the work will continue as YW investigate other water supply systems. AMP 8 will be delivered via DPC, hence zero costs for this period, but the delivery route has not yet been decided for future AMPS and therefore costs for AMP9 onwards are included in our LTDS.
LS3.37 Security - SEMD	AMP8 investment is based on security upgrades at 9 additional Critical National Infrastructure (CNI) sites. However, Step 5 of the CNI criticalities review may identify further CNI sites requiring security upgrades. From AMP9 onwards, expenditure will be reduced to £0 as all investment will become base.
LS3.38 Security - Cyber	Investment reflects mitigation activities associated with tighter regulation and greater cyber targeting of physical assets in the future and being able to better predict the threat/risk vulnerability landscape.
LS4.55 Resilience	Some relatively small-scale investment in relocating assets and improving their resilience to flood risk. Core Pathway reflects 10 sites per AMP from AMP9 onwards.
LS4.56 Security - SEMD	YWS do not have any planned enhancement, the cost will all be base.
LS4.57 Security - Cyber	Investment reflects mitigation activities associated with greater cyber targeting of physical assets in the future and being able to better predict the threat/risk vulnerability landscape.

7.0 Appendices

7.2.2.6. Carbon

These tables outline how each investment line will deliver our strategy over the next 25 years to achieve greenhouse gas reduction in line with Net Zero targets.

Ofwat Line	Core Pathway Descriptions
LS3.39 **Greenhouse gas reduction (net zero)**	Enhancement costs focus on 1) investment in renewables, which will initially be solar solutions and then progress to other technology solutions as efficiencies permit, 2) delivering solutions to reduce emissions associated with purchased chemicals, and 3) reducing embedded emissions in purchased goods and services and capital goods. The investment has been sequenced to align with grid decarbonisation between 2035 and 2040.
LS4.58 **Greenhouse gas reduction (net zero)**	Enhancement costs focus on 1) reducing process emissions (CH4 and N2O) as WwTW, and 2) investment in renewables, which will initially be solar solutions and then progress to other technology solutions as efficiencies permit. The investment has been sequenced to align with grid decarbonisation between 2035 and 2040.

7.0 Appendices

7.3. Appendix C. Our Scenario Testing Impact Assessment

This appendix provides details of how each investment line is impacted by Ofwat's adverse or benign common reference scenarios or our wider reference scenarios. Where we have identified lines that will not be impacted, this is because we do not consider their programmes sensitive to any scenarios, or there is no planned enhancement investment. Where we have identified lines as 'low' impact we have assessed that the changes require to adapt are unlikely to lead to a change in investment plan. Unless otherwise stated, our approach to testing is based on the judgement of subject matter experts.

7.3.1. Testing Ofwat's Common Reference Scenarios

7.3.1.1. Clean Water

WINEP

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS3.1	Biodiversity and conservation - Quality	Low	None	None	None
LS3.2	Eels/fish entrainment screens	None	None	None	None
LS3.3a	Eels/fish passes (YWS assets)	None	None	None	None
LS3.3b	Eels/fish passes (Partnerships initiatives)	None	None	None	None
LS3.4	Invasive Non-Native Species	High	None	None	Low
LS3.5	Drinking Water Protected Areas	Low	None	None	None
LS3.6a	Water Framework Directive	None	Low	None	None
LS3.6b	Water Framework Directive - Groundwater	None	None	None	None
LS3.7	Wetland creation	Low	None	None	None
LS3.8	Trade effluent discharge flow monitoring	None	None	None	None
LS3.9	25-year environment plan	None	None	None	None
LS3.10	Investigations (WINEP/NEP) - desk based study only	None	None	None	None
LS3.11	Investigations (WINEP/NEP) - survey, monitoring or simple modelling	None	None	None	None
LS3.12	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water Totex	None	None	None	None

7.0 Appendices

WRMP

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS3.13	Water enhancement totex (core pathway); Supply-side improvements	None	None	High	None
LS3.14	Water enhancement totex (core pathway); Demand-side improvements (excl leakage and metering)	Low	None	None	Low
LS3.15	Water enhancement totex (core pathway); Leakage improvements	Low	None	None	Low
LS3.16	Water enhancement totex (core pathway); Internal interconnectors	None	None	None	Low
LS3.17	Water enhancement totex (core pathway); New meters requested by existing customers (optants)	None	None	None	None
LS3.18	New meters introduced by companies for existing customers; metering totex	None	None	None	High
LS3.19	Water enhancement totex (core pathway); New meters for existing customers - business	None	None	None	Low
LS3.20	Water enhancement totex (core pathway); Replacement of existing basic meters with AMR meters for residential customers	None	None	None	None
LS3.21	Water enhancement totex (core pathway); Replacement of existing basic meters with AMI meters for residential customers	Low	None	None	Low
LS3.22	Water enhancement totex (core pathway); Replacement of existing AMR meters with AMI meters for residential customers	None	None	None	Low
LS3.23	Water enhancement totex (core pathway); Replacement of existing basic meters with AMR meters for business customers	None	None	None	None
LS3.24	Water enhancement totex (core pathway); Replacement of existing basic meters with AMI meters for business customers	None	None	None	Low
LS3.25	Water enhancement totex (core pathway); Replacement of existing AMR meters with AMI meters for business customers	None	None	None	Low
LS3.26	Water enhancement totex (core pathway); Smart meter infrastructure	None	None	None	Low

7.0 Appendices

Drinking Water Quality

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS3.27	Improvements to taste, odour, and colour (grey solutions)	High	High	None	None
LS3.28	Improvements to taste, odour, and colour (green solutions)	Low	High	None	None
LS3.29	Addressing raw water quality deterioration (grey solutions)	High	High	None	Low
LS3.30	Addressing raw water quality deterioration (green solutions)	None	High	None	Low
LS3.31	Conditioning water to reduce plumbosolvency	None	None	None	None
LS3.32	Communication pipes replaced or relined	None	None	None	None
LS3.33	External lead supply pipes replaced or relined	None	None	None	None
LS3.34	Internal lead supply pipes replaced or relined	None	None	None	None
LS3.35	Other lead reduction related activity	None	None	None	None

Resilience

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS3.36	Resilience	Low	Low	Low	Low

Security

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS3.37	Security - SEMD	None	None	None	None
LS3.38	Security - Cyber	None	None	None	None

Carbon

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS3.39	Greenhouse gas reduction (net zero)	None	None	Low	High

7.0 Appendices

7.3.1.3. Wastewater

WINEP

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS4. 1	Event Duration Monitoring (EDM) at intermittent discharges	None	None	None	None
LS4. 2	Flow monitoring at sewage treatment works	None	Low	None	None
LS4. 3	Continuous River water quality monitoring	None	None	None	None
LS4. 4	MCERTs monitoring at emergency sewage pumping station overflows	None	None	None	None
LS4. 5	Increase flow to full treatment (UIMP5)	None	None	None	None
LS4. 10	Storm overflow - discharge relocation	None	None	None	Low
LS4. 17	Treatment for chemical removal	Low	Low	None	Low
LS4. 18	Chemicals and emerging contaminants monitoring/ investigations/ options appraisals	None	None	None	None
LS4. 19	Treatment for total nitrogen removal (chemical)	None	None	None	None
LS4. 20	Treatment for total nitrogen removal (biological)	None	None	None	None
LS4. 21	Nitrogen Technically Achievable Limit monitoring, investigation or options appraisal	None	None	None	None
LS4. 22	Treatment for phosphorus removal (chemical)	Low	Low	None	Low
LS4. 23	Treatment for phosphorus removal (biological)	Low	Low	None	Low
LS4. 24	Treatment for nutrients (N or P) and / or sanitary determinants, nature-based solution	High	High	None	Low
LS4. 25	Treatment for tightening of sanitary parameters	High	High	None	Low
LS4. 26	Catchment management - chemicals source control	None	None	None	None
LS4. 27	Catchment management - nutrient balancing	Low	Low	None	Low
LS4. 28	Catchment management - catchment permitting	Low	Low	None	Low
LS4. 29	Catchment management - habitat restoration	None	None	None	None
LS4. 30	Microbiological treatment - bathing waters, coastal and inland	Low	Low	None	Low
LS4. 31	Septic Tank Replacements - Treatment Solution	None	None	None	Low
LS4. 32	Septic Tank Replacements - Flow diversion	None	None	None	Low
LS4. 33	Fish Outfall screens	None	None	None	None
LS4. 34	25 Year Environment Plan	Low	Low	None	Low
LS4. 35	Investigations, other (WINEP/NEP) - desk-based studies only	None	None	None	None
LS4. 36	Investigations, other (WINEP/NEP) - survey, monitoring or simple modelling	None	None	None	None

7.0 Appendices

LS4. 37	Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling	None	None	None	None
LS4. 38	Contribution to third party schemes under WINEP/NEP only (not covered elsewhere)	None	None	None	None
LS4. 39	River connectivity (e.g., for fish passage)	None	None	None	Low
LS4. 40	Restoration management (marine conservation zones etc)	None	None	None	Low
LS4. 41	Access and amenity for WINEP/NEP only (not covered elsewhere)	None	None	None	None
LS4. 42	Advanced WINEP (not covered elsewhere)	Low	Low	None	Low
LS4.50	Growth at sewage treatment works (excluding sludge treatment)				
LS4.51	Reduce flooding risk for properties (PC trajectory)	None	None	None	None

DWMP

Note: In addition to LTDS testing, Climate Change and Demand scenarios were also included our DWMP core plan testing.

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS4. 6	Increase storm tank capacity - grey solution (UIMP6)	High	Low	None	None
LS4. 7	Increase storm system attenuation / treatment on a STW - green solution	High	Low	None	None
LS4. 8	Storage schemes to reduce spill frequency at CSOs etc - grey solution	High	Low	None	None
LS4. 9	Storage to reduce spill frequency at CSOs etc - green solution	High	Low	None	None
LS4. 11	Storm overflow - increase in combined sewer / trunk sewer capacity	High	Low	None	Low
LS4. 12	Storm overflow - sustainable drainage / attenuation in the network	High	Low	None	Low
LS4. 13	Storm overflow - source surface water separation	High	Low	None	Low
LS4. 14	Storm overflow - infiltration management	High	Low	None	Low
LS4. 15	Storm overflow - sewer flow management and control	High	Low	None	Low

7.0 Appendices

LS4. 16	Storm overflow - new / upgraded screens	High	Low	None	None
LS4. 60	Additional line 2 - Reduce modelled hydraulic flooding risk for properties.	High	Low	None	Low

Bioresources

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS4. 43	Sludge storage -Tanks (pre-thickening, pre-dewatering or untreated)	None	None	None	None
LS4. 44	Sludge storage - Tanks (thickened/dewatered or treated)	None	None	None	None
LS4. 45	Sludge storage - Cake pads / bays /other	High	None	None	None
LS4. 46	Sludge treatment - Anaerobic digestion and/or advanced anaerobic digestion	Low	None	None	None
LS4. 47	Sludge treatment - Thickening and/or dewatering	Low	None	None	None
LS4. 48	Sludge treatment -Other	Low	None	None	None
LS4. 49	Sludge investigations and monitoring	Low	None	None	None
LS4. 52	First time sewerage	Low	Low	None	None
LS4. 53	Sludge enhancement (growth)	Low	None	None	None
LS4.54	Odour and other nuisance	None	None	None	None

Resilience

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS4. 55	Resilience	High	None	None	Low

Security

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS4. 56	Security - SEMD	None	None	None	None
LS4.57	Security - Cyber	None	None	None	None

7.0 Appendices

Carbon

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS4. 58	Greenhouse gas reduction (net zero)	None	None	None	None

Living with water

Line	Description	Climate Change	Demand	Abstraction Reductions	Technology
LS4.59	Additional line 1 (Partnership in Hull city to reduce flood risk to enhanced status - for surface water flooding)	Low	Low	None	Low

7.3.2. Testing our Wider Reference Scenarios

7.3.2.1. Clean Water

WINEP

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire	Customer affordability concerns
LS3.1	Biodiversity and conservation - Quality	None	None	None	None
LS3.2	Eels/fish entrainment screens	None	None	None	None
LS3.3a	Eels/fish passes (YWS assets)	None	None	None	None
LS3.3b	Eels/fish passes (Partnerships initiatives)	None	None	None	None
LS3.4	Invasive Non-Native Species	None	None	None	None
LS3.5	Drinking Water Protected Areas	None	None	None	None
LS3.6a	Water Framework Directive	None	None	None	None
LS3.6b	Water Framework Directive - Groundwater	None	None	None	None
LS3.7	Wetland creation	None	None	None	None
LS3.8	Trade effluent discharge flow monitoring	None	None	None	None
LS3.9	25-year environment plan	None	None	None	None
LS3.10	Investigations (WINEP/NEP) - desk based study only	None	None	None	None

7.0 Appendices

LS3.11	Investigations (WINEP/NEP) - survey, monitoring or simple modelling	None	Low	None	None
LS3.12	Investigations; (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling water Totex	None	Low	None	None

WRMP

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire
LS3.13	Water enhancement totex (core pathway); Supply-side improvements	Low	Low	None
LS3.14	Water enhancement totex (core pathway); Demand-side improvements (excl leakage and metering)	None	None	Low
LS3.15	Water enhancement totex (core pathway); Leakage improvements	None	None	Low
LS3.16	Water enhancement totex (core pathway); Internal interconnectors	None	Low	None
LS3.17	Water enhancement totex (core pathway); New meters requested by existing customers (optants)	None	None	None
LS3.18	New meters introduced by companies for existing customers; metering totex	None	None	None
LS3.19	Water enhancement totex (core pathway); New meters for existing customers - business	None	None	None
LS3.20	Water enhancement totex (core pathway); Replacement of existing basic meters with AMR meters for residential customers	None	None	None
LS3.21	Water enhancement totex (core pathway); Replacement of existing basic meters with AMI meters for residential customers	None	None	Low
LS3.22	Water enhancement totex (core pathway); Replacement of existing AMR meters with AMI meters for residential customers	None	None	None
LS3.23	Water enhancement totex (core pathway); Replacement of existing basic meters with AMR meters for business customers	None	None	None
LS3.24	Water enhancement totex (core pathway); Replacement of existing basic meters with AMI meters for business customers	None	None	None
LS3.25	Water enhancement totex (core pathway); Replacement of existing AMR meters with AMI meters for business customers	None	None	None

7.0 Appendices

LS3.26	Water enhancement totex (core pathway); Smart meter infrastructure	None	None	None

Drinking Water Quality

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire	Customer affordability concerns
LS3.27	Improvements to taste, odour, and colour (grey solutions)	None	None	None	None
LS3.28	Improvements to taste, odour, and colour (green solutions)	None	None	None	None
LS3.29	Addressing raw water quality deterioration (grey solutions)	None	None	None	None
LS3.30	Addressing raw water quality deterioration (green solutions)	None	None	None	None
LS3.31	Conditioning water to reduce plumbosolvency	None	None	Low	None
LS3.32	Communication pipes replaced or relined	None	None	High	None
LS3.33	External lead supply pipes replaced or relined	None	None	High	None
LS3.34	Internal lead supply pipes replaced or relined	None	None	High	None
LS3.35	Other lead reduction related activity	None	None	None	None

Resilience

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire	Customer affordability concerns
LS3.36	Resilience	None	None	None	High

7.0 Appendices

Security

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire	Customer affordability concerns
LS3.37	Security - SEMD	None	None	None	None
LS3.38	Security - Cyber	None	None	None	None

Carbon

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire	Customer affordability concerns
LS3.39	Greenhouse gas reduction (net zero)	None	None	None	None

7.3.2.2. Wastewater

WINEP

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire	Customer affordability concerns
LS4. 1	Event Duration Monitoring (EDM) at intermittent discharges	None	None	None	None
LS4. 2	Flow monitoring at sewage treatment works	None	None	None	None
LS4. 3	Continuous River water quality monitoring	None	None	None	None
LS4. 4	MCERTs monitoring at emergency sewage pumping station overflows	None	None	None	None
LS4. 10	Storm overflow - discharge relocation	None	None	None	None
LS4. 17	Treatment for chemical removal	None	High	None	None
LS4. 18	Chemicals and emerging contaminants monitoring/ investigations/ options appraisals	None	High	None	None
LS4. 19	Treatment for total nitrogen removal (chemical)	None	None	None	None
LS4. 20	Treatment for total nitrogen removal (biological)	None	None	None	None
LS4. 21	Nitrogen Technically Achievable Limit monitoring, investigation or options appraisal	None	None	None	None

7.0 Appendices

LS4. 22	Treatment for phosphorus removal (chemical)	None	None	None	None
LS4. 23	Treatment for phosphorus removal (biological)	None	None	None	None
LS4. 24	Treatment for nutrients (N or P) and / or sanitary determinants, nature-based solution	None	None	None	None
LS4. 25	Treatment for tightening of sanitary parameters	None	None	None	None
LS4. 26	Catchment management - chemicals source control	None	None	None	None
LS4. 27	Catchment management - nutrient balancing	None	None	None	None
LS4. 28	Catchment management - catchment permitting	None	None	None	None
LS4. 29	Catchment management - habitat restoration	None	None	None	None
LS4. 30	Microbiological treatment - bathing waters, coastal and inland	None	None	None	None
LS4. 31	Septic Tank Replacements - Treatment Solution	None	None	None	None
LS4. 32	Septic Tank Replacements - Flow diversion	None	None	None	None
LS4. 33	Fish Outfall screens	None	None	None	None
LS4. 34	25 Year Environment Plan	None	None	None	None
LS4. 35	Investigations, other (WINEP/NEP) - desk-based studies only	None	None	None	None
LS4. 36	Investigations, other (WINEP/NEP) - survey, monitoring or simple modelling	None	None	None	None
LS4. 37	Investigations, other (WINEP/NEP) - multiple surveys, and/or monitoring locations, and/or complex modelling	None	Low	None	None
LS4. 38	Contribution to third party schemes under WINEP/NEP only (not covered elsewhere)	None	None	None	None
LS4. 39	River connectivity (e.g., for fish passage)	None	None	None	None
LS4. 40	Restoration management (marine conservation zones etc)	None	None	None	None
LS4. 41	Access and amenity for WINEP/NEP only (not covered elsewhere)	None	None	None	None

7.0 Appendices

LS4. 42	Advanced WINEP (not covered elsewhere)	None	None	None	None
LS4.50	Growth at sewage treatment works (excluding sludge treatment)	None	None	None	None
LS4.51	Reduce flooding risk for properties (PC trajectory)	None	None	None	None

DWMP

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire	Customer affordability concerns
LS4. 5	Increase flow to full treatment (UIMP5)	None	None	None	None
LS4. 6	Increase storm tank capacity - grey solution (UIMP6)	None	None	None	High
LS4. 7	Increase storm system attenuation / treatment on a STW - green solution	None	None	None	High
LS4. 8	Storage schemes to reduce spill frequency at CSOs etc - grey solution	None	None	None	High
LS4. 9	Storage to reduce spill frequency at CSOs etc - green solution	None	None	None	None
LS4. 11	Storm overflow - increase in combined sewer / trunk sewer capacity	None	None	None	None
LS4. 12	Storm overflow - sustainable drainage / attenuation in the network	None	None	None	High
LS4. 13	Storm overflow - source surface water separation	None	None	None	High
LS4. 14	Storm overflow - infiltration management	None	None	None	None
LS4. 15	Storm overflow - sewer flow management and control	None	None	None	None
LS4. 16	Storm overflow - new / upgraded screens	None	None	None	None
LS4. 60	Additional line 2 - Reduce modelled hydraulic flooding risk for properties.	None	None	None	High

7.0 Appendices

Bioresources

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire	Customer affordability concerns
LS4. 43	Sludge storage -Tanks (pre-thickening, pre-dewatering or untreated)	Low	None	None	None
LS4. 44	Sludge storage - Tanks (thickened/dewatered or treated)	Low	None	None	None
LS4. 45	Sludge storage - Cake pads / bays /other	Low	None	None	None
LS4. 46	Sludge treatment - Anaerobic digestion and/or advanced anaerobic digestion	Low	Low	None	None
LS4. 47	Sludge treatment - Thickening and/or dewatering	None	None	None	None
LS4. 48	Sludge treatment -Other	High	High	None	None
LS4. 49	Sludge investigations and monitoring	Low	None	None	None
LS4. 52	First time sewerage	None	None	None	None
LS4. 53	Sludge enhancement (growth)	Low	Low	None	None
LS4.54	Odour and other nuisance	None	None	None	None

Resilience

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire	Customer affordability concerns
LS4. 55	Resilience	None	None	None	High

Security

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire	Customer affordability concerns
LS4. 56	Security - SEMD	None	None	None	None
LS4.57	Security - Cyber	None	None	None	None

7.0 Appendices

Carbon

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire	Customer affordability concerns
LS4. 58	Greenhouse gas reduction (net zero)	None	None	None	None

Living with water

Line	Description	Farming rules for water	Society-driven substance intolerance	Lead free Yorkshire	Customer affordability concerns
LS4.59	Additional line 1 (Partnership in Hull city to reduce flood risk to enhanced status - for surface water flooding)	None	None	None	High