PR24

NORTHUMBRIAN WATER *living water* | ESSEX&SUFFOLK WATER *living water*

A3-01 WRMP SUPPLY OPTIONS

NES14

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Glossary

Acronym	Definition
ACWG	All Company Working Group
AMP	Asset Management Plan
ASR	Aquifer Storage and Recovery
AWS	Anglian Water Services
BNG	Biodiversity Net Gain
BOD	Biological Oxygen Demand
Capex	Capital Expenditure
DO	Deployable Output
DWI	Drinking Water Inspectorate
EA	Environment Agency
EBSD	Economics of Balancing Supply and Demand
EDR	Electrodialysis Reversal
EIA	Environmental Impact Assessment
ESW	Essex & Suffolk Water
FAT	Full Advanced Treatment
FFT	Flow to Full Treatment
HLS	High-Level Screening
HMT	HM Treasury
IEA	Integrated Environmental Assessment
IEX	Ion Exchange
IMOD	Investment Model
LRP	Langford Recycling Plant
NPV	Net Present Value
NAV	New appointments and variation
NWG	Northumbrian Water Group
Opex	Operational Expenditure
PCV	Prescribed Concentration or Value
PFD	Process Flow Diagram
PS	Pump Station
PSV	Pressure Sustaining Valve
PWS	Public Water Supply
rWRMP	Revised Water Resource Management Plan
RWPS	Raw Water Pumping Station
SEA	Strategic Environmental Assessment
SPA	Strategic Pipeline Alliance
SRO	Strategic Resource Option
STW	Sewage Treatment Works
Totex	Total Expenditure
TW	Thames Water

Acronym	Definition
UF	Ultrafiltration
UV	Ultraviolet
WFD	Water Framework Directive
WAGS	Waveney Augmentation Groundwater Scheme
WRC	Water Recycling Centre
WRE	Water Resources East
WRMP	Water Resource Management Plan
WRP	Water Reuse Plant
WRPG	Water Resource Planning Guidelines
WRZ	Water Resource Zone
WTW	Water Treatment Works
WwTW	Wastewater Treatment Works

1. INTRODUCTION

1.1. BEST VALUE PLAN FOR SUPPLY OPTIONS

This case sets out our WRMP Supply Options and should be read in conjunction with our WRMP Demand Management (NES15) and NHH Demand Management cases (NES36). We worked with regional stakeholders and neighbouring water companies to identify the best options to include in our WRMP24. We considered what risk could be offset by using demand management, before seeking to develop supply-side options. Our planning approach used least-cost optimisation as well as broader 'best value' decision making criteria to develop a 'Best Value Plan' for WRMP24, including:

- cost to build and operate the plan;
- adaptability and flexibility of the plan to cope with uncertain future needs;
- alignment to the Water Resources North and Water Resources East regional strategies;
- resilience of the plan to severe and extreme drought and other hazards, and the residual risks;
- deliverability of the plan with timescales needed to manage risks;
- alignment to customer preferences; and
- environmental and social impacts of the plan, including net environmental benefit.

Our enhanced water supply options were developed under Essex & Suffolk Water's revised Water Resources Management Plan 2024 (rWRMP24). A WRMP has also been produced for our Northumbrian Water region but has not identified any investment need for supply options and solves the supply demand deficit in the North East through the application of demand management options (DMO). This is described in business case NES15.

The preferred plan for supply options is our Best Value Plan. This includes a range of options designed to integrate with our demand management programme to address the supply deficit in our Essex & Suffolk Water region. The plan represents the outcome of stakeholder and customer engagement, and an extensive benefits assessment process. The options and AMP8 costs are summarised in Table 1.

Section 3 of this document sets out our process for determining our preferred plan, and Section 4 provides more detail on our costing methodology. Table 1 also includes the WreN Transfer (£1.6m) which is funding for feasibility work related to an inter-regional transfer and did not form part of our WRMP Best Value Plan. This is described in Section 1.3.

TABLE 1: OUR WRMP SUPPLY OPTION COSTS – AMP8 ENHANCEMENT COSTS

Option Name	Type	Capex £m	Opex £m
New Linford WTW & Borehole(s) 10Ml/d	New groundwater abstraction and WTW	37.200	4.699
Langham WTW Nitrate scheme	Nitrate removal	40.100	0.00
Langford WTW Nitrate scheme	Nitrate removal	30.738	0.00
Langford WTW UV	Cryptosporidium removal	7.157	0.00
Langford Clarifier upgrade	Treatment capacity upgrade	8.764	0.00
Abberton Raw Water PS	Raw water pumping station capacity upgrade	0.648	0.00
Suffolk Strategic Network	Potable water transfers (Inter-connectors)	117.730	1.249
Bungay wells to Broome WTW and Broome to Barsham WTW transfers	Raw water Intra-water resource zone transfers	8.935	0.00
Lowestoft Reuse	Water reuse scheme	76.437	0.00
North Suffolk Winter Storage Reservoir 7500 and Transfer	New raw water storage reservoir	34.831	0.00
Barsham Nitrate scheme	Nitrate removal	16.017	0.00
WReN / WRW Inter-Regional Transfer Strategic Resource Option (feasibility)	Inter-regional transfer	1.600	0.00
Total		**380.157**	**5.948**

1.2. OUR WRMP

Our statutory Water Resources Management Plan (WRMP24) sets out the investment required to ensure reliable supplies of water for our customers. The plan covers the period from 2025 to 2100 with a particular focus on the minimum 25-year planning period (2025 to 2050).

Through this process, we have established a clear need to improve water supply resilience in the Essex & Suffolk Water region, especially in the Suffolk area where we need to urgently address a material water supply deficit. Reductions in the amount of water we are permitted to abstract from rivers, recently applied by the Environment Agency, and the impact of climate change on levels of rainfall and river flows are key factors driving this need.

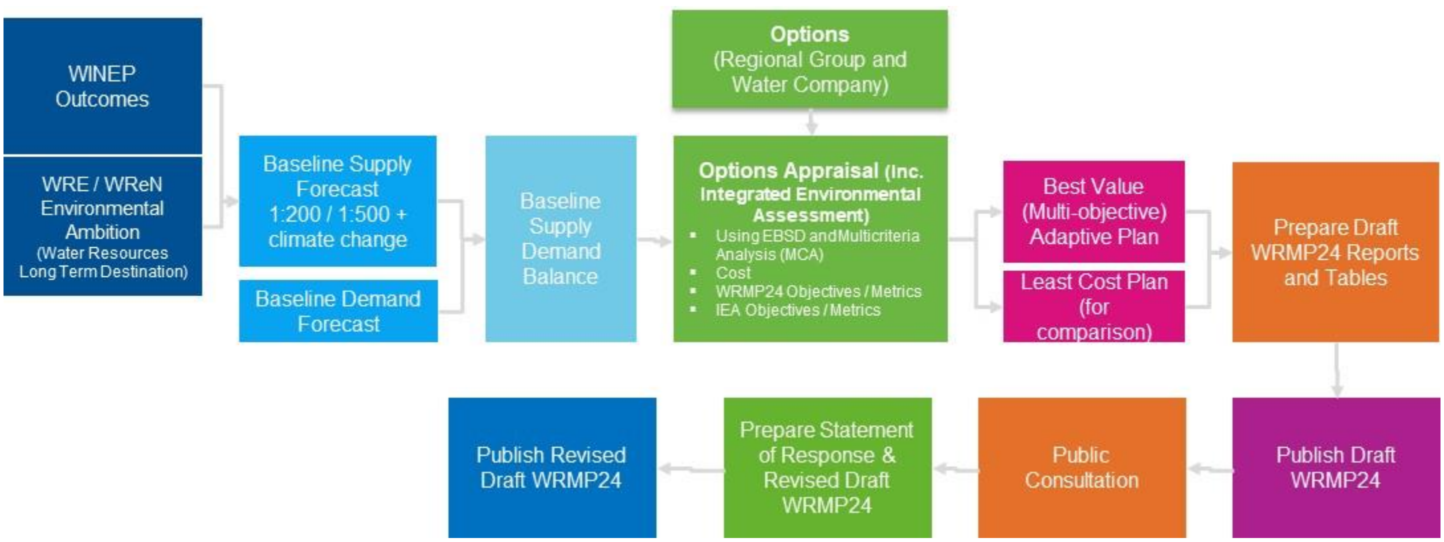
Our supply and demand modelling, which considers future forecasts based on factors including climate change, population growth and changes in environmental legislation, has allowed us to quantify the level of water supply deficit and develop a robust package of options to maintain a resilient supply for our customers over a long-term planning horizon.

The enhancement options outlined in this case have been selected via a comprehensive options development and screening process and have been subject to benefits assessment and customer testing. Our case for securing future water supply in Essex and Suffolk is based on our WRMP24 Best-Value plan and comprises multiple schemes to be implemented in AMP8 as part of a long-term multi-AMP approach. Our WRMP24 is an adaptive plan with four alternative programmes that have been defined by testing our plan against a range of different future scenarios. These adaptive programmes will be reviewed at key decision points in delivery, to ensure we are able to adapt our approach efficiently should the need arise.

It should be noted that this package of supply options has been developed as part of the larger WRMP picture which aims to achieve the best balance for our customers between increasing supply and reducing demand (through our leakage, metering, and demand management activities).

Figure 1 provides an overview showing key steps of our WRMP24 development process referred to within this document.

FIGURE 1: WRMP24 DEVELOPMENT PROCESS



Our supply options have been identified through an extensive process of options development, appraisal and screening, and assessment of benefits. Costs have been developed and assured using our iMOD cost assessment database of previous historical investments. As part of our accelerated delivery proposals that we submitted to Ofwat and Defra and which will form part of the transitional spend for AMP 8, we intend to take forward further work on the design of the material schemes emerging from this plan. We hope that this work will further strengthen the evidence base to support these schemes and to improve design and costing information later in the PR24 process.

In defining the need for investment and identifying the supply side interventions to address the need, we have considered government policy as set out in the Water Resources Planning Guidelines[1] including the requirements to:

[1] Water resources planning guideline - GOV.UK (www.gov.uk)

- provide a secure and clean water supply as expected by customers in a way that provides value for customers, society and the environment over the long-term;
- improve supply resilience by planning to raise customer levels of service for a Level 4 drought plan restrictions (standpipes and rota cuts) from 1 in 200 years to 1 in 500 years by 2040;
- reduce household Per Capita Consumption (PPC) to 110l/head/day by 2050 as well as working with retailers to implement actions to assist non-household (NHH) users to sustainably reduce their water use (by reducing non-household demand by 9% by 2037/38);
- reduce leakage by 50% from 2017/18 levels by 2050;
- customers reduce water demand and water lost through leaks by adopting consistent approaches to support repair and replacement of supply pipes;
- install smart meters as a standard;
- consider compulsory metering in regions assessed by the Environment Agency (EA) to be a Serious Water Stressed Area. The Essex & Suffolk region is currently classified as a Serious Water Stressed Area;
- adapt to climate change; and
- demonstrate a step change in rectifying overreliance on unsustainable water sources.

We have assessed vulnerability to various strategic issues, risks and uncertainties to determine economic and best value modelling approaches using our problem characterisation assessment tool. Our assessment has shown that whilst there is a relatively large deficit problem to solve, the issues associated with this are of low to medium complexity and so well understood. These include:

- the impact of climate change;
- Sustainability Reductions and Environmental Destination impacts; and
- the impact of Covid-19 on household and non-household demand forecasts.

Our revised WRMP24 has been audited by Jacobs consultants[2] to confirm that:

- we have met obligations in developing our plan;
- our plan reflects the Water Resources East regional plan;
- we have developed a best value plan for managing and developing our water resources so we can continue to meet our obligations to supply water and protect the environment; and
- we have developed a plan that is based on sound and robust evidence including relating to costs.

1.3. WREN TRANSFER – STRATEGIC RESOURCE OPTIONS

In addition to our WRMP Best Value Plan, we have identified a funding requirement for feasibility work related to Inter-regional Transfer Strategic Resource Option (SRO). We have included £1.6m Capex for this work in our business case. This is the only element of our supply options business case that relates to our Northumbrian Water region.

[2] WRMP24 Technical Assurance Report September 2022

Northumbrian Water, Yorkshire Water (YW) and United Utilities (UU) have confirmed their WRMP24 preferred final plans. Northumbrian Water and Yorkshire Water have included the 140Ml/d (365 days/annum) Tees to York Transfer from 2040. This is required because the deployable output of Yorkshire Water's River Derwent abstraction will reduce due to sustainability reductions following the re-naturalisation (removal of weir structures etc) of the River Derwent. However, there is a level of uncertainty as investigations to confirm the size of the sustainability reductions will not conclude until 2026/27. Consequently, the final sustainability reductions may be smaller or larger than YW has assumed in the central plan which may result in the selection of different schemes.

Northumbrian Water and United Utilities have both considered a 100Ml/d Kielder Reservoir to United Utilities Transfer option although it was not selected in UU's least cost plan or best value plan for its own security of supply / resilience or in any of its adaptive pathways. Likewise, Water Resources North and Water Resources West have also considered the option to support security of supply and increase resilience in other regions (e.g., Water Resources South East). However, the latest round of regional reconciliation concluded that the transfer was not required, largely because of the high unit costs (£/Ml/d) associated with the scheme and that there were other better value feasible options.

Nevertheless, RAPID would like both options (along with other Yorkshire Water Options) to be further developed, possibly as an SRO. This is because, as the detailed engineering design stage of options progress, there is a risk that SROs in other regions become unfeasible because of an insurmountable issue. Should this be the case, the Kielder Transfer then may become a favoured option.

The surplus of water in Kielder reservoir means we can only provide a raw water export to one of the companies. Consequently, a Strategic Resource Option (SRO) is proposed to:

- review inter-regional transfers between Water Resources North, Water Resources West and Water Resources South East; and
- confirm, of the two Kielder schemes (Kielder to UU or Tees to YW) which option provides the best value.

We have included a funding allowance of £1.6m in our PR24 Business Plan (Table CW4: Rows 56 and 57). The allowance is based on our 50% contribution to the consultancy fee proposal of £3.2million to get the Kielder to UU Transfer to Gate 2 (the end of the feasibility assessment phase). United Utilities will fund the remaining 50%. Yorkshire Water will cover the cost of its schemes. The funding has been profiled so that the work can conclude in time to inform draft WRMP29 supply demand forecasts. The scope for the work is to undertake further hydrological modelling at a water resource zone (WRZ), water company and regional level along with further option feasibility, design, and environmental assessment.

2. NEED FOR ENHANCEMENT INVESTMENT TO PROVIDE NEW SUPPLIES

2.1. INTRODUCTION

This section describes the work we have done as part of our draft WRMP24 to accurately assess our baseline supply demand balance. This has identified significant forecast supply demand deficits in all four of our Essex & Suffolk Water Resource Zones (WRZ). These deficits have informed the need for enhanced investment to deliver the supply-side interventions described in this case.

East Anglia is one of the driest parts of the country and continues to be classified by the Environment Agency as a Serious Water Stressed Area. Essex & Suffolk Water cover two geographically separate supply areas, with water supplied to approximately 1.76 million customers in the Essex supply area and 0.28 million customers in Suffolk and Norfolk, which we refer to as the Suffolk supply area. Within East Anglia we have four WRZs, one in Essex and three in the Suffolk supply area, known as the Blyth, Hartismere, and Northern Central WRZs. Schematic diagrams of the WRZs and associated infrastructure are shown below (Figure 2 and Figure 3).

FIGURE 2: SUFFOLK WRZ

FIGURE 3: ESSEX WRZ

2.2. OUR PREVIOUS WRMP

Our previous WRMP19 was published in 2019 and forecast a final plan supply surplus across the full planning period in all of our WRZs. As such, no supply schemes were required in AMP7. Our AMP7 plan is delivering demand management interventions including reducing leakage by 17.5% by 31 March 2025, as well as a smart metering pilot and water efficiency programmes to reduce per capita consumption to 118l/head/day by 2040.

Key changes to the baseline supply demand balance in our plan since 2019 include:

- **Provision of a 1 in 500-year level of resilience:** this return period is the level of service for Level 4 restrictions on customer demand and specifically relates to the use of standpipes and rota cuts.
- **New abstraction sustainability reductions:** These are applied where a Water Industry National Environment Programme (WINEP) environmental investigation has concluded that an abstraction is not sustainable (i.e., it could have an adverse impact on the environment). In some cases, the annual licensed quantities on our groundwater abstraction licences have been reduced.
- **Environmental Destination:** to deliver longer term sustainability and environmental resilience in our region.
- **Climate change:** We have used the latest UK Climate Projections 2018 (UKCP18) which have had a more significant impact on summer river flows, and therefore deployable output, than the previous UK Climate Projections 2009 (UKCP09) did.
- **Non-household demand:** Our latest non-household demand forecast includes new demand from meat processing (particularly in the Hartismere WRZ) as well as from hydrogen production and new nuclear power stations at Sizewell in Suffolk and Bradwell in Essex.
- **New methods:** We have used new statistical methods for forecasting supply and demand, specifically the use of stochastics for supply forecasts.

In particular, new abstraction sustainability reductions in the Suffolk WRZs and the requirement for a higher level of resilience have introduced new reductions in supply that could not have been forecast in our WRMP19 plan (as these are new requirements since then). Tables 3 and 4 show the impact of each of these key changes.

These changes have resulted in our revised WRMP24 baseline plan forecasting supply and demand deficits in the dry year annual average (DYAA) as follows:

- Supply and demand deficits for Essex and Hartismere WRZs over the whole planning horizon, when planning to provide a 1 in 500-year level of resilience.
- Deficits from AMP8 and AMP9 for our Blyth and Northern Central WSZs respectively.

The following sections explain in more detail the processes we have followed to identify these supply deficits informing the need for enhanced investment as part of our statutory obligations and long-term plans to provide a secure, sustainable supply of water to our customers, and to protect and enhance the environment.

2.3. OUR BASELINE SUPPLY FORECAST

2.3.1 Water Available For Use (WAFU)

The baseline supply forecast confirms the amount of Water Available For Use (WAFU) in Ml/d in each WRZ across the planning period. WAFU is the deployable output (DO) of each source (or group of sources) totalled for the WRZ less:

- future changes to deployable output from sustainability changes, including sustainability licence reductions, long-term environmental destination, a changing climate, and any other expected changes;
- existing transfers and schemes where planning permission is already in place;
- an allowance for short term losses of supply and source vulnerability, known as outage;
- any operational use of water or loss of water through the abstraction-treatment process.

WAFU can then be plotted on a graph against forecast demand (see Section 4 of the rWRMP24 main report) to present a supply demand balance (see Section 6 of the rWRMP24 main report). Where demand is greater than supply in a given year, then a supply deficit is forecast. If demand management options to deliver government targets for leakage reduction and per capita consumption (PCC) do not restore a supply surplus, then new supply schemes may be required.

2.3.2 Summary of baseline supply forecast components

Table 2 illustrates the various components of WAFU and references to the main rWRMP24 report where these components are defined.

TABLE 2: WAFU COMPONENTS AND RWMP24 OUTCOMES

WAFU COMPONENT	DESCRIPTION	RWRMP24 OUTCOME	RWRMP24 REPORT SECTION REFERENCE
Groundwater DO	In line with the EA's WRPG (December 2021) we need to be able to plan to be resilient to a 1 in 200-year drought up to 2039 and to a 1 in 500-year drought to the remainder of the planning horizon.	The total groundwater baseline annual average DO of our Essex and Suffolk area reduced by 1.35 Ml/d from PR19 to PR24, from 56.32 Ml/d to 55.00 Ml/d	Section 3.2.4
Sustainable abstraction	The sustainability reductions we are including in our WRMP24 are significantly higher than those included in our WRMP19 and derive from four sources: • Delivery of agreed licence reductions for some groundwater licences during AMP8, arising from AMP7 WINEP investigations and options appraisals; • Application of EA advised licence caps to groundwater sources by March 2030, or earlier for expiring time limited licences, licences with expiring time limited clauses or on licence variation, to reduce the risk of waterbody deterioration under the Water Framework Directive (WFD) (so-called 'No Deterioration' caps); • Implementation of new Hands off Flow (HOF) conditions on some surface water abstractions during AMP8, arising from AMP7 WINEP investigations, to achieve Environmental Flow Indicator (EFI) compliance at full licence abstraction. • Application of EA advised sustainability reductions and / or stricter HOF conditions for up to nine groundwater and surface water sources by 2026/27 to meet the requirements of the Conservation of Habitats and Species Regulations 2017 (the Habitats Regulations).	The reductions arising from the first three sources have been included within our baseline and / or preferred plan, the total reduction in groundwater licence by March 2030 being 49.06 Ml/d. The potential sustainability reductions for up to nine groundwater and surface water sources by 2026/27 to meet the requirements of the Habitats Regulations, have been included as an adaptive programme within our WRMP24.	Section 3.3
Long-term environmental destination	While the sustainability reductions identified in the previous section are to meet our current WFD and Habs Regs obligations in the shorter term, we are also working with our regional water resources group, WRE, to identify a longer-term environmental destination for our region, to deliver longer term sustainability and environmental	Under the BAU+ scenario, a total reduction of 39.72 Ml/d is forecast as follows: Essex WRZ=2 Ml/d, Blyth WRZ=1.72 Ml/d, Hartismere WRZ=0.65 Ml/d	Section 3.4

WAFU COMPONENT	DESCRIPTION	RWRMP24 OUTCOME	RWRMP24 REPORT SECTION REFERENCE
	resilience.	and Northern Central WRZ = 35.35. This represents an 8% reduction in baseline DO. We have assumed that half of the reductions will be met from 2040/41, and the total reductions from 2045/46.	
Climate change	The UK Climate Projections 2018 (UKCP18) Regional Climate Model (RCM) data have been selected as the most appropriate climate change data set as it supersedes the UK Climate Projections 2009 (UKCP09) data used for WRMP19 climate change analysis.	Total company level DO for 1:500-year scenarios with medium climate change pre and post 2030 EA licence caps: Groundwater: • Pre 2030 – 73.76 Ml/d • Post 2030- 47.41 Ml/d Surface water: • 2050 –26.97 Ml/d • 2080- 43.58 Ml/d	Section 3.5
Water transfers	We have an agreement to supply Anglian Water with an export of 3.05 Ml/d from seven locations of our Essex WRZ, which has been included in our plans. In Northern Central WRZ we have an export agreement with Anglian Water as well for two bulk supplies totalling 0.73Ml/d. Our contractual agreement is for 1 Ml/d import at Cressing, Essex, which has been included within our plans. A total of 19 New appointments and variations (NAVs) are either already in place or expected in the near future, served by a total of four appointees. The majority (95%) of NAV's are for new housing developments within specific areas. The agreed exports for these schemes has been included within our plans.	The total contractual export for all NAVs in our area is 8.68Ml/d. Both the import and export are seen as secure in all circumstances and so no amendments to them are necessary under drought conditions.	Section 3.6

WAFU COMPONENT	DESCRIPTION	RWRMP24 OUTCOME	RWRMP24 REPORT SECTION REFERENCE
Outage allowance	For WRMP19, the outage allowance was based on Monte Carlo simulations using a normal distribution to reflect the possible outages at each WTW. For WRMP24 this has been updated to a 'histogram approach' where actual outages for each WTW were used to create a discrete distribution, based on bins, for each WTW that was then ran through a Monte Carlo simulation.	DYAA outage allowances for each WRZ under 1 in 200 and 1 in 500 LOS scenarios are as follows: 1 in 200 year • Essex WRZ:5.7 Ml/d • Blyth WRZ 0.68 Ml/d • Hartismere WRZ 0.04 Ml/d • Northern Central 8.83 Ml/d 1 in 500 year • Essex WRZ:0 Ml/d • Blyth WRZ 0.68 Ml/d • Hartismere WRZ 0.04 Ml/d • Northern Central 8.83 Ml/d	Section 3.7
Losses from process and treatment	In-line with Environment Agency (2021) supporting guidance, we have considered the following components as part of our determination of total raw water and treated water process losses: • Raw water losses • Raw water operational use • Treatment works losses • Treatment works operational use	All treatment works losses and operational use at WTWs in the Essex WRZ are incorporated into our Essex WRZ Aquator® system model. There are losses accounted for at our East London groundwater fed WTWs at Stifford and Roding and the process loss at Langford WTWs. Process losses at all other WTWs are returned to source waters and are re-abstractable. Therefore, there are no losses required to be incorporated into the WAFU calculation in line 8BL as a reduction in deployable output. The process losses for each of the Suffolk WRZs, as a percentage of total WRZ deployable output, are 3.7% for Blyth, 4.5% for Hartismere,	Section 3.8

WAFU COMPONENT	DESCRIPTION	RWRMP24 OUTCOME	RWRMP24 REPORT SECTION REFERENCE
		and 11.8% for Northern Central.	

2.3.3 Baseline supply assessment results

WAFU values, across the planning horizon, for our WRZs are summarised in Table 3 and 4 below.

TABLE 3: WAFU VALUES FOR ESSEX WRZ

Essex WRZ	2025/26	2030/31	2035/36	2040/41	2045/46
DO	428	428	428	428	428
Climate Change Impact	-16.37	-19.60	-22.53	-25.52	-28.57
Sustainability Reductions	0	-5	-5	-5	-5
Environmental Destination	0	0	0	-2	-2
Outage*	0	0	0	0	0
Process Losses	0	0	0	0	0
WAFU (own sources)	411.27	403.40	400.47	395.48	392.43
Water Imported**	1	1	1	1	1
Water Exported (incl. NAVs)	-29	-32	-11	-11	-11
Total WAFU	**383.59**	**372.59**	**390.17**	**385.18**	**382.13**

*Outage under the 1 in 200 DYAA year scenario is 5.70 Ml/d. This is added as a positive number in the WRMP Data Table 3b, line 9.1FP.
**Chigwell WTW is now incorporated into our Essex WRZ DO, and so the bulk import of raw water is no longer added into line 2BL.

TABLE 4: WAFU VALUES FOR BLYTH WRZ

Blyth WRZ	2025/26	2030/31	2035/36	2040/41	2045/46
DO	14.68	14.68	14.68	14.68	14.68
Climate Change Impact	0	0	0	0	0
Sustainability Reductions	-1.92	-6.00	-6.00	-6.00	-6.00
Environmental Destination	0	0	0	-0.86	-1.72
Outage	-0.68	-0.68	-0.68	-0.68	-0.68
Process Losses	-0.54	-0.32	-0.32	-0.30	-0.27
WAFU (own sources)	11.54	7.68	7.68	6.84	6.01
Water Imported	2.27	1.39	1.39	1.32	1.32
Water Exported	-1.38	-1.38	-1.38	-1.38	-1.38
Total WAFU	**12.43**	**7.69**	**7.69**	**6.78**	**5.95**

TABLE 5: WAFU VALUES FOR HARTISMERE WRZ

Hartismere WRZ	2025/26	2030/31	2035/36	2040/41	2045/46
DO	8.65	8.65	8.65	8.65	8.65
Climate Change Impact	0	0	0	0	0
Sustainability Reductions	-2.27	-2.27	-2.27	-2.27	-2.27
Environmental Destination	0	0	0	-0.33	-0.65
Outage	-0.04	-0.04	-0.04	-0.04	-0.04
Process Losses	-0.30	-0.29	-0.29	-0.24	-0.20
WAFU (own sources)	6.04	6.05	6.05	5.77	5.49
Water Imported	2	1.46	1.46	1.09	0.73
Water Exported	-0.02	-0.02	-0.02	-0.02	-0.02
Total WAFU	**8.02**	**7.49**	**7.49**	**6.84**	**6.20**

TABLE 6: WAFU VALUES FOR NORTHERN CENTRAL WRZ

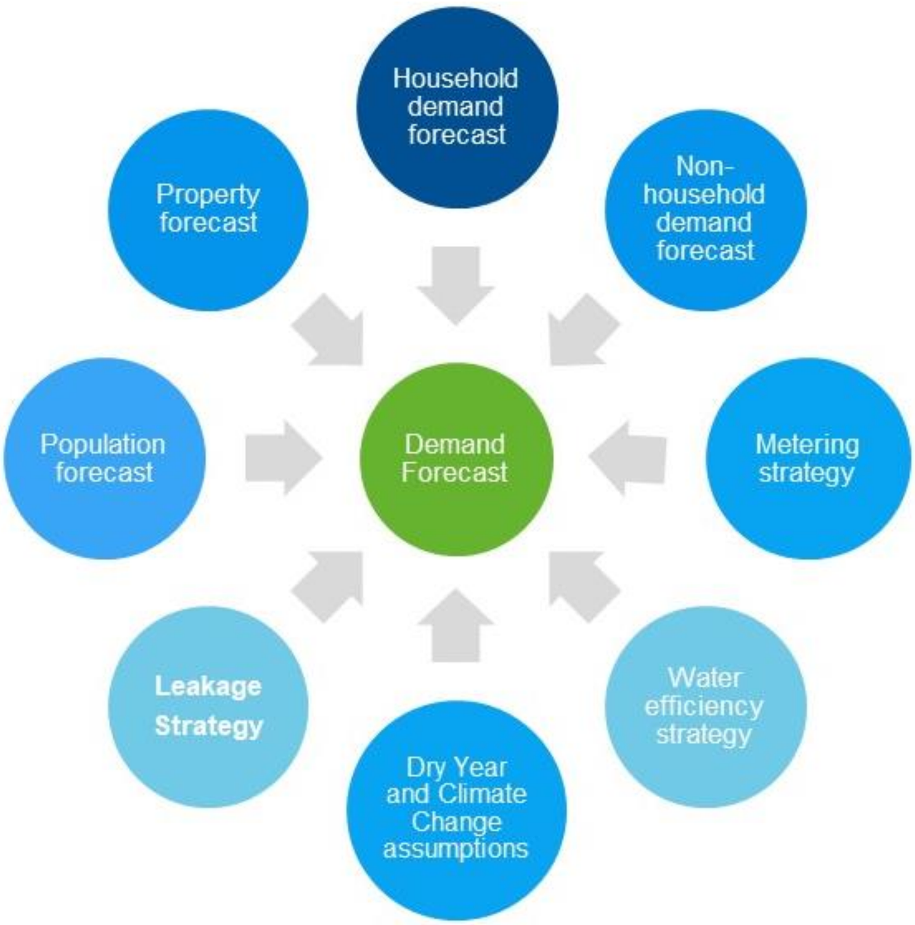
Northern Central WRZ	2025/26	2030/31	2035/36	2040/41	2045/46
DO	77.25	77.25	77.25	77.25	77.25
Climate Change Impact	0	0	0	0	0
Sustainability Reductions	-0.80	-4.85	-6.85	-6.85	-6.85
Environmental Destination	0	0	0	-17.67	-35.35
Outage	-8.83	-8.83	-8.83	-8.83	-8.83
Process Losses	-8.75	-8.38	-8.23	-5.86	-3.49
WAFU (own sources)	58.87	55.19	53.34	38.04	22.73
Water Imported	1.35	1.35	1.35	1.35	1.35
Water Exported	-3.75	-3.20	-3.20	-2.40	-2.40
Total WAFU	**56.47**	**53.34**	**51.49**	**36.99**	**21.68**

2.4. OUR BASELINE DEMAND FORECAST

2.4.1 Overview of demand forecasting

We produced a normal year baseline demand forecast following the Water Resources Planning Guidance (WRPG) for each of the WRZs Essex, Blyth, Hartismere, Northern Central. The normal year demand forecast is the building block for the dry year and critical period forecasts and is adjusted to provide figures for two climate change scenarios.

FIGURE 4: COMPONENTS OF THE DEMAND FORECAST



Our demand forecasts are segmented into:

- measured and unmeasured HH and NHH consumption;
- leakage,
- miscellaneous use,
- and exported water - including water use for New Appointments and Variations (NAVs).

They include assumptions and best estimates for areas such as savings associated with metering, customer behaviour changes, and the impact of Covid-19.

Forecasting the future of demand inherently includes uncertainty. For the long-term water demand forecasting we account for uncertainties including those from; population and housing growth, economic changes, behavioural changes, technological changes, NHH change in water use, weather, climate, government led interventions and private water supplies switching during drought conditions. To understand these uncertainties a suite of demand scenario forecasts has been built covering multiple metering, water efficiency, leakage, and growth options.

2.4.2 Baseline demand forecast component summary

Table 7 illustrates the baseline supply components and links to the main rWRMP24 document where these components are defined.

TABLE 7: DEMAND FORECAST COMPONENTS AND RWRMP24 OUTCOMES

Demand forecast component	Description	rWRMP24 Outcome	rWRMP24 section
Population forecasting	The foundation for demand forecasting is the base year population served and the projected growth of population across the planning horizon, this is a highly specialized fundamental part of the demand forecast, along with property growth. We commissioned specialist consultants Edge Analytics to prepare the population and property growth forecasts for each WRZ in line with best practice methodology following the requirements of the WRPG.	In all WRZ's overall population is forecast to increase. Low, medium and high scenario forecasts have been created to allow for changes in assumptions and uncertainty within the population forecasts. On average for Essex this has resulted in a 22% increase in total population to 2049/50 and for Suffolk a 13% increase.	Section 4.3.1
Property forecasting	Base year property figures are taken from our customer billing database. We have selected three scenarios from Edge Analytics suite of scenarios to give a low, medium and high property growth forecast. These scenarios are the same as the population scenarios.	The number of properties is forecast to increase in all WRZ's. Low, medium and high scenario forecasts have been created to allow for changes in assumptions and uncertainty within the forecasts. On average for Essex this has resulted in a 29% increase over 25 years and for Suffolk a 21% increase in household properties.	Section 4.3.2
Occupancy forecasting	An overall occupancy figure is determined by the Edge Analytics data through total population divided by the total number of billed households for a year to give the overall occupancy rate. However, an overall occupancy figure is at too high a level to be useful for each of the households directly. To ascertain what occupancy to assign to each household metering	The overall occupancy for all households steadily declines from 2.77 in 2021/22 down to 2.62 in 2049/50 in Essex (-5.6%) and 2.34 in 2020/21 down to 2.18 in 2049/50 in Suffolk (-6.9%).	Section 4.3.3

Demand forecast component	Description	rWRMP24 Outcome	rWRMP24 section
	category[3] several occupancy data sources are used to ensure a best estimate for the base year.		
Household customer demand	The household demand forecast has been developed by considering the population in the following five groups: Unmeasured customers, Existing metered customers, New Homes, Meter Optant customers and Selective / Compulsory metered customers. These groups have been chosen as their consumption characteristics are considered to be distinctly different. A peer review of the household demand forecasts has been conducted by specialist consultants Crowder. This review has assured the micro-component forecasting method employed for household demand forecast follows the guidelines for WRMP. Amendments and recommendations following the peer review have been applied to the household demand forecasts.	In summary the baseline household consumption forecast is estimated to increase over the forecasting period which is predominantly driven by population and property growth. Measured consumption increases and unmeasured decreases due to the natural optant metering.	Section 4.4
Impact of Covid-19	The impact of the Covid-19 pandemic and the associated measures to reduce transmission continue to affect the activities of society and have had an unforeseen outcome within the water industry. The large impact on water consumption in homes and businesses as a result of restrictions and lockdowns, combined with the hot and dry weather of 2020 has resulted in some of the highest peaks in water demand we have ever seen.	This modelled data from the Artesia study[4] shows that the PCC increase due to Covid-19 is estimated to reduce to between 2-3% by 2025 compared to a 6-8% increase for 2021/22 (base year). These estimates give an idea of how consumption will vary for the remainder of the Asset Management Plan (AMP) regarding the effect of Covid-19 and have been applied to the micro-component PCC baseline demand forecasts.	Section 4.4.3
Non household demand	To understand our current and future NHH demand we began by analysing our current NHH demand at an industry sector level. We also contacted all Local Authorities located within our operating areas to request information they held on new NHH developments and growth. In addition, we also contacted all our large users[5]	The Final Plan option for non-household demand sees measured new non-household large users demand delayed until the year 2032/33 in our Suffolk WRZ's only. This is due to the delay in supply available to these WRZ's.	Section 4.5

[3] Measured (optant, new build, selective/compulsory, existing) and Unmeasured are the household meter type categories.
[4] Artesia Consulting (2020) Collaborative Study - The impact of Covid-19 on water consumption
[5] A large user is defined as a premise using greater than 20,000 cubic meters per year.

<table>
<tr><th>Demand forecast component</th><th>Description</th><th>rWRMP24 Outcome</th><th>rWRMP24 section</th></tr>
<tr><td></td><td>requesting the provision of expected changes to demand in the short and medium term. Our aim is to continue these conversations with Local Authorities, retailers and large users throughout the WRMP24 process and then into the planning horizon to ensure we have a timely awareness of local hot spots for NHH development.</td><td></td><td></td></tr>
<tr><td>Forecasting leakage</td><td>We have conducted research into quantifying supply pipe leakage (SPL) to better understand this area of total leakage. Our base year total leakage is taken from the current reported actual leakage from our company water balance for the base year following the consistent reporting performance measures[6]. In line with the WRPG total leakage, including supply pipe leakage, is forecast to remain constant from for the planning horizon for our baseline forecast.</td><td>Total forecast leakage<table><tr><th>WRZ</th><th>TOTAL LEAKAGE 2021/22 (ML/D)</th><th>TOTAL LEAKAGE 2024-2050 (ML/D)</th></tr><tr><td>Essex</td><td>53.34</td><td>48.72</td></tr><tr><td>Blyth</td><td>1.93</td><td>1.54</td></tr><tr><td>Hartismere</td><td>1.32</td><td>0.75</td></tr><tr><td>Northern Central</td><td>2.71</td><td>2.78</td></tr></table></td><td>Section 7.3.1</td></tr>
<tr><td>Forecasting metering</td><td>Our current strategy in both Essex and Suffolk areas is to install meters on customer optants and high-water users. In 1990 it became compulsory for all new homes to be fitted with a water meter. Optant metering is where a customer requests a meter from the company and, assuming the meter can be installed at reasonable cost, the company is required to install a meter free of charge. The customer then pays for their water and sewage on a measured basis.</td><td>In Essex by the end of 2024/25 meter penetration is estimated to be 68.51% of domestic properties for our baseline forecast. By the end of the planning horizon (2100) the baseline meter penetration is forecast to be 89.79%.
In Suffolk by the end of 2024/25 meter penetration is estimated to be 73.10% of domestic properties for our baseline forecast. By the end of the planning horizon the baseline meter penetration is forecast to be 86.72%.</td><td>Section 7.3.2</td></tr>
<tr><td>Impact of climate change on demand</td><td>The UKWIR ‘Impact of Climate Change on Water Demand[7]’ results have been used to calculate forecasts of climate change impacts on household water demand. This UKWIR project used statistical analysis on five case studies looking at household and micro-component water consumption and non-household water consumption.</td><td>The report stated that household demand is the only component of demand affected by climate change. Non-household demand is not expected to be affected by climate change.</td><td>Section 4.10</td></tr>
</table>

[6] UKWIR (2017) Consistency in reporting performance measures
[7] UKWIR (2013) Impact of Climate Change on Water Demand

Demand forecast component	Description	rWRMP24 Outcome	rWRMP24 section
Water Efficiency	Included in our plan are three core elements of water efficiency delivery: • Household water efficiency- PCC of 110 l/h/d by 2050 • Smart metering programme- PCC of 110 l/h/d by 2050 • Business demand- reduce NHH demand by 9% by 2038 The interventions are the output of fully costed option appraisal following the appropriate methodologies and guidelines provided by the Environment Agency (EA).	Household water efficiency • Low scenario-0.49 • Medium scenario-0.97 • High scenario-1.08 • Medium enhanced-1.31 Non-Household water efficiency • Total in AMP saving Ml/d-1.45	Section 7.3.3

2.4.3 Baseline demand forecast results

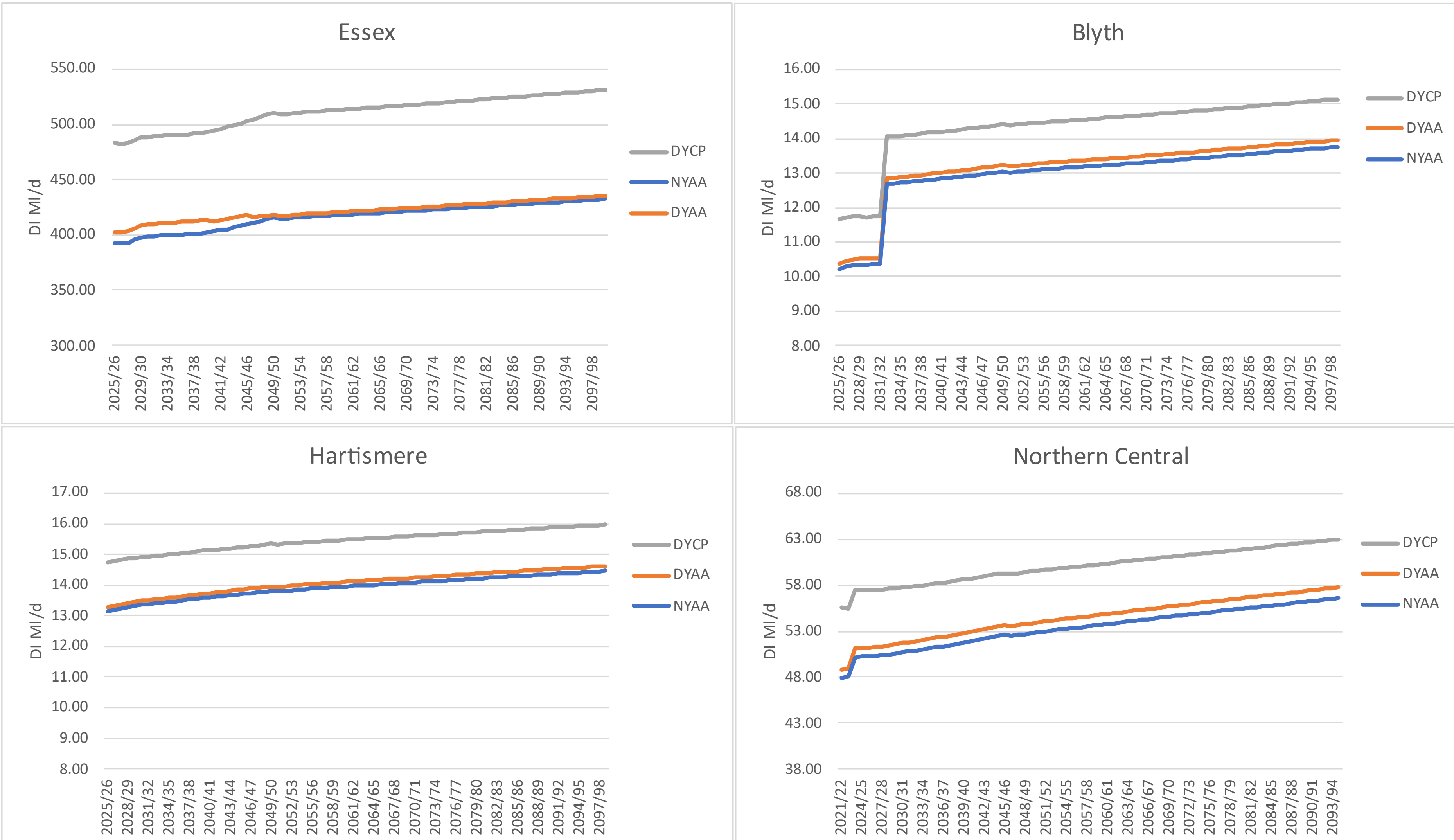
Normal year forecasts have been made against a 2020/21 base year, which has been amended from the published Annual Regulatory report figures to incorporate the rebasing process for properties, as well as normalising the 2020/21 per capita consumptions (PCCs). This ensures a smooth projection from the base year into the forecast.

The baseline demand forecast incorporates the following conditions:

- Customer demand without any further water efficiency or metering interventions from 2025/26 onwards.
- Normal rates of optant, selective and meter replacements from 2025/26
- Leakage remains static from 2025/26
- Population and property growth forecast using Local Authority (LA) Housing Planned growth medium scenario.
- NHH growth forecast with service industries driven by LA Housing Planned growth and new large users requested volumes.
- The impact of climate change on customers' behaviour
- Government led interventions applied to household consumption.

Normal Year, Dry Year and Critical Period baseline demand forecasts for our WRZs are illustrated in Figure 5.

FIGURE 5: BASELINE DEMAND FORECAST DI FOR CRITICAL PERIOD (DYCP), DRY YEAR (DYAA) AND NORMAL YEAR (NYAA) SCENARIOS



2.5. BASELINE SUPPLY DEMAND FORECAST SUMMARY

2.5.1 Baseline Supply Demand Overview

Our baseline dry year supply and demand (SDB) forecasts have been used to produce a Baseline Dry Year Supply Demand Balance for each of our WRZs. All the known changes to the supply forecast and the known baseline demand management policies to 2025 have been included in these calculations.

The baseline supply demand balance calculation is used to identify whether a WRZ is predicted to have a supply deficit at any point over the planning horizon. For each WRZ, a supply demand balance graph has been prepared. The supply forecast is a forecast of Water Available for Use (WAFU) and the demand forecast is a forecast of Distribution Input (DI).

2.5.2 Baseline dry year annual average (DYAA) supply demand balance

Here we have included graphs illustrating the SDB forecast for the dry year annual average scenarios. For critical period please see section 6.3 in the revised draft WRMP24 main report. The key features on each of the graphs are as follows:

- Demand Forecast (the blue line): This is known as DI and includes all household and non-household demand and among other aspects, an allowance for leakage from our network and from customer's homes.
- Target Headroom (THR) (the black dashed line): This is an allowance for uncertainties in both the supply and demand forecasts and has been added to the Distribution Input forecast.
- Supply Forecast (the orange line): This is known as WAFU and forecasts how much water is available for use to meet Distribution Input. It takes account of abstraction licence sustainability reductions and other reductions on deployable output (DO).

Essex WRZ

The baseline supply demand balance graph shows that the Essex WRZ baseline DYAA forecast is a deficit for the whole planning horizon. The 20 Ml/d step up in 2035/36 of the Total WAFU is a result of our current water sharing agreement with Thames Water expiring. Household and Non-household growth results in a gradual increase in Distribution Input from the early 2040s through to the end of the planning period. The gradual decline in WAFU is due to climate change and a reduction in summer river flows.

FIGURE 6: ESSEX WRZ DYAA SUPPLY DEMAND BALANCE GRAPH

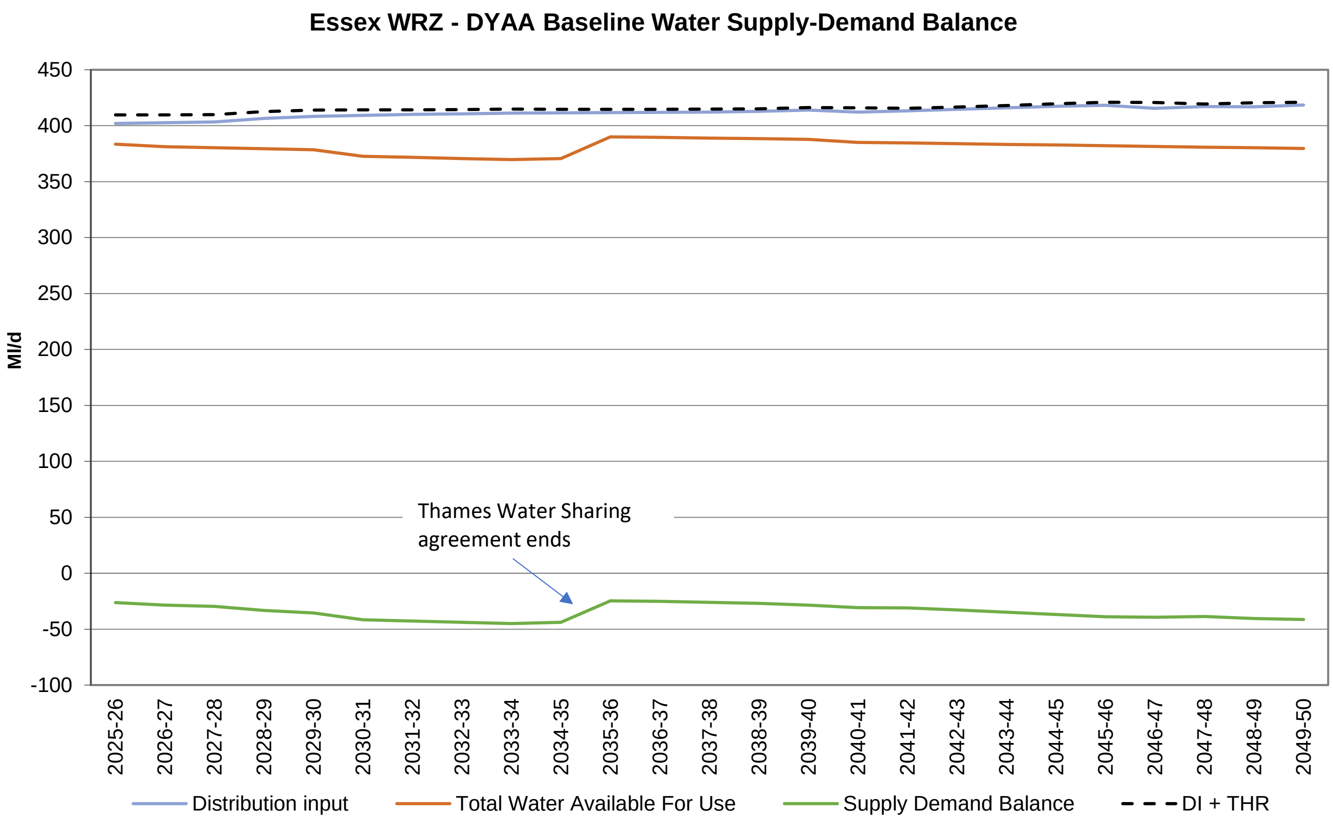


TABLE 8: BASELINE DYAA SUPPLY DEMAND BALANCE FIGURES FOR THE ESSEX WRZ

Essex WRZ	End of AMP8	End of AMP9	End of AMP10	End of AMP11	End of AMP12
	2029/30	2034/35	2039/40	2044/45	2049/50
Supply Demand Balance	-35.51	-43.87	-28.42	-36.81	-41.24

Blyth WRZ

The supply demand balance graph starts with a supply surplus but only in the first year of the planning horizon. From 2026/27 the WRZ falls into deficit as a result of Water Framework Directive (WFD) No Deterioration Sustainability Reductions. This is because two of our time limited abstraction licences expire in 2026 and the Environment Agency (EA) has indicated that the annual licensed quantity will be capped to a recent actual utilisation level. This removes all of our supply headroom until our Best Value Plan demand management and supply options are operational.

The zone goes further into deficit in 2030/31 when AMP7 abstraction licences sustainability reductions are implemented, resulting in a total loss of 6 Ml/d of DO. The deficit increases in 2032 due to a step increase in demand when we will start supplying Sizewell C with 2.2 Ml/d as an annual average and 2.8 Ml/d as a peak daily. It should be noted that this is a baseline deficit and that our final plan allows us to supply Sizewell C and forecasts a supply surplus. The two further steps down in SDB in 2040 and 2045 result from the Business As Usual Plus (BAU+) Environmental Destination licence reductions being made.

FIGURE 7: BLYTH WRZ DYAA SUPPLY DEMAND BALANCE GRAPH

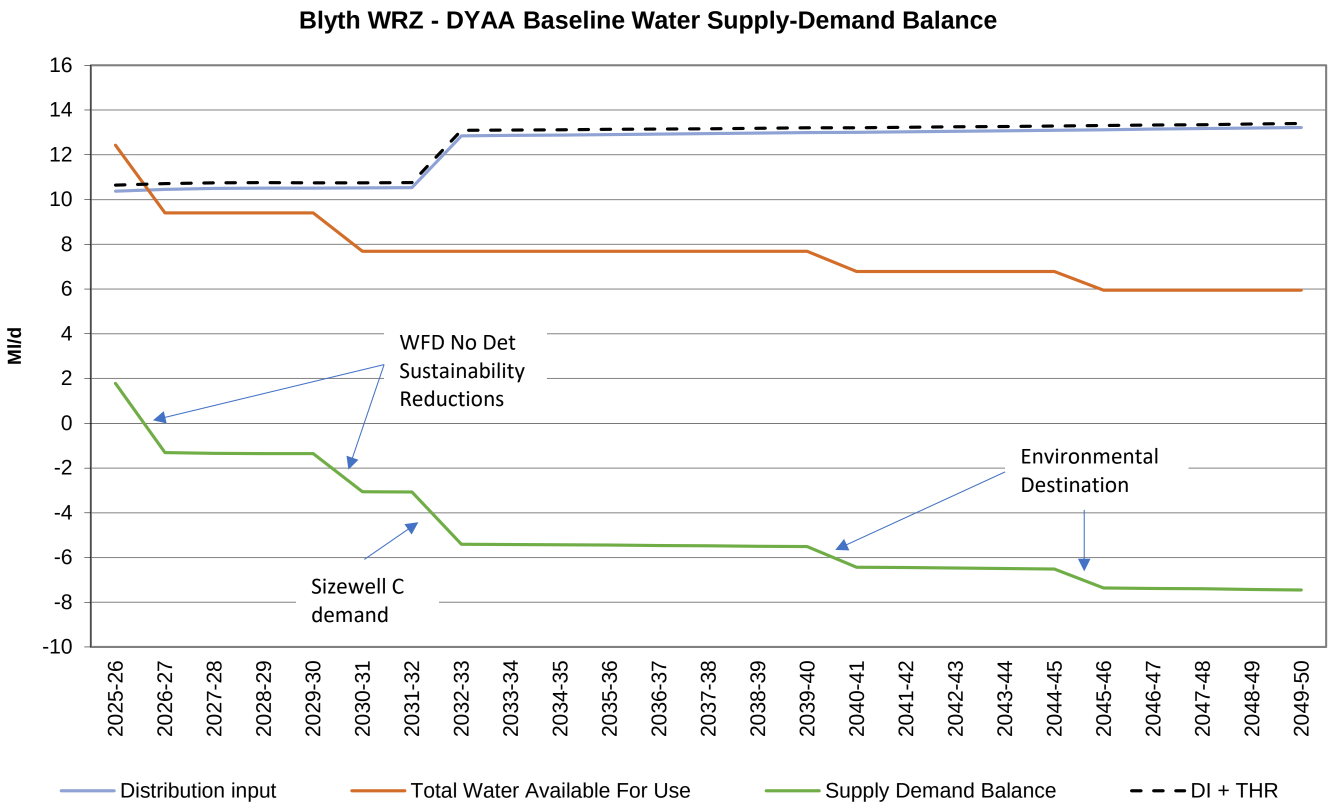


TABLE 9: BASELINE DYAA SUPPLY DEMAND BALANCE FIGURES FOR THE BLYTH WRZ

Blyth WRZ	End of AMP8	End of AMP9	End of AMP10	End of AMP11	End of AMP12
	2029/30	2034/35	2039/40	2044/45	2049/50
Supply Demand Balance	-1.35	-5.43	-5.51	-6.51	-7.45

Hartismere WRZ

The zone is in deficit from the start of the planning period due to the inclusion of new requests for water from non-household businesses on Eye Industrial Estate. This results in a supply deficit for the whole planning horizon. The deficit is increased by 2.27 Ml/d by incorporation of WFD No Deterioration Sustainability Reductions, which are due to be implemented from the start of the planning horizon. This is because all of the Hartismere sources are covered by limited abstraction licences, which expire before the start of AMP8 and the Environment Agency has indicated that these will be capped to recent utilisation levels on renewal. Additionally, there are two further steps down in WAFU because of BAU+ Environmental Destination licence reductions in 2040 and 2045.

To achieve an SDB, our Hartismere WRZ, requires both a moratorium on new non-household demand where the water is used for non-domestic purposes until 2032, and an exemption under Regulation 19 of the WFD to delay the implementation of sustainability reductions until replacement sources of water are available.

FIGURE 8: BLYTH WRZ DYAA SUPPLY DEMAND BALANCE GRAPH

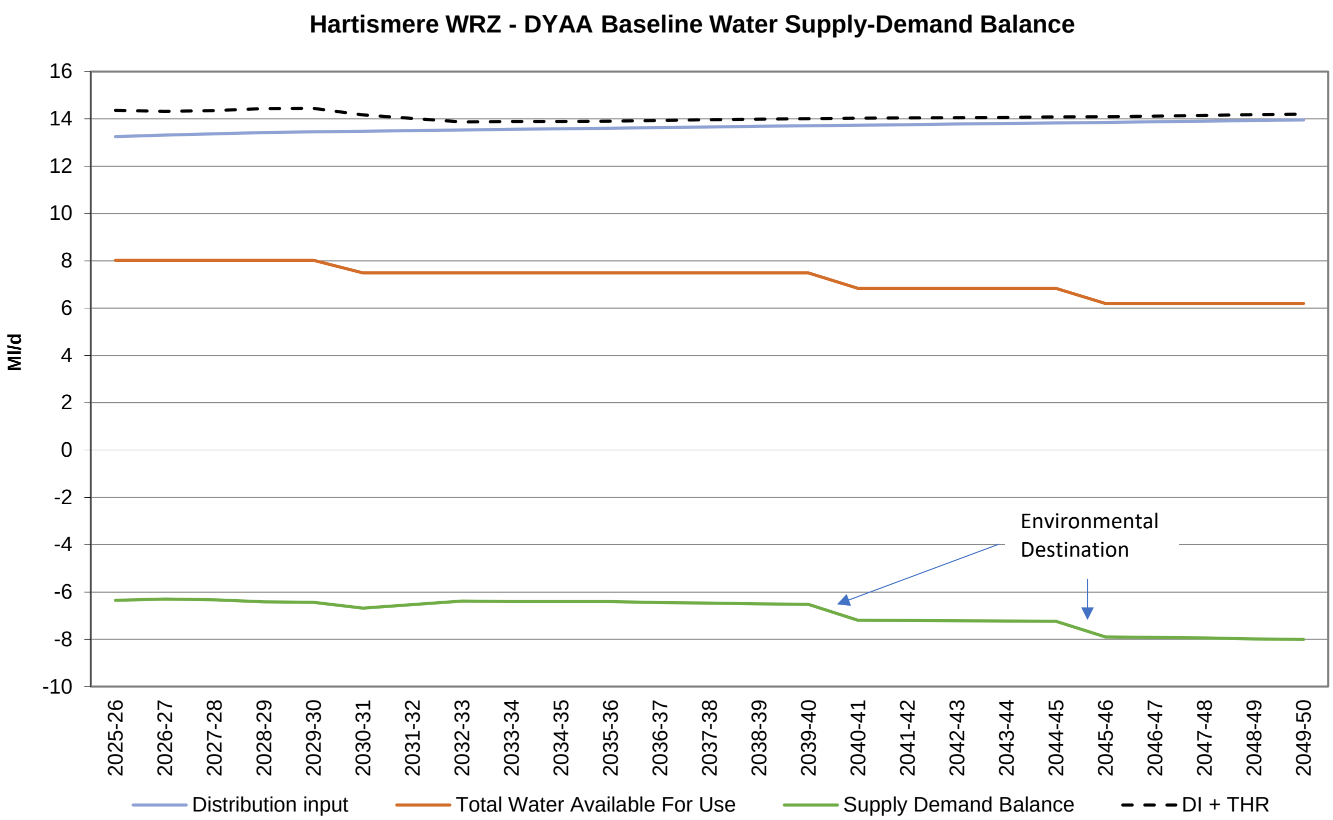


TABLE 10: BASELINE DYAA SUPPLY DEMAND BALANCE FIGURES FOR THE HARTISMERE WRZ

Hartismere WRZ	End of AMP8	End of AMP9	End of AMP10	End of AMP11	End of AMP12
	2029/30	2034/35	2039/40	2044/45	2049/50
Supply Demand Balance	-6.43	-6.40	-6.52	-7.24	-8.01

Northern Central

The supply demand balance (SDB) graph shows a small surplus until 2031/32 and a deficit thereafter. Forecast demand includes future increases in demand from food processing and cosmetics businesses. There are five steps down in the Total WAFU, reflected in the SDB. The first in 2027/28 is because of an increase in non-household demand, the next two in 2030/31 and 2032/33 because of Sustainability Reductions and then a further two because of BAU+ Environmental Destination licence reductions in 2040 and 2045.

FIGURE 9: NORTHERN CENTRAL WRZ DYAA SUPPLY DEMAND BALANCE GRAPH

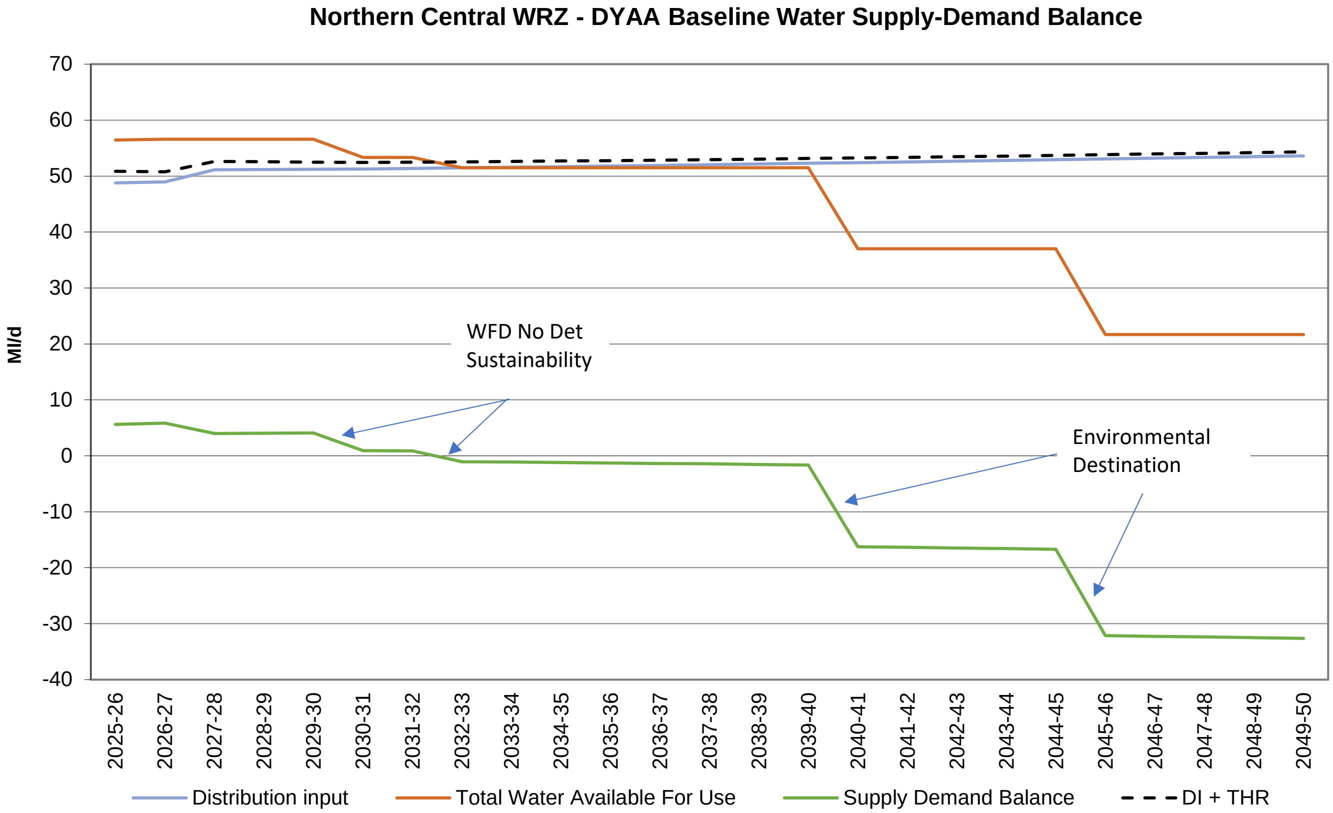


TABLE 11: BASELINE DYAA SUPPLY DEMAND BALANCE FIGURES FOR THE HARTISMERE WRZ

Northern Central WRZ	End of AMP8	End of AMP9	End of AMP10	End of AMP11	End of AMP12
	2029/30	2034/35	2039/40	2044/45	2049/50
Supply Demand Balance	4.08	-1.20	-1.66	-16.72	-32.63

2.5.3 WRMP19 and WRMP24 WAFU comparison

There are differences in our WAFU forecast between WRMP19 and WRMP24 for the years 2025/26, and 2049/50. Table 12 shows a comparison for baseline WAFU components for 2025/26 and Table 13 shows the difference by the end of the WRMP24 planning horizon in 2049/50. The reasons for the key differences are:

- **Deployable Output:** There has been a reduction in the Essex WRZ due to a move to stochastic modelling along with increasing resilience from 1-200 to 1-500. We have also now included Chigwell, Stifford and Roding WTWs in the Essex WRZ Aquator model, so the DO includes the 91 Ml/d bulk import into Chigwell WTW previously entered into line 2BL of the planning tables.
- **Climate Change:** The increased impact of climate change in the Essex WRZ is due to a move from UKCP09 to UKCP18 projections.
- **Sustainability Reductions:** The sustainability reductions we are including in our WRMP24 are significantly higher than those included in our WRMP19.
- **Environmental Destination:** This is a new component of the WAFU calculation for WRMP24.
- **Outage:** The differences are due to changes to methodology to plan for a drought period.
- **Process losses:** The differences reflect use of the latest process loss data and are recalculated each time DO changes over the planning horizon due to sustainability changes. Process losses for the Essex WRZ are now incorporated into the Aquator system model.
- **Water exported:** We have used maximum contractual volumes for New Appointments and Variations (NAVs) in our WRMP24 whereas our WRMP19 forecast actual utilisation.
- **Target Headroom:** We have updated our assessment of component S5 – Gradual Pollution and have introduced a range of resilience profiles (high/medium/low).
- **DI:** The increase in per capita consumption (PCC) is mainly due to Covid-19 and an increase in population (~20,000 additional people than forecast in Price Review 2019 (PR19)). The pandemic has affected a number of customer behaviours.

TABLE 12: WRMP19 AND WRMP24 BASELINE WAFU FORECAST COMPARISON FOR 2025/26

Baseline 2025/26	Essex WRZ		Blyth WRZ		Northern Central WRZ		Hartismere WRZ	
	WRMP19	WRMP24	WRMP19	WRMP24	WRMP19	WRMP24	WRMP19	WRMP24
DO	396.90	428.00	14.68	14.68	80.16	77.25	8.65	8.65
Climate Change	3.20	-16.73	0.00	0.00	-0.75	0.00	0.00	0.00
Sustainability reductions	0.00	0.00	-0.20	-1.92	-1.30	-0.80	0.00	-2.27
Environmental Destination	-	0.00	-	0.00	-	0.00	-	0.00
Process losses	-0.27	0.00	-0.69	-0.54	-3.14	-8.75	-0.30	-0.30
Outage	-29.93	0.00	-0.68	-0.68	-1.36	-8.83	-0.71	-0.04
Target Headroom	32.82	7.62	1.21	0.27	5.27	2.05	0.77	1.11
Water Imported	92.00	1.00	1.35	2.27	1.35	1.35	2.00	2.00
Water Exported	-24.93	-28.68	-1.39	-1.38	-4.09	-3.75	0.00	-0.02
DI	387.80	402.10	9.11	10.38	46.80	48.79	7.57	13.26
SDB	**16.36**	**-26.13**	**2.75**	**1.78**	**18.81**	**5.63**	**1.29**	**-6.35**
Change		**-42.49.01**		**-0.97**		**-13.18**		**-7.64**

TABLE 13: WRMP19 AND WRMP24 BASELINE WAFU FORECAST COMPARISON FOR 2049/50.

Baseline 2049/50	Essex WRZ		Blyth WRZ		Northern Central WRZ		Hartismere WRZ	
	WRMP19	WRMP24	WRMP19	WRMP24	WRMP19	WRMP24	WRMP19	WRMP24
DO	396.90	428.00	14.68	14.68	80.16	77.25	8.65	8.65
Climate Change	4.70	-31.04	0.00	0.00	-1.10	0.00	0.00	0.00
Sustainability reductions	0.00	-5.00	-0.20	-6.00	-1.30	-6.85	0.00	-2.27
Environmental Destination	0.00	-2.00	0.00	-1.72	0.00	-35.35	0.00	-0.65
Process losses	-0.27	0.00	-0.69	-0.27	-2.90	-3.49	-0.30	-0.20
Outage	-29.93	0.00	-0.68	-0.68	-1.36	-8.83	-0.71	-0.04
Target Headroom	21.31	2.40	0.81	0.17	4.27	0.69	0.53	0.25
Water Imported	92.00	1.00	1.35	1.32	1.35	1.35	2.00	0.73
Water Exported	-5.67	-11.30	-1.39	-1.38	-4.09	-2.40	0.00	-0.02
DI	402.15	418.50	9.17	13.22	49.25	53.63	7.86	13.96
SDB	**34.28**	**-41.24**	**3.09**	**-7.45**	**17.23**	**-32.63**	**1.25**	**-8.01**
Change		**-75.52**		**-10.54**		**-49.86**		**-9.26**

2.5.4 Link to long term strategy

This investment is needed as part of the 'ensuring sustainable water supplies' investment area under our Long-Term Strategy (LTS) core pathway. We have identified the need for this investment through the regional and company level water resource management planning process.

Demand management through reducing leakage, increasing metering, and supporting greater water efficiency is a necessary and efficient part of our long-term plan to ensure we can continue to balance water supply and demand over the long-term.

This investment is needed to deliver our long-term targets from the 25-Year Environment Plan and the rates of improvement supported by this case will allow us to follow the right trajectory to meeting the long-term targets that we set out in our long-term delivery strategy (NES_LTDS). This is aligned to our long term WRMP target to:

- Make sure all household customers continue to have a sufficient and secure supply of water ("plan to be resilient to 1 in 500-year drought").

Our WRMP supply options are part of our overall WRMP Best Value Plan which includes our demand management options, which are designed to:

- reduce household water consumption (per capita consumption to 122 l/p/d by 2038 and 110 l/p/d by 2050);
- reduce non-household water demand by 9% by 2038 excluding growth (from 2019/20 levels); and
- reduce leakage by 55% by 2050 in the North East (to 61.1Ml/d) and 40% in Essex and Suffolk (to 40.1Ml/d) so that we achieve the national target of 50% companywide (from 2017/18).

We consider this is low / no regret investment because it is needed:

- to meet statutory requirements in 2025-30, and
- to meet Ofwat's high common reference scenario for water demand.

We therefore consider this investment is necessary in 2025-30 to deliver our long-term delivery strategy. This investment represents a step along the path towards delivering our long-term targets and so we expect further investment to be required at least between 2030 and 2050 to continue to reduce leakage, increase metering and promote water efficiency. This would be required under any future scenario and so is included in our core pathway in our WRMPs and our long-term delivery strategy.

2.6. CUSTOMER SUPPORT

Water Resources East, the regional planning group, carried out some early customer engagement in June 2021. This looked at customer views on the drivers behind the need for new water supplies in the region, including environmental ambition. This concluded that customers view environmental ambition is important – but for the general public and NHH, not at any cost:

- Customers supported restoring past damage, but the cost implications of improving environments means that few customers support the highest ‘environmental destination’.
- Stakeholders with an environmental remit do support the highest environmental destination.

We also undertook **customer research in July 2022** on our draft WRMP. This tested customers’ awareness and views on Essex and Suffolk being designated as water stressed areas.

The majority of the sample overall were not aware that Essex and Suffolk are water stressed areas. This confirmed what we found in the focus groups, where only a small proportion knew about this and where respondents only associated drought with developing countries. Finding out about this made people realise water is a finite resource and made it more real, spurring them on to act now and to be more mindful.

In December 2022, we **discussed our statutory obligations to secure water supply in Essex and Suffolk** with our customers in those area, as part of our discussions with customers about complex bill drivers. This was deliberative research, to understand more complex views before our affordability and acceptability research in 2023.

Customers preferred a reservoir solution, as they felt this would be better value for money in the long-term and there would be a lower cost of maintenance. Participants in Essex recognised the environmental benefits of reservoirs, including local wildlife and tourism and school trips. They felt that investing in a reservoir could add public value to the area (participants had also been discussing public value earlier as part of the same research).

Customers were more concerned about the effluent reuse plant that they discussed (at Lowestoft), as it had a much higher level of maintenance and there were concerns about the technology and higher energy use. Customers felt that energy prices were unpredictable, and this could move the problem to future generations. They were also concerned that the plant would lack public value.

Customers agreed that detailed work would be needed for both options in order to make sure the right decision would be made. However, they thought that a decision needed to be made sooner than 2026. Some customers suggested that a hybrid solution could be an alternative option, taking elements of both the reservoir and effluent plant. Customers asked us to choose the reservoir as this had more benefits.

Our PR24 Board sub-group discussed these findings alongside our draft WRMP, and we subsequently pushed back to regulators on the requirement to meet sustainable abstraction in 2032 – as our customers supported a reservoir option as it had more benefits including public value. We agreed that a reservoir had more benefits, but it would not meet the statutory requirements. We describe how we discussed hybrid options with the EA, as well as exploring smaller reservoirs that could be done in a phased way, in the sections below.

In our **qualitative affordability and acceptability research** (NES49), we discussed the phasing of water supply options. Customers in our Essex and Suffolk regions thought that water supplies were an important priority because these were water stressed areas. Customers were sceptical that a reservoir could be achieved by 2030, but most customers agreed with our plan to provide water supply options in 2025-30, describing this as balancing need with affordability. Some customers thought we should consider a higher phasing, but with no clear bill impacts customers felt that the “medium” option (used in our business plan) was the right one.

Customers noted that they did not have a genuine choice on water supply options, as statutory obligations were the overriding factor. They also discussed the cumulative impacts of investments alongside other enhancements, acknowledging the conflict between wanting to allow bill increases for necessary investments as a citizen but also having to manage personal finances as a customer.

Finally, in our **quantitative affordability and acceptability research** (NES50), customers supported these investments as part of our preferred plan – 74% of customers thought our plan was acceptable.

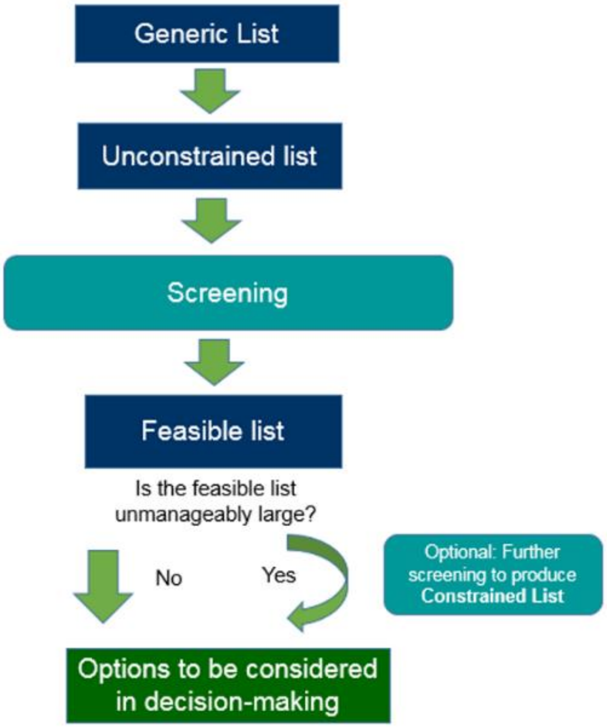
3. BEST SUPPLY ENHANCEMENT OPTIONS FOR CUSTOMERS

3.1. DEVELOPMENT OF SUPPLY OPTIONS

3.1.1 Options Development Methodology Overview

Our methodology for the identification, development and screening of water supply options was developed to align with the process set out in the Water Resources Planning Guideline (WRPG), which was updated on 2 July 2022. The WRPG requires water companies to review all possible options that could contribute to deficit reduction and include all that are likely to be technically feasible within an unconstrained list. The unconstrained list is then screened to remove options with unalterable constraints that make them unsuitable for promotion. Options on the resulting feasible list are further assessed to feed into programme appraisal and optimisation of a best value plan. FIGURE 10 illustrates the phases in the options screening process from generic options to feasible options for consideration as part of decision-making processes and identification of the preferred options for our best value plan.

FIGURE 10: OPTIONS APPRAISAL METHODOLOGY



Generic List: A list of all possible options types

Unconstrained list: All possible schemes and options available to the company based on the generic list

Screening to remove any options with unalterable environmental or planning constraints

Feasible list: Options which are technically feasible and subject to no unalterable planning constraints

Further screening: You should find a balance in your feasible list between having a manageable number of options and having the greatest choice for assessment. The feasible list should include sufficient options to allow real choices when assessing the preferred programme. This subset list should be called your **Constrained list.**

3.1.2 Summary of option screening approach

FIGURE 11 illustrates how the WRPG process has been adopted to undertake a supply option screening approach for ESW. Table 14 summarises the option screening activity from initial generic option screening through to Phase 2 high level environmental screening.

FIGURE 11: OPTIONS APPRAISAL METHODOLOGY

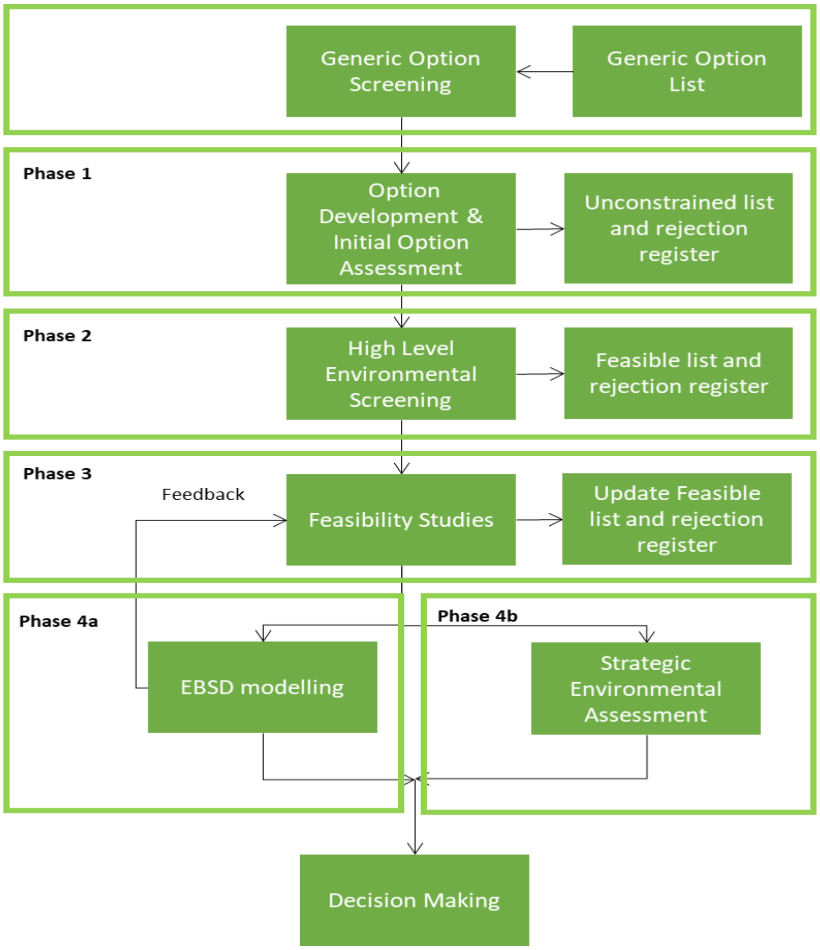


TABLE 14: SUMMARY OF INITIAL OPTION SCREENING APPROACH

Option screening stage	Overview	rWRMP main report section
Generic option screening	A generic option list was developed using UK Water Industry Research (UKWIR) guidance to identify all possible options available to each WRZ. To identify viable options, the generic option list was screened using the following criteria: • Can the option be practically deployed i.e., is the source of water available in the WRZ? • Is it possible to define the option spatially? • Does the technology exist to develop the option (assumed to be post pilot study stage in the UK or a country with a similar regulatory regime)? • Does the supply chain exist to deliver the option? • Are there any other technical issues that prevent deployment of this option in the WRZ? • Are there any environmental issues that prevent deployment of this option in the WRZ?	Section 7.2.2.1
Phase 1: Option development and initial assessment	Viable options from Generic Option Screening were further developed to form an unconstrained option list, with sufficient level of definition to allow Phase 2 High-Level Screening. Option development in this phase focussed on defining specific options in terms of the location, maximum output, and spatial impact. A basis of design/assumption was developed for each option considering the following factors: • industry best practices and standards; • consider regional options; • consider neighbouring water company options; • availability of source water; • resilience; • water quality issues; • impact on water bodies; • environmental designations; • availability of land (at this stage the review is limited to identifying undeveloped land, no assessment is made of competing development or ownership); • existing infrastructure; • proximity to receiving WRZ / supply node; • customer perception; and • stakeholder support / opposition. Options that failed to satisfactorily meet these factors were rejected and added to the rejection register.	Section 7.2.2.2

Option screening stage	Overview	rWRMP main report section
Phase 2: High level environmental screening	A Red-Amber-Green (RAG) approach against environmental topics was used to screen out options that are shown to have red flags against significant criteria. These criteria align with those applied for WRE high-level assessments. Any options which were screened out at this stage were added to the rejection register.	Section 7.2.2.3

3.1.3 Phase 3: Feasibility Studies

Engineering and Design & Financial Cost Assessment

The purpose of this phase was to undertake detailed engineering design and costing to enable an assessment of the feasibility of proposed options. All options that successfully passed High Level Screening were subject to outline engineering design including developing consistent option information as the basis for financial cost assessment and later stages.

The detailed Phase 3 studies structured around the following option categories:

1. Aquifer Storage and Recovery
2. New water Reuse
3. Existing Water Reuse Enhancement
4. New Reservoirs
5. Desalination
6. Transfer Options
7. Groundwater Options

A range of factors were considered within these categories as appropriate including:

- potential impact of climate change;
- timescales for delivery;
- expected yield over 80 years;
- flexibility of operation;
- transfer tie-ins;
- hydraulics;
- route planning and critical crossings;
- site services;
- treatment; and
- risk assessment.

Supply option summaries

Table 15 confirms the total number of options that have been assessed and of those, the number that have been rejected because they were not considered feasible, and the number that have proceeded to the least cost and best value decision-making process.

TABLE 15: SUMMARY OF OPTIONS

	Total Number of Options		
Option Type	Assessed	Rejected	Proceeded
Artificial Storage and Recovery wells / Aquifer Storage and Recovery (ASR)	20	19	1
New Water Reuse Options	11	6	5
Existing Water Reuse Enhancements	1	-	1
New Reservoirs	3	2	1
Desalination	14	2	12
Water Transfer	64	2	62
Groundwater Sources	3	1	2
Nitrate Treatment	6	-	6
Pump Options	2	-	2
Upgrade Options	2	2	2
UV Treatment	1	-	1
Total Number	**127**	**34**	**95**

At the macro level, there is a limited number of feasible supply option types which reflects the significant challenge in East Anglia which is a serious Water Stressed Area, and which has the highest number of water dependant Sites of Special Scientific Interest (SSSI) in the country. Consequently, there is no groundwater available for abstraction licensing and all our Norfolk and Suffolk groundwater licences are subject to sustainability reductions either at renewal for time limited licenses, else by 2030. Surface water is available but only at high flows which means new surface water abstractions must be developed with winter storage reservoirs.

Our feasible options are defined in Table 16 and Table 17 and cover a range of different option types as well as different sizes of option types and have provided us with real choices in the selection of preferred Best Value Plan. Importantly, all options contribute to us meeting our Water Resource Management Plan 2024 (WRMP24) objectives.

TABLE 16: FEASIBLE WATER SUPPLY OPTIONS – ESSEX

No.	Option UID	Option Name	Option Description	Option Type	Deployable Output (Ml/d)	Earliest start date
1	ESW-ABS-002	Linford New WTW	Reinstatement of abandoned artesian well, no network upgrade should be required. New borehole drilled to make use of an additionally available 3.5 Ml/d on the licence. Assume existing borehole provides 3.5 Ml/d and new borehole provides 3.5 Ml/d giving 7 Ml/d overall.	Abstraction	7	2027
2	ESW-ABS-003	Linford New WTW 10 Ml/d	Reinstatement of abandoned artesian well, and WTW capacity to 10Ml/d. Requires drilling of up to two new boreholes, a raw water transfer to a new water treatment works, connection to network and wastewater discharge connection. For WRMP design and costing purposes, it has been assumed that no network upgrade should be required.	Abstraction	10	2027
3	ESW-ASR-004A	Abberton ASR with additional treatment capacity	ASR scheme located near Abberton Reservoir. Single borehole located adjacent to Layer WTW. Additional treatment capacity included at the borehole site. It is assumed that there is sufficient capacity in the River Stour to Abberton Reservoir transfer as well as the Abberton Reservoir to Layer WTW transfer. 80% recovery meaning 3 Ml/d is injected and 2.4 Ml/d is subsequently abstracted from the borehole.	ASR	2.4	2032
4	ESW-ASR-004B	Abberton ASR using existing Layer WTW	ASR scheme located near Abberton Reservoir. Single borehole located adjacent to Layer WTW. No additional treatment capacity included at the borehole site, as it is assumed that the treatment at Layer WTW will be sufficient. It is assumed that there is sufficient capacity in the River Stour to Abberton Reservoir transfer as well as the Abberton Reservoir to Layer WTW transfer. 80% recovery meaning 3 Ml/d is injected and 2.4 Ml/d is subsequently abstracted from the borehole.	ASR	2.4	2032
5	ESW-DES-001	Canvey Island Desalination (Terrestrial)	Seawater desalination plant at Canvey Island with a transfer to Hanningfield WTW. The intake / outfall will be via a pier type structure.	Desalination	25, 31.5, 35, 38, 41.5, 50, 65 100, 190	2032

6	ESW-EFR-001; ESW-EFR-001A; ESW-EFR-001B	Southend-on-Sea Water Reuse	Water reuse plant being fed from Anglian Water's WRC with a transfer to Hanningfield reservoir - output based upon the maximum output from the WRC	Water Reuse	40.5, 20.5, 20	2032
7	ESW-EFR-003	Colchester Water Reuse	Water Reuse plant fed from Anglian Water WRC with transfer to Abberton - developed at max output	Water Reuse	3.5, 6.5, 10, 15	2032
8	ESW-NIT-005	Langford Nitrate Scheme	Electrodialysis Reversal (EDR) or Ion-Exchange (IEX) nitrate treatment at Langford WTW so that final water meets nitrate PCV. Discharge options not yet known - option contains a discharge stream transfer to Maldon STW (AWS)	Nitrate Treatment	2.75	2029
9	ESW-NIT-006	Langham Nitrate Scheme	Electrodialysis Reversal (EDR) or Ion-Exchange (IEX) nitrate treatment at Langham WTW so that final water meets nitrate PCV. Discharge options not yet known - option contains a discharge stream transfer to Colchester STW (AWS)	Nitrate Treatment	0.9	2029
10	ESW-PMP-001A	Abberton RWPS and Langford Clarifier upgrade	Additional pumping capacity pending the completion of a transfer between Abberton Reservoir and Langford WTW. Option also includes an upgrade at Langford WTW	Pump and clarifier upgrade	8	2030
11	ESW-TRA-009	Langham WTW to SPA	On the basis the Strategic Pipeline Alliance (SPA) is constructed (led by Anglian Water)	Transfer (inter-company)	3.5, 6.5, 9.5, 10	2030
12	ESW-UVC-001	Langford UV	Additional ultraviolet treatment contactors to treat for cryptosporidium	UV Treatment	0.2	2029

TABLE 17: FEASIBLE WATER SUPPLY OPTIONS – SUFFOLK

No.	Option UID	Option Name	Option Description	Option Type	Deployable Output (Ml/d)	Earliest start date
			Blyth WRZ			
1	ESW-DES-003-BW	Sizewell Desalination using Beach Well	Construction of a small scale desalination plant using beachwells in the Sizewell area	Desalination (BW)	20.1	2032
2	ESW-DES-003-IG	Sizewell Desalination using Infiltration Gallery	Construction of a small scale desalination plant using infiltration galleries in the Sizewell area	Desalination (IG)	11.2	2032
3	ESW-TRA-001	Barsham WTW to Saxmundham Tower	This option transfers treated water from Barsham WTW (in Northern Central WRZ) through a new main constructed from Barsham to Saxmundham, via Holton	Transfer (interzonal)	15	2028
4	ESW-TRA-008	Sizewell to Saxmundham	Transfer from Sizewell to Saxmundham, using Sizewell Desalination as the water source (ESW-DES-003-BW or ESW-DES-003-IG).	Transfer (intrazonal)	3.5, 8	2028
5	ESW-TRA-010	Transfer from Wherstead (AWS) to Saxmundham	Transfer from Wherstead to Saxmundham, using AW's SPA main as the water source	Transfer (inter-company)	3.5, 10	2028
6	ESW-TRA-010A	Transfer from Wherstead (AWS) to Saxmundham	Transfer from Wherstead to Saxmundham, using AWS's SPA main as the water source. This option assumes that ESW-TRA-010 is not constructed as functions on its own	Transfer (inter-company)	8, 18.5, 34.5, 44	2028
7	ESW-TRA-010B	Transfer from Wherstead (AWS) to Saxmundham	Transfer from Wherstead to Saxmundham, using AWS's SPA main as the water source. This option assumes that ESW-TRA-010 is constructed and supplements it	Transfer (inter-company)	4.5, 8.5, 15, 24.5, 31, 34, 40.5	2028
8	ESW-TRA-012	Transfer from Eye Airfield to Saxmundham	Transfer from Eye Airfield to Saxmundham. This option assumes that ESW-TRA-016 (supplied from California / Caister desalination options) is constructed.	Transfer (interzonal)	3.5, 8	2028
9	ESW-TRA-017	Transfer from Saxmundham to Sizewell	Transfer from Saxmundham to Sizewell. This option assumes that (ESW-TRA-001) Barsham WTW to Saxmundham Tower is constructed.	Transfer (intrazonal)	2.5	2028

Hartismere WRZ						
10	ESW-TRA-011	Transfer from Saxmundham to Eye Airfield	Transfer from Saxmundham to Eye Airfield, using Sizewell Desalination as the water source (ESW-DES-003-BW or ESW-DES-003-IG).	Transfer (interzonal)	6.5, 9.5	2028
11	ESW-TRA-015	Transfer from Barsham to Eye Airfield	Transfer from Barsham WTW to Eye Airfield. This option is required in combination with ESW-TRA-001 Barsham WTW to Saxmundham Tower.	Transfer (interzonal)	6.5, 9.5	2028
12	ESW-TRA-016	Transfer from Norwich (West, AWS) to Eye Airfield	Transfer from Norwich (AW, west – near Little Melton) to Eye Airfield using AWS Great Yarmouth, Caister or Bacton desalination options as the water source.	Transfer (inter-company)	6.5, 9.5, 10, 18.5, 36, 44	2028
13	ESW-TRA-019	Transfer from Holton WTW to Eye Airfield	Transfer from Holton to Eye Airfield. This option is required in combination with (ESW-TRA-001) Barsham WTW to Saxmundham Tower.	Transfer (interzonal)	8.5	2028
Northern Central WRZ						
14	ESW-DES-004-BW	California (Caister) Desalination using Beach Well	Construction of a small scale desalination plant using beachwells in the Great Yarmouth Area near Caister WRC	Desalination (BW)	25.1	2032
15	ESW-DES-004-IG	California (Caister) Desalination using Infiltration Gallery	Construction of a small scale desalination plant using infiltration galleries in the Great Yarmouth Area near Caister WRC	Desalination (IG)	14.0	2032
16	ESW-DES-008-BW	Corton Desalination using Beach Well	Construction of a small scale desalination plant using beachwells in the Lowestoft area near Corton WRC	Desalination (BW)	10.1	2032
17	ESW-DES-008-IG	Corton Desalination using Infiltration Gallery	Construction of a small scale desalination plant using infiltration galleries in the Lowestoft area near Corton WRC	Desalination (IG)	5.6	2032
18	ESW-EFR-002	Lowestoft Water Reuse to Lound Lakes	Water reuse plant fed from Anglian Water's WRC with a transfer to Lound Lakes	Water Reuse	3.5, 6.5, 10, 11	2030
19	ESW-EFR-002A	Lowestoft Water Reuse to Ellingham Mill	Water reuse plant fed from Anglian Water's WRC with a transfer to Ellingham Mill	Water Reuse	3.5, 6.5, 10, 11	2030
20	ESW-NIT-004	Barsham Nitrate Scheme	Electrodialysis Reversal (EDR) or Ion-Exchange (IEX) nitrate treatment at Barsham WTW so that final water meets nitrate PCV. Discharge options not	Nitrate Treatment	2.15	2029

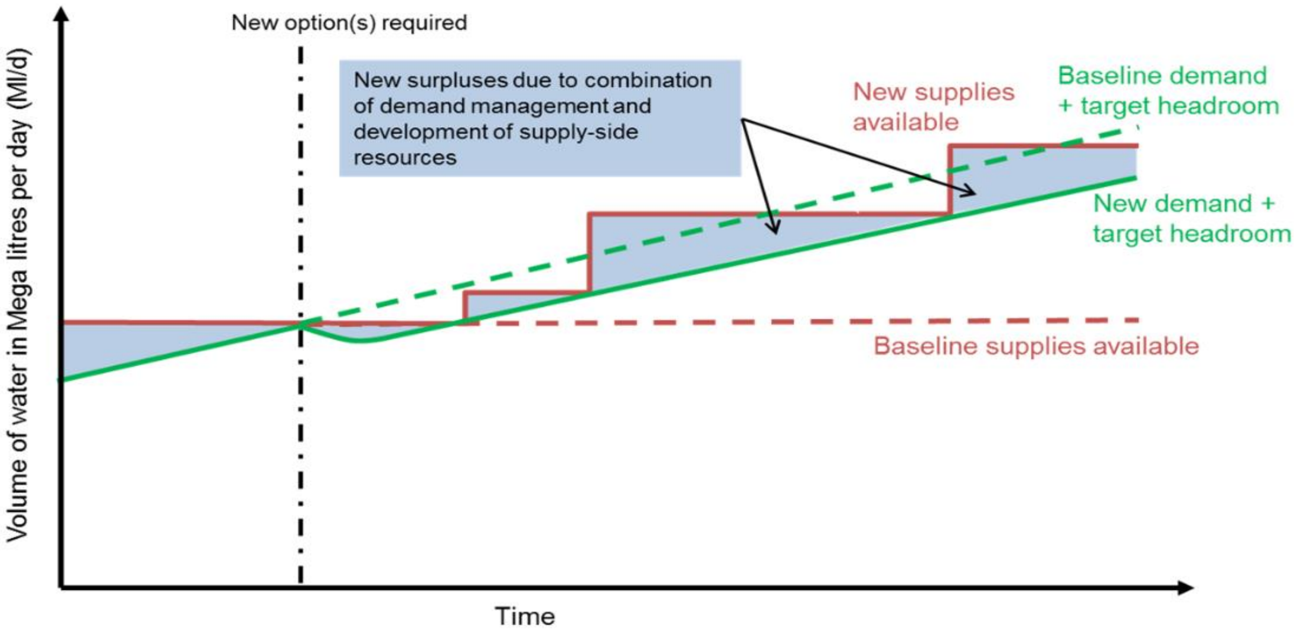
			yet known - option contains a discharge stream transfer to Beccles STW (AWS)			
21	ESW-RES-002A; ESW-RES-002B; ESW-RES-002C	North Suffolk Winter Storage Reservoir	New winter storage reservoir to be filled in winter from River Waveney at ESW's existing Shipmeadow intake and potentially from a new intake on the Hundred River at Kessingland (currently pumped to sea by IDB at Kessingland). IDB indicates annual average of ~30Ml/d available. The IDB is about to setback the sea defence and construct a new Hundred River PS which will have a t-off for winter storage. Option includes cost to upgrade Barsham WTW to treat additional resource.	Reservoir	16.2 (3500Ml reservoir), 18.5 (5000Ml reservoir), 19.9 (7500Ml reservoir)	2033
22	ESW-TRA-007	Norwich (East, AWS) to Barsham WTW Transfer	Transfer to intercept AWS Great Yarmouth, Caister or Bacton desalination options with a transfer to Barsham WTW.	Transfer (inter-company)	3.5, 4, 7.5, 26.5, 34.5, 44	2028
23	03b-0478-B	Caister Water Reuse	Water reuse plant fed by AWS Caister WRC	Water reuse	16.4	2030
24	ESW-TRA-013	Transfer from Saxmundham to Barsham	Transfer from Saxmundham to Barsham WTW, using Sizewell Desalination as the water source (ESW-DES-003-BW or ESW-DES-003-IG).	Transfer (interzonal)	26.5	2028
25	ESW-TRA-014	Transfer from Eye Airfield to Barsham	Transfer from Eye Airfield to Barsham WTW. This option assumes that ESW-TRA-016 supplied from AWS Great Yarmouth, Caister or Bacton desalination options constructed.	Transfer (interzonal)	26.5	2028
26	ESW-TRA-018	Transfer from Bungay Wells to Broome WTW	Transfer from Bungay Wells to Broome WTW (combined option with ESW-TRA-023. Combined DO is 1 Mld).	Transfer (intrazonal)	1	2028
27	ESW-TRA-021	Transfer from Caister-on-Sea EFR to Ormesby	Transfer from Caister-on-Sea EFR Plant (AWS) to Ormesby, using 03b-0478-B as the water source.	Transfer (inter-company)	10	2028
28	ESW-TRA-022	Transfer from AWS Caister-on-Sea Desalination to Caister-Tower	Transfer from Caister-on-Sea Desalination Plant (AWS) to Caister Tower.	Transfer (inter-company)	14, 25.1	2028

29	ESW-TRA-023	Broome to Barsham Transfer	Transfer from Broome WTW to Barsham WTW (combined option with ESW-TRA-018. Combined DO is 1 Mld).	Transfer (intrazonal)	1	2028

3.1.4 Phase 4a: Economic Modelling of Options – EBSD Modelling

The options and costs identified within the detailed Phase 3 feasibility studies were developed for inclusion within Economics of Balancing Supply and Demand (EBSD) modelling and further decision making as part of our Best Value Planning process (section 3.2). We have used EBSD to develop a least cost plan for WRMP24. The EBSD framework has been used by UK Water Companies since 2002 to identify which demand-side and supply-side options are needed to maintain levels of service over a 25-year planning period. The framework applies optimisation techniques to ensure that the group of options selected is the least -cost plan available that can meet forecast future deficits. The EBSD model considers the supply-demand balance for each WRZ at annual timesteps and selects options to address deficits based on a cost per Ml/d and the earliest available date of supply for relevant options. The EBSD approach to investment modelling is illustrated in Figure FIGURE 12.

FIGURE 12: THE EBSD APPROACH TO INVESTMENT MODELLING



The WRPG states that we must forecast our supply and demand over at least the statutory minimum period of 25 years and, where a deficit is identified, consider options to resolve that deficit. Our central least cost plan (based upon central forecasts for growth, climate change, and leakage) has been determined over the 25-year planning horizon to 2050. However, to test the sensitivity of our plan to the planning period, we have also conducted EBSD model runs to 2075 and 2100.

The least cost plan produced by the EBSD model for the 2050 time-horizon is shown in Table 18.

TABLE 18: LEAST COST PLAN TO 2050 – SELECTED OPTIONS

Year Selected	WRZ	Option	Option Ref	Option type	AMP
2027/2028	Essex	Linford New WTW 10 Ml/d	ESW_ABS_003	New WTW and borehole(s) (with raw water transfer)	AMP8
2029/2030		Langford Nitrate scheme	ESW-NIT-005	Nitrate removal	AMP8
2029/2030		Langford UV	ESW-UVC-001	Cryptosporidium removal	AMP8
2029/2030		Langham Nitrate scheme	ESW-NIT-006	Nitrate removal	AMP8
2030/2031		Abberton RWPS and Langford Clarifier upgrade	ESW-PMP-001A	Raw water pumping station and clarifier upgrade	AMP8
2028/2029	Blyth	Barsham WTW Saxmundham Tower	ESW_TRA_001	Potable Water Transfer	AMP8
2028/2029	Hartismere	Holton WTW Eye Airfield	ESW_TRA_019	Potable Water Transfer	AMP8
2029/2030	Northern Central	Barsham Nitrate scheme	ESW-NIT-004	Nitrate removal	AMP8
2030/2031		Bungay wells to Broome WTW transfer and Broome to Barsham WTW transfer	ESW_TRA_018 and ESW-TRA-023	Raw water transfers	AMP8
2032/2033		Lowestoft Water Reuse	ESW_EFR_002A	Water Reuse	AMP9
2040/2041		North Suffolk Winter Storage 7500 Ml and Transfer	ESW_RES_002C	New Reservoir (with raw water transfer)	AMP11

Since publishing out draft WRMP24, we have progressed operational interventions (options) to reduce unplanned outage which increases Water Available for Use (WAFU). These options were not sufficiently developed for our draft WRMP24 and at that point in time, were not considered feasible. However, the options, including nitrate reduction schemes for Barsham, Langham and Langford WTWs and a UV scheme for cryptosporidium management at Langford WTWs, are now all considered feasible and following least cost modelling and Best Value assessments, are now included in our revised draft WRMP24 preferred final plan.

Since consulting on our draft WRMP24, the Environment Agency has asked us to consider if the proposed Lowestoft Reuse option and the North Suffolk reservoir option could be used as a conjunctive use system to increase resilience or the deployable output.

While both schemes are selected in both the core plan and the Habitats Regulation Adaptive Programme, they are not selected at the same time with Lowestoft Reuse being selected in 2032/33 and North Suffolk Reservoir being selected in 2040/41 (driven by Environmental Destination). Both schemes have an individual WAFU gain although at this stage, we do not consider that there would be a conjunctive use WAFU gain. Once both schemes are in supply, Lowestoft Reuse could discharge into the reservoir as this will dilute nitrate concentrations which are likely to be elevated given the reservoir will be filled with high flow river water predominantly in the autumn and winter.

The EBSD tool does not consider other monetised criteria such as carbon or other societal and environmental impacts and benefits. As such the model results represent a least-cost plan with no further optimisation. Best Value Planning as described in section 3.2 below aims to determine whether the inclusion of further monetarised and non-monetarised criteria would identify a plan that deliver the best value as defined by WRPG.

3.1.5 Phase 4b: Strategic Environmental Assessment (SEA) of Options

Our detailed options level assessment approach was aligned with WRE's Integrated Environmental Assessment (IEA) process. This process has been developed through consultation with multiple stakeholders. This is aligned with regulator expectations around regional and water company planning.

Each option was assessed against the Strategic Environmental Assessment (SEA) objectives using defined effect assessment and evaluation criteria based on relevant spatial datasets and professional judgement. The assessment indicated whether the proposed option would help meet or prevent achievement of the SEA objectives. If it contributed to the SEA objectives, then it was considered a positive effect. If the option prevents the SEA objective being met, then it was considered a negative effect. The assessment focused on high-level issues as identified through the objectives, sub-objectives, and key receptors and assets. Note that it was not undertaken to the level of detail that an Environmental Impact Assessment (EIA) would be.

3.2. BEST VALUE PLANNING AND OUR BEST VALUE PLAN

3.2.1 Best Value Planning Introduction

The aim of the WRMP is to present a long-term plan to ensure a secure supply of wholesome drinking water for customers and to protect and enhance the environment. To ensure the WRMP achieves these aims we carry out Best Value Planning.

This aims to determine whether the inclusion of further monetised and non-monetised criteria would identify a plan that delivers the best value, defined by the Water Resources Planning Guideline (WRPG) as 'one that considers factors alongside economic cost and seeks to achieve an outcome that increases the overall benefit to customers, the wider environment and overall society'.

Best Value Planning occurs after the following steps within the WRMP process:

- development of a baseline supply demand forecast for the plan identifying that water resources zones are in deficit over the planning period; and
- options appraisal and development of feasible supply and demand options to address the deficit.

We have undertaken an appraisal of alternative programmes to compare against and justify our preferred Best Value Plan. We have undertaken scenario testing against Ofwat's common reference scenarios to understand any tipping points which might affect our decision-making and programme content.

3.2.2 Problem Characterisation

We used a problem characterisation assessment tool to assess our vulnerability to various strategic issues, risks, and uncertainties and to determine the economic and best value modelling approaches used. This assessment has shown that there is a relatively large deficit problem to solve. However, the issues associated with this are of low complexity and well understood. These include:

- impact of climate change;
- sustainability reductions;
- environmental destination; and
- impact of Covid-19 on household and non-household demand forecasts.

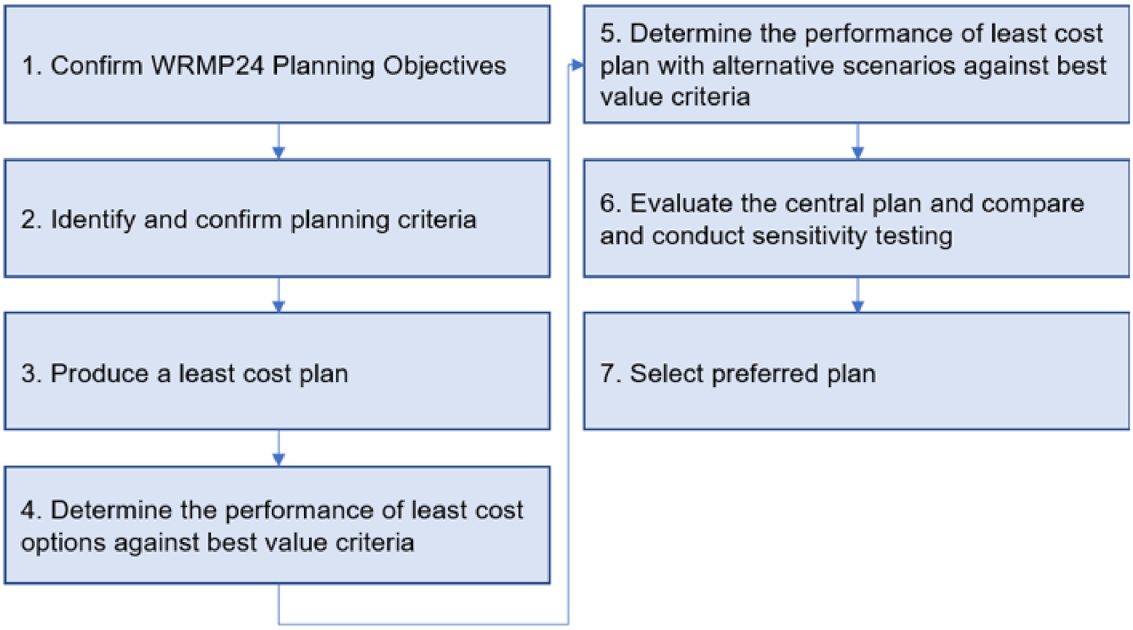
This confirmed that 'Current' approaches (Economics of Balancing Supply and Demand, EBSD) should be adequate, and specific complexities can be examined through the steps recommended in the parallel UKWIR Risk Based Planning Methods project (to assist in the derivation of DO, incorporation of uncertainty etc.)

3.2.3 Best Value Plan Methodology Overview

Following the outcomes of the Problem Characterisation exercise, the Best Value Plan Methodology has been designed to allow for individual assessment of options and portfolios of options against the planning criteria.

Figure FIGURE 13 illustrates the steps undertaken to develop and determine the Best Value Plan. This has been developed to align with the Water Resources Planning Guideline 2021, which sets out the expectations of the regulators. In addition, reference has been made to UKWIR's 2020 guidance 'Deriving a best value water resources management plan'.

FIGURE 13: OVERVIEW OF BEST VALUE PLANNING APPROACH



The steps are briefly described below, and for further detail on the BVP please consult section 8 of the ESW Revised WRMP24 Best Value Plan Technical Report.

Step 1: Confirm WRMP24 Planning Objectives

Our objectives have been chosen because they align with:

- our own Purpose, Vision, and Values;
- our current Performance Commitment Levels (PCLs) and Outcome delivery Incentives (ODIs);
- water Resources East's (WRE) regional plan objectives;
- government expectations for water companies WRMP24s including outcomes of the 25 Year Environment Plan and our local River Basin Management Plans (RBMPs); and
- the overall requirements of the Water Resources Planning Guideline.

The objectives we aim to achieve in our WRMP24 Best Value Plan (BVP) are:

- achieve a secure, resilient, and sustainable supply of water for our customers, moving to a 1 in 500 level of resilience by 2050;
- protect and enhance the environment, ensuring our abstractions are sustainable both in the short and long term;
- reduce leakage from our network and from customer's homes, contributing to a national target of 50% reduction from 2017/18 levels by 2050;
- reduce customer demand to 110 l/head/day by 2050;
- reduce non-household customer demand by 9% by 2037/38 (excluding growth); and
- for all our meters to be smart meters by 2050.

Step 2: Identify and confirm planning criteria

For each plan developed, and options selected, the best value plan criteria listed below have been used to assess whether plans and options deliver best value. The selection of the criteria has been informed by our objectives.

- cost of plan (TOTEX NPV);
- drought resilience;
- biodiversity net gain;
- natural Capital;
- leakage reduction;
- per capita consumption;
- flood risk management;
- multi-abstractor benefit;
- carbon;
- customer preference;
- human and social well-being;
- option deliverability; and
- impact upon designated sites.

Step 3: Produce a least cost plan

Develop a Least Cost Plan using the EBSD model, this Least Cost Plan served as a baseline against which to appraise other programmes. The Least Cost Plan assumed the following:

- central forecasts for supply and demand;
- leakage reduction of 40% by 2050 in the Essex and Suffolk areas;
- central forecast for climate change impacts;
- environmental Destination (ED) licence reductions are based on the BAU+ scenario. Included in this are the BAU+ abstraction licence reductions provided by WRE using its simulator for both groundwaters and surface-waters in the Suffolk WRZs; and for groundwater in the Essex WRZ, with the surface water impacts based on new Hand off Flows (HOFs) on the River Stour, River Blackwater, and the Roman River; and
- central universal metering option.

Step 4: Determine the performance of least cost options against best value criteria

This step assessed the options chosen in the Least Cost Plan against all potential available options for each WRZ using the Best Value Plan criteria. The purpose of this step was to identify if there exist any better performing options (against best value plan criteria) that haven't been chosen in the Least Cost Plan and therefore should be included in a Best Value Plan. Option availability was determined based on earliest delivery date and consideration of any mutual inclusivity/exclusivity with other options. To aid this analysis, parallel option plots were developed to allow a visual assessment of option performance across the full spectrum of Best Value Plan criteria.

Step 5: Determine the performance of least cost plan with alternative scenarios against best value criteria

The objective of this step was to assess alternative plans and the extent to which they meet the objectives as measured using the value criteria. The scenarios considered are summarised in Table 19.

TABLE 19: ALTERNATIVE PLAN AND ADAPTIVE PROGRAMMES

Scenario reference	Description	Adaptive programme/ Alternative plan
Central Plan	Central estimates for demand and supply factors.	
High Environmental Destination	An Adaptive Programme which assumes our AMP8 WINEP Environmental Destination investigations conclude that a higher-level of abstraction sustainability reductions are required (i.e., Enhanced scenario) than our central forecast.	Adaptive Programme
High PCC	There is uncertainty as to whether PCC will reduce as forecast. This Adaptive Programme assumes PCC outturns in line with our High PCC forecast.	Adaptive Programme
Best Environment & Society	Incorporates the lowest level of abstraction from existing sources (Enhanced ED scenario) and the highest level of leakage reduction (50%).	Alternative Plan
North Suffolk Reservoir	The Adaptive Programme we would deliver should AMP7 detailed design conclude that the North Suffolk winter storage reservoir can be delivered more quickly than is currently assumed.	Adaptive Programme
Habitats regulations sustainability reductions	There is uncertainty around the application of EA advised sustainability reductions and/or stricter HOF conditions by 2026/7 for up to nine sources in our Northern Central WRZ, to meet the requirements of the Conservation of Habitats and Species Regulations 2017 (the Habitats Regulations). Once these have been confirmed, we will review the need to move to this Adaptive Programme.	Adaptive Programme

Step 6: Evaluate the central plan and compare and conduct sensitivity testing

Parallel axis plots were used to visually assess the plan level performance of the Central plan against the alternative plan, sensitivity scenarios, and adaptive programmes to review whether the alternatives perform better than the least cost Central Plan against the best value criteria. Table 20 defines the sensitivity scenarios included.

For purposes of assessing Best Value, ESW are using the statutory 2050 timeline for WRMP24. However, sensitivity testing was undertaken by assessing our plan over the 2075 and 2100 timelines to ascertain whether planning for a longer period impacts the selection of options. In addition, further scenarios were assessed, including the Ofwat Common Reference required scenario testing.

TABLE 20: SENSITIVITY SCENARIOS

Least cost planning scenario	Scenario reference	Description	Sensitivity scenario/ Adaptive programme/ Alternative plan
Central Plan	Central Plan	Central estimates for demand and supply factors	
Ofwat Climate Change	Low climate change (impacts)	Lower climate change impact forecasts for supply and demand.	Sensitivity scenario
	High climate change (impacts)	Higher climate change impact forecasts for supply and demand.	Sensitivity scenario
Ofwat Technology	Tech slow	Assume slow adoption of water efficiency technology and a higher demand forecast	Sensitivity scenario
	Tech fast	Assume fast adoption of water efficiency technology and a higher demand forecast	Sensitivity scenario
Ofwat Demand	Low demand	Assumes implementation of higher demand management options to reduce demand	Sensitivity scenario
	High demand	Assumes implementation of lower demand management options resulting in higher demand	Sensitivity scenario
Ofwat Abstraction	Low Environmental Destination	Assumes reductions in abstraction licences as a result of a business-as-usual (BAU) Environmental Destination scenario.	Sensitivity scenario
	High Environmental Destination	Assumes reductions in abstraction licences as a result of an Enhanced Environmental Destination scenario.	Sensitivity scenario*
Per Capita Consumption	Low PCC	Assumes that demand is reduced below that of the central plan through enhanced water efficiency measures	Sensitivity scenario

*Also, an Adaptive Programme.

Step 7: Select preferred plan

This was a qualitative step that undertook decision-making and assurance of alternative plans to select a preferred plan that represents the Best Value Plan, it included the development of a narrative to explain the rationale for the selection of the preferred plan over alternatives.

3.2.4 Best Value Plan Assessment Results

Our Best Value Plan includes both demand management and new supply options. This section focuses on supply options only (NES15 sets out our WRMP Demand Management options).

Option comparison results

As described in section 3.1.8, parallel axis plots were created at a WRZ level to enable comparison of performance of individual water supply options against best value plan criteria.

Taking account of option availability (e.g., earliest delivery date and mutual exclusivity) no alternative options were identified as outperforming those selected under the least cost plan.

To illustrate the approach, we have included here plots for the Northern Central WRZ. Figure FIGURE 14 shows that the Barsham Nitrate Scheme is the only water supply option available for selection in AMP8 and it is selected in the Least Cost Plan. The remaining options are transfers, the selection of which are dependent upon the relative respective water availability and water need between donor and recipient WRZ.

For AMP9 and beyond Figure 15 includes the parallel axis plots for the Northern Central WRZ. It can be seen that the reservoir performs best due to the lowest AIC scores and best overall non monetised BVP criteria performance. Of the remaining options, Lowestoft Reuse performs best against AIC, SEA overall, Biodiversity net gain (BNG), Natural Capital (NC), Carbon, and customer preference criteria, supporting its inclusion in the Central Plan from a best value perspective. The remaining Corton and Caister desalination options only outperform Lowestoft Reuse for option deliverability, which is not considered sufficient to warrant inclusion from a BVP perspective.

For more details see section 6.1 of our ESW Revised WRMP24 Best Value Plan Technical Report.

FIGURE 14: PARALLEL AXIS PLOT SHOWING OPTIONS AVAILABLE IN AMP8 IN NORTHERN CENTRAL WRZ

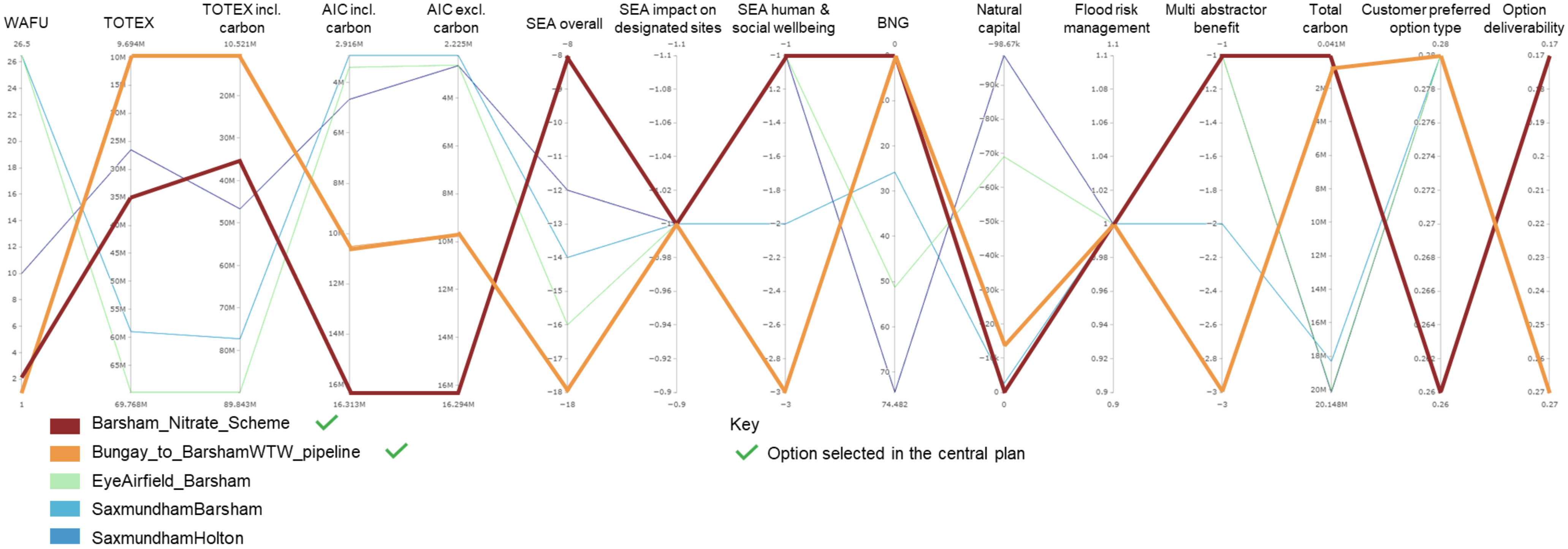
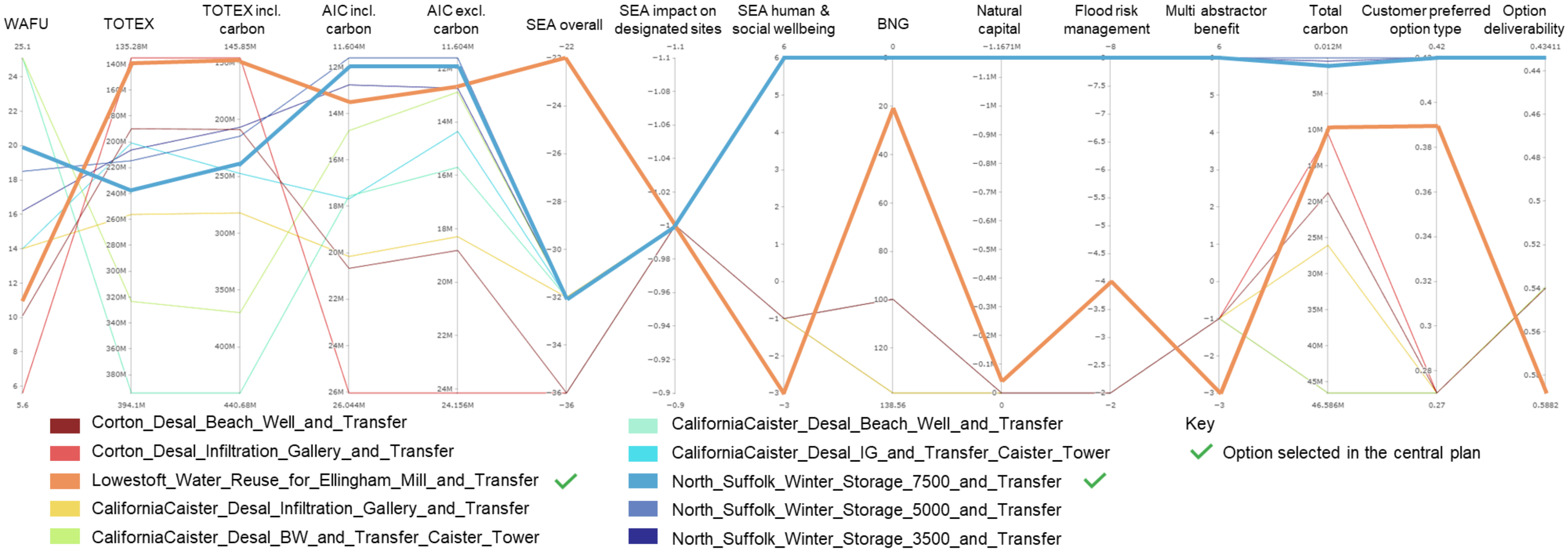


FIGURE 15: PARALLEL AXIS PLOT SHOWING OPTIONS AVAILABLE IN AMP9 IN NORTHERN CENTRAL WRZ



Plan comparison results

A summary of the sensitivity scenarios, Adaptive Programmes, and Alternative Plan is provided in Table 21 including a summary of the options selected in the plans and their performance against best value criteria.

TABLE 21: SUMMARY OF BEST VALUE PLAN RESULTS

Best value plan scenario	Scenario description	Comparison with central plan	Conclusion
Central Plan	Central estimates for demand and supply factors. Medium DMO implementation.	n/a	n/a
Low climate change (impacts)	As per the Central Plan, but using the low climate change scenario on supply forecasts	The scenario is as per the Central Plan in AMP8 and AMP9 except that the Langford UV and Langham Nitrate schemes are not selected. There are further differences in option selection beyond 2040 but for these options, lead times are sufficient for option selection to be refined at later plans based upon additional information on climate change impacts.	While the low climate change scenario provides a Totex saving of approximately 10% compared to the Central Plan the low climate change scenario is not considered best value due to the impact on supply resilience
High climate change (impacts)	As per the Central Plan, but using the high climate change scenario on supply forecasts	The scenario is as per the Central Plan in AMP8 and AMP9 except that Southend Reuse is selected in AMP9 (or Corton Beach Well desalination if the 2100 planning horizon is used). There are further differences in option selection beyond 2040 but for these options, lead times are sufficient for option selection to be refined at later plans based upon additional information on climate change impacts.	The high climate change scenario requires approximately 11% additional Totex compared to the Central Plan and environmental metrics generally perform worse. The high climate change scenario is not preferred due to adverse cost and environmental impacts.
Tech slow	As per the Central Plan except for lower leakage reduction and less water efficiency benefit.	The scenario is as per the Central Plan in AMP8, but in AMP9 Lowestoft Reuse is required earlier in the AMP and Southend Reuse is also required. Beyond 2040 the greater deficit drives additional reuse and desal selection instead of the North Suffolk Reservoir.	The tech slow scenario requires approximately 12% less Totex than the Central Plan as higher expenditure on supply options is more than offset by lower demand management expenditure. However, the Tech slow scenario performs significantly worse against SEA metrics and does not align with policy expectations for leakage reduction. It is not preferred due to these adverse features which are considered to outweigh the Totex benefit.

Best value plan scenario	Scenario description	Comparison with central plan	Conclusion
Tech fast	As per the Central Plan except for greater leakage reduction, more water efficiency benefit, and Office for National Statistics (ONS) population growth.	The scenario includes a reduced programme of supply options compared with the Central Plan combined with further leakage reduction and water efficiency measures. Notwithstanding this the Linford WTW scheme is retained in AMP8, together with the Suffolk transfers.	The Tech fast scenario requires approximately 20% higher Totex than the Central Plan due to the significantly increased demand management expenditure. The Tech fast scenario performs somewhat better than central plan on the SEA metrics, but worse on carbon and deliverability. The scenario is not preferred as the SEA benefits are not considered to outweigh the additional cost, carbon, and deliverability risks.
Low demand	As per the Central Plan except for greater leakage reduction, more water efficiency benefit and ONS population growth.	The scenario includes a reduced programme of supply options compared with the Central Plan combined with further leakage reduction and water efficiency measures.	The low demand scenario requires approximately 12% higher Totex than the Central Plan due to the significantly increased demand management expenditure. The low demand scenario performs somewhat better than the central plan on the SEA metrics, but worse on carbon and deliverability. The plan is not preferred as the SEA benefits are not considered to outweigh the additional cost, carbon, and deliverability risks.
High demand	As per the Central Plan but with lower leakage reduction, lower water efficiency and greater population growth.	The plan is as per the Central Plan in AMP8, but in AMP9 Southend Reuse is also required. Beyond 2040 the greater deficit drives additional reuse and desalination selection instead of the North Suffolk Reservoir, but lead times for these options, are sufficient for option selection to be refined at later plans based upon updated demand forecasts.	The high demand scenario requires approximately 14% less Totex than the Central Plan as higher expenditure on supply options is more than offset by lower demand management expenditure. However, the high demand scenario performs significantly worse against SEA and carbon metrics and does not align with policy expectations for leakage reduction. It is not preferred due to these adverse features which are considered to outweigh the Totex benefit.
Low Environment Destination	As per the Central Plan but using the BAU Environmental Destination scenario	The scenario is as per the Central Plan in AMP8 and AMP9. Beyond 2040 Caister Reuse is selected instead of the North Suffolk Reservoir, but lead times are sufficient for option selection to be refined at later plans based upon additional information on required abstraction reductions.	The low environment destination scenario requires approximately 9% less Totex than the Central Plan and performs similarly to the central plan on SEA, carbon, and deliverability metrics. Depending upon decisions regarding the Environment Destination a change to the Low ED scenario may be required, but the results indicate that this would not impact option selection in AMP8 and 9.

Best value plan scenario	Scenario description	Comparison with central plan	Conclusion
High Environmental Destination	As per the Central Plan but using the Enhanced Environmental Destination scenario	The scenario is as per the Central Plan in AMP8 and AMP9. Beyond 2040 the greater deficit drives additional reuse and desal selection including the large Canvey Island Desalination option for Essex. However, lead times are sufficient for option selection to be refined at later plans based upon additional information on required abstraction reductions.	The Totex cost of the high environment destination scenario is over double that of the Central Plan and the scenario performs worse than the Central Plan across environmental and carbon metrics due to the scale of supply option infrastructure required. It is not therefore preferred compared with the Central Plan.
Low PCC	As per the Central Plan but including high enhanced household water efficiency measures	The plan is as per the Central Plan in AMP8 and AMP9, apart from the selection in AMP9 of the California Caister desalination option instead of Lowestoft Reuse. Beyond 2040 Caister reuse is selected instead of the North Suffolk Reservoir.	Over the 25 year planning horizon the Totex cost for the PCC low scenario is slightly higher than for the Central Plan, and the SEA, carbon and deliverability metrics all perform worse than for the central plan. These conclusions don't hold for longer planning horizons, with changes in the option selection post 2040 requiring further review.
High PCC	As per the Central Plan but including low household and non-household water efficiency measures	The scenario is as per the Central Plan in AMP8, but in AMP9 Southend reuse is required in addition to Lowestoft Reuse. Beyond 2040 the greater deficit drives additional reuse and desal selection instead of the North Suffolk Reservoir, but lead times are sufficient for option selection to be refined at later plans based upon additional information on climate change impacts.	The Totex cost for the PCC high scenario is 16% higher than for the Central Plan, and the SEA, carbon and deliverability metrics all perform worse than for the Central Plan. It is not therefore preferred compared with the Central Plan.
Best Environment & Society	This alternative plan assumes 50% leakage reduction and higher water efficiency measures resulting in a smaller deficit in the medium term, but it also includes the Enhanced Environmental Destination scenario increasing deficits in the longer term.	The plan differs from the Central Plan in not selecting Langford UV and Nitrate schemes, and the Abberton RWPS and Langford clarifier upgrade in AMP8. The higher leakage reduction DMO is resulting in a smaller deficit to address via supply options in AMP8. The plan includes Southend Water Reuse at 40Ml/d, Lowestoft Reuse, Corton Beachwell desalination and Caister Water reuse to address deficits arising from the Enhanced Environmental Destination scenario.	The Totex cost of the Best Environment & Society plan is over double that of the Central Plan and the plan performs worse than the Central Plan across environmental and carbon metrics due to the scale of the demand management and supply option infrastructure required. It is not therefore preferred compared with the Central Plan.

Best value plan scenario	Scenario description	Comparison with central plan	Conclusion
North Suffolk Reservoir	As per the central plan, but this Adaptive Programme selects the North Suffolk Reservoir as soon as it is available.	This Adaptive Programme is the same as the central plan in AMP8, but in AMP9 Lowestoft Reuse is replaced with the North Suffolk Reservoir. The 3.5Mm^3 reservoir size is selected in AMP9 then Caister reuse is required from 2045. If the reservoir size is fixed at 7.5Mm^3 then once it is selected in AMP9, Lowestoft Reuse is selected in 2045.	The Totex cost of the plans that advance selection of North Suffolk Reservoir are between 4% and 15% lower (depending upon the planning horizon) than for the Central Plan and perform similarly on most environmental metrics (although better on biodiversity) and better than the Central Plan on deliverability. However, the North Suffolk Reservoir Adaptive Programme requires a one year extension to the moratorium on new non-domestic supplies in Hartismere and is dependent on the outcomes of the detailed engineering design stage of the both the North Suffolk Reservoir and Lowestoft Reuse.
Habitats Regulations sustainability reductions	As per the Central Plan, but this Adaptive Programme includes further licence reductions based upon the pending review of abstractions under the Habitats Regulations.	The Adaptive Programme is the same as the Central Plan in AMP8, but in AMP9 Lowestoft Reuse is required earlier in the AMP and Caister Reuse is also required. Beyond 2040 the North Suffolk Reservoir is selected at the smaller size of 3.5Mm^3.	Over the 25 year planning horizon the Totex cost for the habitat regulation scenario is slightly higher (10%) than for the Central Plan. Extending the planning horizon to 2075 and 2100 results in a marginally lower Totex than the Central Plan (circa 2.5%) with changes in the option selection post 2040 requiring further review

Figure FIGURE 16 provides an illustrative view of the difference between option selection and/or timing between the various alternative plans discussed in Table 23.

The best value planning assessment supports the selection of the Central Plan from a best value and a monetised (Totex and AIC) perspective. Comparison both at a plan and option level has not identified any alternative plans or options that significantly outperform the Central Plan on a Best Value perspective. Key findings are as follows:

All available AMP8 options are selected under all scenarios and time frames. To address immediate planning deficits, the model is limited to a small portfolio of options for inclusion based upon earliest start date. New water resources are generated by the selection of Linford new groundwater abstraction and WTW. The model also selects three transfers to utilise surplus at the start of the planning period.

In AMP9, the North Suffolk Winter Storage Reservoir represents the best value option available within this timeframe that can provide new WAFU to alleviate growth constraints and emerging deficits. The Least Cost Plan selects Lowestoft Reuse before the North Suffolk Reservoir, and this is primarily driven by the deficits in the plan and that Lowestoft Reuse can be made available before the reservoir.

The two scenarios where the EBSD model is forced to select the North Suffolk Winter Storage Reservoir in 2034 result in plans with a cheaper Totex than the Central Plan. In our revised WRMP24 assessment, to achieve SDB in the North Suffolk Reservoir Adaptive Programme the moratorium on new non-domestic supplies in Hartismere WRZ must be extended for one year (compared to the central plan) to and including 2032/33. Our North Suffolk Reservoir Adaptive Programme is a feasible plan, but we acknowledge it is dependent on the outcomes of the detailed engineering design stage of the both the North Suffolk Reservoir and Lowestoft Reuse and whether the North Suffolk Reservoir can be delivered as quickly as Lowestoft Reuse.

Further detailed design work should be undertaken to confirm the earliest delivery date for the reservoir, scheme costs, and deployable output benefits.

The Central Plan assumes a 40% reduction in leakage by 2050 (in Essex and Suffolk) in addition to a high profile for both metering (i.e., compulsory smart metering by 2035) and water efficiency measures (<110l/head/day by 2050).

FIGURE 16: COMPARISON OF LEAST COST WATER SUPPLY OPTION SELECTION UNDER ALTERNATIVE SCENARIOS FOR THE 2050 TIMELINE

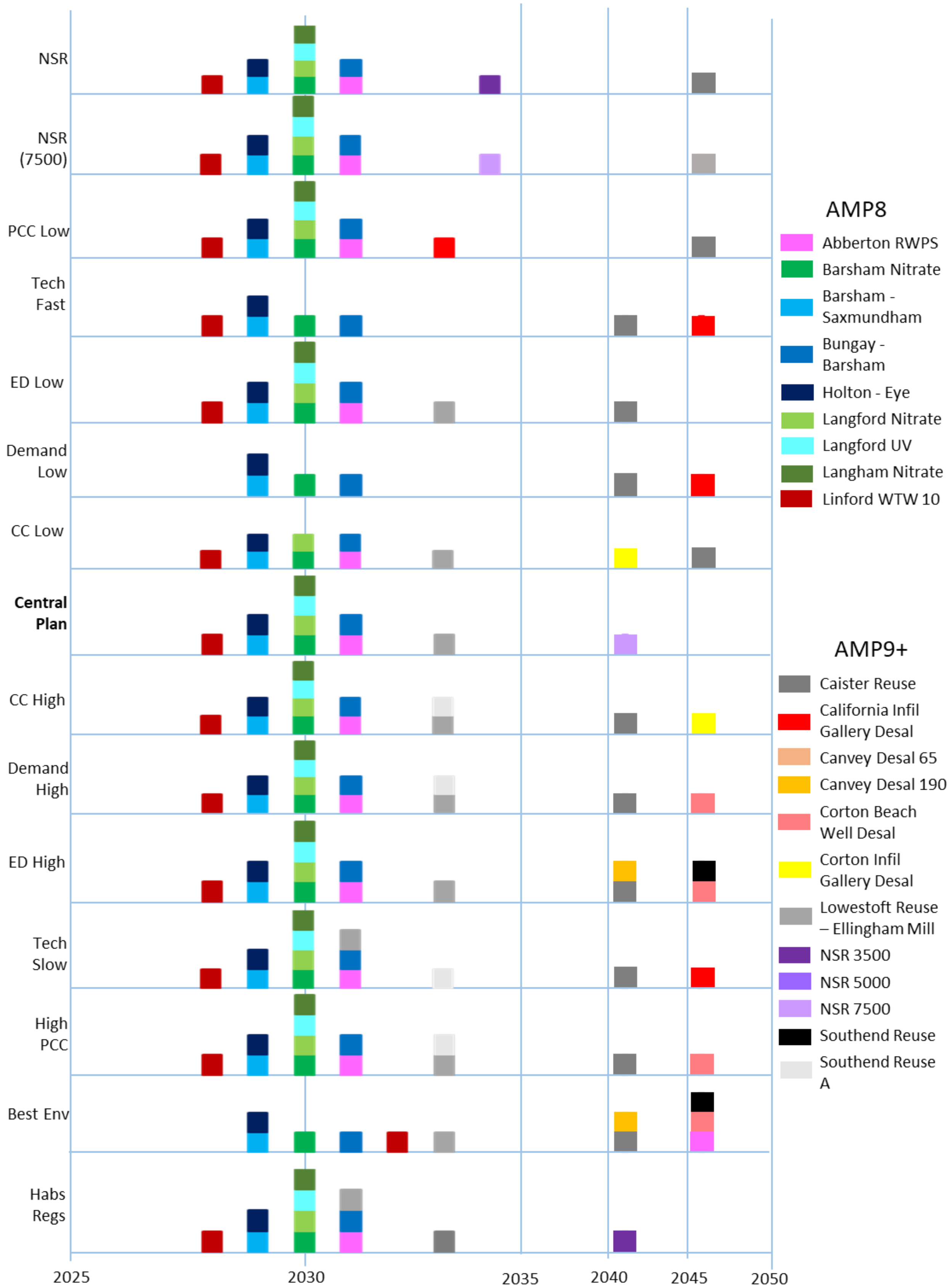
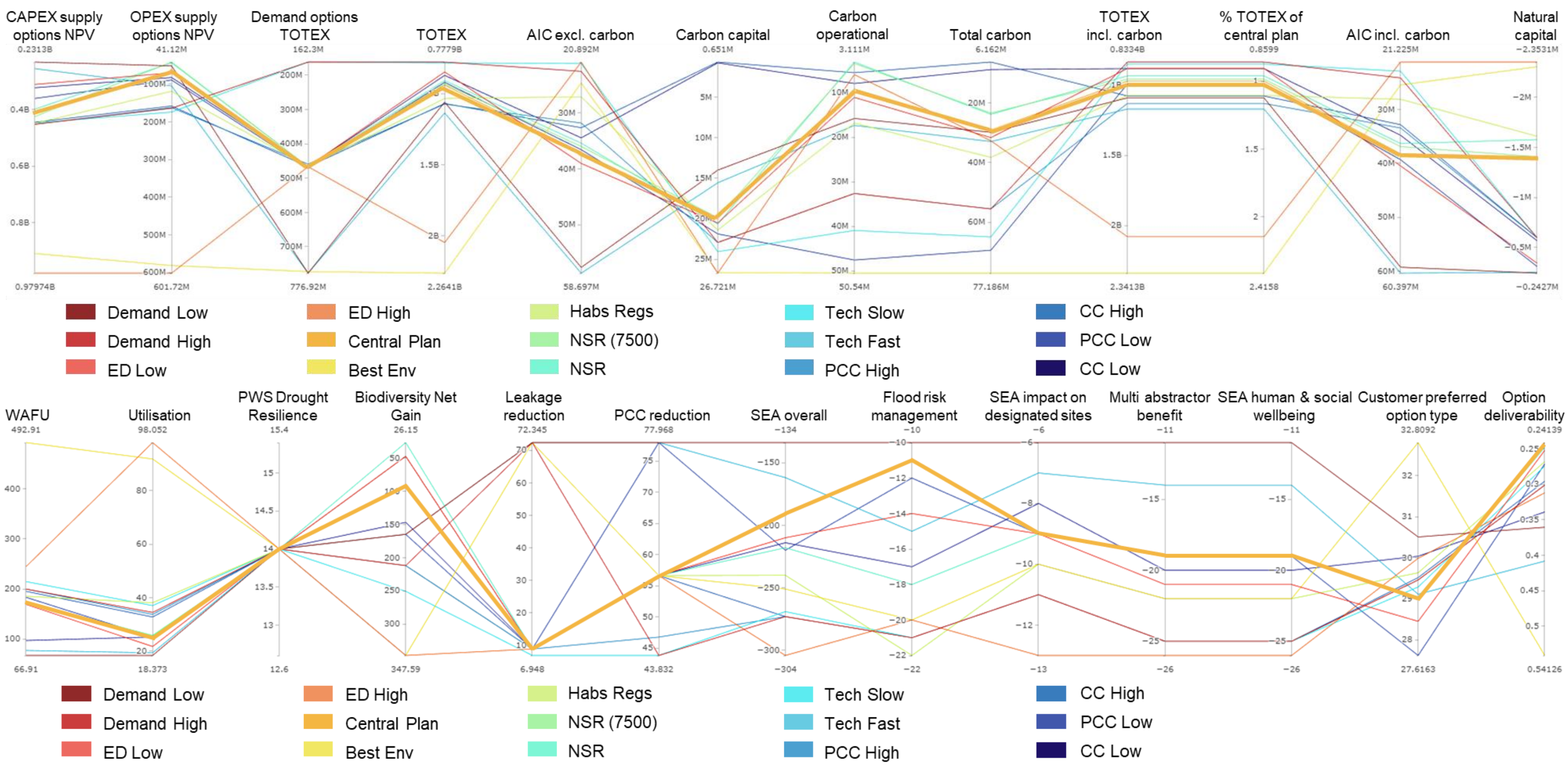


FIGURE 17: PARALLEL AXIS PLOTS ILLUSTRATING PLAN PERFORMANCE AGAINST BEST VAUE PLAN CRITERIA



In general scenarios with more adverse supply demand balance scenarios (e.g., High Climate Change, High PCC, Best Environment) result in plans that score worse across the non-monetised best value plan criteria than the Central Plan. This is primarily being driven by the larger deficits and the plan therefore including more environmentally impactful options such as larger (or multiple) water reuse and/or desalination schemes. Conversely those scenarios with more benign (or smaller deficits) result in some plans that perform better than the Central Plan. The Low Demand and Fast Tech scenarios result in plans that score better against the Strategic Environmental Assessment (SEA) criteria than the Central Plan. However, this plan has a significantly higher Totex than the Central Plan (driven by the high demand reduction measures included in this scenario).

FIGURE 18: SUMMARY OF CENTRAL PLAN 2050 WATER SUPPLY OPTIONS

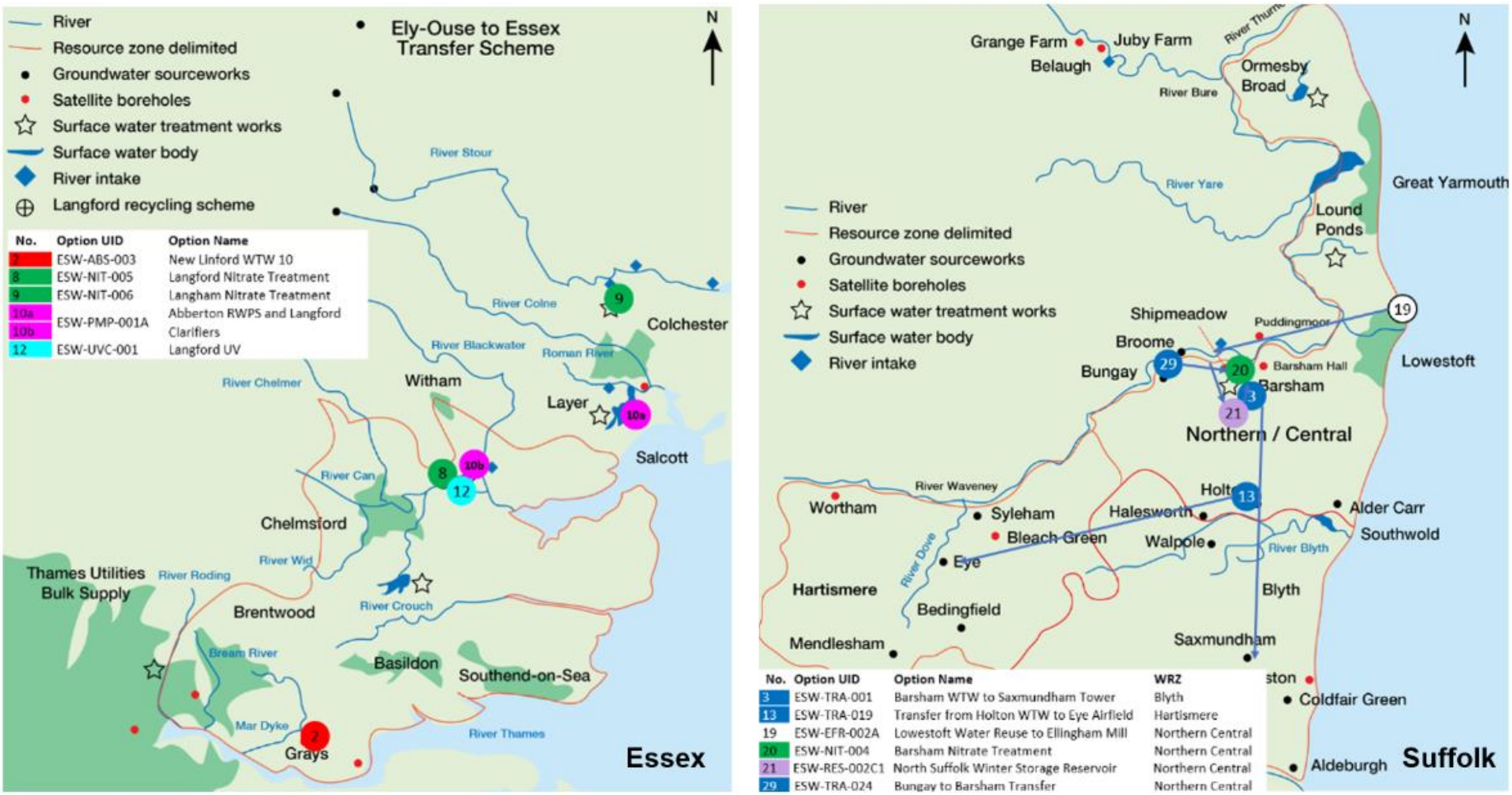


Table 22 and FIGURE 18 detail the least cost and best value plan supply options as identified through the best value plan assessment process. These options are then discussed further, however for details on these options and their development see the rWRMP24 Options Appraisal technical report.

TABLE 22: LEAST COST AND BEST VALUE PLAN SUPPLY OPTIONS

YEAR SELECTED	WRZ	OPTION	OPTION REF	OPTION TYPE	AMP
2027/2028	Essex	Linford New WTW 10	ESW-ABS-003	New WTW and borehole(s) (with raw water transfer)	AMP8
2029/2030		Langford Nitrate Scheme	ESW-NIT-005	Nitrate removal	AMP8
2029/2030		Langford UV	ESW-UVC-001	Cryptosporidium removal	AMP8
2029/2030		Langham Nitrate Scheme	ESW-NIT-006	Nitrate removal	AMP8
2030/2031		Abberton RWPS and Langford Clarifiers	ESW-PMP-001A	Raw water pumping station and clarifier upgrade	AMP8
2028/2029	Blyth	Barsham WTW to Saxmundham Tower	ESW-TRA-001	Potable Water Transfer	AMP8
2028/2029	Hartismere	Holton WTW to Eye Airfield	ESW-TRA-019	Potable Water Transfer	AMP8
2029/2030	Northern Central	Barsham Nitrate Scheme	ESW-NIT-004	Nitrate removal	AMP8
2030/2031		Bungay wells to Broome WTW transfer and Broome to Barsham WTW transfer	ESW_TRA_018 and ESW-TRA-023	Raw water transfer	AMP8
2032/2033		Lowestoft Water Reuse for Ellingham Mill and Transfer	ESW-EFR-002A	Water Reuse	AMP9
2040/2041		North Suffolk Winter Storage 7500 and Transfer	ESW-RES-002C	New Reservoir (with raw water transfer)	AMP11

Linford New WTW

This scheme consists of reinstatement of an abandoned artesian well (previous maximum capacity of 3.5Ml/d. To enable full utilisation of the current abstraction licence, new duty/standby wells for 6.6Ml/d capacity each as a satellite abstraction site. A new water treatment works will be required with an output capacity of 10Ml/d. Network upgrades will also be necessary. As a minimum, mains conditioning will be required, but depending on the final site location, the capacity of some areas of the network may need to be increased to accommodate the higher flows. .

Langford, Barsham and Langham Nitrate schemes

Enhanced treatment has been identified as required at these sites to enable compliance with the WHO nitrate limit for drinking water. Achieving this will provide a WAFU benefit through reduced outage. The treatment technology for these options is yet to be confirmed – options include Electrodialysis Reversal (EDR) and Ion-Exchange (IEX) nitrate treatment processes. A wastewater discharge to neighbouring Anglian Water wastewater sites for treatment of the brine has been assumed.

Abberton RWPS and Langford Clarifier upgrade

This option provides additional pumping capacity pending the completion of a raw water transfer from Layer WTW to Langford WTW in AMP7. This option also includes a clarifier upgrade at Langford WTW. This option provides WAFU benefit through allowing increased transfer capacity.

Langford UV

This scheme consists of provision of additional ultraviolet treatment contactors to treat for cryptosporidium, providing a WAFU benefit through reduced outage.

Barsham WTW to Saxmundham Tower

This option transfers treated water from Barsham WTW (in Northern Central WRZ) to Saxmundham Tower (in Blyth WRZ). This option includes a new 13 Ml service reservoir at Holton.

Holton WTW to Eye Airfield

This option transfers treated water from Holton service reservoir (detailed above) to a new service reservoir at Eye Airfield through construction of a new transfer main. This option includes a new 12 Ml service reservoir at Eye Airfield and associated outlet mains.

Bungay wells to Broome WTW transfer and Broome to Barsham WTW transfer

These options together consist of new raw water pipelines to transfer water from existing groundwater sources at Bungay and Broome for treatment at Barsham WTW.

Lowestoft Water Reuse

This option would take final effluent from Anglian Water's Lowestoft Water Recycling Centre, treat to a high standard and discharge via a transfer pipeline to Ellingham Mill for abstraction downstream at Barsham WTW yielding 11 Ml/d.

North Suffolk Winter Storage (7500 Ml)

New winter storage reservoir to be filled in winter from the River Waveney at ESW's existing Shipmeadow intake and potentially also from a new intake on the Hundred River near Kessingland . This reservoir would be a bunded offline design and has been developed at three sizes (3,500, 5,000 and 7,500 Ml). Water would be transferred from the reservoir for treatment at Barsham WTW and this option includes investment for an upgrade to enable treatment of an additional 16 Ml/d at Barsham WTW.

3.2.5 Long Term Planning

There are uncertainties associated with preparation of both baseline and final plan supply and demand forecasts including:

- how water company and government measures will reduce PCC over time;
- how quickly the climate will change and as it does, how this will affect rainfall patterns, rainfall totals, river flows, reservoir refill and groundwater recharge; and
- how resilient the environment will be to climate change and whether water company abstraction licences will need to be reduced further in the future.

To test the impact of these uncertainties upon option selection, alternative plans have been considered. Section 8.9 of the rWRMP24 technical report details the results of these plans, which are summarised in table 24.

Our Least Cost and Best Value Plan include the same options selected in the same years and therefore the costs are the same for these two plans. The lower cost for the Core Plan reflects the inclusion of our no/low regret options and exclusion of the options planned in the longer term to resolve the deficits resulting from the implementation of Environmental Destination. Our Best Environment & Society Plan assumes a high (Enhanced) Environmental Destination scenario and 50% reduction in leakage by 2050.

TABLE 23: PLAN COSTS

PLAN	SUPPLY OPTIONS			DEMAND OPTIONS	MANAGEMENT		TOTAL PLAN COST		
	CAPEX (£M)	OPEX (£M PA)	TOTEX (CAPEX + NPV OPEX) (£M)	CAPEX (£M)	OPEX (£M PA)	TOTEX (CAPEX + NPV OPEX) (£M)	CAPEX (£M)	OPEX (£M PA)	TOTEX (CAPEX + NPV OPEX) (£M)
Core Plan	319.00	10.66	397.67	406.71	129.67	536.38	725.71	140.33	934.05
Best Value Plan	540.91	11.57	542.04	406.71	129.67	536.38	947.62	141.24	1078.42
Least Cost Plan	540.91	11.57	542.04	406.71	129.67	536.38	947.62	141.24	1078.42
Best Environment & Society Plan	1465.18	118.03	1351.54	631.72	147.22	778.94	2096.89	265.25	2130.48

TABLE 24: ADAPTIVE PROGRAMME COSTS

ADAPTIVE PROGRAMME	SUPPLY OPTIONS			DEMAND OPTIONS	MANAGEMENT		TOTAL PLAN COST		
	CAPEX (£M)	**OPEX (£M PA)**	**TOTEX (CAPEX + NPV OPEX) (£M)**	**CAPEX (£M)**	**OPEX (£M PA)**	**TOTEX (CAPEX + NPV OPEX) (£M)**	**CAPEX (£M)**	**OPEX (£M PA)**	**TOTEX (CAPEX + NPV OPEX) (£M)**
North Suffolk Reservoir	472.25	12.04	501.61	406.71	129.67	536.38	878.96	141.71	1037.99
High PCC	594.20	27.25	662.17	406.71	99.79	506.50	1000.91	127.04	1168.68
High Environmental Destination	237.51	7.30	1414.84	406.71	129.67	536.38	644.22	136.96	1951.21
Habs Regs	518.15	22.07	596.88	406.71	129.67	536.38	924.86	151.74	1133.25

3.2.6 Best Value Plan Benefits

Final plan supply demand balance calculations have been prepared for each of the WRZs accounting for the demand savings and supply gains from our preferred Best Value Plan. Final planning scenario supply demand balance graphs and tabled summary data for each WRZ, under the dry year annual average (DYAA) scenario are presented below:

FIGURE 19: BVP DYAA SUPPLY DEMAND BALANCE GRAPH FOR ESSEX WRZ

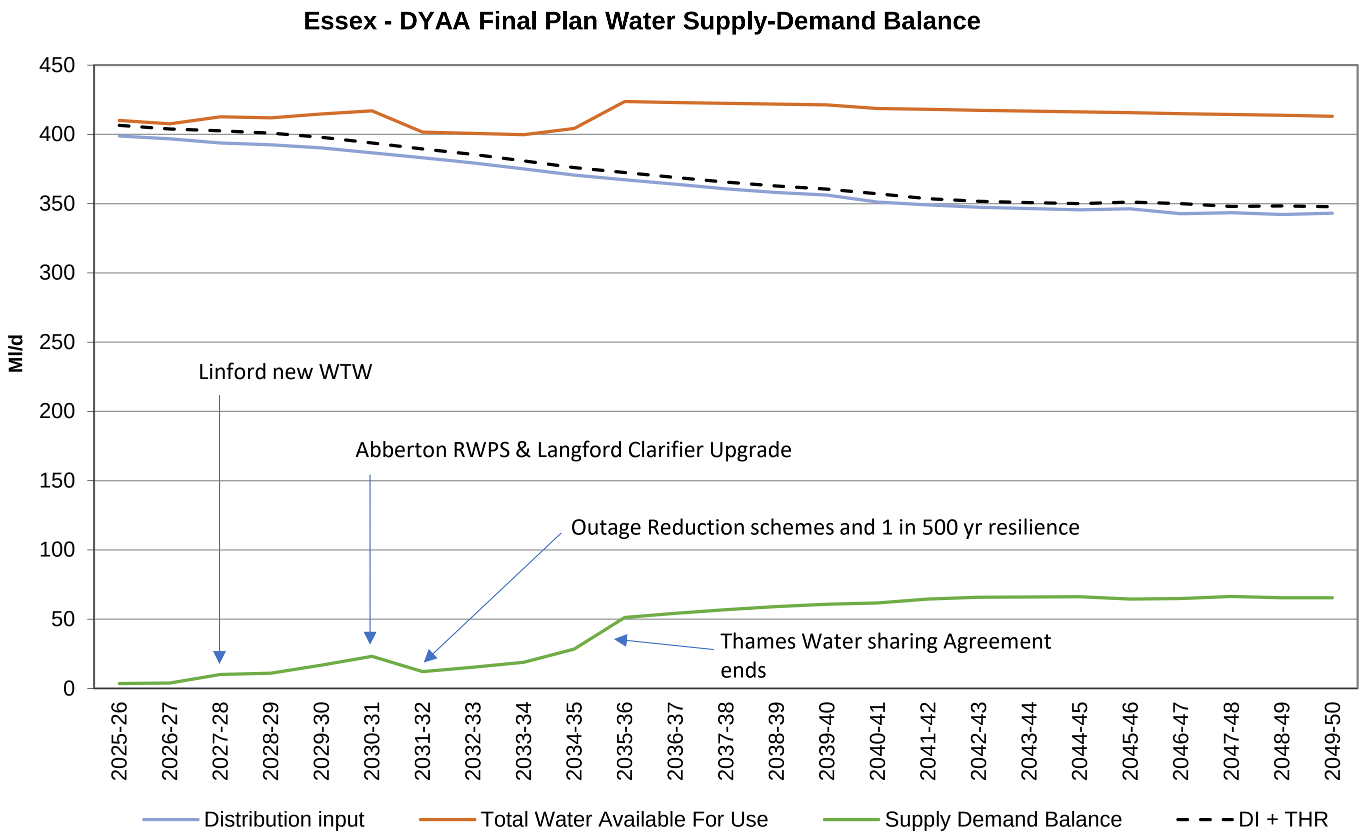


TABLE 25: BVP DYAA SUPPLY DEMAND BALANCE FIGURES FOR THE ESSEX WRZ

Essex WRZ	End of AMP8	End of AMP9	End of AMP10	End of AMP11	End of AMP12
	2029/30	2034/35	2039/40	2044/45	2049/50
Supply Demand Balance	16.99	28.30	60.73	66.20	65.38

The SDB shows the increase in surplus resulting from Linford new WTW in 2027/28, and then the upgrade to the Abberton RWPS and clarifiers at Langford WTW in 2030/31. This ensures that we can maximise the capacity of the Layer WTW to Langford WTW pipeline, the construction of which will be completed in AMP7. The Essex WRZ SDB benefits from the outage reduction schemes from 2029/30, although their principal purpose is not for gain in WAFU, but for resilience under normal year and critical periods, as well as DYAA, to ensure that the water we have forecasted to be available to us, will be, and not unusable due to poor water quality. All of the above options are required for 1 in 500-year resilience to be achieved, which we have forecasted to be from 2031/32. Whilst the Linford new WTW supply option is not needed to achieve surplus under the 1 in 200-year resilience scenario, without it, the surplus in 2027/28 would only be 0.13 Ml/d. The SDB shows a 20 Ml/d step up in 2035/36 when our water sharing agreement with Thames Water comes to an end.

FIGURE 20: BVP DYAA SUPPLY DEMAND BALANCE GRAPH FOR BLYTH WRZ

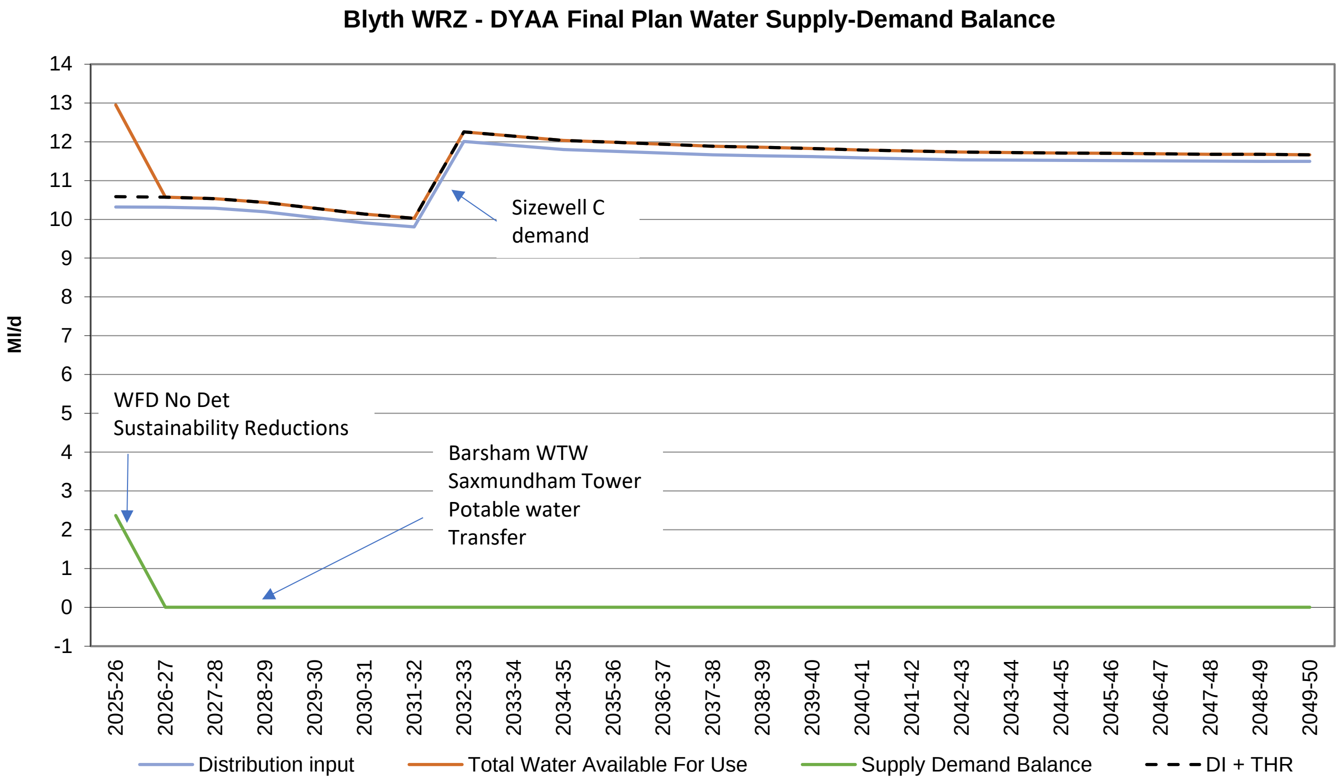


TABLE 26: BVP DYAA SUPPLY DEMAND BALANCE FIGURES FOR THE BLYTH WRZ

Blyth WRZ	End of AMP8	End of AMP9	End of AMP10	End of AMP11	End of AMP12
	2029/30	2034/35	2039/40	2044/45	2049/50
Supply Demand Balance	0	0	0	0	0

The initial surplus is eliminated in 2026-27 due to the sustainability reductions to Holton & Halesworth, Walpole and Little Glemham abstraction licences, which come in on 31 March 2026, requiring the construction of a new potable water transfer. This strategic pipeline allows a transfer of water from the Northern Central Zone to Blyth from 2028/29, initially utilising the baseline surplus in the Northern Central WRZ, and then the new resources provided by the Bungay wells to Broome WTW and Broome to Barsham WTW transfers, Lowestoft Reuse, and the North Suffolk Winter Storage Reservoir. The water imported through the new pipeline meets the subsequent sustainability reductions in 2030/31, and in the 2040s due to Environmental Destination.

For two years before the new transfer is operational (2026/27 – 2027/28), the deficit has been resolved by a small decrease of 0.6 Ml/d in the assumed volume of potable water exported from Walpole WTW in Blyth to the Halesworth area of distribution in the Northern Central WRZ.

FIGURE 21: BVP DYAA SUPPLY DEMAND BALANCE GRAPH FOR HARTISMERE WRZ

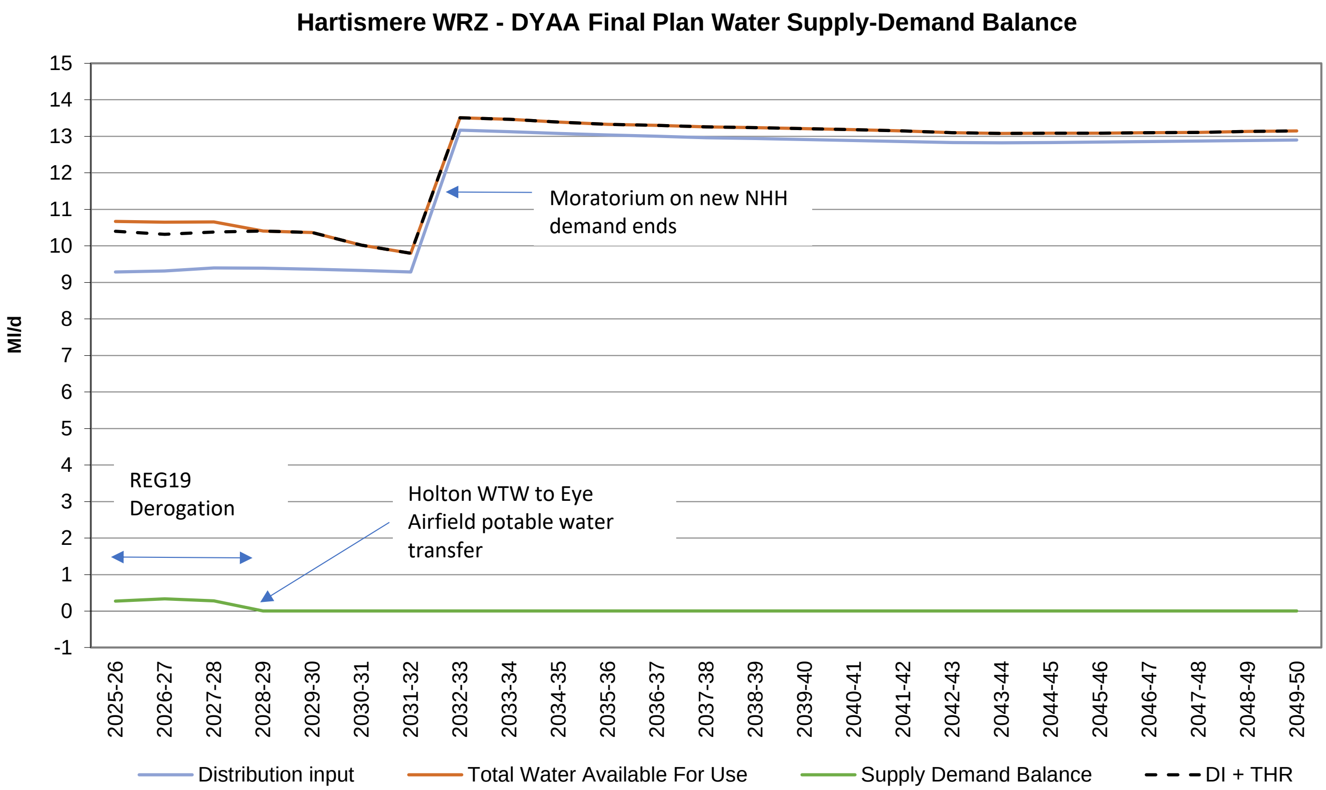


TABLE 27: BVP DYAA SUPPLY DEMAND BALANCE FIGURES FOR THE HARTISMERE WRZ

Hartismere WRZ	End of AMP8	End of AMP9	End of AMP10	End of AMP11	End of AMP12
	2029/30	2034/35	2039/40	2044/45	2049/50
Supply Demand Balance	0	0	0	0	0

The new supply option for the Hartismere WRZ is a pipeline that allows a transfer of water from the Northern Central Zone to Hartismere, initially utilising the baseline surplus in the Northern Central WRZ, and then the new resources provided by the Bungay wells to Broome WTW and Broome to Barsham WTW transfers, Lowestoft Reuse, and the North Suffolk Winter Storage Reservoir. In addition to the above, we know from our draft WRMP work that for our Hartismere WRZ final plan to not be in supply deficit, from the start of the planning period until the new strategic pipeline provides additional resource from 2028/29, we will need to maintain a moratorium on new non-household demand where the water is used for non-domestic purposes. This is incorporated into our WRMP24 Final Preferred Plan demand forecast.

However, even with the moratorium in place, sustainability reductions imposed from the start of the planning horizon, push the WRZ into deficit, as detailed in Section 3.3. To resolve that deficit, our only option is to challenge the timing of the imposition of these sustainability reductions via an application for an exemption to Regulation 19 of the Water Framework Directive on the grounds of Overriding Public Interest (OPI). This is reflected in 6.3FP of the ESWHRT Table 3b WRMP planning tables.

FIGURE 22: BVP DYAA SUPPLY DEMAND BALANCE GRAPH FOR NORTHERN CENTRAL WRZ

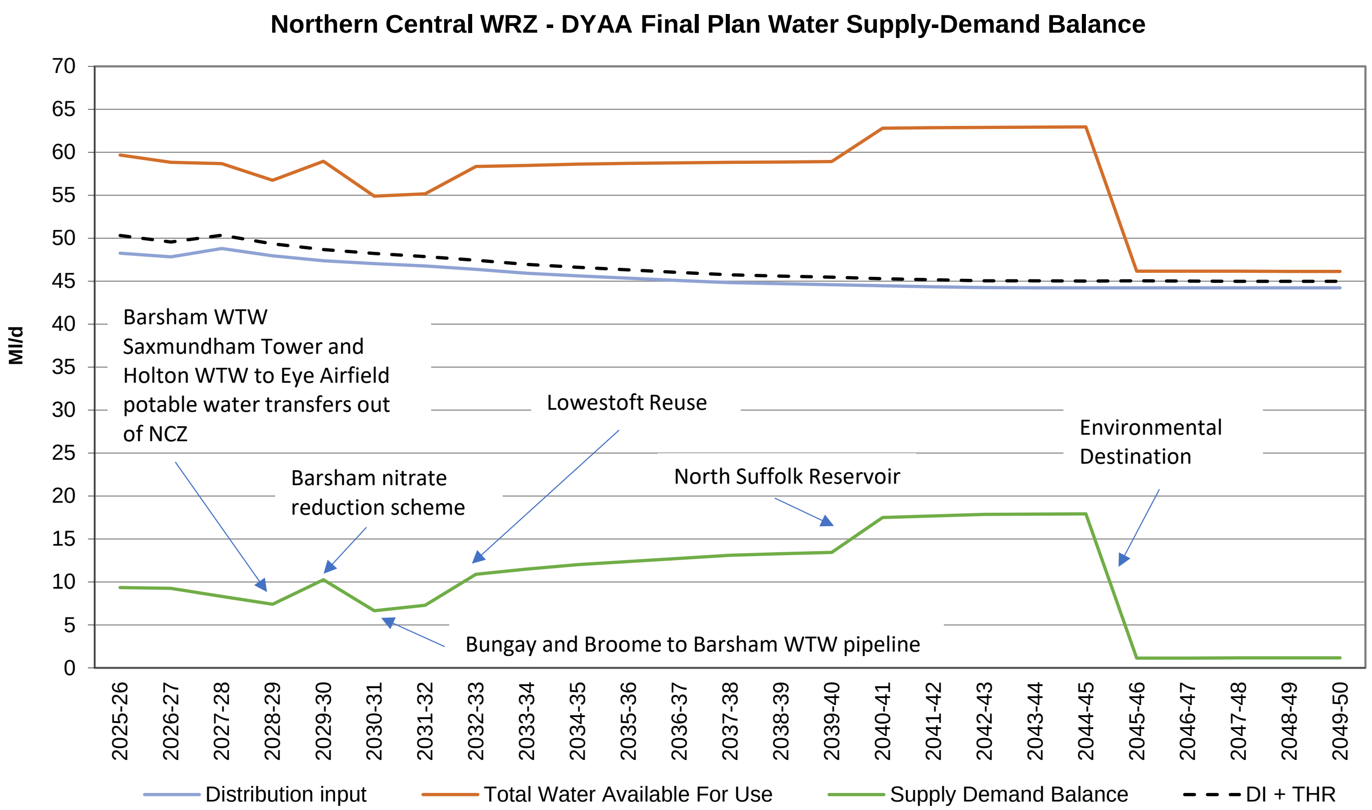


TABLE 28: BVP DYAA SUPPLY DEMAND BALANCE FIGURES FOR THE NORTHERN CENTRAL WRZ

Northern Central WRZ	End of AMP8	End of AMP9	End of AMP10	End of AMP11	End of AMP12
	2029/30	2034/35	2039/40	2044/45	2049/50
Supply Demand Balance	10.26	12.01	13.45	17.93	1.17

The initial surplus in the Northern Central WRZ is used to resolve the deficits in Blyth and Hartismere WRZs via the new strategic pipelines when it becomes operational in 2028/29. This supply is supported by the Barsham nitrate reduction scheme from 2029/30, the principal purpose of which is not for gain in Water Available for Use (WAFU), but for resilience under normal year and critical periods, as well as DYAA, to ensure that the water we have forecasted to be available to us, will be, and not unusable due to poor water quality. This is further supported from 2030/31 by the 1 Ml/d provided by the Bungay wells to Broome WTW and Broome to Barsham WTW transfers.

Additional resources are then required in the Northern Central WRZ to meet its own demand, plus that in Blyth and Hartismere WRZs, via the new potable water transfers. These resources are Lowestoft Reuse in 2032/33, and the North Suffolk Winter Storage Reservoir in 2040/41.

Further graphs and tables showing final planning scenario supply demand balances under the Dry Year Critical Period conditions are included within our revised draft WRMP showing positive balances for all areas.

To ensure we maintain headroom without deficits we will have a moratorium on new non-domestic supplies in our Hartismere WRZ which will remain in place until 2032 when new supplies will be online to support development in the area. The Hartismere moratorium is required because we are forecasting a significant increase in new non-domestic demand which is equivalent to a 35% increase in overall household and non-household demand and new supply schemes will not be developed until 2032. Suffolk is a serious water stressed area with limited supply headroom and we will work with businesses to consider water efficiency and water recycling in order to minimise their mains water needs. Our baseline supply headroom is constrained by the Environment Agency's No Deterioration policy which requires us to maintain groundwater abstraction at or below recent actual levels. Hartismere abstraction licences have been investigated in our part of the Water Industry National Environment Programme (WINEP) which has concluded that all Hartismere abstraction licence annual licensed quantities should be reduced to an agreed sustainable level in 2030.

We have several Drought Plan drought permit options in both our Essex and Suffolk supply areas although we have never needed to use them. The last time we imposed a Temporary Use Ban was in 1998 although we did need to implement our Level 1 Appeal for Restraint drought action in summer 2022, given the exceptionally dry weather. We have not included the deployable output gain from drought permits in our final plan supply demand balance forecasts. We intend to increase the return period of needing Level 3 drought actions (i.e., plan on needing them less frequently) from 2032 once our WRMP supply schemes are in supply.

3.2.7 Customer need

Section 8.2 of the rWRMP24 main technical report provides an overview of the customer research that we have undertaken to understand customers' preferences regarding types of demand management and supply option types.

The following customer research has been undertaken with the results being used to inform the development of our Best Value Plan:

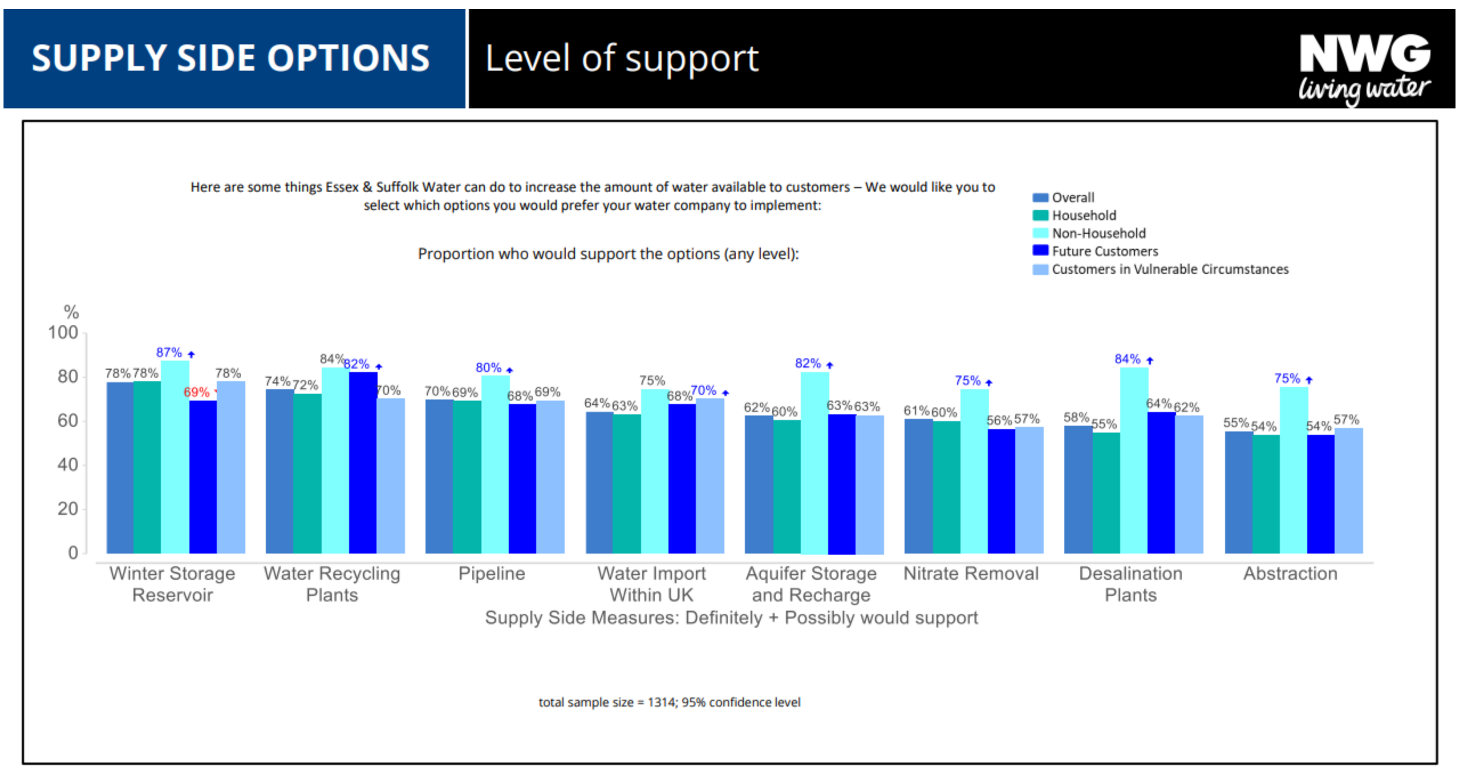
- **ESW WRMP Survey:** We have undertaken quantitative (online and face-to-face surveys) research regarding WRMP24 options with a total of 3,271 customers taking part. The results, presented in a report entitled “Essex & Suffolk Water Water Resources Management Plan Survey report” (July 2022), can be found here.
- **Water Resources East:** We jointly funded further customer engagement as part of a Water Resources East club project. This comprised qualitative, reconvened online workshops with pre- and post- surveys (4 with ESW customers, 4 with Cambridge Water customers and 8 with Anglian Water customers). In-depth interviews were held with non-household customers and stakeholders with a total of 89 participants. The results can be found here.
- **ESW Affordability and Acceptability Research:** our qualitative affordability and acceptability research (NES49).

In summary, customers strongly support leakage reduction and water efficiency and of the metering options, prefer traditional meters over smart meters. Customers prefer more traditional source of water such as groundwater, river abstractions and winter storage reservoirs and least prefer water reuse and desalination options.

The results of all three areas of research are presented in our Customer Research Report which can be downloaded here.

We describe our customer engagement in more detail in section 2.6.

FIGURE 23: EXAMPLE OF OPTIONS RESEARCH OUTPUT (JUNE 2022)



We have used this information to help inform the development of our Best Value Plan. Table 29 below presents a comparison of the options chosen in our Best Value Plan against the views of our customers.

TABLE 29: COMPARISON OF BVP OPTIONS AGAINST CUSTOMER VIEWS

Option Type	Option Name / Target	Customer view	Preferred Final Plan Considerations
Demand Management	40% reduction in Leakage by 2050	Leakage reduction tends to come out as a high or mid priority when ESW customers are asked what is important to them.	The national target is to reduce leakage by 50% by 2050. While we will reduce leakage by 40% by 2050 in our ESW supply area, we will be reducing leakage by 55% by 2050 in our Northumbrian Water region – we increased this target from 50% to 55% in response to customer feedback. At a group level, this means we will reduce leakage by 50% by 2050. Customers support leakage reduction.
Demand Management	Compulsory Metering by 2030 in Suffolk and 2035 in Essex to support a reduction in PCC to 110/litres/head/day by 2050	When metering is presented as part of an overall water efficiency package (e.g., as in our pre-acceptability (2023) research) it is considered a high priority, however when we test it in isolation (e.g., as in our WRMP company and regional research) support is lower.	We consider it a necessary component of our preferred final plan to reduce household consumption and meet national PCC targets. Additionally, from an environmental perspective given our region is a serious water stressed area and many of our existing groundwater abstractions, if fully utilised, would be unsustainable.
Demand Management	Fully smart metered by 2035 to support a reduction in PCC to 110/litres/head/day by 2050	When metering is presented as part of an overall water efficiency package (e.g., as in our pre-acceptability (2023) research) it is considered a high priority. However, when we test it in isolation (e.g., as in our WRMP options research) support drops.	We consider it a necessary component of our preferred final plan. Smart metering provides the largest demand savings and without it, we would not be able to meet the national PCC targets. Additionally, from an environmental perspective, it will help reduce demand and therefore abstraction which is also important given our region is a serious water stressed area and many of our existing groundwater abstractions, if fully utilised, would be unsustainable.

Option Type	Option Name / Target	Customer view	Preferred Final Plan Considerations
Demand Management	Household and Non-household water efficiency programme to support a reduction in PCC to 110/l/hd/d by 2050 and a reduction in business demand of 9% by 2038	Our customer research suggests that PCC is a mid-low priority relative to other measures.	Although water efficiency programmes are a mid to low priority for our customers, they are important in reducing both household and business water demand and are required in order to meet national targets
Supply	Linford new WTW and borehole(s)	Customers prefer more traditional source of water such as groundwater, river abstractions and winter storage reservoirs	Selected in least cost and best value plan and supported by customers.
Supply	Barsham, Langham and Langford Nitrate Removal Schemes	Participants found this option difficult to understand and it received lower levels of support than other options presented. However, 61% of participants supported nitrate removal at any level ('definite' or 'possible' support). There was significantly higher levels of support from non-household participants (75%).	Selected in least cost and best value plan. The majority of customers still supported this scheme even though it was considered a lower priority. We consider it an important scheme in our final plan because it can be delivered relatively quickly and will reduce the amount of unplanned water quality outage. This will mean that we can at least partially lift the mains water non-domestic use moratorium in the Hartismere WRZ earlier than otherwise would have been the case.
Supply	Abberton RWPS and Langford Clarifier	No evidence	Selected in least cost and best value plans to resolve near term supply deficits.
Supply	Suffolk Strategic Pipelines*	No evidence	Selected in least cost and best value plans to resolve near term supply deficits.
Supply	Lowestoft Water Reuse	Participants are open to water recycling and it receives relatively high levels of support. Reassurances would be required about the quality of recycled water and the impact of water recycling on the environment.	Selected in least cost and best value plans to resolve near term supply deficits. Supported by customers.

Option Type	Option Name / Target	Customer view	Preferred Final Plan Considerations
Supply	North Suffolk Winter Storage Reservoir	Winter storage reservoirs have high support because of their minimal impact on the environment and the long-term benefits they bring to communities	Selected in least cost and best value plans to resolve near term supply deficits. Supported by customers.

*Barsham WTW to Saxmundham Tower and Holton WTW to Eye Airfield.

The results of all three areas of research are presented in our Customer Research Report for WRMP which can be downloaded **here**. For our business plan, our full triangulation of customer evidence can be found in our **line-of-sight document** (NES45) and our customer insight summaries.

4. COST EFFICIENCY

4.1. COST METHODOLOGY

4.1.1 WRMP24 Costing

Supply option costing

Financial costs for all options were developed to enable inclusion within our WRMP24 Economics of Balancing Supply and Demand (EBSD) model as used to calculate our least cost plan.

We used option engineering calculations to produce tables of metrics used with our iMOD cost curves to generate costs for each asset, where each option was broken down into a list of assets. Our cost curve formulae come in two curve types: linear and power. These are represented as follows:

TABLE 30: COST CURVE FORMULA

Curve Type	Formula
Linear	$y = ax + b$
Power	$y = ax^b$

Additionally, there are two cost curve categories: CAPEX (capital expenditure) and OPEX (operational expenditure). These are represented as follows:

TABLE 31: COST CURVE FORMULA

Curve Type	y-axis parameter	x-axis parameters
CAPEX	Cost (£)	Calculated engineering metric for instance flowrate, in units such as m^3/d
OPEX	Annual cost (£/y)	Calculated engineering metric for instance flowrate, in units such as m^3/d

The values of CAPEX and OPEX for each asset component were summed to give overall CAPEX, OPEX and TOTEX values for the option.

Risk and overhead allowances

Cost allowances have been included for all options in alignment with wider NWG/ESW standard overheads as shown in Table 32.

TABLE 32: RISK AND OVERHEAD ALLOWANCES

Allowance	Source	Application
Contract overheads	NWG iMod	Base capex
Project overheads	NWG iMod	Base capex + Contract OH
Risk	NWL Risk Allowance Standards	10% of Base capex + Contract OH +project OH
Estimating Uncertainty	NWG Estimating Uncertainty Matrix	30% of Base capex + Contract OH +project OH

Optimism Bias Approach

Optimism bias (OB) has been calculated for all option types. This has been developed in alignment with the All Company Working Group (ACWG) Cost Consistency Methodology, and has been used for the assessment of Best Value Plan as an indicator of scheme deliverability. Table 33 summarises the OB developed for each option type. For purposes of costing options, the estimating uncertainty allowance has been used to cover optimism bias.

TABLE 33: OPTIMISM BIAS

Allowance	Optimism Bias
Desalination	53.9%
Effluent Re-use	58.8%
New Reservoir	43.4%
Transfer	27.5%

4.1.2 Optioneering Review

Between our draft and final WRMP24 submissions, we reviewed the alignment of our WRMP costs with the other water enhancement options being developed via our PR24 process. The purpose of this was to assure the consistency of option development between the WRMP24 options process delivered by Mott MacDonald in line with WRMP24 guidance, and our remaining Water enhancement options developed by Stantec.

As both WRMP and other PR24 options have been costed on the same basis using Northumbrian Water's iMOD cost models, the review focused on the technical outputs of the optioneering process, as any cost differences would be driven by differences in option scope and design assumptions. Stantec engineers responsible for development of the PR24 options reviewed a representative range of WRMP options, including transfer schemes, treatment and re-use schemes, and nitrate options. The review focused on:

- selection of scope items;
- process design and sizing assumptions for pipelines and process units; and
- opex assumptions for power and chemical usage.

The outcome of the review provided assurance of alignment of all aspects of solution development between the two programmes.

Costs shown in our WRMP24 submission differ from those in this case, as our PR24 costs are adjusted to Q2 2022/23 price-base.

Carbon Cost Methodology

The carbon impact of options was considered as part of the feasibility assessment stage, with an NPV of the whole life carbon of each option calculated using HMT Green book carbon prices.

4.1.3 Best Value Option Costs

Table 34 shows the total cost associated with our best value plan supply options, and therefore includes the Capex costs forecast in AMP8, AMP9 and AMP10 required to deliver all options. Opex is shown as an annual operating cost, effective from beneficial completion of each option (The WReN/WRW Inter Regional Transfer option is additional to our WRMP best value plan and is described in Section 1.3).

TABLE 34: SUPPLY OPTION COSTS – TOTAL COST (AMP8 – AMP10)

Option Name	Type	Scope	Capex £m	Opex (Annual) £m
Linford New WTW 10	Groundwater Abstraction and WTW	New WTW and borehole(s) (with raw water transfer)	37.200	1.566
Langham Nitrate scheme	Nitrate Removal	Construction and integration of Electro Dialysis Reduction (EDR) Ion-exchange process	40.100	1.311
Langford Nitrate scheme	Nitrate Removal	Construction and integration of Electro Dialysis Reduction (EDR) Ion-exchange process	30.738	1.092
Langford UV	Cryptosporidium Removal	Construction and integration of UV process	7.157	0.185
Abberton RWPS and Langford Clarifier upgrade	Raw Water Treatment	Raw water pumping station and Clarifier Upgrade	9.412	1.726
Suffolk Strategic Network (Barsham WTW to Saxmundham Tower and Holton WTW to Eye Airfield)	Potable Water Transfers	Barsham WTW to Holton, Holton to Saxmundham Tower and Holton WTW to Eye Airfield transfer pipelines, Holton Service Reservoir, Eye Airfield Service Reservoir, and outlet pumping mains.	117.730	0.624
Bungay wells to Broome WTW transfer and Broome to Barsham WTW transfer	Raw Water Transfers	Bungay wells to Broome WTW and Broome to Barsham WTW raw water transfer pipelines	8.935	0.074
Lowestoft Reuse	Water Reuse	Lowestoft Water Reuse for Ellingham Mill and Transfer	79.701	3.289
North Suffolk Winter Storage Reservoir 7500 Ml and Transfer	New Reservoir	New Reservoir (with raw water transfer)	209.739	0.200 (from AMP11)
Barsham River Works Upgrade	Treatment upgrade	Inlet work capacity upgrade to allow for increased water supply from either the North Suffolk Reservoir or Lowestoft Reuse.	31.643	0.720 (from AMP11)
Barsham Nitrate scheme	Nitrate Removal	Construction and integration of Electro Dialysis Reduction (EDR) Ion-exchange process	16.017	0.967
WReN / WRW Inter-Regional Transfer Strategic Resource Option	Inter-Regional Transfer	Provision for anticipated regional SRO transfers	1.600	0.000
Total			**5893.972**	**11.754**

Table 35 shows the total AMP8 costs for delivery of our best value WRMP supply options. Capex includes proposed AMP8 accelerated spend, currently planned for delivery in years 4 and 5 of AMP7 to enable completion in line with required beneficial use dates opex is shown as the total opex impact in AMP8. Where no opex is recorded, it is because options are scheduled for beneficial completion in year 5 of AMP8 or later, and therefore opex is only incurred beyond AMP8. **Total AMP8 capex is £380.157m. Opex in AMP8 is £5.948m** and is related to Linford new WTW and Suffolk Strategic Network options only.

TABLE 35: SUPPLY OPTION COSTS – AMP8 TOTAL COSTS

Option Name	Type	Scope	Capex £m	Opex £m
Linford New WTW 10 Ml/d	Groundwater Abstraction and WTW	New WTW and borehole(s) (with raw water transfer)	37.200	4.699
Langham Nitrate scheme	Nitrate Removal	Construction and integration of Electro Dialysis Reduction (EDR) Ion-exchange process	40.100	0.00
Langford Nitrate scheme	Nitrate Removal	Construction and integration of Electro Dialysis Reduction (EDR) Ion-exchange process	30.738	0.00
Langford UV	Cryptosporidium Removal	Construction and integration of UV process	7.157	0.00
Abberton RWPS and Langford Clarifier upgrade	Raw Water Treatment	Raw water pumping station and Clarifier Upgrade	9.412	0.00
Suffolk Strategic Network (Barsham WTW to Saxmundham Tower and Holton WTW to Eye Airfield)	Potable Water Transfers	Barsham WTW to Saxmundham Tower and Holton WTW to Eye Airfield transfer pipelines, Holton Service Reservoir, Eye Service Reservoir, Hartismere Distribution upgrade	117.730	1.249
Bungay wells to Broome WTW transfer and Broome to Barsham WTW transfer	Raw Water Transfers	Bungay wells to Broome WTW and Broome to Barsham WTW raw water transfer pipelines	8.935	0.00
Lowestoft Reuse	Water Reuse	Lowestoft Water Reuse for Ellingham Mill and Transfer	76.437	0.00
North Suffolk Winter Storage Reservoir 7500 Ml and Transfer	New Reservoir	New Reservoir (with raw water transfer)	34.831	0.00
Barsham River Works Upgrade	Treatment upgrade	Inlet work capacity upgrade to allow for increased water supply from either the North Suffolk Reservoir or Lowestoft Reuse.	AMP 9/10 delivery	0.00

Barsham Nitrate scheme	Nitrate Removal	Construction and integration of Electro Dialysis Reduction (EDR) Ion-exchange process	16.017	0.00
WReN / WRW Inter-Regional Transfer Strategic Resource Option	Inter-Regional Transfer	Provision for anticipated regional SRO transfers	1.600	0.00
Total			**380.157**	**5.948**

Table 36 provides the Capex spend profile for the £380.157m AMP8 investment required to deliver our Best Value Plan for supply options. As stated above, this includes proposed accelerated spend of £10.888m in 2023/34 and £24.226m in 2024/25.

TABLE 36: BEST VALUE SUPPLY OPTION COSTS – AMP8 CAPEX PROFILE (£m)

Option Name	23/24	24/25	25/26	26/27	27/28	28/29	29/30
Linford New WTW 10	0.544	1.088	17.784	17.784	0.000	0.000	0.000
Langham Nitrate scheme	0.500	2.500	8.020	8.019	8.019	8.019	5.020
Langford Nitrate scheme	0.750	2.250	6.148	6.148	6.148	6.148	3.148
Langford UV	0.500	0.500	1.431	1.431	1.431	1.431	0.431
Abberton RWPS and Langford Clarifier upgrade	0.000	0.000	1.753	1.753	1.753	2.077	2.077
Suffolk Strategic Network (Barsham WTW to Saxmundham Tower and Holton WTW to Eye Airfield)	2.716	5.431	36.527	36.527	36.527	0.000	0.000
Bungay wells to Broome WTW and Broome to Barsham WTW transfers	0.400	0.600	1.787	1.787	1.787	1.787	0.787
Lowestoft Reuse	1.697	3.394	11.659	14.922	14.922	14.922	14.922
North Suffolk Winter Storage Reservoir 7500 and Transfer	3.281	6.563	24.987	0.000	0.000	0.000	0.000
Barsham River Works Upgrade	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Barsham Nitrate scheme	0.500	1.500	3.203	3.203	3.203	3.203	1.203
WReN / WRW Inter-Regional Transfer Strategic Resource Option	0.000	0.400	0.500	0.500	0.200	0.000	0.000
Total	**10.888**	**24.226**	**113.799**	**92.076**	**73.992**	**37.588**	**27.588**

4.2. COST BENCHMARKING

4.2.1 Direct costs

A sample of WRMP project estimates produced as part of the PR24 costing process have been benchmarked against comparable water and wastewater companies. We have selected 5 projects from the WRMP supply options Best Value

Plan as representative of the range of solution types, technologies, and sites, and compared our costs to industry benchmarks.

For each project, we have identified all cost curves where a direct comparison is possible across our industry dataset and benchmarked each one. For example, for Lowestoft Reuse, we have benchmarked 40 individual cost models to form the overall cost-efficiency assessment. These include key process units such as reverse osmosis, screens, clarification tanks, filtration and chemical treatment and storage, as well as other items such as pipework, buildings, and pumping. Cost efficiency is assessed for each cost model, and benchmarked elements are rolled-up into an overall project level assessment.

The benchmarking exercise compares the Northumbrian Water estimated costs against six comparable water and wastewater companies from England and Wales. A mean average of these companies has been used as the benchmark with 25% and 75% percentiles provided as a suitable range. The costs comparisons have been calculated using each company's latest cost curve data, which is the same data used to build each company's PR24 submission. The costs generated by each cost curve are based on the specific sizing of our WRMP options.

The benchmarked costs shown in Table 37 have been adjusted for inflation using CPIH and have a price base of Q2 2022.

TABLE 37: PROJECTS SELECTED FOR INDUSTRY BENCHMARKING

Option Name	NW Cost (£m)	Benchmark (£m)	25%	75%	Delta	Delta %
Lowestoft Reuse 11 Ml/d	23.666	28.365	22.648	36.486	-4.699	-17%
Linford new WTW 10 Ml/d	9.730	10.311	8.249	13.405	-0.581	-6%
North Suffolk Winter Storage Reservoir	1.912	2.349	1.855	3.064	-0.437	-19%
Barsham to Blyth Transfer Main	9.953	12.529	10.023	16.288	-2.576	-21%
Langham Nitrate scheme EDR	11.983	12.232	11.772	12.687	-0.249	-2%
Total	**57.245**	**65.787**	**54.547**	**81.930**	**-8.542**	**-13%**

The benchmarking shows each of the projects is more efficient than the benchmark, with a total efficiency of 13% for all comparable cost curves included in the analysis.

4.2.2 Indirect Costs

We have also carried out analysis to assess our contractor and client indirect costs against the same 6 comparators as the direct costs benchmarking. Indirect costs include but are not limited to project elements such as design, site-setup, professional support, and other costs not directly related to the construction aspect of a project.

Table 38 shows a summary of costs for each of the 6 comparator water companies used in calculating the benchmark. Percentages refer to the amount of indirect cost that is applied for every £1 of direct costs for each respective comparator source.

TABLE 38: COMPARATOR INDIRECT COSTS

Indirect Type	1	2	3	4	5	6	Benchmark
Total Contractor Indirect Cost	42.65%	54.89%	43.99%	42.12%	43.44%	61.00%	48.01%
Total Client Indirect Cost	21.63%	10.96%	32.91%	35.46%	13.22%	40.90%	25.84%
Total Project Indirect Cost	**64.28%**	**65.85%**	**76.90%**	**77.58%**	**56.65%**	**101.90%**	**73.86%**

Table 39 compares our current indirect contractor costs of 36.88% and 26.52% client costs, with the benchmarks calculated in Table 38 above. The analysis shows our contractor indirect costs are 11% more efficient than the benchmark, and our client indirect costs are within 1%. Overall, we are more than 10% more efficient than the benchmark.

TABLE 39: INDIRECT COST BENCHMARKING

Indirect Type	Benchmark	Northumbrian Water	Delta
Total Contractor Indirect Cost	48.01%	36.88%	-11.13%
Total Client Indirect Cost	25.84%	26.52%	0.68%
Total Project Indirect Cost	**73.86%**	**63.40%**	**-10.46%**

5. CUSTOMER PROTECTION

5.1. PERFORMANCE COMMITMENTS

Customers are protected through performance commitments and ODIs on water supply interruptions, but only in extreme circumstances. This enhancement case provides new water supplies for the future, many of which do not provide additional resilience until 2028 or even 2030. So, in practice, there will be very limited protection for customers from ODIs on these benefits.

5.2. PRICE CONTROL DELIVERABLE

Our approach to determining Price Control Deliverables (PCD) is outlined in section 12.3 of A3 – costs (NES04). Our assessment has highlighted that for these enhancements, customers will not be protected by performance commitments.

Therefore, we propose a PCD related to delivery of our 2025-30 water supply schemes, to make sure our customers are protected. In Table 40, we assess these enhancements to test if the benefits are linked to PCs; against Ofwat's materiality of 1%; and to understand if there are outcome measures that can be used.

TABLE 40: ASSESSMENT OF BENEFITS AGAINST THE PCD CRITERIA

Enhancement scheme	Benefits linked to PC?	Materiality	Possible outcomes?
WRMP supply options (NES14)	Fail – very limited protection for customers from ODIs	Pass – 13%	We could set a water available for use (WAFU) outcome for these schemes.

Ofwat's guidance on PCDs expects us to identify water available for use (WAFU), specified in Ml/d, as the deliverable. This deliverable would be aggregated across supply-side improvements to the supply and demand balance and internal interconnectors where appropriate, set out by WRZ.

WAFU is not an effective "unit rate" measure for our water supplies enhancement case, because:

- The impacts of some of our largest schemes on WAFU are not seen until after 2030 (for example, for Lowestoft Reuse or the North Suffolk reservoir).
- Measuring WAFU directly will not be possible until after PR29, when this PCD will need to be reconciled. In practice, we would only be able to measure what each scheme is expected to deliver (which would be identical to a scheme delivery PCD, with the condition that this delivers the WAFU as set out in our WRMP).

Ofwat has not yet set its method for PCDs, or tested how using WAFU would work in practice. We have set out the benefits to WAFU in our published WRMP tables and could provide further details on this as needed – if Ofwat considers that this is a practical way to set this PCD across companies. We propose an alternative approach.

We propose a single **pooled scheme delivery** PCD for three of our water enhancement cases together – that is, **water supplies** (NES14); **reservoir safety** (NES22); and **climate change resilience process enhancements** (NES24). These cases each have a few large schemes with variable costs, and no clear outcome measures. Our **pooled scheme delivery** PCD will be based on the delivery of individual schemes, with the assessment of the delivery of schemes to be done through external assurance reports to be provided at PR29 (including assessment of partial delivery).

For water supplies, we propose that delivering projects to the specification for WAFU benefits as set out in our WRMP should be a condition of scheme delivery, rather than a unit rate.

TABLE 41: SUMMARY OF THE PRICE CONTROL DELIVERABLE FOR OUR WINEP PROGRAMME DELIVERY TO PROTECT CUSTOMERS

Description of price control deliverable	**Pooled scheme delivery** as set in our enhancement cases NES14, NES22, and NES24.
Measurement and reporting	We will report on the delivery of these schemes at the next price review (PR29), including specifying the individual schemes that have been delivered, not delivered, or that the Environment Agency or Defra has decided are no longer required (through any changes to WRMP or to reservoir safety).
Conditions on allowance	Projects must be delivered to the specification set out in WRMP including delivery of benefits to WAFU (NES14). Projects must comply with reservoir safety notices (NES22). Projects must deliver the capacity described in the climate change resilience process enhancements case (NES24).
Assurances	We will provide external assurance, with a duty of care to Ofwat at PR29, that these schemes have been delivered to the specifications described above. Ofwat will set the timetable for this external assurance to be delivered (either for the PR29 business plan, or a later date if they determine this is more appropriate).
Price control deliverable payment rate	We will return funds back to customers for individual projects, as specified in Tables 28 and 29 above (for NES24) – 12 individual schemes to be delivered by the dates specified. For partial delivery, we will return partial funding as determined according to project completion by the external assurance. This includes where projects are completed but do not deliver the WAFU as set out in the WRMP for Essex & Suffolk Water (unless ESW can show that this WAFU has been delivered through other alternative schemes to the satisfaction of the external assurers).
Impact on performance in relation to performance commitments	There is no direct improvement to performance commitments from this enhancement case.

We propose a single PCD for our pooled scheme delivery. This should:

- be set according to individual project costs, rather than a “per project” unit cost. This is because these costs vary considerably, and a single rate would create an incentive to deliver more of the cheapest projects (at the expense of more expensive projects). Ofwat’s guidance in IN23/05 identifies this incentive and expects us to set out scheme level deliverables where costs vary significantly across schemes (so our approach here is consistent with the guidance); and

- not include an automatic penalty for non-delivery (beyond returning the costs to customers). This is because each of these enhancement cases has other penalties that would apply in the case of non-delivery: for WRMP, we would not meet our statutory obligations to supply water; and for reservoir safety, we would not meet our statutory obligations for draw-down capacity. For climate change resilience process enhancements, we would continue to face ODI penalties in hot weather.

We have chosen to aggregate these PCDs because these share the same reporting, assurance, and conditions.

We have included a bespoke **uncertainty mechanism** for this enhancement case in our appendix **A3 – costs** (NES04). This explains that:

Our **Essex & Suffolk Water WRMP24** explains that our final WRMP includes the Lowestoft Water Reuse scheme, rather than the North Suffolk Reservoir. We have chosen this water reuse scheme because it can be delivered more quickly than the reservoir, and so minimises the duration of our moratorium on new non-domestic water supplies in our Hartismere WRZ. However, we would prefer to deliver the North Suffolk Reservoir instead because it has lower energy and carbon costs and has significant potential to build in environmental gain.

In its determinations for accelerated expenditure, Ofwat allowed PR24 accelerated spend to undertake detailed engineering design for the North Suffolk Reservoir. This has started in autumn 2023 and will develop the scheme so that it is “shovel ready” by 2026/27. If, at that point, we conclude that the reservoir would provide better value than Lowestoft Water Reuse scheme, and it can be delivered as quickly, then we would move to the North Suffolk Reservoir Adaptive Programme.

This would require a change to our price controls for 2025-30, removing the remaining costs for the Lowestoft Water Reuse scheme and instead including the remaining costs for the North Suffolk Reservoir.

We propose that Ofwat should include a bespoke uncertainty mechanism to make this change, rather than reopening price controls entirely – similar to decisions for the inclusion of DPC schemes outside/inside price controls, as value-for-money assessments change in practice. We expect that other water companies will propose similar decision points for switching to adaptive programmes, and a common approach should be applied.

As the North Suffolk Reservoir would have wider environmental benefits and public value, we would expect this uncertainty mechanism to consider changes to this PCD too to include the updated expected benefits. There should be customer protection for these benefits, particularly as customers discussed this in our engagement with them, but this would need to be set following the decision in 2026 and the final costs and benefits for the reservoir (if applicable).