WRMP24 Technical Document

Decision making

September 2024

Decision Making Method

1 WRMP24 Introduction

1.1 About our company

Anglian Water is the largest water and wastewater company in England and Wales geographically, covering 20% of the land area.

We operate in the East of England, the driest region in the UK, receiving two-thirds of the national average rainfall each year; that's approximately 600mm.

Our region has over 3,300km of rivers and is home to the UK's only wetland national park, the Norfolk Broads.

Between 2011 and 2021, our region experienced the highest population increase in England. Despite this, we are still putting less water into our network than we did in 1989.

1.2 Planning for the long term

Our company Purpose is “to bring environmental and social prosperity to the region we serve through our commitment to Love Every Drop”. This purpose is at the heart of our business, having been enshrined in our Articles of Association in 2019.

Central to delivering this purpose is planning for the long term; one of the strategic planning frameworks we use to achieve this is the Water Resources Management Plan (WRMP), which details how we will ensure resilient water supplies to our customers over the next 25 years.

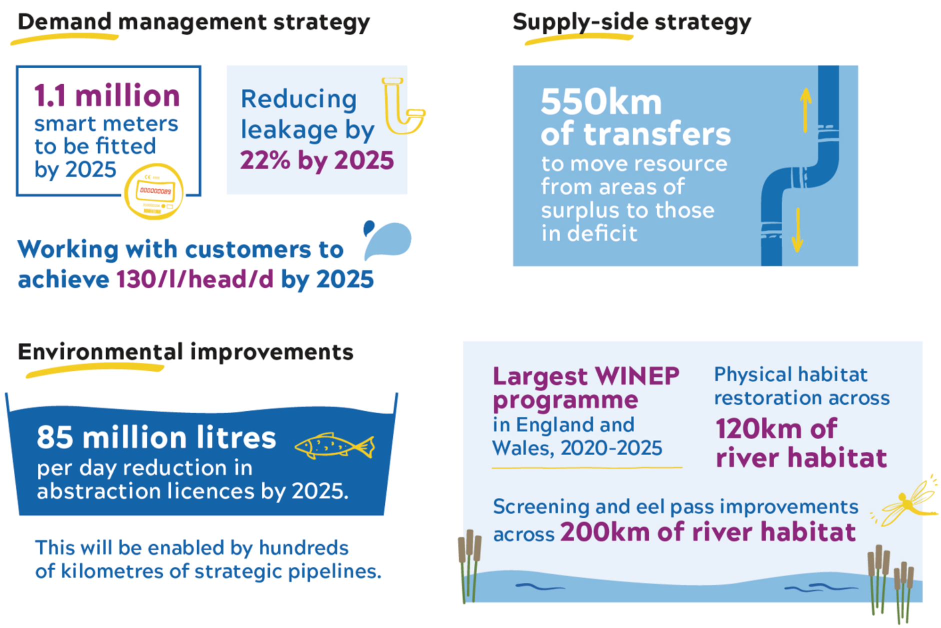
A WRMP looks for low regret investments[1] for our region, giving flexibility to adapt to future challenges and opportunities such as technological advances, climate change, demand variations, and abstraction reductions.

1.3 What is a Water Resources Management Plan

We produce a WRMP every five years. It is a statutory document that sets out how a sustainable and secure supply of clean drinking water will be maintained for our customers. Crucially it takes a long-term view over 25 years, allowing us to plan an affordable, sustainable pathway that provides benefit to our customers, society and the environment.

Our previous WRMP, WRMP19, had an ambitious twin track strategy, combining an industry leading smart meter roll out and leakage ambition with a strategic pipeline across our region, bringing water from areas of surplus to areas of deficit. An overview of the WRMP19 strategy can be seen in Figure 1 below.

Figure 1 Our WRMP19 twin track approach



This WRMP focusses on the period 2025 to 2050, and is known as WRMP24. We have developed it by following the Water Resources Planning Guideline (WRPG)[2], as well as other relevant guidance, in order to meet our statutory requirements. This has ensured our WRMP24:

- Provides a sustainable and secure supply of clean drinking water for our customers.

1 Investments that are likely to deliver outcomes efficiently under a wide range of plausible scenarios
2 https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline

- Demonstrates a long-term vision for reducing the amount of water taken from the environment, and shows how we will protect and improve it.
- Is affordable.
- Maintains flexibility by being able to respond to new challenges.
- Complies with its legal duties.
- Incorporates national and regional planning; and
- Provides best value for the region and its customers.

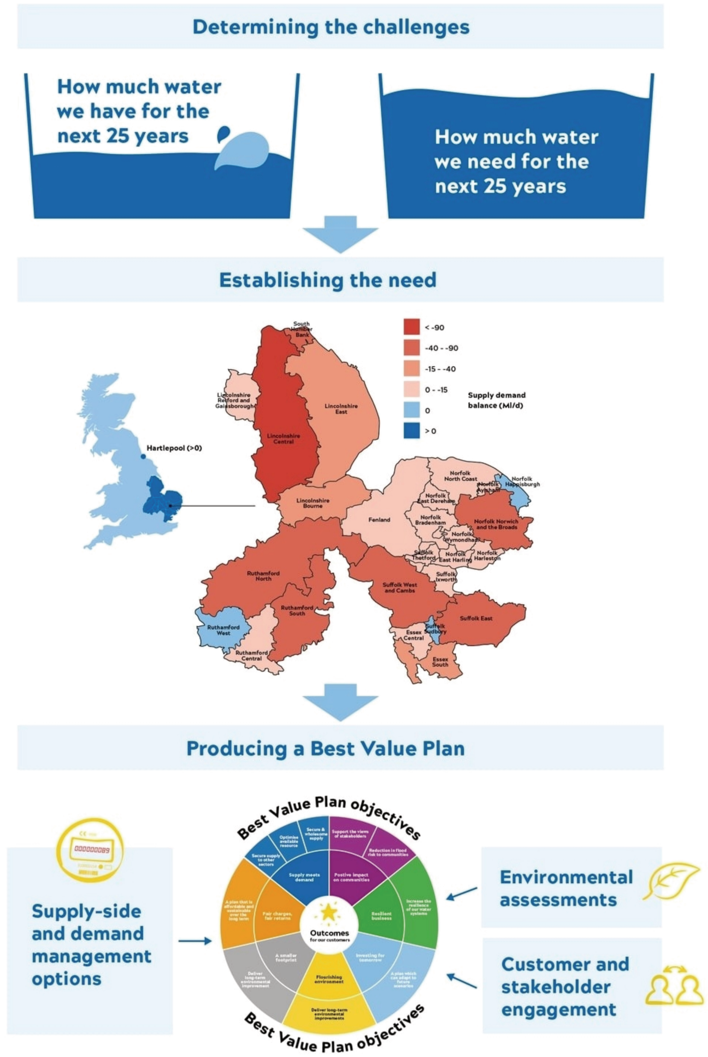
1.4 Developing our WRMP

Our WRMP24 has been progressed following the processes detailed in the WRPG, as shown in Figure 2.

We start by determining the extent of the challenges we face between 2025 and 2050. We achieve this by developing forecasts to establish the amount of water available to use (supply forecast) and the amount of water needed (demand forecast) in our region. When these forecasts are combined, a baseline supply-demand balance is created. This tells us whether we have a surplus of water or a deficit, establishing our water needs for the planning period.

An appraisal for both demand management options and supply-side options is undertaken, starting with an unconstrained list of possible options which progresses through various assessments until a final constrained list is determined.

Figure 2 A high level overview of our WRMP24 planning process



Demand management options aim to reduce the amount of water being used by our customers and lost in our water network. Examples of these options include smart metering and the promotion of water efficiency measures, such as reducing shower times. Supply-side options are also developed; these provide additional water to supply to customers. Examples of these options include new raw water storage reservoirs or water reuse treatment works.

We environmentally assess both demand management and supply-side options so we can understand their potential environmental impacts and what could be put in place to mitigate these impacts; in some cases we exclude options from further consideration.

The next step is for the water savings associated with the chosen demand management options to be added into our baseline supply-demand balance to determine if our region's water needs are met. If the demand management option savings do not solve the need, supply-side options are added into the modelling process. This is undertaken in our Economics of Balancing Supply and Demand (EBSD) model which conducts numerous modelling runs, creating a range of plans that meet our objectives. These plans are also environmentally assessed.

We develop a best value plan from these different model runs and environmental assessments, encompassing the views of our customers and stakeholders who have been consulted throughout the plan's development.

1.5 Best value plan

To ensure we develop the right solution for our region's water needs, we have focused on 'best value'. To us, best value is looking beyond cost and seeking to deliver a benefit to customers and society, as well as the environment, whilst listening and acting on the views of our customers and stakeholders.

These views, from our customers and stakeholders, have helped build our best value framework, shown in Figure 3 which has been used as the basis for our decision making.

Figure 3 Our best value planning objectives

1.6 Our WRMP24

Our best value plan, has been produced following a public consultation on our draft WRMP24. This consultation ran from December 2022 to March 2023. Taking into account consultation feedback and our revised forecasts, we:

- Increased our leakage ambition from 24% to 38%.
- Included projected non-household demand for the South Humber Bank, in north Lincolnshire.
- Developed non-household demand management options.
- Recognised further opportunities to utilise the existing resource we have, and
- Removed abstractions from the supply forecast that are likely to be closed due to Habitats Regulations.

1.7 Strategic context of WRMP24

Our WRMP24 aligns with our Purpose,as well as internal and external strategic plans and initiatives. We have worked collaboratively with internal and external stakeholders, regulators and other water abstractors to achieve this.

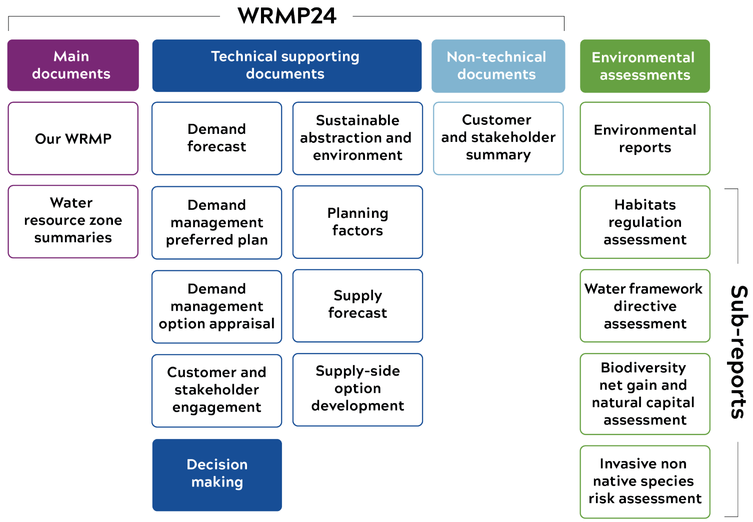
These interactions are highlighted throughout our WRMP24, showing the importance of collaborative planning. For instance, Regional Plans led by Water Resources East (WRE) and Water Resources North (WReN) have been significant in shaping our investment priorities and requirements, with WRE demonstrating the valve of the strategic regional options (SROs) at the regional, multi-sectoral level.

Our WRMP24 has helped shape our company investment strategy for the Price Review (PR24), as well as our Long Term Delivery Strategy. We have also maintained close links with the Drainage Wastewater Management Plan and our Drought Plan.

1.8 Guide to our WRMP24 submission

Our submission comprises a non-technical customer and stakeholder summary, our main report and nine technical supporting documents, shown in Figure 4 below. These technical documents are supported by a suite of independent environmental assessments.

Figure 4 Our WRMP24 reports



This report is concerned with the development of the decision making.

2 What is a best value plan?

The objective of our WRMP24 is to develop a plan which presents best value, both in the short and long term, ensuring a secure supply of water to customers whilst protecting and enhancing the environment.

The Water Resources Planning Guidelines[3] (WRPG) state that we need to consider factors other than just cost whilst developing our plan, see Box 1 below.

Box 1: Definition of a Best Value PlanWater Resources Planning Guideline (WRPG), March 2023, Section 9.

A Best Value Plan

"A best value plan is one that considers factors alongside economic cost and seeks to achieve an outcome that increases the overall net benefit to customers, the wider environment and overall society. A best value plan should also be efficient and affordable to deliver."

Following the WRPG requirements we have developed a plan which meet the needs of the supply demand balance whilst providing best value for our customers, the wider environment and overall society.

This report describes the decision-making methods we have used, how we have developed and appraised alternative plans and how our customers and stakeholder preferences have shaped our best value plan.

3 Water Resources Planning Guideline (WRPG), March 2023, Section 9.

3 How we developed our plan

We consider many factors whilst developing our plan, these include:

- Government policy and expectations on demand management, including leakage reduction, metering and customer usage, described in Demand management preferred plan and Demand management option appraisal supporting technical documents.
- Improvements to protect and enhance the environment by reducing abstraction, see Sustainable abstraction and environment report.
- What is important to our customers and stakeholders in terms of scale and timing of environmental and drought improvements, affordability and the type of option, see Customer and stakeholder engagement supporting technical document.
- The plans from the regional groups.
- A set of feasible supply-side options most appropriate for appraisal to develop our preferred programme of options, see Supply-side option development technical document.
- The benefits of our plan (both monetary and non-monetary) for customers, environment and society (such as public health, well-being, and recreation) and how these are distributed spatially and over time.
- Our plan is based on forecasts of future supply and demand, how does that uncertainty affect our plan? how sensitive is it to these assumptions? How flexible, adaptable are our options to meet future uncertainties?
- How our plan can contribute to achieving the Government's target of net zero by 2050 and the water industry target for net zero operational carbon by 2030.

3.1 What is best value?

The factors, above, have developed our understanding of what best value means to our customers, stakeholders and within our own business.

We have created a best value planning framework, see Section 3.4.2, which identifies outcomes and objectives for our plan. This framework is used to assess and compare plans and options.

The objectives are aligned to our strategic outcomes for customers shown in Figure 5. Definitions of what we mean by outcomes and objectives, are provided in .

Figure 5 Best value plan objectives aligned to outcomes for our customers

Box 2: Best value outcomes and objectives definitions

Outcomes for our plan

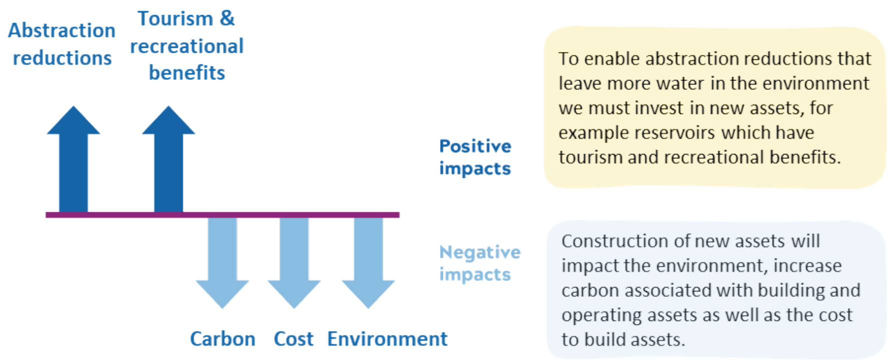
The consequences of achieving our objectives, these are aligned to our strategic Outcomes to Customers, such as a 'Flourishing Environment'

Objectives of our plan

These are the specific goals of our Best Value Plan, such as 'A plan that is affordable and sustainable over the long-term'

It is not possible to just maximise everything, there will be trade-offs between objectives. Figure 6 shows how maximising one objective can affect the others in a negative way.

Figure 6 Best value plan trade-offs



A best value plan maximises these outcomes and objectives whilst recognising and balancing the trade-offs between objectives to deliver the best outcome to customers, stakeholders and the environment.

To get this balance right we have engaged throughout the process of developing our best value objectives and assessing alternative plans with both household and non-household customers as well as our stakeholders, see Customers and stakeholders engagement technical supporting document. Sections 6 and 8 of this report shows how we have used these outputs to shape our plan.

3.1.1 Ofwat public value principles

In 2021 Ofwat published a set of principles for public value. The principles focus on,

1. the conditions in companies which could facilitate delivery of social and environmental value, and
2. set boundaries around what is considered 'public value' from a regulatory perspective.

Table 1 lists the principles and shows how we have addressed them throughout our WRMP process.

Table 1 Ofwat Public value principles

	The Principle	How we have addressed it
Principle 1	Companies should seek to create further social and environmental value in the course of delivering their core services, beyond the minimum required to meet statutory obligations. Social and environmental value may be created both in direct service provision and through the supply chain.	Via option development, and through the incorporation of our six capitals value framework during our wider investment process.
Principle 2	Social and environmental benefits should be measurable, lasting and important to customers and communities. Mechanisms used to guide activity and drive decision-making should support this, for example through setting and using company purpose, wide external engagement and explicit consideration of non-financial benefits	Via objective setting, customer engagement, and through the incorporation of our six capitals value framework during our investment process.
Principle 3	Companies should be open with information and insights on operational performance and impacts (both good and bad). This will support stakeholder engagement, facilitate collaboration and help identify opportunities for delivering additional social and environmental value.	Through stakeholder and customer engagement
Principle 4	Delivery of social and environmental value outcomes should not come at greater cost to customers without customer support.	Incorporation of customer engagement and views throughout option development and appraisal
Principle 5	Companies should consider where and how they can collaborate with others to optimise solutions and maximise benefits, seeking to align stakeholder interests where possible, and leveraging a fair share of third-party contributions where needed. Companies' public value activities should not displace other organisations who are better placed to act	Through option development, and through the incorporation of our six capitals value framework during our wider investment process.
Principle 6	Companies should take account of their capability, performance and circumstances in considering the scope for delivering greater social and environmental value.	Through deliverability testing

3.2 National and regional challenges

As with our previous WRMP, we consider how we contribute to national and regional water resources challenges. For WRMP24 this is through regional planning groups, set out in the National Framework, which provides an indicative scale of challenge for water resources in England over the next generation. This includes public water supplies provided by water companies to customers' homes and businesses; direct abstraction for agriculture, electricity generation and industry; and the water needs of the environment.

Within the regional groups, regional plans are developing in parallel that identify the best options to meet these challenges whilst delivering best value for the environment and society. We are key members of the following regional groups:

- Water Resources East (WRE) which covers the majority of our region and includes membership from Essex & Suffolk Water, Cambridge Water and Affinity Water (for their Brett zone only)
- Water Resources North (WReN) which includes our Hartlepool Water Resource Zone. The other members are Northumbrian Water and Yorkshire Water.

The national framework provides a long-term approach to achieving sustainable abstraction referred to as Environmental Destination. This takes us beyond the previous short-term view of a five year cycle of review and implementation, and provides a requirement to look across a 25 year horizon for delivering environmental improvement by changes to the amount we can abstraction.

The regional plan has informed the development of our best value plan and through a series of iterations between the two plans. For our WRMP we have completed our own evaluation of the decisions made by the regional groups to understand if they truly offer best value to our customers, this is further explained in Section 6.1.

3.3 Strategic Resource Options

At WRMP19 a number of Strategic Resource Options (SROs) were identified. Some water companies received funding to further investigate and develop these options. An alliance of regulators known as the Regulators' Alliance for Progressing Infrastructure Development (RAPID) was set up to help accelerate the development of the new strategic water infrastructure and inform future regulatory frameworks. RAPID is made up of the three water regulators in England: Ofwat, Environment Agency and Drinking Water Inspectorate (DWI).

The SROs follow a gated process where development of the options can only progress if they pass the checks and requirements at these gates. We have two SROs within our supply area, these are:

- Lincolnshire reservoir
- Fens reservoir being developed in partnership with Cambridge Water

A third SRO for the pipeline from Peterborough to Grafham, has been included in the decision making modelling as an unconstrained option, which allows the model to chose the size of the transfer to suit the scenario.

Through the regional plans and our WRMP24 we must provide justification for the need, size and timing of these schemes.

The Lincolnshire reservoir was initially developed in partnership with Affinity Water, but as both the regional and Affinity Water's needs were confirmed it was mutually agreed that the entire benefit from the new resource was required within the WRE plan and that Affinity Water preferred to receive water from other SRO's.

The Fens reservoir, is being developed so that we share the resource with Cambridge Water. To reflect this, we have modelled the costs and benefits for the Fens reservoirs as the proportion available to Anglian Water. This has been based on a 50% share for reservoir options with a total yield of less than 100Ml/d, for options providing more than 100Ml/d it has been agreed that Cambridge Water would require 50 Ml/d and the rest would be available to Anglian Water.

We have modelled a range of reservoir sizes providing different yields for each of the SRO locations, these are shown in Table 2.

The SRO programme is running in parallel to the development of our WRMP and we have used interim data where appropriate for the SRO schemes (post Gate 2) for developing our WRMP. This includes a review of the available sources of supply for each reservoir and update to the assessment of yield to reflect the new hydrological data based on the stochastic droughts we use to forecast 1:200 and 1:500 drought impacts.

There are three possible sources of supply being assessed for the Lincolnshire reservoir, these are,

- **River Trent** has significant water availability and provides a highly climate resilient source for the Lincolnshire reservoir, in support of the Witham source. It is proposed to transfer water, either by pipeline or open channel transfer from the Trent to the Witham, at times when it is not possible to abstract from the Witham itself.
- **River Witham** catchment serves as an important source in its own right, in addition to its function as a transfer route to bring water from the Trent to the reservoir. A pipeline transfer from the Witham to the reservoir is being assessed, alongside an open channel transfer via the South Forty Foot Drain.
- **South Forty Foot Drain** is being considered as a potential additional source to supply the reservoir given its proximity, and potential function as a transfer route for water from the Witham.

There are five possible sources of supply to fill the Fens reservoir, these are,

- **Middle Level** will provide the primary source of water via the Sixteen Foot Drain (or the Forty Foot Drain) adjacent to the reservoir site, when water is available. If required, due to level constraints, water will be transferred to the Middle Level from the other available sources to the reservoir, described below.
- **River Nene (Stanground)** feeds the Middle Level at Stanground via King's Dyke throughout the year. It may be proposed to improve the capacity of this transfer and channel, if required, to enable additional transfer from the River Nene, when water is available.
- **River Great Ouse (Earith)** is being assessed as a transfer option involving either a pipeline to the reservoir or a combination of pipeline and open water transfers to the Middle Level system.
- **Counter Drain (Nene)** is expected to provide a resilient yield to supply the reservoir. The Counter Drain (Nene) currently discharges to the tidal River Nene, downstream of the Dog-in-a-Doublet. Subject to ongoing assessment of availability and water quality, available water could be discharged into the fluvial Nene and transferred to the reservoir via the connection to the Middle Level.
- **Ouse Washes (River Delph)** is located in close proximity to the reservoir, and is regularly flooded with water which is diverted from the River Great Ouse at Earith. This potential source option involves a proposed transfer from the River Delph at or nearby to Welches Dam, and improvements to the Forty Foot Drain to transfer water into the Middle Level system.

For the RAPID Gate 2 assessment the Fens reservoir yields were based on abstraction from the Ouse Washes (River Delph) and River Great Ouse (Earith) only. For the WRMP24, we also model abstraction from the Middle Level with feeds from the River Nene and Counter Drain (Nene). The revised reservoir yields are shown in Table 2, for a range of reservoir sizes.

Table 2 Strategic regional options used in our modelling

	Size (Million Cubic Metres)	Total Yield (Ml/d)	Date into supply	Proportional to Anglian Water
Lincolnshire reservoir	25	105	2038	100%
	50	169	2039	100%
	75	195	2041	100%
	100	214	2046	100%
Fens - Low yield options (Middle Level, Nene, Ouse Washes and Earith)	25	54.0	2036	50%
	50	77.1	2036	50%
	75	100.1	2039	50%
	100	122.8	2042	59%
Fens - High yield options (Middle Level, Nene, Counter Drain and Earith)	25	66.1	2036	50%
	50	88.8	2036	50%
	75	111.1	2039	55%
	100	130.5	2042	62%

We will continue to assess and optimise the potential abstractions from these sources throughout RAPID's Gate 3 and beyond, and so have also modelled a sensitivity test for the Fens sources where we use a potentially higher yielding combination of sources, this data is shown in Table 3.

4 Water Resources Planning Guideline (WRPG), March 2023, Section 1.4.5

Table 3 Strategic regional options used in our sensitivity testing

	Size (Million Cubic Metres)	Total Yield (Ml/d)	Date into supply	Proportional to Anglian Water
Fens - Sensitivity test (Middle Level, Nene, Counter Drain and Ouse Washes)	25	75.9	2036	50%
	50	99	2036	50%
	75	121.9	2039	59%
	100	144.9	2042	65%

3.4 How we make decisions

In this section we provide an overview of how we make decisions within the different scales of planning, see Sections 3.2 and 3.3, and how our customer and stakeholder preferences have been incorporated into the decision making. A full explanation of how we developed the detailed methodology is in Section 4, and the remainder of this report captures how we have applied the decision-making approach to develop our best value plan.

3.4.1 Decision Making Framework

The planning requirements at the different scales of regional, company (WRMP) and strategic options present different levels of complexity and aims. Each of these are determining different elements that feed into our best value plan. For example:

- The SRO projects identify where the reservoirs would be located, the quantity of water available to abstract and treat and how much they cost to design, deliver and put into supply.
- The regional plan provides details of the regional need including multi-sector needs and environmental destination.
- The WRMP then pulls this together to determine and provide justification of the need, timing and scale of the SROs and the other options required in addition to meet the level of environmental destination[4].

Each of these stages use best value metrics to make these decisions, see Figure 7. More details of the interfaces between these areas of work in Section 3.4.6.

Figure 7 Decision making framework

	Regional plan	Water Resource Management Plan*	Strategic Regional Options
Decision making complexity	Extremely complex	Very complex	Fairly complex
Principal guidance	National Framework for Water Resources	Water Resource Planning Guideline	Regulators Alliance for Progressing Infrastructure Development
Aims	Produce a resilient, long-term water resource plan for the region	Achieve a secure supply of water for customers and a protected, enhanced environment	Progress strategic infrastructure to meet the long-term needs of the region(s)
What it determines	Environmental destination and ambition for the region Additional inter-regional transfers Strategic supply-side options and timings SRO need and sizing Non-PWS options	Confirm environmental destination and ambition for the company Company supply-side options and their timing Demand management options and their timing 1:500 Drought resilience timing Licence cap timing Confirm SRO need and sizing SRO sizing, location and timing of need	SRO delivery date Multi-sector opportunities Design and progression of scheme
How is best value applied	Reflects multi-sector aims and needs, as well as looking at inter-regional transfer capability Trades off multiple stakeholder objectives through a high-level large set of search and tracked metrics	Reflects company environmental and societal outcomes and aligns with strategic direction and LTDS Integrates stakeholder and customer views	Aligned with regional plan and company WRMPs Decision making criteria for site location Cost and technical elements of concept design, following design principles

*Statutory document

3.4.2 Best value plan framework

We have developed a best value plan framework based on objectives of what we would like our plan to achieve. These objectives are aligned to our strategic outcomes to customers, see Box 2.

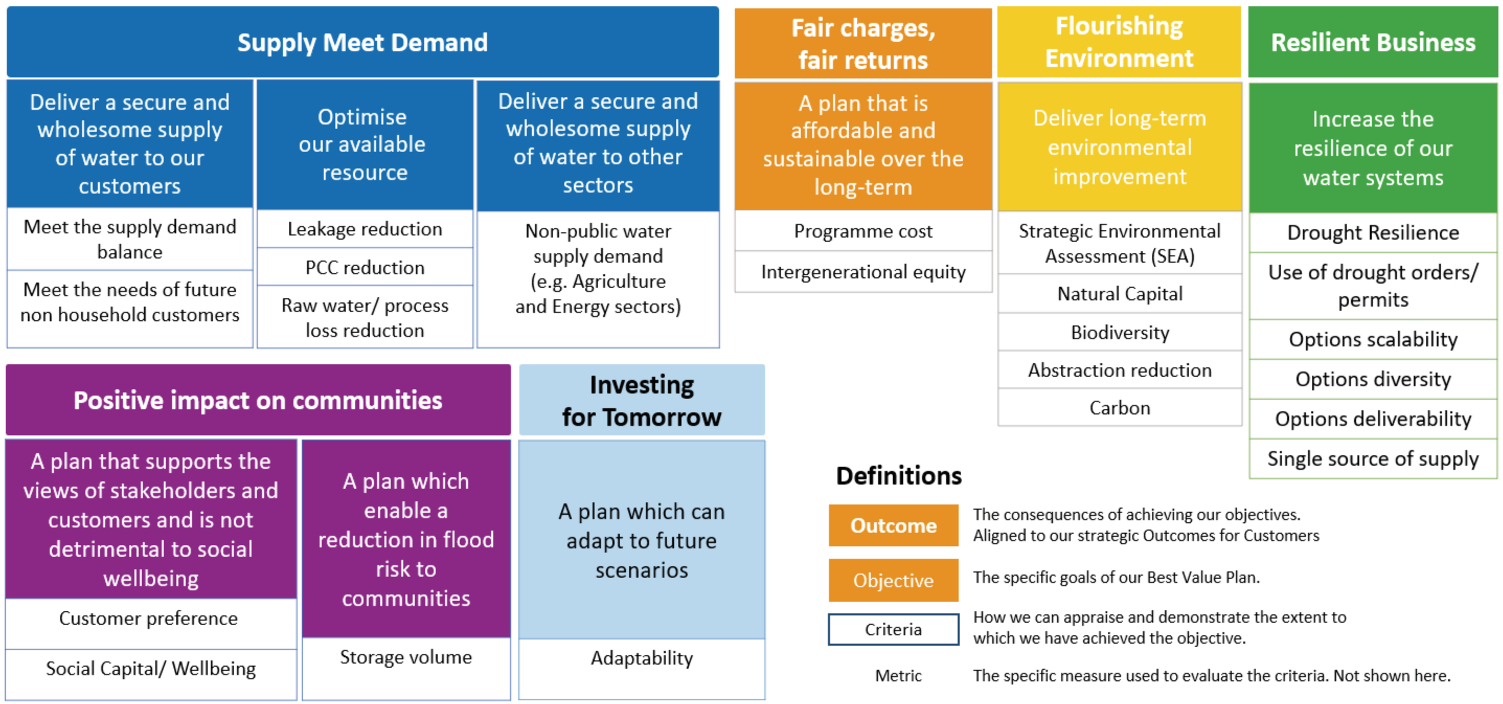
Beneath the objectives sit the criteria we use to demonstrate the extent to which we have achieved objectives. These criteria are either applied at plan level or at individual option level. We use a range of metrics which are the specific measure to evaluate the criteria. These can be quantities, monetised values or qualitive assessments.

The framework has been co-created with our customers via our online community work. We have also worked with our stakeholders and regulators to ensure they are fit for purpose and meet their priorities, Section 3.4.5 has more details of the engagement process.

The criteria and metrics differ slightly from those used for the regional plan and SROs due to the different nature of the decision-making process and sectors involved. However, the objectives that will be achieved remain aligned.

The full best value framework is in Appendix A this provides more details of criteria and metrics.

Figure 8 WRMP Best value plan framework



3.4.3 Intergenerational Equity

Intergenerational equity is the concept of fairness between generations, where meeting today's requirements must not compromise the ability for future generations to meet their needs. When we consider financial costs, we do this within the context of intergenerational equity. In terms of our objective of a 'plan that is affordable and sustainable over the long term' we consider this as the allocation of costs and benefits between current and future customers[5].

We will also consider this concept more broadly when comparing other metrics such as abstraction reduction, timing of impacts, adaptability, and carbon.

3.4.4 Benchmarking a least cost plan

We develop least cost plans which consider only cost and none of the other best value metrics. These least cost plans provide the cheapest way of meeting the supply demand scenario, though they may not offer best overall value.

The least cost plans provide a benchmark for all other plans to be compared against and form the starting point for the development of our best value plan. We clearly explain and document decisions to move away from the least cost plan. More information on least cost plans is provided in Section 4.8.

3.4.5 Customer and stakeholder preferences

We have engaged with households, businesses and future customers, as well as customers in circumstances that make them vulnerable. Qualitative and quantitative engagement has been undertaken, using independent search providers. Collaborative engagement with other water companies has also occurred, ensuring a consistency of approach. Our stakeholders and regulators have been influential in shaping our plan, providing constructive challenge and advice. We have actively participated within the regional planning groups, Water Resources East, Water Resources North and Water Resources South East, as well as companies within the Regulators' Alliance for Progressing Infrastructure Development process. Individual discussion with regional and local stakeholders have also been important to us, allowing the opportunity to discuss topics in depth. This engagement will continue to form the backbone of our WRMP24, as well as our wider business activities. We will continue to engage with our customers and stakeholders on topics that are important to them, and us. See our Customer and stakeholder engagement report for more details. Box 3 summarises the key insights from the engagement with our customers and stakeholders, these have been fundamental for shaping and assessing our alternative plans.

Box 3: Key insights from customer and stakeholder engagement

The key insights from the engagement include:

- Our customers believe that we need to achieve our environmental targets as they are crucial for the future of the planet.
- The environmental destination of 'restore and improve' (known as BAU+) is seen as the preferential scenario by our customers. This view is driven by financial security and concerns over affordability.
- The majority of our customers feel we should achieve our environmental destination sooner than 2050.
- Our customers feel that our Levels of Service for Temporary Use Bans and Non-essential use bans are acceptable. However, they did welcome moving to a higher level of severe drought resilience.
- Most of our customers were unaware of drought permits. Just under half of those engaged with believed that the use of drought permits should be reduced, citing possible environmental impacts. However, when explored holistically this became less of a priority, with affordability and other environmental impacts coming to the fore.
- Achieving higher level of severe drought resilience by 2039 was largely seen as the right time scale by our customers.
- Making the most of what we have remains a priority for our customers with demand management measures being seen as the preferential way of tackling deficits.
- Reservoirs and water reuse were the most preferred supply-side options.
- Seventy nine percent of our customers felt people should pay their water bills on the basis of the amount of water they use.
- Customers support the principle of a best value plan, but there is a core desire from customers for bills to be fair and affordable.

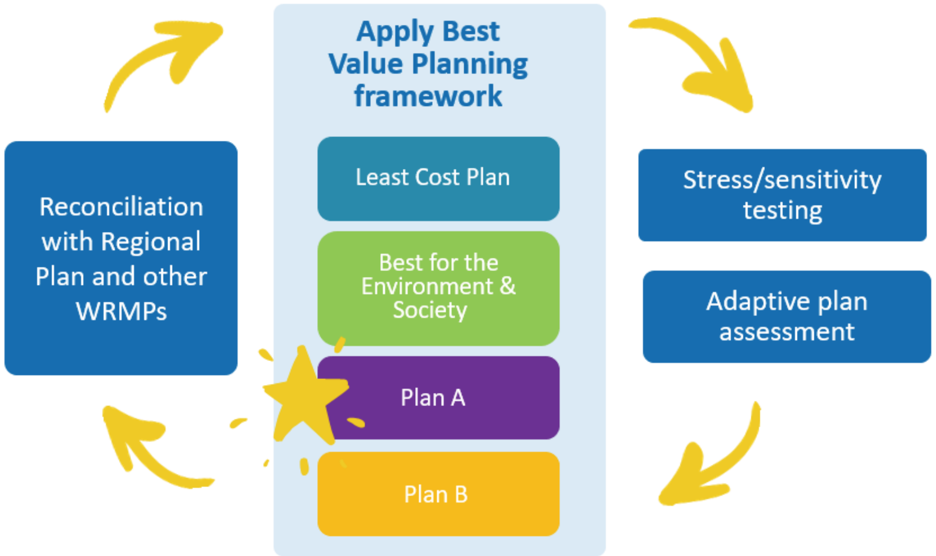
5 UKWIR (2020) Deriving a Best Value Water Resource Management Plan 20/WR/02/14 (Page 61)

3.4.6 Alignment with other plans

Our strategic regional options, regional and company plans are all developed in parallel and require an iterative approach to reconcile and refine plans. The guidance requires our plan to reflect the regional plan unless there is clear justification for not doing so[6].

The regional plan covers different scales and other sector's needs compared to our WRMP which only covers public water supply to our customers. Our decision making methodology includes for modelling to verify some of the regional decisions, see Section 6.1. The iterative approach to aligning the plans shown in Figure 9 ensures that we can feed decisions at a smaller scale back into the regional plan so that plans are aligned. This provides us with the confidence and evidence that the regional plan is also the best value plan for our customers.

Figure 9 Iterative approach to aligning our plans



6 Water Resources Planning Guideline (WRPG), March 2023, Section 2.2

4 Decision-making approach

To appraise and select options to include in our plan we developed a decision making approach following the WRP Guidelines and other best practice methodologies, see Box 4 below.

Box 4: Guidance used to develop our decision making approach:

- Water Resources Planning Guideline (WRPG) (March 2023)
- Water resources national framework Appendix 2: Regional planning (2020)
- Water resources planning guideline supplementary guidance - Adaptive planning, March 2021
- Water resources planning guideline supplementary guidance - Environment and society in decision-making, March 2021
- Water resources planning guideline supplementary guidance - Water resource zone integrity, March 2021
- Water resources planning guideline supplementary guidance - Outage, March 2021
- Water resources planning guideline supplementary guidance - 1 in 500, March 2021
- Water resources planning guideline supplementary guidance - Preventing deterioration, April 2022
- PR24 and beyond: Final guidance on long-term delivery strategies, April 2022
- UKWIR (2016) Decision Making Process Guidance
- UKWIR (2016) Risk Based Planning Methods
- UKWIR (2020) Deriving a Best Value Water Resource Management Plan

We developed our decision making method by referring to all the guidance in Box 4. Much of the guidance overlaps but thefirst stage in all the methods is to define our water resource zones and complete a problem characterisation assessment.

4.1 Water Resource Zone Integrity Assessment

Water resource zones (WRZ) are the principal building blocks used by water companies to develop their supply-demand balances (SDB)[7]. As a water company we are responsible for dividing our region into WRZs.

Water resource zones describe an area within which managing supply and demand for water is largely self contained; where the resource units, supply infrastructure and demand centres are linked such that customers in the water resource zone experience the same risk of supply failure. Water resource zones tend to have the features describes in Box 5.

Box 5: Features of Water Resource Zones[8]

Features of Water Resource Zones:

- Represent the largest area in which all resources can be shared effectively
- Customers within the water resource zone receive the same overall risk to public supply so there is no significant number of people at a higher risk of supply failure
- They are essentially self-contained - defined by infrastructure connectivity and geographic or physical boundaries

The first stage of developing our WRMP is to assess the integrity of the water resource zones we used for the previous WRMP to confirm they are still suitable and define new ones if appropriate. The assessment uses early supply demand forecasts to develop potential scenarios to test the integrity of the zones. Using our WRMP19 zones, we modelled various scenarios for supply and demand, including different levels of growth and environmental destination. This can expose discrete areas of deficit within a larger water resource zone. Where this is the case, we divide the water resource zone into two smaller zones so that the discrete deficit can be exposed and more explicitly included in our modelling.

7 Water resources planning guideline supplementary guidance - Water resource zone integrity, March 2021, section 2.1, page 1
8 Water resources planning guideline supplementary guidance - Water resource zone integrity, March 2021, section 2.2, page 2

There may also be opportunities to combine water resource zones if connectivity between zones is enhanced. Our WRMP19 best value plan included a series of interconnectors between water resource zones which allow resource to be moved from areas in surplus to those in deficit. This gave us an opportunity to combine some water resource zones, but the impact of supply reduction due to licence capping and environmental destination also meant other zones were split into separate water resource zones. In WRMP19 we used 28 (including Hartlepool), our review concluded that 16 should remain unaltered, and the others were either split or combined to make 27 (including Hartlepool) new water resource zones. These changes to boundaries are show in Figure 10.

Figure 10 Changes to water resource zones between WRMP 19 and WRMP24

4.2 Problem characterisation

We start with carrying out a problem characterisation assessment based our new WRMP24 water resource zones to select our modelling approach, following the UKWIR Decision Making Process[9]. There are two elements of the assessment to determine the level of concern:

1. Strategic needs - how big is the problem?
2. Complexity factors - how difficult is it to solve?

The problem characterisation is used to identify appropriate decision-making tools based on the level of complexity[10]:

- Low level concern - use standard current approaches
- Moderate level concern - consider 'extended' approaches
- High level concern - consider 'complex' approaches

For the problem characterisation we simplify our region into 7 areas to carry out the assessment, this is summarised in Table 4.

Table 4 Summary of problem characterisation

Area	Water Resource Zones	Total Needs Score	Total Complexity Score	Level of Concern
1	Lincolnshire WRZs	4	12	H
2	Ruthamford WRZs	6	20	H
3	Fenland WRZ	3	14	M
4	Norfolk WRZs	5	16	H
5	Essex and Suffolk East WRZs	6	17	H
6	Suffolk and West Cambridgeshire WRZs	4	16	H
7	Hartlepool	0	1	L

Five of our areas within the Anglian region have high concern and one with medium. The new interconnectivity between areas, which we are currently delivering as part of WRMP19, mean that we need a consistent modelling method, despite the variations in concern. Our Hartlepool water resource zone is geographically remote and has a low level of concern, we include this within our model but it is completely separate from the influence of our other water resource zones.

We assess risk and uncertainty for each water resource zone to reflect the variations within zones, this is described in more detail in Section 4.9. The assessment shows that we should use the following modelling approaches:

- Anglian Region -a 'complex' approach
- Hartlepool - low concern so current methods to be used if required.

4.3 Modelling approach

In Section 3.4.6 we showed how decision making between the regional plan, WRMP and SROs align. These three areas of work have progressed in parallel requiring an iterative approach to refining best value plans at regional and water company level.

The key interactions are:

- The regional plan shows how the environmental destination will be achieved by developing strategic supply-side options and identifying when these are required.
- The SRO projects will identify the most suitable location, benefit to supply and assess their feasibility.
- The WRMP must present the need for the SROs, their timings, and the justification for our decisions both regionally and company level[11].

Our modelling approach must be suitable to provide the justification to accept the regional decisions and to provide the confidence and evidence that the regional plan is also best value for our customers.

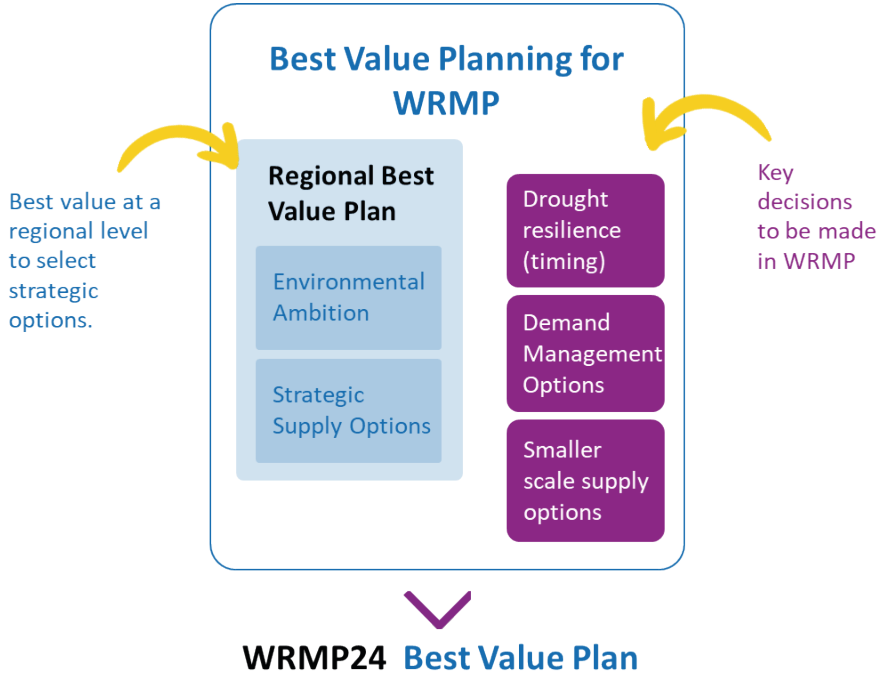
Our modelling approach must be suitable for answering these key questions:

9 UKWIR, 2016 Decision Making Process: Guidance, Stage 3: Problem Characterisation, page 15
10 UKWIR, 2016 Decision Making Process: Guidance, Stage 4: Select appropriate modelling method, page 22
11 Water Resources Planning Guideline (WRPG), March 2023, Section 1.4.5

- What environmental destination are we seeking to achieve in the long-term and when?
- What strategic supply options are required and when?
- When should we achieve 1 in 500-year drought resilience?

Figure 7 in Section 3.4.1 characterises the complexity of decisions in the WRMP compared to the regional plan. Figure 11 shows the key decisions and issues to be resolved following the problem characterisation, and maps where these are to be addressed at regional level, as part of the WRMP or a combination of both.

Figure 11 Key decisions at regional planning and WRMP



This shows that the most complex decisions such as environmental destination and strategic supply options are to be assessed within the regional plan. The moderate concerns such as local/smaller scale supply-side options are to be assessed as part of our WRMP. In summary:

- **Regional Plan Modelling: more 'complex' decisions**
  - Multi-objective robust decision making (MORDM) process, with trade-off stakeholder workshops, to decide strategic regional options
  - Regional Economic of Balancing Supply and Demand (EBSD) model will be used to support decision making, and for scheduling when options are to be delivered
- **WRMP Modelling: 'moderate' decisions**
  - Use a 'hybrid' approach based on 'extended' approaches
  - Use our existing EBSD-MGA model to develop least cost plan and alternative plans within the constraints of the regional plan.
  - optimise small resource and transfer options
  - conduct stress testing and sensitivity testing
  - develop a new simulation model for robustness testing to expose trigger points and provide metric data if required

Box 6: Different modelling processes

Multi-objective robust decision making (MORDM)

A decision making under uncertainty framework. In WRE this involves using a bespoke PyWR (see description below) simulator model driven by a variety of planning scenarios to build a system-based regional representation of what the future could look like from a supply and demand perspective. The main output of the approach is a set of options that are robust to uncertainty. Using modelled system performance metrics, 'pareto optimal' portfolios of options can be identified, as well as trade-off relationships between metrics. The process also involves portfolio stress and vulnerability testing.

Economic of Balancing Supply and Demand (EBSD)

A least-cost optimisation model which economically assesses the balance of supply and demand-side options. Any imbalance between supply and demand can be met either by demand side options, such as metering, water efficiency and leakage, or by providing additional water resources - supply side options.

Modelling to Generate Alternatives (MGA)

A tool used in combination with EBSD to generate a diverse set of near-optimal solutions for consideration by decision-makers.

Simulation modelling using PyWR

PyWR is python code based system modelling tool used as the basis for the WRE simulator model within the MORDM approach. The model is used for solving network resource allocation problems. It has similarities with other packages such as Aquator and MISER, but has advantages of speed and flexibility.

Probabilistic multi-objective investment modelling

Approaches that use a model of the resource system and run generated time series in Monte Carlo fashion to evaluate metrics around resilience and return periods and the costs/benefits of investment.

System simulation modelling

An existing or purpose built supply (or water resource) network model, which interlinks locations of supply and demand, can be used to estimate flows downstream of intakes and/or releases, surface water storage, water use, energy use, and operating costs throughout the water resource network at each user-defined timestep.

Using our EBSD-MGA model ensures that plans are optimised as least cost within the constraints of the input data, so that the overall analysis is multi-objective. To align with objectives, we either adjust the forecast data, options data or a combination. For example, if we want to explore environment objectives by reducing groundwater abstraction in Norfolk, our supply forecast would be reduced to reflect these reductions and the model would then select the least cost combination of options to meet this objective.

The benefit of using our EBSD-MGA model is that it allows us to optimise against individual criteria, for example we can alter one element of the supply or demand forecast at a time to clearly understand the impact of that change. For each run of the model we have a baseline run to compare criteria against which clearly demonstrates the impact of any changes to assumptions providing transparency.

Our modelling approach provides a method for exploring real differences in objectives and providing best value metric data but we still need a method for analysis and comparing the modelling outputs, this is our decision making approach described in Section 4.4.

4.4 Decision making approach

Our decision making method has been developed using the guidance listed in Box 4. We have used the UKWIR Deriving a best value water resources management plan as the basis of our approach. The report recognises that there are a variety of methods and approaches that may equally arrive at a best value plan but recommends multi-criteria decision analysis (MCDA) as one of the appropriate tools[12]. This is structured as a five-step approach:

- Step 1: Problem structuring
- Step 2: Define value criteria and constraints
- Step 3: Determine performance of alternatives against criteria
- Step 4: Determine scores and weights
- Step 5: Evaluation and comparison of alternative plans

The key message is that clear justification must be provided for every decision taken in the development of the plan[13]. This is fundamental to our approach.

To compare plans using MCDA the performance against the various criteria needs to be converted into a single scale. This is undertaken using scores and weights, see Box 8. The views of customers and stakeholders, regulator and government policy priorities, and measures of social benefits are used to determine these[14], as shown in Box 7.

Box 7: Key messages for developing a best value plan[15]

The fundamental principles for developing a best value water resources plan are:

1. The plan must consider a range of factors to offer a benefit or value greater than the statutory minimum requirements to meet supply duties.
2. The plan must be presented in such a way as to robustly and transparently illustrate how and where those factors have been considered.
3. The plan must clearly set out its objectives. Justifications for decision-making should be given that include explanation of how those objectives are met.
4. The plan must demonstrate that meaningful engagement has taken place with regulators, stakeholders and customers at key stages throughout the development of the plan and show how their views and evidence have been taken into account.
5. The plan must be deliverable. Regional plans should be capable of implementation/incorporation by water companies in that region and should have due regard to the company's statutory duties and need for justification of regional decisions to arise at an individual company level.

12 UKWIR (2020) Deriving a Best Value Water Resource Management Plan. Section 3.1, page 27
13 UKWIR (2020) Deriving a Best Value Water Resource Management Plan. Section 3.1, page 27
14 UKWIR (2020) Deriving a Best Value Water Resource Management Plan. Section 5.5.2, page 72.
15 UKWIR (2020) Deriving a Best Value Water Resource Management Plan. Section 3.1, page 27

Box 8: Definitions of scores and weights

Scores

As the criteria used to assess plans can require different types of measurement (metrics). These can include evaluating the probability of something occurring, evaluating the volume of water or deriving monetary values. To compare these metrics each will need to be converted into a common scale.

Weights

Weights are used to represent the relative value of different criteria, or the trade-offs between criteria. They are a way of representing priorities between criteria.

Scores and weights are based on information gained from customers, stakeholders and from valuations of environmental and social impacts. How these are determined, assigned and used within the decision making process should be clearly explained[16].

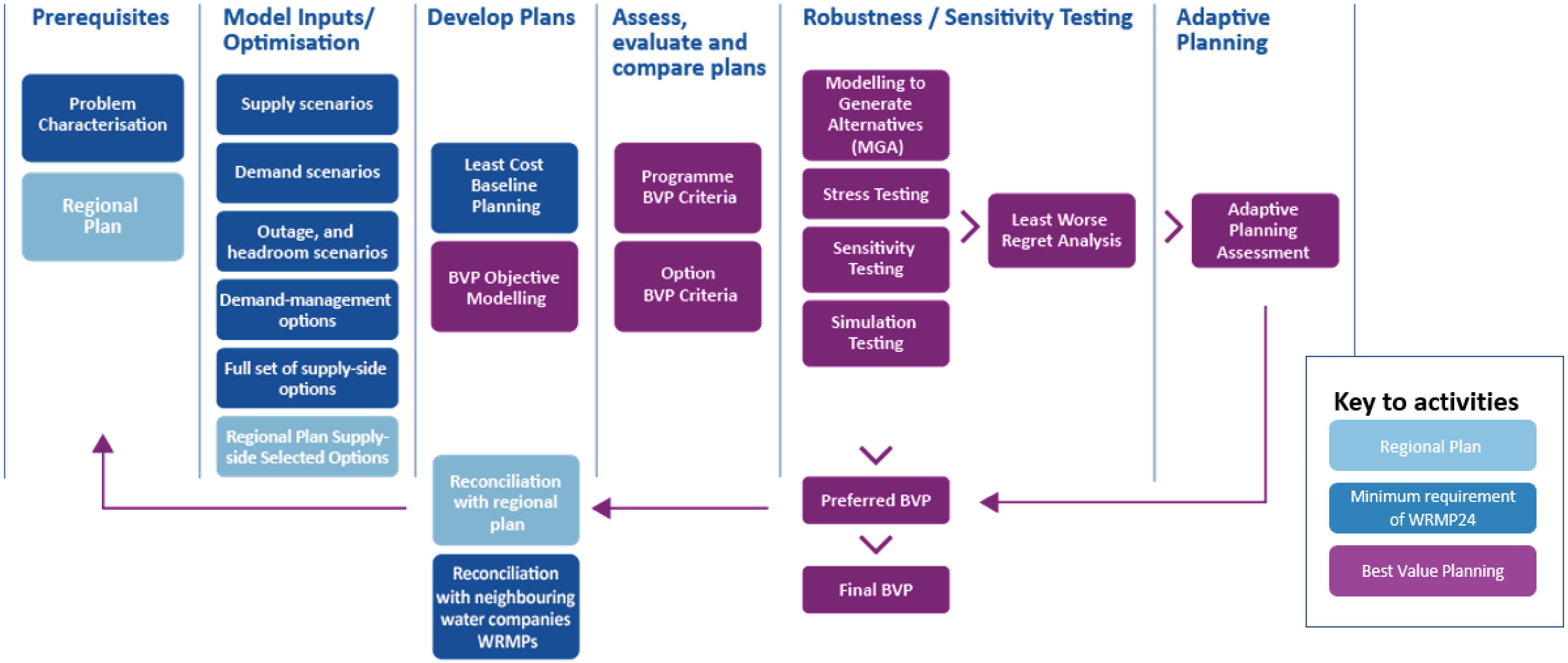
The WRPG require us to be transparent in our methods, data, assumptions and decisions. This is so customers, stakeholders, regulators and government can understand and comment on our plan[17]. Evaluation using scores and metrics can be very complex and not easy to articulate decisions.

Our decision approach is based on the five step MCDA approach. However, we do not include scores or weightings to evaluate plans (step 4). Instead, we use our customer and stakeholder engagement to prioritise what is important to them and use this to shape our plan, which we feel is more transparent than using scores and weight.

- Step 1: **Structuring the Problem** - using the problem characterisation and forecasts of supply and demand to establish the scale of the water resource problem we need to plan for.
- Step 2: **Defining best value** and how we can demonstrate our plan provides best value - this is our best value plan framework, see section 3.4.2.
- Step 3: **Undertake effective engagement to shape alternative plans.** Our engagement with customers, stakeholders and regulators through the whole development of the plan, including our best value planning framework, is used to inform our decisions to shape our best value plan.
- Step 4: **Modelling to develop alternative plans** including a least cost plan to benchmark against.
- Step 5: **Testing plans to future uncertainty -** our alternative plans are based on assumptions and forecasts of future demand and supply. We test our plans to understand how they would be impacted by variations such as population growth and climate change.
- Step 6: **Applying the best value planning framework to evaluate and compare plans** including our least cost plan and alternatives.
- Step 7: **Selecting our best value plan -** using the outputs from steps 4-6 we can identify our preferred plan providing best value to customers, the environment and society whilst being efficient and affordable to deliver.
- Step 8: **Adaptive planning assessment -** sometimes the future uncertainty is such that an adaptive plan is more suitable. Our assessment of our preferred plan provides an understanding of how easy it would be to adapt if the future were to differ from our original assumptions.
- Step 9: **Final alignment with regional plans and other water company plans -** These areas of work have progressed in parallel requiring an iterative approach to refining best value plans at regional and water company level.

16 UKWIR (2020) Deriving a Best Value Water Resource Management Plan. Section 5.5.2, page 75
17 Water Resources Planning Guideline (WRPG), March 2023, Section 1.1.1

Figure 12 Decision making process



Our decision making process is set out in Figure 12. It is an iterative process and some stages are repeated and refined as we develop our plan.

To help structure our decision making we have set out the modelling as a series of questions we need answering, this includes the strategic questions in Section 4.3. Each question requires a model run which generates metrics for analysis including comparison against a baseline model run. This clearly demonstrates the impact of any changes to assumptions and provide differences in metrics. We use the best value framework to show the impact of changing assumptions and where there are not clear differences, we use the customer engagement to prioritise criteria.

At the start of developing our approach we identified the objectives listed in Box 9 to ensure we meet the requirements of the WRP Guidelines, the needs of regional planning, stakeholders, customers and our Business. Our decision making approach meets these objectives.

Box 9: Objectives set for modelling and decision making approach

Objectives set for modelling/decision making approach:

1. Must be clear and transparent
    - All input data/forecasts are clearly understood and suitable for modelling application.
    - All data/forecasts align with regional model and can clearly demonstrate hands off/interfaces between both.
    - All alternative plans can be compared on an equal basis and against the baseline least cost planning.
    - Provide transparent data to explain decisions.
2. Provide robust output
    - Methods are adequate for dealing with uncertainty. Risk and uncertainty methods adjusted as required for modelling application to avoid double counting of risks.
    - Suitable level of complexity aligned to Problem Characterisation i.e. not too simplified/conservative or too complex (black box).
    - Methods are suitable to seek solutions that perform well under uncertainty.
3. Can be easily articulated to customers, Regulators and stakeholders
    - Visualisation of modelling inputs and outputs to support/ provide evidence of decision making.
    - Be able to demonstrate how their views have been taken into account.
4. Suitable to meet best value planning objectives

4.5 How we consider the environment and society in decision making

We consider the environment and society in our decision making to ensure our plan deliver a protected and improved environment and provide benefit to society[18].

There are three approaches[19] we use to cover the aspects of the environment and society in our decision making, these are:

- **Strategic Environmental Assessment (SEA)**
- **Biodiversity Net Gain assessment**
- **Natural Capital assessments**, including Ecosystem Services assessment
- Habitat Regulation Assessment
- Water Framework Directive assessment
- Invasive Non Native Species risk assessment

Box 10 has more details of each of the approaches, which alongside the environmental destination reductions provide an overall environmental package, further details are provided in the WRMP24 Environmental Report (Chapter 5).Our WRMP24 plan making process has undergone a suite of environmental assessments that have supported our approach, the bullets in bold above directly contributed metrics into the decision making process, see Table 9 , with all assessments providing indirect input through the SEA findings. The findings of the HRA, WFD and INNS were also considered in discussion and, in particular, fed into the development and consideration of supply options, discussed in Section 5 of the WRMP24 Environmental Report, and also in the WRMP24'sSupply side options developmenttechnical supporting document

The assessments are applied to all of the feasible options and provide the metrics used within the best value framework to appraise and compare plans. The guidance provides details of how we could consider to combine these assessments to create one metric, if appropriate. However, there are potential issues with double counting of benefits, as some areas such as biodiversity form part of the three approaches that contribute to the

18 Water Resources Planning Guideline (WRPG), March 2023, Section 9.4

19 Water resources planning guideline supplementary guidance - Environment and society in decision-making, March 2021, Section 1.2

metrics. Combining the assessments is not a requirement[20], and we find it simpler to consider them separately as we are not using weights and scores in our decision making method, see Section 4.4.

Box 10: The approaches to include the environment and society in our decision making

Biodiversity net gain

The aim is to measurably improve biodiversity by creating or enhancing habitats in association with new development. Net gain for biodiversity is either an increase in the amount of biodiversity habitats or an improvement to existing habitats through better management. Our plans should consider providing an ambitious level of measurable biodiversity net gain, equal to or beyond 10% per development. This should be incorporated into the design of new options where reasonable, if this is not possible, we are obliged to provide the equivalent off-site.

Natural capital

Natural capital has been defined as 'the elements of nature that either directly or indirectly provide value to people'. It is an approach used to ensure decisions do not devalue, but look to enhance the value of the natural world for society. The benefits we obtain from these natural capital assets are referred to as ecosystem services.

Strategic Environmental Assessment (SEA)

The purpose of the SEA is to evaluate the effects of the plan and reasonable alternatives taking into account the objectives and the geographical scope of the plan in accordance with the Environmental Assessment of Plans and Programmes Regulations 2004.

In addition to the above assessments that contributed direct metrics into our decision making process, we also conducted Habitats Regulation Assessment, Water Framework Directive assessment and Invasive Non Native Species risk assessment, which focussed on the development of supply side options available to decision making, but were also used to inform decision making discussions and were applied to the four plan alternatives. They are reported in the WRMP24 SEA Environmental Report. Sub-reports for each of the other assessments, are also available.

4.6 Policy decisions

The WRPG sets out the requirements for developing our plan. Some components of the forecasts of supply and demand are not fixed in the guidance and need to be optimised as part of the best value planning modelling. There are five key policy decisions:

1. Level of demand management - variations on the roll out and packages of demand management options
2. Licence capping - At the time of preparing our WRMP, the sustainability reduction strategy for the 2022 - 2036 period has not been finalised due to the need for iteration between continued abstraction needs and our ability to replace water by offsetting sustainability reductions with sustainable new options. In order to explore this, we have developed scenarios with variations on the timing of capping abstraction licences to prevent deterioration.
3. Timing of 1:500 drought resilience - the guidance requires us to meet this requirement by 2039[21]
4. Level of environmental destination - there are three scenarios for the level of environmental improvements required by 2050
5. Level of environmental ambition - this is the timing and profile of how we can achieve the level of environmental destination by 2050. The guidance calls for water companies to be ambitious when profiling when they can achieve environmental improvements[22].

We have completed a series of model runs to determine which of these variants should be used in our initial most likely scenario. We model each policy decision in sequence and have to make assumptions on how to represent the other policy decisions to ensure we have only one variable. Figure 13, shows the scenarios and the decision used for modelling the other policy decisions.

20 Water resources planning guideline supplementary guidance - Environment and society in decision-making, March 2021, Section 4
21 Defra (2022) The Water Resources Management Plan (England) Direction 2022
22 Water Resources Planning Guideline (WRPG), March 2023, Section 5.4.2

Figure 13 Variations of policy decisions to include our initial most likely scenario

	Policy Decisions							Decision used in other scenarios
1. Level of demand management	Baseline	Extended low	Extended plus	Aspirational	50% leakage			Aspirational
2. Licence Capping	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 4
3. Timing of drought resilience	2025	2030	2035	2039	2045	2049		2039
4. Environmental Destination	None	BAU	BAU+	Enhance				BAU+
5. Environmental Ambition	2030	2036	2040	2045				2040

4.6.1 Level of demand management

We have modelled four demand management portfolios which are made up from complementary elements of leakage, smart metering and water efficiency interventions.

The baseline is that we continue with our projected AMP7 out-turn for leakage (161Ml/d), have no additional installation of smart meters beyond the AMP7 installation of 1.1M smart meters and have no further water efficiency measure beyond our current programme in AMP7. This also includes an additional 60,000 smart meters installed by 2024/25 as part of the Accelerated Infrastructure Delivery (AID) early AMP8 funding. This provides a benchmark for comparing other portfolios against.

The WRMP24 Demand management option appraisal technical supporting document contains more details of the development of the demand management options and appraisal.

4.6.2 Licence capping

At the time of preparing our WRMP, the sustainability reduction strategy for the capping of licences to recent actual average has not been finalised. We have developed scenarios with variations on the timing of capping abstraction licences to prevent deterioration.

The scenarios were selected following consultation with the Environment Agency, with one scenario chosen as the baseline and the others to test the feasibility of developing new sustainable resources to offset the licence reductions. We have to adopt possible dates in order to model licence reduction scenarios. As a starting position, these are linked to the delivery of more significant supply solutions that go further than the remaining available small supply options and our preferred demand management strategy (see Section 5.2.1). The earliest we could possibly deliver any of these supply options is 2030, with 2032 for desalination and water reuse and 2036 for the earliest an SRO would be available. All of the scenarios apply the same maximum sustainability reduction quantity from 2036 onwards. Section 5.2.2 shows the results from this modelling.

4.6.3 Drought resilience timing

Our WRMP must deliver resilience to a 1:500-year drought event. The guidance asks for us to aim to achieve this by 2039[23] and without drought permits or emergency drought orders. We must determine an optimum timing for increasing drought resilience by considering the costs and benefits of alternative approaches.

We have assessed various timescales for meeting the improved level of resilience including later delivery. The guidance states there is some flexibility in achieving a resilience of '1 in 500' drought though if we choose not to meet this deadline we should clearly explain why it is not efficient to deliver to this date[24].

We have modelled and assessed six dates for increasing drought resilience, see Section 5.2.3.

23 Water Resources Planning Guideline (WRPG), March 2023, Section 4.7
24 Water resources planning guideline supplementary guidance - 1 in 500, March 2021, Section 4

4.6.4 Environmental destination scenario

To deliver long-term sustainability and environmental resilience, we must set out a long-term environmental destination strategy[25]. Environmental destination describes how we will achieve and maintain sustainable abstraction to 2050.

The regional plan has developed a proposed long term environmental destination and sets out the actions to achieve this. However, to ensure the regional plan offers best value for our customers we have also explored how different levels of environmental destination affects our plan. This also allows us to build on the long-term environmental destination set out in the regional plan to address local concerns in our area[26].

We have modelled the scenarios in Box 11.

Box 11: Environmental destination scenarios

BAU: The Business as usual this scenario is to achieve flows to support 'Good Ecological Status' under the Water Framework Directive (WFD) including some chalk streams but it does not include theuneconomic waterbodies. These are waterbodies assessed as uneconomic to recover by the Environment Agency's Abstraction Plan by 2027 as uneconomic to recover.

BAU+: This scenario achieves flows to support 'Good Ecological Status' under the Water Framework Directive (WFD) and does not include uneconomic waterbodies, but goes further than BAU by including reductions to further protect European Protected Sites.

Enhance: Also achieving flows to support 'Good Ecological Status' under the Water Framework Directive (WFD) but this scenario includes the uneconomic waterbodies. It includes further protections for European Protected Sites plus protection for furtherchalk streams, sensitive headwaters and Sites of Special Scientific Interest (SSSIs).

See Section 5.2.4 for results from policy decision modelling of environmental destination.

25 Water Resources Planning Guideline (WRPG), March 2023, Section 5.4.2
26 Water Resources Planning Guideline (WRPG), March 2023, Section 5.4.2
27 Water Resources Planning Guideline (WRPG), March 2023, Section 5.4.2

4.6.5 Environmental ambition - timing

Environmental ambition describes the timeline over which we will achieve environmental destination. The guidance requires us to maintain sustainable abstraction by 2050 but asks for us to be ambitious in considering the timing of when we can achieve this[27].

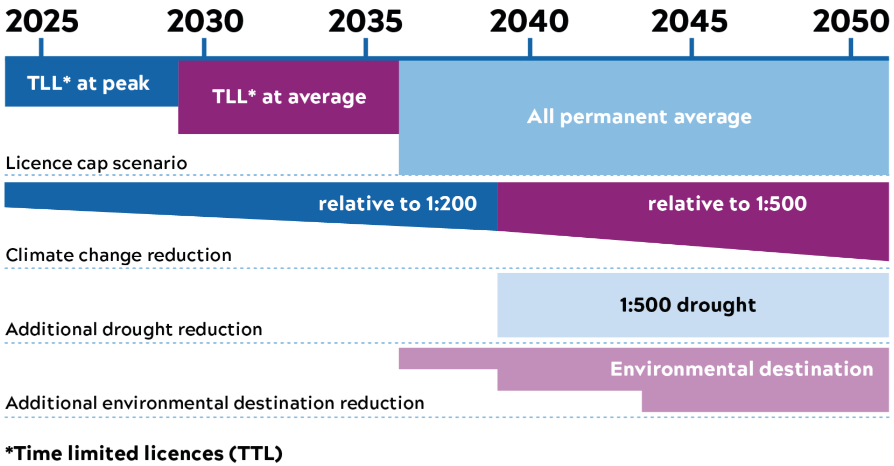
We have explored the impacts to our plan by modelling four dates of when we could try to achieve the different environmental destination scenarios. See Section 5.2.4.

4.7 Structuring the problem to define our initial most likely scenario

Our decision making method is based on EBSD which optimises the options for a single scenario or prediction of the future. We need to determine a baseline scenario as a starting point to compare all other variations against. We have called this our initial most likely scenario.

We have separated each of the supply impacts so that we understand the relative impact of each reduction. This allows us to compile different scenarios ensuring we are not double counting impacts. Figure 14 shows how we can layer the supply impacts to create different supply scenarios.

Figure 14 Layering supply impacts to create scenarios



We have used the output from each of the policy decision analysis to develop our initial most likely scenario, see Section 5.3. As we develop our plan and reflect our customer and stakeholder engagement, we will establish a preferred most likely scenario.

4.8 Modelling to develop alternative plans

Using the initial most likely scenario we are able to start developing alternative plans including the least cost plan, which is the least cost combination of supply options required to meet supply demand deficits. The least cost plan becomes our benchmark to compare all other plans against[28].

We have modelled a series of least cost plans following the UKWIR Economics of Balancing Supply and Demand (EBSD)[29] method using our EBSD-MGA model. These form the starting point for the development of our best value plan. Any decisions to move away from the least cost plan are clearly explained and documented.

We develop a number of versions of the least cost plan; where the assumptions are varied to align with regional planning and our own company policy decisions. These plans enable us to clearly demonstrate the impact of each change in assumptions. The purpose of each least cost plan is described in the Table 5 below.

We have run all of the scenarios in Table 5, however the results showed no variation between each of the least cost plans. In all three scenarios the strategic no/low regret options were selected in the same years as the regional plan. We have used the Supply options least cost plan as our benchmark as this reflects the regional plan but does not constrain the scale or timing of the strategic options. This enables our modelling to inform the development of the final regional plan.

For every scenario we run through our model we produce a set of options. Our modelling approach is to change one variable at a time so we can demonstrate the impact of changing each assumption. This requires over 300 model runs, though not all of these are feasible as they may have unresolved deficits. These runs have been used to refine and inform development of our best value plan as well as create feasible alternative plans.

28 Water Resources Planning Guideline (WRPG), March 2023, Section 10.14
29 UKWIR (2002) Economics of Balancing Supply and Demand (EBSD)

Table 5 Least cost plans modelled

Least cost plan	Assumptions in model	Purpose of Plan
Supply options least cost plan	The preferred demand management strategy is set in the model. Supply options are unconstrained (apart from delivery timescale, option costs and deployable output benefit).	This shows the least cost combination of supply options to meet the needs of Anglian Water customers only. The plan includes our preferred demand management strategy but it does not automatically reflect the outputs from the regional plan.
Regional plan low regret options	The strategic no/low regret supply options from the regional plan are set in the model, but the model is free to optimise when these options are required.	The model determines when the regional plan strategic resource options are needed to be delivered by to meet the needs of Anglian Water. It also selects the least cost combination of other supply options required to meet local deficits.
Regional plan low regret and timings	The strategic supply options from the regional plan are set in the model including the delivery dates set by the regional planning needs.	The model selects the least cost combination of supply side options to meet local needs.

4.9 Testing plans to future uncertainty

Our plan is based on forecasts of future supply and demand needs and whilst we have developed a most likely scenario, there is still uncertainty within the plan. We explore uncertainty through sensitivity testing of our assumptions and stress testing alternative plans to a range of other plausible scenarios. The types of tests we use to assess the robustness of our plans are listed in Table 6.

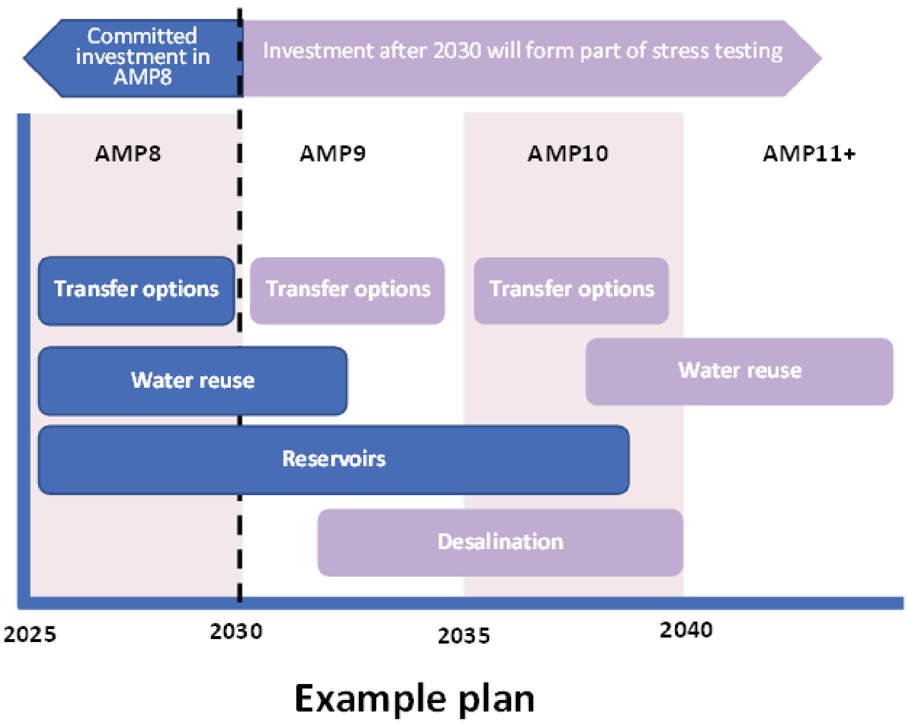
Table 6 Details of robustness and sensitivity tests

Robustness Tests	Purpose	Notes
Modelling to Generate Alternatives (MGA)	What are the next least cost plans? How stable is the optimisation?	This is an automatic output from each of our model runs.
Sensitivity testing	What happens if input assumptions change?	This produces a new least cost version of each plan based on the different input data. An example is, if climate change is higher than expected - would we still have developed the same plan?
Stress testing	How stable is the plan?	For each plan we fix the committed investment needed in AMP8. This means making these options 'must do' in the model. The model is then free to select other options later in the plan to suit the scenario, see Figure 15. This provides us with an understanding of how adaptive each plan is.
Least worse regret	Which plan gives us minimum regret if assumptions change?	This uses the output from the stress testing to compare alternative plans against the Least Cost Plan/s.

The robustness tests provide metric data that forms part of our evaluation and plan selection stage.

For the stress testing we want to understand if we commit to investing in new options in the early years of the plan, can our plan adapt if the future scenario varies from our original forecast. An example of the options we may need to commit to in a plan are shown in Figure 15. These options are modelled in the baseline in our stress testing runs, the model is then free to choose the options later in the plan to meet the various scenarios.

Figure 15 Options included as committed investment in stress testing



Ofwat have published guidance[30] on long-term delivery strategies which outlines an approach to using adaptive pathways planning to develop strategies, using future scenarios to test and develop the adaptive pathway. Box 12 describes some of the key definitions used in the Ofwat guidance. Using these definitions, the committed investment in Figure 15 form the low and no regret options which become the core pathway. Section 4.9.1 covers more on the Ofwat common reference scenarios.

Box 12: Key definitions from Ofwat guidance PR24 and beyond: Final guidance on long-term delivery strategies, April 2022

No-regret investment: Investments that are likely to deliver outcomes efficiently under all plausible scenarios.

Low-regret investment: Investments that are likely to deliver outcomes efficiently under a wide range of plausible scenarios.

Core adaptive pathway: A package of no-and low-regret investments, including investment required to keep future options open.

Adaptive pathway: A package of planned investments over time. Long-term delivery strategies will contain a core adaptive pathway and a number of alternative adaptive pathways.

Alternative adaptive pathway: A package of investments that should be undertaken only under certain circumstances.

4.9.1 Modelling scenarios

The scenarios we model to assess our plans are shown in Table 7. These include the PR24 Common reference scenarios[31].

30 PR24 and beyond: Final guidance on long-term delivery strategies, April 2022
31 PR24 and beyond: Final guidance on long-term delivery strategies, April 2022, Section 4

Table 7 Modelling Scenarios

Forecast / Input	Forecast Component	Variation	PR24 Common Reference Scenario
Supply Forecast	Climate change	High	RCP 8.5 (50th percentile probability level)
		Low	RCP 2.6 (50th percentile probability level)
	Licence caps	Timing	
	Drought resilience	Timing	
	Environment ambition	High	Enhance
		Low	BAU
		Timing	
Demand Forecast	Population growth	High	Local authority plans, no Government led interventions (water labelling etc)
		Low	ONS population and household projections, with Government led interventions
Options	Demand Management Options	High	Aligned to faster technology scenario
		Low	Aligned to slower technology scenario
		Strategy delivers lower demand savings than assumed	
	Supply-side option costs	High for preferred options	
	Supply-side options deliverability	Remove option types (i.e. no Reservoirs, desalination)	
		Vary availability of option dates	
	Supply-side option benefits	Higher yield of Fens reservoir	
Planning factors	Planning periods	Length (years)	
	Outage	Allocation increased	
	Headroom	Sensitivity test using draft WRMP24 allocations	
Regional transfers	Bulk transfers from regional groups	Imports and exports from WReN, WRSE and WRW.	

The output from all the various tests is used to define which scenarios could have the biggest influence on our plan.

4.9.2 Risk and uncertainty

There is uncertainty associated with all forecasts and we include an allowance for this relating to both our supply and demand forecasts.

We provide clear justification of the assumptions and the information used to assess uncertainty for each method. The various modelling methods will allow us to assess the relative contributions of uncertainty, clearly showing which uncertainties have the biggest impact in each water resource zone.

4.9.3 Headroom

Our modelling using EBSD requires the inclusion of target headroom[32]. This provides an element of contingency in our forecasts to account for uncertainty and risk.

The risk components in headroom include:

- uncertainty in the accuracy of base year demand data
- population and growth
- consumption per person
- climate change
- uncertainty in accuracy of supply-side data

Other uncertainties, such as non-renewal of our time limited licences, will be assessed in the scenario testing.

For our EBSD model runs to test uncertainty, see Section 7, we map the scenario against the risks components and adjust the target headroom allowance to reflect the scenario we are modelling. For our adaptive planning stress test scenarios we have avoided the double counting of headroom uncertainty. For example, where plans have been stress-tested to high and low climate change scenarios, we have omitted the climate change elements in the associated headroom dataset used within the modelling.

Further detail on the development and outcome of our headroom assessment is provided in the WRMP24 Planning Factors technical supporting document.

4.9.4 Outage

We include an outage allowance to cover the risk of temporary or short-term losses of supply. The allowance includes both unplanned and appropriate planned outage[33].

As part of our supply options development work, we consider options that may reduce outage. This includes options to reduce treatment works losses, while still complying with drinking water regulations.

Further detail on the development and outcome of our outage assessment for WRMP24 is provided in the Planning factors report.

4.9.5 Options uncertainty

All our modelling uses the feasible supply options set, as described in the Supply-side Options Development report and the preferred demand management strategy, from the Demand Management Options Appraisal report. This is the set of options we consider suitable to take forward for modelling and contains sufficient options to allow for real choices when developing our plans.

Modelling to generate alternatives (MGA) is a function of our model, we use this to see if any options are selected consistently. We may also find that plans generated to meet specific objectives are similar for other objectives.

4.10 Applying the best value planning framework to evaluate and compare plans

Once we have developed alternative plans we can appraise these using our best value planning framework. We have best value metrics for all the 300 model runs but we do not complete detailed analysis for all of these. We narrow down the number of plans to take forward to detailed appraisal including the stress and sensitivity testing stage, Section 7, ensuring we have a range of programmes that demonstrate differences in focus, but which still deliver our objectives[34].

32 UKWIR (2016) Risk Based Planning Methods
33 WRPG supplementary guidance: Outage (2020)
34 Water Resources Planning Guideline (WRPG), March 2023, Section 10.6

Once we have developed a set of alternative plans we use the SEA process to identify and assess the effects each plan may have on the environment, including cumulative and in-combination effects of the programme as a whole.

4.11 Selecting our best value plan

Development of our best value plan is an iterative process and though we have set out the decision making approach in a sequenced order there are stages we may repeat to refine our plan.

We use our best value planning framework to understand the trade-offs between objectives and metrics and select the plan that on balance offers best value to customers, the environment and society whilst being efficient and affordable to deliver.

We engage with our Board throughout the process of developing our best value plan. The members of the Board, have participated extensively in the development of the WRMP24, with different elements being discussed at meetings of the AWS Board and the AWS Management Boards (the Company's Executive Committee) held between December 2022 and July 2023.

This involvement includes the development of our demand management strategy and scrutinising the best value plan.

4.12 Adaptive planning assessment

As our plan has to deal with significant uncertainty associated with:

- The scale and location of abstraction reductions due to environmental destination,
- The deliverability of a range of complex new resource options,
- The reliance on forecast benefits from interventions to reduce demand, such as, behavioural changes resulting from smart metering and Government interventions.
- Demand uncertainties from population and housing growth.

These are described in Section 4.6.4. The guidance states that we consider if an adaptive plan is more appropriate than a 'conventional' WRMP, where there is a single preferred plan[35].

An adaptive plan contains a core pathway and a series of adaptive pathways, see Box 13. Using the outputs from the testing uncertainty stage we compile an adaptive version of our preferred plan. As we are required to identify a long-term preferred plan (including for the Water Resources Planning tables), we define our **preferred best value plan as comprising a core pathway and an adaptive pathway to meet our preferred most likely scenario.** The adaptive pathway contained within our preferred best value plan can be contrasted with alternative adaptive pathways that would be triggered if circumstances turn out differently to what we consider most likely at present (as described in our preferred most likely scenario). We judge whether circumstances are changing based on monitoring a series of metrics that characterise critical uncertainties, for example future abstraction reductions and future demand.

35 Water resources planning guideline supplementary guidance - Adaptive planning, September 2020

Box 13: Core principles of adaptive planning for WRMPs[36]

1. **Problem characterisation**
2. **Examine uncertainty**
3. **Understand different programmes**
4. **Define adaptive pathways for plan:**
   - Determine a set of pathways based on the most critical decisions and uncertainties.
   - Determine the near-term decisions common to all pathways, and pathway-specific decisions.
   - Define your decision method and the information requirements and activities necessary to support this
5. **Create a monitoring plan:**
   - Develop communication on how the adaptive plan will be implemented in practice.
   - Ensure that monitoring metrics are observable and understandable.
6. **Explain our plan:** Set out your adaptive plan in your WRMP and explain your decision-making
7. **Engage with stakeholders and regulators:** Incorporate iterative feedback with stakeholders and regulators in to any technical processes

To develop an adaptive version of our plans we follow the 7 core principles of adaptive planning in Box 13. Core principles 1 -3 are aligned to step 1-structuring the problem and step 5- testing plans to future uncertainty from our decision making approach (see Section 4.4). Step 6: adaptive planning assessment covers the core principles 4 and 5. The last two principles are covered through our consultation process for the draft WRMP.

4.13 Final alignment with regional plans and other water company plans

Our preferred best value plan should reflect the regional plan unless there is clear justification for not doing so[37]. Our decision making methodology includes for modelling to verify some of the regional decisions, see Section 6.1, this is because of the strategic nature of the regional plan where the modelling is at a different scale. For Water Resources East we have aggregated some of our water resource zones, see Figure 16.

Figure 16 Water resource zones used in Water Resources East modelling

36 Water resources planning guideline supplementary guidance - Adaptive planning, September 2020, Figure 1
37 Water Resources Planning Guideline (WRPG), March 2023, Section 2.2

The supply, demand and planning factors for WRE water resource zones are accumulated from the WRMP zones. However the difference in scale of the water resource zones does make for slight variations in the supply demand balance creating deficits within different water resource zones. The nature of the strategic interconnectors from our WRMP19, currently under construction see Section 5.1.1, means that deficits can be located in different zones. For the regional plan the total deficits align with the WRMP.

Our regional plans and strategic options are developed in parallel with our WRMP and the other water company WRMPs. We have ensured alignment through a series of regular sessions with all the water companies within the regional plan, in particular through weekly meetings to discuss modelling between companies and at regional level.

Developing these plans is an iterative process and there are clear links where plans have shaped each other, see Section 11.

5 Structuring the problem to define our initial most likely scenario

5.1 Scale of the problem

Our WRMP24 is the most ambitious plan we have compiled; it builds upon our WRMP19 strategy but tackles substantial additional regional and national challenges, the following Section 5.1.1 describes these additional needs.

5.1.1 Building upon our WRMP19 strategy

Since publishing our WRMP19 we have experienced significant demand pressures as a result of the Covid-19 pandemic, we also have additional supply side challenges such as improved drought resilience and further abstraction reductions to include in our plan. Table 8 shows the additional requirements of WRMP24 compared to WRMP19.

Figure 17 and Figure 18 show the supply and demand forecast for both WRMP19 and WRMP24. Further information and explanation of the difference between the WRMP19 and WRMP24 demand forecast can be found in Section 12.4 and 13.3 of the WRMP24 Demand management preferred plan technical supporting document. Figure 17 uses water available for use (WAFU), see Box 16 for definition of WAFU. The WRMP19 final supply forecast includes the benefits from new resource options planned to be delivered in the planning horizon up to 2045.

Figure 19 shows the difference between WRMP19 and WRMP24 deployable output in 2025/26. The deployable output is the amount of water we treat and put into supply before we export to other water companies through our bulk supply agreements. Therefore this volume is greater than that presented in Figure 17 which shows how much water is available to use to meet our supply demand balance (WAFU). For our WRMP24 we have updated the supply forecast based on different droughts plus we have included the benefits of drought demand savings from temporary use bans and non-essential use bans which aligns with the approach for WRMP19 and the regional plan. We have also incorporated the changes to supply options agreed within the WRMP Annual Review process, see below for more details. The net result of these changes is an increase in deployable output in WRMP24 compared to WRMP19 at regional scale. Our WRMP24 Supply forecast technical supporting document shows the increase in deployable output is focussed in certain areas, particularly Ruthamford and Lincolnshire, whilst Suffolk East and Essex South water resource zones have decreased deployable output. Further details on the differences between the WRMP19 and WRMP24 supply forecasts can be found in the WRMP24 Supply forecast technical supporting document, Section 4.8.

Table 8 Impacts included in WRMP19, WRMP24 and regional plan

	Impact	WRMP19	WRMP24	Regional Plan
Growth	Baseline growth 2020 - 2045		✓	✓
	Growth associated with OxCam		✓	✓
	Impact of Covid-19 on demand		✓	✓
Sustainability reductions	Sustainability reductions (calculated using historic data)	✓		
	Additional licence caps for no deterioration		✓	
	Further sustainability reductions required by climate change		✓	
	Further reductions to enhance the environment (environmental destination)		✓	✓
Climate change	Historic climate change	✓		
	Future climate change	✓	✓	✓
Extreme drought	Increase resilience to 1-in-200	✓		
	Increase resilience from 1-in-200 to 1-in-500		✓	✓
	Drought demand savings (Temporary use bans and Non-essential use bans)	✓	✓	✓

Figure 17 Supply forecasts for WRMP19 and WRMP24

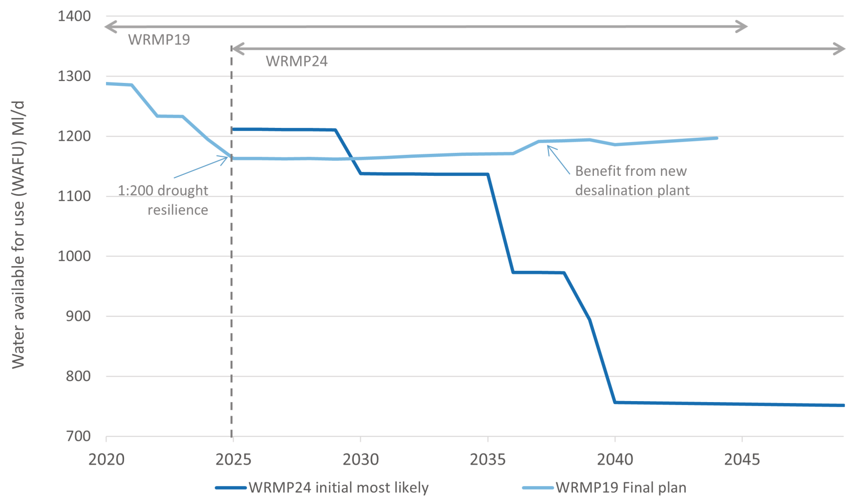


Figure 18 Demand forecasts for WRMP19 and WRMP24

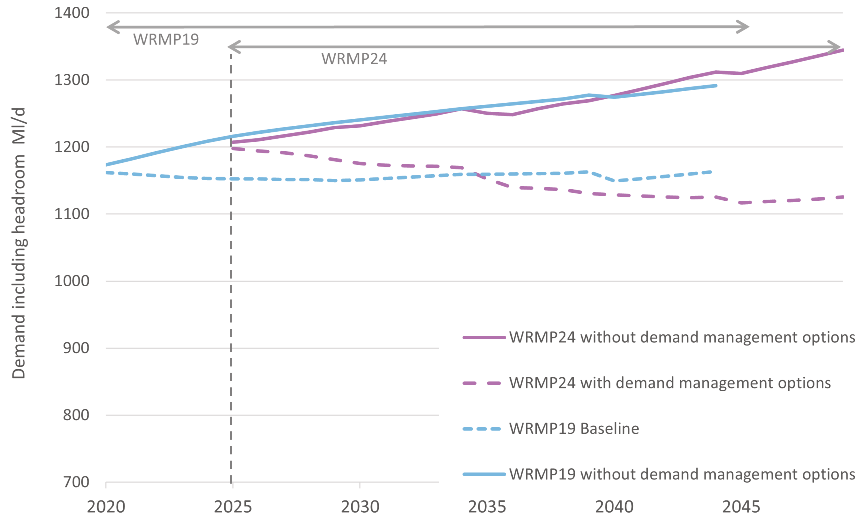
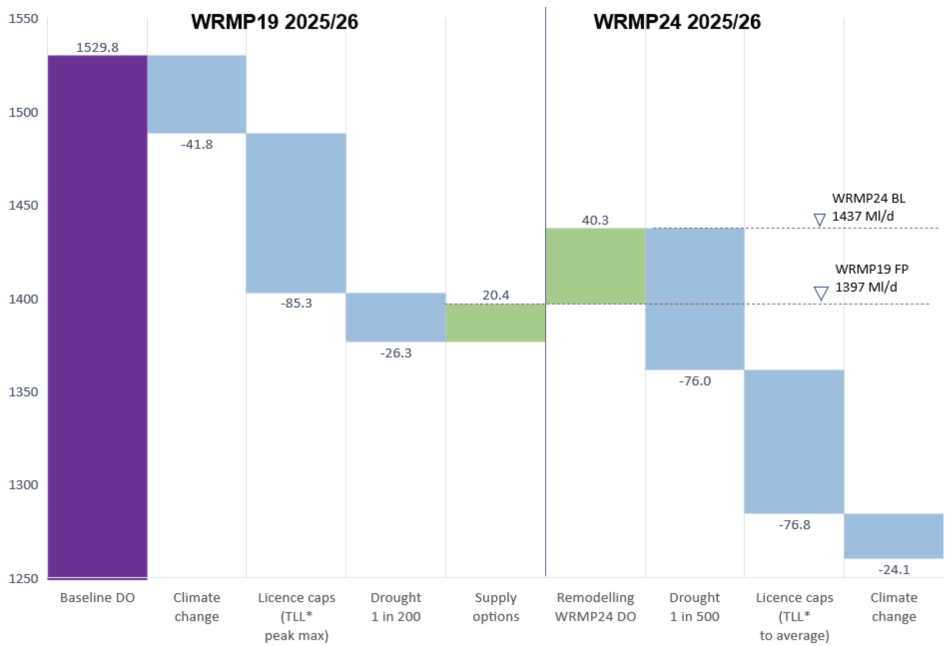
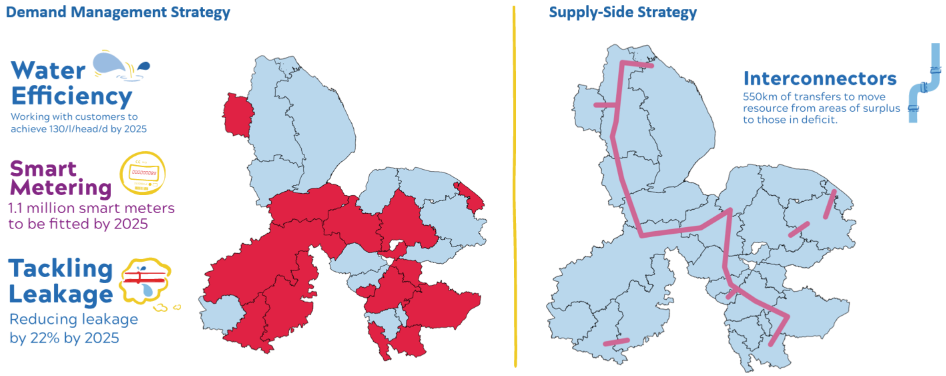


Figure 19 The water available for use components in WRMP19 vs WRMP24. (*Time limited licences)



Our WRMP19 was based on a twin track strategy of demand management and supply-side options. We are currently installing over 400km of interconnectors as part of delivering our WRMP19. These allow water to be transferred between areas of surplus in the north of our region to those in deficit further south. The strategy was designed to be adaptive and allow future new water resource options to slot into the transfer network. WRMP19 includes the development of a new desalination plant in Suffolk in the 2030s.

Figure 20 Our WRMP19 twin track strategy



Our WRMP19 only included the development of new resources in AMP7 in Lincolnshire. The interconnectors work by transferring this surplus to the areas in the south in deficit.Our WRMP24 supply forecast includes the benefits of these schemes, due to be developed in AMP7, from the start of planning forecast in 2025 which aligns with the timings proposed in WRMP19. Through the WRMP19 Annual Review submissions we have made changes to some options, these are,

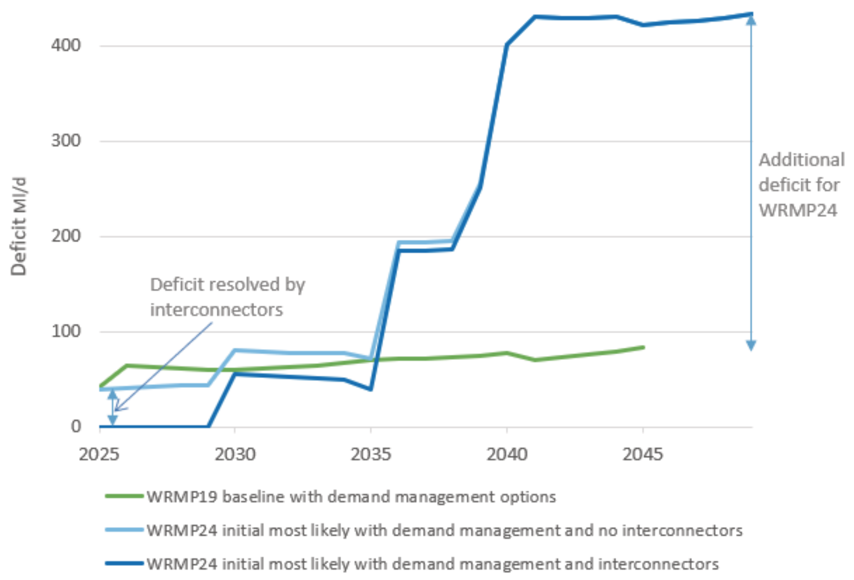
- 2020/21 - Inclusion of River Lark sustainability reduction
- 2021/22 - Alternative North Lincolnshire options

The River Lark scheme involved increasing the capacity of some interconnectors by an additional 5Ml/d. This scheme was selected following a re-evaluation of the PR19 WINEP scheme and other options. Updated catchment modelling using the Environment Agency SAGIS-SIMCAT model had indicated that the original scheme would not be able to achieve the required water quality constraints. The full details of this are set out in section 5.4.3 of our 2020/21 WRMP19 Annual Review.

The WRMP19 interconnectors are integrated into our EBSD model as baseline ‘existing transfers’ which are available in the model from 2025 (the start of the forecast). Existing transfers benefit Water Available for Use and the Supply Demand Balance by providing inter-Water Resource Zone connectivity, which enables water to be transferred from zones in surplus to those in deficit.

For WRMP24 there are significant additional supply reductions which were not a requirement for WRMP19. To understand how our current plan contributes to the new supply demand balance requirements of WRMP24 we have run a version of the model without the benefit from the interconnectors, see Figure 21. This shows that without the interconnectors the regional deficit would have been 40Ml/d at the start of the plan. It also demonstrates the scale of the deficit for WRMP24 at the end of the planning period compared to WRMP19.

Figure 21 Baseline deficit with and without interconnectors



The WRMP19 interconnectors also enable new resource options required for WRMP24 to slot into the transfer network providing a greater range of options to be considered to solve local issues. For example, the interconnectors allow the model to consider resource options in areas other than the immediate water resource zone to resolve deficits, enabling greater opportunity for regional solutions that may provide best value to be selected.

Our WRMP24 demand forecast includes the benefits of the funded PR19 demand management options. This comprise 9.3 Ml/d attributed to leakage reduction, and 10.9 Ml/d attributed to smart metering and water efficiency.

5.2 Policy decision modelling

The policy decisions are the requirements in the guidance that we need to include in our plan but we have flexibility in terms of scale and timing. We model variations of each policy decision to determine how to represent these in our initial most likely scenario.

We use the best value framework at this initial stage but we focus our analysis on the criteria that our stakeholders and customers have identified through our engagement as the most important. Table 9 shows the criteria and metrics used for determining the initial most likely scenario.

Table 9 Best value criteria and metrics used to select initial most likely scenario

Objective	Criteria	Metric
Deliver long-term environmental improvement	Strategic Environmental Assessment (SEA)	Net assessment score
	Natural Capital	Ecosystem Services (£)
	Biodiversity Net Gain	Habitats Units (total restoration)
	Abstraction reduction	Total volume reduced by 2050 (Ml/d)
		Average annual reduction over 25 years (Ml/d)
	Carbon	Quantity of capital carbon (tCO2e)
		Quantity of operational carbon (tCO2e/yr)
A plan that is affordable and sustainable over the long term	Programme Cost	Capex (£)
		Opex (£)

5.2.1 Level of demand management

We have modelled four demand management portfolios which are made up from complementary elements of leakage, smart metering and water efficiency interventions.

The baseline is that we continue with our projected AMP7 out-turn for leakage (161Ml/d), have no additional installation of smart meters beyond the AMP7 installation of 1.1M smart meters and have no further water efficiency measure beyond our current programme in AMP7. This also includes an additional 60,000 smart meters installed by 2024/25 as part of the Accelerated Infrastructure Delivery (AID) early AMP8 funding. This provides a benchmark for comparing other portfolios against.

We develop demand management programmes through the development of 'strategic portfolios'. Each strategic portfolio includes the completion of our smart metering rollout, additional leakage reduction and water efficiency sub-options, and has been built from the bottom-up, at water resource zone level (actual modelling is conducted at the Planning Zone level, and aggregated to water resource zones). We use our problem characterisation to decide upon the geographical focus of each strategic option.

Note that each scenario has been based upon the WRMP24 selected growth forecast, 'OxCam1b'. This growth forecast for properties and population has been based upon Local Authority planning data and includes a reflection of growth associated with the Oxford Cambridge strategic growth arc. Additionally, it should be noted that all scenarios, excluding the baseline, include savings attributed to government led interventions. These interventions lead to significant savings by the end of the WRMP24 planning period (84Ml/d).

Table 10 shows the costs and benefits in terms of water savings for each package of demand management shows the costs and benefits in terms of water savings for each package of demand management. Figure 22 shows the profiles of the different portfolios including headroom.

Table 10 Details of the demand management portfolios

Demand management portfolio	Water savings by 2049/50 (Ml/d)	Total expenditure costs £bn
Baseline	0	0
Extended low	107	0.5
Extended plus	122	1.2
Aspirational	134	4.8
50% Leakage	158	20.9

Figure 22 Profile for demand management portfolios (including target headroom)

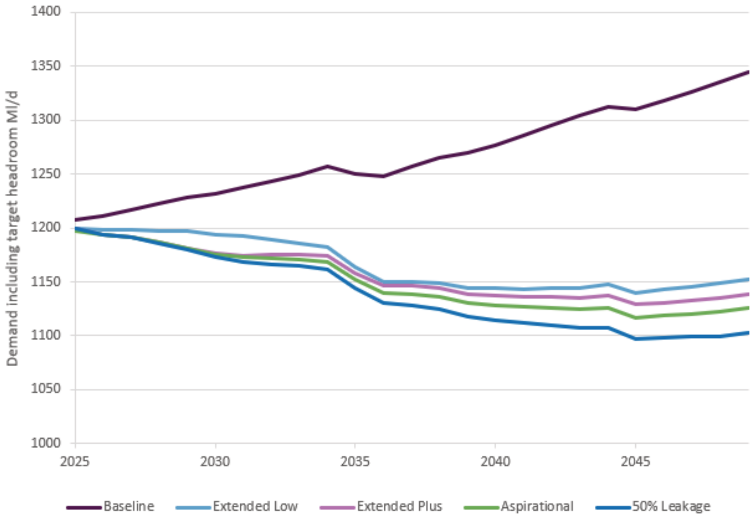


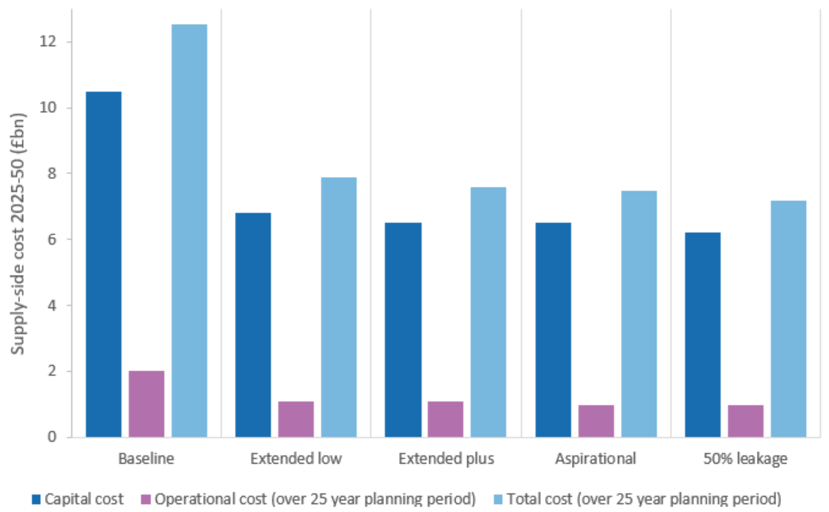
Table 11 shows the components of each portfolio, the demand management options appraisal report has more details of each portfolio and the components within them. The key differences between portfolios is the level of leakage reduction.

Table 11 Components of demand management portfolios

Demand management portfolio	Government Interventions	Leakage	Metering	Water efficiency	NHH DMOs
Baseline	Not included	AMP7	AMP7	AMP7	None
Extended low	Included	24%	3AMP roll out	Low	Medium
Extended plus	Included	31%	2AMP roll out	High	Medium
Aspirational	Included	38%	2AMP roll out	High	Medium
50% leakage	Included	50%	2AMP roll out	High	Medium

Figure 23 shows the cost data for the supply-side options selected in addition to the different demand management packages.

Figure 23 Costs data for supply-side options selected in addition to the different demand management packages



The deferred supply-side investment for each demand management portfolio compared to the baseline is shown in Table 12.

Table 12 Deferred supply-side investment

Demand Management Scenario	Deferred supply-side investment (£bn)
Baseline	0
Extended Low	-4.6
Extended Plus	-4.9
Aspirational	-5.0
50% Leakage	-5.3

The best value planning framework has been applied to the modelling results for all portfolios. Figure 24 compares best value metrics associated with the supply-side options against the baseline of no demand management. It shows where portfolios performs better or worse as a percentage. This shows that all the demand management portfolios perform better than no demand management. All portfolios are very close, because the benefit they provide in terms of supply demand balance is small in proportion to the size of supply-side options needed.

Figure 24 Comparison of best value metrics against baseline of no demand management

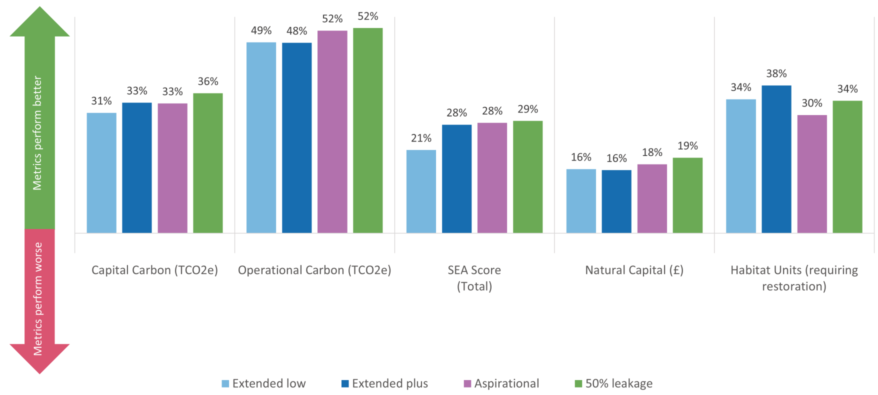
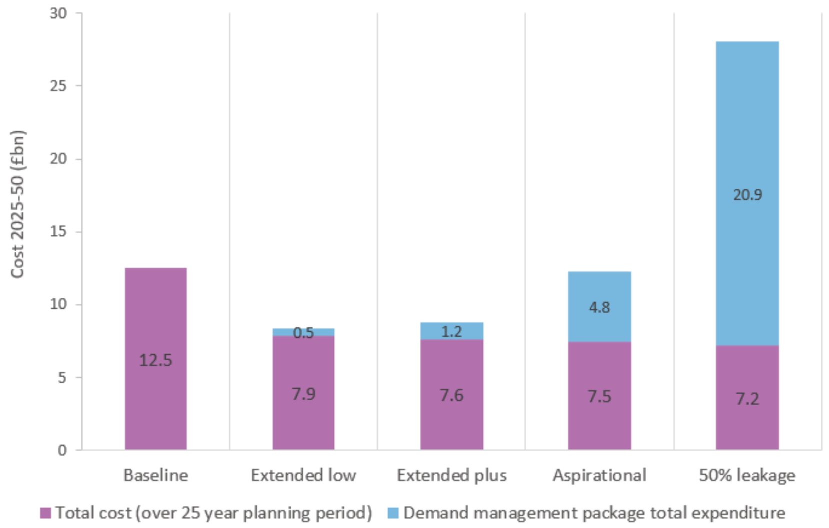


Figure 25 provides the combined supply-side options and demand management option costs. The baseline and Extended low scenarios do not satisfy the full supply demand balance and leave residual deficits. The remaining three portfolios all satisfy the supply demand balance, but the demand management costs increase sharply compared to the supply-side option costs which only slightly decrease.

Figure 25 Total expenditure for both supply-side and demand management options



The results demonstrate that only scenarios Extended plus, Aspirational and 50% leakage portfolios are feasible, without causing residual deficits which are unacceptable with the WRMP24 planning process.

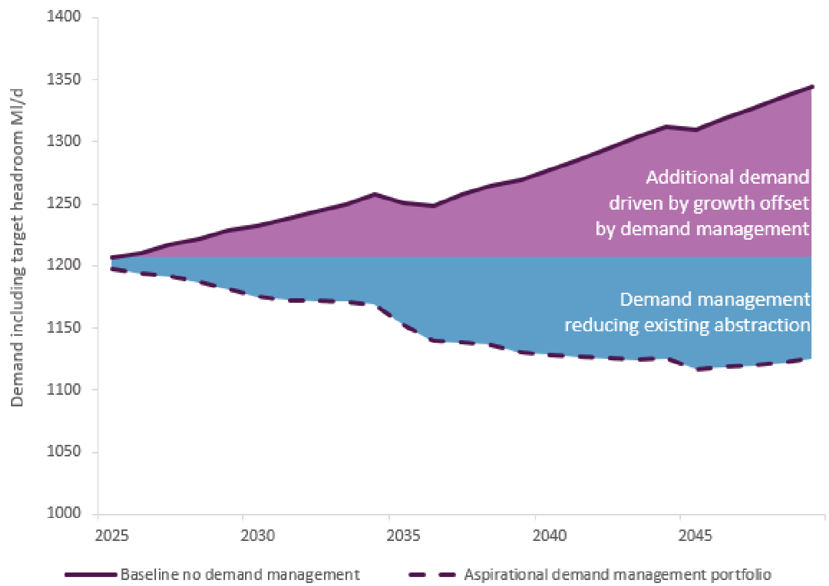
The comparison of portfolios across the best value metrics demonstrates that increasing the amount of demand savings only marginally reduces the investment in supply-side options, but this comes with significant increase in cost for the delivery of the demand management package. This is reflected in the other environmental metrics associated with the supply-side options which do not vary much between portfolios.

For our policy decision making process, we have chosen the Aspirational portfolio of demand management measures to use in our initial most likely scenario. This is more ambitious than Extended plus and includes a higher percentage of leakage reduction which will contribute to the national target of 50% leakage reduction. Although, this option does imply significant cost (for mains replacement), the vast bulk of the cost will be incurred in AMP9 and beyond, and so will be revisited as part of our WRMP29/PR29 planning process.

The 50% leakage goes further towards the national target but it is not cost beneficial as the costs to deliver the additional leakage is disproportionately significant.

Figure 26 shows how the Aspirational portfolio offsets the additional demand from growth and contributes to sustainable abstraction by reducing existing abstraction.

Figure 26 Aspirational demand portfolio reduces demand driven by growth and contributes to sustainable abstraction



The Demand management options report contains more details of the development of the demand management options and appraisal. We also include other variations of demand forecast and demand management options in our sensitivity and stress testing, see Section 7.

5.2.2 Licence capping

We developed an initial five scenarios with an additional two added through consultation with the Environment Agency. These scenarios explore variations on the timing of capping abstraction licences to prevent deterioration, as shown in Table 13. All scenarios applied the same maximum sustainability reduction quantity from 2036 onwards.

The Environment Agency consider scenario 6 as the baseline to compare the other scenarios against. Definitions of licence capping terms is available in Box 14.

Our scenario modelling provides an understanding of:

1. The feasibility to meet the baseline scenario - are there adequate new supply options that can be delivered within the timescales of the baseline scenario?
2. If not, which of the other scenarios are feasible?
3. What is the scale of potential risk of not meeting baseline scenario?
4. Which feasible scenario offers the best value?

Box 14: Definitions for licences and capping

Time-limited licence - a licence that has a specified expiry date. Unsustainable abstraction can be addressed at the point of expiry / licence renewal.

Permanent licence - a licence that does not have an expiry date. Unsustainable abstraction can be addressed through statutory processes.

Maximum Peak licence cap - capping abstraction to the maximum volume of water abstracted in any one year during a historical representative period of abstraction.

Recent Actual Average licence cap - capping abstraction to the total volume of water abstracted during the representative recent actual period divided by the number of years in that period.

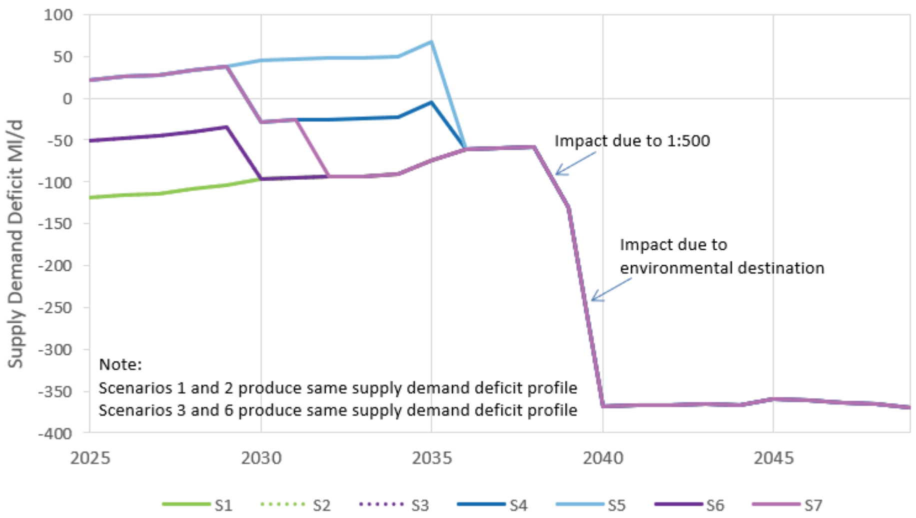
Table 13 Licence capping scenarios

Licence Cap Scenario	Capped at maximum peak	Capped at recent actual average	
	Time Limited Licences	Time Limited Licences	All other Permanent Licences
1	-	2022-2024	2025
2	2022-2024	2025	2025
3	2022-2024	2025	2030
4	2022-2024	2030	2036
5	2022-2024	2036	2036
6	-	2022-2024	2030
7	2022-2024	2030	2032

The model includes the preferred demand management strategy. All the supply-side options are unconstrained, including the WRE no regret options and the smaller supply side options which are available from AMP8. The supply forecast includes environmental destination from 2040, this date was chosen as it ensures the large impact from environmental destination is accounted for but if it was included any earlier in the planning horizon it would dominate the scenario modelling and influence the results of testing licence cap dates. It was assumed drought resilience to 1:500 would commence in 2039.

Table 14 shows the baseline regional supply demand balance for each of the modelled scenarios.

Figure 27 Regional baseline supply demand balance for all licence capping scenarios



The change from maximum peak to recent actual average licences (both time limited licences and permanent licences) creates a deficit in all the scenarios. For some scenarios, including the baseline, there are deficits at the start of the planning period. By 2036 the deficit is the same for all scenarios. Table 14 shows the baseline supply demand balance.

Table 15 shows residual regional supply demand balance after supply-side options selection for each of the modelled scenarios. Scenarios 1, 2, 3 and the baseline, scenario 6, result in residual supply demand deficits. These deficits occur because these scenarios include earlier sustainability reductions, and there are insufficient supply-side options available early in the planning period 2022-2032. By 2032 the deficit is resolved for all scenarios, as this is the timescale when larger and more complex supply options such as desalination and water reuse become available within the model. Any potential WRMP24 plan must maintain the supply demand balance[38], therefore licence capping scenarios 1, 2, 3 and 6 are ruled out from further development.

38 Water Resources Planning Guideline (WRPG), March 2023, Section 4.1

Table 14 Regional baseline supply demand balance in Ml/d for all licence capping scenarios

Scenario	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
1	-119	-116	-114	-109	-103	-97	-95	-94	-94	-91	-74	-62
2	-119	-116	-114	-109	-103	-97	-95	-94	-94	-91	-74	-62
3	-51	-47	-45	-40	-35	-97	-95	-94	-94	-91	-74	-62
4	22	26	28	33	38	-28	-26	-25	-25	-23	-6	-62
5	22	26	28	33	38	45	47	48	48	50	67	-62
6	-51	-47	-45	-40	-35	-97	-95	-94	-94	-91	-74	-62
7	22	26	28	33	38	-28	-26	-94	-94	-91	-74	-62

Table 15 Residual regional supply demand balance after supply-side options selection for each scenario

Scenario	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
1	-112	-108	-106	-92	-87	-40	-38	35	35	37	51	64
2	-112	-108	-106	-92	-87	-40	-38	35	35	37	51	64
3	-43	-40	-38	-24	-19	-40	-38	35	35	37	51	64
4	29	32	33	37	41	15	18	17	31	33	50	45
5	29	32	33	37	41	45	60	60	75	77	94	28
6	-43	-40	-38	-24	-19	-40	-38	35	35	37	51	64
7	29	32	33	37	41	21	24	28	28	31	48	61

The best value planning framework has been applied to scenarios 4, 5 and 7. Figure 28 compares best value metrics for scenarios 5 and 7 against scenario 4. It shows where scenarios 5 and 7 performs better or worse as a percentage. Scenario 7 delivers benefits earliest, reflected in the average abstraction reduction metric. For Scenario 5 one larger desalination plant (Caister 100Ml/d) has been selected replacing three smaller options (Mablethorpe, Caister and Holland on Sea) in scenarios 4 and 7. This is reflected in the SEA score, capital carbon and Habitats units requiring restoration metrics which are influenced by the quantity of new options required.

Figure 28 Best value metrics, scenarios 5 and 7 compared to scenario 4

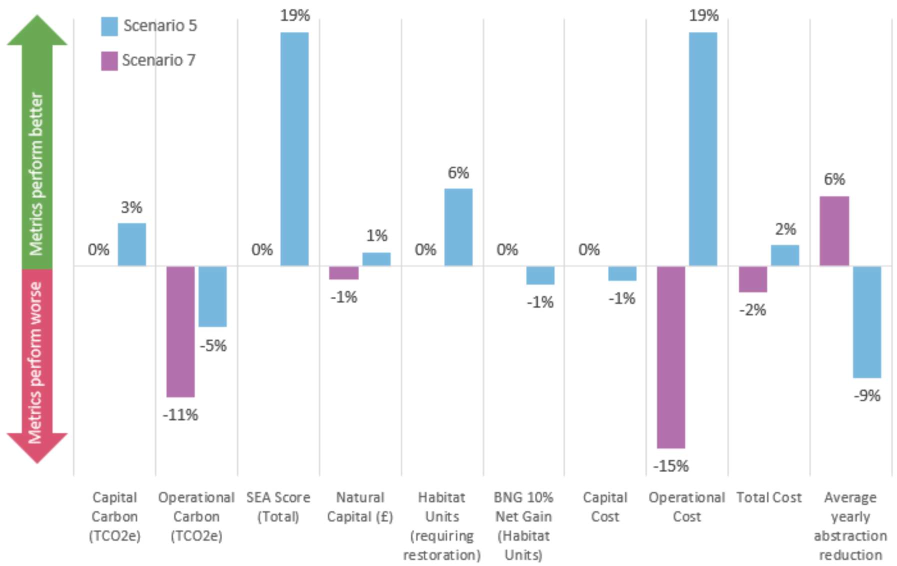


Figure 29 shows the cost metrics in more detail: capital costs are close for all three scenarios with overall total operational costs less for scenarios 4 and 5 which means similar options have been selected but the timing of when they are required differs.

Figure 29 Comparison of costs for scenarios 4, 5 and 7

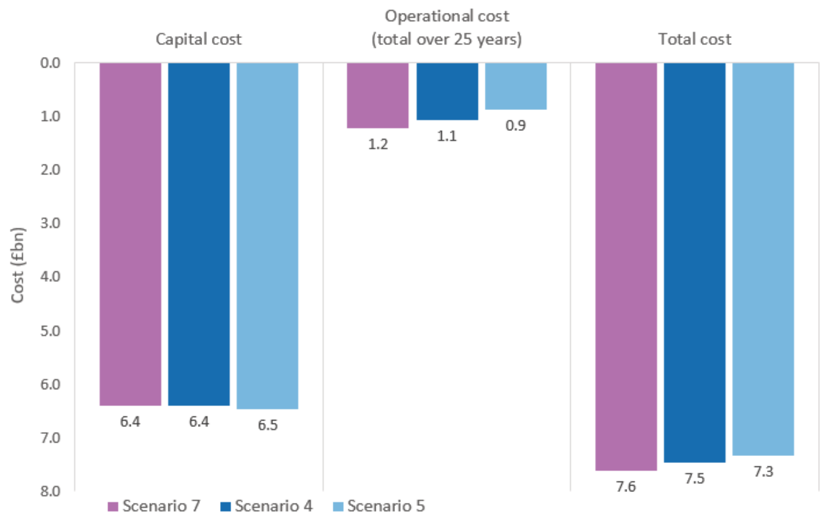


Figure 30 shows the operation cost profile: scenario 7 has significantly higher operational costs at the start of the plan compared to the other two scenarios. This additional early cost is due to large desalination capacity needed to meet the caps in 2032. This higher opex would have a greater immediate impact on customer bills.

Figure 30 Comparison of operational cost profiles

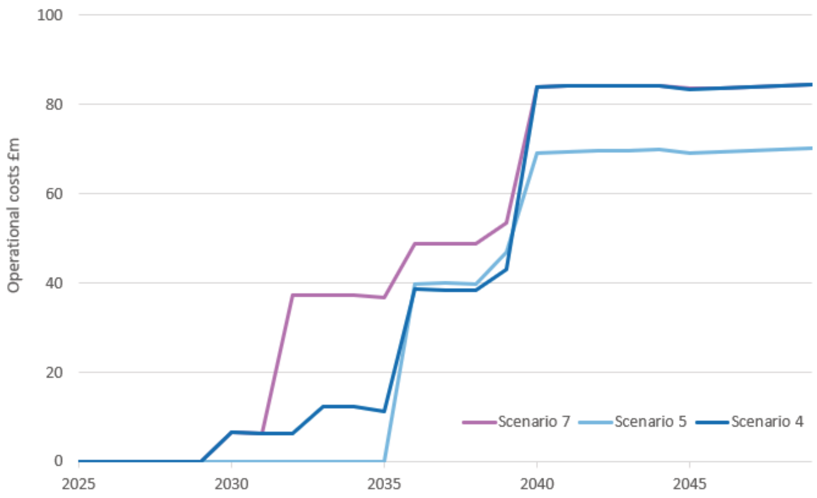
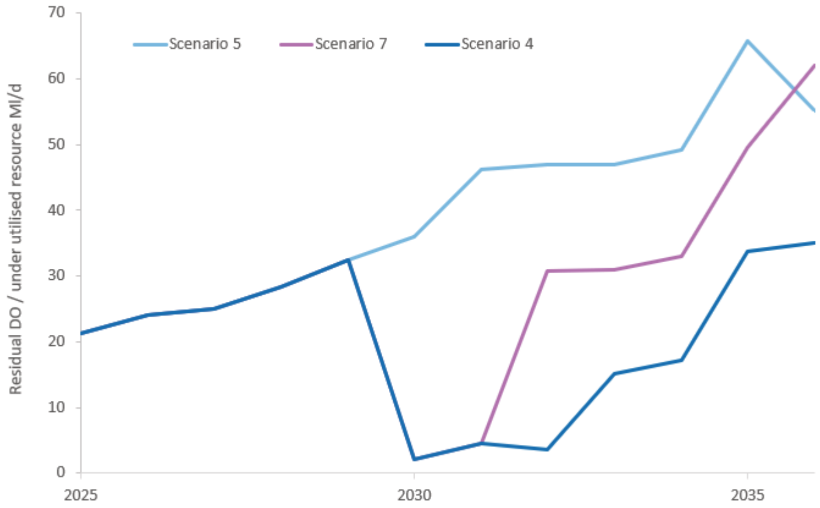


Figure 31 Comparison of unutilised resource



In scenario 7 water reuse and desalination options are required as soon as possible which pushes back the timing of the SRO reservoirs. This reduces the adaptability of the plan as we have to commit to delivering large scale options (notably desalination) right at the start of the plan.

Figure 31 shows the surplus resource for the three feasible scenarios, this is unutilised resource. This indicates how efficient the options are at satisfying the supply demand deficit. A surplus can be a result of developing an option with a maximum capacity greater than required when the options is first needed. This is the case for scenario 7 where large resource options are developed to meet earlier licence caps, but they don't reach full utilisation till later in the plan. In this case the surplus could be avoided by developing incremental/phased capacity or by using the surplus to meet other caps earlier. For scenario 7 all caps are met by 2032 and we could deliver environmental destination earlier in some zones. However, this approach could result in abortive investment by committing to environmental destination reductions before the outcome of the WINEP investigations. Delaying all the licence caps to 2036, Scenario 5, results in a large unutilised surplus until 2036. Once the caps occur the surplus diminishes even with the Fens reservoir coming into the plan in 2036.

All the feasible scenarios have a surplus at the start of the plan. This surplus is 'locked in' with the majority of it within our Ruthamford North WRZ. To enable this resource to be utilised we must build new interconnectors to transfer this on to Water Resource Zones in deficit due to licence caps. The earliest these interconnectors are available is 2030, therefore this surplus cannot be used for capping licences earlier than 2030.

As part of developing a best value plan we will look to optimise the surplus post 2036 through delivering some environmental destination benefits earlier, see 6.2.5.

The abstraction licence caps are required by the Environment Agency to avoid the risk of deterioration, as defined under the Water Framework Directive, to the water bodies we currently abstraction from. The risk of deterioration to water bodies comes from abstracting more than we have historically, within the current licence conditions, by using the headroom within the licence. An increase in demand due to growth could require a licence to be used above historical abstraction.

However, we use demand management to prevent the risk of deterioration. Our preferred demand management strategy provides adequate demand savings that offset the increase in demand - and therefore abstraction - due to growth. This continues our historical performance of not increasing overall abstraction despite significant growth.

We can use distribution input, the amount of water we put into supply, as a simple proxy for deterioration risk within water resource zones. Table 16 compares the distribution input, without the benefits from demand management, up to 2036/37 (when all licence caps will be met) against measured distribution input at the start of the plan 2025/26. Most WRZs show an increase in demand with Hartlepool, Lincolnshire Retford and Gainsborough and Norfolk Harleston being the exception, where demand is reducing over time.Table 17 includes the benefits of our preferred demand management strategy. This shows that only one water resource zone has increased demand up to 2036. This is Ruthamford Central which has no sources within the zone, it is supplied by interconnectors supported by surface water. If growth were to arise we will have our new strategic interconnectors and new (non-groundwater) supply options in the longer-term. This shows there is no risk of deterioration at the water resource zone level for the scenarios that deliver licence caps later than the baseline scenario.

Table 16 Cumulative distribution input, without the benefits from demand management, up to 2036/37

Water resource zone	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37
Essex Central	0	-0.01	-0.03	-0.04	-0.05	-0.06	-0.06	-0.04	-0.01	0.03	0.07	0.1
Essex South	0	0.27	0.5	0.66	0.82	1.02	1.25	1.52	1.78	2.05	2.32	2.58
Fenland	0	-0.07	-0.09	-0.01	0.02	0.05	0.09	0.18	0.26	0.32	0.35	0.35
Hartlepool	0	-0.02	-0.04	-0.06	-0.11	-0.15	-0.19	-0.21	-0.24	-0.26	-0.27	-0.29
Lincolnshire Bourne	0	0.27	0.53	0.73	0.83	0.93	1.04	1.15	1.27	1.38	1.46	1.55
Lincolnshire Central	0	0.27	1.1	1.53	1.77	2.05	2.35	2.72	3.08	3.44	3.78	4.06
Lincolnshire East	0	0.47	1	1.48	1.89	1.81	1.8	1.85	1.93	2	2.07	2.12
Lincolnshire Retford and Gainsborough	0	-0.01	-0.04	-0.06	-0.12	-0.16	-0.19	-0.16	-0.15	-0.14	-0.14	-0.14
Norfolk Aylsham	0	0.03	0.06	0.1	0.14	0.17	0.2	0.24	0.27	0.29	0.33	0.35
Norfolk Bradenham	0	0.02	0.03	0.03	0.03	0.03	0.03	0.06	0.09	0.13	0.16	0.2
Norfolk East Dereham	0	0	0	-0.01	-0.02	-0.03	-0.03	-0.02	0	0.01	0.02	0.04
Norfolk East Harling	0	0.01	0.02	0.03	0.03	0.03	0.04	0.05	0.06	0.07	0.08	0.08
Norfolk Happisburgh	0	0.01	0.02	0.04	0.05	0.07	0.09	0.11	0.14	0.17	0.2	0.23
Norfolk Harleston	0	-0.02	-0.05	-0.07	-0.11	-0.14	-0.17	-0.2	-0.2	-0.2	-0.2	-0.21
Norfolk North Coast	0	0.06	0.1	0.12	0.14	0.17	0.2	0.24	0.28	0.32	0.37	0.42
Norfolk Norwich & the Broads	0	0.26	0.36	0.57	0.76	0.93	1.11	1.28	1.48	1.6	1.76	1.89
Norfolk Wymondham	0	0.02	0.02	0.02	0	-0.01	-0.01	0.02	0.06	0.11	0.15	0.2
Ruthamford Central	0	0.46	1.22	1.78	2.38	2.96	3.64	4.51	5.48	6.49	7.51	8.53
Ruthamford North	0	0.57	1.04	1.21	1.33	1.64	2.1	2.9	3.69	4.45	5.21	5.96
Ruthamford South	0	0.15	1.34	2.01	2.65	3.33	4.03	4.72	5.42	6.09	6.79	7.49
Ruthamford West	0	0.02	0.05	0.05	0.04	0.06	0.08	0.09	0.14	0.18	0.2	0.2

Water resource zone	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37
Suffolk East	0	-0.32	-0.01	0.16	0.2	0.32	0.49	0.69	0.9	1.09	1.23	1.37
Suffolk Ixworth	0	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.04
Suffolk Sudbury	0	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.07	0.1	0.13	0.16
Suffolk Thetford	0	0.02	0.04	0.04	0.03	0.03	0.04	0.06	0.13	0.19	0.26	0.3
Suffolk West & Cambs	0	0.1	0.18	0.24	0.3	0.39	0.48	0.67	0.95	1.27	1.59	1.84

Table 17 Cumulative distribution input, including the benefits from demand management, up to 2036/37

Water resource zone	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37
Essex Central	0	-0.04	-0.09	-0.14	-0.19	-0.24	-0.27	-0.29	-0.29	-0.32	-0.35	-0.38
Essex South	0	0.06	0.08	-0.05	-0.19	-0.28	-0.35	-0.32	-0.3	-0.47	-0.65	-1.02
Fenland	0	-0.66	-0.95	-1.22	-1.6	-1.94	-2.28	-2.63	-2.78	-3.12	-3.5	-4.3
Hartlepool	0	-0.16	-0.33	-0.56	-0.84	-1.02	-1.19	-1.3	-1.37	-1.49	-1.62	-1.74
Lincolnshire Bourne	0	0.16	0.35	-0.18	-1.28	-1.49	-1.69	-1.76	-1.81	-2.06	-2.26	-2.47
Lincolnshire Central	0	-0.23	-0.64	-1.24	-1.79	-2.27	-2.74	-2.91	-3.07	-3.63	-4.41	-5.02
Lincolnshire East	0	-1.2	-1.21	-1.5	-2.15	-2.92	-3.58	-4	-4.99	-5.92	-6.73	-7.4
Lincolnshire Retford and Gainsborough	0	-0.1	-0.2	-0.33	-0.49	-0.63	-0.79	-0.85	-0.92	-1.07	-1.22	-1.36
Norfolk Aylsham	0	0.02	-0.14	-0.17	-0.18	-0.2	-0.22	-0.21	-0.21	-0.23	-0.24	-0.27
Norfolk Bradenham	0	-0.02	-0.04	-0.09	-0.15	-0.2	-0.24	-0.26	-0.26	-0.3	-0.34	-0.38
Norfolk East Dereham	0	-0.02	-0.04	-0.07	-0.11	-0.14	-0.17	-0.18	-0.19	-0.21	-0.47	-0.5
Norfolk East Harling	0	0	0.01	0	-0.12	-0.14	-0.16	-0.17	-0.18	-0.2	-0.21	-0.23

Water resource zone	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37
Norfolk Happisburgh	0	0.01	0.01	-0.14	-0.17	-0.19	-0.2	-0.2	-0.19	-0.19	-0.19	-0.2
Norfolk Harleston	0	-0.03	-0.07	-0.24	-0.55	-1.14	-1.48	-1.55	-1.61	-1.68	-1.74	-1.81
Norfolk North Coast	0	0.03	-0.3	-0.79	-0.94	-1.08	-1.22	-1.28	-1.33	-1.43	-1.78	-1.87
Norfolk Norwich & the Broads	0	-0.04	-0.28	-0.52	-0.75	-0.98	-1.28	-1.43	-1.65	-2.15	-2.59	-3.08
Norfolk Wymondham	0	-0.03	-0.07	-0.17	-0.25	-0.31	-0.38	-0.39	-0.4	-0.44	-0.49	-0.53
Ruthamford Central	0	0.13	0.58	0.58	0.73	0.34	0.54	1.07	1.37	1.78	2.22	2.38
Ruthamford North	0	-0.23	-0.62	-1.56	-4.05	-5.2	-6.01	-6.78	-7.29	-9.18	-10.04	-11.11
Ruthamford South	0	-1.15	-1.49	-2.75	-3.99	-4.61	-5.39	-5.2	-4.97	-5.45	-5.53	-5.88
Ruthamford West	0	-0.17	-0.28	-0.44	-0.89	-1.04	-1.54	-1.61	-1.65	-1.77	-1.87	-2.21
Suffolk East	0	-0.86	-1.95	-2.94	-4.15	-4.65	-5.09	-5.23	-5.34	-5.71	-6.38	-6.8
Suffolk Ixworth	0	-0.03	-0.05	-0.09	-0.14	-0.18	-0.22	-0.25	-0.29	-0.33	-0.36	-0.4
Suffolk Sudbury	0	-0.02	-0.06	-0.1	-0.15	-0.19	-0.23	-0.24	-0.24	-0.28	-0.31	-0.35
Suffolk Thetford	0	-0.02	-0.04	-0.08	-0.13	-0.17	-0.21	-0.22	-0.2	-0.19	-0.19	-0.21
Suffolk West & Cambs	0	-0.43	-0.66	-1.02	-1.34	-1.65	-1.93	-2.77	-2.75	-2.91	-3.32	-3.9

The Environment Agency consider scenario 6 as the baseline to compare the other scenarios against. We have used this in the baseline forecast to complete the WRP tables. However, for the final plan data we must include adjustments in the table to reflect the preferred licence cap scenario. Figure 32 shows the regional deployable output adjustment needed for each scenario, this is the difference in supply demand balance between each scenario and the baseline scenario 6. This difference is the amount of licence, (as deployable output) that is needed to ensure customers can receive a secure supply of water, ahead of new sources being commissioned. The quantities in Figure 32 differ fromFigure 19 as these are residual impacts and take into account any surplus that can be used to meet some of the licence caps.

It is not accepted that the changes in the amount of water that can be abstracted between scenario 6 and the other feasible scenarios necessarily causes deterioration or presents a risk of that nor that the use of scenarios other than 6 automatically gives rise to the need for OPI. However even if OPI is required in order to amend or alter licences our policy decision modelling shows that OPI would be satisfied.

For example, our draft WRMP used scenario 4 and we included an adjustment in the final plan tables to reflect this, in 2025 we included an adjustment of 73Ml/d regionally, i.e. added 73Ml/d back into the supply forecast. Scenario 4 requires less licence cap adjustment than 5.

Figure 32 Adjustments (Ml/d) required for each scenario relative to baseline scenario 6

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Scenario 4	73	73	73	73	73	61	61	61	61	61	61	0
Scenario 5	73	73	73	73	73	134	134	134	134	134	134	0
Scenario 7	73	73	73	73	73	61	61	0	0	0	0	0

- Licence cap adjustment for time limited licences
- Licence cap adjustment for capping permanent licences
- Licence cap adjustment for time limited and permanent licences
- All licences capped to recent actual annual average

The following two figures demonstrate how the licence capping scenario 4 reduces the risk of deterioration over time, firstly for the time limited licences (Figure 33) and secondly for the permanent licences (Figure 34). In both cases, the timing of the licence caps (shown by the purple line), triggers alternative sustainable supply options, whilst demand management ensures that despite population growth, there is not a trend of increasing abstraction over time. This is shown by the decreasing trend of the blue lines, which represent annual variation in demand.

Figure 33 Impact of demand management and licence capping scenario at reducing risk of deterioration for the time limited licences

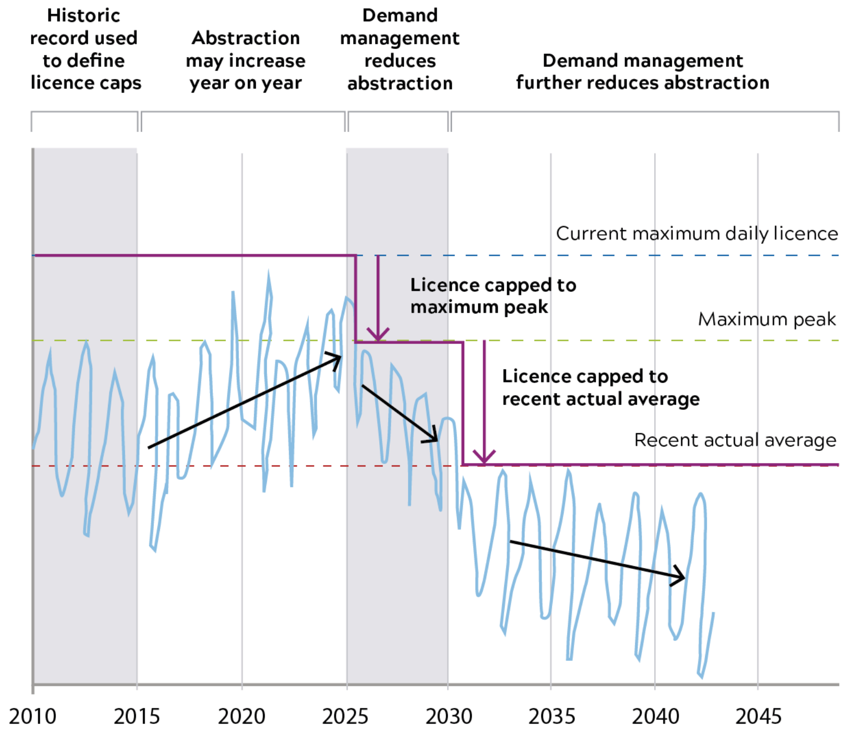
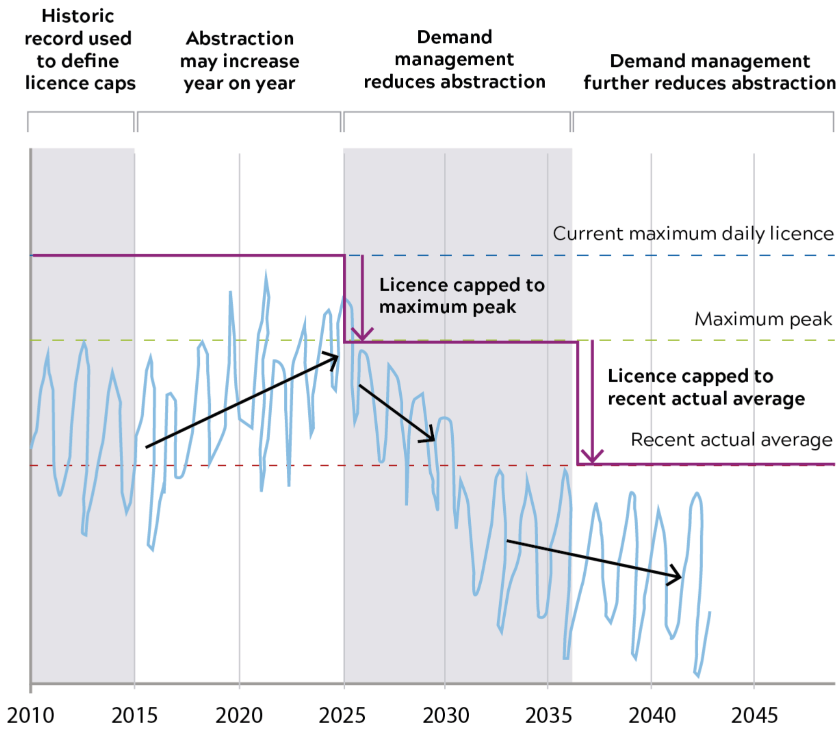


Figure 34 Impact of demand management and licence capping scenario at reducing risk of deterioration for the permanent licences



Scenario 7 delivers benefits earliest, reflected in the average abstraction reduction metric, but this comes with increased operational carbon and cost. We have selected scenario 4 to be included in our initial most likely scenario as this is more ambitious than scenario 5 and is more cost effective and flexible compared to scenario 7.

5.2.3 Drought resilience timing

Our WRMP24 must deliver resilience to a 1:500-year drought event. Environment Agency guidelines state this should be achieved by 2039 and with reduced frequency of management options [39] such as permits.

In a drought situation, we have the opportunity to manage potential impacts by undertaking drought management interventions. This can involve both reducing demand, through temporary use bans (TUBs), non-essential use bans (NEUBs), and making additional supply available through the application of drought permits. We have applied drought management demand savings from TUBs and NEUBs and included these in our initial most likely baseline scenario.

Our Drought Plan 2022 sets out our operational response to protecting public water supplies during a drought in the period 2022-2027. This includes both demand and supply-side interventions to maintain our committed Level of Service provided to our customers.

Our minimum Levels of Service for WRMP24 are summarised in Table 18, as described in our Drought Plan 2022.

In WRMP 2019 we committed to improved level of service by 2025, to ensure that no customers are exposed to the risk of standpipes and rota-cuts in a severe drought event, equivalent to a return period of approximately 1 in 200 years.

Table 18 Levels of Service (LoS)

Level of Service	Action	Frequency (years)
LoS 2	Temporary Use Bans	1:10
LoS 3	Non-essential Use Bans	1:40
LoS 4 (until 2025)	Rota cuts	1:100
LoS 4 (from 2025)		>1:200

We have modelled the possibility of amending our levels of service (i.e. allowing demand side measures to occur more frequently) to understand if this could enable a greater deployable output in our drought-impacted

39 Water Resources Planning Guideline (WRPG), March 2023, Section 4.7

Water Resource Zones.However, the modelling has shown that without breaching the Emergency Storage levels, there is no increase in deployable output by increasing the frequency of demand restrictions.

This is because deployable output is based on a reference drought event, which already has the benefit of demand saving measures included. Any additional benefit from changing levels of service would require a cumulative effect in the years preceding the reference drought, which could theoretically enable an improved starting position. Our analysis has shown no such cumulative effect is present. The reservoirs were able to refill sufficiently in the intervening years between drought events at the current levels of service.

We must determine an optimum timing for increasing drought resilience by considering the costs and benefits of alternative approaches. We have modelled six alternative dates for achieving 1:500 drought resilience, see Table 19.

Table 19 Alternative dates for meeting drought resilience to 1:50

Drought Year	Years of additional resilience compared to the baseline
2025	14
2030	9
2035	4
2039	n/a
2045	-6
2049	-10

Further scenarios were tested to analyse the effect of including drought permit benefits within our forecast, and to understand if 1:500 drought resilience could be delivered earlier when these benefits are included, see Table 20.

Table 20 Drought measures scenarios tested

1:500 drought resilience year	Drought measures included relative to each drought scenario	
	1:200 drought	1:500 drought
2025	None	Drought permits from 2025-2039. Demand savings 2025-2049
2030	Demand savings and drought permits from 2025-2030	Drought permits from 2030-2039. Demand savings 2030-2049
2035	Demand savings and drought permits from 2025-2035	Drought permits from 2035-2039. Demand savings 2035-2049
2039	Demand savings and drought permits from 2025-2039	Demand savings 2039-2049 No drought permits
Baseline	No demand savings or drought permits included.	No demand savings or drought permits included.

The transition to 1:500 drought resilience creates a reduction of 76 Ml/d in our supply forecast, Table 21 shows the water resources zones impacted, these figures do not include the benefits of drought measures, such as demand savings. The scale of the impact is independent of its timing, and therefore remains the same in each scenario.

Table 21 Impact of 1:500 drought resilience on Deployable Output (DO) by water resource zone

Water resource zone	Impact of 1:500 Drought Resilience on baseline deployable output (Ml/d)
Essex South	-4.0
Fenland	-7.2
Lincolnshire Central	-1.9
Ruthamford North	-33.3
Ruthamford South	-27.2
Suffolk East	-2.0
Suffolk West & Cambs	-0.4
Total	**-76.0**

Table 22 shows the residual regional supply demand balance after options are selected for each of the modelled scenarios. Table 23 shows the supply demand balance if the benefits of 1:200 drought permits were to be included from 2025 to 2039.

Where there are deficits this shows there are not adequate new resource options available to resolve the abstraction reductions.

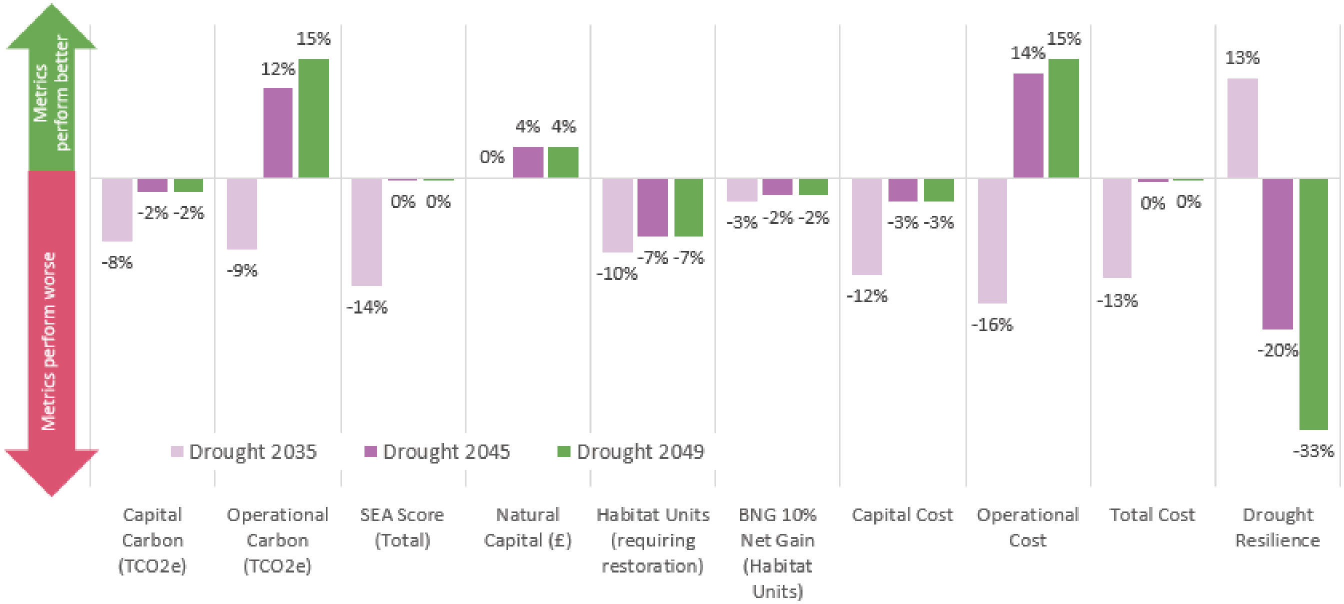
Table 22 Regional residual supply demand balance (Ml/d) scenario comparison

Drought resilience year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
2025	-51	-48	-46	-42	-37	-58	-56	60	60	61	75
2030	30	33	35	38	42	-58	-56	60	60	61	75
2035	30	33	35	38	42	17	20	20	26	28	32
2039	30	33	35	38	42	17	20	20	32	34	50
2045	30	33	35	38	42	18	20	21	33	34	51
2049	30	33	35	38	42	18	20	21	33	34	51

Table 23 Regional residual supply demand balance (Ml/d) scenario comparison (with drought permits included to 2039)

Drought resilience year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
2025 (inc. drought permits)	-35	-31	-29	-24	-19	-40	-38	50	50	52	77
2030 (inc. drought permits)	48	50	50	52	57	-40	-38	50	50	52	77
2035 (inc. drought permits)	48	50	50	52	57	24	26	27	27	28	19
2039 (inc. drought permits)	48	50	50	52	57	11	14	14	14	16	32
2039 (no drought permits)	25	27	28	28	33	11	14	14	14	16	32

Figure 35 Percentage difference in best value metrics compared to baseline scenario of 2039



In all scenarios, 1:500 drought resilience impacts scheduled for 2025 and 2030 result in residual supply demand deficits. These deficits occur because there are insufficient supply-side options available early in the planning period 2025-2032 to manage a deficit of this scale despite the inclusion of a significant demand management programme and a number of smaller supply-side schemes. The deficits are resolved by 2032 in all scenarios, as this is the timescale when larger and more complex supply options such as desalination and reuse become available within the model.

Our WRMP24 must maintain the supply demand balance without any final planning deficits[40], therefore scenarios of delivering drought resilience by 2025 and 2030 are excluded from further analysis as they do not allow us to meet this requirement.

Figure 35 compares the different dates against the baseline scenario of 2039. Delivering 1:500 drought resilience earlier than 2039 would result in large cost, carbon and SEA impacts, while later delivery would reduce these impacts only marginally. This is because a 2035 impact would require a commitment to more operationally costly desalination and reuse options, because the Lincolnshire Reservoir is not deliverable until 2039.

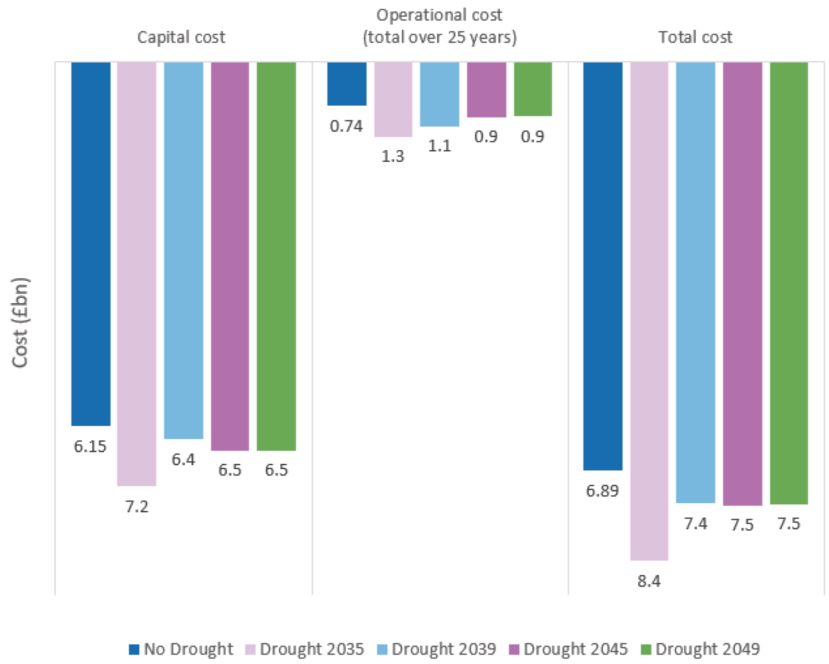
Changing the drought resilience date after 2039 would result in a similar portfolio of options, but with a delay to their timings linked to the selected 1:500 resilience date.

Figure 36 shows the effect of changing the drought resilience date on cost in further detail. A 2035 drought resilience date would significantly increase both capital and operational cost, whereas there is significantly less variability between 2039, 2045 and 2049.

We have commissioned an independent Cost Benefit Analysis that evaluates the cost of option portfolios required for the range of 1:500 drought resilience timings against the economic benefit of avoiding the negative impacts of a 1:500 drought.

40 Water Resources Planning Guideline (WRPG), March 2023, Section 4.1

Figure 36 Cost comparison between alternative drought timings



The analysis found that the later 1:500 drought resilience is achieved, the lower the overall net cost (after balancing costs and benefits). The benefit of achieving 1:500 drought resilience earlier was found to be significantly lower than the cost of earlier delivery. To illustrate the scale of the difference between costs and benefits, the analysis highlighted that moving from a 1:200 to 1:500 drought resilience level is a decrease in drought probability of 0.003. Therefore, a £100 million cost difference between a 2049 and 2039 scenario, would require the benefits of avoiding a drought (i.e. that occurs with certainty) to increase by over £30 billion (£100 million / 0.003) between 2039-2049. This compares to calculated benefits of approximately £60m based on available willingness to pay data.

It should be noted that the cost difference between 1:500 resilience delivery dates after 2040 is overestimated within this analysis, because the cost information used was based on the higher utilisation rates required during a 1:500 drought, occurring in each year. This means that the analysis assumed that every year after 2039 would include operational costs as though we were experiencing a 1:500 drought. The study also quantified benefits only in terms of customer willingness to pay to avoid drought restrictions. However, it can be expected that Anglian Water would in practice incur significant higher operational costs to maintain supply and avoid restrictions in drought conditions, which would be reduced once 1:500 drought resilience was achieved.

The impact of 1:500 drought resilience is primarily a reduction in deployable output of our Ruthamford region. Our policy modelling for environmental destination, see 5.2.4, has shown that the Lincolnshire Reservoir option is triggered by the timing of environmental destination. This means that even if drought resilience was delayed, it would not result in a significant cost reduction because the key option required for its delivery would already have been constructed.

We have included the drought management demand savings from temporary use bans and non-essential use bans to our initial mostly baseline scenario. Table 24 shows the scale of these savings. We have also tested the impact of removing these savings. Including the benefits of demand savings reduces the 1:500 drought impact to 69.9Ml/d.

Table 24 Drought management demand savings

Water Resource Zone	DO benefit against 1:200 drought (Ml/d)	DO benefit against 1:500 drought (Ml/d)
Fenland	0.1	0.1
Ruthamford North	7.2	3.3
Ruthamford South	5.9	2.7
Total	13.2	6.1

Table 25 shows the savings available if drought permits were included in our baseline forecast, in addition to the demand savings of temporary use bans and non-essential use bans. The 1:500 benefits only apply before 2039, following WRPG guidance requirements.

Table 25 Additional benefit of drought permit savings

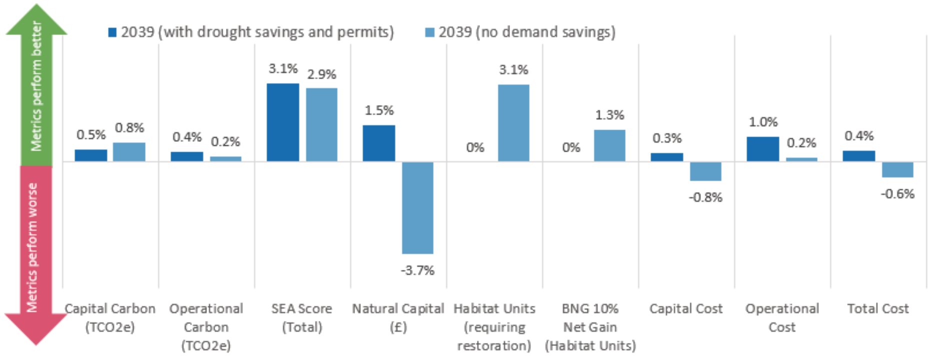
Water Resource Zone	Deployable output benefit against 1:200 drought Ml/d *(additional benefit compared to only demand savings Ml/d)*	Deployable output benefit against 1:500 drought Ml/d (before 2039) *(additional benefit compared to demand savings Ml/d)*
Fenland	0.1	1.4 *(+ 1.3)*
Norfolk and the Broads	5.9 *(+5.9)*	5.9 *(+ 2.6)*
Ruthamford North	9.9 *(+2.5)*	3.52 *(+ 0.8)*
Ruthamford South	8.1 *(+2.2)*	2.88 *(+ 0.2)*
Total	**24 *(+10.8)***	**13.7 *(+7.6)***

We have tested three scenarios of alternative drought measures. These are all based on achieving 1:500 drought resilience by 2039 but vary the inclusion of,

- Demand savings
- Demand savings and drought permits
- No demand savings or drought permits

Figure 37 shows the effect on best value measures by comparing the percentage difference against the no demand savings or drought permit scenario .

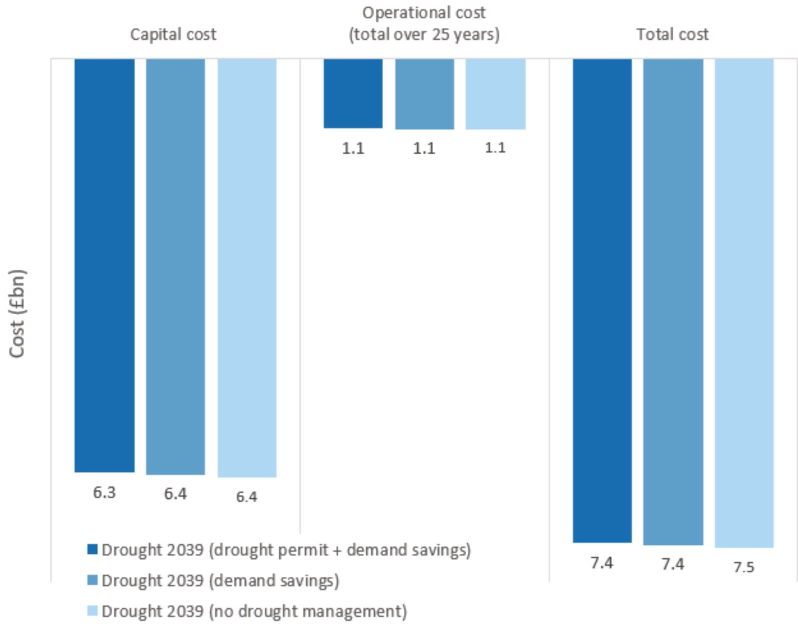
Figure 37 Percentage difference in best value metrics compared to scenario of no drought measures



Overall there is relatively little sensitivity to varying the chosen drought management action, with most metrics showing less than 1% differentiation. This is because the majority of selected options remain the same, with some variation in the timing of their implementation. For example, one option may be delayed slightly if drought permits are used in addition to demand savings, and an additional option is required if no demand savings are used.

Figure 38 compares the cost differences between alternative drought management scenarios. This shows relatively little sensitivity between scenarios, due to the majority of options being identical. There are feasibility risks associated with drought permits associated with their potential environmental impacts and as such cannot be a guaranteed option.

Figure 38 Cost comparison for alternative drought management scenarios



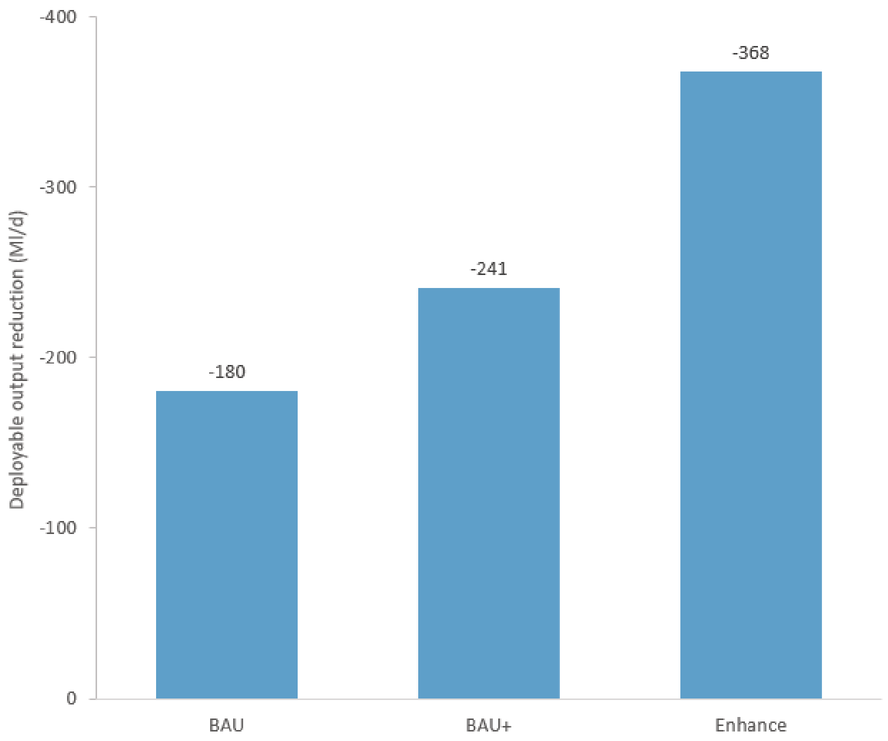
We need to meet the requirements and customers have told us they feel the date is about right. We will therefore use 2039 initial most likely scenario[41]. The inclusion of drought permit benefits does not provide significant cost savings as they do not enable options to be delayed. Therefore we have not included drought permits in our initial most likely scenario but they could be considered as potential interventions as part of adaptive planning.

41 Customer and stakeholder engagement technical supporting document, Section 9.5

5.2.4 Environmental destination and ambition scenarios

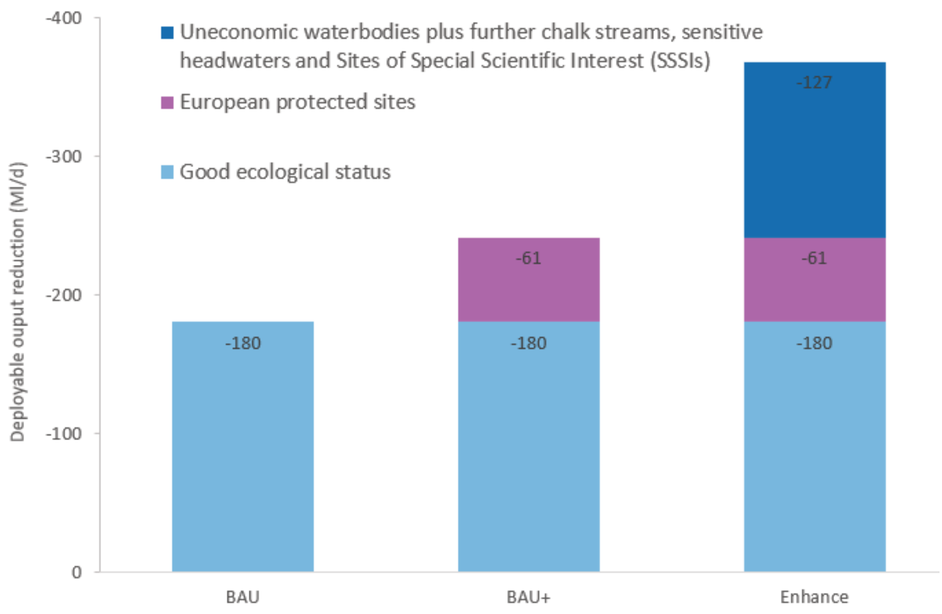
We have modelled the three levels of environmental destination with varying starting dates and profiles to meet the full destination by the 2050 date, see Figure 39.

Figure 39 Reductions to our supply forecast as deployable output from the environmental destination scenarios



The impact of environmental destination in Figure 39 is quantified in terms of change to deployable output, the different terms used to describe the supply forecast and reductions are described in. Figure 40 shows the proportion of abstraction interventions which form the components of the scenarios.

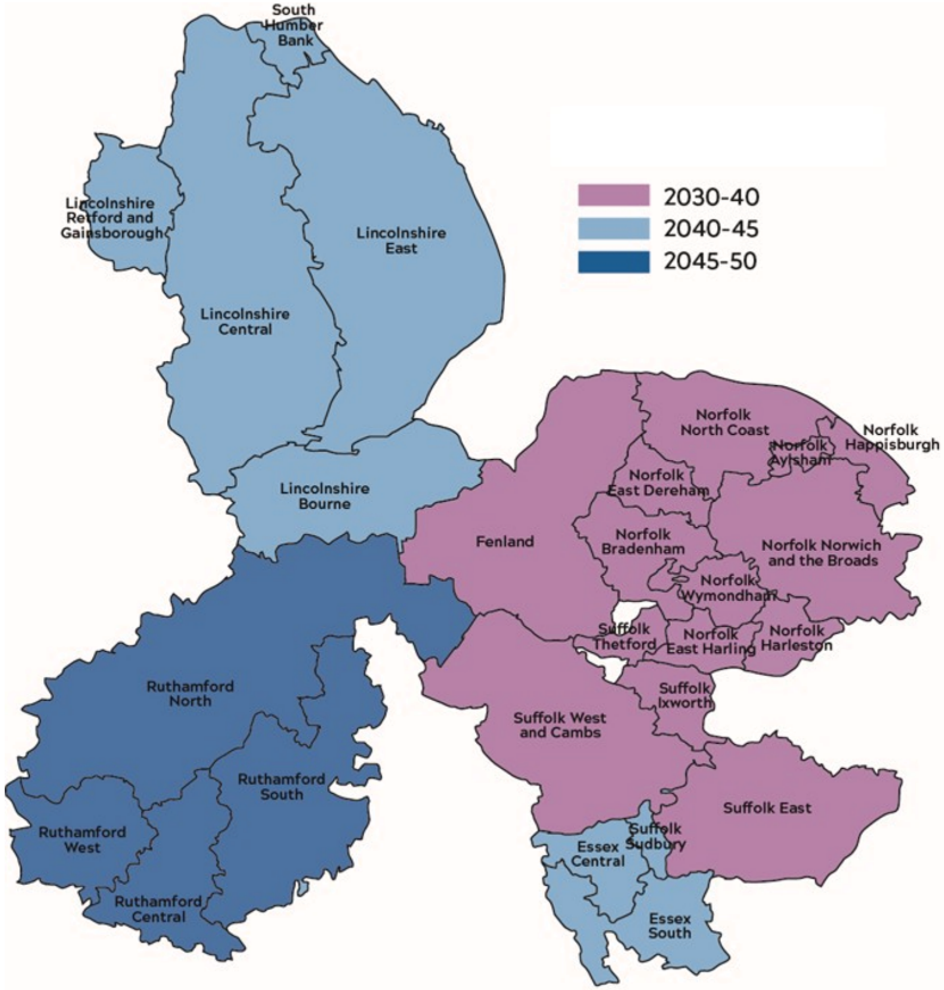
Figure 40 Components of each environmental destination scenario



The three environmental destination scenarios have been modelled with a range of starting dates. The reductions have been applied as a step change in one year (with four different years tested) or profiled starting with the highest priority catchments.

For the profiled scenarios we have prioritised Water Resource Zones that contain sources where reductions in abstractions have the potential to improve the environment in parts of our region, see Sustainable Abstraction and Environment report. These are shown inFigure 41.

Figure 41 Prioritisation of Water Resource Zones for environmental destination reductions for profiled scenarios



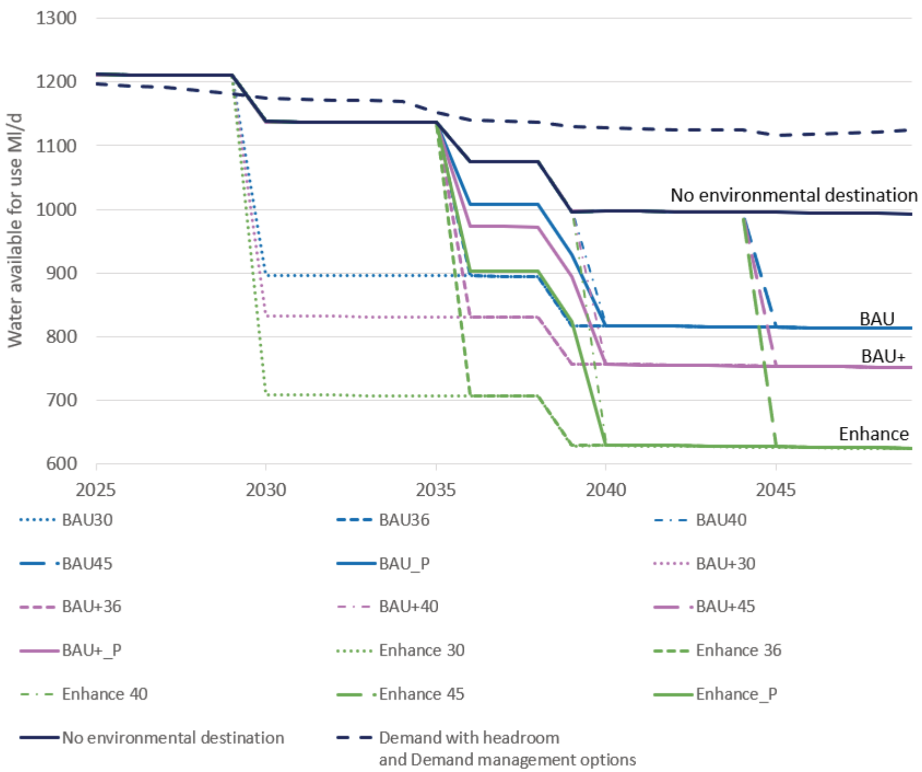
The three environmental destination scenarios were combined with the five ambition scenarios plus a baseline of no environmental destination to create 16 scenarios, these are listed in Table 26.

Table 26 Environmental destination scenarios

Environmental destination scenario	Environmental ambition scenario	
	Applied as	Year
None	Not applicable	Not applicable
BAU 30	Step change	2030
BAU 36	Step change	2036
BAU 40	Step change	2040
BAU 45	Step change	2045
BAU P	Profiled	Starting in 2036
BAU+ 30	Step change	2030
BAU+ 36	Step change	2036
BAU+ 40	Step change	2040
BAU+ 45	Step change	2045
BAU+ P	Profiled	Starting in 2036
Enhance 30	Step change	2030
Enhance 36	Step change	2036
Enhance 40	Step change	2040
Enhance 45	Step change	2045
Enhance P	Profiled	Starting in 2036

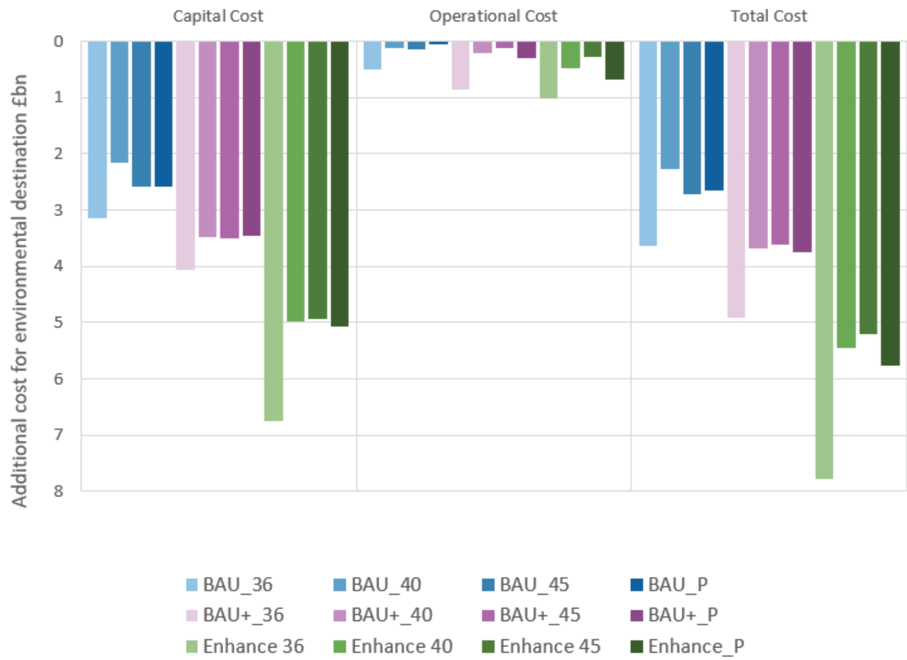
We have used the best values metrics to assess the impacts of changing the timing and profiling of the different levels of environmental destination.

Figure 42 Baseline supply demand balance for environmental destination scenarios



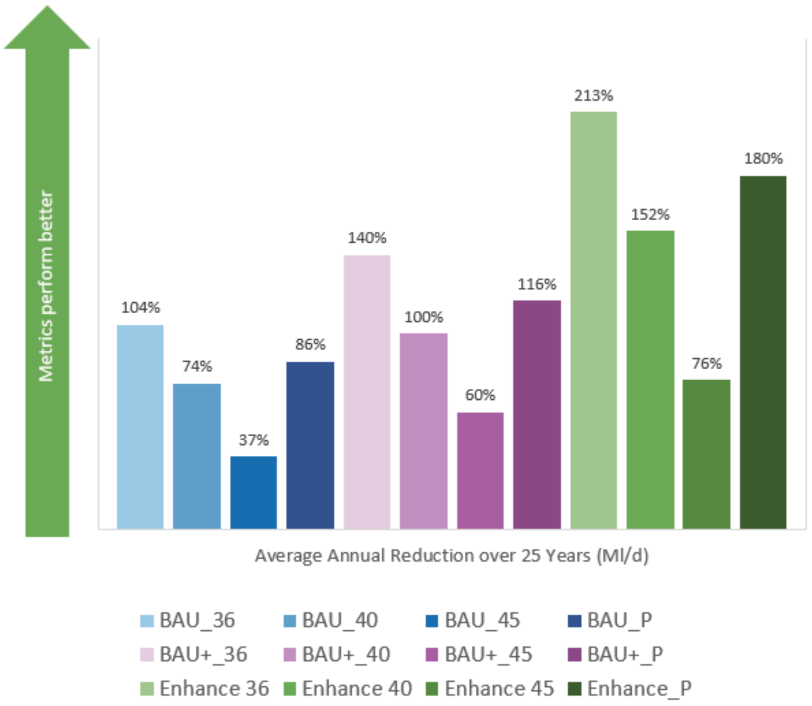
[Figure 42](#) shows the baseline supply demand balance for all the scenarios. All scenarios including no environmental destination result in deficits by 2030. Once we include the supply-side options we find that the scenarios starting in 2030 for all three levels of environmental destination result in unresolved deficits, therefore it is not feasible to deliver the abstraction reductions before 2036. Deficits appear because there are insufficient supply-side investment options to satisfy demand at the start of the planning period. For WRMP24, any proposed plan must maintain the supply demand balance, therefore these environmental ambition scenarios are ruled out from further development.

Figure 43 Cost metrics for all feasible scenarios compared against baseline of no environmental destination



In [Figure 43](#) the additional costs compared to the baseline scenario of no environmental destination are presented. This shows delivering environmental destination in 2036 requires the highest level of investment, in these scenarios the Fens reservoir is selected but does not provide enough resource to meet the full need in 2036 requiring desalination and water reuse in addition. For the scenarios starting in 2040, 2045 and profiled from 2036 the capital costs are close but the operational costs vary due to the timing of when new resources are required.

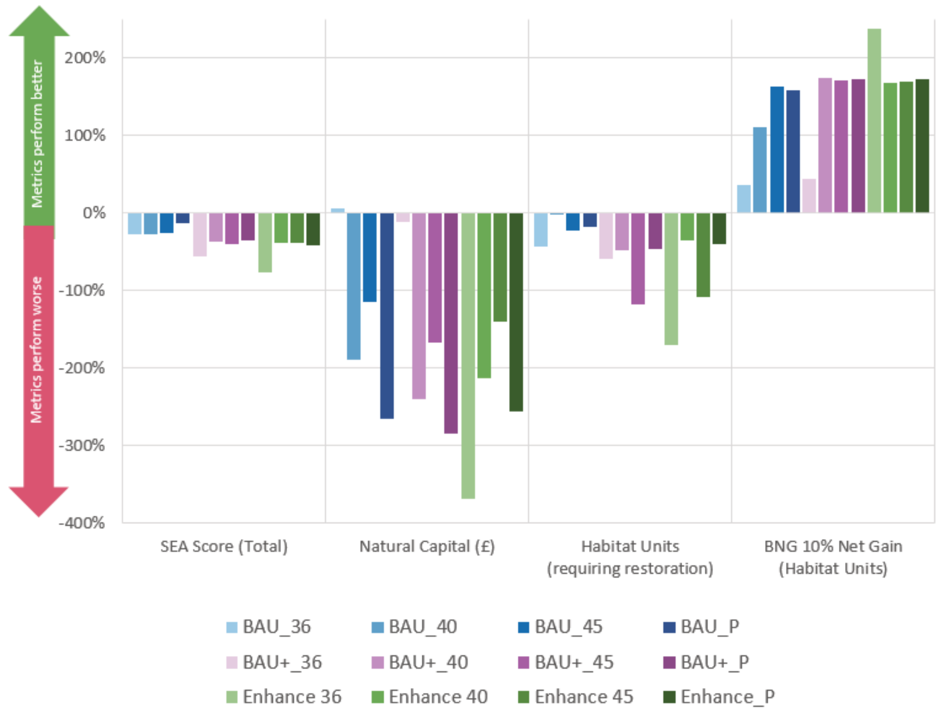
Figure 44 Comparison against no environmental destination for the average annual reduction over 25 years.



[Figure 44](#) compares the average annual reduction metric against the no environmental destination scenario as a percentage. This metric represents the level of abstraction reduction and the timing of when it is achieved by measuring the average annual abstraction reduction over the entire planning period compared to a no-reduction scenario.

For all levels of environmental destination, the earlier the reductions are applied the better performing the average annual reduction metric. The prioritised catchment options are only marginally higher than the scenarios based on 2040. A similar trade-off between larger abstraction reduction and environmental metrics can be seen in [Figure 45](#).

Figure 45 Comparison of environmental metrics against baseline scenario of no environmental destination

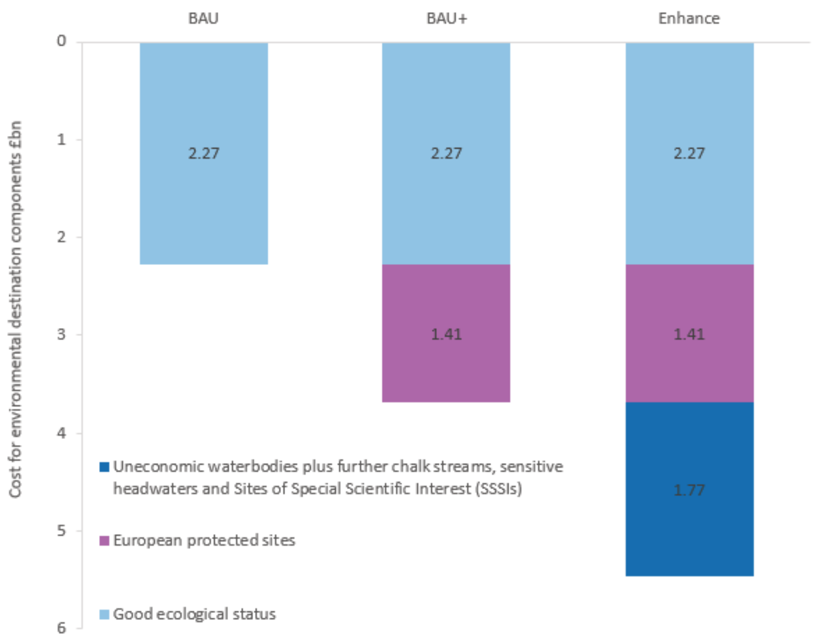


The metrics show that starting environmental destination from 2040, 2045 or phasing priority catchments from 2036 are close in terms of costs, SEA scores and BNG 10% net gain metrics. Phasing the priority catchments provides the greatest average annual reduction over 25 years for each level of environmental destination.

To assess the level of the environmental destination we compare the three scenarios starting in the same year, 2040. The BAU scenario is the legal minimum required to achieve flows to support 'Good ecological status' under the Water Framework Directive (WFD) and our assessment considers the costs and benefits of going beyond BAU to achieve BAU+ or Enhance.

[Figure 46](#) compares the investment needed to meet the components of the scenarios, see Box 11 for definitions.

Figure 46 Comparison of 2040 scenarios to show the cost per environmental destination component



To assess the benefits of environmental destination we have used a benefits appraisal tool created by the Environment Agency and based on the outcomes of the National Water Environment Benefits Survey (NWEBS).

The tool assigns a monetary benefit to each waterbody in our region attaining good ecological status for river channel and flow. Some catchments are shared between water companies. To resolve this, spatial analysis was used to proportionally allocate the benefits based on the area of each catchment located within company boundaries.

Following consultation with the Environment Agency, the following assumptions were used to generate benefits for each of the environmental destination scenarios:

- BAU: Uneconomic waterbodies excluded.
- BAU+: Uneconomic water bodies excluded, except for those linked to European protected sites. The willingness to pay for delivering 'good' status for water bodies linked to European protected sites was increased from 'central' to 'high'
- Enhance: All waterbodies included. The benefit of delivering 'good' status for water bodies linked to European protected sites, chalk streams and SSSIs was increased from 'central' to 'high'.

The costs are based on an annual benefit value (in 2020 prices), which has been applied to each year within the 25 year forecast period where environmental destination reductions are in place for each Water Resource Zone.

The outcome of this is shown in Figure 47. Though the costs and benefits are a magnitude different, this shows that proportionally the benefit of going beyond BAU to BAU+ is similar to the cost. However for Enhance the costs are significantly higher than the benefits, which is reflective of the inclusion of the non-economic water bodies within this scenario.Table 27 shows the costs and benefits per Ml/d reduction.

Figure 47 Comparison of 2040 scenarios to show the benefits per environmental destination component

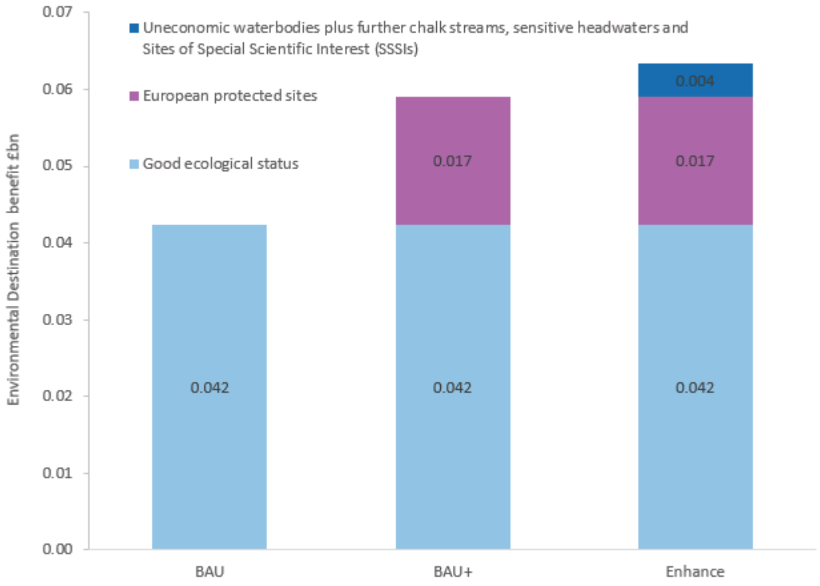
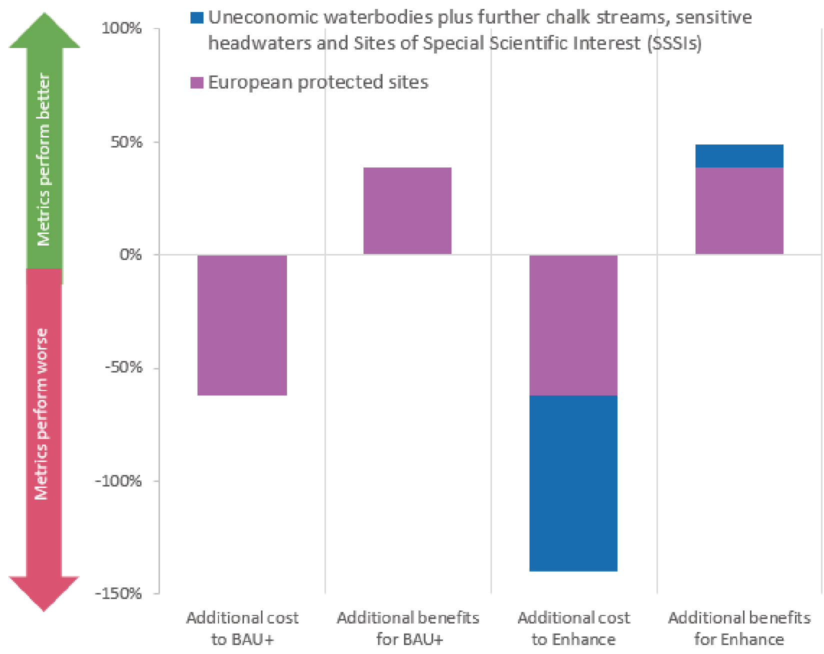


Table 27 Costs and benefits per abstraction reduction

	Good ecological status	European protected sites	Uneconomic waterbodies plus further chalk streams, sensitive headwaters and Sites of Special Scientific Interest (SSSIs)
Cost £m per Ml/d reduction	12.6	23.1	14.0
Benefit £m per Ml/d reduction	0.24	0.27	0.03

By comparing the percentage change of costs and benefits of going beyond BAU, Figure 48, this shows that the increase in benefit of achieving BAU+ is proportionate to the costs. However this is not the case for moving to the Enhance scenario where the benefits are significantly less than the cost.

Figure 48 comparison of costs and benefits for going beyond BAU as a percentage



Our analysis shows that the trade-off for greater abstraction reduction is poorer performance in expenditure as we need to build more new resources to replace those lost. The lowest cost scenario in terms of total expenditure is BAU with a later implementation date (from 2040 onwards) as this requires the lowest capital cost to replace the lost abstraction and has fewer years of operational costs included in the total expenditure.

The assessment of costs and benefits for the level of environmental destination show that the amount of expenditure to achieve the highest level of Enhance is not proportional to the benefits. However the cost to achieve BAU+ does appear to be proportional relative to the benefits gained.

Through the regionally planning it has been agreed to use BAU+ as the environmental destination scenario in the regional plans[42]. Our analysis supports this decision to develop the plan to achieve BAU+. However the plan includes developing adaptive pathways to demonstrate how we could achieve BAU or Enhance in the future.

The assessment shows that the ambition profile where higher-priority water resource zones have abstraction reduced in 2036 and then lower priority ones in 2040 and 2045 is suitable to use for the initial most likely scenario. This bespoke scenario allows for early reductions where they are needed the most, whilst delaying the negative environmental impacts of investments in less sensitive zones. This scenario is based on profiling impacts for whole water resource zones in specific regional areas of our supply system rather than individual sources within a zone, see Figure 41. This approach is suitable for the initial most likely scenario but more detailed assessment would be required to confirm locations of where to prioritise abstraction reductions.

5.3 Initial most likely scenario

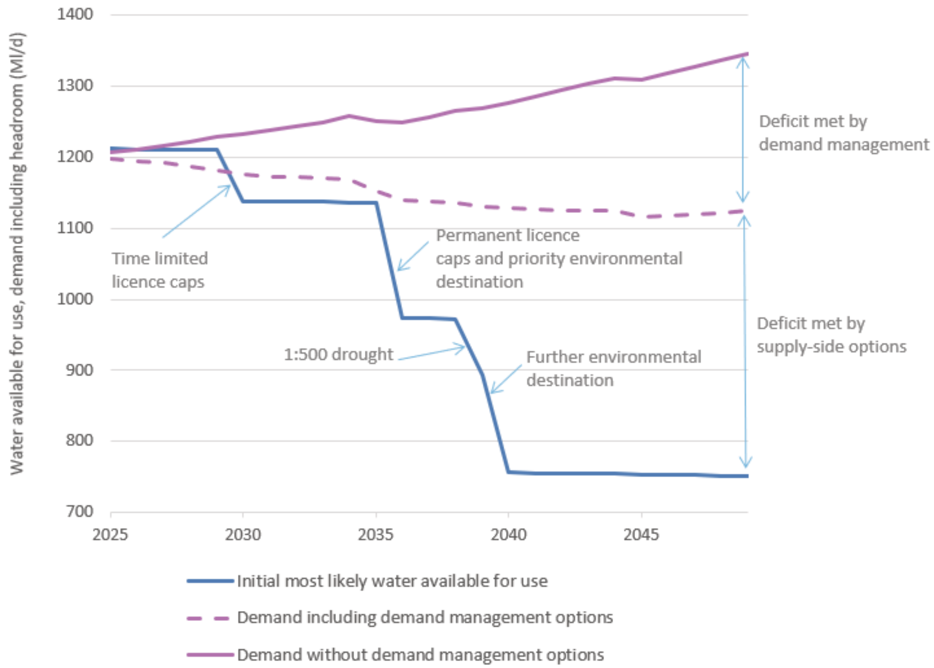
The policy decision modelling is used to determine our initial most likely scenario. The modelling concludes the following should be included,

- Aspirational demand management portfolio
- Licence cap scenario 4 - all licences capped at peak by 2025, time limited licences capped at average 2030 and all other licences capped at average by 2036.
- Drought resilience to 1:500 achieved by 2039
- Environmental destination scenario is BAU+ profiled starting in 2036

Our initial most likely scenario is shown in Figure 49 and is the scenario we use to develop our initial least cost plan.

The supply demand balance graph in Figure 49 covers the Anglian region of our supply system, it does not include our geographically discrete water resource zone in Hartlepool. This zone remains in surplus over the whole planning period, with approximately a 4Ml/d surplus in 2049/50. It also does not include the non potable demand for our South Humber Bank Water Resource Zone.

Figure 49 Our initial most likely scenario



The guidance states that the planning period we use should be appropriate to the risks we face, which must cover at least the statutory minimum of 25 years. However It may be appropriate, depending on our challenges and risks to plan for the next 50 years. This is to ensure our plan identifies the right solutions to meet future pressures [43].

42 Meeting our future water needs, the next steps with environment destination scenarios and sustainability changes within water resources planning. Environment Agency 3rd May 2022
43 Water Resources Planning Guideline (WRPG), March 2023, Section 4

Figure 50 shows the initial most likely scenario supply demand balance graph extended to cover 75 years. The deficits in our plan are created by reductions to our abstraction due to,

1. Licence capping
2. Drought resilience
3. Environmental destination
4. Climate change

The first three reductions are all required to be met within the first 25 years of the plan. Predictions for climate change show that the water available to abstract will steadily decline beyond 2049/50.

Our demand management forecast has been extended to cover 75 years, this shows a continuation of growth beyond 2049/50. If we continue with our strategy to use demand management to offset the net increase in demand due to growth, our demand beyond 2049/50 could remain at similar levels.

Figure 50 Extended supply demand balance over 75 year planning period

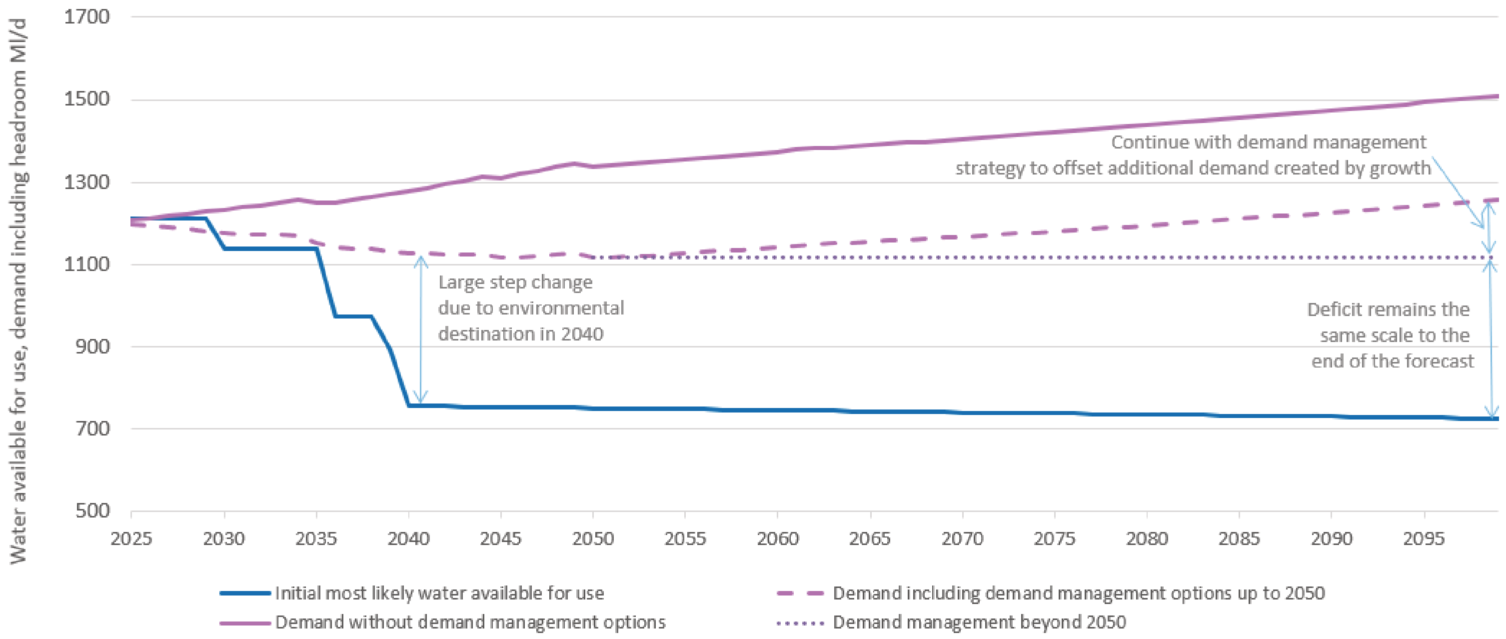


Table 28 shows the incremental deficits over time. This shows that the deficit by 2049/50 is significantly greater than deficits later in the plan. If demand management is extended beyond 2049/50 the deficits are driven by climate change. We will become more resilient to climate change within the first 25 years as we shift from groundwater abstraction to more resilient supply options of increased raw water storage and desalination.

Our initial most likely scenario is based on BAU+ level of environmental destination, if we were to change to the more challenging Enhance scenario in the future this would still be within the first 25years of our plan.

Table 28 Incremental deficits over planning period

	2025/26	2049/50	2074/75	2099/2100
Incremental deficit including demand management up to 2050	0	434	65	93
Incremental deficit if we include demand management beyond 2050	0	434	3	13

Given the challenges and risks we face and the uncertainty with planning further into the future, it is appropriate for our plan to be based on 25 years. However we will test our plans to ensure they can adapt to further future pressures by carrying out sensitivity tests for 50 years. It should also be noted that our investment model completes assessment of option costs over a 80 year horizon and selects the least cost combination to satisfy the deficits within the planning period set, in our case 25 years. WRMP24 will be reviewed and revised for WRMP29, when further information following the results of WINEP investigations and delivery of demand management options will be available.

6 Modelling to develop plans

6.1 Least cost plan for initial most likely scenario

Using our initial most likely scenario we develop a series of least cost plans that explore the impacts to option selection when the regional no and low-regret options are included or modelled as unconstrained, see Table 5.

The impact of including the benefits of demand management are included as part of the policy decision, see Section 5.2.1and through sensitivity testing we understand the impact of varying the planning horizon, Section 7.

Through our ongoing liaison with the Environment Agency we originally agreed to use the 'Regional plan low regret options plan' as our benchmark, see Table 5. However we have found through the least cost modelling that strategic no and low-regret options were selected in the same years for all least cost plans. Therefore we have used the Supply options least cost plan as our benchmark as this reflects the regional plan but does not constrain the scale or timing of the strategic options.

This confirms that the least cost plan with the regional plan options unconstrained is suitable as the initial least cost plan.

6.2 Developing an alternative plan

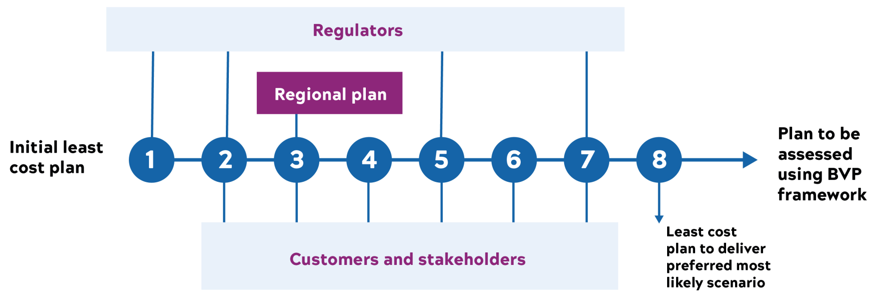
We have developed an alternative plan that is shaped by considering the factors described in Section 2. These include:

- Reflecting the regional plan
- Using the feedback from stakeholders, customers, regulators and within our own business
- Aligning with neighbouring water company plans

We sequentially apply each factor in an individual model run so it is explicit what the impact of each stage is on shaping the plan. The first seven iterations have led to adjusting the initial most likely scenario to maximise best value planning objectives, creating a preferred most likely supply scenario and an alternative plan using this scenario. The eighth iteration is a least-cost optimisation against the preferred most likely supply scenario, which is used for comparison with the alternative plan.

Figure 51 summarises the iterations to shape the plan using feedback from our engagement with customers, stakeholders, our wider business and other neighbouring water companies.

Figure 51 Schematic of the iterations to shape plan using feedback from engagement



We have used key best value metrics to compare each iteration against the initial least cost plan. These graphs show if the iteration performs better or worse as a percentage difference compared to the initial cost plan.

6.2.1 Iteration 1: Develop a bespoke licence cap scenario (feedback from Regulators)

Our initial most likely scenario incorporates licence cap scenario 4 which is based on time limited licences reduced to average recent actual by 2030, all other permanent licences by 2036. In response to stakeholder feedback we have developed a bespoke scenario to bring forward permanent licence caps such that all available resource is fully utilised.

Starting with scenario 4 we identify surplus resource that could be fully utilised by bringing forward some of the permanent licence caps without triggering the need to develop additional schemes at the start of the plan.

Scenario 8 is licence cap timing scenario that is additional to those presented in Section 5. It was developed over many iterations, where new supply forecasts were created with variations of licence caps timescales and locations. Figure 52 shows the final modelled scenario that utilised all surplus resource, and was used for scenario 8.

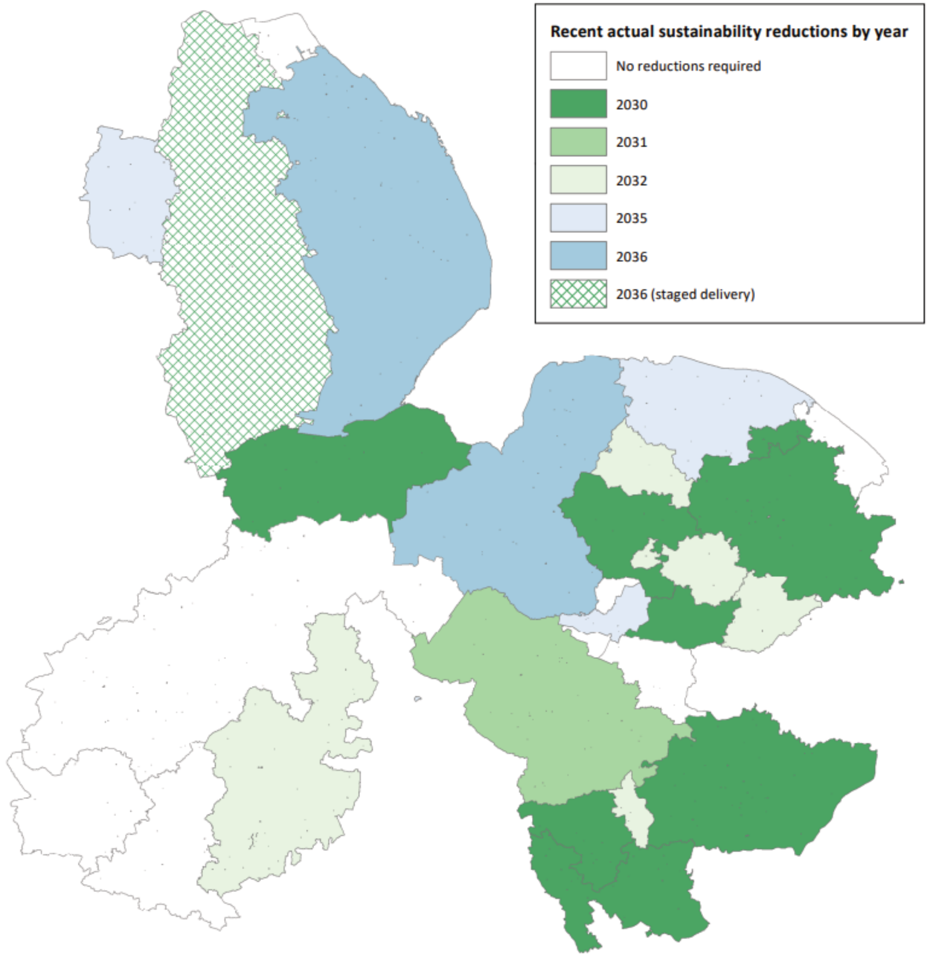
In Hartlepool water resource zone the permanent licence caps to average can be met in 2030.

Table 29 shows the cumulative percentage of overall permanent licence caps delivered in each year up to 2036.

Table 29 Cumulative percentage of overall permanent caps delivered by Scenario 8

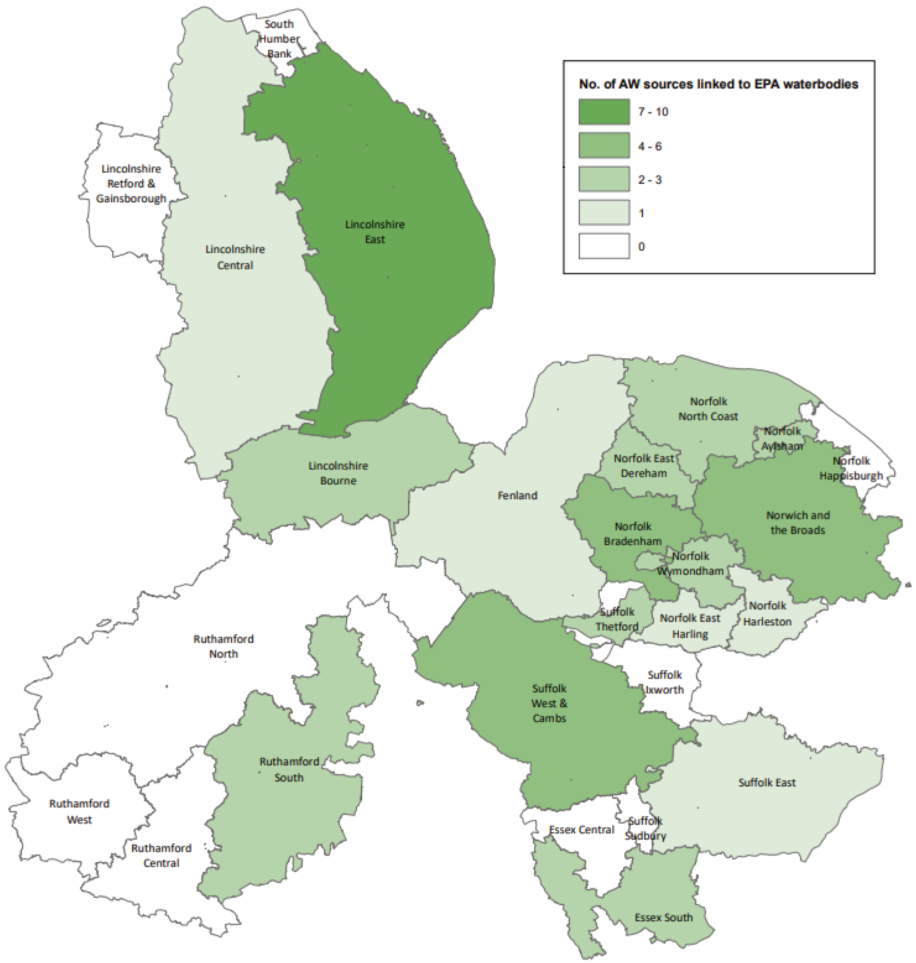
	2030	2031	2032	2033	2034	2035	2035
% of overall permanent caps to recent actual annual average delivered by year	38%	44%	55%	54%	54%	63%	100%

Figure 52 Water Resource Zones where permanent licences are capped to recent actual annual average in Scenario 8



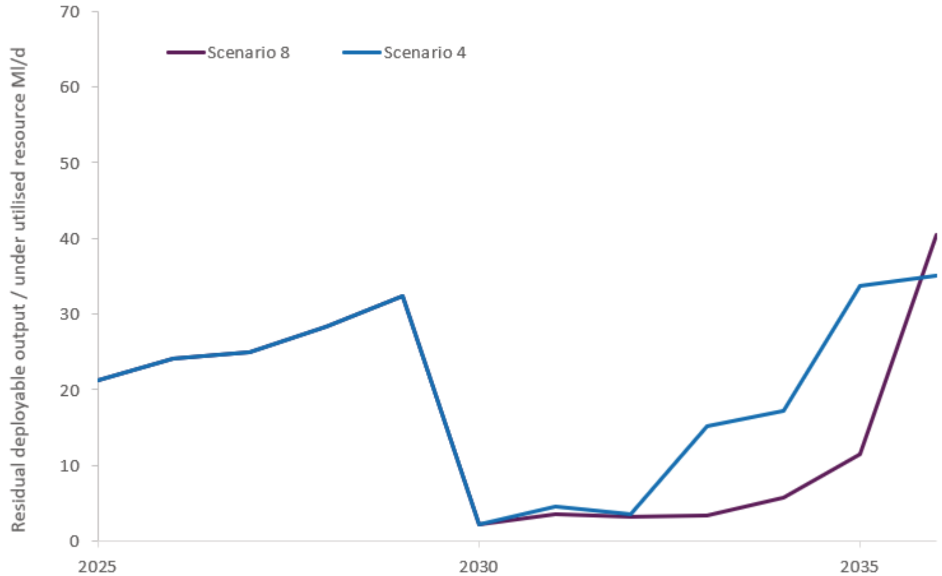
Where possible we have prioritised reductions where our abstraction interacts with European protected sites, these are shown in Figure 53.

Figure 53 Number of Anglian Water sources linked to European protected waterbodies by water resource zone



[Figure 54](#) shows the surplus resource for scenarios 4 and 8, this is unutilised resource. The indicates how efficient the options are at satisfying the supply demand deficit. A surplus can be a result of developing an option with a maximum capacity greater than required when the options is first needed.

Figure 54 Comparison of unutilised resource

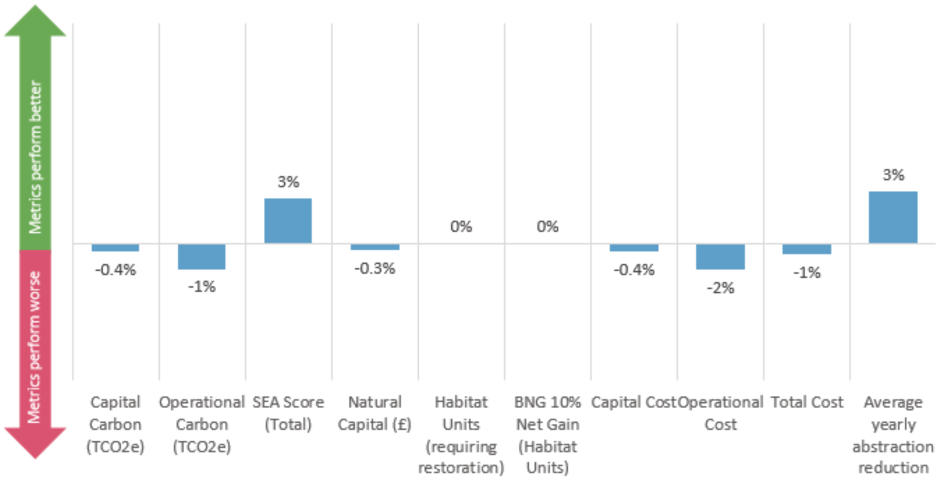


Both scenarios have a surplus at the start of the plan. This surplus is 'locked in' with the majority of it within our Ruthamford North Water Resource Zone. To enable this resource to be utilised we must build new interconnectors to transfer this on to zones in deficit due to licence caps. The earliest these interconnectors are available is 2030, therefore this surplus cannot be used for capping licences earlier than 2030.

As part of developing this alternative plan we optimise the surplus post 2036 through delivering some environmental destination benefits earlier, see Section 6.2.5.

Figure 55 shows the comparison of best value metrics for scenario 8 against scenario 4 as a percentage. This shows that scenario 8 performs almost identically to scenario 4 in terms of environmental metrics as the same schemes are required in both. There is an increase in operational cost and carbon due to the additional utilisation of the options. The bespoke scenario provides a 3% benefit to the average yearly abstraction metric, which indicates that it provides more water back into the environment faster, than scenario 4.

Figure 55 The difference in best value metrics for iteration 1 compared against the initial least cost plan



The Environment Agency consider scenario 6 as the baseline to compare the other scenarios against. We have used this in the baseline forecast to complete the baseline data in the WRP tables. However, for the final plan data we must include adjustments in the table to reflect the preferred licence cap scenario. Figure 56 shows the regional deployable output adjustment needed for each scenario, this is the difference between each scenario and the baseline scenario 6. This difference is the amount of licence, (as deployable output) that is needed to ensure customers can receive a secure supply of water, ahead of new sources being commissioned.

It is not accepted that the changes in the amount of water that can be abstracted between scenario 6 and the other feasible scenarios necessarily causes deterioration or presents a risk of that nor that the use of scenarios other than 6 automatically gives rise to the need for OPI. However even if OPI is required in order to amend or alter licences our policy decision modelling shows that OPI would be satisfied.

Scenario 8 requires less licence adjustment than 4.

Figure 56 Adjustments (Ml/d) required for each scenario relative to baseline scenario 6

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Scenario 4	73	73	73	73	73	61	61	61	61	61	61	0
Scenario 8	73	73	73	73	73	52	51	41	41	41	33	0

Licence cap adjustment for time limited licences (2025–2029)
Licence cap adjustment for capping permanent licences (2030–2035)
All licences capped to recent actual annual average (2036)

6.2.2 Iteration 2: maximise low regret investment (feedback from customers/Regulators/wider business/consultation)

Our policy decision modelling determined our initial most likely scenario. However, there is still uncertainty with this scenario due to the range of plausible futures. The most significant element of uncertainty is the location and scale of environmental destination. As part of the regional planning process, it has been agreed that there will be a series of environmental destination investigations in the AMP8 Water Industry National Environment Plan (WINEP). The scope of these investigations is still to be finalised. It is likely they will involve more detailed modelling and assessment of the sensitive catchments where our groundwater abstractions are located. The outcome of the investigations will enable us to better understand the long-term sustainable abstraction requirements for the region, which will help to determine the strategic solutions and sustainable reductions required to deliver the environmental destination.

Our initial most likely scenario, BAU+ starting in 2036, triggers several large resources options. These require a lead time of 7-15 years, meaning we would have to commit considerable investment into designing, planning and construction of some elements of these schemes before the WINEP investigations are completed.

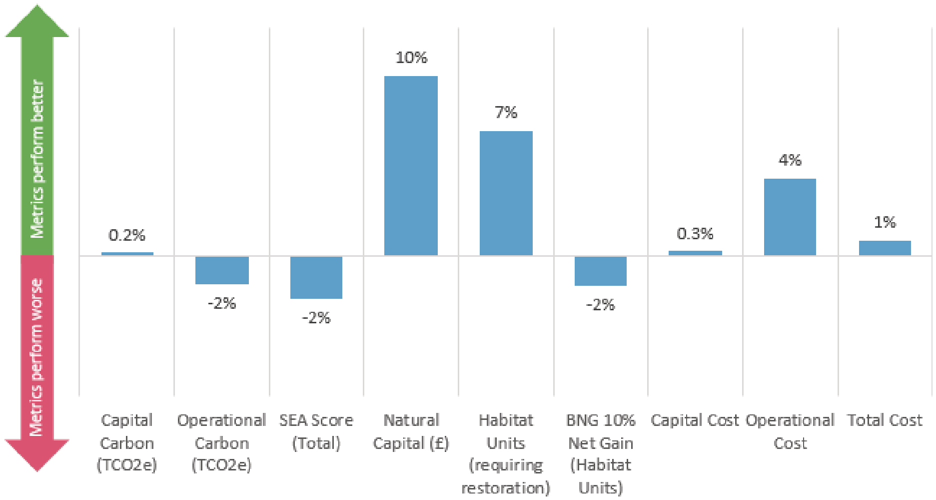
To maximise low regret investment, by avoiding investment we may later regret, we would need to meet the environmental destination reductions in 2040. This would allow the plan to adapt to the outcome of the WINEP investigations. The new resource options triggered to meet environmental destination needs are moved to 2040.

Table 30 shows the options and years they are required that have changed between iterations. Figure 57 shows the difference in best value metrics for iteration 2 compared against the initial least cost plan as a percentage.

Table 30 Options replaced in Iteration 2

Iteration 1			Iteration 2		
NTB28	Caister Lowesoft water reuse	2036	NTB20	Caister desalination 25 Ml/d	2040
FND29	Fens reservoir (50MCM)	2036	FND29	Fens reservoir (50MCM)	2039

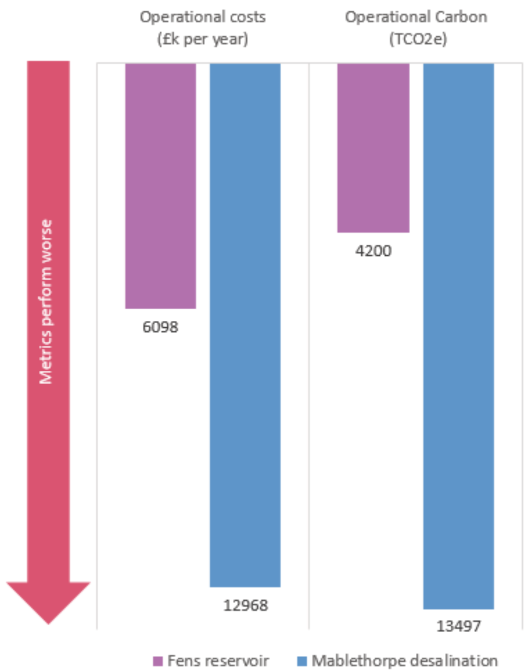
Figure 57 The difference in best value metrics for iteration 2 compared against the initial least cost plan



6.2.3 Iteration 3: maximising benefits for customers, the region and environment (feedback from customers and stakeholders, external review)

The WINEP investigations will enable us to tailor solutions later in the plan to match the need once the evidence has been provided. In the previous iteration one of the outcomes of moving the environmental destination to 2040 was that the Fens reservoir was required later in the plan, 2039, see Table 4. The large Mablethorpe desalination plant was selected in 2036 in both iteration 1 and 2, to meet the deficits created by licence caps.

Figure 58 Operational costs and carbon for reservoir and desalination options



We have a requirement to make sure we achieve an efficient, sustainable and secure supply of water that protects the environment effectively[44]. As part of this we have a commitment to minimise operational energy and carbon. Figure 58 shows the operational carbon and costs associated with Fens reservoir and Mablethorpe desalination.

For the SEA environmental metrics the Fens reservoir performs better than the Mablethorpe desalination option, these are shown in Figure 59. For Habitat units requiring restoration the reservoir and desalination perform similarly in terms of the impact on existing biodiversity. However, when the requirement for 10% net gain is considered, the reservoir provides a significant improvement compared to the desalination option Figure 60.

Figure 59 SEA metrics for reservoir and desalination options

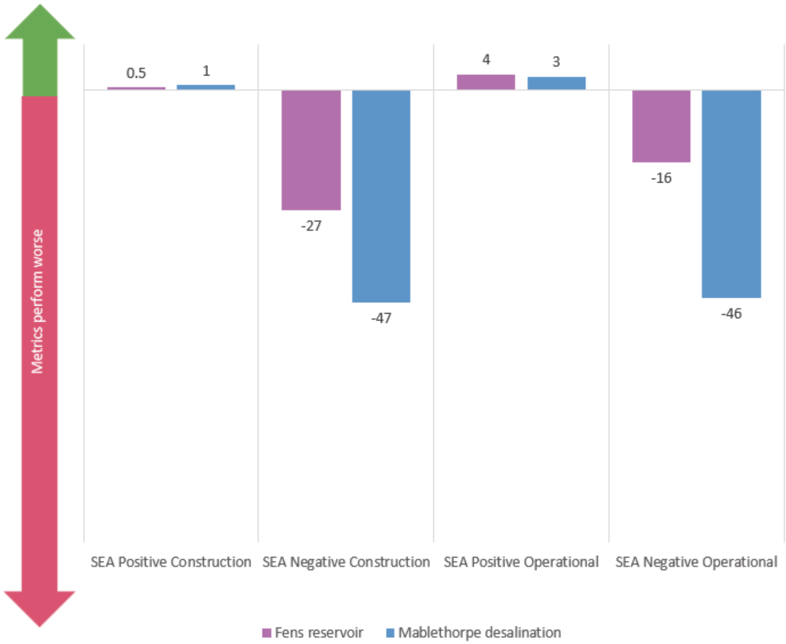
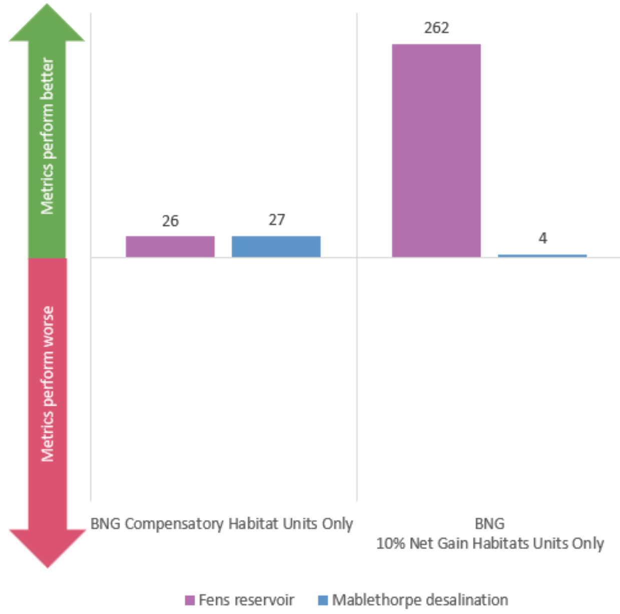


Figure 60 Habitat units and BNG metrics for reservoir and desalination options



Reservoirs give us the opportunity to provide outdoor spaces and recreation. We have commissioned an external study of the recreational and socio-economic benefits associated with reservoirs in comparison to desalination and reuse options. The research used a range of methodologies, including creating a theory of change logic chain, a literature review, review of case studies, and economic impact modelling. The review found that the key socio-economic benefits which were found to be delivered by reservoirs stemmed from recreational activities and public access to green space. These benefits included mental and physical health, education, tourism and wider economic benefits due to increased visitors to surrounding areas. Desalination and water reuse present more limited opportunities to create these benefits.

44 Water Resources Planning Guideline (WRPG), April 2022, Section 5.4

The desalination plants are more scalable and can be sized to provide the exact capacity needed compared to reservoirs. Therefore to develop an adaptable plan it is preferable to build the reservoirs earlier and add desalination plants later in the plan once the need and scale has been confirmed by the WINEP investigations. Deferring the desalination plants also provides greater opportunity for technological developments that may increase efficiency and reduce energy requirements.

We have worked very closely with our neighbouring water companies through the regional plan and developing our company WRMPs. Bringing forward Fens reservoir to 2036 and moving Mablethorpe desalination back to 2039 is reflective of the regional planning needs.

Table 31 Options and year required changed between iteration 2 and iteration 3

Iteration 2			Iteration 3		
LNE6	Mablethorpe desalination 50Ml/d	2036	LNE6	Mablethorpe desalination 50Ml/d	2039
FND29	Fens reservoir (50MCM)	2039	FND29	Fens reservoir (50MCM)	2036

By bringing Fens reservoir forward to 2036 the Mablethorpe desalination plant moves back to 2039. Figure 61 shows the comparison of delivering Fens reservoir earlier in the plan in preference to the Mablethorpe desalination plant as a percentage. As both options appear in the two iterations most metrics remain the same in the two iterations. However the timing of the options does impact the overall operational cost and carbon, with desalination later in the plan these metric perform better.

Figure 61 Best value metrics for reservoir earlier in the plan (iteration 3) compared to desalination earlier in the plan (iteration 2)

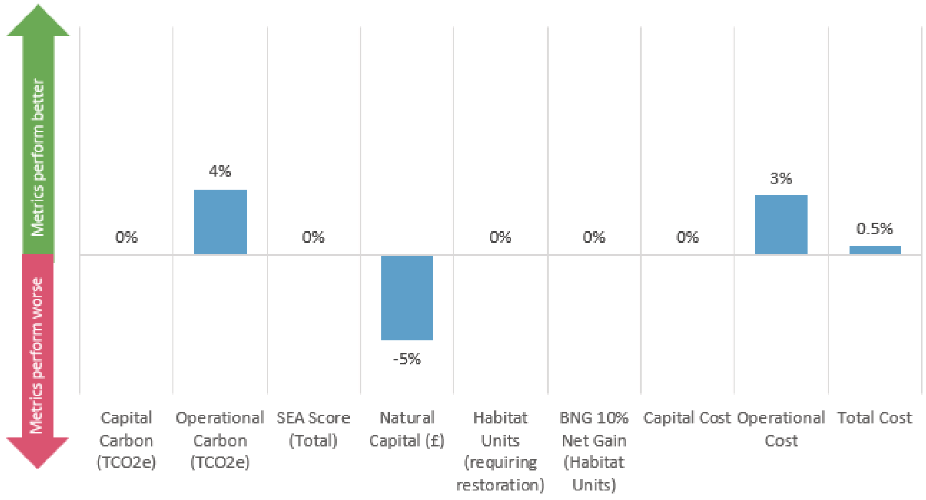
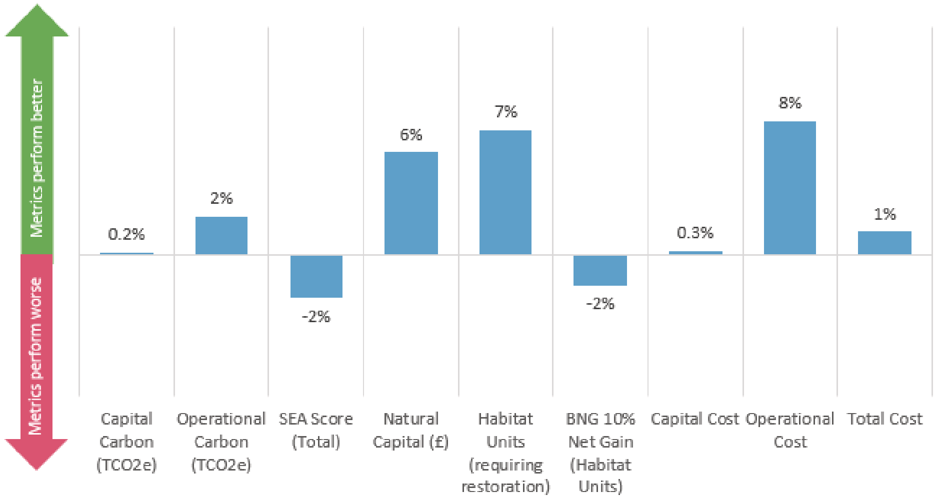


Figure 62 compares the best value metrics of iteration 3 against the initial least cost plan as a percentage.

Figure 62 Best value metrics for iteration 3 compared against the initial least cost plan



6.2.4 Iteration 4: maximise utilisation of surplus resource (feedback from customers and stakeholders)

The construction of new resource options can provide an initial surplus until full utilisation is required. In the previous iteration there is an initial surplus after Fens reservoir goes into supply in 2036, but this reduces in 2039/40 once 1:500 drought resilience is realised.

Table 32 Iteration 3 surplus due to Fens reservoir

Water resource zone	Surplus Ml/d				
	2036/37	2037/38	2038/39	2039/40	2040/41
Fenland	16	17	17	0.6	0
Ruthamford North	7.9	7.9	7.9	0	0

Following feedback from customer and stakeholders, we should seek to utilise all surplus resource and look for opportunities to accelerate supply reductions.

As the surplus in Fenland Water Resource Zone in Table 32 reduces significantly in 2039/40 we would only be able to use this minimum number to reduce supply.

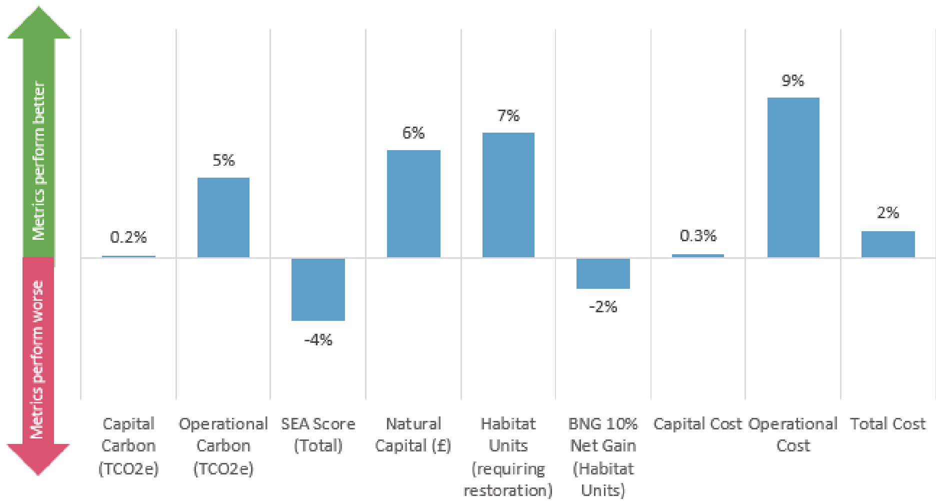
If the drought impact in Ruthamford North and South was delayed to 2040/41 this may create a surplus in Fenland that could be used for 4 years to meet other supply reductions earlier. Table 33 shows the impact to the supply demand balance if the drought impact is delayed by one year.

Table 33 Iteration 4 surplus with drought in Ruthamford moved to 2040/41

Water resource zone	Surplus Ml/d				
	2036/37	2037/38	2038/39	2039/40	2040/41
Fenland	16	17	18	15	0
Ruthamford North	7.9	7.9	7.9	2.6	0

This creates a consistent surplus of 15Ml/d to be utilised from 2036 to 2040.

Figure 63 The difference in best value metrics for iteration 4 compared against the initial least cost plan



6.2.5 Iteration 5: deliver environmental destination earlier in preference to drought (feedback from customers)

Our engagement with customers has shown that they would choose delivery of environmental destination supply reductions earlier in preference to increasing drought resilience. We have modelled the equivalent environmental destination reductions to the surplus available in some of our Norfolk, Suffolk and Ruthamford South water resource zones, see Figure 64. These are in areas known for environmental sensitivity and are likely to be priority catchments in terms of environmental destination.

Table 34 shows how the surplus created by moving the drought back to 2040 is utilised once we bring forward some environmental destination. Table 35 shows the percentage of total environmental destination per year.

Table 34 Iteration 5 surplus with Ruthamford drought 2040/41 and environmental destination Norfolk WRZs brought forward to 2035

Water resource zones	Surplus Ml/d					
	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41
Fenland	0	6	4	2	9	0
Ruthamford North	0	0	0	0	0	32

Table 35 Percentage of total environmental destination supply reductions required to meet BAU+ achieved in year

	Before 2035	2036	2037	2038	2039	2040
% of overall environmental destination (BAU+) delivered by year	0.05%	9.04%	9.04%	9.04%	9.04%	100%

Figure 64 Water resource zones where environmental destination can be delivered earlier than 2040

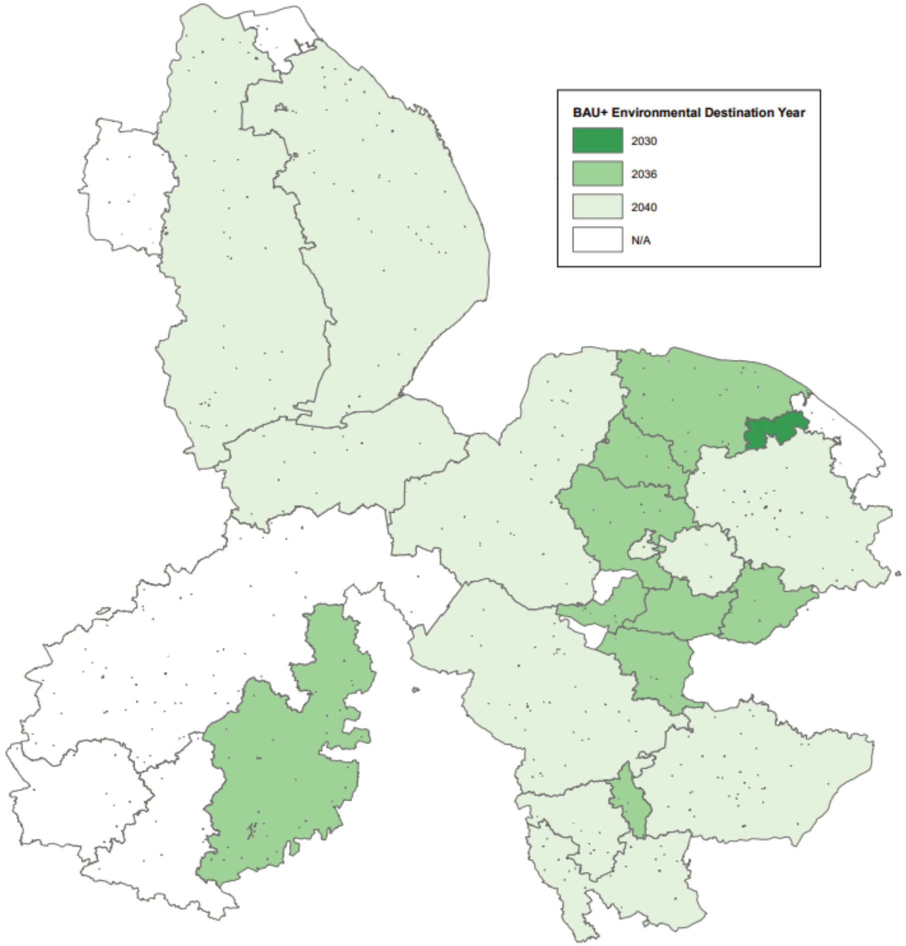
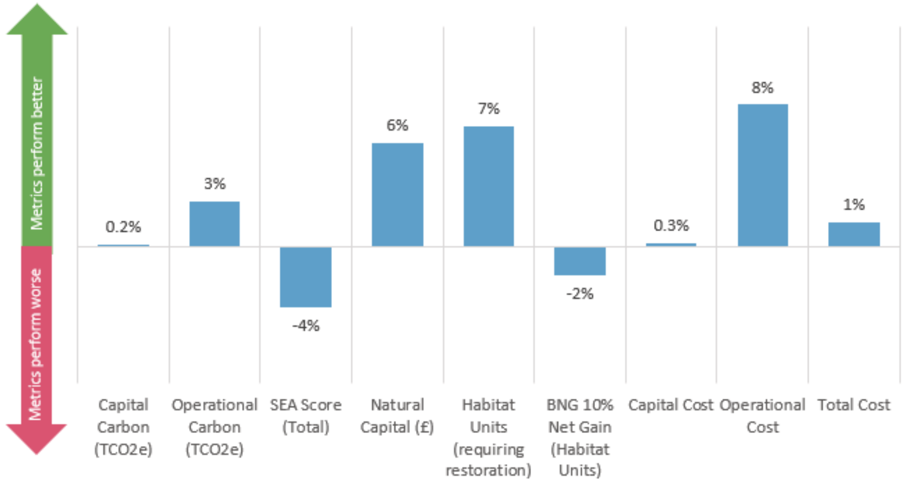


Figure 65 Best value metrics for iteration 5 compared against the initial least cost plan



6.2.6 Iteration 6: Future opportunities for regional benefit (feedback from customers/regulators/stakeholders)

We have two desalination plant options on the Norfolk coast located at Caister and Bacton. Both options include a transfer to connect into the same location within our existing network, the main difference is that Bacton is further away and requires a longer pipeline. This is reflected in Bacton being slightly higher in cost.

However locating the desalination plant further north up the Norfolk coast to Bacton could provide opportunities to work with other industries, in particular the energy sector. This may provide benefits of shared assets such as intakes/outfalls which could reduce costs and provide efficiencies. This stretch of coast line also benefits from greater certainty that the shoreline will continue to be protected into the future, see WRMP24 Supply-side options development technical supporting document, Appendix 1 - Desalination. There are water quality benefits of locating the plant at Bacton compared to Caister as the seawater is less turbid meaning it is easier and cheaper to treat.

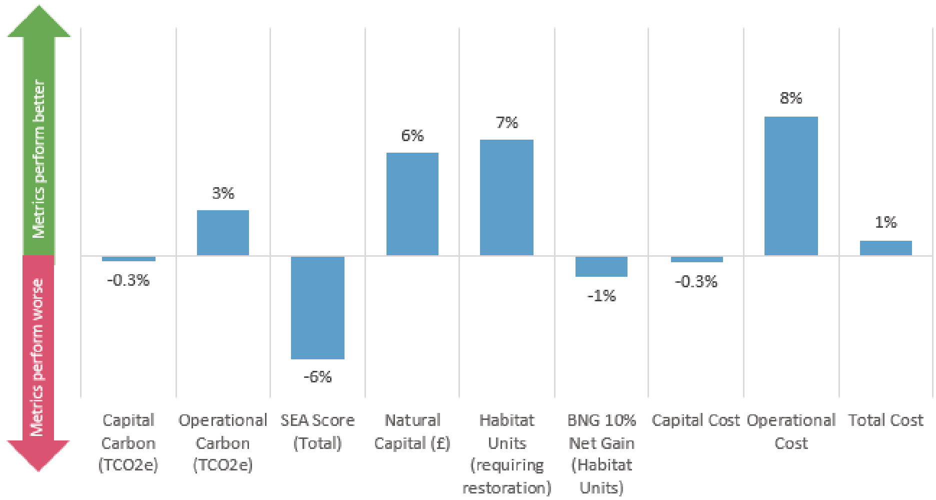
Figure 66 shows that both plants are close in environmental metrics. The costs for both options are included in Table 36.

Figure 66 Comparison of environmental metrics for Bacton and Caister desalination options

Table 36 Costs for Caister and Bacton desalination options

Option Ref	Option name	Capital costs (£m)	Annual costs (£m/yr)
NTB20	Caister desalination 25Ml/d	363	19.5
NTB28	Bacton desalination 25Ml/d	385	19.6

Figure 67 Best value metrics for iteration 6 compared against the initial least cost plan



6.2.7 Iteration 7: maximise existing resource and improve resilience (feedback from customers/regulators/wider business)

We have developed a number of backwash recovery schemes at some of our groundwater treatment works. These take process water which would have been discharged from the works and return it back into the start of the treatment process. Though these options only provide a small increase in deployable output they allow us to more fully utilise the water which we have abstracted. There are 13 options which are listed in Table 37, these sum up to provide a total benefit of 4.1M/d.

Table 37 Backwash recovery options

Water resource zone	Option Reference	Deployable output increase Ml/d
Essex Central	EXC7	0.3
Essex South	EXS7	0.3
Fenland	FND26	0.24
Norfolk Bradenham	NBR9	0.2
Lincolnshire East	LNE3	1.3
Norfolk North Coast	NNC5	0.18
Norfolk North Coast	NNC6	0.2
Norfolk Aylsham	NAY4	0.75
Norfolk East Dereham	NED3	0.1
Norfolk Harleston	NHL7	0.2
Norfolk Aylsham	NAY5	0.1
Suffolk East	SUE25	0.17
Suffolk Thetford	SUT6	0.05

In each iteration of developing the alternative plan the number and timing of the backwash recovery schemes has varied according to need.

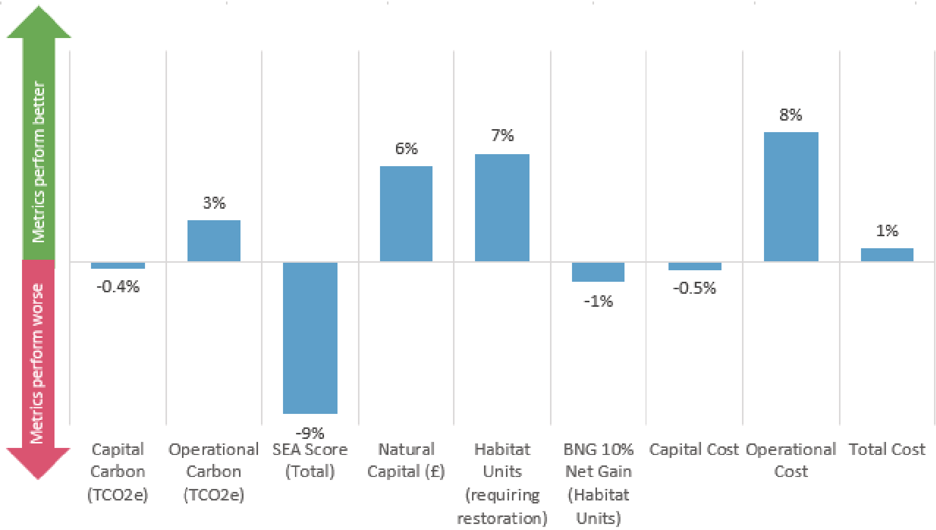
We believe that it is the right thing to do to maximise all opportunities to use water efficiently and have included all the backwash recovery options in this iteration of the alternative plan.

However as the backwash recovery options only provide a small increase in deployable out at each of the works there is a risk that upon implementation that they do not deliver the full assumed benefit. In most water resource zones a secondary new supply-side options is required alongside the backwash recovery option, as the backwash options are not large enough to fully satisfy the deficit. However in Norfolk Aylsham water resource zone the inclusion of both backwash recovery options is adequate to satisfy the deficit.

Norfolk Aylsham is a small mainly isolated zone with 14% increase in distribution input over 25 years, which is expected to be offset by our demand management portfolio. It is one of our most environmentally sensitive zones with a risk of future abstraction reductions due to Habitats Regulations. The Environment Agency have indicated the River Bure catchment which passes through the Aylsham WRZ will be subject to further assessment of the impacts of abstraction as part of the Broads Sustainable Abstraction Plan in between now and 2024. Therefore we have included a transfer from our Norfolk Norwich and the Broads water resource zone to Aylsham to provide a robust resilience supply which can be supported by the more strategic resources of Fens reservoir and Bacton desalination.

The impact to metrics from including the backwash recovery options and transfer to Aylsham are shown in Figure 68.

Figure 68 Best value metrics for iteration 7 compared against he initial least cost plan



6.2.8 Iteration 8: what is the least cost plan to deliver the preferred most likely scenario

Through the iterations to develop an alternative plan we have altered the initial most likely scenario, this becomes our preferred most likely scenario. This has evolved from our initial most likely scenario and it is useful to understand what would be the least cost plan to meet this updated scenario. Through the iterations described above we have constrained the options set to develop the plan, to understand the equivalent least cost we need to use the unconstrained options set used to developed initial least cost plan.

This becomes the version of the least cost plan that we will use as the benchmark for comparing other plans against.

Figure 69 shows the summary comparison of the alternative plan and the least cost plan based on the preferred most likely scenario against the initial least cost plan. As shown, the differences between the two scenarios are relatively minor, with a similar performance across the majority of metrics. The option differences between the two plans are shown inTable 38 . As described in the previous iterations, these option differences enable Plan B to align more closely with the preferences of our customer and stakeholder preferences and our broader best value framework. Bacton desalination provides more potential for conjunctive use with the energy sector, and is a more robust location in terms of shore line protection than Caister. The inclusion of all backwash recovery options in the alternative plan maximises opportunities to use our existing water resources more efficiently. Finally, the transfer to Aylsham provides additional resilience to both customer supplies and the sensitive environmental receptors within this small and mainly isolated zone, and enables greater adaptability.

Figure 69 Comparison of alternative plan and preferred most likely scenario least cost plan against initial least cost plan

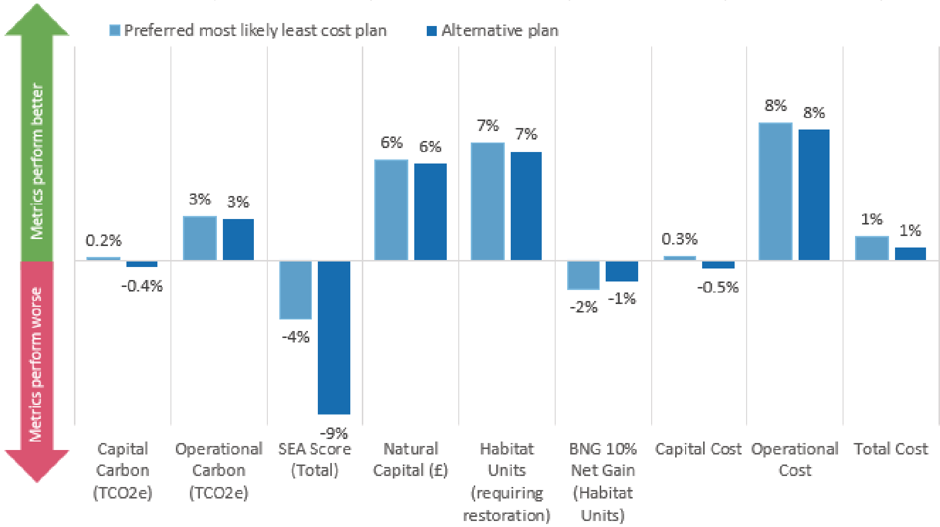


Table 38 Differences between least cost and alternative plan

Least cost plan	Alternative plan
NTB20 Caister desalination (25Ml/d)	NTB28 Bacton desalination (25Ml/d)
8 No of backwash recovery options included in the plan	13 No of backwash recovery options included in the plan
Not included	NAY1 Norfolk Norwich & the Broads to Norfolk Aylsham transfer (3Ml/d)

6.2.9 The preferred most likely scenario

The scenario used to develop iteration 8 becomes our preferred most likely scenario and includes the following:

- Scenario 8 sustainability reductions to abstraction licences (time limited licences reduced to average recent actual by 2030, all licences by 2030-2036)
- Medium climate change (with high and low climate change included in headroom)
- Environmental destination scenario is BAU+ starting in 2040 for everywhere apart from the WRZs in Figure 64.
- Drought resilience to 1:500 by 2039/40 for everywhere apart from Ruthamford North and South WRZs which is 2040/2041

As part of the iterations for developing the preferred most likely scenario the timings when we reduce abstractions and return water to the environment changes. This is represented as the average yearly abstraction metric which is shown in Figure 70 for each iteration. The average reduction is used because it shows the relative benefit of delivering abstraction reductions earlier between alternative plans. A plan which delivers abstraction reduction earlier than another would have a larger annual average reduction over the 25 year period.

Figure 70 Average annual reduction metric for the iterations

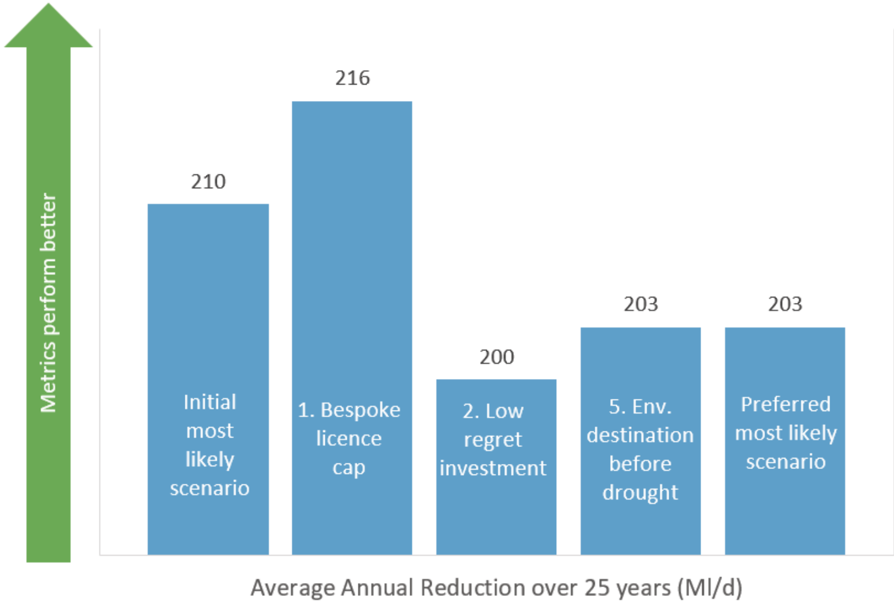
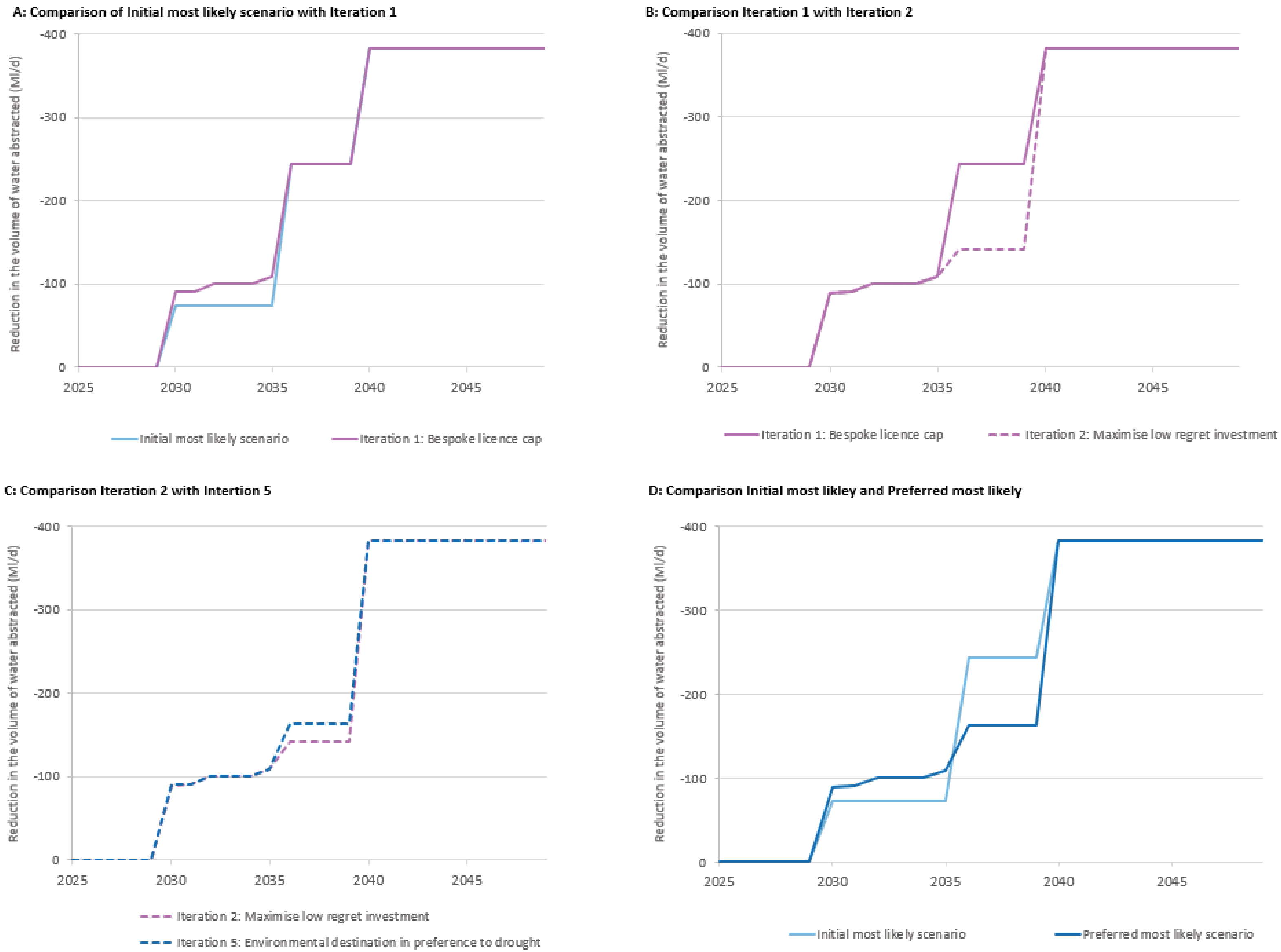


Figure 71 shows the timing of abstraction reductions between the iterations in further detail. Graph A shows the bespoke licence cap iteration improves upon the initial most likely scenario, by optimising potential for the delivery of early abstraction reductions in the 2030 to 2036 period. The low regret iteration shown in Graph B moves the environmental destination abstraction reductions to 2040, which enables us to adapt to the WINEP investigations, and minimise the regret of committing to early desalination options unnecessarily. Iteration 5, the environmental destination before drought (which becomes the preferred most likely scenario), shown in Graph C, brings forward some environmental destination abstraction reductions in prioritised environmentally sensitive areas during the 2036 to 2040 period, using available surplus resource from the Fens Reservoir. Comparison of the initial most likely scenario and the preferred most likely scenario , Graph D, shows that the preferred plan delivers more reductions in abstraction volumes between 2030 and 2036, but delivers environmental destination reductions later. All plans arrive at the same abstraction reduction destination of -383 Ml/d by 2040.

Figure 71 Regional abstraction reduction profiles of alternative plan creation iterations



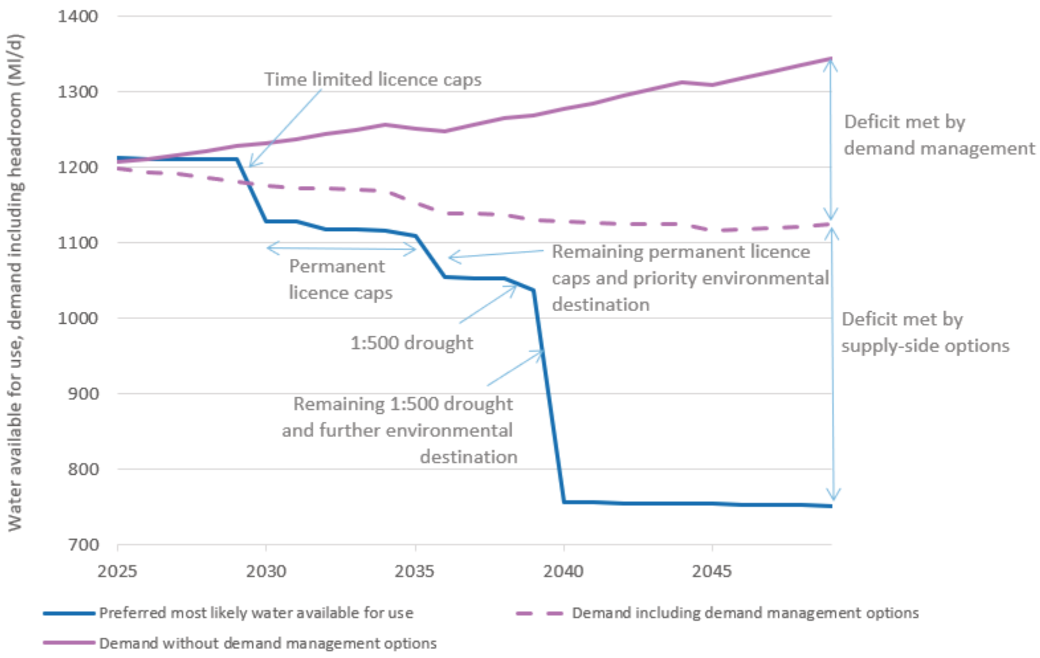
The preferred most likely scenario is based on BAU+ and profiles the reductions to allow the later part of the plan to be informed by the WINEP investigations. It maximises opportunities to utilise early surplus within the plan to deliver licence caps and environmental destination reductions in the most sensitive areas sooner. To enable these earlier reductions, we must delay drought resilience to 1:500 by one year to 2040. This scenario has been shaped by our customer and stakeholder engagement.

In the preferred most likely scenario the strategic options are triggered by

- Fens reservoir in 2036 triggered by permanent licence caps to average.
- Lincolnshire reservoir in 2040 required to meet the needs of environmental destination; this also enables drought resilience to 1:500 to be achieved in the Ruthamford zones.

Figure 72 shows the supply demand balance for the preferred most likely scenario.

Figure 72 Supply demand balance for the preferred most likely scenario



6.3 Best for the environment and society

We consider the environment and society in our decision making to ensure our plan delivers a protected and improved environment and provides benefit to society[45]. We use our SEA, biodiversity net gain and natural capital assessments as part of the application of our best value planning framework to assess and compare all our plans, see Section 4.5, and for further information, the WRMP24 SEA Environmental Report.

We have explored developing a plan which emphasises our environmental objective to 'Deliver long-term environmental improvement' to understand the trade-offs.

Initially, we tested if the initial most likely scenario could be delivered with an alternative constrained set of options which may offer better benefits to the environment. These model runs and conclusions are listed in Table 39.

Our analysis demonstrated that restricting the most carbon intensive options results in larger options being selected to compensate for them, and a higher cost and carbon overall plan, which is not considered to be desirable for the environment and society.

There is a clear correlation between cost and carbon, the greater the size of assets we need to build, the greater the cost and the greater the amount of carbon. As our model optimises on cost, it always selects the lowest cost portfolio of options which in turn is also the lowest carbon plan.

Table 39 Model runs to explore maximise environmental benefits based on initial most likely scenario

Question	Scenario	Conclusion
Could we maximise use of all existing supply resources before developing new ones?	All options that restore deployable output, minimise process or raw water losses are 'must do'.	This develops the same amount of desalination but at different locations. There is less water reuse capacity and 13 schemes are developed which reduce losses, totaling 4.1Ml/d.
Could we develop a plan with the lower operational carbon new resource options?	Remove top 20% of options with highest operational carbon per Ml/d	Builds additional desalination capacity. Overall option capital carbon and operational carbon is increased alongside cost.
Could we develop a plan with the lower embodied carbon new resource options?	Remove top 20% of options with highest embodied carbon per Ml/d	Builds additional desalination capacity. Overall option capital carbon and operational carbon is increased alongside cost.

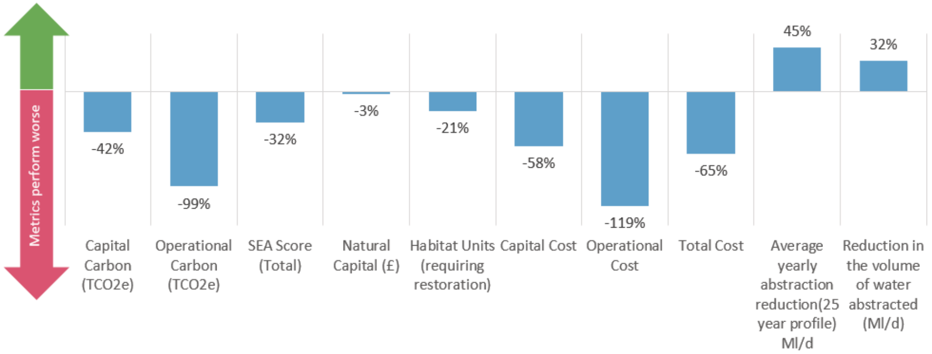
This led to developing a supply scenario which focused on achieving the highest level of abstraction reductions delivered at the earliest feasible date. This best for environment (abstraction) scenario is based on the following supply impacts:

- Using the highest environmental destination scenario, Enhance, by 2036
- Scenario 8 sustainability reductions to abstraction licences (time limited licences reduced to average recent actual by 2030, all licences by 2030-2036)
- Medium climate change scenario
- Increase drought resilience to 1:500 by 2039

45 Water Resources Planning Guideline (WRPG), April 2022, Section 9.4

Using the full options set we have run the model to produce the least cost set of options to meet best for the environment (abstraction) scenario. See Figure 73, for how this plan compares to the initial least cost plan.

Figure 73 The difference in best value metrics for best for the environment (abstraction) plan compared against the initial least cost plan



6.4 Plans to take forward to best value framework assessment

We have four plans to apply the full best value framework against, these are:

- Plan A: Initial least cost plan based on the initial most likely scenario
- Plan B: Alternative plan based on preferred most likely scenario
- Plan C: Least cost plan based on preferred most likely scenario
- Plan D: Least cost plan based on best for environment (abstraction) scenario

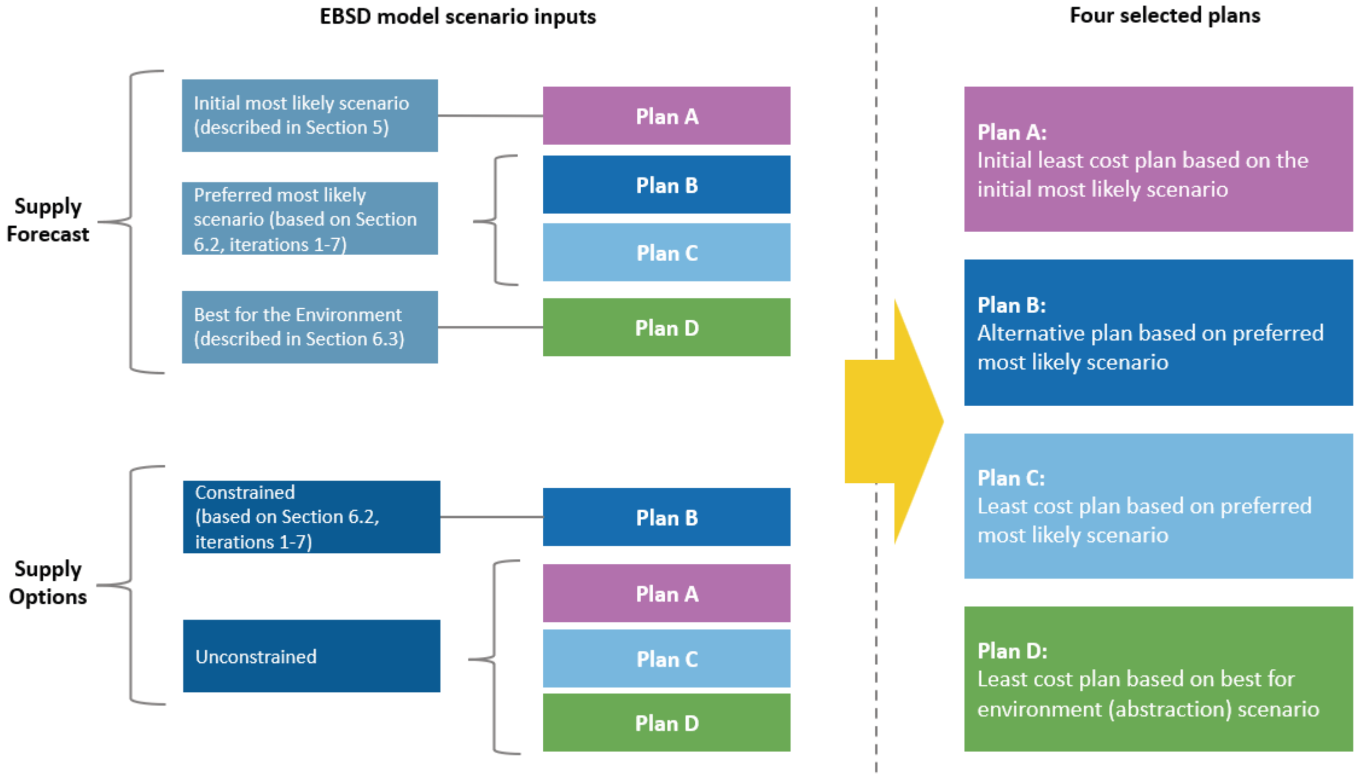
We have named each plan alphabetically to help articulate the best value planning framework assessment.

The alternative plans are based on three scenarios. The scenarios present different timing and scales of abstraction reduction.

- **Initial most likely (Plan A):** This is based on achieving BAU+ environmental destination starting in 2036 and profiled over time by prioritising the most sensitive areas of our region. However, by delivering large reductions early opportunities for the plan to be adapted based on the outcome of WINEP investigations are limited. In this scenario we achieve 1:500 drought resilience by 2039.
- **Best for the environment (abstraction) (Plan D)**: The largest level of environmental destination reductions based on the Enhance scenario are met as early as possible within the planning period. This prevents the ability for the plan to be adjusted to suit the outcomes from WINEP investigations. Drought resilience to 1:500 is achieved in 2039.
- **Preferred most likely (Plan B and Plan C)**: Based on BAU+ this scenario profiles the reductions to allow the later part of the plan to be informed by the WINEP investigations. It maximises opportunities to utilise early surplus within the plan to deliver environmental destination reductions in the most sensitive areas. To enable these earlier reductions, we must delay drought resilience to 1:500 by one year to 2040. This scenario has been shaped by our customer and stakeholder engagement.

Figure 74 summarises the composition of the four plans.

Figure 74 Summary of the modelling scenario used to select the four plans taken forward for best value planning assessment



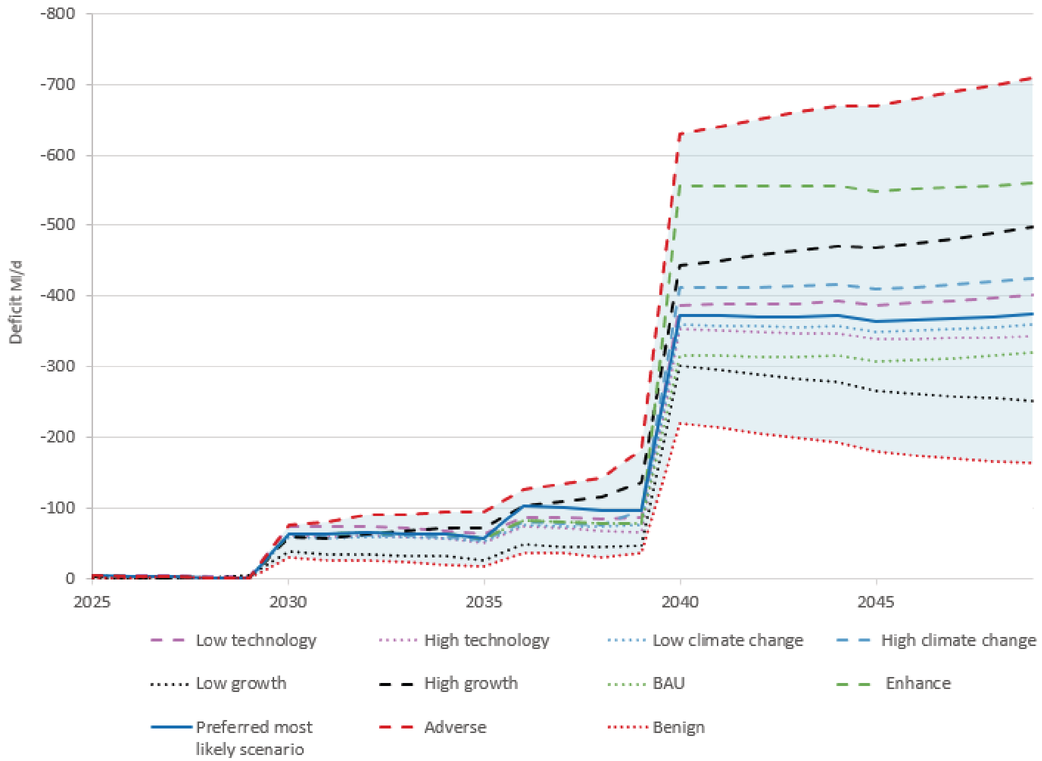
7 Testing plans to future uncertainty

We test the four plans using the scenarios listed in Table 7 which include the eight Ofwat common reference scenarios plus the two extreme scenarios described below:

- Adverse -based on the high scenarios for climate change, demand, and abstraction reductions, and the slower scenario for technology
- Benign - based on the low scenarios for climate change, demand, and abstraction reductions, and the faster scenario for technology

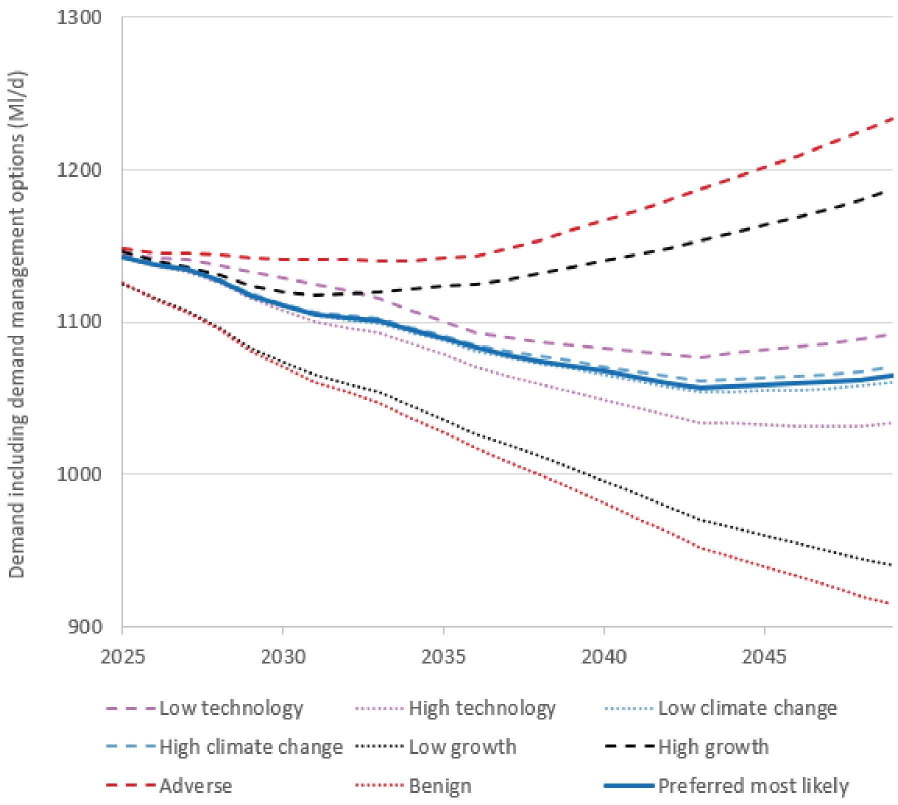
Figure 75 shows the deficit profile for each Ofwat scenario with our preferred most likely scenario. The shaded area shows the extremes of the Adverse and Benign scenarios. The greatest variation is from 2040 when the impacts from environmental destination occur, the deficit range is 546Ml/d between the Adverse and Benign scenarios in 2050.

Figure 75 Deficit profiles for the Ofwat common reference scenarios



These scenarios require variations to the demand, supply and target headroom forecasts. Figure 76 shows the demand forecast used in the Ofwat scenarios.

Figure 76 Demand forecast used for Ofwat common reference scenarios



We adjust target headroom for the testing of uncertainty to ensure we are not double counting the impacts. The adjustments are shown inTable 40.

Table 40 Adjustments to target headroom for scenario testing

Scenario	Adjustment to baseline headroom
Preferred most likely	None
Low climate change	Climate change components removed
High climate change	Climate change components removed
Low growth	Growth components removed
High growth	Growth components removed
Low technology	None
High technology	None
Abstraction reductions - BAU	None
Abstraction reductions - Enhance	None
Adverse	Climate change and growth components removed
Benign	Climate change and growth components removed

7.1 Modelling to generate alternatives

Our EBSD model includes a function 'model to generate alternatives' (MGA). The EBSD model optimises over many iterations to find the least cost combination of options. When we use the MGA function the model output includes the near cost optimal solutions which are a set of alternative plans with costs close to the least cost iteration.

We use this to understand how stable the options are within a plan and compare options across plans too.

Within each plan the MGA shows the options are mostly stable with variations due to slightly different smaller transfers and timing of when options are required.

Looking across the four plans the MGA shows that the options within Plan B's (the alternative plan based on the preferred most likely scenario) core pathway were selected in all other plan MGA outputs, with the exception being Colchester water reuse, which is not within any of the MGA output for Plan D (best for the environment (abstraction)).

7.2 Sensitivity testing

For the sensitivity testing we explore what happens if the assumptions put into our model change. This produces a new unconstrained least cost version for each scenario based on the different input data.

We model changes to the following components:

- Supply forecast
- Demand forecast
- Options - supply-side and demand
- Planning factors

The sensitivity runs are based on the preferred most likely scenario, and therefore are assessed against Plan C. Plan C is used as it represents the default (unconstrained and least cost) version of the preferred most likely scenario. As noted in Section 6.2.8, Plan C is almost identical to Plan B. We only change one element of the preferred most likely scenario in each run, this ensures we can understand the impact of that change in assumption.

As our sensitivity analysis aims to identify tipping points in our plan, it focuses on the options selected, supply-demand balance and associated cost, rather than the full suite of best value planning criteria.

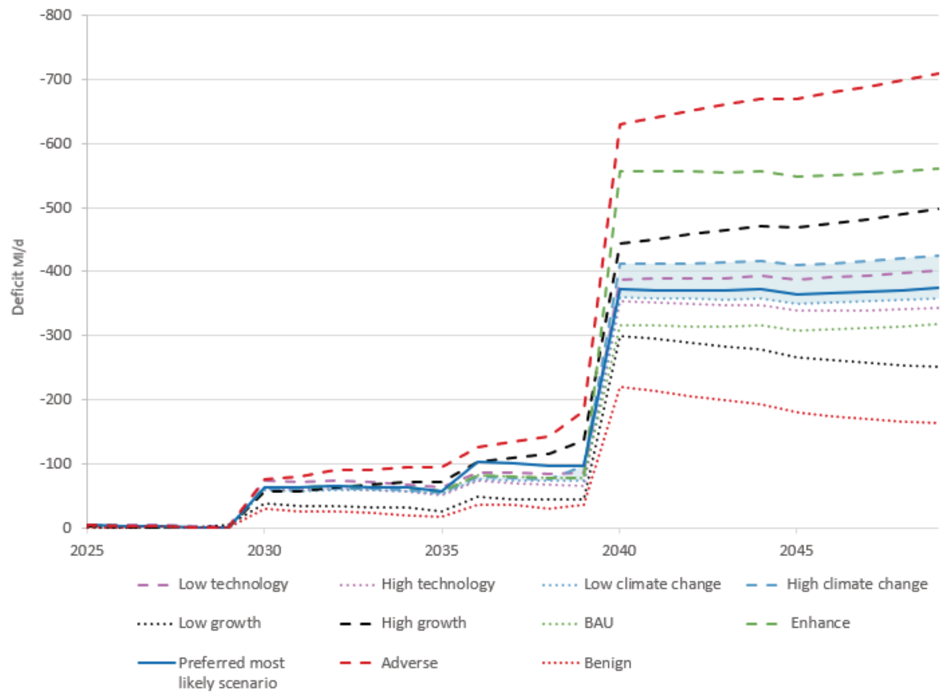
We have structured the analysis around a series of questions to understand,

- If the Ofwat common reference scenarios were used instead of our preferred most likely scenario, how does this impact option selection (see Section 7.2.1)
- Changes to the options both supply and demand (see Sections7.2.2 and 7.2.3)
- Variations to the planning factors (See Section 7.2.4)
- How options from other regional groups could impact the plan (see Section7.2.5).

7.2.1 Ofwat common reference scenarios

The shaded area in Figure 77 shows the range of deficit created by varying the climate change assumptions. This shows at the start of the plan the variation between scenarios is minimal, after 2040 it diverges slightly within a range of deficit of 66Ml/d by 2050.

Figure 77 Deficit profile showing the range of the Ofwat common reference scenarios for climate change



The growth scenarios have the largest range at the start of the plan compared to the other Ofwat scenarios, shown shaded in Figure 78. The range increases after 2040 with deficit variation of 245Ml/d at the end of the forecast. The preferred most likely scenario aligns to the high growth scenario in the first 10 years, this is because the high growth scenario does not include target headroom where the preferred scenario does. Note that the high growth scenario does not include the benefits of government-led demand interventions, whilst the low growth scenario does.

Figure 78 Deficit profile showing the range of the Ofwat common reference scenarios for growth

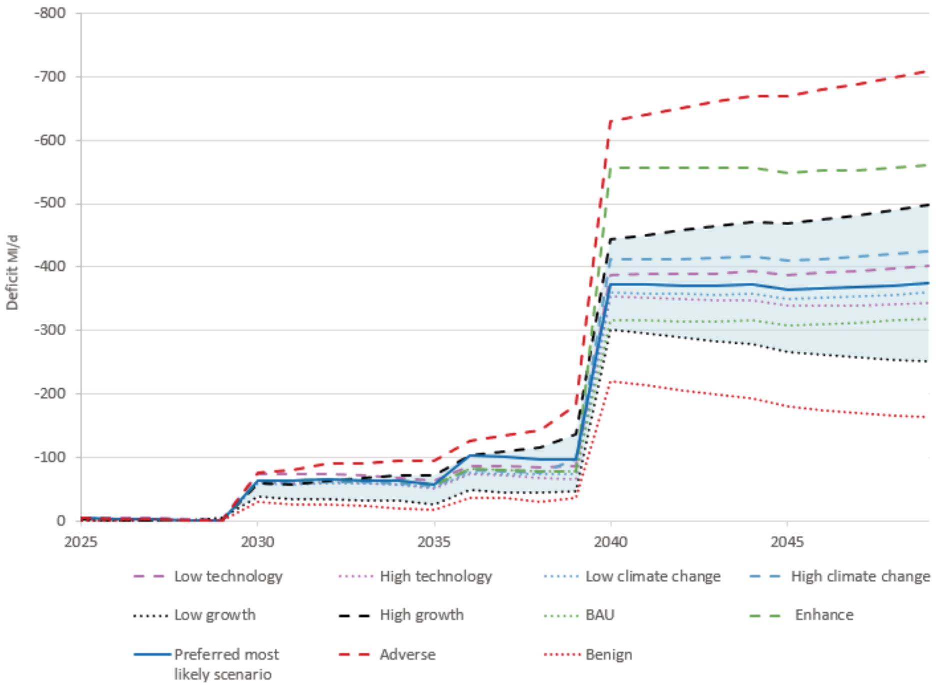
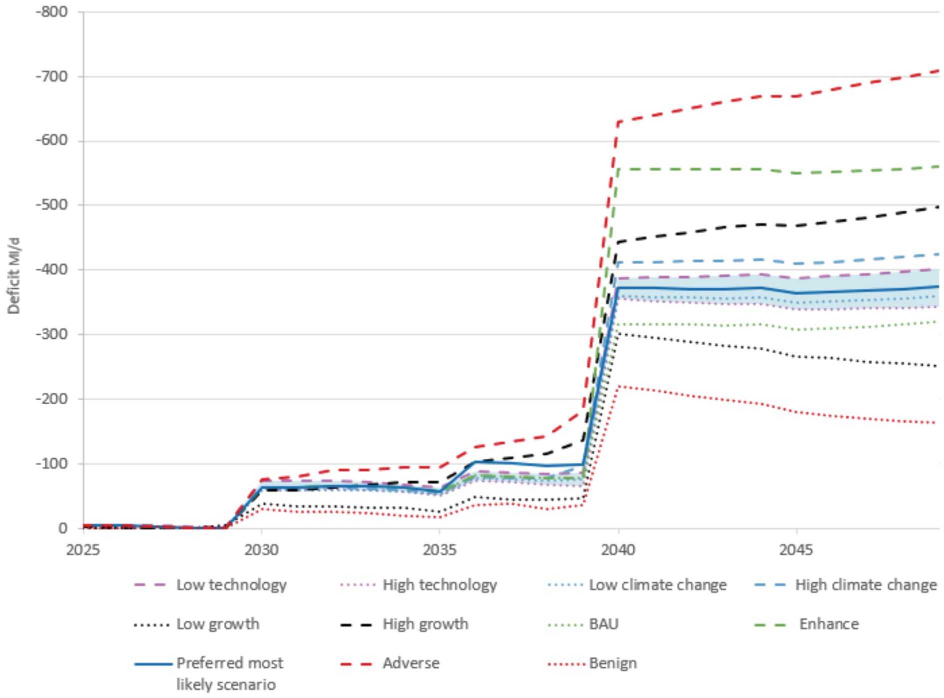


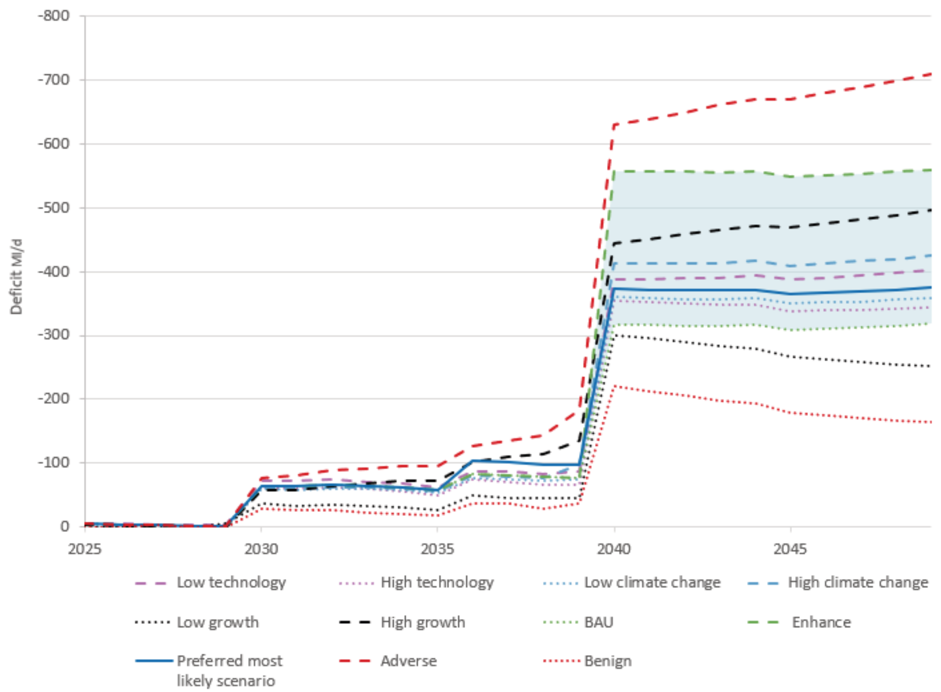
Figure 79 Deficit profile showing the range of the Ofwat common reference scenarios for technology scenarios



The technology scenarios enable us to see how the development and adoption of future technology may influence efficiency by reducing demand and costs. In Figure 79 the shaded area shows the range of deficit influenced by the technology scenarios. The range is minimal for the first 15 years of the plan and varies more once the impact of environmental destination occurs in 2040. By the end of the forecast in 2050 the deficit range is 58Ml/d. Note that both the low and high technology scenarios include the benefits of government-led demand interventions.

For the sensitivity testing the variations to the environmental destination scenarios have been applied in full at 2040 and as such do not include any earlier delivery of environmental destination as in our preferred most likely scenario. However if we did adopt an alternative level of abstraction reductions we could still use any surplus within the plan to deliver local benefits to priority catchments. Figure 80 shows the variation after 2040 as the shaded area, the deficit range by the end of the plan is 241Ml/d.

Figure 80 Deficit profile showing the range of the Ofwat common reference scenarios for environmental destination



We compare the options selected in the sensitivity tests against those selected in Plan C, the least cost plan in response to our preferred most likely scenario in order to show the range of variability in water available to use (WAFU) required, and cost terms, as well as understand which options are picked most frequently across the range of scenarios. For the sensitivity tests we did not constrain any of the options including the regional no-low-regret ones. In all scenarios the model selected the Lincolnshire reservoir sized at 50MCM, however the Fens reservoir was selected less consistently. For our modelling we only include the proportion of the Fens reservoir allocated to Anglian Water for the costs and the benefits, see Table 2. Modelling the relevant proportion of Fens reservoir as unconstrained is useful to understand how it impacts options selection in our plan but it does not reflect the regional needs and therefore we repeat the modelling to include the Fens reservoir but do not restrict the timing of when it is required. These runs are more reflective of the regional needs and are shown in Figure 84, Figure 82 and Figure 86, these show the capacity of option type, the frequency of option selection and the costs of each scenario. In Figure 81, Figure 82 and Figure 83, the same information is shown, but for the impacts without Fens reservoir constrained.Note that not all option types are represented in Figure 82 and Figure 85, the backwash recovery and trade options are not included.

Figure 81 The capacity of option type in each Ofwat scenario - without constraint of Fens reservoir

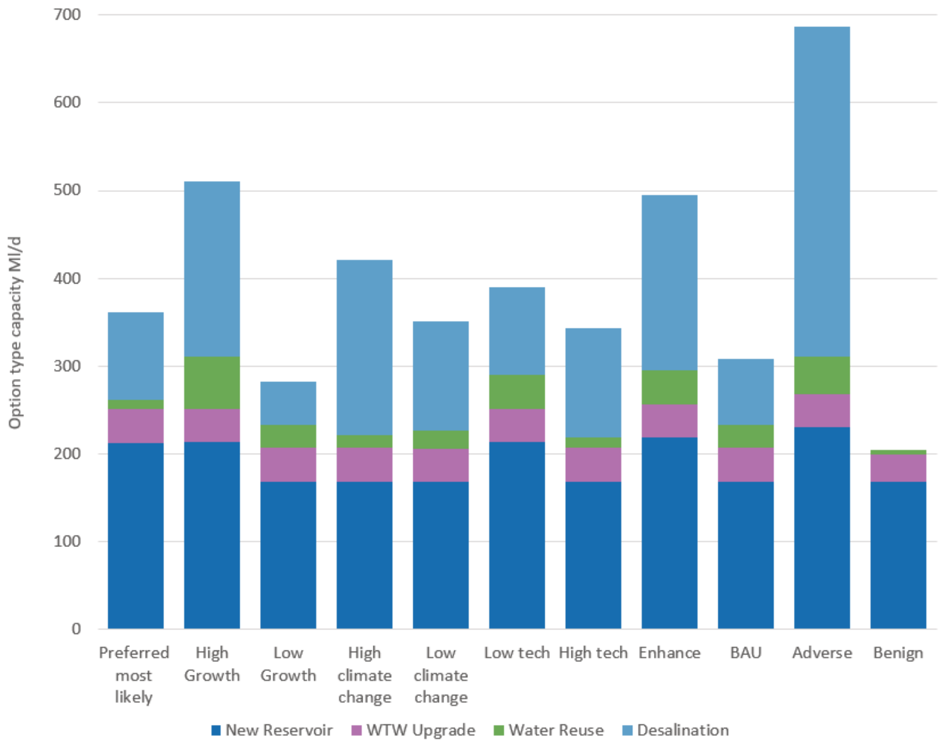


Figure 82 Frequency options are selected within Ofwat scenarios but without Fens reservoir constrained

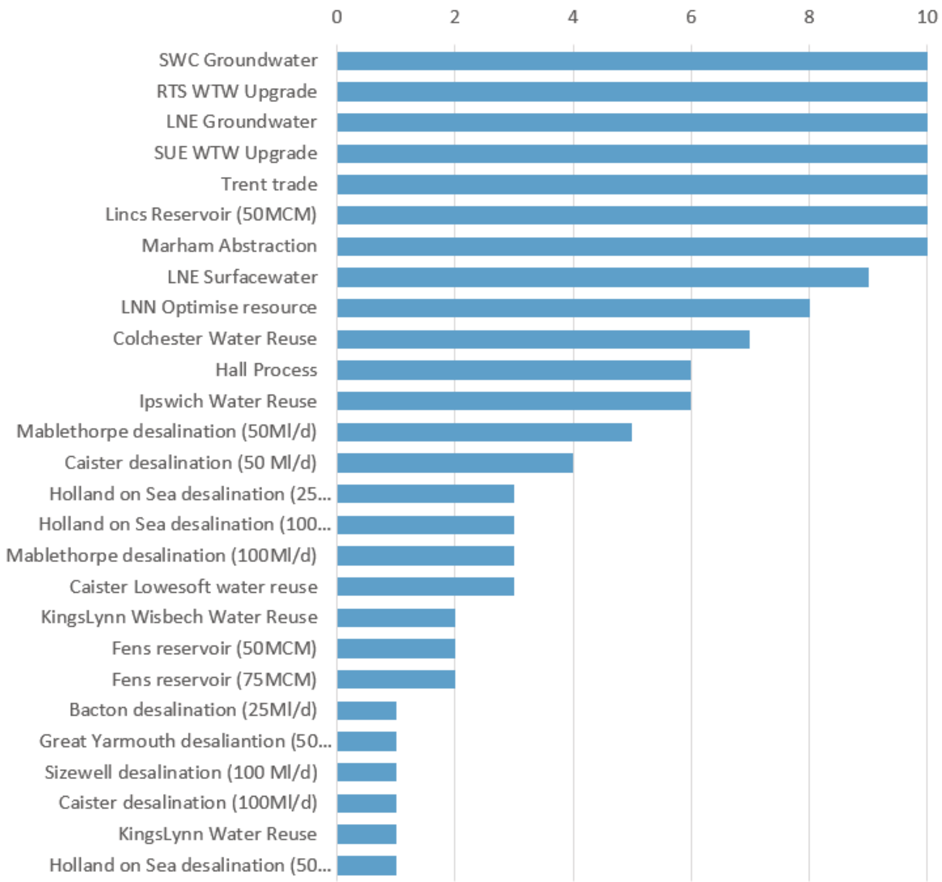


Figure 83 The costs in each Ofwat scenario - without constraint of Fens reservoir

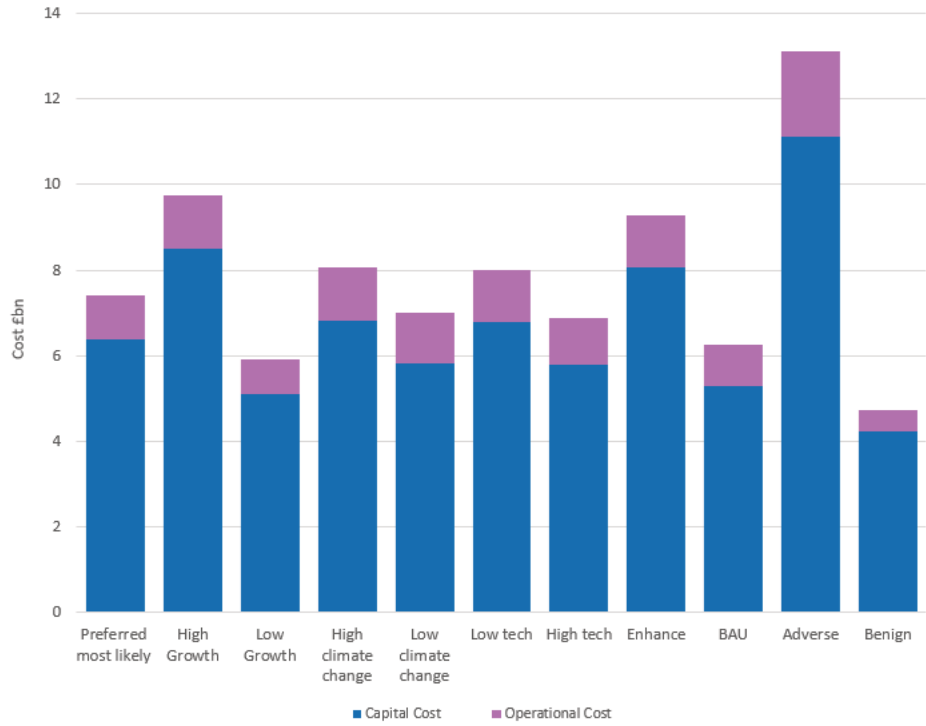


Figure 84 Option type capacity with Fen reservoir constrained

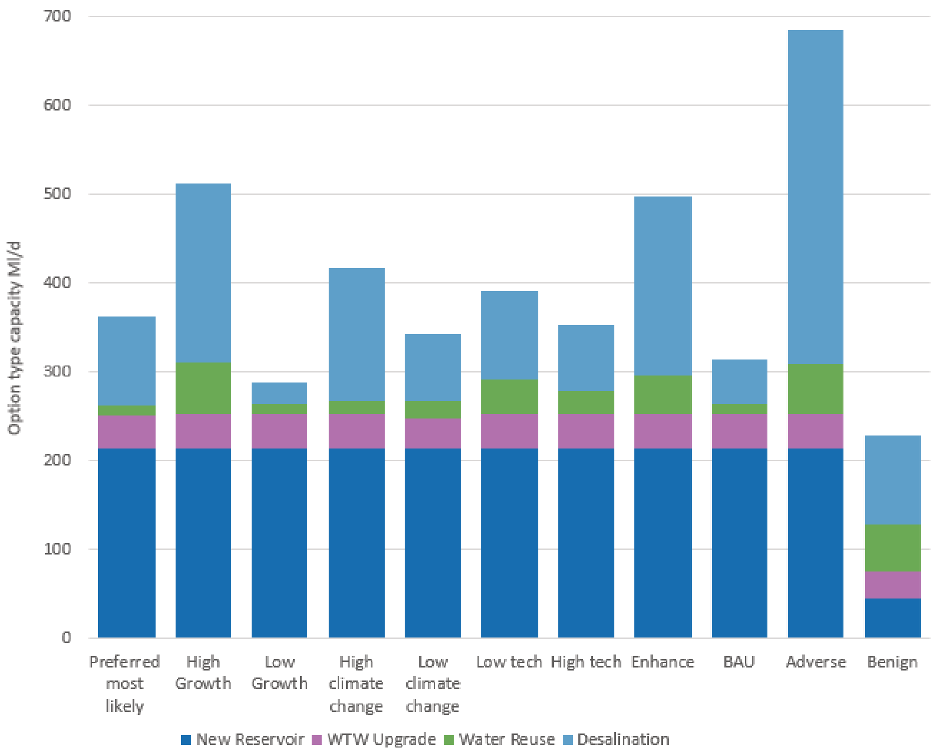


Figure 85 Option frequency in Ofwat scenarios with Fens constrained

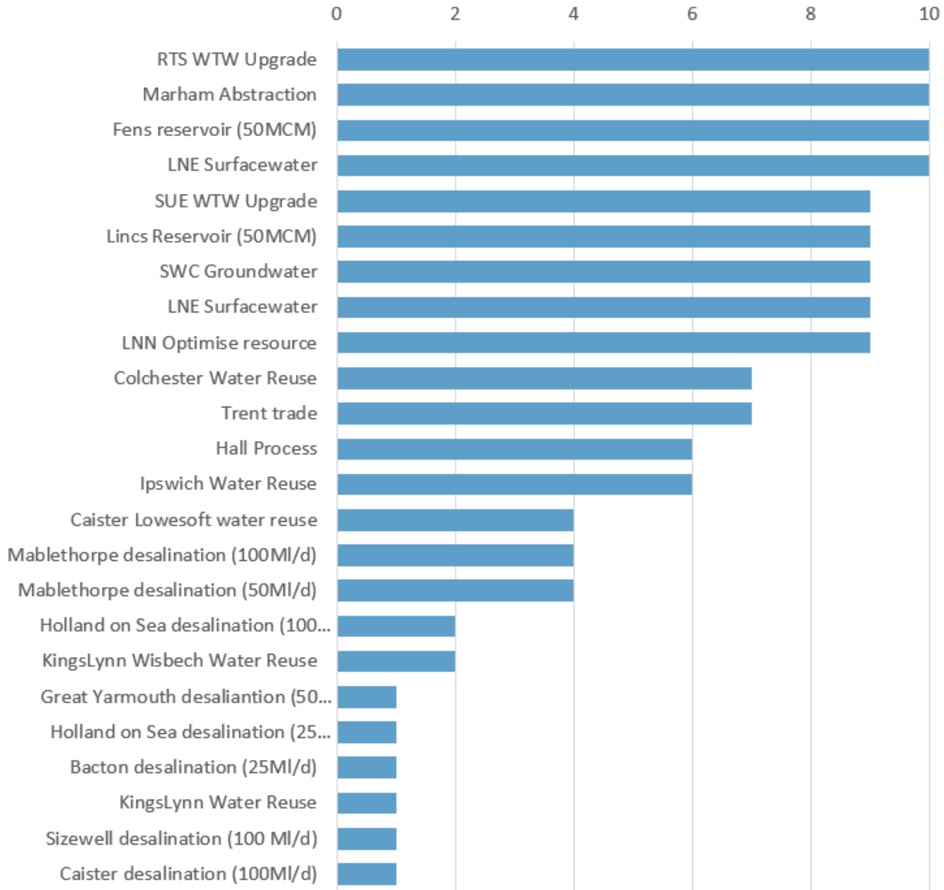
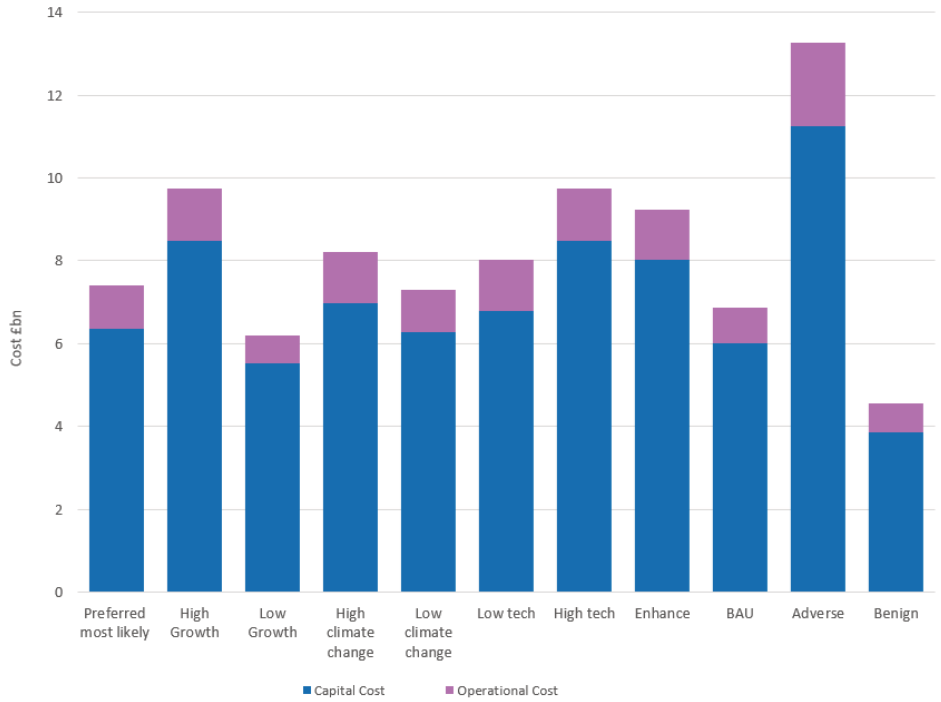


Figure 86 Total costs for Ofwat scenarios with Fen constrained



7.2.2 Demand management options sensitivity

Three tests were undertaken to test sensitivity to alternative demand management scenarios:

- What if the demand management options (DMOs) delivered lower benefits (reduced by 50%) than assumed?
- What if Non-household growth increased by 10%?
- What if there were no government-led demand interventions?

Figure 87 and Figure 88 compare the sensitivity of the alternative scenarios in terms of supply option selection and cost. In all alternative scenarios, additional resource of 20-30 Ml/d and cost increase of £0.6 - 1bn would be required compared to the preferred most likely scenario. Both strategic reservoir options are selected in all plans, but the larger 75 MCM Fens reservoir option is selected but delivered later in 2040. The remaining resource requirements are addressed with additional desalination or reuse option capacity which is required earlier in the plan, from 2032 onwards.

Figure 87 Sensitivity of option type and capacity to alternative demand management scenarios

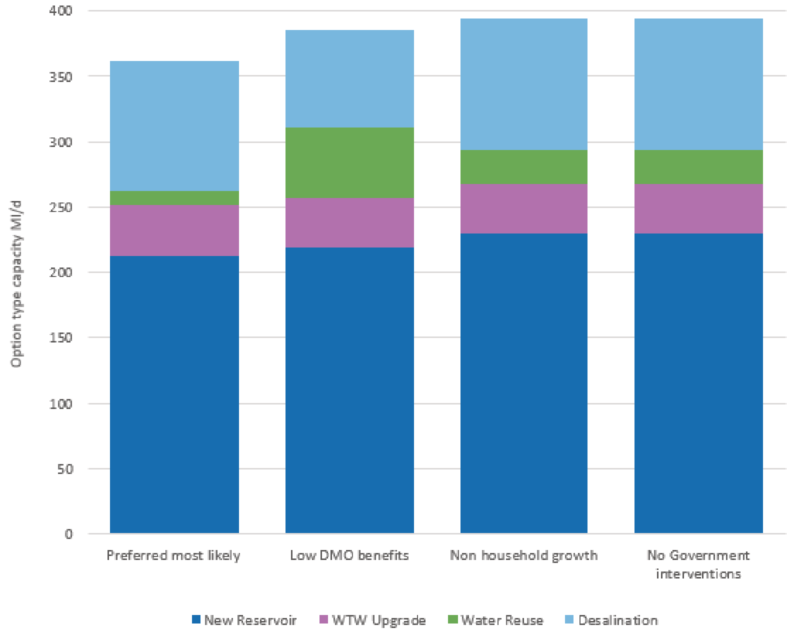
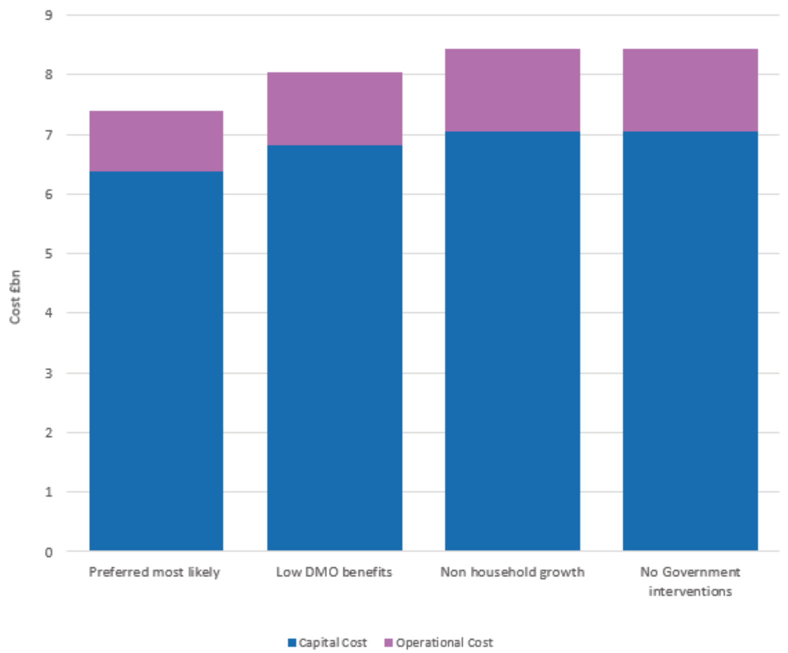


Figure 88 Cost sensitivity of alternative demand management scenarios



7.2.3 Supply-side options sensitivity

Sensitivity tests are carried out to understand how the plan would differ with alternative options constraints. The results are shown inFigure 89 in terms of options selection, Figure 90 shows the costs, and are summarised below:

- ***What if there were no reservoir options?*** The plan would require an additional 250Ml/d of desalination capacity, from 2032 onwards. The capital cost is slightly reduced by 1.6% but the large increase in operational costs results in overall total expenditure increase compared to Plan C.
- **What if there was no Fens reservoir included in the plan?** An additional 25Ml/d of desalination and extra 18Ml/d of water reuse would be required. The operational costs increase but the total expenditure is the same as Plan C. However this scenario does not take into account the need to supply Cambridge Water from Fens reservoir and therefore from a regional perspective is not feasible.
- ***What if there was no Lincolnshire reservoir?***The plan requires considerably more desalination capacity if Lincolnshire reservoir was not included in the plan. An additional 150Ml/d desalination and 18Ml/d of water reuse is required. The rest of the resource is made up from taking the full output from the Fens reservoir (rather than sharing with Cambridge Water). The capital cost for this plan is significantly higher, due to inclusion of the total costs for the Fens reservoir, which drives the total expenditure significantly above Plan C. This scenario is not feasible when considering the regional needs and shows that all plans will require some desalination capacity.
- ***What if there were no desalination options?***This increases the capacity of the water reuse options by 50Ml/d. The rest of the resource is made up from taking the full output from the Fens reservoir (rather than sharing with Cambridge Water). The capital cost for this plan is significantly higher, due to inclusion of the total costs for the Fens reservoir, which drives the total expenditure significantly above Plan C. This scenario is not feasible when considering the regional needs and shows that all plans will require some desalination capacity.
- ***What if there were no water reuse options?***This plan replaces the water reuse with additional desalination capacity over the planning period. The total expenditure is only marginally greater than Plan C.
- ***What if there were no desalination or water reuse options?*** This plan results in large regional supply-demand deficits from 2040 onwards, despite choosing to utilise the full capacity of the Fens reservoir (rather than sharing with Cambridge Water). There are too few options, without desalination and wastewater reuse, available to produce a feasible plan, plus this scenario is not feasible when considering the regional needs.As such it has not been presented in the figures below.
- ***What if there were no backwash recovery options?***There would be small deficits of less than 0.5 Ml/d in the 2030 - 2032 period, where no other options are available. Overall, the plan would become slightly more expensive with more reuse capacity required.

Figure 89 Option and capacity sensitivity to option type availability

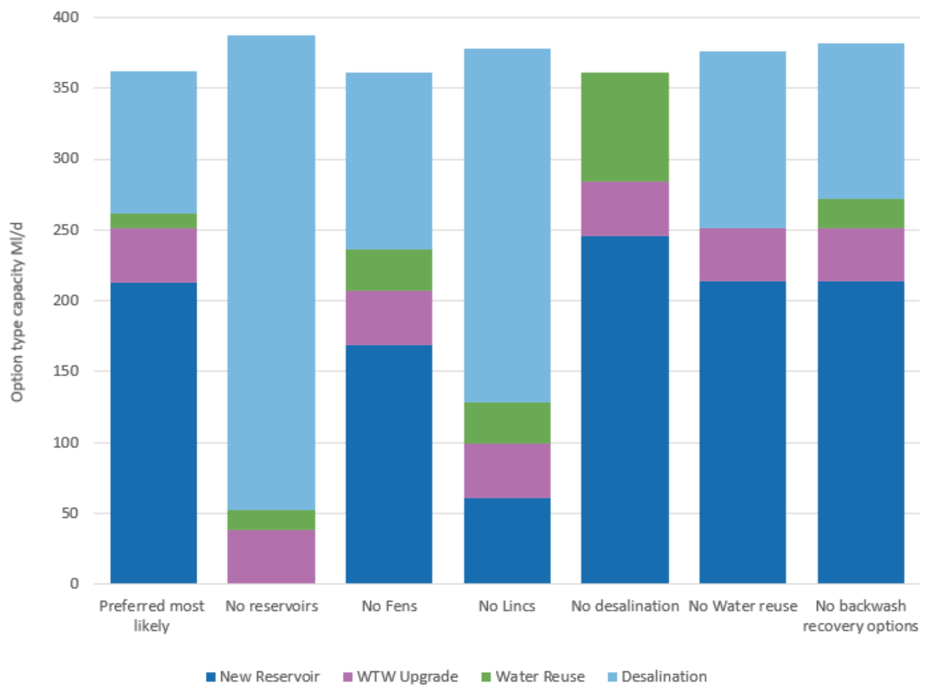
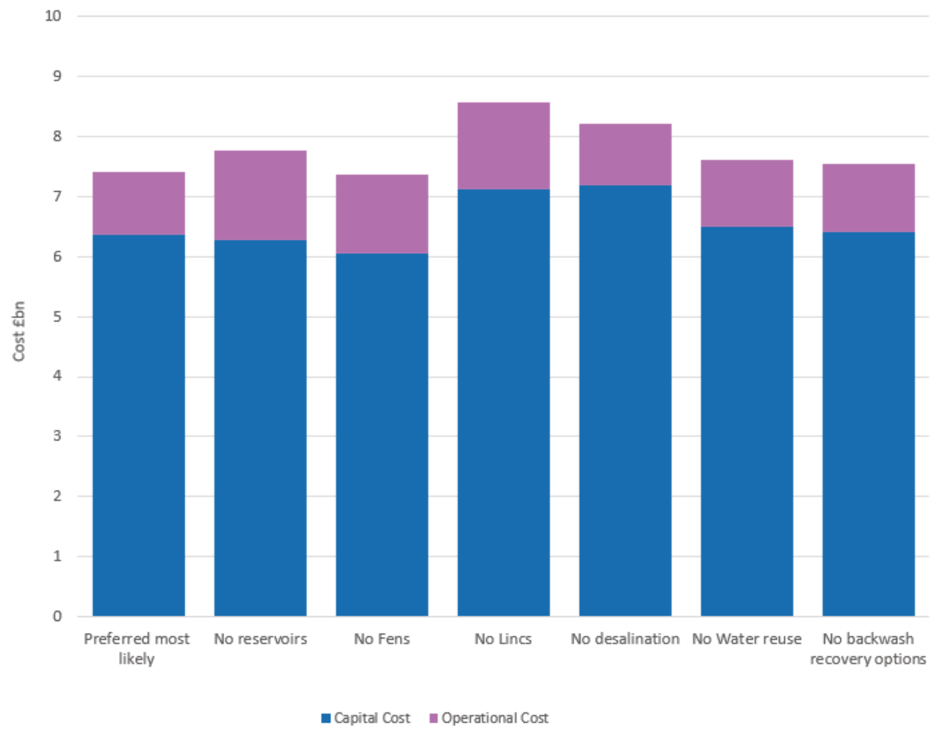


Figure 90 Portfolio cost sensitivity to option type availability



A series of sensitivity tests were undertaken to understand the effects of alternative SRO scenarios. The results are shown in Figure 91 in terms of option type and capacity, Figure 92 in terms of cost, and are summarised below:

- ***What if the Fens reservoir had a higher yield?*** If through the continuing design and development of the Fens reservoir additional raw water sources were deemed feasible this could increase the yield from the reservoir. This test shows how the plan would change if the reservoir could provide more water into supply. This still selects the same options as Plan C, with slight alteration to the utilisation of options.
- ***What if Fens reservoir connected to the system in a different location within our system?***This explores if we connected the new reservoir into another location within our network. It still uses the preferred reservoir location it just has a different transfer to connect into our network. For Fens reservoir we have modelled connecting further south into our Suffolk West and Cambs water resource zone. Though there are changes to the interconnectors required to transfer the reservoir through our network, the costs are almost identical to Plan C.
- ***What if Lincolnshire Reservoir connected into a different area of our system?*** This explores if we connected the Lincolnshire reservoir into our Lincolnshire Central water resource zone. The preferred reservoir site is still used but we assume a different transfer route to connect into our network from the reservoir. This results in the reservoir being under utilised as despite increasing the interconnector capacity from the north of Lincolnshire down to Ruthamford North Water resource zone by 100Ml/d, there are capacity limits on how the reservoir can be deployed. To overcome this the model has selected to build additional desalination capacity to provide an extra 25Ml/d, instead of further increasing the interconnector capacity.

This results in the higher capital expenditure compared to Plan C, due to the extra desalination and interconnector capacity required to transfer resource from north Lincolnshire to the areas in need further south.

- ***What if low regret options (Fen and Lincolnshire reservoirs) were 10% more expensive?*** This plan is same as Plan C in all regards except for cost.
- ***What if the reservoir option alternative sizes were available at the same time?*** All alternative Fen reservoir size options were given the same availability date of 2036, and all Lincolnshire reservoir sizes were made available from 2039. In this scenario, the same 50 million cubic meter reservoir sizes as plan C were selected. The cost and options composition was identical to Plan C.

Figure 91 Option and capacity sensitivity to alternative SRO scenario

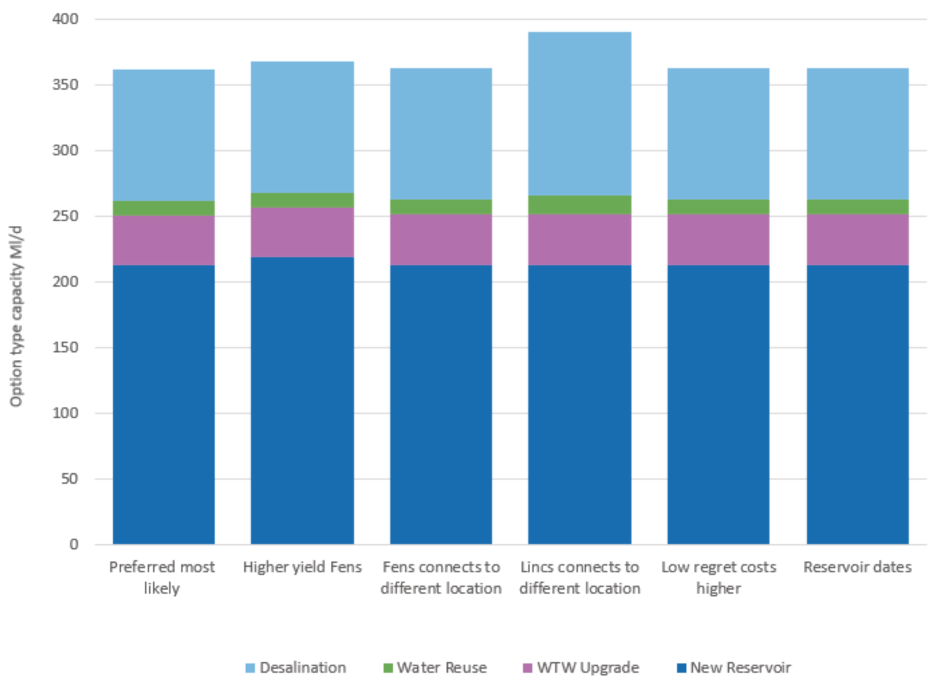
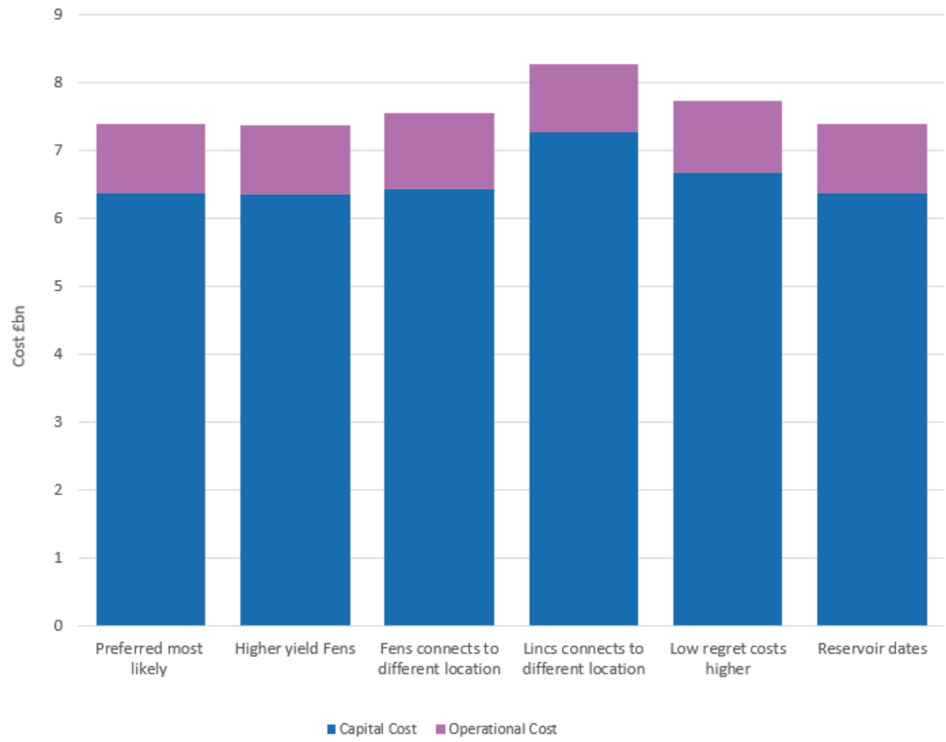


Figure 92 Portfolio cost sensitivity to alternative SRO scenario



7.2.4 Planning factors sensitivity

This includes variations in outage, headroom and the planning horizon. The results in terms of option type and capacity, and cost are shown in Figure 93 andFigure 94 and summarised below:

- ***What if we extend the planning horizon for our four plans?***We have extended the length of the planning period for all four plans and compared them against the original version over 25 years, seeTable 41. Note that for Plan A the model has chosen to delay the date for Fens into supply, however this scenario does not take into account the need to supply Cambridge Water from Fens reservoir and therefore from a regional perspective is not feasible.

Table 41 Comparison of plans over extended planning period

Plan version	Comparison of plan over 25 and 50 years
Plan A: Initial least cost plan based on the initial most likely scenario	For the longer planning horizon the model switches to building more desalination early in the plan and pushes the Fens reservoir back from 2036 to 2055, and at a larger capacity (100MCM). This requires 100Ml/d of desalination capacity and 32Ml/d of water reuse by 2036 (compared to 50Ml/d and 39Ml/d of water reuse in 25 year horizon). It should be noted that we are only modelling our share of the Fens reservoir and the model is free to choose when to deliver it to meet our needs only. In reality the need for this shared asset could be required earlier to meet Cambridge Water's need. The Lincolnshire reservoir is required in 2039 in both versions of the model at 50MCM capacity. Up to 2036 the interconnector network remains largely the same between both planning horizons.
Plan B: Alternative plan based on preferred most likely scenario	When analysed for the 50 year horizon the model chooses to build an additional 11Ml/d water reuse from 2062 and increase the capacity of the desalination to 100 Ml/d by 2040 compared to 75Ml/d for the 25 year run. Apart from the additional desalination the other options before 2050 remain the same and are required at the same dates as the version optimised over 25 years, including both reservoirs. The interconnector network remains the same up to 2040 and post 2055 it steadily adds smaller 10 Ml/d transfers to the system.
Plan C: Least cost plan based on preferred most likely scenario	Over both planning horizons the Lincolnshire reservoir options is selected in the same year at the same capacity (50MCM). Fens is selected at the largest capacity (100MCM) in 2055, but as Plan A, this is not reflective of the regional needs. The biggest difference by optimising over longer duration is that builds significantly larger desalination capacity early on in the plan, the Holland on Sea option becomes 100Ml/d compared to 25Ml/d. Because it builds the large desalination capacity in the 2040s, later on it adds a smaller water reuse option in the 2070s. The transfer network in the longer duration plan is similar up to 2036, but then it builds some additional larger transfer to distribute the additional desalination capacity across the region.
Plan D: Least cost plan based on best for environment (abstraction) scenario	Plan D is based on delivering the largest benefits as early as possible. As such all of the new resource options are required before 2039, after this there were no additional resource options needed over the 50 year planning horizon. The options were mostly delivered in the same year as the 25 year period, with only some slight differences in the in 2036. Both the reservoir options were required in the same years in the 50 year and 25 year plans. The longer duration plan only required two additional transfers after 2055.

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What if outage increased towards the end of the planning period? This scenario was based on the outage rate doubling by 2050 using a linear scaling approach, resulting in a 22 Ml/d additional impact by 2050. This plan brings forward reuse and desalination capacity earlier in the plan. The total expenditure would be about £500 million greater than Plan C.

- ***What if we used the draft WRMP24 headroom profile?***The headroom components and glidepaths were updated between the draft and final WRMP, as described in the WRMP24 Planning Factors technical supporting document.This plan results in a small reduction in the overall quantity of new resource required, more reuse and less desalination. The overall cost is the same.

Figure 93 Option type and capacity sensitivity to alternative planning factor scenarios

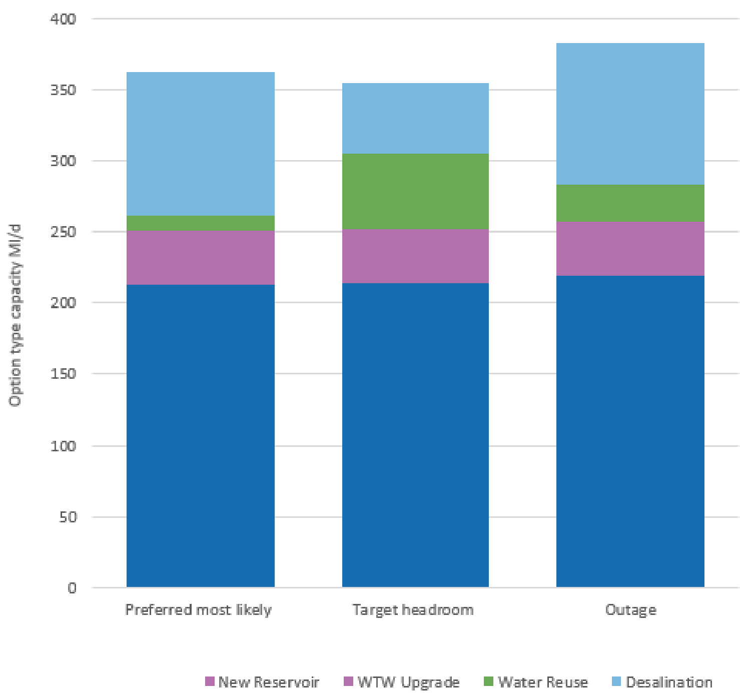
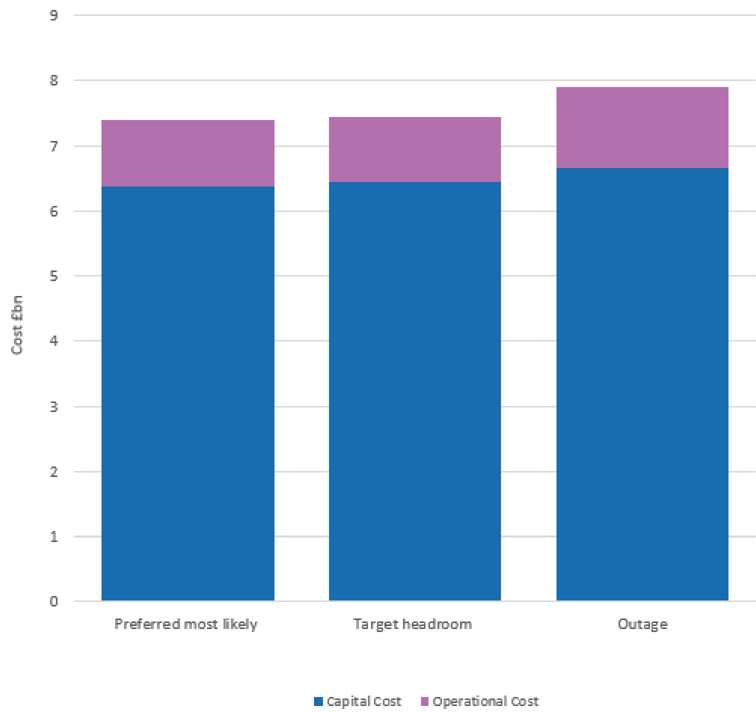


Figure 94 Portfolio cost sensitivity to alternative planning factor scenarios



7.2.5 Transfers from other regional groups

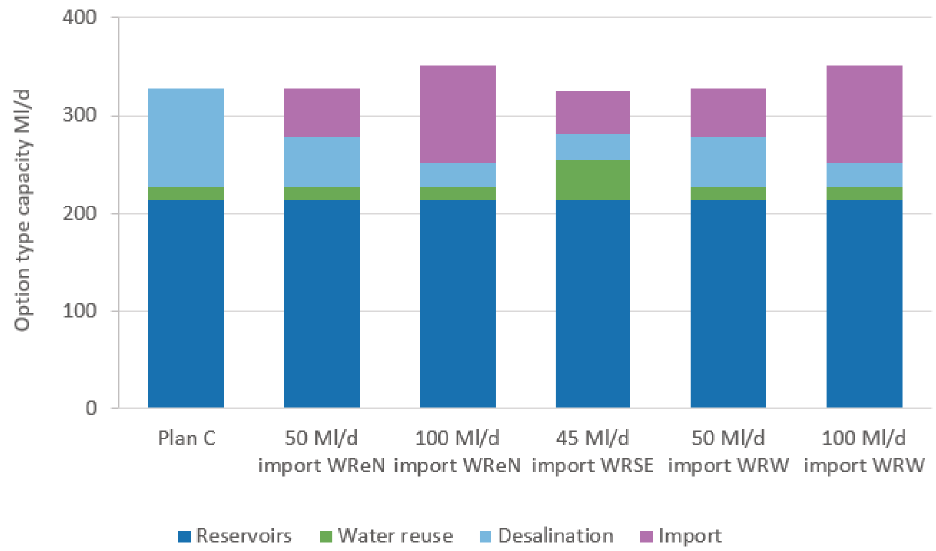
We have modelled a series of potential transfers from the other regional groups. These are theoretical options to understand how our plan could adapt if one of the regional groups in subsequent planning rounds developed an option which could be shared between regions. This work is a repeat of the Regional Reconciliation 3 process, which seeks to ensure alignment between the five regional planning groups, in particular around the timing and selection of transfer options. This modelling provides a understanding at water company level, seeTable 42. All imports and exports are modelled as starting from 2040.

Table 42 Regional transfers modelled

Regional Group	Import/Export	Size of transfer (Ml/d)
Water Resources North (WReN)	Import	50
		100
	Export	50
		100
Water Resources South East (WRSE)	Import	45
	Export	50
		100
Water Resources West (WRW)	Import	50
		100
	Export	50
		100

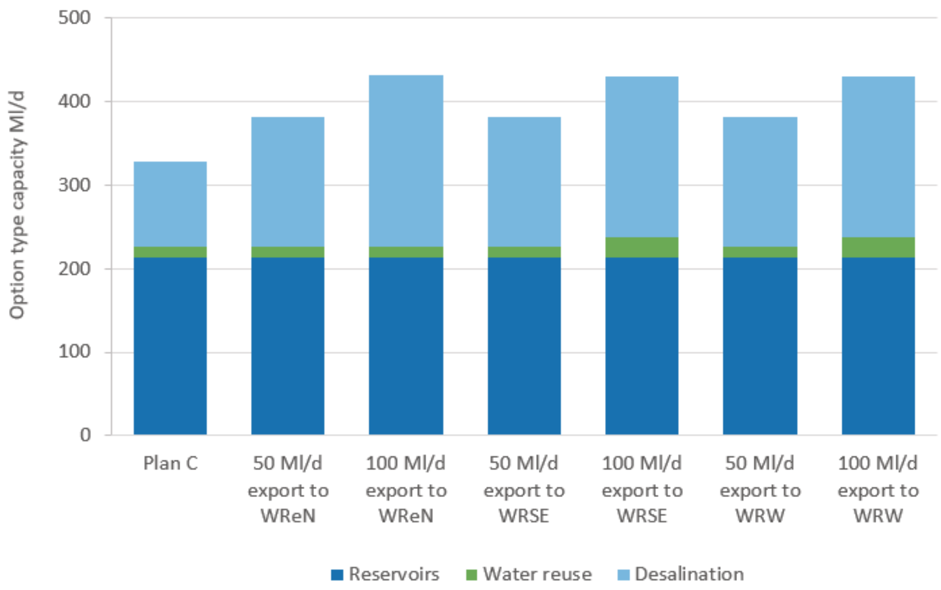
Figure 95 shows the impact the import scenarios have on the capacity of the different option types compared to Plan C. For the 50Ml/d import scenarios the capacity of desalination decreases proportionally to the import. The 100Ml/d imports create a surplus as the resulting capacity of new resource is greater than Plan C. The 45Ml/d transfer from WRSE is a reverse trade where we reduce our export to Affinity Water from our Grafham Water treatment works, in this scenario the plan adjusts by decreasing the desalination capacity but also increasing the capacity of water reuse.

Figure 95 Capacity of different option types for regional import scenarios



The export scenarios are shown in Figure 96. In all scenarios the capacity of desalination increases to match the export volume.

Figure 96 Capacity of option types for regional exports



7.3 Stress testing

The stress testing establishes how stable plans are or if an adaptive approach is more suitable. We use this stage to understand if we commit to investing in new options in the early years of the plan, can our plan adapt if the future varies from our original forecast. An example of the options we may need to commit to in a plan are shown in Figure 15. In our stress testing runs these options are modelled as set within our baseline, the model is then free to choose the options later in the plan to meet the various scenarios.

The scenarios we use to stress test the plans include the eight Ofwat common reference scenarios[46] , seeTable 43.

For the stress testing we only change the relevant element of the model input data, this ensures we can clearly understand the impact of varying individual assumptions. Figure 97 shows the supply demand deficits for each stress test scenario.

46 PR24 and beyond: Final guidance on long-term delivery strategies, April 2022

Table 43 Stress testing scenarios

Forecast / Input	Forecast Component	Variation	PR24 Common Reference Scenario
Supply Forecast	Climate change	High	High RCP 8.5 (50th percentile probability level)
		Low	Low RCP 2.6 (50th percentile probability level)
	Environment ambition	High	Enhance
		Lower	BAU
Demand Forecast	Population growth	High	High based on Local Authority Plans without Government interventions
		Low	Low based on ONS trend data with Government interventions
Options	Demand Management Options	High	Faster technology scenario - includes 50% leakage
		Low	Slower technology scenario - longer smart meter roll out same leakage benefits as preferred plan, lower assumed water efficiency benefits

Figure 97 shows the range of variability across the Ofwat common reference stress test scenarios, presented as alternative regional supply demand deficit profiles, as previously detailed in Section 7.2.1. The Ofwat common reference scenarios have been applied to the preferred most likely scenario and follow the profile for abstraction reductions used in this scenario. Plans A and D are based on different profiles, however the deficits by 2050 will be the same for Plans A, B and C which are all based on BAU+ environmental destination. For Plan D the deficit will be the same as the Enhance scenario shows in the figures below.

We summarise the assessment for each plan in the following figures. These show how the option types and their supply benefit, or water available for use (WAFU), are profiled over the planning period. These are then compared these against the deficits created from each of the scenarios presented below, and previously described in further detail in Section 7.2. Where the stress test scenariosupply demand deficit lines are above the available new WAFU, shown by the colour block, there is potential for supply deficits. Whilst when the available WAFU is above the supply demand deficit lines, there is potential for surplus resource.

Figure 97 Supply demand deficits for each stress test scenario

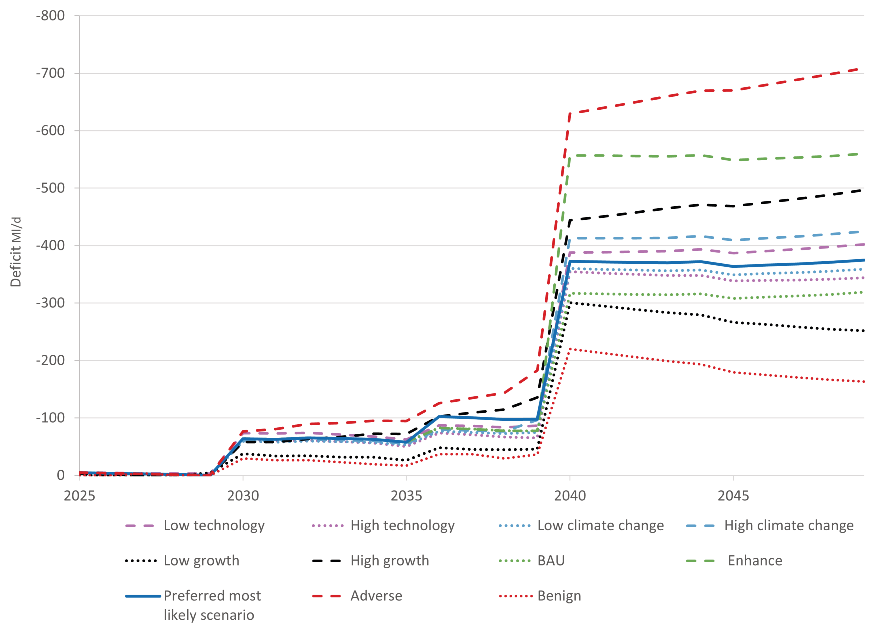
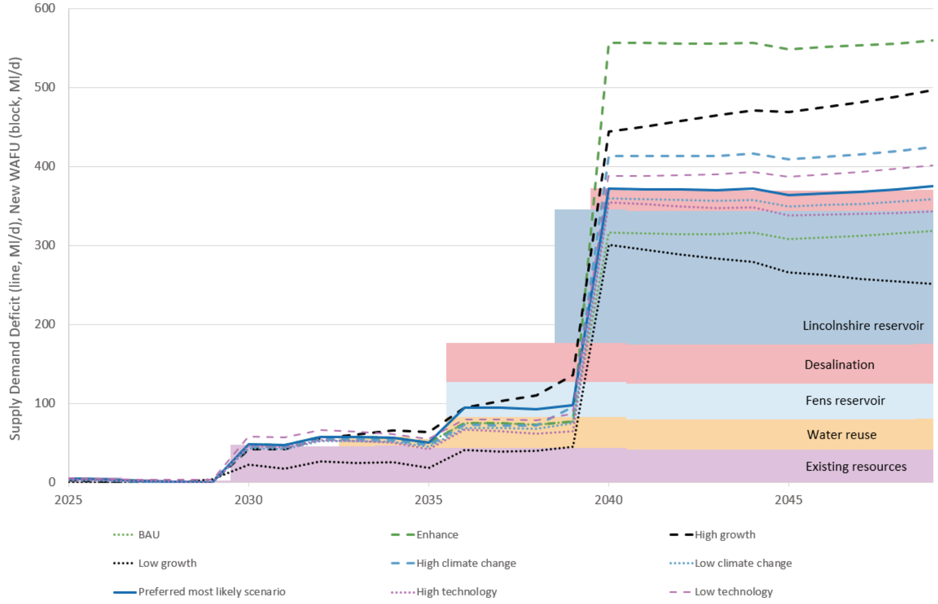
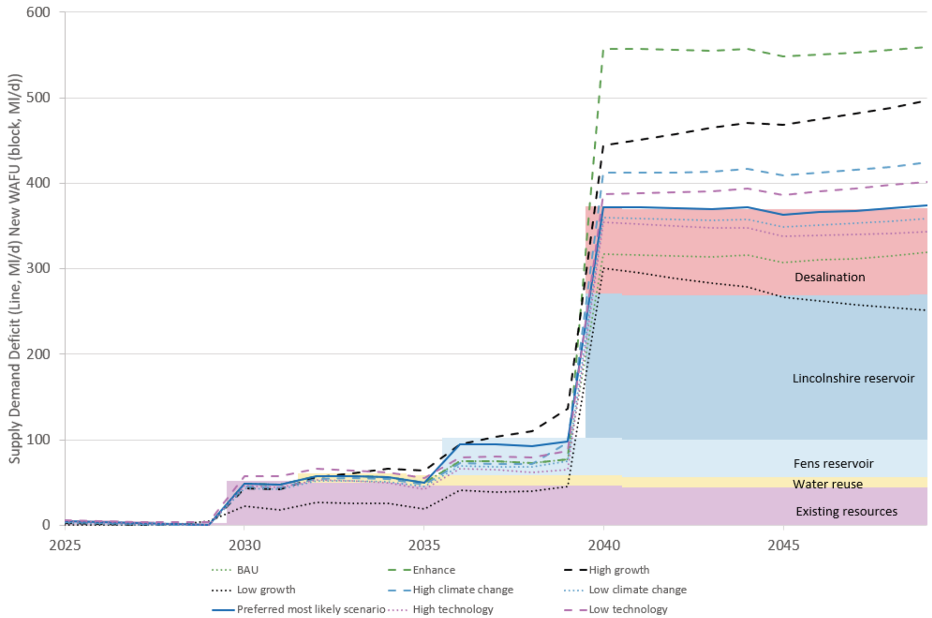


Figure 98 Plan A: Initial least cost plan - stress test summary



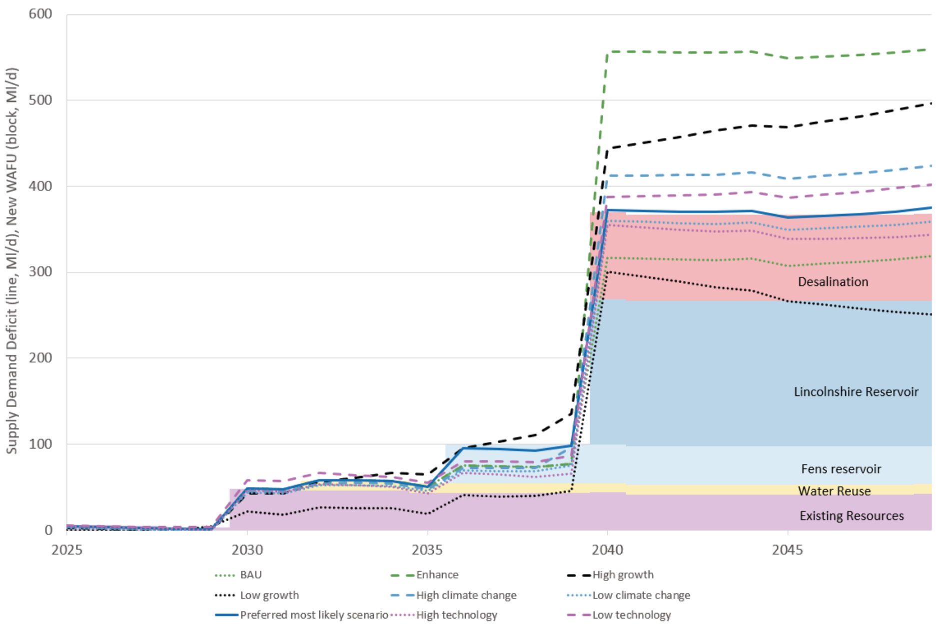
Plan A is based on the initial most likely scenario, which requires schemes to be developed earlier than the preferred most likely scenario, which the stress tests are based on. This creates a surplus in 2036 from new desalination capacity and the Fens reservoir. These options would have to be implemented before the outcome from the WINEP investigations was available, which means that if the environmental destination reductions were less than assumed, BAU for example, we would have surplus resource from the Lincolnshire reservoir at the end of the plan.

Figure 99 Plan B: Alternative plan based on preferred most likely scenario: stress test summary



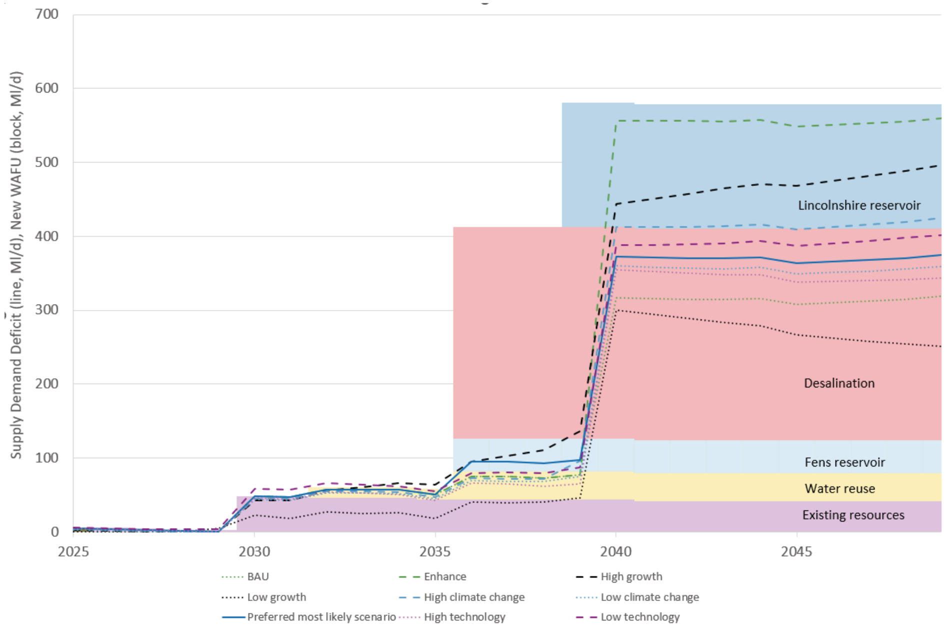
For Plan B the low technology scenarios slightly exceed the WAFU from the existing resource options, up until 2032 when the water reuse option becomes available. To resolve this deficit an adjustment to licence caps would be required. After 2032 there is adequate resource to meet the range of scenarios. After 2040 the deficits all fall within the range of potential desalination options. This element of the plan is the subject to the most uncertainty driven by abstraction reductions for environmental destination. The desalination options can be scaled up and down to meet the need of environmental destination once confirmed by the WINEP studies.

Figure 100 Plan C: Least cost plan based on preferred most likely scenario - stress test summary



Plan C is similar but demonstrates slightly less headroom to manage potentially more severe scenario of high growth in the 2032 to 2040 period than Plan B. This would require additional small existing resource options to resolve. By 2040, the deficits fall within the range of potential desalination options.

Figure 101 Plan D: Least cost plan based on best for environment (abstraction) scenario - stress test summary



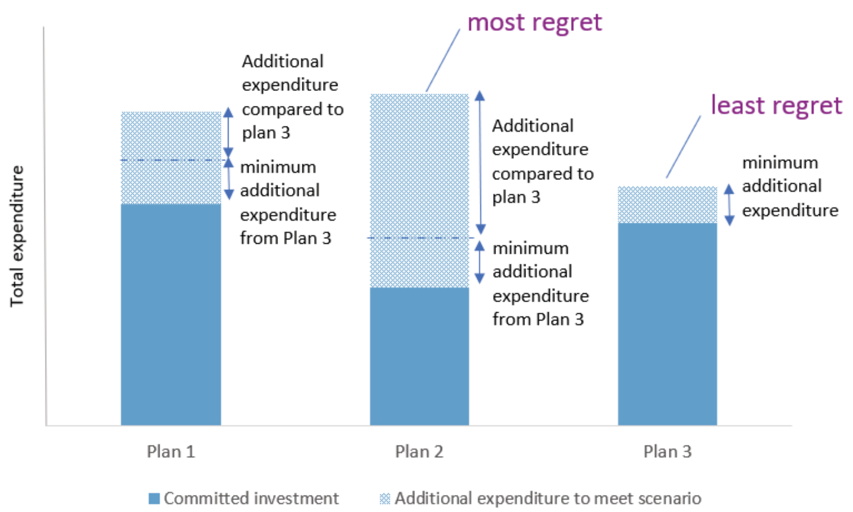
Plan A and D would both result in potential unnecessary early expenditure if environmental destination abstraction reductions determined by the AMP8 WINEP studies turn out to be lower than the current scenarios.

7.4 Least worst regret analysis

Least worst regret analysis is a tool used for decision making under uncertainty, particularly when it is difficult or inappropriate to assign probabilities to possible future scenarios[47]. The method looks to minimise 'regret' across all scenarios analysed, where 'regret' can be considered as the difference between a decision and the optimal decision. In our analysis this is represented as the difference in total expenditure.

We use this method to assess if we commit to the options required at the start of each plan and the future varies, how much additional investment is required to meet the future need. We then identify the plan with the minimum additional spend (the optimal decision) and compare against the other plans. The plan with the least regret is the version that requires the lowest additional spend compared to the other plans, see Figure 102 with an example for one scenario.

Figure 102 Example of how least worst regret analysis is applied to one scenario



In the example Plan 3 has the least regret as it requires the minimum additional expenditure to meet the scenario. We apply this method to all the scenarios and identify the regret for each plan. We then deduct the minimum regret from the other plans. This shows us which plan and scenario cause the worst regret and which the least worst regret.

The options we would need to commit to in AMP8, for each of the four plans are applied to the 10 Ofwat common reference scenarios to determine which investment portfolio has the most potential for 'regret' measured in overspend compared to the minimum cost for the scenario.

Figure 103 Summary of least worst regrets analysis

47 Stan Zachary (3 August 2016), Least worst regret analysis for decision making under uncertainty, with applications to future energy scenarios, p. 1

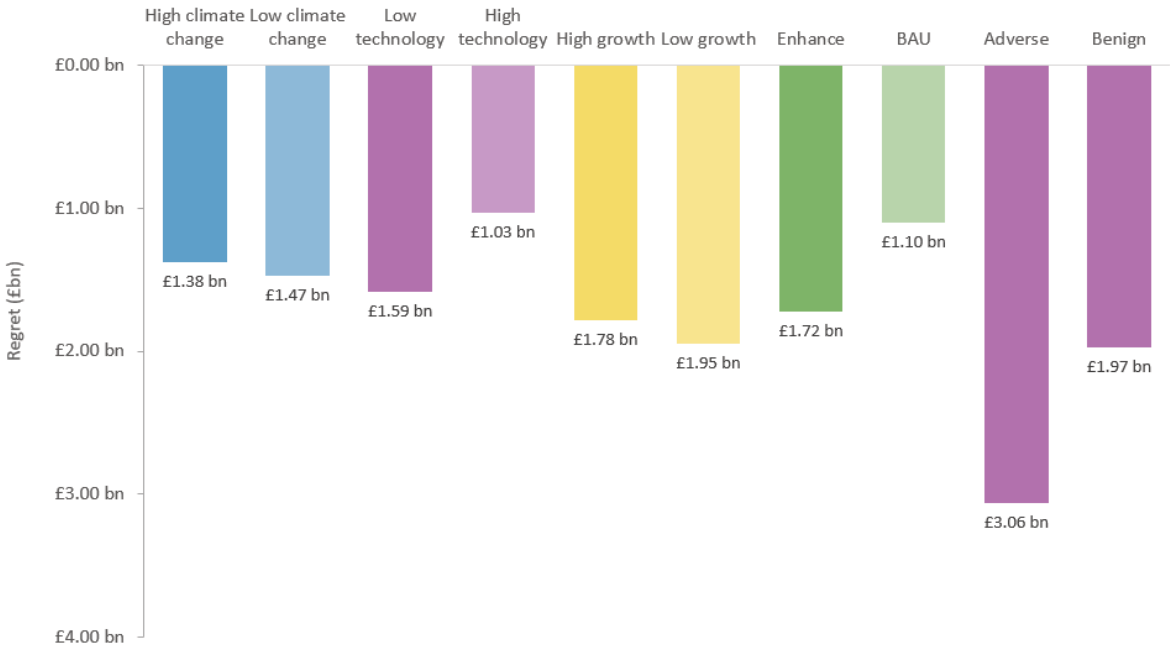
Figure 103 summarises the least worst regrets assessment, the full details are in Appendix C. Plan D has the highest portfolio costs across all scenarios. When compared to the minimum cost required to resolve the stress test scenarios, Plan D has the greatest overall 'regret' at £5.93bn, which was due to its performance against the Benign scenario. Therefore, Plan D is the worst performing on this metric.

Plan B was the best performing, with the least worst regret of £0.99 bn, which was due to its response against the Benign stress test scenario.

Further least worst regrets analysis was undertaken to demonstrate the effect of committing to investments planned according to each of the 10 Ofwat common reference scenarios and then testing the performance in cost terms of these committed investments against the remaining scenarios. The results are shown in Figure 104.

Regret measured across the common reference ranges from £1.03 to £3.06bn. This demonstrates that committing to plan supply-side investments according to any single one of the common reference scenarios would result in greater potential for regret than Plan B and C if an alternative scenario were to materialise. Planning according to the Adverse scenario demonstrates the greatest regret, which was caused by its performance in adapting to the 'Benign' scenario, followed by the performance of a portfolio based on the Benign scenario adapting to the Adverse scenario. Third worst was a plan based on the low demand scenario, with a max regret of £1.95bn due to its performance against the Adverse scenario.

Figure 104 Summary of least worst regrets analysis against common reference scenarios



7.5 Conclusions

The sensitivity testing of input assumptions has shown,

- Varying the climate change scenario does not significantly impact the plans. WRMP19 included the large step change of historical climate change. In WRMP24, the climate change impact has been recalculated to the base year of 1990, following updated guidance and data, and is assessed with and without severe and extreme droughts. As a result, we are only looking at future impacts which are relatively small in comparison to the other supply reductions; drought resilience, licence capping and environmental destination.
- All plans need an element of desalination capacity. When we excluded desalination there were insufficient alternative options to meet the need. The reservoirs options could be replaced with desalination but at considerably higher operational cost. The fact that desalination is scalable means that it can be sized to meet the need.
- Exclusion of either reservoir impacts the ability to supply Cambridge Water and therefore are considered unfeasible as these plans do not meet the regional needs.
- Extending the length of the planning period from 25 years to 50 years has greatest impact on the least cost plans, Plan A and Plan C. In these plans when optimised over the longer duration larger desalination options are developed earlier on in the plan. Plan B remains mainly stable extending the horizon, though it does build an additional 25Ml/d of desalination capacity in 2040. The reservoir options are developed at the same time, both the other new resource options and the interconnector network remain the same prior to 2036. Post 2055 an additional two water reuse schemes (29Ml/d) and further desalination (25Ml/d) are required. Plan D remains almost identical over the longer planning horizon, due to the fact that all of the need is met by 2039 with additional transfer options needed in 2055.
- If in subsequent rounds of planning imports from other regions were available the impact to the plan would be to reduce the desalination capacity in 2040, if the transfers were deemed better value to developing the desalination. They would not impact the capacity of the reservoirs.
- If a neighbouring region needs an export from us in the future we would need to build additional desalination capacity sized to the export volume.

The stress testing shows that the largest variation is the deficit caused by environmental destination. Our preferred most likely scenario has been developed to be adaptive to the level and location of environmental destination by delaying most of the reductions to allow the WINEP investigations to inform the plan.

All the plans include the SRO reservoir options which through the regional plan have been identified as the most robust and low regret options. However, Plans A and D require desalination capacity to meet the earlier supply reductions which makes the Lincolnshire reservoir an additional or 'top up' option to meet the needs of environmental destination. For Plan A most of the low or benign scenarios, such as low climate change or growth, fall within the reservoir capacity and therefore there is a risk that if these scenarios were to occur, we may have excess resource. Plan D is more severe where the Lincolnshire reservoir capacity is only required to meet the most extreme scenario of Enhance environmental destination.

Plans B and C are both based on the preferred most likely scenario which shifts the preference to deliver reservoirs earlier to meet the more certain need and builds desalination later in 2040. The scale and location of desalination can be adjusted to meet the need once confirmed through the WINEP investigations. This is also reflected in the least worse regret analysis which shows Plans B and C having the least regret.

We have modelled the SROs as unconstrained where appropriate, this ensures the full range of reservoir sizes and yields can be considered by the model. Through the sensitivity and stress testing this has demonstrated that for both reservoirs the 50MCM is the most robust sized reservoir. The Lincolnshire Reservoir is consistently selected at 50 MCM across all sensitivity and stress test portfolios. The Fens reservoir is selected at 50 MCM across the majority of stress test, but does show more variability, with larger and smaller options selected in specific scenarios. For the sensitivity tests we did not constrain any of the options including the regional no-low-regret ones and only included the proportion of the Fens reservoir allocated to Anglian Water for the costs and the benefits, see Table 2. Modelling the relevant proportion of Fens reservoir as unconstrained is useful to understand how it impacts options selection in our plan but it does not reflect the regional needs.

8 Applying the best value framework

We have applied the best value framework to the four alternative plans. The results are summarised here and the full detail can be found in Appendix C.

8.1 Objective: Deliver a secure and wholesome supply of water to our customers

Our WRMP24 must maintain the supply demand balance without any final planning deficits[48], therefore we discount any plans which do not meet the supply demand balance. All four of the plans meet our Levels of Service (LoS) criteria.

8.2 Objective: Optimise our available resource

The plans also meet the following demand criteria equally as they are all based on the same demand forecast which includes our Aspirational demand management portfolio:

- Meet the needs of future non-household customers
- Leakage reduction of 38 % from a 2017/18 baseline
- PCC reduction to 110 l/h/d by 2050, from 136 currently

8.3 Objective: Deliver a secure and wholesome supply of water to other sectors

We have included an estimate for future demand for non-public water supply for other sectors such as energy production. As part of our consultation, we liaised with companies who will be involved with the South Humber Bank Hydrogen production and carbon capture development. These industries have provided their current assessments of water requirements, indicating that they envisage an initial estimate of 60Ml/d will be needed in the near term (next 10 years). These requirements will, in the main, be for non-potable water, which does not appear in our potable water demand forecast. However, we have included a 60Ml/d non-potable demand requirement, glide-pathed to 2031/32 (as well as an assessed volume of approximately 1Ml/d in the Lincolnshire Central water resource zone for potable water) which is common to all plans. The 60 Ml/d non-potable demand directly triggers our South Humber Bank desalination option, and does not interact with our wider supply system. It therefore does not affect overall options selection and optimisation modelling. As the demand is discrete, we have excluded the option from our presented best value metric assessment in this section.

Other multi-sector needs such as agriculture form part of the development of the regional plan. Therefore, we have not included this metric in our assessment.

8.4 Objective: A plan that is affordable and sustainable over the long term

A best value plan should be efficient and affordable with distributional impacts, societal and intergenerational equity[49]. We use the cost of the options within each plan to assess how they perform against our objective to create a plan that is affordable and sustainable over the long term. We include both the capital costs needed to construct the options and the costs to operate the options over the planning period of 25 years. These two components are combined to provide the total expenditure costs, see Box 15.

We consider both the total and the distribution of expenditure across the five AMPs in the 25 year planning period. All the plans contain the same demand management activities and as such the costs for these have not been included in this stage of the assessment. In Section 5.2.1 we combine both the supply and demand options to assess the overall costs of the preferred plan.

Figure 105 andFigure 106 show the total expenditure and distribution of costs for the supply-side options within the four plans.

48 Water Resources Planning Guideline (WRPG), March 2023, Section 4.1
49 Water Resources Planning Guideline (WRPG), March 2023, Section 9.2

Box 15: Definitions of cost metrics

Capital costs (capex): Includes the costs to plan, design, build and commission new options.

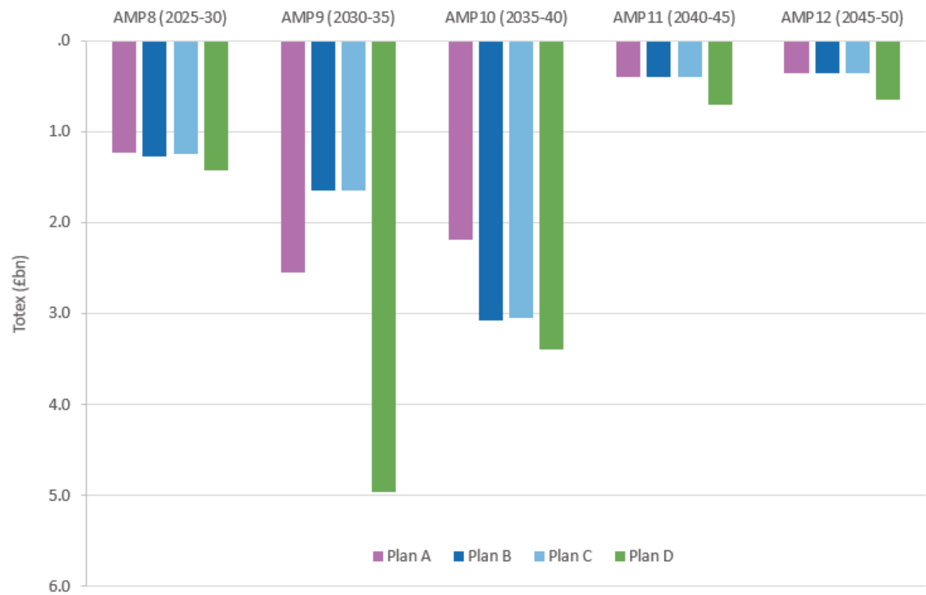
Operational costs (opex): Includes all the costs to operate the new assets over the planning period. These include energy, chemicals, maintenance and labour.

Total expenditure (totex): This is the sum of the capex and opex over the planning period.

Asset management period (AMP): Water companies produce 5-year strategic investment plans. These are presented in our Business Plan. The start of our WRMP24 will be AMP8.

Figure 105 Total supply-side options programme costs over 25-year planning period (2025-50)

Figure 106 Total expenditure for supply-side options per AMP for each plan



Plan D has the highest overall cost, this is because it is delivers greater abstraction reductions and therefore needs greater investment to develop new resources to off-set those lost. Plans B and C have relatively similar costs, with Plan C having slightly lower operating costs and therefore less total expenditure.

The distribution of expenditure reflects the timing of the supply reductions. Plans A and D have significantly greater costs in AMP9 when the majority of the investment falls to meet the earlier reductions by 2036. The profiles for Plans B and C closely align across the planning period. All four plans require similar expenditure at the start of the plan in AMP8.

We consider how each plan will contribute to future customer bills. We have used Ofwat's guidance to develop our calculation of long-term bill impacts[50]. For our analysis we have forecasted the average bill increases per household over a longer period of 50 years. This is because the capital

50 Ofwat (2022) PR24 and beyond: Final guidance on long-term delivery strategies

cost element within our modelled portfolios will be subject to long-term financing arrangements. As most water resources supply options have long asset lives (50+ years), using a longer timescale to generate an average allows us to more accurately demonstrate how investments could affect bills over the long-term. It is important to note that this is a metric used to compare plans and does not represent absolute bill increases, as we are only considering one element (supply-side options) which goes into the calculation of customer bills.

Figure 107 Annual bill increase per household for the supply-side options (2025-2075)

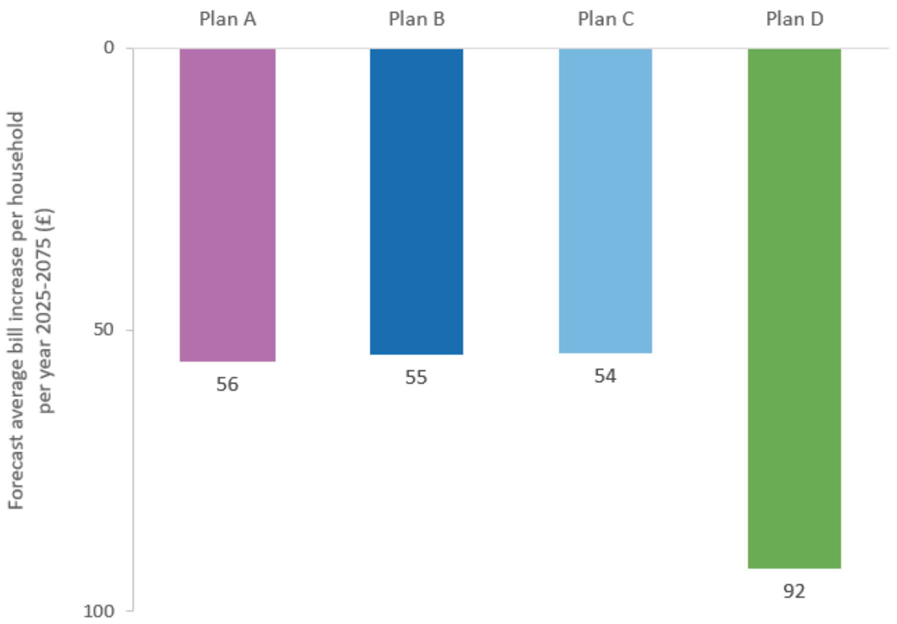


Figure 107 shows that Plan D creates a significantly higher bill increase compared to the other plans. We also consider how the bill impacts are distributed over time, see Appendix E: for more details. Plans A and D require larger bill increases towards the start of the planning period which reflects the higher expenditure needed in AMP9 to meet earlier supply reductions.

When we consider costs, we do this within the context of intergenerational equity. This is the concept of fairness between generations, where meeting today's requirements must not compromise the ability for future generations to meet their needs. In terms of our objective of a 'plan that is affordable and sustainable over the long term' we consider this as the allocation of costs and benefits between current and future customers[51]. But intergenerational equity is more than just cost and we consider this concept when comparing other metrics such as the environmental ones, timing of impacts, adaptability and carbon.

When considered in average household bills terms, customers in the early period of the planning horizon are expected to pay significantly less than those later on in the plan once infrastructure has been constructed. This is consistent with the greater benefits in terms of sustainable abstraction, drought resilience and recreation and amenity opportunities that would be available for customers later in the plan.

8.5 Objective: Deliver long-term environmental improvement

One of our key objectives of our WRMP24 is to deliver long-term environmental improvement. The four plans offer different scales and timing of environmental improvement by reducing abstraction.

Plan D is based on providing the greatest level of environmental improvement (Enhance) as soon as possible. Figure 108 shows how much each plans reduces the amount of water to be abstracted shown in terms of deployable output (this is a different way of representing the reductions compared to Figure 39, see Box 16 for details of the different terms used to describe supply forecast reductions).

51 UKWIR (2020) Deriving a Best Value Water Resource Management Plan.

Figure 108 Reduction in volume of water abstracted (deployable output) due to environmental destination by 2050

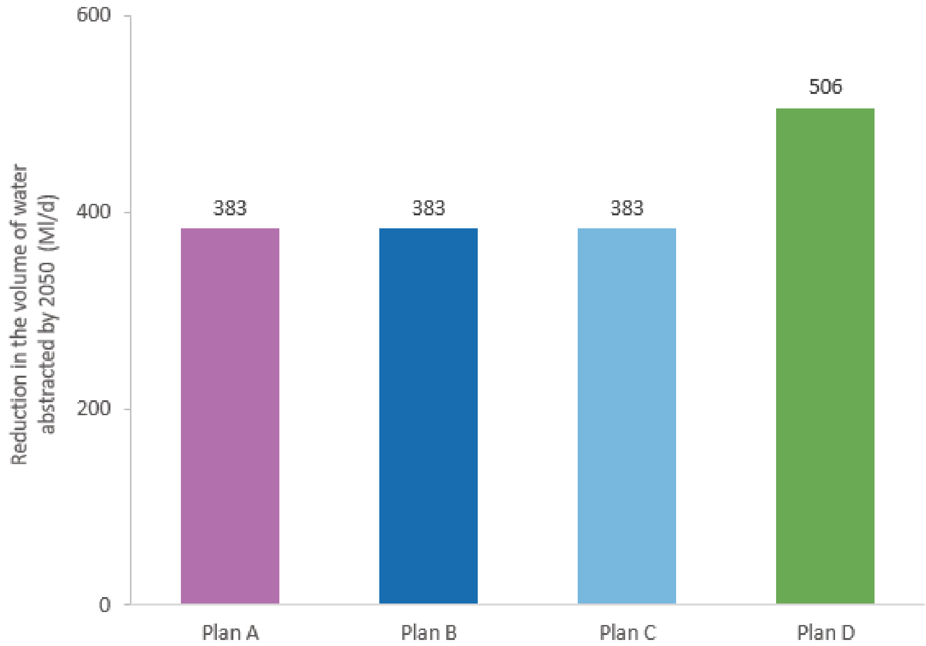


Figure 109 shows the profile of reductions over time to demonstrate the differentiation between the timings of abstraction reductions between the plans . This shows that although Plans B and C provides the same end level of reductions as Plan A, they deliver some targeted benefits earlier in the 2030 to 2036 period. Plan A then delivers greater benefits than B and C over the 2036 to 2040 period, after which point all reductions have been made. Plan D follows the same profile as Plans B and C between 2025 and 2036, then increases beyond the other plans to meet the Enhance environmental destination scenario.

Box 16: Different terms used to describe the supply forecast and reductions

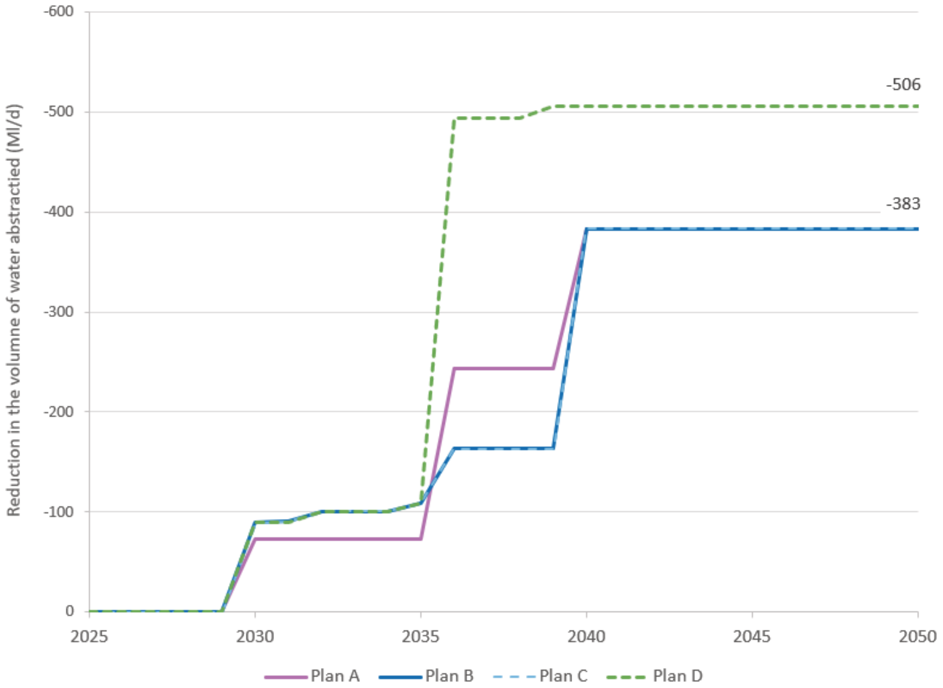
Abstraction licence reductions: Our abstraction licences set out the terms for our abstraction from either surface water or groundwater sources. These include limits on the amount of water we can abstraction over a year and a maximum daily limit. They are authorised and monitored by the Environment Agency. The reductions to the amount we can abstract to improve the environment through licence caps and environmental destination are calculated as a reduction to our licence.

Deployable output (DO): deployable output is a measure of the quantity of water we can output from our water treatment works. This figure includes constraints such as the yield of the source, the abstraction licence, the treatment capacity of the water treatment works and pumping capacity to supply the distribution network.

Water available for use (WAFU): this is a measure of the actual water we can use within a water resource zone to meet demand. This is what is left after we have exported water to other companies through our bulk export arrangements, transferred to other water resource zones through the interconnectors and a deducted an allowance for outage to carry out maintenance. Water available for use is the measure we use in the supply demand balance, including the supply demand balance graphs within this report.

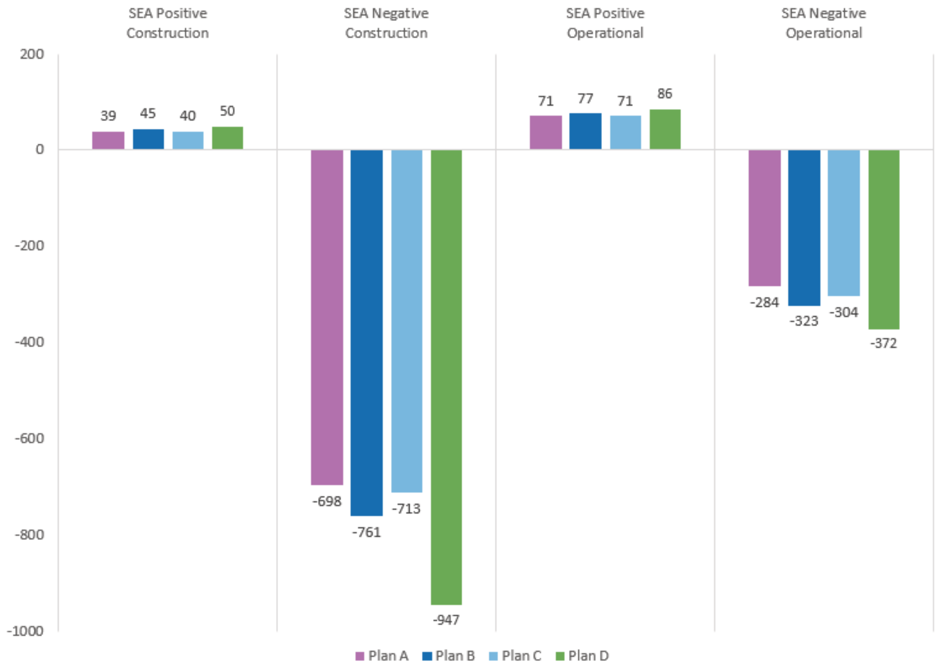
When we consider abstraction reductions with the other environmental metrics there is a trade-off. Greater reductions require more schemes to off-set the lost resource, these come at a cost to the environment in terms of construction and operational impacts, habitats lost and natural capital.

Figure 109 Abstraction reduction profile (2025-2050)



The strategic environmental assessment (SEA) assesses all the supply-side options and provides scores that reflect the construction and operational negative and positive impacts. Figure 110 shows how the plans compare using the SEA scores.The complete SEA findings for Plans A, B, C and D can be found in Chapters 6 and 7 of the WRMP24 SEA Environmental technical supporting document.

Figure 110 Strategic environmental assessment (SEA) scores



The positive benefits for both construction and operational are similar for all plans. The biggest difference is the negative impacts where Plan D performs worst.

Our plan looks to contribute to, and enhance, the natural environment by providing opportunities for biodiversity gain and enhancement[52]. Net gain for biodiversity is either an increase in the amount of biodiversity habitats or an improvement to existing habitats through better management[53]. Requirements set out in the Environment Act, the secondary legislation for which is expected to come into force in autumn 2023, will mean that supply options that require planning permission, or a Development Consent Order (DCO) delivered during the Plan's period will need to deliver 10% Biodiversity Net Gain (BNG); as such, ultimately all Plan's will lead to BNG. In addition, the assessment found a number of the reservoir options on the feasible list generate direct net gains in habitat units as a result of

52 Water Resources Planning Guideline (WRPG), March 2023, Section 9.4.4
53 Water resources planning guideline supplementary guidance - Environment and society in decision-making, March 2021, Section 1.2

the option's delivery, notably the Lincolnshire Reservoir.However, in our analysis we needed to understand the overall performance between plan options, rather than just that of specific reservoir supply side options.

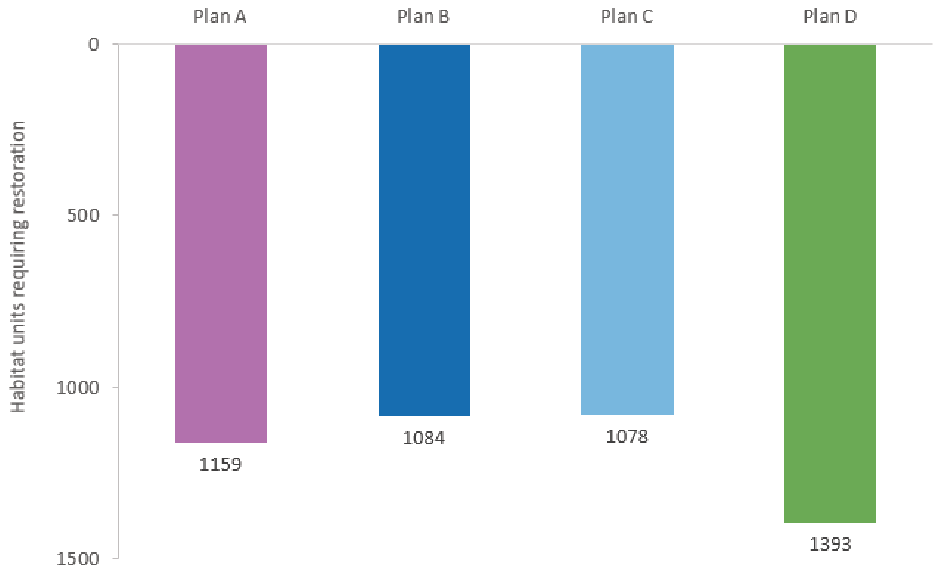
We therefore use the number of habitat units which are predicted to require restoration as an indication of the scale of investment needed to meet the biodiversity net gain targets. We have applied the mitigation hierarchy whereby avoiding biodiversity impacts is preferable to compensating for them.Further details on our BNG Roadmap for WRMP24 are presented in Chapter 4 of rdWRMP24'sBiodiversity net gain and natural capital assessmentsub report.Therefore, portfolios requiring more biodiversity restoration perform less well than those requiring less. Figure 111 shows these for the four plans.

As indicated above, the results presented exclude the positive BNG scores associated with the reservoir options (including the SROs), as these options are consistent between portfolios.

We are expected to take a natural capital approach, by considering the plans effects on the provision of ecosystem services to society, this is a way of considering the value nature provides either directly or indirectly to people[54]. The benefits we obtain from natural capital assets are referred to as ecosystem services. Our assessment of ecosystem services is based on a monetised quantification of the following ecosystem services and their net change due to an option being delivered:

- Food production
- Carbon storage
- Natural hazard management
- Air pollution removal.

Figure 111 Habitat units requiring restoration (excluding reservoirs)

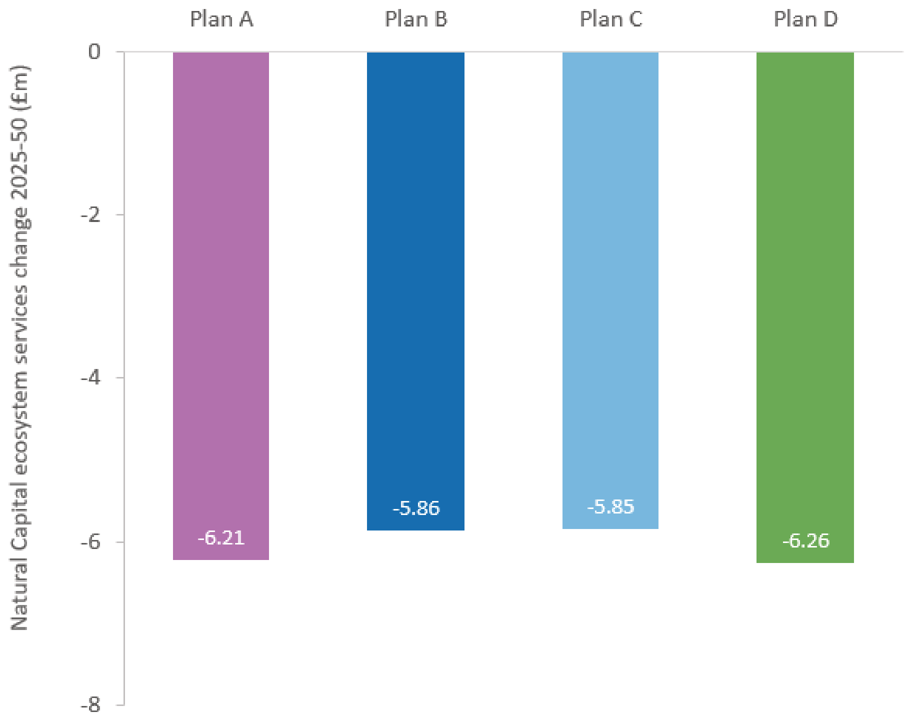


All of our plans show a negative impact on ecosystem services, as water resources supply options are typically constructed on farmland, requiring a land use change away from food production, which drives the majority of monetised losses presented below.

As part of the SRO reservoir projects we are working with stakeholders to explore irrigation support, which could increase the productivity of land close to the reservoir. This benefit has not been included in the assessment at present.

54 Water resources planning guideline supplementary guidance - Environment and society in decision-making, March 2021, section 1.2

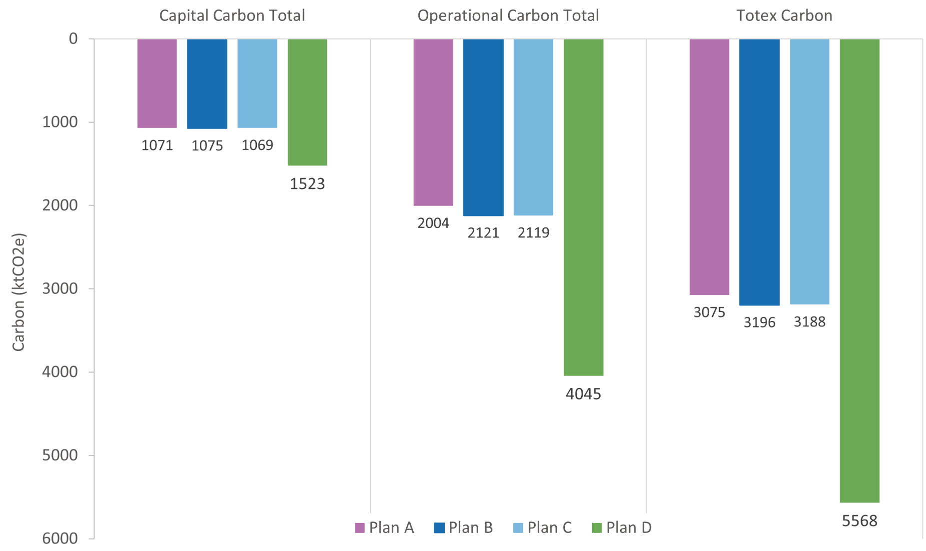
Figure 112 Natural capital ecosystem services comparison total change 2025-50 (£m)



8.5.1 Carbon

The Government has committed to reducing greenhouse gas emissions to net zero by 2050. Anglian Water, along with the rest of the English water companies, have committed to net zero operational carbon by 2030[55]. In quantifying carbon we consider both the carbon associated with the construction of new options, capital carbon, and that produced through operational activities, operational carbon. Figure 113 shows the quantities of carbon for each of the plans. The quantities are presented as tonnes of carbon equivalent based on assumptions of how much carbon is the production of materials, used in construction plant and operational energy usage. These numbers have been calculated using current carbon emission factors. This gives us comparable quantities for assessment. InAppendix D:, we assess to how these quantities will and could change, when we consider our company net zero strategy and potential future carbon scenarios.

Figure 113 Comparison of carbon quantities



When we assess plans, we consider the profile of operational carbon over time. Plans that have high operational carbon towards the end of the planning period provide greater opportunity for sourcing green energy, as the market increases with demand across all sectors. Figure 114 shows the profiles for the four plans. Plans B and C have slightly more operational carbon profile at the start of the plan compared to Plan A due to the additional licence caps addressed in those plans. Plan C would require more energy from renewables up to 2040.

The quantities of operational carbon presented in our assessment are based on the additional requirements from new assets. They do not consider the reduction in carbon from ceasing abstraction at our existing

55 Water Resources Planning Guideline (WRPG), March 2023, Section 8.3.2

groundwater sources. The carbon associated with the replacement sources, such as desalination, is an order of magnitude larger than that from our less carbon intensive groundwater sources.

The operational carbon reduced from groundwater sources lost is significantly lower, as they require minimal treatment, and are typically located locally requiring less power for distribution. In contrast, desalination options have high operational carbon requirements, due to power intensive treatment processes and are typically located some distance from the areas they supply.

Figure 114 Operational carbon profiles

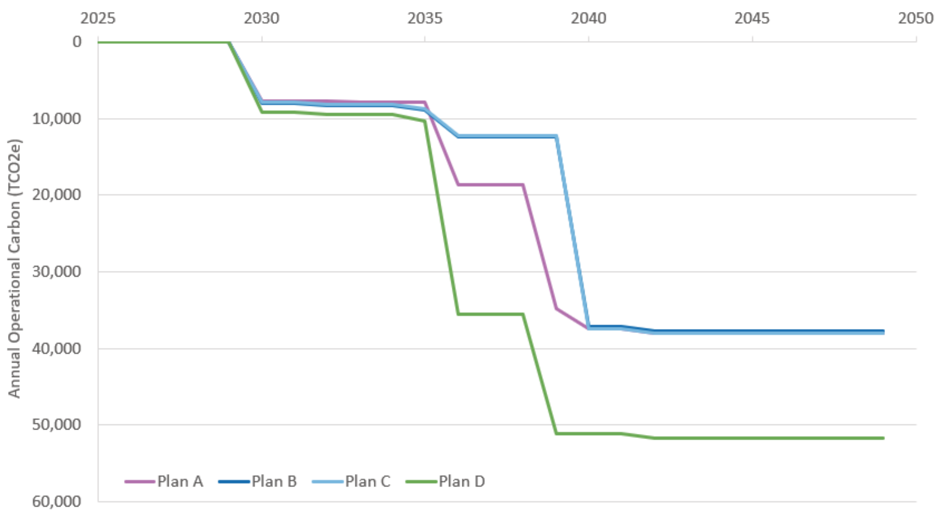
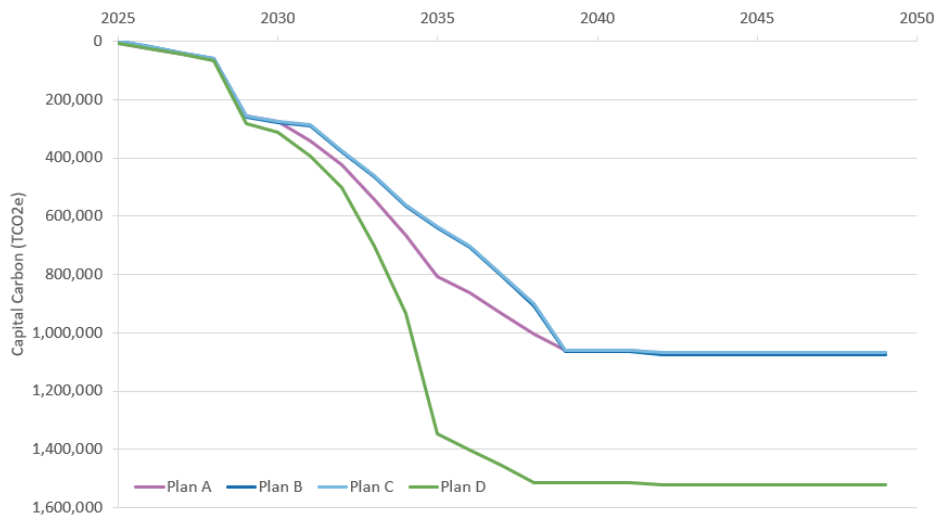


Figure 115 shows the profile of capital carbon incurred over time for each portfolio. Capital carbon would be expected to increase over time in all plans. Plans A and D require capital carbon impacts to be incurred earlier in the time horizon, as they have earlier infrastructure construction commitments. Plans B and C delay more capital carbon impacts later in the planning horizon, which enables more time for additional low-carbon construction techniques to be enabled.

The SRO reservoir options are the largest contribution to capital carbon within the plans. The most significant factor is the diesel fuelled earth moving plant needed for the construction of the reservoirs work. We have already engaged with the supply chain to develop opportunities for alternative plant such as that powered by electricity or Hydrogen to reduce this carbon.

See Appendix Appendix C: andAppendix D: for more details about the costs of carbon and how we test uncertainty about assumptions.

Figure 115 Profile of capital carbon



8.6 Objective: Increase the resilience of our water systems

The completion of our WRMP19 schemes ensures we are resilient to 1:200 drought. For WRMP24 we must further increase our resilience to more extreme drought, to 1:500. All of our plans achieve this level of resilience.

For developing alternative plans, see Section 6, we consider the choice of delaying drought resilience by one year to enable four years worth of environmental destination reductions to be brought forward in the most sensitive areas of our region. Our customer and stakeholder engagement shows that customers feel drought resilience by 2039 is about the right timescale but their preference is to deliver environmental improvements earlier. This formed our preferred most likely scenario used for Plans B and C which delay the need for the Lincolnshire reservoir by one year.

We also consider the resilience associated with the supply-side options in terms of delivery and diversity. All four plans include both SRO reservoirs. The largest variation between plans is the number and capacity of desalination options. Desalination is the best option in terms of scalability to match the need. However, there must be adequate time for the WINEP investigations to inform the scale of the need before we commit to constructing new assets. This is the basis of our preferred most likely scenario and therefore Plans B and C perform best for these metrics, see Appendix C: for more details.

8.7 Objective: A plan that supports the views of regional stakeholders and water companies' customers and is not detrimental to social wellbeing

All plans have a positive recreation benefit which is linked to the delivery of the reservoirs. Plan A and Plan D have slightly higher overall recreational value over the 25 year forecast period as they deliver the Lincolnshire Reservoir one year earlier.

We use our customer and stakeholder engagement to assess the extent the alternative plans meet their preferences. Plans B and C are shaped by our customer engagement and reflects their preferences for delivering environmental improvements ahead of drought resilience, developing water reuse as their preferred option type whilst balancing costs, environmental and carbon impacts. For stakeholder preferences Plan B performs best, see Appendix C: for full details.

8.8 Objective: A plan that can adapt to future scenarios

The stress testing, in Section 7.3, shows that the largest variation is the deficit caused by environmental destination.

All the plans include the SRO reservoir options which through the regional plan have been identified as the most robust and low regret options. However, Plans A and D require desalination capacity to meet the earlier environmental destination reductions which makes the Lincolnshire reservoir an additional or 'top up' option to meet the full needs of environmental destination at the end of the plan. Plans A and D would both result in potential unnecessary expenditure if environmental destination reductions determined by the AMP8 WINEP studies turn out to be lower than the current scenarios.

Plans B and C are both based on the preferred most likely scenario which shifts the preference to deliver reservoirs earlier to meet the more certain need and builds desalination later in 2040. Desalination is the most adaptive option where the scale and location can be adjusted to meet the need once confirmed through the WINEP investigations. This is also reflected in the least worse regret analysis which shows Plans B and C having the least regret.

9 Selecting our best value plan

To select our best value plan, we use our best value planning framework to assess the four alternative plans, these are:

- Plan A: Initial least cost plan based on the initial most likely scenario
- Plan B: Alternative plan based on preferred most likely scenario
- Plan C: Least cost plan based on preferred most likely scenario
- Plan D: Least cost plan based on best for environment (abstraction) scenario

The alternative plans are based on three scenarios. The scenarios present different timing and scales of abstraction reduction.

- **Initial most likely:** This is based on achieving BAU+ environmental destination starting in 2036 and profiled over time by prioritising the most sensitive areas of our region. However, by delivering large reductions early opportunities for the plan to be adapted based on the outcome of WINEP investigations are limited. In this scenario we achieve 1:500 drought resilience by 2039.
- **Best for the environment (abstraction)**: The largest level of environmental destination reductions based on the Enhance scenario are met as early as possible within the planning period. This prevents the ability for the plan to be adjusted to suit the outcomes from WINEP investigations. Drought resilience to 1:500 is achieved in 2039.
- **Preferred most likely**: Based on BAU+ this scenario profiles the reductions to allow the later part of the plan to be informed by the WINEP investigations. It maximises opportunities to utilise early surplus within the plan to deliver environmental destination reductions in the most sensitive areas. To enable these earlier reductions, we must delay drought resilience to 1:500 by one year to 2040. This scenario has been shaped by our customer and stakeholder engagement.

9.1 Key trade-offs

The assessment has highlighted key trade-offs where one criterion may perform well at the expense of another. The scale and timing of environmental destination affects the costs, carbon and environmental metrics.

Delivering environmental destination earlier requires plans to contain more desalination or water reuse options, as these are the only larger scale new resource options available. This results in higher operational costs over a longer period within the planning horizon, increasing operational cost, carbon and creates higher total expenditure. This trade-off is demonstrated in Figure 117, where Plan D provides greatest abstraction reductions but also has the highest total investment and whole life carbon.

Achieving the larger scale of environmental destination, requires more alternative resources to be developed to off-set the resource lost. This increases capital costs and carbon, which creates the highest total expenditure, see Figure 117. This trade-off is also reflected in Figure 116 where Plan D based on the Enhance scenario performs worse on all the environmental metrics as well as cost and carbon.The SEA also provides discussion and comparison in the performance of the four plan alternatives, this can be found in Section 7.6 of the WRMP24 SEA Environmental Report.

On balance Plans B and C perform best when considering these trade-offs.

Figure 116 Trade-off of average annual abstraction against environmental metrics

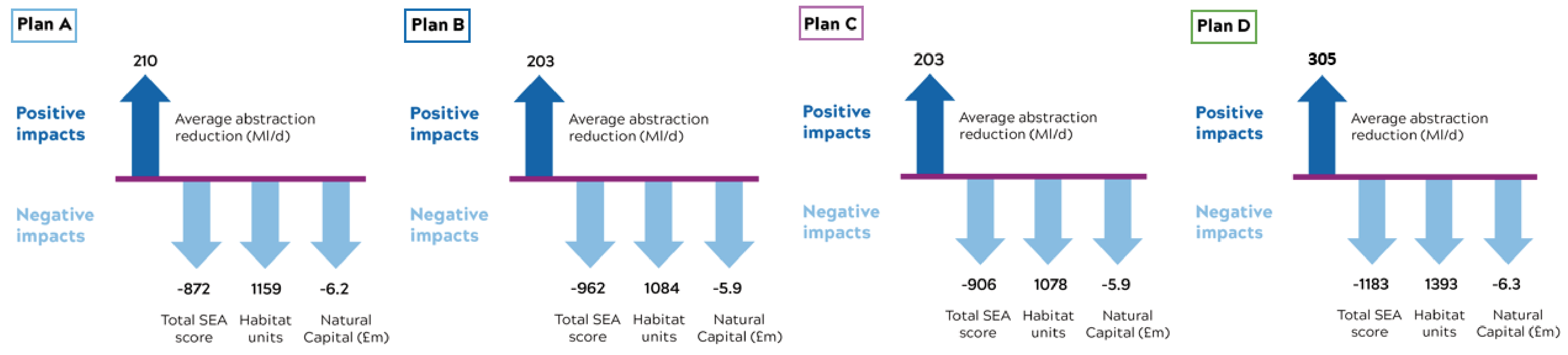
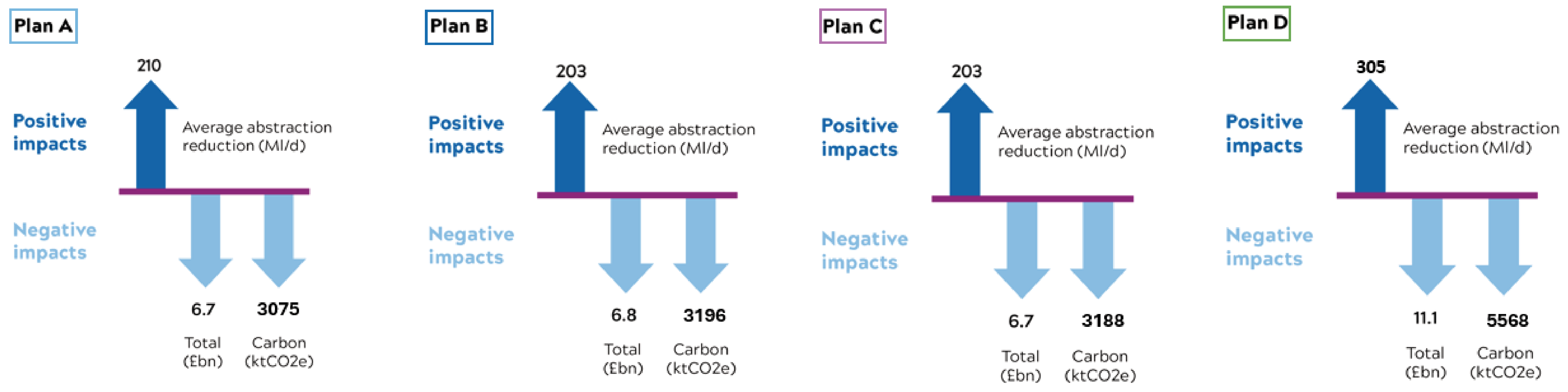
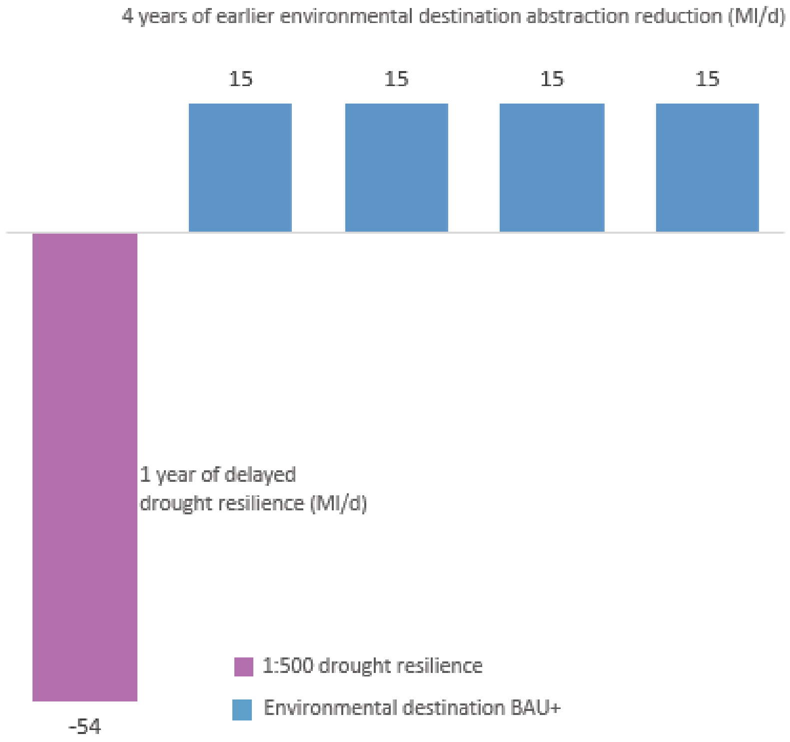


Figure 117 Trade-off of average annual abstraction against cost and carbon metrics



Another trade-off is whether to use the initial surplus from the larger new resource options to deliver increased drought resilience to 1:500 earlier or use this to achieve environmental destination sooner. Through the iterations to develop Plan B and C we took this further and assessed the choice of delaying drought resilience by one year to enable abstraction reductions to be brought forward by four years. Figure 118 summarises this trade off, delaying 54 Ml/d of drought resilience by one year to 2040/41 enables 15 Ml/d to be saved each year for 5 years between 2036 and 2040. This step is explained further in iteration 5 of developing an alternative plan (Section 6.2.5).

Figure 118 Trade-off to delay drought resilience to enable environmental destination earlier



56 Water Resources Planning Guideline (WRPG), March 2023, Section 4.1

Our preferred most likely scenario delays drought resilience in two of our water resource zones to enable efficient use of surplus resource to meet environmental destination needs. This scenario, used for Plans B and C, was shaped by our customer and stakeholder engagement, where customers state that they feel drought resilience by 2039 was about the right timescale but their preference is to deliver environmental improvements earlier. This scenario delays the need for the Lincolnshire reservoir by one year.

9.2 Best value objectives

Our WRMP24 must maintain the **supply demand balance** without any final planning deficits[56], therefore we discount any plans which do not meet the supply demand balance. All four of the plans meet the criteria. The plans also meet the demand criteria equally as they are all based on the same demand forecast including the Aspirational demand management portfolio.

We have considered drought **resilience** in the trade-off discussion above, but this outcome also includes resilience associated with the supply-side options in terms of delivery and diversity. All four plans include both SRO reservoirs. The largest variation between plans is the number and capacity of desalination options. Desalination is the best option in terms of scalability to match the need. However, there must be adequate time for the WINEP investigations to inform the scale of the need before we commit to constructing new assets. This is the basis of our preferred most likely scenario and therefore Plans B and C perform best for this criteria.

We also assess the delivery risk of plans; we base this on the number of options required on the earliest available date they could be delivered by. Plan B and C both perform similarly for this metric compared to plans A and D. The main difference between Plan B and C is the selection of Caister desalination in Plan C instead of Bacton desalination in Plan B. As described in Section 6.2.6 our assessment has shown that Bacton desalination is likely to be more favourable in terms of deliverability due to opportunities for shared assets with the energy sector and better water quality, meaning that overall Plan B has the lowest delivery risk.

All the plans include the SRO reservoirs which provide the greatest potential for **net beneficial opportunities for local communities.**

We consider how adaptive the plans are for the **investing for tomorrow** objective. All the plans include the SRO reservoir options which through the regional plan have been identified as the most robust and low regret options. Plans B and C are both based on the preferred most likely scenario which delivers reservoirs first to meet the more certain need and builds desalination later in 2040. The scale and location of desalination can be adjusted to meet the need once confirmed through the WINEP investigations. Plans B and C are based on the preferred most likely scenario and therefore perform best.

All plans align with the concept of **intergenerational equity**, in that their financial costs correspond to the timings where benefits such as reductions in unsustainable abstractions, 1:500 drought resilience and recreation and amenity benefits are enabled. Plan B and C are best for intergenerational equity, as they reduce the possibility of customers paying for assets with less certain benefits, such as desalination options which might not be required depending on the outcome of AMP8 WINEP investigations.

Plan B and C meet all the objectives similarly, however the key differences between the two plans are:

- For Plan B the inclusion of a transfer to Aylsham water resource zone
  - This is a small mainly isolated zone with a 14% increase in distribution input over the 25 years, which is expected to be offset by demand management.There ispotential for further non-household demand and this area has very high summer demand. The transfer provides a **resilient,secure and wholesome supply of water to our customers.**
  - As one of our most sensitive zones because of the proximity of our abstractions to the River Bure chalk stream, we have prioritised licence caps and environmental destination within this zone. These needs can be met using surplus created by new supply-side options to **deliver long-term environmental improvement.**
  - The zone is at risk of future licence reductions due to Habitats Regulations, so the transfer provides an opportunity to **adapt to future scenarios.**
  - The transfer provides a robust resilient supply to this zone, supported by the more strategic resources of Fens reservoir and Bacton desalination i**ncreasing resilience.**
- The inclusion of Bactondesalination in Plan B instead of Caister desalination
  - Bacton desalination option provides more potential for a conjunctive use with energy sector supporting a **secure and wholesome supply of water to other sectors.**
  - Bacton is a more robust location in terms of shore line protection ensuring the **plan that can adapt to future scenarios** whilst being **affordable and sustainable over the long term.**
- Plan B includes delivery of all backwash recovery options, which aligns with our objective to **optimise our available resource** by maximising all opportunities to use water efficiently.

Based on the evidence of our best value planning assessment, and the advantages over Plan C described above, Plan B offers best value for our customers and stakeholders whilst providing benefits to society and protection to the environment.

Table 44 summarises how Plan B, our best value plan, meets the best value planning objectives.

Table 44 How Plan B meets the best planning objectives

<table>
<tr><th>Outcome</th><th>Objective</th><th>How Plan B meets the objectives</th></tr>
<tr><td rowspan="3">Supply meets demand</td><td>Deliver a secure and wholesome supply of water to our customers</td><td>Our WRMP24 must maintain the supply demand balance without any final planning deficits, plan B meets this.</td></tr>
<tr><td>Optimise our available resource</td><td>Plan B includes our preferred demand management options.
Plan B contains all the backwash recovery options which maximises our use of available resources.</td></tr>
<tr><td>Deliver a secure and wholesome supply of water to other sectors</td><td>Plan B includes 60Ml/d of forecast non-potable demand for future hydrogen production and carbon capture industrial development in the South Humber Bank WRZ. This demand is directly linked to the South Humber Bank desalination option and does not influence the rest of the supply system. Other multi-sector needs form part of the development of the regional plan. We have not included any future demand for agriculture, however there is ongoing work as part of the development of the SRO reservoir options to evaluate potential benefits for agriculture.</td></tr>
<tr><td>Fair charges, fair returns</td><td>A plan that is affordable and sustainable over the long term</td><td rowspan="3">These objectives are a key trade-off as the scale and timing of environmental destination adversely affects the costs, carbon and environmental metrics.
Plan B meets the expectation to achieve BAU+ scenario. The timing of environmental destination for Plan B allows the WINEP investigations to inform the strategy ensuring efficient costs, carbon and environmental metrics later in the plan where there is the greatest uncertainty.
Plan B performs well in terms of cost, carbon and environmental metrics, and avoids the potential adverse effects of earlier commitment to desalination.
Plan B includes a transfer to Aylsham water resource zone, an environmentally sensitive zone. This enables improved adaptation to future sustainability reductions.</td></tr>
<tr><td>Flourishing Environment</td><td>Deliver long-term environmental improvement</td></tr>
<tr><td>A smaller footprint</td><td>Deliver long-term environmental improvement</td></tr>
<tr><td>Resilient Business</td><td>Increase the resilience of our water systems</td><td>Plan B meets drought resilience to 1:500 in 2039 but delays some areas to 2040 in order to prioritise environmental needs reflecting the preference from our customers.
Plan B includes both SRO reservoirs, supported with desalination options which provide scalability to match the need. In Plan B there is adequate time for the WINEP investigations to inform the scale of the need before we commit to constructing new assets.</td></tr>
</table>

Outcome	Objective	How Plan B meets the objectives
		Plan B includes a transfer to Aylsham water resource zone, which is an isolated zone. This enables enhanced resilience. Plan B includes Bacton desalination option, which has better potential for conjunctive use with the energy sector, and adaptability to future climate change than the alternative Norfolk desalination option.
Positive impact on communities	A plan that supports the views of regional stakeholders and water companies' customers and is not detrimental to social wellbeing	Plan B includes the SRO reservoirs, which provide the greatest potential for net beneficial opportunities for local communities. Plan B is shaped by our customer engagement and reflects their preferences for delivering environmental improvements ahead of drought resilience, developing water reuse as their preferred option type whilst balancing costs, environmental and carbon impacts.
Investing for tomorrow	A plan which can adapt to future scenarios	Plan B is based on delivering environmental destination at a time that enables the plan to be informed by the outcomes of the WINEP investigations. This allows the plan to adapt to the greatest level of uncertainty in our forecasts.

10 Adaptive planning assessment

The guidance states that we should consider if an adaptive plan is more appropriate than a 'conventional' WRMP, where there is a single preferred plan. An adaptive plan contains a core pathway and a series of adaptive pathways, see Box 12.

Our testing for uncertainty has shown that the most significant areas to consider for creating an adaptive plan are:

- Large range in deficit within the medium term due to the scale and location of environmental destination.
- The WINEP investigations at the start of the period will provide clarity on the level and location of environmental destination.
- We cannot deliver a plan without any desalination, as there are not adequate alternative resource options.
- Desalination is scalable and can be sized up or down to meet the need once the deficit has been confirmed.
- The SROs are triggered by supply reductions; Fens is needed to meet capping permanent licences to average and Lincolnshire Reservoir is environmental destination and drought resilience
- Due to the lead time of the reservoirs and the medium term impacts that drive the need for the SROs we need to commit to investment to further develop these at the start of the plan.
- If either of the reservoirs did not progress through a gate process, we would need to replace them with desalination and/or water reuse options.
- The modelling to generate alternatives (MGA) shows that all but one of the options needed early in each of the four plans considered are consistent across plans. The exception was Colchester water reuse, which was not selected in Plan D (best for the environment).

Using the outputs from the testing uncertainty stage we compile an adaptive version of our preferred plan. As we are required to identify a long-term preferred plan (including for the Water Resources Planning tables), we define our **preferred best value plan as comprising a core pathway and an adaptive pathway to meet our preferred most likely scenario**. The adaptive pathway contained within our preferred best value plan can be contrasted with alternative adaptive pathways that would be triggered if circumstances turn out differently to what we consider most likely at present (as described in our preferred most likely scenario). We judge whether circumstances are changing based on monitoring a series of metrics that characterise critical uncertainties, for example future abstraction reductions and future demand.

For some of the adaptive pathways it is not possible to satisfy all deficits, due to the time needed to deliver options. The adjustment to abstraction reductions, in these pathways, is the difference in the supply demand balance that is needed to ensure customers can receive a secure supply of water, ahead of new sources being commissioned.It is not accepted that these adjustments necessarily causes deterioration or presents a risk of that nor that this automatically gives rise to the need for OPI. However even if OPI is required in order to amend or alter licences our decision making modelling shows that OPI would be satisfied.

Using these outputs from the testing uncertainty stage we have compiled an adaptive version of our preferred plan, Plan B.

10.1 Pathways

An adaptive plan contains a core pathway and adaptive pathways, see Box 12.

Our core pathway consists of the no-and-low-regret investments we need to commit to in AMP8, this includes the SROs due to the length of time to plan, design and construct them. From our testing for uncertainty the options within Plan B's core pathway were selected in all MGA alternatives and across other plans too. The core pathway includes:

- Transfers needed in AMP8 to connect water resource zones to the WRMP19 interconnectors.
- Options where we are making upgrades/improvements to maximise output from existing resources.
- Water reuse scheme required in early AMP9, but development/design must start in AMP8 approved as part of the Accelerated Infrastructure Development programme.
- The two SROs, Fens and Lincolnshire reservoirs.
- Our preferred demand management strategy.

These investments are required in all the stress testing scenario including the Ofwat reference scenarios. The other schemes within Plan B are considered part of the adaptive pathway for our preferred plan. These either have shorter delivery periods and can be delivered within an AMP, or are required later in the plan.

We have identified scenarios which could trigger an alternative adaptive pathway to our preferred plan, these are related to the following risks: to late delivery of key schemes, options do not provide expected benefits or forecast assumptions change.The SEA Environmental Report (Section 7.7) provides further information on the comparative environmental performance of the BVP's adaptive pathways. The scenarios we have developed to provide adaptive plans are as follows:

Delivery risks

- The Fens reservoir (FND29) is delivered later than planned
- The Lincs reservoir (RTN17) is delivered later than planned
- The interconnector between Ruthamford South and Suffolk West Cambs (via Cambridge Water) is later than planned (CAM4,SWC8)
- The interconnectors to Norfolk are later than planned (NBR6, NTB10)
- Marham abstraction is deemed unfeasible (FND22)
- Suffolk West Cambs WRZ groundwater is deemed unfeasible (SWC13)

Risk that demand management is less beneficial than assumed

- Demand management portfolio does not deliver the benefits assumed for behavioural changes resulting from smart metering and Government interventions.

Changes to scale of environmental destination from WINEP investigations

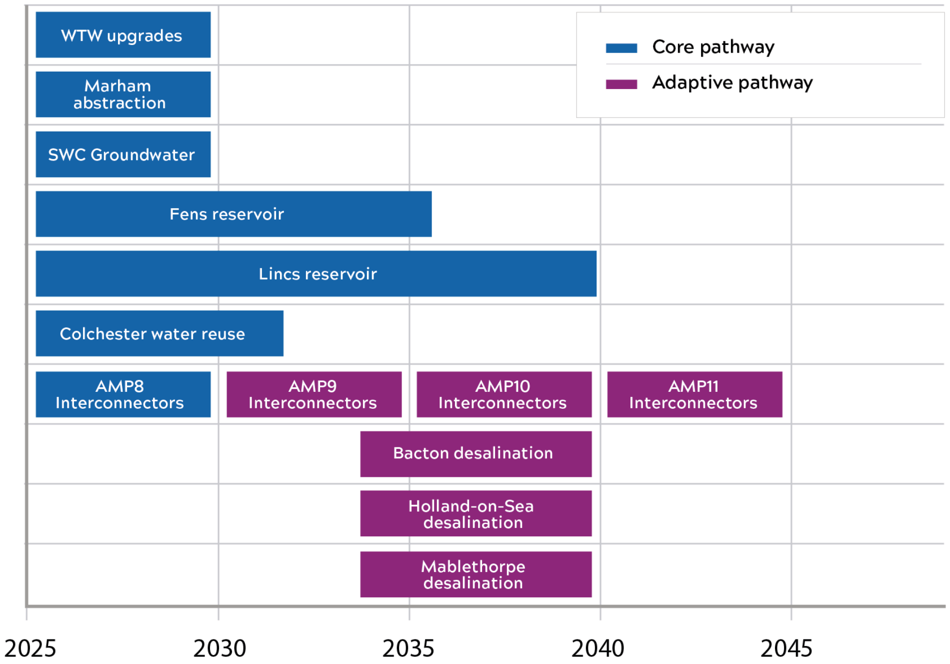
- Change to deliver BAU scenario
- Change to deliver Enhanced scenario

Uncertainty due to climate change and population growth is included in our headroom allowance, see WRMP24 Planning Factors supporting technical document.

10.1.1 Adaptive pathway 1: Best value plan

Our best value plan, Plan B, contains a core pathway and adaptive pathway. Figure 119 shows the options within each pathway. The interconnectors required to be constructed in AMP8 form part of the core pathway. Interconnectors required later in the plan are considered to be deliverable within an AMP and so form part of the adaptive pathway. Figure 119 also represents the length of time to deliver options, showing where the development of options will span multiple AMPs.

Figure 119 Plan B supply-side options within core and adaptive pathway



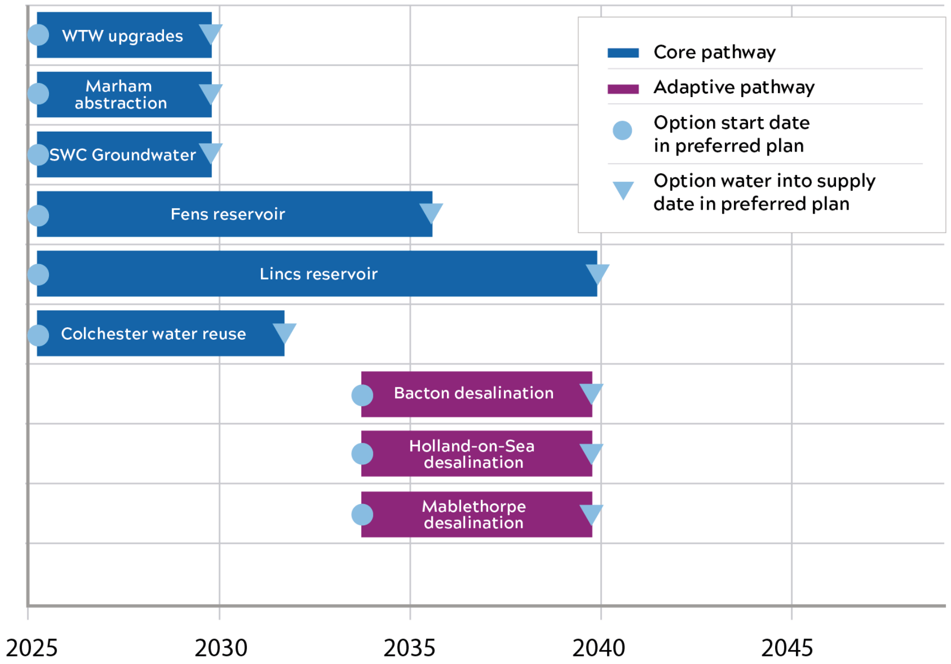
We have developed a series of diagrams to represent how the plan would adapt to each scenario. These only include the changes to the new resource options as any changes to the adaptive pathway interconnectors can be adjusted within an AMP as part of the WRMP/Business planning cycle The diagrams include,

- the dates of when options start and put water into supply for the preferred plan and the alternative adaptive version.
- when the capacity of options is adjusted to meet the scenario

- options which are no longer required in a scenario
- residual deficits which could result in later abstraction reductions or later deliver of environmental destination

Figure 120 shows the adaptive pathway diagram for the preferred best value plan.

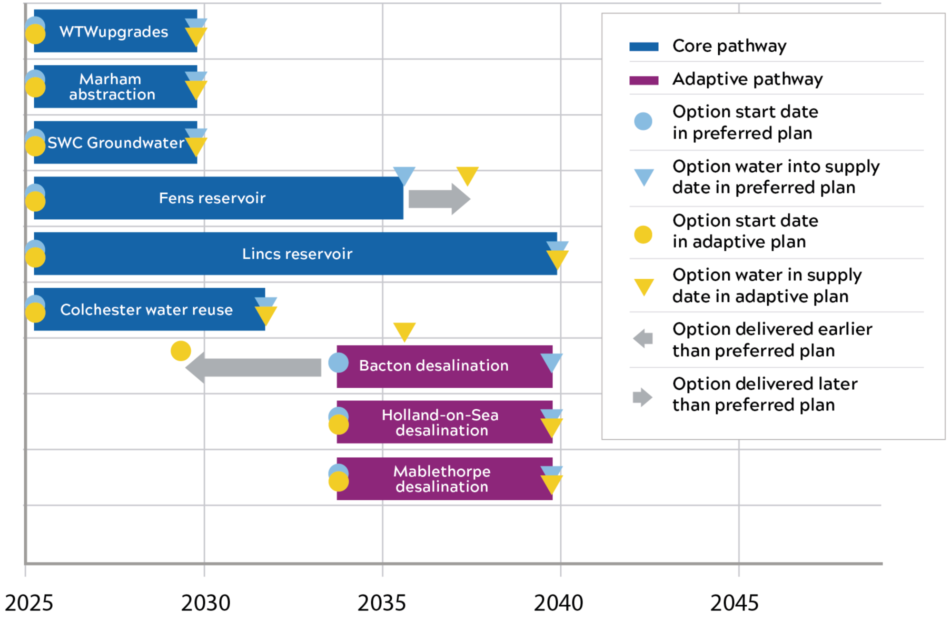
Figure 120 Adaptive pathway 1 diagram - best value plan



10.1.2 Adaptive pathway 2: Fens reservoir is delivered later than planned

We have developed an alternative adaptive pathway to show how the plan would adjust if the Fens reservoir took an additional 2 years to deliver, this is shown in Figure 121.

Figure 121 Adaptive pathway 2 diagram - if the Fens reservoir was delivered later than planned

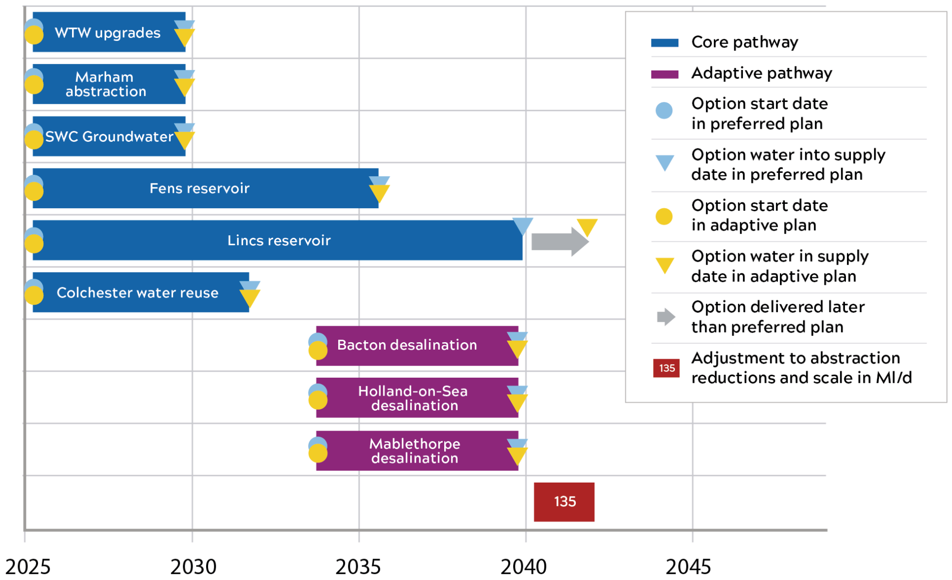


If Fens reservoir was 2 years later than planned we would have to switch to developing Bacton desalination plant from the end of AMP8. This does not require the desalination plan to alter capacity it is just required earlier in the plan. This ensures we can still deliver permanent licence caps to recent actual annual average as planned in 2036.

10.1.3 Adaptive pathway 3: Lincolnshire reservoir is delivered later than planned

In this scenario we the Lincolnshire reservoir is not available until 2042, 2 years later than planned, this is shown in Figure 122.

Figure 122 Adaptive pathway 3 diagram - if the Lincolnshire reservoir was delivered later than planned



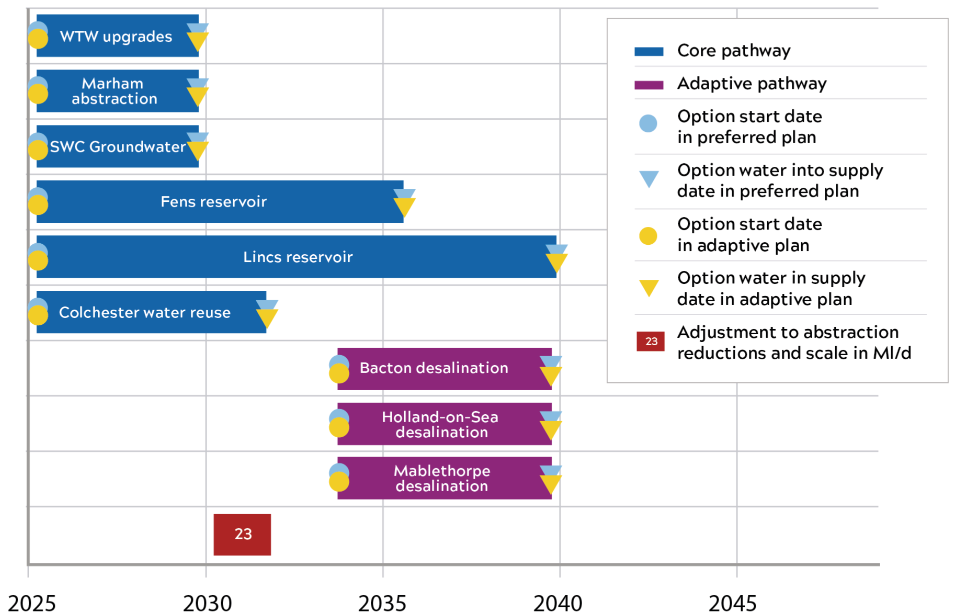
Lincolnshire reservoir is required to meet the abstraction reductions due to environmental destination and increased drought resilience in 2040. By 2040 we would have already delivered the adaptive desalination resource options. If the reservoir was delayed we would not develop an alternative new resource option because it would only be required for 2 years and would need to provide at least an additional 135Ml/d. We would therefore consider partially delaying Environmental Destination abstraction reductions or 1:500 drought resilience. We would also investigate the feasibility of increasing demand management, in particular further leakage reduction. This would not be sufficient to meet the full shortfall, but if it was assessed as cost effective we could meet some of the abstracted reductions as planned in 2040.

10.1.4 Adaptive pathway 4: Ruthamford South to Suffolk West and Cambs (via Cambridge Water) interconnector is later than planned

The two interconnectors which connect our Ruthamford South WRZ to Suffolk West and Cambs WRZs via Cambridge Water (CAM4 and SWC8) will be complex to design and construct. The total route is 75km of 900mm and 1000mm diameter steel pipeline. It involves crossing the River Great Ouse, the A14, a National Grid gas pipeline and the East coast mainline.

We have developed an alternative adaptive pathway which shows the impacts if these interconnectors were delivered a year later, this is shown in Figure 123.

Figure 123 Adaptive pathway 4 diagram - if Ruthamford South to Suffolk West and Cambs (via Cambridge Water) interconnector later than planned



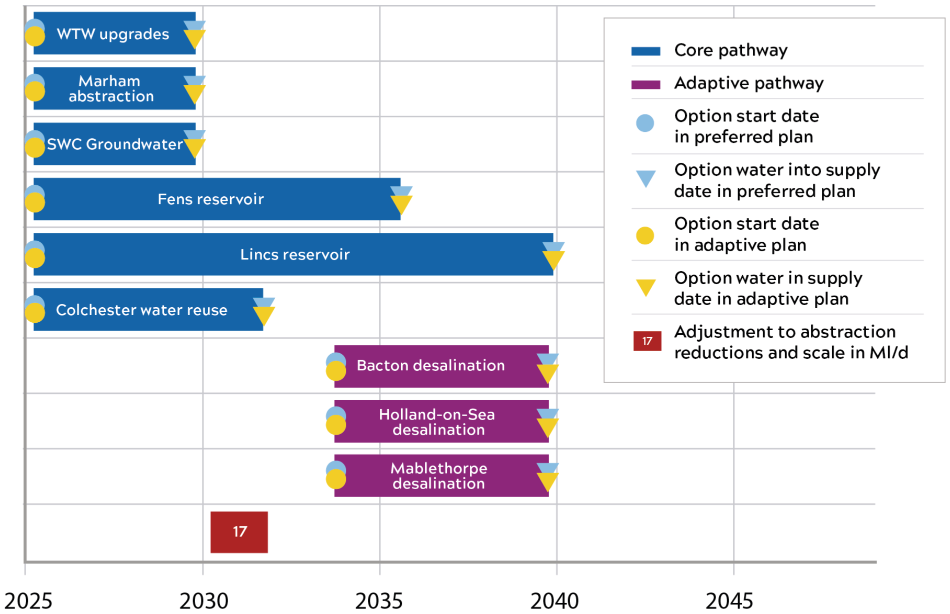
Ruthamford South WRZ to Cambridge Water (CAM4) and Cambridge Water to Suffolk West & Cambs WRZ (SWC8) are needed to transfer surplus resource in Ruthamford eastwards to meet caps to time limited licence in 2030. In the preferred plan all new resource options available in AMP8 are selected to meet the licence caps. No alternative options are available to make up the shortfall if the interconnectors are delayed. We would investigate the feasibility of increasing demand management, in particular further leakage reduction. This may not be adequate to meet the full shortfall, but if it was assessed as cost effective, it could reduce it. Therefore, the delay creates a residual deficit which would require an adjustment to the licence caps.

10.1.5 Adaptive pathway 5: The interconnectors to Norfolk are later than planned

There are two interconnectors which extend our WRMP19 interconnector network to Norfolk (NBR6, NTB10). These will be complex to design and construct as they require approx. 80km of 900mm steel and 603mm Ductile Iron pipeline. The route involves crossing a National grid gas pipeline and the A47 and there is a high risk of archaeological finds.

We have developed an alternative adaptive pathway which shows the impacts if these interconnectors were delivered a year later, this is shown in Figure 124.

Figure 124 Adaptive pathway 5 diagram - if Fenland WRZ-Norfolk Bradenham WRZ-Norfolk Norwich & the Broads interconnectors later than planned

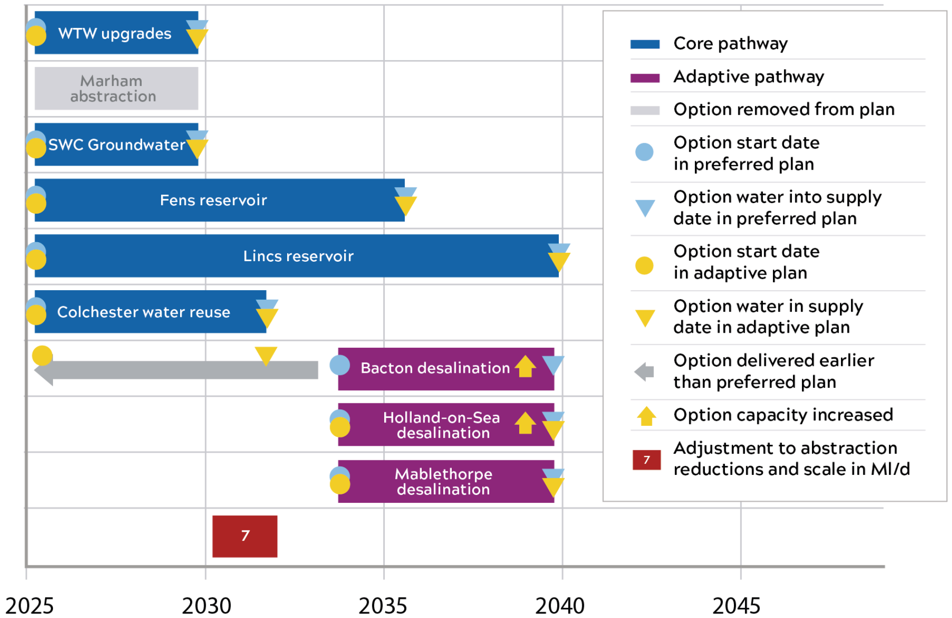


The interconnectors to Norfolk are required to meet time limited licence caps in 2030, but also to enable the closure of two of our sources from 2030 in relation to The Broads SAC review. No alternative options are available to make up the shortfall if the interconnectors are delayed, although it should be noted that there is uncertainty regarding The Broads SAC review that will only be resolved in 2024. We would investigate the feasibility of increasing demand management, in particular further leakage reduction. This may not be adequate to meet the full shortfall but if it was assessed as cost effective, it could reduce it. Therefore the delay creates a residual deficit which would require an adjustment to the licence caps.

10.1.6 Adaptive pathway 6: Marham abstraction is deemed unfeasible

We have been working closely with the Environment Agency to investigate relocating the abstraction point for our Marham water treatment works to another location on, or near, the River Nar. Work is ongoing to monitor flows to confirm the feasibility of this option. Therefore, we have developed an alternative adaptive pathway to show the impact if the ongoing investigations into Marham abstraction (FND22) concluded the option was unfeasible; this is shown in Figure 125.

Figure 125 Adaptive pathway 6 diagram - if Marham abstraction is deemed unfeasible



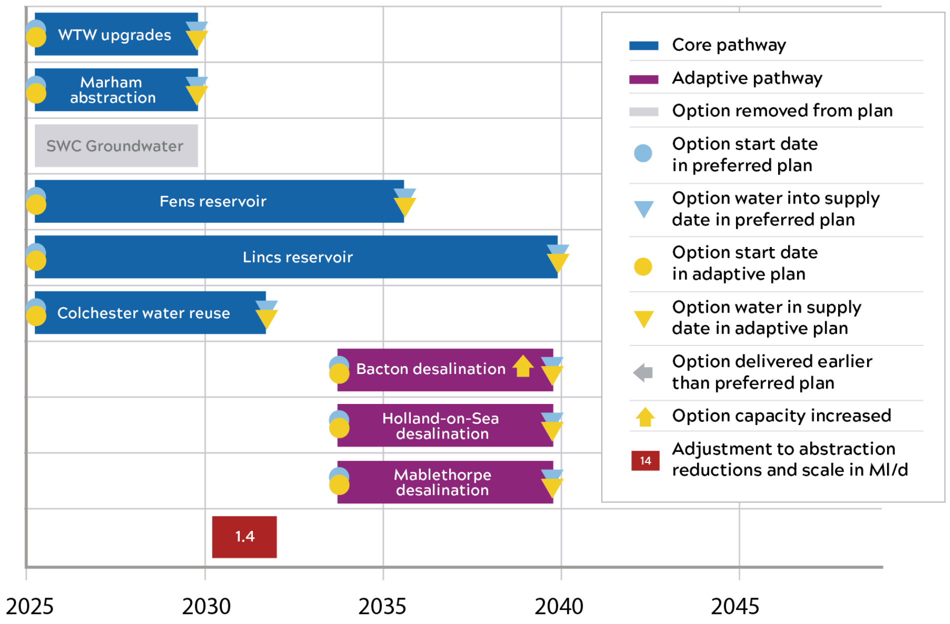
We do not have any other options that we can deliver within AMP8 if the Marham abstraction scheme is removed from the plan. We would have to switch over to developing the Bacton desalination option in AMP8, rather than starting it in AMP9 as in the preferred plan. However, the earliest this could be delivered is 2032, which will leave two years with residual deficit which would have to be met by an adjustment to the licence caps. To make up the long-term shortfall in resource the capacity of the desalination plants will need to be increased, this requires Bacton to increase to 35Ml/d and Holland on Sea to 30Ml/d.

There could be opportunity to either phase the increased capacity at Bacton by delivering 15Ml/d from 2032 and then developing the full capacity in 2040. Or this could be an opportunity to deliver more abstraction licence reductions earlier using the surplus from a larger plant earlier on in the plan.

10.1.7 Adaptive pathway 7: Suffolk West and Cambs groundwater is deemed unfeasible

The Suffolk West & Cambs WRZ groundwater option (SWC13) requires a new borehole to be relocated to allow us to continue using the licence. Following liaison with the Environment Agency we are conducting studies to establish the impact on the headwaters. If this work concludes that the option is not feasible we have developed an adaptive pathway, shown in Figure 126.

Figure 126 Adaptive pathway 7 diagram - if Suffolk West & Cambs groundwater is deemed unfeasible



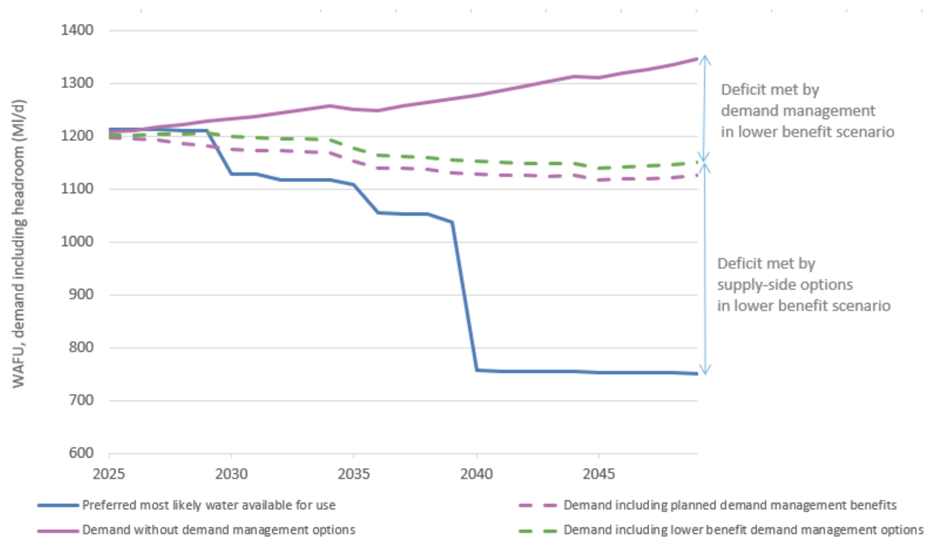
As the Suffolk West & Cambs groundwater options is required in AMP8 we do not have an option to replace it with, which leaves a residual deficit between 2030-2032 that would have to be met by an adjustment to the licence caps. The option is small, and after 2032 the other options within the plan can make up the shortfall until 2040 when the desalination plants are required; at this stage we would need to increase the Bacton plant from 25Ml/d to 28Ml/d.

10.1.8 Adaptive pathway 8: Demand management is less effective than planned

This scenario assesses the impact to our preferred plan if the demand management portfolio does not deliver the benefits assumed for behavioural changes resulting from smart metering and Government-led interventions.

The scenario assumes the same roll out of smart meters, but a lower level of effectiveness at reducing demand. The change to the supply demand balance based on the preferred most likely scenario is shown in Figure 127.

Figure 127 Supply demand balance adaptive pathway 8 - if demand management is less effective than planned



The adaptive pathway diagram for this scenario is shown in Figure 128.

Figure 128 Adaptive pathway 8 diagram - if demand management is less effective than planned

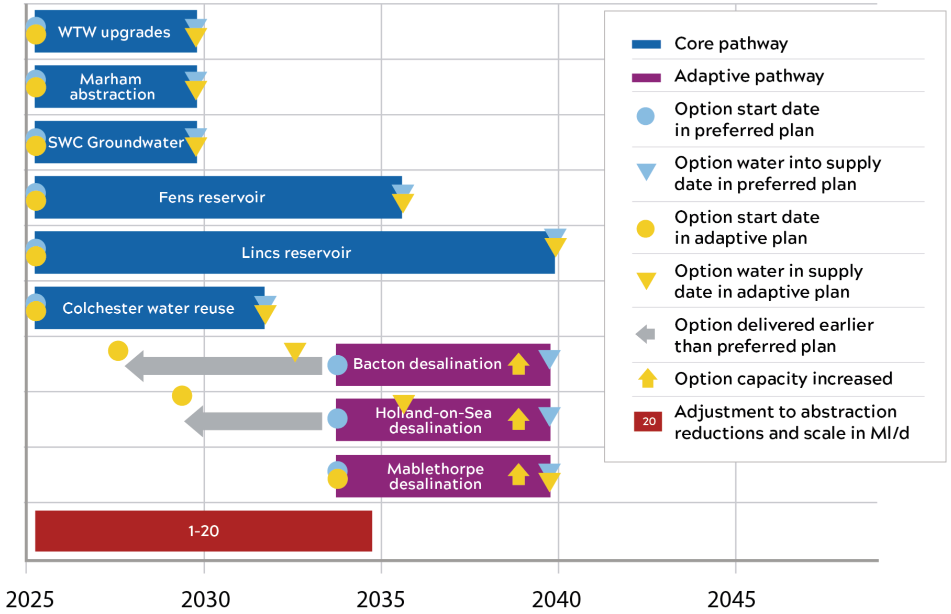


Figure 128 shows we would bring forward the development of the Bacton desalination option to start in AMP8, rather than starting AMP9 as in the preferred plan. This would require us to initiate design and develop the Bacton scheme in AMP8 to a stage where we can switch to actual construction and delivery earlier than the preferred plan through AMP9 transition funding if appropriate. The Holland on Sea desalination plant would need to be brought forward to commence at the end of AMP8, to tie in with WRMP29 and Price Review 2029 (PR29). All desalination plants would require an increase in capacity, with Bacton increasing to 45Ml/d, Holland on Sea increasing to 32Ml/d and Mablethorpe from 50Ml/d to 65Ml/d.

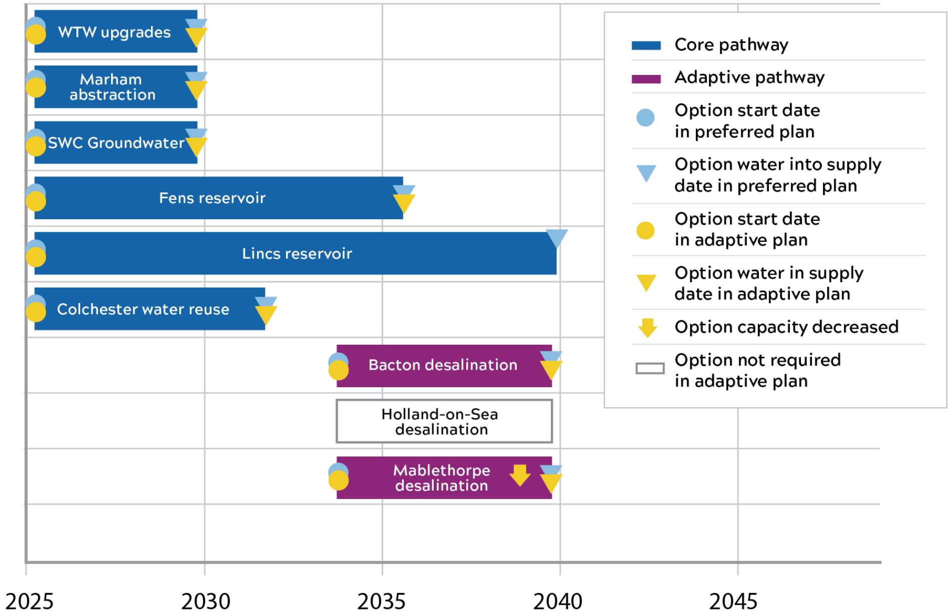
The demand management is a pivotal component of our preferred plan, especially early in the planning period when we have limited feasible supply-side options. If the benefits from the demand management options were lower, we would have residual deficits that would have to be met by an adjustment to the licence caps.

However, we would investigate the feasibility of increasing the leakage component of demand management strategy. This would not be adequate to meet the full shortfall, but would but reduce it, if it was assessed as cost effective.

10.1.9 Adaptive pathway 9: Change to deliver BAU scenario

Our preferred best value plan is based on delivering the BAU+ level of environmental destination by 2040. The plan includes a series of Environmental Destination investigations in the AMP8 Water Industry National Environment Plan (WINEP). The scope of these investigations is still to be finalised. It is likely they will involve more detailed modelling and assessment of the sensitive catchments where our groundwater abstractions are located. The outcome of the investigations will enable us to better understand the long-term sustainable abstraction requirements for the region, which will help to determine the strategic solutions and sustainability reductions required to deliver the Environmental Destination. Therefore, our plan needs to be able to adapt to meet the needs once confirmed by the investigations. Figure 129 shows the alternative adaptive pathway diagram for BAU.

Figure 129 Adaptive pathway 9 diagram - if we change to meet BAU scenario

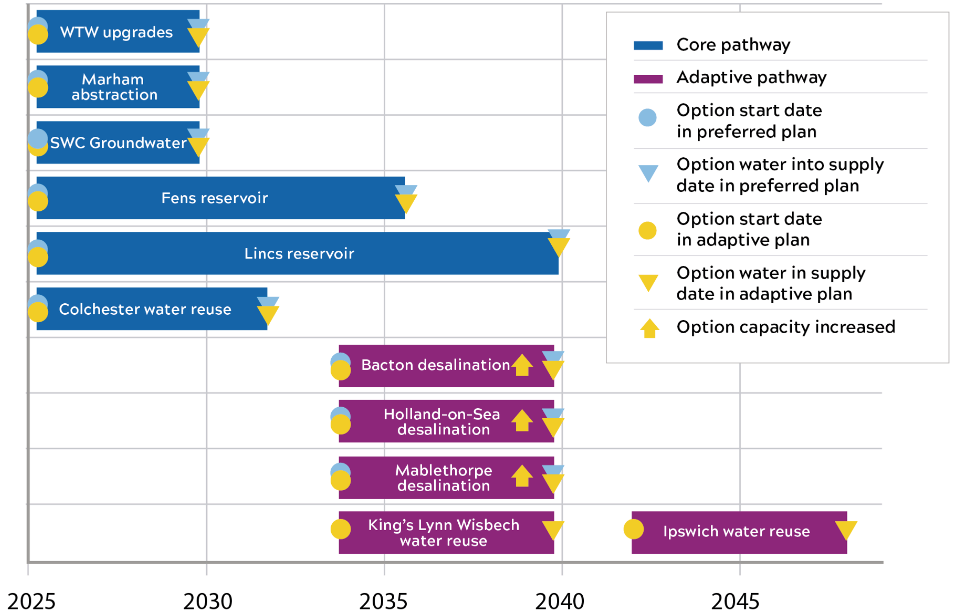


The BAU scenario requires less abstraction reductions compared to BAU+ used for our preferred best value plan. In this scenario we would not require the Holland on Sea desalination plant and we could reduce the capacity of Mablethorpe desalination from 50Ml/d to 25Ml/d.

10.1.10 Adaptive pathway 10: Change to deliver Enhance scenario

The Enhance scenario requires the largest scale of licence reductions. Figure 130 shows how the plan would respond to this, following the outcome of the WINEP investigations.

Figure 130 Adaptive pathway 10 diagram - if we change to meet Enhance scenario



The scale of the abstraction reductions is significantly higher for the Enhance scenario and we would need to increase the capacity of options within the preferred plan plus deliver additional options. Figure 130 shows that all three desalination options would need to be developed at a higher capacity, with Bacton at 50Ml/d and both Holland on Sea and Mablethorpe at 100Ml/d. We would also need to deliver two additional water reuse options at Kings Lynn/Wisbech and Ipswich.

10.2 Decision and trigger points

As part of the adaptive planning process we must decide upon the circumstances that would lead us to switch to an alternative adaptive pathway. Our plan must identify the following,

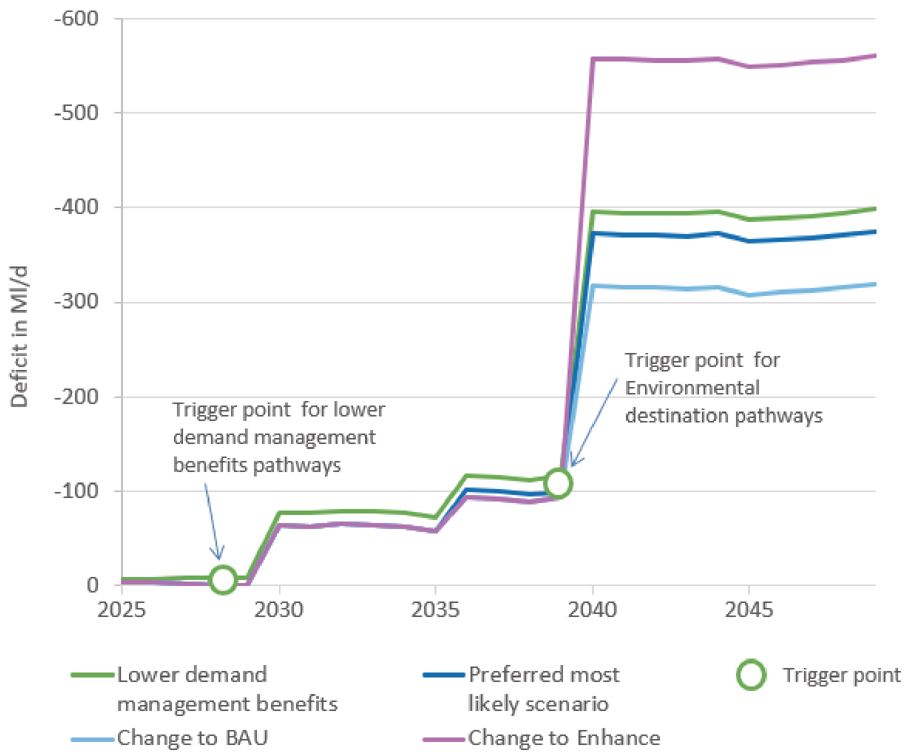
- **Trigger point:** the point by which an alternative adaptive pathway would need to be followed in order to cope with the changed circumstances
- **Decision point**: the point in time when a decision would need to be taken about whether an alternative adaptive pathway is to be triggered. This is either set at the same point in time as the trigger point, or in advance[57]

Our 10 alternative adaptive pathways,

- either follow the same supply demand balance as the preferred plan, but deliver the options in a difference sequence, such as the delivery risk pathways,
- or they are based on a different supply demand balance due to changes in forecast, such as the lower demand management benefits or the different environmental destination scenario.

Figure 131 shows the deficit created in each scenario and shows the trigger point for the pathways based on supply demand balance changes.

Figure 131 Supply demand deficits for scenarios



For the delivery risk pathways the trigger point is linked to when we need to switch to deliver alternative option or option capacity. The decision point is linked to delivery timescales for options. Table 45 summarises the decision and trigger points for adaptive pathways.

57 PR24 and beyond: Final guidance on long-term delivery strategies, Ofwat, April 2022

Table 45 Summary of pathways

Ref	Adaptive pathway name	Why is it a risk?	What are doing to address risk?	When will we know that the risk is likely to occur?	Decision point	Trigger point
1	Preferred best value plan	The scale and location of environmental destination not confirmed	AMP 8 WINEP investigations, these investigations will further our understanding of the scale of deficits required to deliver the environmental destination and therefore could influence our plan from 2040	2027 to inform WRMP29	2029	2040
2	Fens reservoir was delivered late	Large complex scheme. Part of the Environmental Impact Assessment, environmental monitoring may flag previously unknown risks that could cause delays to delivery.	Stakeholder engagement through RAPID - Cross regulator buy-in to project early warnings Monitoring as part of environmental impact assessment Monitor any potential delays during the construction phase	2026 to inform Gate 5 Revise triggers as part of WRMP29 informed by knowledge of construction phase	2029	2029
3	Lincolnshire reservoir was delivered late	Large complex scheme Part of the Environmental Impact Assessment, environmental monitoring may flag previously unknown risks that could cause delays to delivery.	Stakeholder engagement through RAPID - Cross regulator buy-in to project early warnings Monitoring as part of environmental impact assessment Monitor any potential delays during the construction phase	2026 to inform Gate 5 Revise triggers as part of WRMP29 informed by knowledge of construction phase	N/A as not changing plan	2040
4	Ruthamford South to Suffolk West and Cambs (via Cambridge Water) interconnector is late	Large complex scheme	Early engagement with delivery route to look at planning Monitor any potential delays during the construction phase	2024/25 Revise triggers as part of WRMP29 informed by knowledge of construction phase	2025	2025

Ref	Adaptive pathway name	Why is it a risk?	What are doing to address risk?	When will we know that the risk is likely to occur?	Decision point	Trigger point
5	The interconnectors to Norfolk are late	Large complex scheme	Early engagement with delivery route to look at planning Monitor any potential delays during the construction phase	2024/25 Revise triggers as part of WRMP29 informed by knowledge of construction phase	2025	2025
6	Marham abstraction is deemed unfeasible	Potential for the relocation of the abstraction point for our water treatment works could cause deterioration. Licence conditions imposed from Environment Agency/Natural England could restrict deployable output benefit from option	Working with the Environment Agency to understand operation of their assets. Programme of water quality sampling to understand the treatability of the raw water to progress detailed design	2024/5	2025	2025
7	Suffolk West & Cambs groundwater is deemed unfeasible	Not agreeing the licence and/or no certainty of how long we could retain the licence	Study, monitoring. Preparing a report to present to EA to inform decision.	2024/5	2025	2025
8	Demand management is less effective than planned	We have based our demand forecast on the savings in AMP7, behavioural change in AMP8 could be different. We also include reductions due to Government led interventions, which are beyond our control.	Demand management monitoring programme. Update forecasts every 5 years as part of WRMP planning cycle.	2028 to inform WRMP29	2029	2029
9	Meet BAU scenario	The scale and location of environmental destination not confirmed	AMP 8 WINEP investigations, these investigations will further our understanding of the scale of deficits required to deliver the environmental destination and therefore could influence our plan from 2040	2028 to inform WRMP29	2029	2040

Ref	Adaptive pathway name	Why is it a risk?	What are doing to address risk?	When will we know that the risk is likely to occur?	Decision point	Trigger point
10	Meet Enhance scenario	The scale and location of environmental destination not confirmed	AMP 8 WINEP investigations, these investigations will further our understanding of the scale of deficits required to deliver the environmental destination and therefore could influence our plan from 2040	2028 to inform WRMP29	2029	2040

10.3 Monitoring plan

We develop a monitoring plan to provide us with the information to make decisions on which future pathway we need to follow. Our monitoring uses some of the metrics developed in best value planning framework and allows us time to make decisions.

Though our plan is adaptive to future uncertainty it is relatively simple in terms of decision and trigger points. The decision points will form part of the five year cycle of water resource planning and feature in WRMP29 and WRMP34. This process will include updates to forecasts for external influences such as population growth and climate change.

The WINEP investigations in AMP8 will provide the clarity on the scale and location of environmental destination. The output from these will be captured in WRMP29.

We will continue to monitor and assess the effectiveness of demand management strategy throughout AMP8, the findings will be reflected in our WRMP29 update to the plan. Our 'Demand Management Monitoring Framework' will allow us to:

- Investigate and understand our customers' consumption patterns andattitudes to water consumption, allowing us to model our baselinepopulation and understand how demographic change will modifyforecasts over time.
- Scientifically analyse the demand management portfolio to ensure ourwater efficiency teams are concentrating on the most effective optionsand targeting them at customers who will benefit the most.
- Model and test demand management options, so they can be realisticallyincluded in our future forecasts for WRMP29 and beyond.

For further details on the Demand Management Monitoring Framework, refer to the Demand Management Preferred Plan technicalsupporting document, section 13.4.

We will report on monitoring these factors as part of the WRMP annual review process.

11 Final alignment with other plans

Our regional plans and strategic options are developed in parallel with our WRMP and the other water company WRMPs. We have ensured alignment through a series of regular sessions with all the water companies within the regional plan, in particular through weekly meetings to discuss modelling between companies and at regional level.

Developing these plans is an iterative process and there are clear links where plans have shaped each other, see Section 6.

11.1 Regional plans

Our WRMP reflects the regional plans, which were published in December 2023.

11.1.1 Water Resources East (WRE)

The Environment Agency requires water resources plans to use the BAU+ environmental destination scenario as the most likely scenario and regional plans adopted this as the core scenario for inter-regional reconciliation. For our policy decision modelling we completed our own assessment of the costs and benefits of the level and timing of environmental destination to determine our most likely scenario, see Section 5. This concluded that BAU+ profiled by delivering higher-priority water resource zones earlier should form our initial most likely scenario, reflecting the regional plan.

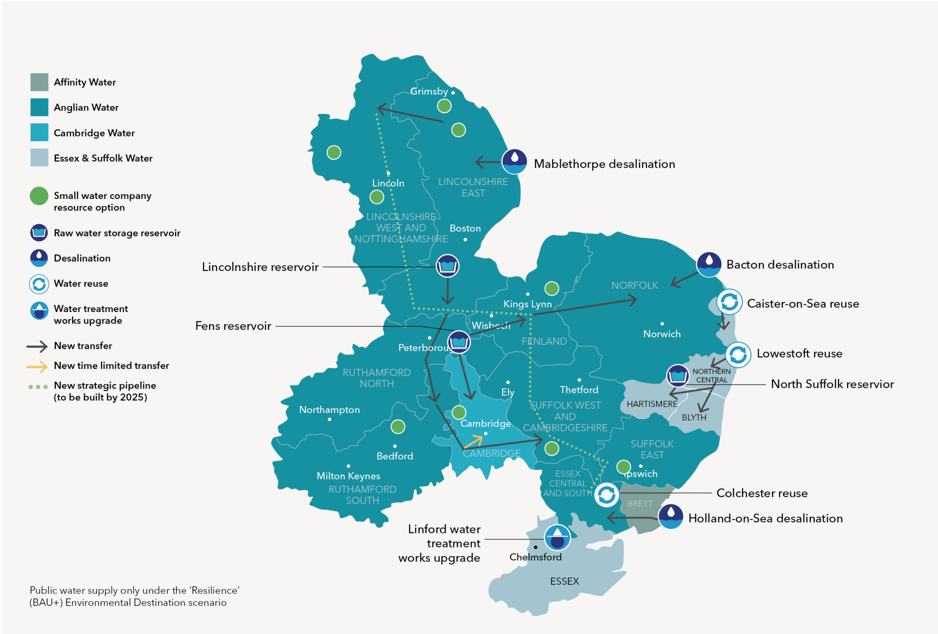
All our alternative plans incorporate the WRE low regret solutions, the two SRO reservoirs. However, we have also verified that these options are included in unconstrained least cost runs, see Section 6.1.

Our WRMP modelling has identified when the reservoirs are required to meet the needs of the supply demand balance. This has been fed back into WRE to ensure alignment with regional and other companies' needs.

The other supply-side options within our WRMP reflect the regional plan, though the capacities of options may vary slightly, see Figure 132.

The transfer network within our best value plan reflects the regional plan. However, for WRE we use different scale water resource zones, see Section 4.13, which means some of the regional transfers are represented in our WRMP as a series of smaller schemes needed for local distribution. This is most notable in Norfolk.

Figure 132 Regional Water Resources Plan for Eastern England



11.1.2 Water Resources North (WReN)

Our Hartlepool water resource zone falls within the WReN regional plan and is totally discrete with no connectivity to other supply systems. It does not go into deficit over the planning period and the surplus is not significant enough to develop trading opportunities with neighbouring companies.

11.2 Strategic Resource Options (SROs)

The strategic resource options (SROs) are developing in parallel and will be publishing their Gate 3 submissions in September 2024. We have used interim data developed from Gate 2 but updated with new hydrological data and design developments for costs, delivery dates and benefits in our decision making. For most model runs to develop and test plans the SROs were modelled as 'unconstrained. The interim data provides consistency with the basis of the cost for the non-SRO options.

All the alternative plans we have assessed contain the two SRO reservoirs and therefore revised costs will not affect the comparison of relative differences.

The timing of when the SROs are needed within our plan is linked to capping licences and environmental destination reductions (see 10). If the SROs delivery programme were extended this would mean postponing some of these abstraction reductions.

11.3 Cambridge Water

The SRO Fens Reservoir, is being developed in partnership with Cambridge Water. The scheme is being developed so that we share the resource proportionally. From our modelling a 50MCM reservoir has been selected which allows the resource to be shared equally between companies. To reflect this, we have modelled the costs and benefits for the Fens reservoirs as 50% of the total. Our plan requires the Fens reservoir in 2036 which aligns to Cambridge Water's needs.

The route of one of our transfer options goes via Cambridge Water's system. This provides a resilience link or opportunity to support Cambridge Water ahead of Fens reservoir being available, using spare capacity within the new transfer. This would be dependent on Affinity Water's Grand Union Canal scheme. The full capacity option is to be delivered in 2032 which will temporary reduce their need to fully utilise the transfer from our Grafham water treatment works. The surplus at Grafham can then be transferred onto Cambridge Water via the surplus capacity in our pipeline.

Cambridge Water have confirmed that they require this transfer as soon as it would be available. We have included the elements to enable the trade in the supporting WRMP data tables.

We will continue to work with Cambridge Water on development of the potential Milton water reuse scheme.

11.4 Essex and Suffolk Water

The Lowestoft water reuse scheme features in the regional plan and Essex and Suffolk Water's option set. This scheme is selected in their modelling and is closer to their demand needs compared to our option of transferring it onto Norwich. However this option has not been selected in our plan.

Essex and Suffolk Water's plan selects Lowestoft reuse in 2032, whereas our plan does not require an option in the Norwich and the Broads WRZ until 2040, when Bacton desalination plant is triggered by the needs of environmental destination. Therefore, it is not expected that the option will be available to us once the scale of supply reductions needed is confirmed by the WINEP investigations as part of WRMP29. We will continue to work with Essex and Suffolk Water through the regional plan and final WRMPs to align strategies.

11.5 Affinity Water

The Lincolnshire Reservoir was initially developed in partnership with Affinity Water, but as both the regional and Affinity Water's needs were confirmed it was mutually agreed that the entire benefit from the new resource was required within the WRE plan and that Affinity Water preferred to receive water from other SROs.

We operate a shared water treatment works in our Essex South water resource zone with Affinity Water, this is based on an agreement to operate at 50:50 split from 2025. The Colchester water reuse option in our plan uses existing capacity at the treatment works which cannot be fully utilised due to reductions in reservoir yield from climate change, supply licence reductions and drought resilience. The treated water from our water recycling centre will make up this shortfall in raw water. This scheme will only benefit Anglian Water customers and it has been agreed with Affinity

Water that they will continue taking 50% of the equivalent volume based on the yield of the reservoir before the water reuse scheme is implemented.

To support the Cambridge Water regional option to use surplus capacity from the GUC scheme we have reduced our transfer to Affinity Water from our Ruthamford South water resource zone to reflect the onward transfer into Cambridge.

12 Summary of our best value plan

Our best value plan, Plan B, offers the best balance of cost, resilience, adaptability and environmental improvements and excludes the highest environmental risk options. It has been shaped by our customer and stakeholder engagement and reflects the regional plan, aligning and supporting other neighbouring water company plans.

It is based on a three-tier strategy:

1. **Making best use of existing resources,** through demand management, upgrades to existing water treatment works, a new water reuse facility and an extension to the transfer network to move resource to areas in need.
2. **Strategic water resource options**, development of two new reservoirs to provide a robust, secure supply of water whilst creating recreational and social benefits.
3. **Adaptive future resources,** by using the WINEP investigations to confirm the location and scale of environmental destination, we can ensure we only develop new resources sized to meet the need.

Our demand management strategy includes actions for our discrete Hartlepool zone which will remain in surplus over the planning period.

Figure 133 shows a schematic of the supply options that form our best value plan and when they are required. A description of how the strategy would be implemented over the planning horizon is shown in Figure 134.

Figure 133 Schematic of best value plan

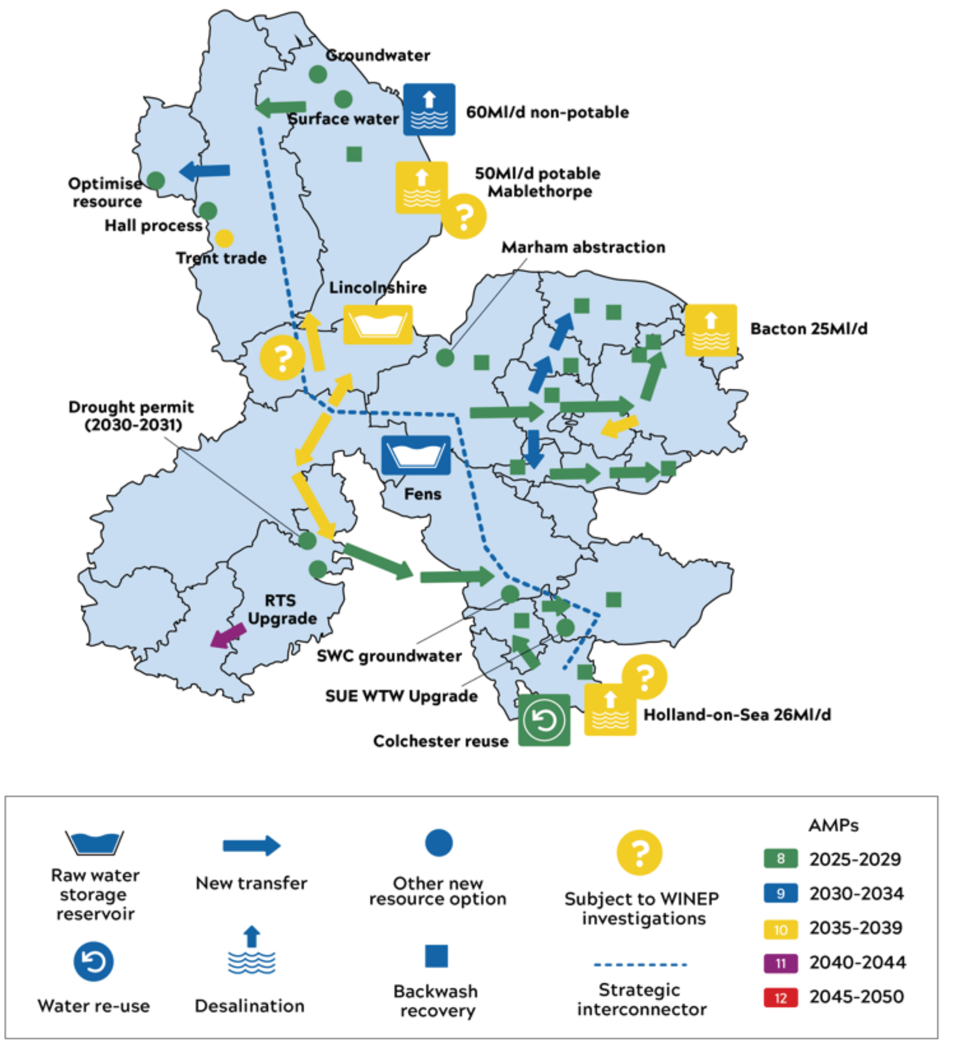
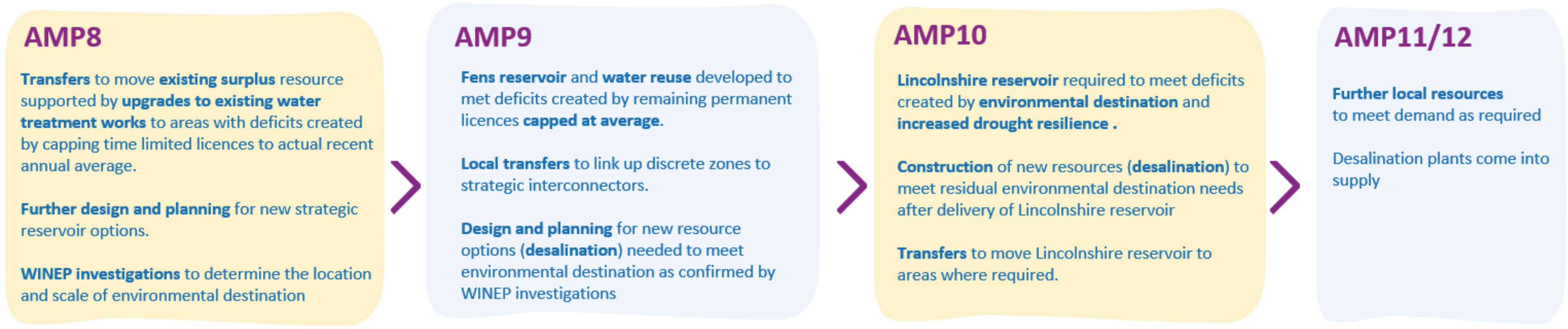


Figure 134 Best value plan - a multi-AMP strategy



Appendix A: Best value planning framework

Our best value framework is based on the objectives of what we would like our plan to achieve.

The framework is built around the concepts of outcomes, objectives, criteria, and metrics as set out in the guidance[58,59]. Our objectives are aligned with our company strategic outcomes, which have been developed based on the views of our customers, and are aligned to UN Sustainable Development Goals[60].

Beneath the objectives sit the criteria we use to demonstrate the extent to which we have achieved objectives. These criteria are either applied at plan level or at individual option level. We use a range of metrics which are the specific measure to evaluate the criteria. These can be quantities, monetised values or qualitive assessments and provide a measure of how much value is delivered.

Each programme of options or plan must meet certain legal and regulatory requirements and we define these criteria as a constraint. Other criteria provide opportunities for delivering additional value, which we describe as optimised criteria. These are used as part of our modelling process to directly test and develop alternative programmes. Where criteria are measured based on model outputs, we term them tracked. See Box 17 for definitions used with in our best value planning frameworks.

We have developed a broad range of objectives criteria and metrics suitable for assessing and understanding the differences between plans.

Box 17: Definitions used in best value planning framework

Outcomes for our plan: The consequences of achieving our objectives, these are aligned to our strategic Outcomes to Customers, such as a 'Flourishing Environment'

Objectives of our plan: These are the specific goals of our Best Value Plan, such as 'A plan that is affordable and sustainable over the long-term'

Criteria: These are used to demonstrate the extent to which we have achieved objectives. These criteria are either applied at plan level or at individual option level.

Constraint criteria: Criteria required to meet legal and regulatory requirements.

Optimised criteria: These are the criteria that provide opportunities for delivering additional value used as part of our modelling process.

Tracked criteria: Criteria based on model outputs.

Metrics: the specific measure to evaluate the criteria.

Options metrics: these metrics are assigned to individual options.

Programme metrics: these metrics are applied to the scenario being tested. They are associated with the model input data such as the supply forecast and are used to understand the differences between scenarios, for example these show differences in abstraction reductions between plans.

58 Water Resources Planning Guideline (WRPG), March 2023
59 UKWIR (2020) Deriving a Best Value Water Resource Management Plan
60 Anglian Water Services Limited Strategic Direction Statement 2020-2045

Table 46 Outcome: Supply meets demand

Objective	Value Criteria	Criteria Type	Metric	Metric type	Good outcome	Further information
Deliver a secure and wholesome supply of water to our customers	Meet the supply demand balance	Constraint	Residual deficit (Ml/d)	Programme	No residual deficit.	All viable programmes must not have deficits in over the 25 year planning period. This is a legal requirement.
	Meet the needs of future NHH customers	Tracked	Extent to which future NHH demand is built into the forecast	Programmes	Agreed approach with relevant stakeholders.	60 Ml/d demand included in South Humber Bank for future Hydrogen and Carbon capture development.
Optimise our available resource	Leakage reduction	Tracked	Water UK Public Interest Commitment (PIC) target: triple rate of sector wide leakage reduction by 2030[61] (Ml/d) National Infrastructure Commission (NIC) target: sector wide 50% reduction in leakage by 2050 from a 17/18 baseline (Ml/d)	Programme	Achieve sector-wide targets: PIC: 1767 Ml/d leakage sector-wide by 2030 67.96 l/prop/day 5.37 m3/km/day NIC: 1539 Ml/d leakage sector-wide by 2050 55.51 l/prop/day 4.39 m3/km/day	See demand management report for further details.
	PCC reduction	Tracked	PCC (litres/person/d).	Programme	National framework target of 110 l/h/day	See demand management report for further details.
	Raw water/ process loss reduction	Tracked	Quantity of water from options which reduce raw water losses (Ml/d)	Options	Higher	
Deliver a secure and wholesome	Non-public water supply demand (e.g. Agriculture and Energy sectors)	Optimise	Future demand of non-public water supply users included in the programme (yes/ no)	Programme	Include outcomes of regional plan.	Outcomes of WRE process included. Test impact of alternative WRE solutions on PWS

61 Water UK (2019) Public Interest Commitment

Objective	Value Criteria	Criteria Type	Metric	Metric type	Good outcome	Further information
supply of water to other sectors.						

Table 47 Outcome: Fair charges, fair returns

Objective	Value Criteria	Criteria Type	Metric	Metric type	Good outcome	Further information
A plan that is affordable and sustainable over the long term	Programme cost	Optimise	Capex, Opex and Totex (£)	Options/ Programme	Lower	
		Tracked	Average household bill impact 2025-50 (£/year)	Options/ Programme	Lower	Our model to estimate the household bill impact, uses the methodology set out in Ofwat's Long Term Delivery Strategy guidance[62].
	Intergenerational equity	Tracked	Ratio of Totex in last 10 years of plan (2040-50) to first 10 years (2025-35)	Programme	Balance of costs and benefits aligned	Internal discussions ongoing to align this approach with PR24 process.
		Tracked	Ratio of household bill impact in last 10 years of plan (2040-50) to first 10 years (2025-35)	Programme	Balance of costs and benefits aligned	

Table 48 Outcome: Flourishing Environment

Objective	Value Criteria	Criteria Type	Metric	Metric type	Good outcome	Further information
Deliver long-term environmental improvement	Strategic Environmental Assessment (SEA)	Tracked	SEA Positive Construction (Score)	Options	Higher	As part of SEA assessment all options are scored according to their positive and negative construction and operation impacts. We have screened criteria to avoid double counting. We will also present summarised overall benefits and disbenefits.
		Tracked	SEA Negative Construction (Score)		Less negative	

62 Ofwat (2022) PR24 and beyond: Final guidance on long-term delivery strategies (Page 66)

Objective	Value Criteria	Criteria Type	Metric	Metric type	Good outcome	Further information
		Tracked	SEA Positive Operation (Score)		Higher	
		Tracked	SEA Negative Operation (Score)		Less negative	
	Natural capital	Tracked	Natural capital ecosystem services (£/year)	Options	Higher benefit or lower impact	An annualised financial value of environmental harm / gain generated from the assessment of the following ecosystem services: carbon sequestration, natural hazard management, air pollution prevention, and food production. Results can be positive or negative.The results at portfolio level have been presented as total cost profiled over the 25 year planning horizon.
	Biodiversity	Tracked	Habitat units requiring restoration (habitat units)	Options	Lower	Following BNG metric 3.0[63] The metric measures the total amount of biodiversity which must be created after scheme construction to achieve Biodiversity Net Gain 10%. The metric is a sum of the compensatory units to replace any impact of the scheme and the additional units required to achieve 10% BNG.
			Biodiversity Net Gain compensatory units only	Options	Lower	This metric measures the amount of habitat that is lost and must be replaced as a result of a new option.
			Biodiversity Net Gain 10% Net Gain (Habitat Units)	Options	Higher	This measures the additional habitat units that will be created to achieve 10% net gain, once the scheme is developed.
	Abstraction reduction	Constraint	Reduction in total volume of water abstracted from	Programme	Higher	Metric dependent on selected Environmental Destination scenario.

63 Natural England (2021) The Biodiversity Metric 3.0 (JP039)

Objective	Value Criteria	Criteria Type	Metric	Metric type	Good outcome	Further information
			sensitive environments by 2050 (Ml/d)			
		Tracked	Average reduction in the volume of water abstracted 2025 to 2050 (Ml/d)	Programme	Higher	This metric captures variation in Environmental ambition. Programmes where abstraction reductions are implemented earlier in the planning horizon will perform better.

Table 49 Outcome: A smaller footprint

Objective	Value Criteria	Criteria Type	Metric	Metric type	Good outcome	Further information
Deliver long-term environmental improvement	Carbon	Tracked	Capital carbon and operational carbon (tCO2e) and operational energy use (kw/h)	Options	Lower	Total tCO2e will be used as a differentiator metric between portfolios. We will also assess the distribution of carbon emissions over time within portfolios in further detail, considering company strategies and commitments to reducing operational and capital carbon.
		Tracked	Monetised change in greenhouse gas emissions (£)	Options	Lower	We will present the monetised change in greenhouse gas emissions resulting from portfolios following BEIS methodology[64]. This will be adjusted to consider company operational carbon strategies and opportunities to reduce capital carbon.

64 Department for Business, Energy & Industrial Strategy (2021) Valuation of greenhouse gas emissions: for policy appraisal and evaluation

Table 50 Outcome: Positive impact on communities

Objective	Value Criteria	Criteria Type	Metric	Metric type	Good outcome	Further information
A plan that supports the views of regional stakeholders and water companies' customers and is not detrimental to social wellbeing	Recreation benefit	Tracked	Recreation benefit (£/ year)	Options	Higher	Information extracted from Natural Capital Ecosystem services report. Double counting avoided. The Gateway 1 SRO ecosystem services assessment values for the Lincolnshire Reservoir have been used as a proxy for recreation benefit within the WRMP. More detailed quantitative assessment of recreation benefits from the SRO options is still being developed as part of the RAPID process. Wider customer and stakeholder views have been incorporated into the development of our Best Value Plan, see decision making method report.
A plan that supports the views of regional stakeholders and water companies' customers and is not detrimental to social wellbeing	Customer preference	Tracked	Customer preference (qualitative assessment)	Portfolio	Portfolio aligns with customer preferences	Portfolios of options were qualitatively evaluated for alignment with customer preferences (as identified through our qualitative and quantitative customer engagement activities).

Table 51 Outcome: Investing for tomorrow

Objective	Value Criteria	Criteria Type	Metric	Metric type	Good outcome	Further information
A plan which can adapt to future uncertainty	Adaptability	Tracked	Least Worst Regret (£)	Portfolio	Less regret	Least Worst Regret analysis carried out to measure ability of alternative portfolios to adapt to stress test scenarios. Regret is measured as additional cost compared to the minimum cost a portfolio requires to adapt to a scenario.
A plan which can adapt to future uncertainty	Adaptability	Tracked	Adaptive pathways assessment	Portfolio	Able to adapt to a range of future uncertainties	Portfolio adaptability evaluated using stress test scenarios.

Table 52 Outcome: Resilient Business

Objective	Value Criteria	Criteria Type	Metric	Metric type	Good outcome	Further information
Increase the resilience of our water systems	Drought Resilience	Constraint	Achieve 1 in 500-year drought resilience (date achieved)	Portfolio	Delivery of 1 in 500 drought resilience	All portfolios must achieve 1:500 drought resilience by 2040.
		Tracked	Years of additional 1:500 drought resilience compared to baseline.	Portfolio	More additional years	To test the impact of delivering drought resilience earlier than 2040 we will develop portfolios with alternative timings.
		Tracked	LoS failures (WRE simulator metric)	Portfolio	Comparable LoS metrics to WRE	Not included in WRMP24 assessment.
	Options scalability	Tracked	Qualitative assessment of option scalability.	Options	Opportunities for scalability included in the programme.	Some options such as desalination options can developed as scalable modules, whereas others, such as, reuse cannot. Scalable options offer greater flexibility to adapt to uncertain future scenarios.
	Options diversity	Tracked	Quantify % of Water Available Use benefit attributed to each option type. Utilise the Shannon Index to convert into a single diversity metric.	Options	More diversity is preferable	A metric to assess the diversity of new resource options selected by portfolio. Diversity increases resilience by distributing risk.
	Options deliverability	Tracked	Delivery risk index	Portfolio	Lower risk index score	An index calculated by counting the number of schemes within each portfolio where the delivery date matches earliest possible start date and multiplying by the scheme WAFU.
			Number of schemes identified as having potential delivery complexities associated with environmental risks.	Options	Lower	Each of these factors decrease the likelihood of the portfolio being able to deliver schemes in time to achieve required outcomes.

Objective	Value Criteria	Criteria Type	Metric	Metric type	Good outcome	Further information
			Number of schemes likely to be subject to Direct Procurement for Customers (DPC)	Options	Lower	
			Number of schemes likely to require Development Consent Orders (DCO)	Options	Lower	
	Single source of supply	Tracked	Change to % of population supplied by a single source	Options	Lower % of population on a single source of supply.	We have used the PR19 metric however this will be not be included in PR24.

Appendix B: Alternative plans details

Plan A - Option details

Figure 135 Plan A: Initial least cost plan based on the initial most likely scenario

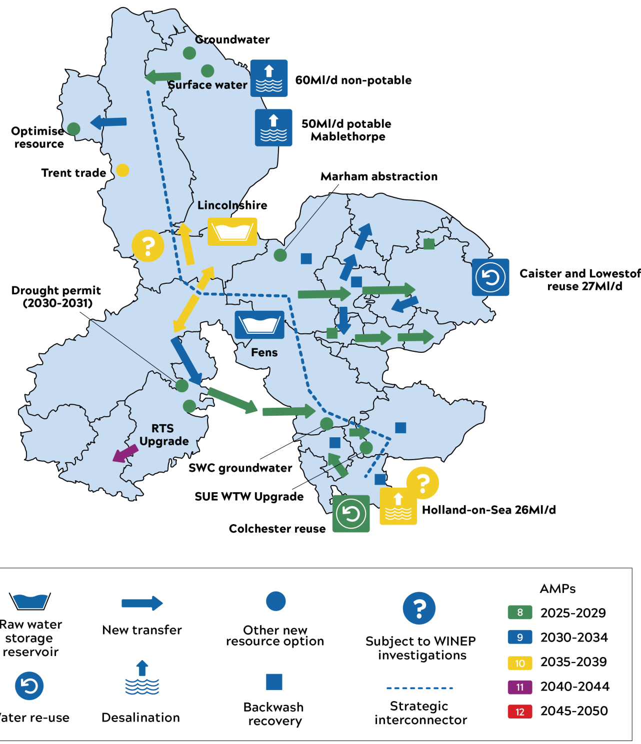


Table 53 Plan A new resource options

Year Selected	Water resource zone	Option Ref	Option name	Capacity of option (Ml/d)	Option type
2030	Fenland	FND22	Marham Abstraction	7.9 up to 2039, 12.3 after 2039	Upgrade to existing treatment works
2030	Lincolnshire East	LNE11	Lincolnshire East Groundwater	7.5	Upgrade to existing treatment works
2030	Lincolnshire East	LNE12	Lincolnshire East Surface Water	13 before 2039, 7.3 after 2039	Upgrade to existing treatment works
2030	Lincolnshire Retford & Gainsborough	LNN3	Lincolnshire Retford & Gainsborough WTW Upgrade	0.7	Upgrade to existing treatment works
2030	Norfolk Aylsham	NAY5	Backwash water recovery, Essex Central WTW	0.1	Backwash recovery
2030	Ruthamford South	RTS16	Ruthamford South Drought Permit	2.1	Drought permit
2030	Ruthamford South	RTS21	Ruthamford South WTW Upgrade	9.5 up to 2039, 6Ml/d after 2039	Upgrade to existing treatment works
2030	Suffolk East	SUE23	Suffolk East WTW Upgrade	1.7	Upgrade to existing treatment works
2030	Suffolk Thetford	SUT6	Backwash water recovery, Suffolk East WTW	0.1	Backwash recovery
2030	Suffolk West Cambs	SWC13	Suffolk West Cambs new Groundwater Source	2.6	New borehole and treatment
2032	Essex Central	EXC7	Backwash water recovery, Essex Central WTW	0.3	Backwash recovery
2032	Essex South	EXS7	Backwash water recovery, Essex South WTW	0.3	Backwash recovery
2032	Fenland	FND26	Backwash water recovery, Fenland WTW	0.2	Backwash recovery
2032	Norfolk Bradenham	NBR9	Backwash water recovery, Norfolk Bradenham WTW	0.2	Backwash recovery
2032	Suffolk East	SUE25	Backwash water recovery, Suffolk East WTW	0.2	Backwash recovery
2033	Essex South	EXS19	Colchester WRC direct to Ardleigh Reservoir (no additional treatment)	11.4 up to 2039, 13.9Ml/d after 2039	Water Reuse
2036	Lincolnshire Central	LNC28	Bulk trade agreement - River Trent	7.0	Trade
2036	Lincolnshire East	LNE6	Mablethorpe desalination Seawater (50 Ml/d)	50.0	Desalination

Year Selected	Water resource zone	Option Ref	Option name	Capacity of option (Ml/d)	Option type
2036	Norfolk Norwich & the Broads	NTB28	Lowestoft and Casiter reuse combined (to Costessey) - treatment	27.5	Water Reuse
2036	South Humber Bank	SHB9	South Humber Bank Non-potable desalination (60 Ml/d)	60.0	Desalination
2036	Fenland	FND29	Fens reservoir high yield 50MCM	44.4	New Reservoir
2039	Ruthamford North	RTN17	Lincolnshire reservoir 50MCM	169.0	New Reservoir
2040	Essex South	EXS10	Holland on Sea desalination seawater (26 Ml/d)	26.0	Desalination

Table 54 Plan A transfers

Year Selected	Water resource zone	Option Ref	Option name	Capacity (ml/d)
2030	Cambridge	CAM4	Ruthamford South to Cambridge Potable Water Transfer (50 Ml/d)	50
2030	Lincolnshire Central	LNC25	Lincolnshire East to Lincolnshire Central Potable Water Transfer (29 Ml/d)	29
2030	Essex Central	EXC3	Essex South to Essex Central Potable Water Transfer (10 Ml/d)	10
2030	Norfolk Bradenham	NBR6	Fenland to Norfolk Bradenham Potable Water Transfer (45 Ml/d)	45
2030	Norfolk East Harling	NEH3	Suffolk Thetford to Norfolk East Harling Potable Water Transfer (5 Ml/d)	5
2030	Norfolk Harleston	NHL4	Norfolk East Harling to Norfolk Harleston Potable Water Transfer (5 Ml/d)	5
2030	Norfolk Norwich & the Broads	NTB10	Norfolk Bradenham to Norfolk Norwich & the Broads Potable Water Transfer (20 Ml/d)	20
2030	Suffolk East	SUE24	Suffolk Sudbury to Suffolk East Potable Water Transfer (5 Ml/d)	5
2030	Suffolk West Cambs	SWC8	Cambridge to Suffolk West Cambs Potable Water Transfer (50 Ml/d)	50

Year Selected	Water resource zone	Option Ref	Option name	Capacity (ml/d)
2036	Lincolnshire Retford & Gainsborough	LNN1	Lincolnshire Central to Lincolnshire Retford & Gainsborough Potable Water Transfer (3 Ml/d)	3
2036	Norfolk East Dereham	NED2	Norfolk Bradenham to Norfolk East Dereham Potable Water Transfer (10 Ml/d)	10
2036	Norfolk North Coast	NNC4	Norfolk East Dereham to Norfolk North Coast Potable Water Transfer (10 Ml/d)	10
2036	Norfolk Wymondham	NWY1	Norfolk Norwich Broads to Norfolk Wymondham Potable Water Transfer (5 Ml/d)	5
2036	Ruthamford South	RTS24	Ruthamford North to Ruthamford South Potable Water Transfer (75 Ml/d)	75
2036	Suffolk Thetford	SUT5	Norfolk Bradenham to Suffolk Thetford Potable Water Transfer (10 Ml/d)	10
2039	Ruthamford North	RTN29	Ruthamford North to Ruthamford North Potable Water Transfer (60 Ml/d)	60
2040	Lincolnshire Bourne	LNB1	Ruthamford North to Lincolnshire Bourne Potable Water Transfer (20 Ml/d)	20
2040	Lincolnshire Central	LNC16	Ruthamford North to Lincolnshire Central Potable Water Transfer (20 Ml/d)	20
2042	Ruthamford Central	RTC3	Ruthamford South to Ruthamford Central Potable Water Transfer (20 Ml/d)	20

Plan B - Option details

Figure 136 Plan B: Alternative plan based on preferred most likely scenario

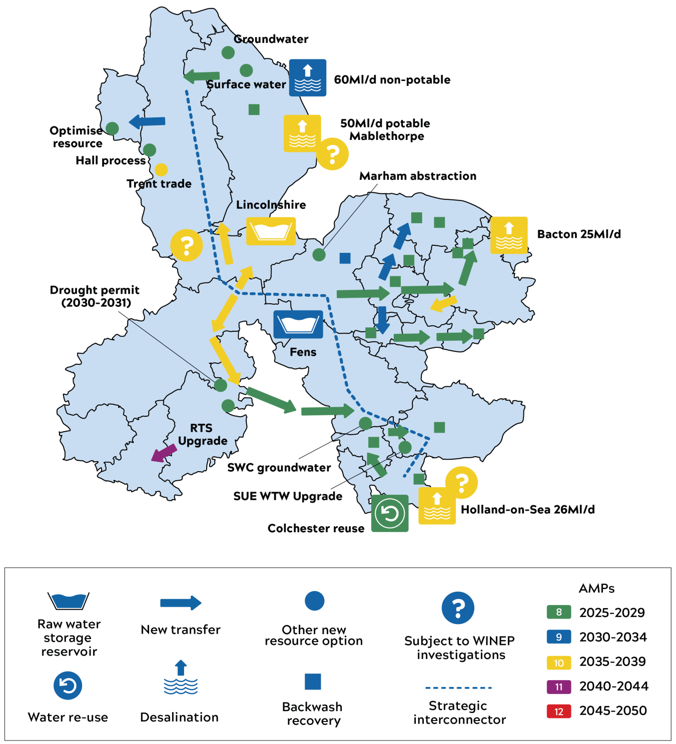


Table 55 Plan B new resource options

Year Selected	Water resource zone	Option Ref	Option	Capacity (Ml/d)	Option type
2030	Essex Central	EXC7	Backwash water recovery, Essex Central WTW	0.3	Backwash recovery
2030	Fenland	FND26	Backwash water recovery, Fenland WTW	0.24	Backwash recovery
2030	Fenland	FND22	Marham Abstraction	7.9 up to 2039, 12.3 after 2039	Upgrade to existing treatment works
2030	Lincolnshire Central	LNC30	Lincolnshire Central WTW Upgrade	3.2	Upgrade to existing treatment works
2030	Lincolnshire East	LNE11	Lincolnshire East Groundwater	7.5	Upgrade to existing treatment works
2030	Lincolnshire East	LNE12	Lincolnshire East Surface Water	13 before 20309, 7.3 after 2039	Upgrade to existing treatment works
2030	Lincolnshire Retford & Gainsborough	LNN3	Lincolnshire Retford & Gainsborough WTW Upgrade	0.72	Upgrade to existing treatment works
2030	Ruthamford South	RTS16	Ruthamford South Drought Permit	2.07	Drought permit
2030	Ruthamford South	RTS21	Ruthamford South WTW Upgrade	9.5 up to 2040, 6Ml/d after 2040	Upgrade to existing treatment works
2030	Suffolk East	SUE23	Suffolk East WTW Upgrade	1.7	Upgrade to existing treatment works
2030	Suffolk Thetford	SUT6	Backwash water recovery, Suffolk East WTW	0.05	Backwash recovery
2030	Suffolk West Cambs	SWC13	Suffolk West Cambs new Groundwater Source	2.6	New borehole and treatment
2030	Essex South	EXS7	Backwash water recovery, Essex South WTW	0.3	Backwash recovery
2030	Norfolk Bradenham	NBR9	Backwash water recovery, Norfolk Bradenham WTW	0.2	Backwash recovery
2030	Norfolk North Coast	NNC5	Backwash water recovery, Norfolk North Coast WTW	0.18	Backwash recovery
2030	Norfolk North Coast	NNC6	Backwash water recovery, Norfolk North Coast WTW	0.2	Backwash recovery

Year Selected	Water resource zone	Option Ref	Option	Capacity (Ml/d)	Option type
2030	Lincolnshire East	LNE3	Backwash water recovery, Lincolnshire East WTW	1.3	Backwash recovery
2030	Norfolk Aylsham	NAY4	Backwash water recovery, Norfolk Aylsham WTW	0.75	Backwash recovery
2030	Norfolk East Dereham	NED3	Backwash water recovery, Norfolk East Dereham WTW	0.1	Backwash recovery
2030	Norfolk Harleston	NHL7	Backwash water recovery, Norfolk Harleston WTW	0.2	Backwash recovery
2030	Norfolk Aylsham	NAY5	Backwash water recovery, Norfolk Aylsham WTW	0.1	Backwash recovery
2032	Essex South	EXS19	Colchester WRC direct to Ardleigh Reservoir (no additional treatment)	11.4 up to 2039, 13.9Ml/d after 2039	Water Reuse
2034	Suffolk East	SUE25	Backwash water recovery, Suffolk East WTW	0.17	Backwash recovery
2036	South Humber Bank	SHB9	South Humber Bank Non-potable desalination (60 Ml/d)	60	Desalination
2036	Fenland	FND29	Fens reservoir high yield 50MCM	44.4	New Reservoir
2040	Essex South	EXS10	Holland on Sea desalination seawater (26 Ml/d)	26	Desalination
2040	Lincolnshire Central	LNC28	Bulk trade agreement - River Trent	7	Trade
2040	Lincolnshire East	LNE6	Mablethorpe desalination Seawater (50 Ml/d)	50	Desalination
2040	Norfolk Norwich & the Broads	NTB17	Bacton desalination Seawater (25 Ml/d)	25	Desalination
2040	Ruthamford North	RTN17	Lincolnshire reservoir 50MCM	169	New Reservoir

Table 56 Plan B transfers

Year Selected	Option Ref	Water resource zone	Option name	Capacity (Ml/d)
2030	CAM4	Cambridge	Ruthamford South to Cambridge Potable Water Transfer (50 Ml/d)	50
2030	LNC25	Lincolnshire Central	Lincolnshire East to Lincolnshire Central Potable Water Transfer (29 Ml/d)	29

Year Selected	Option Ref	Water resource zone	Option name	Capacity (Ml/d)
2030	EXC3	Essex Central	Essex South to Essex Central Potable Water Transfer (10 Ml/d)	10
2030	NAY1	Norfolk Aylsham	Norfolk Norwich & the Broads to Norfolk Aylsham Potable Water Transfer (3 Ml/d)	3
2030	NBR6	Norfolk Bradenham	Fenland to Norfolk Bradenham Potable Water Transfer (45 Ml/d)	45
2030	NEH3	Norfolk East Harling	Suffolk Thetford to Norfolk East Harling Potable Water Transfer (5 Ml/d)	5
2030	NHL4	Norfolk Harleston	Norfolk East Harling to Norfolk Harleston Potable Water Transfer (5 Ml/d)	5
2030	NTB10	Norfolk Norwich Broads	Norfolk Bradenham to Norfolk Norwich Broads Potable Water Transfer (20 Ml/d)	20
2030	SUE24	Suffolk East	Suffolk Sudbury to Suffolk East Potable Water Transfer (5 Ml/d)	5
2030	SWC8	Suffolk West Cambs	Cambridge to Suffolk West Cambs Potable Water Transfer (50 Ml/d)	50
2032	SUT5	Suffolk Thetford	Norfolk Bradenham to Suffolk Thetford Potable Water Transfer (10 Ml/d)	10
2035	LNN1	Lincolnshire Retford & Gainsborough	Lincolnshire Central to Lincolnshire Retford & Gainsborough Potable Water Transfer (3 Ml/d)	3
2035	NED2	Norfolk East Dereham	Norfolk Bradenham to Norfolk East Dereham Potable Water Transfer (10 Ml/d)	10
2035	NNC4	Norfolk North Coast	Norfolk East Dereham to Norfolk North Coast Potable Water Transfer (10 Ml/d)	10
2040	LNB1	Lincolnshire Bourne	Ruthamford North to Lincolnshire Bourne Potable Water Transfer (20 Ml/d)	20
2040	LNC16	Lincolnshire Central	Ruthamford North to Lincolnshire Central Potable Water Transfer (20 Ml/d)	20
2040	NWY1	Norfolk Wymondham	Norfolk Norwich & the Broads to Norfolk Wymondham Potable Water Transfer (5 Ml/d)	5

Year Selected	Option Ref	Water resource zone	Option name	Capacity (Ml/d)
2040	RTN30	Ruthamford North	Lincolnshire Central to Ruthamford North Potable Water Transfer (75 Ml/d)	75
2040	RTS24	Ruthamford South	Ruthamford North to Ruthamford South Potable Water Transfer (75 Ml/d)	75
2042	RTC3	Ruthamford Central	Ruthamford South to Ruthamford Central Potable Water Transfer (20 Ml/d)	20

Plan C - Option details

Figure 137 Plan C: Least cost plan based on preferred most likely scenario

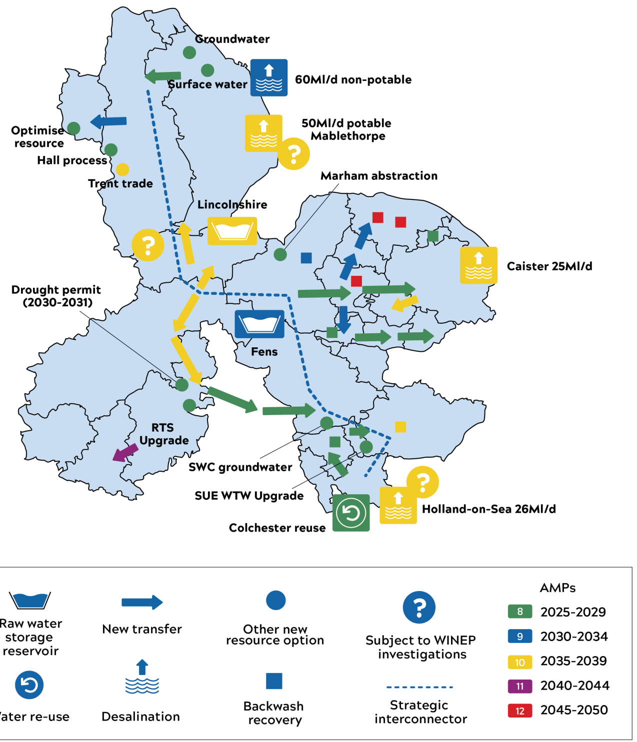


Table 57 Plan C new resource options

Year Selected	Option Ref	Water resource zone	Option name	Capacity (Ml/d)	Option type
2030	EXC7	Essex Central	Backwash water recovery, Essex Central WTW	0.3	Backwash recovery
2030	FND22	Fenland	Marham Abstraction	7.9 up to 2039, 12.3 after 2039	Upgrade to existing treatment works
2030	LNC30	Lincolnshire Central	Lincolnshire Central WTW Upgrade	3.2	Upgrade to existing treatment works
2030	LNE11	Lincolnshire East	Lincolnshire East Groundwater	7.5	Upgrade to existing treatment works
2030	LNE12	Lincolnshire East	Lincolnshire East Surface Water	13 before 20309, 7.3 after 2039	Upgrade to existing treatment works
2030	LNN3	Lincolnshire Retford & Gainsborough	Lincolnshire Retford & Gainsborough WTW Upgrade	0.72	Upgrade to existing treatment works
2030	NAY5	Norfolk Aylsham	Backwash water recovery, Norfolk Aylsham WTW	0.1	Backwash recovery
2030	RTS16	Ruthamford South	Ruthamford South Drought Permit	2.07	Drought permit
2030	RTS21	Ruthamford South	Ruthamford South WTW Upgrade	9.5 up to 2040, 6Ml/d after 2040	Upgrade to existing treatment works
2030	SUE23	Suffolk East	Suffolk East WTW Upgrade	1.7	Upgrade to existing treatment works
2030	SUT6	Suffolk Thetford	Backwash water recovery, Suffolk East WTW	0.05	Backwash recovery
2030	SWC13	Suffolk West Cambs	Suffolk West Cambs new Groundwater Source	2.6	New borehole and treatment
2032	EXS19	Essex South	Colchester WRC direct to Ardleigh Reservoir (no additional treatment)	11.4 up to 2039, 13.9Ml/d after 2039	Water Reuse
2034	FND26	Fenland	Backwash water recovery, Fenland WTW	0.24	Backwash recovery
2036	FND29	Fenland	Fens reservoir high yield 50MCM	44.4	New Reservoir

Year Selected	Option Ref	Water resource zone	Option name	Capacity (Ml/d)	Option type
2036	SHB9	South Humber Bank	South Humber Bank Non-potable desalination (60 Ml/d)	60	Desalination
2040	EXS10	Essex South	Holland on Sea desalination seawater (25 Ml/d)	26	Desalination
2040	LNC28	Lincolnshire Central	Bulk trade agreement - River Trent	7	Trade
2040	LNE6	Lincolnshire East	Mablethorpe desalination Seawater (50 Ml/d)	50	Desalination
2040	NTB20	Norfolk Norwich & the Broads	Casiter desalination Seawater (25 Ml/d)	25	Desalination
2040	RTN17	Ruthamford North	Lincolnshire reservoir 50MCM	169	New Reservoir
2040	SUE25	Suffolk East	Backwash water recovery, Suffolk East WTW	0.17	Backwash recovery
2049	NBR9	Norfolk Bradenham	Backwash water recovery, Norfolk Bradenham WTW	0.2	Backwash recovery
2049	NNC5	Norfolk North Coast	Backwash water recovery, Norfolk North Coast WTW	0.18	Backwash recovery
2049	NNC6	Norfolk North Coast	Backwash water recovery, Norfolk North Coast WTW	0.2	Backwash recovery

Table 58 Plan C transfers

Year Selected	Option Ref	Water resource zone	Option name	Capacity (Ml/d)
2030	CAM4	Cambridge	Ruthamford South to Cambridge Potable Water Transfer (50 Ml/d)	50
2030	LNC25	Lincolnshire Central	Lincolnshire East to Lincolnshire Central Potable Water Transfer (29 Ml/d)	29
2030	EXC3	Essex Central	Essex South to Essex Central Potable Water Transfer (10 Ml/d)	10
2030	NBR6	Norfolk Bradenham	Fenland to Norfolk Bradenham Potable Water Transfer (45 Ml/d)	45
2030	NEH3	Norfolk East Harling	Suffolk Thetford to Norfolk East Harling Potable Water Transfer (5 Ml/d)	5
2030	NHL4	Norfolk Harleston	Norfolk East Harling to Norfolk Harleston Potable Water Transfer (5 Ml/d)	5
2030	NTB10	Norfolk Norwich Broads	Norfolk Bradenham to Norfolk Norwich & the Broads Potable Water Transfer (20 Ml/d)	20

Year Selected	Option Ref	Water resource zone	Option name	Capacity (Ml/d)
2030	SUE24	Suffolk East	Suffolk Sudbury to Suffolk East Potable Water Transfer (5 Ml/d)	5
2030	SWC8	Suffolk West Cambs	Cambridge to Suffolk West Cambs Potable Water Transfer (50 Ml/d)	50
2032	SUT5	Suffolk Thetford	Norfolk Bradenham to Suffolk Thetford Potable Water Transfer (10 Ml/d)	10
2035	LNN1	Lincolnshire Retford & Gainsborough	Lincolnshire Central to Lincolnshire Retford & Gainsborough Potable Water Transfer (3 Ml/d)	3
2035	NED2	Norfolk East Dereham	Norfolk Bradenham to Norfolk East Dereham Potable Water Transfer (10 Ml/d)	10
2035	NNC4	Norfolk North Coast	Norfolk East Dereham to Norfolk North Coast Potable Water Transfer (10 Ml/d)	10
2040	LNB1	Lincolnshire Bourne	Ruthamford North to Lincolnshire Bourne Potable Water Transfer (20 Ml/d)	20
2040	LNC16	Lincolnshire Central	Ruthamford North to Lincolnshire Central Potable Water Transfer (20 Ml/d)	20
2040	NWY1	Norfolk Wymondham	Norfolk Norwich Broads to Norfolk Wymondham Potable Water Transfer (5 Ml/d)	5
2040	RTN30	Ruthamford North	Lincolnshire Central to Ruthamford North Potable Water Transfer (75 Ml/d)	75
2040	RTS24	Ruthamford South	Ruthamford North to Ruthamford South Potable Water Transfer (75 Ml/d)	75
2042	RTC3	Ruthamford Central	Ruthamford South to Ruthamford Central Potable Water Transfer (20 Ml/d)	20

Plan D - Option details

Figure 138 Plan D: Least cost plan based on best for environment (abstraction) scenario

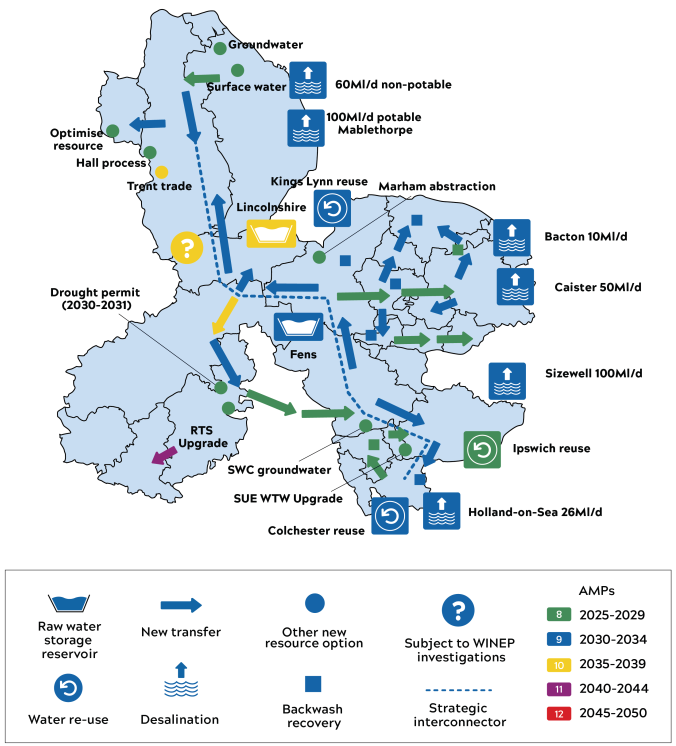


Table 59 Plan D new resource options

Year Selected	Option Ref	Water resource zone	Option name	Capacity (Ml/d)	Option type
2030	RTS16	Ruthamford South	Ruthamford South Drought Permit	2.07	Drought permit
2030	EXC7	Essex Central	Backwash water recovery, Essex Central WTW	0.3	Returns
2030	NAY5	Norfolk Aylsham	Backwash water recovery, Essex Central WTW	0.1	Returns
2030	FND22	Fenland	Marham Abstraction	7.9 up to 2039, 12.3 after 2039	WTW Upgrade
2030	LNC30	Lincolnshire Central	Lincolnshire Central WTW Upgrade	3.2	WTW Upgrade
2030	LNE11	Lincolnshire East	Lincolnshire East Groundwater	7.5	WTW Upgrade
2030	LNE12	Lincolnshire East	Lincolnshire East Surface Water	13 before 20309, 7.3 after 2039	WTW Upgrade
2030	LNN3	Lincolnshire Retford Gainsborough	Lincolnshire Retford & Gainsborough WTW Upgrade	0.72	WTW Upgrade
2030	RTS21	Ruthamford South	Ruthamford South WTW Upgrade	9.5 up to 2039, 6Ml/d after 2039	WTW Upgrade
2030	SUE23	Suffolk East	Suffolk East WTW Upgrade	1.7	WTW Upgrade
2030	SWC13	Suffolk West Cambs	Suffolk West Cambs new Groundwater Source	2.6	WTW Upgrade
2032	SUE1	Suffolk East	Ipswich water reuse	14.5	Water Reuse
2036	EXS10	Essex South	Holland on Sea desalination seawater (25 Ml/d)	25	Desalination
2036	LNE7	Lincolnshire East	Mablethorpe desalination Seawater (100 Ml/d)	100	Desalination
2036	NTB30	Norfolk Norwich & the Broads	Bacton desalination Seawater (10 Ml/d)	10	Desalination
2036	NTB21	Norfolk Norwich & the Broads	Caister desalination Seawater (50 Ml/d)	50	Desalination
2036	SHB9	South Humber Bank	South Humber Bank Non-potable desalination (60 Ml/d)	60	Desalination
2036	SUE16	Suffolk East	Sizewell desalination Seawater (100 Ml/d)	100	Desalination

Year Selected	Option Ref	Water resource zone	Option name	Capacity (Ml/d)	Option type
2036	FND29	Fenland	Fens reservoir high yield 50MCM	44.4	New Reservoir (with raw water transfer)
2036	EXS7	Essex South	Backwash water recovery, Essex South WTW	0.3	Returns
2036	FND26	Fenland	Backwash water recovery, Fenland WTW	0.24	Returns
2036	NBR9	Norfolk Bradenham	Backwash water recovery, Norfolk Bradenham WTW	0.2	Returns
2036	NNC6	Norfolk North Coast	Backwash water recovery, Norfolk North Coast WTW	0.2	Returns
2036	SUT6	Suffolk Thetford	Backwash water recovery, Suffolk East WTW	0.05	Returns
2036	LNC28	Lincolnshire Central	Bulk trade agreement - River Trent	7	Trade
2036	EXS22	Essex South	Colchester water reuse	5.7	Water Reuse
2036	FND3	Fenland	Kings Lynn water reuse	17.4	Water Reuse
2039	RTN17	Ruthamford North	Lincolnshire reservoir 50MCM	169	New Reservoir (with raw water transfer)

Table 60 Plan D transfers

Year Selected	Option Ref	Water resource zone	Option name	Capacity (Ml/d)
2030	CAM4	Cambridge	Ruthamford South to Cambridge Potable Water Transfer (50 Ml/d)	50
2030	LNC29	Lincolnshire Central	Lincolnshire East to Lincolnshire Central Potable Water Transfer (50 Ml/d)	50
2030	EXC3	Essex Central	Essex South to Essex Central Potable Water Transfer (10 Ml/d)	10
2030	NBR3	Norfolk Bradenham	Fenland to Norfolk Bradenham Potable Water Transfer (20 Ml/d)	20
2030	NEH1	Norfolk East Harling	Norfolk Harleston to Norfolk East Harling Potable Water Transfer (5 Ml/d)	5

Year Selected	Option Ref	Water resource zone	Option name	Capacity (Ml/d)
2030	NHL2	Norfolk Harleston	Norfolk Norwich & the Broads to Norfolk Harleston Potable Water Transfer (10 Ml/d)	10
2030	NTB10	Norfolk Norwich & the Broads	Norfolk Bradenham to Norfolk Norwich & the Broads Potable Water Transfer (20 Ml/d)	20
2030	SUE24	Suffolk East	Suffolk Sudbury to Suffolk East Potable Water Transfer (5 Ml/d)	5
2030	SWC8	Suffolk West Cambs	Cambridge to Suffolk West Cambs Potable Water Transfer (50 Ml/d)	50
2035	LNN2	Lincolnshire Retford & Gainsborough	Lincolnshire Central to Lincolnshire Retford & Gainsborough Potable Water Transfer (10 Ml/d)	10
2035	NED1	Norfolk East Dereham	Norfolk Bradenham to Norfolk East Dereham Potable Water Transfer (5 Ml/d)	5
2035	NNC4	Norfolk North Coast	Norfolk East Dereham to Norfolk North Coast Potable Water Transfer (10 Ml/d)	10
2036	EXS16	Essex South	Suffolk East to Essex South Potable Water Transfer (10 Ml/d)	10
2036	LNB1	Lincolnshire Bourne	Ruthamford North to Lincolnshire Bourne Potable Water Transfer (20 Ml/d)	20
2036	LNC17	Lincolnshire Central	Lincolnshire East to Lincolnshire Central Potable Water Transfer (100 Ml/d)	100
2036	LNC16	Lincolnshire Central	Ruthamford North to Lincolnshire Central Potable Water Transfer (20 Ml/d)	20
2036	NAY3	Norfolk Aylsham	Norfolk Norwich & the Broads to Norfolk Aylsham Potable Water Transfer (10 Ml/d)	10
2036	NNC3	Norfolk North Coast	Norfolk Aylsham to Norfolk North Coast Potable Water Transfer (10 Ml/d)	10
2036	NWY1	Norfolk Wymondham	Norfolk Norwich & the Broads to Norfolk Wymondham Potable Water Transfer (5 Ml/d)	5

Year Selected	Option Ref	Water resource zone	Option name	Capacity (Ml/d)
2036	RTS23	Ruthamford South	Ruthamford North to Ruthamford South Potable Water Transfer (60 Ml/d)	60
2036	FND15	Fenland	Suffolk West Cambs to Fenland Potable Water Transfer (20 Ml/d)	20
2036	RTN22	Ruthamford North	Fenland to Ruthamford North Potable Water Transfer (100 Ml/d)	100
2036	SUT1	Suffolk Thetford	Norfolk East Harling to Suffolk Thetford Potable Water Transfer (5 Ml/d)	5
2036	SWC6	Suffolk West Cambs	Suffolk East to Suffolk West Cambs Potable Water Transfer (50 Ml/d)	50
2039	RTN12	Ruthamford North	Ruthamford North to Ruthamford North Potable Water Transfer (50 Ml/d)	50
2042	RTC3	Ruthamford Central	Ruthamford South to Ruthamford Central Potable Water Transfer (20 Ml/d)	20

Appendix C: Applying the best value framework

We have four plans to apply the full best value framework against, these are:

- Plan A: Initial least cost plan based on the initial most likely scenario
- Plan B: Alternative plan based on preferred most likely scenario
- Plan C: Least cost plan based on preferred most likely scenario
- Plan D: Least cost plan based on best for environment (abstraction) scenario

The alternative plans are based on three scenarios. The scenarios present different timing and scales of abstraction reduction.

- **Initial most likely:** This is based on achieving BAU+ environmental destination profiled over time by prioritising the most sensitive areas of our region. However, delivering large reductions early limits opportunities for the plan to be adapted based on the outcome of WINEP investigations. In this scenario we achieve 1:500 drought resilience by 2039.
- **Best for the environment (abstraction)**: The largest level of environmental destination reductions based on Enhance are met as early as possible within the planning period. This prevents the ability for the plan to be adjusted to suit the outcomes from WINEP investigations. Drought resilience to 1:500 is achieved in 2039.
- **Preferred most likely**: Based on BAU+ this scenario profiles the reductions to allow the later part of the plan to be informed by the WINEP investigations. It maximises opportunities to utilise early surplus within the plan to deliver environmental destination reductions in the most sensitive areas. To enable these earlier reductions, we must delay drought resilience to 1:500 by one year to 2040. This scenario has been shaped by our customer and stakeholder engagement.

The options contained within each Plan are presented in Appendix B.

The full range of best value metrics within each outcome are compared for Plans A to D below.

Objective: Deliver a secure and wholesome supply of water to our customers

Our WRMP24 must maintain the supply demand balance without any final planning deficits[65], therefore we discount any plans which do not meet the supply demand balance. All four of the plans meet the criteria.

Objective: Optimise our available resource

The plans also meet the following demand criteria equally as they are all based on the same demand forecast:

- Meet the needs of future non-household customers
- Leakage reduction of 38 % from a 2017/18 baseline
- PCC reduction to 110 l/h/d by 2050, from 136 currently

The plans do differentiate on the raw water/ process loss reduction metric. Plan B includes 4.1Ml/d of backwash recovery capacity, compared to 1.4 Ml/d in Plans A, C and D.

Objective: Deliver a secure and wholesome supply of water to other sectors

We have included an estimate for future demand for non-public water supply for other sectors such as energy production. As part of our consultation, we liaised with companies who will be involved with the South Humber Bank Hydrogen production and carbon capture development. These industries have provided Anglian Water with their current assessments of water requirements, indicating that they envisage an initial estimate of 60Ml/d will be needed in the near term (next 10 years). These requirements will, in the main, be for non-potable water, which does not appear in our potable water demand forecast. However, we have included a 60Ml/d non-potable demand requirement, glide-pathed to 2031/32 (as well as an assessed volume of approximately 1Ml/d in the Central Lincolnshire WRZ for potable water), which is common to all plans. The 60 Ml/d non-potable demand directly triggers our South Humber Bank desalination option, and does not interact with our wider supply

65 Water Resources Planning Guideline (WRPG), March 2023

system. It therefore does not affect overall options selection and optimisation modelling. As the demand is discrete, we have excluded the option from our presented best value metric assessment in this section.

Other multi-sector needs such as agriculture form part of the development of the regional plan. Therefore, we have not included this metric in our assessment.

Objective: A plan that is affordable and sustainable over the long term

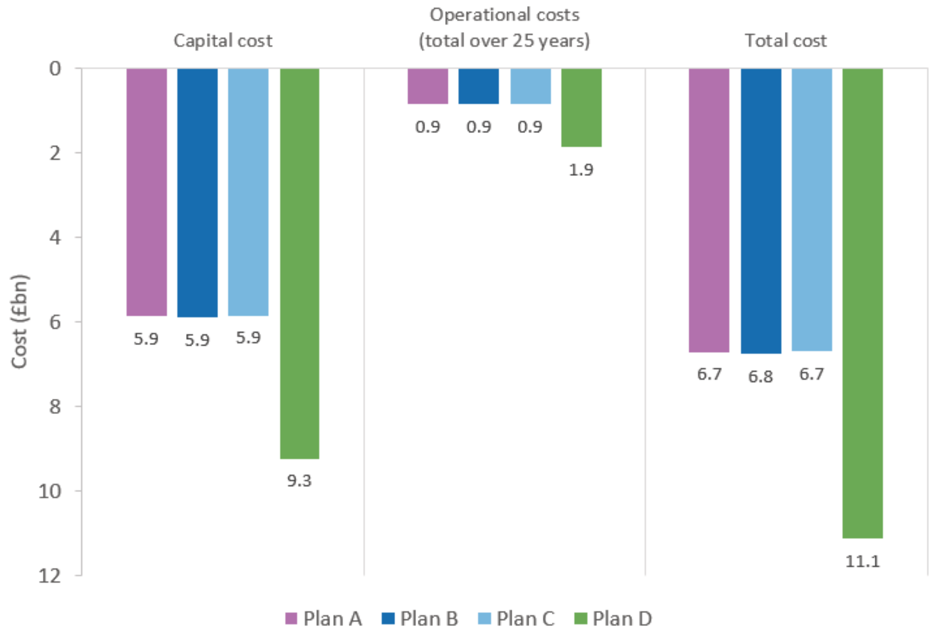
A best value plan should be efficient and affordable with distributional impacts, societal and intergenerational equity[66]. We use the cost of all the options within each plan to assess how they perform against our objective to create a plan that is affordable and sustainable over the long term. We include both the capital costs needed to construct the options and the costs to operate the options over the planning period of 25 years. These two components are combined to provide the total investment costs. All costs are presented in 20/21 financial year terms and include an allowance for optimism bias.

We consider both the total and the distribution of expenditure across the five AMPs in the 25-year planning period. All the plans contain the same demand management activities and as such the costs for these have not been included in this stage of the assessment. In Appendix E we combine both the supply and demand options to assess the overall costs of the preferred plan.

66 Water Resources Planning Guideline (WRPG), March 2023, Section 9.2

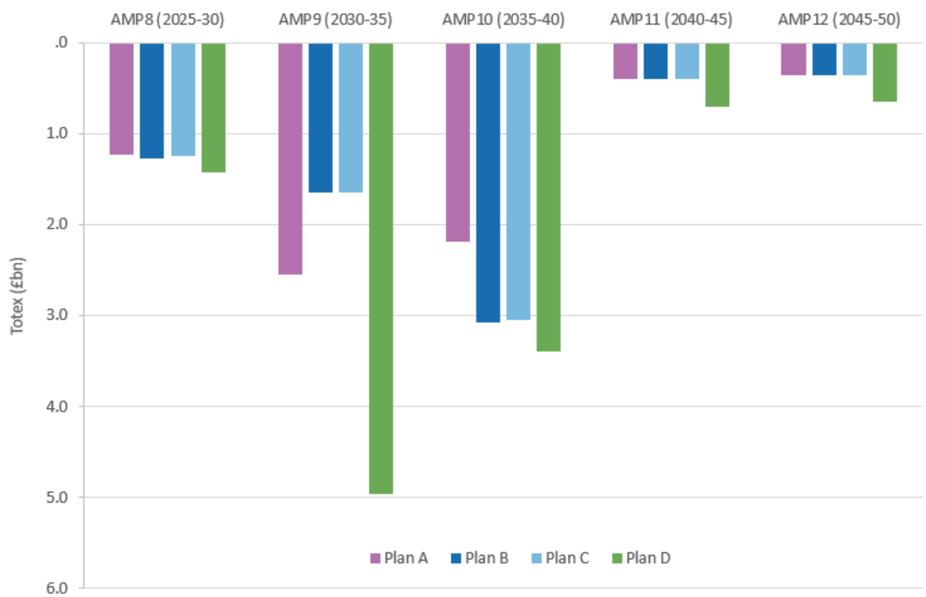
Programme Costs

Figure 139 Total programme cost comparison (2025-50)



Plan D has the highest overall cost, this is because it is delivers greater abstraction reductions and therefore needs greater investment to develop new resources to off-set those lost. Plans A, B and C have relatively similar costs.

Figure 140 Distribution of total investment by AMP period



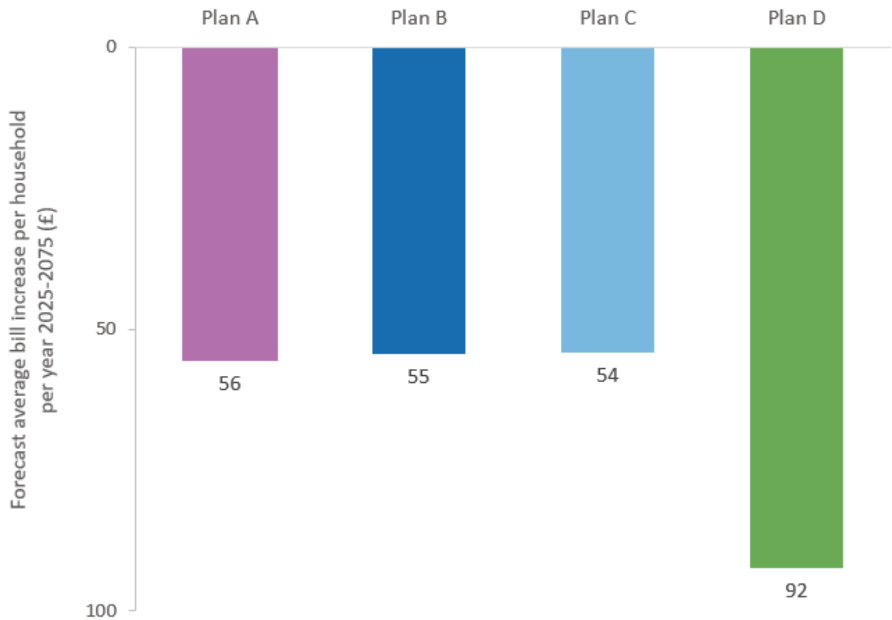
The distribution of expenditure reflects the timing of the supply reductions. Plans A and D have significantly greater costs in AMP9 when the majority of the investment falls to meet the earlier reductions by 2036. The profiles for Plans B and C closely align across the planning period. Plans A, B and C require similar expenditure at the start of the plan in AMP8.

Household bill changes

Figure 141 shows a comparison of average household bill increases between the four supply-side plans. Household bill impacts have been forecasted up to 2075 based on assumptions set out in Appendix A2 of Ofwat's guidance on long-term delivery strategies[67]. The bill impact calculation is subject to limitations, such as uncertainty in predicting asset utilisation over long time frames, potential uncertainty in delivery costs and forecasting population change. The impacts also represent only part of the wider factors which determine a household bill, as other contributions to the bill may also go up or down over time. The results therefore should not be considered as a definite prediction of cost per household; however they do show an indicative relative difference between the plans for planning and decision making purposes.

67 Ofwat (2022) PR24 and beyond: Final guidance on long-term delivery strategies

Figure 141 Average annual bill increase per household 2025-2075, based on supply-side portfolio only.



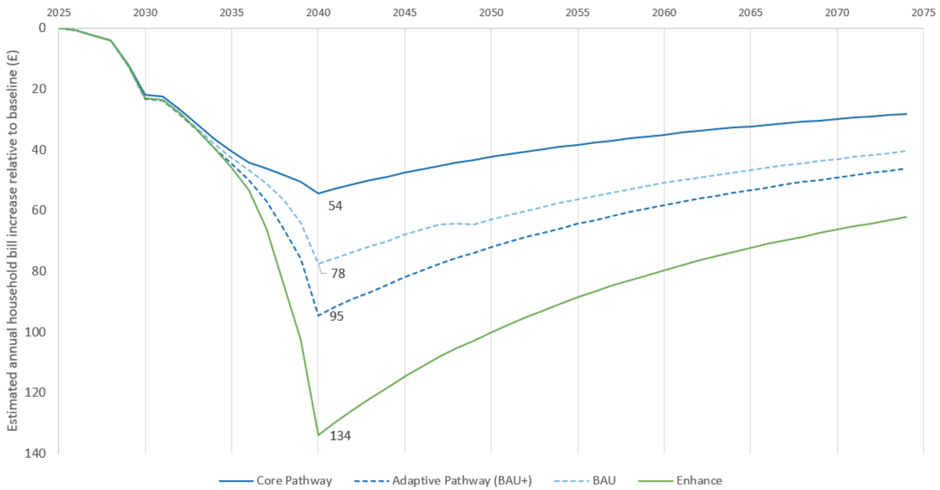
Bill increases for Plans A to C are relatively similar at an average of £54-56 per year. Plan D is approximately 67% higher at £92 per year. This is because Plan D has greater utilisation of opex intensive desalination options.

Household bill profile

Figure 142 compares the profile of household bills between the four plans.

Plan D and A have higher bills in the 2036-2040 period owing to larger abstraction reduction at that time. Post 2040 plans A-C have a similar decreasing trajectory. Plan D has the highest bill profile as it has the most significant environmental destination reductions.

Figure 142 Comparison of bill increase profile per household.



Intergenerational equity - cost

Intergenerational equity can be defined as the allocation of costs and benefits between current and future customers[68]. To achieve intergenerational equity this difference in terms of costs has been quantified as the ratio between the first and last 10 years of expenditure and average household bill change.

As Table 61 shows, when considered in total investment terms, all plans have a similar distribution of cost, with more expenditure at the start of the plan than at the end.

68 UKWIR (2020) Deriving a Best Value Water Resource Management Plan

Table 61 Ratio between total investment in first and last 10 years of plans

Portfolio	2025-2035 Total investment (£bn)	2040-2050 Total investment (£bn)	Ratio
Plan A	3.8	0.8	0.20
Plan B	2.9	0.8	0.26
Plan C	2.9	0.8	0.26
Plan D	6.4	1.4	0.21

Table 62 Ratio between average household bill increase in first and last ten years of plan

Scenario	2025-2035 Average household bill increase (£)	2040-2050 Average household bill increase (£)	Ratio
Plan A	19.1	80.5	4.2
Plan B	16.8	83.5	5.0
Plan C	16.6	82.9	5.0
Plan D	28.0	132.9	4.7

As shown in Table 62, when considered in average household bills terms, customers in the early period of the plan would expect to pay significantly less than those in the latter period of the plan. This is because reservoir and other infrastructure costs are limited in the short term and increase significantly in line with the 2040 1:500 drought resilience and environmental destination benefits. The timing of these financial costs is consistent with the greater benefits in terms of sustainable abstraction and drought resilience that would be available for customers by that time.

Objective: Deliver long-term environmental improvement

Abstraction reduction

One of our key objectives of our WRMP24 is to deliver long-term environmental improvement. The four plans offer different scales and timing of environmental improvement by reducing abstraction.

Plan D is based on providing the greatest level of environmental improvement (Enhance) as soon as possible. Figure 143shows how much each plans reduces the amount of water abstracted from the environment measured by the decrease in deployable output from abstraction licence reductions.

Figure 143 Abstraction reduction by 2050

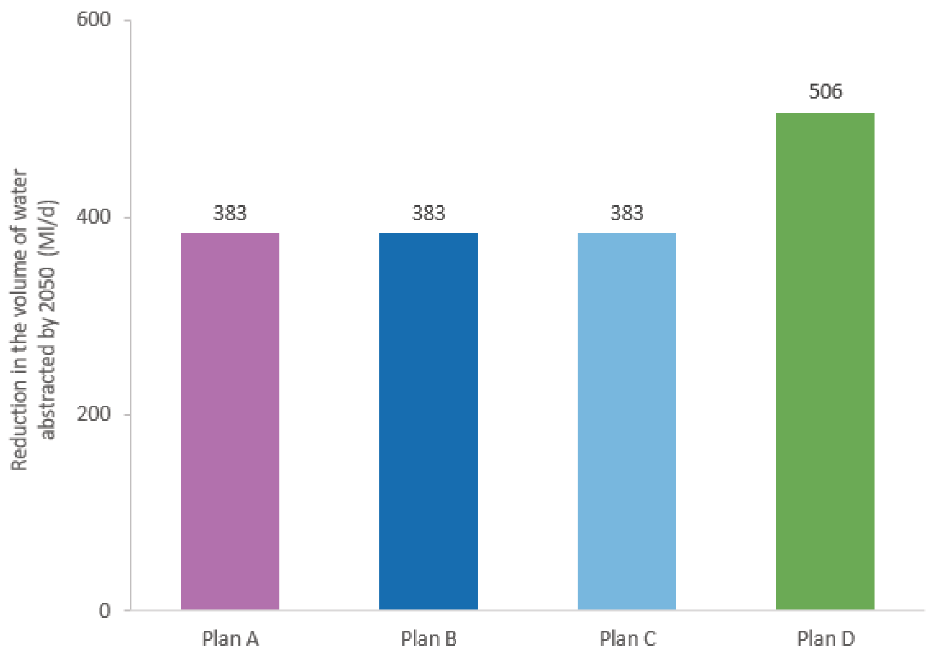
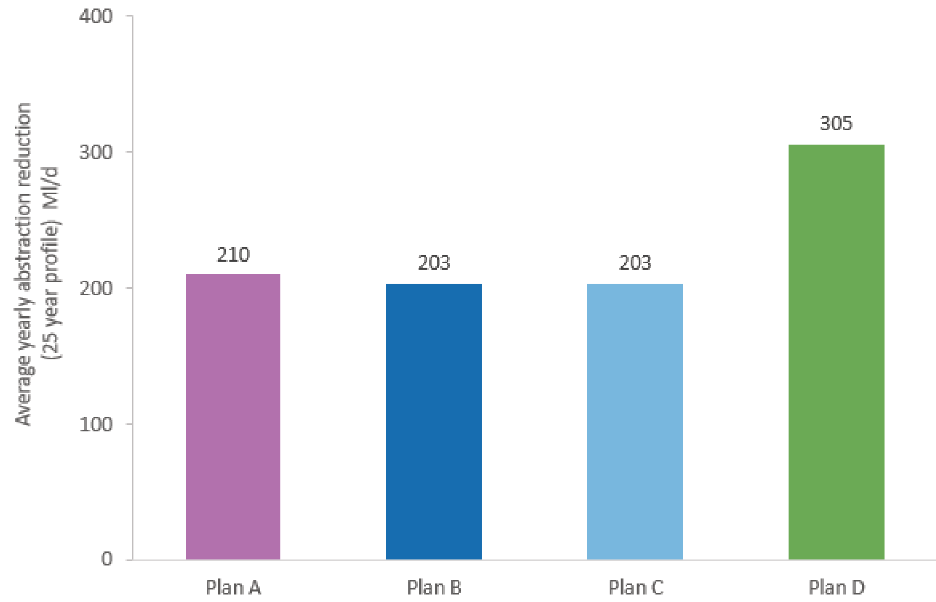


Figure 144 Average annual abstraction reduction 2025-50



To illustrate the different abstraction reduction profiles between plans we calculate the average annual reduction, which is shown in Figure 144. This demonstrates that even though Plan A provides the same end level of reductions as Plans B and C, it delivers these benefits slightly earlier.

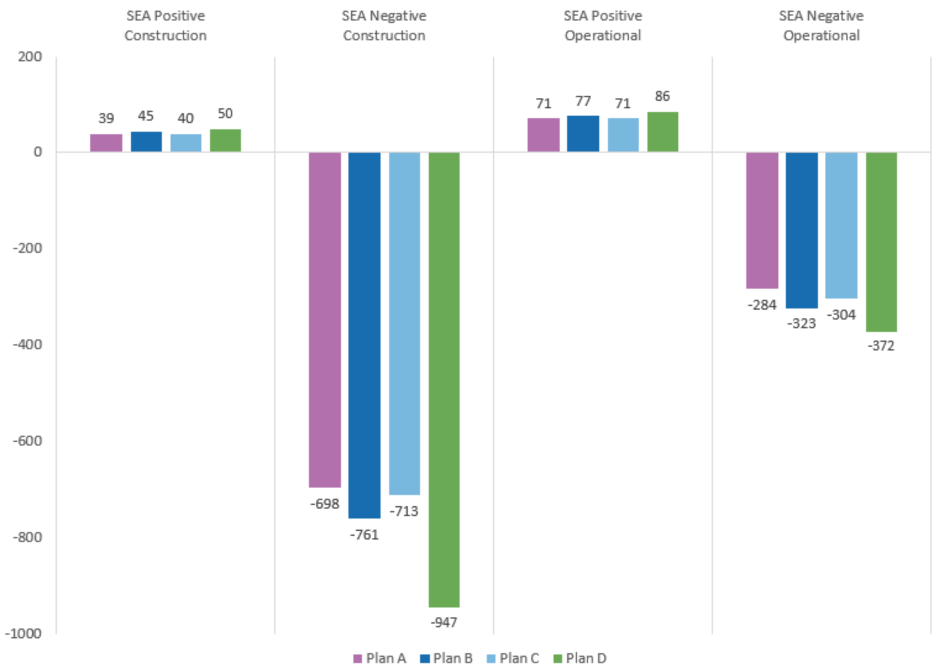
SEA Scores

When we consider abstraction reductions with the other environmental metrics there is a trade-off. Greater reductions require more schemes to off-set the lost resource; these come at a cost to the environment in terms of construction and operational impacts, habitats lost and natural capital.

The strategic environmental assessment (SEA) assesses all the supply-side options and provides scores that reflect the construction and operational negative and positive impacts.

The figure below shows performance across Strategic Environmental Assessment for the four portfolios. All portfolios have a overall negative scoring for both construction and operation, based on the environmental impacts of the selected options. Plan D performs worst because it results in more options being selected.

Figure 145 SEA score comparison



The positive benefits for both construction and operational are similar for all plans. The biggest difference is the negative impacts where Plan D performs worst.

Habitat units requiring restoration

Our plan looks to contribute to, and enhance, the natural environment by providing opportunities for biodiversity gain and enhancement[69]. Net gain for biodiversity is either an increase in the amount of biodiversity habitats or an improvement to existing habitats through better management[70].We use the number of habitat units which the assessment predicts will require restoration, based on the strategic scale option design, as an indication of the scale of investment needed to meet the biodiversity net gain targets.

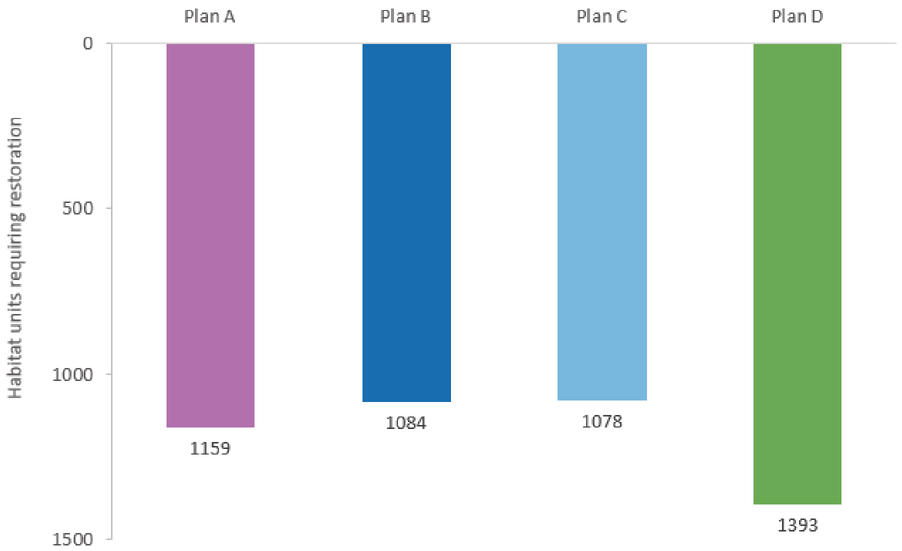
We have applied the mitigation hierarchy whereby avoiding biodiversity impacts is preferable to compensating for them. Therefore, portfolios requiring more biodiversity restoration perform less well than those requiring less.

The figure below shows the change in biodiversity habitat units resulting from the four plans. Plan D results in the greatest reduction in biodiversity, followed by Plan A and C. Plan C has the lowest impact on biodiversity. As indicated in the main text, ultimately all plans would result in Biodiversity Net Gain through the commitment to achieve 10% improvement for every delivered project, as established by the Environment Act (2021).

The results presented have excluded the biodiversity factors associated with the reservoir options (including the SROs), as the SRO options are consistent between portfolios.

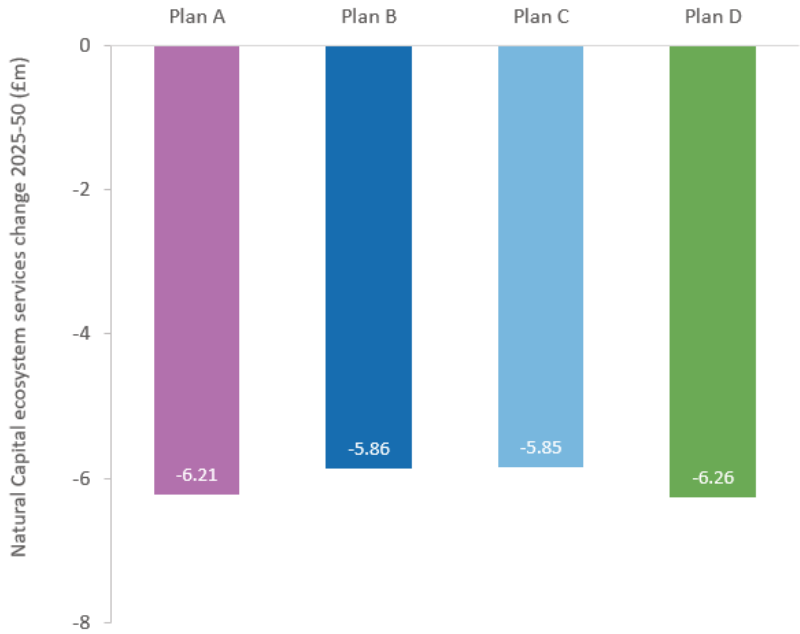
69 Water Resources Planning Guideline (WRPG), March 2023, Section 9.4.4
70 Water resources planning guideline supplementary guidance - Environment and society in decision-making, March 2021, section 1.2

Figure 146 Habitat units requiring restoration (excluding SRO reservoir options)



Natural Capital

Figure 147 Natural capital ecosystem services comparison total change 2025-50 (£m)



We are expected to take a natural capital approach, by considering the plans effects on the provision of ecosystem services to society, this is a way of considering the value nature provides either directly or indirectly to people[71]. The benefits we obtain from natural capital assets are referred to as ecosystem services. Our assessment of ecosystem services is based on a monetised quantification of the following ecosystem services and their net change due to an option being delivered:

- Food production
- Carbon storage
- Natural hazard management
- Air pollution removal.

71 Water resources planning guideline supplementary guidance - Environment and society in decision-making, March 2021, section 1.2

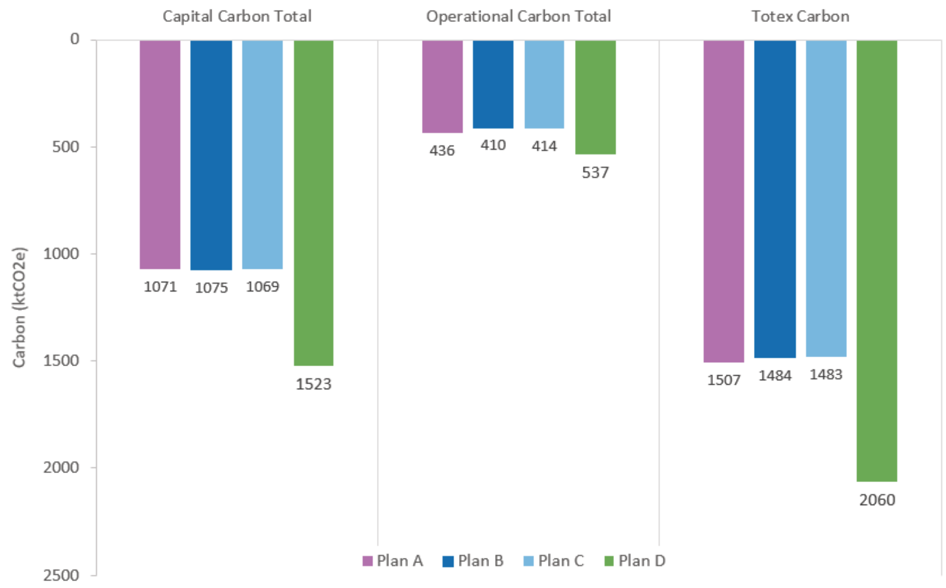
All portfolios have a negative impact on natural capital ecosystem services. This is because supply options typically reduce the availability of agricultural land. Plan D performs worst in this metric it requires the most supply-side options.

As part of the SRO reservoir projects we are working with stakeholders to explore irrigation support, which could increase the productivity of land close to the reservoir. This benefit has not been included in the assessment at present.

Portfolio Carbon Totals

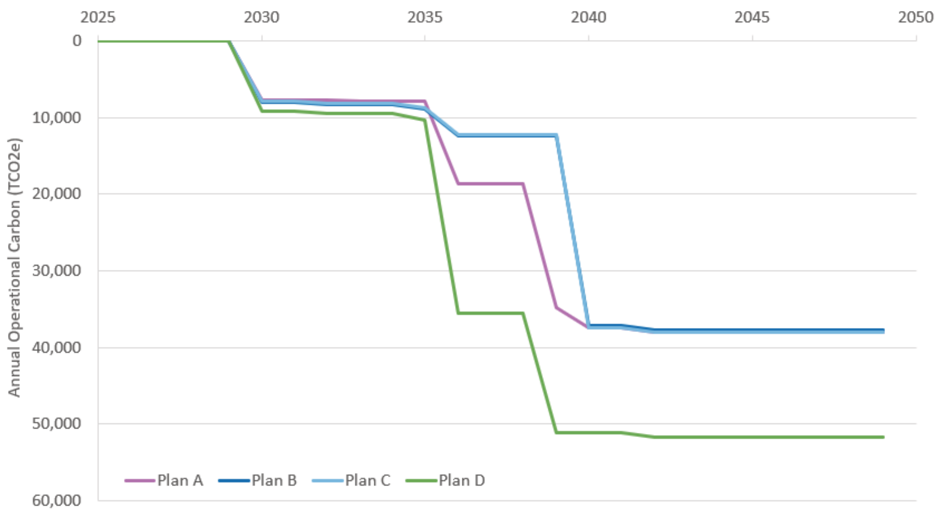
The Government has committed to reducing greenhouse gas emissions to net zero by 2050. Anglian Water, along with the rest of the water sector, have committed to net zero operational carbon by 2030 . We consider both the carbon (measured as tonnes of CO2 equivalent (tCO2e)) associated with the construction of new options, capital carbon, and that produced through operational activities, operational carbon.Figure 148 shows the quantities of carbon for each of the plans. The quantities are presented as tonnes of equivalent carbon based on assumptions of how much carbon is the production of materials, used in construction plant and energy usage from the grid today. This gives us comparable quantities for assessment but we also look forward to how these quantities will change when we take into account the commitment to net zero operational carbon by using renewable energy in Appendix D:.

Figure 148 Portfolio carbon totals comparison



Baseline Operational Carbon Profile

Figure 149 Operational carbon profile for the four plans



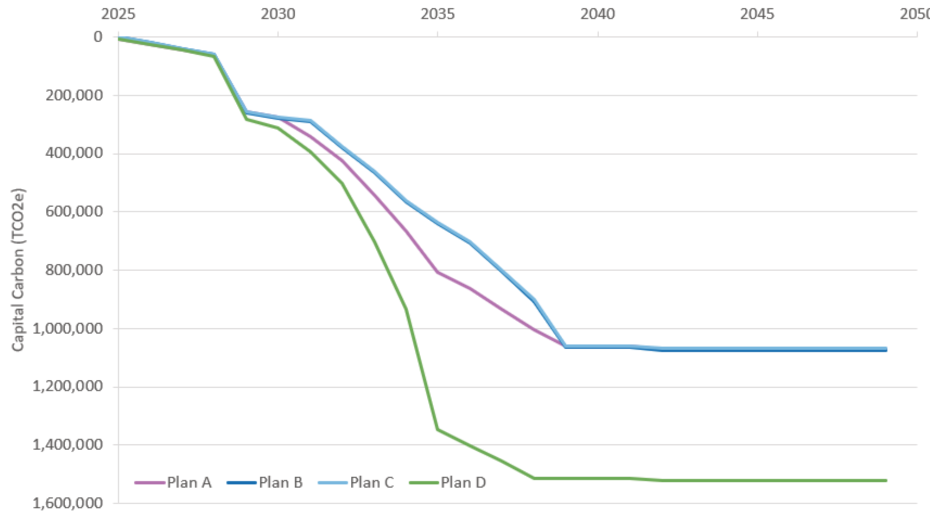
Plans B and C have slightly more operational carbon profile at the start of the plan compared to Plan A due to the additional licence caps addressed in those plans. Plan C would require more energy from renewables up to 2040.

The quantities of operational carbon presented in our assessment are based on the additional requirements from new assets. They do not consider the reduction in carbon from ceasing abstraction at our existing groundwater sources.

The operational carbon reduced from groundwater sources lost is significantly lower, as they require minimal treatment, and are typically located local to demand, meaning less power for distribution. In contrast, desalination options have high operational carbon requirements, due to power intensive treatment processes and are typically located some distance from the areas they supply.

Baseline Capital Carbon Profile

Figure 150 Baseline capital carbon profile for the four plans



Plan D has the greatest capital carbon impact, both in scale and in timing. From a capital carbon perspective, it is preferable to delay investments until later in the planning horizon, to have more time available for the development of low and zero carbon construction techniques. Plans B and C have similar level of capital carbon resulting from their selected options. However, Plan A performs worse as it requires earlier infrastructure development.

The SRO reservoir options are the largest contribution to capital carbon within the plans. The most significant factor is the diesel fuelled earth moving plant needed for the construction of the reservoirs work. We have already engaged with the supply chain to develop opportunities for electric powered plant to reduce the carbon.

Cost of Carbon

Figure 151 Cost of carbon (cumulative over 25 year planning horizon). Dashed lines show high and low series, full line is central series

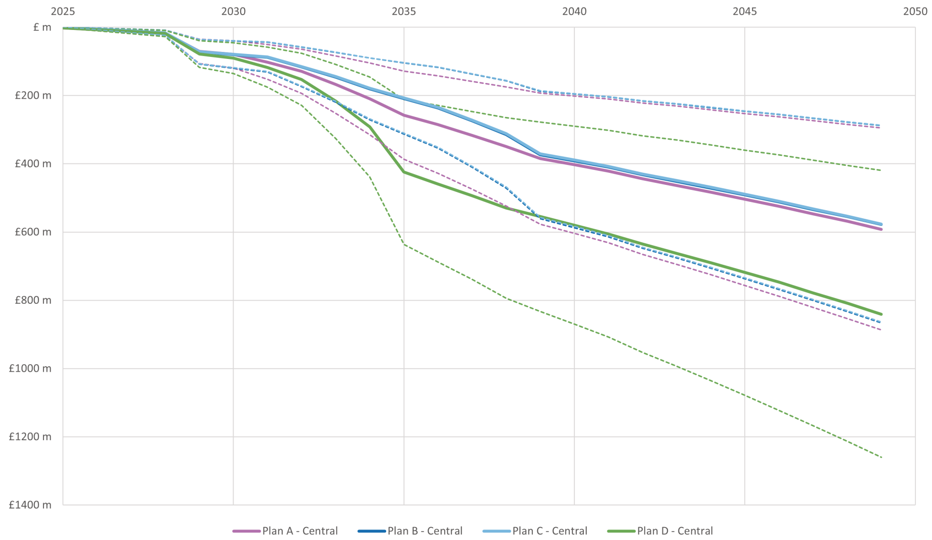


Figure 150 presents the cost of carbon, using the Department of Business, Energy and Industry[72] carbon values in 2020 prices per tonne of CO2 equivalent, for the carbon baseline using PR19 models. The carbon values represent a monetary value that society places on one tonne of carbon dioxide equivalent (£/tCO2e) and are used to estimate a monetary value of the greenhouse gas impact of policy proposals during policy design, and after delivery.

The cost profiles between plans are aligned with the operational and capital carbon profiles described above, with Plan D having a much higher cost of carbon than the other three.

All options chosen in our preferred plan will feed into our carbon neutral strategy. Anglian Water as an infrastructure organisation is using the principles of PAS 2080 as a framework to transform the benefits of our systems and provide a sustainable legacy by working collaboratively across all value chain parties with a common goal to reduce carbon and cost. As part of our 2030 net zero strategy our goal is to achieve net zero by 2030 and to maintain this thereafter. We have also set a 70% capital carbon reduction target by 2030, from a 2010 baseline. Further information about our carbon commitment can be found in our net zero strategy document[73].

Both capital and operational carbon are a fundamental aspect of our asset investment process. As water resources options pass through our asset delivery process from outline design, to detailed design, to investment delivery, operational carbon and capital carbon will be measured at every stage, and opportunities for reduction and mitigation identified and assessed. Opportunities to generate or be powered by renewable energy or sequester carbon will also be explored as part of our decision-making framework.

We expect the level of uncertainty associated with option carbon assessments to reduce as options are developed and mature. The SRO process is considering opportunities for carbon mitigation and sequestration as part of the design of the reservoir options.

Objective: Increase the resilience of our water systems

Drought Resilience

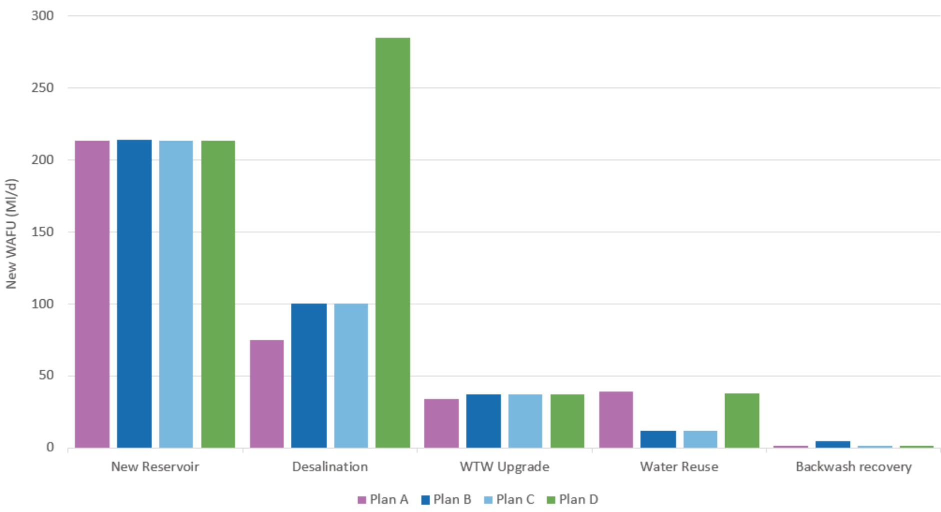
The completion of our WRMP19 schemes ensures we are resilient to 1:200 drought. For WRMP24 we must further increase our resilience to more extreme drought, to 1:500. All our plans achieve this level of resilience.

For developing alternative plans, see Section 6.2.5, we consider the choice of delaying drought resilience by one year to enable abstraction reductions to be brought forward by four years. Our customer and stakeholder engagement shows that customers feel drought resilience by 2039 is about the right timescale but their preference is to deliver environmental improvements earlier. This formed our preferred most likely scenario used for Plans B and C which delay the need for the Lincolnshire reservoir by one year.

72 Department for Business, Energy & Industrial Strategy (2021) Valuation of greenhouse gas emissions: for policy appraisal and evaluation
73 Anglian Water (2021) Our net zero strategy to 2030

Options Diversity

Figure 152 Option diversity



All four plans include both SRO reservoirs. The largest variation between plans is the number and capacity of desalination options. The only different between Plans B and C is that B contains more backwash recovery options.

Options scalability

Desalination is the best option in terms of scalability to match the need. However, to avoid regret there must be adequate time for the WINEP investigations to inform the scale of the need before we commit to constructing new assets.

Table 63 Desalination timings and scale comparison

Plan	Pre-2040 Desalination		Post-2040 Desalination	
	Number	WAFU	Number	WAFU
Plan A	1	50	1	25
Plan B	0	-	3	100
Plan C	0	-	3	100
Plan D	5	285	0	-

Plans A and D require desalination options to be delivered in 2036, close to their earliest possible date of 2032. This provides less opportunity to factor in scaling opportunities as a large option size must be committed early in the forecast. Plans B and C require desalination options to be delivered after 2040 and on an adaptive pathway, providing more opportunities for developing a scalable design to meet the needed requirements and timescales as they arise.

Options deliverability

Delivery risk was calculated using the following factors:

- Delivery risk index: An index calculated by counting the number of schemes within each portfolio where delivery date matches earliest possible start date, and multiplying by the scheme WAFU. A higher score is worse.
- Number of schemes likely to be subject to Direct Procurement for Customers (DPC)
- Number of schemes likely to require Development Consent Orders (DCO)

Table 64 Summary of deliverability metrics between the four plans

Plan	Schemes with earliest possible delivery date (No.)	Delivery Risk by WAFU total	DPC Option (No.)	DCO Option (No.)
Plan A	19	470	8	2
Plan B	22	322	8	2
Plan C	21	319	8	2
Plan D	22	494	13	2

Plans D is the worst preforming, with the highest delivery risk by WAFU and more schemes likely to by DPC.

Single source of supply

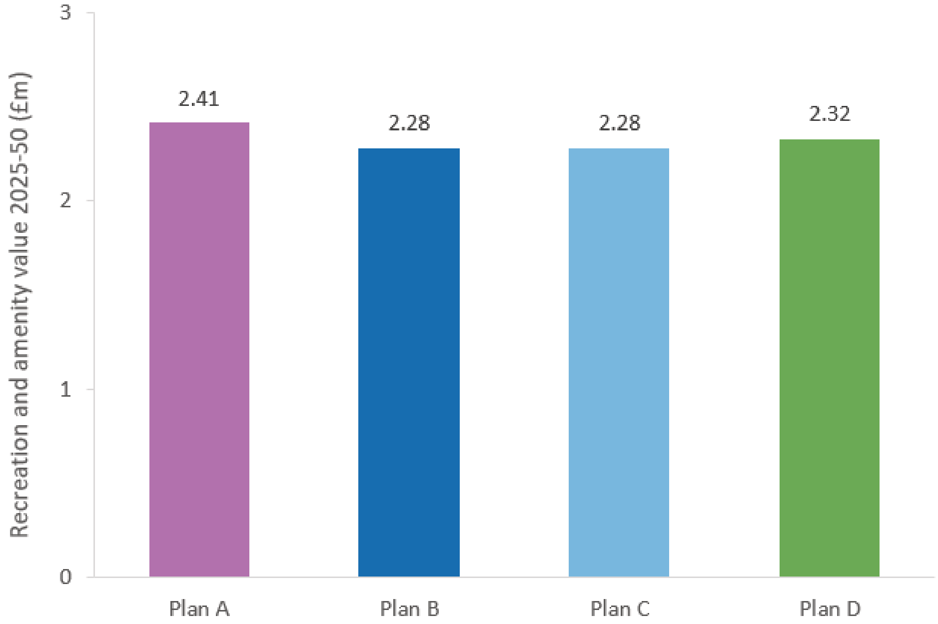
For our PR19 business plan we use a metric called 'Single source of supply resilience' to quantity the percentage our customers who receive their water form a single source of supply. If there was a catastrophic failure at the treatment works leading to the works being taken out of supply for a significant amount of time, we would not be able to redirect an alternative source of supply without investment. In PR19 we have included investment to reduce the risk from 24.7% to 14.1% by the end of AMP7.

The options which could provide a resilience benefit are the same in all four versions of the plan. Over the planning period the risk could reduce by around 2% with additional investment required to the schemes within our WRMP24.

Objective: A plan that supports the views of regional stakeholders and water companies' customers and is not detrimental to social wellbeing

Recreation and amenity benefits are mainly associated with the reservoir options only, which provide multiple opportunities for benefits.

Figure 153 Recreation and amenity value



All plans have a net positive recreation benefit. Plan A and Plan D have slightly higher overall recreational value as they deliver the Lincolnshire Reservoir one year earlier.

Customer preference

Table 65 Customer preference

Outcome	Key insights from customers and stakeholders engagement	Plan A	Plan B	Plan C	Plan D	Comments
Flourishing environment	We need to achieve our environmental targets as they are crucial for the future of the planet.	✓ (green)	✓ (green)	✓ (green)	✓ (green)	All the plans include abstractions reductions for environmental destination.
	The environmental destination of BAU+ is the preferential scenario at present. This view is driven by financial security and concerns over affordability.	✓ (green)	✓ (green)	✓ (green)	✓ (red)	Plans A, B and C are based on BAU+ and Plan D is Enhance.
	The majority feel we should achieve our environmental destination sooner than 2050.	✓ (green)	✓ (orange)	✓ (orange)	✓ (green)	All the plans deliver environmental destination earlier than 2050. Plans A and D deliver the biggest benefits earliest in the planning period. However Plans B and C deliver earlier licence cap reductions compared to Plan A
Resilient business	Our levels of service for temporary use bans and non-essential use bans are acceptable. However, they did welcome moving to a higher level of severe drought resilience.	✓ (green)	✓ (green)	✓ (green)	✓ (green)	All the plans achieve 1:500 drought
	Achieving higher level of severe drought resilience by 2039 was largely seen as the right time scale by our customers.	✓ (green)	✓ (green)	✓ (green)	✓ (green)	The plans deliver drought resilience by 2039 or 2040.
	Making the most of what we have remains a priority with demand management measures being seen as the preferential way of tackling deficits.	✓ (orange)	✓ (green)	✓ (orange)	✓ (orange)	All the plans include our preferred demand management options. Plan B maximises the use of existing resource by included the most backwash recovery options.
	Reservoirs and water reuse were the most preferred supply-side options.	✓ (orange)	✓ (green)	✓ (green)	✓ (red)	All the plans include both reservoir options. Plans B and C include a water reuse early in the plan. Plans A and D contains desalination options early and water reuse.
Fair charges, fair returns	Customers support the principle of a best value plan, but there is a core desire from customers for bills to be fair and affordable	✓ (green)	✓ (green)	✓ (green)	✓ (red)	Plan D is more expensive to deliver and will have greatest impact on customer bills. Plans A, B and C provide the best balance of cost verses environmental improvements.

✓ (green)	✓ (orange)	✓ (red)
Plan achieves customer preference	Plan meets customer preference but is not best performing plan	Plan partially meets customer preference but is worse performing plan

Stakeholders' preference

Plans B and C are based on the preferred most likely scenario, which has been developed in accordance with stakeholder and customer preferences, as set out in 6.2 . Therefore Plan B and C are best aligned to overall stakeholder and customer preferences.

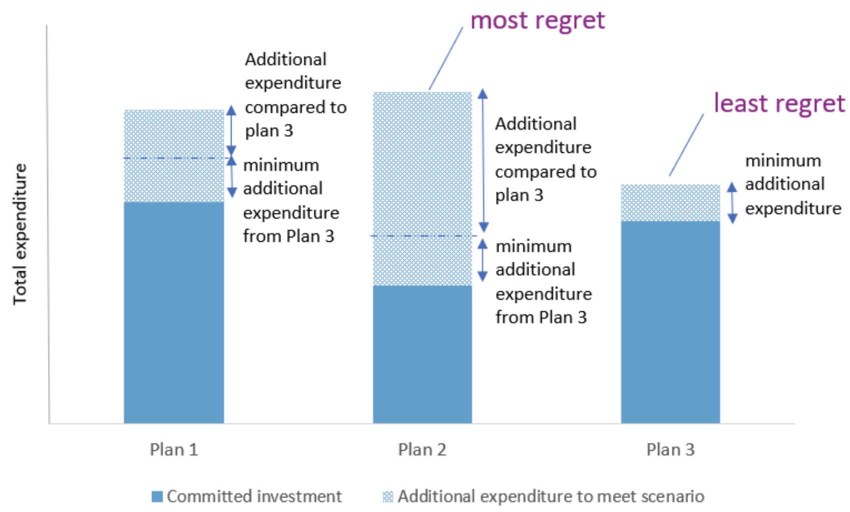
Objective: A plan that can adapt to future scenarios

Least Worst Regrets Analysis

Least worst regret analysis is a tool used for decision making under uncertainty, particularly when it is difficult or inappropriate to assign probabilities to possible future scenarios[74]. The method looks to minimise 'regret' across all scenarios analysed, where 'regret' can be considered as the difference between a decision and the optimal decision. In our analysis this is represented as the difference in total expenditure.

We use this method to assess if we commit to the options required at the start of each plan and the future varies, how much additional investment is required to meet the future need. We then identify the plan with the minimum additional spend (the optimal decision) and compare against the other plans. The plan with the least regret is the version that requires the lowest additional spend compared to the other plans, see Figure 154 an example for one scenario.

Figure 154 Example of how least worse regret analysis is applied to one scenario



In the example Plan 3 has the least regret as it requires the minimum additional expenditure to meet the scenario. We apply this method to all the scenarios and identify the regret for each plan (Table 66). We then deduct the minimum regret from the other plans (Table 67). This shows us which plan and scenario cause the worse regret and which the least worse regret.

The options we would need to commit to in AMP8,for each of the four plans was applied to the 10 Ofwat common reference stress tests scenarios to determine which investment portfolio has the most potential for 'regret' measured in overspend compared to the minimum cost for the scenario. Performance of the four plans was also compared to the results of committing to planning against each of the Ofwat common reference stress test scenarios.

Table 66 andTable 67 show the results of the Least Worst Regrets assessment, which are summarised in Figure 155 for the four plans using for the best value planning assessment, and Figure 156 for the Common

74 Stan Zachary (3 August 2016), Least worst regret analysis for decision making under uncertainty, with applications to future energy scenarios, p. 1.

Reference Scenarios. Plan D has the highest portfolio costs across all scenarios. When compared to the minimum cost required to resolve the stress test scenarios, Plan D has the greatest overall 'regret' at £5.93bn. Therefore, Plan D is the worst performing on this metric.

Plan A is the second worst performing, with a worst regret of £1.98 bn.

Plans B is the best performing, with a worst regret of £0.99bn against the Adverse scenario.

Table 66 Totex investment (2025-50) by plan and stress test scenario

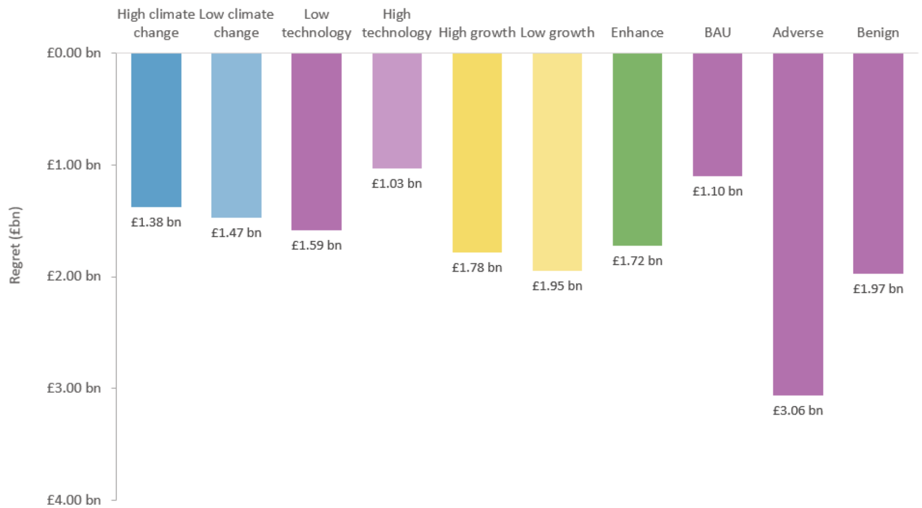
		Portfolio Totex (£bn)														
		Four plans for BVP assessment				*Ofwat Common Reference Scenarios*										
		Plan A	Plan B	Plan C	Plan D	*High climate change*	*Low climate change*	*Low technology*	*High technology*	*High growth*	*Low growth*	*Enhance*	*BAU*	*Adverse*	*Benign*	Minimum
Scenario	High Climate Change	£8.66 bn	£8.46 bn	£8.31 bn	£10.97 bn	£8.07 bn	£8.32 bn	£8.48 bn	£8.30 bn	£8.40 bn	£8.27 bn	£8.32 bn	£8.40 bn	£8.77 bn	£8.20 bn	£8.07 bn
	Low Climate Change	£7.43 bn	£7.32 bn	£7.27 bn	£10.87 bn	£7.05 bn	£7.02 bn	£7.47 bn	£7.05 bn	£7.61 bn	£7.06 bn	£7.52 bn	£7.18 bn	£8.14 bn	£7.35 bn	£7.02 bn
	High Technology	£7.35 bn	£7.16 bn	£7.22 bn	£10.84 bn	£6.88 bn	£7.02 bn	£7.31 bn	£6.87 bn	£7.51 bn	£6.92 bn	£7.40 bn	£7.01 bn	£8.13 bn	£7.00 bn	£6.87 bn
	Low Technology	£8.34 bn	£8.01 bn	£8.00 bn	£11.28 bn	£8.05 bn	£8.16 bn	£8.02 bn	£7.99 bn	£8.00 bn	£8.00 bn	£7.97 bn	£8.10 bn	£8.37 bn	£8.12 bn	£7.97 bn
	High Growth	£10.52 bn	£10.30 bn	£10.07 bn	£11.63 bn	£9.95 bn	£10.23 bn	£10.19 bn	£10.30 bn	£9.75 bn	£9.84 bn	£10.00 bn	£10.18 bn	£9.66 bn	£9.89 bn	£9.66 bn
	Low Growth	£6.97 bn	£6.41 bn	£6.41 bn	£10.64 bn	£6.53 bn	£6.48 bn	£6.47 bn	£6.14 bn	£6.87 bn	£5.90 bn	£6.71 bn	£6.35 bn	£7.92 bn	£6.30 bn	£5.90 bn
	Enhance	£9.88 bn	£9.71 bn	£9.60 bn	£11.18 bn	£9.57 bn	£9.82 bn	£9.72 bn	£9.69 bn	£9.54 bn	£9.28 bn	£9.27 bn	£9.83 bn	£10.10 bn	£9.32 bn	£9.27 bn
	BAU	£7.19 bn	£6.76 bn	£6.62 bn	£10.82 bn	£6.26 bn	£6.53 bn	£6.70 bn	£6.25 bn	£6.89 bn	£6.23 bn	£6.86 bn	£6.27 bn	£8.04 bn	£6.36 bn	£6.23 bn
	Adverse	£12.59 bn	£11.83 bn	£11.86 bn	£14.23 bn	£13.21 bn	£13.30 bn	£12.29 bn	£12.86 bn	£12.90 bn	£13.78 bn	£13.17 bn	£12.93 bn	£13.28 bn	£13.80 bn	£11.83 bn
	Benign	£6.54 bn	£5.55 bn	£5.57 bn	£10.49 bn	£5.68 bn	£5.58 bn	£6.15 bn	£5.11 bn	£6.34 bn	£4.94 bn	£6.28 bn	£5.22 bn	£7.62 bn	£4.56 bn	£4.56 bn

Table 67 'Regret' by portfolio. Regret is assessed as the difference between a portfolio cost to meet a scenario and the minimum cost to meet the scenario across all portfolios

		Portfolio Regret (£bn)													
		Four plans for BVP assessment				*Ofwat Common Reference Scenarios*									
		Plan A	Plan B	Plan C	Plan D	*High climate change*	*Low climate change*	*Low technology*	*High technology*	*High growth*	*Low growth*	*Enhance*	*BAU*	*Adverse*	*Benign*
Scenario	High Climate Change	£0.59 bn	£0.39 bn	£0.24 bn	£2.89 bn	£0.00 bn	£0.25 bn	£0.40 bn	£0.22 bn	£0.33 bn	£0.19 bn	£0.24 bn	£0.33 bn	£0.70 bn	£0.12 bn
	Low Climate Change	£0.41 bn	£0.29 bn	£0.24 bn	£3.85 bn	£0.03 bn	£0.00 bn	£0.44 bn	£0.03 bn	£0.59 bn	£0.04 bn	£0.50 bn	£0.15 bn	£1.12 bn	£0.33 bn
	High Technology	£0.48 bn	£0.29 bn	£0.35 bn	£3.97 bn	£0.01 bn	£0.15 bn	£0.44 bn	£0.00 bn	£0.63 bn	£0.04 bn	£0.53 bn	£0.13 bn	£1.26 bn	£0.13 bn
	Low Technology	£0.37 bn	£0.04 bn	£0.02 bn	£3.31 bn	£0.08 bn	£0.19 bn	£0.05 bn	£0.02 bn	£0.03 bn	£0.03 bn	£0.00 bn	£0.13 bn	£0.40 bn	£0.14 bn
	High Growth	£0.86 bn	£0.63 bn	£0.41 bn	£1.97 bn	£0.28 bn	£0.57 bn	£0.52 bn	£0.63 bn	£0.08 bn	£0.17 bn	£0.33 bn	£0.52 bn	£0.00 bn	£0.23 bn
	Low Growth	£1.07 bn	£0.50 bn	£0.51 bn	£4.74 bn	£0.62 bn	£0.58 bn	£0.57 bn	£0.24 bn	£0.97 bn	£0.00 bn	£0.81 bn	£0.45 bn	£2.02 bn	£0.40 bn
	Enhance	£0.61 bn	£0.45 bn	£0.33 bn	£1.91 bn	£0.30 bn	£0.55 bn	£0.45 bn	£0.42 bn	£0.27 bn	£0.01 bn	£0.00 bn	£0.57 bn	£0.83 bn	£0.05 bn
	BAU	£0.96 bn	£0.53 bn	£0.39 bn	£4.59 bn	£0.03 bn	£0.30 bn	£0.47 bn	£0.02 bn	£0.66 bn	£0.00 bn	£0.63 bn	£0.04 bn	£1.80 bn	£0.12 bn
	Adverse	£0.76 bn	£0.00 bn	£0.03 bn	£2.40 bn	£1.38 bn	£1.47 bn	£0.46 bn	£1.03 bn	£1.07 bn	£1.95 bn	£1.34 bn	£1.10 bn	£1.45 bn	£1.97 bn
	Benign	£1.98 bn	£0.99 bn	£1.01 bn	£5.93 bn	£1.12 bn	£1.02 bn	£1.59 bn	£0.55 bn	£1.78 bn	£0.38 bn	£1.72 bn	£0.66 bn	£3.06 bn	£0.00 bn
Worst Regret		£1.98 bn	£0.99 bn	£1.01 bn	£5.93 bn	£1.38 bn	£1.47 bn	£1.59 bn	£1.03 bn	£1.78 bn	£1.95 bn	£1.72 bn	£1.10 bn	£3.06 bn	£1.97 bn

Figure 155 Summary of least worst regrets analysis by portfolio

Figure 156 Summary of least worst regrets analysis against common reference scenarios



Appendix D: Best Value Plan - Future Carbon pathways

This appendix describes how the carbon impact of the supply options selected in our Best Value Plan could change based on our company carbon commitments and net zero strategy.

The carbon metrics presented in the Best Value framework represent the baseline carbon position of our alternative profiles and were built up from carbon assessment via our PR19 carbon modelling tools. This analysis assumes that the carbon intensity associated with the construction and operation of assets remains constant throughout the analysis period.

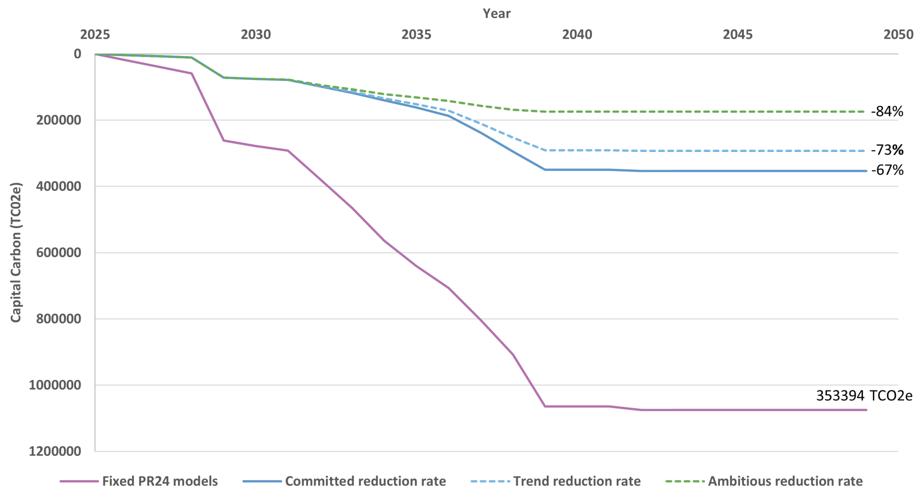
During the delivery process we would anticipate that the actual carbon impact of our strategy is likely to be significantly lower than the baseline carbon numbers presented. We report on our operational greenhouse gas emissions in detail on annual basis as part of our Annual Integrated Report[75].

Capital Carbon

There is uncertainty in the extent to which reductions in capital carbon could be achieved in the timescale of our programme, particularly in how fast other key sectors such as concrete, and steel production could decarbonise to meet the Government commitment to net zero by 2050.Figure 157 demonstrates how the capital carbon impact of Plan B could differ under alternative capital carbon futures. It shows 4 different scenarios:

- Baseline capital carbon using PR24 carbon models.
- Committed reduction rate. The capital carbon reduction we will achieve according to our Net Zero 2030 strategy of a 70% reduction against our 2010 PR09 baseline.
- Trend reduction rate. The capital carbon reduction if our Net-Zero strategy rate of carbon reduction was continued to 2050.
- Ambitious reduction rate. Net zero construction achieved by 2040, modelled for comparison purposes.

Figure 157 Plan B - alternative capital carbon pathways



If we meet our committed reduction rate by 2040, we can expect to reduce the overall capital carbon impact of the Plan B by 67% against our PR19 baseline, increasing to 73% if our carbon reduction remains on trend. In an ambitious decarbonisation scenario (modelled as achieving net zero construction techniques by 2040), a reduction in Capital Carbon of 84% across the total 25-year investment plan could be achieved.

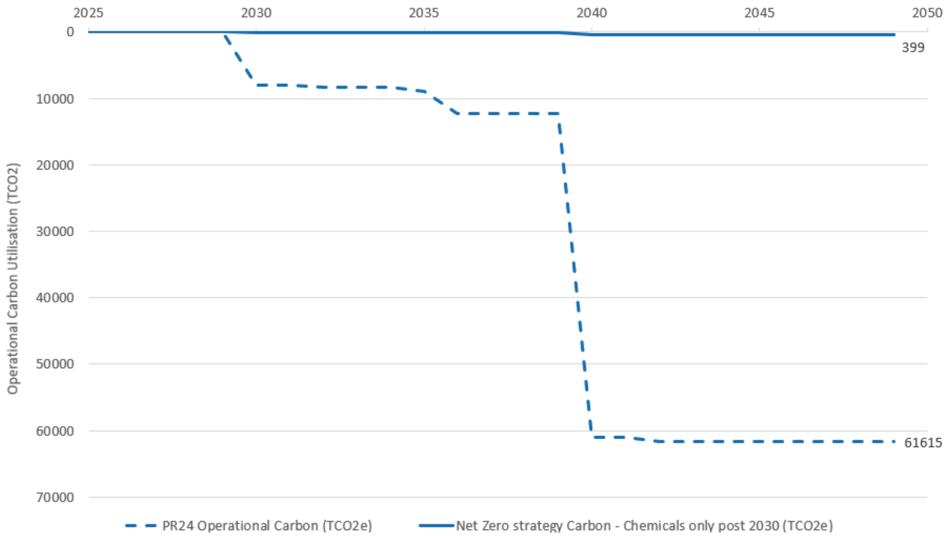
Operational Carbon

Our Net Zero strategy commits us to achieving net zero operational emissions by 2030.Figure 158 shows the effect of this strategy on the operational carbon data presented in in Section 8. The PR24 baseline shown in the dashed line results in annual carbon emissions of 61,615 tCO2e per year by 2050. Under our net zero strategy, we can expect carbon emissions to be significantly lower. There will be a small amount of carbon

75 The most recent Annual Integrated Report is available here: https://www.anglianwater.co.uk/siteassets/household/about-us/air-2023.pdf. See page 81 for a summary table of our emissions, and pages 74 to 82 for further details of our climate strategy, climate risk management approach and climate-related metrics and targets.

emissions associated with process chemicals, resulting in annual emissions of 399 tCO2e by 2050. It is likely that this number would reduce further if production of the chemicals used decarbonises over time.

Figure 158 Plan B baseline operational carbon compared to the outcome of our Net Zero strategy

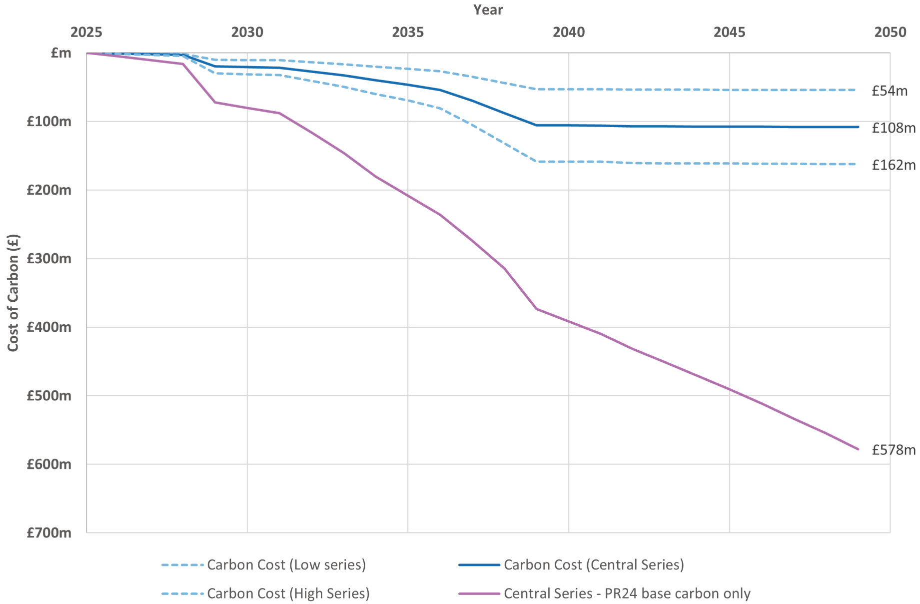


Cost of carbon

Figure 159 presents the cumulative cost of carbon, comprising the cost of carbon, using the Department of Business, Energy and Industry[76] carbon values in 2020 prices per tonne of CO2 equivalent, for both the carbon baseline using PR24 models, and the carbon future according to our capital and operational carbon Net Zero strategy commitments. The carbon values represent a monetary value that society places on one tonne of carbon dioxide equivalent (£/tCO2e) and are used to estimate a monetary value of the greenhouse gas impact of policy proposals during policy design, and also after delivery.

As Figure 159 shows, a reduction from £578 to £108m would be expected for the central cost series.

Figure 159 Plan B cumulative cost of carbon, PR19 baseline compared to committed carbon reductions



76 Department for Business, Energy & Industrial Strategy (2021) Valuation of greenhouse gas emissions: for policy appraisal and evaluation

Appendix E: Best Value Plan - Adaptive Pathways household bill assessment

This Appendix builds upon our adaptive pathways assessment to demonstrate how the core and adaptive pathways could result in changes to household bills (modelled using Ofwat's long term planning guidance assumptions, as described in Section 8.4).

Household bill impacts have been forecasted up to 2075 based on assumptions set out in Appendix A2 of Ofwat's guidance on long-term delivery strategies. The bill impact calculation is subject to limitations, such as uncertainty in predicting asset utilisation over long time frames, potential uncertainty in delivery costs and forecasting population change. The impacts also represent only part of the wider factors which determine a household bill, as other contributions to the bill may also go up or down over time. The results therefore should not be considered as a definite prediction of cost per household. However, they do show an indicative relative difference between plans and pathways for planning and decision-making purposes. All costs are presented as 20/21 price base, and do not include the effects of future inflation. The costs are also based on WRMP24 financial data, which includes a factor for optimism bias, this factor would not be present in PR24 financial data.

As set out in Section 10, the core scenario represents the investments in our preferred plan which we would have to commit to in AMP8. The adaptive pathways then show how our future investment decisions could adapt to future scenarios. For this assessment, we have focussed on adaptability to the scale of Environmental Ambition, ranging from BAU to Enhance.

Supply-side adaptive pathways household bill changes

The adaptive pathways have been translated into household bill changes, as shown in Figure 160 and Figure 161. Graph A shows the household bill changes due to supply-side investments profiled annually. Household bills rise to a peak of £54 additional per year by 2040 in the core scenario. Adaptability to the scale of environmental destination results in an additional peak annual increase of £23 for BAU, £40 for BAU+ and £79 for Enhance. This significant increase in household bills is driven by the fact that desalination solutions are required to meet the environmental destination scenarios. These solutions have a significant annual operational cost component. The way the household bill calculation is structured means that operational costs have an immediate impact on bills, in comparison to capital expenditure which is spread over time.

Graph B shows the change in average household bills AMP by AMP. In the core scenario, average bills would increase by £4 in AMP8, a further £24 in AMP9, a further £18 in AMP10 and a further £5 in AMP11. The range of uncertainty depending on the selected environmental destination scenario is shown in purple.

Demand-side household bill changes and stress-tests

Figure 162 shows the household bill changes resulting from the demand-side preferred investment portfolio, as well as the 50% leakage scenario. The preferred investment portfolio results in average household bills increasing by £4-6 in AMP8, followed by a relatively flat profile, gradually increasing to between £20-40 between 2045 and 2050. The increase towards the end of the profile can be attributed to mains replacement activities. The 50% leakage profile is similar, but shows an exponential increase over the 2025-2050 period to a peak of a £191 increase. This cost reflects the the diminishing returns of the required mains replacement investments which would be required to achieve 50% leakage.

Combined supply and demand household bill impacts

Figure 163 and Figure 164 combine the supply and demand-side portfolios to demonstrate a potential overall household bill impact. Graph A shows in the core scenario, bills increase to a peak of £87 per household per year by 2040.

Graph B shows that the in the core scenario, average bills would increase by £8 in AMP8, a further £24 in AMP9 and further £21 in AMP10 and a further £13 in AMP11. The range of uncertainty depending on the selected environmental destination scenario is shown in purple.

Figure 160 Supply-side investments adaptive pathways presented as household bill changes. A - Annual household bill change.

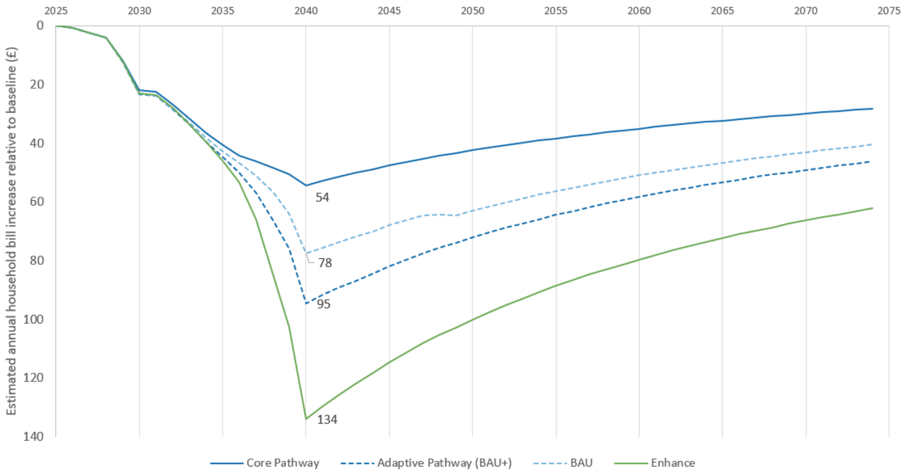


Figure 161 Supply-side investments adaptive pathways presented as household bill changes. B - Average change in bill per household AMP on AMP

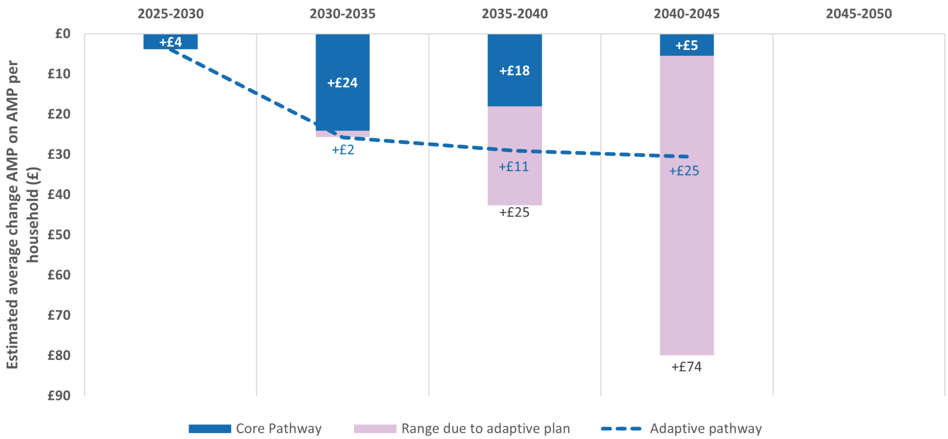


Figure 162 Average annual household bill change for preferred demand management programme (Enhanced Plus) and 50% leakage reduction and low technology stress test scenarios

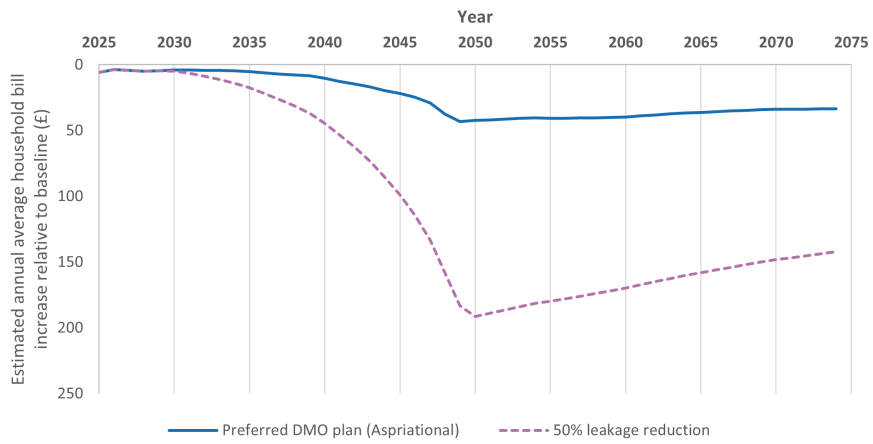
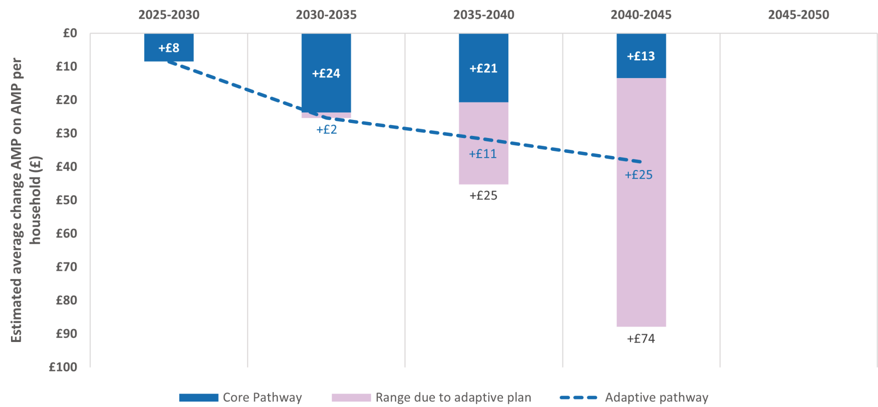


Figure 163 Combined supply and demand-side investment programme adaptive pathways, presented as household bill changes. A - Annual household bill change.

Figure 164 Combined supply and demand-side investment programme adaptive pathways, presented as household bill changes. B - Average change in bill per household AMP on AMP



Appendix F: Preliminary Economic Impact Assessment

To support our best value planning assessment, we have commissioned the creation of a preliminary economic impact assessment, which assesses the potential for localised jobs creation and Gross Value Added (GVA) [77] from those jobs for our desalination, water reuse and reservoir options. The model has been completed by a third party consultant . The model used provides an initial assessment, which will be further validated and expanded to support the ongoing development of the SRO programme.

The model has been produced to analyse and compare the economic impacts of each of the proposed options for intervention. The data is presented in terms of temporary jobs during the development and construction phase, full time equivalent (FTE) or permanent equivalent jobs across all phases and the associated employment generated GVA. It includes:

- **Direct employment:** directly generated through the construction and day-to-day operation of the intervention.
- **Indirect employment:** created and/or sustained in suppliers to the plant. These jobs represent the cumulative effect through the supply chain as initial suppliers make purchases from their suppliers and so on.
- **Induced employment:** supported by the wages and salaries of workers employed both directly by the intervention, and indirectly by suppliers to the intervention.
- **Catalytic employment:** large scale development can be expected to increase the 'gravity' of an economy or a particular sector. Suppliers often locate or set up branches near to their main customers and - land use planning and sectoral policy permitting - it is possible that the proposed developments could exert a considerable 'attraction' effect on their locations and in their related sectors. These wider catalytic benefits are not captured within the model, as they cannot be directly attributed to the reservoir, but are still important to consider.

We have used the toolkit to provide an initial estimate of jobs creation and GVA from those jobs for each of the four plans, as well as draw an initial comparison on the jobs creation and GVA benefits of reservoirs compared to desalination options.

Gross Value Added

Gross Value Added (GVA) is the value generated by any unit engaged in the production of goods and services. This metric measures added value into the economy by an industry or sector. Please note this is not to be conflated with Gross domestic product (GDP) which measures the total value of all goods and services produced by an economy over a given time period.

The model's outputs are provided across the two key stages of the project, the development phase (planning and design) and the construction phase. This is because different GVA per worker calculations are required to calculate a more complete figure for total GVA. GVA per-worker calculations were made for the industries involved in the development and construction phases by dividing industry GVA by industry employment. Both data sets were sourced from the Office for National Statistics (ONS). These calculations are then multiplied by the model's employment estimates to generate a final total Net Value Added figure for each stage of the proposed intervention.

Additionality

Additionality is the extent to which something happens as a result of an intervention that would not have occurred in the absence of the intervention. The number of jobs will be presented as gross (total) jobs created however, in line with industry standards and relevant guidance, other 'additionality' factors have been applied to also allow for an estimate of the net new jobs to be made. The additionality factors taken into consideration include:

- **Leakage** - The proportion of outputs that benefit those outside of the intervention's target area or group. For example, if the project is in Cambridge and consultants are working in London, this would contribute to leakage in the development phase.
- **Displacement/substitution** - The proportion of intervention outputs/outcomes accounted for by reduced outputs/outcomes elsewhere in the target area. For example, a construction company

77 Gross Value Added is the value generated by any unit engaged in the production of goods and services

brought in from another part of the country moves their labour from one area to another, this is displacement.

- **Deadweight** - Effects/impacts that would have occurred regardless if the project was implemented or not. For example, some of the site was due to be built by local government anyway, before the intervention was put forward.

Model overview and inputs

The model uses the Fixed capital costs for each of the reservoir, water reuse and desalination options as inputs. Other inputs include estimates of the length of the development and construction phases for each scheme, and estimates of additionality factors for Leakage, Displacement and Deadweight as defined above.

These assumptions are then converted to full time equivalents and GVA by applying Office for National Statistics GVA statistics and worker numbers by region and sector.

Table 68 andTable 69 show the assumptions that were applied to each of the options for the development and construction phases following [78]. These are rough estimates made to suggest the approximate proportion of additionality expected from each type of intervention.

Table 68 Assumptions applied to each factor for the development phase by option type

Additionality Reference			
Option type	**Leakage**	**Displacement**	**Deadweight**
Reservoir	25%	10%	10%
Desalination	25%	50%	10%
Reuse	25%	25%	10%

Table 69 Assumptions applied to each additionality factor for the construction phase by option type

Additionality Reference			
Option type	**Leakage**	**Displacement**	**Deadweight**
Reservoir	10%	25%	10%
Desalination	10%	25%	10%
Reuse	10%	25%	10%

The main differentiator is considered to be the displacement factor, which is assumed to be higher for desalination and water reuse options compared to reservoirs. This assumption has been made due to the large number of existing reservoirs in the East of England and no existing desalination plants, meaning staff and other specialists may need to be brought in from elsewhere in the country or abroad, displacing benefits.

78 Homes and Communities Agency guidelines Homes & Communities Agency (2014) Additionality Guide 4th Edition

Model results

Comparison of Reservoirs against Desalination options

The trade-off between reservoirs and desalination is a key aspect of our WRMP24 plan. To estimate the difference from a jobs creation and GVA perspective, we have calculated the total jobs creation (full-time equivalent (FTE)) and GVA for all options of each type using the toolkit, then divided this by the total water available for use (WAFU) created by these options. This creates an average number of FTE and Gross Value Added per megalitre during the development and construction phases.

Table 70 shows the result of this process. As shown, based on the assumptions applied, it has been estimated that reservoir options have around 30% more jobs creation and gross value added potential per megalitre for the East of England region compared to desalination options.

Table 70 Estimate of number of East of England based full-time equivalent jobs and GVA for Desalination and Reservoir options per megalitre of new water available for use created.

	Desalination	Reservoir	% difference
Full-time equivalent (FTE) per Ml (No.)	23	30	31%
Gross value added per Ml (£)	£ 2,259,078	£ 2,983,393	32%

Jobs creation and GVA data for the four plans taken forward for Best Value Framework assessment

Figure 165 and Figure 166 show the estimate East of England full-time equivalent jobs and gross value added data calculated (based on the assumptions above) for the four plans taken forward to best value planning framework assessment.

Figure 165 Estimated number of East of England full-time equivalent jobs during development and construction phases of the four plans (reuse, desalination and reservoir options only)

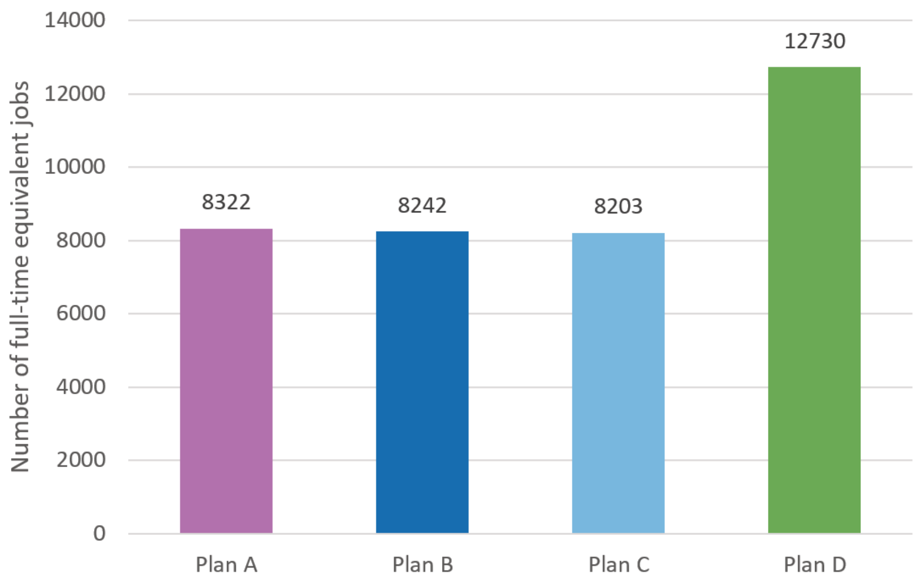


Figure 166 Estimated of East of England GVA based on the number of full-time equivalent jobs during development and construction phases of the four plans (reuse, desalination and reservoir options only)

The results indicate a similar economic impact from plans A to C and a larger impact from Plan D. This is primarily because plans A to C have similar levels of capital expenditure, whereas Plan D has higher levels of capital expenditure because of the investment required to realise the Enhance environmental destination scenario.

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THE QUEEN'S AWARDS FOR ENTERPRISE: SUSTAINABLE DEVELOPMENT 2020

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