WSX03 - Long term delivery strategy

Business plan 2025-2030

Wessex Water
YTL GROUP

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WSX03 - Long term delivery strategy

CONTENTS

This supporting document is part of Wessex Water's business plan for 2025-2030.

Please see WSX00 – Navigation document for where this document sits within our business plan submission.

More information can be found at wessexwater.co.uk

1. Ambition

1.1. Current Status

Wessex Water is the regional water and sewerage company for a large part of the South West of England as shown in Figure 1. Our vision is to, through water, support our customers health and wellbeing and enhance the diverse communities we serve.

Our mission is to:

- To provide reliable, affordable services for all customers and communities
- To deliver a better environment for nature and people
- To be a great place to work for all
- To be a trusted, financially strong company with fair investor returns

We have:

- 2.8 million customers
- C 3,000 employees
- Work with over 10,000 contractors
- Over 47,000km of water mains and sewers, and over 3,000 treatment, storage, and pumping sites.

Whilst we are one of the smallest water and sewerage companies (WASCs) we have a region that covers large cities such as Bristol for sewerage services and Taunton, Poole and Bath for water and waste water alongside many small rural communities serving just a small number of properties. Our region contains 27% of the country's chalk streams, 11.5% of the country's sites of special scientific interest (SSSIs), areas of outstanding natural beauty (AONBs) covering 30% of our region and many areas of special designation beyond this.

Our historical performance has been excellent; whilst our pollutions performance has dropped in recent years which has affected our Environmental Performance rating from the Environment Agency, our long-term history is one of meeting and beating our targets and consistently being at the forefront of the industry in areas such as customer service, supply interruptions and internal sewer flooding. Figure 2 shows our performance for 2022-23. Our overall history of good performance has led to a trusted relationship with regulators and allowed us to trial new and innovative methods of delivery such as catchment permitting in the Bristol Avon in AMP7 following a long history of catchment management after we were the first to introduce this, firstly at our drinking water sites to safeguard our raw water sources, and more recently in Poole Harbour on the waste water side.

However, maintaining and rebuilding where necessary this excellent service provision, both customer and environmental, will not be without its challenges. As customer, regulator, government and environmental expectations and requirements increase alongside a cost of living crisis for 2025-30 and beyond, we as a company and an industry will need to work with our customers, stakeholders, and wider partners to deliver requirements in a more collaborative outcomes focused approach.

Figure 1 - The Wessex Water region

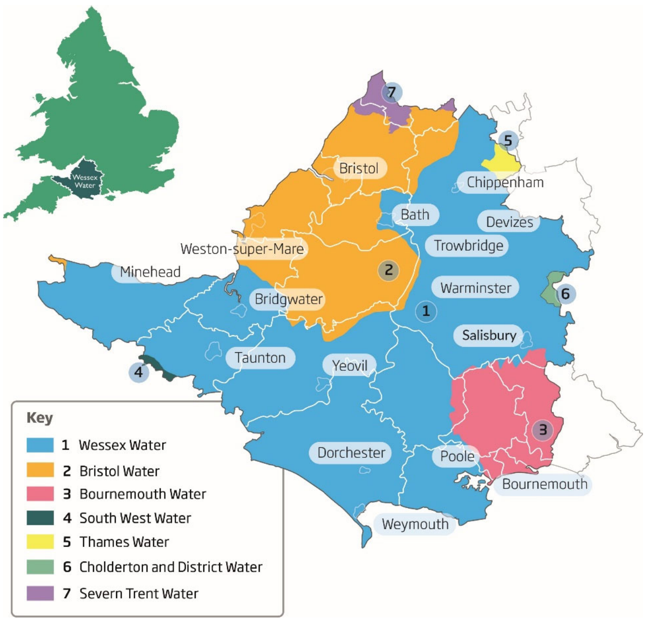
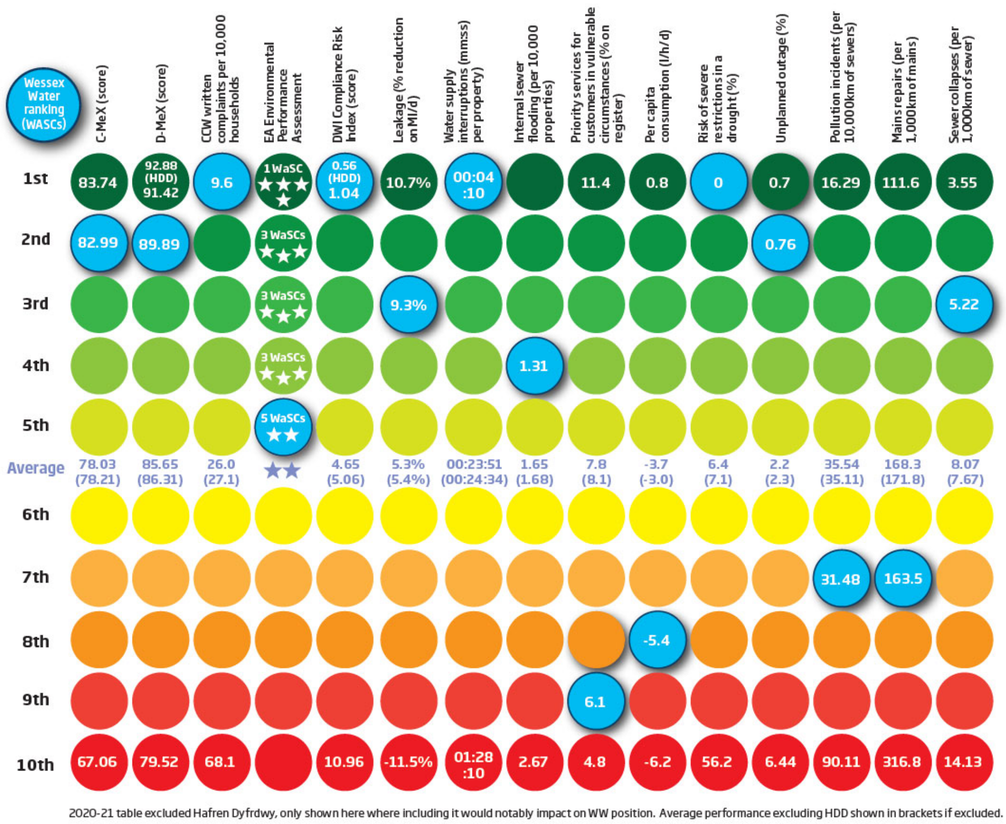


Figure 2 - Wessex Water performance compared to the other Water and Sewerage Companies (WASCs) for 2022-23



1.2. Future ambition

Our strategic direction statement was revised in 2021 following extensive consultation with the Wessex Water Services Limited Board, customers and stakeholders. At its heart is a desire to move to a new direction for water; one focused on delivering the outcomes that our customers and stakeholders have identified as key themes to focus on,

The outcomes span our sphere of existing activity and go well beyond it. We commit to:

- Continuing to lead the water industry on the delivery of core services for customers, communities, and the environment, despite the steeply rising challenges involved in doing so.
- Raising the bar on what is considered leading performance, looking outside of the water industry for benchmarks and committing to even higher levels of service.
- Rising to changing societal expectations on the health of the water environment, including a commitment to completely eliminate the discharge of untreated sewage from storm overflows.
- Playing our part in addressing wider societal and environmental challenges, which will take us into a new realm of environmental stewardship and leadership.

They are succinctly summarised in Figure 3 below and are supported by key metrics that we believe are the key measures of an outcomes approach; one focused on the overall impact on customers, communities, and the environment, rather than a focus on specific output targets.

These key metrics are then linked again to the industry common performance commitments that underpin the long-term delivery strategy (LTDS); Table 1 summarises our ambition across our outcomes and the associated performance commitments.

Figure 3 - Wessex Water's eight outcomes

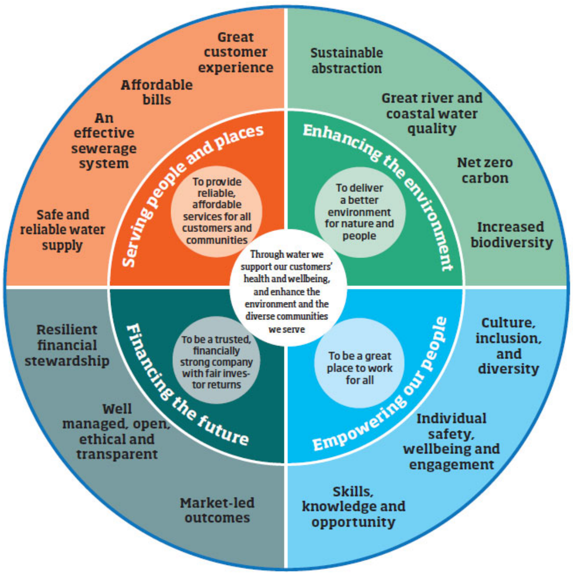


Table 1 - Performance commitment targets out to 2050

Performance commitment	Target in 2050	SDS outcome area	SDS target(s)
Water supply interruptions	0 minutes interruptions over 3 hours	Safe and reliable water	0 minutes interruptions over 3 hours 100% compliance, always
Compliance risk index (CRI)	1.5 score		
Customer contacts about water quality	0.97 per 1,000 population		
Unplanned outage	5.02%		
Internal sewer flooding	Halve the number of incidents from the 2019/20 baseline: 0.66 and 8.25 incidents per 10,000km of sewer respectively	Effective sewerage system	Halve the impact of supply interruptions
External sewer flooding			
Storm overflows	Average of 9.8 spills per overflow		
Sewer collapses	9.78 per 10,000km of sewer		
Leakage	50% reduction on 2017/18 baseline	Safe and reliable water	100% compliance with abstraction licences
Per capita consumption	110l/h/day		
Business demand	15% reduction by 2050		
Mains repairs	179.0 per 1,000km of mains		
Total pollution incidents	0	Excellent river and coastal water quality	0 pollution incidents
Serious pollution incidents	0		

Discharge permit compliance	99.68%		Total tonnes of phosphorus and nitrogen removed (linked to environmental regulations at the time)
Bathing water quality	86.4%		
River water quality (phosphorus)	Based on the environmental performance discussed later – 80.87% reduction in phosphorus removed		
Biodiversity	Creation of an additional 5,000 units of biodiversity	Biodiversity	Double our contribution
Operational greenhouse gas emissions (water)	0 tonnes	Carbon	Net zero company
Operational greenhouse gas emissions (wastewater)	0 tonnes		

This LTDS articulates the key investment areas we have identified as necessary to deliver these ambitious outcome targets and associated performance commitments, framing our PR24 business plan for 2025-30 in the context of our longer term ambitions. Our PR24 plan cannot be viewed in isolation; it is the next step in our journey to our 2050 targets and continuing to lead the industry in delivering for customers, communities, and the environment.

1.3. Projections in a world of uncertainty

It is important to note that our LTDS cannot cost up every activity that will enable the company to meet its statutory and licence obligations, now and in the future. The scenarios posed by Ofwat, and those that we have shared our thinking into beyond these scenarios, cannot forecast every likely regulatory expectation that may result in the coming years. It is a space that has seen in recent years huge shifts in expectations, driven both by regulations and public perception. However, we support the need for looking to forecast future bills and have created this LTDS with this in mind to demonstrate potential future cost scenarios.

Take for example the recent guidance on continuous river water quality monitoring. This PR24 programme of circa £80m has rapidly developed over the last 2 years and is not one that would have been forecast even five years ago. Likewise, the development of the fair share principle and ever-refining water quality models in recent years has shifted delivery expectations on water companies. By the end of AMP7 we will have met all of our PR19 WINEP fair share requirements for reducing phosphorus and nitrogen levels in the rivers and coastal waters, but the requirements for PR24 and beyond have taken a further step change in this area.

We have therefore based this LTDS and its ambition on, where possible, known changes that are likely to impact us alongside the requirements set out in the common reference scenarios (demand, technology, climate change and abstraction reductions - commented on further in 3.1, and then in sections 3.2 – 3.8 in more detail for each operational area we consider). These form the basis of our adaptive pathways as they will have a material effect on our activities in future years.

Further environmental regulation in waste water
A significant part of our PR24 investment is in nutrients – circa £900m. We believe that this step change in requirements will continue into the future, and so have looked to give an estimate of the costs this could entail using both green and grey solutions (grey being the more traditional built asset solutions such as chemical treatment, with green solutions covering options such as on-site wetlands as well as more catchment based solutions) in two adaptive pathways. We have also looked to estimate the impact of increasing regulations in the microplastics and pharmaceuticals space, noting that regulation and treatment options in this area are in their infancy. This is covered in more detail in section 3.5.

A loss of landbank for sludge disposal
A loss of landbank, whether driven by regulatory requirements, climate change or from public pressure, will have a material impact on our ability to dispose of our sludge. Whilst we believe a greater understanding in the industry is needed into the appropriateness of Advanced Thermal Conversation (ATC) technologies, we will be seeking to explore these in AMP8 in partnership with other companies. Our AMP8 investment therefore sees us scale up our current treatment approaches in a low regrets approach, with adaptive pathways detailing estimates of the impact ATC technologies, if successful, or incineration if ATC is not, could have on our investment plans for the future should we lose the ability to spread sludge to land.

Raw water quality deterioration
Catchment management has allowed us to defer significant investment in our water treatment centres (WRCs) through working with farmers to reduce nitrates and pesticides entering our drinking water sources, and this low regrets approach underpins our plans for 2025-30 – we intend to increase our catchment schemes in 10 of our drinking water catchments. However, catchment management alone has not been enough at one of our sites to negate the need for an asset solution, and our plan now includes the requirement to build a nitrate removal plant at Sturminster Marshall (where we are also delivering catchment management programmes).

Whilst we still firmly believe that catchment management, and preventing the issue from occurring at source rather than treating the issue later down the line, is the right approach, we have considered the implication on our investment needs if a wider range of asset solutions were to be required. This is covered in more detail in section 3.3.

Customer service
Although not a key requirement of the LTDS, we have sought to include a brief commentary of where customer service may go in the future as per section 3.9. However, this area like others remains uncertain given the rapid changes that can be seen in customer expectations; services such as Alexa and Google Home may have been forecast on Tomorrow's World 25 years ago, but even now with their rapid development we are still looking at how they can best be used to serve our customers in the future. Who knows that will be here in 25 years' time?

Wider cost uncertainties
We support the concept of long-term delivery strategies, but the documents and forecasts need to be read and interpreted with caution. We cannot forecast every regulatory change that will occur. And for those that we have sought to plan for here, the long-term nature of this document means that costs must be treated with caution.

Costs for solutions can change significantly even within a 5 year regulatory period for a myriad of reasons (change in requirements, site conditions varying, cost pressures from the supply chain) even without the current backdrop of high inflation and rising costs. Forecasting future uncertainties and the solutions that may resolve these situations, and then their associated costs out to 2050, compounds this uncertainty. This LTDS has been put together with the most appropriate costs and expectations we are able to deliver at this point in time but will change over the coming years.

A particular area of uncertainty with regards to carbon is the current industry reported data used for nitrous oxide; this area of data is again in its infancy, and depending on what AMP7 and AMP8 data reveals, could see large changes in the emissions that are estimated from our, and the rest of the industries, water recycling centres. We have included an adaptive pathway to account for this potential step change in emissions. However, the relative immaturity and uncertainty of carbon reporting in general is worth highlighting as something that will change over time.

1.4. Alignment with current SPSs and regulation

Long term planning is not unknown to us; planning in the long term and identifying core low/no regrets investments is a key part of our business to ensure value for both customers and the environment. As commented on above for example, our long history in water we were the first water company to implement catchment management to seek to reduce the incoming levels of nitrates in our water sources through working with farmer and landowners, rather than treating the issue at our sites, in a bid to identify where significant capital investment may be able to be delayed or cancelled entirely.

Water Resources Management Plan's (WRMP) looking at our water resource needs out to 2080 have been in place since 1995, and submitted our first Drainage and Waste Water Management Plan (DWMP) in May 2023, both following extensive consultations.

The Water Industry National Environment Plan (WINEP), although focused more on the short term than the DWMP and WRMP, is another key framework which underpins our business activities. All three of these frameworks consider the UK Government's strategic policy statement and Environment Act targets. The LTDS summarises the approaches taken in these much longer submissions. For more detail, please see the WRMP (WSX61) and the DWMP (WSX60) as well as the business plan appendices WSX16 - Waste Water Networks Plus strategy and investment and WSX12 - Water Resources strategy and investment that detail our approach to the WINEP and the DWMP and WRMP.

We have used the outputs from all three of these areas, alongside the additional areas highlighted in section 1.1.3, to underpin our LTDS. Whilst the ambition is to align our LTDS and PR24 plans with the WRMP and DWMP entirely, there are differences between both these strategic planning frameworks and our PR24 plans, as detailed in the documents WSX16 and WSX12 detailed above. These changes have resulted from changes to regulatory requirements that were either confirmed after publication of the DWMP, or too close to the publication of the WRMP to allow for it to be updated, as well as internal business reviews on affordability and deliverability of our PR24 plans.

- The main differences are detailed in Table 2.

Table 2 - Changes between the DWMP and WRMP as published and our PR24 submission

Changes between WRMP and PR24 submission (see 3.2.1)	Changes between DWMP and PR24 submission
A reduction in our AMP8 smart metering programme, reducing target smart meter penetration for HH and NHH from 75% to 40%	Nutrient neutrality expenditure has increased in AMP8
A reduction in our Leakage activity, reducing our target leakage reduction from 7.7Ml/d to 3.5 Ml/d	Growth at WRCs has changed
	The storm overflow programme has been reduced
	Continuous water quality monitoring has reduced
	Monitoring of emergency overflows has been reduced
	Pollution reduction strategy and blockage detection - increased number of monitors and activities
	Reduction in flood risk Partnership budget

1.5. Customer and stakeholder insight

Our ambitions have not been developed in isolation – we have used customer and stakeholder insight gained throughout our PR24 process, and that obtained in our day to day research, to inform our outcomes and plans for the long term alongside regulatory requirements. This is commented on further in section 2.2.3, but key changes we have made to our plans as a result of customer feedback include:

- A greater emphasis on leakage reduction to achieve our sustainable abstraction outcome
- Scaling back our smart metering rollouts over 2025-30 and extending the programme int subsequent AMPs to aid affordability concerns
- Reviewing our approach for storm overflows, maintaining the focus on those that have the greatest environmental impact but profiling our investment to address affordability concerns over the 2025-30 period in the context of the significant investment needed in nutrients.

1.6. Approach

In producing this LTDS we have built on the work of the WRMP, DWMP, WINEP and wider PR24 planning activities, as well as the BAU long term planning commented on previously. We have considered the activities and commented on them in later sections (3.2-3.8) in six main themes to align with our outcomes:

1. Sustainable abstraction (water resources –section 3.2)
2. Safe and reliable water (water treatment centres and networks – section 3.3)
3. Effective sewerage system (focusing largely on our sewerage networks – section 3.4),
4. Excellent river and coastal water quality (largely covering our water recycling centres – section 3.5),
5. Bioresources activities associated with carbon reduction (section 3.6),
6. Activities focused on carbon reduction (section 3.8).

An improvement to biodiversity underpins all of our outcomes but there is a section (3.7) commenting explicitly on our purely biodiversity focused activities as well as the section on customer service detailed above.

The tables that sit alongside this document go beyond these key areas. Any assumptions and costs are detailed in WSX54 – Long term strategies tables commentary for these additional lines.

This approach has resulted in overall adaptive pathways diagrams for the supply and waste sides of the business as detailed in section 2.1, with adaptive pathways linking to the six areas listed above. Our adaptive pathways focus on what we believe to be the core areas of enhancement expenditure needed in these areas.

2. Strategy

2.1. Strategic Response

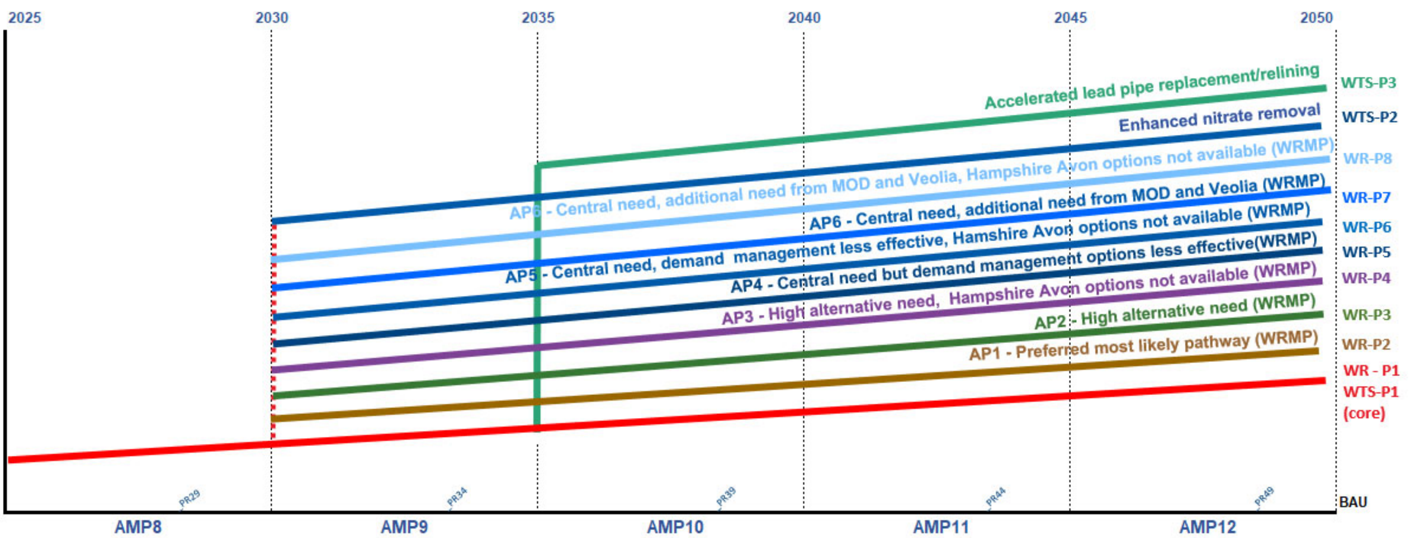
2.1.1. Long term delivery strategy outputs

◆ The remaining sections of this document detail how our core and adaptive pathways have been created, taking on board Ofwat's requirements in their final guidance for LTDS's. However, in summary we have the sets of pathways detailed in Figure 4 and Figure 5 across our supply and waste operations. More detailing, including decision and trigger points, are given in sections 3.2– 3.8.

These have been developed and tested using our industry knowledge, options evaluation process and scenario forecasting to create a set of plausible and material pathways that we anticipate we may migrate between and our operational activities employ as we approach 2050. These have been created within the framework of the four industry common reference scenarios (demand, climate change, technology and abstraction reduction) alongside our own wider anticipated futures; a change in environmental regulation on the waste water side affecting our investment in not only nutrient reduction (a significant part of our investment for PR24 at £900m) but also potential future major requirements in the space of microplastics and pharmaceuticals and a potential loss of landbank for the industries bioresources as commented on in section 1.3.

They are not mutually exclusive – we may need to follow a number of these adaptive pathways in the future.

Figure 4 - Supply adaptive pathways diagram



Supply core pathway

As our core pathway, this includes our core assumptions from the WRMP, albeit with some adjustments to our smart metering rollout (a slightly slower rollout than in our final WRMP), a slightly slower leakage trajectory initially (to aid affordability in AMP8) but with the supply side investigations needed to keep future resource options open. It contains a stable delivery profile for lead pipe replacement beyond AMP8, and the investment needed to deliver the PCs detailed in Table 1.

Supply adaptive pathway details

Accelerated lead pipe replacement (LS3a)

As detailed further in section 3.3, our core pathway delivers a reduction of 6,000 lead pipes for AMP8 then 12,000 for each subsequent five year period. However, it is possible that in the future the DWI may impose more formal timescales on companies to remove their lead in their network and leading to customers' homes. This adaptive pathway therefore shows an increase in our lead activity to meet a 2050 date for a lead free network.

Enhanced nitrates removal (LS3b)

As commented in previous sections we have a long history in utilising catchment management to remove the need for costly treatment (both monetary and environmentally) treatment at our water treatment centres. However, our core pathway includes investment in an asset solution during AMP8 at one site, and enhanced catchment management at a further nine sites to remove the need for further asset solutions. It is possible that at some of these sites it may not be successful; we have therefore included an adaptive pathway that, over AMPs 9 and 10, sees these further nine sites requiring an upgrade to their existing treatment processes or new processes constructed and the catchment management approach ending. Further detail is provided in section 3.3.

WRMP AP1 – Most likely WMRP pathway

This pathway shows our most likely pathway from the WRMP – it has an increase in the number of license changes required with an effective demand management strategy and no additional need from the Hampshire Avon. Further detail is in section 3.2.4.

WRMP AP2 – High alternative need

This adaptive pathway shows an increase in licence volume changes and an increased demand. Further detail is in section 3.2.4.

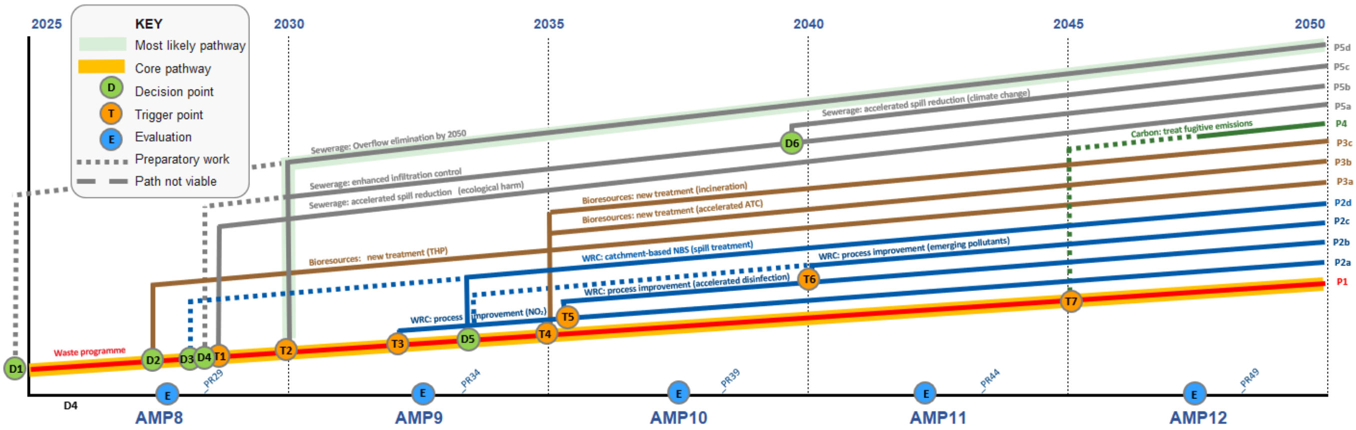
WRMP AP5 – Demand management less effective and Hampshire Avon options not available

This pathway illustrates what would happen if demand management strategies were to be less effective and the Hampshire Avon supply options are not viable. Further detail is in section 3.2.4.

WRMP AP6 – Additional needs from MoD and Veolia

This pathway shows what additional need could be from the MOD and Veolia and the impact it would have combined with additional needs in the Hampshire Avon.

Figure 5 - Waste adaptive pathways



Wastewater core pathway

Our waste core pathway includes the investment needed to deliver the PCs as detailed in Table 1 as per the supply equivalent. Although the AMP8/9 investment profiles for storm overflows differ to our DWMP after recent reviews, the overall ambition is to still meet the legislative requirements for these by 2050. For bioresources we include the expansion of liming and digestion on the assumption that the land bank does not close. For water recycling centres, we include forecast costs to meet the current set of 2037 targets, but no further assumption on P and N beyond this. We do include some forecasts for increased chemical permits, as well as more bathing waters being designated across future AMPs.

Waste adaptive pathways details

Accelerated climate change (LS4a)

This adaptive pathway links with the adverse scenario for climate change. Expanded on further in sections 3.4 and 3.5, it seeks to highlight what increased investment would occur as a result of climate change following a more adverse trajectory than our core pathway anticipates. The key expenditure changes are, as detailed in LS4a:

- An increase in expenditure in our sewer networks in the areas of storm overflows, hydraulic flooding and infiltration reduction to cover the more intense rainfall events that are forecast to occur over the winter,
- On our water recycling centres, an increase in resilience costs to cover rising sea levels and increased protection against flooding,
- An increase in the costs for phosphorus and nitrogen capital and operational costs, anticipating a change in permits due to changing weather patterns,
- An increase in odour and other nuisance costs due to a likely need to increase our odour control as temperatures increase in the summer,
- An increase in the number of barns required for bioresources and sludge storage as we approach 2050, again to mitigate the impact of more rainfall and wetter winters impacting our ability to spread sludge.

It is worth highlighting that operational costs under base are likely to change under this scenario, as pumping costs for rainwater in winter for example is required. However, this is not commented on in detail in this LTDS as its focus is enhancement expenditure.

Wet wipes being banned (LS4b)

Although this makes no material change to our enhancement expenditure as it would result in a drop of circa £10m per AMP in our base costs (commented on further in section 3.4) we felt this was a critical pathway to highlight due to the impact that wet wipes have on blockages in sewers and the subsequent flooding incidents or pollutions that may occur.

Overflow elimination by 2050 – DWMP core pathway (LS4c)

Our DWMP contains as its core, aligned with our SDS, the ambition to eliminate storm overflows. It increases the costs to address storm overflows, with more detail provided in section 3.4.

Water recycling centres - enhanced nitrate removal (LS4d)

In AMP8 we are participating in industry trials for enhanced nitrogen removal technologies. If these are found to be successful we anticipate a change in nitrogen permit levels which this scenario seeks to identify. It sees a slight reduction in capital costs, but increases in operational expenditure. This is commented on further in section 3.5.

New Bathing/recreational waters - Water recycling centres – accelerated disinfection (bathing water acceleration) (LS4e)

Our core pathway includes increasing the number of bathing sites from 2 per AMP with this adaptive pathway increasing this to 4, highlighting what an increase in public and regulatory appetite in this area could mean. Costs are inherently difficult to forecast as it will be highly location dependent. This is commented on further in section 3.5.

Water recycling centres – P and N permit expansion seeing catchment and nature based solution deployment (LS4f)

Being allowed to address phosphorus and nitrogen permits through nature based solutions (NBS) at a wider catchment scale is something we have been lobbying for during the PR24 process. We proposed a small trial in the Bristol Avon of catchment permitting, but we believe that a catchment based approach including engagement with farmers and landowners should be permitted in the future. This pathway forecasts sites to 1,000 population equivalent (PE) having P permits of 0.25mg/l applied to them, allowing catchment approaches to be exploited fully. As a large part of our area is covered by AMP8 requirements the savings are not as great as could have been seen otherwise, but if tighter P permits down to 0.25mg/l were implemented at sites below 1,000PE the savings could be greater. This is commented on further in section 3.5.

Water recycling centres – P and N permit expansion seeing catchment and site based solution deployment (LS4g)

This pathway forecasts sites to 1,000 population equivalent (PE) having P permits of 0.25mg/l applied to them, but unlike the scenario above, does not exploit catchment nature based solutions. This is commented on further in section 3.5.

Bioresources – Loss of landbank and ATC implementation - (LS4h)

If landbank availability reduces to 50% by 2035, we will need to plan for diversification of sludge outputs in PR29 to unlock alternative disposal outlets by 2035. If viable ATC solutions are ready by PR29, we would plan ATC to be implemented in AMP9 to replace the existing anaerobic digestion process in phases which is illustrated by tis adaptive pathway. This is commented on further in section 3.6.

Bioresources - Loss of landbank and incineration delivery - (LS4i)

If landbank availability reduces to 50% by 2035, we will need to plan for diversification of sludge outputs in PR29 to unlock alternative disposal outlets by 2035. If ATC is not ready by PR29, we will need to plan for incineration instead (P3). If landbank were to close completely by 2050, we will need to continue transitioning from anaerobic digestion to either 100% ATC or 100% incineration. This is commented on further in section 3.6.

Carbon – fugitive emissions capture (LS4j)

As commented on in section 1.3 the is a high degree of uncertainty over the levels of nitrous oxide emissions from the industries water recycling centres. This adaptive pathway seeks to cover what could be required if expenditure were required to cover appropriate tanks. This is commented on further in section 3.8.

A note for reading our adaptive pathways diagrams

In developing our adaptive pathways diagrams we considered a range of examples from across the water industry and beyond, ranging from simple to incredibly complex. Often they tended to focus on a single issue such as water availability or sea level rise, rather than needing to summarise a range of adaptive pathways under a range of scenarios and eventualities. Our combined pathways therefore show the key options we have identified, with the relevant decision and trigger points. Decision points show when we believe we will need to decide whether or not to implement a given adaptive pathway and trigger points show when the activity will commence, with typically multiple decision points merging to form one trigger point when activity can start following the 5 yearly price reviews.

The activities are grouped into bioresources, water recycling centres, sewerage, carbon, water resources and water treatment centres and networks.

2.2. Performance commitment profiles

Section 4.2 in foundations within this document contains a copy of the table LS1 (the main table is in WSX046 – Data tables) detailing the trajectories our LTDS seeks to forecast the enhancement costs for out to 2050, with the 2050 targets detailed earlier within this document. All of these performance commitment profiles are delivered by the common reference scenarios and adaptive pathways other than those detailed below.

Leakage, PCC and Business Demand

Under AP 5 (LS3e) we forecast the scenario where our leakage investment is less effective than anticipated. This leads to the profile detailed in Table 3 - Reduced leakage, PCC and business demand performance under our alternative pathway for less effective demand expenditure for the leakage, PCC and business demand performance commitment (our demand expenditure delivers only circa 50% of the expected impact compared to our core pathway):

Table 3 - Reduced leakage, PCC and business demand performance under our alternative pathway for less effective demand expenditure

PC	Performance level forecast per year												
	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2039-40	2044-45	2049-50
Leakage (%age reduction - PC)	13.3%	13.4%	13.8%	14.2%	14.8%	15.6%	16.6%	17.7%	18.9%	20.1%	23.6%	26.7%	29.7%
PCC (%age reduction PC)	-2.1%	-1.7%	-1.2%	-0.6%	-0.1%	0.5%	1.2%	2.0%	2.8%	3.6%	7.0%	8.6%	9.8%
Business demand	-0.3%	0.3%	1.1%	2.0%	2.8%	3.5%	4.2%	4.7%	5.3%	5.8%	6.8%	6.8%	6.9%

(%age reduction – PC)													

River water quality

Under our APs WRC-P3A and WRC-P3B the kg of phosphorus removed would increase as the number of sites we are installing P removal at would increase. We have not included a forecast for this, but it would be in excess of the figures provided in LS1 and the table in section 4.2.

Supply scheme benefits

The supply scheme benefits vary under each adaptive pathway as detailed in Table 4, due to the range of supply side schemes selected in each adaptive pathway as detailed in section 3.2.

Table 4 - variations in supply scheme benefits across our adaptive pathways (unit - Megalitres per day (Ml/d) supply-side benefit delivered to the supply-demand balance)

	Performance level forecast per year												
	2025-26	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**	**2033-34**	**2034-35**	**2039-40**	**2044-45**	**2049-50**
AP1	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	5.00	5.00	14.50	14.50	14.50
AP2	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	5.00	5.00	50.00	61.70	61.70
AP5	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	5.00	5.00	50.13	50.13	50.13
AP6	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	5.00	5.00	32.90	32.90	32.90

Wastewater network storage volume delivered or avoided

The storage volumes delivered/avoided vary under each adaptive pathway as detailed in table 5, and commented on further in section 3.4.

Table 5 - variations in wastewater network storage volume delivered or avoided across our adaptive pathways (Effective network storage benefit (m³) from both grey and green infrastructure)

Pathway	Outcome forecast – wastewater network storage volume delivered or avoided												
	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2039-40	2044-45	2049-50
Core - Enh	0.0	13,878	23,130	58,343	68,193	82,301	82,301	82,301	82,301	82,301	236,931	132,199	86,107
Demand benign - Enh	0.0	13,878	23,130	58,343	68,193	81,816	81,816	81,816	81,816	81,816	235,533	131,419	85,598
Demand adverse - Enh	0.0	13,878	23,130	58,343	68,193	82,729	82,729	82,729	82,729	82,729	238,163	132,886	86,554
Climate change benign – Enh	0.0	13,878	23,130	58,343	68,193	76,524	76,524	76,524	76,524	76,524	220,298	122,918	80,062
Climate change adverse – Enh	0.0	13,878	23,130	58,343	68,193	82,301	82,301	82,301	82,301	82,301	255,032	142,299	92,685

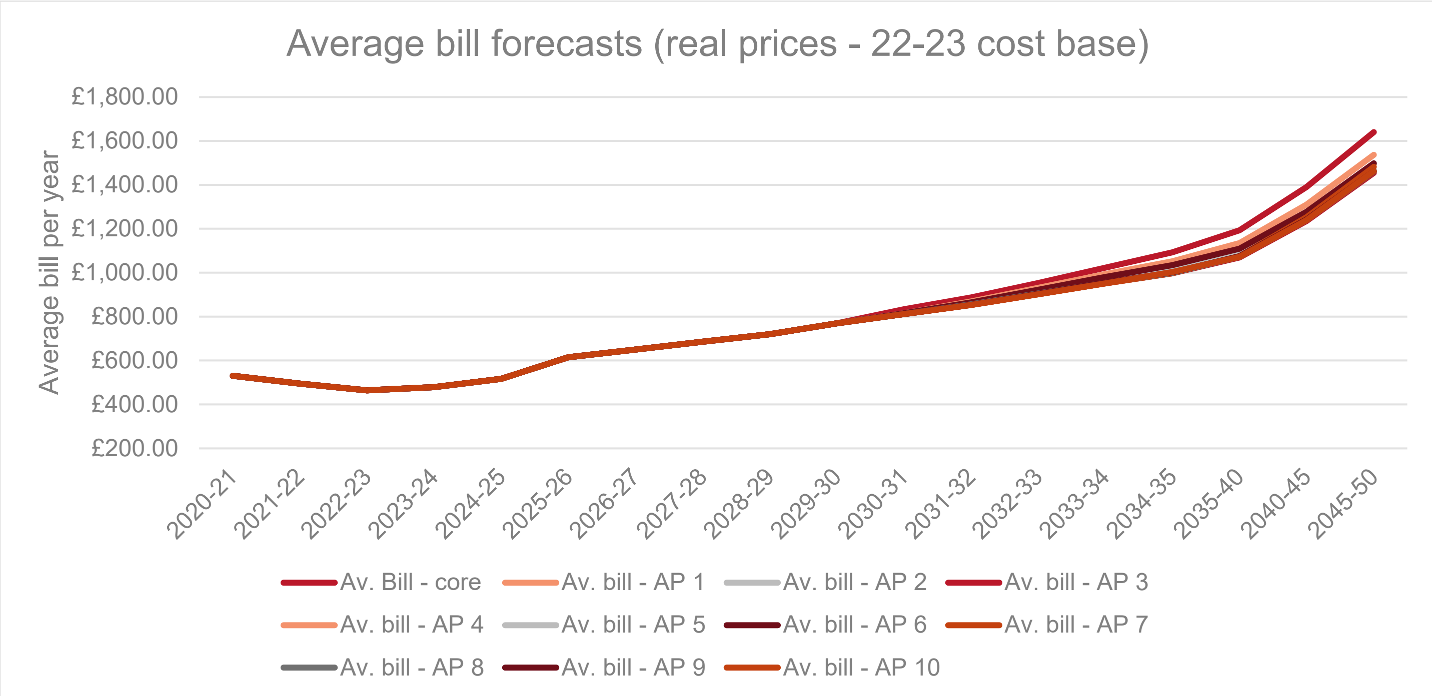
2.3. Customer bill impact

Figure 6 shows the average bill per year for each of our adaptive pathways (note that the waste/supply ones have simply been added together rather than any specific matching).

The total bill out to 2050 ranges from circa £1,450 to £1,640 on average, with a smooth increase over time rather than short sharp shocks and erratic movements. Our modelling of performance commitment trajectories and deferring some improvements, such as supply interruptions, to later AMPs, has aided this smoother profile.

It is worth highlighting that the 2025-26 to 2029-30 bill impacts will vary from those proposed in the wider plan; for this graph we have followed to Ofwat guidance, whereas our full AMP8 plan is based on more sophisticated financial modelling.

Figure 6 - Long term customer bill impacts



2.4. Our approach to solutions identification

As per section 1.3, it is important to note that our LTDS cannot forecast or cost every activity that will enable the company to meet its statutory and licence obligations out to 2050. The scenarios posed by Ofwat, and those that we have shared our thinking into beyond these scenarios, cannot forecast every likely regulatory expectation that may result in the coming years.

This LTDS therefore gives an overview of the high-level costs and activities we believe are, with the current knowledge, needed to meet these requirements. They will evolve in the future, in terms of:

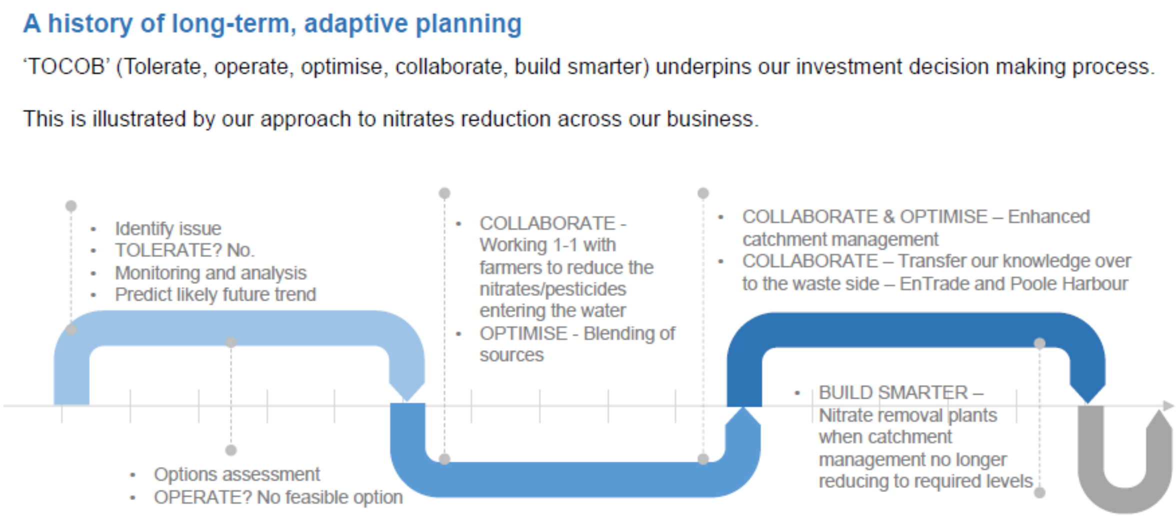
- our knowledge of the success of activities and their ability to deliver the outcomes,
- the cost of said activities, and additional requirements that are placed upon us,
- as well as the regulatory framework under which we deliver them (as highlighted in some of our adaptive pathways).

This approach is not unknown to us; planning in the long term and identifying core low/no regrets investments is a key part of our business. Take, for example, our long history in water quality and catchment management as illustrated by Figure 7.

It has led to the development of our 'TOCOB' approach which underpins our PR24 investment options appraisal– every investment need identified should be reviewed and the potential solutions challenged to understand whether we can:

- **Tolerate** the need – is activity needed now? Can we live with the risk if there is indeed a risk?
- **Operate** to address the need – are we able to adjust the way we operate to mitigate or remove the need?
- **Collaborate** to address the need – can we work with third parties to resolve a joint issue in a more effective manner?
- **Optimise** to address the need – can we, using our existing assets, optimise their performance with relatively minor investment to deliver the required need?
- **Build smarter** to address the need – if building is the required solution, can we improve the value of our build creating greater environmental and social value than the traditional 'grey asset' solution (e.g. through a green solution on site, a modular build that can be scaled up over time).

Figure 7-Illustrating our approach to 'TOCOB' over time.



2.5. Customer insights

Customers are a key part of our decision making process alongside other regulators and stakeholders. Where we are able to meaningfully, we seek their views on outcomes, priorities, delivery options and affordability as summarised in WSX06 – Customer research triangulation. We have engaged with a wide range of stakeholders; our formal research projects seek to cover the demographics of our region and we have a Young Persons Panel that takes place every year gaining the view of our future customers.

This research has influenced our PR24 plans, and our long term delivery strategy, and our PR24 plan, as follows.

- **Creating our outcomes**
  - Our research concluded in October 2021 helped us create our eight outcomes around which our plan, and long term delivery strategy, has been created. We have always sought to have a more outcomes based approach, such as in PR19 supporting systems approaches and our continuation advocation of

work with farmers, landowners, customers and wider partnerships, but we wanted to develop the themes that underpin our plan in conjunction with customers and stakeholders.

- **Affordable bills**
  - Through the creation of our PR24 plan, maintaining affordability has been key. As we have progressed through to submission it has become clear that the cost of living crisis has continued and customers are increasingly focused on affordability. This has led us to deferring several investments in PR24 (commented on in the points below) and adjusting our low and no regress investments in AMP8 to ensure we propose a plan that is affordable for customers. This has pushed some investment into AMP9.

Safe and reliable water
  - This was an area of priority for customers. In our AAT testing customers ranked supply interruptions as the lowest priority of the three PCs in the supply area which supports our approach in AMP8, and indeed in the LTDS, to defer investment in supply interruptions until later AMPs given we are already an industry leader in this area. This is also supported by the willingness to pay research we conducted in autumn 2022 where we saw a status quo preference for this area for AMP8.

- **Sustainable abstraction**
  - Our customer research has fundamentally changed our plans for smart metering; whilst our final WRMP has plans for rolling out smart meters to over 90% of properties by 2030, in our AAT qualitative stages this was found to be an area customers were less supportive of. We have since scaled this back to rolling out to 40% of properties in AMP8, spreading the investment over a longer period to assist in affordability given the lower support for this investment
  - Research has also seen us increase our investment in AMP8 and commit to a 50% reduction in leakage by 2050; our willingness to pay research into sustainable abstraction saw customers show a preference towards leakage reductions despite a higher unit cost, increasing our investment in this area form the original amount we proposed in the draft WRMP. Although the amount in our final WRMP does not fully align with our final PR24 business plan – again, adjusted to aid affordability concerns, customers wish to see us focus investment in this area alongside supporting them to reduce their consumption
  - Supply side investment was also flagged in our WRMP research to be important to customers; our AMP8 business plan sees us invest in a number of low regrets options assessments for supply side schemes to allow us to keep future resource options open in AMP9 and beyond, options for which are contained in section 3.2 of this LTDS and our WRMP.

- **Effective sewerage system**
  - A number of our areas of research show that customer support investment in reducing storm overflows. However, affordability has been flagged as a concern (for example in our AAT qualitative testing) which has led to us scaling back our investment in this area from our original proposed plan to a lower amount to reduce bills.
  - Customer research for our DWMP was also supportive of investment in reducing flooding incidents. We wish to improve our performance on external flooding in AMP8 hence the sharper drop in target here, to then overall see a halving in both internal and external flooding by 2050.

- **Excellent river and coastal water quality**
  - Our DWMP research in September 2021 indicated customers support a reduction in pollution incidents pre 2030 rather than deferring until 2040 and beyond, supporting our increased investment and trajectory in this area.
- **Carbon**

  - Whilst this is a less important area to see increased investment for some customers, it remains a key commitment for the industry and the government, and we must play our part to help the UK reach net zero emissions and reduce our impact on climate change.
  - We have an adaptive pathway to demonstrate our commitment to deferring investment until greater certainty is known on nitrous oxide emissions from water for example, instead focusing in AMP8 on understanding these emissions more thoroughly with the rest of the industry.

- **Biodiversity**
  - Supporting the environment, which underpins several outcomes, has now become an important area for customers alongside what has traditionally been seen as our core areas of focus – the supply of drinking water and treatment of waste water. In delivering all of our outcomes we seek to improve biodiversity as part of the solution, but also have a focus, as detailed in this LTDS and in WSX25 – Improving biodiversity – on enhancing the natural capital of the land we own more generally. This has also been a key focus of our Customer Challenge Group and Catchment Panel.

- **Excellent customer service**
  - Whilst not an area of cost focus for this LTDS, our ambition is to be a top ten service provider in the UK by 2050. Our willingness to pay research showed customers are happy with the service they receive now, but in the future, we will ensure we continue to provide the service customers have come to expect from us, and other industry leaders.

2.6. Monitoring, Reporting and Evaluation

We will routinely monitor the implementation of our long term delivery strategy (LTDS) for PR24, noting progress via our annual performance review (APR) and evaluating overall achievement via a stand-alone evaluation in 2027. Our annual report (supported by 6-monthly internal reporting) will track trends in key metrics and progress against targets; assess the accuracy of our forecasts; and the extent to which changing conditions affected our delivery pathway (via decision or trigger points). By contrast, our programme evaluation will determine the overall effectiveness of our LTDS (including the scenarios and adaptive pathways) by assessing the extent to which it enabled specified outcomes to be achieved.

3. Rationale

3.1. Common Reference Scenarios

The bulk of section 3 comprises of the rationale for the core adaptive pathways in each of the investment areas. However, the key expenditure changes seen in each benign and adverse/low and high common reference scenarios (CRSs) are detailed below in section 3.1.1 and 3.1.2 for water and waste water respectively. For further information on the common reference scenarios please see the Ofwat LTDS guidance. These increases align with our WRMP and DWMP where appropriate.

The CRS expenditure tables only see forecast increases in enhancement costs – in many areas increases in operational costs, such as increased pumping of rainwater during an adverse climate change scenario, may be seen.

3.1.1. Water

Climate change – low

This is the same as our core pathway for our water resources related areas. The impact of climate change is dwarfed by the abstraction licence reductions that are set to impact our water resource position by 2035 (climate change has circa 1% impact) and so is not material. There are no other changes to other areas either under this scenario.

Climate change – high

This is the same as our core pathway for our water resources related areas. The impact of climate change is dwarfed by the abstraction licence reductions that are set to impact our water resource position by 2035 (climate change has circa 1% impact) and so is not material. There are no other changes to other areas either under this scenario.

Demand – Low

Our core pathway uses the low demand forecasts hence is appropriate here. No other areas are affected by low demand forecasts.

Demand – adverse

Our WRMP alternative pathway 2 (high needs scenario) would have been appropriate here, but contains other material combinations of possible futures. As a result we have run a specific high demand scenario with higher levels of growth forecast to populate this CRS. No other areas change (lead pipe replacement unaffected for example as new developments will not contain lead, and this should not have a material impact on for example mains repairs).

Technology – low

Under this CRS, costs to deliver greenhouse gas reductions are assumed to increase to deliver areas such as wind turbines, so we see a higher cost than the core. The expenditure on supply interruptions also gets pushed back by 5 years as we assume that technology is slightly slower in this profile.

Technology – high

Under this CRS, costs to deliver greenhouse gas reductions are assumed to improve for areas such as wind turbines. The expenditure on supply interruptions costs slightly less as we assume technology will reduce in price.

Abstraction reductions – low

Under abstraction reductions, the area that would change is due to water resources. Our core pathway reflects a benign position on what the lowest level of reduction in licences is likely to be.

Abstraction reductions – high

Our WRMP alternative pathway 2 (high needs scenario) would have been appropriate here, but contains other material combinations of possible futures. As a result we have run a specific scenario beyond our WMRP modelling for this scenario to show the increased costs in this area resulting from high abstraction needs.

3.1.2. Waste water

Climate change – low

Our expenditure on storm overflows and hydraulic flooding sees costs fall due to lower levels of rainfall than anticipated. We also forecast that 2 fewer barns will be needed in AMP9 as lower rainfall will likely see less restrictions on sludge spreading and therefore lower levels of storage needed.

Climate change – high

Under this scenario we see higher expenditure on a number of areas due to increase rainfall; storm overflows, hydraulic flooding and infiltration reduction, water recycling centre resilience odour control costs, nitrogen and phosphorus schemes and bioresources due to a need for more barns.

Demand – Low

In this scenario our expenditure on future storm overflow and hydraulic flooding costs will decrease due to lower volumes in the sewers (although not as materially as under climate change scenarios), as well as a reduced need for barns in bioresources due to less sludge being produced. We also anticipate our water recycling centre growth funding will bs less, as well as forecast costs for odour and nuisance due to growth near our centres being less likely.

Demand – adverse

The cost change here largely mirror, in principle but not magnitude, the demand low scenario; an increase in storm overflows and hydraulic flooding, additional growth capacity at our water recycling centres as well as further investment in odour and nuisance as developments are likely to be closer to our sites, an increase in the number of barns for resources to accommodate larger sludge volumes

Our water recycling centres may however see an increase in expenditure on sanitary parameters as loads increase.

Technology – low

We have no changes to cost under this slower scenario. Cost changes in areas such as monitors and comms were considered, but there has been a rapid drop in costs in the last two years that we do not foreseeing increasing, and our AMP8 plan includes a large rollout of monitors.

Technology – high

Under the high scenario we provide a forecast for treatment costs at our water recycling centres reducing as processes and efficiency are improved. Cost changes in areas such as monitors and comms were again considered as per the slow scenario, but we do not believe the reduction in costs the last two years due to the recent increase in rollout of such devices will be repeated.

3.2. Water Resource Management

This LTDS section has been designed to align with the content of our revised draft water resource management plan (WRMP24) wherever possible. At the time of submission of this plan, the revised draft WRMP24 has been submitted to regulators following public consultation and receipt of representations earlier in 2023.

In the WRMP we have developed an adaptive plan following the joint regulatory guidelines, where we have in effect, in LTDS terminology, used wider scenario testing to develop our alternative programmes. In this section we summarise the WRMP development in the context of the long-term delivery strategy, explain how our plan scenarios map to the individual common reference scenarios, and explain how our plan has been tested using the relevant benign and adverse scenarios.

The plan sections relevant to the LTDS are summarised here, with cross references to the WRMP documents and technical appendices accordingly.

3.2.1. Key differences and alignment to the WRMP

This LTDS section has been designed to align with the content of our water resource management plan (WRMP) wherever possible. In particular section 6 of the WRMP main narrative describes the process of developing our adaptive plan. However, the following differences should be noted to avoid confusion when comparing documents:

- There are slight differences in terminology, particularly regarding the use of the words ‘scenario’ and ‘pathway’, with this document following Ofwat guidance for LTDS development.
- Pathway references in the WRMP use core pathway and an alphanumeric reference for each Alternative Programme (AP1, AP2…. etc). , while for consistency with other parts of this document, references start with P1 for the core pathway, and P2, P3….etc for alternate pathways.
- The core and alternate pathways elsewhere in this document focus on significant enhancement interventions that will result in improvement, and one or more alternate pathways can operate at the same time. By contrast, the WRMP developed its pathways around a programme of supply-side and demand-side interventions that respond to different plausible future conditions. This was done on the basis that the LTDS guidance states that companies should present their 'most likely' pathway from their WRMPs as an alternative pathway in their long-term delivery strategies, where this is not the same as the core pathway. Therefore, alternative pathways should represent whole programmes of investment, as opposed to specific individual interventions.

A further difference to our WRMP24 is that in response to the July 2023 EA Information Letter 17/2023 to consider phasing activities from PR24 into future price review periods, we have adjusted our demand management strategy for our business plan from that proposed in our revised draft WRMP24. This includes a reduction in our AMP8 smart metering programme, reducing target smart meter penetration for HH and NHH from 75% to 40% and a reduction in our leakage activity, reducing our target leakage reduction from 7.7Ml/d to 3.5 Ml/d. Although these elements of our demand management strategy have now been phased to deliver less in AMP8, we still remain committed to achieving the same targets as proposed in WRMP24 by the end of AMP9. These changes in the phasing of demand-side activity do not affect the adaptive programmes, and decision-points for moving to alternative pathways.

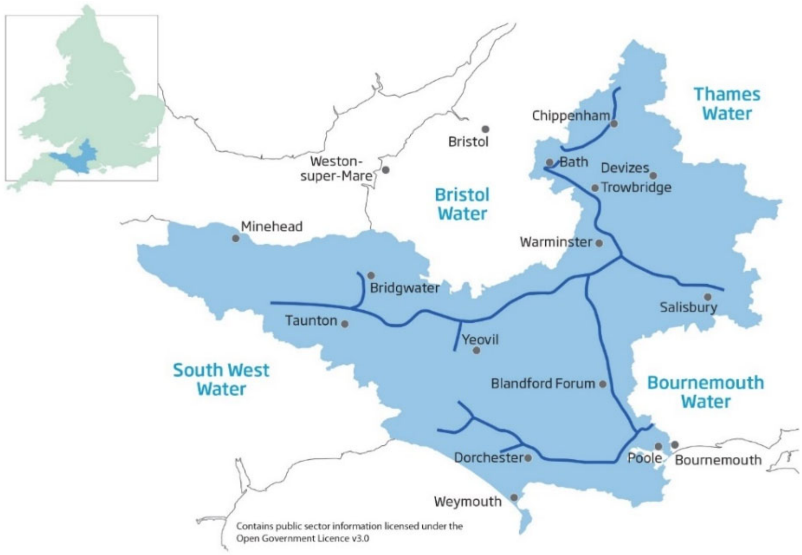
It is also important to note the close relationship between this Water Resources Management section and the following Water Treatment and Supply section. Whilst the demand reduction strategy is developed in the WRMP, enhancement for leakage and smart metering is funded through the Supply Network Plus price control, so these activities are also discussed in section 3.3.

3.2.2. Water Resources: Current Status

We supply 1.3 million people and over 40,000 business with water, distributing approximately 340 megalitres per day (Ml/d) via 11,800 km of water mains. We use more than 70 sources distributed across our supply area which range in capacity from less than 0.6 Ml/d to 45 Ml/d. Approximately 70% of households are metered.

Our supply area is illustrated in Figure 8. Three quarters of our water resource for public supply comes from groundwater sources in the south and east of our region. Important aquifers for us are located under Salisbury Plain, the Cotswolds and the Dorset Downs. The remainder of our water supplies come from impounding reservoirs located in Somerset.

Figure 8 - The Wessex Water region, with key towns, neighbouring water companies and key water mains



The main river catchments in the region include the Bristol Avon, which includes the Great Oolite aquifer, in the north, the chalk catchments of the Hampshire Avon, the Dorset Frome and Piddle, the Stour in East and South, and the Parrett and Tone in the West. Whilst our regional water resources come from six distinct water resource zones, as our key trunk mains and integrated Grid system enables us to transfer between zones we consider the region to be a single water resource zone for the purposes of modelling our water supply demand balance and investment needs. It is at this level that we aggregate our available supplies and forecast demand to calculate the supply demand balance.

Our WRMP sets out how we will meet demand and protect the environment through to 2080, which is consistent with the West Country Water Resources Group (WCWRG) regional plan. It provides a detailed description of the resource assessment and optioneering processes used to characterise plausible future scenarios, forecast their impact, and determine the optimum operational response required to ensure we deliver a best value plan while achieving the goals defined in our Strategic Direction Statement and satisfying statutory obligations.

We are building water resource resilience to climate change and population growth through a combination of demand side and supply side initiatives.

3.2.3. Supply-Demand Balance and Scenario Impacts

There are multiple factors that can affect the supply-demand balance and in our region. Our WRMP combines a range of factors together and their impact on the overall supply-demand balance. This section summarises the supply-demand balance, and therefore the primary driver for water resources investment, and summarises how the factors considered in the long-term delivery strategy scenario testing map to and impact on the supply-demand balance. The main drivers for achieving affecting our supply demand balance are summarised in Table 6.

Table 6 Summary of drivers for investment required to achieve sustainable abstraction

Driver	Description
Climate Change	• Climate change will lead on average to warmer and wetter winters and hotter and drier summers and affect supply system resilience to drought conditions.
Licence Changes to protect the environment	• Licence changes are required to reduce abstraction from the environment, to achieve compliance with Habitats Regulations and the Water Framework Directive. Our supply area contains important chalk catchments and habitats that require protection. Under our main central planning scenario, we need to reduce abstraction by nearly 20% by 2050, with the majority of these reductions expected to take place in 2035. • These reductions are spatially focussed in groundwater dominated areas of our supply system, including the Bristol Avon and the Chalk catchments of the Piddle, Dorset Stour, and primarily the Hampshire Avon which is a SSSI river and Special Area of Conservation. Veolia Water and the MoD are also making licence changes in the catchment, and as well as our own need, will require additional supply to meet demand.
Drought Risk and Levels of Service	• We are required through the WRMP process to increase our drought resilience for level 4 drought restrictions (the point at which we would need stand pipes and rota cuts) from 1 in 200 to 1 in 500 level of service from 2039 and by 2050 at the latest.
Demand growth	• There is future uncertainty in demand as a result of changing customer behaviour, population and property growth and changing business demand. Growth within and near the Hampshire Avon catchment is particularly important as to avoid the imposition of water neutrality, Natural England and the Environment Agency have asked us to ensure we can meet new growth without increasing abstraction beyond current levels.
Regulatory expectations on demand management	• There are several regulatory targets for demand management which have been set out under the Environment Act 2021 to reduce the use of public water supply in England per head of population by 20% by 2038 from the 2019/20 reporting year figures[1]. • To achieve this, the following targets have been outlined in the Environment Improvement Plan[2] and the Plan for Water[3]: by 31 March 2038, reduce PCC to 122 litres/person/day, reduce leakage by 37%, and reduce business demand by 9%. • This is part of the trajectory to achieving 110 litres/person/day household water use, a 50% reduction in leakage from 2017/18 levels[1], and a 15% reduction in non-household water use by 2050. • An additional trajectory for the reduction of distribution input per head has been set at 9% by 31 March 2027 and 14% by 31 March 2032. • An additional trajectory for the reduction in leakage has been set at 16% by 2025, 20% by March 2027, and 30% by March 2032.

[1] Water targets Detailed Evidence report.pdf (defra.gov.uk)
[2] Environmental Improvement Plan (publishing.service.gov.uk)
[3] Plan for Water: our integrated plan for delivering clean and plentiful water - GOV.UK (www.gov.uk)

Raw water quality deterioration	• Deterioration in raw water quality as a result of climate change and more extreme weather events, and catchment pollution from agro-chemicals (pesticides and nutrients) and turbidity represent a historic and changing threat to drinking water quality compliance in the Wessex Water region.

*To develop our adaptive plan in the WRMP, we considered uncertainty in a range of factors that influence the supply demand balance, including climate change, population and property growth, household and non-household water consumption, and abstraction reductions and generated for each of these factors a low, central and high scenario. We then combined these factors to derive alternative supply-demand balance scenarios as shown in figure 9. From the ensemble of 9 scenarios, we then selected a plausible low (scenario 9), central (scenario 3) and high (scenario 6) supply demand balance scenario to develop the adaptive plan. These scenarios were then used to develop the WRMP and are therefore equivalent to wider scenario testing of the LTDS guidance. As shown in **Error! Reference source not found.**, we chose the combined scenarios so as not to combine the more extreme scenarios for each future uncertainty factor to avoid planning for implausible future scenarios.*

Table 7 shows for each factor how the low, central and high scenarios were combined to produce the ensemble of supply-demand balances in **Error! Reference source not found.**.

The baseline supply-demand balance for this central scenario is shown in figure 9 – our main planning scenario used to develop our preferred “most likely” plan. Available supplies decline gradually over the planning period primarily as a result of increased demand relating to population and property growth and consumption change, and a relatively minor climate change impact. The main driver of deficit in the supply demand balance is as a result of significant licence change reductions required to protect the environment, which are scheduled in 2029-30, 2049-50, but primarily from 2035. This is the single largest factor driving near term investment and therefore the investment strategy of the plan. We also anticipate that water quality challenges will be limited to a few groundwater boreholes where nitrate concentrations may require blending or a temporary hold on abstraction. The following summarises the anticipated impacts associated with the Ofwat common reference scenarios in our region.

Figure 9 - Baseline WRMP supply demand balance

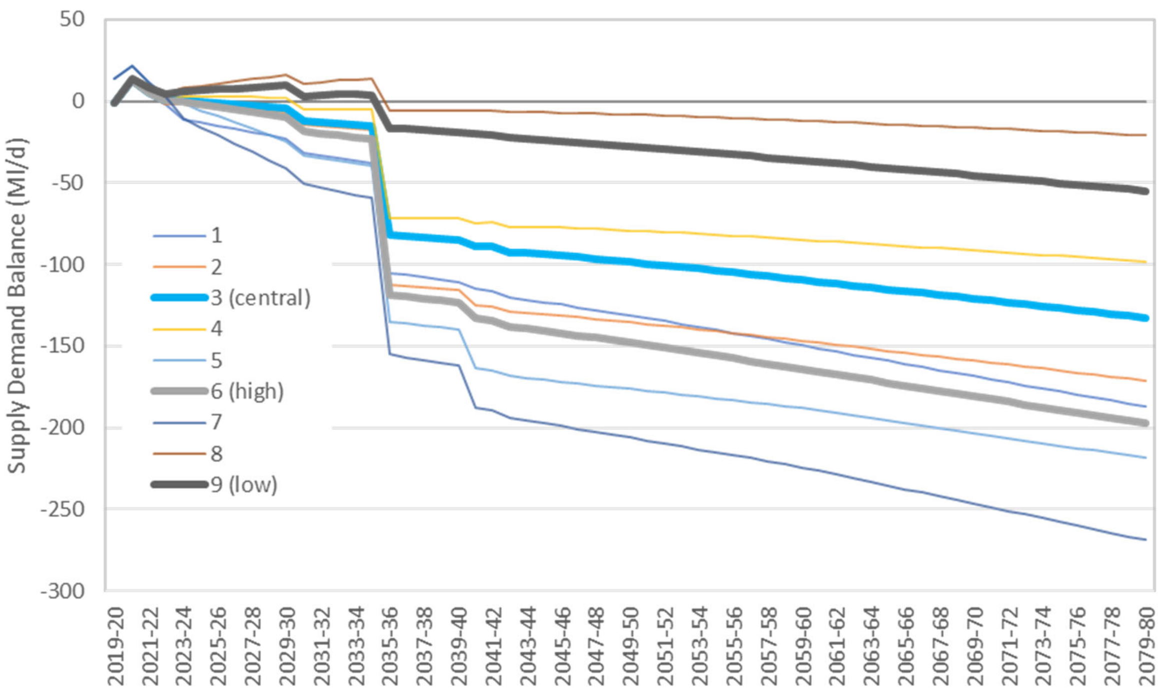


Table 7- Supply Demand Balance scenarios considered.

SDB Scenario	Future Uncertainty Factors				
	PCC	Population and Property Growth	Non-Household Demand	Climate Change	Environmental Destination
1	Central	High	High	High	Central - main
2	Central	Central	Central	High	High - main
3 (central)	Central	Central	Central	Central	Central - main
4	Central	Low	Low	Low	Central - main
5	High	Central	Central	High	High - main
6 (high)	Central	High	Central	Central	High- main
7	High	High	High	High	High - main
8	Low	Low	Low	Low	Low- main
9 (low)	Low	Central	Central	Central	Low - main

The factors that we have considered in our supply demand balance scenario testing were chosen to cover the impacts on the supply demand balance of the alternative benign and adverse scenarios for each of the future drivers, as summarised in **Error! Reference source not found.**.

Table 8 - Mapping between WRMP scenarios and Ofwat common reference scenarios

Scenario	WRMP inclusion
Climate Change - Benign Low RCP2.6 **Climate Change - Adverse RCP8.5**	Benign and adverse scenarios included in our SDB uncertainty factors as the **low** and **central** scenarios, with the high represented by the regional/global climate models. **Adverse scenario** already represented in the **central SDB scenario** and therefore the most likely "preferred" pathway.
Demand - Benign lower growth forecast **Demand - Adverse Higher growth forecast**	The benign ONS population and household projections is used as our **central SDB scenario**, and the adverse local authority forecast is used as our **high SDB scenario**. Labelling household goods with water efficiency details and minimum standards as set by the government, are included in all demand management strategies, including the preferred strategy 7.
Abstraction Reductions Benign – Current legal requirements	Ofwat scenarios only cover policy uncertainty in future licence reductions, not the epistemic uncertainty in

Abstraction Reduction Adverse – Enhanced scenario	reductions required to meet licence changes that need to be resolved through WINEP investigations. These latter uncertainties are also accounted for in the WRMP scenarios that were developed beyond those provided in the national framework using latest WRGIS data and in liaison with local EA (see supply forecast technical appendix, Section 3). Therefore additional local and regional analysis has been used to validate and build the scenarios. Given the majority of our sources are facing investigations to meet current legal requirements, our **central SDB scenario** represents the benign scenario, and our high SDB scenario represents the **adverse scenario.**
Technology Benign – Faster development	Alternative demand management strategies include different rates of smart meter roll out. Demand strategy 7 includes full smart meter roll out (all customers billed) by 2040 representing the adverse scenario. Demand strategy 1 included full smart meter roll out by 2030 – therefore meeting the 2035 requirement of the benign scenario
Technology Adverse – Slower development	

Climate Change

The Met Office's latest assessment of climate change impact on weather in the UK (UKCP18) forecasts increasing probability of warmer, wetter winters and hotter, drier summers. Modelling conducted for our WRMP considered the impact of this climate change trend on deployable output for low, central and high scenarios.[4] The scenarios considered are as follows:

- Low – median of the probabilistic RCP 2.6 distribution (equivalent of LTDS benign scenario)
- Central – median of the probabilistic RCP 8.5 distribution (equivalent to LTDS adverse scenario)
- High – mean of the median RCM RCP 8.5 distribution and GCM RCP 8.5 distribution
-

The low and central scenarios are consistent with the LTDS benign and adverse scenarios; we also considered as a high scenario the RCM and GCM products from UKCP18 to explore the full range of products on our WRMP. The impact of climate change on deployable output is shown in table 9. The difference in impact on the supply-demand balance and therefore future investment between the benign and adverse scenarios is 0.58Ml/d under the annual average scenario and 0.33Ml/d under the critical period scenario. This compares to our supply-demand balance deficit from 2035 of 50Ml/d and 82Ml/d, and so at most 1%.

Table 9 - Variability in climate change impact across the planning horizon (Ml/d)

Plan Scenario	Impact Scenario	2019-20	2029-30	2039-40	2049-50	2079-80

[4] Further details can be found in the Supply Forecast technical appendix of the WRMP.

Critical Period (DYCP)	Low (benign)	0.21	0.29	0.36	0.43	0.64
	Central (adverse)	0.05	0.06	0.08	0.10	0.14
	High	-1.78	-2.38	-2.97	-3.56	-5.35
Annual Average (DYAA)	Low (benign)	-1.24	-1.65	-2.06	-2.47	-3.71
	Central (adverse)	-1.52	-2.03	-2.54	-3.05	-4.57
	High	-5.49	-7.32	-9.15	-10.98	-16.47

Demand

Historically water demand has been falling since the mid-1990s due to leakage reduction, declining commercial demands and an increase in water efficiency through customer metering. Our central "most likely" planning scenario forecasts an increase in demand of 53 Ml/d from 2024-25 to 2079-80, driven primarily by increased population, and changing water consumption behaviour.

Our central supply demand balance scenario used to develop our preferred most likely investment plan uses the benign demand scenario, as the ONS population and property projection is more consistent with our historical trajectories of demand growth. Our high SDB scenario (on which WRMP Alternative Programmes 2 and 3 are optimised to meet; see below) use the adverse local authority scenario, alongside other "adverse" factors.

If we isolate this single "adverse" demand scenario, and calculate the impact of the difference between the benign and adverse demand scenarios, then applying the adverse local authority projections increases the supply-demand balance deficit compared to the central planning scenario that uses the benign ONS projections by 7Ml/d DYAA and 8Ml/d DYCP by 2035-36, and by 2049-50 increases the deficit by 13Ml/d DYAA and 15Ml/d under the DYCP scenario.

Technology

The technology scenario does not impact on the supply-demand balance in the WRMP process, but rather on the options that may be implemented to solve any deficits. The main amount of licence reductions that is being made is in 2035 to meet the significant change in water available for use (licence reductions). The majority of the smart meter roll out under our preferred programme strategy 7, which will deliver full smart metering by 2040 occurs prior to 2035, with customers not compulsorily billed, but moved over to smart metering through change of occupier, where we will also see the benefit of smart metering on plumbing and supply pipe losses for all metered customers prior to 2035. To test our preferred "most likely" plan against the benign scenario would be to move more smart metering into AMP8 but would not change our overall plan given the need to meet licence changes in 2035, given the activity we are already undertaking under the preferred plan.

The most likely impact resulting from other technological change will be a declining cost of established technologies such as filtration systems, reverse osmosis and nitrate removal, which may make water treatment and water recycling more affordable.

Abstraction Reduction

The overarching main driver of need in our plan – particularly in the near term – is the scale of licence reductions that need to be made to meet future demand. The long-term delivery strategy guidance requires using an adverse scenario equivalent to the EA's enhanced scenario from environmental destination, and a benign scenario using current known legal requirements. The guidance also states that additional local and regional analysis can be used to validate and build the scenarios.

As we have explained in the WRMP Supply Forecast technical appendix Section 3, the majority of our licence changes are not driven by future environmental needs either under climate change (environmental destination) or by future changes, but to meet current needs, as determined through current WFD needs and Habitats regulations needs, most notably in the Hampshire Avon – and as reflected in the request in the statements of response to the draft plan for Wessex Water to ensure existing abstractions do not increase above recent actual abstraction, prior to licence reductions, to avoid the imposition of water neutrality. This is reflected in the timing of those licence changes, which are occurring primarily in 2035 (table 10); the majority of sources have, alongside ED investigations in AMP8 for all sources, AMP8 regular or no-deterioration investigations as driven by WRMP or HRA driven investigations relation to rCSMG criteria.

Table 10 - Total DO losses in the baselline SDB resulting from licence reductions in 2035 and 2050 (Ml/d)

	DYAA			DYCP		
Source	**Low**	**Central**	**High**	**Low**	**Central**	**High**
Sustainable abstraction (WINEP AMP7) and Environmental Destination for 2035	-17.61	-53.69	-87.58	-25.02	-70.91	-98.67
Sustainable abstraction (WINEP AMP7) and Environmental Destination for 2050	-17.69	-60.13	-102.36	-26.35	-76.84	-109.96

The long-term delivery strategy guidance acknowledges that future abstraction required to protect the environment is uncertain, and acknowledges this is due to climate change and demand impact on the environment as well as future policy changes. Whilst the need to refine information is acknowledged, it does not, however, acknowledge the significant epistemic uncertainties that exist today in how much licence reduction is needed to protect the environment, than can only be reduced through detailed WINEP investigations that can take understanding beyond the relatively high level assessments of need undertaken in WRGIS, and therefore those included in the national framework that form the basis for the assessments of future need. These investigations are required and scheduled under the WINEP programme so that there is evidence of the impact of licenced abstraction on both the flow regime (using more refined hydrological and hydrogeological models) and on the ecology – so that the relationship between ecological health and river flows is established in the river reaches in question. Our WRMP scenarios for licence changes have also accounted for this uncertainty in our scenarios when developing the low, central and high scenarios.

Based on the above, and given the significant need driven by short term needs by 2035, consistent with current legal requirements, our central planning scenario, and the scenario used to develop our preferred “most likely” pathway, is consistent with the benign abstraction scenario, and our high need scenario is consistent with the adverse abstraction scenario.

3.2.4. Decision-making process and adaptive plan development

We identified a range of supply and demand management options for our draft WRMP and filtered our unconstrained options list using a range of technical and environmental criteria to derive a feasible options list of 86 options. The WRMP decision-making process is explained in detail in the Supply Demand Balance, Decision Making and Uncertainty technical appendix of the WRMP: briefly, we developed applied a hybrid decision-making approach where we for our central supply demand balance scenario we optimised and compare a range of plans including least cost and alternative best value solutions to solve the central SDB scenario, accounting for government expectations and environmental constraints on new supply options. Through this process we identified a **preferred most likely plan** as Plan 3 – which was not least cost but meet demand targets and environmental screening criteria (**Error! Reference source not found.**). The key features of this plan are:

- Demand management strategy of leakage, metering and water efficiency for households and non-households to meet government targets for PCC, DI and leakage, and also reduce abstraction in the short term on the Hampshire Avon catchment, prior to the implementation of supply-side schemes from 2035.
- Increased import from Bristol Water and increased reservoir capacity and internal transfer from the west of our supply system to the east.

Table 11- Comparison of plans for developing the preferred most likely plan

Plan	Programme Cost (£NPVm)	Drought (1 in 500 resilience by 2039/40)	Environment		Carbon tCO_2 equivalent	Abstraction reduction - Environmental Destination	Government Demand Expectations
			NC	BNG			
Plan 1	£550M	2039/40	-76	22	290,724	Meets 2035 licence reductions	No
Plan 2	£834M	2039/40	-39	14	397,103	Meets 2035 and licence reductions	Yes
Plan 3	£834M	2039/40	-39	14	397,103	Meets 2035 licence reductions	Yes

To develop the adaptive plan we considered a range of key criteria and uncertainties influencing the plan. These include:

- **Supply demand balance scenarios** – alternative supply demand balances, as summarised above, where uncertainty in future licence reductions, demand growth and climate change are considered. The way these reflect the LTDS benign and adverse scenarios is considered above. We have developed our adaptive plan using plausible low and high supply-demand balance scenarios, as shown in Section **Error! Reference source not found.**.
- **Demand management strategy effectiveness** – the effectiveness of future demand management measures are uncertain, as demand is influenced by a range of factors beyond the control of the company, including future climate change, changing demand resulting from post-covid changes and in response to changing economic circumstances and the recent cost of living crisis. We have tested whether whilst investing in Demand Strategy 7, only half the benefits of the strategy are achieved.
- **Additional need from Ministry of Defence Sites and Veolia Water Services** – Alongside licence reductions in the catchment to achieve sustainable abstraction for Wessex Water, both the Ministry of Defence and Veolia Water Services may require additional volumes of water to meet their future needs that those already accounted for in our central supply-demand balance, which in part depends on the outcome of subsequent environmental investigations in the 2025-2030 period. We have modelled scenarios where an additional 9.84Ml/d is required. These additional demands would be in the eastern part of our supply system in the Hampshire Avon.

- **Hampshire Avon options** – one solution to meet the needs of licence changes in the Hampshire Avon catchment for both Wessex Water and other users' needs is to combine existing abstractions and move them further downstream to different locations that have more water in the river and then supply this water back upstream to existing demand centres. Investigations are being taken forwards under the WINEP programme in the 2025-2030 period to assess option feasibility. Whilst these options have not been selected under our preferred "most likely" plan, it is important our plan adapts to uncertainty in availability under other plausible future scenarios.

Based on these criteria, we derived 7 alternative scenarios of need to our preferred plan, and using our WRMP decision making tool, identified the options/programme selected to meet needs under each potential future. These options are shown in **Error! Reference source not found.**.

Table 12 - Options selected under alternative scenarios, as indicated by the date at which scheme development needs to start. Blue shading of option names indicated those options taken forwards in the Ofwat Core Programme

ID	Option Name	Preferred AP1	Low	High AP2	High AP3	Cen. AP4	Cen. AP5	Cen. AP6	Cen. AP7
57.07	Demand Strategy 7	2025		2025	2025	2025	2025	2025	2025
57.06	Demand Strategy 6		2025						
9.19	Reduced levels of service, moving to 1:500 to 1:200	2025	2025	2025	2025	2025	2025	2025	2025
9.16	Temporary Use Bans	2025	2025	2025	2025	2025	2025	2025	2025
41.01	Drought Permit - Stour catchment	2025	2025	2025	2025	2025	2025	2025	2025
41.06	Drought Permit - Bride catchment	2025	2025	2025	2025	2025	2025	2025	2025
59.01	Mere Stream Support	2025	2025	2025	2025	2025	2025	2025	2025
39.01	Underutilised licence - Monkswood Reservoir	2056		2048	2028	2028	2028	2057	2053
39.02	Underutilised licence: Upton Scudamore	2028		2028	2028	2028	2028	2028	2028
70.06	Increased Reservoir Capacity and East Transfer	2026		2026	2026	2026	2026	2026	
22.04	Friar Waddon GAC and Upwey improvements	2054				2026	2026	2054	2054

52.02	Poole Water Recycling and Transfer – Stour use 50%			2025	2025	2025	2025		
70.01	Bristol Import and onwards transfer I	2026		2026				2026	2026
38.01	Underutilised licence due to water quality: Belhuish			2028			2053		2050
70.02	Bristol Import and onwards transfer II				2026	2026	2026		
38.12	Sutton Poyntz - nitrate treatment			2046	2046				
34.1	Amesbury boreholes			2025		2055			
32.36	New Reservoir: Pudding (Bristol Avon)			2034	2032				
33.01	Groundwater: Aquifer Storage Recharge - Wareham Basin			2043	2028				
18.1	Danesborough to Kingston St Mary upgrade			2056	2057				
30.02	Currypool Pump Storage - Hawkridge			2051	2052				
21.13	Camp Hill to Earlsdown			2070	2057				
38.11	Underutilised licence: Empool			2028	2028				
23.01	Sutton Bingham increased peak capacity								2027
18.28	Bristol Import to North Bath (BA1)				2029				
55.05	Summerslade to Sturminster reinforcements - 5.5Ml/d pt 1				2026				
54.06	Mendips and transfer to Summerslade - 17.5Ml/d				2049				
21.12	Pewsey resilience: Chirton			2049					

25.03	Summerslade to Camp Hill reinforcements				2057				
70.03	Bristol Import and onwards transfer III			2026					
70.04	Bristol Import and onwards transfer IV				2026				
70.05	Bristol Import and onwards transfer V								2026
70.07	Hampshire Avon Boreholes and Transfer							2025	

Therefore the criteria that we used to develop our adaptive plan form a wider range of criteria than including in the long term delivery strategy, many of them specific to the circumstances of our water resources management planning problem.

Based on the scenario analysis undertaken, the adaptive plan and associated pathways have been developed accounting for Ofwat's PR24 and beyond – Final guidance on long term delivery strategies[5]. The development of the adaptive pathways is as follows.

Ofwat Core Programme

All activities which are selected under all scenarios are considered no- and low-regret options and are included in a **core pathway** as these activities need to be undertaken to be ready for all plausible future scenarios. This includes:

All activities under the low scenario – the only option selected under the low scenario that differs to the other scenarios is the demand management strategy. However, given Demand Strategy 7 is required under the preferred "most likely" programme to meet government policy expectations, and is also required to meet needs under the two high SDB programmes (AP2 and AP3), and that the strategies are mutually exclusive, means **Demand Management Strategy 7** is selected under the core pathway. Further details about the Demand Management Strategy 7 can be found in the Demand Management Strategy technical appendix to the WRMP.

All activities selected under all scenarios – drought permit options (41.01 and 41.06), temporary use bans (9.16), the local stream support option (59.01) and reduced levels of service (9.19).

Activities to be ready for all plausible future scenarios – Programmes AP2 to AP7 are included in the plan alongside the preferred "most likely" programme (AP1) as the plan alternative pathways/programmes. Under the core programme, in addition to those schemes being taken forwards across all scenarios, there are 12 additional schemes to be taken forwards under the core pathway in AMP8 2025-2030. These options are being selected in the core programme because across all pathways the earliest start date fall between 2025 and 2028, and therefore activity is required under those schemes to keep alternative future pathways open. The schemes selected in the core pathway are highlighted in **Error! Reference source not found.**.

For these schemes, to keep future pathways open, we plan to take these 12 options forwards through the design and development phases (enabling work) of the schemes towards the date of the next WRMP (draft in 2027 and

[5] PR24-and-beyond-Final-guidance-on-long-term-delivery-strategies_Pr24.pdf (ofwat.gov.uk)

revised draft/final plan in 2028) towards the **trigger point** for determining which future pathway to follow in 2030. Of the supply schemes being taken forwards in AMP8, a number of the schemes have common source and transfer elements – for example there are several schemes that utilise an import from Bristol Water and onwards transfer to different parts of the supply system. The costs included in the plan under the core pathway for scheme design and development do not duplicate these elements.

The key reason for needing to take a range of options forwards in AMP8 is due to the significant need that must be met in 2035, and the key uncertainties that need to be resolved in the next planning period. Six options are also selected under the core pathway, which have their earliest start dates across pathways from 2028 (39.01, 39.02, 38.01, 33.01, 18.28 and 38.11). We will narrow down our future uncertainties by the time of the next draft plan in 2028, and use dWRMP28, and the information gathered to date, to determine whether these additional six schemes need to be taken forwards. For these schemes, depending on the outcome of dWRMP28 in 2027-28, we would seek AMP9 transition funding to take these options forwards to design and development, to inform our decision point in 2030.

The alternative programmes/pathways, and the selection criteria for following each pathway are shown in Table 13.

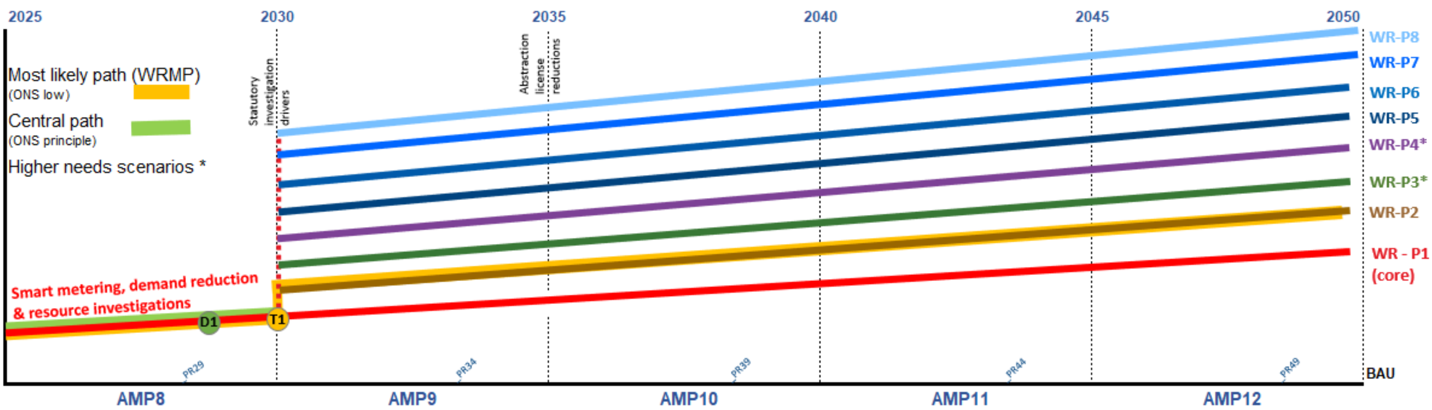
Table 13 Pathway Options and Selection Criteria. Note not all pathways have been included in our LTDS tables

WRMP Path	LTDS Path	Description	Pathway Selection Criteria
Core	WR-P1	Ofwat Core Pathway	Low future supply demand balance need
AP1	WR-P2 (LS3c)	Preferred “most likely” path	Volume of licence changes required and future demand forecasts follow the central supply-demand balance scenario, demand management strategy is effective, and no additional need in the Hampshire Avon.
AP2	WR-P3 (LS3d)	High Alternative Need	Volume of licence changes required and future demand forecasts follow the high supply-demand balance scenario, the demand management strategy is effective, and Hampshire Avon options selected are viable.
AP3	WR-P4	Higher Alternative Need and Hampshire Avon options unavailable	Volume of licence changes required and future demand forecasts follow the high supply-demand balance scenario, the demand management strategy is effective, and Hampshire Avon options are not viable.
AP4	WR-P5	Central need, demand management less effective	Volume of licence changes required and future demand forecasts follow the central supply-demand balance scenario, demand management strategy is less effective, Hampshire Avon options are viable, and no additional needs in the Hampshire Avon.
AP5	WR-P6 (LS3e)	Central need, demand management less effective, Hampshire Avon options not available	Volume of licence changes required and future demand forecasts follow the central supply-demand balance scenario, demand management strategy is less effective, Hampshire Avon options are not viable, and no additional needs in the Hampshire Avon.
AP6	WR-P7 (LS3f)	Central need, additional need from MoD and Veolia	Volume of licence changes required and future demand forecasts follow the central supply-demand balance scenario, demand management strategy is

WRMP Path	LTDS Path	Description	Pathway Selection Criteria
			effective, Hampshire Avon options are available, and additional needs in the Hampshire Avon.
AP7	WR-P8 P8	Central need, additional need from MoD and Veolia, no Hampshire Avon options available	Volume of licence changes required and future demand forecasts follow the central supply-demand balance scenario, demand management strategy is effective, Hampshire Avon options unavailable, and additional needs in the Hampshire Avon.

The adaptive plan pathways shown above are presented visually in Figure 10. As described above, our plan is dominated by significant near term uncertainty as to the volume of licence changes required in 2035, and the effectiveness of demand side measures, as well as additional needs and future options availability in the Hampshire Avon to meet these needs.

Figure 10 - Adaptive Pathway Visualisation for Water Resources



This figure also indicates that up to 2030, the core pathway corresponds with the central and most likely pathways identified in our WRMP. The most likely approach then switches to adaptive pathway P2 at the start of AMP9. However, information received during AMP8 investigations may result in a different alternate pathway being proposed in our PR29 LTDS for AMP9 once we have a more detailed understanding of scenarios and drivers.

Water resources Path 1 (core pathway) was designed to satisfy Ofwat requirements, representing the best value alternative that responds to benign future scenarios for climate change, demand and abstraction reduction, and a slow development scenario for technological development. Each alternate pathway was designed to respond to more adverse scenarios than the core path, and thus have a greater positive impact on the supply-demand balance. Pathways P5 to P8 are alternatives to WR-P2, while pathways WR-P3 and WR-P4 are designed to respond to higher needs scenarios.

Table provides current estimates of probability that the core and adaptive pathways are followed. This confirms that the core pathway is the only option for AMP8, with WR-P2 being slightly more likely than WR-P1 from AMP9 onward.

Table 14 - Core and Adaptive Pathways Developed

Path	Decision Yr	Trigger Yr	Likelihood AMP8 (%)	Description	Likelihood post AMP8 (%)
WR-P1	NA	NA	100%	Ofwat Core Pathway	20%
AP1 WR-P2	2028	2030	NA	Preferred 'most likely' pathway	21%
AP2 WR-P3	2028	2030	NA	High Alternative Need pathway 1	10%
WR-P4	2028	2030	NA	High Alternative Need pathway 2 – Hampshire Avon options not available	10%
WR-P5	2028	2030	NA	Central Alternative Pathway 1 – demand management strategy less effective	10%
AP5 WR-P6	2028	2030	NA	Central Alternative Pathway 2 – Demand management less effective, Hampshire Avon options not available	5%
AP6 WR-P7	2028	2030	NA	Central Alternative Pathway 3 – Additional need from MoD and Veolia	12%
WR-P8	2028	2030	NA	Central Alternative Pathway 4 – Additional need from MoD and Veolia, no Hampshire Avon Options	12%

3.2.5. Stress Testing

Stress testing of proposed pathways was conducted during development of the WRMP, to confirm pathways were sufficiently resilient to deliver our ambition and meet our obligations under plausible extremes for the common reference scenarios. We also undertook sensitivity testing of the plan to some additional scenarios, including delaying the timing of licence change reductions, and timing of achieving 1 in 500 drought resilience.

Based on the assessment of how sensitive the chosen plan is to the alternative benign and adverse scenarios, and how they have already been accounted for in the WRMP plan and adaptive plan development (See Section 3.2.3), we have additionally tested the plan to the adverse licence change scenario and the adverse demand scenario, which are also presented alongside the key adaptive pathways in the supporting tables.

We have assessed the impact of the adverse scenario as part of our higher need scenario that represents a plausible high need scenario, for which adaptive programmes AP2 and AP3 meet the need. If we isolate this single factor "adverse" abstraction reduction scenario, and assess how this changes the investment in our preferred "most likely" plan (e.g. the difference between benign and adverse), then this would increase NPV by £193m, and leads to the selection of supply side schemes already selected under the high need scenario programmes AP2 and AP3 (52.02, 38.01, 38.11, 21.12 and 70.03) and not earlier than their selection under those pathways. The adaptive plan therefore can adapt to meet the needs of the adverse abstraction scenario alone.

If we isolate this single factor "adverse" demand scenario, and assess how this changes the investment in our preferred "most likely" plan, then this would increase NPV by £56m, and leads to the selection of supply side schemes already selected under the High need scenario programmes AP2 and AP3 (52.12, 38.12, 38.11, 34.10) and not earlier than their selection under those pathways. The adaptive plan therefore can adapt to meet the needs of the adverse scenario alone.

Our preferred plan has been shaped by customer research undertaken specifically for this WRMP and by insight projects associated with our wider PR24 business planning programme. Table 15 summarises how the preferred adaptive plan meets customer preferences.

Table 15 - WRMP customer research outputs

<table>
<tr><th>Key customer insight</th><th>How our plan addresses the insight</th></tr>
<tr><td>Customers generally have a low awareness of the importance of water conservation.</td><td rowspan="3">The combination of smart metering roll out and wider water efficiency services for households (Home Check) and non-households will help customers understand their water usage, drive reductions in water wastage (leaking toilets and taps) and support behaviour change through enhanced engagement.</td></tr>
<tr><td>Customers either underestimate their water usage or don't pay attention to it at all.</td></tr>
<tr><td>A common perceived benefit of installing smart meters is to save money on water bills.</td></tr>
<tr><td>Leakage is commonly a preferred solution for reducing demand and reliance on abstraction.</td><td>Our preferred plan will see leakage reduce by 50% over the 25 year long term horizon</td></tr>
<tr><td>Customers expressed strong support for reducing reliance on abstraction from vulnerable sources, even beyond the proposed targets for reduction, and to pursue a combination of alternative supply and demand options.</td><td>The demand and supply measures we'll implement will mean we can accommodate licence reductions from the most sensitive sources.</td></tr>
</table>

3.2.6. Assumptions and Uncertainty

The WRMP and its associated appendices detail assumptions and uncertainties relevant to the development of our water resources interventions and pathways, with the following sections providing an overview of key assumptions and areas of uncertainty. The WRMP considered both baseline uncertainty and future uncertainty. Baseline uncertainty is attributed to limitations in our understanding of current supply-demand balance under drought conditions, and our ongoing investigations will enable us to refine our understanding and thus reduce baseline uncertainty over time. By contrast, future uncertainty relates to limitations in our understanding of how changing external factors may impact our supply-demand balance, and thus our operations. The six areas of future uncertainty considered in our WRMP modelling were:

- Timing of environmental destination and sustainability reduction.
- Household demand due to population growth and property development (including the effectiveness of demand management strategies).
- Non-household demand (including additional need from Ministry of Defence Sites and Veolia Water Services).
- Climate change impacts.
- Water pollution impacts on supply availability in times of drought.
- Abstraction point relocation in the Hampshire Avon catchment to meet the needs of licence changes, and other license reductions and the feasibility of these schemes.

These themes correspond very closely to the Ofwat common reference scenarios for climate change, demand, technology and abstraction reduction. The main difference is the technology item, which can be explained as we do not anticipate significant technological development for water resources beyond what is currently known, which corresponds with the Ofwat ‘slow’ scenario for technology. Mott MacDonald undertook uncertainty analysis and modelling to determine an appropriate target headroom, based on the UKWIR methodology.

The key future uncertainties and assumptions considered in developing the adaptive plan are:

- Water resource zones: we assess our resource on the basis of a single supply area, due to the extent of our grid and distribution network.
- Planning scenarios: we considered both dry year annual average (DYAA) and dry year critical period (DYCP).
- Demand forecast: both DYAA and DYCP demand were considered when demand is high before temporary use bans imposed.
- Supply forecast: we estimated supply availably in a drought with likelihood of 1 in 500 years (0.2% in any year) by 2039, and a in 1 in 200 drought for alternative level of service prior to 2039.
- Supply demand balance scenarios: We have developed our adaptive plan using plausible low and high supply-demand balance scenarios.
- Customer demand: Forecast without any further water company intervention; all AMP7 water efficiency and metering programmes should end.
- Leakage: leakage was assumed to remain static from the first year of the plan (2025-26) throughout the planning period.
- Demand management strategy: the effectiveness of our strategy is uncertain, as demand is influenced by a range of factors beyond the control of the company, including future climate change, changing demand resulting from post-covid changes and in response to changing economic circumstances and the recent cost of living crisis.
- Drought options: No demand side (e.g., temporary use bans or non-essential use bans) or supply side options (e.g. drought permit options) are included in the baseline plan supply-demand balance.
- Additional demand: the Ministry of Defence sites and Veolia Water Services may require additional volumes of water in addition to our central supply-demand balance. Actual demand will depend largely on the outcome of environmental investigations in 2025-2030, but some of our modelled scenarios anticipate this by an additional demand of 9.84Ml/d in the eastern part of our supply system in the Hampshire Avon.
- Abstraction reductions: potential license reductions in the Hampshire Avon catchment could be addressed by combining existing abstractions and moving them further downstream where river flow is greater, then transferring this water back upstream to existing demand centres. This would obviously incur additional costs for infrastructure and pumping (and impact on net zero targets although we assume grid electricity will decarbonise) , and investigations under the WINEP programme during 2025-2030 will assess the feasibility of this approach.
- Sustainability reductions: the impact of any confirmed or likely sustainability changes as identified for implementation in AMP8.
- Transfers: Existing transfers will continue to the extent of bulk supply agreements.

3.3. Water treatment & supply

3.3.1 Current Status

Wessex Water has an extensive portfolio of water treatment and supply assets, comprising 64 water treatment centres, over 300 service reservoirs, 12,000 km of supply mains and almost 300 pumping stations. We treat and distribute an average of 340 million litres of clean water a day from over 70 sources, and supply approximately 1.3 million people and over 40,000 businesses. Around 25% of supplies come from surface water sources in Somerset, with the remainder from groundwater boreholes and springs across Dorset and Wiltshire.

Our water treatment and supply operations ensure our customers are satisfied with the quality, quantity and reliability of their supply, while complying with regulatory requirements. We manage our assets and operations to minimise the impact of challenges such as asset deterioration, leakage, bursts and contamination. The operational flexibility and resilience of our water supply operations is enhanced by our integrated Grid which enables bulk transfer of water across the region from areas of surplus to those in deficit. Figure 3 in section 3.2.2 illustrates the extent of our supply network, showing the main transfer pipeline routes and our integrated supply Grid.

Our water treatment and supply operations are currently industry leading, as demonstrated by our consistently low compliance risk index (CRI) score (just over 1 in 2022). As a result, we do not plan any specific enhancement investment planned linked to our CRI performance commitment. However, there are tightening regulations on the horizon for both lead and PFAS in drinking water, which may affect our performance in the longer term.

Water leakage from our distribution network and customer pipes represents under-utilised resource; we estimate that current leakage rates are approximately 20% of total supply, or 50 litres per customer each day. We are committed to achieving 50% leakage reduction by 2050 (compared to a base year of 2017/18) and are forecast to meet our PR19 obligations of 15% reduction which should set us on the glide path to achieving this new target. We have historically met our leakage reduction targets, despite challenges from leakage breakouts during more severe weather events. However, we are committing to further investment and innovation to ensure we can meet future challenging regulatory targets and maintain operational resilience by focusing on longer term preventive maintenance activities such as leak reduction and mains replacement. We employ a range of strategies to reduce leakage under our Active Leakage Control (ALC) programme. We monitor leakage on our 12,000 km water mains network by segregating it into discrete District Metered Areas (DMAs) within which we can measure flow rates. Control Zones within each DMA enable us to identify leakage locations. Once leaks are identified, they are confirmed and scheduled for repair according to their priority. We currently find and fix around 15,000 leaks each year; around 50% of these leaks are invisible.

Significant progress has been made over the past 5 years as we transition towards a ‘smart network’. This transition involves the installation of fixed acoustic, pressure and flow loggers providing 15-minute data and associated alarms which enable us to detect leaks sooner. We also have a mature pressure management operation, with around 2,000 pressure reducing valve (PRV) assets in service, which reduce the risk of leaks and bursts by controlling the pressure delivered to around three-quarters of properties. AMP 7 also saw the introduction of a dedicated trunk main leakage team to target detection of leaks on trunk mains throughout our region. Section 3.2 on water resources comments further on our leakage strategy, but it is closely linked with our supply operations activity in this section.

The number of mains repairs required is an indicator of asset health and should remain relatively stable if mains replacement activity is sufficient. However, mains repair figures in relation to asset health can be skewed by years with greater pro-active leakage reduction activity. The numbers of mains repairs undertaken historically by Wessex Water has been variable due to this intrinsic link to the intensity of leakage reduction activities. Our deterioration modelling indicates we will need to increase the amount of pipe replacement in the future to reduce the risk of pipe bursts.

Some older parts of the distribution network still have lead pipes, which we are progressively replacing. We estimate there are around 110,000 lead service pipes in our region, each service pipe comprises a customer supply pipe (owned by the customer) and a communication pipe (owned by Wessex Water). We replace around 1,500 of these pipes each year to reduce the incidence of lead in drinking water. Our current strategy for reducing lead involves a twin track approach of plumbosolvency control to manage the public health risk in the short to medium term, and pipe replacement to remove lead from our network over the longer term. Plumbosolvency control through phosphate dosing has been implemented in zones where sample and asset data indicate that >5% of services are lead. In AMP7 we are targeting proactive replacement of 9,000 lead and metallic communication pipes. Our current policy is to replace both our communication pipe and the customer's supply pipe, free of charge up to outside the property only, except for where there are excessive associated costs.

We have actively reduced supply interruptions, through business-as-usual use of line stopping, network infusion and other techniques. In AMP7, we are also installing additional pressure monitoring in key locations across our network so that we can become aware of a service failure in these areas almost immediately. Having significantly reduced supply interruptions over the past two AMPs, under our core pathway we don't forecast any enhancement spending on Supply Interruptions until AMP10 when new technology may become available.

Nitrate concentrations in groundwater from historical and recent agricultural activity continue to present a significant risk to potable water quality in some parts of our region. Our approach is to apply catchment management approaches in the first instance (a low regrets approach), to reduce further contamination by restricting nitrate use. If this does not achieve sufficient reduction in nitrate concentrations, we then apply source substitution and/or blending solutions, with treatment solutions (e.g., ion exchange) only considered as a last resort. There are a small number of sources across our network where we need to reduce flows or turn off sources due to seasonal increase in nitrate/ pesticide contamination. Modelling in 2020/21 suggested that some sources where nitrate concentrations had previously been stabilising were still rising, which has led us to commit to further monitoring and modelling for all sources on a biannual basis, to better inform the future risk profile and inform the design of potential future interventions that may be required.

The latest modelling data has led us to propose the installation of ion exchange treatment at Sturminster Marshall WTC, as data suggests nitrate concentrations have not yet peaked and will subsequently not start reducing for a significant period. Ion exchange is proposed as blending may not sufficiently mitigate risks to deployable output in the long term.

We apply a similar monitoring and catchment risk assessment approach for managing other contaminants in raw water supplies, such as pesticides and per- and polyfluorinated alkyl substances (PFAS). We have developed and implemented a risk-based monitoring strategy for 48 PFAS in response to DWI guidance on PFAS (information letters in May 2021 and March 2022). We are also undertaking detailed catchment risk assessments in relation to potential sources of PFAS and have produced and submitted an AMP8 PFAS strategy to the DWI. We have identified 32 tier 2 sites (medium risk) and currently have no tier 3 sites (high risk). However, we have had a single tier 3 result from one of our sources where we are now implementing an appropriate blending regime to ensure the site as a whole remains in tier 2.

We will continue to further develop our understanding of PFAS, their sources and treatment options through research projects, industry groups, national steering groups and learning from international case studies. We will also maintain our engagement with UKHSA and Local Authorities in relation to any new or deteriorating risk sources.

Although we have not identified a need for long term investment in treatment to mitigate the risk of PFAS, we will continue to review our options for control measures should a site meet the tier 3 requirements so that control measures may be implemented as quickly as possible if necessary.

Customer contacts about water quality relating to appearance, taste and odour is a common performance commitment and we are committed to further reducing the disruption and other negative social impacts for customers from this. In 2021 we were one of a number of companies issued with a DWI Regulation 28(4) Notice for the specific purpose of reducing our discolouration (black, brown and orange) customer contacts, both regionally and in specific water quality zones. We are also above the national average for taste and odour contacts.

We are working to reduce customer contacts concerning appearance, taste and odour via a combination of asset management (predominantly mains replacement), operational performance (predominantly mains conditioning and flushing), and customer relationship management. This approach is proving successful and has reduced customer contacts steadily from a three-year average of 2.3 contacts per 1,000 population in 2013/14 to 1.3 contacts per 1,000 population in 2022/23. However, there is scope for further improvement to improve our performance in this area and we propose a significant uplift in capital maintenance base expenditure in AMP8 and beyond, focusing on the replacement of trunk mains.

There are a number of innovative approaches that we have developed in AMP7 that have influenced our enhancement spend forecast for AMP8, for example having reduced supply interruptions to industry leading performance defers enhancement expenditure in this area in AMP8. Similarly, our proactive catchment management approach has deferred and in some cases avoided the need for enhancement expenditure for further additional treatment for nitrates and pesticides.

3.3.2 Scenario Impacts on outcomes

The WRMP details our forecasting climate change and demand impacts on water available for supply. Table 16 below summarises our forecasts for how plausible futures could affect our operations and considers Ofwat's common reference scenarios (marked with an asterisk) as well as regulatory change and land use change.

Table 16 - Scenario impacts on outcomes

Scenarios	Impacts
Climate change*	Modelling suggests climate change will have a relatively small negative impact on deployable output, mostly attributed to impacts on surface reservoir storage. However, longer drier summers could result in significantly higher peaks in demand even if annual average PCC is reduced through smart meter and water efficiency. Distribution networks may be affected by wetter winters and drier summers, which may affect ground conditions and increase the risk of damage to underground structures. They may also be affected by extreme storm events that cause flood damage to above ground assets. Climate change is not currently forecast to have a significant impact on water quality.
Demand*	Population growth will be the main driver of increased peak week demand. However, this will be mitigated by our demand management strategy, and supply flexibility provided by our integrated supply Grid. Our WRMP24 forecasts a supply demand balance deficit from 2035 linked to abstraction licence reductions in the Hampshire Avon catchment. Environmental investigations are ongoing to determine the extent of reductions required but this is likely to have a significant impact on water available for use and hence further pressure on demand reduction strategies.

Technology*	While we do not anticipate significant technological advances in the next decade, deployment of available technology is likely to become more affordable. The early detection of supply interruption could significantly improve our supply continuity, but we do not anticipate new detection technology to be available for several years (deployable in AMP9 for the 'fast' development scenario, or AMP10 under a slow technology future). Advances in pipe-lining technology could benefit our lead reduction programme, allowing us to cost effectively address the issue of lead at customer taps and reduce our reliance on phosphate dosing. Advances in water treatment technology, in particular aspects relating to sustainability and reduced carbon footprint, may allow for efficiencies over existing technology. The most likely treatment enhancement for Wessex Water would be the deployment of nitrate removal technology at selected water treatment centres from AMP8.
Abstraction reduction*	The EA's sustainable abstraction policy proposes abstraction licence reductions in some areas, in particular to reinstate flow in chalk streams. Wessex Water may be significantly affected by this, with licence reductions proposed in the Hampshire Avon area. Our WRMP24 forecasts a supply demand balance deficit from 2035 primarily driven by these licence changes. To continue to meet demand will require us to maximise the output of key remaining sources, manage demand by reducing per capita consumption and leakage and consider strategic supply side investment.
Regulatory change	We anticipate increasing regulatory pressure to remove lead from internal customer lead pipes and fittings. The prescribed concentration for lead is likely to be halved by 2036 (from 10 µg/l to 5 µg/l0 in-line with changes to the EU Directive. The DWI is increasingly expecting water companies work towards having 'lead free' networks, though we do not currently anticipate change until after 2050. Changes to DWI regulations around PFAS and nitrates would also impact our supply strategy, driving the requirement for further treatment schemes and/or more substantive blending options.
Land use change	There may be substantial changes to land use in response to future government agricultural policy, while cropping practices may change as a result of wetter winters and drier summers. These changes may impact on the availability and quality of water resources, such as changes to groundwater recharge patterns, and the timing of fertiliser application affecting the magnitude and occurrence of nitrate peaks in groundwater abstractions. We propose to manage these changes by a combination of farmer engagement and investment in supply management.

3.3.3 Response Options

Response options relating to supply demand balance, such as leakage reduction and smart metering, are set-out in our WRMP and also summarised in section 3.2.3 above. Table 17 below describes response options specific to water treatment and supply (water networks plus price control).

Table 17 - Water Treatment and Supply Response Options

Topic	Generic Options
Lead reduction	• Only carry out reactive lead pipe replacement in response to sample failures • Continue with AMP 7 expenditure on proactive lead pipe replacement (equivalent to ~6000 comms pipes replaced/AMP) • Double expenditure on proactive lead pipe replacement compared to AMP7 (equivalent to ~12000 comms pipes replaced/AMP) • Further increase expenditure of AMP7 proactive lead pipe replacement (equivalent to ~18000 comms pipes replaced/AMP) • Extend proactive lead pipe replacement policy to replace more internal lead pipes and fittings. • Change approach to stop replacing galvanised supply pipes to focus the programme fully on lead
Nitrate Management	• Continue with current catchment management approach. • Carry out enhanced catchment management for higher risk sites • Install more nitrate removal plants at higher risk sites. • Install more robust blending schemes at higher risk WTCs or in the network. • Turn off higher risk sites, substituting supply with alternative sources
Supply Interruptions	• Continue with current supply interruption strategy and level of performance. • Increase investment in currently available measures from AMP 8 onwards to begin reduction towards our long-term target. • Increase investment from AMP 9 onwards if new technology in supply interruption detection becomes available. • Increase investment from AMP 10 onwards if new technology in supply interruption detection becomes available
Appearance, Taste and Odour	• Continue with current level of activity of mains flushing and mains replacement. • Increase mains flushing activity. • Increase mains replacement activity. • Increase mains replacement activity with a greater focus on trunk mains. • Optimise current water conditioning at WTCs and in the supply network. • Add additional water conditioning treatment at WTCs and/ or in the supply network. • Increase water quality and pressure monitoring across the supply network
Asset Health – Mains Replacement	• Continue with current AMP 7 levels of mains replacement. • Reduce mains replacement compared to AMP 7 levels. • Increase mains replacement to 0.4% per annum • Increase mains replacement to 1% per annum
Resilience	• Our maintenance proposals include continual improvement in our assets and systems to ensure we provide a resilient supply in the short to medium term.

	• Our core pathway includes significant enhancement expenditure from the WRMP which ensures resilience of supply over the longer term
Demand reduction	Demand reduction options are considered within the WRMP options analysis process and include a range of: • Smart metering options • Leakage options • Water efficiency options

3.3.4 Options Assessment

Options relating to supply demand balance, such as leakage reduction and smart metering, were assessed as part of the WRMP process and further detail on this is provided in our WRMP and summarised in section 3.2.4. of this document.

Options specific to Water Treatment and Supply described above were considered by internal subject matter experts and initially screened based on feasibility and high-level cost-effectiveness taking into account deliverability and the current economic climate. A constrained list was then progressed to be input into our investment planning tool (EDA – Enterprise Decision Analytics) to further refine options into 'best value' and 'lowest cost' compared alongside numerous other supply and waste investment options for AMP 8, with the learnings applied to the forecasting of the LTDS activities.

3.3.5 Recommended Approach

As a diverse operation there are multiple opportunities to improve our performance. Our review of preferred options revealed that they could be assembled into distinct packages of interventions that respond to different future scenarios, and led to us developing the following pathway options:

WTS-Path 1 Core pathway including preferred mains replacement and leak reduction strategies.

WTS-Path 2 Adaptive Pathway - Enhanced nitrate removal

WTS-Path 3 Adaptive Pathway - Accelerated lead pipe replacement/relining

Figure 11 summarise how we will deploy these pathways to improve performance (relative to business as usual and achieve our objectives over the next 25 years. Our approach involves a combination of business as usual, new enhancement initiatives to satisfy benign future scenarios, and other interventions we expect will be needed under more challenging futures.

Figure 11 - Adaptive pathway diagram for Water Treatment and Supply

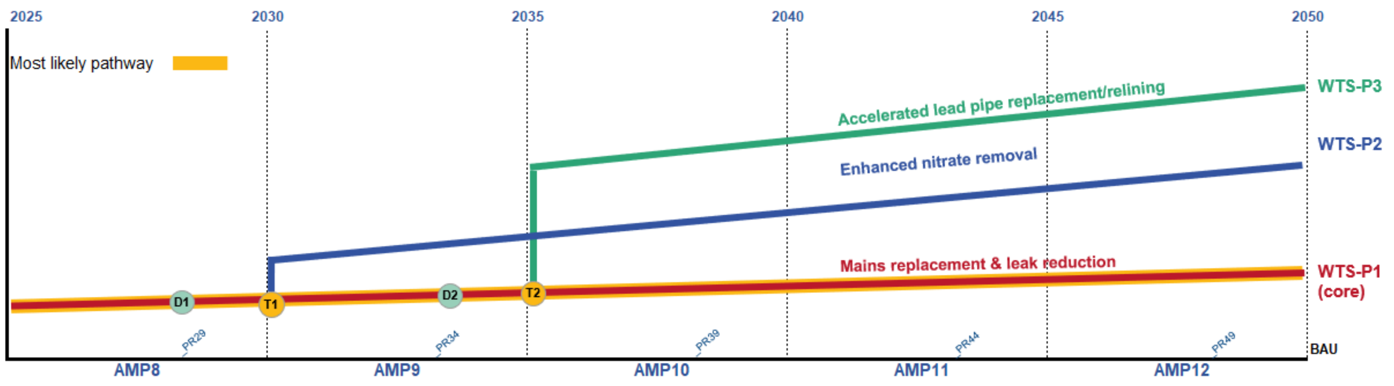


Table summarises the decision points and trigger points described below and provides an estimate of the likelihood that each pathway would be triggered.

Table 18 - Water supply and treatment decision and trigger points

Path	Decision Year	Trigger Year	Likelihood %	Description
WTS-P3	2033	2035	25%	Accelerated lead pipe replacement/relining
WTS-P2	2028	2030	20%	Enhanced nitrate removal schemes
WTS-P1	2023	2025	100%	Smart metering, mains replacement & leak reduction

We consider that Path 1 will be sufficient to deal with anticipated operational challenges under benign future scenarios, which represents our core pathway. One or more alternate paths could be deployed if future conditions are more adverse than anticipated, although we do not currently anticipate the need to transition to an alternate path during AMP 8.

Business as usual

While business as usual does not contribute to our estimates of enhancement expenditure, it provides an understanding of our operational baseline and contextualises proposed enhancements. Our business-as-usual activities comprise both reactive and proactive interventions prioritised through our risk and asset management systems as detailed in WSX10 Maintaining our services section of the business plan.

Path WTS-P1 – Mains replacement and leak reduction (our core pathway)

Our recommended approach for meeting water treatment and supply requirements under plausible benign future scenarios incorporates the following main areas of enhancement investment, which are linked to the Water Networks Plus price control.

Smart metering

The rollout of advanced metering infrastructure (smart meters) to 95% of household and non-household properties across our region by 2035 will provide near real-time usage data allowing us to better target our leakage reduction, customer engagement and water efficiency efforts. Initial roll-out in AMP8 will focus on the Hampshire Avon area where associated demand savings would help mitigate potential significant abstraction licence reductions.

Leakage reduction

We are committed to meeting our regulatory target of 50% leakage reduction by 2050. We plan to reduce leakage by 3.5 Ml/d between 2025-2030, and a further 8.6 Ml/d between 2030-35 taking us to 32% leakage reduction compared to our 2017/18 baseline and a significant way to achieving 50% reduction by 2050.

To achieve this, we will build on our current leakage reduction strategy with greater focus on expanding our acoustic logging and smart network capabilities, using data to bring about efficiencies in the 'find and fix' backbone of our operation. Smart metering data will also play a key role in the evolution of our leakage strategy, allowing us to identify and help resolve customer supply pipe leaks to realise associated benefits much sooner than current detection methods. In addition to these 'fix' activities we will also expand programmes that prevent future leakage such as pressure management and asset renewal, making leakage the primary focus of some key mains replacements. By focusing on both fix and prevent elements, we hope our leakage reduction strategy will enable us to achieve sustainably low levels of leakage.

Nitrate management

Recent nitrate modelling shows the majority of sources have or should soon reach their peak nitrate levels. This suggests we should not invest heavily in nitrate treatment unless absolutely necessary - nitrate contamination of raw water across the region should be continually reducing in light of changing agricultural practices driven by government legislation.

Our recommended approach to managing nitrate levels in our water supply is to continue with our effective catchment management approach across our region and from 2025 to focus enhanced catchment management efforts at ten high risk sites (identified through nitrate modelling). Whilst this may not be sufficient to negate the need for nitrate treatment at all sites in the long term, it should at least minimise the extent of treatment required. Where we cannot sufficiently manage nitrate concentrations in treated water through catchment management, we will continue to employ blending regimes and seasonal outages of certain sources where supply can be substituted from elsewhere (although we anticipate that supply substitution will become increasingly difficult in-light of forecast supply/demand deficit from 2035). New nitrate treatment schemes will be the last resort option in our strategy due to inherent environmental and carbon costs but we do forecast the need to, in AMP9, rollout nitrate removal at an additional two sites.

Mains replacement

Our long-term plan for water distribution is to maintain stable asset health. We have just over 12,000km of water mains in our network and plan to increase our proactive replacement programme from 0.23% per annum to 0.4% per annum from 2025 and anticipate further increases may be required in AMP9 and beyond to maintain stable asset health in the long term. Prioritisation of mains replacement will be based on an integrated approach which considers data describing mains repairs and bursts, supply interruptions, leakage, customer contacts about water quality, and water quality compliance risks.

The main focus of our water quality driven mains replacement programme is reducing Brown Black and Orange customer contacts, which are the biggest single component of appearance taste and odour contacts and typically relate to corrosion in unlined metallic water mains and service pipes. Many contacts occur following network disturbance, such as a burst. Prioritising water quality mains replacement on brown, black and orange customer contacts also reduces the risk of compliance failures in the network, particularly with regard to iron and manganese corrosion from unlined metallic pipes. Water quality driven mains replacement need is primarily identified using flushing data, discolouration customer contact data and asset age/condition assessments.

Supply Interruptions

We have consistently reduced supply interruptions down to deliver industry leading Water and Sewerage Company (WASC) performance. We have set ourselves the stretching aspirational target of zero interruptions of longer than three hours by the year 2050. We are planning to retain our current level of performance in 2025-2030 and 2030 - 2035, through business-as-usual use of line-stopping, under-pressure techniques and network infusion. This flat trajectory is supported by customers current satisfaction in this area as commented on in earlier sections.

Achieving our planned trajectory to zero supply interruptions of greater than 3 hours by 2050 will require a step change from our already industry leading performance in this area. This step change could be enabled by new technology becoming available for faster identification of supply interruptions We remain uncertain about when this new technology will be available, but our current estimation is by 2035. Development of our LTDS for PR29 will review the status of technology and if suitable technology becomes available, we will increase investment from 2030. Taking advantage of innovative technology as soon as possible will give us the best chance of achieving our stretching long-term target. As technology is a common reference scenario this is not included as a separate adaptive pathway. Over the long term we also anticipate improvements in supply interruptions from our investment in leakage, with improved and more widespread data.

Appearance, Taste and Odour

Having dealt with all our “hotspots” for customer contacts about water quality in the past, the remaining contacts are spread over most of our area making the costs to make further significant reductions prohibitive. Our strategy is therefore based on around incremental improvement over time which may require a sustained higher level of water quality driven mains replacement funded from increased base expenditure allowances. We will also enhance our mains flushing programme and investigate installing additional water conditioning in the supply network if required.

Lead replacement

We had planned to increase investment in our proactive lead pipe replacement programme from 2025 from c.£13m in AMP7 to c.£27m in AMP8 and sustain this level of investment over the long-term planning period. However, due to the impact on customer bills of our PR24 programme as a whole, a decision was taken to revert back to c.£13m expenditure for AMP8 and from AMP9 increase to c.£27m. There is currently no plan to deviate from this as no specific guidance or legislation has been issued from the DWI on when they expect water companies to have a lead-free network. There could be a reduction in the PCV for lead in the medium term, but this would just divert investment to more reactive pipe replacement and not necessarily require a significant adjustment in expenditure as more of the forecast spend would be focused on reactive work, reducing the number of planned replacements to keep a total replacement programme on budget.

In AMP8 we will target replacement of 6,000 lead communication pipes and aim to also replace the associated customer supply pipe in approximately 50% of instances. We are targeting a lower number of lead pipe replacements than AMP7 due to a change in strategy from maximising the number of pipe replacements that can be achieved, to focusing on those pipe replacements that will deliver the greatest public health benefits but may have a higher unit cost. The pipe replacement rate will then increase to approximately 12,000 in AMP9 when investment is doubled but thereafter is anticipated to decline as priority sites are resolved and progressively smaller replacement jobs become less cost-effective. We also remain steady at this level for some time.

Adaptive Path WTS-P2 – Enhanced nitrate removal

We expect not to need further nitrate removal plant schemes other than at Sturminster Marshall (forecast for delivery by 2030) as illustrated in our core pathway with catchment management being our low regrets operational strategy, although nitrate modelling shows not all sites may have reached their peak nitrate levels. Environmental investigations in 2025-30 will inform final decisions on abstraction licence reductions from 2035 in-line with sustainable abstraction guidelines. Depending on the extent of these licence reductions, our options to blend higher nitrate water may become limited and maximising our existing sources may become more critical - turning sources off seasonally due to high nitrates and substituting supply may no longer be feasible. There is also uncertainty over whether the DWI may lower the PCV for nitrates in treated water which could tip some high-risk sites over into being non-compliant.

Development of our LTDS for PR29 will include consideration of the need for additional nitrate removal plants (decision point D1), and if needed trigger our enhanced nitrate removal adaptive pathway (Trigger point T2) in 2030. This adaptive pathway forecasts the costs for upgrading or building new nitrate removal plants at all ten of the sites at which in AMP8 we are prioritising enhanced catchment management. Whilst all ten may not be required, we felt it appropriate to illustrate the potential costs if these were identified as needed. We have spread these costs across AMP9 and AMP10 As nitrate removal schemes are completed, enhanced catchment management for the associated site will be phased out as the risk is fully mitigated.

We perceive the likelihood of needing further nitrate removal schemes to be relatively low as our current modelling suggests the majority of at-risk sites have reached their peak nitrate concentrations. In addition we continue to pursue a proactive catchment management approach.   Furthermore, UK regulations around the use of nitrate-based fertilisers have tightened in recent years and will likely continue to be become more restrictive in the future. However, there remains uncertainty on a minority of at-risk sites having reached peak nitrate concentration, how existing sites will need to be maximised in future licence reduction scenarios and if the PCV for nitrates in treated water will be reduced. For these reasons we attributed a 20% likelihood of following this adaptive pathway from 2030.

Note that underneath this pathway we have not reduced our unplanned outage PC performance. This is because sites go out for reasons other than nitrate levels – turbidity for example. In the future this PC could be reviewed.

Adaptive Path WTS-P3 – Acceleration of lead pipe replacement/ relining

The acceleration of our proactive lead pipe replacement programme will depend largely on if and when the DWI set out guidelines and associated legislation on their expectation for water companies to achieve a 'lead free' network. We anticipate that there may be technology advances in the next decade that enable a more efficient approach to lead reduction, which could accelerate our programme although have not sought to forecast these costs as they do require approval by the DWI. These may include pipe re-lining technologies that protect supplies over the long term that can be used to re-line difficult to replace supply pipes and internal plumbing.

Information gathered during AMP8 and AMP9 will inform the development of our LTDS for PR34, enabling a decision on whether to accelerate our lead reduction programme (decision point 2), and if required trigger the associated adaptive pathway in 2035 (trigger point 3).

We think it is highly likely the DWI will respond to modest levels of ambition on lead pipe replacement presented in PR24 plans across the industry with further guidance for companies ahead of AMP10. However, as the public health risk of lead is effectively mitigated through phosphate dosing, expensive lead pipe replacement programmes may struggle to achieve binding statutory targets in the medium-term whilst investment in other areas is prioritised and customers are protected from excessive bill increases. For these reasons we attributed a 25% likelihood to following this adaptive pathway from 2035.

3.3.6 Stress Testing

If there were no adaptive pathways, the reference scenarios have the potential to impact delivery of water treatment and supply outcomes and performance commitments. Abstraction reduction and regulatory change are the reference scenarios most likely to have the greatest impact on delivery. If we had no options to adapt our activity to mitigate changes, we may be unable to supply sufficient water to meet demand or we may become non-compliant with water quality regulations.

Our core and adaptive pathways have been developed to ensure we meet all statutory requirements in these areas and remain aligned with industry best practice, maintaining or improving our level of performance in relation to other water and sewerage companies.

We forecast our core pathway will be sufficient to deliver satisfactory performance against current known performance commitments under benign future scenarios. Outcomes of activities relating to the demand management portfolio chosen as part of our core pathway (leakage reduction and smart metering) have been modelled against relevant performance commitments in our WRMP to ensure statutory and other expected targets are met.

Each adaptive pathway considers a different adverse future scenario and adapts associated programmes to meet the new challenge, ensuring adequate performance is maintained. One or more adaptive pathway may be required to meet all future scenarios.

3.3.7 Assumptions and Uncertainty

- Our supply demand forecast developed for the WRMP estimates supplies will be maintained in a drought with likelihood of 1 in 500 years, equivalent to 0.2% in any one year by 2039, and in 1 in 200-year drought for alternative level of service prior to 2039.Demand management strategies have been developed to maintain supplies under these conditions.
- We remain uncertain about the effectiveness of our demand management measures, such as smart metering and water efficiency programmes, to reduce overall demand as population grows.
- We assume nitrate treatment plants schemes will become fully operational by the final year of the AMP in which work begins.
- Based on nitrate modelling data, we assume no new sites will be deemed high risk from 2030 unless the PCV for nitrates in treated water is reduced.
- We assume the cost of a new nitrate treatment plant to be £10m and of an upgrade to an existing nitrate treatment plant to be £5m. In our adaptive pathway for enhanced nitrate removal, we assume 7 schemes over two AMPs and costs are split proportionally.
- We assume phosphate dosing for plumbosolvency reduction will need to be phased out long term due to the unsustainability of this policy, so investment for lead reduction is all focused on lead pipe replacement with no funding for new phosphate dosing schemes.
- We remain uncertain on the timeline for regulatory changes relating to water quality - lead, nitrates.
- We remain uncertain on the timeline for new technology related to pipe lining and supply interruption detection to reach the market.

3.4. Sewerage

Wessex Water's sewerage network assets include 35,000km of gravity sewers, 2,150 pumping stations and 1,296 storm overflows. Sewers take wastewater from our customers' homes and businesses and conveys the flow by gravity to the Water recycling centre (WRC), where the wastewater is purified before being discharged back to the environment. Sewage pumping stations (SPS) are required at some locations to lift flows over hills or into higher sewers or WRCs through pressurised pipes called rising mains. Storm overflows act as relief valves, allowing excess storm water to be released to rivers, ground or sea, in order to protect properties from sewer flooding during heavy rainfall. Approximately 80% of our storm overflows are located within urban sewerage networks serving towns and cities, and 262 storm overflows are at WRCs where they protect treatment works from flooding. Although storm overflows are an integral and important part of our drainage system, the Environment Act has set targets for reducing the frequency of overflows via the Storm Overflow Discharge Reduction Plan (SODRP)6.

This section of the long-term delivery strategy presents a synopsis of content in our Drainage and Wastewater Management Plan (DWMP) that was published in May 2023 and is downloadable from our website (https://corporate.wessexwater.co.uk/our-future/our-plans/drainage-and-wastewater-management-plan).

Our long-term core sewerage plan is designed to achieve the following performance targets:

- SODRP compliance (assuming the mid-climate change scenario of 20% uplift in rainfall intensity)
- Continuous monitoring of water quality from AMP8 (subject to confirmed final guidance from Defra)
- Halve the number of sewer flooding incidents by 2050
- Zero pollution incidents by 2050
- Deploy nature-based solutions or sustainable solutions where they represent best value

There are significant uncertainties in long term planning for sewerage assets and operations in the next 25 years, which we have accommodated into our planning via the use of adaptive pathways developed in accordance with Ofwat guidance. Key areas of uncertainty include the impact of climate change on storm frequency and severity, future regulatory control of non-flushable items such as wet-wipes, which in turn may impact our ability to achieve our ambition of eliminating untreated storm overflows.

3.4.1. Current Status

Wessex Water has committed to three strategic outcomes relevant to sewerage network, namely: having an effective sewerage system; excellent customer experiences, and good environmental water quality. Specific performance commitments associated with these objectives are:

- Internal flooding: 0.71/10,000 connections
- External flooding: 9.7/10,000 connections
- Storm overflows: tba
- Sewer collapses: 12.17/1,000km

Similar to many other water companies, the operation and maintenance of our sewerage network faces a range of challenges. Investment constraints have adversely affected our network maintenance and expansion. Our repair and renewal work has not been sufficient to prevent asset deterioration, while capacity enhancement has not kept pace with the increase in new properties and increased run-off from paving of permeable surfaces. This has increased the risk of incidents such as blockages, collapses, flooding and overflows. Around 90% of our sewer

[6] https://www.gov.uk/government/publications/storm-overflows-discharge-reduction-plan

flooding incidents are due to blockages and collapses. Sewer blockage by non-flushables has been a particular challenge in some areas, requiring us to invest heavily in preventive maintenance and blockage removal. Some of our sewers in chalk catchments are also subject to high levels of groundwater infiltration, which increases the amount of sewage to be conveyed and the risk of storm overflow.

We have a good understanding of our storm overflows and are increasing the extent of monitoring and modelling across our network, to improve our ability to understanding of hydraulic performance and opportunities to optimise the network. Our investment priorities for AMP8 and beyond are heavily focused on reducing the frequency and impact of storm overflows and we are investing in a range of improvement initiatives including: reducing inflow and infiltration, increasing network capacity. are working with the Environment Agency to determine whether wetlands can be used to reduce the polluting impact of storm overflows.

While our overall performance has been very good, a small number of serious pollution incidents and increasingly strict environmental performance requirements mean that we currently have a 2-star environmental performance assessment (EPA) rating.

3.4.2. Scenario Impacts on outcomes

Table 19 summarises the impacts the common reference scenarios could have on our operations in this area. Of the common reference scenarios, the impacts of climate change have the largest level of uncertainty. Our core plan for flooding and storm overflow improvements includes a 20% increase in design rainfall intensity for climate change. This allowance for climate change in the design and construction of solutions is the current best practice. With benign (-6%) and adverse (+6%) scenarios the solutions will need to be:

- Hydraulic flooding improvements: 11% reduction for benign and a 13% increase for adverse scenarios
- Storm overflow improvements: 7% reduction for benign and an 8% increase for adverse scenarios.

Climate change is also predicted to increase sea levels in the long term. For PR29 we will undertake more assessments of the impact of sea level rise. This may require surface water outfalls or storm overflows discharges to be pumped in the future, whereas most currently discharge be gravity.

Growth uncertainty does not change the requirements as significantly as climate change. Our core plan for growth assumes the development rates detailed in the local authorities' local plans. With benign (-30%) and adverse (+30%) scenarios the solutions will need to be:

- Hydraulic flooding improvement: 0.3% reduction for benign and a 0.1% increase for adverse scenarios
- Storm overflow improvements:0.6% reduction for benign and an 0.5% increase for adverse scenarios.

Technology is a difficult scenario to evaluate. Some areas may require increased investment (e.g. due to communications equipment needing to be replaced – like PSTN) but other areas may develop lower cost solutions, such as low-cost monitoring techniques (such as in- sewer monitors). The timing difference of 5 years in the scenario is unlikely to be material.

Technology has changed significantly over the past 25 years. The replacement of PSTN lines is an example of how technology can impact our business by £7m. It will change again over the next 25 years, hopefully to improve service and reduce costs.

Other changes in technology (or similar areas) are hard to forecast. For example, we are proposing to construct 28 constructed wetlands to treat groundwater induced storm overflow discharges, which was not possible a decade ago.

Changes in technology is very subjective and uncertain, so we have assumed that we will continue using current technology, including wetlands.

It would be positive to see that in a few years, communication technology has advanced so that very low-cost monitors could be installed in every manhole giving near real time data on how our vast sewerage system is behaving. Artificial intelligence software could automatically compare the performance data with 'live' hydraulic computer simulations to see if something is going wrong, and we could react proactively. This could lead to having more active control in our sewers to enable automatic optimisation of the performance.

Some of this technology is available already. We have examples of active control such as the North Bristol strategy and the Bournemouth coastal interceptor sewer, but only apply it to the larger systems (where there is data and more storage available). Live modelling is also possible, as we trialled in Weymouth for our PR19 business plan.

The abstraction scenario is not relevant to wastewater.

Table 19 - Common reference scenario potential impacts on sewerage

Scenarios	Impacts
Climate change*	• Increasing storm intensity will increasing flood risk and storm overflow volumes being discharged to the environment • Wetter winters will increase the risk of seasonal groundwater inundation leading to flood flooding, restricted toilet use and storm overflow discharge volumes and duration. • Tidal increase will increase the risk of flooding due to submerged discharges and could prevent storm overflows from discharging
Demand*	• Population growth increasing • Expanding urban development • Increased trade flows
Technology*	• Lower cost solutions could be developed • High costs requirements if technology becomes obsolete (eg, PSTN lines)
Abstraction reduction*	• No impact.
Regulatory change	• Stricter regulatory requirements will need more enhancement investment. • Review of the storm overflow discharge reduction policy or continuous water quality monitoring plans – could reduce investment requirements
Ambition	• Elimination of untreated discharges would require significant investment (c£9billions more) which is probably unaffordable and would have a large carbon impact.

* Ofwat common reference scenarios

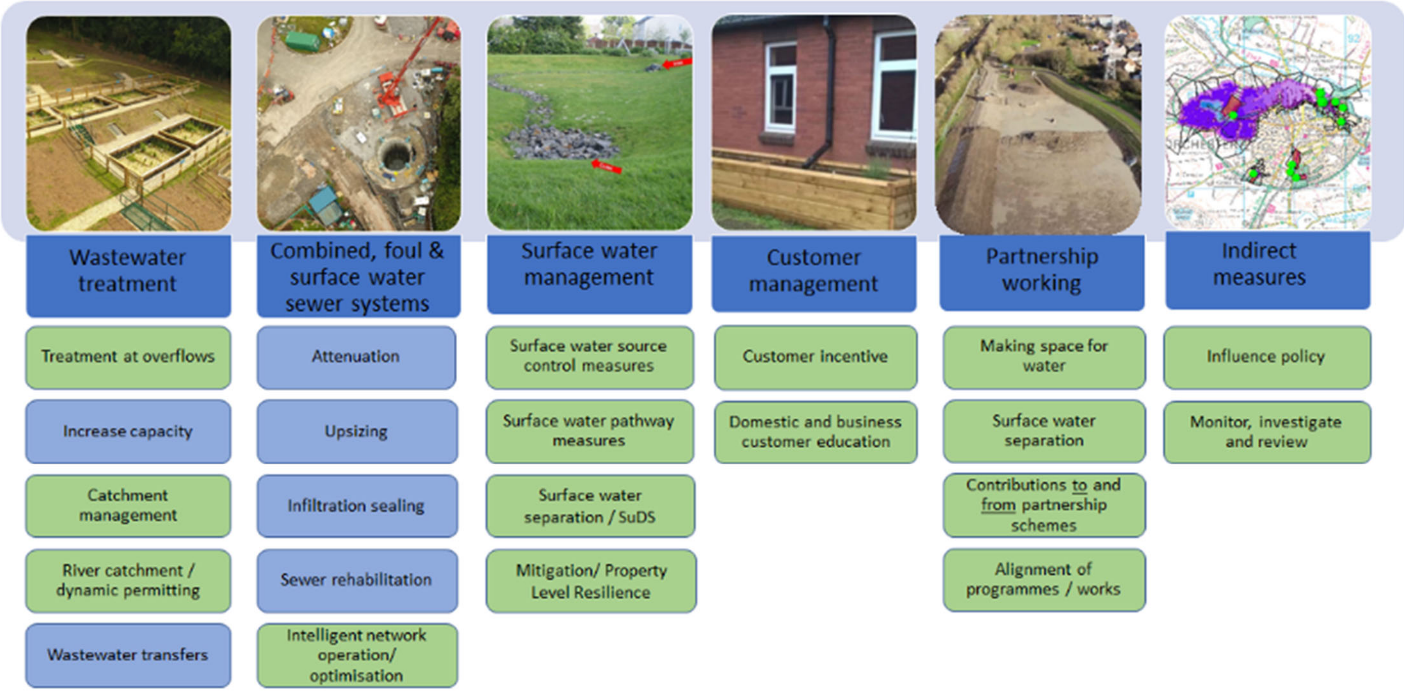
3.4.3. Response Options

The optioneering stages of the DMWMP and WINEP evaluated over 25 thousand options for flooding and storm overflows solutions. This required over 500,000 hydraulic computer model simulations. This detailed optioneering informed the DWMP (draft and final), the WINEP and this PR24 & LTDS submission. Table 20 and figure 12 show the options considered.

Table 20 - Options considered for sewerage network activities

Topic	Generic Options
Combined, foul and surface water sewer systems	- Intelligent network operation - Increase capacity existing foul/combined networks - Wastewater transfers - Sewer rehab - Sewer groundwater infiltration reduction - Property Level Resilience (PLR) - Attenuation - Sewer maintenance
Surface water management	- SW source control measures - 5% - SW source control measures - 10% - SW source control measures - 25% - SW source control measures - 50% - SW pathway measures - 5% - SW pathway measures - 10% - SW pathway measures - 25% - SW pathway measures - 50% - Separate flows
Customer management	- Water efficient appliances - Water efficient measures (property/community/industrial) - Customer incentive - Domestic and business customer education - Greywater treatment and re-use - Blackwater treatment and re-use
Partnership working	- Making space for water - Surface water separation - Contributions to and from partnership schemes - Alignment of programmes and works - Development of joint evidence bases
Indirect measures	- Influencing policy - Investigate and monitor - Future technology

Figure 12 - Extract from our DWMP showing the range of options considered



Hydraulic sewer flooding has historically been designed to occur only during storms above 1 in 20 or 1 in 30 year return periods. The National infrastructure Commissions and Defra are reviewing surface water flood risk. Their initial thoughts were to align all flood risk to a higher design standard with other flood risk management authorities (such as 1 in 100 years for river flooding). Should this become policy then £billions of investment will be required.

3.4.4. Options Assessment

The generic options relating to combined, foul, and surface water systems included a range of nature-based solutions as well as traditional solutions. Table 21 details the options that progressed through the screening stages.

Table 21 - Summary of options that made it through the screening process

Generic options type	Generic Option description	Screened?
Intelligent network operation	Controlling flow movement in response to live data allows the system to be operated proactively, maximising the use of existing assets. These options cover a range of different approaches e.g., modifying the start-stop levels at strategic pumping stations, creation of new network control points which allow for flow to be temporarily held back in the catchment	Yes
Increase capacity existing foul /	Replace sewer with a large diameter sewer to increase capacity	Yes

Generic options type	Generic Option description	Screened?
combined networks		
Wastewater transfers	The movement of flow to another WRC area, or company	Yes
Sewer rehabilitation	Sewer rehabilitation to improve asset health and prevent collapses	Yes
Sewer groundwater infiltration reduction	Infiltration sealing Nature based wetland treatment	Yes
Property Flood Resilience (PFR)	Non return valves, pumps, flood gates etc	Yes
Attenuation	Creates additional volume to reduce storm impact	Yes
Sewer maintenance	Cleaning, repair, and rehabilitation of sewers to maintain service	Yes
SW source control measures 5% to 50% of the contributing area	Managing surface water and maximising its potential for re-use. Opportunities for large-scale source control installation such as retrofitting SuDS in highways and around buildings, as well as aligning with ongoing programmes like local authority highway upgrades or major opportunity area developments.	Yes
SW pathway measures - 5% to 50% of the contributing area	The need to provide safe conveyance (as opposed to storage) for floodwater during an extreme rainfall event (when the capacity of the sewer network is exceeded). Could, significantly mitigate the risk of considerable damage to public and private property and even loss of life that could result from an extreme rainfall event	Yes
Separate flows	Separate surface water from combined systems by constructing new surface water networks.	Yes
Mitigation	Surface water receptor measures. Keep floodwater away from buildings and strategic infrastructure in event of a storm. This would include property level protection (floodgates etc.)	Yes

Generic options type	Generic Option description	Screened?
Domestic and business customer education	A roll out of an education programme to improve understanding of the importance of reduced flows and misuse of the system, and the impact this has on the environment and sewerage system.	Yes
Contributions to and from partnership schemes	Contributions are an essential element to collaborative projects that aim to deliver multiple outcomes and to support the progression of best value options instead of lowest cost. The WINEP methodology sets an aspirational target for companies to secure 20% co-funding of non-statutory actions and to seek further co-funding beyond this level at their discretion.	Yes

Options description

Our preferred option in all cases is to mimic nature and keep rainwater as close to where it lands a possible and preventing it entering sewers, resolving the issue at source. Green or nature based solutions are more sustainable than traditional storage solutions, and can provide wider benefits such as wellbeing and biodiversity. They are the right solution for new developments where land is available for swales and above ground ponds and wetlands. However, retrofitting these nature based solutions into an urban environment can be disruptive and expensive. The costs far outweigh the current monetised benefits. A current UKWIR research project is reviewing this which may result in the benefits being reviewed, and promoting more sustainable solutions in the future.

We have been working with other risk management authorities for decades try to deliver more efficient schemes by working with partners – for example, we have a project that was constructed in Bristol almost 20 years ago. Our DWMP has created more interactions with partnership working, with us hosting many meeting and partnerships to look for synergies that partnership working can provide opportunities to deliver more efficiently.

We are always looking for innovation to drive more efficiencies and better deliverability. We were one of the first companies to embrace no-dig technology – so that we can repair and line sewers without digging up roads – excellent customer experience. Recently we have innovated by developing artificial intelligence to automatically code defects from CCTV inspections. For planning purposes this is ideal, as it means the CCTV inspection time is greatly reduced, so we can inspect more sewers than before for the same cost.

Intelligent network operation

This option uses artificial intelligence to control the flow movement in sewers in response to live data. This allows the system to be operated proactively, maximising the use of existing assets. These options cover a range of different approaches e.g., modifying the start-stop levels at strategic pumping stations, creation of new network control points which allow for flow to be temporarily held back in the catchment. Smart networks. Premature discharges from the sewer can happen when there are downstream build-ups of wipes, fat or silt in the sewers which restricts the carrying capacity of the pipe. During wet weather it can be difficult to determine whether the sewer is filling up due to the sheer volume of rainwater or partial blockage

Our new Artificial Intelligence software can predict what the level of sewage in the sewer should be depending on the amount of upstream rainfall and the time of the day. Based on machine learning algorithms, the software predicts an expected depth. If the depth of sewage exceeds or is lower than this expected range, the monitor will send out an alarm to enable us to investigate and resolve before the overflow operates.

This new software has proved to be highly successful in helping to prevent premature discharges caused by partial blockages. We are now in the process of applying it to all storm overflow monitors by summer 2023. Further details can be found in our Pollution Incident Reduction Plan[7] (PIRP).

Smart networks and continuous monitoring and reporting data live is now expected of water companies. We have had a near-real time website reporting of Storm overflow discharges on our website for almost 10 years.

We are developing a website to show all our event duration monitoring data in near real time, to give complete visibility of when they are discharging and may be impacting on water quality. We nearly have complete EDM coverage of our storm overflow discharges and have one of the highest success rates (low down-time).

Continuous water quality monitoring (CWQM) is mentioned in the Environment Act as being required upstream and downstream of all our discharges from WRCS and Storm overflows. It is considerably more widespread than the current arrangement for monitoring river water quality undertaken by the Environment Agency. The current guidance will see us install close to 500 monitors in AMP8, and 1,400 monitors in AMP9.

Increase capacity existing foul/combined networks

This option considers replacing existing sewers with larger diameter sewers to increase capacity. This can involve localised increases in the capacity of the network through: upsizing, addressing hydraulic restrictions, or by constructing new sewers and tunnels.

Wastewater transfers

The option of considering wastewater transfers involves the movement of flow from one WRC catchment to another WRC area or company where there is available capacity. This was considered for sites that had potential based on available capacity, but on more detailed review other network-focused options provide better value benefits.

Sewer rehab

Sewer rehabilitation to improve asset health and prevent collapses. We assess the need for sewer inspection and rehabilitation as per Wessex Water's risk-based policies to improve asset health condition and reduce the risk of future collapses.

Infiltration sealing

During prolonged wet periods groundwater levels rise above our public sewers and private sewers and drains. Any cracks or holes in the sewer system can allow the groundwater to infiltrate and can inundated the sewers. This can cause sewer flooding and restricted toilet use which can continue for many weeks during very wet winters. We have produced a video explaining this phenomenon[8] and what can be done.

Catchments that are vulnerable to groundwater inundation are subject to Infiltration Reduction Plans. These plans are our commitment to inspecting sewers and making good any significant defects that could let the groundwater infiltrate into the sewer. This is normally achieved by lining the sewer with a watertight liner.

[7] https://www.wessexwater.co.uk/environment/protecting-and-enhancing-the-environment/pollution-incident-reduction-plan
[8] How groundwater causes sewer flooding - YouTube

We have a formal process of inspecting and sealing sewers identified to be letting groundwater infiltrate our sewers. We are currently investing over £1 million per year on our infiltration reduction programme (IRP). Further details of the groundwater infiltration programme can be found on our DWMP portal.

Options to reduce the risk of infiltration are

- to replace with new pipes by open cut,
- sewer lining
- sewer sealing using gel techniques
- or constructing wetlands to treat the very dilute sewage.

Attenuation

Attenuation measures create additional volume within the sewer network to reduce storm impact. This option can apply to foul, combined and surface water sewers and can involve grey or nature-based solutions.

Traditional methods within the wastewater industry have led to attenuation tanks being installed to attenuate and store flows during storm events for release into the sewer network at a later time. Alternative nature-based solutions could include SuDS or surface water attenuation measures.

Surface water separation and Sustainable urban Drainage Systems (SuDS)

The option to separate surface water from combined systems by constructing new surface water networks can be achieved through a variety of traditional measures which could include upsizing existing surface water sewers, constructing first time surface water sewerage schemes, or by using nature-based solutions which could involve attenuation of surface water flows that would otherwise discharge into combined sewers.

Surface water source control measures

Surface water source control measures involves the management of surface water, maximising its potential for re-use which could be through a range of measures including the use of Sustainable urban Drainage Systems (SuDS). Opportunities for large-scale source control installation provide great opportunities for partnership working to deliver surface water management improvements through retrofitting in highways and around buildings, as well as aligning with ongoing programmes like local authority highway upgrades or major developments.

The term SuDS can refer to a wide range of measures including attenuating rain gardens, bioretention, disconnecting downpipes, installing filter drain, gravel paving, green roof, permeable paving, ponds, rain gardens, rain gardens (surface), soakaways, swales, tree pits, water butts and wetlands.

Surface water pathway measures

Surface water pathway measures look for opportunities to provide a safe conveyance of surface water (as opposed to storage) to direct flood flows during extreme rainfall (when the capacity of the drainage infrastructure is exceeded). This could, mitigate the risk of considerable damage to public and private property and even loss of life that could result from an extreme rainfall event.

Other mitigations

Keep floodwater away from buildings and strategic infrastructure in event of a storm. This would include property flood resilience measures (floodgates etc.) and non return valves

Domestic and business customer education

Wessex Water clears approximately 13,000 sewer blockages each year, costing over £5 million. Data shows that around 75% of these blockages are caused by misuse – predominantly wet wipes and fats entering the sewerage system. Wipes, sanitary products, fats, oils, and greases can build up to form blockages that in turn cause sewerage to back up and 'escape' from sewers into homes, gardens, and the environment. These flooding incidents can be detrimental to the environment and distressing for our customers in addition to being financially costly to clear up.

Although we will continue to improve our sewerage network, this will not solve the issue of sewer misuse – addressing the issue 'at source' by encouraging customers to adopt blockage-friendly behaviours and dispose of waste appropriately or not generate the waste in the first place is pivotal to protecting our customers from blockages and flooding incidents.

Our current strategy uses data to identify blockage hotspot areas to focus customer engagement where it can have most impact. We plan to build on this approach to engage with all customers who experience blockages due to sewer misuse. These customers may receive a letter offering advice, a face-to-face visit, or be offered one of our free waste packs to help them prevent future blockages. Targeted engagement will also be supplemented with more public awareness campaigns.

Our future working will additionally see customer engagement on the topic of stormwater separation including advice and support on what can be done at a household and community level to help reduce flooding incidents.

We have also worked with local businesses to get them to help us in the fight against fatbergs. In communities where high levels of blockages are understood to be caused by the food sector, we have visited flood service establishments including restaurants, pubs, cafes, fast food outlets, takeaways, and schools to review their daily kitchen practices and what equipment – if any – they have installed to trap fats, oils, and grease (FOG) to prevent them from entering the sewer network.

Community engagement

We have regular engagement with communities regarding drainage and wastewater infrastructure through correspondence and attendance at established forums with the Lead Local Flood Authority and support to the flood warden network of volunteers that exists across many communities within the Wessex Area.

This regular engagement with communities enables flood wardens and representatives to gain a good understanding of roles and responsibilities relating to flood risk and understand how to report any concerns.

Partnership working

Partnership working is a cross-cutting theme that can be applied to many of the generic options considered. The approach to partnership working needs to be able to be flexible to adapt and suit the opportunities that may arise to work together, respect a need for flexibility for timing of delivery (as collaborative projects are often influenced by stakeholders' resources or funding which adds an element of risk to timing of delivery and successful project completion).

Partnership working can involve an extensive suite of measures which can include

- contributions to and from projects,
- use of Wessex Water investment in infrastructure in certain areas to be used as match funding to draw in contributions from other sources
- development of collaborative models
- involvement in the co-creation, funding, support, and delivery of initial investigations,
- delivery of small-scale amendments to large scale strategic interventions and strategic flood alleviation schemes.

Partnership working will continue to establish more integrated working with opportunities for collaboration to be explored as standard when taking options forward in partnership priority areas.

Influencing policy

We have a track record of influencing policy at a national and local level. A Wessex Water director has represented WaSC's on the Defra / EA storm overflows taskforce and has chaired the storm overflow legislation options review task and finish group. We are also promoting wet wipes should be banned.

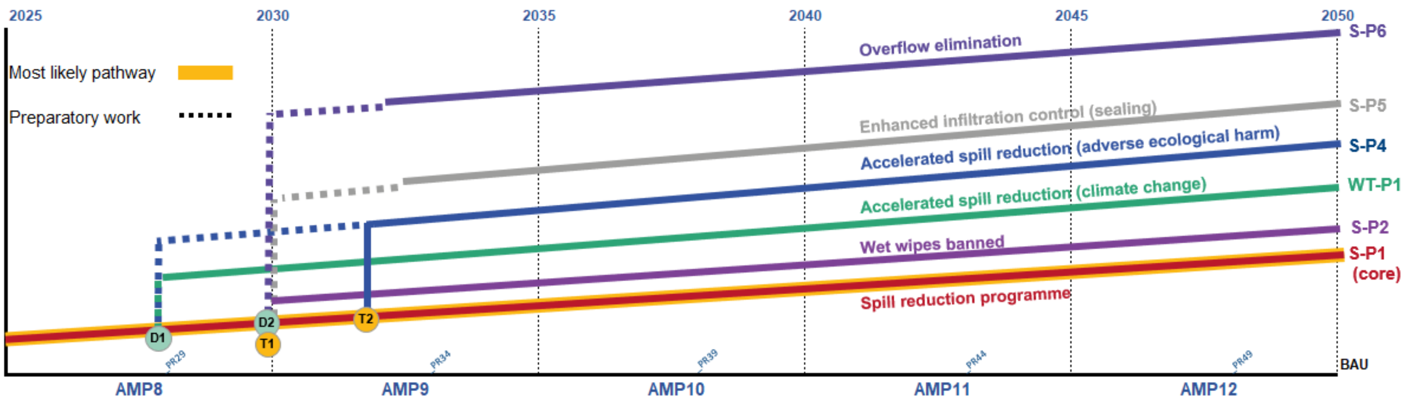
3.4.5. Recommended Approach

Our investment is dominated by 5 phases of the spill reduction programme to achieve SODRP compliance, each of which comprises (identify enhancement spend from the following):

- Additional storage (grey is best value in AMP8, but greener options may be viable in later AMPs)
- Network rehabilitation
- Inflow reduction
- Sealing to reduce infiltration
- Smart network to monitor conditions and provide early warning of blockage/defects
- Pump station improvements to reduce emergency overflows
- Overflow screening
- Overflow disinfection at Poole Harbour (if storage is not buildable)
- Wetlands to reduce groundwater induced overflows

Figure 13 shows the roadmap for the sewerage adaptive plans in this LTDS with the likelihood information in table 21. The DWMP contains further details of these and other adaptive pathways.

Figure 13 - Sewerage adaptive pathways diagram



Decision Points:
D1 EA decision on wetland at an overflow treatment option
D2 Decisions on AMP9 strategic objectives:
- overflow elimination vs reduction
- acceleration of infiltration control programme

D3 Decision to accelerate spill reduction (worsening storm frequency/intensity)

Trigger Points:
T1 Investigations show harm at bathing beaches
T2 SODRP policy change bans wet-wipes

Rationale used in developing the adaptive pathway visual:

- If wet wipes are banned, blockage removal costs will decline significantly assuming there are no detrimental replacements (£10m an AMP from base is estimated)
- The spill reduction programme combines inflow reduction & increased storage
- More impactful interventions will be needed if:
- climate change is more extreme than currently anticipated
- monitoring of receiving waters reveals ecological harm from spills
- The sustainable approach for spill reduction is to reduce inflow & infiltration
- Elimination of overflows will require enormous investment
- Growth in sewage production will not have a significant impact on total discharge (but could lead to localised challenges where capacity is limited)

Table 22 - Decision, trigger years and likelihood details for sewerage adaptive pathways

Path	Decision Yr	Trigger Yr	Likelihood %	Description
S-P6* (LS4c)	2028	2030	5%	Overflow elimination
S-P5	2028	2030	40%	Enhanced infiltration control (sealing)
S-P4	2028	2032	25%	Accelerated spill reduction (adverse ecological harm)
WT-P1* (LS4a)	2028	2030	20%	Accelerated spill reduction (climate change)
S-P2* (LS4b)	2030	2030	25%	Wet-wipes banned
S-P1* (LS4 – Core)	2023	2025	100%	Spill reduction programme

**Indicates that these are pathways for which we provide estimated costs for. The Ofwat LS tables are indicated in brackets. Not that the remaining pathways are detailed in the DWMP.*

The effective sewerage plan is dominated by the significant SODRP investment programme. Our core plan is the best value plan, low/no regrets plan to deliver the requirements by 2050. This has 5 phases (AMPs) of delivery over the next 25 years.

Our DWMP contains more details in all effective sewerage areas. This LTDS focusses on storm overflows, flooding and wet-wipes.

Our core storm overflow plan

Our core plan is the best value plan to deliver the SODRP requirements by 2050. Phase 1 starts improvements in the high priority catchments (chalk stream, SSSI, Ramsar etc). We should also achieve the interim targets in the SODP by delivering similar investments per phase, subject to some uncertainties.

Our PR24 plan is slightly smaller than our draft submission of the WINEP following the EA letters of 5 July and 18 July. These allowed adjustments in certain areas (Environment act bathing waters and monitoring emergency overflows) for affordability, deliverability and water industry resource reasons.

Adaptive pathways

Adaptive pathways will allow our long term delivery strategy to adjust more efficiently to reflect new information, options and experiences to address the current and future uncertainties that may be realised going forward.

Adaptive plans will allow us to move away from the core plan following triggers to identify that need for change and decision points to change the direction. Figure 13 maps the roadmap for an adaptive plan. The trigger points are normally mid-cycle and the decision points are likely to be the final determination of the business plans or developing future cycle DWMPs. Our adaptive pathways are as follows:

Elimination of untreated storm overflow discharges

Our core long term plan has our best estimate of what is required by 2030 and has a line of sight for delivery by 2050. However, there are current uncertainties (such as elimination of storm overflows, continuous water quality monitoring and investigations) and many future uncertainties, such as climate change.

The core plan achieves the governments storm overflow discharge reduction plan, using no/low regret solutions. The preferred plan (Sew_AP1) completely eliminates untreated discharges in line with our current strategic direction statement by 2050. This will require an additional £9billion to achieve this ambitious outcome. Some of the previous schemes (eg AMP8) will need to be revisited by undertaking more surface water separation or proving additional storage or capacity.

The estimated cost for this elimination of storm overflows above the core plan is £9 billion. This is our estimate based on model predictions and simple cost curves for traditional solutions

The triggers to decide this adaptive pathway are:

- our customer willingness to pay about affordability
- whether we can offset the carbon footprint
- the governments review of their SODRP in 2027.

Decision points will be the final determination of the business plans or the update to our Strategic direction statement.

Climate change adaptive plan

Climate change and population growth is happening and researchers say there's now a 66% chance we will pass the 1.5 ^{o}C global warming threshold between now and 2027. We are therefore already at the low climate change scenario of 1.5^{o}C to 2^{o}C referred to in the LTDS

Current best practice when designing hydraulic (flooding and storm overflow) improvements schemes is to allow for known growth and a 20% increase in design storm intensities to account for climate change. So our core plan already contains a mid-climate change scenario. The high climate change forecast would result in more intense rainfall leading to more flooding and more storm overflow discharges, requiring bigger solutions that will cost more.

We have used our hydraulic computer models to predict how much larger the solutions would need to be for the high climate change scenario. For flooding, the risk of flooding in a storm shows that for the high climate change scenario 30% more properties would also be at risk of flooding. For storm overflows, the models predict an 8% increase in discharge volumes for the high scenario compared to the core scenario.

Sensitivity of growth projections are much lower with less than +/-1% variation. We do not think that is material, when we have already allowed for the increase in intensity for climate change. If we are successful in our plans to reduce per capita consumption flow rates (see our Water resource management plan), then this could mitigate increases in growth numbers.

The trigger for this adaptive plan will be the global temperature increasing towards 4^{o}C. The decision could be made if temperature keeps increasing at the DWMP or business plan submissions.

Wetwipes being banned

If wet wipes were banned or made to be rapidly degradable, then the number of pollution and flooding incidents would reduce considerably. The industry is pushing for this. This would be a cost saving adaptive pathway.

The trigger and decision point would be the change in legislation to ban wet wipes or make them rapidly degradable.

We estimate our opex costs could be reduced by £10m per AMP.

3.4.6. Stress Testing

As detailed above, significant modelling and stress testing has taken place particularly around the climate change scenarios to ensure that the pathways we present are robust.

3.4.7. Assumptions and Uncertainty

The following assumptions have been made:

- Rainfall/infiltration has 99% of the impact on flow in combined sewers, and is much more significant than increased sewage discharges due to population growth (which represents 1%)
- Sea level rise will not impact on the operation of sea outfalls
- We are currently assuming clustering is allowed for continuous river water quality monitors
- Post DWMP submission we deferred circa £150m of storm overflows expenditure to AMP9. This has been included in the tables on the same pro-rated basis as the DWMP across grey, green and source surface water separation.

3.5. Wastewater Treatment

Wastewater and stormwater delivered from the sewage network is delivered to water recycling centres (WRCs) for processing to mitigate the impact it has on the environment. The wastewater is a mixture of household and non-household foul water and industrial trade effluent as well as roof, road and land run off. The treated wastewater ultimately ends up in rivers and coastal waters so must be treated to prevent harm to the environment. Each WRC has a discharge consent issued by the Environment Agency detailing the acceptable levels of pollutants in the final effluent. The pollutants of focus are typically total suspended solids (SS), biological oxygen demand (BOD), Ammonia (NH_3), and total phosphorus (P). Each pollutant has a different impact on the environment – excessive levels of TSS can choke rivers of oxygen preventing aquatic life from breathing, NH_3 is toxic to plants and animals while BOD and P are nutrients causing eutrophication.

To treat the sewage to the requirements in the discharge permit various types of physical, chemical and biological processes are used. BOD and NH_3 are typically removed with a combination of biological and physical process with bacteria consuming the pollutants. SS is settled in tanks or filtered, and P can be removed through chemical precipitation or biological adsorption.

Increasingly chemical limits are being added to WRC permits, and we envisage that in the future microplastics and pharmaceuticals could also be permitted, although at what levels are currently unknown.

The discharge permit also has specific requirements about flows entering and leaving the works. The discharge permit will have a value called dry weather flow (DWF) which is the minimum daily flow following a dry period. The DWF is used to determine the acceptable level of pollutants in the final effluent. The pass forward flow (FPF, formally known as the Flow to Full Treatment (FFT)) is the maximum hydraulic capacity of the treatment works. Flows in excess of this value are classed as storm flows and are permitted to spill to the environment (having been screened and usually after first passing through a storm tank/lagoon which capture most solids).

3.5.1. Current Status

We currently have 398 WRCs treating effluent from a combined population equivalent of c3.5 million and an overall flow of 330,000,000 m^3/year.

All of our treatment works have biological treatment incorporated as the main backbone of the works. Two broad types of biological process are used with larger plants typically using the activated sludge process (ASP) with bacteria suspended in large aeration tanks and smaller works usually relying on fixed film biological filtration with bacteria forming a film on stone media or disks.

In AMP7 we are currently upgrading 63 WRCs to comply with new P permits as part of the WINEP programme for the Environment Agency. Treatment for P typically involves addition of ferric sulphate dosing to precipitate the P and tertiary filtration to remove the resulting solid P particulates but – generally when targeting less stringent permits – it can be feasible to utilise a nature-based solution or biological P removal instead. Due to the nature of our WRCs we generally employ chemical treatment processes to achieve the amount of phosphorus removal required. We are aware that this is not the most sustainable solution and that the increasing demand for more stringent levels of phosphorus removal will exacerbate this further.

During AMP6 (2015-2020) and AMP7 (2020-25) we have continued to investigate alternative and more sustainable options for meeting the outcomes required by an expanding phosphorus removal programme. These have included:

- Catchment Permitting: Spreading the risk and avoiding excess asset redundancy by targeting stretch permits across several sites within the same catchment, reducing the overall capex and opex.
- Catchment Nutrient Balancing: Working with farmers to reduce phosphorus run-off from agricultural land to off-set that to be removed by asset solutions at WRCs.

- Constructed wetlands: Habitat creation to encourage the natural removal of phosphorus, as an alternative to investing at smaller WRCs when combined with flexible permitting.

Early in AMP7 we upgraded West Huntspill WRC for improved disinfection treatment, and Wareham WRC for nitrogen removal.

One of the most high profile issues facing sewage treatment currently is the hydraulic capacity of treatment works in relation to premature spills to storm. Excessive storm spills are being addressed through catchment based solutions and reviewing sewage pumping and CSO design. In addition we are looking at end of pipe solutions increasing overall hydraulic capacity of the treatment works to keep the number of spills below 10 per annum. This is being achieved using a variety of grey and nature-based solutions through increasing storm tank capacity and nature based wetland solutions for ground water infiltration.

Our performance commitments relevant to waste water treatment during AMP8 are:

- Discharge permit compliance
- Bathing water quality
- River water quality (phosphorus)

3.5.2. Scenario Impacts on outcomes

The scenarios that were considered when assessing our future wastewater treatment operations are summarised in table 23.

Table 23 - Waste water treatment options considered

Scenarios	Impacts
Climate Adverse	- Hotter weather would cause an increased spend on odour and resilience. AMP9 similar to AMP8 spend with AMPs 10, 11 and 12 seeing a 10% increase. - Drier summers have risk of much reduced river flow prompting a tightening of discharge permits, possibly on a seasonal basis – forecast to increase spend on P and N chemical treatment in AMP10 by 1% - Storms – Longer drier summers but with more extreme rainfall could cause reduction in overall flows to be treated as more overflows would be in operation, however this would generally be mitigated through storm overflow improvements (e.g. attenuation or storage). drier summers may lead to the requirement for more internal recirculation of flows within WRCs to maintain sufficient wetting rates of biological processes, leading to more opex. - Climate benign would be the same as core in terms of investment. - Hotter weather brings risk of increased fugitive emissions of methane and potentially NO2
Demand adverse	- Population growth would increase the quantity of that needs treating. Growth line increase spend by 2.5% from AMP9 onwards - In addition, with increased population growth is the risk of more housing development close to existing treatment works so additional odour removal required. Odour lines increased spend by 2.5% from AMP10 onwards - Sanitary line increase by 5% from AMP9
Demand benign	- Decreasing population would free up treatment capacity reducing required investment by an immaterial amount that is not forecast - Growth line decrease spend by 2.5% from AMP9 onwards - Odour lines decrease spend by 2.5% from AMP10 onwards
Technology fast	- Increasing technology development often comes with benefits usually around footprint and opex but often comes at an increase in CAPEX to realise those

Scenarios	Impacts
	benefits. Our prediction that the overall cost balance for AMP10/11/12 would benefit P and N drivers as well as sanitary, growth, chemicals by reducing OPEX by 2%
Technology slow	- Delivery for core pathway for nitrogen etc. the technology is already available so slower technology development will not affect the timings as effectively business as usual will apply

3.5.3. Response Options

The options in table 24 have been generated to address the adverse scenarios listed in Section 3.5.2.

Table 24 - Options to address adverse scenarios

Topic	Generic Options
Growth	- Rationalisation/centralisation - Modify consents/permits - Effluent re-use - Increase treatment capacity (grey and/or green)
Treatment for tightening sanitary determinands	- Modify consents/permits - Catchment management initiatives - River catchment/dynamic permitting
Odour	- Increase treatment capacity (grey and/or green)
Bathing Waters	- Treatment at overflows - Modify consents/permits - Increase treatment capacity (grey and/or green)
Nutrients (N&P)	- Treat/pre-treat in network - Rationalisation/centralisation - Modify consents/permits - Catchment management initiatives - River catchment/dynamic permitting - Increase treatment capacity (grey and/or green)

3.5.4. Options Assessment

Our LTDS costs have been based on the principles followed to derive our PR24 business plan. The unconstrained options are described below showing the options initially considered when a WRC has been identified as requiring improvements. Table 25 which options passed through screening and which were discounted.

Table 25 - Wastewater treatment options screening summary

Generic options type	Generic Option description	Passed screening criteria?
Treat/pre-treat in network	Chemical dosing prior to flow reaching the treatment works to relieve the load transferred to the WRC or to remove contaminants	No
Treatment at overflows	Use of reedbeds / wetlands to provide treatment for discharges to the environment	Yes
Increase treatment capacity (grey and/or green)	Increase the efficient use of the existing capacity with the existing assets or invest on new assets to provide additional capacity within site footprint	Yes
Rationalisation/centralisation	Close smaller treatment works and transfer flows to a larger one	Yes
De-centralisation	Remove flows from a treatment works and create localised treatment works	No
Modify consents/permits	Review the permit with the Environment Agency and meet new permit conditions	No
Catchment management initiatives	These options are concerned with treating either diffuse or point-source non-domestic elements of wastewater before they enter the sewer system, or by treating and controlling the other contributors to the environment	Yes
River catchment/dynamic permitting	Work with the EA to spread loading across the catchment	Yes
Effluent re-use	Recycle wastewater treatment works flow within the catchment	No

All options that passed the screening criteria were then put through a multi-criteria assessment process to determine the preferred option. We have taken a catchment-based approach in considering the best value / least cost options to achieve the required improvements. Cost and benefit models have been used to determine both best value and least c**ost options (if different) for a range of potential solutions at any given WRC. Options have been assessed against a range of possible future consents to determine the best treatment solution for different permit scenarios, looking WLC but also considering load reduction where relevant. This provides useful data when comparing adverse or benign scenario impacts.**

3.5.5. Stress Testing

Our core pathway shows the costs to continue to provide wastewater treatment services under the following assumptions:

- WRC permitting for P and N does not go beyond that which is currently required by legislation
- Forecasting some costs for chemical removal
- Growth is as expected – reasonably benign
- Supporting the creation of two bathing waters per AMP (assuming 1 large, 2 medium and 5 small WRCs per bathing water, noting all potential bathing waters will have a different make up of sites contributing to the water quality)

In terms of how the adverse scenarios will affect delivery, tighter legislation and increased population will apply pressure to existing assets from both ends. Some WRCs will struggle to meet tightened permits and others will not have sufficient capacity to receive more flows from increased population. To some extent many treatment works currently overperform with regards to their sanitary determinants so there will be element of buffer in the system.

Compared to the baseline pathway we see an increase of 1% on P and N treatment and 10% increase on odour spend if climate change is worse than predicted. Population increase will add 2.5% to growth spending, 2.5% to odour and 5% for sanitary spend. Details of the breakdown of impacts to spending are provided in the DWMP.

The core pathway is acceptable for addressing all of the benign reference scenarios listed above. Benign scenarios are generally business as usual with some risk of over investment in some areas, but performance will not be affected.

Future scenario spend has been based on best industry practice linked in the historic spend over previous AMP cycles for particular scenarios/drivers. A range of future adverse scenarios have been costed to feed into the assessment of how that spend would be affected overall with more adverse future predictions.

3.5.6. Recommended Approach

For WRCs we have developed the following adaptive pathways, summarised in figure 14 and table 25:

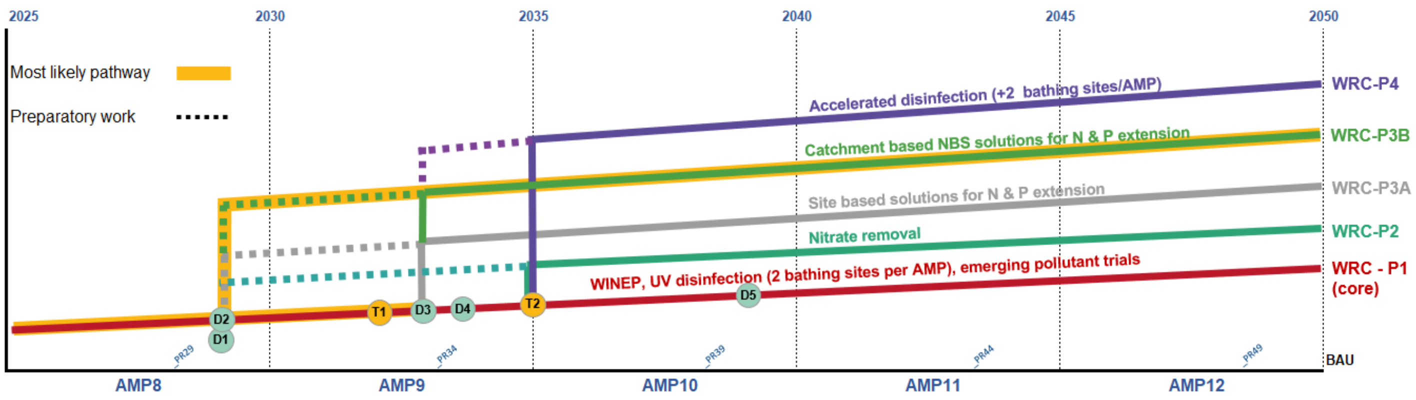
Extension of the current permits on P and N to sites across the region – grey asset solution: We believe it is likely that there will be a requirement to achieve more stringent P and N permits, recognising potential scope for change within the Water Framework Directive (WFD), Habitats Directive (HD) and the Environment Act (EnvAct). This could lead to providing P removal to the technically achievable limit at all inland WRCs above 1,000 population equivalent. This could be seen as speculation, but given the changing of requirements every AMP cycle is not considered unreasonable, although we do not wish to forecast this in the core scenario. We have therefore included an adaptive pathway identify how such an extension could affect our costs if the only solutions permitted were traditional asset based approaches.

Extension of the current permits on P and N to sites across the region – catchment based solution: As per the above, should there be a requirement for more nutrient removal, then it is likely to be prescriptive. Tighter permits would not allow further NBS schemes as they cannot be relied upon to meet tighter limits. Our alternative PR24 approach, however, is for more expansive catchment permitting and more flexible permitting / risk sharing between the company and environmental regulator. Hybrid solutions could be achieved with ferric dosing. This would take 20% of the core pathway costs for Chemical P-removal and N removal costs would move to the NBS forecast. Remaining P and N forecasts would then be reduced by 10%

New technically achievable limits: after AMP8 trials it is assumed that the new lower limit for nitrogen will now be achievable. For AMP9 schemes there would more nitrogen schemes so more CAPEX and OPEX. New sites come in, we would plan to do more earlier, so that what we do is better - upgrading to achieve new limits. From AMP9+ we assume that capex will be reduced and opex is increased as we assume the technology will be cheaper but more expensive to operate. Please note that because we are not forecasting major investment in nitrogen removal beyond AMP9 the costs in the adaptive pathway are not huge. But if you were to apply these going forward on a wider rollout of tighter N permits, the cost implications could be more. Hence why we have included this as an adaptive pathway for illustrative purposes.

An increase in the number of designated bathing waters: for bathing water schemes, rather than carrying out schemes for 2 bathing sites we have assumed going to 4 sites per AMP. This would double the cost from AMP10 onwards. This has been included due to the current public focus in this area.

Figure 14 - Waste water treatment adaptive pathway



Decision Points

D1 Nitrogen trials establish new Technically Achievable Limits (TAL)

D2 Extension of N and P permits beyond current areas confirmed, EA accept catchment located Nature Based Solutions (NBS) as viable for nutrient control

D3 Further bathing beaches start to be identified

D4 PR39 LTDS & Business Plan

D5 PR44 LTDS & Business Plan

Trigger Points

T1 Outcome of pilot trials for N removal (end 2033)

T2 Further bathing beach designations start

The following rationale were used to develop the adaptive pathway visual:

- Nutrients are causing adverse impacts in river catchments and aquifers, and require a combination of catchment management solutions and nutrient reduction from the WRC final effluent discharges.
- WRC final effluent and storm discharges present a bacteriological risk to recreational users downstream so require some form of disinfection.
- Disinfection can reduce bacteriological risk, but needs to be applied to multiple WRC discharges upstream of designated bathing waters.
- The core path provides disinfection for 2 designated bathing waters/year, but accelerated disinfection will be needed if further bathing waters are designated.

- New standards for nitrate in final effluent will require improved nitrate reduction at WRCs.
- NBS (e.g. wetlands, reed beds) can be used to treat or polish wastewater and may present a more sustainable alternative to 'grey' solutions
- Deployment of NBS in AMP8 will be challenging due to the time required to arrange for land acquisition, development permits and operating/maintenance arrangements.
- There are a range of emerging pollutants where research is currently underway to assess their impact and treatment options. This may result in new treatment requirements being brought in in the future.

Table 26 – Decision/trigger years for waste water treatment

Path	Decision Yr	Trigger Yr	Likelihood %	Description
WRC-P4 (LS4e)	2033	2035	45%	Accelerated disinfection (+2 bathing sites/AMP)
WRC-P3B (LS4f)	2028	2033	60%	Catchment based NBS deployment and P & N extension
WRC-P3A (LS4g)	2028	2033	80%	Grey asset based NBS deployment and P & N extension
WRC-P2 (LS4d)	2028	2035	90%	Enhanced nitrate removal
WRC-P1	2028	2033	95%	WINEP, UV disinfection (2 bathing sites/AMP), emerging pollutant trials

3.5.7. Assumptions and Uncertainty

The following key areas of assumptions and uncertainty are highlighted:

- Future regulation is unclear and has a material impact on this area as seen by the increase in investment in this area. Our core and adaptive pathways above detail the assumptions we are making about no further legislation on N and P (core), whilst including some assumptions for the expansion of chemicals permits
- We do not know the rate of creation of new inland bathing waters but have sought to indicate a potential cost for this
- Costs are estimated as per our current PR24 process

3.6. Bioresources

Sewage treatment processes produce a liquid by-product stream known as sewage sludge that contains the organic and inorganic solid material from sewage. Sewage sludge from water recycling centres (WRCs) would typically be transported to dedicated sites known as bioresources centres (BCs) for treating the sludge through anaerobic digestion or lime stabilisation before it is then dewatered and applied on agricultural land as a soil additive. The activities associated with transporting, treating, and recycling sewage sludge to land are known in the industry as bioresources.

Recycling sewage sludge to land reduces the need for inorganic fertilisers and enables the return of beneficial nutrients such as nitrogen and phosphorus to the ground. The inappropriate application of sludge to land can pollute receiving waters via run-off or nutrient leaching or could contaminate land if heavy metals are present. Sewage sludge application to land therefore is subject to a code of practice and the national Biosolids Assurance Scheme (BAS), which requires sludge meets prescribed standards before it is applied to land. While incineration and vitrification can convert sludge into an inert waste for landfilling, these processes have significantly higher energy requirements than digestion and dewatering, with consequences for achievement of our decarbonisation goals.

3.6.1. Current Status

Each year our 398 water recycling centres produce a total of 61,000 TDS of sewage sludge, which is transported as liquid sludge or dewatered cake to our nine bioresources centres. These plants consist of two advanced anaerobic digestion plants, three conventional anaerobic digesters and four dewatering/liming sites. About 90% of incoming sludge goes to digestion and 10% to dewatering and liming. Our most significant sludge digestion operation is at Avonmouth, which treats approximately 50% of all our sewage sludge. Our anaerobic digestion plants produce biogas which is about 60% methane, and this is either combusted to generate heat and electricity required by the digestion process or exported to the grid as biomethane. This biogas represents 28.5 GWh of renewable energy generation each year and contributes significantly towards our decarbonisation efforts.

Treated biosolids are recycled to a landbank comprising 60,600 hectares of agricultural land and we achieve 100% compliance with Biosolids Assurance Scheme quality certification requirements for storage, transportation and land application. We currently have sufficient landbank to recycle all our biosolids, but we expect future landbank availability to reduce due to the changes in the Farming Rules for Water (FRfW) regulation which restricts biosolids application on soils that are high in nutrients. Depending on the extent of the changes to FRfW, there could be insufficient landbank to allow us to continue recycling all our biosolids to land by 2035. We also have 4 storage barns for storing 50% of our sludge for 6 months a year to mitigate the risk associated with prolonged wet weather in winter periods, when it is not possible or necessary to apply biosolids to land. This could also affect landbank availability.

The sludge management process also involves tanker and truck transfers of raw sludge to digestion facilities, and treated sludge to storage and land disposal sites. Reducing the water content of sludge reduces the volume of material to be transported and stored, so dewatering presents operational advantages if it can be done cost effectively.

Our strategy for delivering efficient and reliable bioresources services to our customers is to provide sufficient resilience in our entire bioresources supply chain to ensure that our sludge can be treated and recycled in a safe, reliable, and sustainable way. We also aim to maximise the potential of nutrient and energy value in sludge to minimise the cost and carbon footprint of our bioresources service.

3.6.2. Scenario Impacts

The scenarios that were considered when assessing our future biosolids operations are summarised in table 27.

Table 27 - Scenario impacts considered for bioresources

Scenarios	Impacts
Climate change*	• Wetter winters limit opportunities for sludge disposal to the landbank (increasing the need for temporary storage). • Increasing storm intensity will affect landbank accessibility by increasing the risk and frequency of run-off and contaminant export to watercourses. • Increasing flood risk for low-lying agricultural land may remove some disposal sites from the landbank.
Demand*	• Population growth increasing the quantity of sewage solids (the region's population has grown by 10% since the mid-1990s and is forecast to grow a further 10% in the next 25 years). We forecast total sludge production to increase by 0.4% each year c. 72,800 tds in 2050 due to population growth. • New wastewater treatment processes (e.g., chemical dosing to remove phosphorus) can increase inorganic sludge production and reduce the dry solids (quality) of the sludge produced. Based on our sludge production model, we forecast total sludge production to increase to c. 90,000 tds in 2050 due to the combined effects of population growth and additional sludge from P removal. • Expanding urban development may remove some disposal sites from the landbank.
Technology*	• New wastewater treatment processes (e.g., chemical dosing to remove phosphorus) can increase inorganic sludge production and reduce the dry solids (quality) of the sludge produced. • New biosolids treatment processes may improve sludge dewatering, reducing the volume of biosolids for disposal to land. • More efficient sludge treatment technology could reduce the quantity of biosolids for disposal to the landbank. • New wastewater treatment technology could reduce the concentration of emergent contaminants in sewage sludge (e.g. microplastics, pharmaceuticals, PFAS). • Replacing our diesel-fuelled tanker fleet with electric or biomethane-fuelled tankers would reduce the carbon footprint of biosolids transportation by road (if the electricity they use comes from renewable generation).
Abstraction reduction*	• No impact.
Regulatory change	• Stricter regulatory requirements (i.e., FRfW) for the quality of sludge or application to land could reduce landbank availability. • Closure of the landbank would mean that current sludge treatment and disposal approaches would become redundant and would need to be replaced with alternatives that do not rely on the landbank (e.g. incineration, advanced thermal conversion, vitrification).

* Ofwat common reference scenarios

While new digestion technologies present opportunities to extend the effective lifetime of our landbank by reducing biosolids volumes, the most immediate risk to our bioresources operation is presented by the prospect of new regulatory requirements that either reduce or remove landbank access before we have deployed an alternative technology at sufficient scale.

The water industry and farming community are still adapting to changes recently introduced by the Farming Rules for Water (FRfW). For example, a Regulatory Position Statement (RPS) by the EA still allows for spreading during winter months although this may change. Further regulatory changes are being considered by the EA, and the current plan is to revoke the longstanding framework of the Sludge (Use in Agriculture) Regulations 1989 and including these operations under the Environmental Permitting (England and Wales) Regulations (EPR) 2016 in the lead-up to PR29 or PR34.

There are also concerns around potential hazards associated with emerging contaminants and how these may affect the disposal of biosolids to land. In addition, biosolids to land remains subject to its acceptability by customers. Conversely, the demand for biosolids and other digestate to land has increased as a consequence of increasing mineral and fossil fertiliser costs. Likewise, recent increases in gas prices has created more interest in developing biomethane plants to process manure and other organic waste, thus taking some pressure off the landbank.

The UK water utilities jointly commissioned a study by Grieve Strategic & ADAS to look at a number of potential scenarios of minimal to maximum regulatory change for biosolids to land and determine its impact on the landbank (required and available area).

The conclusion of the landbank assessment is that at a national level there is sufficient agricultural land to recycle all biosolids in Scenarios 1 to 3, but insufficient agricultural land in Scenarios 4 and 5. *Please refer to the supporting document 'WSX18 - Bioresources strategy and investment' for further details on the landbank scenarios in the assessment undertaken by Grieve Strategic.* Companies will be competing for the same landbank in certain regions in Scenarios 4 and 5. One of these regions is the South West /South Wales area where we will potentially be competing against South West Water, Severn Trent Water and Dŵr Cymru Welsh Water for landbank.

The landbank assessment by Grieve Strategic also concluded that the most likely scenario is Scenario 4. If this scenario materialises, there will be a deficit of c. 4,200,000 ha of available land to enable all biosolids to be recycled at a national level by 2035. This would mean a significant amount of biosolids would need to be disposed via incineration or landfill, as there are currently no other viable disposal routes for sludge. There is therefore a need to invest in the diversification of sludge outputs, such as the development of ATC technologies, to open new sludge disposal routes by 2035 and avoid disposal by incineration.

3.6.3. Response Options

Wastewater treatment is an essential process for maintaining public health, which fundamentally relies upon the removal of sludge from effluent, so stopping sludge treatment and disposal is not a viable option. The main constraint on current operations is the availability of landbank for biosolids disposal. Optioneering therefore focused on options to reduce pressure on the landbank, by decreasing the quantity of sludge produced, finding alternate disposal options, and transforming biosolids into a more environmentally acceptable form.

A range of established sludge treatment technologies are currently available, with others currently in development. The unconstrained options list considered for bioresources are detailed in table 28.

Table 28 - Options considered for bioresources

Topic	Option
Do nothing	As indicated by the title, do not react to the change. Not appropriate
Increase storage capacity	Increase biosolids storage capacity to deal with reduced land application window

Alternative disposal outlets	Find alternatives disposal outlets to the agricultural landbank (e.g. forestry, land remediation)
Market solutions	Use available capacity at wastewater treatment facilities operated by other companies
Install additional advanced digestion plants	Install additional Advanced Digestion (AD) plants to reduce sludge volumes, such as Thermal hydrolysis process (THP)
Install advanced thermal conversion plants	Install Advanced thermal conversion (ATC) plants to create an inert biochar that can be disposed or recycled outside the agricultural outlet (e.g., used as an aggregate in construction materials). A few examples of ATC processes are gasification, pyrolysis, and hydrothermal conversion.
Instal sludge drying	Install sludge drying after digestion to create a pelletised product that can be more easily transported and/or combusted.
Install sludge incineration	Install sludge incineration facilities to combust the sludge, leaving only an inert ash for landfilling or reuse.
Install nutrient recovery technologies	Install nutrient recovery technologies such as struvite recovery to reduce nutrients loads and reduce landbank requirements.
Upstream treatment enhancement at sources or WRCs	Reduce quantities of hazardous substances in sludge through installing treatment technologies on wastewater and/or sludge treatment, and through source control.

Options from this list were put through a preliminary coarse screening process to consider their likely feasibility, viability, reliability, affordability and ability to deliver desired outcomes. This resulted in the shortlist described in the next section.

3.6.4. Options Assessment

The following options were shortlisted for more detailed assessment:

Option A: Existing digestion, increased storage capacity and disposal to landbank (100%)

This option uses increased storage to moderate imbalance between continuous sludge production and intermittent land application, maximising utilisation of currently available land bank. This option will be sufficient as long as there is sufficient landbank to recycle all our biosolids. It will not be viable if the landbank availability reduces below 75% or if the landbank outlet is completely removed. As explained in previous sections, how and when this risk materialises remains uncertain. However, based on the national landbank model, we will most likely not have sufficient landbank by 2035 to recycle all our biosolids. Therefore, we estimate that this option will be sufficient until c. 2035.

Option B: Phased ATC implementation to replace digestion; assume landbank availability reduces to 50% by 2035 and to 0% by 2050

In this option, we will implement ATC to replace our existing digestion process in phased approach to achieve 50% ATC treatment by 2035 and 100% ATC treatment by 2050. As this process does not produce biosolids, the effect is to halve biosolids going to the land, meaning existing landbank capacity would be sufficient until c. 2035, and sludge treatment operations would be more resilient in the meantime.

ATC is a developing technology unlike anaerobic digestion, which is tried and tested. The water sector will need to collaborate on ATC technology trials in AMP8 to enable viable ATC solutions to be developed. Irrespective of the outcome of the trials, the landbank will need to be retained. If regulators were to reduce or prohibit future landbank access, the only options available would be either ATC (if viable) or incineration.

Option C: Phased incineration of sludge for disposal; assume landbank availability reduces to 50% by 2035 and to 0% by 2050

While incineration is an established technology, it is expensive to deploy, difficult to secure planning permission (due to community concerns about smoke and odour nuisance) and not aligned with our carbon or net zero goals. Disposal by incineration will also increase sludge transportation costs, as sludge from all water recycling centres will need to be transferred to regional incinerator sites (because incineration relies on large economies of scale to be viable). As large-scale incineration is not a favoured strategy internally within Wessex Water as well as within the wider industry, we are considering incineration as a last resort option.

All options were then put through a multi-criteria assessment process based on the PESTLE analysis to determine the preferred option, which considered the following:

- Political – government policy on energy self-sufficiency, resource recovery, etc.
- Economic – cost of energy and sludge outputs (e.g., biosolids, biochar, ash), and incentives
- Social – perception of biosolids, incineration, odour issues
- Technology – technology readiness of ATC, volume, and quality of sludge outputs for disposal
- Legal – permit compliance, H&S compliance
- Environmental – carbon benefits, emissions, circular economy, soil health and air quality

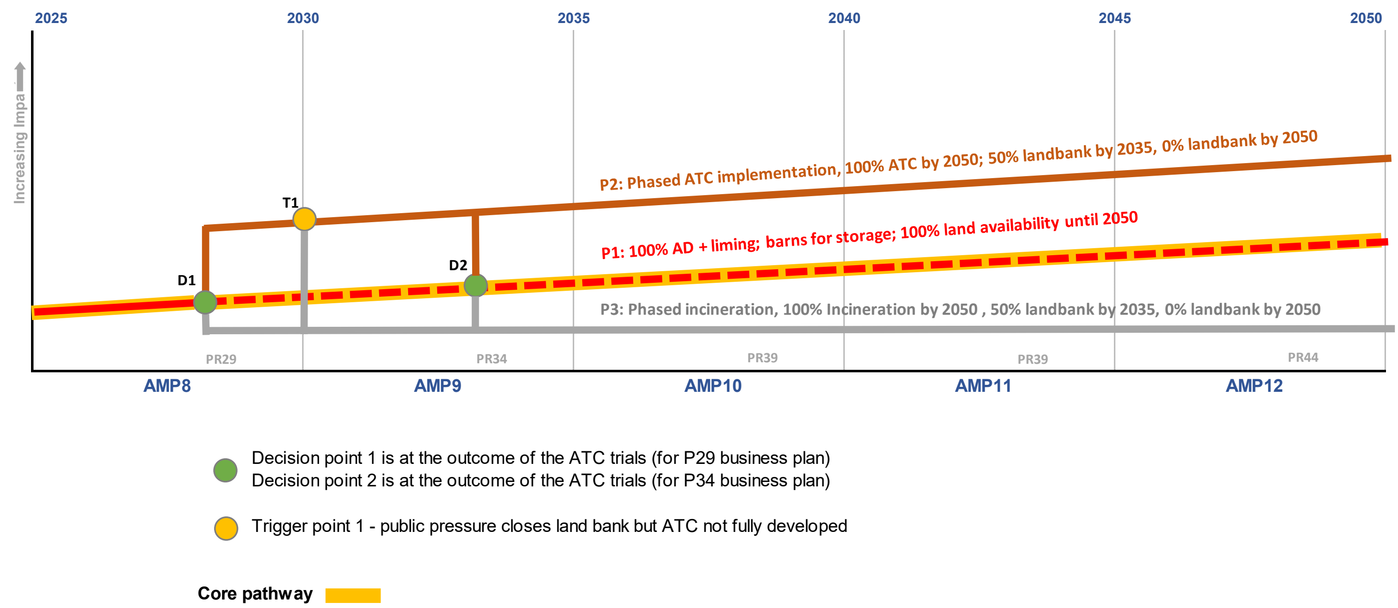
The assessment process revealed that all options were viable under different circumstances, with choice of the most appropriate option depending mainly upon whether landbank access would continue, the rate of population growth and the outcome of industry ATC trials. All three options were therefore carried forward to the adaptive pathway presented in section 3.7.7.

We are aware Ofwat are keen to see wider trading in the bioresources market, as evidenced by the extension of the bid assessment framework to this area. We are supportive of this approach and will continue to explore market options as they arise. We have already run a significant market enquiry in partnership with Severn Trent in 2022 which unfortunately did not lead to any immediate market opportunities; all options presented would require creating treatment assets on existing company sites rather than utilising existing spare capacity in the market (which, from this exploration, we do not believe exists in a material amount at this stage to encourage more competitive trading).

3.6.5. Recommended Approach

The adaptive pathway figure 15 and table 29 indicates how the three options may be deployed over the next 25 years to achieve organisational objectives. It illustrates how different technologies can be deployed as the operating environment becomes more challenging (with the higher lines indicating responses to the more challenging conditions).

Figure 15 - Bioresources adaptive pathways



Decision Points
D1 Outcome of the industry ATC trials (informs PR29 business plan)
D2 Determined by the viability of ATC rollout and landbank availability (informs PR34 business plan)

Trigger Points
T1 Public pressure closes land bank early, but ATC yet to be fully developed

Table 29 - Bioresources adaptive pathways decision and trigger years

Path	Decision Yr	Trigger Yr	Likelihood %	Descriptor
B-P3	2028	2032	25%	Phased incineration (assumes 50% landbank availability by 2035 and 0% by 2050)

B-P2	2028	2032	50%	Phased ATC implementation (assumes 50% landbank availability by 2035 and 0% by 2050)
B-P1	2023	2025	50%	100% digestion and lime treatment with sludge storage (100% land disposal)

The core strategy (B-P1) is to treat as much sludge through anaerobic digestion (to increase renewable energy generation and reduce treated sludge volumes for disposal) and rely on lime treatment for resilience management, as per our bioresources strategy outlined in the previous section. Our review of anaerobic digestion, ATC and incineration concluded that anaerobic digestion is the currently the treatment solution that is most cost efficient and provides the best carbon benefits. Therefore, we would want to continue with anaerobic digestion as our main treatment process for as long as possible, until it is no longer viable due to landbank restrictions or closure.

The risk of initial small reductions in landbank availability (e.g. 10-20%) can be mitigated through additional sludge storage in AMP8. If landbank availability continues to decrease in AMP9, we will need to plan for diversification of sludge outputs in PR29 to unlock alternative disposal outlets by 2035. If viable ATC solutions are ready by PR29, we would plan ATC to be implemented in AMP9 to replace the existing anaerobic digestion process in phases (B-P2). If ATC is not ready by PR29, we will need to plan for incineration instead (B-P3). If landbank were to close completely by 2050, we will need to continue transitioning from anaerobic digestion to either 100% ATC or 100% incineration.

The following rationale were used to develop the adaptive pathway visual:

- Current sludge management relies on digestion to reduce sludge volume, and barns to store digested sludge pending disposal to landbank
- Climate change may reduce landbank access due to increased rainfall, waterlogging and flooding of disposal sites
- Current sludge digestion is dependent on availability of the landbank for disposal of digested sludge
- Landbank access restrictions will significantly impact the viability of existing sludge treatment & disposal arrangements
- We are currently exploring alternative sludge treatment and disposal options to reduce dependence on the single landbank outlet for disposal
- In the long term, we plan to deploy alternative sludge treatment technologies (such as ATC or incineration) to achieve diversification of our sludge outputs, which will open new outlets for sludge disposal/recycling
- The risk of initial landbank reduction will be managed through increased biosolids storage; any further reduction would likely require existing biosolids to be removed from the agriculture outlet through deployment of ATC or incineration
- If viable ATC solutions are identified by PR29, we would plan for a phased implementation of ATC
- If evidence shows landbank closure is likely and ATC is not a viable option, we will plan for incineration as the only viable option
- There may be scope to share new sludge treatment facilities with other water companies and sludge generators.

Decision Points

The adaptive pathway approach has two decision points which define the approach for PR29 and PR34 Business Plans and will be informed by the outcome of any industry ATC trials or wider information available on the suitability of ATC technologies for use on sewage sludge. Additional details on decision points are summarised in table 30.

Table 30 - Bioresources decision points additional information

Decision Point	Conditions	Response to Stricter Regulation
D1	ATC evidence is positive	Transition to ATC
	ATC evidence is not positive	Maintain current operations (digestion)
	ATC evidence is ambiguous	Maintain current operations (digestion)
D2	Landbank is unaffected	Maintain current operations (digestion)
	1-50% landbank constraint	Transition to ATC
	>50% landbank constraint	Transition to incineration

Trigger Points

While there is currently no regulatory policy or commitment to restrict landbank access for biosolids disposal, we have opted to consider that future restrictions could be imposed. While the magnitude and timing of a potential restrictions remains unknown, we have prepared our operational response which would be initiated via the trigger points in table 31, which define different responses based on the severity of landbank constraint.

Table 31 - Bioresources trigger points additional information

Trigger Point	Landbank Constraint	Response (sludge treatment & disposal)
T1	<50%	Transition to ATC
	≥50%	If on digestion path, transition to ATC (if viable) or incineration (if ATC is not viable)

We anticipate having a much clearer understanding of ATC viability and the prospect of future landbank constraints when preparing our PR29 LTDS and Business Plan. This will enable us to further refine our adaptive pathways, decision points and trigger points.

3.6.6. Stress Testing

Current forecasts are that increasingly wet weather due to climate change will reduce landbank availability and that this will be compounded by population growth and wider deployment of phosphorus removal technology. The most adverse combination of these factors is referred to as the adverse composite scenario, under which we estimate that there would be insufficient landbank to dispose of all the biosolids that we produce.

3.6.7. Assumptions and Uncertainty

Wessex Water assumes the most likely benign future will not differ significantly from current conditions, while the most likely adverse future (for the next 25 years) will be characterised by the following:

- No substantive change in the quality characteristics of sewage sludge (other than a minor increase in solids, phosphorus and iron content if ferric dosing is deployed at water recycling centres).
- No substantive improvement or deterioration in existing sludge treatment assets or their performance.
- Wessex Water will continue to treat and dispose of all biosolids generated by its water recycling centres.

- Steady increase in rainfall impacting landbank access.
- Steady increase in sewage production (up to 10%) impacting sludge production.
- No substantive advance in sludge treatment technology.
- Potential regulatory change before PR29 or PR34, reducing landbank capacity (by up to 50%).

The main areas of uncertainty relevant to planning bioresources operations are:

- Whether landbank access will be restricted, when it may occur, and to what extent.
- Whether ATC is a viable technology for deployment at our bioresources centres.
- Whether regional options will emerge for biosolids treatment or incineration.

While there is no current indication that the landbank will be constrained or withdrawn in the future, we consider that in the wake of public resistance to storm overflows on the sewerage network, there is a reasonable likelihood that the public may in the future also consider it unacceptable to dispose of biosolids to land. Consequently, when assessing options we will favour those that reduce our reliance on landbank disposal.

3.7. Biodiversity

3.7.1. Current Status

The Wessex Water estate amounts to slightly fewer than 3,000ha, including 2,158 company-owned sites, many of which support an operational function such as supply-side water treatment centres and reservoirs, waste-side water recycling centres. The Wessex Water landholding also includes undeveloped land adjacent to or separate from existing sites which provide capacity for future operational growth, plus source protection land and sites under long-term leases to individuals or organisations.

As of 2022, approximately 41% of Wessex Water land was being managed for biodiversity (i.e, it has a specific conservation/environmental management plan or conservation tenancy). The majority of land management for biodiversity was in place prior to the ecological surveys conducted in 2015-2020 and the following biodiversity valuation. Wessex Water can now use this information to target efforts towards maximising biodiversity enhancement at relevant sites.

Wessex Water are the stewards of 293 hectares of land designated as a Site of Special Scientific Interest (SSSI). This protection recognises that these habitats are the most important areas for wildlife in England. Wessex Water are committed to managing SSSIs to ensure they can meet and maintain favourable condition. Currently, 93% are meeting the target of being in favourable or unfavourable recovering condition. The national average is that 89.1% of SSSIs are in favourable or unfavourable recovering condition.

Our land varies considerably in quality and use, from ‘typical’ half hectare sized water recycling centres that are busy, intensively managed operational sites to several hectares of farmland, often managed with low inputs to protect water sources. Much of this land, especially land set aside and protected for water supply, is of conservation value or has the capacity to be of value for wildlife.

Using ecological survey data collected between 2015-2020 and the Biodiversity Metric developed by Defra (BM3.0), Wessex Water identified the biodiversity value of their estate, notably:

- The Wessex Water landholding baseline (18/01/2022) was valued at 14,348 Biodiversity Units (BU)
- Our largest sites have the greatest biodiversity impact. Small Wessex Water sites of less than 0.5 hectares (1,825 sites) contribute only 395BU compared to sites of greater than 0.5 hectare (333 sites) contributing 13,952BU.;
- The top ten sites which contribute the greatest Biodiversity Unit value account for 63.4% of Wessex Water landholding’s total Biodiversity Unit value.
- The habitat types on Wessex Water landholdings with the greatest contribution to the overall Biodiversity Unit value of the estate are neutral grasslands followed by reservoir and lowland mixed deciduous woodland.

Wessex Water aims to manage such land sympathetically through Site Environment Plans (SEPs) wherever it is compatible with supply and waste water treatment activities, and to improve site management where possible. The SEP framework not only manages habitats, species and features of positive value, but also controls negative impacts such as invasive non-native plants.

Wessex Water delivers various conservation management approaches through its standard Grounds Maintenance operations. Beyond this, current resources enable delivery of technical conservation management on a number of ‘legacy sites’, including visitor sites, in addition to statutory sites.

Wessex Water is delivering a tree planting programme to increase trees and woodland across our region to support biodiversity and deliver wider benefits while contributing to national targets. 60,000 trees have been planted over AMP7 to date both on and off the Wessex Water landholding.

Further biodiversity enhancement delivered by Wessex Water, but which is not explicitly captured (in terms of their costs) by this area of the LTDS, includes:

- Minimising the impact of our activities through improving and expanding our sites without compromising the habitats and species they support
- Supporting partnerships and projects to improve biodiversity outside our sites and activities
- Working at a catchment scale and with partners to ensure the environmental integrity and biodiversity of river and groundwater catchments while integrating biodiversity options into our catchment management work with farmers and landowners
- Choosing nature based solutions to problems.

Wessex Water has a duty to enhance and protect biodiversity as laid down in legislation such as the *Water Industry Act 1991, the Environment Act 1995, and Natural Environment and Rural Communities Act 2000 (as amended by the Environment Act 2021), and the* Water Industry Code of Practice for Conservation, Access and Recreation (CAR).

Defra's guidance to public authorities on implementing the biodiversity duty gives more detail, including the need for Wessex Water to integrate its duty when:

- developing policies and strategies and putting them into practice
- engaging with the planning system and developing our infrastructure
- managing:
    - land and buildings, woodlands and natural areas
    - community amenities (e.g., recreational activities on reservoirs)
    - the impacts from waste and pollution; energy; water; wood and plant products
- making decisions about procurement
- implementing economic, environmental and social programmes (e.g., Asset Management Plan programme).

In addition to the enhanced biodiversity duty, the *Environment Act 2021*, sets out that Wessex Water must:

- achieve the statutory minimum level of biodiversity net gain for all schemes subject to planning permission. (Wessex Water will go further than this and ensure that all development schemes, irrespective of whether they require planning permission, will achieve no net loss of biodiversity and from 2025, achieve a net overall gain);
- contribute to achieving the environmental targets set out under the Act, including:
    - halting the decline in species abundance by 2030
    - increasing species abundance by at least 10% by 2042, compared to 2030 levels
    - improving the England-level GB Red List Index for species extinction risk by 2042, compared to 2022 levels
    - creating or restoring in excess of 500,000 hectares of a range of wildlife-rich habitats outside protected sites by 2042, compared to 2022 levels
    - 70% of the designated features in the Marine Protected Area network to be in favourable condition by 2042, with the remainder in recovering condition

In relation to national and regional targets, Wessex Water's duties, aims and targets are influenced by other external directions on biodiversity, including:

- the 25 Year Environment Plan
- the Environmental Improvement Plan 2023
- Defra's Integrated plan for delivering clean and plentiful water
- existing local Nature Recovery Networks, e.g., as published by the West of England Nature Partnership

- the lists of Habitats and species of principal importance in England set out by Section 41 of the Natural Environment and Rural Communities Act
- legal protections given to habitats and species such as the Conservation of Habitats and Species Regulations 2010, the Wildlife and Countryside Act 1981 (as amended), the Protection of Badgers Act 1992 and the Hedgerow Regulations 1997, among others.

- Wessex Water are committed to complying with all nature conservation legislation. The following company biodiversity aims relate to our obligations to further the general biodiversity objective set out in the Environment Act to conserve and enhance biodiversity across our land and region;
- double our contribution to the region's biodiversity over the next 25 years;
- improve or create habitat on our landholding which will achieve a minimum of 5,000 biodiversity units, once it has reached maturity, by 2050 (an average improvement of 1,000 BUs per AMP, more than doubling our current impact).

Wessex Water's commitments to no net loss and overall biodiversity net gain (from AMP8) go beyond current government requirements and demonstrate Wessex Water's commitment to enhancing biodiversity. Wessex Water believe that the targets and outcomes set out in our Biodiversity Action Plan will not only meet our duties to both conserve and enhance biodiversity, but will place us in a strong position to be one of the industry leading water companies for biodiversity.

Please note that the commentaries in WSX47 and our main narrative WSX02 for biodiversity focus on the impact that the performance commitment will have based on the requirement to report on nominated land. This performance commitment activity forms part of this strategy for the LTDS, but the activities described in subsequent sections here go above and beyond this PC reporting need to meet our aspiration to create an additional 5,000 biodiversity units. It also meets wider stakeholder expectations, in accordance with the performance commitment definition, to show that our wider landholding is not declining - i.e. that our conservation activities go beyond the nominated land.

3.7.2. Scenario Impacts on outcomes

The scenarios that were considered when assessing future biodiversity conservation and enhancement are detailed in table 32.

Table 32 - Biodiversity scenario impacts

Scenarios	Impacts
Climate change*	• Changing temperature and water availability may affect the health and survival of species, their number, geographic range, and the condition of the areas they occupy. • Biodiversity management approaches may become more reactive, shifting from preserving past/present conditions to accommodating new species and ecosystems, and facilitating transition to a new ecosystem state). • A warmer climate with hotter, drier summers may be challenging for some species, and could increase the risk of new pest incursion and wildfire. • Warmer and wetter winters may result in lower pest mortality and, through various pathways, cause changes in the composition and structure of habitats.
Demand*	• WW customers have identified Biodiversity as *a* key deliverable when assessing willingness to pay, suggesting a future expectation for WW to deliver greater biodiversity engagement and enhancement. • Population growth has the potential to increase visitation to catchments, which could result in greater public awareness of the need to enhance biodiversity, but could have a negative impact if population growth results in rural land use being converted to urban

	development, or increased risk to SSSIs, or increases the risk of pest species being introduced. Intensification of agricultural production could undermine biodiversity of associated aquatic and terrestrial ecosystems on the WW estate and more widely across the region.
Technology*	• Emerging monitoring technologies for habitats and species may improve the resolution, efficiency and cost-effectiveness of biodiversity monitoring. • The deployment of nature-based solutions for inflow reduction, overflow treatment and effluent polishing presents an opportunity for biodiversity enhancement (particularly where they replace traditional technologies).
Abstraction reduction*	• Restoration of flow in chalk streams should improve the resilience of freshwater species, while the associated raising of water tables should benefit associated flora and fauna.
Regulatory change	The methods and scale of WW biodiversity services (both on and off the WW estate) may be affected by Local Nature Recovery Strategies, Species Conservation Strategies, Protected Sites Plans (created under the Environment Act) and the wider Nature Recovery Network and changes to the Environment Act or stricter regulatory requirements for habitat management and creation.

**Ofwat common reference scenarios*

Overall, we have not adjusted our costs in this area to react to the common reference scenarios.

3.7.3. Response Options

The main biodiversity opportunities for enhancing biodiversity across the WW estate are associated with our plans to expand tree planting; install nature-based solutions associated with drainage networks and wastewater treatment; reinstate wetlands; reduce groundwater abstraction that should increase baseflow in chalk streams; enhance habitat management; and habitat creation.

The main constraints affecting delivery of biodiversity enhancement and creation on the Wessex Water estate include the availability of suitably sized tranches of land (many sites are too small to practicably manage) and the availability of unconstrained land (e.g. not earmarked for treatment expansion, outside of long-term tenancies, etc).

Optioneering consequently focussed on identification of appropriate land parcels for biodiversity enhancement and their prioritisation to meet Wessex water's aims. Larger unconstrained land parcels typically offer greater efficiency in terms of conservation management delivery. Opportunities for biodiversity enhancement and creation beyond the WW estate were also considered. The unconstrained options list for Biodiversity identified the options detailed in table 33.

Table 33 - Unconstrained options considered for biodiversity

Topic	Options
Managing Wessex Water land	a. Prioritise land appropriate for habitat enhancement and deliver management where practicable b. Identify land appropriate for enhanced habitat creation and deliver habitat creation where practicable c. Establish appropriate process for measuring and 'accounting' the biodiversity value of Wessex Water land d. Deliver a step change in management of SSSIs to ensure management actions are appropriate for delivering favourable condition e. Enhance Water Recycling Centres for birds of conservation concern

Increased tree planting	a. Deliver a step change in tree planting during AMP8
Minimise the impact of Wessex Water activities *Considered holistically when reviewing solutions*	a. Ensure all capital developments achieve no net loss of biodiversity annually b. Ensure all capital developments aim to achieve an overall net gain for biodiversity c. Ensure all relevant capital developments requiring planning permission achieve biodiversity net gain from November 2023
Supporting partnerships and projects *Captured in the contribution to 3rd party schemes and 25 year environment plan cost lines in the LTDS tables*	a. Deliver partnership projects, working with catchment partners, to improve natural capital b. Fund and support projects through the Wessex Water Partners Programme c. Fund local projects through Wessex Water Foundation's Environment Grant
Boost biodiversity through Wessex Water catchments *Not explicitly valued at this stage, would be considered if catchment management were allowed for reduction of P and N at WRCs*	a. Deliver partnership projects, working with catchment partners, to improve natural capital b. Deliver habitat improvements in catchment management areas
Increase use of nature-based solutions *Considered as part of options assessment in other areas; biodiversity value not explicitly calculate beyond AMP8.*	a. Deliver nature-based solutions to improve storm overflows, creating new or enhancing existing wetlands b. Assess and report on the performance and wider benefits delivered by nature-based solution assets created and maintained across our region
Purchase marginal agricultural land suitable for conservation management *Not considered further at this stage*	As title

Only costs relating to the first two areas in table 32 are captured by the LTDS data tables that relate to the biodiversity lines. Costs relating to the other bullets, where biodiversity unit gain is not the key driver, are captured elsewhere within the LTDS data table as indicated by the italicised text. The Biodiversity Unit gain of all these works would in future be included against the biodiversity target where appropriate but has not been forecast for the LTDS.

3.7.4. Options Assessment

Options from the long list above were then put through a preliminary screening process by senior staff and management responsible for Biodiversity, which considered their likely feasibility, viability, reliability, affordability and ability to deliver desired outcomes. This resulted in all options being considered essential components to achieve Wessex Water's strategic commitment to enhance biodiversity for PR24, while there is currently no indication that challenges or opportunities would change substantively for AMP9 and beyond. As the biodiversity area does not face any substantial change through the common reference scenarios, all options combined effectively represent the Core Pathway, with no alternate pathway identified at this stage (although this may change in future LTDS documents as more becomes known about biodiversity challenges and opportunities across the Wessex Water estate). Correspondingly there are currently no decision points or trigger points in the absence of any alternate pathways.

3.7.5. Recommended Approach

The proposed enhanced management for biodiversity will be initiated from 2025, with preparatory work starting in 2024. The opportunity for future biodiversity enhancement is likely to decrease over time as the most practicable (largest, most straight-forward) sites are enhanced. Consequently, diminishing returns mean that future costs to deliver the same Biodiversity Unit gain will increase over time. There are no alternative pathways beyond the core for this area.

Rationale behind a single core pathway as follows:

- Current efforts to boost biodiversity (under WINEP and SEP) are sufficient to achieve corporate objectives
- Impacts under the common reference scenarios are not sufficient to warrant the need for an alternate pathway
- Interventions under the water resources, sewerage and waste treatment areas will also have a positive contribution to biodiversity
- Future impacts of climate change may have unforeseen biodiversity impacts, which will be addressed via future LTDS iterations.

3.7.6. Stress Testing

The development of the core pathway for biodiversity considered the low and high extremes of plausible climate change, demand, technology and abstraction reductions when identifying the appropriate strategy to meet the strategic objective of 'increasing biodiversity' together with the high-level outcomes and associated targets presented in the Wessex Water Biodiversity Action Plan, namely:

- Conserve and enhance biodiversity across our land and region; and
- Double our contribution to the region's biodiversity over the next 25 years through achieving a minimum of 5,000 biodiversity units across our landholding by 2050

In the short to medium term it is considered likely that the confirmed and potential scenario variables will likely result in a relatively low and limited impact to the package of options that represent the proposed core pathway.

With reference to regulatory change, it is expected that the Environment Act targets will heavily influence future work around biodiversity, with the delivery of the actions necessary to meet these targets increasing in cost as simpler measures become exhausted and more detailed and/or intensive solutions are needed to meet the multi-faceted challenges that will continue to emerge. It is likely that targets and constrained land availability will shape Ofwat Biodiversity Performance Commitments in the future, potentially resulting in increasing costs. Although Wessex Water has no visibility or clarity on this, the Data Table includes an estimate of these costs. Additionally, in the near-to-medium future, appropriate land is identified for practicable ecological enhancements.

The proposed package of options can also help to mitigate scenario variables over the long-term. For example, with respect to climate change, amended conservation strategies together with the implementation of specific management options, will improve ecological resilience to climate change. We don't foresee immediate reactive management, rather, instead, more proactive work delivered through management plans to reinforce ecological resilience. In the long-term, management approaches may shift from preserving historical or current conditions to accommodating new species and ecosystems and facilitating transition to a new ecosystem state (e.g., from freshwater ecosystems to brackish ecosystems as sea levels rise). If this were to occur, the type and nature of habitat management may change however it is not likely to result in a step change in the cost of management.

Overall, in the short to medium term, the risk of material and significant unforeseen change is not anticipated and the potential for this to occur is low. It is therefore considered that the core pathway would be delivered as the core pathway strategy identifies, most likely with limited change.

No divergence from the proposed core pathway is anticipated and it is considered that the approach will satisfy the common reference scenarios.

3.7.7. Assumptions and Uncertainty

.Costs relating to the various spending streams have been spread evenly throughout each AMP, including the step change in tree planting (£6m) during AMP8.

Further assumptions relating to costs:

- Assumptions for the Capex/Opex split within the Data Tables use AMP7 as a guide;
- The Biodiversity PCs in AMPs 9-12 (2030-2050) have been estimated based upon previous spend. In reality we do not know that nature of the PCs for these AMPs and hence cannot realistically estimate costs as this PC is in its infancy with it being introduced in AMP8;
- WINEP project costs relating to biodiversity are captured elsewhere within the LTDS.

The methods and scale of WW biodiversity services (both on and off the WW estate) may be affected by Local Nature Recovery Strategies, Species Conservation Strategies, Protected Sites Plans (created under the Environment Act) and the wider Nature Recovery Network, and changes to the Environment Act or stricter regulatory requirements for habitat management and creation.

- With reference to regulatory change, it is expected that the Environment Act targets will heavily influence future work around biodiversity, with the delivery of the actions necessary to meet these targets increasing in cost as simpler measures become exhausted and more detailed and/or intensive solutions are needed to meet the multi-faceted challenges that will continue to emerge. It is likely that targets and constrained land availability will shape Ofwat Biodiversity Performance Commitments in the future, potentially resulting in increasing costs. Wessex Water has no visibility or clarity on this, however in the near-to-medium future appropriate land is identified for practicable ecological enhancements and the data table includes an estimate of additional costs.
- Species Conservation Strategies (SCS) and Protected Site Plans (PSP) have not yet been published by Natural England. Protected Sites within our landholding are currently managed directly through 'business as usual'. PSP may result in change to this management however Protected Sites have been assessed by Wessex Water within the last three years (through the AMP7 Biodiversity PC) and appropriate management

initiated in consultation with Natural England. It is therefore not expected future management requirements will diverge too significantly from current management. Indirect impacts, such as nutrient loading, to Protected Sites outside our landholding may result in PSPs identifying a step change requirement for nutrient management. Such indirect impacts however are captured elsewhere within the LTDS and are not included within the Biodiversity data tables.

3.8. Greenhouse gas emissions

3.8.1. Current Status

The need for action

The world faces a climate emergency that we must address in two ways. Firstly, we must decarbonise all aspects of human activity, to reduce the risk of dangerous climate change. Secondly, we need to adapt to the effects of climate change: in our case, drier summers, wetter winters, and more frequent extreme weather events.

We must collectively adapt to these future impacts and reduce our greenhouse gas emissions. The Paris Climate Agreement aims to a) hold the increase in the global average temperature to well below 2°C above pre-industrial levels; and b) pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels. The UK Government aims to achieve net zero carbon emissions by 2050 and as part of the 2008 Climate Change Act, has legally-binding carbon budgets, placing a restriction on the amount of greenhouse gases the UK can emit over five-year periods.

Our ambition

By 2030, we aim to achieve net zero operational carbon emissions. These are our annual emissions linked to our energy use and transport, plus other greenhouse gases that are emitted from sewage and sludge treatment processes. Our PR24 plan achieves these ambitions and are detailed in WSX23 – Our route to net zero. This LTDS focuses on the alignment with the Ofwat performance commitment definition as per the tables that are populated alongside this,

However, our goal does not end there. We also aim to achieve net zero total carbon emissions by 2040 at the latest. This includes our operational emissions outlined above, plus embodied emissions linked to construction materials, and consumables such as treatment chemicals.

We aim to be a genuinely sustainable water company, and reducing our carbon footprint is one of the many environmental, social and economic issues that this entails. Decarbonising our activities must connect with other environmental work, linking with our efforts to promote sustainable land use, protect biodiversity and the water environment, improve resource efficiency and reduce air pollution. This in turn will benefit our customers and the communities we serve. Additionally, the economic and financial rationale for reducing our carbon footprint is becoming more compelling. Renewable energy generation offers financial benefits in terms of sold energy or avoided energy purchase, as well as the subsidies that are offered. Reducing the use of imported electricity and gas, and generating our own energy, can create financial savings.

Our current position

In 2022-23 our net emissions were 104 kilotonnes carbon dioxide equivalent. Around 65% of this is related to energy use, 25% from sewage and sludge process emissions and 10% from transport. We have a long track record of carbon management work through a wide range of activities.

Future emissions

Various trends, and emerging knowledge and technology, are influencing likely future greenhouse gas emissions. These can be characterised as a series of upward pressures (headwinds), acting at the same time as opportunities and wider shifts towards a lower carbon economy (tailwinds).

Headwinds:

- recalibration of nitrous oxide and possibly methane emissions
- accounting additions: chemicals; sludge to land; fossil-fuel extraction and production (as well as distribution)
- construction carbon: related especially to WINEP, storm overflows, water supply resilience
- additional energy use as a consequence of regulated investment.

Tailwinds:

- rapid decarbonisation of grid electricity, and gradual decarbonisation of fuels and transport
- wider technological opportunities e.g. biochar, hydrogen
- growth and mainstreaming of nature-based solutions.

Greenhouse gas emissions reporting is becoming more nuanced, with multiple reporting exercises each year. Of particular importance will be future reporting under according to our Public Interest Commitment net zero carbon target; our statutory corporate reporting (e.g. Taskforce or Climate-Related Financial Disclosure (TCFD), and the reporting requirement of the common performance commitment during 2025-30.

Our plan for 2025-30

Background reductions in the UK's carbon footprint will mean that our energy and transport emissions will fall by around one third from our current position. We therefore need to take concerted action between now and 2030 to reduce our operational carbon emissions to net zero. We will do this by:

- Emissions avoidance measures, such as reducing water use and leakage; increasing the use of lower carbon transport; and promoting nature-based solutions that avoid energy use.
- Optimisation measures, such as energy efficiency work and systems for monitoring and controlling nitrous oxide from sewage treatment.
- Renewable energy – increasing the amount of biogas that we generate from anaerobic digestion and pursuing opportunities for wind and solar power, either as generators or as the end-user.

Innovative options

Reductions in background emissions and the most readily-available options will not be sufficient to achieve our goal of net zero carbon. We will need to pursue more innovative options involving emerging science and technology, such as turning sewage sludge into biochar, as well as promoting nature-based solutions.

While these methods are not yet well-established, we are assessing their maturity and availability and will take part in trials where appropriate.

Offsetting

This would be a last resort if we were unable to secure net zero carbon emissions from background reductions, our own operations and from emerging science and technologies.

Beyond operational carbon emissions

We plan to develop a whole-life 'total carbon' approach, rather than treat operational emissions and embodied carbon in the materials and products we use as separate issues. This will include building whole-life carbon into our decision-making processes, to enable our transition into a truly low carbon business. Looking ahead, this will necessarily mean challenging assumptions about the best ways to carry out investment.

3.8.2. Scenario Impacts on outcomes

We have looked at the interplay of the LTDS common reference scenarios and our greenhouse gas emissions. Tale 33 summarises our viewpoint on the impact of each reference scenario for each of the main items included in our emissions calculations. In the grading used, 1 = low impact (i.e. will not affect a significant portion of our overall carbon footprint), 3 = medium impact and 5 = high impact. High, med, low indicates our level of confidence in this assessment.

Further explanation is given below.

Table 34 - impact of common reference scenarios on operational areas greenhouse gas emissions

	Climate change		Technology		Demand		Abstraction reduction	
	Benign	Adverse	Benign	Adverse	Benign	Adverse	Benign	Adverse
Purchased fuels (sc.1&3)	1 Med	1 Med	2 High	2 Med	1 Med	1 Med	1 High	1 High
Process emissions	2-3 Low	2-3 Low	4 Med	4 Med	1 Med	3 Med	n/a	n/a
Transport	1 Med	1 Med	3 High	3 High	2 Med	2 Med	n/a	n/a
Electricity use	1 High	2 Med	2 Med	2 Med	1 High	1 High	1 Med	1 Med
Renewable purchase & generation	1 Med	2 Med	2-3 Med	2-3 Low	1 Low	1 Low	1 Med	1 Med
Grid electricity (sc2&3)	1 High	1 High	4 Med	4 Med	1 High	1 High	1 High	1 High
Chemicals	2 Low	2 Low	2 Med	2 Med	1 Med	1 High	1 High	1 High
Biosolids to land	3 Med	3 Med	3 Med	3 Med	1 Med	1 Med	-	-
Other supply chain items	2 Med	3 Med	3 Med	3 Med	2 Med	2 Med	1 Med	1 Med
Embodied carbon	3 Med	4 Med	4 Med	4 Med	3 Med	3 Med	4 Med	4 Med

Climate change

- **Fuels:** we would potentially need to use standby generators more in response to extreme weather events (e.g. heatwave, flooding, intense freeze / thaw) that impact energy infrastructure or affect the capacity of our assets. This increase would be less pronounced in the benign scenario. However, the extent of emergency standby generator use caused by weather specifically, rather than other factors is not certain, and if low carbon methods become more available over time the impact on emissions would be low

- **Process emissions:** there could be higher wastewater process emissions with heatwave conditions, although the science is still developing in this area (and hence why we are rolling out a nitrous oxide emissions monitoring programme in AMP8, with a small number of test sites we are trialling at the moment, to better understand this). Under the benign scenario this impact would be similar to today, and would remain one of several influencing factors.

- **Transport:** it is conceivable that there would be more non-routine journeys linked to adverse weather, but the total impact on our emissions would be low, especially as the vehicle fleet decarbonises over time.

- **Energy use and generation**: heatwaves, dry conditions and prolonged wet weather all have an upward impact on pumping energy i.e. to meet peak water demand and convey storm water. Prolonged wet weather could lead to more storm overflow operation, leading to less biomass received at sludge treatment centres, reducing our renewable energy generation. All of these impact could be experienced during both scenarios, but more frequently in the adverse version.

- **Chemicals:** additional use of treatment chemicals during adverse weather is possible but the impact of weather is probably small compared with other factors

- **Biosolids to land**: Adverse weather (e.g. heatwaves and prolonged rainfall) would likely add to pressure to reduce or restrict use of biosolids in land outlets, This impact could be experienced during both scenarios, but with temporary or permanent landbank closure more likely in the adverse version. The impact on our scope 1 or scope 3 emissions would depend on alternative uses of biosolids.

- **Embodied carbon:** with more frequent extreme weather events there could be more pressure to reinforce our infrastructure through additional investment in capacity (e.g. storm water attenuation). In the absence of major decarbonisation in the construction materials supply chain this could lead to significant addition embodied carbon emissions.

Technology

The contrasting pace of technology development in the benign and adverse scenario is reflected in the rate of emissions reduction across each of the items set out below.

- **Fuels**: We expect to see growing availability of low carbon alternatives to heat and electricity produced by gas and diesel – which together account for around 10% of our current emissions. As well as biogas and biomethane, alternatives include hydrotreated vegetable oil (HVO) and other biofuels; heat recovery via heat exchangers; green hydrogen; batteries; and advanced thermal technologies linked to biosolids. Adoption of any of these options will depend on useability and economics which will be dynamic, driven by production efficiencies and scale, demand, subsidies and public policy.

- **Process emissions:** We expect to see real time monitoring of nitrous oxide and methane becoming more commonplace. This could have a notably beneficial impact on our emissions through subsequent modification (or even coverage in the longer term) of sewage treatment methods, repair of sludge treatment assets, and forced extraction of methane. The assumed difference between the reference scenarios centres on the success of these techniques – many of which are relatively novel – and the degree to which they are found to be reliable, verifiable and cost effective.

- **Transport:** Decarbonisation of cars and vans is expected to happen concertedly between 2025-35, especially as the technology is already demonstrated. In both scenarios, decarbonisation of medium and heavy goods vehicles would follow later, but more quickly in the benign scenario. Cars and vans account for around 20% of our transport emissions, which are around 7% of our total operational gross emissions.

- **Energy use and generation**: technology is critically important for reducing energy use through smart control systems and more efficient electrical equipment such as pumps, motors and blowers. The improving efficiency of renewable generation technologies is very evident and we expect to see them becoming mainstream and widely integrated across our asset base. We expect the water sector to increasingly adopt wind and solar as well as the more traditional technologies i.e. hydro, biogas CHP. Efficiency and renewable generation can counteract the emissions associated with additional energy required to meet tight water and effluent standards We expect to see deployment continue to be informed by the economic rationale as much as environmental benefits. Contrasting advances between the two scenarios is based on further cost—effectiveness gains in the technologies involved.

- **Chemicals:** we are at an early stage of quantifying the carbon footprint of treatment chemicals. It is conceivable that technology will bring about treatment solutions that use lower volumes of chemicals, although it is likely to have a small impact overall and maybe involves larger energy inputs instead. The use of treatment chemicals is more likely to be influenced by regulation and the efficacy of alternatives such as nature-based solutions and catchment management.
- **Biosolids to land**: with a more adverse technology scenario it is possible that reuse of biosolids on land is phased out and relatively basic alternatives such as incineration are used instead. IN a scenario where technological advances are more successful we can see a role for advanced thermal technologies, which might give rise to biosolids products that are deemed acceptable to land use.
- **Embodied carbon:** with a more positive technology scenario, we can expect to see advances in lower carbon structural materials as well as recovery and reuse options, that reduce the embodied carbon of infrastructure. In a more adverse scenario we would expect the current dominant materials (concrete / cement, steel, plastics) to continue being used in their current form.

Demand

Population growth and consequent increasing demands for water and wastewater services would act as upward pressure on our greenhouse gas emissions. Plausible reasons include greater demand for water leading to increased treatment and pumping energy consumption; greater biological load at water recycling centres, leading to higher process emissions; more use of treatment chemicals; higher sludge volumes; and expansion of infrastructure to provide capacity, increasing our embodied carbon footprint. However, these effects are likely to be gradual, and outpaced by the rate of decarbonisation in energy and transport. Progress to reduce process emissions in the face of a growing population served by our wastewater business is less certain.

Abstraction reduction

We believe the greenhouse gas emissions implications of abstraction reduction to be relatively small. It would not necessarily lead to reduced water consumption, but it will likely require more pumping of water over longer distances via our integrated grid, and more use of water supply chemicals such as granular activated carbon if reservoir sources are to be used more than previously. The former will be mitigated by decarbonisation of electricity supplies.

3.8.3. Response Options

Our approach to developing the response options followed the following steps.

1. We started with the inventory of items reported in annual disclosures, and the size / materiality of each:
   - Scope 1 - fossil fuels (mainly gas and diesel); process emissions (methane and nitrous oxide); transport;
   - Scope 2 - grid electricity
   - Scope 3 – upstream energy-related emissions, public transport, contractors, chemicals, sludge reuse on land, construction materials
   - Renewable energy use (which reduce electricity emissions) and export (which can be subtracted from gross emissions).

We incorporated the emissions reductions attributable to our AMP8 proposals to produce a 2030 position for scopes 1-3 and their component parts.

2. We looked at broad trends, opportunities and risks for 2030 onwards associated with each of the items in 1. above. This included national decarbonisation targets and pathways related to the Government's carbon budgets.

3. As noted in the section above, we considered the impact of the Common Reference Scenarios on the main components of the outcome, concluding that the Technology CRSs are the most material. We also took into account the assumptions made by Ofwat regarding decarbonisation of energy and transport.

4. In the light of the above, we considered the plausible levels of decarbonisation from the following:

a) 'background' changes in the economy, such as decarbonisation of electricity
b) aspects that are likely to become more readily-available or a standard option through the supply chain, such as low carbon vehicles
c) aspects where a more concerted effort would be needed and we would need to make an investment case – on an enhancement basis – at future price reviews

Items a) and b) are built into the core pathway that we have modelled; section 3.8.4 below provides more detail.

Items in c) were used to further build the core pathway for 2030-50 and also devise an initial set of adaptive pathways as set out in section 3.8.4 below. Step 4 was also informed by the interventions outlined in the Water UK net zero route map and the Jacobs net zero technology review. For the purposes of this exercise, our referencing of these documents can be considered as a partial mapping exercise – we have noted items according to their maturity and whether we are likely to see their implementation before 2030; however we have not assigned implementation periods to the less mature technologies. Our high-level view of implementation periods, and whether they are likely to be core pathway or future enhancement items, is shown at the end of this chapter.

As noted in points 2 and 3 above, our core pathway is heavily influenced by the UK commitment to achieve net zero carbon emissions by 2050, and Ofwat's assumption on electricity and transport emissions. Specifically, regarding the latter:

Faster technology scenario:

- Low-emission HGVs and fleet by 2030 and carbon-free baseload electricity by 2035
- The whole-life financial cost of low-carbon construction materials equals that of conventional building materials by 2035

Slower technology scenario:

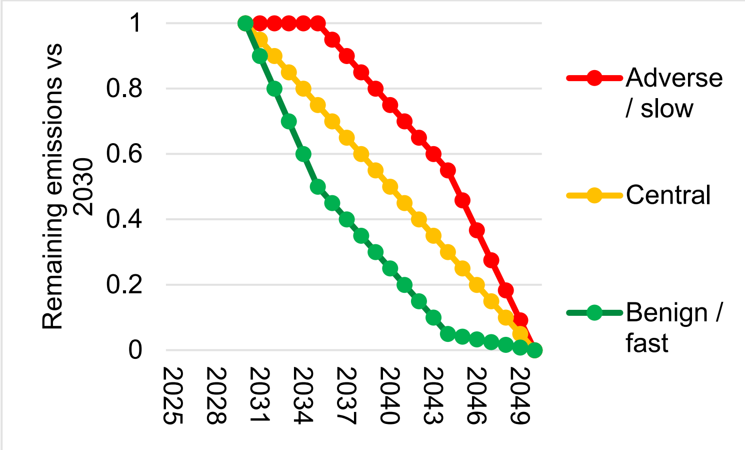
- Low-emission HGVs and fleet by 2040 and carbon-free baseload electricity by 2035.
- The whole-life financial cost of low-carbon construction materials continues to fall, but conventional building materials remain cheaper throughout the period to 2050.

Also, "…developments in bioscience, for example to reduce carbon emissions and treat wastewater more efficiently" and "increasing availability, higher quality and lower cost of low-carbon construction materials.

Figure 16

For the core pathway we have made a series of top-down assumption that can be applied to create item-by-item profiles.

Firstly (see right), the simplest default is a straight line to zero emissions from 2030 to 2050 as per the UK commitment; this becomes the central path. Either side, we have developed benign and adverse pathways, where emissions reduction advance ahead of, or lag behind, the central path. We have applied this approach to scope 1 fuels, and scope 3 items not covered by bespoke set out below (e.g. contractors, chemicals, sludge).

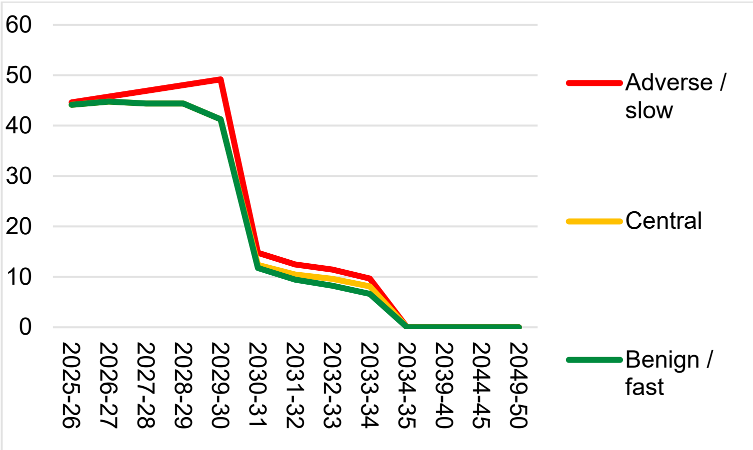


We then created bespoke top-down 2030-50 pathways for grid electricity, vehicles and process emissions.

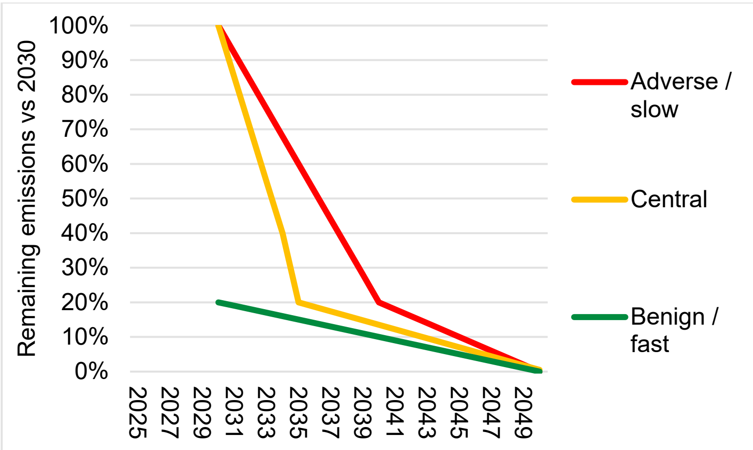
Figure 17

For grid electricity (right), we use for the central path a) the 2022-23 grid average emissions factor to 2029-30 as per the AMP8 performance commitment; b) the DESNZ carbon intensity forecast for 2030-35; c) a zero carbon intensity factor for 2035 onwards as per Ofwat's LTDS guidance.

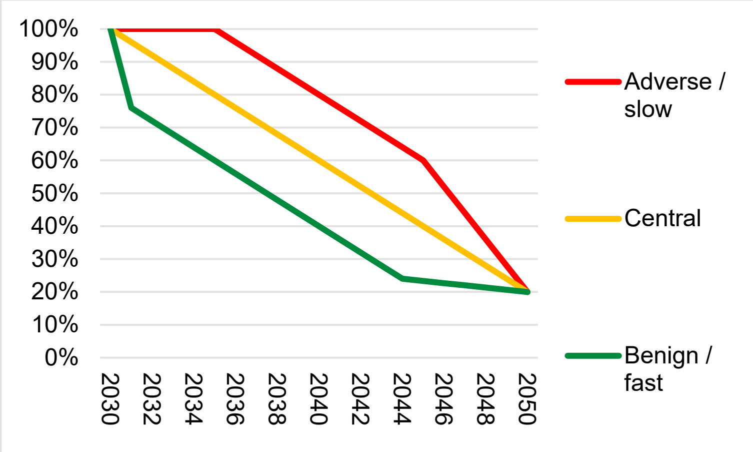
The chart (right) shows resulting scope 2 emissions for our combined water and wastewater services, in kilotonnes CO2e.



For vehicles, we have applied Ofwat's descriptors in the technology CRS, i.e. Fast – Low-emission HGVs and fleet by 2030 ; Slow - Low-emission HGVs and fleet by 2040. This wording is somewhat ambiguous: it could be interpreted as the ready availability of low emissions vehicles; or that *new* vehicles would be exclusively low emissions by those dates; or at most the complete transition of the fleet to low emissions by those dates. In our interpretation, we have adopted the second of these options, and assumed that HGVs bought before each date in question are gradually take out of service.

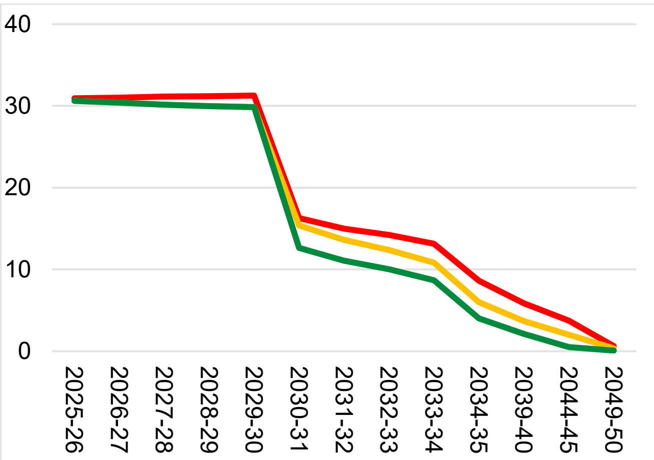


For process emissions, we have assumed that readily-available methods – focused on process optimisation and asset maintenance – will lead to steady reductions in the central pathway, but will not eliminate process emissions by 2050. This reflects that nature of prevalent infrastructure such as small water recycling centres with trickling filters where the ability to control nitrous oxide emissions is very much unknown. For this reason we project 80% reduction from 2030 to 2050, rather than 100%. This 80% is an estimate based on tackling our larger works (typically ASP treatment technology) and also looking at how we can reduce emissions in areas such as trickling filters on smaller works. We have assumed that all scenarios will reach a similar point by 2050 in terms of reductions available, but it is possible some may lag behind later.

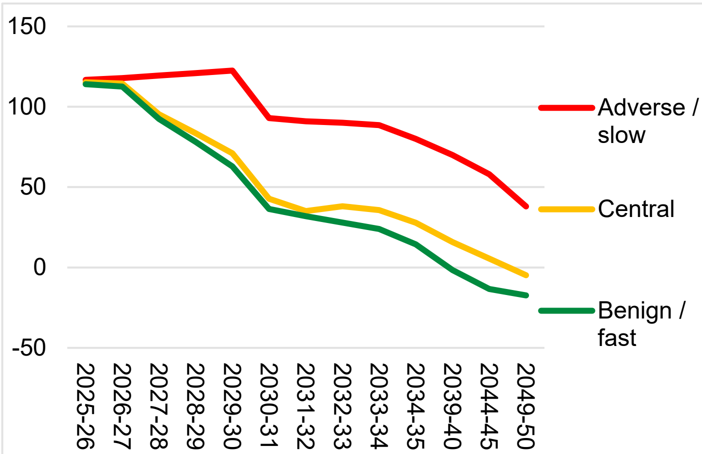


In this way, applying these pathways to the 2030 start position gives a top-down profile to 2050 (see followng graphs). However, it does not differentiate between base and enhancement activities, or those that are enhancement to being with and later become part of our base spend (see below for our interpretation of those terms.

Water: net operations emissions kt CO_2e



Wastewater: net operational emissions kt CO_2e



(nb. Waste profile includes retention of biomethane certificates post-2030)

3.8.4. Options Assessment

Looking at potential drivers of enhancement investment beyond 2030, we considered a number of factors that would feed into our core pathway and / or potential adaptive pathways. We believe there will be growing pressure to control fugitive emissions as they will be the dominant emission in the future, while energy and transport emissions fall. We also believe that there will be changes required to biosolids treatment drive by emerging pollutants and nutrients, which will affect our emissions profile – although there is too much uncertainty to quantify the impact at present. Regarding embodied carbon there will also be a growing emphasis on scope 3 emissions, especially construction materials, as the sector moves toward wholelife carbon thinking and decision making.

Core pathway
Table 35 sets out the options we are proposing for 2025-30 as the next stage of moving towards a net zero carbon position. These are taken from our proposals for AMP8 which are also informed by items in the Water UK route map and the Jacobs Net Zero Carbon Review, and form a large part of our core pathway for 2030-50.
It also covers additional headline items for expenditure from 2030 onwards, likely as part of the core pathway e.g. effluent heat recovery at more sites; sewer heat recovery at high volume parts of the network; and further extension of nitrous oxide monitoring & control.

Drawing on Ofwat's LTDS guidance, our interpretation of base or enhancement classifications for net zero carbon activity is:

- Base: year-on-year costs and carbon management methods. Some of which are inherited from previous years, with others being newly introduced but becoming part of the company's operational costs and savings
- Enhancement: new approaches that involve investment to achieve a permanent reduction in emission to a new 'base' level. This will typically result in the creation of a new asset that the company owns and operates to deliver the emissions reduction.

Table 35 - Base versus enhancement categorisation

Base / enhancement			
	2025-30	**2030-50**	
Fossil fuels			
CHP: reducing natural gas use	Base	Base	Avonmouth only
HVO for standby generation	Base	Base	50% by 2030, growth thereafter
Effluent heat recovery (Avonmouth)	Enhancement	Enhancement	Possible extension post-2030 where on-site heat is needed
Process emissions			
Nitrous oxide: monitoring & control	Enhancement	Enhancement	Possible extension post-2030
Nitrous oxide capture / conversion	-	Enhancement	Dependent on suitable technology, potential adaptive pathway
Methane monitoring	Base	Base	Information gathering in 2025-30
Methane: leak repair	-	Base	Programme built from AMP8 surveys / monitoring
Methane: sludge storage covers	Enhancement	Enhancement	IED requirement
Vehicles			
Electric vehicles (car & vans)	Base		Gradual introduction
Biofuel HGVs	Base	Base	Wider roll-out post-2030, becoming standard post-2035

Hydrogen HGVs	-	Enhancement	Potential adaptive pathway
Electric vehicle charging infrastructure	Enhancement	Base	Possible further enhancement post-2030
Electricity			
Current hydro generation	Base	Base	Limited scope for more
Current food waste power use	Base	Base	Avonmouth only
Current biogas CHP - yield growth	Base	Base	Growth with sludge volume
Core energy efficiency	Base	Base	Ongoing programme
Fine bubble diffused aeration	Base	Base	Selected sites 2025-30, possibly more after
Solar – on-site, power offtake	Base	Base	Selected sites 2025-30, possibly more after
Wind – on site	-	Enhancement	Potential new installations post-2030, potential adaptive pathway
Neighbouring renewable private wire	Base	Base	First implementation during 2025-30
Power purchase agreements	Base	Base	Company-wide
Subtractions			
Retaining biomethane certificates	-	Base	Being sold to 2030 at least
Carbon offsets	Base	Base	For corporate net zero target
Sewer heat recovery		Enhancement	Dependent on neighbouring heat requirement

We identified three potential adaptive pathways involving capture of process emissions; large scale expansion of onsite renewable energy, and the development of hydrogen technologies, especially for large vehicles. The development of these would be linked to certain decision points:

- The potential for policy shifts to affect PR34 / AMP10 planning:
- The fact that more accurate quantification of emissions - especially from process emission monitoring – should enable better targeted interventions.
- Response to a shift toward more self-generation of renewables (e.g. solar and onshore wind) based on economics and relative reputational benefit
- Response to technological advances may make the use and even generation of alternative fuels (e.g. green hydrogen) more affordable and feasible, and speed-up deployment

Linked to the bioresources long-term strategy, the outcomes of any advanced thermal conversion trials, plus other innovation trials during 2025-30 involving wastewater technologies would also have a large bearing on carbon and represent an adaptive pathway scale shift.

Particular trigger points that we identified were:

T1 Hydrogen and biofuel technology becoming more affordable and available for heavy and medium goods vehicles, enabling a faster transition away from diesel

T2 Any requirement to enclose & treat major sources of fugitive emissions to reduce greenhouse gas emissions (note: this is an IED requirement for methane during 2025-30. The findings of methane and nitrous oxide monitoring during 2025-30 will inform future planning and is the hypothesised trigger for more radical action

T3 Any decisions to install onshore wind turbines for renewable energy generation at a number of sites.

3.8.5. Recommended Approach

From the possible items set out above, we propose the following for inclusion in the **core pathway** as **enhancement investments.**

Water supply – post 2030:
- Wind turbines at company sites (two by 2040, four by 2045, six by 2050) at 3MW average capacity each

Waste water – 2025-30:
- Effluent heat recovery at Avonmouth
- Nitrous oxide monitoring

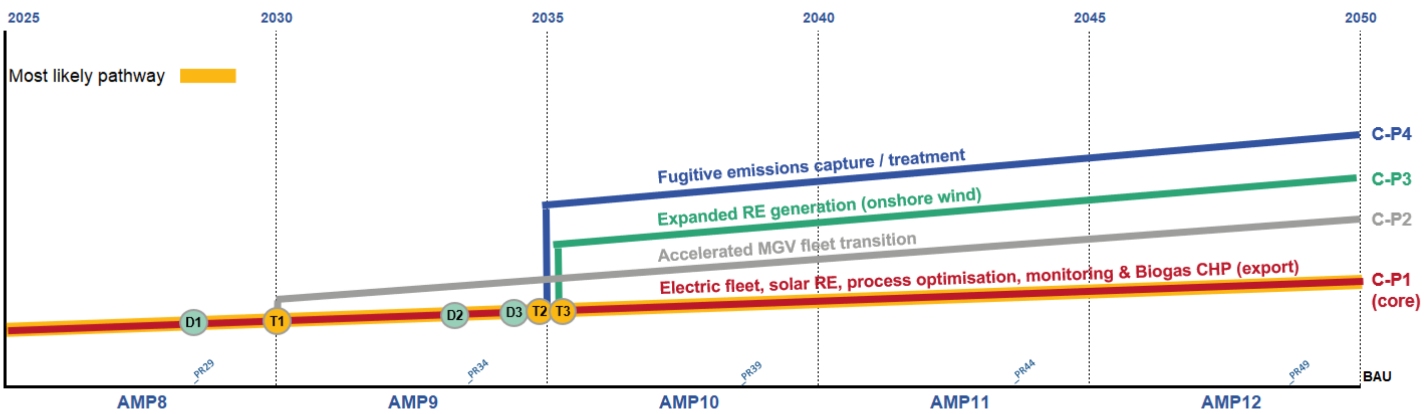
Waste water – post-2030:
- Further effluent heat recovery to assist digester heating
- Wider nitrous oxide monitoring and predictive analytics
- Sewer heat recovery
- Wind turbines at company sites (two by 2040, four by 2045, six by 2050) at 3MW average capacity each

These are mainly focused on decarbonising heat and process emissions, and thus go beyond the background economy-wide decarbonisation of electricity and transport that make up a large part of the reductions in the top-down pathways shown in section 3.8.3. Plans for deployment from AMP9 onwards will largely be developed from the experience of AMP8 activity on process emissions optimisation, heat recovery, and vehicle decarbonisation. It is important to reiterate that decarbonisation from background changes and base maintenance will continue to occur during 2030-50, and complement core pathway enhancement proposals here. Moreover, it is likely that investments that are initially enhancements (such as electric vehicle charging infrastructure during AMP8), become part of routine, base maintenance subsequently.

Nb the following would be new activities but are allocated to base as they involve repair and maintenance, or replacement, of existing assets
- methane repair work following monitoring
- more novel low carbon HGVs (e.g. hydrogen powered).

Adaptive pathways
Three of the options gave rise to our <u>initial</u> adaptive pathways (P2-P4) in figure 18, with decision/trigger years and likelihoods detailed in table 36

Figure 18 - Greenhouse gas adaptive pathways



Decision Points

D1 Review as part of PR29 planning
D2 Policy shifts in PR34/AMP10 planning:
Improved understanding of emissions profile (from monitoring) enables better targeting of interventions
Growing reputational risk associated with carbon credits drives strategic shift toward self-generation of renewables (via onshore wind)
D3 STW technology trial outcome (positive result enables enhanced emissions capture / treatment from activated sludge)

Trigger Points
T1 Hydrogen/biofuel technology becomes more affordable/available for medium goods vehicles (MGV), enabling accelerated fleet transition
T2 Enclose & treat major sources of fugitive emissions to reduce GHG emissions (& odour where nearby development)
T3 Install onshore wind turbines for renewable energy generation

Table 36 - Greenhouse gas adaptive pathways decision and trigger years and likelihoods

Path	Decision Yr	Trigger Yr	Likelihood %	Description
C-P4 (LS4j)	2033	2035	50%	Fugitive/process emissions capture
C-P3	2033	2035	25%	Expanded renewable generation (solar & wind)
C-P2	2030	2030	30%	HGV hydrogen tech
C-P1	2023	2025	100%	Core path items e.g. electric fleet, solar, process emissions optimisation & biogas CHP

Rationale used to develop the initial adaptive pathway visual including the following points:

- Current measures to reduce energy consumption (e.g. via aeration optimisation) will reduce emissions, but by reducing amounts in the future
- Monitoring methane and nitrous oxide is planned for larger WTCs to quantify emissions & inform future planning
- Technological advance may make alternative fuels/vehicles more affordable & speed deployment (e.g. electric, biofuel, hydrogen) for medium and heavy goods vehicles.
- Potential future requirements to enclose and treat major sources of fugitive emissions to reduce greenhouse gas emissions as well as addressing odour
- Questionable authenticity of some carbon credits could result in their withdrawal or reduced availability in future, requiring alternatives (e.g. expanded renewable energy generation) to further decarbonisation goals.

In order to maintain control over the number of adaptive pathways presented across the full range of long-term delivery strategies, it has been decided to restrict the number for greenhouse gas emissions to a single adaptive pathway. Process emissions capture is the adaptive pathway selected, largely due to the potentially very significant increase in actual measured nitrous oxide emissions, and the fundamental rethinking of secondary treatment assets that may be required – or at least the cost of coverage, capture and processing.

The costs to cover sewage treatment to limit nitrous oxide emissions are extremely uncertain, as it has not taken place to date. We do not yet know whether it would require hermetically sealed units, nor if gas extraction would be required, nor the processing of extracted gases subsequently. An alternative approach involves photocatalysis, where the combination of light and metallic substances can lead to the decomposition of a problem gas – in the case of nitrous oxide it would involve break-down to nitrogen and oxygen gas. The Net Zero Carbon hub trial in the West Midlands of Suez' AirAdvanced®ActiLayer, will help demonstrate the applicability of this method for nitrous oxide emissions reduction.

A noted on the previous page, we would expect a decision point in 2033, as understanding grows of the ability for emission monitoring and control to make adequate reductions and also to better target the locations need more radical interventions, followed by an investment trigger for the PR34 / AMP10 business plan.

3.8.6. Stress Testing

In the absence of the adaptive pathway we would have residual gross emissions from process emissions. Under the current reporting method and the central and benign paths these would be at a manageable level in the 2040s; i.e. they could be 'neutralised' by retention of green gas certificates and carbon offsets. However, the cost of achieving this would be much more challenging if a) the standard emissions factor for N_2O is revised upwards in line with the IPCC revision, and b) we are not able to evidence lower emissions from real time monitoring and control. With an adverse / slower technology reference scenario this challenge would be greater still and our gross wastewater emissions would lag behind a net zero by 2050 flightpath.

Regarding conformity with statutory requirements, the pathways pay heed to the UK's net zero obligations. At present, this does not translate into direction regulation of the water sector's greenhouse gas emission; however, we expect between 2030-50 being subject to more external intervention. This will likely involve a combination of increased regulator scrutiny, fiscal mechanisms and in some cases direct compliance-based regulation (e.g. permits).

3.8.7. Assumptions and Uncertainty

The principal assumptions and uncertainties in our forecasting are as detailed in table 37.

Table 37 - Greenhouse gas key assumptions and uncertainties

	Assumptions	Uncertainties
UK & international decarbonisation	• The fastest rate of decarbonisation happening in the electricity sector (with full decarbonisation by 2035), followed by heat and transport	• Exact carbon intensities for grid electricity in future years
On-site fossil fuels	• Gradual introduction of non-diesel alternatives up to 2030; further expansion thereafter	• Long-term local availability of HVO • Suitability of hydrogen as a sustainable alternative to diesel / gas
Process emissions	• Principally data gathering during 2025-30 (enhancement); potential extension of monitoring post-2030. • Main focus post-2030 on active control (optimisation, base) and potential capture / conversion (enhancement)	• The true extent of nitrous oxide and methane emissions • The ability to monitor nitrous oxide from trickling filters • Consistently achievable reductions through optimisation • The performance of containment or gas conversion
Transport	• Installation of charging infrastructure during 2020-25 (enhancement) • Introduction of low carbon vehicles as alternatives to fossil fuel vehicles; the price difference ; the price different is enhancement for 2025-30 • Purchase of low emission HGVs would be base after 2030 under the 'high' technology scenario and	• Long-term availability of bio-fuels at volume • The affordability and sustainability of hydrogen fuel

	after 2040 under the low technology scenario, with a transition period while the older fleet is phased out.	
Electricity	• Renewable grid electricity power purchase agreements sought up to 2035 • Grid electricity decarbonised by 2035 • Expansion of self-generated renewables post-2035 would be based on economic rationale, rather than CO2 reduction	• Actual grid carbon intensity in 2035 and beyond • The future economics of small scale self-generated renewables; future fiscal incentives
Embodied carbon, supply chain	• Slower decarbonisation of key, international supply chain sectors i.e. concrete, steel, chemicals, plastics • Construction carbon becomes a routine part of scope 3 reporting; other bought products become carbonised ad reported annually with scope 3 • Higher costs for lower carbon alternatives; would be classed as enhancement within the core pathway.	• Stakeholder attitudes towards trade-offs e.g. greater protection of the water environment vs higher capital carbon volumes • Actual future capital carbon for resilience related to water and wastewater volumes

Table 38 below set out key technologies and methods for decarbonisation over the next 25 years, drawing on the Water UK net zero routemap and the Jacobs net zero technology review. This is offered as a summary of approaches that we will be either implementing, or monitoring for potential implementation post-2030. The first table includes items on Net Zero Technology Review shortlist, rather than the full list.

Table 38 - Wider list of key technology methods for decarbonisation

Burning of fossil fuels		
Divert biogas to boilers and stop natural gas to CHP plant	WUK	Reduction planned in 2025-30
Gas oil replaced by HVO	WUK	Base; starting in 2025-30
Hydrogen generators	WUK	Core path enh.; post-2030
Electric/ battery powered standby generation to reduce grid imports	WUK	Core path enh.; post-2030
Low energy drying methods for sludge or biosolids	NZTech	Core path enh.; post-2030
Heat recovery from onsite influents / effluents	NZTech	Core path enh.; post-2030
Process emissions		
Alternative treatment - anaerobic treatment / MABR / alternative ammonia removal	Both	Core path enh. ; post-2030
Monitoring & optimisation to minimise methane emissions	Both	Core path enh.; monitoring during 2025-30
Monitoring & optimisation to minimise nitrous oxide emissions	Both	Core path enh.; monitoring & potential optimisation during 2025-30
Vacuum methane recovery	NZTech	Core path enh.; potentially during 2025-30
Conversion of secondary nitrifying treatment to nitrifying/denitrifying	NZTech	Core path enh; where there is a water environment driver
Transport		
Biofuels, biomethane (HGVs)	Both	Starting in 2025-30
EVs	WUK	Base; starting in 2025-30 (cars and vans)
Hydrogen	WUK	Both; post-2030
Transport - Efficiency	WUK	Base; ongoing
Electricity		
Accelerated leakage reduction, water efficiency	Both	Base; ongoing, depending on other factors

Control or analytics upgrades; high efficiency blowers and small pumps	WUK	Base; ongoing
Reducing power demand - smart control / analytics	WUK	Base; ongoing
Using additional CHP power on site	WUK	Base; volume depends on competing uses of biogas
Catchment approaches to reduce treatment power	WUK	Base; ongoing
Replacing ageing equipment with modern equivalents	WUK	Base; ongoing
Rainwater harvesting to reduce wholesome water demand.	WUK	Localised interventions; driven by surface water management
Pump efficiency	NZTech	Base; ongoing
Bioresources		
Co-digestion of sewage sludge with other organic materials	NZTech	Core path enh.; unlikely due to regulatory constrains
Advanced AD - enzymatic hydrolysis	NZTech	Base; ongoing
Advanced AD - thermal hydrolysis	Both	Core path enh.; not preferred as a long-term option
Intermediate thermal hydrolysis	NZTech	Core path enh. not preferred as a long-term option
Biodrying of sludge or biosolids	NZTech	Core path enh.
Gasification / pyrolysis of sludge or biosolids	NZTech	Core path enh.
Renewables		
Hydropower – dam head and run of river	WUK	Base; very localised
Solar	WUK	Core path enh.; roll-out in 2025-30
Wind	WUK	Core path enh.; post-2030
Biomethane to grid	NZTech	Base; ongoing
Power Purchase Agreements, renewables	NZTech	Base; from 2025-30
Natural sequestration		
Tree planting	WUK	Base; expanding during 2025-30; main CO2 benefits in 2040s

Grassland restoration	WUK	Base; potentially, linked to water drivers
Peatland restoration	WUK	Not applicable
Other		
Government-led water labelling	WUK	Not applicable
Stormwater separation & treatment with NBS	NZTech	Core path enh.; expanding activity
Ammonia stripping (liquors)	NZTech	Core path enh.; post 2030

The following items were excluded from the shortlist of the Net Zero Carbon Technology review on the basis of having not yet reached maturity for deployment during 2025-30. These will also be on our watchlist for potential trialling and implementation post-2030.

- Carbon capture storage and utilisation
- Renewable fuel for HGVs: hydrogen; battery electric
- Hydrogen from biogas/biomethane
- Microbial fuel cells
- Mainstream (cold) anaerobic treatment
- Mainstream dissolved methane recovery from wastewater (e.g. degas membrane)
- Mainstream deammonification
- Biocatalyst technologies
- Final effluent electrolysis
- Covered forced aeration processes with headspace air abatement

3.9. Retail

Our aim is to, by 2050, be a top 10 customer service provider in the UK, based on the UKCSI; we are currently 93rd. We will also continue to maintain our top position on the water industry measures of customer experience.

Our success to date in delivering excellent customer service has been due to our going the extra mile ethos and our strong desire to continuously improve our service based on customers' feedback. We will not waiver from these fundamentals making sure our service always meets our customers' expectations.

It is difficult to envisage the developments in technology and communication that will take place over the next 25 years and what our customers will expect from their water company. It's inevitable that the potential in digital interaction and self-service capability is going to increase, as well as its popularity. Indeed, our Young People's Panel of future customers can't envisage a non-digital water service. There will be more and more choice of alternative communication channels that customers can use to interact with us and for us to update them on our services and the use of Artificial Intelligence will know no bounds.

We will be fully smart metered by 2035 and smart technology will continue to advance beyond that giving us and our customers a wealth of data about and more control over the services we consume and the bills we pay. By 2050 we could be in a position where we have fully smart homes.

So, to make this further step change in our service we will:

- Continue to embrace new technologies and digital developments to provide an effortless service, giving customers more control of and information about their water services.
- Always make it as easy and convenient as possible for customers to interact with us by adopting new and emerging communication channels but remaining true to our longstanding 'warm voice at the end of the phone' philosophy for those customers that want it.
- Seize every opportunity to positively engage with our customers be it a communication alongside a bill, working with a local community project or conducting roadworks.
- Use data to be able to predict when problems may occur on our network before they impact customers and better diagnose problems in customers' homes, avoiding the need for visits and reducing resolution times.
- Continue to upskill and empower our workforce to do whatever it takes to deliver the best outcomes for customers when they contact us.
- Keep up with customers' changing expectations, seeking feedback on our service at every opportunity and using it to continuously improve our service.
- Ensure all customers, whatever their situation, can access and use our services when they need them.
- Respond to change in the developer and business retail markets amending our service offering accordingly.
- Continue to play our part in the community and contribute to the wellbeing of our customers for example by providing access to our sites for recreation; through our role as a large employer; funding local community and environmental improvement projects; helping communities tackle shared goals of reducing water demand and sewer misuse and/or through our education team's engagement work in schools and across the region to equip our customers of the future.

3.10. Miscellaneous areas

There are a small number of areas that do not fall under the previous sections. Our high level; assumptions for these areas are detailed in this section. None of these areas vary under the common reference scenarios or adaptive pathways.

3.10.1. Cyber and SEMD

✂

3.10.2. Investigations and environmental drivers such as eels and fish passes

These are forecast based on AMP7 and AMP8 numbers where relevant; either averages of the two AMPs expenditure if appropriate (or on occasion if a single AMP is more representative of the types of activities, rolling this expenditure forward). Further detail is in our commentary document WSX54 Long term strategies table commentary.

3.10.3. Partnership working and wider environmental lines

For the 25 year environment plan driver we have forecast that our current level of expenditure continues; we believe our current projects in the Wellow and Cam Valley, once completed, are likely to be replaced by similar projects.

4. Foundation

4.1. Assumptions

Assumptions that are specific to each areas forecasts are detailed in sections 3.2 – 3.8. However, there are wider assumptions that underpin this LTDS.

Economic growth, changes in household incomes and affordability

We have not sought to forecast future changes in economic growth or household incomes; this LTDS sets out the investment that we currently believe will be required under our core and adaptive pathways now and in the future. This will need to be revised, as aMP8 plans have been throughout the PR24 process to date, in light of the affordability constraints at the time of delivery, with support being extended for customers as we are doing for PR24 and as detailed in WSX02 – Our main narrative in the affordability chapter. Similarly we have made no assumptions on changes in customer vulnerability.

Availability of skills and supply chain capacity

AMP8 will see a significant step change in the programmes required to be delivered across the industry. Our LTDS, whilst seeing this increased level continue, does not forecast such a step change again in the future; our nutrients programme will be replaced by storm overflows and activities in the bioresources space, utilising this capacity that will support the AMP8 delivery. Deliverability is further commented on in WSX29 – Transition and Deliverability.

Cost of inputs

We have made no assumptions on the cost of inputs beyond keeping them at 22/23 prices. If and when we see material changes in costs in the future, these will be factored into our options development processes to ensure that the most appropriate solutions are identified at that point in time.

Government and regulatory policy

As commented on in this LTDS, we cannot forecast the future regulatory changes that will occur. We have assumed some changes (such as the further extension of phosphorus and nitrogen permits) and have highlighted uncertainties in other areas and the implications this could have (such as for bioresources) alongside the abstraction scenarios specified for the WRMP.

Wider water industry activity

We assume that knowledge sharing between companies will continue to develop, allowing more effective development of solutions. Although the innovation fund is in its infancy, we hope that it will create opportunities that can be utilised in the future and bring down the cost of delivery. No explicit activities have been factored into our forecasts beyond those detailed in sections 3.2-3.8 (rationale sections for each area).

Wider sector activity

We have not made any assumptions on other sectors beyond the water industry having fundamental shifts in the expectations placed on them, for example increases in expectations on farmers for P and N reductions. Our nitrates plan for supply assumes catchment management is successful, with an adaptive pathway if this is not the case. For bioresources, we are forecasting changes to come in at some point limiting the ability to spread sludge to land as detailed in our adaptive pathways.

Customer behaviour and attitudes

As detailed in our retail section, forecasting where the customer service industry will be in 2050 is an unknown. However, we have included in our LTDS the adaptive pathways for bioresources and loss of landbank as we believe customers views on the appropriateness of spreading sludge to land may well impact our future operations. A continued change in attitudes has also underpinned the adaptive pathway for accelerated bathing waters and eliminating sort overflows – both key issues for many customers at this point in time.

Innovation within the company

Innovation is key to delivering our plans now and in the future in the best value way possible. We will continue to encourage innovation within Wessex Water, as demonstrated by many of the case studies throughout our plan. Where opportunities are identified that provide effective solutions to our business challenges we will seize them; our work with Stormharvester, as detailed in our executive summary document WSX01, is a suitable example of where an initial challenge for the business and its solution has been extended to provide a wealth of benefits.

Cost efficiencies

Assumptions on cost efficiencies would be in our base allowances for each AMP going forward. In the cost forecasts for the LTDS we have assumed costs at 22/23 levels unless specified in sections 3.2-3.8. The main efficiencies we have sought to forecast are in section 3.5 (waste treatment) for potential treatment cost efficiencies under adaptive pathways and common reference scenarios.

Levels of asset health and resilience

Our AMP8 plan sees us ask for a step change in our base expenditure to increase our spend on capital maintenance. The most significant increase relates to our Bioresources sites where our planned programme includes plant upgrades to meet the needs of process safety alongside targeted asset replacements to ensure compliance with IED and EPR requirements. In Water Treatment and Water Recycling, the increased investment targets many assets installed in the early 2000s that will reach end of life by 2030. We are looking to proactively replace or refurbish these assets before they fail, utilising deterioration modelling to inform future investment requirements and allow prioritisation based on risk.

This more proactive approach to the management of our assets will allow us to further improve our asset health, supporting performance commitments such as discharge permit compliance and CRI, as well as providing best value for our customers. In areas such as mains replacement and sewer collapses, we will be seeking continual incremental increases in base expenditure over future AMPs to maintain asset health. This has started with the proposed first step change in mains replacement activity in AMP8. This could in future affect our 2050 performance commitment aspirations.

4.2. Performance commitment trajectories

Our performance commitment forecasts are based on the following trajectories to meet our 2050 targets and are detailed in table 39.

Trajectories for AMP8 and beyond are based on a combination of customer views, regulatory expectations and affordability as detailed earlier in this document.

Table 39 - Forecast performance out to 2050

Performance commitment	Unit	Performance level forecast per year												
		2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2039-40	2044-45	2049-50
Water supply interruptions	mm:ss	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	03:00	01:30	00:00
Compliance risk index (CRI)	Score	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Customer contacts about water quality	Number per 1,000 population	1.25	1.23	1.21	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.07	1.02	0.97
Internal sewer flooding	Number of incidents per 10,000km	1.29	1.26	1.24	1.21	1.19	1.16	1.14	1.11	1.08	1.06	0.92	0.79	0.66
External sewer flooding	Number of incidents per 10,000km	16.14	15.35	14.58	13.81	13.07	12.25	11.84	11.43	11.02	10.63	9.834	9.043	8.252
Biodiversity	Biodiversity units	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.05	0.15	0.15	0.15	0.15	0.15
Operational greenhouse gas emissions (water)	Tonnes	30,617	30,395	30,135	29,965	29,847	12,635	11,064	10,026	8,669	4,003	2,103	492	82
Operational greenhouse gas emissions (wastewater)	Tonnes	117,244	115,651	113,184	109,486	101,665	36,417	31,848	27,958	23,910	14,322	-1,687	-13,437	-17,377

Leakage	%age reduction	13.4	13.7	14.5	15.4	16.6	18.1	20.1	22.5	24.8	27.1	34.3	41.5	46.3
Leakage – three year average	Ml/d	63.53	63.29	62.71	62.01	61.19	60.03	58.57	56.86	55.15	53.43	48.19	43.78	39.37
Leakage – in year figure	Ml/d	63.33	62.75	62.04	61.23	60.29	58.57	56.86	55.15	53.43	51.72	47.31	42.90	38.49
Per capita consumption	%age reduction	-1.9	-1.3	-0.3	0.9	2.0	3.2	4.6	6.2	7.8	9.3	16.1	19.4	21.9
PCC – three year average	l/h/d	140.51	139.65	138.23	136.58	135.02	133.36	131.44	129.28	127.07	124.98	115.63	111.05	107.69
PCC – in year figure	l/h/d	139.95	138.19	136.55	135.01	133.51	131.57	129.24	127.03	124.95	122.97	114.52	110.27	107.08
Business demand	%age reduction	3.8	4.8	6.3	8.0	9.6	11.0	12.3	13.4	14.4	15.4	17.2	17.3	17.4
Business demand – three year average	Ml/d	78.55	77.72	76.46	75.08	73.77	72.62	71.62	70.72	69.87	69.03	67.56	67.46	67.35
Business demand – in year figure	Ml/d	77.91	76.47	75.02	73.76	72.53	71.57	70.76	69.84	69.02	68.22	67.56	67.43	67.33
Total pollution incidents	Incidents per 10,000km of sewer	21.18	20.23	18.81	17.67	15.67	14.97	14.16	13.42	12.68	11.95	8.22	4.535	0
Serious pollution incidents	Number of incidents	1.00	1.00	1.00	1.00	1.00	1	1	1	1	1	1	1	0
Discharge permit compliance	%age compliance	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.37	99.37	99.37	99.68

Bathing water quality	% compliance	85.70	85.70	85.70	85.70	85.70	86.4	86.4	86.4	86.4	86.4	86.4	86.4	86.4
River water quality (phosphorus)	%age reduction in phosphorus	45.02	45.61	45.94	47.94	49.30	56.52	56.55	57.42	80.12	80.87	80.87	80.87	80.87
Storm overflows	Average number of spills per overflows	23.50	23.50	22.82	22.14	21.13	20.11	19.77	19.43	18.42	16.72	12.48	10.44	9.76
Mains repairs	Number of repairs per 1,000km of mains	168.77	170.39	170.79	171.11	171.42	173.4	174.6	175.0	175.3	175.6	178.0	179.0	179.0
Unplanned outage	% of peak week production capacity	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02
Sewer collapses	Number of collapses per 1,000km of sewer	6.12	6.12	6.12	6.12	6.12	6.3	6.3	6.3	6.3	6.3	7.4	8.5	9.8
Supply-side benefit delivered to the supply-demand balance	Megalitres per day (Ml/d)	0	0	0	0	0	5	5	5	5	5	5	5	5
Effective network storage benefit from both grey and green infrastructure	m^3	0	13,878	23,130	58,343	68,193	82,301	82,301	82,301	82,301	82,301	23,6931	13,219	86,107

4.3. Delivering from base

The tables we have submitted alongside this document (see WSX46 - Data tables) contain details of the enhancement expenditure we are currently forecasting is necessary to meet the range of scenarios presented here. We assume when forecasting customer bills that we are funded, for PR24 and into the future, for the level of base expenditure we are submitting in our wider PR24 submission.

Our document WSX47– Outcomes tables commentary (and in section 1.X.3 for each performance commitment) – goes into detail on the performance we expect to deliver from base for our performance commitments, and those same principles underpin this LTDS.

5. Board Assurance

5.1. Assurance Process

The Board supports the Company's approach to long-term stewardship and challenges the management team to both set an ambitious strategy across all aspects of the business and that each individual element of delivery is aligned with that strategy. The Board therefore supports the concept of the Long-Term Delivery Strategy (LTDS) as one very similar to the approach it already takes. This strategic framework is a key component of the Company's approach to achieving its long-term objectives, bringing together the suite of strategic plans.

In February 2022, the Board considered the strategic direction statement (SDS), which frames the long-term delivery strategy. The Board were clear that the LTDS must align with the SDS in order to remain aligned to the holistic approach to delivering outcomes and to ensure that the Company does the best for customers, communities and the environment in the long term. The PR24 Non-Executive Group spent considerable time and effort focusing on the intent and detail within the SDS to ensure it reflects the Company's high level of ambition. This led to revisions to outcomes, metrics, and targets. The relationship between the 25 year objectives set out in the SDS and the proposed five year plan was challenged to confirm the credibility of each. This ensured that the next 5 year plan would be representative of the first 5 year of the LTDS. The Board have continued to refer back to the SDS outcomes throughout the development of the LTDS and the Plan to ensure that the proposals are all pulling in the same direction and that the Plan is credible, ambitious, and specific in its aims.

In October 2022, the Board reviewed the proposed structure of the LTDS and the core and common reference scenarios and, in February 2023, the Board reviewed the methodology used to set the performance forecasts to 2050. The Board discussed whether the LTDS represented the best strategy to meet the Company's stated long term objectives and how they can continue to support ongoing engagement with our regulators to develop the most efficient planning framework. The Board noted the uncertainty of future statutory and regulatory licence obligations and has taken this into account when reviewing the planning frameworks. As the LTDS is based upon adaptive planning principles the Board is confident in assuring the Plan given future uncertainties and given the ability to react to changes in regulation and other external factors.

In February 2023, the Board were also briefed on the customer engagement, both carried out to date and planned, to ensure that the LTDS reflected customer priorities. The Board is content with the proposals to ensure that the LTDS delivers the best solutions at the right investment pace based on customer feedback and delivers on the targets set out in the SDS.

In June 2023, the Board again discussed the performance commitment levels to 2050 which were developed as part of the LTDS. It was confirmed that these aligned with the outcomes in the SDS, although was noted that for some outcomes there were more PCs than overarching metrics. The Board also noted the inherent risk in targeting stretching performance commitment levels for Total Pollution Incidents and Serious Pollution Incidents. The Board is confident that a reduction in incidents can be achieved with the level of investment being proposed, and committed to implementing mitigation measures for third parties as well as improving sewer monitoring required to achieve the performance level. The Board also challenged the proposed approach to mains repairs noting that it is particularly stretching and requires a change in approach, being satisfied that with sufficient funding the target can be achievable.

During this period, the Board also reviewed the customer research conducted in Spring 2023, which shows that customers' top outcomes were 'safe and reliable water', 'effective sewerage system', 'excellent river and coastal quality' and 'affordable bills'. This information was reflected in the LTDS. The outcome of the affordability and acceptability research was used to influence the Plan, in particular for smart metering and storm overflows.

In August 2023, the Board reviewed the outcomes of the customer engagement to test smart metering and storm overflow investment trajectories, the results of which were incorporated into the LTDS. In response to this customer feedback, the smart metering programme was scaled back with a further roll out in AMP9. Both deliverability and affordability concerns were flagged with the acceleration of the storm overflow plans, also leading to a scaling back albeit noting the political, public, and Company desire to ensure the programme remains as ambitious as possible. These are examples of the steps the Board has taken to secure long term affordability for current and future customers.

The Board have scrutinised the strategic planning frameworks that align to the LTDS to confirm consistency. The specific challenges across these strategic planning frameworks can be found in the Costs and Outcomes section of WSX44 – Our assurance strategy and assurance statements.

5.2. Assurance statement

We fully recognise and embrace the importance of Board level challenge of the PR24 Business Plan (the "**Plan**") and are clear that our Board is fully satisfied that the Plan represents the long-term vision and ambition of the Company within the current statutory and regulatory requirements.

We have a very experienced and talented Board, and, as we have evidenced, we have fully engaged and utilised those talents at every stage of the development of the Plan. This is how we have ensured that the final Plan represents a high quality, financeable and deliverable part of a long-term strategy to provide the services that our customers want and is affordable.

The Board's scrutiny of the Plan and engagement with it, is founded on the Board having assured itself that Wessex Water's internal systems for generating the data and information on which the Plan is based are consistent, accurate and assured and that there are effective internal systems, controls, and processes to ensure that the data and information on which the Plan is based are wholly reliable. This has provided the basis for the Board to robustly challenge Company management on all the key elements of the Plan and as a whole.

The Board has been particularly focused on ensuring that all the elements of the Plan have been stress tested, considering multiple options to mitigate risks across a wide range of scenarios and we are confident that the Plan is adaptive to future developments. While the future is by nature uncertain, our Board involvement with the Plan has helped to ensure that the Plan provides a robust five-year foundation for taking us from where we are now to delivering on our longer-term objectives, while continuing to meet our statutory and licence obligations, across an extremely wide range of future eventualities in an efficient and customer focussed manner. The WINEP will require updating to take into account recent legal and regulatory changes including nutrient neutrality and Common Standards Monitoring Guidance.

There are other areas where there has either been regulatory resistance or lack of response to proposals that are material to the company meeting its statutory and licence obligations. The members of the Board have also recognised that scrutiny of the Plan must also align with their wider statutory duties under the Companies Act including the need to promote the success of the Company. In considering and challenging the Plan, the Board has therefore considered the long-term consequences of their decisions, the fostering of relationships with suppliers and customers and the impact of operations on the community and the environment and concluded that it is consistent with ensuring a deliverable, affordable and financeable Plan that achieves the goals set for the Company.

Finally, as a Board we are confident that the Plan comfortably exceeds Ofwat's minimum expectations for a Quality Plan and we are proud of the ambition it shows to exceed the expectations of our current and future customers and deliver high quality water and sewerage services for them on an affordable basis into the long term.

Based on the PR24 governance and assurance process and detailed evidence of challenge and recommendations described above, the Board makes the following assurance statement:

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 the best possible strategy to efficiently deliver its 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;
- has been informed by customer engagement; and
- has taken steps to secure long-term affordability and fairness between current and future customers.

The Board has challenged and satisfied itself that the 2025-30 business plan implements the first five years of the long-term delivery strategy. However, the Board also recognises that due to the latest regulatory changes published at the time of submission, adjustments to the WINEP programme are likely to be required to meet new statutory obligations.

The Board has challenged and satisfied itself that:

- the full implication of the 2025-30 business plan for customers was considered and that the plan achieves value for money; and
- the long-term delivery strategy protects customers' ability to pay their water bill over the long term and delivers fairness between what existing customers will pay and what is paid for by future customers.

The Board has challenged and satisfied itself that:

- the performance commitment levels in the plan are stretching but achievable and reflect performance improvements expected from both base and enhancement expenditure;
- the expenditure forecasts included in the company's business plan are robust and efficient;
- the needs for enhancement investment are not influenced by non-compliance or non-delivery of programmes of work (both base and enhancement) that customers have already funded
- the options proposed within the business plan are the best options for customers and a proper appraisal of options has taken place;
- PR24 plans and the expenditure proposals within them are deliverable and that the company has put in place measures to ensure that they can be delivered. This includes setting out the steps the Board has taken to satisfy itself that supply chain risk is manageable and delivery plans account for:
  - the ability of the Company and its supply chain to expand its capacity and capability at the rate required to deliver the increased investment;
  - the impact of similar levels of growth across the sector and any overall sector and supply chain capacity constraints; and
  - key supply chain risks and capacity constraints, such as the availability of specialist resource or components, e.g. river quality monitors, smart meters, or SuDS designers.
- the plan includes price control deliverables covering the benefits of material enhancement expenditure (not covered by performance commitments);
- that the expenditure proposals are affordable by customers and do not raise bills higher than necessary; and
- the expenditure proposals reflect customer views, and where appropriate are supported by customers.

The Board provides assurance that the Plan is financeable on the basis of the notional capital structure, consistent with the definition adopted in the Risk and Return section above of maintaining target credit ratings at least two notches above the minimum of the investment grade under a base case scenario, and over the period from 2025-2030.

The Board provides assurance that the actual company is financially resilient over the 2025-2030 period and beyond under the Plan.

The Board provides assurance that the company’s customer engagement and research meets the standards for high-quality research and any other relevant statements of best practice and has been used to inform its business plan and long-term delivery strategy.

Please see WSX44 – Our assurance strategy and assurance statements – for the fully signed statements.