Anglian Water

WATER DATA TABLES COMMENTARY

IAP Response April 2019

RESPONSIBLE BUSINESS OF THE YEAR 2017
BUSINESS IN THE COMMUNITY

THE QUEEN'S AWARDS FOR ENTERPRISE: SUSTAINABLE DEVELOPMENT 2015

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SUMMARY OF CHANGES - SEPTEMBER 2018 TO APRIL 2019

The table below summarises the changes to the input cells in the Water data tables. Where appropriate table commentary has been updated.

Note: Where line numbers have changed in the data tables, we have re-numbered the commentary accordingly, even if the commentary itself has not been updated.

Data table	Lines amended	Years amended
WS1 - Wholesale water operating and capital expenditure by business unit	1-2, 5, 7, 12, 21	2018/19
	12, 14	2019/20
	1, 7, 12, 14-15, 18, 21	2020/21
	1, 7, 12, 15, 18, 21	2021/22 to 2024/25
WS1a - Wholesale water operating and capital expenditure by business unit including operating leases reclassified under IFRS16	1-2, 5, 7, 12, 21	2018/19
	12, 14	2019/20
	1, 7,12, 14-15, 18, 21	2020/21
	1,7 , 12, 15, 18, 21	2021/22 to 2024/25
WS2 - Wholesale water capital and operating enhancement expenditure by business unit	11	2019/20
	17	2020-21
	14, 18, 53, 56, 57	2020/21 to 2024/25
WS2a - Wholesale water cumulative capital enhancement expenditure by purpose	11	2019/20
	17	2020/21
	14, 18	2020/21, 2023/24 to 2024/25
WS3 - Wholesale water properties and population	1-2, 4, 14	2018/19
WS4 - Wholesale water other (explanatory variables)	No change	-
WS5 - Other wholesale water expenditure	1, 3	2020/21 to 2024/25
WS7 - Wholesale water local authority rates	No change	-
WS8 - Third party costs by business unit for the wholesale water service	24	2020/21 to 2024/25
WS10 - Transitional spending in the wholesale water service	No change	-
WS12 - RCv allocation in the wholesale water service	No change	-
WS12a - Change in RCV allocation in the wholesale water services	No change	-

Data table	Lines amended	Years amended
WS13 - PR14 wholesale revenue forecast incentive mechanism for the water service	15-18, 20, 22	2018/19
	30-31	2019/20
WS15 - PR14 wholesale total expenditure outperformance sharing for the water service	9	2018/19 to 2019/20
	24-27	2019/20
WS17 - PR14 water trading incentive reconciliation	No change	-
WS18 - Explaining the 2019 final determination for the water service	9	2020/21 to 2024/25
	13	2017/18
Wr1 - Wholesale water resources (explanatory variables)	No change	-
Wr2 - Wholesale water resources opex	1, 4-5	2018/19
	4	2019/20
	5	2020/21, 2021/22 and 2024/25
	4-5, 7	2020/21 to 2024/25
Wr3 - Wholesale revenue projections for the water resources price control	3-8	2020/21 to 2024/25
Wr4 - Cost recovery for water resources	3, 8, 13, 16	2020/21 to 2024/25
	16	2025/26 to 2029/30
Wr5 - Weighted average cost of capital for the water resources control	11-13, 19	2020/21 to 2024/25
	19	2025/26 to 2029/30
Wr6 - Water resources capacity forecasts	No change	-
Wr7 - New water resources capacity - forecast cost of options beginning in 2020-25	No change	-
Wr8 - Wholesale water resources special cost factors	No change	-
Wn1 - Wholesale network plus raw water transport and water treatment (explanatory variables)	No change	-
Wn2 - Wholesale water network plus water distribution (explanatory variables)	9, 31	2017/18 to 2024/25
Wn3 - Wholesale revenue projections for the water network plus price control	3-8	2020/21 to 2024/25
	11	2020/21 to 2022/23
	25-26	2017/18 to 2024/25

Data table	Lines amended	Years amended
Wn4 - Cost recovery for water network plus	3, 8, 11	2020/21 to 2024/25
	11	2025/26 to 2029/30
Wn5 - Weighted average cost of capital for the water network plus control	11-13, 19	2020/21 to 2024/25
	19	2025/26 to 2029/30
Wn6 - Wholesale water network plus special cost factors	No change	-

WHOLESALE WATER EXPENDITURE

This commentary provides supporting information on our totex programme for AMP7. An overview of the Totex expenditure contained within the price control is detailed in the supporting table commentary for WS1, WS2 and WS2a.

In this section we:

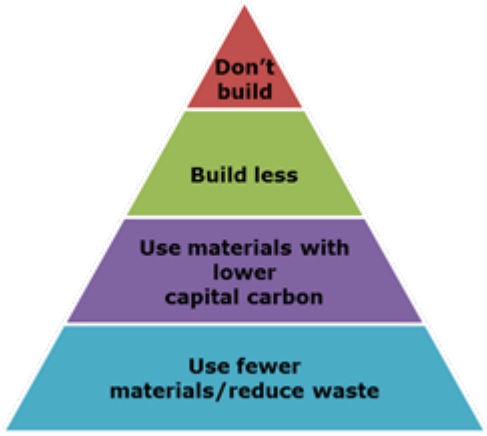
- summarise our approach to developing our enhancement expenditure (see *Efficiency and Innovation* chapter in Our Plan for full details)
- provide detailed business cases (aligning to the Ofwat IN18/11, July 2018), and
- provide supplementary information to the table lines.

Our approach to asset management

In this section we summarise the key features of our approach to asset management which ensure that we develop robust plans that deliver benefits of greatest value to customers at the lowest whole-life cost. This topic is discussed more fully in Chapter 10 of Our Plan (*Efficiency and Innovation)*.

Our approach is based on continuous planning and management of assets and investments, supported by our Copperleaf C55 system, which ensures that we deliver efficient outcomes for customers. The key features of our approach are:

Step 1: We challenge need



Where possible, we use no-build solutions, reducing both capital cost and carbon. In challenging need, we assess and place a value on the consequences of asset and service failure. Our approach to challenging need includes use of:

- Deterioration and Service risk impact models. These models provide forecasts on the likely rate of decline in the performance of our assets and the associated impact. They are particularly useful in determining our maintenance plans.
- Data on the value to customers, society and the environment of service improvements arising from investment. Full details are set out in Chapter 12 of Our Plan (*Customer Engagement*).
- Data on the costs we will incur from failure to invest. Our Business Impact Matrices (BIMs) are the comprehensive set of private costs associated with specific aspects of service, such as the costs associated with particular events like sewer flooding incidents.
- Evidence from the field. feedback on asset performance from our field-based teams, who are closest to the asset is used to inform our investment plans.

Step 2: We select the most appropriate and innovative solution

By challenging the default use of traditional, high carbon assets, we are able to reduce costs. When we do need to build new infrastructure, we make sure we minimise the materials used and ensure these are low carbon. For example, we have used innovative zero cement concrete to reduce carbon in the base slabs of our assets by 60%.

A big change we have made to reduce carbon and costs of our below ground infrastructure has been moving from open cut to no dig solutions. Since 2009, we have moved from using 95% open cut solutions.

For our above ground (non-infra) assets we have taken a totex approach. We have prioritised reusing existing assets, using no-build solutions or building less and making use of standard products and building off site. We have also developed digital models that allow us to test possible options in a virtual environment rather than on site. All of these approaches ensure we reduce both costs and carbon in building new infrastructure.

Our alliancing model also provides the platform for long-term relationships and investment which helps to drive innovative solutions. This is described in Chapter 10 of our Plan (*Efficiency and Innovation)*.

Step 3: We ensure solutions selected are cost efficient, informed by a comprehensive evidence base

The quality of any decision is constrained by the volume and quality of the evidence on which it is based. When assessing investment requirements, we have a comprehensive system for capturing the widest and most recent set of private, societal and environmental costs and benefits which allow us to determine the optimal level of investment. This consists of a number of key components:

- Costs: Since 2003 we have captured the outturn costs of completed capital projects at equipment and plant group level. We have over 38,000 projects comprising over 270,000 data points. We capture project costs at sub-systems level (e.g. civil costs of rapid gravity filters) and assess and categorise indirect costs. Both the scale and level of granularity of this database is unrivalled in the water industry, with nearly a million records.
- Delivering value to customers: Our evidence based approach means that we use the most efficient costs and latest innovations to develop our plans. So customers continually benefit from efficiency driven by totex and innovation in our cost base. Where there are new technologies we validate and challenge estimates provided by third parties. In addition we are able to develop cost estimates that are based on confirmed contract costs for a project or very similar work (e.g. schedule of rates, framework agreements, fixed price contracts) where appropriate.
- We have further enhanced our approach to ensure alliance overheads (OH) are reflected in our cost base. We assign an alliance on a project by project basis and work type which enables us to reflect the overhead incurred rather than a one size fits all approach.

Overall Cost Benefit Approach

We have undertaken cost benefit analysis across both base and enhancement totex within our plan using a common methodology, implemented through our C55 investment planning system:

- Financial costs (and cost savings) are discounted using the Weighted Average Cost of Capital (WACC)
  - Assessed as the whole life cost over a 40 year planning horizon, including ongoing operating costs and renewal activities
  - These are annualised (dividing by sum of private discount rates)
  - This is the equivalent annualised costs (EAC)
- Non-financial benefits are discounted and annualised using the Social Time Preference Rate (STPR), as provided by the Treasury Green Book
  - These are customer, wider societal and environmental triangulated values obtained through our valuation workstream (as described in our Valuation Completion Report)

    - Assessed as the whole life benefit over a 40 year planning horizon
    - These are annualised (dividing by sum of social discount rates)
    - This is the equivalent annualised benefits (EAB)
- Objective function : Maximise EAB less EAC subject to meeting constraints
    - Max Equivalent Annualised Value (EAV)= Max equivalent annualised net benefit

Our approach to computing annualised costs and benefits is in line with UKWIR Approach to CBA (2010) and the Treasury Green Book. We have configured our investment planning system, C55, with the Social Time Preference Rate for all non-financial benefit values of 3.5% diminishing to 3.0% after 30 years.

Costs and income are discounted at a rate 2.3% to reflect the expected Weighted Average Cost of Capital (WACC).

Within C55 we assess our confidence in the solution proposed for each option (alternative) considered for the plan. Following the final option selection we then apply our continuing productivity and efficiency assumption to further challenge our costs to ensure they are efficient.

Investments featuring in our WRMP as well as our AMP7 plan, also go through the rigorous option selection and WRMP specified cost benefit assessment process described in our WRMP document, as well as the final options being taken through the Cost Benefit process described above

A final EAV is then calculated for the purposes of producing our marginal cost curves for incentive rate setting. The EAB used in incentive rate setting is also derived directly from investments considered in the plan.

Expenditure profiling

In this section we describe the approach for expenditure profiling across the AMP7 period, this is based on best practice methodologies and enables to accurately forecast the cash profile on a project by project basis.

In developing our Plan we have taken into account obligation dates and delivery timescales for all of our projects. Within the enhancement area we have over 3,000 individual projects that have been reviewed, challenged and validated.

The cash profiles for each project are based on a standard set of cash profiles determined from historical delivery data and are a function of scale and the type of project which is automatically applied, the user can substitute the profile if required if there is a good reason to do so. There are 15 capital and 16 operational cost profiles within C55 investment planning and optimisation system.

The capital cost profiles specify:

- The number of years the spend will occur (between a single year and 5 years)
- The percentage of the total capex to be spent in each year
- The lower and upper ranges of total capex spend that these are available.

The operational cost profiles specify:

- The year the opex spend starts
- The percentage of the total opex to occur each year

The standard Capital Cost profiles are:

- 1 year: 100%
- 2 year linear - Yr 1 start
- 2 year linear - Yr 2 start
- 2 years: 10%, 90%
- 2 years: 17%, 83%
- 2 years: 30%, 70%
- 2 years: 32.6%, 67.4%
- 3 year linear - Yr 1 start

- 3 years: 10%, 60%, 30%
- 3 years: 5%, 55%, 40%
- 4 year linear - Yr 1 start
- 4 years: 5%, 30%, 50%, 15%
- 5 years: 20% per year
- 5 years: 50%, 12.5% each year after
- 3 years: 5%, 10%, 85%

The standard operational cost profiles are:

- 1 year: 100% starting in year 1 of capex
- 3 years linear, starting in year 2 of capex
- 3 years: 10%, 60%, 30%, starting in year 2 of capex
- 5 years, 20% each year, starting in year 2 of capex
- 50% for last capex year, 100% thereafter
- 4 years linear - Yr1 start
- 3 year linear, starting in year 1 of capex
- 2 years: 33%, 67%
- 5 years - 20% per year
- 2 years linear, starting in year 1 of capex
- 2 years linear, starting in year 2 of capex
- 4 years linear, starting in year 2 of capex
- 1 year, 100% starting in year 2 of capex
- 100% in Year 4
- 25% for last capex year, 100% thereafter
- 0% for last capex year, 100% thereafter.

This comprehensive and sophisticated set of profiles enables us to accurately profile and plan our future expenditure for each project or programme of activity.

Taking this approach there will be yearly variations in totex expenditure related to the type of project, delivery period, planned delivery date and obligation date. This is complex but enabled by the functionality of C55. The outputs are used to validate the expenditure, challenge the totex expenditure profiles and complete all the PR19 tables. The profile aligns to the activities, outputs and regulatory obligations defined in the business plan tables.

WS1 - WHOLESALE WATER OPERATING AND CAPITAL EXPENDITURE BY BUSINESS UNIT

Changes for our IAP Response

Following Ofwat's initial assessment of plans published on 31 January 2019 we have reviewed our Plan and made one change in the Wholesale Water area. This relates to the ban on the outdoor use of metaldehyde announced on 19 December 2019. We have made the following changes:

- Removed the costs of metaldehyde treatment from our new water treatment works investments -£46.788 million capex and -£616,000 opex.
- Removed the product substitution payments for farmers from our catchment management enhancement opex -£20.661 million and capex -£105,000 opex.

In addition to the changes for metaldehyde, we have restated our tables following a request from Ofwat to show developer requested diversions spend gross of grants and contributions. This is explained further in Section B, below.

More detail on the changes made can be found in our updated enhancement business cases in the commentary for WS2.

We have not updated all of the table commentary for WS1, but have provided updated graphs to reflect the new position by price control as shown below. We have not updated the Raw Water distribution graph as this is unchanged. We have also provided an update for AMP6 total expenditure forecasts.

Our totex approach

When considering the component parts of our totex expenditure in this plan, we have given particular focus to botex and enhancement expenditure. Clearly botex is made up of opex and capital maintenance and we have, in some areas, made significant transfers from capital maintenance to opex reflecting either how we expect the money to be accounted for (for example the trend to cloud computing in Information Services technology), or to reflect more effective use of totex solutions to deliver our outcomes.

Whilst it is not a sub-total in the tables, it can be clearly seen in most price controls individually, and certainly collectively, that we have tightly controlled our total botex spend, including stretching efficiency challenges, whilst having some significant, but offsetting, movements from capital maintenance to opex.

Our large enhancement programme, driven by the requirements of the WINEP and WRMP programmes also result in significant cost increases in opex, either as a more effective way to meet outcomes, or as the more traditional operating cost impact of our planned capital schemes, where a capital solution remains the most appropriate totex solution.

Water Resources

This table commentary includes a detailed explanation of our proposed Totex expenditure, for the Water Resource Price Control.

We set out:

- a brief summary of the assets and services included within each Price Control
- a longer-term outlook
- our AMP7 Totex expediture plan

Summary of the assets and service within the Water Resources Price Control

Assets

- 8 Dams and Impounding Reservoirs (providing 50% of our supply)
- 16 River Abstraction Pumping Stations (providing 50% of our supply)
- 3 Raw Water Transfer Pumping Stations
- 450 Groundwater Boreholes (at 200 sites)
- 148km of Raw Water Abstraction Mains and Tunnels
- 7,000 hectares of land managed
- 49 Sites of Special Scientific Interest (SSSI)

These assets support the delivery on average of 1,050 Ml/d of raw water to our water treatment plants. During peak demand periods, abstraction can increase to approximately 1,400 Ml/d.

Services

The water resources price control comprises six principal service areas:

1. **Abstraction licences** - dictate how much water we can abstract from rivers, reservoirs and aquifers. Management of our abstraction licences includes a significant programme of environmental assessment, to ensure compliance with the Water Framework Directive and other legislation. We work closely with the Environment Agency to ensure our abstraction levels are sustainable.
2. **Catchment Management** - working with key partners such as farmers, landowners, local businesses and communities to address contamination of water supplies. Our catchment management strategy aims to improve raw water quality at source and minimise the need for additional treatment.
3. **Operation and Maintenance** - extends to activities related to identification of replacement sources, licence management, related legal obligations, and the abstraction infrastructure. These activities include inspections, operation, refurbishment and maintenance of our assets.
4. **Biodiversity** - this includes the conservation of habitats and species located on our operational sites and reservoirs. Our duties extend to the protection of fish passage and eel migration at our river intake assets.
5. **Recreation** - our reservoirs and water parks provide an excellent opportunity to engage communities in their role in the water cycle, but we need to ensure they remain safe and serviceable.
6. **Water resources adaptive planning** – planning activities to develop large supply options that may be required beyond 2025 to ensure our water supply system remains resilient.

To deliver these six services we manage service, risk and performance through an integrated business team which gives alignment from source to our water treatment plants. The scope of this includes day to day source management, refill and level monitoring.

Longer term outlook

Our long term strategy is set out in our Strategic Direction Statement (Annex 1a to our Plan) and Chapter 7 *Resilient Water Supplies*.

Raw water abstraction assets are critically important. They form the first stage of our water supply system, meaning all downstream services are dependent on them. The pressures of climate change, growth and environmental protection mean we need to be sure that our raw water abstraction system is sustainable in the future.

Many of our assets that abstract from rivers are more than 50 years old and have complex maintenance needs and are either at or approaching the end of their asset lives. Maintenance becomes less effective and replacement needs emerge to maintain levels of service. Some assets in the group, for example large capacity abstraction pumps, require long lead times for the procurement of replacement parts.

Our groundwater abstraction boreholes operate in a complex environment with each aquifer presenting different water quality, maintenance and contamination vulnerability challenges. Each borehole and its associated equipment and infrastructure is at a different stage of its asset life, requiring site-specific management strategies.

Climate change is likely to reduce the quality of raw water in the future and increase the risk of drought. More frequent intense downpours could result in increased agricultural nitrate and pesticide run-off, reducing the quality of water entering our systems. This is a particular issue in our region, which is intensively farmed. Traditional end of pipe solutions are expensive and unsustainable. We therefore need innovative solutions, working collaboratively with land users in our region.

We also need to increase our resilience to severe drought. We have assessed risks to the future security of our water supplies in our Water Resources Management Plan (WRMP), as detailed in our *Resilient Water Supplies* chapter.

Our WRMP includes a scheme to create new resources to support non-potable transfers. This is classified as part of the Water Network Plus price control. The Network Plus Price Control also includes WRMP investment in water transfers to address sustainability reductions.

How customers have shaped our Plan

Our Plan has been driven by our customers' priorities. We will deliver the most stretching performance in areas that matter most to them and improve performance across the board. Our customer engagement and how it has shaped our Plan is set out in Chapter 5 (*How customers have shaped our Plan)* and Chapter 12 *(Customer Engagement*).

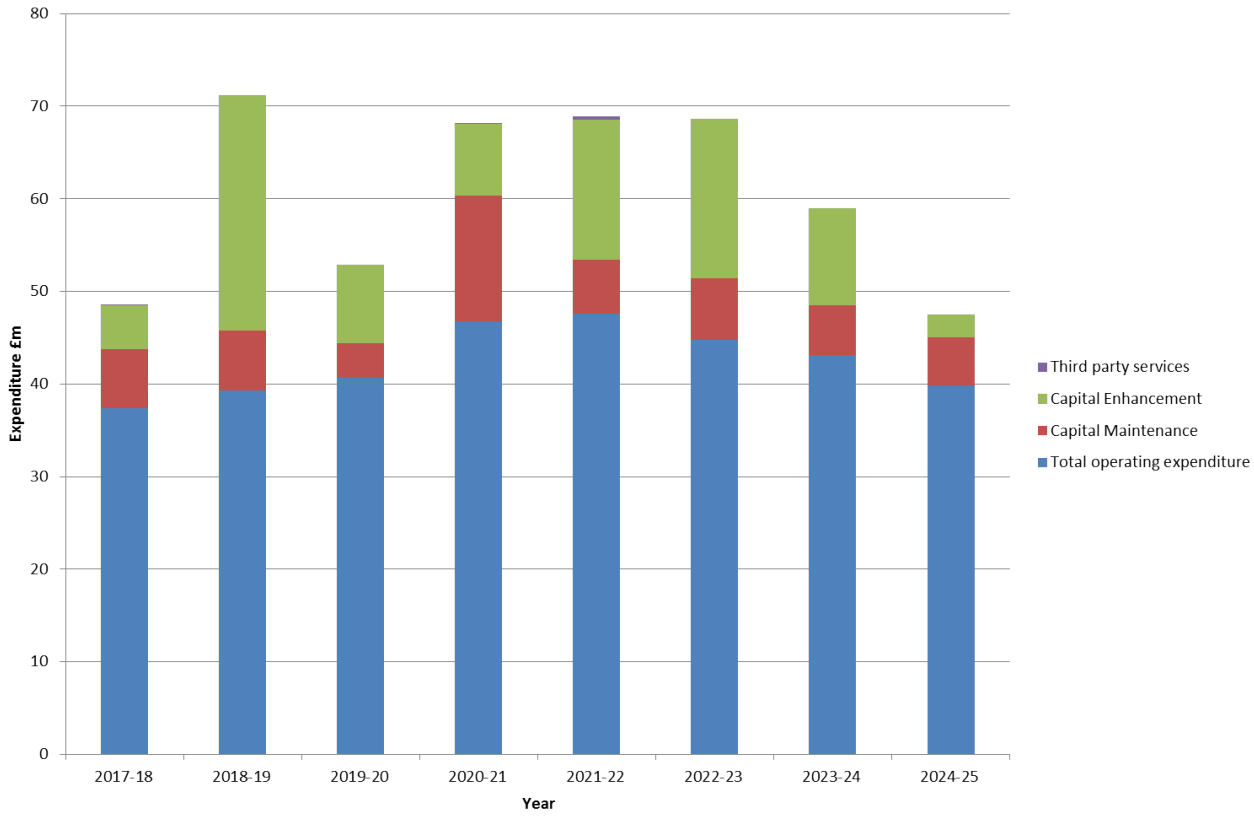
AMP7 Expenditure

Our expenditure requirements align to the Water Resources RAG 4.07 reporting guideline boundaries.

The overall totex Plan for this price control is £312.2 million. This expenditure is post-efficiency, 2017/18 prices, net of grants and contributions.

The totex expenditure within this price control is summarised in the following chart.

Figure 1 Water Resources Totex expenditure



Maintaining service to customers

Raw Water Storage Reservoirs (Surface Water) - £2.9 million

In the west of our region, water supply is mainly provided by the large pumped storage reservoirs of Rutland Water, Grafham Water and Pitsford Reservoir. We also operate pumped storage reservoirs at Alton Water, Covenham Reservoir, and Ardleigh Reservoir (ownership shared with Affinity Water), and two natural catchment reservoirs at Hollowell and Ravensthorpe. Our eight raw water reservoirs, along with eight direct supply river intakes, provide approximately 50% of our water supply. Our planned Totex Expenditure for these storage assets is based on the findings of our annual reviews and the statutory 10 year inspections under Section 10 of the Reservoir Act 1975.

River Abstraction, Pumping Stations and Aqueducts (Asset Health) - £10.0 million

Our plans are based on asset surveys to assess the risk of failure, taking into account their system configuration. We are proposing increased investment of £0.8 million in innovative condition and performance monitoring technology, such as temperature and vibration monitoring, for our largest and most critical raw water pumping assets.

Enhanced monitoring will improve our knowledge of when to refurbish or replace assets, reducing lengthy and expensive unplanned failures and improving resilience. We have targeted investment in assets which have the greatest unplanned interruptions impact should they fail. Our award winning Energy Management Monitoring System (EEMS) allows us to gather energy data and trends enabling us to set trigger levels if assets exceed pre-set efficiency targets, an indicator of asset health.

We have made provision in our plans for assets we own that are shared under long standing Legal Agreements e.g. Ardleigh Reservoir.

Groundwater – Borehole Asset Management (Asset Health) - £16.8 million

The remaining 50% of our water supply is provided by groundwater abstracted from 200 sources comprising 450 boreholes. Our groundwater assets, some dating back to the nineteenth century, range in depth from 10m to 500m, and penetrate a variety of different aquifer types. Our plans are based on surveys and predictive models of asset failure. Each aquifer presents unique hydro-chemical challenges, requiring source specific asset management strategies, which extend to raw water distribution and pumps.

These assets are maintained by our in-house team of groundwater engineering specialists, who provide flexible and fast response service for replacing borehole pumps. Together with a stock of new and refurbished pumps, we can meet the business need to safeguard supplies to water treatment works and ultimately to customers.

We have developed a detailed plan to minimise the resilience risk associated with our groundwater sources. We have included for the drilling of five replacement boreholes, as a result of asset deterioration.

Recreation - £4.0 million

Our Plan includes increased investment in recreation site furniture and signs, and water efficiency at toilet blocks. Our reservoirs and water parks provide an excellent opportunity to engage communities in their role in the water cycle. In AMP7, we will invest to develop the information and education opportunities available at these sites, and improve accessibility to all members of the community.

Biodiversity

We own more than 7,000 hectares of land, 40% of which is designated as Sites of Special Scientific Interest, across 49 sites. We also own 70 Local Wildlife Sites and 26% of our land holding is designated as Habitat of Principal Importance, which we manage on a day to day basis, all of which is captured on our Natural Capital balance sheet.

Enhancing service to customers

The commentary to table WS2 sets out in detail our proposed enhancement expenditure and business cases with supporting evidence for each line where we are proposing investment in AMP7.

Enhancement - River Abstraction, Pumping Stations and Aqueducts - £8.4 million

We are required to deliver four intake screens and two tilting gate schemes to meet the requirements of the Eel Directive in AMP7. Our proposals include positive exclusion screens meeting the guidance and standards set by the Environment Agency.

Enhancement - Groundwater - Sustainable Abstraction Management (included within the Water Resources Environmental Measures enhancement case) - £29.2 million

Over AMP7, we are required to reduce the volume of water abstracted from our groundwater boreholes by 83.5 Ml/d to achieve sustainable levels under the Water Framework Directive driver in the Water Industry National Environment Programme (WINEP). We have accounted for this in our supply demand balance and any associated investment to make up the deficit is included in our Water Network Plus Price Control as part of the WRMP expenditure.

Additionally, the Environment Agency has identified 10 water bodies where an increase in abstraction above historical rates may cause deterioration in water body status before 2040. Our Plan includes investment for further investigation and appraisal of mitigation options at these sites, which is required to ensure that we meet our Water Framework Directive obligations. Satisfactory completion of the investigations is important to ensure the continued security of our abstraction licences and to inform the need for future investment requirements to address potential sustainability reductions.

Our AMP6 National Environment Programme (NEP) investigations have identified a number of water bodies and protected areas where our abstractions are causing an unacceptable environmental impact. We have agreed a series of cost beneficial mitigation options with the Environment Agency

which have been included in WINEP for AMP7 delivery. In addition to number of licence reductions we will be delivering 21 mitigation schemes including new river support schemes, extensive river restoration and various adaptive management schemes.

Enhancement - Catchment Management - £19.2 million

Our region includes areas of unique importance to the UK agricultural sector. It produces more than two thirds of England's sugar beet crop, a third of its potato crop and is a major cereals producer. Many important crops are highly susceptible to slug damage. Successful arable production therefore requires slug control along with wider pesticide application regime to control weeds. Soil type and weather conditions in the region can see elevated levels of pesticides in our raw waters from run-off. This poses a challenge to surface water quality, where pesticides such as metaldehyde cannot be removed by conventional treatment.

Biodiversity (included within the Water Resources Environmental Measures enhancement case) - £5.3 million

We have a statutory duty to comply with biodiversity Legislation such as the Wildlife and Countryside Act and Natural Environment and Rural Communities Act. These investments will contribute to our biodiversity delivery in AMP7. Invasive non-native species (INNS) is a new standalone driver in the WINEP for AMP7. This reflects the increasing impact INNS are having on the environment, economy and society, as well as the need to invest to mitigate and, where possible, eliminate their impacts.

In collaboration with the Environment Agency, we have developed a series of investments to meet our legal obligations. Our increased investment programme in this area will include:

- Biodiversity improvements to the River Wensum, a chalk stream with an international conservation designation;
- a pilot catchment management project to protect biodiversity on the catchment upstream of Pitsford Reservoir and improve water quality;
- a review and upgrade of our biosecurity measures;
- engaging and educating staff;
- controlling and eradicating invasive species on our land;
- undertaking surveillance, monitoring and risk assessment of invasive species; and
- working in partnership nationally and regionally to safeguard our sites from species currently not found on our land.

Enhancement / DPC - Water Resources Adaptive Planning - £18.7 million

Our Plan includes continuing the industry leading Water Resources East (WRE) initiative to the next stage of development. This work directly links into the development of our Water Resources Management Plan (WRMP). We have included proposals for researching and the requirements of an adaptive plan as a parallel scope of work, which includes aquifer storage and recharge, effluent re-use, desalination and new raw water storage.

Our Plan includes the pre-planning of storage reservoirs in the South Lincolnshire and South Norfolk areas. In the next AMP we intend to finalise the location and commence the outline pre-planning, sufficient to meet the requirements of the Development Consent Order planning process to enable these investments to progress quickly if the need is confirmed at WRMP24. Our assessment shows that a new reservoir would be suitable for Direct Procurement for Customers (DPC). The development costs are detailed in table App21 and are included within this price control. Our approach to DPC is covered in Chapter 11 *The role of markets, incentives and behaviours* and annexes to that chapter.

Through the Water Resources Management Plan, we have allowed for investment to manage risks relating to severe drought.

Water Network Plus

This table commentary include a detailed explanation of our proposed totex expenditure for the water network plus price control.

We set out:

- a brief summary of the assets and services included within each price control
- a longer-term outlook, and
- our AMP7 Totex expediture plan.

Summary of the assets and service within the Water Network Plus Price Control

Assets

- 647km of Raw Water Transport Mains
- 9 Re-lift Pumping Stations
- 3 Raw Water Storage Reservoirs
- 15 Surface Water Treatment Sites (supplying 50% of water into supply)
- 117 Ground Water Treatment Plants (supplying 50% of water into supply)
- 38,420km of Potable Water Distribution Mains
- 464 Water Boosters
- 381 Potable Water Storage Tanks (250 reservoirs and 131 water towers)
- 2.3 million Water Meters

These assets supply on average 1,050 Ml/d of raw water to our water treatment plants. During peak demand periods, treatment can increase to approximately 1,400 Ml/d.

Services

The water networks plus price control comprises five principal service areas to enable us to serve our customers:

1. **Water Networks** (raw and treated water distribution)– planning and delivery of activities to maintain the service we give to customers, leakage management, pressure management and enhancements to meet the needs of growth.
2. **Water Treatment** – extends to all activities in the management of complex systems and treatment plants.
3. **Improving Water Quality** – providing enhancements to meet regulatory requirements and address the issues of raw water deteriorating water quality.
4. **Enabling Sustainable Growth** - proactive investment to ensure our assets ensure they enable sustainable growth.
5. **Investing in Resilience** – planning and delivery of enhancements to give a resilient service to our customers.

To deliver the five services we manage service, risk and performance through an integrated business team which gives alignment from water treatment plants to the customers taps.

Longer term outlook

Our long term strategy is set out in our Strategic Direction Statement (Annex 1a to our Plan) and Chapter 7 *Resilient Water Supplies*.

Driven by the needs of our Water Resources Management Plan (WRMP) to address the challenges of drought, climate change, environmental sustainability of our abstraction licences and supporting sustainable economic growth in the area, our Plan incorporate strategic interconnections between our supply systems to better manage our current resources and an ambitious demand management programme. This continues to drive industry leading levels of leakage and a 10 year smart metering programme providing our customers, and us the ability to work together to better manage consumption and demand.

By the end of AMP7 we will have made a fundamental step change in securing the region's future in terms of resilient water supplies and ensured that we can support sustainable economic and population growth in the region for the future.

We also need to increase our resilience to severe drought.

We have assessed these risks to the future security of our water supplies in our Water Resources Management Plan, as detailed in Resilient Water Supplies. Our WRMP includes a scheme to create new resources to support non-potable transfers. The scheme is located on the Humber bank and is classified as part of this price control.

How customers have shaped our Plan

Our Plan has been driven by our customers' priorities. We will deliver the most stretching performance in areas that matter most to them and improve performance across the board. Our customer engagement and how it has shaped our Plan is set out in Chapter 5 (*How customers have shaped our Plan)* and Chapter 12 *(Customer Engagement*).

AMP7 Expenditure

Our expenditure requirements align to the Water network plus RAG 4.07 reporting guideline boundaries.

The overall Totex Plan for this price control is £2,411.8 million. Totex Expenditure is post-efficiency, 2017/18 prices, net of grants and contributions.

The table commentaries include a detailed explanation of the totex expenditure. Specifically Table WS1 contains the details of our Botex requirements and Table WS2 for Totex Enhancement.

The totex expenditure within this price control is summarised in the following charts:

Figure 2 Treated water distribution totex expenditure

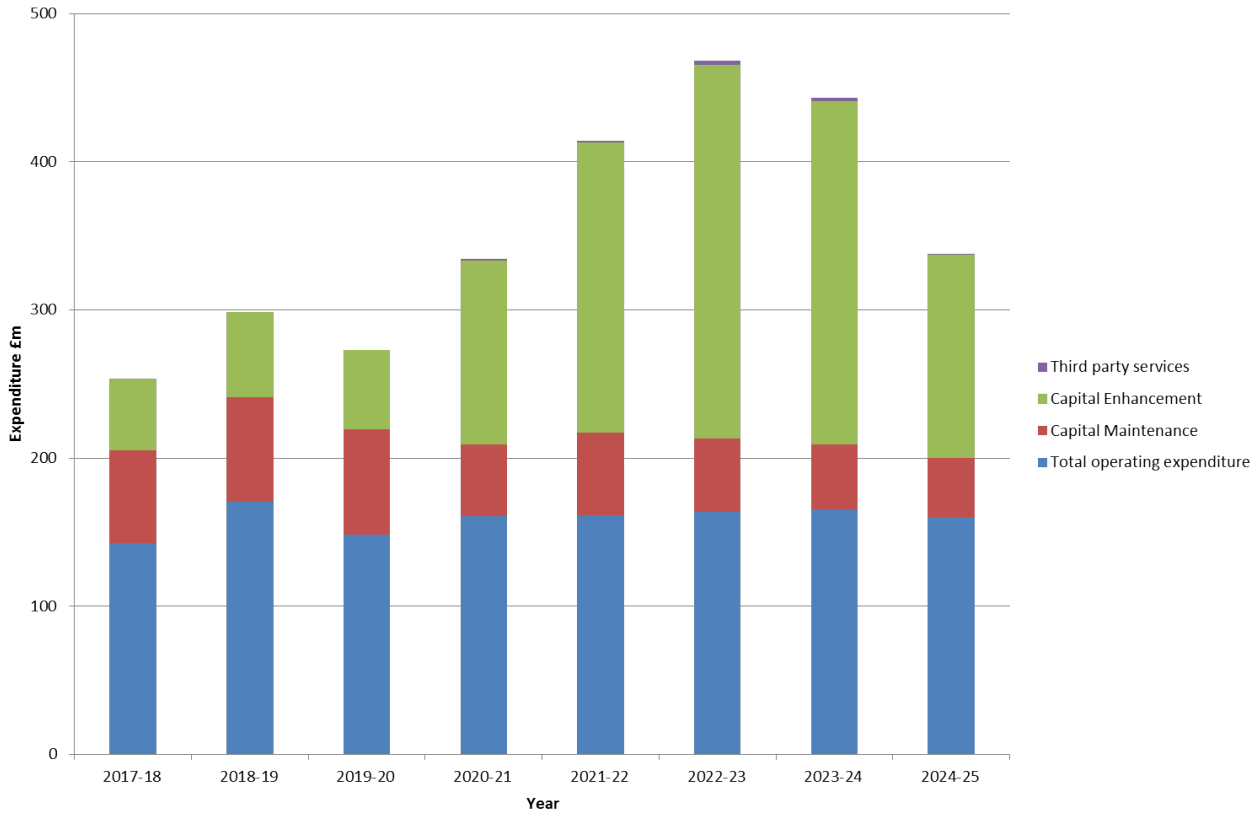


Figure 3 Raw water distribution totex expenditure

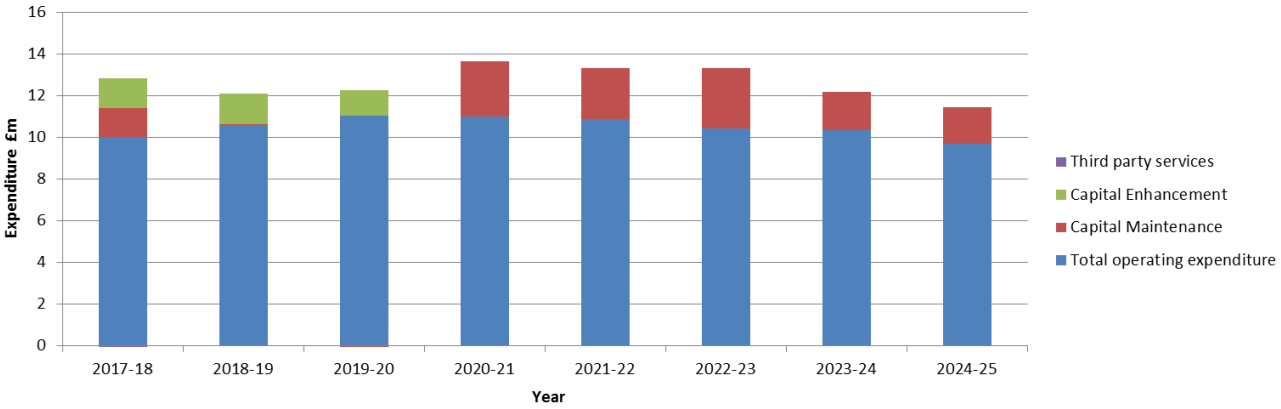
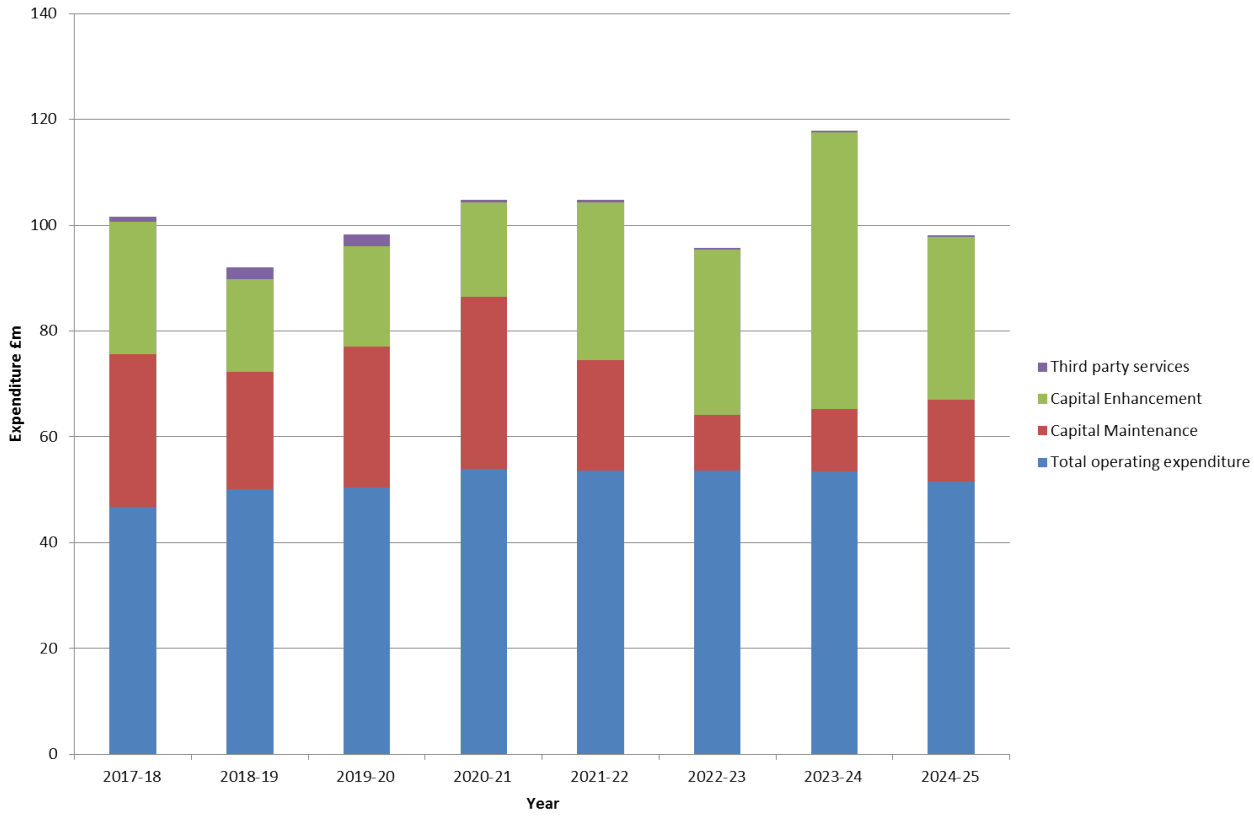


Figure 4 Water treatment totex expenditure



Maintaining service to customers

Raw Water and Treated Water Distribution Mains - £248 million

The long term trend for total mains bursts has remained relatively stable since 2002 which has been reflected in our serviceability performance. Annual variation is seen in this measure which is primarily driven by weather patterns, particularly relating to soil moisture deficit (SMD) and temperature.

We are proposing a continuation of our current strategy to maintain the health of this class of assets. By continuing to invest in network calming and pressure management to maximise the life of these assets whilst investing over £120 million in AMP7 for renewal and rehabilitation of this infrastructure.

We will also be prioritizing investment in assets which cross other key infrastructure assets where failure would lead to a service disruption on other key infrastructure or utilities and / or repair would be difficult and lead to prolonged supply interruptions.

We will continue with our planned Preventative Maintenance Programme (PPM) using initiatives such as sedimentation mains flushing, air valve and critical valve inspections. We will continue to work to identify alternative PPM technologies particularly on trunk mains where we recognise conventional PPM flushes are not appropriate.

We optimise our networks through pressure management techniques to 'calm' the network and reduce pressure fluctuations. This reduces burst main rates and provides water quality benefits principally by reducing the risk of discolouration. Industry leading leakage levels also have positive water quality benefits.

Our mains replacement programme is optimised and targeted to those areas where failures impact most on our customers in terms of interruptions to supply, flooding and discolouration as well as simply high burst frequencies. We use the outputs of our deterioration and consequence models (which have been refreshed during AMP6) as well as asset failures to identify those mains that have the greatest overall customer impact.

Our Interruptions to Supply (I2S) performance during AMP5 was 20 minutes. We have worked hard in AMP6 to change the way we think about and approach Interruptions to Supply. We have spent time understanding the root cause of Interruptions, such as weather effects, long duration events and third party actions and damage. Working with and benchmarking against other companies identified that our telemetry and early warning systems allow us to more accurately identify the start of interruptions, and that we have a clearer and more auditable trail, especially when verifying events. Using the integrated strategy we developed we have driven Interruptions down to an annual average of 9 minutes 07 seconds over the first three years of AMP6.

Treated Water Storage Tanks (Water Towers and Reservoirs) - £19.7 million

We have the largest stock of water towers in the country (46% of the total), due to our flat topography. Water towers are a specific issue for us because they are expensive to refurbish and deteriorate externally faster than other structures as they are in exposed areas. A long term strategy is being developed and investment prioritised for the assets in most need of refurbishment due to their condition or health and safety risks. Maintaining the excellent quality of water from our Water Treatment Works all the way to our customers' tap is essential and the integrity of our storage points is a key component of this.

In 2015/2016 we substantially revised our internal inspection risk assessment process to more fully incorporate design and construction risk factors. We have also reduced the maximum inspection interval from 10 years to nine years as part of this revised risk approach. This more proactive approach results in a larger inspection and refurbishment programme each year. The enhanced data capture process in this AMP will further inform AMP7 investment needs.

Pumping Systems - £9.9 million

Our flat topography means that we need to pre-pump water leaving our Water Treatment Works. Based on a combination of surveys and forward looking service risk based models we have developed the Totex Plan which is a combination of capital and operational expenditure to maintain asset health.

Water Treatment Works - £91.2 million

There are a number of sites or process stages that require significant refurbishment or replacement in AMP7. These have either reached the end of their expected life or are showing signs of significant deterioration.

The material changes for AMP7 for the Water Treatment price control fall into seven key areas:

- Ozone generation plants.
- Aged (circa 1950s) pressure filter sites.
- Significant buildings maintenance needs on large sites.
- Replacement rather than regeneration of GAC at selected sites.
- Membrane treatment maintenance.
- Treatment to deal with excessive algal blooms at two surface water reservoir sites.
- Replacement of bulk chlorine at our top tier Control of Major Accident Hazards (COMAH) site.

We have more than 100 complex water treatment sites, many of which had technologically advanced treatment processes installed in the early 1990s, principally for the removal of nitrates and pesticides. These types of highly technological assets tend to have a shorter life span than more traditional treatment processes. Future investment opportunities will be used to take advantage of new advancements in treatment processes, bringing operational efficiencies, cost savings, and carbon savings to our asset investments, whilst continuing to invest to maintain the reliability and integrity of our Water Treatment Works.

We have two reservoir-supplied surface water treatment works that suffer from excessive algal blooms that overload the current treatment capacity and compromise deployable output. We have included costs for installing pre-treatment at these sites.

We have a planned programme of replacing assets that have become obsolete and no spares are available. This will be a continuing theme as technological advances will mean our equipment will become out of date sooner. Obsolescence in shorter lifespan assets will continue to be addressed through targeted investment programmes with continued development of a strategic spares holding.

There is an increasing need to improve compliance of WTW discharges and management of water treatment work sludge. We have planned investment and improved maintenance of the wash water handling and settlement process streams at WTWs.

Alongside the usual requirement to maintain high levels of health and safety to reduce business risk we intend to replace the Top Tier COMAH installation at one of our EKP sites.

The storage of large quantities of bulk chlorine presents an inherent hazard to the environment and the general public. Although the risk is carefully managed and the installation well maintained, this plant is an ageing installation and with the replacement this plant will remain as our highest risk installation.

This will be complemented by our on-going rolling programme of refurbishment on all our other chlorine gas systems to maintain the reliability and safety of these systems.

At our water treatment sites we have deployed the same strategy of inspections of our storage tanks to those in our network which is detailed above.

Enhancing service to customers

To meet our customers' needs, our Plan includes proposals to deliver:

- Over 500km of water mains
- 5 metaldyhide Treatment Plants
- 1 Effluent Reuse Treatment Plant (non potable)
- 4 Nitrate Treatment Plants
- Over 1 million smart Meters and a fixed network
- 5,000 proactive lead pipe replacements

The commentary to table WS2 sets out in detail our proposed enhancement expenditure and business cases with supporting evidence for each line where we are proposing investment in AMP7. These cases are:

Facilitating growth and improving resilience

- WRMP: Supply side strategy
- Driving down the leakage frontier
- Smart metering
- Housing growth
- Security of Network and Information systems (NIS) compliance
- Resilience programme
- SEMD
- Pluvial and fluvial flood protection

Improving Water Quality - £56.7 million

- Nitrates
- Water in buildings
- Lead
- Catchment management
- Eels directive

AMP6 Total expenditure forecasts

We have updated our totex forecast for 2018/19 and 2019/20, reflecting our latest view of opex and capex. Whilst for 2018/19 we have a reasonable view of the split of our costs between price controls, we do not do the actual split until after year end when we prepare our financial statements for the Annual Performance Report. For 2018/19 we forecast our Water Totex expenditure to have increased by £12.1 million, made up of an increase of £25.3 million in operating costs and a decrease of £13.2 million in capital expenditure. This largely reflects the ongoing impact on our water supply and distribution systems of the 'beast from the east' and the hot dry summer in 2018. For 2019/20 our forecast opex is unchanged and we have reduced our forecast capital expenditure by a further £12.0 million. We have also reflected higher Grants and contributions receipts in 2018/19 of £4.1 million due to increased developer activity and assumed these result in higher capex in 2019/20. Overall there is no change to the cumulative net Totex forecast over the two years.

SECTION A: OPERATING EXPENDITURE (EXCLUDING ATYPICAL EXPENDITURE)

Lines 1 to 4 and 7 to 8: Operating expenditure

Included within the Table Block A is both base operational cost (Botex element) and enhancement operating costs as detailed in table WS2, lines 40 to 77. The allocation between the two elements is detailed in the following table.

Operating Expenditure £m	2020/21	2021/22	2022/23	2023/24	2024/25	Total AMP7
Base operating expenditure (Botex element)	243.0	252.2	251.2	248.9	234.1	1,229.4
Enhancement operating expenditure (Table WS2 Block B)	30.9	24.2	27.1	28.8	32.9	143.9
Total (Table WS1 Block A)	**273.9**	**276.4**	**278.3**	**277.7**	**267.0**	**1,373.3**

Base Operating Expenditure

Base Operating expenditure for AMP7 has been assessed using our expected outturn for 2019/20 as a start point. The planned 2019/20 outturn agrees to a business plan that has been approved at board level and reflects our best estimate of reported operating costs. The allocation of costs to individual rows is based on the apportionment of actual costs reported in 2017/18, amended for

any specific changes where the existing apportionment would be inappropriate. The figures in the tables below are pre Real Price Effect inflation and therefore will not agree to numbers in the data tables, but are provided to give further insight into our changes in operating costs..

Water Resources

We are forecasting an increase in other operating expenditure in AMP7 when compared to our 2019/20 run rate. The key drivers for the increases are:

- Capex to opex decisions - these include the transfer of on premises IT to a cloud based solution. These costs would have previously been capitalised but in AMP7 will be accounted for as an operating cost.
- Enhancement operating costs - almost the whole increase arising from enhancement opex is due to the programme of work in relation to the Water Industry National Environment Programme (WINEP) being introduced by the Environment Agency, in particular the additional costs associated with drinking water protected area schemes and water framework directive measures with the latter peaking in years two and three of the AMP. More detail on enhancement operating costs is in our commentary on section WS2.

We have set ambitious efficiency targets during the AMP: and their impact on forecast costs are set out below. This topic is discussed more fully in Chapter 10 of our Plan *(Efficiency and Innovation)*.

Annual increase/ (decrease) from AMP6 run-rate £m	2020/21	2021/22	2022/23	2023/24	2024/25	Total AMP7
Capex to opex decisions	1.6	(0.9)	0.8	1.5	1.5	**4.5**
Other opex changes	0.5	0.4	0.2	0.1	0.1	**1.3**
Enhancement operating costs	8.2	13.0	12.8	10.7	10.2	**54.9**
Efficiency and productivity improvements	(1.4)	(1.9)	(3.1)	(3.8)	(7.2)	**(17.4)**
Total annual increase	**8.9**	**10.6**	**10.7**	**8.5**	**4.6**	**43.3**

Raw Water Distribution

We are forecasting minimal changes to our raw water expenditure over the AMP, with our cost reducing in real terms due to the efficiency measures we have assumed. The increase in costs arising from capex to opex decisions is due to the transfer of on premises IT to a cloud based solution (£1.3 million). These costs would have previously been capitalised but in AMP7 will be accounted for as an operating cost. Other opex changes are largely due to additional planned maintenance work and asset performance monitoring.

Annual increase/ (decrease) from AMP6 run-rate £m	2020/21	2021/22	2022/23	2023/24	2024/25	Total AMP7
Capex to opex decisions	0.3	0.4	0.3	0.2	0.2	**1.4**
Other pex changes	0.4	0.3	0.3	0.3	0.2	**1.5**
Enhancement operating costs	0.0	0.0	0.0	0.0	0.0	**0.0**
Efficiency and productivity improvements	(0.4)	(0.4)	(0.7)	(0.9)	(1.7)	**(4.1)**
Total annual increase/ (decrease)	**0.3**	**0.3**	**(0.1)**	**(0.4)**	**(1.3)**	**(1.2)**

Water Treatment

We are forecasting an increase in other operating expenditure in each AMP7 when compared to our 2019/20 run rate. The key drivers for the increases are:

- Capex to opex decisions - these include the transfer of on premises IT to a cloud based solution at a total cost of £10.1 million over the AMP. These costs would have previously been capitalised but in AMP7 will be accounted for as an operating cost. We also have other forecast totex transfers totaling £18.0 million over the AMP.
- Enhancement operating costs - increase over the AMP, resulting from investment to address lead standards, water deterioration and compliance with the EU Directive on the security of Network and Information Systems at our sites. More detail on enhancement operating costs is in our commentary on section WS2.

We have set ambitious efficiency targets during the AMP, and their impact on forecast costs are set out below. This topic is discussed more fully in Chapter 10 of Our Plan *(Efficiency and Innovation)*.

Annual increase/(decrease) from AMP6 run-rate £m	2020/21	2021/22	2022/23	2023/24	2024/25	Total AMP7
Capex to opex decisions	6.1	5.5	6.2	5.8	5.7	**29.3**
Other opex changes	0.2	0.4	0.5	0.8	1.0	**2.9**
Enhancement operating costs	0.4	0.7	1.1	1.4	2.8	**6.4**
Efficiency and productivity improvements	(1.6)	(2.1)	(3.4)	(4.2)	(7.9)	**(19.2)**
Total annual increase	**5.1**	**4.5**	**4.4**	**3.8**	**1.6**	**19.4**

Treated Water Distribution

We are forecasting an increase in other operating expenditure in AMP7 when compared to our 2019/20 run rate. The key drivers for the increases are:

- Capex to opex decisions - these include the transfer of on premises IT to a cloud based solution at a total cost of £21.4 million over the AMP. These costs would have previously been capitalised but in AMP7 will be accounted for as an operating cost
- ODI opex costs reflect the additional expenditure planned on service restoration
- Other opex changes include a number of areas of smaller expenditure increases including additional planned maintenance, source to tap analytics, mitigation of extreme weather events and water efficiency work
- Enhancement operating costs - almost the whole increase arising from enhancement opex is due to demand side enhancements from our Water Resources Management Plan (WRMP) (dry year annual average conditions) totalling approximately £74 million; £4 million on water framework directive measures, £5 million on resilience and £4 million on meeting lead standards, with the balance being a mix of smaller enhancement schemes. More detail on enhancement operating costs is in our commentary on section WS2.
- We have set ambitious efficiency targets during the AMP, and their impact on forecast costs are set out below. This topic is discussed more fully in Chapter 10 of Our Plan *(Efficiency and Innovation)*.

Annual increase/(decrease) from AMP6 run-rate £m	2020/21	2021/22	2022/23	2023/24	2024/25	Total AMP7
Capex to opex decisions	(6.9)	6.0	8.3	6.2	6.1	**19.7**
ODI opex	3.9	3.4	3.5	3.5	3.5	**17.8**
Other Opex changes	1.5	1.9	1.9	2.1	2.1	**9.5**
Enhancement operating costs	23.4	12.0	15.4	19.9	24.7	**95.4**
Efficiency and productivity improvements	(4.7)	(6.2)	(10.0)	(12.5)	(23.4)	**(56.8)**
Total annual increase/ (decrease)	**17.2**	**17.1**	**19.1**	**19.2**	**13.0**	**85.6**

Enhancement Operating Expenditure

Using an investment business case approach developed on a bottom up basis and taking the outputs from our C55 investment planning tool (see lines 12 to 20 for explanation), we have identified areas of change in our operating costs during AMP7. We have applied the incremental change to costs in the relevant year. The costs include elements that will be on-going operational costs into AMP8, and others that are one-off costs under IFRS.

The change in enhancement operational costs builds up from specific requirements for each investment rather than a broad brush allowance methodology. Each investment has a full audit trail and is specific to each investment option (or alternative). These costs are used for developing whole life costs, and the best value alternative is selected using prioritisation and optimisation techniques available in the C55 system. The operational costs are used in all cost benefit analyses which is a component of the business case approach. The allocation of operational costs has been validated to ensure IFRS rules are met.

Lines 5 and 6: Renewals expensed in year (infrastructure and non-infrastructure)

Renewals expensed are based on the expected 2019/20 outturn, as the level of reactive work is not expected to change over the next AMP. The reduction in costs over the AMP reflects our efficiency assumptions.

Line 10: Third party services

Third party service costs consist of the costs for bulk supply, supply of non-potable water and third party costs incurred. Our AMP7 costs are based on our 2019/20 forecast outturn which reflects our underlying run rate.

SECTION B: CAPITAL EXPENDITURE (EXCLUDING ATYPICAL EXPENDITURE)

Lines 12, 18 and 20 – Water diversions expenditure and contributions

Following Ofwat's clarification on the treatment of diversion contributions, the £19.1 million of contributions forecast to be received from local authorities, highways authorities and private companies to divert water mains in AMP7 have been shown on line 20. This diversion revenue was previously netted off capital expenditure and included in full on line 12.

The £19.1 million of expenditure forecast for water diversions in AMP7 has been included in full as third-party expenditure on line 18 in accordance with RAG 4.07. This expenditure was previously split between line 12 (£12.8 million over AMP7) and line 18 (£6.3 million over AMP7)

For AMP6, all water diversion contributions received or forecast have been netted-off capex in alignment with the treatment recorded in the corresponding Annual Performance Reports.

We assume 100% contribution against all water diversions expenditure and there is no change to the total forecast expenditure or contribution. Net totex remains unchanged as a result of these changes to reporting of diversions.

Lines 12 to 19: Capital expenditure

The C55 system holds all the information for our expenditure plan and allows us to review and extract data as required for each investment and their alternatives.

For the PR19 Business Plan tables the key fields are:

- Investment Area - Either Water or Wastewater
- Cost Allocation - Business Investment Code (BIC) identifier aligned to RAG 4.07 enabling for up to five drivers and allows:
  - further definition of purpose against RAG 4.07 reporting boundaries
  - infrastructure and non infrastructure allocations for tables
  - capital and operational cost allocations

- allocation of RAG Business Units, and
- the allocation to price control.

These core fields allow for the allocation of expenditure for the PR19 data tables for the scenario approved by the Portfolio Owner. A bespoke report has been developed for the primary purpose of completing the PR19 data tables.

Capital expenditure in table WS1 is stated on the basis that IFRS 16 (leases) has been adopted by the company from 1 April 2019. Table WS1A shows capital expenditure on the basis that IFRS 16 had not been adopted. Incremental operational costs have been included in table WS1, lines 1 to 11.

Lines 12 and 13: Maintaining the long term capability of the assets (infrastructure and non-infrastructure)

Our overall approach to the development of our botex plan is described in our Plan (Chapter 10 Efficiency and Innovation). Capital maintenance profiles are often more stable than enhancement because of the nature of ongoing maintenance. However, we have coded some specific activities to capital maintenance that are required to be completed at specific times in the AMP. This can cause uneven spend profiles particularly within individual sub-components of price controls.

Water Resources

The peak in investment in 2021/22 for Water Resources is driven by our decision to bring forward borehole replacement works. Completing this work early will allow more time for borehole commissioning which can take time (the chemistry of the raw water changes in reaction to the abstraction). Completing this work early also helps to secure supplies at those sites and thereby improve resilience.

Treated Water Distribution

The reason for the sharp increase in spend in 2018/19 and 2019/20 followed by a reduction in AMP7 reaching a low in 2024/25 is for a variety of reasons:

- In our AMP6 forecasts we are showing our planned programme of reinvestment of outperformance. This will be complete before the start of 2020/21
- In our AMP7 forecasts we have sought to improve totex decision making in delivering outcomes for customers. This has the effect of moving spend from capital maintenance into opex
- To balance pipe-laying resources in AMP7, which will be required for the construction phase of trunk mains in our enhancement programme, we have brought forward two large mains replacement schemes totalling over £10 million, most of which is planned to occur in 2021/22 and 2022/23. This has driven up spend in those years relative to the normal mains replacement programme.

Lines 14 and 15: Other capital expenditure (infrastructure and non-infrastructure)

Enhancement capex profiles will often vary by year and by price control depending on the timing of the investment need. This is driven by obligation dates agreed with regulators as well as the duration of projects and availability of delivery resources. Our plan has been optimised using our investment planning tool C55 to achieve the best profile of expenditure to reduce variability of bills and balance resource requirement in our supply chain, whilst ensuring we meet all our obligation dates. For some lines this results in uneven spend profiles. Details of the obligations that we are required to achieve are available on request. More detail on the individual enhancement cases is available in our table commentary to WS2.

Line 16: Infrastructure network reinforcement

Network reinforcement is driven by growth forecasts. The growth forecasts used as the basis for our profiles is contained in App28. This is not constant in each year of the forecast, but where possible we have smoothed the profile of investments.

Line 18: Third party services

The 2017/18 third party services capital expenditure of £1.0 million is in relation to capital expenditure for the fulfillment of bulk supply agreements at Wing and Grafham Water Treatment Works.

The reasons for the provision for third party services is explained more in the table commentary for WS8.

Treated Water Distribution

In AMP6 our approach has been to treat diversion works and fire hydrants as neutral in spend and therefore not reported in these figures. In the reported figures for AMP7 we have split out our diversion and fire hydrant works in line with the guidance and included the contribution to offset the capex, hence the increase in this line from 2019/20 to 2020/21.

SECTION C: TOTEX

Lines 20 to 21: Grants and contributions - operating expenditure / capital expenditure

As per the updated data table structure issued in January 2019, we have split grants and contributions by operating and capital expenditure. It should be noted that all grants and contributions are included in line 21 (capital expenditure). The forecast for 2018/19 has also been updated to reflect better information as we are further through the report year.

Line 20: Grants and contributions - operating expenditure

We are not forecasting any contributions towards operating expenditure.

Line 21: Grants and contributions - capital expenditure

The data in this line is taken from App28, lines 7 to 12. Contributions are expected to be received from developers and predominately follows the new charging regime that came into being on 1 April 2018. The revenue is based on a per house contribution and therefore aligns to the increased housing numbers predicted to occur from 2020.

Following Ofwat's clarification on the treatment of diversion contributions, the £19.1 million of contributions forecast to be received from local authorities, highways authorities and private companies to divert water mains in AMP7 have been shown on line 21. This diversion revenue was previously netted off capital expenditure and included in full on line 12.

The £19.1 million of expenditure forecast for water diversions in AMP7 has been included in full as third-party expenditure on line 18 in accordance with RAG 4.07. This expenditure was previously split between WS1, line 12 (£12.8 million over AMP7) and WS1, line 18 (£6.3 million over AMP7).

For AMP6, all water diversion contributions received or forecast have been netted-off capex in alignment with the treatment recorded in the corresponding APRs.

We assume 100% contribution against all water diversions expenditure and there is no change to the total forecast expenditure or contribution. Net totex remains unchanged as a result of these changes to reporting of diversions.

The following table identifies the grants and contributions by specific areas for Water.

RAG Accounting Definitions - Water	2020/21	2021/22	2022/23	2023/24	2024/25	Total
Connection Charge - Section 45	14.254	15.928	16.703	16.642	15.331	78.858
Infrastructure Charge Receipts - Section 146	10.290	13.870	12.260	11.770	11.310	59.500

RAG Accounting Definitions - Water	2020/21	2021/22	2022/23	2023/24	2024/25	Total
Requisitioned Main - Section 43, 55 and 56	5.984	6.687	7.013	6.987	6.437	33.108
Other contributions (price control)	0.000	0.000	0.000	0.000	0.000	0.000
Diversions - Section 185	3.478	3.855	4.030	4.017	3.721	19.101
Other contributions (non-price control)	0.000	0.000	0.000	0.000	0.000	0.000
Total	**34.006**	**40.340**	**40.006**	**39.416**	**36.799**	**190.566**

SECTION D: CASH EXPENDITURE (EXCLUDING ATYPICAL EXPENDITURE)

Line 23: Pension deficit recovery payments

Deficit recovery payments are allocated to price control and service based on on the allocation principles previously used.

The value of deficit payments is known and has been agreed between the company and the pension trustees. The agreed deficit payments are reflected in the table.

Line 25: Totex including cash items

This is the sum of lines 22 to 24.

SECTION E: ATYPICAL EXPENDITURE

Lines 26 to 28: Atypical expenditure

Our atypical expenditure in 2017/18 is as reported in our Annual Report and Accounts. We are not forecasting any atypical items from 2018/19 onwards.

SECTION F: TOTAL EXPENDITURE

Line 37: Water totex including cash items and atypical expenditure

This is the sum of lines 25 and 36.

WS1A - WHOLESALE WATER OPERATING AND CAPITAL EXPENDITURE BY BUSINESS UNIT INCLUDING OPERATING LEASES RECLASSIFIED UNDER IFRS16

Table WS1a shows water operating, capital, cash and atypical expenditure profiles before the impacts of the adoption of IFRS16, the new lease accounting standard, are taken into consideration. Table WS1 shows the same expenditure profiles adjusted for IFRS16, which is expected to be adopted by the Company in the year ended 31 March 2020.

For full commentary on these expenditure profiles, please see the commentary for WS1.

The adoption of IFRS 16 has the impact of decreasing operating expenditure between 2019/20 and 2024/25 by a total of £3.8 million and decreasing capital expenditure by £2.9 million over the same period.

The full impact of IFRS 16 adoption is as detailed in table App33 and the associated commentary.

For commentary on sections A to E of this table please see the corresponding commentary in table WS1.

WS2 – Wholesale water capital and operating enhancement expenditure by purpose

Lines 1 to 38: Enhancement expenditure by purpose

The information presented in this table reconciles with table WS2a.

Lines 40 to 77: Enhancement expenditure by purpose - operational

The expenditure includes for the full year effect of the operational costs for schemes which are delivered at the end of AMP6 along with the additional operation costs for projects delivered in AMP7. The planned operational costs include for on-going operational costs associated with new assets and schemes, and for one off costs under IFRS accounting standards.

The information presented in this block is excluded from table WS2a as operational costs are not reported.

Enhancement expenditure – supporting information (enhancement business cases)

In this section we provide detailed enhancement business cases to support our planned enhancement expenditure. These are cross referenced to the table lines.

We have developed a comprehensive set of enhancement business cases covering the all of our Enhancement Expenditure. These business cases align to Ofwat IN18/11 information letter published in July 2018.

Deep Dive Enhancement Business Cases

Where through the IAP assessment, Ofwat has assessed our Plan as either a 'pass' or 'N/A' assessment we conclude that Ofwat is fully satisfied with the information provided in our September plan. We therefore focus attention solely upon those areas where Ofwat has not fully satisfied (i.e. we have received a 'partial pass' or 'fail' assessment), we provide additional evidence below to address each point of feedback on our business cases.

We have retained the information provided in our September 2018 Plan for completeness, and we have only provided additional evidence at the front of each case where Ofwat had specific concerns.

Within this section we have not included commentary of the enhancement modelling approach which is contained within Chapter 5 of our IAP response.

The totex enhancement expenditure for the Water Service is summarised in the following table and provides the index to the evidence base contained within this section. We have ordered them into deep and shallow dives.

Summary of enhancement expenditure – deep dives

Business case	Our Plan Totex (£m) [1]	Ofwat IAP assessment (£m)	Summary of new information provided	Page number
WRMP Supply Side Strategy	580.709	428.372	Summary of information and breakdown of costs to support the 2020-2025 enhancement expenditure unit cost analysis Additional information to support the need for long-term enhancement expenditure	33

Business case	Our Plan Totex (£m) [1]	Ofwat IAP assessment (£m)	Summary of new information provided	Page number
			Additional information and breakdown of costs for investigations and future planning.	
Smart Metering	181.844	96.766	Base information for third party comparison of unit costs Additional costs comparison evidence from Yarra Valley, Australia and Valencia, Australia. Our proposal for a true-up mechanism to protect customers from paying twice for smart metering.	59
Resilience Programme	66.777	15.200	Further details of investments in our resilience programme Further details on our optioneering approach	74
Nitrates (Raw Water Deterioration)	25.52	15.489	Further detail of the scheme level costs for each site Explanation of the cost allocation approach Explanation of the options considered for each scheme Further clarification of the approach to assessing cost effiency	104
Water Resources Environmental Measures	34.516	17.787		118

1 with adjustments post September Plan

Summary of enhancement expenditure – shallow dives

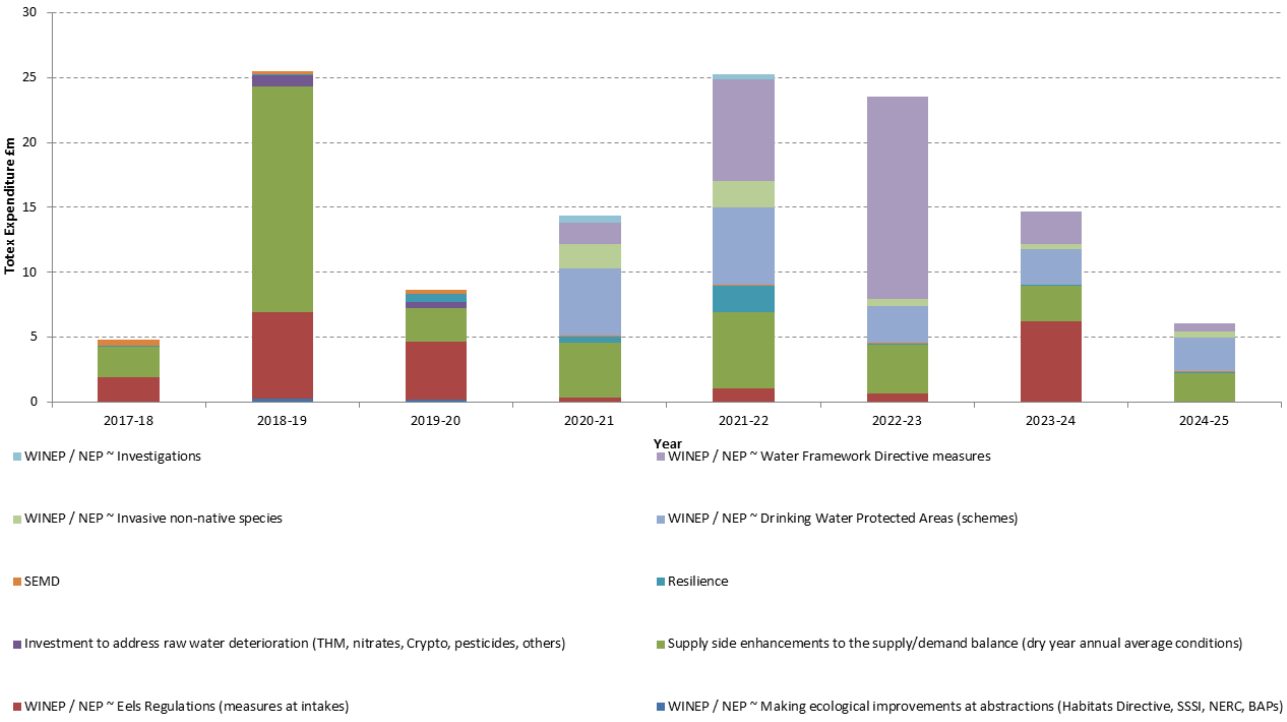
Business case	AMP7 Total Expenditure (£m) [1]	Summary of new information provided	Page number
Housing Growth	276.257	No changes to the business case	131
Driving Down the Leakage Froniter	76.939	No changes to proposed totex. Full response on our leakage proposals provided in Chapter 6 of our IAP response.	136
Catchment Management	39.969	Plan adjusted to reflect the ban on metaldehyde and to align with ministerial guidance.	142
Lead and Water in Buildings	31.154	Additional information on the breakdown of the analysis of pipe replacement.	148
Security of Network and Information Systems (NIS) Compliance	15.143	Clarification to highlight that our expenditure is to provide additional security infrastructure and connectivity at our sites, and not replacement for obsolete existing equipment.	154

Business case	AMP7 Total Expenditure (£m) [1]	Summary of new information provided	Page number
Properties at Risk of Persistent Low Pressure	9.119	Clarification to highlight that investment is to improve pressure at properties experiencing low pressure problems, and is not associated with growth in the region.	161
Eels Directive	8.371	No changes to the business case.	167
Security and Emergency Measures Direction (SEMD)	1.876	Further details highlighting that the expenditure relates to providing enhanced security at our sites and not maintaining existing equipment.	170
Pluvial and Fluvial Flood Protection	0.039	No changes to the business case.	174

1 includes adjustments made post September Plan

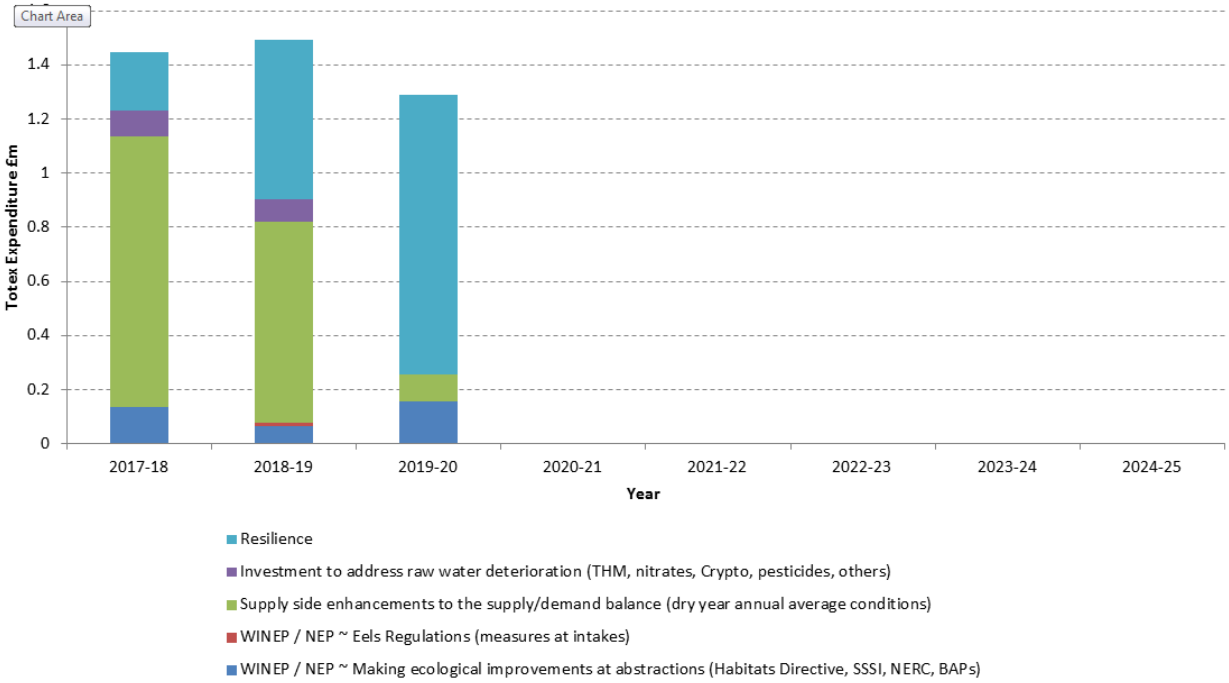
Please note: the spend in our enhancement tables include a negative adjustment for the enhancement spend on third party expenditure to comply with the validation check in WS1 and WWS1 that the sum of lines 14-16 should equal the total enhancement capex. Some of the third party spend we have allocated to line 18 is also enhancement spend, so this adjustment is required for the validation rule to work.

Figure 5 Water Resources enhancement totex expenditure by purpose



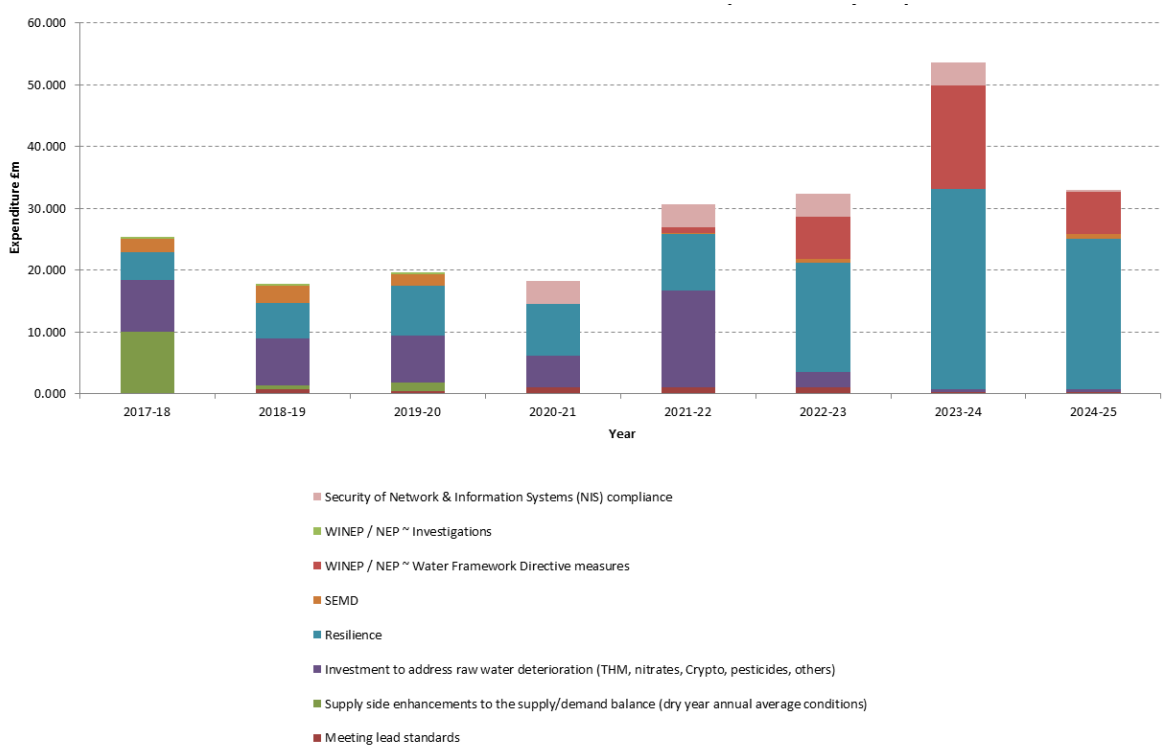
The variances in the profile relate to the delivery of projects required under the Water Industry National Environment Programme (WINEP) obligations under the Eels Regulations and Ecological Improvements. We have allowed some early investment under the Resilience heading to improve the service we give to our customers.

Figure 6 Raw water distribution enhancement totex expenditure by purpose



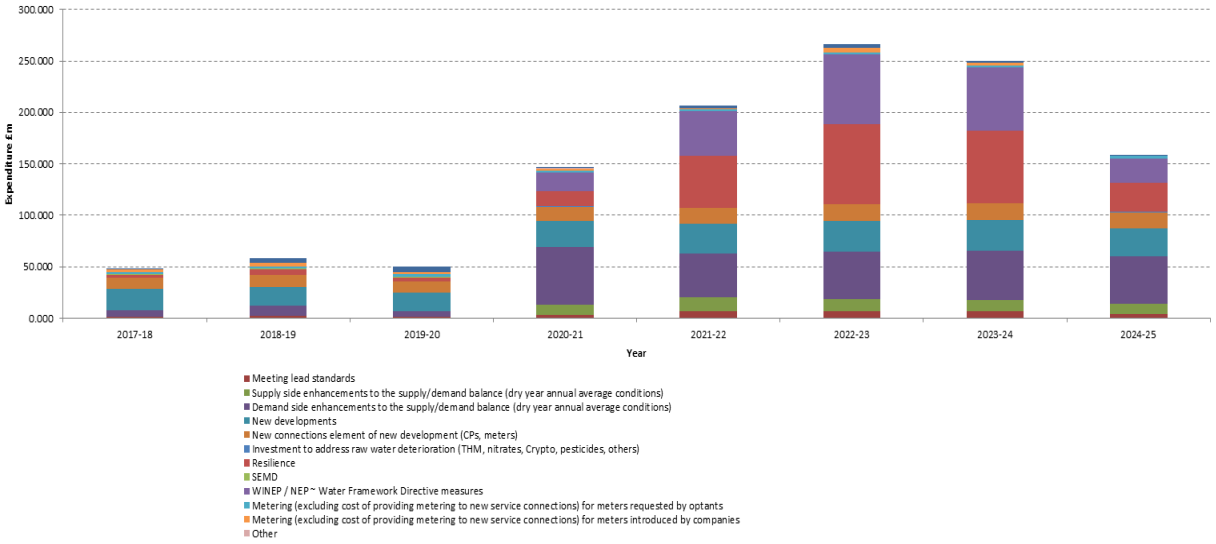
There are no enhancement schemes planned for AMP7. The expenditure profile in AMP6 relates to forecasts to complete remaining obligations. The average planned expenditure the remaining two years of AMP6 is £1.4 million.

Figure 7 Water Network+ treatment enhancement totex expenditure by purpose



The profile of expenditure is by obligation dates agreed with the Environment Agency and the delivery of schemes in our Water Resources Management Plan (WRMP) as a result of the Restoring Sustainable Abstraction (RSA) driver. The second block of expenditure relates to the delivery of a lead in water reduction programme and the removal of nitrates as a result of deteriorating raw water quality, both of these areas are supported by the Drinking Water Inspectorate (DWI).

Figure 8 Water network+ distribution enhancement totex expenditure by purpose



The key variance in profile in AMP7 relates to the delivery of the supply and demand management investments to support our WRMP. These are large complex projects that take extended periods to plan and deliver. In some cases the delivery profile is 4 years therefore the cash profile varies significantly.

Board Assurance

Deloitte, external assurance providers for financial elements of our Plan, reviewed tables WS2 and WWS2 to confirm that an audit trail, including supporting information and applicable documented assumptions, was available to support the data in the tables. They also confirmed that reporting requirements had been adhered to.

Jacobs, external assurance providers for technical elements of our Plan, reviewed our approach to developing investment portfolios, including the cost estimation process and the optimisation of portfolios. They reviewed a number of specific investment areas as part of their scope of work. They confirmed to our Board that there are no material concerns.

Further information on the reviews carried out are available in the reports from Deloitte and Jacobs, provided to Ofwat as annexes to our Plan.

Jacobs and Deloitte have been engaged again since our Plan submission in September 2018 to assure our query responses that resulted in data changes and changes made to our data following publication of the IAP on 31 January 2019.

WRMP Supply Side Strategy

Additional evidence in response to IAP (31 January 2019)

Overview

This document provides additional evidence for all elements of the supply demand feeder model assessment save for leakage enhancement, which is detailed in chapter 6 of our main IAP Response.

This enhancement business case should be read in conjunction with our model review of the Supply Demand Balance in chapter 5 of our main IAP Response.

This enhancement business case also provides a summary of the changes we have made to our Plan as a result of the recently announced metaldehyde ban. Treatment scope has been removed from a number of investments, which reduces the overall proposed totex by £47.4m.

Ofwat has removed 20% of costs of the internal interconnections element of the WRMP supply side investment programme due to "*insufficient justification provided for the majority of scope*." This is before the "company level efficiency challenge" is applied. Evidence of the justification of scope, and the process of selecting best value options, is fully provided in our revised draft WRMP submission, which was summarised in the Resilient Water Supplies chapter of our September Plan. It was also within our original enhancement case, which is provided again here for ease of reference.

We met with Ofwat on 19 February 2019 and discussed the assessment of our internal interonnectors programme including explaining why we felt the challenge on need and scope was inappropriate, given the rigorous WRPM process we had already gone through. We have prepared a presentation which summarises the WRMP options appraisal process and we look forward to the opportunity to take Ofwat through this material.

Our response to the "company level efficiency challenge" is set out in chapter 5 of our main IAP Response.

Ofwat has assessed this expenditure as part of the supply demand feeder model. The Ofwat assessment is split into six enhancement areas:

- 2020-25 enhancement
- Long-term enhancement
- Strategic regional solution development
- Internal interconnections
- Leakage enhancement
- Investigations and future planning

	Our Plan £m	IAP Assessment £m	Difference £m	Difference %	1 April adjusted investment figures [1]
Capex	571.441	428.372	152.337	26.2	524.654
Opex	9.268				8.652
Totex	580.709	428.372	152.337	26.2	533.306

1 removal of metaldehyde treatment

Ofwat feedback	Summary of evidence provided in response
2020-2025 enhancement expenditure: *62.0 Ml/din identified 2020-25 supply-side benefits assessed at the industry median unit cost which is lower than the company unit cost.*	Summary of information and breakdown of costs to support the 2020-2025 enhancement expenditure unit cost analysis
Long term enhancement expenditure:*Insufficient evidence provided to justify the development of options identified. A development allowance (based on the South Lincolnshire reservoir, the costs being challenged against average industry scheme-type costs and the company efficiency) is provided. It is expected that if South Lincolnshire reservoir or an alternative scheme meets the requirements of Direct Procurement for Customers (DPC) scheme consideration (such as the £100m whole-life totex threshold) and is ultimately deemed suitable it will be procured through the DPC process.*	Information to support the need for the long term enhancement expenditure, drawn from our revised draft WRMP, as submitted to Defra in September 2019.
Strategic regional solution development: *Joint development of an eastern regional solution/transfer. Enhancement allowance added in line with the policy decisions described in Section 5 of this slide pack.*	Details of our response to the 20% scope challenge, drawn from our revised draft WRMP.
Internal Interconnections: *20% efficiency challenge applied due to the insufficient justification provided for the majority of scope. Company level efficiency is subsequently applied. Options Central Lincolnshire WRZ to Nottinghamshire WRZ transfer and Norwich & the Boards WRZ to Happisburgh WRZ Transfer have significantly higher costs than the forecast industry median unit cost. Expenditure is allocated at the industry forecast median unit cost and the company should investigate and provide further justification that the interconnection is the best value option. Further protection for customers required.*	Details our response to the 20% efficiency challenge on the scope justification, as outlined above, in line with our revised draft WRMP. New marketing testing information [redacted] Our response to the company level efficiency challenge is provided in Section 5.3 of our main IAP response. Additional breakdown of costs provided to support enhancement expenditure unit cost analysis.
Investigations and future planning: *Insufficient detail provided to separate future planning expenditure from aggregated expenditure above*	Additional information and breakdown of costs for investigations and future planning

Investment summary

This investment supports our Water Resources Management Plan (WRMP) supply side strategy, as outlined in the Resilient Water Supplies chapter of our September Plan. Our strategy includes investment in the following schemes:

- A new Water Treatment Works (WTW) to treat water from our Pyewipe Water Recycling Centre (WRC) to supply our non-household customers on the South Humber Bank sized at 6Mld – coded to lines 14 (53%) and 18 (47%).

- A new WTW will treat the water we currently supply to our South Humber Bank customers (from a surface water intake) to a potable standard to support the strategic transfers from north to south – coded to lines 14 (53%) and 18 (47%).
- 3 water treatment sites on transfers between water resource zones to ensure the water quality transferred is compatible with the water in the receiving zone.
- 16 new strategic potable transfer mains and associated infrastructure, to move water between Water Resource Zones (WRZs), from areas of surplus to areas of deficit. The total length of new transfers exceeds 500km – coded to lines 14 (53%) and 18 (47%).
- Pre-planning work for future new water resources capacity schemes including winter storage reservoirs, desalination and water reuse schemes – all coded to water resources in line 8.
- Work to support regional planning as part of Water Resources East (WRE) and the preparation of our WRMP24 - all coded to water resources in line 8.

The balance of the investment on line 14 is explained in our enhancement case entitled 'Resilience Programme'.

Impact of Metaldehyde Ban

A number of the schemes in the WRMP supply side programme included scope to treat metaldehyde. This included metaldehyde treatment at new surface water treatment works (Elsham) and also treatment for metaldehyde where water was being transferred between a zone with a metaldehyde undertaking, to a zone without. We have assessed the impact of the metaldehyde ban on the WRMP supply side investments and have made the following changes. The cost reductions associated with this are summarised in the table at the end of this new section of the enhancement case.

- CLN13a-New 31 Ml/d potable WTW at Elsham - treatment only. The treatment process in our September Plan was based on our Hall WTW treatment process which is suitable for the removal of metaldehyde. For the IAP Response we have reduced the investment to a standard surface water treatment process (removing £5.1m capex)
- ELY9 North Fenland WRZ to Ely WRZ, HPB1 - Norwich & the Broads WRZ to Happisburgh WRZ, RTS Intra RZ - Meppershall PZ and CLN15-Treatment for ELN transfers – We have removed these treatment elements and adjusted the modelling requirements to account for the change. The investments still include a treatment facilities to ensure the quality of the transferred water is compatible with the water in the receiving system. (removing £41.7m capex).

Ofwat's action requires that we agree the scale and timing of changes we make with the Drinking Water Inspectorate (DWI). On the 19 March 2019 we met with representatives from the DWI and explained the changes we have made. The DWI confirmed acceptance and support for the changes we have incorporated into our plan.

2020-2025 enhancement expenditure

Ofwat feedback

"62.0 Ml/din identified 2020-25 supply-side benefits assessed at the industry median unit cost which is lower than the company unit cost."

The efficiency chapter of our main IAP Response (chapter 5 Supply Demand Balance) contains full analysis of Ofwat's modeling approach for 2020-2025 enhancement expenditure. Below, we provide a more detailed breakdown of scheme by scheme costs to assist Ofwat in assessing our proposed expenditure. There are five investment schemes in our WRMP supply side programme which are consistent with this category of expenditure. Three of the schemes are integrated with interconnector schemes as together they deliver the additional capacity. However, in order to present the expenditure in such a way that they can be assessed accurately, a breakdown has been provided. The table below provides the scheme name, capacity, treatment complexity and costs for the five schemes that deliver additional treatment capacity in 2020-2025.

Scheme description	Integrated with WRMP interconnector scheme	Treatment complexity	Capacity (Ml/d)	Capex (£m)	Opex (£m)
SHB2a-Pyewipe Water Reuse for Non-potable use - treatment	No	W6	6	25.318	0.507
CLN13a-New 31 Ml/d potable WTW at Elsham - treatment only	No	W4	31	40.684	0.318
CLN15- treatment for ELN transfer (25MLD)	Yes	SD	25	16.204	0.071
ELY9 North Fenland WRZ to Ely WRZ Non Infra only	Yes	SD	20	16.465	0.647
RTS Intra RZ - Meppershall PZ Non Infra Only	Yes	SD	5	5.187	0.030

Long term Enhancement Expenditure

Ofwat feedback

"Insufficient evidence provided to justify the development of options identified. A development allowance (based on the South Lincolnshire reservoir, the costs being challenged against average industry scheme-type costs and the company efficiency) is provided. It is expected that if South Lincolnshire reservoir or an alternative scheme meets the requirements of Direct Procurement for Customers (DPC) scheme consideration (such as the £100m whole-life totex threshold) and is ultimately deemed suitable it will be procured through the DPC process."

Evidence to support the need for this investment, including our rigorous options appraisal approach and future stress testing and scenario modelling, is fully set out in our revised draft WRMP. It is repeated here for convenience. The investment we propose is critical to enabling the timely delivery of the future water resource options that may be required at WRMP24. The ability to deliver pre-planning for AMP8 resource schemes is fundamental to the adaptive planning approach which underpins our WRMP strategy. The future water resources needs in our region are inherently uncertain and we have completed stress-testing of our best value plan (as part of the WRMP process), to assess the impact of this uncertainty and the likely need for future water resource schemes. We have specifically assessed the impact of:

- Higher climate change scenarios;
- The need to deliver resilience to extreme (1 in 500 year) drought events;
- Uncertainties associated with long-term savings delivered through demand management programmes such as smart metering;
- The need for further future sustainability reductions and;
- The need to transfer resources to our neighbouring companies.

The outputs from the stress testing identify the potential need for additional supply-side capacity in the future (AMP8 and beyond). We will continue to assess the need for new supply-side schemes as we prepare for WRMP 2024, but recognise that new supply-side schemes are complex to deliver and have long planning timescales. These timescales make it unfeasible to deliver the schemes within one planning cycle, so we have to start planning now for schemes that may be required for delivery between 2025-2035. This is why we, along with other companies in the south east, have

put forward an adaptive planning approach that accounts for future uncertainty.Delivering this pre-planning activity now will ensure that these schemes are ready to implement if they emerge in our Preferred Plan at WRMP 2024.

The strategic options we we propose are those most likely to be selected in our WRMP24 strategy, as supported by our WRMP option appraisal process. They include:

- Two reservoir storage options in South Lincolnshire and North Fenland WRZs;
- Trading with Severn Trent Water;
- Desalination at Felixstowe, and;
- Water reuse and river augmentation schemes in Ipswich and Kings Lynn.

We will also continue to develop our thinking around the future role of innovative water resources options such as Aquifer Storage and Recovery (ASR).

The development activities to be delivered as part of this programme include:

- Site selection and preliminary geotechnical investigations for reservoir storage options;
- Engineering designs;
- Flood risk assessment;
- Planning and undertaking studies to support Environmental Impact Assessments;
- Preparation for the planning application process and potentially including some schemes under a Development Consent Order, and;
- Preparation for the delivery of options through Direct Procurement for Customers.

Of the options we describe above, the South Lincolnshire Reservoir is the only onewe consider to have a high enough capacity (150 Ml/d) to be considered strategic in the context of the South East. We therefore propose this option be incorporated into Ofwat's strategic regional solution development proposals (see below and chapter 4 of our main IAP Response). The North Fenland Reservoir, which is the next largest scheme, has a capacity of 50 Ml/d.

However, the development costs we include here for the South Lincolnshire Reservoir, do not fully reflect the scale of Ofwat's ambition for schemes to be "construction ready" in early AMP8; the cost profile included in the September submission had the development costs phased across AMP7 and into early AMP8. This reflected our understanding of the timing of the need for the scheme to be construction ready at the time of our Plan.

The costs also do not reflect the 150 Ml/dl capacity option that would be needed to support the needs of the wider South East and the transfer to Affinity Water. The costs were a best estimate at the time of submission based on our understanding of Affinity's Water's WRMP, which has since been changed to include a 100 Ml/d transfer from Anglian Water as part of an adaptive plan. We therefore propose that Ofwat assesses the development expenditure for the 150 Ml/d South Lincolnshire Reservoir option, and associated 100 Ml/d transfer to Affinity Water, as part of the strategic regional solution proposals.

We have completed a full assessment of the South Lincolnshire Reservoir for suitability for DPC, the results of which were presented in our September Plan and were accepted by Ofwat. We recognise that some of the other longer term options may qualify as beneficial to customers under DPC. Early in AMP7, we we will undertake work to assess these options, and their suitability for DPC.

In order to support Ofwat's analysis we provide below a more detailed breakdown of costs and activities.

Scheme description	Capex (£m)	
South Lincolnshire Reservoir	£9.763	Note – does not reflect full scope of 150 Ml/d day scheme, Affinity transfer or full costs to be "construction ready" in AMP7. We propose Ofwat considers this investment within the scope of the

Scheme description	Capex (£m)	
		strategic regional solution development programme. Indicative development costs for the reservoir and transfer to Affinity transfer combined are £61m (based on 6.4% of full scheme capex), but we will work with the joint company group and Ofwat ahead of draft determination to finalise the detailed cost build up. See strategic regional solution development section in this document, and in Chapter 4 for further details.
Adaptive Planning	£5.741	Includes development costs for Kings Lynn and Ipswich reuse schemes, Felixstowe desalination, North Fenland reservoir, trading option with Severn Trent and innovative ASR investigations.

Strategic regional solution development

Ofwat Feedback

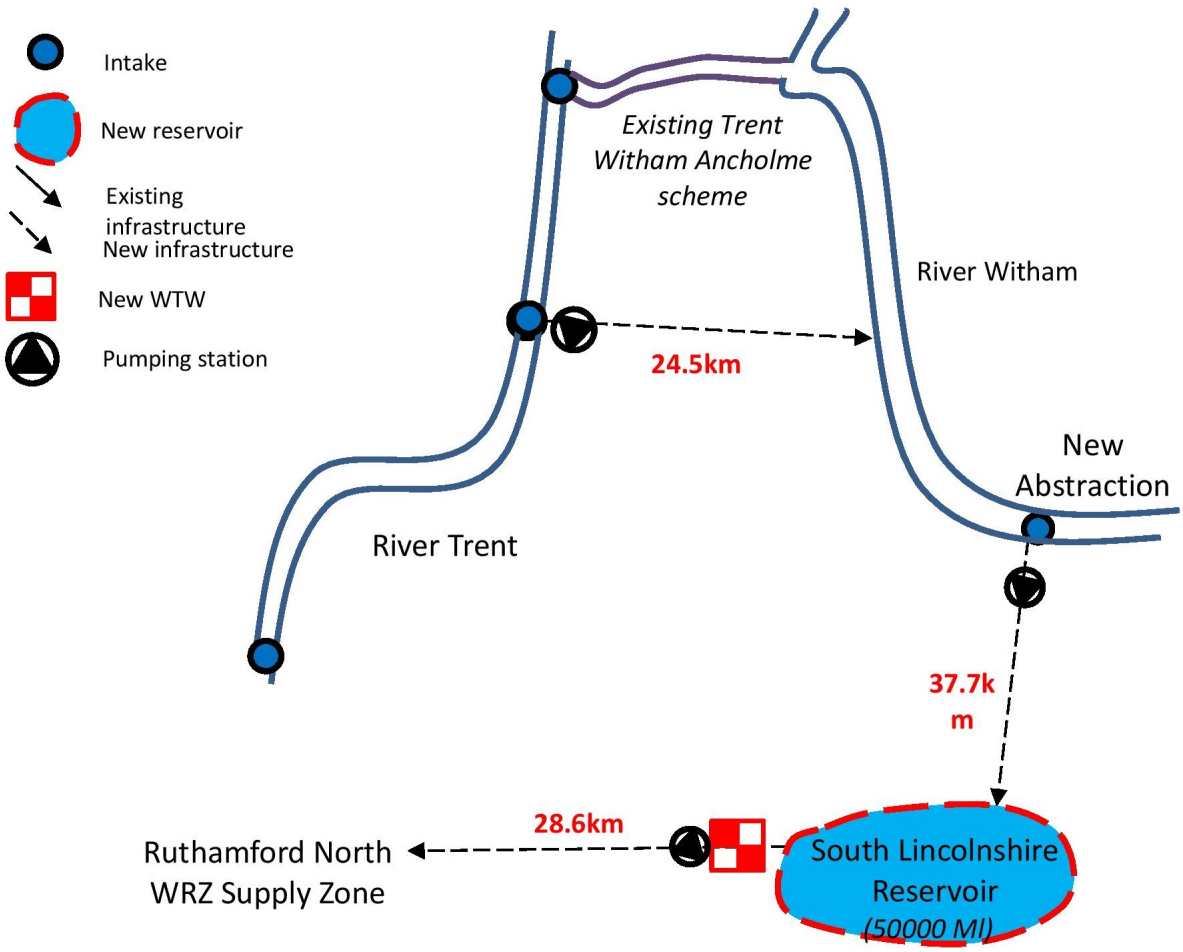
"Joint development of an eastern regional solution/transfer. Enhancement allowance added in line with the policy decisions described in Section 5 of this slide pack."

We welcome Ofwat's proposals on strategic regional solution development. The current Ofwat strategic regional solution proposals include the transfer from Anglian Water to Affinity Water, based on the costs that Affinity presents in their WRMP19. However, these costs are not the full development costs for the option, but are based on an indicative commercial trading agreement we provided to support Affinity's option appraisal process. The 100 Ml/d transfer between Anglian and Affinity also needs the South Lincolnshire reservoir scheme to be delivered for it to be viable. We therefore propose that the strategic regional solution programme includes an allowance for the development of the South Lincolnshire Reservoir option, as well as the infrastructure needed to deliver a transfer from Anglian to Affinity.

We have included some high level details of the option here for reference, but will continue working with the joint company working group, the regional groups (WRE, WRSE), Affinity Water and Ofwat to finalise a set of consistent scheme costs ahead of Draft Determination. The work plan in the Joint Statement on Strategic Regional Solution development sets this out (see appendix 4a). We are in the process of establishing the scheme working group for the eastern regional solution transfer, including the South Lincolnshire Reservoir.

The South Lincolnshire Reservoir forms part of our set of feasible options in our WRMP19. The eastern regional solution included in the Ofwat proposals is dependent on the delivery of the South Lincolnshire Reservoir to provide the upstream resource for the transfer. The scheme is designed to deliver up to 150 Ml/d from a new bunded pumped storage reservoir of 50,000Ml capacity. The reservoir will be refilled from a new abstraction on the Witham at Boston. The option includes the intake and intake pipelines, as well as a new WTW and a potable supply pipeline into the existing network. In addition, there is a new 300Ml raw water transfer scheme from the River Trent to the River Witham for abstraction at Boston. This scheme, combined with a transfer pipeline to Affinity Water with a capacity of 100 Ml/d, represents a strategic water resources option to support the needs of the wider South East of England. A schematic of the option, taken from our WRMP, is provided below.

Picture 2



The combined indicative capex for the reservoir and the transfer to Affinity is £952m. Applying Ofwat's 6.4% allocation, as outlined in the supply demand feeder model, would result in an allowance of £61m, split between Anglian and Affinity as part of the strategic regional solution development expenditure proposals.

We have already completed extensive work to prepare for the future delivery of this option, including site selection studies, scoping work for environmental surveys and stakeholder engagement with the South Lincolnshire Water Partnership.

The reservoir scheme has also been assessed as suitable for Direct Procurement for Customers, the results of which were presented in our September Plan.

Internal Interconnections

Ofwat Feedback

"20% efficiency challenge applied due to the insufficient justification provided for the majority of scope. Company level efficiency is subsequently applied. Options Central Lincolnshire WRZ to Nottinghamshire WRZ transfer and Norwich & the Boards WRZ to Happisburgh WRZ Transfer have significantly higher costs than the forecast industry median unit cost. Expenditure is allocated at the industry forecast median unit cost and the company should investigate and provide further justification that the interconnection is the best value option. Further protection for customers required."

Our response to the challenge on internal interconnections is split into two sections. A response to the challenge around insufficient justification of scope is provided, drawing on the evidence already submitted in our revised draft WRMP and Resilient Water Supplies chapter of our September Plan . We then provide additional information to support the scheme efficiency assessment. A response to the company level efficiency challenge is provided in the efficiency chapter 5 of the main IAP Response. We have provided a response to the request for a customer protection mechanism for these investments in the customer protection chapter of our main IAP Response (Section 4.2).

Scope

The need for this investment is clearly set out in the Resilient Water Supplies chapter of our September Plan and in our revised draft WRMP. The statutory WRMP process sets out detailed technical guidance for assessment of need, option development and option appraisal. Defra, supported by the Environment Agency, are accountable for ensuring this process is fully adhered to and that the WRMP strategy represents best value for customers and the environment whilst meeting the challenges of growth, climate change, severe drought and environmental needs.

Ofwat was fully consulted as part of this process and provided a detailed representation on our draft WRMP during the consultation period in 2018. Ofwat raised concerns around the clarity of our appraisal and identified the need for further evidence to justify the options selected in our preferred plan. We provided a full response to these concerns in our Statement of Response and revised draft WRMP. Specifically, we included a new chapter in our revised draft WRMP to strengthen the justification for our preferred plan. We also updated the supporting graphics specifically to help explain the drivers for each of the interconnector schemes. This updated justification was summarised in our Resilient Water Supplies chapter of our September Plan, along with the new graphics. Further detail can also be found in our revised draft WRMP on our company website. Ofwat also had direct access to our full revised draft WRMP submission to Defra (including supporting technical documents) in September 2018 via the Defra 'huddle'.

We believe we have already fully responded to Ofwat's challenge around justification of need for our preferred plan as part of the statutory WRMP consultation process. We received a letter from Defra in February 2019 requesting additional information to support our Statement of Response, ahead of a decision by the Secretary of State on the publication of our final WRMP. This letter did not request any further information relating to the justification of need for our preferred plan. Therefore, this new challenge on the scope of our plan from Ofwat at this late stage in the WRMP process presents a significant risk to our ability to deliver the full scope of our AMP7 WRMP supply side plan securing resilient water supplies for our customers.

Furthermore, there appears to be a inconsistency in the Ofwat analysis of our Plan between the supply demand feeder model assessment and the test area assessment. An extract from the test question assessment is provided below, which supports our strategy, describing that we have provided sufficient, high quality evidence.

Test Question CMI3 *To what extent has the company set out a well evidenced long-term strategy for securing resilient and sustainable water resources, considering a twin track approach of supply-side and demand-side options and integrating third party options where appropriate, to meet the needs of customers and the environment in the 2020-25 period and over the longer term?*

Ofwat response: *Anglian Water provides a high quality plan on its long-term strategy for water resources incorporating the use of markets to this aim.*

The company provides sufficient and high quality evidence to using markets and engaging with third parties, with some evidence of an ambitious and innovative approach. On supply-side, the company has reached out to neighbouring companies such as Affinity water and Cambridge water to explore regional solutions, with an export to Affinity water likely to begin in 2025-2030. Demand options, include their work with equipment manufacturers for enhancing leakage detection and developers for use of grey water and rainwater harvesting technology. The company also demonstrates ambition in exploring solutions that go beyond what is required of the WRMP process, by setting up a goal oriented innovation shop window which has already produced actionable solutions on leakage management. On the future deployment of bilateral markets the company does not go beyond providing the required business tables WR6 and WR7.

The company also provides high quality evidence for its long-term strategy on water resource management. A minor issue related to limited information around variance between the 'least cost' and 'best value' plan. The concerns are mitigated by the customers expressing support for the overall business plan.

We recognise that the WRMP process is complex and we are keen to support Ofwat in helping to understand the assessment of need and options appraisal process and how we move from least cost to best value. We have therefore prepared a presentation pack which provides a detailed description of our option appraisal process. We would be happy to take Ofwat through this material face to face, and look forward to the opportunity to do this ahead of Draft Determination.

Unit Rate

Ofwat has also challenged the unit rate for two of the interconnector schemes. Many of the interconnector schemes also include treatment costs and therefore cannot be directly compared with industry average unit rates. To support the efficiency assessment, we have provided a more detailed breakdown of the interconnector costs, excluding the treatment elements. This is presented in the table below (the treatment costs are excluded from this table, but where treatment is included in the scope of the scheme, for which the costs are presented in the 2020-2025 section of this document, that has been indicated). We have also provided some new benchmarking data of our costs using data obtained in the OJEU tendering process for the strategic pipelines, which we have started since our September Plan.

The strategic interconnector investments (excluding the treatment elements) are made up of pipelines, booster pumping and storage reservoir components. The overall percentage split between these three components is 85% pipelines (£344m), 11% booster pumping (£44m) and 4% storage reservoirs (£14m).

We recognise that the unit rate for Happisburgh WRZ transfer is higher than the Ofwat industry median used in the feeder model (£1.39/Ml/d). This is because, in addition to the pipeline, the scheme includes a 2Ml buffer storage reservoir, de-chloramination equipment and a flow balancing tank. These components are required to allow the transferred water to integrate into the existing infrastructure and supply system. The pipeline costs account for approximately 34% of the total Capex (£2.4 m), with these additional investment requirements accounting for 66% (£4.8m).

Interconnector Investment Summary

Investment Name	Treatment Included in 2020-2025 enhancement table	Ml/d transferred	Km	Capex (£k)	Opex (£k)
CLN16-New Elsham WTW to new North Lincoln SR		62	55.935	72.636	0.138
SLN6-Central Lincolnshire WRZ to South Lincolnshire WRZ		63	55.838	28.528	2.378
RTN27-South Lincolnshire WRZ to North Ruthamford WRZ		67	49.404	54.806	1.142
SFN4-North Ruthamford WRZ to South Fenland WRZ		40	55.510	49.928	0.118
NFN4_02a-1034-Emneth Hungate - Stoke Ferry		20	21.991	13.565	0.097
ELY9 North Fenland WRZ to Ely WRZ	Yes	20	34.296	23.680	0.015
NWM6-Ely WRZ to Newmarket WRZ		20	16.094	14.666	0.473
CVY1-Transfer from Newmarket WRZ to Cheveley WRZ		1	8.979	2.486	0.031
BHV5-Newmarket WRZ to Bury Haverhill WRZ		20	33.045	19.610	1.238
ESU8-Bury Haverhill WRZ to East Suffolk WRZ		20	43.504	25.397	0.407
SEX4-East Suffolk WRZ to South Essex WRZ		15	41.496	24.291	0.066
HPB1 - Norwich & the Broads WRZ to Happisbirugh WRZ		1.5	4.583	7.250	0.096
NTM1 Potable Hub-02a-1223a&1223b -CLN-NTM		3.5	41.099	12.833	0.278
BHV Intra RZ Bury Haverhill Transfers		8	17.7	14.638	0.568
RTC2-Ruthamford South WRZ to Ruthamford Central WRZ		12	22.293	8.322	0.013
SD Resilience - Diddlington WTW		1.5	11.530	2.200	0.003
RTS Intra RZ - Woburn PZ		5	2.236	3.541	0.041
NNR8-Little Melton - High Oak		5	12.295	3.940	0.006
THT1 - Bury to Ixworth to Thetford tranfers		3	0.000	0.647	0.058
RTS Intra RZ - Meppershall PZ	Yes	5	9.600	3.216	0.004

Investment Name	Treatment Included in 2020-2025 enhancement table	Ml/d transferred	Km	Capex (£k)	Opex (£k)
SHB2b - Transfer from Pyewipe to non-potable network		20.4	18.516	15.898	0.065
Totals				402.078	7.235

Market testing our data

Since the submission of our Plan in September we have started an OJEU tendering process for our Water Resources Management Plan strategic pipelines (internal interconnections). This has provided us with the opportunity provide Ofwat with new information as we have been able to market test our unit rate with construction companies using tendered cost information. [redacted]

Pipelines

A total of six interconnector investments (£217m or 63% of the total Capex) include pipelines greater than or equal to 600mm diameter. The unit rate comparisons are therefore considered representative of the majority of our interconnector investments.

The figures below demonstrate that our modelled unit rates are well below for Open Cut in Field, which contribute to 98% of the scheme pipeline values.

Investigations and Future Planning

Ofwat feedback

Insufficient detail provided to separate future planning expenditure from aggregated expenditure above.

We are disappointed that Ofwat has disallowed expenditure in this area, especially in relation to supporting the work of the regional planning groups. We have included £3.210m to support future planning, in recognition of the need to undertake sophisticated planning methods that account for planning under deep uncertainty and the implementation of an adaptive planning framework.

Investment summary for 2020-2025 enhancement and Interconnectors

Investment name	Description	Water treatment		Treated water distribution		Treatment in distribution		Ml/d capacity of WTW or transferred	Km
		Capex £m	Opex £m	Capex £m	Opex £m	Capex £m	Opex £m		
CLN13a-New 31 Ml/d potable WTW at Elsham - treatment only	New WTW	40.684	0.318					31	N/A
CLN15-Treatment for ELN transfer (25MLD)	New WTW					16.204	0.071	25	N/A
SHB2a-Pyewipe Water Reuse for Non-potable use - treatment	New WTW	25.318	0.507					6	N/A

Investment name	Description	Water treatment		Treated water distribution		Treatment in distribution		Ml/d capacity of WTW or transferred	Km
		Capex £m	Opex £m	Capex £m	Opex £m	Capex £m	Opex £m		
SHB2b - Transfer from Pyewipe to non-potable network	Interconnector scheme			15.898	0.065			20.4	18.516
CLN16-New Elsham WTW to new North Lincoln SR	Interconnector scheme			72.636	0.138			62	55.935
SLN6-Central Lincolnshire WRZ to South Lincolnshire WRZ	Interconnector scheme			28.528	2.378			63	55.838
RTN27-South Lincolnshire WRZ to North Ruthamford WRZ	Interconnector scheme			54.806	1.142			67	49.404
SFN4-North Ruthamford WRZ to South Fenland WRZ	Interconnector scheme			49.928	0.118			40	55.510
NFN4_02a-1034-Emneth Hungate - Stoke Ferry	Interconnector scheme			13.565	0.097			20	21.991
NWM6-Ely WRZ to Newmarket WRZ	Interconnector scheme			14.666	0.473			20	16.094
CVY1-Transfer from Newmarket WRZ to Cheveley WRZ	Interconnector scheme			2.486	0.031			1	8.979
BHV5-Newmarket WRZ to Bury Haverhill WRZ	Interconnector scheme			19.610	1.238			20	33.045
ESU8-Bury Haverhill WRZ to East Suffolk WRZ	Interconnector scheme			25.397	0.407			20	43.504
SEX4-East Suffolk WRZ to South Essex WRZ	Interconnector scheme			24.291	0.066			15	41.496
HPB1 - Norwich & the Broads WRZ to Happisbirugh WRZ	Interconnector scheme			7.250	0.096			1.5	4.583
NTM1 Potable Hub-02a-1223a&1223b -CLN-NTM	Interconnector scheme			12.833	0.278			3.5	41.099
BHV Intra RZ Bury Haverhill Transfers	Interconnector scheme			14.638	0.568			8	17.7

Investment name	Description	Water treatment		Treated water distribution		Treatment in distribution		Ml/d capacity of WTW or transferred	Km
		Capex £m	Opex £m	Capex £m	Opex £m	Capex £m	Opex £m		
RTC2-Ruthamford South WRZ to Ruthamford Central WRZ	Interconnector scheme			8.322	0.013			12	22.293
SD Resilience - Diddlington WTW	Interconnector scheme			2.200	0.003			1.5	11.530
RTS Intra RZ - Woburn PZ	Interconnector scheme			3.541	0.041			5	2.236
NNR8-Little Melton - High Oak	Interconnector scheme			3.940	0.006			5	12.295
THT1 - Bury to Ixworth to Thetford tranfers	Interconnector scheme			0.647	0.058			3	0.000
RTS Intra RZ - Meppershall PZ	Interconnector scheme			3.216	0.004	5.187	0.030	5	9.600
ELY9 North Fenland WRZ to Ely WRZ	Interconnector scheme			23.680	0.015	16.465	0.647	20	34.296
Totals [1]		66.003	0.824	402.078	7.235	37.857	0.748		

1 The difference in opex totals from this scheme by scheme table with the summary table is accounted for by the full year opex effect of AMP6 enhancement investments completed in 2019/20

ORIGINAL ENHANCEMENT BUSINESS CASE AS AT SEPTEMBER 2018

WRMP Supply Side Strategy

Price Control(s)	Water Resources, Water Network Plus
Business Plan table and line(s)	Table: WS2 Lines: A8 and B47 (water resources column only), A14 and B53 (part), A18 and B57 (water treatment and treated water distribution columns only)

Best Value Option

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A8	4.192	5.852	3.708	2.747	2.217	18.715
	A14	17.534	53.307	92.770	95.490	33.844	292.945
	A18	15.549	47.273	82.268	84.680	30.012	259.781
							Capex: 571.441
Opex (£m)	B47	0.000	0.000	0.000	0.000	0.000	0.000
	B53	0.014	0.162	0.397	1.129	3.304	5.006
	B57	0.012	0.144	0.349	0.973	2.784	4.262
							Opex: 9.268

AMP7 carry over costs: £0.000m

The details of the cost benefit analysis for this expenditure is included in our Water Resource Management Plan.

Investment Summary

This investment is to support our Water Resources Management Plan (WRMP) supply side strategy, as outlined in the Resilient Water Supplies chapter of our main submission. Our strategy includes investment in the following schemes:

- 16 new strategic potable transfer mains and associated infrastructure, to move water between Water Resource Zones (WRZs), from areas of surplus to areas of deficit. The total length of new transfers exceeds 500km – coded to lines 14 (53%) and 18 (47%).
- A new Water Treatment Works (WTW) to treat water from our Pyewipe Water Recycling Centre (WRC) to supply our non-household customers on the South Humber Bank sized at 6Mld – coded to lines 14 (53%) and 18 (47%).
- A new WTW will treat the water we currently supply to our South Humber Bank customers (from a surface water intake) to a potable standard to support the strategic transfers from north to south – coded to lines 14 (53%) and 18 (47%).
- Pre-planning work for future new water resources capacity schemes including winter storage reservoirs, desalination and water reuse schemes, Water Resources East and planning for a new storage reservoir – all coded to water resources in line 8.

The balance of the investment on line 14 is explained in our enhancement case entitled 'Resilience Programme'.

Need for Investment

Is there persuasive evidence that an investment is required?

Despite our extensive programme of demand management (as outlined in separate enhancement cases for leakage and smart metering), investment in supply side options is still required to offset the impacts from climate change, severe drought and sustainability reductions. These impacts are distributed across our region and are described in more detail in the Resilient Water Supplies chapter in the main submission.

At the end of this business case we have provided a table detailing the following for each WRZ:

- The baseline supply demand balance at the end of the WRMP planning period, if we were to make no investment.
- The baseline supply demand balance following the implementation of our demand management strategy.
- The baseline supply demand balance following the implementation of our demand management strategy and the proposed supply side investment.

This information has been included to illustrate the need to deliver specific transfer investments to address deficits at a WRZ level.

We have made significant investment across our region in the past to secure supplies in the event of drought; since the 2012 drought for instance, we have invested £47m in drought schemes. However, as this example shows, this type of investment has generally occurred in response to periods of drought, rather than being directly linked to the WRMP regulatory planning process.

At PR14, we included three WRMP related investment schemes, in response to environmental drivers (sustainability reductions). These schemes are currently in delivery as part of our AMP6 capital programme. Whilst we have recognised the threat of climate change for some time, in the past we have largely been able to accommodate this risk through 'headroom'. However, for the fist time, in AMP7, in line with EA guidelines, there is the need to make additional investments in order to ensure we can continue to be resilient to the challenges climate change poses. This is supported by our customers, as discussed in more detail later.

The WRMP19 process marks a step change in the scale of the challenge with respect to the future pressures on our supply demand balance. The key elements that have changed between PR14 and PR19 are described below.

What incremental improvement would the proposal deliver?

The Environment Agency (EA) water resources planning guidelines have been updated to reflect the need to plan to a reference level of service for severe drought restrictions (1 in 200 years). This policy change has been driven by the Water UK National Water Resources Planning Framework, and is supported by more recent work completed by the National Infrastructure Commission. Drought planning is now included as a specific investment driver in WRMPs, in an addition to the guidance for WRMP19. This aligns with customer support of increasing our future resilience to drought.

The recommended technical approach for assessing climate change impacts on water resources has also changed. The EA states that companies must take account of the fact that the climate has changed and will continue to change. There is a clear recognition that investment to provide resilience to climate change cannot be deferred. This message was reinforced in the consultation responses to our draft WRMP.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

There is clear recognition from customers and government that our water resources are facing increasing pressure and that our approach to planning as an industry needs to adapt in order to sufficiently meet this challenge and deliver future resilience to customers. In a published joint letter from industry regulators (Building Resilient Water Supplies: a joint letter. Defra, Ofwat, DWI, EA 9th August 2018), there is a call for increased ambition in company business plans for the 2020 to 2025 period. Specifically, the letter states that companies should "begin work now on projects and transfers to enhance resilience." Our proposed strategy delivers this ambition.

Need for Enhancement Expenditure

Why is it enhancement (and not base)?

This investment is classified as enhancement expenditure because it improves the quality of service we are able to provide our customers, and the benefits to the environment.

The three drivers for this investment are:

Drought resilience – improving levels of service for our customers, to ensure resilience against a severe drought event

Climate change – there is a need to invest to address the impacts of climate change on our sources. This reflects the latest water resources planning guidelines from the Environment Agency. We are improving our customer's levels of resilience to the changing climate.

Sustainability reductions – There is a need to invest to protect our environment and we have a legal obligation under the Water Framework Directive to reduce the amount of water we take from the environment. The programme of investment benefits not just our customer's, but also the environment.

The investment also contributes to the delivery of our target of reducing the number of customers supplied by a single source of supply to 14%, which is further explained in our Resilience Enhancement case.

What does the expenditure enhance?

The expenditure enhances the level of service we are able to provide to our customer's, ensuring our entire region is resilient against a severe drought event.

The investment also ensure we are resilient to the current and future impacts that climate change has on the amount of water available to put into supply.

The investment increases the inter-connectedness of our water mains network. This enables a reduction in customer's on a single source of supply which increases the security and resilience of our customer's water supplies in the future. Finally, the proposal will also deliver environmental enhancements through reducing abstractions.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

Our proposed investment strategy for the WRMP has been informed by our extensive customer engagement programme. We have undertaken targeted engagement to understand customer's views around the resilience of their water supply and risk of severe restrictions. This revealed that enhancing resilience is important to our customers and supports our twin track approach between reducing demand and improving supply.

"The online community activities on drought resilience found that over 80% of the (70) customers who took part said "yes" to investment to ensure a consistent water supply to homes during a period of drought" (Anglian Water Customer Research & Engagement Synthesis Report, 2018, v.14, p170).

A key question covered in 'Be The Boss' Digital Engagement in April 2018 was whether to invest now or later to mitigate climate change risk. 64% wanted us to invest to protect against climate change now. As a result, our final WRMP includes bringing forward that climate change mitigation investment to meet our customer's expectations. Further description of our customer engagement work can be found in the 'How Customers Have Shaped Our Plan' and 'Resilient Water Supplies' chapters of our main submission.

Finally, we carried out a public consultation of our draft WRMP, between March and June 2018. We received feedback from key stakeholders including Ofwat, the EA, Natural England, Local Authorities, LEPs and industrial customers. We have used this feedback to inform the investment plan outlined here.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

We have followed a robust approach to the development of a final preferred investment plan, as set out in the EA Water Resources Planning guidelines and UKWIR methodologies. All possible options have been through a detailed screening and feasibility assessments and we have worked extensively with our neighbouring water companies to identify potential transfer options. In deciding on a final investment programme we have considered cost, carbon emissions and environmental benefits. Further details of all the options we considered can be found in our revised draft WRMP on our website, and includes options such as inter-company transfers and desalination plants.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Using the industry standard economics of balancing supply and demand approach and the EA best value approach set out in the EA guidelines, we have developed a long term best value plan. Multiple scenarios have been run to establish what the best plan is, the risks and the costs. This is fully documented in our published revised draft WRMP, which has been updated to reflect consultation feedback.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

"Anglian has a mature approach to future risk and has good experience of the types of risks and uncertainties." (*Anglian Water PR19 Technical Assurance Executive Summary for 13 August 2018 completed by Jacobs*).

We have undertaken a series of 'stress tests' to ensure that our plan is robust against future uncertainties, including the need to invest to provide resilience against extreme drought events, lower levels of achieved demand management and more severe climate change scenarios. We are confident that our strategy is flexible and can adapt to future risks.

In addition, we have already started on the delivery of the strategy to minimise the risks associated with the delivery of this significant programme of investment.

Has the impact on natural capital and the environment been considered?

Our strategy is based on making the best use of existing resources before developing new ones. In turn we will not have to increase the volume of water we abstract, meaning environmental impacts are mitigated and the natural capital value delivered by the current environmental status can be maintained. The concept of not wasting a precious resource is generally supported by our customers and "they prefer interventions that avoid perceived wastage" (*Anglian Water Customer Research & Engagement Synthesis Report, 2018, v.14, p174*). In developing our best value strategy, we have considered the environmental benefits of the proposed investments. We will continue to work on assessing natural capital as we deliver our strategy and work towards WRMP24.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

"We used our reviews and audits of a representative sample of Anglian's Investment portfolios (including the WRMP portfolio) to confirm the robustness of the identified needs and solutions and the selection of preferred options."

"We found that Anglian's business planning methodologies and its tools for identifying needs and solutions, estimating costs and benefits and optimising expenditure were robust from a technical perspective and based upon sound risk-based principles using reliable asset-specific data."

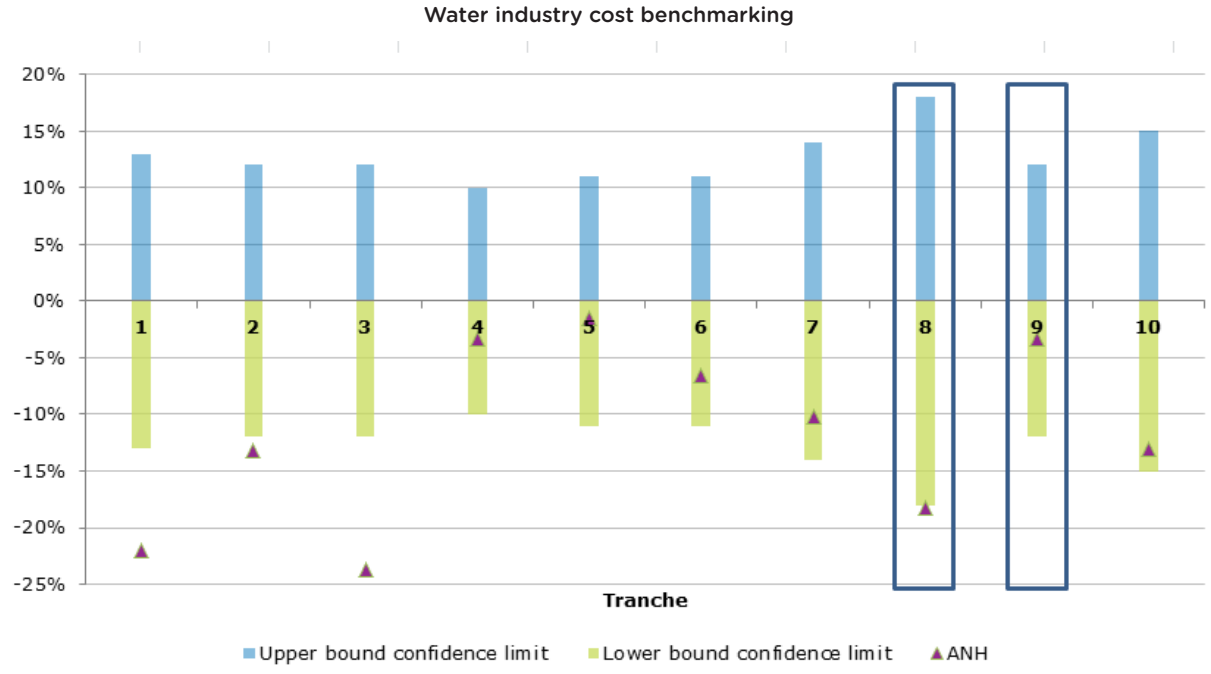
'Anglian Water PR19 Technical Assurance Executive Summary for 13 August 2018' completed by Jacobs.

Is there high quality third party assurance for the robustness of the cost estimates?

The costs used are based on current out turn costs supplemented by information from our cost library of completed projects. These costs contain embedded AMP6 efficiencies. Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models. Additionally, for the new WTW at Pyewipe WRC which will supply industrial customers on the South Humber Bank, we have taken steps to reduce cost by taking a modular approach to the build of this site. The movement from 'design and construct' towards 'logistics and assembly' means it is possible to increase productivity and efficiency whilst reducing carbon, time on site and therefore cost. Sizing the pipelines and civil structures for the full 20 Ml/d that will be required in the long term forecast, but only costing for the mechanical and electrical equipment required for the 6 Ml/d required in the early part of AMP8.

Our costs have been externally reviewed and benchmarked by Mott MacDonald against other water companies' costs for PR19, and have been shown to be efficient.

Programme	Tranche Ref	Enhancement business case reference	AW Cost (£m)	Industry Average (£m)	Delta between AW & Industry (%)	Confidence Range
WRMP infrastructure	8	WRMP Supply side strategy	249.9	305.7	-18%	+/-18%
WRMP non-infrastructure	9	WRMP Supply side strategy	87.8	90.8	-3%	+/-12%



Full details of their work are set out in the *Efficiency and Innovation* chapter of our Plan.

For clarity, whilst the purpose of the expenditure is resilience to climate change, drought and the ability to comply with sustainability reductions in water resources, we have treated this expenditure as Water Network Plus in line with the guidance received during the RCV allocation Q&A in January 2018.

Management Control

Is the cost driven by factors beyond management control?

The need for this investment is driven by the requirement under WINEP to reduce the volume of water abstracted at our groundwater sites. This requirement is outside of management control. It is also driven by the need to comply with current policy on drought and climate change. We have taken steps to minimise this impact by developing a best value plan which prioritises demand management (see leakage and smart metering enhancement cases), makes best use of existing resources and is flexible enough to adapt to uncertain future needs.

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

All possible options for our supply side strategy have been through detailed screening and feasibility assessments and we have worked extensively with our neighbouring water companies to identify potential transfer options. We have used the industry standard economics of balancing supply and demand approach in developing our best value plan, as well as considering other factors such as carbon emissions, environmental benefits and future flexibility of the plan. This ensures that we are not only delivering the best value plan for our customers over the next five years but also in the long term.

Further details of all the options we considered can be found in our revised draft WRMP on our website.

We have worked extremely hard over a number of years to make the case to Government for a partial ban on metaldehyde as this would reduce costs to customers and the environment. However, until such a ban is implemented, the additional costs of water treatment in our plan are driven up by the requirement to treat for metaldehyde in drinking water supplying customers in areas outside of our current Metaldehyde Undertaking. This requires treatment to avoid deterioration in water quality and infringing the Water Supply (Water Quality) regulations. To reduce the impact of this on bills we have taken measures to reduce spend where possible.

We have also tested the schemes against the Direct Procurement for Customers tests. We have concluded through a series of value and discreetness tests that the best value solution for customers is for us to deliver these investments.

Whilst we have taken all reasonable steps to control the costs, including applying further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan, it should be noted that we have selected the best value option, rather than the least cost plan. We believe that a more expensive plan that delivers real value and service improvements for our customers is preferable to a less expensive plan delivering no or negligible value that leaves our customers vulnerable to the uncertainties and challenges the future holds.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

As a business we set out to honour our commitments. Customers can rightly challenge and ask what protection there is if we don't. For this portfolio the protection consists of the following implications for non-delivery.

Failure to meet the future supply and demand commitment, driven by population growth, climate change and sustainability reductions. There are significant financial penalties associated with this.

Reputational damage with our customers which could be reflected in through C-Mex performance.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

The successful delivery of our WRMP strategy directly contributes to a number of our customer outcomes including, but not limited to, 'Supply Meets Demand, 'Resilient Business' and 'A Flourishing Environment'.

Affordability

Has the impact on affordability been considered? For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

In a WRMP specific activity in March 2018 with our online community, we set out a series of choices for customers that built on each other, from a base position that simply met legal requirements, through to a set of investments that would provide drought resilience, mitigation to climate change risk and some element of future-proofing on top of that risk mitigation. Customers overwhelmingly chose the full package with 71% voting for the most comprehensive investment option, knowing that there would be an associated bill impact of around £10.

Most of our customers (>80%) say that a bill rise of up to 2.5% is affordable and good value for the investments we will deliver. Nonetheless, we know from a range of sources that some customers (less than 20%) have difficulties paying their bill. In AMP7 we will therefore deliver a step change with regards to supporting customers who have difficulty affording their water bill, with capacity to assist 475,000 customers per annum with our affordability schemes. We will also make this help much easier to access.

This is covered in more detail in our 'Customer Bill, Affordability and Supporting Customers in Vulnerable Circumstances' Chapter.

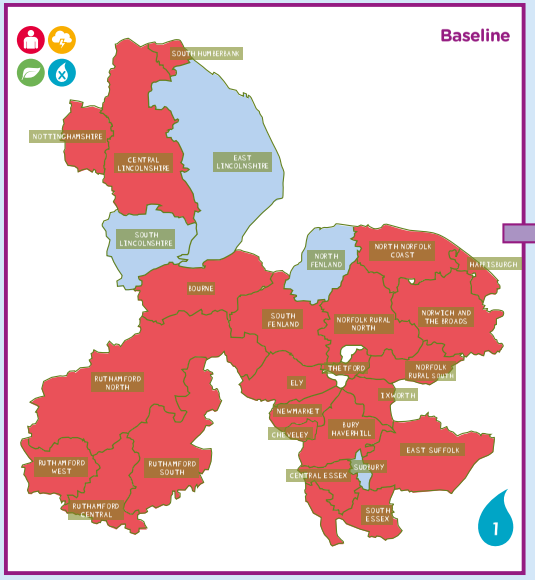
Key Assumptions

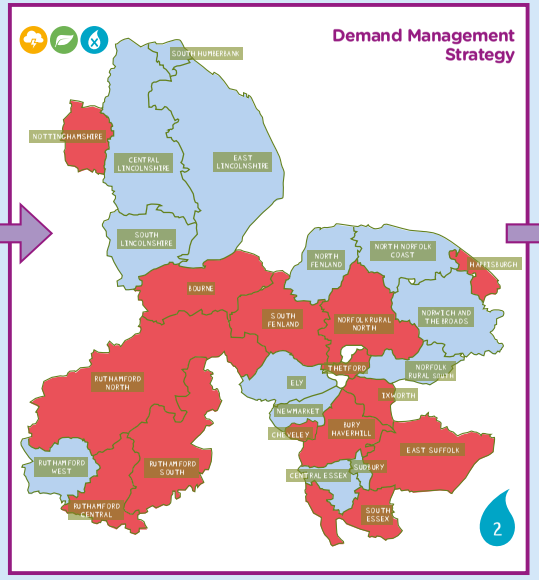
In developing this WRMP supply side investment strategy, we have implemented a process of stress testing to account for future uncertainty, and limit the risks associated with any assumptions.

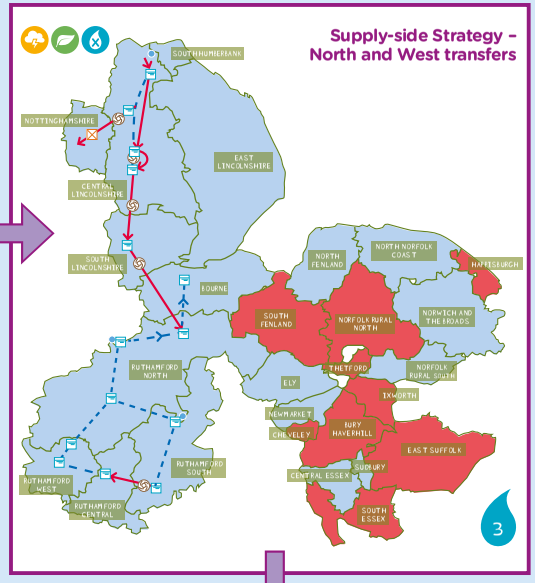
The programme of WRMP supply side investment assumes that the demand management strategy, specifically smart metering and leakage, will be successful in delivering the savings we have outlined. Nonetheless, we need to plan adaptively in case demand savings are less than we have accounted for in our plan. As such, we have also made a key assumption that in the future our region will require new water resources capacity to address increasing pressures. The need for new capacity is identified in our 25 year Strategic Direction Statement, WRMP and in the long term plan for our region in the Water Resources East strategy. We have therefore designed the transfer schemes between zones at an appropriate capacity to be able to distribute new future water sources more effectively.

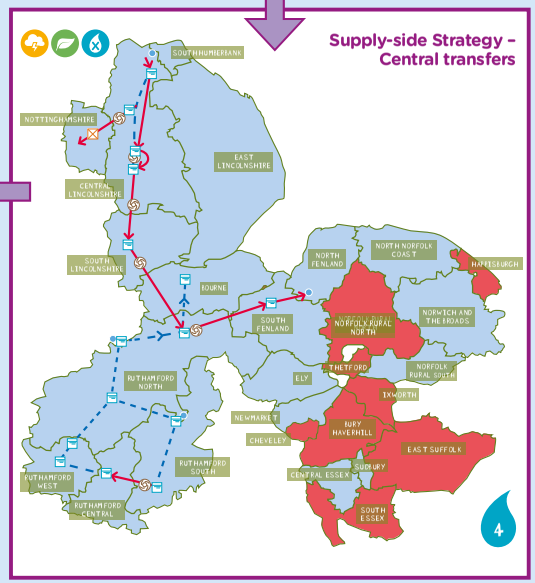
OUR WRMP STRATEGY

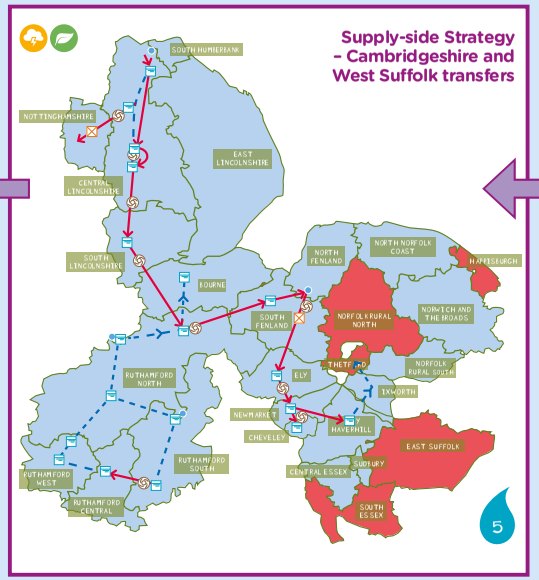
love every drop
anglianwater

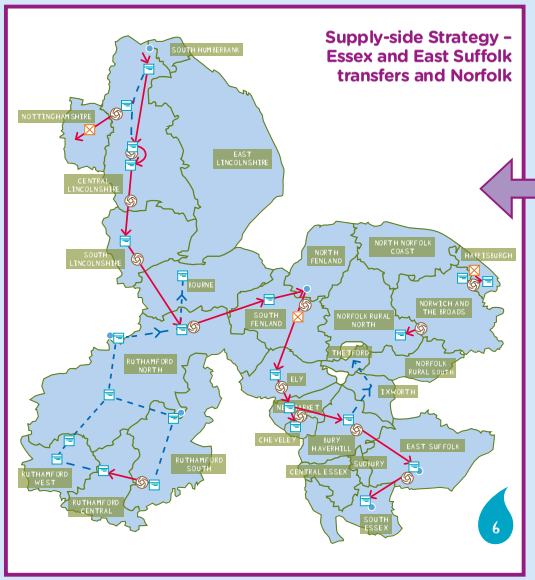












1. WRZs in surplus/deficit by 2044-45 (baseline).

2. WRZs in surplus/deficit by 2044-45, after Demand Management schemes implemented.

3. New treatment capacity to create new resource (Pyewipe) and maximise existing resource in our East Lincolnshire zone.
Transfer south, utilising new capacity, to address deficits in our Central Lincolnshire WRZ, driven by drought and sustainability reduction impacts.
Deficits driven by climate change and sustainability reductions in Ruthamford WRZs addressed by transfer into Ruthamford North. Using existing infrastructure, this water is distributed to Ruthamford South and Bourne WRZ.

4. Key strategic transfer between our Ruthamford North and Fenland WRZs. Scheme supports deficits in our South Fenland WRZ, which are driven by sustainability reductions and drought impacts.
Allows resources to be "bumped" across to North Fenland and transferred into the East of our region where we have further deficits.

5. Transfers utilising resource from the west of our region, and surplus from North Fenland WRZ address sustainability reduction and drought impacts in discrete groundwater systems, where there are no other resource options available.

6. A transfer linking the East Suffolk WRZ to the South Essex WRZ allows resources to be shared between these two WRZs, supported by transferred/'bumped' resource from the north and central areas.
The Norfolk area is mainly in surplus for the entire plan with the exception of Happisbugh WRZ and North Norfolk Rural, where deficits are driven by environmental needs. There is adequate surplus resource to allow a local transfer between neighbouring WRZs.

Surplus
Deficit
Population growth
Climate change
Environmental needs
Drought resilience

Smart Metering

Additional evidence in response to IAP (31 January 2019)

Summary

AMP7 Expenditure	Our Plan (September 2018) £m	IAP Assessment £m	Difference £m	Difference %
Capex (£m)	118.516	96.766	85.078	46.79
Opex	63.328			
Totex	181.844	96.766	85.078	46.79

Where Ofwat has assessed our Plan as either a 'pass' or 'N/A' assessment we conclude that it is fully satisfied with the information provided in our September plan.

We therefore focus attention solely upon those areas where Ofwat is not fully satisfied (i.e. where we have received a 'partial pass' or 'fail' assessment); we provide additional evidence below to address each point of feedback.

Ofwat has assessed our smart metering programme using a deep dive. This assessment has two components:

- Optant and selective programmes (where we're installing new meters); and
- Smart metering roll out (where we're replacing existing dumb meters).

In this updated enhancement business case we provide:

- Clarification on previous benchmarking and provide further evidence on why our costs for smart metering are efficient
- Further commentary on why our approach to smart metering maximises benefit to customers and achieving our demand management strategy in line with our WRMP
- Clarification of the interaction of this case with the maintenance costs of meter replacement such that it is not appropriate to reallocate funds from this enhancement case to botex as Ofwat has done in the IAP
- An outline of how customers will be protected through a customer protection mechanism as discussed in chapter 4.3 of our main IAP response.

Ofwat IAP assessment and summary of our response

Ofwat feedback **Robustness and efficiency of costs - partial pass**	Summary of our evidence in response
The company refers to its trials of smart metering in Newmarket and Norwich as a source of costs for its proposals and compares its costs with smart meter installation costs outside of the industry (USA) and has third party assurance from KPMG indicating that the costs appear robust in comparison with the available data.	The comparative cost per meter data that we have provided focusses on replacing existing (dumb) meters with smart meters and not full install to smart meter as Ofwat has interpreted in the IAP assessment. We have reviewed the third party benchmarking provided by KPMG and are confident the benchmarking is comparable with companies replacing existing (dumb) meters with smart meters. For example, the largest scale smart meter programme is:

Ofwat feedback Robustness and efficiency of costs - partial pass	Summary of our evidence in response
The costs per meter that Anglian Water provides are lower than the schemes it compares to and significantly lower than the costs of installing a new smart meter or the industry median new metering unit installation rate. However, the activity relating to this expenditure is focused upon replacing existing meters which would be expected to be cheaper than existing meter installation. We have apply our company specific efficiency challenge to the costs which is based on comparison with other companies' business plan submissions. Anglian Water company level efficiency challenge 15%	Austin Water, TX, USA - £240 per meter (250,000 meters) We have made the base information for this comparison available. We have provided further evidence of cost comparison from three international case studies. In each case, the smart meter rollout programme has been about the replacement of existing (dumb) meters with smart meters. These case studies reveal unit costs of: Yarra Valley Water, Victoria, Australia -£114 per meter/ £190 per meter including network costs (800,000 meters) Valencia, Spain - £120 per meter (550,000 meters) These compare to our smart meter unit costs of £127 per meter/ £164 per meter including network costs (1.1 million meters). To reach this unit cost level we have taken steps to ensure our costs are efficient as possible (for example, by proposing a programme of replacement (£59 per meter) rather than retrofitting radio modules and pulseheads onto existing meters (£83.50 per meter). From the benchmarking evidence available for the costs of replacing existing meters with smart meters, we believe that the costs in our plan are efficient, and should not be subject to a further 15% efficiency challenge.

Ofwat feedback Customer protection - fail	Summary of our evidence in response
Anglian Water reference the 'Anglian Water PR19 Technical Assurance Executive Summary for 13 August 2018' completed by Jacobs which finds that the estimating and planning process was robust from a technical perspective. For demand management the company refers to its PCC and leakage reduction performance commitments as providing protection for its customers in the form of underperformance penalties however it is noted that the penalties are lower than the significant enhancement expenditure proposed.	We reaffirm our commitment to our two-AMP strategy and will be unable to deliver our ambitious demand management programme set out in our WRMP, and our performance commitments for PCC and leakage if we do not install these meters as planned. We propose a simple symmetric true up mechanism, applicable at the end on AMP7 to protect customers from paying twice for smart metering whilst ensuring customers benefit from flexibility in delivery.

Ofwat feedback Customer protection - fail	Summary of our evidence in response
Marked as a fail overall because the company needs to demonstrate that it is committed to installing the proposed number of meters and that in the case of a shortfall in numbers expenditure will be returned to the customers.	

Ofwat feedback

The activity relating to this expenditure is focused upon replacing existing meters which would be expected to be cheaper than existing meter installation. We have apply our company specific efficiency challenge to the costs which is based on comparison with other companies' business plan submissions.

Initial benchmarking

In our September plan, we presented benchmarking data comparing our unit rate of replacing a dumb meter with a smart meter with other US utilities.

Ofwat recognised that our costs are lower than the schemes we compared to and significantly lower than the costs of installing a new smart meter or the industry median new metering unit installation rate.

Ofwat dismissed this evidence in favour of a company specific efficiency challenge on the basis that the activity benchmarked is focussed on replacing existing meters which would be expected to be cheaper than a new meter installation.

Ofwat's assumption that the benchmarking does not compare comparable activities is incorrect. Our initial submission made reference to this benchmarking comparing to "initial roll-out of smart meters". We believe this has incorrectly been interpreted as being for full meter installation rather than a replacement of an existing meter with a smart meter.

We can confirm the benchmarking sources used for this analysis are examples of the replacement of existing dumb meters with smart meters, with a single exception (Harris County, which is part conversion and part new installation). This is the same as our proposed enhancement programme. They are not the costs of installing a new smart meter from a "no meter" starting point.

We recognise that we did not make the sources of this information available at the time of our submission. With this IAP response, we have appended the KPMG slides as an appendix 5g.

For completeness, the information sources for each example from the United States are provided below.

1. Pleasanton - A $7 million programme to replace 22,000 water meters in the city-:
2. Roundrock: A $7.2 million programme to replace 31,600 meters
3. Cedar Park: A $5.19 million programme to replace 22,000 meters
4. Austin Water: An $80 million programme to replace 250,000 meters
5. Harris County: A $540,000 programme to retrofit 325 meters and install 1,025 new meters
6. Seabrook: A $1.7 million programme for to upgrade meters for 12,500 population
7. Berea: A $1.7 million programme to replace 4,000 water meters
8. Abilene: A $14 million programme to replace 40,000 meters
9. Kennedale: A $1.7 million programme to replace 3,000 meters

1-http://www.govtech.com/dc/articles/Pleasanton-Calif-to-Deploy-New-Smart-Water-Meters-in-Effort-to-Conserve.html

2 -https://ceregportal.com/wsi/documents/poster_sessions/2016/P-2.pdf

3-https://www.cedarparktexas.gov/Home/Components/News/News/888/32?npage=2

4-http://www.govtech.com/fs/What-Will-Smart-Meters-Cost-Austin-Water.html

5-http://www.twdb.texas.gov/financial/programs/SWIFT/doc/abridged-applications/2016/Harris_County_MUD_50.pdf

6-http://www.twdb.texas.gov/financial/programs/SWIFT/doc/abridged-applications/2016/Seabrook.pdf

7-https://www.cleveland.com/berea/2016/05/berea_to_install_new_high-tech.html

8-http://www.twdb.texas.gov/financial/programs/DWSRF/doc/SFY18/DraftAmended_SFY18_DWSRF_PPL.pdf (page 14)

9-https://www.fwweekly.com/2017/01/11/saving-water-a-drop-at-a-time/

This demonstrates our unit cost benchmarking to be a reasonable comparison, and that our cost per meter is low on a like-for-like comparison relative to these benchmarks.

As a further consideration, whilst we are clear that the benchmarking activity is consistent (i.e. dumb to smart replacement), it is not clear from the information sources whether the comparative costs include communication and network costs, or whether they only reflect the costs directly associated with individual meters.

To control for the impact of this uncertainty, we consider the following. Our unit cost for smart meter replacement is £127 per unit excluding network costs, or wider customer engagement costs associated with the rollout. Including our network costs adds £37 to the unit cost per smart meter installation giving a total unit cost of £164 per smart meter.

Irrespective of knowing whether comparators include this cost (i.e. worst case for AW is that they don't) we still compare favourably. Our £164 per unit This compares to £173 per smart meter for Roundrock (the next lowest cost) and £240 per smart meter at Austin, which is most comparable in terms of scale of smart meter programme (250,000 meters).

Further benchmarking

Since the submission of our September plan, we have continued to seek further comparisons that are similar in scale to our programme, and also based on a "dumb-to-smart" meter replacement programme to provide further benchmarking evidence. We have sourced data from Australia and Spain, as set out in further case studies below.

Case Study: Yarra Valley Water – Digital meter roll out

In collaboration with the Victorian government, Yarra Valley Water (YVW) is currently in the process of developing a proposal for the roll-out of 800,000 digital ("smart") meters over a 4-5 year period. This case study is highly relevant as their proposal is comparable to the smart meter programme that forms our AMP7 Plan.

We have worked with YVW to find out more about the scope and costs of their proposals. The scale of meter roll out and planned timetable is of a scale consistent with our AMP7 investment. Critically, the YVW case digital meter programme is based on the replacement of all existing dumb meter stock with digital meters.

YVW is currently conducting digital meter trials as a way to improve and inform their current assumptions on both the potential costs and benefits of the full rollout. Whilst at an early stage, YVW has confirmed that the benefits of smart meters in relation to customer use and customer side leakage detection are promising. The results accord with our evidence from our smart metering trials in Newmarket.

Overall unit costs for the rollout are £191 per meter when network costs are included, and £114 when network costs are not included. This gives us further confidence that our £164 unit cost with - and £127 unit cost without - network costs are within a reasonable range of efficient delivery costs.

The full details of the YVW development are not in the public domain, however colleagues at YVW have agreed that they would be happy to discuss their progress on digital metering roll-our directly with Ofwat.

Valencia

In Valencia, 550,000 smart meters have been rolled out up to December 2018. These smart meters replace the existing dumb meters. The nature of the smart meter rollout in Valencia is particularly driven by the high proportion of flats whose meters are stored together in 'batteries' in the flat basements. This allows dumb meters to be exchanged in batches more quickly and at lower cost by unscrewing the existing meter and replacing with the new smart meter.Combined with the fact that Valencia is far more urban than the Anglian region, these factors reduce the installation time per smart meter.

Overall unit costs for Valencia are £120 per meter, excluding network configuration (which uses Sim cards and is significantly different to our proposal). Given the operational differences highlighted above, this provides us with further assurance that our unit costs are efficient.

Conclusion

Noting that the USA comparisons provide a like-for-like comparison; that our costs are at the lower end of this comparative analysis; and that comparisons with Yarra Valley and Valencia which have a smart meter roll out similar in scale to our proposal give similar unit cost figures, we believe there is strong evidence that our costs are efficient and therefore consider Ofwat's company specific efficiency challenge inappropriate.

Ensuring efficient network costs

To determine our unit cost level, we have taken steps to ensure our costs are as efficient as possible.

In developing our strategy we determined that the optimal solution was to use a managed, rather than an in-house service. This is consistent with the lessons learned by the power industry when rolling out smart energy meters, as well as other water companies in the UK and around the world.

A managed network is better suited to gathering vast amounts of data from diffuse sources, coming from 1 hourly reads from over 1 million meters by the end of AMP7. Partnering with industry leaders also allows us to exploit the rapid rate of change in this area and keep driving down the costs whilst ensuring the integrity of the data.

At the time of building the business case, there were two AMI technologies that had seen any form of rollout — Flexnet and Diehl.

The Flexnet solution was selected for the following principal reasons.

- Based on 1,045,113 meter replacements planned in smart meter areas in AMP7, using Flexnet saves £2.9m compared with Diehl.
- The delivery risk is also lower as this as been tested on a large scale across the world already, meaning it is a lower risk. The Diehl solution has only been used in much smaller volumes.
- The Flexnet solution uses existing communication masts to collect the data, whereas the Diehl solution would require a new set of masts to be installed with a heavy dependency on negotiating with 3rd parties to find sites for the network receivers.

We considered two possible solutions to our smart meter rollout:

- Retrofitting a smart meter solution to an existing meter
- Replacing the current meter with a smart meter solution

We conducted analysis to understand which of these two options provided the best value for customers for any full roll out in AMP7. We considered the whole life cost of both recognising that retrofitting might avoid the cost of a new radio meter, but introduces the need to purchase, splice, and fit the pulsehead and radio assembly. The supply costs of these units create a significant cost differential in favour of the replacement option as shown in the table below.

Hardware Costs

Hardware needed	Retrofit cost	Replacement cost
Pulsehead	£17.00	N/A
Radio module	£45.00	N/A
Radio meter	N/A	£37.50
Smartpoint	£21.50	£21.50
Total	**£83.50**	**£59.00**

There are 1,045,113 meter replacements planned in identified smart meter areas in AMP7. Replacing dumb meters instead of retrofitting them saves £25.6m of costs from our plan. We have decided to adopt a replacement strategy as this is more cost effective for customers.

To maximise the benefits of our smart meter programme we are rolling out smart meters on a geographical basis. Our prioritisation is based on targeting district meter zones which deliver the most benefit to the supply demand balance.

This approach maximises a number of benefits including:

- Efficient per unit labour costs of replacing meters in close proximity, reducing the need to revisit the area at later dates
- Data consistency on leakage at a DMZ level
- Total coverage of the impact of Water efficiency and customer engagement strategies focussed to target whole areas
- Maximising the efficiency of data collection and the fixed network investment

In the smart meter rollout areas prioritised for AMP7, there are a mix of meters which would have been replaced in the AMP7 because they had reached the end of their life or were due to be replaced, and those that would not have been replaced in the absence of a smart metering roll-out. Where a meter was due to be replaced within the AMP in any case, we have only included the uplift cost of a smart meter over a dumb meter replacement. Only where we would not have replaced a meter in an AMP have we used the full unit costs in the enhancement case.

Our unit costs

The measures highlighted above have allowed us to ensure that our meter replacement cost is efficient as highlighted in the table below.

Meter installation costs

		Enhancement		Capital maintenance (£m)	Volume replaced	Volume installed new	Unit cost £/meter
		Capex (£m)	Opex (£m)				
AMP7 smart meter roll out							
1	New smart meters (optants and introduced by Anglian Water)	12.61	0.00	0.00	0.00	44,887	280.99
2	Dumb exchanged for smart (at end of life or when faulty)	22.41	0.00	33.73	442,733	0	126.80
3	Dumb exchanged for smart (before end of life)	71.78	0.00	0.00	602,380	0	119.16
4	Smart increment - new connections in roll out areas	4.15	0.00	0.00		51,244	80.99
				Sub-total	**1,045,113**	**96,131**	
AMP7 metering outside of smart meter roll out areas							
5	Dumb exchanged for dumb (at end of life or when faulty)	0.00	0.00	20.91	193,063	0	108.31
6	New dumb meters (optants and introduced by Anglian Water)	7.56	0.00	0.00	0	27,477	275.28
				Sub-total	193,063	27,477	
AMP7 other items required							
7	Fixed data network	0.00	42.35	0.00	All smart meters lines 1-4		37.1
8	Demand management programme	0.00	20.98	0.00			
	Grant total	**118.52**	**63.33**	**54.64**	**1,238,176**	**123,608**	

Our replacement unit costs (£127 per meter) in our enhancement case are calculated from line 2 in this table (dumb exchanged for smart at the end of their useful life. or when failed). This provides a representative unit cost for both proactive and reactive meter exchange, providing a more reasonable comparison with other benchmarks. We have not used the line 3 unit cost of £119 per meter as these are all proactive replacements which have a lower cost than reactive replacements. Combining the two, weighting based on volume would give a unit cost of £122 per meter. These unit costs refer only to the meter replacement costs and not the water efficiency, leakage investigation and fixed network costs which are also included in the overall enhancement case.

The table also highlights (in line 2) that, where a meter is due to be replaced in the AMP or where a meter fails and is replaced with a smart meter, the dumb-for-dumb replacement cost is allocated to capital maintenance, with only the smart meter uplift costs included as enhancement expenditure.

The volume of meters replaced under line 2 is lower than Ofwat's calculation based on historic renewal rates. This is because year-to-year changes in the number of meters installed manifest in future years in the number of meters that have reached the end of their lifespan and require replacement. The 'volume replaced' figure in line 2 is based on the number of meters that will be due for proactive replacement or are likely to require a fix in AMP7. This is based on our actual meter data. It is not appropriate to forecast this figure based on a historic average rate of replacement as this will not reflect the meter stock which are reaching end of their useful lives.

Ofwat feedback - customer protection

Penalties are lower than the significant enhancement expenditure proposed... the company needs to demonstrate that it is committed to installing the proposed number of meters and that in the case of a shortfall in numbers expenditure will be returned to the customers.

We reaffirm our commitment to our two-AMP strategy. This is an integral part of our Water Resources Management Plan and we will not be able to deliver our ambitious demand management programme set out in our WRMP. We will fail to meet our obligations under the Water Resources Management Plan framework, and we will be penalized under our PCC and Leakage ODIs. We recognise Ofwat's comments around the scale of PCC and Leakage ODI incentives when compared to the smart metering programme.

We propose a simple symmetric true up mechanism, applicable at the end on AMP7 to protect customers.

The basis of this mechanism is that for any meters not installed during AMP7, we will transition the associated enhancement expenditure into AMP8. This means that any investment requested at PR24 to complete our smart meter rollout would be net of any expenditure we had already received in AMP7 and carried into AMP8. Customers would be protected as we would not request this expenditure again as part of the PR24 process.

This ensures that customers do not pay twice for any smart meters and enables flexibility in the precise profile of roll-out.

ORIGINAL ENHANCEMENT BUSINESS CASE AS AT SEPTEMBER 2018

Smart Metering

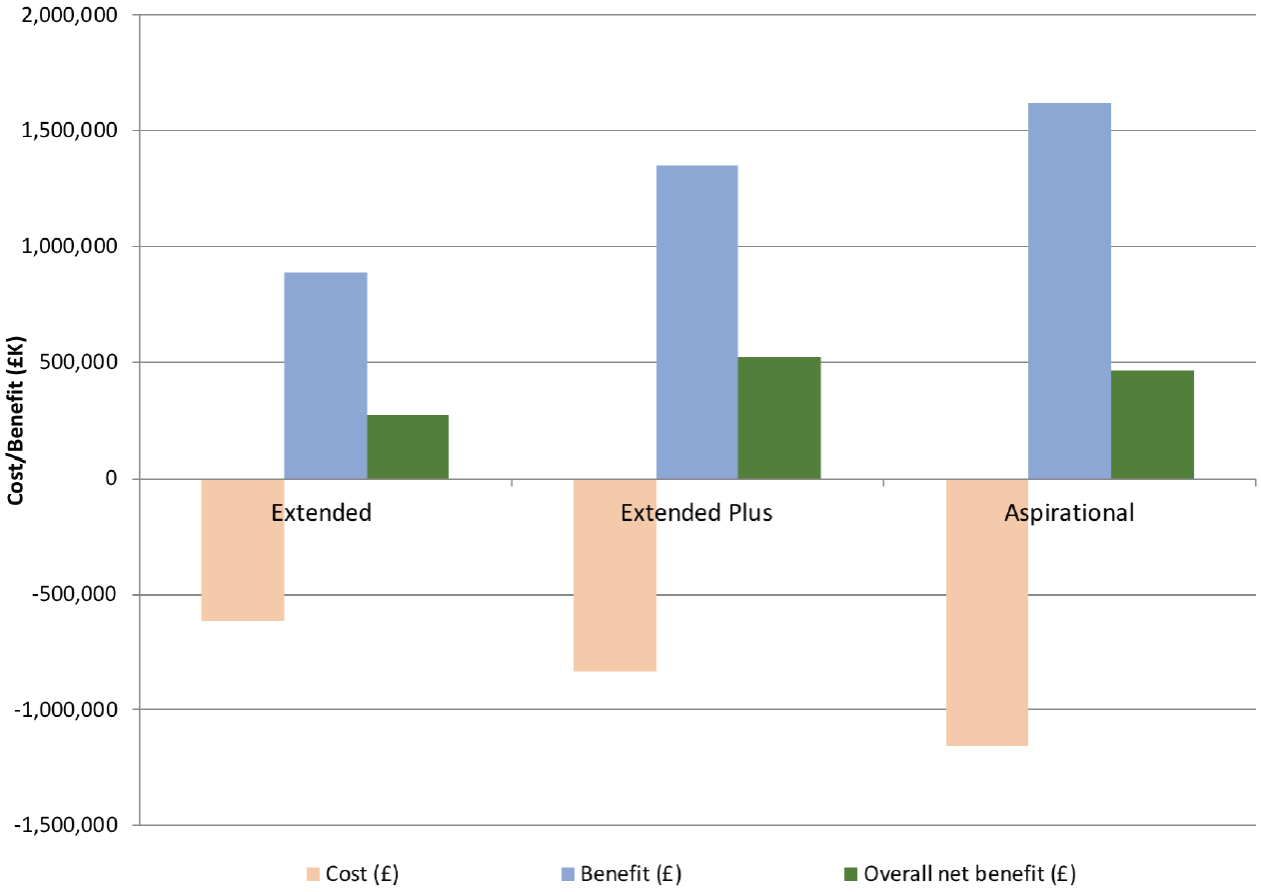
Price Control(s)	Water Network Plus
Business Plan table and line(s)	Table: WS2 Lines: A10 (58%), A21, A22, B49 (90.97%), B60, B61

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A10	17.879	14.065	22.786	22.921	20.690	98.340
	A21	2.455	2.212	2.155	1.947	1.852	10.621
	A22	1.718	0.463	4.277	2.570	0.527	9.555
							Capex: 118.516
Opex (£m)	B49	20.597	8.273	10.112	12.001	12.346	63.328
	B60	0.000	0.000	0.000	0.000	0.000	0.000
	B61	0.000	0.000	0.000	0.000	0.000	0.000
							Opex: 63.328
AMP7 carry over costs: £0.000m							

Our 'Extended Plus' demand management strategy(including smart metering, leakage and water efficiency programmes) has the strongest economic business case of the three strategic options we assessed, as illustrated below. The full details of the costs and benefits of our overall demand management strategy are presented in figure 4.7 in our revised Draft Water Resources Management Plan.

Figure 18 WRMP demand management options



Investment Summary

This investment is for a smart metering programme that will replace our entire 'dumb' meter stock with smart meters over the next 10 years (2 AMPs). By the end of AMP7 we expect to achieve:

- 95% meter penetration
- savings of nine Ml/d as a result of smart meter induced behavioural change, and
- a further nine Ml/d saving from more effective identification of customer supply pipe leakage (CSPL).

This programme of activity is an integral part of our leakage reduction programme and these business cases need to be read in that context.

Need for Investment

Is there persuasive evidence that an investment is required?

Smart metering is essential to help mitigate the potential 109 Ml/d increase in demand expected in our region over the next 25 years as a result of a forecast growth in population over the same period of one million people. Our demand management strategy has been designed to counteract this growth, although we expect further pressure on our water resources as a result of climate change, sustainability reductions and the need to increase resilience (see WRMP Supply Side Strategy case). Reducing leakage is a separate and important component of our demand management strategy in AMP7, the costs of which are covered in a separate enhancement case. To cope with these growing challenges, a step change in reducing demand is required. However,

we cannot expect to achieve this by continuing with what we have done in the past. This is why we are committing to the new and innovative solution of smart metering, complemented by applying behavioural and economic nudges.

By the end of AMP6 our meter penetration is forecast to be 91%, with 85% of households paying a measured bill. Over the last 10 years we have seen approximately 4% per year of all unmeasured customers opt to switch to measured charges per year. Whilst we predict the percentage of unmeasured customers opting to switch to measured charges to remain at around 4% per year, the volumes will decrease annually as our meter penetration increases. By the end of AMP7 we forecast that we will achieve 95% meter penetration with 92% of our customers on measured charges. We also expect the cost of the installation to increase as the remaining unmetered properties are those where a meter fit will be more challenging.

What incremental improvement would the proposal deliver?

Better quality customer water consumption data from smart meters will help us to better educate customers regarding their water usage. This will assist us in influencing their behavior to deliver expected behavioral change savings of 9 Ml/d by 2030, rising to 23 Ml/d by 2045. Household customers involved in several qualitative research and engagement activities suggested that being on a meter focuses their minds on water use and encourages saving (Anglian Water Customer Research & Engagement Synthesis Report, 2018, v.14, p120). We expect an additional saving of 9 Ml/d by 2025 as a result of being able to identify CSPL earlier. Reducing demand delivers multiple benefits. It reduces the need for treatment, pumping and construction of new water sources and treatment assets; this will contribute towards our track record of reducing carbon emissions and aligns with our goal to become a carbon neutral business by 2050.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

Although there are some mixed views on smart meters overall, *"Acceptability research revealed that overall acceptability of the Strategic Direction Statement is high among all customer groups"* and that *"there was a consistent theme in terms of the elements customers would like to see more strongly emphasised: customer education; technology/smart metering; flooding; the environment and pollution and affordability"* (p49).

Smart metering directly contributes to our 'Supply Meets Demand' and 'A Flourishing Environment' outcomes. In the acceptability research 'Supply Meets Demand' was voted as the second most important of Anglian Water's 10 outcomes, with 93% viewing this as important (p50), whilst in the Acceptability research on the Strategic Direction Statement, 'A Flourishing Environment' was ranked sixth of the 10 outcomes, with 83% of customers saying this was important (p205). Customers also rated the environment third of the company's six challenges, seen as important by 85% of customers (p205).

Source: Anglian Water Customer Research & Engagement Synthesis Report, 2018, v.14.

Need for Enhancement Expenditure

Why is it enhancement (and not base)?

This investment is classified as enhancement (rather than base) expenditure because it will greatly improve the quality of water consumption data we hold for our customers, and consequently the service we will be able to provide. It is a critical enabler to reducing consumption (PCC) and leakage.

What does the expenditure enhance?

Better quality customer consumption data will allow us to proactively inform our customers if they have a leak on their pipework and provide them with assistance to find it. This will reduce our customer's water bill in cases where historically a leak may have gone unnoticed until the next meter reading date. This also helps us to reduce demand and therefore enhance the size of the population we are able to serve with existing resources.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our Plan is driven by the requirements of our customers.

Prioritising demand side measures in line with our customers' expectations has led us to investigate the use of smart meters to help customers manage consumption. Customers, particularly the more technologically inclined segments, have told us they would like the option of using more technology to manage their usage and accounts. At our Water Festival in Norwich we asked customers if they wanted a smart meter and 72 per cent said yes, 16 per cent said no, while the remaining 12 per cent were not sure. Concerns were articulated over security and use of the data generated, so it is likely that support would increase with more assurance on those issues.

To further investigate how customers might benefit from smart metering, we have been running two large scale, long term trials in our region. We have installed over 6,000 smart meters in our Shop Window in Newmarket, and 10,000 meters in and around Norwich. Both groups of customers have access to a secure website where they can see their usage, and receive tailored tips on water saving based on answers to questions such as whether they have a garden or not, and what type of shower they use. These trials have shown us that customers with smart meters feel very positive about them, because they enable them to save money, not just through reducing wasteful use, but more importantly through being able to identify leaks on their own property. We have completed nearly 1,000 leak investigation visits to customers' homes based on the data collected, and in our longer running trial in Newmarket, we have seen an average reduction in use of 17 litres per property per day as a result.

An interaction with a segment of our online community living in Newmarket confirmed that customers value the peace of mind a smart meter can give them both in keeping track of daily usage, and also to identify a leak on their property quickly. They felt that smart meters should be accessible and useful to all customers, and that smart meters are no longer a futuristic gadget, but, along with other utility smart meters, are now necessary to help reduce misuse and taking water for granted.

We fully expect that smart meters will be the norm in future, and that they will open up options for supporting behaviour change and demand management. This is why we have an extensive smart metering investment as part of our plan, which will see near-universal roll out of smart meters over the next two AMPs.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

Given the synergies between leakage reduction, smart metering and behavioural changes to enhance water efficiency, it was essential to consider demand management programmes holistically. In order to consider the widest range of options we developed and reviewed an unconstrained list of ideas that drew on our current business practices and how we could improve them, practices in other UK water companies, other sectors (such as gas and electricity) and other countries on demand management and behaviour change, alongside opportunities provided by technology and latest academic research. These options were then reviewed to develop a shortlist of feasible options which were packaged into Aspirational (high), Extended Plus (medium) and Extended (low) strategic options for further analysis.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

There are wider customer benefits associated with this investment. We will proactively inform our customers if they have a leak on their pipework and assist them to find it. With the information provided by smart meters we can also provide advice on tariffs, how to reduce their bill and use

the data to offer new assisted living services for customers in vulnerable circumstances. Through our portal and app, we will provide a fully digitalised experience to help customers manage their usage and offer them products, rewards and incentives to save our precious resources. Please refer to our WRMP for full details relating to the whole life value of this investment.

For further information on the cost benefit analysis we have undertaken and our customer support for smart metering, please refer to the resilient water supplies chapter in our main submission, and our revised draft WRMP.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

"Anglian (Water) has a mature approach to future risk and has good experience of the types of risks and uncertainties." (Anglian Water PR19 Technical Assurance Executive Summary for 13 August 2018 completed by Jacobs).

Has the impact on natural capital and the environment been considered?

Demand management solutions are environmentally favorable in comparison to developing new sources of supply. This approach means more water is able to remain in the environment to support the habitats, ecosystems and wildlife that also rely upon our regions water resources. This is especially so given the water stressed status of our region, as classed by the Environment Agency and the fact that there is ample customer support for protecting the environment.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Actual cost data from AMP6 has been used to calculate AMP7 costs where appropriate. This means that our estimate of costs includes efficiencies already achieved, as described in the Efficiency & Innovation chapter of our Plan. We are confident that engagement with our supply chain has provided us with robust cost data. The data transmission network will form a considerable part of the cost of smart metering. The costs associated with this have been based upon our current partners for the Newmarket and Norwich Smart Meter trials as part of the network procurement process.

Our Intergrated Metering and Developer services (IMDS) Alliance (with Clancy and Kier) will implement the Smart Metering Programme. This approach has a number of advantages that allows for greater productivity and efficiency, especially in large programmes of work such as our smart meter programme.

- We can more easily source all the skills and people required and progress projects more quickly as a result of the mature and efficient working relationships that we have developed.
- Kier installed the meters and endpoints for both Newmarket and Norwich in our recent smart metering trials. Consequently we have a good idea of the rates of install that we should expect in the main rollout, and are clear on the activities that are critical to Quality Assurance.
- The programme is region-wide and would therefore involve both partners, driving productivity and efficiency, and stimulating best practice
- The Alliance aligns Partners' aims with those of AW by applying company specific and Alliance wide pain/gain incentives via performance measured gateways.

In addition, because this investment will reduce demand, long term cost savings can be expected as a result of ongoing reduced treatment and pumping costs. These will also help to reduce our carbon emissions, so aligns with our 'A Smaller Footprint' customer outcome. Further carbon reduction will be achieved as we work to drive metal out of the body of the body of meters. Both our current and proposed meter supplier both use entirely polymer bodied construction for the majority of meters supplied.

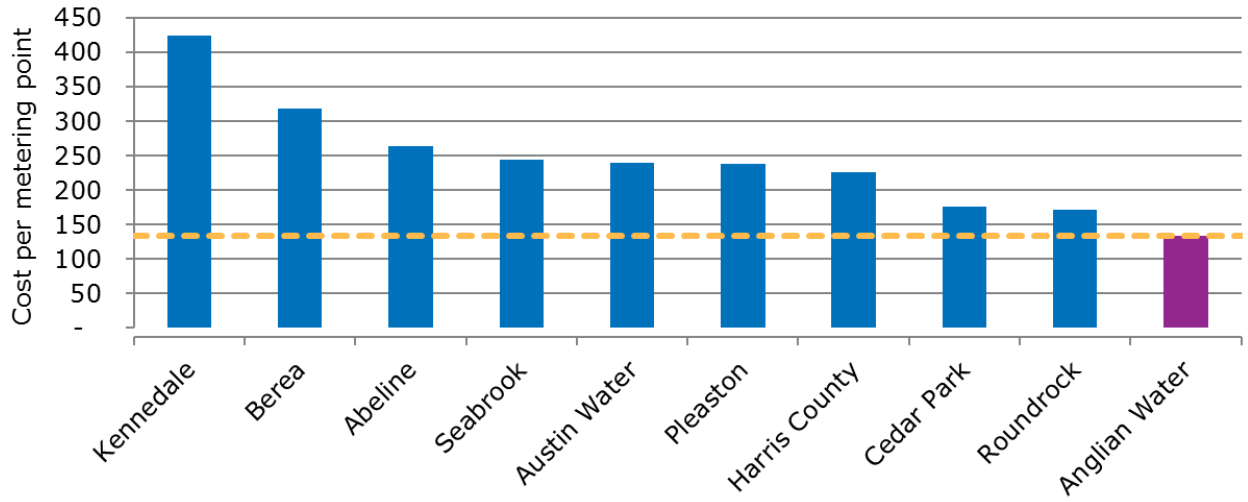
The savings in meter reading costs are reflected in the efficiency savings included in the retail price control.

Is there high quality third party assurance for the robustness of the cost estimates?

We are able to provide third party assurance for the robustness of these cost estimates from the KPMG smart metering investment case review. *"We have reviewed Anglian Water's approach to developing their Smart Metering Programme both through reviewing documents and interviewing key project team members. Based on this, we consider that the business case has been prepared following a robust process, utilising both analysis and customer engagement. We consider this to be a challenging programme both in terms of delivery and against the high level cost benchmarks we have been able to obtain."*

Due to details of cost for many smart water meter programmes not being publicly available, KPMG obtained costs for the initial roll-out of smart water meters within the US between 2014 and 2016. The analysis found that our costs are at the low end of the range, as illustrated below.

Figure 19 Benchmark costs 2014-2016 Smart meter roll out



Source: KPMG research

Management Control

Is the cost driven by factors beyond management control?

The population is forecast to increase by one million people over the Water Resources Management Plan (WRMP) period (25 years), with a potential increase in water demand of 109 Ml/d. It is this growth in population and associated water consumption that drives the need for our smart metering investment to help meet this demand. This driver is beyond our control.

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

Costs have been controlled as far as is reasonably practical by considering the widest possible range of options during optioneering and going through a robust analysis process, including cost benefit analysis, in order to identify the best value package of demand management solutions.

We have benchmarked our costs against published data as set out above. We have also applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

The alternative solution would require us to develop new supply side capacity to meet the demands of growth in our region. This programme supports our leakage programme and is integral to its success because of the visibility smart meters will provide of CSPL .

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

As a business we set out to honour our commitments. Customers can rightly challenge and ask what protection there is if we don't. For this investment the protection consists of the following implications for non-delivery.

- Reputational damage that could be reflected in our C-MeX performance.
- Meeting our future supply and demand challenge will become even more challenging.
- Underperformance penalties of up to £13.9m for not meeting our PCC (per capita consumption) performance commitment.
- Underperformance penalties up to £54m for not meeting our leakage performance commitment.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

In AMP7 we will continue to have a leakage performance commitment and a new performance commitment for PCC. This programme is an integral part of meeting that target and is therefore covered by the incentive mechanism.

Affordability

Has the impact on affordability been considered?

As we roll out our smart metering programme it will become easier for our customers to monitor their water usage, which in turn will help them budget more effectively. The launch of a new App for our customers will improve ease of contact. Registration to our online account management portal, "My Account", will enable customers to submit meter readings, link their usage to charges, drive water efficiency and create opportunities for them to generate more frequent bills, helping them with seasonal budgeting or 'paying as they go'.

Most of our customers (>80%) say that a bill rise of up to 2.5% is affordable and good value for the investments we will deliver. Nonetheless, we know from a range of sources that some customers (less than 20%) have difficulties paying their bill. In AMP7 we will therefore deliver a step change with regards to supporting customers who have difficulty affording their water bill, with capacity to assist 475,000 customers per annum with our affordability schemes. We will also make this help easier to access. This is covered in more detail in our '*Customer Bills, Affordability and Supporting Customers in Vulnerable Circumstances*' Chapter.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

We have tested this investment against the Direct Procurement for Customers tests. It has been concluded this does not meet the criteria. This test also allows us to demonstrate value for money to customers. Further details of this process are provided in the supporting material in our DPC annexes.

Key Assumptions

We have used the following assumptions for our demand forecast and cost benefit analysis modelling.

- Demand reduction of 15% in household consumption when customers switch from unmeasured to measured status (based on average unmeasured PPC values at Water Resource Zone level).
- 18% reduction in consumption when installing a smart meter to an unmetered property. This therefore assumes a 3% reduction in consumption when replacing a 'dumb' meter with a smart meter.
- A reduction in CSPL and plumbing losses due to the availability of hourly data and 'night flow' information.
- Increased smart meter data will help reduce distribution losses through a greater understanding of the overall network.

Resilience Programme

Additional evidence in response to IAP (31 January 2019)

Summary

We provide evidence to enable Ofwat to conclude that our proposed investments are required, are the best option for customers and that we have robust and efficient costs.

AMP7 expenditure	Anglian Water Plan (September 2018)	Ofwat assessment (January 2019
Capex (£m)	65.105	15.200
Opex	1.672	
Totex	66.777	15.200

Where through the IAP assessment, Ofwat has assessed our Plan as either a 'pass' or 'N/A' assessment we conclude that Ofwat is fully satisfied with the information provided in our September plan.

We therefore focus attention solely upon those areas where Ofwat has not fully satisfied (i.e. we have received a 'partial pass' or 'fail' assessment), we provide additional evidence below to address each point of feedback

Investment summary

To deliver a truly resilient service to our customers, we think about all aspects of our systems and adopt an all hazards approach. We have invested in resilience measures to protect our customers over previous AMPs with significant investments to providing resilience to our customers in Norwich (AMP4), Peterborough (AMP5) and in this AMP we will be completing schemes to provide resilience to our customers fed from Grafham WTW and completing two significant power resilience schemes as well as a number of further smaller network resilience schemes. As such resilience is not new to us and this AMP7 programme builds on the measures taken in previous amps. We regularly review our resilience risks. For our AMP7 investment programme our Resilience Technical Working Group (TWG) which was formulated to develop this portfolio.

Our methodology for reviewing our current programme and developing the resilience programme for AMP7 followed a structure approach involving business risk owners & subject matter experts (SMEs) from across our organisation with support and challenge from specialist consultants.

The development of this portfolio commenced in March 2017 with a cross business workshop looking at operational resilience at a system level. The outputs from this workshop were evaluated, grouped into work streams and further developed by the Technical Working Group (TWG). Each resilience area was assessed in using our Risk, Opportunity and Value (ROV) process with need, root cause and alternative options fully evaluated. The Resilience TWG challenged and ratified the need and customer benefit for each of the resilience risks assessed. We were then able to identify and make choices on the scale of risk reduction required.

Our investments not only support the four R's approach to Infrastructure resilience (Resistance, Redundancy, Reliability and Response and recovery) but also align to recent guidance provided by the DWI and our strategic and our business area risk register. We have adopted a Source to Tap approach, utilizing systems thinking to understand the interdependencies and complexities impacting on providing a resilient service to our customers. For our WTW Resilience programme we have used facilitated Hazop workshops to identify risks.

We have also looked at the way our systems interact with and depend on other critical infrastructure, such as energy, transport or communication networks, we have promoted investments in all three of these areas in our programme.

Areas of identified improvement and investments not considered to qualify as enhancement expenditure have been removed from this portfolio and incorporated in our AMP7 capital maintenance programme. The remaining investments which specifically enhance our resilience capabilities cover a broad range of identified investment areas which support our all hazards approach to operational resilience. The highest risk areas with most benefit to customers were taken forward to form the resilience submission in our Plan.

Our Resilience programme for AMP7 will improve the reliability and security of our supplies to our customers through a suite of integrated measures which complement investments in our base costs and build on investments made in previous AMPs. These investments include:

Investment Overview

Investment Area	Example investments
Single Source of Supply Risk Mitigation	Seven investments to connect isolated communities to a second source of water supply.
Emergency Response	Mobile treatment facilities to provide emergency responses. Upgrade Key & Locking Systems, CCTV, Alarm Systems, Enhance Ozone Area
Known Water quality challenges	An ultra violet plant (UV) at Covenham Water Treatment Works (WTW) to mitigate Cryptosporidium risk An investment in our Hartlepool region to dual an existing water main to reduce the risk of our customers receiving discoloured water. Enhanced monitoring at one of our reservoirs.
WTW Resilience	Telemetry communication resilience improvements at 63 sites. Installations to reduce fire risk in critical electrical panels at 35 sites. Upgrading unreliable incoming power supplies at 50 sites. 112 separate investments at 76 sites to improve the resilience of our Water Treatment Works by eliminating single points of failure (SPoFs). Securing critical communications
Supply System Resilience	Communication resilience Critical infrastructure crossing

Ofwat IAP Assessment and summary of our response

Ofwat feedback Need for Investment, partial pass	Summary of evidence provided in response
The investment line includes as proportion of the investment to support the WRMP supply side strategy (Line 14 = £292.945m capex, Line 53 = £5.006m opex). This includes 16 new strategic potable transfer mains (500km); (2) New WTW (6 Mld) to treat water from Pyewipe WRC for non-household customers; (3) New WTW to supply South Humber Bank customers, and should be considered alongside other parts of the supply and demand programme. The remainder has been assessed under resilience programme (£22.8m capex) consists of activities to mitigate a single source of supply risk to connect isolated communities to a second source of water supply, mobile treatment facilities to provide emergency responses and upgrading unreliable incoming power supplies at five sites which are accepted in this investment line. The other activities, such as maintenance activities to avoid process failure, telemetry upgrades and fire risk for critical panels are regarded as base expenditure. None of the investment in this area relates specifically to protecting assets from flooding risks as per the National Flooding Resilience Review.	We give details of the investments in this area. We have proportionally allocated the costs from our Water Resources Management Plan (WRMP) in line with RAG accounting guidelines We have allowed for capital expenditure of £39k for dealing with pluvial and fluvial flooding. See our Pluvial and Fluvial flooding business Case

Ofwat feedback - Best option for customers, partial pass	Summary of evidence provided in response
Evidence of detailed customer consultation is presented and indicates strong customer support for measures that increase resilience in water supplies. The company reports "Each scheme has been fully assessed as part of our Risk Opportunity and Value (ROV) process". It is assumed that all schemes put forward in the business plan passed the ROV process even though this is not explicitly stated. This process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution." However the company does not support this statement with examples relating	We provide details of our approach and examples to meet the IAP challenge

Ofwat feedback - Best option for customers, partial pass	Summary of evidence provided in response
to this enhancement line showing information on alternatives or individual cost/benefits/risk reduction for example.	

Ofwat Feedback Robustness and efficiency of costs, fail	Summary of evidence provided in response
Detailed cost breakdown is provided to test whether costs are efficient. The company states that "...our costs of doing so have been developed using our well populated cost model library that has been developed over several AMPs using data from previously delivered projects, price adjusted to the relevant year. The costs are based on current out turn costs and therefore include embedded efficiencies delivered in AMP6." As a detailed cost breakdown is not provided and there is insufficient detail on optioneering a 20% efficiency challenge and a further company specific efficiency is applied.	We provide details of the options considered, the recommended option and a detailed cost breakdown.

Ofwat Feedback: Need for Investment

"The investment line includes a proportion of the investment to support the WRMP supply side strategy..... The other activities, such as maintenance activities to avoid process failure, telemetry upgrades and fire risk for critical panels are regarded as base expenditure. None of the investment in this area relates specifically to protecting assets from flooding risks as per the National Flooding Resilience Review."

Our Response

As this area has been classified as a partial pass so our response focuses on the areas where the need for enhancement investment has been challenged.

In the IAP response OFWAT refer to some investments as 'maintenance activities'. The WTW Resilience programme does not cover maintenance investments, it includes investment to provide additional measures to address significant risks from low likelihood but high consequence events caused by single points of failure inherent in the design of our WTWs. This programme is closely aligned to regulatory expectations, such as:

- Ofwat's definition of resilience which is 'the ability to cope with, and recover from, disruption and anticipate trends and variability in order to maintain services for people and protect the natural environment now and in the future'.
- The Drinking Water Inspectorate's expectations that every company will proactively take measures to improve the resilience of their water treatment works in AMP 7 by improving their capabilities in 'containment and recovery' from potential events that might otherwise impact on consumers, with a view to maintaining levels of drinking water quality protection, confidence, acceptability and service.

It is evident from the Resilience Deep Dive in the Initial Assessment of Plans (IAP) that a number of other water companies have also put forward programmes for projects related to Single Points of Failure at water treatment works which have been supported as enhancement expenditure in the IAP.

All investments in the Resilience enhancement programme were assessed for there eligibility for inclusion prior to finalising the programme. A number of other investments relating to resilience have been included in our botex costs.

Failures of water treatment assets that affect customer supplies generally occur less often than network asset failures, but the impact is often greater. Therefore, during AMP6 we have been developing a wide ranging water treatment works resilience programme identifying and mitigating single points of failure in the process stream. This is part of our system-based approach to resilience. This innovative and industry-leading programme, which has been commended by the Drinking Water Inspectorate, reviews critical points of failure at water treatment works and assesses whether they can be recovered from a failure event before normal safe service to customers and the environment is impacted.

In reviewing our resilience framework we have used an all hazard approach. This identifies specific areas where we need to deliver improved resilience to our customers, these include Power, Communications and Fire. We have adopted a system based approach to our planning to complement our WTW Resilience programme described above. As a result, we have included in our plan a number of further investments to mitigate risks identified in the supply system connecting our treatment works to our customers. These are designed to provide resilience to low probability but high impact events which could severely disrupt service to our customers. These include providing standby power generation to key sites, duplication of critical control system communication links and additional fire prevention measures in critical control panels.

There are also some additional areas included in this business case that relate to both Resilience and Security. These include enhancements to site access control and alarm systems which provide a resilience benefit but also are required to meet SEMD requirements.

A further area of resilience is through improved quality monitoring at one of our reservoir sites to provide early indication of contamination risks and allow preventative measures to be implemented.

In our Plan data table we have proportionally allocated costs from the Water Resources Management Plan (WRMP) to provide resilience. This allocation aligns to RAG guidelines.

We have allowed for £39k for Flood Embankments to protect our assets from Pluvial and Fluvial Flooding. This is included in our enhancement case for Pluvial and Fluvial. During AMP6 we will have protected these critical assets and the additional expenditure in AMP7 is due to changes in published flood maps.

Ofwat Feedback: Best Option For Customers

"The company reports "Each scheme has been fully assessed as part of our Risk Opportunity and Value (ROV) process…. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution." However the company does not support this statement with examples relating to this enhancement line showing information on alternatives or individual cost/benefits/risk reduction for example."

Our Response

We have included below a table identifying the alternative options considered for the investments contained within this portfolio. This illustrates the equivalent annualized costs, benefits and value for each alternative. All schemes passed through the ROV process.

The outputs allow for any RPE effects above the stated inflationary factor of CPIH. The tables exclude efficiency factors we subsequently applied to these investments in our submitted Business Plan data tables.

Options for Single source of Supply Risk Management

Investment	Alternative	EAV (£m)	EAB (£m)	EAC (£m)	Recommended alternative
Single Source of Supply Risk Mitigation - Raithby WTW	SD Resilience Raithby - Manby to Kenwick Reinforcement	-0.025	0.071	0.096	Yes
	SD Resilience Raithby - Manby to Kenwick Uprate Pumps	-0.424	0.078	0.502	No
Single Source of Supply Risk Mitigation - Saltersford WTW	Saltersford WTW resilience - alinged to WRMP	-0.127	0.298	0.425	Yes
Single Source of Supply Risk Mitigation - Ardleigh WTW	PR19 SD Resilience Ardleigh WTW Aligned with WRMP	-0.051	0.074	0.125	Yes
Single Source of Supply Risk Mitigation - Clay Hill WTW	PR19 SD Resilience - Clay Hill - Aligned with WRMP	0.240	0.276	0.035	Yes
	PR19 SD Resilience - Clay Hill	0.205	0.304	0.099	No
Single Source of Supply Risk Mitigation - Gt Horkesley WTW	PR19 Resilience - Great Horkesley Bypass Aligned with WRMP	-0.002	0.190	0.191	Yes
	PR19 SD Resilience Ardleigh WTW and Great Horkesley WTW v3	-0.353	0.230	0.583	No
Single Source of Supply Risk Mitigation - Lower Links WTW	PR19 SD Resilience Lower Links Aligned with WRMP - Booster upsize	0.036	0.072	0.036	Yes
	S10070870 - PR19 SD Resilience Lower Links - v3	-0.012	0.080	0.092	No
Single Source of Supply Risk Mitigation - Raydon WTW	WRMP Link and Booster	-0.211	0.109	0.320	Yes
	S9793692 - PR19 SD Resilience Raydon RSP3_112_GtCornard and Nedging	-0.212	0.099	0.311	No

Options for Emergency response

Investment	Alternative	EAV (£m)	EAB (£m)	EAC (£m)	Recommended alternative
Mobile Treatment Facilities - Improve Resilience - Alternative Supplies Optimisation	1) Clean Static Tanks, Bag and Tag	7.646	7.679	0.033	No
	2) Replace Static Tanks with CCB's	5.291	5.309	0.017	Yes
	3) Increase Tankers and New CCBS	8.232	8.319	0.088	No
	4) Increase Tankers	8.167	8.239	0.072	No
Mobile Treatment Facilities - Improve Resilience - Meeting SEMD Thresholds	1) Invest in 36 - 20,000 Litre Tankers	7.458	7.963	0.504	No
	2) Invest in 36 - 20,000 Litre Tankers with 400 CCBs	7.443	7.963	0.520	No
	3) Invest in 14 - 20,000 Litre Tankers	7.738	7.963	0.225	No
	4) Invest in 7 - 20,000 Litre Tankers	6.485	6.574	0.090	Yes
	5) Invest in 7 - 20,000 Litre Tankers with 400 CCBs	7.849	7.963	0.114	No
Mobile Treatment Facilities - Maintain Quality - New Emergency Equipment (UV and Filtration Units)	7 New UV and 5 Filtration Units with Plug and Play to 12 sites	3.279	3.455	0.176	No
	4 New UV and 2 Filtration Units with Plug and Play	3.267	3.362	0.095	Yes
Mobile Treatment Facilities - Maintain Quality - New Emergency Equipment (Plug and Play)	4 New UV and 2 Filtration Units with Plug and Play		Not assessed	0.073	Yes
Emergency Preparedness - Securing Critical Comms	Minimum option	0.234	0.075	0.309	Yes
	Base option	0.558	0.189	0.746	No
	Stretch option	1.164	0.328	1.492	No

Investment	Alternative	EAV (£m)	EAB (£m)	EAC (£m)	Recommended alternative
Emergency Preparedness (Upgrade Key & Locking Systems, CCTV, Alarm Systems, Enhance Ozone Area)	Various (Upgrade Key & Locking Systems, CCTV, Alarm Systems, Enhance Ozone Area)	85.765	86.469	0.704	Yes

Options for Known Water Quality Challenges

Investment	Alternative	EAV (£m)	EAB (£m)	EAC (£m)	Recommended alternative
Covenham Crypto Risk	Permanent UV installation	14.447	14.589	0.143	Yes
	Cloves Bridge Raw Water Main Extension	-0.554	0.051	0.605	No
PR19 Resilience - Hartlepool Throston Main	New main	0.376	0.409	0.033	Yes
PR19 Enhanced River Flow Monitoring - Pitsford Reservoir	Continuous Flow Monitoring (3 locations)	0.820	0.919	0.099	Yes
	Spot Flow Monitoring (3 locations)	0.263	0.368	0.105	No

Options for Water Treatment Works Resilience

Investment	Alternative	EAV (£m)	EAB (£m)	EAC (£m)	Recommended alternative
Fire resilience	Provide fire trace in panels	18.565	18.603	0.038	Yes
PR19 Power Resilience - Power Failure Protection	Power Resilience Brown Out Protection - 10 sites/year Auto Reset	13.761	13.862	0.100	Yes
	Power Resilience Brown Out Protection - 2 sites/year Auto Reset	3.153	3.173	0.020	No
	Power Resilience Brown Out Protection - 4 sites/year Auto Reset	6.760	6.798	0.038	No
	Power Resilience Brown Out Protection - 20 sites/year Auto Reset	17.991	18.177	0.186	No

Investment	Alternative	EAV (£m)	EAB (£m)	EAC (£m)	Recommended alternative
PR19 WTW Resilience - Risk of WQ failure due to contamination of treated water in contact tank from assets above (16 nr contact tanks)	New contact tank	783.456	785.446	1.990	No
	Refurbishment of Contact Tank	792.908	792.978	0.070	Yes
PR19 WTW Resilience - Installation of Run to Waste Facility (60 nr)	Installation of manual run to waste facility	587.278	588.318	1.040	Yes
	Installation of automatic run to waste facility	598.938	603.605	4.667	No
PR19 WTW Resilience - Alton Post Large Balance Tank Run to Waste	Installation of manual run to waste facility	1.179	1.207	0.028	No
	Installation of automatic run to waste facility	1.802	1.912	0.110	Yes
PR19 WTW Resilience - Dosing Lines	Installation of standby dosing lines	10.084	10.199	0.116	Yes
PR19 WTW Resilience - Alton WTW Iron Monitors	Installation of combined outlet iron monitor	0.009	0.001	0.010	Yes
	Installation of individual iron monitors	-0.036	0.001	0.037	No
PR19 WTW Resilience - NTU Monitors	Installation of NTU Monitors	25.687	26.310	0.623	Yes
PR19 WTW Resilience - Various (Risk Dashboards, Installation of Panel and Monitors)	Risk Dashboards, Installation of Panel and Monitors	5.295	6.490	1.195	Yes

Option for Supply System Resilience

Investment	Alternative	EAV (£m)	EAB (£m)	EAC (£m)	Recommended alternative
Communications Resilience	Duplicate external comms with radio link	35.881	36.054	0.174	Yes

Investment	Alternative	EAV (£m)	EAB (£m)	EAC (£m)	Recommended alternative
Critical infrastructure crossing	Dual main	1.577	1.679	0.103	Yes

*EAV = Equivalent Annualised Benefit (EAB) – Equivalent Annualised Cost (EAC) (based on a 40 year planning horizon)

EAB and EAC align to the Treasury Green Book Methodology and the Ofwat recommended Spackman approach to annuitising and discounting. This ensures the maximum net benefit is derived for the service objectives set by our customers

Our Risk, Opportunity and Value (ROV) process has been utilized to determine the best value options for customers. In addition to the summary provided above we give more detailed examples of the development of our WTW Resilience programme and how the ROV process has been applied to individual investments.

Overview of optioneering

Risk Opportunity and Value provides the tools and processes to help us collaboratively make best value asset investment decisions for our customers. The process is supported by trained facilitators and involves workshops with business owners and SMEs to determine the root cause of the need, the range of alternative options to be considered and the best Totex solution to address the risk.

The ROV process is designed to identify the best value options to mitigate risks and their causes. This may not always be the cheapest, or the one with the most benefit, but the one that offers the best value for money.

The process does this by taking the total cost (whole life cost) of each option and dividing that by an annualised risk benefit. This produces a rough payback period or 'Risk Index' and allows us to compare options on value.

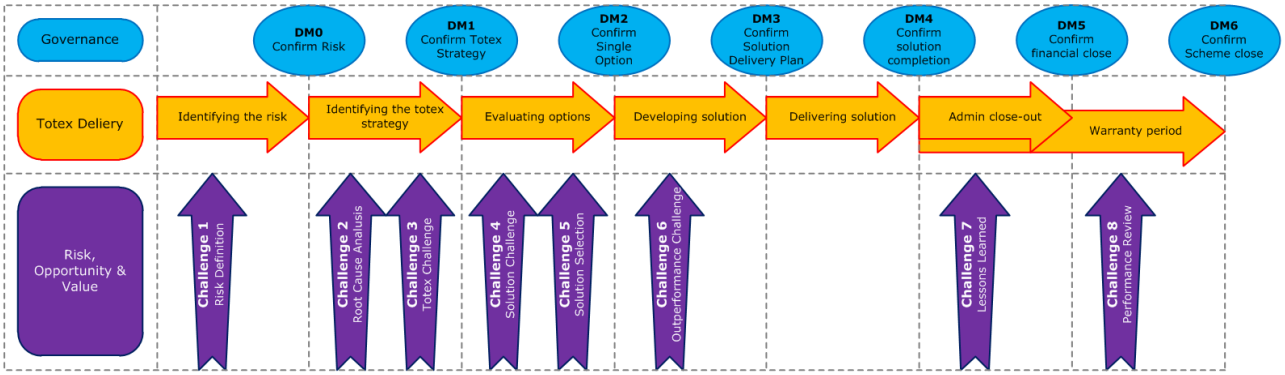
Whole life cost = Risk Index

(Baseline risk - residual risk)

The ROV process provides a collaborative, structured approach to understanding risks, their causes and helps us to identify best value mitigations and learning.

The diagram below provides an overview of how these processes fit together and where the ROV Challenge sessions feature.

Picture 3 Overview of ROV process



The ROV Process is supported by the Business Impact Matrices (BIMs). The BIMs are designed to monetise risk and link service failures to the resultant cost impact associated with that failure. These help us to translate service failures into an economic impact which allows us to understand risk economically, helping us to compare the effectiveness of different solution options using the ROV process.

These matrices feature:

- All the potential service failures that could affect our business at a customer, environmental or regulator level.
- The resultant cost impact associated with that failure
- Examples of additional activity (or Propex)

This provides a common and consistent framework to assess the value of each option. The selected alternative for each area of investment in this portfolio has been determined through ROV as having the highest equivalent annualised value.

The selected alternatives are described in each of the subsequent sections along with a table of other considerations which are in line with the areas Ofwat has indicated they would like to see on preferred options.

Case Study on option selection

We identify risks through facilitated Hazard and Operability Analysis (HAZOP) workshops to develop innovative risk dashboards which will give a single view of assets in an easy-to-use and navigable way. We were recently recognised for this work in the 2017 Chief Inspector's Report where DWI commented on our workshop at Barrow WTW highlighting that the findings have contributed to programmes of work to address risks associated to single points of failure over the coming years. Our water treatment works resilience programme will link closely with our development of the new Asset Health Performance Commitment of Unplanned Outages.

Mott MacDonald were commissioned by Anglian Water to deliver the water treatment resilience project for 32 high risk assets and develop a proof of concept criticality dashboard for Alton WTW. The aim of the project was to:

1. Model the capability and criticality of assets at each site
2. Identify investment opportunities for PR19 that are critical for site operation and to maintain water supply and quality during challenge periods e.g. poor raw water quality or extended high demand
3. Provide a proof of concept for a dynamic dash boarding capability for one view of the assets.

The criticality model assigns each asset at site a risk score based on likelihood and consequence of a failure. This allows assets to be categorised and ranked so that current risk can be compared with expected risk.

Risk = Probability of Asset Failure

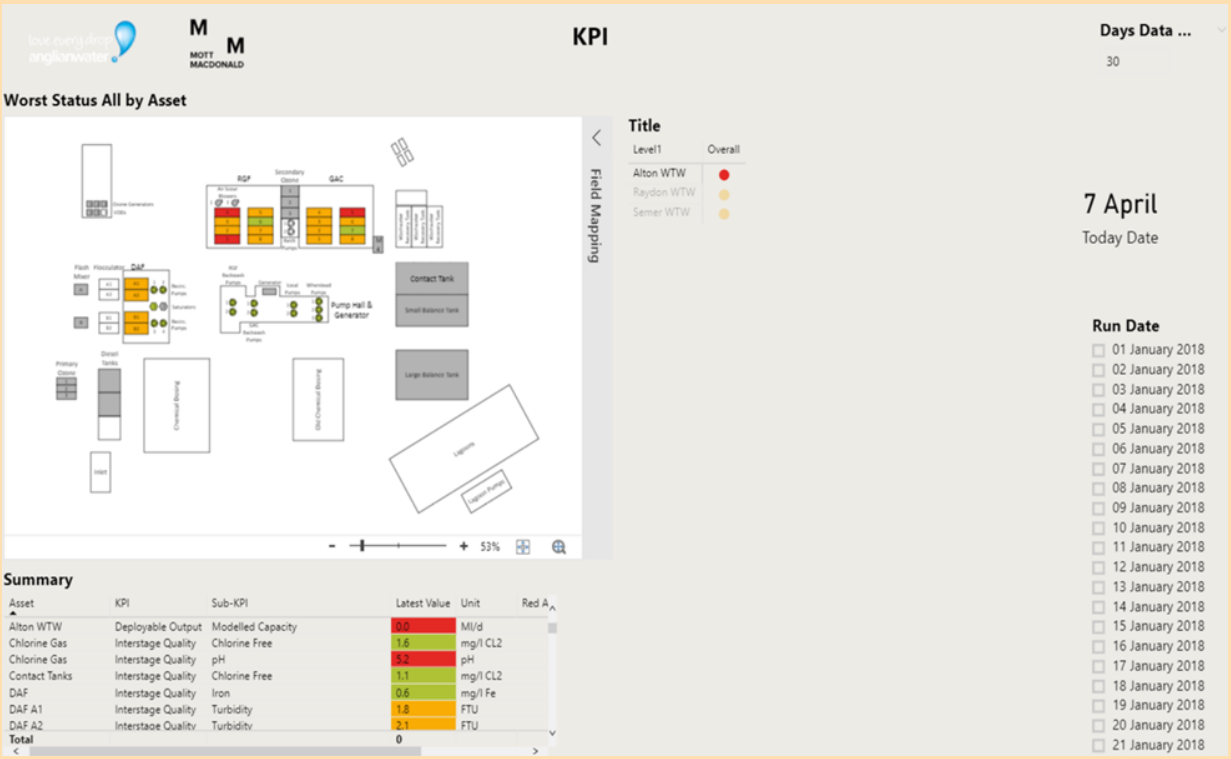
*Probability mitigation failure (e.g. duty/standby)

*Financial consequence of failure

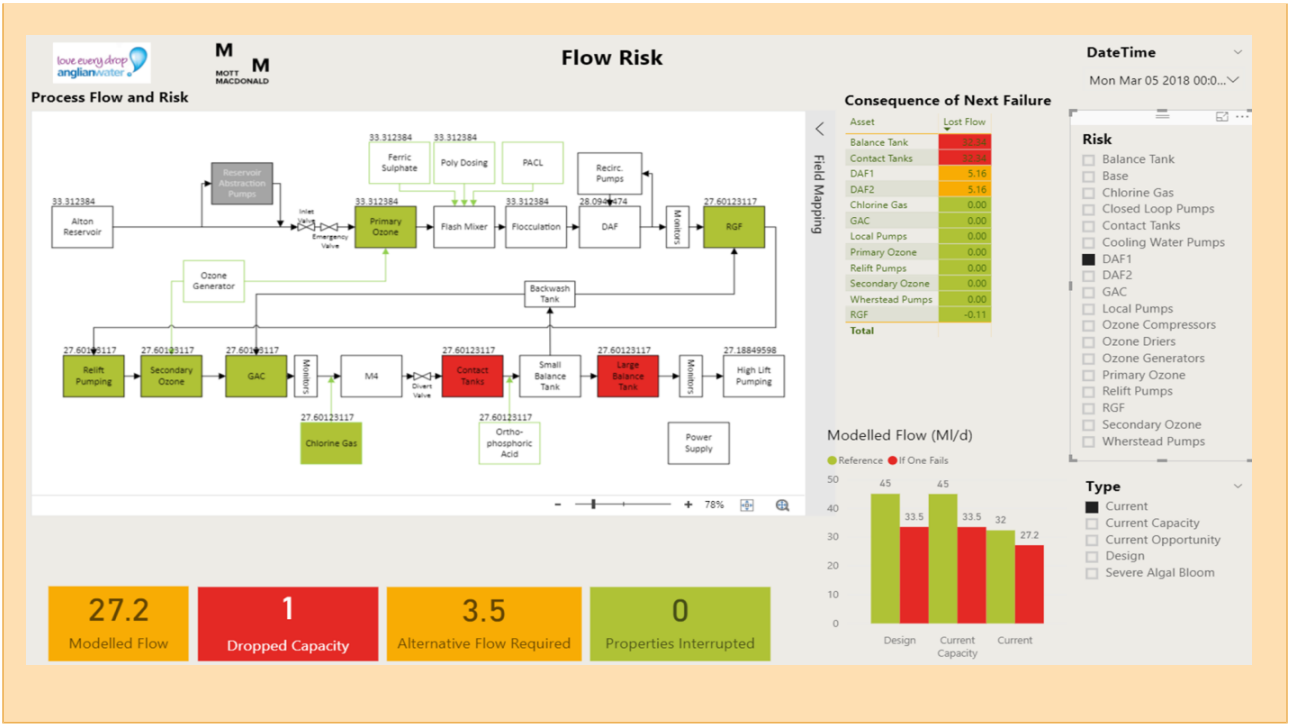
At every HAZOP workshop each process at site was validated to confirm:

- What the important assets are
- How many are required to work
- What the likely consequences could be
- Process diagrams
- Can the process be managed in eventualities of poor water quality

Alton WTW was chosen as the proof of concept site as this is a critical source which we are unable to have significant outage due to the potential impact it would have on continuity of supply.



Proof of concept criticality dashboards are currently in the design phase. Examples include the ability to highlight the status of each of our process assets with respect to water quality parameters:



Ofwat Feedback: Robustness and Efficiency of Costs

"As a detailed cost breakdown is not provided and there is insufficient detail on optioneering a 20% efficiency challenge and a further company specific efficiency is applied."

Selection of Recommended Alternatives

The selected alternative for each area of investment has been determined through ROV as having the highest equivalent annualised value. The selected alternatives are described in each section along with a table of other considerations which are in line with the areas Ofwat have indicated they would like to see on preferred options.

Single Source of Supply Risk Mitigation

A range of alternatives have been investigated for each investment to provide options to mitigate the risk to customers only fed from one supply point. This has included standby water treatment works and interconnecting strategic mains between supply systems. The preferred alternative selected for each of the investments involves linking customers to a second source of supply through interconnecting mains and water boosters where required. The selection of preferred alternatives in this investment area has been designed to exploit synergies with our WRMP supply side strategy of strategic inter-connector schemes. In all areas we have selected alternatives that link to our WRMP strategy where new infrastructure is passing close to the affected supply system presenting an opportunity to connect into the new system. In all cases this is more cost efficient than standalone alternative solutions.

Other considerations for single source of supply risk mitigation

Assessment Area	Summary
Uncertainty on delivery or changing needs	Our alliance partners have a proven track record of delivering this type of project. This programme is a continuation of similar AMP 5 & AMP 6 investments and options are well developed. There is an interdependency with the completion of our WRMP supply side system of interconnectors for which we have developed a customer protection mechanism
Customer preferences	Across multiple qualitative research and engagement activities, customers and stakeholders express general support for preventative action and long-term planning to build resilience. Tackling resilience was regarded as Anglian Water's core remit. Similarly, in the Acceptability research on the Strategic Direction Statement, there was least support for excluding resilience from the four long-term goals among the 8% of customers who felt one of the goals should be excluded. However, in the same research, of the 10 customer outcomes, resilience was rated lower (5th) in order of importance (seen as important by 86% of customers). Planning for the future, however, was ranked 2nd of six key challenges facing the company, seen as important by 86% of customers. (The highest ranking challenge was voted as important by 89%, and least important by 52%).
Environmental impact	The environmental impact of this programme is minimal and is limited to the impact of pipeline construction activities which will be managed to protect the environment from adverse impact through an Environmental Impact Assessment.
Use of innovation	By challenging the default use of traditional, high carbon assets, we reduce unnecessary material costs. When we do need to build new infrastructure, we make sure we minimise the materials used and ensure these are low carbon. For example, we have used innovative zero cement concrete to reduce carbon in the base slab of our assets by 60%. A big change we have made to reduce carbon and costs of our below ground infrastructure has been moving from open cut to no dig solutions. Since 2009, we have moved from using 95% open cut solutions, to using 75% no dig solutions in 2018. In AMP 6 we have been increasingly utilizing Molecular Orientated (Mo) PVC pipe material to further reduce carbon and cost
Impact on company resilience	In 2015 we had 46.9% of our customer on a single system, by the end of AMP 6 we intend to reduce this to 24.7%. By the end of AMP 7 we intend to reduce this further to 14.1%. This programme of work contributes to achieving this target. In AMP6 this has been linked to a Resilience ODI.

Emergency response: Mobile Treatment Facilities

The ability to provide temporary treatment at low complexity sites to mitigate the risks of raw water contamination is an essential part of our resilience strategy for smaller groundwater sites. All our high risk sites were risk assessed. The factors considered when selecting the preferred alternatives were aquifer contamination risk, current treatment complexity, ease of installation of equipment, historical risks and events, likely duration and current capabilities of emergency equipment. Permanent installations, enabling works only to allow rapid installation of treatment units and treatment units only with deployment plans but no enabling works. The preferred alternative selected included no permanent installations, a reduced number of treatment units (4 UV units and 2 filtration units) and enabling works only at high risk sites with complex installation requirements.

Within this portfolio are also investments to allow us to meet the reviewed SEMD requirements (3% of population) for provision of alternative supplies to our customers through tankering and provision of bowsers/bottled water. In assessing our requirements we have reviewed our current overall population served and population from each WTW, learning from previous incidents around deployment rates and mobilization rates for the different available options (e.g. bowsers, static tanks, collapsible combi boxes). The wide range of options was evaluated through ROV to determine the best value alternative. The selected alternatives in the two investments were to increase tankering capability by seven tankers (20,000 litre capacity) and invest in collapsible combi boxes to increase the speed of deployment and availability. The selected alternatives give the best EAV overall and meet the SEMD requirements.

Other considerations for Mobile Treatment Facilities

Assessment Area	Summary
Uncertainty on delivery or changing needs	These are known needs with a high delivery certainty. These are proven solutions based on a design develop over two AMPs through collaboration with key suppliers and our Alliance partners with experience of delivering these solutions.
Customer preferences	Across multiple qualitative research and engagement activities, customers and stakeholders express general support for preventative action and long-term planning to build resilience. Tackling resilience was regarded as Anglian Water's core remit. Similarly, in the Acceptability research on the Strategic Direction Statement, there was least support for excluding resilience from the four long-term goals among the 8% of customers who felt one of the goals should be excluded. However, in the same research, of the 10 customer outcomes, resilience was rated lower (5th) in order of importance (seen as important by 86% of customers). Planning for the future, however, was ranked 2nd of six key challenges facing the company, seen as important by 86% of customers. (The highest ranking challenge was voted as important by 89%, and least important by 52%)
Environmental Impact	There is no environmental impact from this programme of works. It off-sets carbon intensive capital solutions by providing modular units which can be rapidly deployed.
Use of innovation	Innovation is evident in the development of our standard products which are modular off-site build units and have been further refined over a number of AMP periods. The designs have been developed to allow rapid deployment with minimal permanent infrastructure required.
Impact on company resilience	This investment provides resilience protection to our high risk groundwater sites and to meet our SEMD commitment to provide alternative supplies during a resilience event.

Emergency Response: Emergency Preparedness

For continued compliance with SEMD requirements at CNI sites some specific enhancements have been recommended in a CPNI audit. These are specific requirements from the audit so have not been evaluated through ROV.

Further improvements required to site security (benefiting security and resilience) involve improvements to site security and intruder detection systems. CCTV, intruder detection and perimeter and building security remain the principal layer of security implemented to protect key operational assets across our estate.

The selected alternatives considered were selected from the range of systems and functionality available. The alternatives selected allow integration of detection and tracking systems across our CNI sites and site wide integration of security systems across all other sites. The selected option is the minimum option required to satisfy the audit requirements.

Other considerations for Emergency Preparedness

Assessment Area	Summary
Uncertainty on delivery or changing needs	These are known needs with a high delivery certainty. Some are SEMD requirement and compliance is measure through CPNI audits.
Customer Preference	Across multiple qualitative research and engagement activities, customers and stakeholders express general support for preventative action and long-term planning to build resilience. Tackling resilience was regarded as Anglian Water's core remit. Similarly, in the Acceptability research on the Strategic Direction Statement, there was least support for excluding resilience from the four long-term goals among the 8% of customers who felt one of the goals should be excluded.
Environmental Impact	There is no environmental impact from this programme of work. The selected technology has low carbon impact.
Use of innovation	The selected alternatives considered were selected from the range of systems and functionality available. The alternatives selected utilize best available technology to allow integration of intruder detection and tracking systems across our CNI sites.
Impact on company resilience	These investments provide resilience by reducing the risk of supply interruption due to 3rd party damage to critical systems and processes.

Known Water Quality Challenges:- Hartlepool Throston Main

Significant investment in new treatment at Dalton Piercy WTW has been carried out this AMP. This has mitigated a significant amount of water quality and resilience risk in this area but this main remains a single point of failure and is preventing further improvements and investments in the area as it restricts operational interventions. Although a variety of options were investigated which included imports from other Water companies none were feasible so when assessing this risk it was determined that this was a single option solution for duplication of this section of main.

Other considerations for PR19 Resilience - Hartlepool Throston Main

Assessment area	Summary
Uncertainty on delivery or changing needs	These is a known need with a high delivery certainty. Our alliance partners have a proven track record of delivering this type of project.
Customer Protection	Across multiple qualitative research and engagement activities, customers and stakeholders express general support for preventative action and long-term planning to build resilience. Tackling resilience was regarded as Anglian Water's core remit. Similarly, in the Acceptability research on the Strategic Direction Statement, there was least support for excluding resilience from the four long-term goals among the 8% of customers who felt one of the goals should be excluded.

Assessment area	Summary
Environmental Impact	The environmental impact of this programme is minimal and is limited to the impact of pipeline construction activities which will be managed to protect the environment from adverse impact through an Environmental Impact Assesment.
Use of innovation	A big change we have made to reduce carbon and costs of our below ground infrastructure has been moving from open cut to no dig solutions. Since 2009, we have moved from using 95% open cut solutions, to using 75% no dig solutions in 2018. In AMP 6 we have been increasingly utilizing Molecular Orientated (Mo) PVC pipe material to further reduce carbon and cost.
Impact on company resilience	This schemes provide resilience and quality benefits to our customers in the Hartlepool area by removing a single point of failure in the system and allowing quality risks to be removed. It complements our AMP 6 investment in new treatment at Dalton Piercy WTW.

Known Water Quality Challenges: PR19 Enhanced River Flow Monitoring - Pitsford Reservoir

The three investments at Pitsford reservoir improve resilience to drought by providing continuous flow measurement of the natural feeder flows into the reservoir. This allows better prediction and modeling of the risk of drought conditions for the reservoir and a better understanding of potential catchment and quality challenges.

Continuous or spot monitoring alternatives were considered but continuous monitoring provided the best overall value of the options selected.

Other considerations for PR19 Enhanced River Flow Monitoring - Pitsford Reservoir

Assessment Area	Summary
Uncertainty on delivery or changing needs	These are known needs with a high delivery certainty.
Customer preferences	Across multiple qualitative research and engagement activities, customers and stakeholders express general support for preventative action and long-term planning to build resilience. Tackling resilience was regarded as Anglian Water's core remit. Similarly, in the Acceptability research on the Strategic Direction Statement, there was least support for excluding resilience from the four long-term goals among the 8% of customers who felt one of the goals should be excluded.
Environmental impact	There is no environmental impact from this programme of work. The selected technology has low carbon impact. There are environmental benefits through better prediction and modeling of the risk of drought conditions for the reservoir impacting on ecology.
Use of innovation	The selected alternatives considered were selected from the range of systems and functionality available.
Impact on company resilience	The three investments at Pitsford reservoir improve resilience to drought by providing continuous flow measurement of the natural feeder flows into the reservoir.

Water Quality Challenges: Covenham Crypto Risk

Alternatives to mitigate the risk of high levels of raw water cryptosporidium which impact on the resilience of Covenham water treatment works. Alternatives considered included, treatment at potential contamination sources in the Louth canal (primary raw water source), direct connection of the secondary raw water source to Covenham Reservoir (currently pumps into the Louth canal), cryptosporidium treatment at Covenham WTW sized to the required AMP 7 works output. The selected alternative (cryptosporidium treatment at Covenham WTW with UV) provides the lowest capital cost and also highest certainty of risk reduction for customers.

Other considerations for Covenham Crypto Risk

Assessment Area	Summary
Uncertainty on delivery or changing needs	This is a proven solution based on a design developed and implemented over multiple AMPs through collaboration with key suppliers and our Alliance partners who are experienced of delivering these solutions.
Customer preferences	Across multiple qualitative research and engagement activities, customers and stakeholders express general support for preventative action and long-term planning to build resilience. Tackling resilience was regarded as Anglian Water's core remit. Similarly, in the Acceptability research on the Strategic Direction Statement, there was least support for excluding resilience from the four long-term goals among the 8% of customers who felt one of the goals should be excluded.
Environmental impact	There is no environmental impact from this programme of work. The selected technology has low carbon impact and no waste streams from the treatment process.
Use of innovation	Innovation is evident in the development of our standard products which are modular build units and have been refined over a number of AMP periods.
Impact on company resilience	This scheme provided resilience for customers fed by Covenham WTW and reduces the likelihood of supply restrictions.

WTW Resilience: Fire Resilience

This is a continuation of a multi AMP programme of work increasing the resilience of our sites by reducing the risk of fires at sites. This programme continues from an AMP 6 programme of installation of fire suppressant systems in critical control panels that limits the extent of damage and spread of fire in control rooms and Motor Control Centres (MCC).

A range of options and different technologies have been assessed through the current programme and the most efficient option (FireTrace) has been used to develop the AMP 7 programme and cost base. The 35 most critical installations have been selected as priority for investment.

Other considerations for single source of Fire Resilience

Assessment Area	Summary
Uncertainty on delivery or changing needs	These are known needs with a high delivery certainty. The investments are based on a proven design developed in AMP 6 with key suppliers and our Alliance partners.

Assessment Area	Summary
Customer preferences	Across multiple qualitative research and engagement activities, customers and stakeholders express general support for preventative action and long-term planning to build resilience. Tackling resilience was regarded as Anglian Water's core remit. Similarly, in the Acceptability research on the Strategic Direction Statement, there was least support for excluding resilience from the four long-term goals among the 8% of customers who felt one of the goals should be excluded.
Environmental impact	There is no environmental impact from this programme of work. The selected technology has low carbon impact.
Use of innovation	Through collaboration with key suppliers we have trialed a range of alternative technologies to develop a standard product best fitted to individual applications.
Impact on company resilience	These investments provide resilience by reducing the risk of supply interruption due to fires in critical control panels.

WTW resilience: Power Resilience - Power Failure Protection

This is a continuation of a multi AMP programme of work increasing the resilience of our sites by reducing the risk of power failures at sites causing water quality events, supply interruptions and infrastructure damage. This programme continues from an AMP 6 programme where sites have been prioritized in terms of criticality. The alternative scope selected has been based on the average scope of schemes completed in AMP 6. The selected option provides protection to the 10 most vulnerable sites.

Other considerations for single source of PR19 Power Resilience - Power Failure Protection

Assessment Area	Summary
Uncertainty on delivery or changing needs	These are known needs with a high delivery certainty. The investments are based on a proven design developed in AMP 6 with key suppliers and our Alliance partners.
Customer preferences	Across multiple qualitative research and engagement activities, customers and stakeholders express general support for preventative action and long-term planning to build resilience. Tackling resilience was regarded as Anglian Water's core remit. Similarly, in the Acceptability research on the Strategic Direction Statement, there was least support for excluding resilience from the four long-term goals among the 8% of customers who felt one of the goals should be excluded.
Environmental impact	Across is no environmental impact from this programme of work. The selected technology has low carbon impact.
Use of innovation	Through collaboration with key suppliers we have trialed a range of alternative technologies to develop a standard product best fitted to individual applications.
Impact on company resilience	This provides enhanced resilience to our customers reducing the risk of power failures at sites causing water quality events, supply interruptions and infrastructure damage.

Water Treatment Works Resilience

This investment looked at a number of common areas identified through our HAZOP workshops to identify potential risk of single point of failure and also individual issues identified at a site level.

Where we have raw or partially treated water over contact tanks, we have identified that this poses an inherent risk to drinking water quality and we have evidence of that increased risk. Our options considered the removal of risk of untreated or raw water over fully or partially treated water; this considered the lining of the contact tank and the construction of a new contact tank.

These options have been identified using business experts who have been involved in our Risk Opportunity and Value (ROV) workshops. The selected alternative is to line these contact tanks to mitigate that risk rather than replace the structure.

We have identified the requirement to install run to waste functionality to enable containment and expedient recovery of a number of our water treatment works, following potential process issues. Our options considered the installation of a manual run to waste and the installation of an automatic run to waste option. These options have been identified using business experts who have been involved in our Risk Opportunity and Value (ROV) workshops.

The selected alternative is the lowest cost alternative of a manually operated system.

Additional dual on line-turbidity monitor requirements to monitor process performance is included within this investment and supports the run to waste investment detailed previously. The selected option is to provide dual validation at critical points which present a single point of failure.

Other considerations for single source of Water Treatment Works Resilience

Assessment Area	Summary
Uncertainty on delivery or changing needs	Needs have been identified through structured HAZOP workshops. A proof of concept for an innovative risk dashboard has been developed for one site. This will give a single view of assets and clear visualization of risks in an easy-to-use and navigable way. These have been used to develop the AMP 7 investment programme.
Customer preferences	Across multiple qualitative research and engagement activities, customers and stakeholders express general support for preventative action and long-term planning to build resilience. Tackling resilience was regarded as Anglian Water's core remit. Similarly, in the Acceptability research on the Strategic Direction Statement, there was least support for excluding resilience from the four long-term goals among the 8% of customers who felt one of the goals should be excluded. Participants in several qualitative research and engagement activities identified that delivering high quality, safe, clean drinking water is a fundamental expectation of the company. For example, at the Customer Forum events held in 2015 "providing safe reliable and clean drinking water" was rated as the most important responsibility for Anglian Water by those who attended.
Environmental impact	All scheme solutions will be to protect the environment from adverse impact through a robust Environmental Impact Assessment. For our above ground (non-infra) assets, we will take a totex approach, prioritizing on reusing existing assets, using no-build solutions or building less and making use of standard products and building off site. We have also developed digital models that allow us to test possible options in a virtual environment rather than on site. All of these approaches ensure we reduce both costs and carbon in building new infrastructure.

Assessment Area	Summary
Use of innovation	We have developed an industry leading innovative risk dashboard which will give a single view of assets in an easy-to-use and navigable way. Alton WTW was chosen as the proof of concept site as this is a critical source which we are unable to have significant outage due to the potential impact it would have on continuity of supply. The Proof of concept criticality dashboards are currently in the design phase. Examples include the ability to highlight single points of failure in the treatment process and the status of each of our process assets with respect to key water quality parameters.
Impact on company resilience	These investments provide additional measures to address significant risks from low likelihood but high consequence events caused by single points of failure inherent in the design of our WTWs. Failures of water treatment assets that affect customer supplies generally occur less often than network asset failures, but the impact is often greater. Therefore, during AMP6 we have been developing a wide ranging water treatment works resilience programme identifying and mitigating single points of failure in the process stream. This is part of our system level approach to resilience. This innovative and industry-leading programme, which has been commended by the Drinking Water inspectorate, reviews critical points of failure at water treatment works and assesses whether they can be recovered from a failure event before normal safe service to customers and the environment is impacted.

Supply Side Resilience: Critical Infrastructure Crossings

Reducing the risk of prolonged supply outages from failure of mains crossing trunk roads, railways or watercourses where repair times can be extended and damage to other infrastructure or public disruption are significant risks is the focus of this portfolio. Through statistical analysis of our GIS data and further desktop review by engineers a prioritized risk based programme has been developed. This is a multi AMP strategy with thirteen schemes being prioritized. Alternatives were assessed for the schemes on an individual basis and where operational alternatives such as rezoning or provision of alternative supplies were viable options these schemes were reprioritized as lower risks. Like for like duplication of the mains only at the critical point of crossing were the selected alternatives

Other considerations for Critical Infrastructure Crossing

Assessment Area	Summary
Uncertainty on delivery or changing needs	These are known needs with a high delivery certainty. Our alliance partners have a proven track record of delivering this type of project.
Customer preferences	Across multiple qualitative research and engagement activities, customers and stakeholders express general support for preventative action and long-term planning to build resilience. Tackling resilience was regarded as Anglian Water's core remit. Similarly, in the Acceptability research on the Strategic Direction Statement, there was least support for excluding resilience from the four long-term goals among the 8% of customers who felt one of the goals should be excluded.

Assessment Area	Summary
Environmental Impact	The environmental impact of this programme is minimal and is limited to the impact of pipeline construction activities which will be managed to protect the environment from adverse impact through an Environmental Impact Assesment.
Use of innovation	Data science and statistical analysis has been used to develop the programme and understand the risks to be mitigated. A big change we have made to reduce carbon and costs of our below ground infrastructure has been moving from open cut to no dig solutions. Since 2009, we have moved from using 95% open cut solutions, to using 75% no dig solutions in 2018. In AMP 6 we have been increasingly utilizing Molecular Orientated (Mo) PVC pipe material to further reduce carbon and cost.
Impact on company resilience	These schemes provide resilience to our customers from prolonged outages through removing single points of failure with complex and lengthy repairs.

Supply System Resilience: Communications Resilience

This is a new area of identified risk which has arisen from our system level review of resilience. All our Water Treatment works are secured by back–up communication systems reducing the risk of critical control signals being disrupted by 3rd party users, atmospheric events, asset failure or failures of communication providers equipment. This programme extends this resilience to other key control points within the wider distribution system. The alternative has been selected as the most cost efficient technology based on ten trial sites investigated this AMP and involves the lowest number of sites from the criticality assessment carried out.

Other considerations for Communications Resilience

Assessment Area	Summary
Uncertainty on delivery or changing needs	These are known needs with a high delivery certainty. The investments are based on a proven design developed in AMP 6 with key suppliers and our Alliance partners.
Customer Protection	Across multiple qualitative research and engagement activities, customers and stakeholders express general support for preventative action and long-term planning to build resilience. Tackling resilience was regarded as Anglian Water's core remit. Similarly, in the Acceptability research on the Strategic Direction Statement, there was least support for excluding resilience from the four long-term goals among the 8% of customers who felt one of the goals should be excluded.
Environmental Impact	There is no environmental impact from this programme of work. The selected technology has low carbon impact.
Use of innovation	Through collaboration with key suppliers we have trialed a range of alternative technologies to develop standard products best fitted to individual applications. They are aligned with our Operational Technology (OT) strategy. We have developed our Information Services Alliance to deliver the technology and digital infrastructure requirements of the business, a first in the technology sector

Assessment Area	Summary
Impact on company resilience	These investments provide resilience by removing single points of failure in our control systems OT network.

ORIGINAL ENHANCEMENT BUSINESS CASE AS AT SEPTEMBER 2018

Resilience Programme

Price control	Water Network plus
Business Plan table and line(s)	Table: WS2 Lines: A14 and B53 (part)

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A14	10.469	11.981	10.515	14.419	17.720	**Capex: 65.105**
Opex (£m)	B53	0.162	0.226	0.306	0.451	0.526	**Opex: 1.672**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £1,206.979m		
Whole life value (EAV)*: £1,200.612m					Whole life cost (EAC)*: £6.368m		

* Note: Annualised values over 40 years

Investment Summary

To deliver a truly resilient service to our customers, we think about all aspects of our systems and adopt an all hazards approach. Our Resilience programme for AMP7 will improve the reliability and security of our supplies through a suite of measures including:

- single source of supply risk mitigation with seven investments to connect isolated communities to a second source of water supply; this reduces the risk of Interruptions to Supply
- mobile treatment facilities to provide emergency responses
- an ultra violet plant (UV) at Covenham Water Treatment Works (WTW) to mitigate Cryptosporidium risk
- reducing the risk of failure of infrastructure assets at critical crossings (over or under significant road, rail and water courses), with 13 investments to reduce the risk of interruptions to supply
- one investment in our Hartlepool region to dual an existing water main to reduce the risk of our customers receiving discoloured water
- telemetry communications at 91 sites
- reducing fire risk in critical electrical panels at 48 sites
- upgrading unreliable incoming power supplies at five sites, and
- 136 separate investments at 54 sites to minimise water treatment process failures.

Need for Investment

Is there persuasive evidence that an investment is required?

Our investments in this price control are focused on our customer priorities, maintaining current high levels of performance and improving in areas which customers view as a priority. For instance, improving the security and reliability of future supplies in the face of drought. Our resilience case aligns to Ofwat's expectation:

"Ofwat expects water companies to consider hazards that may disrupt services and determine how they will cope and recover from these; importantly resilience is not just about dealing with today's variability in hazards, but the anticipation and implementation of long-term changes in a range of diverse factors".

The need for investment is therefore driven by the desire of our customers and regulators to overcome existing areas of vulnerability in our system and ensure that we are resilient to more severe droughts as a result of climate change.

What incremental improvement would the proposal deliver?

With our strong focus on system level resilience and our long term ambition to have no properties supplied by a single system by 2035, we intend to continue to reduce the number of customers supplied by a single supply system in AMP7. In 2015 46.9% of our customers were on a single system; by the end of AMP6, we intend to reduce this to 24.7% and by the end of AMP7 we intend to reduce this further to 14.1%. In AMP7 we will therefore continue our multi-AMP strategy to reduce the population served by a single supply, with a long term ambition to reach zero by 2035. We have proposed a bespoke resilience performance commitment for this measure. For more information see our Performance Commitment chapter.

Our proposed investment in new strategic transfer mains inter-connecting water resources zones (as described in our WRMP supply side strategy enhancement case) presents the opportunity to provide resilience to a number of customers currently only connected to one source of supply in an efficient way requiring much smaller investment compared to developing standalone solutions.

Our 'Too Critical to Fail' programme will further improve the resilience of our WTWs thus reducing the likelihood of customer service failure. During the last price review our supply demand resilience strategy was to provide dual sources of supply for different groups of populations exposed to the risk of loss of supply due to a resilience event. The strategy has been implemented over successive AMPs based on prioritising the largest populations at risk.

AMP6 included investment in standby power generation at our two largest WTWs (Grafham and Wing). The investment for Wing WTW was rejected by Ofwat in their assessment of costs at PR14 and has subsequently been funded through re-prioritisation of AMP6 expenditure. This investment was supported in a report by Ofgem stating that there is a 1-in-12 probability of a 5-hour power interruption resulting from a shortfall in the supply-demand balance.

AMP6 saw a number of infrastructure failures at critical crossings (for instance major roads) which presented a significant risk of interruption to supply. An exercise was undertaken to identify all our infrastructure assets at critical crossings, which have been ranked with the largest risk assets included in the plan.

There has been increased focus from the DWI who are concerned about water companies' ability to contain an issue and recover a site before there is an impact on water quality or water sufficiency. We therefore defined 'Too Critical To Fail' as sites which cannot be recovered from a failure event before normal, safe service to customers and the environment is impacted. Work has been undertaken to develop the potential incentives and performance levels underpinning performance commitments.

In reviewing our resilience framework we have used an all hazard approach where we have identified specific areas where we need to deliver resilience to our customers, these include Power, Communications and Fire.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

We have undertaken extensive customer engagement to understand customer views around the resilience of their water supply, seeking to understand what resilience means to them, what aspects they think are most important and how they can best be involved in the solutions. We think big and long term, at a full supply system scale (from source to source), including corporate, operational and financial, and interactions with other systems in our region (such as energy).

Need for Enhancement Expenditure

Why is it enhancement (and not base)?

This expenditure is considered to be enhancement (rather than base) because it enhances customer service by reducing the risk of unplanned supply interruptions to customers from low likelihood, but high impact events through a range of foreseeable scenarios. The investment therefore increases the likelihood that we will be able to continue to provide 'business as usual' services under unique or extreme future conditions or events.

Building increased resilience to unforeseen events is our key long term strategy. In support of our investments outlined in our WRMP, system thinking and resilience in the round require us to think about all aspects of providing a resilient service to customers. Further continued investment is proposed to provide resilience against known risks (asset failure, power failure, flooding, drought) and also investment in control and mitigation measures in WTWs deemed 'too critical to fail'.

What does the expenditure enhance?

This proposal enhances resilience in a range of areas by reducing risk and increasing our capacity to cope with foreseeable high impact events. This includes reducing the risks associated with fires, unreliable power supplies, asset or water quality failures and increasing our capacity to cope with periods of extreme weather. 'Resilient Services' is one of our ten core outcomes and in our Strategic Direction Statement we have set ourselves a long term ambition to make the east of England resilient to drought and flooding.

Our strategy is aligned to Ofwat's definition of resilience: "the ability to cope with and recover from disruption and anticipate trends and variability in order to maintain services for people and protect the natural environment now and in the future".

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

Exploring customer views on the topic of resilience has been a major focus of our research and engagement activity, across willingness to pay, qualitative and quantitative methods. From our Customer Research & Engagement Synthesis Report (2018), engagement with customers suggests that "customers support investment to protect the water system and promote greater resilience. In principle, customers are willing to pay more themselves to help fund resilience measures, however this is contingent on Anglian Water "doing its bit" to address the issues too" (p170).

For many customers, imagining the future is a difficult and sometimes worrying task. The pressures of everyday life mean many customers are focused on getting through the next few weeks or months. The term "resilience" was not well understood and does not resonate with them; people preferred simpler terms such as "long-term planning". However, once they spent more time exploring the topic, customers became much more interested, engaged and "awakened" to resilience challenges.

"The online community activities on drought resilience found that over 80% of the (70) customers who took part said "yes" to investment to ensure a consistent water supply to homes during a period of drought. These customers did not feel that a known risk should be ignored, [and] did not believe that in "modern" Britain people should have to suffer extreme measures (such as cutting water to homes)" (p170).

This view has been reinforced in the response we received to the recent freeze-thaw event via our business as usual channels.

Moreover, our Customer Engagement Forum (CEF) has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our Plan is driven by the requirements of our customers. In particular reference to our work with customers on resilience, the CEF noted the strong weight of customer evidence that convinced them that customers are clearly in favour of making the necessary investments now to guarantee the resilience of services over the longer term

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

Each scheme has been fully assessed as part of our Risk Opportunity and Value (ROV) process. This process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

The investments included in these portfolios are specifically around prevention rather than response and recovery options which are covered in the SEMD area of the plan (see separate enhancement case).

Our plan continues to invest in key areas to maintain the condition of our assets to ensure reliable provision of services. We will do this efficiently, by adopting our leading and innovative Source to Source approach to optimisation at a system level. We will also exploit innovative 'Water Company of the Future, today' process technology and ways of working as they are developed in our Shop Window.

The single Supply Resilience Investments include alternatives which have synergies with the new strategic transfers in the Water Resources Management Plan. These therefore present a totex strategy. Our previous plans included large standalone and independent infrastructure alternatives.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Our Risk Opportunity and Value (ROV) process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution.

Has the impact on natural capital and the environment been considered?

We understand that a resilient environment is the foundation of our resilience and we look for solutions that build natural resilience where appropriate.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

We have put in place robust well-tested frameworks for assessing and managing threats. Our systematic approach considers the impact and our interdependency on other utilities, such as power and communication providers. Our Board and management are directly involved. Nested within those frameworks, we have a well established process for mitigating impacts and for responding to events that threaten our service. As a result, we are confident in the areas that we have identified and their need for investment.

We need to deliver a truly resilient service to our customers, despite future challenges such as more extreme weather as a result of climate change. Our costs of doing so have been developed using our well populated cost model library that has been developed over several AMPs using data from previously delivered projects, price adjusted to the relevant year. The costs are based on current out turn costs and therefore include embedded efficiencies delivered in AMP6. To ensure we deliver the best value for our customers, we intend to take the opportunity to fully exploit the synergies between some of the investments with our WRMP Supply Side Strategy investments during AMP7. Our Alliance setup will further increase the efficiency of delivery. The mature and well developed relationships both within and between the Alliance and ourselves means we are able to operate with optimum levels of trust and co-operation. The Alliance also aligns Partners' aims with our own by applying company specific and Alliance wide pain/gain incentives via performance measured gateways.

We have also innovated to maximise efficiency. For example, we have invested in the development of a tool (GeoPLM) that is able to do a virtual 'flyover' of proposed pipeline routes to identify features of interest. It is able to show the location of EA main rivers and floodplains, SSSIs, RAMSAR sites, listed buildings, ancient woodland, Common Land, National Parks, Special Conservation Areas, Village Greens, Registered Parks and Gardens, Scheduled Ancient Monuments, public rights of way and development sites. It also shows us where our existing assets are. This helps us to plot routes

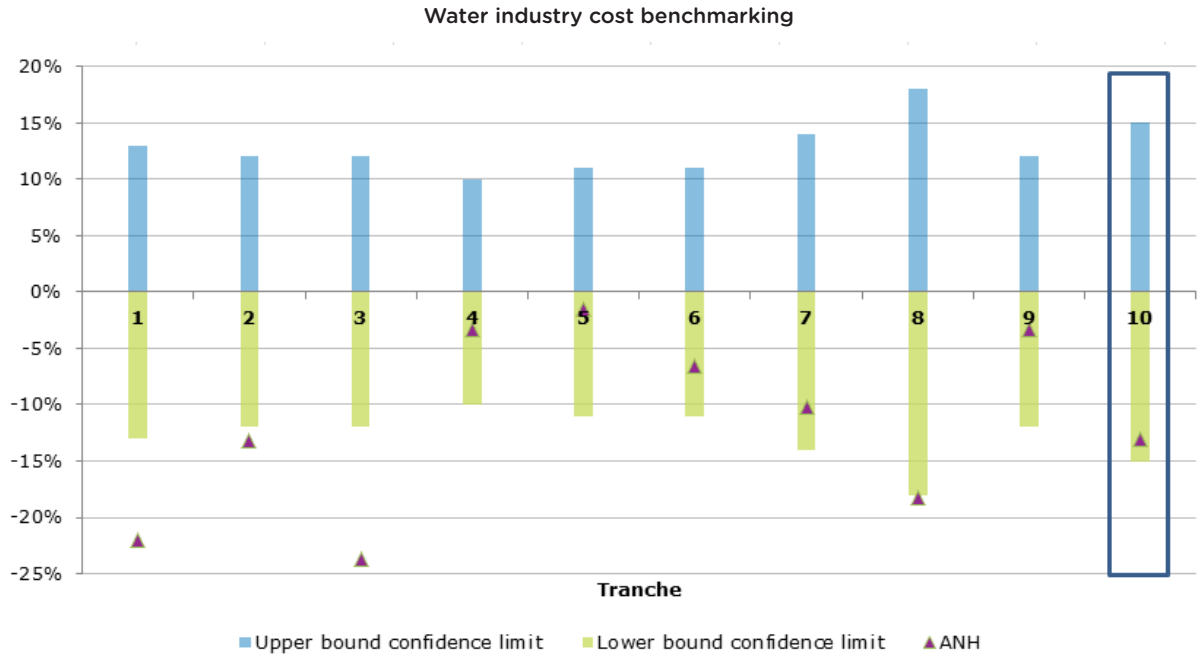
that avoid these features where possible and consider access to the pipeline (for construction) to ensure we develop 'constructable' routes, whilst avoiding significant disruption to our customers and the environment.

Is there high quality third party assurance for the robustness of the cost estimates?

The costs used are based on current out turn costs supplemented by information from our industry leading cost library of completed projects. This means the investment includes embedded efficiencies from AMP6. Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models.

Our costs have been externally reviewed and benchmarked by Mott MacDonald against other water companies' prices for PR19, and have been shown to be efficient. Full details of their work are provided in the *Efficiency and Innovation* chapter of our Plan.

Programme	Tranche ref	Enhancement business case reference	AW Cost (£m)	Industry Average (£m)	Delta between AW & Industry (%)	Confidence range
Sustainable resilient systems	10	Resilience	10.5	12.0	-13%	+/-15%



Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The majority of investment in this area is outside management control as it is driven by regulatory (Drinking Water Inspectorate (DWI)) expectations that all companies will improve their resilience at WTW to ensure there is adequate capability to 'contain and recover' from events in such a way that customer supplies are not compromised.

The remaining investments in this business case are integral, yet proportionate to achieving our outcomes and customer expectations.

All investment options are fully evaluated through our Risk, Opportunity and Value (ROV) process. This process allows us to develop and evaluate alternative solutions to address risk and then select the most cost effective Totex Plan. When we need to change our approach or invest to increase resilience, we use best value, adaptive approaches.

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

Our proposed Covenham UV Investment (Cloves Bridge (Great Eau) Drought and Water Quality Hybrid Scheme) is an example of where we have selected a preferred strategy from multiple options through the ROV process. The strategies considered ranged from the use of alternative sources via new infrastructure, additional treatment at the potential source, and additional treatment at the WTW.

In addition, we have applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

As a business we set out to honour our commitments. Customers can rightly challenge and ask what protection there is if we don't. Customer protection consists of the following implications for non-delivery:

Multiple performance commitments are all heavily impacted by resilience events that these investments have been identified to prevent. These include:

- We have proposed a bespoke resilience performance commitment specifically related to this area of investment with a continuation of our percentage of customer properties supplied by a single supply system. Maximum underperformance penalties for this performance commitment across AMP7 would be £13.9m.
- Our performance against the 'Water supply interruptions' performance commitment is also likely to be negatively affected if we do not invest to improve resilience. Maximum underperformance penalties for this performance commitment across AMP7 would be £12.5m.

Other performance commitments impacted by this expenditure are Compliance Risk Index, Event Risk Index, unplanned outages and overall customer satisfaction as reflected through C-MeX performance. It would also give the potential for infringement of the Water Supply (Water Quality) (Amended) Regulations 2018.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

The main customer benefit from this series of resilience focused investments is an increased security of supply. This directly related to our 'Investing for Tomorrow' and 'Resilient Services' outcomes.

Affordability

Has the impact on affordability been considered?

The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

Our extensive customer engagement confirms that over 80% of customers support an increase in bills of at least 2.5% to deliver investments in resilience and environmental protection as set out in the Customer Engagement sections of our Plan, and in the Synthesis Report. For those customers that may struggle to pay, we are delivering a step change in support, as set out in the *Affordability and Vulnerability* chapter of our Plan.

Key Assumptions

Any assumptions will have been detailed in the Risk Opportunity and Value Reports. Where data to support the potential risks is not available business experts through the ROV process will make assumptions on the potential impacts and their likelihood.

Nitrates (Deteriorating Raw Water Quality)

Additional evidence in response to Ofwat's Interim Assessment of Plan (31 January 2019)

Summary

This document provides additional evidence to demonstrate that we have robust and efficient costs.

	Our Plan £m	IAP Assessment £m	Difference £m	Difference %
Capex	22.778	15.489	7.289	32
Opex	2.742	0	2.742	100
Totex	25.520	15.489	10.031	39

Where through the IAP assessment, Ofwat have assessed our Plan as either a 'pass' or 'N/A' assessment we conclude that Ofwat is fully satisfied with the information provided in our September plan.

We therefore focus attention solely upon those areas where Ofwat were not fully satisfied (i.e. we have received a 'partial pass' or 'fail' assessment), we provide additional evidence below to address each point of feedback.

This investment is to provide:

- installation of ion exchange plants at two blending reservoirs (Irby and Little Saxham)
- installation of ion exchange at Gayton Water Treatment Works (WTW), and
- additional ion exchange capacity at Wighton WTW.

This investment is to ensure continued compliance with the drinking water nitrate standard of 50 mg/l in the final water at each of the four sites. Due to the considerable lag time to realise any benefits from catchment management activities on nitrate levels in the raw water, in the short to medium term, catchment management must be supplemented with ion exchange treatment.

IAP Ofwat Assessment and summary of our response

Ofwat feedback - Robustness and efficiency of costs - Fail	Summary of evidence provided in response
We find no scheme level costs in the BP documents for the projects to address raw water deterioration. If we take the scheme level costs from the DWI letters of support which are Wighton £3.8m, Little Saxham Reservoir £8.9m, Irby Reservoir £27m and Gayton £4.15m. Their total value is £43.85m. We find insufficient evidence of the scope and scale of the works to be undertaken at each site or of scheme.	Explanation of variation between scheme level costs provided and levels of costs from DWI letters of support Further detail of scheme level costs for each site Further detail of scheme level costs for each site for WINEP DrWPA groundwater catchment management programme

Ofwat feedback - Robustness and efficiency of costs - Fail	Summary of evidence provided in response
The basis on which the proportion of each scheme is allocated to RWD lacks clarity. ANH should provide a justification to support its cost allocation.	Explanation of the approach of cost allocation
We apply 20% challenge to the submitted costs because of a lack of evidence of optioneering and provision of scheme level data	Explanation of options considered for all schemes. A scheme-level breakdown of costs for each option.
We also apply a further company specific cost efficiency challenge*	See our response in Chapter 5 of our IAP Response
ANH has employed Mott MacDonald to assess its cost efficiency. Mott Macdonald identifies ANH to be on average 12% below the industry average, however, this figure is subject to a +/- 15% confidence. [10d P2/P3].	Clarification of Mott MacDonald approach and data used.

Ofwat Feedback:

"We find no scheme level costs in the BP documents for the projects to address raw water deterioration. If we take the scheme level costs from the DWI letters of support which are Wighton £3.8m, Little Saxham Reservoir £8.9m, Irby Reservoir £27m and Gayton £4.15m. Their total value is £43.85m. We find insufficient evidence of the scope and scale of the works to be undertaken at each site or of scheme."

Our Response

The costs referenced in our feedback are whole life costs used in our DWI submission and are not capital costs. The exception to this is the costs included for Gayton within the DWI letter of support. This explains the difference in cost between the DWI letters of support and the scheme level costs provided below.

The table below show the details for the projects selected for inclusion within our Plan. The section below details the options we considered. The outputs allow for any Real Price Effects (RPE) above the stated inflationary factor of CPIH. The tables exclude any efficiency factors we have subsequently applied to these investments in our Business Plan Data Tables.

Selected Option Costs

Project	Irby Reservoir	Little Saxham Reservoir	Gayton Water Treatment Works	Wighton Water Treatment Works	Total
C55 reference	1010996	I011003	I011016	I011007	
Initial capital cost (£) [1]	11,788,147	4,456,251	5,471,280	1,992,941	23,708,619

Project	Irby Reservoir	Little Saxham Reservoir	Gayton Water Treatment Works	Wighton Water Treatment Works	Total
Full year annual operating costs (£)	373,345	69,701	200,749	13,923	657,718

1 pre efficiency

Further information on the option selected and on water treatment works capacity is provided within the detailed options cost table at a site level outlined below.

Ofwat feedback

"The basis on which the proportion of each scheme is allocated to RWD lacks clarity. ANH should provide a justification to support its cost allocation."

Our Response

We have allocated our costs based on principle use aligning to RAG2.07 and RAG 4.07 cost allocations. None of the new assets provided are used in our Water Resource operations. Therefore we have not proportionally allocated any costs.

Ofwat feedback

"We apply 20% challenge to the submitted costs because of a lack of evidence of optioneering and provision of scheme level data."

Our response

In the section below we have detailed the list of options we considered for this enhancement case. These were the only viable options and were developed through our Risk, Opportunity and Value (ROV) process. The costs and benefits were developed using our asset planning and optimisation system. These investments and costs were reviewed by our independent assurance providers (Jacobs)and were reviewed by Mott MacDonald when undertaking the benchmarking exercise.

The options and their Equivalent Annualised Values (EAV) for this business case are summarised in the table below. In all cases the largest net benefit (EAV) was chosen.

[1]	Blending (£m)	Shutdown WTW & transfer treated water from Marham WTW (£m)	Treatment (£m)	Catchment management (£M)[2]
Irby Reservoir	7.985	N/A	13.947	N/A
Little Saxham Reservoir	3.327	N/A	4.527	N/A
Gayton Water Treatment Works	N/A	-86.592	14.353	N/A

Wighton Water Treatment Works	N/A	0.099	0.300	N/A

1 *EAV = Equivalent Annualised Benefit (EAB) – Equivalent Annualised Cost (EAC) (based on a 40 year planning horizon).
2 Catchment management costs are provided under 'Table – Catchment Management Related Projects' and are included within our WINEP DrWPA groundwater nitrate catchment management programme.

We include a short summary of each option immediately below and further detail at the end of this enhancement case.

Blending with low nitrate sources

Our blending options include for the transfer of low nitrate water in sufficient quantity and quality to allow effective blending so the nitrate standard is achieved. These transfers have been identified using business experts who have been involved in our Risk, Opportunity and Value (ROV) workshops.

Shutdown WTW and transfer treated water from another WTW

Our transfer of treated water options include the transfer of low nitrate water in sufficient quantity and quality to allow for the closure of the high nitrate sources in order for the nitrate standard to be achieved. These transfers have been identified using business experts who have been involved in our Risk Opportunity and Value (ROV) workshops. These transfers include the closest low nitrate source of treated water of sufficient quantity to enable source closure.

Treatment

Our treatment options are based on our proven and innovative Ion Exchange Plant which has gone through a number of iterations over a number of AMPs. An example of how this process has become modular is detailed later.

Catchment Management

Within our DWI submission 31 December 2017, we included the following commentary for all four of the nitrate schemes under options considered:

> *'An option for catchment management on its own is not considered feasible; this is due to the results of our modelling showing that the time it would take to realise any reduction in nitrate would not prevent an exceedance of the PCV in the final water. This is supported by the Environment Agency. Catchment management for nitrate is currently proposed for this catchment in the WINEP but this is still under development and details of what will be permitted are yet to be agreed with the Environment Agency.'*

To ensure sustainability of the proposed plants in this enhancement case we have allowed for catchment management to address the long term rise in nitrates that are predicted.

Catchment management proposals are included within our WINEP DrWPA groundwater nitrate catchment management programme (C55 reference I018898). These cover one to one stakeholder engagement to include the sources which supply the four WTW, which are included in the WINEP (details are provided in the table below).

EA Sub Area	Scheme Name	Driver Code (Primary)	WTW
East Anglia (West)	DrWPA - Risby	DrWPA_IMP	Saxham
Lincs & Northants	DrWPA - Harbrough	DrWPA_IMP	Irby
Lincs & Northants	DrWPA - Healing	DrWPA_IMP	Irby
Lincs & Northants	DrWPA - Little London	DrWPA_IMP	Irby
Lincs & Northants	DrWPA - Littlecoates	DrWPA_IMP	Irby
East Anglia (East)	DrWPA - Wighton	DrWPA_ND	Wighton

EA Sub Area	Scheme Name	Driver Code (Primary)	WTW
East Anglia (West)	DrWPA - Gayton	DrWPA_ND	Gayton

WINEP catchment management allows £21k each for Little Saxham reservoir (WTW), Wighton WTW and Gayton WTW, and £84k for Irby reservoir (WTW). The scope is provided within the WINEP groundwater Measures Specifications Forms which are due for submission to the Environment Agency end of March 2019.

Ofwat Feedback:

"We also apply a further company specific cost efficiency challenge"

Our Response

Our response to modeling approaches is provided separately in chapter 5 of our IAP Response.

Additional Information on our optioneering

We have summarised below additional information we considered when selected the preferred option for each investment. This is the same for each investment as the preferred option in each case is treatment.

Assessment area	Summary
Uncertainty on delivery or changing needs	Our alliance partners have a proven track record of delivering this type of project. The forecast increases in nitrate are robustly modeled and provide the basis for the treatment options. Due to the difference in costs it is unlikely a blending option will be cost beneficial. Additionally there are inherent resilience risks with the blend option.
Customer preference	Customers were not consulted in the specific area as this relates to compliance with the drinking water standard for nitrate. Customers were consulted on catchment management and their opinions were taken into account.
Environmental impact	The brine waste from the plant will be treated via regeneration effluent tanks and subsequent discharge to sewer with the exception of Wighton WTW where the brine shall be treated via the existing regeneration effluent tank and existing discharge route. A catchment management approach will become the sustainable systems approach in the long term.
Use of innovation	The preferred option is based on our ion exchange process which was originally used in the food processing area. Ten ACWA ion exchange plants were installed in AMP4; this introduced the innovative multi-port valve which allowed for continuous vessels in service. ACWA plants were also installed in AMP5 and AMP6. Further evolution of the ion exchange plant to a more modular delivery continues.
Impact on company resilience	This project provides resilience to increases in nitrate levels in the raw water ahead of catchment management being effective in the long term.

Irby Reservoir

The selected option is treatment as it is the most cost beneficial, and the only option which will achieve compliance with the nitrate standard whilst ensuring that we meet demand on the system. It should be noted that Irby Reservoir currently provides a blending point to achieve nitrate

compliance. Four high nitrate borehole sources consisting of twenty separate individual boreholes, currently feed into Irby Reservoir along with additional blending from 2 lower nitrate water treatment works. Of the four borehole sources, two sources are on significantly reduced outputs due to nitrate levels, with all four sources continuing to show an increased nitrate trend. Additionally the option assessed for blending (I010996) detailed below proposed further utilisation of one of the lower nitrate sources (Covenham WTW) along with enabling works, any restriction in flow from this source would result in the requirement to stop flow from the high nitrate sources; resulting in this option becoming no longer resilient on this basis alone.

A detailed summary of the options and costs are given in the following table.

Detailed Option Costs

[1]	Blending	Treatment
C55 reference	I010996	I010996
Initial Capital Costs (£m)	16.380	11.788
Full Year Annual Operating Costs (£m)	0.345	0.373
EAB -Equivalent Annualised Benefit (£m)	8.915	14.967
EAC - Equivalent Annualised Cost (£m)	0.930	1.020
EAV – Equivalent Annualised Value (£m) (EAB-EAC)	7.985	13.947
Works Capacity (Ml/d)		35.95

1 Catchment management costs are provided under 'Table – Catchment Management Related Projects' and are included within our WINEP DrWPA groundwater nitrate catchment management programme.

Little Saxham Reservoir

The selected option is treatment as it is the most cost beneficial, and the only option which will achieve compliance with the nitrate standard whilst ensuring that we meet demand on the system. The option assessed for blending (I011003) detailed below proposed the use of an existing low nitrate water treatment works along with enabling works, however insufficient spare capacity from this source will be a future challenge. This results in this option become not resilient.

A detailed summary of the options and costs are given in the following table:

[1]	Blending	Treatment
C55 Reference	I011003	I011003
Initial Capital Cost (£M)	6.920	4.456
Full Year Annual Operating Costs (£M)	0.083	0.070
EAB- Equivalent Annualised Benefit (£M)	3.669	4.844
EAC - Equivalent Annualised Cost (£m)	0.342	0.317
EAV - Equivalent Annualised Value (£m) (EAB-EAC)	3.327	4.427
Works Capacity (Ml/d)		4.09

1 Catchment management costs are provided under 'Table – Catchment Management Related Projects' and are included within our WINEP DrWPA groundwater nitrate catchment management programme.

Gayton Water Treatment Works

The selected options is treatment as it is the most cost beneficial, and the only option which will achieve compliance with the nitrate standard whilst ensuring that we meet demand on the system. The option assessed for the shutdown of Gayton WTW and the transfer of water from an alternative source (I011016) detailed below, proposes the transfer of water from Marham Water Treatment Works and enabling works. Marham WTW is a groundwater and surface water site and currently has ion exchange treatment to ensure compliance of the high nitrate levels from the groundwater source, with the surface site providing additional low nitrate blending. The surface water source is subject to a reduction in sustainable abstraction license change with the removal of the surface water license 31 March 2025. This is not considered a long term feasible option due to future demand issues and the potential for spare capacity challenge.

A detailed summary of the options and costs are given in the following table.

Detailed Option Costs

[1]	Shutdown WTW and transfer treated water from Marham WTW	Treatment
C55	I011016	I011016
Initial Capital Cost (£m)	6.212	5.471
Full Year Annual Operating Costs (£M)	0.167	0.201
EAB - Equivalent Annualised Benefit (£M)	-86.552	14.842
EAC -Equivalent Annualised Cost (£m)	0.400	0.489
EAV - Equivalent Annualised Value (£m)	-86.952	14.353
Works capacity (Ml/d)		11.8

1 Catchment management costs are provided under 'Table – Catchment Management Related Projects' and are included within our WINEP DrWPA groundwater nitrate catchment management programme.

Wighton Water Treatment Works

The selected options is treatment as it is the most cost beneficial, and the only option which will achieve compliance with the nitrate standard whilst ensuring that we meet demand on the system. The option assessed for the shutdown of Wighton WTW and the transfer of water from an alternative source (I011007) detailed above, proposes the transfer of water from Marham Water Treatment Works and enabling works. Marham WTW is a groundwater and surface water site and currently has ion exchange treatment to ensure compliance of the high nitrate levels from the groundwater source, with the surface site providing additional low nitrate blending. The surface water source is subject to a reduction in sustainable abstraction license change with the removal of the surface water license 31 March 2025. This is not considered a long term feasible option due to future demand issues and the potential for spare capacity challenge.

A detailed summary of the options and costs are given in the following table.

Detailed Option Costs

	Shutdown WTW and transfer treated water from Marham WTW	Treatment
C55 Reference	I011007	I011007

Initial Capital Cost (£m)	9.476	1.993
Full Year Annual Operating Costs (£m)	0.047	0.014
EAB -Equivalent Annualised Benefit (£m)	0.488	0.460
EAC - Equivalent Annualised Cost (£m)	0.389	0.160
EAV – Equivalent Annualised Value (£m) (EAB-EAC)	0.099	0.300
Works Capacity (Ml/d)		1.07

Ofwat Feedback:

"The independent estimates provided by Mott MacDonald give assurances that our costs are efficient. The confidence levels provided by Mott MacDonald are from other companies and it their assessment of the robustness of the estimate based on the data confidence they have in their database".

Our Response

The independent estimates provided by Mott MacDonald give assurances that our costs are efficient. The confidence levels provided by Mott MacDonald are from other companies and it their assessment of the robustness of the estimate based on the data confidence they have in their database.

ORIGINAL ENHANCEMENT BUSINESS CASE AS AT SEPTEMBER 2018

Nitrates (Deteriorating Raw Water Quality)

Price Control	Water Network Plus
Business Plan table and lines	Table: WS2 Lines: A13, B52

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A13	5.144	15.541	2.093	0.000	0.000	**Capex: 22.778**
Opex (£m)	B52	0.022	0.325	0.737	0.830	0.828	**Opex: 2.742**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £26.274M		
Whole life value (EAV)*: £24.288					Whole life cost (EAC)* : £1.986m		

* Note: annualised values over 40 years

Investment Summary

This investment is to provide:

- installation of ion exchange plants at two blending reservoirs (Irby and Little Saxham)
- installation of ion exchange at Gayton Water Treatment Works (WTW), and
- additional ion exchange capacity at Wighton WTW.

This investment is to ensure continued compliance with the drinking water nitrate standard of 50 mg/l in the final water at each of the four sites above. Due to the considerable lag time to realise any benefits from catchment management activities on nitrate levels in the raw water, in the short to medium term, catchment management must be supplemented with ion exchange treatment.

Need for Investment

Is there persuasive evidence that an investment is required?

Raw water nitrate levels currently exceed the standard of 50 mg/l at a number of the raw water sources feeding into Irby (Grimsby) and Little Saxham blending reservoirs, and Wighton and Gayton WTW. Due to increasing nitrate levels in the raw water sources and increasing trends in some of the historically lower nitrate (blending) sources, the blending capacity is gradually decreasing, meaning the final water nitrate concentrations are increasing.

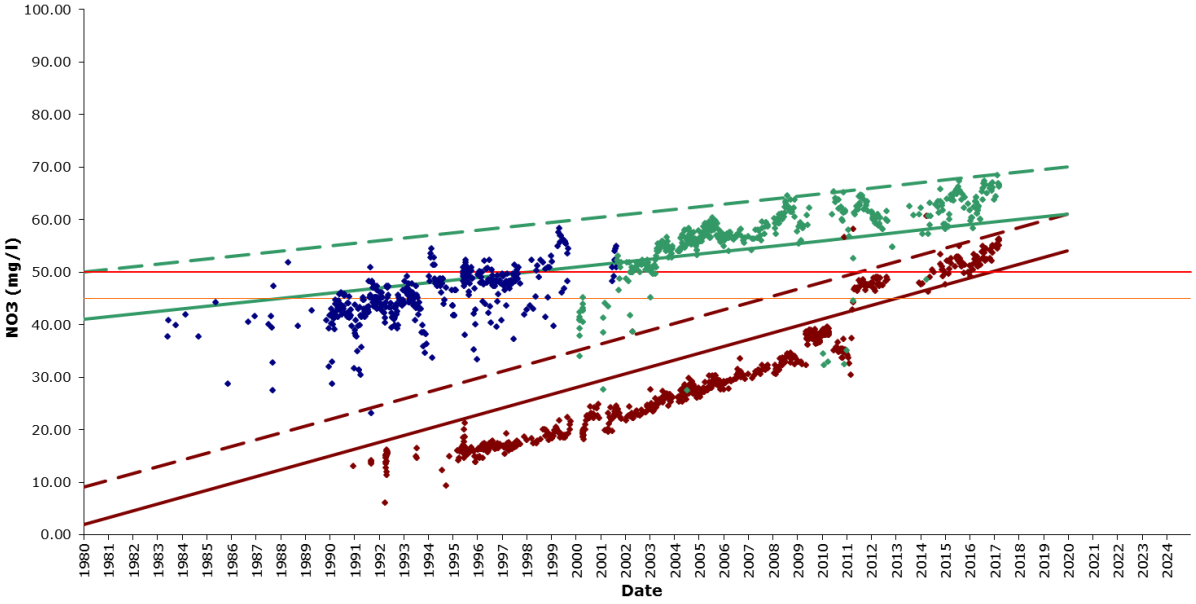
Predictions of when the current blending or ion exchange treatment solutions will become insufficient to ensure nitrate compliance are based on our nitrate prediction models. We predict that the current methods used at each site will become insufficient to achieve final water nitrate compliance by the first year of AMP8. Investment is therefore required in AMP7. Furthermore, the deployable output of some sites is limited as blending constraints have been required to ensure compliance with the standard at the final water point. This is resulting in sub optimal use of these sources with the potential to impact upon the resilience of water supplies.

In previous AMPs, nitrate concentrations in the raw water sources of each site meant that blending with lower nitrate sources could successfully be used as a treatment solution, or in the case of Wighton WTW, that existing ion exchange treatment was sufficient to cope with the nitrate concentrations arriving at the works.

Raw water nitrate levels continue to rise within a number of the sources feeding the four sites listed above. For instance, the graph below illustrates the increasing nitrate concentration in the raw water sources at Wighton since 1980. Although nitrate concentrations have been rising in the past,

during AMP7 or within the first year of AMP8 we predict nitrate concentrations will reach a point beyond which the current treatment solutions at each site will be unable to ensure compliance with the drinking water nitrate standard of 50 mg/l.

Figure 20 Wighton nitrate data



Under the requirements of the Drinking Water Inspectorate (DWI) Guidance Note: 'long term planning for the quality of drinking water supplies', all nitrate schemes require written support from the environmental regulator. We have received letters of support from the DWI (ANG01-Gayton- Nitrate, ANG02 - Irby reservoir - nitrate, ANG04 - Little Saxham reservoir – nitrate, ANG06 – Whighton WTW – nitrate) and the Environment Agency (AWS DrWPA Nitrate 21_12_2017) for the installation/enhancement of ion exchange treatment at the sources outlined above. Additionally, we have also received a copy of 'PR19 CCG ANH Drinking Water Inspectorate statement' letter to Ofwat detailing our water quality schemes and DWI decisions.

What incremental improvement would the proposal deliver?

This investment would secure the final water quality at each of the four sites with respect to final water nitrate concentrations. This will also allow the deployable output of some of the raw water sources to increase, as abstraction volumes would no longer be limited by blending constraints. Thus, the resilience of supplies in terms of quantity will also increase.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

This investment is linked to the 'Safe, Clean Water' outcome and customers view the delivery of this as the most vital service we offer. Please refer to 'Best Option for Customers' section for evidence of customer support.

Need for Enhancement Expenditure

Why is it enhancement (and not base)?

This expenditure is considered to be enhancement (rather than base) expenditure because it enhances the quality of drinking water we are able to supply to our customers. Additionally, the catchment management activities associated with this investment and obligation requirements will aim to improve raw water deterioration of nitrates within the associated catchments in the long term.

What does the expenditure enhance?

Specifically, this investment improves the security of final water quality by ensuring nitrate concentrations at the four sites do not exceed the drinking water standard of 50 mg/l. In our Strategic Direction Statement published in 2017, 'Safe, Clean Water' is one of our 10 long term outcomes that we will deliver for customers and the environment.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our Plan is driven by the requirements of our customers. For this investment, our acceptability research provides evidence of customer priorites, as below:

"In the Acceptablilty research on the Strategic Direction Statement, customers judged safe, clean water as the most important of Anglian Water's ten outcomes (97% saying this was important)" (p127).

"Achieving 100% compliant and chemical-free drinking water was considered the most important goal (95% of customers felt this was important)" (p130).

Source: Anglian Water Customer Research & Engagement Synthesis Report, 2018, v.14.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

1. Blending: Alternative low nitrate raw water sources for blending were explored as an option, however none are available within the aquifers for all four of the WTW outlined.

2. Catchment management: previous catchment modelling for nitrate in AMP5 for a number of sources, including those which feed the four sites detailed above, showed the benefits of catchment management are likely to take >25 years to be realised. Therefore catchment management cannot currently provide the solution in isolation.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement? Has risk been assessed? Have flexible, lower risk solutions been assessed?

Our Risk Opportunity and Value (ROV) process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution. This process has been assessed and is supported by the Drinking Water Inspectorate. *"As with previous periodic reviews Water Companies seeking technical support from the Inspectorate must demonstrate the need for each proposal. The case for justification must be accompanied by evidence of the company's option appraisal process to identify the most robust sustainable and cost effective solution with evidence that the preferred solution will adequately address the risk and deliver the required outcome within an appropriate timescale."* PR19 Drinking Water Inspectorate statement for Anglian Water Services Ltd Customer Engagement Report to Ofwat 29th June 2018'

Has the impact on natural capital and the environment been considered?

Wherever possible more environmentally sensitive solutions are used, such as blending. Where build solutions are necessary, low carbon build solutions are adopted where possible.

Robustness and Efficiency of Costs

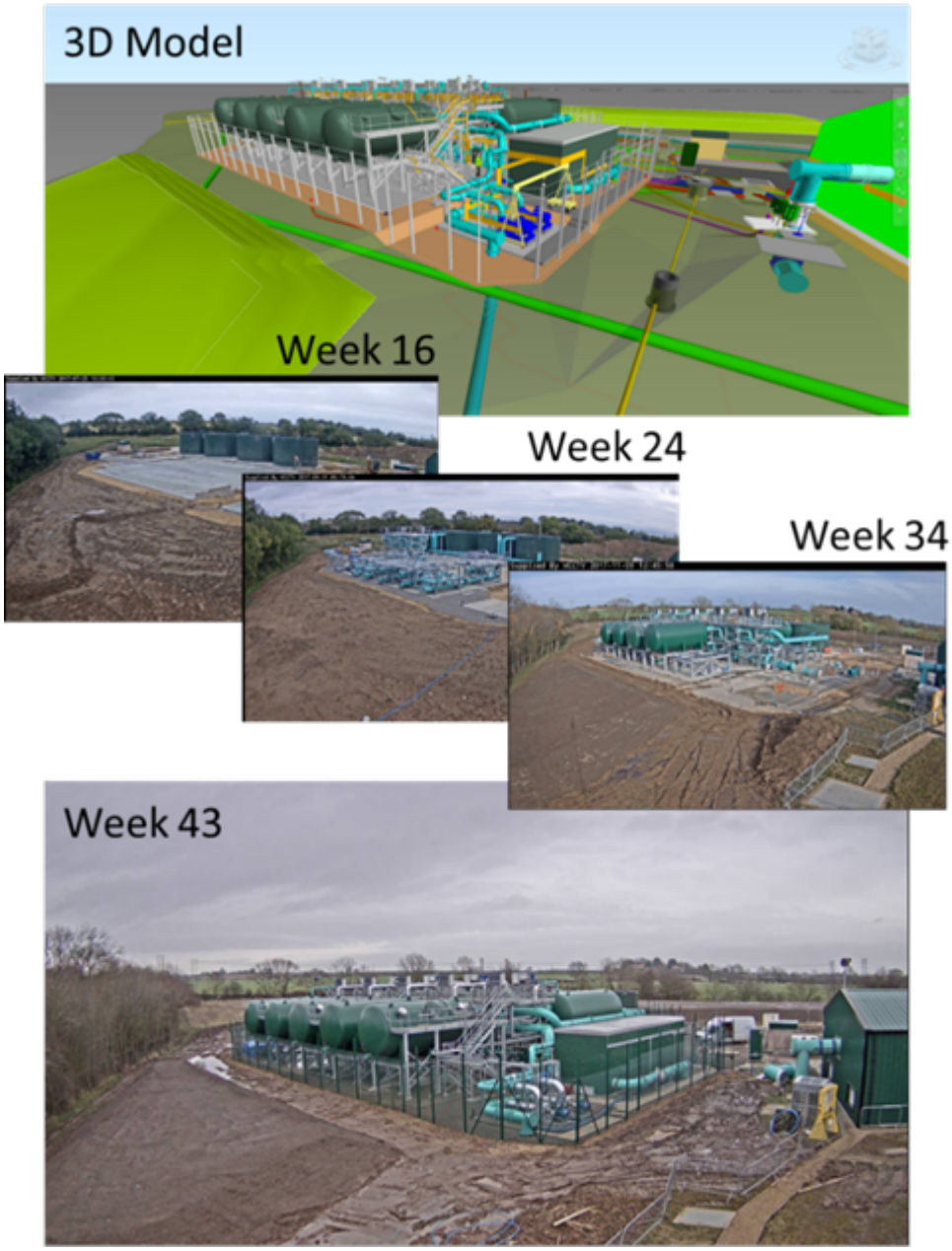
Is there persuasive evidence that the cost estimates are robust and efficient?

A robust, scientific methodology for predicting future nitrate concentrations was developed and used during planning for AMP3, AMP4 and AMP5. This approach was also supported by the DWI in the development of our AMP6 schemes at PR14. We have applied the same modelling methodology for AMP7, coupled with the same enhanced assessment of risk as in AMP6, in line with our Drinking Water Safety Planning approach.

Costs have been developed from outturn AMP6 costs so that efficiencies already achieved form the baseline for our future costs estimates as described in the *Efficiency and Innovation* chapter of our Plan.

We have adopted a modular approach in developing our solutions, as illustrated by the WTW example below. This modular approach reduces time on site and improves quality. From the outset the operational teams are fully involved and the end product matches their requirements. This 'design once, build many' approach marks a movement away from the 'design and construct' mentality towards 'logistics and assembly'. By constructing off-site and assembling on-site as in the automotive industry, it is possible to increase productivity and efficiency whilst reducing embodied carbon and therefore cost. The efficiencies of delivering projects in this way are embedded within our plan and the costs are based on current outturn costs. These latest unit costs reflect the lower costs of design, the lower cost of construction associated with lower assembly costs, and the lower commissioning costs associated with using a standard product. In addition as shown below the development of virtual models of a site allows for the testing of potential solutions in the digital environment which avoids delay and duplication of costs in the real world environment.

Figure 21 Dalton Piercy - Digital design overview



Is there high quality third party assurance for the robustness of the cost estimates?

Our approach here has been externally audited by our third party technical assurance providers Jacobs.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The cost of this investment is outside of management control because it is driven by our statutory obligation under The Water Supply (Water Quality) (Amended) Regulations 2018 to ensure that we are compliant with the nitrate drinking water standard of 50mg/l.

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

We recognise that 'built' end of pipe solutions are not always the most cost effective way to achieve water quality targets. This is why we are increasing our catchment management activities in AMP7. However, the benefits from catchment management will not be realised in time to negate the need for this investment.

Despite this, the costs have still been controlled by considering a range of alternative solutions and conducting a cost benefit analysis for each option.

In addition, we have applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

These schemes will be covered by the Regulation 28 Notice process, therefore setting out a legal obligation to deliver against the Notice requirements. We have a strong track record in delivering against our regulatory requirements and to date have not missed a regulatory deadline. Additionally, progress reports are a key requirement of the obligation and enforcement action could be considered by the DWI in the failure to meet the Notice.

Failure of the nitrate standard would impact on the Compliance Risk Index (CRI) and potentially the Event Risk Index (ERI as measured by the DWI. The CRI and ERI are also stand alone performance commitments within our PR19 business plan. It also would be an infringement of The Water Supply (Water Quality) (Amended) Regulations 2018.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

The key customer benefit from this investment is improved security of final drinking water quality. This directly relates to our 'Safe, Clean Water' customer outcome.

Affordability

Has the impact on affordability been considered?

The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term.

Key Assumptions

We assume that no new blending sources become available.

Estimates of when blending sources and additional ion exchange treatment will be required are based upon rising historical nitrate trends in the raw water sources. It is therefore assumed that these rising nitrate concentrations in the raw water sources will continue at the same rate.

Water Resources Environmental Measures

Additional evidence in response to IAP (31 January 2019)

Summary

We provide further evidence to enable Ofwat to conlcuce that our propose investment is the best option for customers, the cost are robust and efficient and customers are appropriately protected.

AMP7 Expenditure

	Our Plan (September 2018) £m	Ofwat IAP Assessment £m
Capex	23.234	17.787
Opex	11.282	0
Total	34.516	17.787

IAP Assessment Approach

Ofwat have assessed our expenditure in this area as part a number of enhancement feeder models, specifically;

- Wholesale Water Enhancement Feeder Model Investigations - shallow dive. No further information provided.
- Wholesale Water Enhancement Feeder Model Invasive Species & non-native species -Shallow dive No further information provided.
- Wholesale Water Enhancement Feeder Model Water Framework Directive

Wholesale Water Enhancement Feeder Model Water Framework Directive

Ofwat feedback: Best option for customers, partial pass	Summary of evidence provided in response
ANH demonstrate that customers rank environmental enhancement highly, p5, with clear demonstration of engagement with Customer Engagement Forum, EA and Natural England. ANH state that the size of the holistic WINEP programme results in a modest increase in bills that is within the bounds of what a large majority of customers considered acceptable. We have not been able to identify bespoke information regarding the wholesale water WFD schemes at a more granular level. We have been unable to identify a clear specific example that demonstrates effective solution optioning and cost efficiency in this area. We do however note the significant SDB challenge in this area in the round and reduction in abstraction licence costs	We have outlined the options appraisal approach taken in AMP6 to define the wholesale water WFD schemes. This approach demonstrates effective solution optioning against multi-criteria analysis and ensures cost efficiency through robust cost benefit analysis; an approach both supported and approved by the Environment Agency. We have selected one WFD scheme to use as an example for how the options appraisal approach has been applied. We have also provided the full list of WFD schemes included within our plan to allow the schemes to be viewed at a more granular level.

Ofwat feedback: Robustness and efficiency of costs, partial pass	Summary of evidence provided in response
We note that ANH have undertaken external cost benchmarking against other water companies' costs for PR19, and have been shown	We have provided an overview of the cost estimate approach that we applied to the WFD schemes included within our plan. This includes

Ofwat feedback: Robustness and efficiency of costs, partial pass	Summary of evidence provided in response
to be efficient. These are named projects across ten programmes are mostly related to WINEP or WRMP, but do not specifically cover any Wholesale Water WFD projects. We do however note the significant SDB challenge in this area in the round and reduction in abstraction licence costs	a summary of our approach to external auditing and assurance in this area. We are confident that that the cost estimate approach taken is efficient and provides best value for customer. Further details on the modelling approach taken for WFD schemes in Chapter 5 of our main IAP Response.

Ofwat feedback: Customer protection, partial pass	Summary of evidence provided in response
We have identified the Water industry national environment programme (WINEP), PR19ANH_32, performance commitment, with outperformance ODI only to incentivise delivery, noting this is related to all WINEP obligations (some exceptions in WWW which are clearly noted). Clear demonstration of engagement with Customer Engagement Forum, EA and Natural England is evidvent. However, there is no evidence/protection that customers will not pay if interventions are delayed or cancelled in the original plan, though there have been further discussions raised by other areas within WINEP, Query ANH-IAP-CE-003	The detail of our WINEP Adjustment Mechanism is set out in Chapter 4 of the IAP Response document.

Ofwat Feedback: Best Option for Customers

ANH demonstrate that customers rank environmental enhancement highly, p5, with clear demonstration of engagement with Customer Engagement Forum, EA and Natural England. ANH state that the size of the holistic WINEP programme results in a modest increase in bills that is within the bounds of what a large majority of customers considered acceptable. We have not been able to identify bespoke information regarding the wholesale water WFD schemes at a more granular level. We have been unable to identify a clear specific example that demonstrates effective solution optioning and cost efficiency in this area. We do however note the significant SDB challenge in this area in the round and reduction in abstraction licence costs

Our Response

We are committed to achieving sustainable levels of abstraction, supporting our "flourishing environment" outcome for customers and the environment. We have successfully delivered schemes to reduce the impact of abstraction through AMP3, AMP4, AMP5 and AMP6. In AMP7, sustainable abstraction will continue to be addressed through the WINEP and beyond.

Options appraisals have been carried out as required in the AMP6 National Environmental Programme (NEP5), and as defined in the scoping documents issued by the Environment Agency (EA). The overall aim of the options appraisal process is to identify options the meet the criteria relevant to the status of the water body being considered, and are cost-beneficial.

The PR14 NEP outlined 25 waterbodies and designated sites where current abstractions were judged to be causing, or had the potential to cause, environmental issues according to River Basin Management Plans (RBMP) classifications. In early AMP6, we carried out options appraisals to determine how best to address these issues. These were completed according to the December 2017 deadline, set by the EA in order to ensure that we could include the outcome within our Water Resources Management Plan (WRMP).

We looked at a number of potential options to reduce or mitigate the potential effects of abstraction on low flows, groundwater bodies and water dependent terrestrial ecosystems. The options appraisals were completed in line with EA scoping plans and the options were selected following detailed multi-criteria analysis, cost-benefit analysis and discussion with the EA.

A long list of options was produced for each scheme based on the requirements outlined in the scoping documents. The options were scored according to:

- feasibility and risk (15% weighting),
- performance against WFD objectives (65% weighting), and
- wider socio-environmental considerations, including ecosystem services (20% weighting)

The highest scoring options, and those preferred by the EA, were carried through to a short list. The option to switch abstraction off (i.e. source closure) was included in all short lists to provide a baseline comparison. Other short list options included;

- Do Nothing
- Abstraction Reductions
- Water Resources Support Options
- Effluent Reuse
- Closure & Relocation of Source
- Smarter Conjunctive Use
- River Restoration & River Management
- Combined Options

Cost benefit analysis was carried out on all short listed options, whereby capital, operational and maintenance costs were compared against environmental benefits surveys using the National Water Environment Benefits Survey (NWEBS).

One specific example is the River Gaywood where our abstraction is potentially impacting on the system. A total of 28 options which could be deemed technically feasible and deemed worthy of further consideration in terms of likelihood to achieve the respective desired WFD objectives were considered for the River Gayton. Examples of the options include abstraction reductions at our Gayton, Congham, Hillington, Manor Farm and Lanky Hill sources, eight river support options using groundwater from existing licensed quantities, four options from purpose built river support schemes, treated water from Grimston STW and a number of river restoration measures. These options were taken through the multi-criteria tool, where five options were taken forward as shortlisted options. Following cost benefit analysis, the preferred option (River Restoration) was selected and approved by the EA.

The full list of WFD schemes included within our Plan is listed below;

Water Resource Zone	Investment Name	Recommended alternative
North Norfolk Coast	Mitigation Options - West Runton Common	Pond support
Bury - Haverhill	Mitigation options BHV3 River Lark Recirc	Recirculation
Bury-Haverhill, Ely, Newmarket	Mitigation Options - Cavenham Stream	River restoration

Water Resource Zone	Investment Name	Recommended alternative
Ely, Newmarket	Mitigation Options - Lee Brook	River restoration
Norfolk Rural North, South Fenland	Mitigation Options - Old Carr Stream	River restoration
Norfolk Rural North, South Fenland	Mitigation Options - River Gadder	River restoration
North Fenland	Mitigation Options - River Gaywood	River restoration
Ruthamford North	Mitigation Options - River Gwash - River Restoration	River restoration
North Fenland	Mitigation Options - River Heacham	River restoration
Ixworth	Mitigation Options - River Sapiston - River Restoration	River restoration
Ixworth	Mitigation Options - Stowlangtoft Stream - River Restoration	River restoration
Norfolk Rural North, South Fenland	Mitigation Options - Stringside Stream	River restoration
Bury-Haverhill, Ely, Newmarket	Mitigation Options - Tuddenham Stream - River Restoration	River restoration
Ely, Newmarket	Mitigation Options - River Kennett-Lee - River Restoration	River restoration
Bury-Haverhill	Mitigation Options - River Linnet - River Restoration	River restoration
Bourne	Mitigation Options - West and East Glen - River Restoration	River restoration
Ruthamford South	Mitigation Options - Broughton Brook - River Restoration	River restoration
Central Lincs	Mitigation Options - Barlings Eau	River support
Ruthamford South	Mitigation Options - Broughton Brook - River Support	River support
Central Lincs, East Lincs	Mitigation Options - Northern Chalk (Skitter-Habrough Brocklesby)	River support
Ely, Newmarket	Mitigation Options - River Kennett-Lee - River Support	River support
Bourne, East Lincs, South Lincs	Mitigation Options - River Slea	River support
Norfolk Rural North	Mitigation Options - River Tiffey	River support

Water Resource Zone	Investment Name	Recommended alternative
Bourne	Mitigation Options - East Glen - River Support	River support
Central Lincs, & East Lincs	Mitigation Options - Northern Chalk (Skitter-Habrough Kirmington)	River support
Central Lincs, & East Lincs	Mitigation Options - Northern Chalk (Habrough - Barrow Beck)	River support
Central Lincs, & East Lincs	Mitigation Options - Northern Chalk (Laceby)	River support
Ixworth	Mitigation Options - River Sapiston - River Support	River support
Ixworth	Mitigation Options - Stowlangtoft Stream - River Support	River support
Bury-Haverhill, Ely & Newmarket	Mitigation Options - Cavenham Stream - River Support	River support
Bury-Haverhill	Mitigation Options - River Linnet - River Support	River support (Recirculation)

Ofwat feedback: Rubustness and efficiency of costs

We note that ANH have undertaken external cost benchmarking against other water companies' costs for PR19, and have been shown to be efficient. These are named projects across ten programmes are mostly related to WINEP or WRMP, but do not specifically cover any Wholesale Water WFD projects. We do however note the significant SDB challenge in this area in the round and reduction in abstraction licence costs.

Our Response

The river restoration scheme costs have been calculated in consultation with our delivery partners and the incorporation of the unit costs from the AMP6 programme where available. The costs were built based on length of reach (m) restored which included tree planting, buffer strips, gravel augmentation, re-meandering, etc. The river and pond support schemes, and recirculation scheme costs have been calculated using our cost models. The costs in our corporate cost model have been developed over several AMPs using data from previously delivered projects, price adjusted to the relevant year. This means that efficiencies already achieved form the baseline for our future costs estimates as described in the Efficiency & Innovation chapter of our Plan.

Our approach has been externally audited by our third party technical assurance providers Jacobs. Where cost models do not exist for activities we have used supplier, partner and consultant quotes. These have been shared and agreed with the EA.

Ofwat feedback: Customer Protection

We have identified the Water industry national environment programme (WINEP), PR19ANH_32, performance commitment, with outperformance ODI only to incentivise delivery, noting this is related to all WINEP obligations (some exceptions in WWW which are clearly noted). Clear demonstration of engagement with Customer Engagement Forum, EA and Natural England is evidvent. However, there is no evidence/protection that customers will not pay if interventions are delayed or cancelled in the original plan, though there have been further discussions raised by other areas within WINEP, Query ANH-IAP-CE-003

Our Response

In AMP7, we have proposed an adjustment mechanism to return investment associated with investment in current "amber" schemes which do not in the future receive ministerial support This is detailed in chapter 4 of our main IAP Response. This proposed mechanism returns 90% of assumed expenditure and we have actively sought customers' views on this approach. The majority of customers agree with that this proportion is an effective way to incentivise us to continue to challenge whether schemes are required in this area.

ORIGINAL ENHANCEMENT BUSINESS CASE AS AT SEPTEMBER 2018

Water Resources Environmental Measures

Price Controls	Water Resources / Sewage Treatement
Business Plan table and lines	Table: WS2 Lines: A3, A18 (water resources only), A19, B42, B57 (water resources only), B58 Table: WWS2 Lines: A4, B51

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A3	1.067	1.293	0.022	0.022	0.022	2.427
	A18	0.673	4.763	12.666	1.505	0.212	19.820
	A19	0.545	0.442	0.000	0.000	0.000	0.987
							Capex: 23.234
Opex (£m)	B42	0.795	0.750	0.556	0.365	0.411	2.877
	B57	0.993	3.050	2.946	0.999	0.417	8.405
	B58	0.000	0.000	0.000	0.000	0.000	0.000
							Opex: 11.282
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £55.667m		
Whole life value (EAV)*: £53.857m					Whole life cost (EAC)*: £1.810m		

Totex Expenditure 2017/18 Prices including RPE and post-productivity - WWS2

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A4	0.000	0.000	0.000	0.000	0.000	**Capex: 0.000**
Opex (£m)	B51	0.043	0.087	0.000	0.000	0.000	**Opex: 0.130**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £0.021m		
Whole life value (EAV)*: £0.016m					Whole life cost (EAC)*: £0.005m		

* Note: annualised values over 40 years

Please note: The Totex Expenditure table for WWS2 is included above is for reference only and the costs have not been double counted.

Investment Summary

This investment is to deliver environmental measures in water resources. It covers WINEP mitigation options and measures to address invasive non-native species (INNS). It includes a total of 33 mitigation schemes. These schemes have been identified from our AMP6 National Environment Programme (NEP) investigations. The schemes are required as part of the AMP7 Water Industry NEP (WINEP) and comprise:

- 14 river support schemes – coded to line 18 and 57
- 15 river restoration schemes – coded to line 18 and 57
- one recirculation scheme – coded to line 18 and 57
- one pond support scheme – coded to line 18 and 57
- two monitoring schemes – coded to line 18 and 57, and
- 10 investigations and options appraisals into sustainable abstraction – coded to line 19 and 58.

This case also covers a range of investments relating to biodiversity and Invasive Non Native Species (coded to line 3 and 42), focusing on:

- the removal of a weir on river Wensum, a chalk stream with an international conservation designation (Special Area of Conservation)
- a pilot project on a catchment upstream of Pitsford surface water impounding reservoir, looking at how investment to protect biodiversity will also contribute to water quality and quantity improvements
- critical species (Killer Shrimp, Quagga Mussel and Floating Pennywort) and critical pathway risks (raw water transfers and recreation at water parks)
- additional risk assessments in support of potential further investment in AMP8, and
- supporting catchment activities to manage INNS as joined up action at the catchment level, the scale at which many species are best managed.

For our management of INNS investments, the preferred options were derived through discussions with local Environment Agency (EA) area teams and then approved by the EA at a national level.

This case also covers one Water recycling scheme at Market Harborough WRC to achieve a conservation driver on the river Welland (EA ref 7AW202231). We have chosen to explain the supporting case for it alongside all the other environmental measures we're making on the water resources price control.

Need for Investment

Is there persuasive evidence that an investment is required?

The need for investment in our mitigation schemes is to meet River Basin Management Plan (RBMP) objectives under the Water Framework Directive (WFD) in order to maintain abstraction licences. The Environment Agency (EA) AMP6 National Environment Programme (NEP) identified a number of waterbodies and protected areas where Anglian Water abstractions are potentially causing a negative impact upon the environment. The AMP6 NEP requires us to complete a programme of options appraisals to identify the best value solutions. Solutions are generally a reduction to licensed abstraction (a sustainability reduction), an 'NEP mitigation option', or a combination of both. This case covers the 'NEP mitigation option' aspect (investment needs arising from the sustainability reductions are contained within the WRMP investment programme). Solutions have been agreed with the EA and Natural England following a detailed investigation and options appraisal process and included as requirements of the WINEP.

The solutions have also been made resilient to meet WFD 'No Deterioration' requirements, set out in the AMP7 WINEP and used to inform our WRMP.

The separate need for investment in INNS is driven by legislation. We have a statutory duty to comply with environmental legislation under the Water Industry Act, Wildlife and Countryside Act and Natural Environment and Rural Communities Act. This includes complying with the law to protect sites of high nature conservation value and prevent the spread of INNS.

Defra's guidance to Ofwat for PR19 states their expectation that Ofwat should seek assurance from companies that they are planning and investing appropriately to meet their environmental obligations.

In WISER, Natural England sets out its expectation of water companies. The WISER states 'You have an important role to play in preventing further damage and in enabling recovery. The status of wetland biodiversity is linked to the health of the wider catchment. You are important players in the action needed to tackle diffuse pollution and to improve the wildlife connectivity between designated sites.'

Our investment at Market Harborough is driven by the Biodiversity driver under WFD, and is required to improve water body status adjacent to our water recycling centre. This investment is opex as it is planned to be delivered through partnership funding and therefore cannot be capitalised.

What incremental improvement would the proposal deliver?

Historically, we have promoted a limited number of mitigation schemes in order to maintain our abstraction licence conditions; in AMP6 we will deliver six schemes in total comprising:

- two fish habitat schemes
- three river restoration schemes, and
- one river support scheme (with Essex and Suffolk water).

We have also completed 25 options appraisal schemes in the first two years of AMP6.

WINEP requires a significantly larger number of mitigation schemes, 33 in total compared to six schemes in AMP6. Furthermore, it includes new types of mitigation schemes such as a recirculation scheme and river support schemes (the river support scheme in AMP6 is being delivered by Essex and Suffolk Water).

The number of investigations and options appraisals has reduced from 25 to 10. However, whilst we normally carry out investigations and options appraisals in separate AMP cycles, they are now required in the same AMP and hence the investment remains of similar value to that of AMP6. Whilst most schemes continue to have year two obligation dates, one scheme, the River Brett, has a year one obligation date to meet the RBMP objective for the waterbody.

On INNS, WISER requires water companies to understand pathways of spread on our assets and across whole catchments. This knowledge should then be used to 'consider measures to control and manage INNS where the species or locations pose a risk of deterioration in WFD status or to achieving conservation objectives at SSSI and Habitats Directive sites.'

We have invested over the long term to manage sites of conservation value. Our SSSIs are 99% in favourable condition and other high priority sites are being managed positively. In addition we are working in partnership with other organisations such as Wildlife Trusts and Keep Britain Tidy to support conservation projects across catchments and the wide countryside. We also provide support to colleagues across the business to manage compliance risks from, for example, protected species such as great-crested newts.

We are undertaking a biodiversity audit of our sites to bring modern conservation evidence and research to bear on our landholdings. This will influence our land management approach, bring more sites into conservation management.

Our work on INNS during AMP6 has been designed to;

- Help staff understand the problem INNS cause
- Help water park visitors to be biosecure
- Address problems early to protect staff and assets and save costs
- Facilitate collaboration with others, as this is the best way to address the impacts of INNS

We have invested in biosecurity measures across some of our water parks to help recreational visitors clean their footwear and equipment to stop the spread of species. We have also installed containment facilities at Grafham Water to stop killer shrimp getting into the river Great Ouse. At Morcott Water Treatment Works we installed a new facility to keep zebra mussels out of the water treatment process.

We have also removed floating pennywort from a stretch of river upstream of our abstraction on the river Great Ouse in order to keep it out of Graham, Water, where it could become more damaging and more costly to manage.

We produced an eLearning module and INNS guidebook for our staff so they know what to do when they find INNS on our assets and how to stop the spread of INNS.

Need for Enhancement Expenditure

Why is it enhancement (and not base)?

This expenditure is considered to be enhancement (rather than base) as it is all driven by legal obligations and enhances the quality of water courses and ground water sources. In our Strategic Direction Statement published in 2017, one of our four long term ambitions was to 'work with others to achieve significant improvement in ecological quality across our catchments'. It supports one of our ten outcome goals – 'A Flourishing Environment'.

What does the expenditure enhance?

Improved water quality will improve the ecological status of inland water bodies at these locations, therefore improving biodiversity and enhancing the natural capital of our region. It is driven by statutory obligations to meet River Basin Management Plan (RBMP) objectives under the Water Framework Directive (WFD) and WINEP obligations.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our Plan is driven by the requirements of our customers.

Our customers support investments that reduce our impact on the environment. Results from the online community suggest customers are supportive of the company's plans to conserve habits and biodiversity. Environmental protection was ranked third out of Anglian Water's six major challenges, seen as important by 85% of customers (Anglian Water Customer Research & Engagement Synthesis).

The legislative framework governing nature conservation is still in force and this has been supplemented by the 25-year Environment Plan, which reiterates the imperative to protect existing wildlife sites and water bodies in good health as well as investing to enhance rivers and sites in poor condition. Government has stated it wants this to happen at a catchment and landscape scale to maximise the benefits nature provides.

INNS are increasingly recognised as a threat to the natural environment as well as to society and the economy. A very conservative estimate of the current cost of INNS to the water industry is £7.5 million pa (IKWIR research). The Invasive Alien Species Regulation came in to force across Europe on 1st January 2015. Member states must have processes and plans in place to deal with INNS of EU concern. As a result the Water Industry National Environment Program (WINEP) for PR19 now includes a specific driver for INNS. This is the first time such a standalone driver has appeared in the WINEP.

A series of investments have been agreed with the Environment Agency. The majority of investments do not have an equivalent in PR14. They are linked to our legal obligations under the Wildlife and Countryside Act, Natural Environment and Rural Communities Act and the Invasive non-native Species Regulation.

We are required to undertake 'invasive non-native species' (INNS) assessments, to evaluate the risk of transferring INNS and, if a risk is identified, to consider mitigation options. The key driver from the EA for this work is no deterioration in the current WFD status, through prevention and management at an asset and catchment scale. We have considered alternatives for the INNS programme, primarily between different levels of resource for intervention and between investigation only or to include options appraisal.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Our Risk Opportunity and Value (ROV) process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

The programme is based on WINEP as defined by the EA. The final mitigation options have been selected through the AMP6 options appraisal programme and agreed with the EA. Our proposed investment is therefore required by, and has the support of, and the EA. Examples of some of the alternative mitigation options considered are listed below:

- Do nothing
- Abstraction reduction
- Source closure
- Source relocation
- River support
- River restoration
- Trading
- Use of existing transfers
- Support from Water Recycling Centre discharge.

The options of 'do nothing' and 'investigation only' were also considered for the investigation and options appraisal schemes but these were rejected as they do not meet statutory requirements.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Our Risk, Opportunity and Value process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. The societal impacts are calculated using our extensive societal valuation work. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution, with the least impact on bills both in the short and long term.

Has the impact on natural capital and the environment been considered?

All investments are required to deliver environmental improvements under our AMP7 WINEP programme enhancing Natural Capital.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

During AMP6, options appraisals for schemes to be delivered in AMP7 were undertaken. This included extensive modelling and option analysis, multi-criteria assessment and cost-benefit analysis in order to identify the best value options to be selected. The final options have been agreed with the EA and have fed into the WINEP and the WRMP.

Our costs have been developed using our corporate cost model library that has been developed over several AMPs using data from previously delivered projects, price adjusted to the relevant year. This means that efficiencies already achieved form the baseline for our future costs estimates as described in the *Efficiency & Innovation* chapter of our Plan.

Cost and carbon models developed from previous similar investments have also been used where possible (e.g. Grafham Diddington Brook scheme).

The river restoration scheme costs have been calculated in consultation with delivery partners. The river and pond support schemes, and recirculation scheme costs have been calculated using our cost models as described above. The monitoring scheme costs have been calculated using the unit costs from the AMP6 programme from the cost model library.

The investigation and options appraisal costs have been based on actual costs from the AMP5 and AMP6 programmes.

Is there high quality third party assurance for the robustness of the cost estimates?

Our approach here has been externally audited by our third party technical assurance providers Jacobs. Where cost models don't exist for activities we have used supplier, partner and consultant quotes. These have been shared and agreed with the Environment Agency.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

All investment in this business case are statutory WINEP obligations. Failure to complete these mitigation measures, investigations and options appraisals by the obligation dates outlined in WINEP would put abstraction licences, and therefore our ability to maintain water supplies to our customers, at risk from AMP7 onwards.

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

Solutions have been agreed with the EA and Natural England following a detailed investigation and options appraisal process and included as requirements of the AMP7 WINEP. We have also applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

As a business we set out to honour our commitments. Customers can rightly challenge and ask what protection there is if we don't. For this business case the protection consists of the following implications for non-delivery:

- Enforcement action from the Environment Agency for failure to deliver a WINEP obligation or comply with biosecurity laws.
- Not delivering the mitigation options could make it more likely that the EA would reduce our abstraction licences at these sites.
- Customer complaints potentially to CC Water.
- Reputational damage that could be reflected through C-MeX performance.
- In AMP7, for the first time we will introduce a new WINEP Performance commitment (described in the main narrative). This performance commitment is designed to incentivise faster delivery of the WINEP, to unlock benefits for customers and the environment early.

Affordability

Has the impact on affordability been considered?

The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term.

Key Assumptions

All options have been selected following a lengthy and robust options appraisal process, and are now agreed with the EA as statutory obligations. Assumptions include:

- Environmental legislation will remain or strengthen post-brexit
- The condition of the River Wensum SAC will not improve without the removal of the weir
- INNS impacts will increase in the future as new species get to the UK or spread to our region from elsewhere in the UK
- Tackling INNS early and at source is the most cost-effective approach
- Collaborating with other organisations to address some species (such as Himalayan balsam) is best done at the catchment scale

Shallow Dives

In the following section we have included for completeness our enhancement business cases that were subject to a shallow dive by Ofwat for IAP. We have addressed concerns raised by Ofwat and detailed adjustments made to our catchment management investment as a result of the metaldehyde ban.

In this section we do not comment on the enhancement modeling approach, as response and comments are detailed in Chapter 5 of our IAP Response.

Housing Growth

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to the new developments and new connections (water growth model) in chapter 5 of our main IAP Response for comments on the IAP assessment of costs.

Price Control(s)	Water Networks Plus
Business Plan table and line(s)	Table: WS2 Lines: A8 (treated water distribution column), A11, A12, B47 (treated water distribution column), B50, B51

Best Value Option

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
	A8	9.987	13.322	11.618	10.979	9.995	55.901
Capex (£m)	A11	25.324	28.250	29.606	29.416	27.541	140.136
	A12	14.254	15.927	16.703	16.641	15.331	78.856
							Capex: 274.893
Opex (£m)	B47	0.020	0.153	0.265	0.308	0.348	1.093
	B50	0.000	0.063	0.062	0.061	0.060	0.247
	B51	0.005	0.005	0.005	0.005	0.005	0.024
							Opex: 1.364

AMP7 carry over costs: £9.584m	Whole life benefit (EAB)*: £286.408m
Whole life value (EAV)* : £274.899m	Whole life cost (EAC)*: £11.510m

*Note: Annualised values over 40 years

Investment Summary

Approximately 200,000 new houses are forecast to be built in the our region in AMP7, based on Local Authority published plans. In order to meet the demand from these alongside the expected long term growth associated with projects such as the Cambridge-Milton Keynes-Oxford (CAMKOX) corridor we will be required to deliver:

- a programme of network reinforcement involving distribution and trunk mains, water boosters and storage (allocated to line 8: treated water distribution)
- the provision of new housing estate mains (allocated to line 11), and
- new connections (allocated to line 12).

Please note: the expenditure allocated to water resources on line 8 is covered by the Water Resources Management Plan supply side enhancement case.

Need for Investment

What incremental improvement would the proposal deliver?

The cross party Government commitment to improve housing supply to meet established housing need means new housing levels will be greater than previous AMPs and beyond the AMP6 forecast of 96,700. Measures to increase supply range from supporting the building of more social housing, provision of grants to overcome site constraints, to the creation of large scale new communities built using enhanced development corporation powers. Looking further ahead, the CAMKOX

corridor is an area of development of national significance and is predominately in Anglian Water's statutory area. The proposal to plan for the forecasted 200,000 (approximately) new houses in AMP7 will ensure the business investment aligns with this scale and pace of change.

Is there persuasive evidence that an investment is required?

We have a duty under the Water Industry Act to provide new water networks to meet the demand of new developments as highlighted above. The need for investment has been determined in line with Defra and Environment Agency (EA) guidance that growth should be based on housing forecasts as determined by Local Authority statutory local plans. Local Planning Authorities establish housing need and distribution based upon a statutory plan preparation process, including examination in public. The methodology for defining growth rates through population trends, housing markets and spatial constraints is set out in the National Planning Policy Framework and subject to scrutiny by stakeholders and independent planning inspectors. There is now a statutory duty on Local Authorities to prepare a local plan every five years with those failing to do so put in to special measures.

Housing delivery against these housing targets is closely monitored, with mechanisms in place to address undersupply or overcome site constraints and delays. It provides a sound baseline to inform the location, size and timing of the growth forecast. The same data was used in the Water Resource Management Plan (WRMP) with over 5,000 development sites forecast to be connected to our network in AMP7.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

Supporting sustainable housing growth is one our four long term ambitions in our Strategic Direction Statement, which we developed through engagement with our customers. Our Customer Engagement Forum has commented that they were impressed to see that we took customers on a journey with us as we developed our priorities and plans for PR19 and beyond – looking at both current and future challenges facing the region, particularly in terms of population growth and climate change.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

This expenditure is considered to be enhancement (rather than base) because it enhances the capacity of our water network in order to meet the demand of approximately 200,000 new houses forecast to be built in the region in AMP7. In our Strategic Direction Statement published in 2017, one of our four long term ambitions is to 'enable sustainable economic and housing growth in the UK's fastest growing region'.

What does the expenditure enhance?

The expenditure enhances our asset base in terms of network reinforcement involving distribution and trunk mains, water boosters and storage as well as provision of new housing estate mains and new connections. The investment will allow the provision of new water networks to meet the demand of new developments as required by our duty under the Water Industry Act.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

Customers are concerned that population growth and new development should be sustainable. In the Acceptability testing on our Strategic Direction Statement (SDS), enabling growth was seen as the second most important of the company's four long-term goals. Customers want the company

to plan ahead, influence the planning system, and work with developers to design-in water efficiency for new homes and communities. (Anglian Water Customer Research & Engagement Synthesis report, 2018, v.14, p175).

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

Where appropriate, multiple options have been assessed for network reinforcement schemes. Through our experience of working on large development sites we know that some sites will take many years and phases to be completed. As such we have evaluated market build out rates and reflected this in our plans for a phased delivery where possible. This allows us to better understand when off site infrastructure upgrades may be necessary and ensure that we plan and deliver them in the optimal way.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Keeping pace with the scale of change, while working with local authorities to prioritise investment, ensures this proposal represents best value for customers in the long term. In addition, we work closely with Local Planning Authorities to include the building regulations part G2 optional higher level of water efficiency for new development within their Local Plans to limit additional demand. This requires all planning applicants to demonstrate how the 110 litres per person per day standard will be met, rather than the normal requirement of 125 litres per person per day. Local authorities have been very supportive of this approach with to date over 90 per cent of those within our water area including the standard within an adopted plan, emerging plan or making a commitment to include at the next appropriate stage. Ultimately, reflecting our customer's views to limit demand, our target over the next few AMPs is for all new housing to be delivered with design standards for 80 litres per person per day.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Each scheme is individual in nature and all alternative options are considered as part of our Risk Opportunity and Value (ROV) process. Our ROV process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution.

Has the impact on natural capital and the environment been considered?

Our work with Local Planning Authorities results in lower household consumption rates, reducing the amount of water we need to abstract. This is beneficial to the natural environment.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

The scale of this investment is driven by the need to support the development of approximately 200,000 new homes in our region during AMP7. This forecast is determined by Local Authority statutory local plans which establish housing need and distribution based upon a statutory plan preparation process. We therefore have confidence in the housing growth forecast that drives this investment. Whilst housing growth presents challenges, we have taken this opportunity to engage with Local Planning Authorities to enhance the level of water efficiency within their local plans. Local authorities have been supportive of this approach. This helps to mitigate future demand in our region and minimise the long term costs of ensuring supply can continue to meet demand.

The forecast expenditure needed for Housing and Estate Mains (HEMS), Intra-Planning Zones (IPZ) and new connections has been determined against a baseline of achieved out turn unit rates per dwelling based on AMP6 costs. Thus, efficiencies already achieved form the baseline for our future costs estimates, as described in the Efficiency & Innovation chapter of our Plan. A HEMs/IPZ scheme is designed and costed based on a developer's layout, however these are not available for forecasting future housing costs. We are therefore relying on historic averaging of all development sites, as

we do not expect a large overall change in the current market make-up of development sites (size, layout, brownfield-greenfield split), although CAMKOX is expected to deliver more new town development.

Network reinforcement costs are based on cost base models. These are all validated based on historic costs. The requirement for network reinforcement has been determined using hydraulic modeling. Using spatial data from Local Planning Authorities, we have been able to forecast potential locations for critical development sites and model sites to the nearest water main. This high-level modelling provided an initial understanding of the risk versus cost. Prioritising the highest risk sites, we have undertaken detailed modeling to provide a business case for those sites where network reinforcement will be necessary to supply water to a new development or to protect existing customers from an unacceptable deterioration in service.

Is there high quality third party assurance for the robustness of the cost estimates?

Our approach to Housing Growth has also been audited by our external assurance provider (Jacobs), who have confirmed to our Board that there are no material concerns. This has informed our Board's support for the assurance statement in the plan. *"We found that Anglian's business planning methodologies and its tools for identifying needs and solutions, estimating costs and benefits and optimising expenditure were robust from a technical perspective and based upon sound risk-based principles using reliable asset-specific data".* (Jacobs 'Anglian Water PR19 Technical Assurance Executive Summary, 13 August 2018').

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The need for this investment is outside of management control because it is driven by a duty under the Water Industry Act to provide new water networks to meet the demand of new developments. This duty covers the requisition of "offsite" network reinforcement, Intra Planning Zone (IPZ) mains (linking a site to an existing water main), "onsite" housing estate mains (HEMs) and new connections.

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

The costs of meeting this need have been controlled as far as possible by conducting a cost benefit analysis on a range of alternative options to identify the best value option. The costs are based upon recent outturn costs of projects delivered during AMP6. We have also applied further totex stretch efficiency and productivity challenges, as described in the Efficiency and Innovation chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

As a business we set out to honour our commitments with customers rightly being able to challenge and ask what protection exists if we do not. For this portfolio the customers are protected against non-delivery by:

- Customer complaints either direct or to Consumer Council for Water.
- Potential enforcement action from Ofwat for failure to provide new water networks to meet the demand of new developments, our duty under the Water Industry Act.
- Reputational damage with developers (and other types of customer) which may be reflected through D-MeX performance, the new AMP7 mechanism that will have significant financial performance incentives (up to £16m across the AMP).

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

The main benefit of this investment is to ensure we can provide new customers moving into homes within our region with a reliable supply of safe, clean water. This investment will also help to mitigate any negative impacts to existing customers as a result of connecting new developments to supply. This investment therefore relates to a number our of 10 customer outcomes, including 'Supply Meets Demand' and 'Delighted Customers'.

Affordability

Has the impact on affordability been considered?

The analysis that has been undertaken (as described in the 'Robustness & Efficiency of Costs' section) allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

Whilst this is a large investment, we envisage that the increase in revenues from a growing customer base will lessen the impact of this investment on customers' bills.

Key Assumptions

Increased housing demand and supply will continue to be driven in AMP6 through unmet demand, and supply interventions of central and local Government.

Housing need and supply targets have been obtained from Local Planning Authorities. We are required to use this source of data for our WRMP and it is the best option for obtaining a robust housing forecast for AMP7.

Driving Down the Leakage Frontier

IAP Response

We have made no changes to the proposed totex for this enhancement business case.
We refer Ofwat to Chapter 6 of our IAP response where we have provided an integrated response which covers multiple aspects of our leakage proposals.

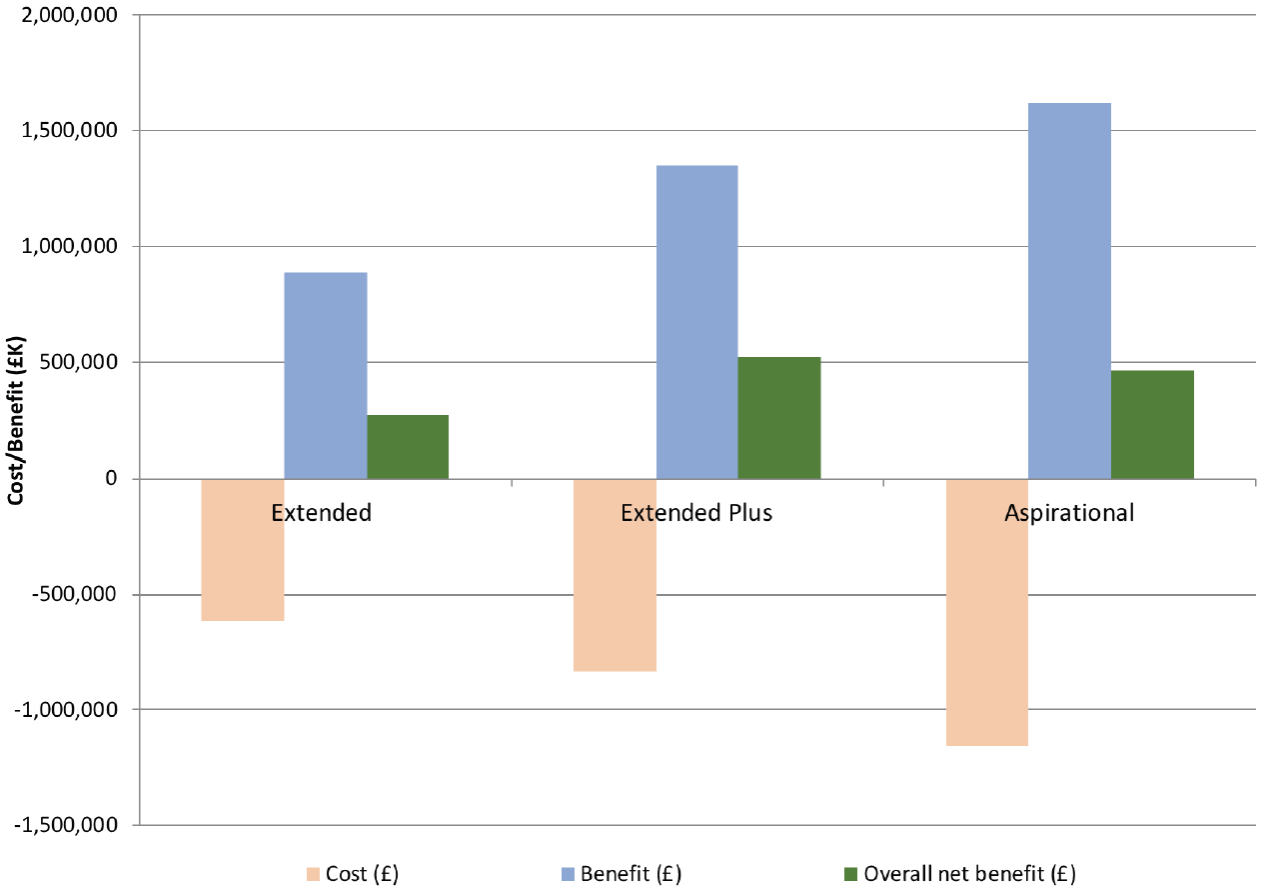
Price control	Water Network Plus
Business Plan table and lines	Table: WS2 Lines: A10 (42%), B49 (9.03%)

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A10	16.808	19.828	12.123	11.091	10.804	**Capex: 70.654**
Opex (£m)	B49	0.530	0.897	1.259	1.618	1.980	**Opex: 6.285**
AMP7 carry over costs: £0.000m							

Our 'Extended Plus' demand management strategy (including smart metering, leakage and water efficiency programmes) has the strongest economic business case of the three strategic options we assessed, as illustrated below. The full details of the costs and benefits of our overall demand management strategy are presented in figure 4.7 in our revised Draft Water Resources Management Plan.

Figure 22 WRMP demand management options



Investment Summary

Internationally, leakage from water pipes is measured by the Infrastructure Leakage Index (ILI), which was developed by the International Water Association. Water suppliers are categorised using this index in Leakage Performance Categories (LPC), ranging from A1 (the best) to D2 (the worst). Anglian Water's ILI is currently 1.3 giving us a rating of A1, putting us among the best performing water suppliers globally. However, we understand that our customers see any leakage as wasteful, and as part of our strategy to balance supply and demand we have decided to push further with our leakage reduction to reach levels of leakage never before achieved in the UK. The investment for this is a key component of our preferred demand management 'Extended Plus' option, as detailed in our Water Resources Management Plan (WRMP), and is essential for us to tackle the supply and demand challenge our region faces in the future. For further information see the 'Resilient Water Supplies Chapter' of our Plan. We will deliver a step change in leakage reduction, from our expected end of AMP6 position of 177 Ml/d (as a three year average) to 147 Ml/d (as a three year average) by the end of AMP7. This saving represents a reduction in excess of the Ofwat requirement to reduce leakage in AMP7 by a minimum of 15%. Importantly, this is from a current frontier level for the sector.

Need for Investment

What incremental improvement would the proposal deliver?

Reducing leakage rather than having to develop additional supply side options delivers improvements in a number of areas. Firstly, more water is able to remain in the environment to support the habitats, ecosystems and wildlife that also rely on our regions water resources. This directly contributes to delivering our 'A Flourishing Environment' outcome. Secondly, demand

management options allow greater capital and embodied carbon savings compared to 'built' supply side options. This aligns with our goal to become a carbon neutral business by 2050, our 'A smaller footprint' outcome and our aspirations on natural capital. Finally, if we are perceived to be 'doing our bit' by our customers, they are more likely to embrace water saving behaviors themselves, allowing further demand management saving opportunities to be realised. The investment will push the frontier, setting a new benchmark for all companies.

Is there persuasive evidence that an investment is required?

Population in our region is forecast to grow by one million people over the 25 years to 2045, based on Local Development Plan forecasts. As a result, we expect demand to increase by up to 109 Ml/d by 2045. Because our region is considered to be under serious water stress by the Environment Agency (EA), we must manage this future supply and demand challenge as far as possible by focusing on demand management solutions rather than through developing new sources of supply. This means reducing leakage further, a direction also supported by Government and other stakeholders. Even though we are already the frontier company, we believe that it is still appropriate to reduce leakage by at least 15% by 2025, in line with the requirement set out in Ofwats PR19 Final Methodology.

As the frontier performer on leakage in the UK, we are leading in the development of new and innovative approaches to tackle leakage. Over recent years we have invested in a number of innovative schemes, piloted in our Shop Window; for instance making use of drones and noise loggers. Because leakage levels were higher in the past, each Ml/d reduction was less challenging to find and fix and the associated cost per unit of leakage reduction less.

The future is different because leakage has steadily gained momentum as a priority for our customers and stakeholders. As balancing supply and demand becomes more challenging with climate change and population growth, and we therefore ask more from our customers in terms of adopting water efficient behaviors, the amount of water lost due to leakage has become an increasing focus. Hence, it is more important than ever that we play our part in reducing demand. Because we will be reducing our leakage from an already industry-leading level, we expect the additional reductions to be even more challenging. The future therefore requires increasingly innovative approaches.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

Tackling leakage consistently emerges as a key priority for our customers. Customer engagement revealed that only 13% of people felt leakage was the best aspect of water services, and 41% felt it was the worst (p66). This demonstrates that our industry leading position does not negate the need for investment in this area. Moreover, a clear message from our customer engagement was that leakage can be a strong disincentive to customers adopting water-saving behaviours (p186). Reducing leakage further therefore also improves the opportunity to work with our customers to help them lower their consumption.

Source: Anglian Water Customer Research & Engagement Synthesis Report, 2018, v.14.

Need for Enhancement Expenditure

Why is it enhancement (and not base)?

This investment is enhancement in nature as it delivers a step reduction in our level of leakage. This investment supports growth in our region and mitigates the need for new sources of water to be identified and developed which would fall under the enhancement heading.

What does the expenditure enhance?

Reducing our leakage on this scale significantly reduces demand. This allows us to serve a greater population without the need to increase supply. Assuming an average per capita consumption of 133l per day, our projected 30 Ml/d per day saving by 2025 would allow us to serve over 250,000 extra people without needing to increase supply.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

This investment relates to our 'Supply Meets Demand' outcome. From our Customer Research & Engagement Synthesis Report (2018), reducing leakage is a clear priority for our customers. "In the main online community trial, customers felt the company's commitment to reducing leakage should take pride of place in communications from Anglian Water, as it should be the company's priority" (p191).

In relation to water services, the Main Stage Willingness to Pay research suggests that leakage is the second most important issue for household customers (60% said this was very important) (p51).

We also asked customers in the consultation on our outline plan whether we should continue to drive leakage down, or remain at current levels. 78% voted to continue to reduce leakage, even though the incremental costs are increasing, and that they were willing to pay for an enhanced outperformance payment in order to see that happen. As a result, our plans for leakage are extremely ambitious to match the appetite from our customers.

Our Customer Engagement Forum welcomed the fact that we propose to continue our ambitions to be best-in-sector on leakage performance by continuing to drive down leakage, reinforced by strong customer support for this approach.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Fixing leaks has also been identified from the Domestic Customer Survey as the aspect "most likely to increase customers' assessment of the value for money they receive from Anglian Water" (p89). Significantly reducing leakage also aligns with regulatory and government priorities; recent publications by the EA, National Infrastructure Commission, Defra and Ofwat all highlight leakage reduction as a priority.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

In order to consider the widest range of demand management options, we developed and reviewed an unconstrained list of demand management options that considered our current business practises and how we could improve them, practises in other UK water companies, other sectors (such as gas and electricity) and other countries, alongside opportunities provided by technology and latest academic research. These options were then reviewed to develop a shortlist of feasible options which were then packaged into high, medium and low strategic options for cost-benefit analysis. This analysis can be seen as part of our Final WRMP and has been conducted in line with the EA's WRMP guidance.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Leakage and demand management investment is more flexible than 'built' supply side options, as it can be scaled more readily. There is a risk that built options become stranded investments. There is some risk however given the plan is to reduce leakage to a level never seen before in the UK.

"Anglian has a mature approach to future risk and has good experience of the types of risks and uncertainties." (Anglian Water PR19 Technical Assurance Executive Summary for 13 August 2018 completed by Jacobs).

Has the impact on natural capital and the environment been considered?

Reducing leakage means more water can remain in the environment to support habitats, ecosystems and wildlife that also rely on our regions water resources to maintain a healthy state. We recognise that a flourishing environment provides numerous natural capital benefits, such as improving water quality and biodiversity. Amongst others, these are valuable ecosystem services. This is an important benefit and was accounted for when selecting our preferred package of demand management activities to manage the future supply and demand challenge.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Driving down leakage is a key aspect of our demand management plan to combat the increase in demand expected from forecast population growth. This remains cost beneficial under a combination of future scenarios as tested in our Adaptive Management Plan meaning that it still provides value for money despite factors including more severe climate change and lower than expected water efficiency savings.

Furthermore, our sector leading innovation on driving down leakage has taken us to the frontier of leakage efficiency. In recent years we have adopted a number of innovative solutions to drive down leakage, including noise loggers and drones. In AMP7, we are proposing a number of new innovative solutions in order to achieve our next step change in reducing leakage and delay the need for more costly mains renewal schemes. This includes the roll-out of smart meters to reduce customer supply pipe leakage (CSPL) by nine Ml/d by 2025 and a new generation of our current noise loggers that will allow accurate leakage detection over much greater distances (due to the sensitivity of this further details cannot be provided at this stage). Many of these innovations have been trialed in our 'Shop Window' programme in Newmarket to prove their effectiveness before being rolled out more widely across the business. It is this culture of continuous innovation that will allow us to achieve our end of AMP7 leakage target of 147 Ml/d (3 year average) without relying on far more expensive solutions such as mains renewal.

Finally, where possible our costs are based upon our current out turn costs. This means that the delivery of our leakage control activities in AMP7 will include the embedded cost efficiencies that we have achieved up to this point in AMP6.

Is there high quality third party assurance for the robustness of the cost estimates?

UKWIR's 'Long-term Leakage Goals' report estimates the lowest achievable leakage savings and costs are now and what they might be in 25 years' time. These report found that leakage control costs rise gradually until the point where pressure management, metering and find and fix have reached their limit and mains renewal becomes the only way of achieving further leakage savings at a much-increased level of cost.

Also, we have commissioned Jacobs to provide independent technical assurance regarding the robustness of the information we submit in our business plan. They conclude that *"the plan is founded on reliable information resulting in a robust plan in which Anglian Water, its customers and stakeholders can have confidence"* (Anglian Water PR19 Technical Assurance Executive Summary, 13 August 2018). Jacobs have also provided assurance of costs included within our WRMP.

Management Control

Is the cost driven by factors beyond management control?

Reducing leakage is an important component of our long term demand management strategy. This strategy is driven by the need to off-set the increase in demand we expect as a result of forecast population and economic growth in the region. This increase in population and economic growth is out of our control. In addition, we must rely upon demand management options as far as possible to cope with this challenge because of the water stressed nature of our region. This is also beyond our control.

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

The costs have been controlled as far as is reasonable practical by considering an unconstrained list of possible demand management solutions. Multiple 'packages' were then subject to a robust cost benefit analysis process in order to identify the best value option for customers, under a range of alternative future scenarios. The costs of the leakage control aspect of our demand management plan have been controlled by using innovation to drive down leakage, rather than more costly mains renewal options. Costs have also been controlled by ensuring our delivery of leakage control activities is as efficient as possible. Evidence for this is provided in the 'obustness & Efficiency of Costs section above.

We have also applied further totex stretch efficiency and productivity challenges to costs, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

As a business we set out to honour our commitments. Customers can rightly challenge and ask what protection there is if we don't. For this investment the protection consists of the following implications for non-delivery:

- Potential to miss our leakage performance commitment and incur an underperformance financial penalty of up to £54m (AMP7 total) through the ODI mechanism.
- Reputational damage that could be reflected in our C-MeX performance, especially as leakage has increasingly become a customer priority.
- Reduced stakeholder confidence in our overall demand management plan to offset future increases in demand driven by population growth.
- Loss of our industry leading status with regards to leakage.
- If we fail to balance supply and demand, this could lead to water supply interruptions to supply and use bans. This could lead to underperformance penalty from our water supply interruptions and Guaranteed Standard of Service payments to customers.

Affordability

Has the impact on affordability been considered?

Most of our customers (>80%) say that a bill rise of up to 2.5% is affordable and good value for the investments we will deliver. Nonetheless, we know from a range of sources that some customers (<20%) have difficulties paying their bill. In AMP7 we will therefore deliver a step change with regards to supporting customers who have difficulty affording their water bill, with capacity to assist 475,000 customers per annum with our affordability schemes. We will also make this help much easier to access. This is covered in more detail in our '*Customer Bill, Affordability and Supporting Customers in Vulnerable Circumstances*' Chapter in the main narrative.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

Alternative approaches to meet housing growth demand would require the development of new sources and transfer pipelines. Our customers have informed us they do not like to see leaking pipes. Both the costs and the benefits from this strategy ensure that costs and hence bills are minimised.

Key Assumptions

That we achieve our 2020 leakage target of 177 Ml/d (as a three year average). This will be challenging but we believe we are on track to do so.

By the end of AMP7, 23.3 Ml/d of savings will be achieved through infrastructure renewal and optimisation schemes; the remaining 6.7 Ml/d reduction will be achieved through smart meter driven customer supply pipe leakage savings.

Catchment Management

Adjustments since IAP

There were no specific issues raised in the IAP since Ofwat's analysis focuses on the capex component of this enhancement case. We have adjusted our Plan to reflect the ban on metaldehyde and align with Ministerial Guidance.

Cost adjustment is required following the announcement of a UK wide ban on metaldehyde announced 19 December 2018. This ban means that from June 2019 onward it will be illegal to sell metaldehyde to persons wishing to use it outside. This includes all agricultural use that is not inside a greenhouse. The application of metaldehyde to land not 'under glass' will be illegal from June 2020 onwards. This requires us to make alterations to our catchment management proposals for metaldehyde control.

Reason for change: Existing catchment management proposals for metaldehyde control are based on product substitution e.g. paying farmers the cost difference between metaldehyde and the more expensive slug control alternative; ferric phosphate. We have been advised by the Environment Agency that once metaldehyde becomes illegal, we are not expected to include product substitution in our WINEP plans to control it.

Regulatory expectation is that we must support the introduction of the metaldehyde ban through continuation of our agricultural engagement activity and increased monitoring to demonstrate it has been successful in protecting drinking water quality. We have also been instructed from the Minister that catchment management must continue and the DWI therefore we continue to need investment in this area.

The resulting reduction in enhancement opex from these changes is £20.661m, with a small decrease in capex of £105k. An updated version of the expenditure table is shown below:

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total £m
Capex £m	A17	0.383	0.000	0.000	0.000	0.000	0.383
Opex £m	B56	4.744	5.918	2.757	2.746	2.655	18.820

The remaining opex of £18.820 is for catchment advice to farmers to encourage them to use best practice to reduce raw water pollution from pesticides, fertilizers (phosphate) and animal waste. This includes; events, farm visits, farm risk assessments, provision of mapping to show high risk areas and provision of performance data, investigation of failures, provision of information on environmental conditions to advise farmers on when to apply chemicals to minimise their loss to water, engagement with EA to bring about enforcement and additional monitoring to safeguard public health.

For the total pesticide element – this is a trial to see whether we can reduce pesticide loading in the raw water through working with faremrs to a sufficient level to reduce treatment (e.g. reduce ozonation or chemical use) or even to enable us to build smaller footprint treatment in future".

Capex solutions to the above would be;

- Metaldehyde – build new advanced oxidation treatment across our region (£595m capex, £18m p/a Opex additional running costs)

- Total pesticides – is none. This is a trial to see whether we can offset future capital costs of additional treatment or additional opex costs associated with reduction in certain treatment stages such as level of ozonation
- Phosphate – invest in additional treatment (such as we have had to do at Alton this AMP) to improve settlement and filtration to address issues with high turbidity as a result of algal loading risking compromise to disinfection.
- Livestock – install and operate UV at all potentially vulnerable locations or, seek new ground water sources in the event that a source had to be abandoned due to pollution.
- Nitrates – install additional nitrate treatment in all potentially vulnerable locations.

We refer Ofwat to WINEP/ NEP Drinking Water Protected Areas (Schemes) Model review in Chapter 5 of the IAP Response for our comments on the IAP Assessment of costs.

Price Control	Water Resources
Business Plan table and lines	Table: WS2 Lines: A17, B56

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A17	0.488	0.000	0.000	0.000	0.000	**Capex: 0.488**
Opex (£m)	B56	6.157	8.535	8.433	8.289	8.068	**Opex: 39.481**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £111.696m		
Whole life value (EAV)*: £102.943m					Whole life cost (EAC)*: £8.752m		

* Note: Annualised values over 40 years

Investment Summary

This investment is for a package of enhanced catchment management measures covering the areas below:

- Metaldehyde control in pumped catchments: we will extend our 'Slug it Out' campaign to pumped catchments within our high risk areas, working collaboratively with an estimated 8,500 farmers.
- Total pesticides: we will broaden our current approach to develop 'in-yard' interventions for total pesticides to prevent raw water pollution within a trial area. We hope to understand how this approach could reduce pesticide treatment costs in the future, if rolled out more widely in AMP8.
- Agricultural phosphorous control: we will focus on our surface water impounding reservoirs with known nutrient issues to reduce our risk of extreme algal growth which leads to treatment challenges and threatens supply security. This will be achieved through working with farmers to provide on-farm advice and education, aimed at reducing nutrient losses into water bodies. For example, the type of fertilizers purchased and the way in which they are stored and applied.
- Livestock high risk groundwater sources: engage with the entire supply chain on the potential detrimental impact that intensive livestock farming can have on raw water quality if livestock is located within a Source Protection Zone (SPZ). We continue to engage with the Environment Agency (EA) on this in seek of their support.
- Groundwater nitrate engagement: work with farmers in key locations to reduce their use of nitrate fertiliser which causes contamination of raw waters used for abstraction.
- Groundwater Drinking Water Protected Areas investigations: an investigation at Barnham Cross to investigate rising solvent concentrations. We continue to engage with the EA on this in seek of their support.

Need for Investment

Is there persuasive evidence that an investment is required?

We have agreed with the Drinking Water Inspectorate (DWI) that our current metaldehyde undertakings shall be extended into AMP7 and shall reflect the enhanced approach to widen our Slug It Out activities, we shall submit our revised surface water Undertaking in line with the regulatory deadlines.

A number of regulators and the Government (the EA, the DWI, Defra) in high profile documents have outlined their support for catchment management. For instance, the Water Industry Strategic Environmental Requirements (WISER) encourages companies to develop catchment management activities to reduce pollution in the waterbodies from which they abstract. The DWI expect companies to include catchment management as part of a risk based approach to understanding and mitigating risk to water quality. Catchment management is also a fundamental element of our refreshed Strategic Direction Statement. As a result of our commitment to catchment management, we were recently asked to co-create the Catchment Declaration by HRH Prince Charles, a collaborative initiative bringing together private, public and third party sectors to jointly deliver catchment management solutions. It recognises that the challenges to water across the UK cannot be resolved by any one organisation or sector alone and supports the delivery of the Governments 25 Year Environment Plan.

The success of AMP6 programmes has shown the benefits catchment management can deliver. Thus, for AMP7 the scope will be extended over a greater number of catchments.

What incremental improvement would the proposal deliver?

Catchment management can provide far greater natural and social benefits alongside greater cost efficiency compared to 'end-of-pipe' treatment solutions, therefore providing a more attractive solution for both our customers and the environment.

During AMP5 we built our first Water Treatment Works (WTW) to treat metaldehyde (Hall WTW). This provides a template to replicate the treatment process at our other surface WTW and enables us to forecast the cost of end of pipe treatment for metaldehyde. We estimate the capital expenditure to be £595m with an additional operational expenditure of £18m per annum. A catchment management solution, incentivising farmers not to use metaldehyde in the first instance provides the opportunity for a far a more cost effective option. It should be noted that the benefits of catchment management do not solely relate to metaldehyde, but also to wider agricultural issues such as nutrient losses. When combined with treatment, catchment management reduces the risk of exposing our customers to unacceptable water quality, whilst having positive impacts on our carbon and sustainability targets.

We have trialled product substitution for metaldehyde around six of our strategic impounding reservoirs as part of our 'Slug it Out' campaign. This has involved the natural catchments with the exception of a small pumped catchment trial. These trials have proved largely successful. More broadly, engagement has been undertaken over a range of agricultural issues as we seek to build relationships to take the programme forwards on a wider footing in AMP7.

Our catchment management approach has also included significant collaborative stakeholder engagement. This has allowed additional initiatives such as pesticide amnesty and partnership working to deliver a wide range of different initiatives. All other areas of proposed investment including the extension of 'Slug it Out' to cover pumped catchments (representing a scaling up of the AMP6 work) are new and represent an increase in our catchment management activity as expected or requested by our regulators (EA, Defra, DWI) and through advisory legislation (WISER and WINEP). This will see a scaling up of farmer engagement from working with numbers in the hundreds in AMP6 to thousands in AMP7 (8,500 farmers are forecast to manage land in our high risk areas).

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

Simon King, Farmer, Lincolnshire:

"We think having a Catchment Advisor is a good thing, and does help us, particularly with focusing on slug pellet use reduction. [We] view Anglian Water more as partners in protecting water, than just another water company".

Need for Enhancement Expenditure

Why is it enhancement (and not base)?

This expenditure is considered to be enhancement (rather than base) as it enhances drinking water quality by improving the raw water quality within the associated catchments in the long term. Our catchment activity for metaldehyde aims to reduce the risk of non compliance as required by our statutory obligations. This forms part of our risk based approach to minimise pollution in the water we abstract and to avoid, where possible, raw water quality deterioration. Our long term aim is to reduce end-of-pipe treatment requirements which are expensive both to build and maintain. This expenditure will support our 'Safe, Clean Water' outcome, one of our 10 long term outcomes set out in our refreshed Strategic Direction Statement published in 2017, that we will deliver for our customers and the environment.

What does the expenditure enhance?

This enhancement expenditure will allow us to increase the scale of the catchment management activities undertaken in AMP6, and undertake new activities and scope never undertaken before. In our base operating costs, we have allowed sufficient to continue with our current level of activity funded from enhancement in AMP6 as a pilot. This expenditure has been promoted after extensive discussions with the Drinking Water Inspectorate as the measures proposed will become a statutory requirement for the extension of our current metaldehyde, clopyralid and total pesticides surface water Undertaking.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

Our Customer Research & Engagement Synthesis report (2018) provides evidence of customer support for a number of areas directly related to catchment management. For instance, 'Safe, Clean Water' is considered as the most important of the ten customer outcomes with 97% of customers feeling this was important (p50); in the Acceptability research on the Strategic Direction Statement 'A Flourishing Environment' was ranked 6th of the 10 outcomes, with 83% of customers saying this was important (p206), and there was some support for the principle of prevention being better than cure (p139). Customers are also generally supportive of Anglian Water working in partnership with other stakeholders. Our Customer Engagement Forum has commented positively on our approach to catchment management and the desire to see this extended during AMP7, which this proposal takes forward.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

A ban on metaldehyde has been considered as the best and most effective option and this is something we have lobbied hard for a decision on. As a metaldehyde ban is yet to be implemented, we have also considered investing further in end-of-pipe built solutions. However, as stated, this does not provide the best value option for customers given the anticipated costs, based on those incurred as a result of constructing and running Hall WTW.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

End of pipe treatment has been considered and costed for metaldehyde removal based upon the advanced oxidation treatment process installed at our Hall WTW. These costs are significant, hence our decision to pursue catchment management as a longer term, more cost effective and sustainable solution that delivers wider environmental and societal benefits. The estimated capital cost of rolling this out to all our surface water sites is £595m and £18m per annum additional operating costs.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

For our surface water Undertakings, we have limited the number of catchments and areas by taking a risk based approach. We have identified that we should focus on pumped catchments for our product substitution activities. For agricultural phosphorous this is based on our surface water sites deemed to be of high algae risk. For total pesticides we have included costs for a limited number of farm yard sites following a risk based approach for this trial work.

Has the impact on natural capital and the environment been considered?

There is a growing expectation amongst Government, regulators and our customers that we should aim to address pollution at its source with positive natural capital and environmental benefits, as opposed to relying on engineered and chemical-dependent end-of-pipe solutions. This has led to an increased interest and expectation around catchment management activities. In addition to meeting these expectations, catchment management and natural capital enhancing solutions will form an essential part of our totex delivery thinking in AMP7 where they afford greater benefits (environmental and societal) and financial efficiency over more traditional 'end-of-pipe' asset creation options.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Is there high quality third party assurance for the robustness of the cost estimates?

Costs have been developed from out turn AMP6 costs. The efficiencies already achieved therefore form the baseline for our future costs estimates as described in the Efficiency & Innovation chapter of our Plan. The costs for incentivising farmers are reflective of market rates and have been reduced from AMP6 rates. Full details of where costs have been derived from and the assumptions behind how cost models were built are included within the supporting evidence in our C55 investment system. This has been externally audited by our third party technical assurance providers, Jacobs. The efficiencies that are possible from taking a modular approach to built solutions in other cases are not applicable here, given that the reason we are pursuing catchment management is to avoid the need for build solutions.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The measures proposed for metaldehyde will form part of our extended surface water legal Undertaking and as such are not within our control. Our current metaldehyde, clopyralid and total pesticide undertaking for our surface sites expires on the 31 March 2020. This programme of enhanced activity within our high risk areas shall become a statutory requirement for their extension into AMP7.

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

If we adopted end of pipe solutions for metaldehyde across our region, the estimated capital cost would be £595m, in addition to operational costs of £18m per annum. A catchment management solution incentivising farmers to adopt more environmentally sensitive farming techniques and to use alternatives to metaldehyde in the first instance is by far a more cost effective option.

We are further controlling overall catchment activity costs by taking a risk based approach to limit the number of catchments in which we will focus in AMP7. We have identified that we should focus on pumped catchments for our metaldehyde product substitution activities, whereas for agricultural phosphorous we will focus on our high algae risk surface water sites. For total pesticides we have included for a limited number of farm yard sites for this risk based trial.

We are not fully funding all the measures we are proposing. Instead, we are taking a partnership approach with only marginal cost of product substitute being allowed. This approach is being adopted for pesticides where we will work with farmers to develop 'in yard' controls where part funding has been allowed.

We have also applied further totex stretch efficiency and productivity challenges to costs, as described in the *Efficiency and Innovation* chapter of our Plan.

Finally, we have also worked extremely hard over a number of years to make the case to Government for a partial ban on metaldehyde which would reduce costs to customers and the environment.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

The metaldehyde programme of work will be included within the Undertaking process, therefore setting out a legal obligation for us to deliver against the Undertaking requirements. We have a strong track record in delivering against our regulatory requirements and to date have not missed a regulatory deadline. Additionally, progress reports are a key requirement of the obligation and enforcement action could be considered by the DWI if we fail to meet the Undertaking.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

Failure of the metaldehyde and total pesticide standard would impact on the Compliance Risk Index (CRI) and potentially the Event Risk Index (ERI), as measured by the DWI. The CRI and ERI are also stand alone performance commitments within our PR19 business plan. It also would be an infringement of The Water Supply (Water Quality) (Amended) Regulations 2018.

Through our Natural Capital performance commitment, we will report our delivery of catchment management and record its contribution to improving the natural capital of our region.

Customers will gain in the long term through a reduced need for additional expensive end-of-pipe treatment solutions.

Affordability

Has the impact on affordability been considered?

This investment will reduce bills in the long term by mitigating the need to construct and operate expensive treatment plants as described above.

Key Assumptions

Metaldehyde prices will remain stable post Brexit.

Government policy changes post Brexit will not encourage significant intensification of UK agriculture.

Lead and Water in Buildings

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

However, we have provided additional information on the breakdown of the analysis of pipe replacement.

Based on our historical costs and cost base models, the cost to replace a lead communication pipe was £1028, at an average length of 2 metres, giving a unit rate of £514 per metre of pipe replaced. For AMP7, our proposal includes the replacement/rehabilitation of both the communication pipe and the customer owned side of the pipework. The length therefore is significantly longer, our cost build up uses an estimated average of 20 metres. We have estimated the cost to replace 5250 lead pipes (from water main to kitchen tap) as £22.305m, giving a cost of £4,229 per pipe and a unit rate of £212 per metre which is in line with the industry average.

We have developed our planned and reactive pipe replacement investment to align to the 'Long term planning for quality of drinking water supplies' and the DWI requirement to consider the benefits of the replacement of the customer side of the pipework.

We refer Ofwat to the model review of the Wholesale Water Enhancement feeder model Lead Standards (Chapter 5) for our response to the IAP assessment of costs.

Price Control	Water Network Plus
Business Plan table and line(s)	Table WS2 Lines: A6, A25, B45, B64

Lead

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A6	3.250	6.690	6.377	5.803	2.903	**Capex: 25.023**
Opex (£m)	B45	0.862	0.929	0.982	0.9990	0.966	**Opex: 4.728**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £0.909m		
Whole life value (EAV)*: £0.496					Whole life costs (EAC)*: 0.421m		

* Note: annualised values over 40 years

Water in Buildings

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A25	0.000	0.000	0.000	0.000	0.000	**Capex: 0.000**
Opex (£m)	B64	0.314	0.281	0.276	0.270	0.262	**Opex: 1.403**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £0.005m		
Whole life value (EAV)*: £-0.280m					Whole life cost (EAC)* £0.285m		

* Note Annualised values over 40 years

Investment Summary

This investment is to continue to meet the lead standard as set out in our lead strategy. The best value option for mitigating levels of lead in drinking water is an integrated package of measures that includes:

- planned replacement / rehabilitation of lead communication and service pipes when necessary
- reactive replacement / rehabilitation of lead communication and service pipes when necessary
- the installation of seven new orthophosphoric acid dosing plants, and
- the uprating of three existing orthophosphoric plants.

Our Water in Buildings Strategy is an integrated package of measures used to assess and manage the risks to consumers posed by the quality of water within public buildings. This strategy was implemented during AMP6 and has been continually developed and enhanced for AMP7. A percentage of customer complaints received annually are attributable to breaches of the Water Fittings Regulations and a number of Drinking Water Inspectorate (DWI) reportable events have been directly linked to issues on customers' property caused by infringements of the Water Fittings Regulations. Further enhancement to our Water in Buildings strategy will include:

- identifying and inspecting additional public buildings which are not covered by our current Notice requirements
- a collaborative approach to working with Trading Standards to aid and enforce point of sale compliance for the sale and distribution of compliant fittings and products aimed at retailers and manufacturers, and
- further development of our customer awareness and behavioural change campaign promoted through our 'Keep Water Healthy' and social media proactive approaches.

Need for Investment

Is there persuasive evidence that an investment is required?

There is a need for investment because we assess lead pipework to pose a risk to drinking water quality across the Anglian region. As part of our drinking water safety planning approach, we undertake an assessment of risks to water quality relating to lead across our public water supply zones. Our lead strategy includes a programme of measures to secure or facilitate compliance with the lead standard across the Anglian Water region. Additionally, our Water in Buildings strategy assesses a region wide risk to our consumers posed by the water quality risks arising from Water in Buildings. We currently have Regulation 28 Notices covering our lead and Water in Buildings strategies.

We estimate we have circa 517,000 lead communication pipes in our region. The Water Supply (Water Quality) (Amended) Regulations 2018, require companies to inform customers of the health risks of lead and ways to reduce lead levels at the customer's tap following any infringement of the lead standard. It also requires us to replace our communication pipe following non compliance with the standard if found to be lead.

Investment in this area is also important; we have strong evidence for limited customer awareness of the potential detrimental impact of plumbing changes on drinking water quality within buildings. This evidence is available from a national survey which the WRAS (Water Regulations Advisory Scheme) undertook in February 2017 to measure the understanding of consumers and the approach of retailers at the point of sale to some key questions. Additionally infringement of Water Fittings Regulations can be evidenced through water quality event notifications and compliance data.

What incremental improvement would the proposal deliver?

At PR09 we created a risk based lead strategy to cover a series of approaches and programmes of work delivered by an integrated package of measures. This included the uprating or first time installation of plumbosolvency control at a number of water treatment works (WTW), planned lead pipe replacement or rehabilitation, customer education on the risks associated with lead

pipework and subsequent risk of elevated lead levels in drinking water, in addition to a collaborative approach working with public health teams to identify vulnerable customers and provide specific customer education and advice.

Our lead strategy has been further developed as part of the PR19 process for AMP7 and was submitted to the DWI by the required deadline of 31 December 2017. The DWI Guidance Note: 'Long term planning for quality of drinking water supplies', requires companies to continue with the implementation of their risk based approach to manage compliance with the lead standard. The guidance note reiterates the seven measures which should be in all companies risk based approach to lead. Our strategy includes all seven of these measures. The guidance note also requests that companies consider opportunistic replacement of lead communication pipes and customers' service pipes as part of planned replacement work and following any lead PCV failure. Following further discussions with the DWI, the inspectorate also wishes companies to consider replacement up to the kitchen tap. We will conduct trials in AMP7 using innovative techniques to rehabilitate the entire supply pipe up to the customer's tap. This will inform our longer term strategy around lead and help us to prepare for a potentially lower lead standard of 5 micrograms/l; this is currently under consideration as part of the amendments to the Drinking Water Directive.

We have also developed our Water in Buildings approach for AMP7 which was successfully submitted to the DWI. This includes additional areas of opportunity, especially with the customer educational packages of work, behavioral change through our 'Keep Water Healthy' campaign and the delivery of NVQ training modules at plumbing colleges across the region. Recent water quality reportable events and property inspection outcomes continue to highlight the issue of maintaining compliance with Water Fittings Regulations within domestic and public buildings.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

This investment directly relates to achieving our 'Safe, Clean Water' outcome, which we know is a priority for our customers.

"Participants in several qualitative research and engagement activities identified that delivering high quality, safe, clean drinking water is a fundamental expectation of the company"... "In the Acceptability research on the Strategic Direction Statement, customers judged safe, clean water as the most important of Anglian Water's ten outcomes (97% saying this was important" (Anglian Water Customer Research & Engagement Synthesis report, 2018, v.14, p127).

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our Plan is driven by the requirements of our customers.

Need for Enhancement Expenditure

Why is it enhancement (and not base)?

This expenditure is considered to be enhancement (rather than base) as it enhances the quality of drinking water we supply to our customers. This is supported by the Drinking Water Inspectorate (DWI) under Regulation 28 Notices. The DWI letters of support references are ANG03 - lead strategy – lead and ANG05 - Water in Buildings – various parameters. In our Strategic Direction Statement published in 2017, 'Safe, Clean Water' is one of our 10 long term outcomes that we will deliver for customers and the environment.

What does the expenditure enhance?

Specifically, the expenditure enhances water quality by reducing the likelihood that the drinking water standard for lead and various parameters will be exceeded at the customers' tap.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

This investment relates to our 'Safe, Clean Water' outcome. This is a fundamental customer expectation and is seen as the most important of Anglian Water's ten outcomes. Achieving 100% compliant and chemical free drinking water is seen as the most important of the company's seven water quality and customer satisfaction goals.

A package of measures currently delivers a programme of work against our lead and water in buildings Regulation 28 Notices which are aligned to our lead strategy and our Water in Buildings strategy. The DWI's expectations are for companies to continue with a risk based approach by way of a lead strategy and details what measures should be included. Additionally the inspectorate expects companies to continue to enforce the Water Supply (Water Fittings) Regulations 1999 to protect wholesomeness and consumers. This investment is therefore largely driven by regulatory requirements.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

We considered not including the replacement/rehabilitation of customers' service pipes following opportunistic work on the distribution system and following PCV failures. However, this was supported as being valuable to inform future thinking.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement? Has risk been assessed? Have flexible, lower risk solutions been assessed?

Our Risk Opportunity and Value (ROV) process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution. This process has been assessed and is supported by the Drinking Water Inspectorate. *"As with previous periodic reviews Water Companies seeking technical support from the Inspectorate must demonstrate the need for each proposal. The case for justification must be accompanied by evidence of the company's option appraisal process to identify the most robust sustainable and cost effective solution with evidence that the preferred solution will adequately address the risk and deliver the required outcome within an appropriate timescale."* PR19 Drinking Water Inspectorate statement for Anglian Water Services Ltd Customer Engagement Report to Ofwat 29th June 2018'

Our cost benefit analysis is informed by the customer valuation work we have carried out for PR19. In our research we have found that in general our customers have not expressed a strong willingness to pay for addressing lead in drinking water relative to other issues such as leakage. For this reason the analysis shows this investment as not cost beneficial based on customer opinion alone. However, we have worked with the Drinking Water Inspectorate to develop a programme that addresses public health risk in the highest risk areas, and believe that the proposed investment is proportionate.

Has the impact on natural capital and the environment been considered?

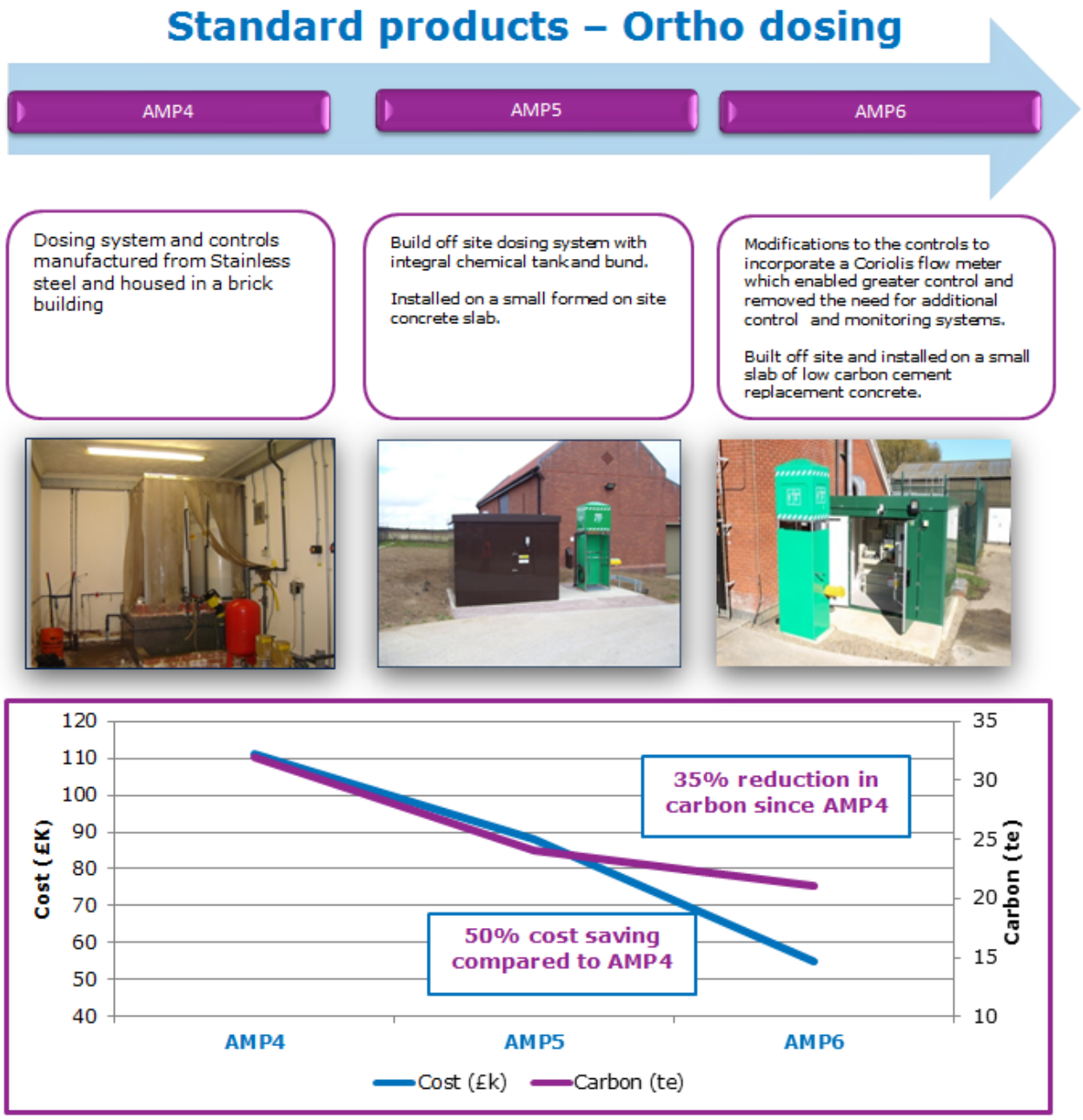
Wherever possible low carbon solutions such as 'no-dig' technology will be utilised; innovative techniques for in-situ rehabilitation are being trialed in AMP7.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Costs have been developed from out turn AMP6 costs so that efficiencies already achieved form the baseline for our future costs estimates as described in the *Efficiency and Innovation* chapter of our Plan. Costs for communication pipe replacement and new or uprated plumbosolvency control schemes are based upon cost base models which are all validated models based on current out turn costs which have embedded efficiency.

The schematic overleaf shows the history of cost reduction in dosing plants over the past three AMPs. The unit costs have virtually halved since AMP4. The costs used in our plan reflect our current costs with these efficiencies embedded.



Cost	£111.2k	£88k	£55k
Carbon	32te	24te	21te
Number delivered	17	23	18
Average time on site	6-7 weeks	3-4 days	3-4 days

Is there high quality third party assurance for the robustness of the cost estimates?

Our approach here has been externally audited by our third party technical assurance providers Jacobs.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The cost of this investment is outside of management control because it is driven by our statutory obligation under The Water Supply (Water Quality) (Amended) Regulations 2018, to ensure that we are compliant with the standards. The DWI expects water companies to have a lead strategy and also to have a Water Fittings Regulation inspection programme and to enforce the Water Supply (Water Fittings) Regulations 1999.

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

In addition to basing our estimates on efficient costs drawn from our AMP6 performance, we have then applied further totex stretch efficiency and productivity challenges to those costs, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

These schemes will be covered by the Regulation 28 Notice process, therefore setting out a legal obligation to deliver against the Notice requirements. We have a strong track record in delivering against our regulatory requirements and to date have not missed a regulatory deadline. Additionally, progress reports are a key requirement of the obligation and enforcement action could be considered by the DWI if we fail to meet the Notice requirements.

Failure of the drinking water quality standards would impact on the Compliance Risk Index (CRI) and potentially the Event Risk Index (ERI) as measured by the DWI. The CRI and ERI are also stand alone performance commitments within our PR19 business plan. It also would be an infringement of The Water Supply (Water Quality) (Amended) Regulations 2018.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

This claim will provide customer benefits in the form of improved drinking water quality. This directly relates to our 'Safe, Clean Water' outcome.

Affordability

Has the impact on affordability been considered?

The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills. It is also worthy of note that "findings from the events suggest people's priorities may change on receiving more information. For example, water quality was re-prioritised above affordable bills when customers were made aware of the extent of lead piping in the system and the need to replace this" (Anglian Water Customer Research & Engagement Synthesis report, 2018, v.14, p48).

Key Assumptions

We will continue our risk based approach to lead as supported by the DWI, which includes a package of measures to include enhanced plumbosolvency control, planned pipework replacement, working collaboratively with health professionals and local authorities (where applicable, particularly focusing on vulnerable customers with respect to lead), and general customer education and awareness.

Additionally, we shall continue our risk based approach to Water In Buildings which is also supported by the Inspectorate and covers additional public building inspections, collaborative working with Trading Standards and customer education and awareness.

Security of Network & Information Systems (NIS) Compliance

Ofwat feedback:

ANH is proposing to spend £15.2m on security covering both SEMD (£1.7m) and non-SEMD (£13.6m).

We consider that some of the costs to upgrade or replace older systems should not be classed as enhancement expenditure and should form part of its base allowance. We propose the following changes:

- Disallow £1.7m planned to upgrade its CCTV at its CNI and NI sites.

- Propose to reduce cyber costs by 25% as we consider some of these costs includes replacement costs and should be included in base costs.

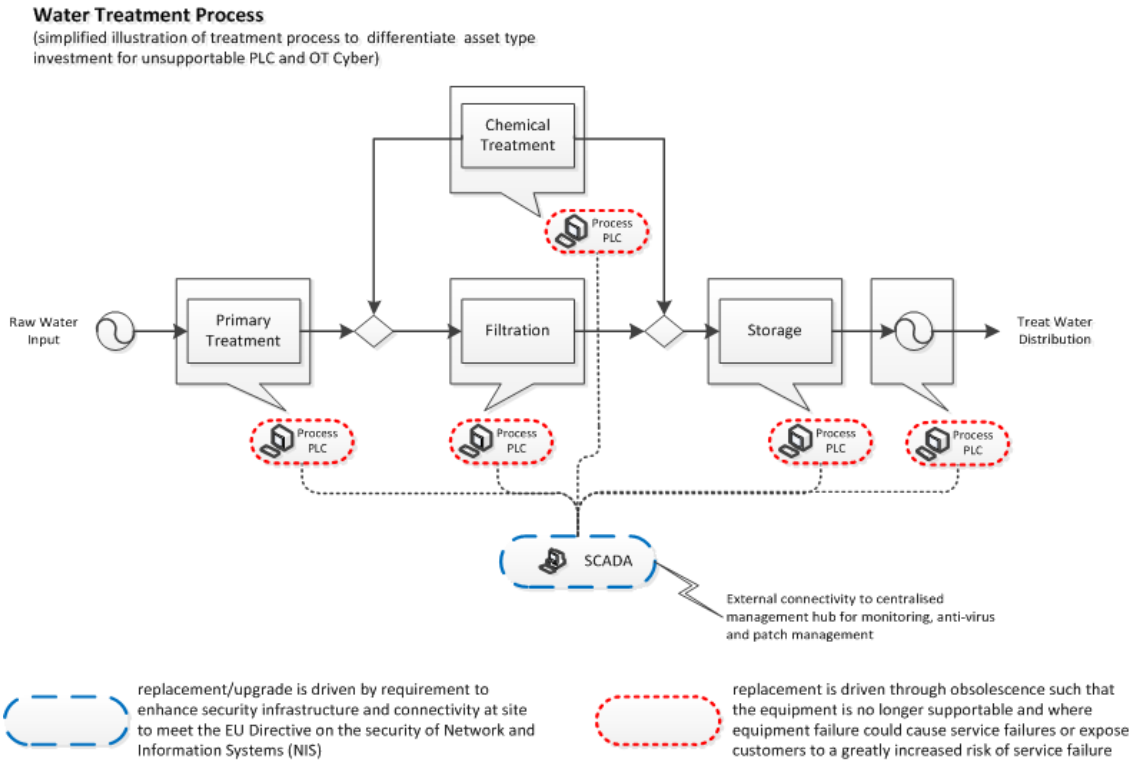
Our response to IAP feedback

This expenditure is not for replacement of obsolete existing equipment. The activity is to provide additional security infrastructure and connectivity at our sites to meet the EU Directive on the security of Network and Information Systems (NIS) approved in August 2016. This expenditure is therefore enhancement not maintaining existing equipment under Botex.

Historically, equipment is not replaced via a maintenance strategy but instead the need to replace is driven through obsolescence such that the equipment is no longer supportable and where equipment failure could cause service failures or expose customers to a greatly increased risk of service failure. Assets are usually classed as unsupportable once manufacturer spares availability and support ceases, and support from third parties and/or in-house capabilities is no longer obtainable.

Our unsupportable PLC investment will continue into AMP7 in parallel with and in addition to this Cyber Security investment. The former replaces the in-process control systems (the PLCs for WTW filters, for example) whereas this Cyber Security investment will focus on making the overarching site SCADA system secure.

Picture 4



In previous AMP's, unsupportable PLC replacement investment has been on average around £1.5m per AMP which is prioritised alongside other obsolete equipment needs. Whilst this varies according to emerging need through the AMP, we plan to spend a similar amount in AMP7 to be funded through the Water Obsolete Equipment planning portfolio included within our Botex plan. The additional investment in this enhancement case is therefore not represented in historic spend, and is therefore not included in Botex modeling and should be considered wholly enhancement expenditure over and above maintenance expenditure.

We refer Ofwat to the Water SMD and non-SEMD costs model review in Chapter 5 of the IAP Response for our comments on the IAP Assessment of costs.

Price controls	Water treatment and bioresources
Business Plan table and lines	Table: WS2 Lines: A26, B65

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A26	3.357	3.357	3.360	3.362	0.000	**Capex: 13.437**
Opex (£m)	B65	0.354	0.348	0.343	0.335	0.327	**Opex: 1.706**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £2.790m		
Whole life value (EAV)*: £-0.374m					Whole life cost (EAC)*: £3.163m		

Please note: see WWS2 'Security of Network & Information Systems (NIS) Compliance' enhancement case for totex expenditure details. The text in this enhancement case covers the WS2 and WWS2 'Security of Network & Information Systems (NIS) Compliance' investments, so is not repeated in the WWS2 Management & General Enhancements case.

*Note: annualised values over 40 years

Investment Summary

This investment is required to enable us to comply with the EU Directive on the security of Network and Information Systems (NIS) approved in August 2016. As an 'operator of essential services', we need to be compliant with the new directive. To achieve this, we need to:

- implement a reference Operational Technology (OT) secure architecture
- survey the most vulnerable sites to understand the risk they pose to Anglian Water should they be subject to a cyber-incident and assess the remedial work required to bring them in line with the reference architecture
- implement remedial work at the highest risk sites
- implement Core Data Centre systems and networks required to deliver the reference architecture
- penetration test Supervisory Control and data acquisition (SCADA) systems, and
- develop cyber security standards based on the Security Policies for OT/SCADA systems.

We have identified approximately 120 sites with SCADA and HMI control systems that would be considered within the scope of this directive. This will enable us to upgrade and centrally connect these industrial control systems responsible for water supply. Moreover, the move towards interconnectivity will help us to run our sites in a smarter and more resilient way.

Need for Investment

Is there persuasive evidence that an investment is required?

The EU Directive on the security of Network and Information Systems (NIS) was approved in August 2016, giving Member States 21 months to embed the Directive into their respective national laws. The DWI has published its 'Day 1 Guidance' to provide an overview of the implementation of the NIS Regulations 2018 for the water sector and inform operators of the essential service (OES) of what to expect when the Regulations come into effect. This is a new Directive that requires enhanced security measures beyond our current practice, reflecting the fact that cyber risk facing national infrastructure has become an increasingly recognised issue.

Because we are one of the organisations deemed by the NIS Competent Authorities to be an 'operator of essential services', we need to be compliant with the new Directive. Additionally, security services (such as SOC) can be utilised to monitor the real time status of our critical networks to ensure their resilience. It is critical to our business that cyber security is an integrated part of these developments, rather than an afterthought.

Our control systems are legacy and thus very difficult to secure. With the introduction of NIS and the drive towards new technologies and site to site interconnectivity, we cannot continue to operate using outdated and therefore vulnerable operating systems and hardware, especially as the global cyber risk continues to increase. As such, we asked an independent third party organisation (Atkins) to undertake a cyber security assessment on our behalf to validate our current understanding of risk within our Operational Technology estate and identify any potential areas of risk. This also examined potential changes which are expected to affect operations in the future, for instance increased regulatory focus on cyber security, cloud adoption for data storage and interconnectivity of sites.

The initial risk assessment work undertaken by Atkins examined potential changes which are expected to affect our operations in the future. The key areas highlighted are:

1. Increased regulatory focus on cyber security – the recent launch of a cyber security strategy for the UK water industry and European initiatives such as General Data Protection Regulations (GDPR) and the Network Information Security (NIS) directive make it clear that we will be held responsible for making sure that our customers are protected from cyber-attacks.
2. Ubiquitous connectivity – the Internet of Things (IoT) and the Industrial Internet of Things (IIoT) are familiar terms now. The Internet Protocol (IP) underpins these developments and unfortunately exposes them to all the associated risks that IT has been dealing with for decades. It is critical

to our business that cyber security is an integrated part of these developments rather than an afterthought. The technology will pose security issues but also provide for significant business benefit and operational efficiencies if implemented securely.

3. Mobile technologies – this type of communication will decrease the attack surface as the use of simple existing protocols such as GPRS will be readily adopted in remote machine-to-machine (M2M) networks, that can detect, isolate and function independently, requiring minimal human intervention. For the water industry, in general, the emerging M2M technology will enable smart pipes to measure water quality, detect leaks, distribute water, detect problems, and many more.
4. Cloud adoption – this goes hand in hand with IoT and IIoT. Cloud will be the preferred repository for data collected by IIoT devices so it will be essential that security requirements for cloud can be specified and audited by Anglian Water. A migration to the cloud or use of cloud appliances with control systems requires a thorough analysis of the potential challenges and risks. Vendor-based solutions that utilise cloud computing will continue to develop, beyond secure hosting and distributing SCADA applications. These new applications, software and appliances will resemble Software as a Service (SaaS) and offer special features that are tailored to control system implementations and industrial sectors. Their value will lie in the enhancement of control system performance, increased availability and reduced cost of ownership.
5. Inter-connectivity of sites - Recent trends underlined the tendency towards a redesign in network or system architecture to perform interconnectivity both internally and externally by maintaining an acceptable level of service in the face of various faults and challenges to normal operation. Resilience through smart relay interconnectivity that communicates with Remote Terminal Units (RTU) using fibre-optic connections in accordance with standard protocol IEC-61850 is a growing trend in operational technology. Although this may be a trend that requires tremendous resources it is possible to utilise this technology in a smaller scale and where criticality is paramount.
6. Everything as a Service (EaaS) – increasingly we will find that vendors prefer a service model to a product model. Assessing the cyber security of a vendor and understanding the impact of a breach requires a different approach to assessing internal risk.
7. Increased role in the power market – We are a major consumer of electric power and a significant generator as well. As this market becomes more flexible there will be more opportunities but exploiting them will require secure and reliable access to data.

What incremental improvement would the proposal deliver?

Although this investment is to comply with a new obligation, securing our legacy operational technology could enable smarter operational sites making use of modern interconnectivity in the future that could provide significant business benefit and operational efficiencies.

This investment will deliver the following:

- Creation of a reference Operational Technology secure architecture based on the latest OT security policies, covering all OT systems, not just SCADA
- Surveying the most vulnerable sites to understand the risk they pose to Anglian Water should they be subject to a cyber-incident
- Implementing Core Data Centre systems and networks required to deliver the reference architecture
- Assess each surveyed site to determine the remedial work required to bring it in line with the reference architecture
- Implementing remedial work at the highest risk sites
- Penetration Testing for SCADA systems
- Developing Cyber Security Standards based on the Security Policies for OT/SCADA systems

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

Customers told us through their feedback on our SDS they expect us to digitally transform our business. This was expected to be here and now rather an a future, longer term ambition.

"The online activities focused on cybersecurity found that the NIS Directive was viewed as a step in the right direction. The Directive aligned with customer views about water being a precious resource that needs to be safeguarded. It was seen as reassuring and helpful in driving up standards…" (Anglian Water Customer Research & Engagement Synthesis report, 2018, v.14, p46).

Need for Enhancement Expenditure

Why is it enhancement (and not base)?

This expenditure is considered to be enhancement (rather than base) expenditure because it is in response to a new regulatory obligation that enhances the quality of the service we are able to provide our customers by increasing the security of our customers water supplies. Whilst this investment does not in itself allow us to operate our sites in smarter ways, failure to adequately protect our legacy operational technology on our sites will hinder our ability to take advantage of more modern technologies in the future for the benefit of our customers.

What does the expenditure enhance?

Enhancing the security of our vulnerable highest risk sites, our network and information systems will provide lasting benefits to our current and future customers through enhancing the resilience of our assets. Thus, this contributes to our 'Resilient Business' outcome goals.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Overall, our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our Plan is driven by the requirements of our customers.

As it is a legal requirement that we comply with this NIS Directive, we must progress with a hardware refresh scheme across our region. Nonetheless, the topic of cyber security has been explored for the first time in a series of discussions in the online community. This found that cyber security is a real concern for customers and they expect us to have a high level of cyber security in place that goes beyond the minimum.

In a poll conducted as part of the online discussions, 53% of customers felt that we should go above and beyond minimum security standards, even if this involved additional cost, 44% felt that the company should ensure all aspects of the company were safe, but at a "reasonable" cost, and only 3% felt that we should be focused on meeting the minimum standards required to comply with the law.

Although some customers expected anti-virus measures to be part of the existing system, and others reacted against having to spend more to protect against carelessness by third parties (feeling this should be resolved by those responsible and covered by their insurance), in relation to our asset protection plan, there was particular buy-in to the notion of protecting against external attacks on water assets (p47).

Source: Anglian Water Customer Research & Engagement Synthesis report, 2018, v.14

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

This investment covers an assessment of our highest risk sites which we believe will fall within the scope of the NIS directive: these are Water Treatment Works and Sludge Treatment Centres. Remedial work will be directed to the highest risks identified from this work. We have not included works on all sites which may be vulnerable to attack (such as Water Recycling Centres) as the risk is deemed to be lower and they may fall outside the scope of the NIS directive. We will however enhance security to the OT on these sites as part of individual cases to invest as and when greater connectivity and more modern technologies can drive business and customer benefit.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Our proposed option allows for remote security updates to high risk sites. An alternative considered was for manual security updates but was rejected – whilst this would allow for modest savings on the proposed programme within AMP7, this solution would need to be repeated for all future AMPs, whereas by moving to remote updates we fundamentally change our ability to manage security at those sites efficiently over the long term.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

The proposed approach is risk-based and will only remediate high risk sites under the NIS directive, the exact requirements of which remain unclear.

Has the impact on natural capital and the environment been considered?

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient? Is there high quality third party assurance for the robustness of the cost estimates?

As each site has it own design characteristics until a full site survey is completed to determine complexity and configuration the actual on site remediation costs for each site are unknown.

The cost model used is based on known identifiable assets and an average per site cost based on the introduction of equivalent capability previously commissioned for IT services (for example BT fixed line communications).

Costs have been developed from outturn AMP6 costs so that efficiencies already achieved form the baseline for our future costs estimates as described in the *Efficiency and Innovation* chapter of our Plan.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

Although it will deliver improvements to the security of the service we provide our customers, this investment is driven by the need to comply with the EU directive on the security of network and information systems (NIS).

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

We have limited the scope of this activity to Water Treatment and Sludge Treatment sites only due to the higher level of risks at those sites and so reduced the scope of activities to help control the cost.

The costs have been derived by developing average unit costs models for the programme. We have then applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

We are legally obliged to comply with the NIS directive and deliver on its requirements. In addition, failure to adequately secure our operational technology from rising cyber security threats exposes us to attack that could significantly damage our performance against ODIs such as supply interruption and C-Mex.

The reputational damage suffered by businesses affected by cyber security incidents are significant, and could be catastrophic if the incident compromised the supply of drinking water to our customers.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

Affordability

Has the impact on affordability been considered?

Our cost model allows the best value, lowest whole life costs to be identified. This has helped us to ensure that whilst the enhancement is to help us meet a legal requirement, we are delivering it in a way which does not raise bills higher than absolutely necessary.

Key Assumptions

Version 1.0 of the relevant standards were published on the 30 April 2018. The DWI has subsequently published its 'Day 1 Guidance', but is yet to take the National Cyber Security Centre (NCSC) published frameworks and issue a water industry specific version. We have therefore had to make a number of assumptions regarding what this framework will contain, in particular:

- how loss of an OT system may impact upon the supply, quality or sufficiency of water
- unique user authentication at plant level
- remote security monitoring of industrial networks, and
- anti-malware protection for industrial computers.

Properties at Risk of Persistent Low Pressure

Ofwat feedback at IAP

The specific IAP feedback is repeated below *for completeness.*

"ANH claims that this investment will achieve UQ performance. Its states: 'this investment is to reduce the number of reportable properties facing persistent low pressure to 106 by the end of AMP7. This target is based on upper quartile performance compared to other WASCs (2016/17 data).' [Table Commentary P87]. "

The company also states: This is a stretching improvement and accounts for our work not only to take properties off the register but also significant ongoing action to prevent properties coming onto the register. We expect to find more pressure issues as we roll out smart technology on our network. The significant growth forecast for our region will increase the likelihood of low pressure issues. We estimate that we will need to invest to keep around 720 properties from being added to the register in AMP7. Increased demand during periods of warm weather can also impact pressure on the network, which may increase the number of properties that could be added to the register without action being undertaken by us.[BP P236].

ANH have bespoke PC and financial ODI for Props at risk of Low pressure [BP P160] ODI includes outperformance payment.

Decision: ANH documentations identifies that part of the investment should be reallocated to growth. We reallocate of 50% of costs to new developments.

Our Response

The solutions are based on historic and known issues where customers are experiencing low pressure problems (either currently reportable or borderline) and are not associated with growth in the region. Any impact on existing customers is modelled as part of our assessment of growth applications and any investments to mitigate this are carried out as part of our growth programme, which is entirely separate from this programme. The additions and removals investment is to provide an improvement in the pressure to those properties that were previously borderline and have now become reportable.

We have stated in our Plan (page 236) that '*We expect to find more pressure issues as we roll out smart technology on our network. The significant growth forecast for our region will increase the likelihood of low pressure issues*'. When engineering a scheme to cater for growth we would expect a no detriment to our existing customers.

We refer Ofwat to the Addressing low pressure model review in Chapter 5 of our IAP Response for our comments on the IAP allocation of costs.

Price Controls	Water Network Plus
Business Plan table and lines	Table: WS2 Lines: A4, B43

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A4	0.941	2.698	3.389	1.231	0.454	**Capex: 8.713**
Opex (£m)	B43	0.067	0.070	0.073	0.090	0.106	**Opex: 0.406**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £11.624m		
Whole life value (EAV)*: £11.110m					Whole life cost (EAC)*: £0.515m		

*Note: Annualised values over 40 years

Investment Summary

The purpose of this investment is to reduce the number of reportable properties facing persistent low pressure to 106 by the end of AMP7. This target is based on upper quartile performance compared to other WASCs (2016/17 data). For more information please see our Properties at Risk of Persistent Low pressure proposed performance commitment in the Performance Commitment chapter of our business plan.

Investment will be made in traditional schemes such as laying mains, booster pumping stations and improvements to connectivity, in addition to a cost effective solution using a simple, small booster that we have developed for improving pressure to individual or small groups of properties.

Note: Investment for the Low Pressure Database has been coded to table WS2 line 26 and is therefore included in the Management and General Enhancements case.

Need for Investment

Is there persuasive evidence that an investment is required?

Our long term strategy is to reduce the number of reportable properties to negligible levels. We plan a further reduction in AMP7 as part of this overall strategy. This is driven by a need to improve customer service for the small number of properties where we do not meet the level of service we strive for. This investment is also needed to ensure that any further properties identified by our ongoing monitoring with borderline low pressure, are mitigated.

We have reported the number of properties receiving low pressure (former Ofwat DG2 measure) since privatisation as part of serviceability. There has been a reducing trend in reportable properties over the last 14 years, from 1,184 at the start of 2004/05 to 297 at the end of 2017/18. The table below shows the movement in the DG2 Register each year. As well as investing to reduce the overall number of properties, we invest every year to ensure additional properties identified through our monitoring are targeted with solutions.

Prolonged periods of warm, dry weather such as we have experienced in 2018 can lead to additional areas experiencing low pressure and hitting the trigger levels defined by the guidance. This is because of increased customer demand for water during warm, dry weather. We will continue to monitor and invest to prevent impact upon our customers.

Movements in the DG2 Register 2004/05 to 2017/18

Year	Start	End	Change	Additions	Removals
2004/05	1,184	1,049	-135	*	*
2005/06	1,049	653	-396	1,843	2,239
2006/07	653	869	216	*	*
2007/08	869	651	-218	212	430
2008/09	651	517	-134	318	452
2009/10	517	612	95	1,487	1,392
2010/11	612	636	24	847	823
2011/12	636	536	-100	310	410
2012/13	536	611	75	240	165
2013/14	611	524	-87	144	228
2014/15	524	505	-19	155	174
2015/16	505	462	-43	127	170
2016/17	462	460	-2	316	318
2017/18	460	297	-163	258	421

* Data not available

What incremental improvement would the proposal deliver?

The improvement this proposal will deliver is to reduce the number of properties suffering from persistent low pressure to 106 by the end of AMP7.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

"In the consultation on Anglian Water's draft PR19 plan, customers in the online community were introduced to the company's plans to reduce persistent low pressure. Customers were told that Anglian Water has improved its performance considerably in the past 15 years, reducing the number of properties on the low pressure register by 50% since 2005. They were also told that the company is proposing to ensure only 106 properties (0.49 properties per 10,000 connections) suffer from severe low pressure by 2025. The consultation found that participants were pleased to hear about the improvements Anglian Water has already made in this area. A target of 106 felt quite low to participants, however some wanted more information on why an ever lower target can't be achieved" (Anglian Water Customer Research & Engagement Synthesis, 2018, v.14, p135).

Need for Enhancement Expenditure

Why is it enhancement (and not base)?

This investment is considered to be enhancement (rather than base) expenditure because it improves the quality of service we can provide customers suffering from existing low pressure.

What does the expenditure enhance?

The expenditure increases the water pressure at properties that normally receive pressure below the reference level.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our Plan is driven by the requirements of our customers.

This investment is linked to the 'Delighted Customers' and 'Investing for tomorrow' outcomes. For further information see our low pressure performance commitment proposals in our Plan.

Low Pressure was our second most important issue for customers at PR14. PR19 customer engagement suggests that the issue is diminishing in importance but is still important, particularly for customers directly affected.

"For water services, both household and non-household customers assigned the highest value to reducing service failures related to persistent low pressure" (p48).

"A total of 220 household respondents reported experiencing a problem with their water service. Of these, the most commonly cited problems were a concern about the aesthetic quality of tap water (taste, smell or appearance) or hardness (53% or 116 respondents for both). This was followed by one-off low pressure incidents (33%, 72 respondents)"... "For the 81 non-household customers who had experienced a problem with their water service, concerns about the aesthetics of water were also the most common issue (75%, 61 respondents), followed by occasional low pressure (37%)" (p67).

Source: Anglian Water Customer Research & Engagement Synthesis report, 2018, v.14.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

As the properties that experience low pressure are in specific locations, and due to the hydraulic characteristics of the network, any interventions are generally location specific. In each case we evaluated a range of totex solutions including operational solutions such as optimising or rezoning the network (including cross connecting to adjacent systems), and capital solutions such as mains reinforcements and new booster pumps. We have also developed a solution for individual (or small groups of) properties during AMP6 using a simple, small booster. In some cases, implementing this

solution for properties at the critical point in a network will then enable us to optimise the remainder of a zone by reducing pressures for the remainder of the properties in the area, whilst keeping them above the reference level.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

We are confident that our proposed solution provides the best long term value for customers. This is because we have considered a wide range of options (as outlined above) and have conducted a cost benefit analysis for each option.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

All options have been through our internal ROV (Risk, Opportunity, Value) process in order to highlight the potential risks associated with any investment.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

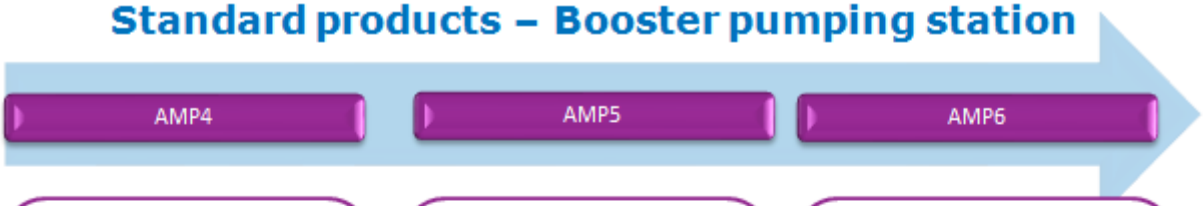
Costs for known investments use our cost base models which are all validated models built from current costs. Where the exact location for investment is not yet known, costs are based on historical activity and AMP6 actual unit rates which have been inflated to a common price time basis.

During the last three AMPs we have consistently reduced costs. For instance, our unit costs have reduced by 60% since AMP4 and we now use a modular offsite construction technique, as illustrated overleaf. The cost used to develop this programme are based on our current costs, meaning that efficiencies already achieved form the baseline, as described in the *Efficiency & Innovation* chapter of our Plan.

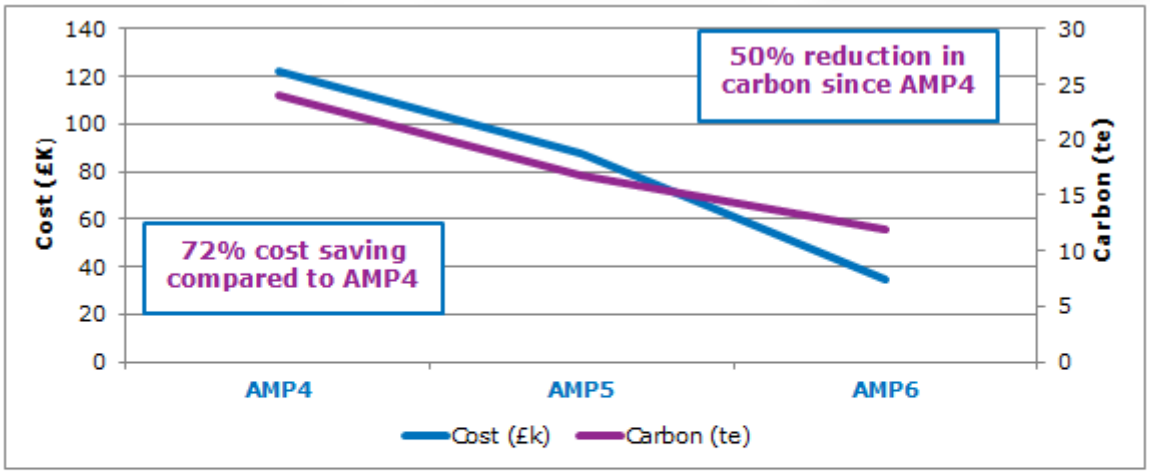
Is there high quality third party assurance for the robustness of the cost estimates?

Our approach here has been externally audited by our third party technical assurance providers Jacobs.

Standard products – Booster pumping station



AMP4	AMP5	AMP6
Booster station constructed on site using traditional construction methods.	Off-site build. All mechanical and electrical components installed in GRP kiosk before delivery. Base former ensured buried pipe and cable ducts were located correctly in concrete base slab.	New supplier provided a design with an alternative pump motor and wall mounted inverters for speed control.



Cost	£122.2k	£87.3k	£34.6k
Carbon	24te	16.8te	12te
Number delivered	9	11	5
Average time on site	5-6 weeks	1-2 weeks	1-2 weeks

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

This investment is driven by our desire to improve customer service for the small number of properties where we are currently unable to deliver the levels of service we strive for, with regards to water pressure.

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

The costs of meeting this investment have been controlled as far as possible by conducting a cost benefit analysis on a range of alternative options to identify the best value option.

Beyond this, we have applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

As a business we set out to honour our commitments. Customers can rightly challenge and ask what protection there is if we don't. Customer protection consists of the following implications for non-delivery:

In AMP6 we have a separate Low Pressure performance commitment, which will continue in AMP7. There will be up to £20.8m underperformance penalties in AMP7 for this performance commitment.

Customer complaints potentially to CC Water.

Reputational damage that could be reflected through C-MeX performance.

Customers who experience low pressure can claim compensation payments under the Guaranteed Standards of Service.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

The main customer benefit from this investment is an improved service for those living in properties suffering from persistent low pressure. This benefit directly relates to our 'Resilient Business' and 'Investing for Tomorrow' outcomes.

Affordability

Has the impact on affordability been considered?

The selected options deliver the best value possible for customers, with a whole life value of over £11m.

Key Assumptions

We continue to assumed our surrogate reference level 13mh (meters head). We have adopted this level since 2006.

Eels Directive

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to the WINEP/NEP Eels Regulations (Water) model review in Chapter 5 of our response on the IAP assessment of costs.

Price Control	Water Resources
Business Plan table and lines	Table WS2 Lines: A2, B41

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A2	0.356	1.042	0.693	6.190	0.000	**Capex: 8.281**
Opex (£m)	B41	0.004	0.010	0.014	0.025	0.038	**Opex: 0.090**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £13.793m		
Whole life value (EAV)*: £13.271m					Whole life cost (EAC)*:0.522m		

*Note: annualised values over 40 years

Investment Summary

This investment is required to meet the Eels (England and Wales) Regulations (2009) which seek to reverse the severe decline in eel stocks in our rivers. It delivers the best value possible for customers whilst meeting the requirements of the Environment Agency (EA). We plan to invest in the following schemes.

- Best practice positive exclusion screening at four river intakes (Bucklesham Mill, Clapham, Duston Mill and Tinwell).
- Eel by-passes at two tilting gate river structures (Mill River and Cloves Bridge).

Eel investigations at three reservoirs (Ardleigh Reservoir, Rutland Water and Alton Water).

Need for Investment

What incremental improvement would the proposal deliver?

A number of surface water intake structures have been assessed as non-compliant with the Eels (England and Wales) Regulations (2009). The Regulations seek to reverse the severe decline of eel stocks in the UK.

Is there persuasive evidence that an investment is required?

In AMP6, the EA applied a priority rating to ensure that investment was targeted at the most critical intake assets. The EA assessed the remainder of our intake structures as medium-low or low criticality. It was agreed that remedial works would be carried out in later investment periods and time limited exemptions were issued.

In most cases, schemes must be implemented in AMP7. In some cases, an investigation is required in AMP7 to determine the level of investment required in AMP8. This programme of work is an agreed obligation under the WINEP. Obligation dates have been agreed and issued.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

This investment directly links to our ODI of 'A Flourishing Environment' by supporting the sustainability of eel stocks in the UK. Our customers are supportive of our plans to reduce the negative impacts of our activities on the environment. (Anglian Water Customer Research & Engagement Synthesis report, 2018, v.14).

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

This investment is considered to be enhancement (rather than base) because it will improve the ecological status of our rivers in accordance with the Eels (England and Wales) Regulations (2009).

What does the expenditure enhance?

The expenditure will help to enhance eel stocks in our rivers. It forms part of the agreed WINEP obligations

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

Our customers ranked environmental protection as third out of Anglian Water's six major challenges, and it was regarded as important by 85% of customers. Customers who took part in our online community engagement regarded the company's plans to reduce its negative impact on the environment as indisputably positive.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

At the river intake sites we plan to invest in positive exclusion screening. The installation of band screen intake solutions was also considered, however, this option does not comply with EA best practice. Our experience in AMP6 is that acceptance of band screens by the EA is very low. This option was therefore discounted on this basis. Extensive liaison took place with the EA to discuss the design approval process and the type of option required for AMP7 before arriving at this conclusion.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

We are one of a number of companies who abstract water from rivers. Under the regulations there is no requirement to demonstrate the scheme has a positive benefit cost ratio.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Alternative options were considered but did not meet the EA requirement to have a positive exclusion screen.

Has the impact on natural capital and the environment been considered?

These schemes are driven by the need to improve the environment. Where possible we have used natural capital solutions, for example eel by passes.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Reservoir investigation costs are based on the AMP6 reservoir investigation unit rate; tilting gate and intake screening costs have been derived using the latest unit cost information which is contained within our extensive cost information library. This means that efficiencies already achieved form the baseline for our future costs estimates as described in the Efficiency & Innovation chapter of our Plan.

Is there high quality third party assurance for the robustness of the cost estimates?

Our Totex Cost Estimation approach has been reviewed by our external assurers (Jacobs). The costs we have developed are based on out turn costs from AMP6 so have embedded efficiencies. All costs have been completed in a consistent way and have been independently reviewed and validated by our Totex Costs Estimation team.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The cost of this investment is outside of management control because it is driven by the obligation to meet the requirements of the Eels (England and Wales) Regulations (2009).

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

A full cost benefit analysis on a range of alternative options to identify the best value option has been undertaken. However, there is a requirement from the EA to use positive exclusion screens. This limits the options available for consideration. However, working with the EA we have endeavoured to control the costs by targeting the most critical intake assets.

We have also applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

As a business we set to honour our commitments and have a track record of delivering our obligations. Customers can rightly challenge and ask what protection there is if we do not. For this portfolio the protection consists of the following implications for non-delivery:

- Enforcement action from the EA for failure to deliver obligations.
- Customer complaints, potentially to Consumer Council for Water.
- Reporting our contribution to improving the natural capital of our region through our Natural Capital performance commitment.
- Reputational damage that could be reflected through C-MeX performance.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

In AMP7, for the first time we will introduce a new WINEP performance commitment (described in the main narrative). This performance commitment is designed to incentivise faster delivery of the WINEP, to unlock benefits for customers and the environment early.

Affordability

Has the impact on affordability been considered?

The selected options deliver the best value possible for customers whilst meeting the requirements of the EA. This obligation is not subject to a cost benefit test.

Key Assumptions

It is assumed that best practice screening will be required at all intakes within the WINEP programme.

Security and Emergency Measures Direction (SEMD)

Ofwat feedback at IAP

ANH is proposing to spend £15.2m on security covering both SEMD (£1.7m) and non-SEMD (£13.6m).

We consider that some of the costs to upgrade or replace older systems should not be classed as enhancement expenditure and should form part of its base allowance. We propose the following changes:

- Disallow £1.7m planned to upgrade its CCTV at its CNI and NI sites.

Our Response to IAP feedback

On 27th April 2018, Jacobs completed the three yearly external SEMD audit of the company's Alarm Monitoring Centre (AMC). This investment forms part of the requirements under SEMD arising from the findings of this audit. This work has been validated by our specialist auditors and fully meets the requirements of the direction and associated updated Advice notes from Defra AN/0, AN/4 and AN/8. The expenditure relates to providing enhanced security to our key sites not maintaining our existing equipment. We have included the maintenance costs separately in our Plan under botex.

- £550k CCTV enhancement expenditure – Assets on eight CNI and NI sites are protected by a range of inter- dependable security solutions. The proposed digital CCTV solution will replace the current analogue system which no longer meets the requirements, providing enhanced video analytics and new functionality - Intruder tracking, ANPR and video management application to substantially improve monitoring and data retention compliant with GDPR and DPA legislation.
- £1.3m CCTV enhancement expenditure will be invested in new technology to protect bulk resilience fuel storage tanks from theft and spillage where there is currently no security. Those sites most at risk have been identified by extrapolating information from 'Source Compound Vulnerability Data' and designated 'Critical Sites,' reliant upon resilience generators in order to maintain essential services.
- Overt CCTV cameras will act as a visible deterrent, whilst video analytics monitored real-time will ensure an effective joint Anglian Water / Police response to quickly apprehend intruders to prevent contamination, loss of water or an interruption to supply and to enable successful prosecution of offenders.

Our response to the Water SEMD and non-SEMD Costs modelling approach is included in Chapter 5 of our IAP Response assessment of costs.

Price Control	Water Resources, Water Networks Plus
Business Plan table and line	Table: WS2 Lines: A15, B54

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A15	0.093	0.257	0.638	0.000	0.721	**Capex: 1.709**
Opex (£m)	B54	0.000	0.007	0.024	0.041	0.095	**Opex: 0.167**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £113.584m		
Whole life value (EAV)*: £113.381m					Whole life cost (EAC)*:£0.203m		

*Note Annualised values over 40 years

Investment Summary

This investment is for the upgrade of security systems in order to comply with the requirements of the Security and Emergency Measures Direction (SEMD). Specific site investment needs have been reviewed by our SEMD Auditor; for security reasons they have not been listed. The primary activity is the upgrade of CCTV.

Need for Investment

Is there persuasive evidence that an investment is required?

The UK threat level from international terrorism is 'Severe', meaning an attack is highly likely (MI5, 2018; UK Government, 2018). Whilst the threat to the water industry is low the Centre for the Protection of National Infrastructure highlight on their website that the *"...continual diversification of the threat, the ambition and capability of terrorist groups to target UK infrastructure is likely to continue to evolve."*

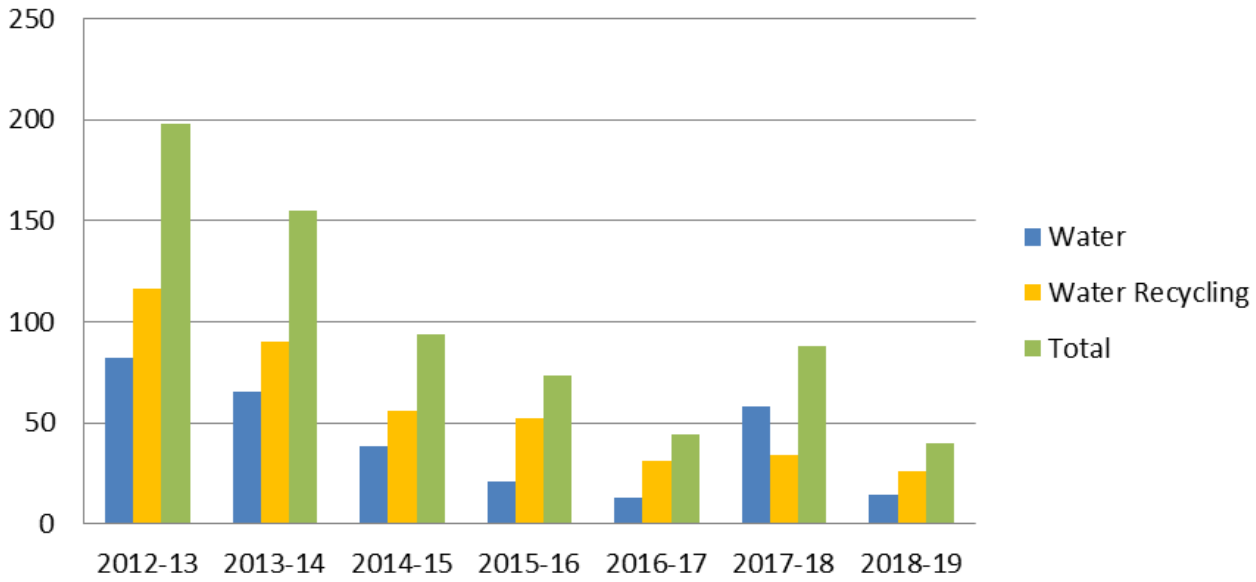
Security Advices Notes are produced by the Security Service and issued by Defra under the Security and Emergency Measures Direction 1998 (SEMD). Water undertakers are legally obliged to comply with their content and the supporting Defra/Council of Water UK Guidance. Enforcement action under the Water Industry Act 1991 may be taken against companies that fail to comply with the SEMD. This may result in prosecution, fine, formal warning, caution or action plan.

Defra meets with our security team biannually to verify SEMD compliance.

We complete annual internal and external SEMD audits and quadrennial external Critical National Infrastructure (CNI) site audits (a Defra requirement), which provides us with a robust process to ensure that the security measures we implement are appropriate and in accordance with regulatory requirements.

As can be seen in Figure 1 below, security incidents across our operational sites have fallen year on year as SEMD security measures have been implemented with the exception of 2017/18. The spike during 2017/18 is likely to be partly attributable to changes in the way security incidents are reported. There have been only two reported thefts at CNI and National Infrastructure (NI) sites since 2012, both occurring during 2017. On both occasions, the incidents related to security breaches at non-designated vulnerable points and therefore posed no threat to potable water. There are also no reports of intruders penetrating SEMD security and gaining direct access to raw or potable water.

Figure 23 Security incidents at operational sites



What incremental improvement would the proposal deliver?

The requirement for CCTV to provide early verification at CNI and NI sites has not changed, and neither has the need to install security measures to harden CNI vulnerable assets (ozone areas) or for patent protected locking systems and SEMD alarms, but those existing systems require significant upgrading to resolve, for example, network connection problems to ensure that they provide appropriate risk mitigation to keep pace with the evolving threat and to provide SEMD compliance.

Investment in AMP7 will include upgrades to key and locking systems, alarms and CCTV.

Need for Enhancement Expenditure

Why is it enhancement (and not base)?

This investment is considered to be enhancement (rather than base) because it is needed to meet the requirements of the Security and Emergency Measures Direction (SEMD).

What does the expenditure enhance?

The expenditure will enhance security at our water sites.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of? Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

Our customers expect reliable supplies of high quality water. The security measures we employ mitigate the risks from deliberate acts of terrorism or extortion, and also protect our sites from theft, damage and malicious acts of sabotage that could jeopardise this service.

Due to the low value of this investment and the sensitive nature of the topic, this has not been direct subject for customer consultation. However, it is directly related to the provision of resilient services which has strong customer support, as detailed in the Resilience Programme enhancement case.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

The proposed interventions are by far the most cost effective options, are consistent with the measures previously installed and in the case of the CCTV upgrade make best use of the existing CCTV, providing value for money.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Options are carefully considered in accordance with the Water UK Security Standards to ensure SEMD compliance and are assessed through our facilitated Risk, Opportunity and Value process. The option to install security rated fences with perimeter intruder detection systems around each of our large sites was considered, but would be significantly more expensive and would not provide the remote monitoring that CCTV can deliver. CCTV provides the capability to verify an alarm remotely, within a safe environment, from which an appropriate response can be promptly and effectively coordinated.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient? Is there high quality third party assurance for the robustness of the cost estimates?

The Water UK (2017) criteria for categorising sites by the impact that their failure can cause has been used in order to identify the most suitable security measures commensurate with the risk of that impact occurring. This has been used to ensure that each asset is adequately protected and that very costly security measures are not implemented where they are not actually required.

Costs have been built up based on actual costs from AMP6 so include embedded efficiencies from AMP6.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The cost of this investment is outside of management control because it is driven by the obligation to meet the requirements of the Security and Emergency Measures Direction (SEMD). The costs of meeting this have been controlled as far as possible by conducting a cost benefit analysis on a range of alternative options to identify the best value options.

Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

In addition to basing our estimates on efficient costs drawn from our AMP6 performance, we have then applied further totex stretch efficiency and productivity challenges to those costs, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

As a business we set out to honour our commitments. Customers can rightly challenge and ask what protection there is if we don't. Customer protection consists of the following implications for non-delivery:

- Enforcement action under the Water Industry Act for failure to comply with SEMD.
- Customer complaints potentially to CC Water.
- Reputational damage that could be reflected through C-MeX performance.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

This investment increases the resilience of the services we provide from security related threats and is directly linked to our 'Resilient Business' outcome.

Affordability

Has the impact on affordability been considered?

The selected options deliver the best value possible for customers whilst meeting the requirements of the SEMD.

Key Assumptions

CCTV: We have engaged with our current provider when building these investments so predict with a degree of certainty the hardware required.

Locking system: Included in resilience enhancement case. Figures are based upon historic data (numbers of locking systems) and verification is based upon lock audits carried out at eight operational water sites (selected as a representation of small, medium and large sites). The survey included the number of locks and associated costs.

Alarm rationalisation: Included in resilience enhancement case. Figures are based upon historic data (numbers of alarm systems) and verification is based upon a survey completed at a representative site.

Pluvial and Fluvial Flood Protection

Ofwat feedback at IAP

In view of the stated purpose of the forecast expenditure we consider it appropriate to reallocate it to the water resilience line.

Our Response

Our enhancement business case remains unchanged £39k.

Price Control	Water Network Plus
Business Plan Table and lines	Table: WS2 Lines: A24, B63

Totex Expenditure 2017/18 Prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total (£m)
Capex (£m)	A24	0.000	0.000	0.000	0.039	0.000	**Capex: 0.039**
Opex (£m)	B63	0.000	0.000	0.000	0.000	0.000	**Opex: 0.000**

AMP7 carry over costs: £0.000m — Whole life benefit (EAB)*: N/A

Whole life value (EAV)*: N/A — Whole life cost (EAC)*: N/A

*Note: annualised values over 40 years

Please see WWS2 Pluvial and Fluvial Flood Protection enhancement case for details relating to this investment.

WS2A - WHOLESALE WATER CUMULATIVE CAPITAL ENHANCEMENT EXPENDITURE BY PURPOSE

SECTION A: CUMULATIVE CAPITAL ENHANCEMENT EXPENDITURE BY PURPOSE

Lines 1 to 38: Cumulative capital enhancement expenditure by purpose

The derivation for the core data and the allocation to the purpose for this table is described in the commentary for WS2. The tables are completed by using the outputs from our C55 System which contain project level investment details. We have excluded any additional on-going operational and maintenance expenditure to ensure the assets maintain their required function. We have excluded any projects that are booked to operational costs as part of IFRS, for example Partnership Funding.

This table identifies the cumulative capital enhancement projects (schemes and investigations) delivered in the report year. We have noted the reporting requirements that this table does not collect historic data. References to AMP5 and AMP5 driver codes in the line definitions are therefore redundant but have been retained for simplicity.

Where a quality enhancement scheme (or the proportionally allocated component of a quality enhancement scheme) has more than one cost driver, we have allocated the expenditure attributable to the primary driver to the relevant line. This has been undertaken by using our Business Investment Codes (BIC). Any net additional cost for delivering any further drivers have been included in the relevant line.

We have therefore assumed the costs of the project are proportional allocated against drivers rather than total project costs against a single primary driver. An example is given below. We have conformed with the requirement that the costs in the table are the cumulative total.

Capital Expenditure - Proportional Allocation Example

Example	£m	Business Investment Code 1 Allocation	Business Investment Code 2 Allocation	Business Investment Code 3 Allocation
Water Treatment Works	%	60	30	10
For a £10 million Project	£m	6	3	1

WS3 - WHOLESALE WATER PROPERTIES AND POPULATION

Lines 1 to 2: Residential properties billed for measured water (external meter and not external meter)

We forecast that the number of properties billed for measured water will continue to increase over AMP7.

Data has been derived from recorded information and the projected forecasts for customers switching from unmeasured to measured supplies, as well as anticipated new build properties, in alignment with our Water Resources Management Plan (WRMP).

2017/18 data is based on recorded property numbers. The total property numbers have been calculated as part of our year-end reporting process, based upon premise data recorded in internal systems. This allows the derivation of both measured and unmeasured property totals. Additional metering data allows us to calculate the split between internal and external meters.

Forecast data has been derived using our WRMP household and population forecast model, baselined to our internal year-end reporting totals for 2017/18.

Forecast growth has been aligned with planning information (collated by Edge Analytics) as provided by Local Planning Authorities in line with the requirements set out for the WRMP.

The split between external and internal meters is in accordance with historic trends.

The 2018/19 forecast has been updated to reflect better information now that we are further through the report year.

Line 3: Business properties billed measured water

2017/18 data has been based on recorded business property numbers receiving measured bills.

Forecast data is in line with recent trend evidence (derived by Servelec analysis of an internal dataset) and in alignment with our WRMP. WRMP regression analysis suggests a marginal decrease in business properties over time, by 0.3% per year, which is shown in our forecast data in line 3.

Line 4: Residential properties billed for unmeasured water

As the number of properties billed for measured water increases, we anticipate the number of properties billed for unmeasured water will decrease accordingly.

2017/18 data has been based on recorded property numbers receiving unmeasured bills.

Forecast data has been derived from the projected forecast for customers switching from unmeasured to measured status (included in the WRMP forecast model) and the forecast for new build properties, in alignment with the WRMP.

Forecast figures have also been derived using the Local Planning Authority forecast figures (as analysed and collated by Edge Analytics) in accordance with the requirements set out in the WRMP.

The measured and unmeasured split has been derived using baseline outturn data and the meter installation / optant forecast, as used in the WRMP demand forecast.

The 2018/19 forecast has been updated to reflect better information now that we are further through the report year.

Line 5: Business properties billed unmeasured water

Unmeasured business properties have been forecast in line with recent trend evidence (derived by Servelec analysis of an internal dataset) and in alignment with the WRMP, which is forecast to decrease by 8.4% per year. This accounts for a very small proportion (approximately 0.5%) of the business property total by the end of AMP8.

Line 6: Total business connected properties at year end

This total is business properties for measured and unmeasured customers in our region, which is forecast to reduce by approximately 0.3% per year.

Line 7: Total residential connected properties at year end

This totals residential properties for measured and unmeasured customers for our region, which is forecast to increase by approximately 9.6% to the end of AMP7.

Line 8: Total connected properties at year end

This value aggregates residential and business properties for our region, which is forecast to increase by approximately 8.9% to the end of AMP7.

Line 9: Number of residential meters renewed

This line includes residential meters renewed both reactively and proactively. We are on target to achieve our current business plan targets for AMP6.

AMP7 volumes are consistent with our proposals of installing a smart meter network across our region over 10 years. Smart meters will be installed in supply zones identified for smart metering in AMP7. Visual read meters will be installed in areas identified for smart metering in AMP8 under our reactive metering programme.

Line 10: Number of business meters renewed

This line includes business meters renewed both reactively and proactively. We are on target to achieve our current business plan targets for AMP6.

Proposed AMP7 volumes support our desired aim of installing a smart meter network across our region over 10 years. Smart meters will be installed in supply zones identified for smart metering in AMP7. Visual read meters will be installed in areas identified for smart metering in AMP8 under our reactive metering programme.

Line 11: Number of meters installed at the request of optants

This line includes meters installed at existing unmetered properties under our Meter Option scheme. All properties metered under this programme are residential properties. We believe the annual volume of these types of meter installs will continue to reduce year on year as our meter penetration continues to increase. In AMP6 to date we have not achieved our annual targets as fewer customers have applied than expected. We believe this trend will continue for the remainder of AMP6.

Historically we have seen a 4% meter install uptake in our unmetered property population each year. As stated above we have started to see this percentage diminish in AMP6. We have used the AMP6 profile as the basis for our AMP7 plans. Smart meters will be installed in supply zones identified for smart metering in AMP7. Visual read meters will be installed in areas identified for smart metering in AMP8 under our reactive metering programme.

Line 12: Number of selective meters installed

This line includes residential and business properties metered under our selective and enhanced metering programmes. Our selective metering programme typically targets unregistered properties or properties where the existing method of charging is no longer valid.

We have reduced our planned enhanced installs for the remainder of AMP6. We will now not install an enhanced meter in AMP6 in water stressed areas where we are planning early to install a smart meter in AMP7.

Our enhanced metering programme provides the majority of the proposed AMP7 installs. We plan to continue with enhanced metering in areas of most water stress in AMP7. All meters installed in AMP7 under the enhanced programme will be smart meters. The annual volumes proposed in

AMP7 are based on the anticipated installs in each supply zone. These volumes are dependent on the current level of meter penetration. Our aim is to achieve a minimum meter penetration of 95% in each supply zone.

Line 13: Total number of new business connections

2017/18 data is based on recorded connection numbers.

Forecast data is as provided by the Local Planning Authorities in line with the requirements set out in the WRMP. The number of new business connections is forecast to decrease by approximately 9.9% to the end of AMP7.

Line 14: Total number of new residential connections

2017/18 data is based on recorded connection numbers.

Forecast data is as provided by the Local Planning Authorities, in line with the requirements set out in the WRMP guidelines. This data provides for an expected increase in housing in our region, which reflects the government need to increase housebuilding, particularly in the Oxford / Milton Keynes / Cambridge corridor (which is predomintently in our region). It should be noted that forecast data does not reflect previous trend information, however, WRMP guidelines indicate that we must use Local Planning data and not constrain growth in the WRMP.

The 2018/19 forecast has been updated to reflect better information now that we are further through the report year.

Line 15: Total population served

Population is calculated to reflect our SAP premise information (as apportioned to the relevant local authority), Office for National Statistics (ONS) population data and 'local authority' household new connection projections. Population is derived using the estimation of households that we serve as a percentage of the Department of Communities and Local Government (DCLG) totals, applied to the ONS Local Authority Unitary Authority (LAUA) population assessments. Trend based occupancy rates are used in addition to this to generate plan based population projections (in accordance with WRMP guidelines). We have also taken into account communal population, which is derived from Census data.

2017/18 data is calculated as part of our year-end reporting process.

Forecast data is provided in accordance with the WRMP methodology, utilising Local Planning Authority projections to derive a plan based population forecast.

Sources that have been referenced include:

- ONS Sub National Population Projections (SNPP)
- DCLG Household projections
- Local Authority Plan projection data
- ONS mid-year estimates
- Census data communal population
- SAP baseline AWS household data.

Line 16: Number of business meters (billed properties)

2017/18 data is based on recorded total non-household numbers.

Forecast data is in line with recent trend evidence (derived by Servelec analysis of an internal dataset) and in alignment with our WRMP. WRMP regression analysis suggests a marginal decrease in business properties over time, by 0.3% per year, which is shown in line 3 above. This is reflected in the forecast reduction in the number of business meters (billed properties) showing in this line.

Line 17: Number of residential meters (billed properties)

2017/18 data is based on recorded total household numbers.

Forecast data has been estimated using forecast meter penetration data and the total residential property forecast (measured and unmeasured). This also includes properties which currently have a meter, but are not yet billed on a measured basis.

Line 18: Company area

Our Geographic Information System (GIS) team keeps records of the Appointed Area for water, as amended (negatively) by any insets run by third parties within our appointed area and (positively) by any insets we operate in the appointed areas of other undertakers. For the purpose of this line, the assumption is that the aggregate area of any new insets within our area will be offset in each year by new insets (amounting to the same aggregate area) we operate in other undertakers' areas.

WS4 - WHOLESALE WATER OTHER (EXPLANATORY VARIABLES)

Line 1: Number of lead communication pipes replaced for water quality

This line consists of both planned and reactive replacement of lead communication pipes.

Planned replacements include those pipes replaced as part of our proactive lead replacement work. We have estimated the profile of work to be lower at the beginning and end of the AMP to allow for project commencement and completion patterns which are typical for this programme of work.

Reactive replacements are those pipes replaced either following water quality failures or if requested by customers. We have estimated the AMP7 forecast based upon the previous five years historical replacement figures.

For AMP7 the DWI has asked companies to consider replacing customer side pipework, up to the kitchen tap, as part of a long term approach to reduce lead levels in drinking water. We anticipate that this will form part of the step reporting requirement against our lead notice.

The table below shows the AMP7 forecast split between planned and reactive lead communication pipes replacement:

	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total
Planned	200	1,000	1,000	1,000	300	3,500
Reactive	350	350	350	350	350	1,750
Total	**550**	**1,350**	**1,350**	**1,350**	**650**	**5,250**

Lines 2 and 3: Total supply side enhancements to the supply demand balance

In our Water Resources Management Plan (WRMP) our supply-side measures for AMP7 are almost exclusively transfers of existing resources. The only exception is new resource development on South Humber Bank, which will be constructed during AMP7. We are including 6 Ml/d in 2024/25 to account for this.

Lines 4 and 5: Total demand side enhancements to the supply demand balance

For pre 2020 values, demand side enhancement savings have been derived using meter optant data in conjunction with assessed savings from water efficiency measures (based upon per property saving assumptions).

Savings have been assessed for the following programmes:

- 'Bits and Bobs' - (on-site audits by our technicians) - assumed saving of 50 l/property/day
- Drop 20 programme - assumed 25 l/property/day
- Leakage - assumed difference between present and previous year
- Enhanced metering (optant metering, selective metering) programme - assumed saving 50 l/property/day upon switching.

For post 2020 values, demand side enhancement savings have been derived from the preferred WRMP demand management options for water efficiency, 'smart metering' and leakage which have been aggregated to produce their overall impact on the supply demand balance in Ml/d.

It is noted that AMP7 savings show a distinct increase over those for AMP6, reflecting our ambitious programme of demand management in the WRMP.

These reductions in demand have been derived at a 'per property' and 'per capita' level, as appropriate, for inclusion in the demand forecast and have been factored into the WRMP dry year annual average (DYAA) demand forecast Distribution Input figures.

Reductions have been calculated for a range of water efficiency measures, including 'bits and bobs' and 'leaky loos', based upon assumed savings and the size of a targeted group per year.

Additionally, savings have been calculated for optants (15% reduction in consumption per property from unmeasured to measured status) and the introduction of 'smart' metering (an additional 3% reduction).

Finally, savings have been calculated for leakage, based upon modelled values for reductions in Customer Supply Pipe Losses (CSPL) and distribution losses.

Demand management options include:

- Unmeasured household water efficiency savings (Ml/d)
- Measured household water efficiency savings (Ml/d)
- Leakage (distribution loss) savings (Ml/d)
- Smart Metering (distribution loss) savings (Ml/d)
- Smart Metering (customer supply pipe leakage) savings (Ml/d)
- Smart metering (customer use efficiency) savings (Ml/d).

Demand savings for Critical Peak can be shown:

	2020/21	2021/22	2022/23	2023/24	2024/25
Unmeasured HH efficiency saving (Ml/d)	0.15	0.15	0.14	0.13	0.12
Measured HH efficiency saving (Ml/d)	1.99	1.99	2.02	1.96	1.81
Leakage DL saving (Ml/d)	4.67	4.67	4.67	4.67	4.67
Metering DL saving (Ml/d)	0.00	0.00	0.54	0.43	0.90
Metering CSPL saving (Ml/d)	2.21	1.99	1.94	2.03	1.34
Metering Customer use saving (Ml/d)	2.59	2.15	2.32	2.45	1.53
Total	**11.62**	**10.95**	**11.64**	**11.67**	**10.37**

Demand savings for DYAA can be shown:

	2020/21	2021/22	2022/23	2023/24	2024/25
Unmeasured HH efficiency saving (Ml/d)	0.15	0.14	0.13	0.12	0.12
Measured HH efficiency saving (Ml/d)	1.93	1.93	1.96	1.91	1.75
Leakage DL saving (Ml/d)	4.67	4.67	4.67	4.67	4.67
Metering DL saving (Ml/d)	0.00	0.00	0.54	0.43	0.90
Metering CSPL saving (Ml/d)	2.21	1.99	1.94	2.03	1.34
Metering Customer use saving (Ml/d)	2.59	2.15	2.32	2.30	1.52
Total	**11.55**	**10.88**	**11.56**	**11.46**	**10.30**

For the DYAA conditions, demand management options impacting measured and unmeasured consumption have been modified by the following factors:

- Average Measured Household DYAA factor (for all WRZs): 1.027
- Average Unmeasured Household DYAA factor (for all WRZs): 1.034

For the Dry Year Critical Peak (DYCP) conditions, demand management options impacting measured and unmeasured have been modified to reflect the WRMP Water Resource Zones (WRZs) where a critical peak has been presented:

Critical peaking factors have been calculated for all WRZs for measured and unmeasured households. The following WRZs have been reported in the WRMP as having a Critical Peak and thus the demand management option savings have been factored for these zones and these uplifted values included in the reported critical peak figures.

WRZ Peaking	Measured Household	Unmeasured Household
Bury Haverhill (BHV)	1.332737	1.410916
Central Essex (CEX)	1.277168	1.352087
Happisburgh (HPB)	1.483423	1.570442
Ruthamford Central (RTC)	1.253871	1.327424
South Fenland (SFN)	1.324477	1.402172

Note the average values for Anglian Water are:

- Average Measured Household Critical Peaking Factor (for all WRZs): 1.313
- Average Unmeasured Household Critical Peaking Factor (for all WRZs): 1.390

Once the savings for the demand management options for these resource zones have been factored this has produced the demand management option savings uplifted to reflect critical peak conditions. Note that only measured and unmeasured savings effects have been factored.

For the DYAA conditions, demand management options impacting measured and unmeasured consumption have been modified by the following factors:

- Average Measured Household Dry Year Annual Average Factor (for all WRZs): 1.027
- Average Unmeasured Household Dry Year Annual Average Factor (for all WRZs): 1.034

Lines 6 to 8: Energy consumption water network plus, water resources and wholesale

The estimated energy consumption forecast for water operations at the end of AMP7 has been set at 427,254 MWh, a 17% increase from the forecast baseline year 2019/20 of 363,993 MWh. The movement is primarily explained by the expected delivery profile of OC01 AMP7 schemes.

A number of assumptions have been made in calculating the forecast energy consumption for water wholesale business unit:

- The data for all periods has been updated in line with the methodology used in the 2017/18 Annual Performance Report. This reflected the change in Ofwat guidance and a methodology that used the financial split for electricity consumption
- We have applied a financial split from regulatory accounts between water resources and water network plus for grid electricity consumption
- For existing data, we have applied a confidence grade of A2 as the majority of raw data is based on metering and has been audited as part of the ISO-14064 certification process. For forecast data we have applied a confidence grade of C4 as this is based upon extrapolation of metered data
- Forecast electricity consumption (both imported from the grid and on-site generation) for 2019/20 and AMP7 uses the 2018/19 power budget as a baseline, with the incremental change in Revenue Impact of Capital Schemes (RICS) on enhancements and OC01 (annual net change in electricity use) factored into each year
- Forecast RICS reporting up to 2019/20 provides an anticipated date of delivery and as a result we can determine the kWh change in each year. For OC01 for AMP7, rather than a forecast delivery date we have the final year of capital spend and so a straight line projection approach has been used. This assumes that all schemes are delivered midway through the delivery year. The assumption is that half of the total change in kWh for a scheme is assumed in the delivery year and for subsequent years, 100% of the scheme is included
- We have included forecast energy from renewable sources generated and to be used on site. For water operations this only includes solar

- Grid electricity and fuel (oil and natural gas) used in offices has been included and split equally between water and water recycling
- Fuel oil is not recorded on our corporate systems in the categories required and so for forecast fuel oil to be used on water operations, the same split used for the electricity forecast has been assumed
- Transport is not recorded on our corporate systems in the categories required and so for forecast transport to be used on water operations, the same split used for the electricity forecast has been assumed
- For transport (fleet fuel) the split between water and water recycling is not measured and therefore we have assumed a 50/50 split
- We have assumed a 35% thermal efficiency for natural gas consumption in converting to energy output
- Transport for company cars is collected as mileage. We have converted mileage into kWh through using the UKWIR Carbon Accounting Workbook Version 12 through calculating miles to carbon dioxide equivalent to litres.

Line 9: Mean Zonal Compliance

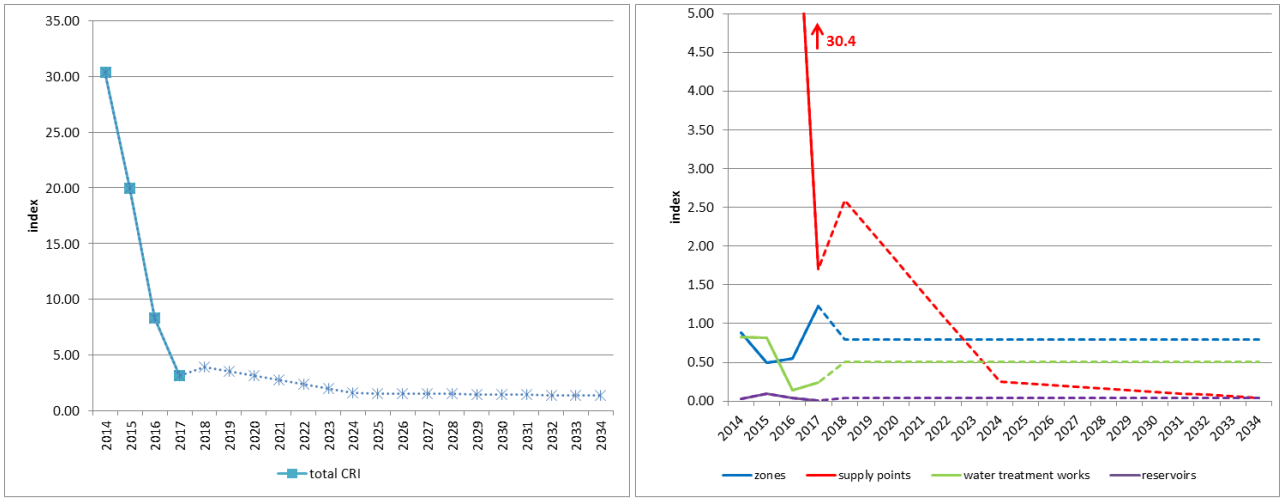
Mean Zonal Compliance is being replaced by the new measure, the Compliance Risk Index (CRI), so has not been forecast beyond 2019/20.

Line 10: Compliance Risk Index

Our CRI is forecast to reduce across the AMP. We have estimated our CRI for supply points for 2018 based on an average of our surface water supply point outputs and a targeted maximum number of compliance failures. Through our metaldehyde strategy, we will target reductions in the supply point contribution to CRI by the end of AMP7, with an allowance of one metaldehyde exceedance by 2024. Looking ahead a further ten years to 2034, our long term strategy is to eliminate all metaldehyde exceedances. Our CRI for supply points is set as a glide-path between these points.

The CRI for zones, water treatment works and reservoirs have been calculated by taking the average of each sub component for the last four years. Data for 2014 to 2016 has been provided by DWI for Anglian Water and excludes Hartlepool Water, which was reported separately at this time. The data for 2017 is provisional, and awaits confirmation. The 2017 provisional result and all forecasting include Hartlepool Water.

Figure 24 Compliance Risk Index, Total and by Sub Components, Historic and Forecast



Line 11: Event Risk Index

We have calculated our combined Event Risk Index (ERI) for 2015 to 2016 from data provided by the DWI for Anglian Water and Hartlepool Water regions. Our 2017 ERI is taken directly from figures provided by the DWI. We are still working to understand this measure, and we have therefore forecast ERI as the average of these scores for the last three years.

Line 12: Volume of leakage above or below the sustainable economic level

Values for forecast leakage have been calculated using the Demand Forecast Model, based upon forecast growth and the influence of demand management options. The Economic Leakage Level (ELL) value has been maintained at the previous value derived by the leakage team (211 Ml/d) and the difference per year has been calculated and reported.

WS5 - OTHER WHOLESALE WATER EXPENDITURE

SECTION A: OTHER TOTAL EXPENDITURE

Lines 1 and 3: Directly attributable employment costs and FTEs

Although some direct opex employment costs can be allocated to service, many employees work across operational boundaries and therefore, where not directly allocated, we have used a management assessment of time spent by service. We classed all employees within this category as directly attributable.

The number of direct Full Time Equivalents (FTEs) is assessed from the total employment costs using an average cost per employee.

The change in FTEs and costs in 2018/19 is based on the change in establishment in the previous year and therefore our expected outturn.

The only anticipated change in direct employment costs in 2019/20 is through RPI.

Our AMP7 direct FTEs and costs take 2019/20 as a starting point and are increased to reflect additional resources required resulting from our capital programme during AMP7. Lines 1 and 3 have been amended to reflect our revised forecast of employment costs and FTEs resulting from the changes made in enhancement expenditure in table WS2.

Lines 2 and 4: Indirectly attributable employment costs and FTEs

Indirectly attributed employment costs are made up of indirect operational employees, employees engaged on capital schemes and general and support employees. General and support employment costs are allocated by an appropriate cost driver as part of our regulatory accounts process.

Indirect operational employment costs and employment costs in relation to capex activity are allocated as a proportion of direct employment costs.

The number of indirect FTEs is assessed from the total employment costs using an average cost per employee.

The change in FTE and costs in 2018/19 is based on the change in establishment in the previous year and therefore our expected outturn.

We expect indirect FTEs to reduce in 2019/20, and the water share has been apportioned by upstream service.

Our assumption is that indirect FTEs remain constant after 2019/20.

Line 5: Costs associated with Traffic Management Act

Reported costs reflect costs directly charged to treated water distribution jobs, including permits and fixed penalty notices. We assume costs increase in line with inflation levels from 2017/18.

SECTION B: SERVICE CHARGES

Line 7: Environment Agency service charges / discharge consents

Water resources reflects abstraction charges reported under 'Other direct operating expenditure. These costs are assumed to increase in line with RPI less any assumed efficiency and productivity assumptions.

Environment Agency charges are based on a roll forward of the reported 2017/18 value.

WS7 - WHOLESALE WATER LOCAL AUTHORITY RATES

Section A: Water wholesale local authority rates

Our starting point is the reported charge for 2017/18 (line 8) which is then adjusted for recharges made as part of our annual reporting process to arrive at the charge received via the Valuation Office Agency (VOA) on line 3. The value of transition relief is a calculated number, intended to smooth the impact of the last revaluation in 2017. Our transition relief numbers have been entered as positive numbers as we saw a reduction in our liability as a result of the 2017 revaluation.

In 2018/19 and 2019/20, the gross charge in line 1 assumes a CPI increase on the prior year with no further transition relief available after 2018/19.

Based on the assessed use of our sites, we make a recharge to third party services which is included in the total recharge to third parties on table WS1 line 10. We also make a recharge to water services to reflect the occupancy of non-water sites. These recharges are assumed to continue in line with the current levels during AMP7 and are an estimate based on the charges before transition relief. The recharge from other business units reflects recreation use at water sites that is charged through local business rates..

It is important to note that AMP7 straddles three separate revaluation periods with the rateable value of water assets fixed for the duration of each rating list. The 2017 list is effective for the first year of the AMP and will then be followed by further revaluations in 2021 and 2024. There is currently no reliable information to project the likely rateable values at the 2021 or 2024 revaluations, or any information on rate poundage or transition relief arrangements. We have therefore adopted the 2019/20 liability in row 1 as the minimum liability payable in each year of AMP7.

Section B: Analysis of change in charge before transitional relief

We are unable to reconcile the movement in 2017/18 as this is formula driven, which we are unable to change. Table WWS7 does not include a reconciliation for 2017/18, and we assume this should be the same for table WS7.

There is no impact to our rates assessment arising from revaluation or change to asset stock. The CPI increases in line 12 reflect the anticipated growth in liability and the adjustment on line 14 reflects the change to a 2017/18 price base in AMP7. Line 13 contains minor rounding adjustments.

WS8 – THIRD PARTY COSTS BY BUSINESS UNIT FOR THE WHOLESALE WATER SERVICE

Blocks A and B: Operating expenditure

Reported costs are based on rolling forward our 2019/20 forecast as we do not expect costs to change materially during AMP7.

Blocks C and D: Capital expenditure

Reported costs are based on the guidance in RAG4 Appendix 1 as per the guidance.

Line 15: Non potable water (which are not bulk supplies)

We are including in our overall PR19 Plan expenditure on a non-potable final effluent re-use plant at our Pyewipe site in Grimsby. This will supply industrial customers on the South Humber Bank. However, the driver for this investment is from our Water Resource Management Plan (WRMP), and enables us to free up potable output from another site. The investment was not requested by the industrial customers and they are not contributing to it. We have therefore excluded this investment from this line.

Lines 21 to 22: Contribution for capital expenditure at Wing WTW (Severn Trent Water) and Grafham WTW (Affinity Water)

We have two sites which provide bulk exports to neighbouring water companies: Affinity Water from Grafham WTW and Severn Trent from Wing WTW. We have included in block D the spend relating to these sites, and included only the proportion of spend that the other water company will contribute, not the full capital expenditure we will invest, on the basis that the costs of providing the bulk export are only this proportion of the capital expenditure. Grafham receives a 40.9% contribution, Wing 7%.

Line 23: Fire hydrants

For AMP7, we have included capital expenditure for the historic run rate of new requests for hydrants.

For AMP6, expenditure net of contributions on hydrants continues to be reported within the main capital expenditure pot, which is consistent with PR14 final business plan and APR reporting.

Line 24: Water mains diversions

The £19.1 million of expenditure forecast for water diversions in AMP7 has been included in full as third-party expenditure on line 18 in accordance with RAG 4.07. This expenditure was previously split between third party capex on WS8, line 24 (£6.3 million over AMP7) and WS1, line 12 - Maintaining the long term capability of the assets ~ infra (£6.3 million over AMP7).

For AMP6, all water diversion contributions received or forecast have been netted-off capex in alignment with the treatment recorded in the corresponding APRs.

We assume 100% contribution against all water diversions expenditure and there is no change to the total forecast expenditure or contribution. Net totex remains unchanged as a result of these changes to reporting of diversions.

WS10 – TRANSITIONAL SPENDING IN THE WHOLESALE WATER SERVICE

We have included transition expenditure for the water network plus price control in accordance with the published guidelines .

The programme and projects we have identified allow for smooth delivery from AMP6 to AMP7 and will enable us to meet agreed completion dates with our quality regulators.

SECTION A: TRANSITION CAPITAL EXPENDITURE PURPOSES

Lines 1 to 42: Transition capital expenditure purposes

Our plans include £22.4 million of transition expenditure in 2019/20 for the water service. This represents 1.9% of our planned enhancement capital expenditure in the water service.

This transition plan will allow more effective use of resources rather than having a stop-start approach. The scale of the transition plan has been mitigated by reinvestment of efficiencies, the release of shareholder funds into the business and through mature, long term alliances.

Specifically for the water service we have also recognised that our Water Resources Management Plan (WRMP) needs an 'early start' to achieve the regulatory outputs. In identifying this challenge we will be enhancing the capability of our supply chain through a new focused delivery route. To reduce the risk of late delivery we have already commenced enabling development activities in 2018/19 in this critical area. It is expected our new delivery partner will be appointed in November 2018.

We have an early obligation for a new nitrate plant in AMP7 that is supported by the Drinking Water Inspectorate (DWI) and one sustainability reduction scheme at Ludham under the Restoring Sustainable Abstraction (RSA) driver in 2020/21, which is part of our water resources price control but this is considered to be exceptional under the reporting requirements.

We have developed a set of principles that align to the Ofwat criteria as set down in the guidance to WS10 and WWS10:

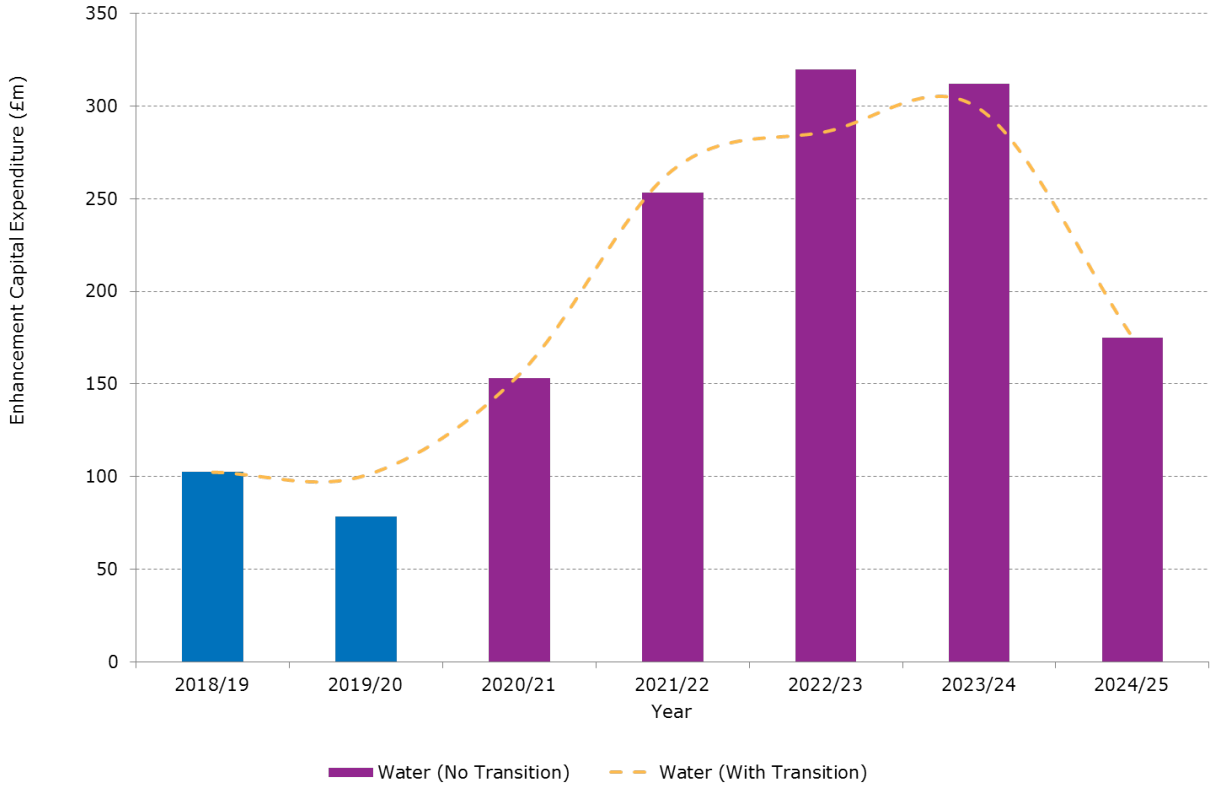
- **Principle 1:** Ofwat compliance: All expenditure will need to comply with the Ofwat guidance (network plus only), except in exceptional circumstances.
- **Principle 2:** Smooth expenditure profile: Enabling a smooth ramp up of expenditure into AMP7 (minimising the amplitude of expenditure) and enabling a smooth customer bill profile in AMP7.
- **Principle 3:** AMP7 early obligations: To ensure that we meet regulatory milestones for projects that will require delivery in years one and two of AMP7 (2020/21 and 2021/22).
- **Principle 4:** Smoothed resource profile: Enabling continuity of work for resources across all alliances but particularly those with design resource. This principle also relates to major programmes of work that will be a challenge to complete in AMP7 such as growth, large diameter water mains and the water recycling quality programme.

The overall transition programme has been developed in conjunction with our existing alliance partners to minimise the impact between AMP6 and AMP7.

Our plans allow for the projects and programmes and align to table WS2. The forecast expenditure is included in table WS1 and WS2 as stated in the reporting requirements.

The positive impact of including this transition is detailed in the figure below and shows the smoothing effect on the enhancement programme in 2019/20 and the first two years of AMP7.

Figure 25 Water enhancement capital expenditure profile (excluding G&C)



The table below give further details on the investment we are planning to include in our transition plan:

Water transitional expenditure 2019/20

Ofwat Line Ref	Transition Capital Expenditure Purpose	AW Investment Ref	Project or Programme Name	Capital Expenditure 2019/20 (2017/18 Prices)
WS10, A13	Enables the delivery of the Nitrate Removal Plant within agreed timescales	I001996	Irby - Raw Water Deterioration - Nitrate	1.681
WS10, A14	Enables delivery of the Early Obligation Scheme. required deliver by March 2021	I009936	Ludham - WRMP19 - HPB1 - Norwich & the Broads WRZ to Happisbirugh WRZ	4.242
WS10, A14	Allows early planning and Environmental Impact Assessments to be completed	Various	WRMP Plan - Pipelines	13.828
WS10, A26	To improve resilience of our core operational technology	I019397	IT Core - OT Security - Water	1.658

Ofwat Line Ref	Transition Capital Expenditure Purpose	AW Investment Ref	Project or Programme Name	Capital Expenditure 2019/20 (2017/18 Prices)
WS10, A39	To improve the resilience of our water supply network linking into projects delivered to meet the requirements of the Water Resources Management Plan	I013174	TWD - Network Interconnectivity	0.991
			Total Transition Expenditure	**22.400**

SECTION B: TRANSITION SUMMARY TOTALS

Line 43: Total gross transitional expenditure

This block is the total of lines 1 to 42.

Line 44: Grants and capital contributions for transitional expenditure

There will be no receipts of grants and contributions.

Line 45: Total net transitional expenditure

The total net transitional expenditure is £22.400 million and is detailed above.

WS12 – RCV ALLOCATION IN THE WHOLESALE WATER SERVICE

SECTION A: WATER RESOURCES NET MEAV

As per our January submission, our approach here is different to that taken for the bioresources RCV allocation, where we did carry out a fresh asset valuation exercise, using a methodology based on an estimation of the economic value of bioresources assets (in a hypothetical competitive market). We consider that a fresh asset valuation would not be appropriate for the water resources RCV allocation, due to some important differences to the case of the bioresources RCV allocation:

- As Ofwat identifies, under an unfocused approach to the RCV allocation it would be necessary that any full revaluation considers the value of water resources assets and the value of water network plus assets. This means a full revaluation would be much more costly and time-consuming than the bioresources valuation which focused on bioresources assets and did not need to consider the value of other wastewater assets (e.g. sewers and sewage treatment assets)
- There are particular challenges for the valuation of water resource assets. There have been a limited number of large-scale water resources projects completed since privatisation. Accurately valuing water resource assets is particularly complex, and given the limited recent examples of large scale water resource assets, such as impounding or pumped storage reservoirs, being constructed in the UK there is consequently a degree of subjective judgement required to determine a valuation. Water resources assets tend to be idiosyncratic with specific features being strongly influenced by local geography, hydrology and site history
- There is less benefit in carrying out a detailed asset revaluation when used for an unfocused RCV allocation: under Ofwat's regulatory policy not to apply a focused RCV allocation to water resources (a policy which we support), the water resources RCV is not intended to be set at a level which equals or approximates the economic value of water resources assets. The unfocused allocation approach means that the resulting RCV for water resources would only represent a fraction of economic value, reducing the potential benefit available from the type of detailed valuation work we undertook for bioresources.

Line 1: Net MEAV per regulatory accounts as at 31 March 2015

The roll forward of the March 2015 position to March 2017 has been calculated using summarised asset data.

Line 2: Disposals

No water resource assets with net value where disposed of.

Line 3: Reclassification

Reclassification has occurred at one site, Lincoln Hall, which has moved from water treatment to water resources due to the retention time of the reservoir.

For our updated valuation, and following Ofwat's feedback report, we adopted the approach of only including in net MEAV, the value of M&G assets that form part of water resources under the principal use rule, which reduces the total net MEAV for M&G compared to the January submission.

Line 4: Inflation

Inflation was based on 2017/18 year-end RPI.

Line 5: Additions

We categorise expenditure for reporting purposes using Business Investment Codes (BICs). The BICs are a matrix of codes for each Reg Account group; infra / non-infra, maintenance, enhanced service levels, quality and growth. Individual capital projects are assigned up to five of these codes, so expenditure against these projects can then be reported.

Expenditure is then grouped per BIC to enable Annual Performance Report and information request reporting. It is this data that is used to form the basis of additions.

Line 6: Depreciation

Depreciation in calculated from individual assets which are each assigned a regulatory account evaluation group. For 2015/16, 18 months depreciation was applied and for 2016/17 six months. This is the same as for the bioresources RCV submission.

Line 7: Other adjustments

No other adjustments were made.

SECTION B: ROLL FORWARD

The roll forward of additions and depreciation has been updated using the latest information available from our asset management systems using the same source data as WS1.

This includes changes in forecast expenditure on the Eels Directive and Norwich sustainability scheme.

Expenditure on M&G assets has been assigned to the business unit of principle use. This is in contrast to the January submission where M&G for shared used assets was allocated proportionally between business units .

SECTION C: RCV AS AT 31 MARCH 2020

In our allocation of the wholesale water RCV we have maintained a consistent approach to our January 2018 submission, basing our analysis on net MEAV, where net MEAV represents the gross MEAV minus cumulative depreciation (on a current cost basis).

Updating our analysis from report year 2016/17 data to 2017/18 data, our estimates of the net MEAV of water resources assets as a proportion of the net MEAV of wholesale water assets (comprising water resources assets and water network plus assets) is 6.61% (excluding third party).

TARIFF IMPACT

Impact of cost of capital

The resulting impact from cost of capital for 2017/18 if RCV had been allocated as we now propose, as compared to WS12b submitted in January 2018 for report year 2015/16, shows a minor reduction in the revenue requirement reallocated from water resources to network plus. This reflects primarily that other costs (opex and capital maintenance) have increased year on year under the revised cost allocation for report year 2017/18, and therefore the balance of revenue available (under the revenue control) to operating profit has reduced.

Impact of proposed RCV allocation on customers

The allocation of the water RCV between water resources and network plus has the potential to affect customers' tariffs. Indeed, some degree of tariff impact is to be expected. The use of net MEAV represents a new allocation of value between water resources and network plus which differs to that reflected in Anglian Water's current water tariffs. In this context, we consider a tariff impact analysis an important part of the overall process. We set out our approach and results below.

In calculating the revenue requirement across customer groups for charge setting, our cost allocation work utilises three principle cost drivers for Water Resources; namely volume, six month seasonal peak and average day peak week.

We interpret this as being consistent with Ofwat's previously published guidelines which say to 'include some resource capacity costs (ground and river water abstractions used to meet peak demands) ...in the peaking factor analyses'.

Therefore, water resources costs associated with dams and impounding reservoirs have been allocated to six month seasonal peak, with a proportion also allocated to volume using Ofwat's proposed exponent of 0.7 to reflect economies of scale. By comparison, the costs associated with raw water aqueducts and source pumping stations, which relate to the transfer of water to long term storage, are driven by volume only.

Approximately 75% of water resources revenue requirement is allocated to volume.

On this basis, that proportion of cost allocation based on peak will result in a minor variation in revenue recovery between customer classes, given for the six month seasonal peak and the average day peak week, the peak factors are:

- Higher at the system peak for household customers than non-household customers; and
- Higher at the system peak for smaller non-households than larger non-households.

We therefore allocate costs using peak factors, as this results in a fair recovery of revenue.

The proposed change of moving from a gross to a net asset valuation tends to weight towards long lived (infrastructure) assets, which is compounded by the focus of recent investment towards distribution system assets. Therefore this results in an increase in distribution system assets and a reduction in water resources and water treatment assets.

Proportion of revenue requirement

Asset Valuation	Water Resources	Raw Water Distribution	Water Treatment	Water Distribution
Gross MEAV	12.1%	2.4%	24.3%	61.2%
Net MEAV	11.9%	2.5%	21.1%	64.5%

As our January 2018 submission detailed, although the reallocation of the RCV results in a variable impact on different customer classes, these are considered overall to be immaterial, particularly when compared to the potential impact of CPI+K, and is well within the 5% threshold set out in the Ofwat charging rules.

Households

On average household customers would see no material change in their bill.

Measured customers with low usage (i.e a lower ratio of volumetric to fixed charges) would see the largest impact, with a change in their bill of between 1.6% and 0.8% for customers using 25m^3 and 50m^3 per annum respectively.

Potable non-households

Typically non-households and in particular large users, make a lower contribution at the distribution system peak to both peak hour and peak day demand, than households. As a result, the distribution costs, which typically account for approximately 60% of the revenue requirement, are lower for non-households than households on average and therefore result in a lower network plus unit cost. Whilst the water resources unit costs are broadly the same reflecting the minor differences in peak factors between customer classes as discussed above.

Therefore the increase in the distribution system assets has a smaller impact on non-households than for households due to the lower contribution made by this customer class at the system peak and is more than offset by the reduction in water treatment assets.

As a result we estimate the impact of the reallocation is a change in bills of between -0.3% and -1.0% for small/medium non-households and larger users respectively.

Non-potable non-households

We supply non-potable water to approximately 15 customers through a discrete system in the Immingham area of the Humber.

We treat our non-potable water to a relatively high standard, the treatment process varying only in that there is no final "polishing" stage.

The cost differential between potable and non-potable solely reflects the different level of water treatment with all other services consistent with the regional average. The resulting level of 'discount' is therefore relatively small.

As a result we estimate that the impact of the RCV reallocation on non-potable customer classes is a change in bills of between -0.6% and -0.9% for medium non-households and large users respectively. This is broadly similar to that for non-household potable customers.

Bulk Supplies

Approximately 95% of bulk supply revenues are from two cost sharing agreements. These agreements apportion the operating, capital and financing costs of the supplies between the parties and as a result are not impacted by the proposed RCV allocation.

The remaining bulk supply revenues are from standard wholesale charges. The impact of the change is therefore as described for non-households.

WS12A - CHANGE IN RCV ALLOCATION IN THE WHOLESALE WATER SERVICE

The movements in Net Modern Equivalent Asset Value (NMEAV) in table WS12 are broken into additions, reclassification and inflation.

The movements are then calculated as a percentage movement in Regulatory Capital Value (RCV).

This percentage has been converted in to a monetary value of RCV to complete the table.

The movements in forecast expenditure are due to re-prioritisation of the investment programme.

The movements in allocations of assets between business units relates to management and general assets.

WS13 – PR14 WHOLESALE REVENUE FORECAST INCENTIVE MECHANISM FOR THE WATER SERVICE

Ofwat action ref ANH.PD.A5 PR14: Wholesale revenue forecasting incentive mechanism - Anglian Water is required to provide evidence to explain its forecast performance in tables WS13

For report year 2018/19 in the table submitted the recovered revenue was forecast to be in line with allowed revenue under the control, therefore no revenue adjustment and no penalty was forecast. The evidence was not available at the time to conclude that the outcome would be other than that we recovered the level of allowed revenue.

We set charges for a Charging Year in the preceding December, using the latest forecast of charge multiplier data to calculate charges in order to recover the revenue allowed under the control. We were required to submit WS13 before 28 July 2018. Given the constraints of the assurance and board sign-off process we finalised our data table submission using data up to Period 2 (May) in the financial year. At that point in the year it was too soon to determine whether revenue recovery for the report year 2018/19 would vary materially from the allowed revenue used to calculate charges. The main elements that historically have been seen to affect variations in revenue are summer demand, optant metering, prior year accounting adjustments and the level of connection charges. Being only 1/6 of the way through the year at Period 2, whatever the early indications may have suggested, we have experience of those reversing before the end of the year (and in the case of summer demand, with a wet July/August quickly reversing any earlier increases in year to date demand), and so took a neutral position as the most reasonable for that point in time.

The PR19 Reconciliation Rulebook notes that for the year report year 2018/19 Ofwat will have complete information on actual recovered revenues and RPI at the time of setting allowed revenues at PR19, therefore, it will make an adjustment to allowed revenues for the incentive calculated through the WRFIM formula for PR19. We therefore understood that the figure for report year 2018/19 was in any event indicative for the purposes of WS13; and the indications at the time of submission were inconclusive as to the level of any variation in recovered revenue as compared to the level of allowed revenue.

Prior to the year end for 2018/19, we have updated our forecast for recovered revenue. This shows an over-recovery of £10.3 million, representing 2.2% of allowed revenue (£476.8 million).

This reflects an over-recovery of main charges against allowed revenue of £5.4 million, resulting from prior year accounting adjustments (£3.2 million) and higher customer demand than forecast when setting tariffs. Actual recovery of grants and contributions revenue is £4.9 million higher than the revised forecast, reflecting increased levels of connection charges compared to the available forecast when setting main charges.

For report year 2019/20 we have not updated our forecast.

SECTION A: COMPANY DETAILS FOR WRFIM

Line 3: Company has accepted WRFIM licence modification

Modification of condition B of our licence was published by Ofwat in November 2016.

SECTION C: ALLOWED REVENUE

Line 9: Allowed revenue - water

Pre-populated cell.

Allowed 2014/15 wholesale water revenue as set out in the letter, "Final determination of price controls" addressed to Peter Simpson from Cathryn Ross, dated 12 December 2014.

Line 11: K - water

Wholesale water revenue K factor for each each of AMP6 is summarised in the table below.

Description	2015/16	2016/17	2017/18	2018/19	2019/20
Final Determination K	0.00%	1.34%	0.89%	0.58%	0.56%
ODI K prior year adjustment				-0.15%	-0.75%
ODI K adjustment			0.16%	0.76%	1.35%
K	0.00%	1.34%	1.05%	1.19%	1.16%

The K factor for 2015/16 was set at zero, and for 2016/17 reflects the figure set out in the the letter, "Final determination of price controls" addressed to Peter Simpson from Cathryn Ross, dated 12 December 2014.

The K factor for 2017/18 reflects the K set out in the final determination letter referred to above, adjusted for the in period ODI reward of £0.5m (2012/13 prices) for report year 2015/16 as set out in Ofwat's document "Final determination of Anglian Water's in-period outcome delivery incentives for 2015-16", dated 15 December 2016.

The K factor for 2018/19 reflects the K set out in the final determination letter, adjusted for the in period ODI reward of £2.6m (2012/13 prices) for report year 2016/17 as set out in Ofwat's document "Final determination of in-period ODIs for 2016/17", dated 15 December 2017.

The K factor for 2019/20 reflects the K set out in the final determination letter, adjusted for the forecast in period ODI reward of £4.6m (2012/13 prices) for report year 2017/18 based on forecast leakage performance.

Line 12: Total revenue forecast - water

The total allowed wholesale revenue for each year of AMP6 reflects the revenue before any adjustment for under/over recovery of revenue from prior years (year *t-2*) or AMP5 blind year adjustment is taken into account.

The subsequent adjustment for under/over recovery of revenue from prior years is as per the WRFIM mechanism set out in the PR14 Rulebook.

SECTION D: AMP5 RCM BLING YEAR ADJUSTMENT

Line 13: RCM blind year 2014/15 adjustment for implementing via WRFIM - water

Pre-populated cell.

The RCM adjustment as notified to us by Ofwat in their document "Consultation on the final 2010-15 reconciliation - company-specific index - Anglian Water", published October 2016

Line 14: Percentage of RCM adjustment by year - water

We informed Ofwat in a letter dated 4 November 2016 that we would apply 100% of the blind year adjustment to our 2017/18 allowed revenue.

SECTION E: REVENUE RECOVERED

Lines 15 to 18: Revenue recovered

The data reported is household and non-household measured and unmeasured wholesale revenue.

Report year 2015/16 to 2016/17

Data is taken from table 2I of the APR. The value of measured non-household revenue for 2015/16 as reported in the APR has been corrected for £11.5m of non-potable supply revenue that should have been reported as third party revenue within the control.

Report year 2017/18

Data is taken from table 2I of the APR.

Report year 2018/19

Data is taken from the management account forecast of the year end out-turn position as at Period 11 (February) 2018/19.

Report year 2019/20

Data is taken from the spread sheet model used to calculate forecast revenue. This is consistent with the customer projections in WS3 and the revenue cap.

Line 19: Water: Third party revenue - household

We have no household third party revenue.

Line 20: Water: Third party revenue - non-household

Third party revenue from non-households relates to non-potable supplies to a discreet system in the Immingham area. Projections for 2018/19 to 2019/20 are consistent with recent trends.

Line 22: Water: Grants and contributions

Prior to the year end for 2018/19, we have updated our forecast out turn for the current year. This is consistent with the data in App28.

SECTION F: VARIANCE ANALYSIS OF GRANTS AND CONTRIBUTIONS

Line 24: Water: Capital contributions from connection charges and revenue from infrastructure charges (PR14 FD)

Grants and contributions allowed revenue as set out in the FD in 2012/13 prices.

SECTION G: PENALTIES

Line 27: Main revenue adjustment as incurred - water

Report year 2017/18

The main revenue adjustment incurred of -£1.8m relates to report year 2015/16 revenue over-recovery of £1.7m (out-turn prices) compared to allowed revenue.

This reflects a greater recovery of grants and contributions revenue compared to that forecast.

Report year 2018/19

The main revenue adjustment incurred of -£9.2m relates to report year 2016/17 revenue over-recovery of £8.1m (out-turn prices) compared to allowed revenue.

This reflects an over-recovery of main charges against allowed revenue of £6.8m. This was a result of prior year accounting adjustments (£2.9m) and higher customer numbers than forecast when setting tariffs.

Actual recovery of grants & contributions revenue was £1.3m higher than forecast (out-turn prices), reflecting increased levels of connection charges.

Report year 2019/20

The main revenue adjustment incurred of -£12.9m relates to report year 2017/18 revenue over-recovery of £11.2m (out-turn prices) compared to allowed revenue.

This reflects an over-recovery of main charges driven by a combination of reduced optant metering (where unmeasured charges are higher than the average measured bill) and higher household demand, together with prior year accounting adjustments (£5.3m).

Actual recovery of grants & contributions revenue was £2.5m higher compared to forecast (out-turn prices), reflecting higher levels of connection charges.

The calculation of allowed revenue for the report year 2017/18 reflects the FD14 updated for RPI plus K, adjusted for the following :

- The report year 2015/16 in-period ODI out-performance payment of £0.5m (re-priced to £0.7m);
- The report year 2014/15 blind year adjustment of -£0.8m (repriced to -£1.0m); and
- The report year 2015/16 revenue over-recovery of £1.7m (re-priced to £1.8m).

Line 28: Penalty adjustment as incurred - water

Report year 2017/18

The over-recovery in report year 2015/16 of £1.7m represents 0.4% of the allowed wholesale revenue of £443.0m. This is within the 2% dead-band and therefore no penalty arises.

Report year 2018/19

The over-recovery in report year 2016/17 of £8.1m represents 1.8% of the allowed wholesale revenue of £453.6m. This is within the 2% dead-band and therefore no penalty arises.

Report year 2019/20

The over-recovery in report year 2017/18 of £11.2m represents 2.4% of the allowed wholesale revenue of £465.5m. Therefore a penalty of 2.4% attaches to the total value of the over-recovery.

Line 29: WRFIM adjustment as incurred - water

Report years 2017/18 to 2019/20

The line reflects the sum of the main revenue adjustment and the penalty adjustment from the lines above.

Line 30: WRFIM Total reward / (penalty) at the end of AMP6 - water

The value of the aggregated year 4 (report year 2018/19) and year 5 (report year 2019/20) main revenue adjustment and penalty adjustment, priced at report year 2019/20 outturn prices.

Report year 2018/19

Prior to the year end for 2018/19, we have updated our forecast for recovered revenue for the current year. This shows an over-recovery of £10.3 million, representing 2.2% of allowed revenue (£476.8 million).

This reflects an over-recovery of main charges against allowed revenue of £5.4 million, resulting from prior year accounting adjustments (£3.2 million) and higher customer demand than forecast when setting tariffs. Actual recovery of grants and contributions revenue is £4.9 million higher than the revised forecast, reflecting increased levels of connection charges.

Report year 2019/20

Recovered revenue is forecast to be in line with allowed revenue, therefore no revenue adjustment and no penalty arises.

The calculation of allowed revenue reflects the FD14 updated for forecast RPI of 3.4% plus K as per the Final Determination letter, adjusted for the following:

- The forecast in-period Leakage ODI out-performance pre-tax payment of £4.6m for report year 2017/18 (re-priced to £6.6m (post tax)); and
- Over-recovery of revenue in report year 2017/18 of £11.2m (re-priced to £12.9m); and
- The accelerated repayment in report year 2018/19 of £6.0m of report 2017/18 over-recovery (re-priced to £6.4m).

Line 31: WRFIM Total reward / (penalty) at the end of AMP6 - water

This line reflects the outputs of the Revenue adjustments feeder model (PR19-Revenue-adjustments-feeder-model-01h).

WS15 – PR14 Wholesale Total Expenditure Outperformance Sharing for the Water Service

Section B: Menu Choices

Line 6: Water: Final menu choice

In the pre-populated tables this has only been entered to one decimal place. We have corrected this to equal line 4 (Water: Implied menu choice). We notified Ofwat of this error and agreed it should be corrected.

Section C: Totex

Line 9: Water: Actual Totex

The years 2015/16 and 2016/17 are pre-populated cells taken from the published Regulatory Accounts. The year 2017/18 is taken from the published Regulatory Accounts (Table 4D, line 24).

We have updated our totex forecast for 2018/19 and 2019/20, reflecting our latest view of opex and capex. Whilst for 2018/19 we have a reasonable view of the split of our costs between price controls, we do not do the actual split until after year end when we prepare our financial statements for the Annual Performance Report. For 2018/19 we forecast our Water Totex expenditure to have increased by £12.1 million, made up of an increase of £25.3 million in operating costs and a decrease of £13.2 million in capital expenditure. This largely reflects the ongoing impact on our water supply and distribution systems of the 'beast from the east' and the hot dry summer in 2018. For 2019/20 our forecast opex is unchanged and we have reduced our forecast capital expenditure by a further £12.0 million.

In addition we have also reflected higher Grants and Contributions receipts in 2018/19 of £4.1 million due to increased developer activity and assumed these result in offsetting higher capex in 2019/20. As a result there is no change to the cumulative net Totex forecast over the two years resulting from this change.

Section D: Adjustments to Totex

Line 10: Water: Third party services (opex)

The years 2015/16 and 2016/17 are pre-populated cells taken from the published Regulatory Accounts. The year 2017/18 is taken from the published Regulatory Accounts (Table 4D Line 10).

Line 11: Water: Third party services (capex)

The years 2015/16 and 2016/17 are pre-populated cells taken from the published Regulatory Accounts. We have made Ofwat aware that there is a minor restatement on line 11 on table WS15 to reflect a revised position for 2015/16 and 2016/17. We had previously reported nil capital expenditure against third party services in the 2015/16 and 2016/17 APRs. However on review of prior-year third party expenditure, it was apparent that we had incurred third-party capital expenditure of £0.703 million in 2015/16 and £0.534 million in 2016/17.

The year 2017/18 is taken from the published Regulatory Accounts (Table 4D, line 18).

Line 12: Water: Pension deficit recovery costs

Years 2015/16 and 2016/17 are pre-populated cells taken from the published Regulatory Accounts. The year 2017/18 is taken from the published Regulatory Accounts.

Line 13: Water: Other cash items

Years 2015/16, 2016/17 and 2017/18 are taken from the published Regulatory Accounts. We do not anticipate any other cash items in the final two years of AMP6, but will report any that do occur in the relevant APR.

Line 14: Water: Disallowables

Years 2015/16, 2016/17 and 2017/18 are taken from the published Regulatory Accounts. We do not anticipate any other cash items in the final two years of AMP6, but will report any that do occur in the relevant APR.

Line 15: Water: Transition expenditure

This line is pre-populated. Ofwat have recognised that the pre-populated figure has been incorrectly pre-populated with companies' business plan forecasts of transition expenditure rather than actual transition expenditure. The correct entry for this cell should be £25.310 million and has been corrected in our submission.

SECTION E: PAYG

Line 16: Water: PAYG ratio

This line is pre-populated from the PR14 Final Determination.

SECTION F: BUSINESS RATES IDOK

Lines 17 to 23: Business rates IDoK

We have left Block F blank on the basis we have assessed the change in cost of business rates and do not consider the thresholds to trigger an IDoK have been met. Given this, and the fact that including the data in the model when there is no IDoK triggered interferes with the calculations of the model, we have, for transparency included the table as it would have been had we completed it.

F	Business rates IDoK					2017/18	2018/19	2019/20	2015-20
17	Company specific water business rate sharing rate	WS15017	%	2	-				75.00%
18	Menu Cost Sharing Rate	WS15018	nr	2	-				0.49
19	Menu Choice Expenditure Factor	WS15019	%	2	-				100.72%
20	Water business rate constant 2017, 2018, 2019	WS15020	nr	3	2012-13 FYA (RPI)	43.175	43.175	43.175	
21	Water business rate constant 2017, 2018, 2019	WS15021	nr	3	Outturn	48.51	50.159	51.714	
22	Applicable Water Business Rate Costs	WS15022	nr	3	Outturn	41.935	41.569	41.567	
23	Water: IDoK Business rates adjustment	WS15023	nr	3	Outturn	0	0	0	

Line 18: Menu Cost Sharing Rate

This is a pre populated cell, which Ofwat had populated as 0.50. The correct input should be from the PR14 FD menu feeder model and should therefore be 0.49.

Line 19: Menu Choice Expenditure Factor

This is a pre populated cell, which Ofwat had populated as 100.00%. The correct input should be from the PR14 FD menu feeder model and should therefore be 100.72%.

SECTION G: TOTEX MENU ADJUSTMENTS

Lines 26 to 27: Totex menu revenue adjustment and RCV adjustment

These lines reflects the outputs of the Revenue adjustments feeder model (PR19-Revenue-adjustments-feeder-model-01l-for=publication) and the RCV adjustment feeder model (PR19-RCV-adjustments-feeder-model-June-2018-update).

WS17 – PR14 WATER TRADING INCENTIVE RECONCILIATION

The data table and commentary for WS17 were previously provided in July 2018 as part of our PR14 Reconciliation Information submission. No changes have been made to the data table or commentary since then.

Our Trading and Procurement code was published for consultation in August 2018.

Inter water Company trading forms a key element of our current water supply arrangements. These are classified as trades or bulk transfers – see table below. The bulk transfers are exports from our system and are parts of water sharing agreements under the requisite reservoir orders.

Trading party	AWS WRZ	Direction	Max. Average (Ml/d)	Max. Peak (Ml/d)
Severn Trent Water	Ruthamford North	Export	18.00	18.00
Affinity Water	Ruthamford South	Export	91.00	109.00
Affinity Water	South Essex	Export	7.80	7.80
Cambridge Water	Thetford	Import	0.25	0.25
Essex & Suffolk Water	South Essex	Import	3.00	4.50

The most recent trading agreement is with Cambridge Water and is dated 31 October 2013. There were no new trades that started in the period 2015 to 2020.

We have considered further water resource sharing options as part of the development of our next Water Resources Management Plan. At this point of the planning process, only a variation as a short term 'reverse trade' to the bulk supply to Affinity Water (Central) from Ruthamford South is likely to emerge in the revised draft WRMP when published in September 2018. Trading incentives do not apply to an arrangement of this type. In summary, no new trades which would qualify for water trading incentives are likely to emerge as options to balance supply and demand over the period 2020 to 2025.

We are preparing a draft trading and procurement code. A delay in publishing will allow for up to date information on our supply demand balance to be included as well as links to the published plans and related supporting technical documents. Our trading and procurement code would be approved in accordance with the guidance issued by Ofwat in February 2018.

Line 1: Does the company have an Ofwat-approved trading and procurement code?

The plan and timetable for our trading and procurement code is outlined above. The draft code will enter the formal consultation process before September 2018.

** Our Trading and Procurement code was published for consultation in August 2018.*

WS18 - Explaining the 2019 Final Determination for the Water Service

Section A: Customer Service

Line 1: Residential customers metered

This is the actual and forecast total percentage of residential customers receiving a billed metered water supply and is derived from internal year-end reporting for the baseline and from the Water Resources Management Plan (WRMP) demand forecast model for the plan period.

This figure aligns with the total number of residential properties billed for measured water in table WS3, lines 1 and 2, divided by the total number of residential properties from table WS3, lines 1, 2 and 4.

Forecast measured property figures have been derived for the WRMP, based upon the additional new-build property projection (from Local Authority Planning Data) and the metering (switcher / optant) forecasts.

This aligns with the methodology used for table WS3.

Residential properties billed for measured water

Data has been derived from recorded information and the projected forecast for customers switching from unmeasured to measured and new build properties, in alignment with the WRMP.

2017/18 data is based on the number of recorded properties. Total property numbers (water account) have been calculated as part of our year-end reporting process, based upon internal SAP premise data and income and tariffs data. This allows the derivation of both measured and unmeasured property totals. Additional metering data allows the derivation of the numbers of internal / external connections.

Forecast data for the total number of measured properties has been derived using the WRMP household and population forecast model, baselined to year-end reporting totals.

Forecast growth has been aligned with planning information (collated by Edge Analytics) as provided by the Local Planning Authorities in line with the requirements set out in the WRMP.

The measured and unmeasured split has been derived, using baseline outturn data and the meter installation / optant forecast provided by the Metering team, as used in the WRMP demand forecast.

Additional metering data

The figures compare to the number of household properties where we have fitted a meter, set out in the table below.

	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
% of household properties fitted with a meter	87.73%	89.18%	90.31%	91.25%	92.11%	92.67%	93.87%	94.68%	95.09%

The difference between the figures in line 1 and those in the table above reflect those properties where a meter has been fitted under our enhanced metering programme but which have not yet been activated for charging purposes.

The AMP6 enhanced metering programme is compulsorily installing water meters in designated planning zones. We are installing meters in Fenland, Norwich, the Broads and Ruthamford South Water Resource Zones (WRZs) as well as metering Norfolk Rural, North Norfolk Coast, March and Ely. By providing consumption data and possible savings to customers the programme aims to encourage them to switch to measured charges. We will not complete any of the individual areas

listed above until the final year of AMP6. This allows us to keep resources we need at an efficient level. We aim to have 91% of customers with a meter and 85% paying measured charges by the end of AMP6.

We will continue with the enhanced programme in AMP7. We are proposing to install meters in the following WRZs: Central Lincolnshire, East Lincolnshire, Fenland, Norwich and the Broads, Essex, Ely and Ruthamford North. We are proposing to install smart meters in these WRZs to enable us to provide hourly consumption data to customers. We will do this proactively via a web portal and mobile app to help them better understand their individual water use, encouraging them to switch and also reduce their consumption further. We aim to have 95% of customers with a meter and 89% paying measured charges by the end of AMP7.

Line 2: Number of contacts about drinking water (taste, odour and discolouration)

Our total number of appearance and taste and odour water quality contacts is forecast to remain stable through the next AMP. Figures exclude contacts that are reported to DWI as a reportable event. All other consumer contacts under the DWI sub categories of 'appearance' and 'taste and odour' are included, in line with the Discover Water reported data for 'appearance' and 'taste and smell'

SECTION B: RESILIENCE

Line 3: Number of catchment management schemes

Schemes will run over more than one year as water quality improvement and behavioral change require time to implement. The exact number of schemes per year may still change as we are waiting on Ministerial guidance regarding metaldehyde; these figures should be taken as a guide at this point.

Customer support for catchment management is high in preference to end of pipe solutions and the approach represents an increase in activity compared with AMP6 to reflect this, alongside meeting increased regulatory expectations to demonstrate the approach as business as usual.

SECTION C: AFFORDABILITY

Line 4: Number of people receiving help paying their water bill

Reported numbers exclude customers billed on our behalf by other water companies, such as Cambridge Water, Affinity Water, Thames Water and Severn Trent.

The historic volume is a unique count of customer accounts that benefited from one or more affordability scheme during the year. There was insufficient historic data to report 2015/16 on this basis which is why these cells are blank.

Our affordability schemes include:

1. Assistance funds
2. Back on track schemes
3. Breathing Space
4. Concessionary tariffs, including Watersure, Aquacare Plus and our LITE tariffs
5. Commitments to pay
6. Income maximisation assessments
7. Leakage allowances
8. Charges holidays
9. Temporary installment arrangements, including installment plans, court plans, payment schemes with debt and Department for Work and Pensions (DWP) direct payments.

Temporary installment arrangements definitions:

- Installment plans – temporary installment arrangement for customers in arrears who cannot afford to clear the current balance and ongoing charges before the next bill is due. Affordable installment amount and frequency agreed with customer after income and expenditure assessment

- Court plans – installment arrangements agreed with customers to clear their outstanding county court claim by affordable installments
- Payment schemes with debt – installment arrangement for customers in arrears who can afford to clear the current balance and ongoing charges before the next bill is due. Affordable installment amount and frequency agreed with customer after income and expenditure assessment
- DWP direct payments – deductions made by DWP from customers in receipt of income related benefits

The historic figures do not consider the following schemes when calculating the unique customer count: assistance fund, Breathing Space, income maximisation assessments and charges holidays with consumption. However, it is likely many of these customers would have also benefited from a scheme that was included.

With the exception of 'concessionary tariffs' and 'temporary installment arrangements' the analysis included schemes that were present at the start of the year, those created during the year, those that ended during the year and those that continued into the following year. Concessionary tariffs and temporary installment arrangements included those present at the end of the financial year only.

The increase in the number of customers assisted from 2018/19 through to 2024/25 reflects an increase in the assistance we will make available to customers with affordability issues, with take-up driven by targeted promotion of the help available. This is set out in detail in the *Affordability and vulnerability* chapter of our Plan.

SECTION D: MARKETS

Line 5: Number of direct procurement water service schemes

There are no schemes planned for delivery in AMP7 using the Direct Procurement Contract (DPC) route. We anticipate a new surface water reservoir planned for delivery by 2035 will be procured by this route in AMP8. Full details of our analysis is provided in chapter 11. The Role of Markets, Incentives and Behaviours and supporting appendices.

Lines 6: The volume of water traded

This is the actual and forecast volume of water traded. The volume of water traded includes the total volume of potable, non-potable, raw and partially treated water that is imported and exported between incumbent water and sewerage and water only companies.

This will be expressed in Ml/d of distribution, based as an aggregate of exports and imports.

The forecast figure has been derived from Distribution Input (DI) data provided by the leakage team and has been projected as a three year rolling average, based upon historic data, for the PR19 planning period.

SECTION E: ENVIRONMENTAL

Line 7: Length of rivers improved as a result of WINEP Water Resources schemes

The Water Resources elements of the Water Industry National Environment Programme (WINEP) includes schemes with Water Framework Directive, Habitats Directive, Sites of Special Scientific Interest (SSSI), and Natural Environment and Rural Communities Act 2006 (NERC) drivers.

The AMP6 data for 2015/16 to 2019/20 is based on schemes that are included in the AMP6 National Environment Programme (NEP). We are reporting on the length of rivers improved as a result of the AMP6 NEP Water Resources Implementation schemes. This includes river restoration schemes for the River Nar, Laceby Beck and Skitter Beck, and sustainability (abstraction licence) changes related to the River Wensum. We have not included any allowance for the AMP6 options appraisals and investigations.

The AMP7 data for 2020/21 to 2024/25 is based on the schemes that have been included in the WINEP as issued by the Environment Agency (EA) on 31 March 2018. We are reporting on the length of rivers improved as a result of the proposed AMP7 implementation schemes associated with a water resources function as per the WINEP, such as those identified for sustainability changes, river support, recirculation, and river restoration. We have not included any allowance for AMP7 investigations or options appraisals as they will not directly result in river improvement. Where river lengths are duplicated in WINEP, such as where multiple schemes improve the same stretch of watercourse, the duplication has been removed.

Line 8: Greenhouse Gas Emissions from Water operations

The estimated forecast for annual carbon emissions released from water operations at the end of AMP7 has been set at 74,986 t/CO2e (rounded to 75 kt/CO2e in the data table), a 16% decrease from the forecast baseline year 2019/20, of 89,038 t/CO2e (rounded to 89 kt/CO2e in the data tables). This movement is primarily explained by a forecast increase in renewable electricity generated on-site, reducing the reliance upon grid electricity, in particular through a step-increase in solar generation forecast for 2019/20 and the reduction in grid electricity emissions factors through AMP6 and AMP7.

A number of assumptions have been made in calculating the forecast Greenhouse gas emissions from water operations:

- The data for all periods has been updated in line with the methodology used in the 2017/18 Annual Performance Report
- Forecast greenhouse gas emissions are directly impacted by the energy consumption forecast in data table WS4
- For existing data, we have applied a confidence grade of A2 as the majority of raw data is based on metering and has been audited as part of the ISO-14064 certification process. For forecast data we have applied a confidence grade of C4 as this is based upon extrapolation of metered data
- We have excluded forecast energy from renewable sources generated and to be used on site
- There is no guidance on which emission factors to use to convert from litres to kWh for fuel consumption. We have used the Energy Consumption Calculator Spreadsheet (SEAI PS)
- We have used the UKWIR Greenhouse Gas Carbon Accounting Workbook Version 12 in calculating emissions for 2017/18
- An assumption that in 2023/24 and 2024/25, 30% of company owned vehicles and vehicles used on company business, and 15% of company vans will be electric has been adjusted within transport
- We have used the latest forecast from BEIS on future grid emission factors
- We have identified a discrepancy between BEIS forecasts and actuals for previous years and have, therefore, applied a correction factor.

SECTION F: BILL IMPACTS

Line 9: Change in the average residential customer water bill over the period

Report years 2019/20 to 2024/25

Figures have been calculated based upon App7, line 39 (Average total bill - water).

SECTION G: TOTAL EXPENDITURE (REAL PRICES ~ 2017-18 FYA CPIH DEFLATED)

The data for years 2017/18 onwards aligns to WS1 line 36, with 2018/19 and 2019/20 deflated by CPIH to 2017/18 financial year average prices.

The data for 2015/16 and 2016/17 agrees to that reported in the 2017 Information Request, inflated by CPIH to 2017/18 financial year average prices.

Line 11: Total number of residential and business customers who receive a water bill

The number of residential and business customers for 2015/16 and 2016/17 is prepared on the same basis as 2017/18 onwards. The latter are a calculated line from the sum of WS3 lines 1 to 5. Namely the sum of residential and business customers billed for measured and unmeasured water.

Business customers reported are those that receive a billable service as we do not bill business customers directly since exiting from the non-household retail market.

The forecasts for 2018/19 have been updated to reflect better information now that we are further through the report year.

SECTION H: CUSTOMER ENGAGEMENT

We have updated the number of customers engaged with to include the engagement activities since submitting our Plan in September 2018. The total number of residential retail customers engaged with prior to submitting our IAP Response is now 515,859.

Line 13: Number of residential retail customers engaged with on the business plan

Customer engagement so far has included 501,591 engagements with customers plus exposure of our plans and intention to consult on them to the equivalent of 8.5 million people.

We consider engagement with customers can happen on several different levels, and we have developed an engagement scale to articulate this, as set out below.

1	2	3	4	5
Brand awareness	**Business awareness and education**	**Support given for an element of investment**	**Committed to behaviour change**	**Choice made between investment options**
Typically this will be through media or through presence at events	This is mostly one way, and would involve us pushing messages out, rather than two way engagement, complaints are placed here as its transactional	This level starts to become a more two-way conversation, and involves some detail on a specific question	Customers would have engaged to the point of understanding their impact and being prepared to contribute	This is in depth engagement about several aspects of our plan. It might involve trade offs, or detailed discussions for example in focus groups

We include in the data table engagements rated between 2 and 5 on our scale as these engagements have helped drive the development of the plan. Engagements that are rated 1 on our scale are included for completeness in the index below, and italicised, but are not included in the data table. We have included all customer types in our engagement which includes household, non-household and retailers. We have reported engagements rather than unique customers that we have engaged with, as for a lot of our channels we have no way of tracking whether the same customer participated in more than one channel.

Customer engagement channels

Channel	Primary methodology (incl depth)	Supplier	Geographical spread	Sample strategy [1]	Representation	Vulnerabilities	Output	Depth
1. Segmentation January 2017	Quantitative research	Allto Consulting	Random across region including Hartlepool	1000 – Anglian region 200 – Hartlepool region Quota based, ONS stats for our region	Representative of customer base	Yes, 13% self identified, 21% deemed	Six customer segments set out in PowerPoint report and eight golden questions	5
2. Customer world focus groups January 2017	Focus groups	Given London	Six towns within the Anglian region	44 chosen to represent AW segments	Targeted segments	One group with vulnerabilities, one group with English as a second language	Key insights set out on PowerPoint report	5
3.Co-creation workshops March 2017	Qualitative in depth, co-creation	Given London	Four towns within the Anglian region and one in Hartlepool	60 – Anglian region 15 - Hartlepool chosen to represent AW segments	Targeted segments including one group recently suffering 2-4 day outage	Information not captured for this work	Key insights set out in PowerPoint report with ideas pack. Separate Horncastle outage report	5
4. H2OMG - visitors August 2017	Count of visitors	The Forum, Norwich	Based in Norwich with visitors from across the region	*32,973* self selecting	Not captured	Not captured	PowerPoint report setting out findings	1
5. H2OMG - engagements August 2017	Voting – water wheel	Spring, 12 Degrees	Based in Norwich with visitors from across the region (map available)	1,100	Not captured except for segments in testing the water	Not captured	PowerPoint report setting out findings	4
	Survey – magnet maze			733				5
	Pledges – beat the bog			823				4

Channel	Primary methodology (incl depth)	Supplier	Geographical spread	Sample strategy [1]	Representation	Vulnerabilities	Output	Depth
	Survey – testing the water			1,678				3
	Voting – info desk			1,012				5
	Conversations			15,479				2
6. H2OMG – Social media August 2017	Reach Engagement	-	Region wide but focused on East Anglia	*346,599* 24,206	Not captured	Not captured	PowerPoint report setting out findings	1 2-5
7. H2OMG – Traditional media August 2017	Reach	Archant Mustard TV	East Anglian media outlets	*3,286,622*	Not captured	Not captured	PowerPoint report setting out findings	1
8. Acceptability research (phase 1) May 2017	Quantitative research	Accent	Random across region including Hartlepool	979 – HH Anglian region 50 – HH Hartlepool 498 – NHH Anglian region Quota based, latest census data	Representative of customer base	Income and receipt of benefits	Findings set out by segment in PowerPoint report	5
9. Acceptability research (phase 2) January 2018	Quantitative research	Accent	Random across region including Hartlepool	945 – HH Anglian region 50 – HH Hartlepool 500 – NHH Anglian region Quota based, latest census data	Representative of customer base	Income and receipt of benefits	Findings set out by segment in PowerPoint report	5

Channel	Primary methodology (incl depth)	Supplier	Geographical spread	Sample strategy [1]	Representation	Vulnerabilities	Output	Depth
10. Acceptability research (phase 3) April 2018	Quantitative research	Accent	Random across region including Hartlepool	1,000 Dual supplies 200 Cambridge W 200 Essex and Suffolk W 200 Hartlepool W	Representative of customer base, and different service types	Identified and reported separately	Findings set out by segment in PowerPoint report	5
11. Vulnerability research May 2017	Ethnographic depths	Accent Community Research	In-home interviews around the region including Hartlepool	40 – Anglian region 4 – Hartlepool representing various types of vulnerability	Focus on vulnerability	100% representation	Joint report setting out recommendations plus two detailed reports	5
12. Community Ambassadors September 2017 and on-going	Face to face engagement, using clickapads to capture poll results	-	Random across region including Hartlepool	524 as at May 18, all Anglian region to date	Self selecting community groups	Not captured, will be some representation in some groups	Spread sheet setting out poll results	3
13. Online community May 2017 and on-going	Qualitative research	Incling	Random across Anglian region (map available)	23,610 as at May 18, from a periodically refreshed 500 participant base	Self selecting, segments roughly correspond to AW segments	20% with someone in their household with a disability, 2% always and 24% sometimes have difficulty paying	PowerPoint reports including qual insight, polls and quotes for each topic	5
14. The Bus June 2017	Poll boxes Online quiz	Given London	18 locations in Anglian region (map available)	7,009 self selecting 443 self selecting	Not captured	Not captured	Slides in CEF update	3 4
15. Community ODI research Quarterly 2015 - 2018	Quantitative research	Alto	Random across region including Hartlepool	3,661 - Anglian 637 – Hartlepool Quota based, ONS stats for our region	Representative of customer base	22% of respondents deemed	Topline results report each quarter plus detailed presentation covering the three years	2

Channel	Primary methodology (incl depth)	Supplier	Geographical spread	Sample strategy [1]	Representation	Vulnerabilities	Output	Depth
16. Education takeaways May 2017	Homework for Primary school children	-	Random across Anglian region	106 – 53 responses containing a child and their responsible adult's replies	Future customers	Not captured	Spread sheet setting out responses	3
17. Customer Board January 2018 and on-going	Meetings with the Customer Board	-	Members are from across the region	7 (intended 8 but one dropped out)	Selected from the online community after application		Minutes	5
18. Strategy review – co-creation September 2017	Focus group – based on how to engage with customers	Given London	Peterborough (Wadenhoe)	6 from Peterborough area	Small sample, not representative	Not captured	Second phase engagement programme	5
19. Complaints and Operational job analysis	Collation of internal stats on inbound channels and topics	-	Random across Anglian region	216,841 – Anglian region	Customers with a complaint, not representative	Not captured		2
20. Ofwat SIM surveys	Quantitative research by Ofwat	Allto	Random across region including Hartlepool	900 – selected batches of customers who have contacted us	Customers who have contacted AW between 2016 -17 Q1 and 2017-18 Q2	Not captured	SIM survey results	2
21. Social polls December 2017	Two polls on Facebook and Twitter	-	Across region – some may not be customers	1,262 Self selected	Not representative	Not captured	Poll results	3
22. Social media analysis February 2018	Analysis of seven online channels for insight about Anglian Water	Linkfluence	Across region – some may not be customers	*26,300* self selected	Not representative	Not captured	Report setting out insights gained from social	1
23. H2O Lets Go!	Footfall at on the ground events	Given London	14 locations including Hartlepool for the electric van, quiz	13,325 – footfall around the van and the events	Self selected from people at the van location	Not captured	PowerPoint report setting out aims and findings, and engagement numbers	2

Channel	Primary methodology (incl depth)	Supplier	Geographical spread	Sample strategy [1]	Representation	Vulnerabilities	Output	Depth
			respondents random across the region including Hartlepool					
	Pledge cards			151 pledges				4
	Be the Boss			5,016 participants				5
	Digital plan			*2,610* views				1
	Social polls			11,277 votes				3
	Social media reach			*776,410* reach				1
	Social media engagement			25,333 likes, shares, clicks				3
	Video views			57,570 views				2
	Traditional media reach			*4,043,800*				1
	Brand exposure hours			*5,996* hours				1
	BH Weekend video			9,403 views and clicks				2
24. Vulnerability focus groups April 2018	Focus groups	Community Research	Six groups across the Anglian region and one in Hartlepool	43 – Anglian region 9 - Hartlepool	Targeted groups focused on specific vulnerabilities	This is the focus of this work and several vulnerabilities represented	Report setting out insights gained and recommendations for Anglian to consider	5
25. Retailers May 2018	Interviews	-	A retailers licence covers Anglian and Hartlepool regions	5 of the 21 with a licence in our region	Mix of retailer types including incumbent and new entrant	Not applicable	Minutes from meetings	3

Channel	Primary methodology (incl depth)	Supplier	Geographical spread	Sample strategy [1]	Representation	Vulnerabilities	Output	Depth
26. ODI and RORE May 2017	Quantitative research	ICS	Random across Anglian region	602	Quota based, representative of our region	14% of respondents supported through WaterSure, 32% had disability in household	Key findings set out in Powerpoint report	5
27. Lead pipe replacement survey	Pilot in Norwich asking affected properties to contribute 50% of replacement costs	-	Norwich	600	Limited to Norwich targeting properties with lead pipes	Not recorded	Note from the lead strategy team	3
28. Future customer workshops October 2017	Focus groups	-	Three towns in our Anglian region	25 secondary school pupils	Future customers	Not recorded	Workshop notes	5
29. Focus groups stage 2 December 2017	Focus groups	Given London	Anglian and Hartlepool regions	21 from three towns in Anglian region 9 from Hartlepool	Mix of ages and circumstances Daventry customers recruited from those suffering recent outage	Not recorded	Key insights set out in PowerPoint report with ideas pack. Separate Daventry outage report	5
30. Future customer workshops February 2018	Workshops	-	Northampton	56 year 11 students	Future customers	Not recorded	Workshop notes	3
31. Main stage WTP survey September 2017	Quantitative stated preference research	ICS and Eftec	Random across region including Hartlepool	11 – cognitive interviews 30 – 2 hall tests 109 – pilot DCE	Quota based, representative of our region		Detailed report setting out findings supported by a number of appendices	5

Channel	Primary methodology (incl depth)	Supplier	Geographical spread	Sample strategy [1]	Representation	Vulnerabilities	Output	Depth
				157 – pilot BWS 750 – HH main DCE study Anglian region (combined services & sewerage only) 150 – HH main DCE study Hartlepool region 453 – HH main BWS study Anglian region (combined services) 448 – NHH customers Anglian region (combined services & sewerage only) 52 – NHH customer Hartlepool region				
32. Second stage water resources WTP survey September 2017	Quantitative stated preference research	ICS and Eftec	Random across Anglian region	19 – cognitive interviews 31 – 2 hall tests 200 – pilot 1,008 – HH main DCE survey 408 – NHH main DCE survey 16 – post survey focus groups	Quota based, representative of our region	Not recorded	Detailed report setting out findings supported by a number of appendices	5

Channel	Primary methodology (incl depth)	Supplier	Geographical spread	Sample strategy [1]	Representation	Vulnerabilities	Output	Depth
33. Subjective wellbeing analysis November 2017	Wellbeing Valuation to assess the impact of flooding & roadworks on reported wellbeing	Simetrica	Random across Anglian region	64,526 respondents included within calculations	Respondents to Annual Population Survey (APS) – UK wide continuous household survey (ONS). Assumed to be representative	Not recorded	Report setting out effect of flooding and traffic incidents on customers wellbeing	2
34. Environmental viewpoints analysis September 2017	Q analysis – quantifying subjectivity	UEA	Specific to a river system in Norfolk	62 river users in Norfolk	Targeted to river users in Norfolk	Not recorded	Report setting our five view points	3
35. Macroeconomic analysis October 2017	Gross Value Added (GVA) analysis of the impact on businesses from severe water restrictions	NERA	Across Anglian region	12 in-depth interviews with NHH customers	Targeted to NHH sectors who would experience reduction in GVA	Not recorded	Report setting out the conclusions from the in-depth interviews	3
36. Valuation Completion Report – Focus Groups December 2017	Focus groups to review findings from previous studies (PR14 and PR09)	ICS and Eftec	Peterborough & Kettering	32 (8 in each of the 4 focus groups)	Targeted with range of gender, age and SEG	Not recorded	Write up in the valuation completion report	5
37. CCWater research report – water matters	Quantitative research	CCWater	Random across Anglian region	2,800 (in seven annual waves of 400)	Representative, each year from 2012-13 to 2017-18	Not recorded	Report published on CCWater website	5
38. CCWater research report – water matters	Quantitative research	CCWater	Random across Hartlepool region	1,050 (in seven annual waves of 150)	Representative, each year from 2012-13 to 2017-18	Not recorded	Report published on CCWater website	5

1 Sample strategy counts the number of interactions with customers. In a lot of cases that is the same as the number of customers, but in some, for example the online community, the same customers will engage on a variety of topics. Italicised numbers rating 1 on the depth scale are not counted in the overall engagement number, and are reported as an awareness number.

WR1 – WHOLESALE WATER RESOURCES (EXPLANATORY VARIABLES)

Lines 1 to 8: Water supplied to distribution input from different sources

Historical and baseline

The data used includes imports and water for non-potable use but exclude exports. This is in accordance with the previous guidance given for Chapter 12 of the June Return (2011).

Values have been provided in Ml/d, reconciled with year-end reporting values and forecast Normal Year Annual Average (NYAA) Distribution Input (DI) values.

Forecast

Values have been derived from regression analysis of historic trends for each of the volumetrically split elements, reconciled with the ground water (GW) / surface water (SW) projections derived for the WTW coded forecast.

GW and SW codings for the plan period have been applied to the Water Resources Management Plan (WRMP) forecast for DI to derive GW / SW volumes for plan period. Consequently, the volumetric splits have been reconciled to this forecast (see Table Wn1).

Line 1: Water from impounding reservoirs

The reported baseline estimates are based on DI from the following reservoir sources:

- Ravensthorpe WTW (Ruthamford North RZ): 100% inflow from natural inflow ("natural")
- WTW supplied from both Ravensthorpe Reservoir and Hollowell Reservoir
- Alton WTW (East Suffolk RZ): 31% natural inflow from Alton Water
- Pitsford WTW (Ruthamford North RZ): 44% natural inflow from Pitsford Reservoir
- The splits for Alton and Pitsford.

Forecast volumetric values show little change over the period to 2024/25; this is in alignment with the Water Treatment Works GW / SW forecast and WRMP forecast DI totals (see table Wn1).

Line 2: Water from pumped storage reservoirs

The reported baseline estimates are based on DI from the following reservoir sources:

- Alton WTW (East Suffolk RZ): 69% pumped inflow from Alton Water
- Ardleigh WTW (South Essex RZ): 82% pumped inflow from Ardleigh Reservoir
- Covenham WTW (East Lincolnshire RZ): 100% pumped inflow from Covenham Reservoir
- Grafham WTW (Ruthamford South RZ): 99% pumped inflow from Grafham Reservoir
- Pitsford WTW (Ruthamford North RZ): 56% pumped inflow from Pitsford Reservoir
- Wing WTW and Morcott WTW (Ruthamford North RZ): 88% pumped inflow from Rutland Water.
- Grafham WTW (Ruthamford South RZ): 99% pumped inflow from Grafham Reservoir
- Pitsford WTW (Ruthamford North RZ): 56% pumped inflow from Pitsford Reservoir
- Wing WTW and Morcott WTW (Ruthamford North RZ): 88% pumped inflow from Rutland Water.

The three sources with pumped inflow greater than 80% are counted as 100% pumped inflow (as per the guidance).

If the current trend continues, the volume of DI from pumped storage reservoirs is predicted to increase slightly; this is in alignment with the Water Treatment Works GW / SW forecast and WRMP forecast DI totals (see table Wn1).

Line 3: Water from river abstractions

The reported baseline estimates are based DI from the following river abstraction sources:

- Bedford WTW (River Ouse)
- Elsham WTW (River Ancholme)
- Hall WTW (River Trent)
- Heigham WTW (River Wensum)
- Marham WTW (River Nar)
- Stoke Ferry WTW (River Wissey).

Based upon current trend, the volume of DI from river abstraction is predicted to decrease slightly, in alignment with the Water Treatment Works GW / SW forecast and WRMP forecast DI totals (see table Wn1).

Line 4: Water from boreholes, excluding managed aquifer recharge water supply schemes

Historic data is based upon previously reported figures in Information Request tables.

Forecast values have been derived from WRMP forecast DI values and the Water Treatment works GW / SW forecast; this suggests a slight decrease in the volume of DI from boreholes.

Line 5 to 6: Water from artificial recharge and artificial storage and recovery water supply schemes

We operate no such schemes and forecast values are maintained as zero.

Line 7: Water from saline abstraction schemes

We operate no such schemes and forecast values are maintained as zero.

Line 8: Water from reuse schemes

We operate no such schemes and forecast values are maintained as zero.

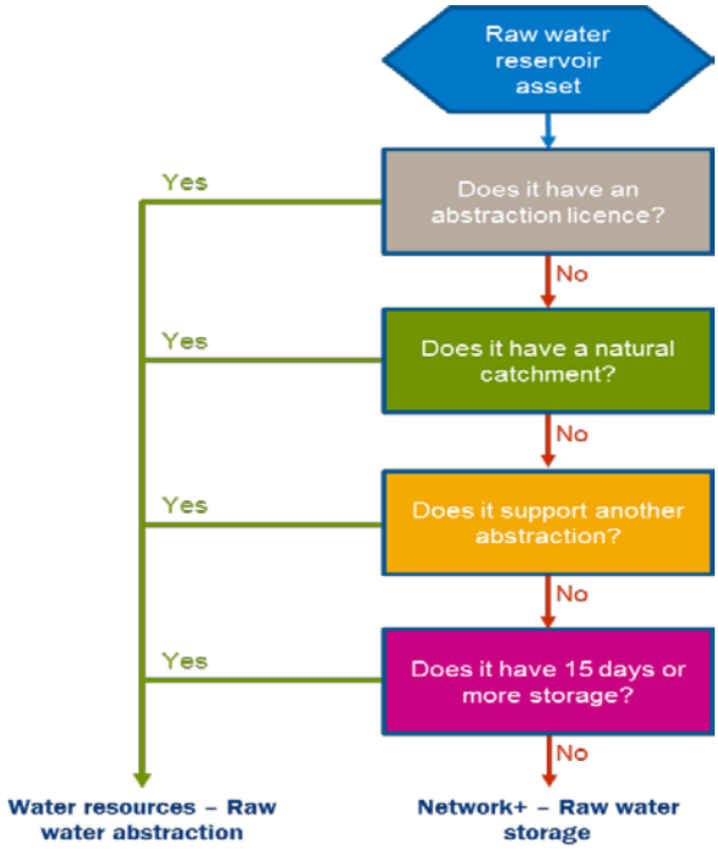
Lines 9 to 21: Number and capacity of sources

The data for these lines is reported to be consistent with the Annual Performance Review (APR) and Ofwat RAG 4.07 guidance. Forecasted numbers reflect proposed supply schemes and sustainability reductions as detailed in our Water Resources Management Plan 2019 (WRMP 2019).

Lines 9 and 10: Number of impounding reservoirs and pumped storage reservoirs

The reported numbers reflect the number of reservoirs classified as raw water abstraction based on the following RAG 4.07 flow chart:

Figure 26 RAG 4.07 flow chart to classify raw water reservoir assets as either water resources or network+



Impounding Reservoirs

- Ravensthorpe (Ruthamford North RZ): 100% inflow
- Hollowell (Ruthamford North RZ): 100% inflow

Pumped Storage Reservoirs

- Alton Water (East Suffolk RZ): 69% pumped
- Ardleigh reservoir (South Essex RZ): 82% pumped
- Covenham reservoir (East Lincolnshire RZ): 100% pumped
- Grafham Water (Ruthamford South RZ): 99% pumped
- Pitsford reservoir (Ruthamford North RZ): 56% pumped
- Rutland Water (Ruthamford North RZ): 88% pumped
- Cadney Carrs (East Lincolnshire RZ): 100% pumped
- Costessey Pits (Norwich & the Broads RZ): 100% pumped

In addition to our eight previously reported reservoirs, the RAG 4.07 guidance means we now also class Cadney Carrs and Costessey Pits as raw water reservoirs. Cadney has storage >15 days, and Costessey Pits has an abstraction licence.

The definition for these lines specifies that the reservoirs should be classified as either pumped or impounding, on the basis of the majority of the type of flow that they receive.

Line 11: Number of river abstractions

We are reporting seventeen river abstraction for the period 2017/18 to 2024/25. This consists of:

Seven direct river intakes:

- Cadney (River Ancholme)
- Clapham (Bedford Ouse)
- Hall (River Trent)
- Heigham (River Wensum)
- Costessey (River Wensum)
- Marham (River Nar)
- Stoke Ferry (River Wissey)

Ten indirect supporting river abstractions:

- Tinwell (River Welland for Rutland Water)
- Wansford (River Nene for Rutland Water)
- Offord (River Great Ouse for Grafham Water)
- Duston Mill (River Nene for Pitsford reservoir)
- Sroughton (River Guipping for Alton Water)
- Bucklesham (Mill River for Alton Water)
- East Mills (River Colne for Ardleigh)
- Covenham intake (Louth Canal for Covenham reservoir)
- Cloves Bridge (River Great Eau for support to Covenham)
- Cut-off-Channel (for support to Stoke Ferry)

Bath Springs and Cringle Brook intake at Saltersford, and Foxcote reservoir, do not enter supply so are not included in the reported list.

Line 12: Number of groundwater works excluding managed aquifer recharge

We report 208 groundwater sources for 2017/18 which is one less than previously reported in 2016/17. This is due to one source no longer being used. Of these, 198 are in the Anglian region and 10 are in the Hartlepool area.

A summary of the changes to the number of groundwater works over the reporting period is below:

- In 2018/19 we are reporting one additional source entering supply
- In 2021/22, we lose a groundwater source due to a sustainability reduction.

Lines 13 to 15: Number of artificial recharge, aquifer storage and recovery and saline abstraction schemes

We do not operate any such schemes.

Line 16: Total number of sources

The reported number is summed from lines 7 to 12.

Line 17: Number of reuse schemes

This line captures the creation of a new water reuse scheme coming into supply in 2024/25. This is the only scheme funded under the water resources control after 1 April 2020. The scheme is included in our WRMP, and more details are in table Wr7.

Line 18: Total number of water reservoirs

The reported number of 13 includes the impounding and pumped storage reservoirs reported in lines 9 (2) and 10 (8) as well as bank-side storage reservoirs at the following locations:

1. Heigham Large Deposit Reservoir – for Heigham WTW
2. Bedford – for Clapham WTW
3. South Clifton – for Hall WTW

Although raw water is pumped into these reservoirs, RAG 4.07 guidance (as shown above) classes them as network + raw water storage rather than raw water abstraction, and therefore these have not been included in Lines 9 and 10. The purpose of these reservoirs is to provide resilience rather than storage and as such they do not have an abstraction licence or a natural catchment. On review of the guidance, the Heigham Large Deposit Reservoir is now also included increasing the total count from 12 to 13.

There are no forecast changes to the number of water reservoirs for the period 2017/18 to 2024/25.

Line 19: Total capacity of water reservoirs

The capacity of all water reservoirs has been revised in line with guidance to reflect the design / construction capacity of the reservoir where possible, and this remains constant in line with the number of reservoirs. Previously this capacity was reported based on data from bathymetric surveys completed in 1999. This is a change from 213,893 Ml to 227,583 Ml.

Lines 20 to 21: Number and capacity of source pumping stations

For the 2016/17 Information Request, the number and capacity of intake and source pumping stations included both raw water abstraction and transfer pumping. Raw water transport has now been disaggregated with its own lines and included in table Wn1. Data entries have been recalculated to reflect this.

Following guidance in the RAG 4 and RAG 2 Guidelines & Appendices, we have identified raw water transport pumps within surface water systems and groundwater sources. Surface water transport has been split between abstraction to reservoir and abstraction from reservoir to treatment. Groundwater sources have been split based on the proportion of pumping head that that goes to treatment (considered to be raw water abstraction) and the proportion that goes to supply (considered to be water distribution). Line 21 reports the proportion of pumping capacity that is associated with the raw water abstraction from groundwater sources.

We previously reported the total number of boreholes (490 in 2017/18), but following a review of the guidance and feedback from a previous audit, this has been revised to the number of groundwater sources as reported in line 12 (208 in 2017/18).

Line 20: Total number of intake and source pumping stations

In 2016/17 we reported:

- 29 intake and source pumping stations including two gravity intake systems at Ravensthorpe Reservoir
- 490 boreholes.

In line with the disaggregation of raw water transport pumps and audit feedback, for 2017/18 onwards we are reporting:

- 20 intake and source pumping stations including one gravity intake system at Ravensthorpe Reservoir
- 208 groundwater sources.

The number of intake pumping stations forecast to increase by one in 2024/25 to reflect the new water reuse scheme. The number of groundwater sources is forecast to change as summarised in line 12.

Line 21: Total capacity of intake and source pumping stations

The reported capacity has been recalculated from the 2016/17 Information Request data to reflect the disaggregation of raw water transport from total pumping capacity and no longer includes transfer pumping stations.

The river abstraction and reservoir intakes and capacities are referenced in a survey of the raw water abstraction assets (Atkins, 2012) and updated by the Energy Team. The number of boreholes and pumps is reported in a borehole database maintained by the Water Resources Management Team. This is cross referenced with data from the Groundwater Engineering Unit (GEU) and Energy Team for the pump capacities. Both data sets have been updated for this table, along with the APR.

For a small number of boreholes (4) the rated power of individual borehole pumps could not be sourced from the SAP (corporate asset database) or the GEU records. For these, energy team site audit data was used to populate the pump capacity.

Changes to pump capacity are forecast in line with line 20. Groundwater pumping capacity varies between years due to changes in operation and loss or commissioning of boreholes, but these changes have been aggregated to source level. A summary of the change in intake and source pumping stations capacity is below:

- In 2018/19 gain of 46 kW reflecting a new source coming online and gain of four, loss of two boreholes at various locations
- In 2021/22, loss of 52 kW due to complete loss of source
- In 2024/25 a new water reuse scheme will enter supply. This scheme is detailed in our draft WRMP 2019. Predicted gain of 119 kW.

Line 22: Total length of raw mains and conveyors

The line for 2017/18 has been calculated using the latest in-service company-owned raw water mains data out of G/water (our corporate mapping system). As this system is constantly being improved and maintained, this is a more accurate set of numbers. The lengths have also been calculated using the guidance provided in RAG 4.07. The projected increases have been built using lengths reported as part of our WRMP. The increase of 0.9km in 2022/23 is due to a planned water reuse scheme.

Line 23: Average Pumping Head - raw water abstraction

We are forecasting no significant change to our Distribution Input (DI) over the next AMP. Increases in demand from growth will be mitigated by a combination of demand management and leakage reduction. As such the forecast for average pumping head over the next AMP is for it to remain the same as 2017/18.

Line 24: Total number of raw water abstraction imports

We operate no such schemes for raw water import/export and forecast values maintained as zero.

Line 25: Water imported from 3rd parties' raw water abstraction systems

We operate no such schemes for raw water import/export and forecast values maintained as zero.

Line 26: Total number of raw water abstraction exports

We operate no such schemes for raw water import/export and forecast values maintained as zero.

Line 27: Water exported to 3rd parties' from raw water abstraction systems

We operate no such schemes for raw water import/export and forecast values maintained as zero.

WR2 – WHOLESALE WATER RESOURCES OPEX

Section A: Opex analysis

Lines 1 to 6

We have taken our 2017/18 outturn and applied forecast updates in 2018/19 and 2019/20 in line with our internally approved business plan. The key updates to our total water resources costs over AMP7 are set out below.

We are forecasting an increase in water resources expenditure in AMP7 when compared to our 2019/20 run-rate. The key drivers for the increase are:

- Capex to opex decisions - these include the transfer of on-premise IT to a cloud based solution. These costs would have previously been capitalised but in AMP7 will be accounted for as an operating cost. The costs associated with capex to opex decisions and other opex changes have been allocated to each water resources process on an actual basis where known, or apportioned against AMP6 indirect costs.
- Enhancement operating costs - almost the whole increase arising from enhancement opex is due to the programme of work in relation to the Water Industry National Environment Programme (WINEP) being introduced by the Environment Agency, in particular the additional costs associated with drinking water protected area schemes and Water Framework Directive measures with the latter peaking in years two and three of the AMP. We have directly allocated enhancement operating expenditure to the relevant water resources processes. More detail on enhancement operating costs is in our commentary on table WS2.
- We have set ambitious efficiency targets during the AMP; their impact on forecast costs is set out below. Details on our efficiency assumptions are in chapter 10.Efficiency and Innovation.

Annual increase/ (decrease) to water resources from AMP6 run-rate £m	2020/21	2021/22	2022/23	2023/24	2024/25	Total AMP7
Capex to opex decisions	1.6	(0.9)	0.8	1.5	1.5	**4.5**
Other opex changes	0.5	0.4	0.2	0.1	0.1	**1.3**
Enhancement operating costs	8.2	13.0	12.8	10.7	10.2	**54.9**
Efficiency and productivity improvements	(1.4)	(1.9)	(3.1)	(3.8)	(7.2)	**(17.4)**
Total annual increase	**8.9**	**10.6**	**10.7**	**8.5**	**4.6**	**43.3**

Water Resources Processes

Impounding Reservoirs

The increase from 2020/21 is in other direct costs and is all as a result of enhancement operating expenditure in relation to pesticide and catchment management. Following this increase from 2020/21, overall costs remain flat for the AMP, with total enhancement opex costs over the AMP of £6.7 million (pre-efficiency).

Pumped Storage

The significant increase within total water resources opex is on pumped storage as a result of enhancement operating expenditure in relation to agricultural phosphorous management and catchment management. Total costs over AMP7 are £34.2 million with an increase of £4.8 million in 2020/21 and approximately £7.3 million per year in 2021/22-2024/25. The cost increase is all reported within other direct costs.

River Abstractions

Other direct costs increase by £3.5 million over the AMP (pre-efficiency), due to enhancement operating expenditure resulting from biodiversity and invasive species management (£3 million) and enhanced river flow monitoring (£0.5 million).

Groundwater

Other direct costs increase over the AMP by £10.5 million due to enhanced opex cost increases on managing drinking water in protected areas (approximately £1.7 million) and our Water Resources Management Plan (approximately £8.8 million), with the latter peaking in 2021/22 and 2022/23 of the AMP.

Line 7: Historical cost depreciation

The allocation of total forecast water resources depreciation to the end of AMP7 between impounding reservoirs, pumped storage, river abstractions and boreholes is based on the asset costs used for the PR09 MEAV calculation. This split has been used consistently for all years in AMP6 and AMP7.

Section B: Analysis of abstraction charges

In our experience, the annual application and advertising charges vary significantly year-to-year as the Environment Agency decide on licence requirements. We have therefore taken an average of the previous 10 years to derive a starting point for 2019/20. When adjusted for CPIH, we believe this reflects a reasonable estimate of costs over AMP7.

Our total forecast abstraction charge per year is included in table WS1 line 3. Wr2 line 11 is the balancing amount to ensure that Wr2 line 12 agrees with table WS1.

WR3 – WHOLESALE REVENUE PROJECTIONS FOR THE WATER RESOURCES PRICE CONTROL

SECTION A: WHOLESALE WATER RESOURCES REVENUE REQUIREMENT AGGREGATED BY BUILDING BLOCKS

Line 1: PAYG - wholesale water resources

This equals table WS1, line 21 (Totex) (water resources column) multiplied by table Wr4 line 19 (Total PAYG rate ~ water resources).

Line 2: Pension deficit repair contributions - wholesale water resources

This has been set to equal table WS1, line 22 (Pension deficit recovery payments) (water resources column).

Lines 3 to 11: Wholesale water resources revenue requirement

These lines have been populated using the outputs of Ofwat's PR19 financial model and mapping tool.

Line 12: Total wholesale water resources revenue requirement

2019/20 has been populated consistent with the customer projections in WS3 and the revenue cap. This has been split between Water Resources and Network Plus as detailed in section E.

For 2020/21 to 2024/25 the total represents the sum of lines 1 to 11.

SECTION B: WHOLESALE WATER RESOURCES – OTHER PRICE CONTROL INCOME

Line 13: Third party revenue - wholesale water resources

Third party revenue included within the price control relates to non-potable water supplies to non-households. This revenue has been analysed between water resources and network plus on the same basis as described in section E.

Projections for 2019/20 to 2024/25 are consistent with recent trends showing no material change in demand.

SECTION C: WHOLESALE WATER RESOURCES – NON-PRICE CONTROL INCOME (THIRD PARTY SERVICES)

Line 14: Bulk supplies - contract not qualifying for water trading incentives (signed before 1 April 2020) ~ water resources

Wholesale revenue from bulk supplies includes those supplies reflecting historic arrangements for local network top-up to bordering undertakers, new supplies to New Appointments and Variations (NAVs) and two cost sharing agreements negotiated between the parties.

The historic arrangements and NAV supplies are all based on standard wholesale tariffs and are therefore analysed between water resources and network plus as described for business revenue in section E.

The cost sharing agreements are designed to provide an appropriate allocation of operating, capital and financing costs between the parties. The costs are allocated based either on the proportion of the capacity reserved to each party, the volume of water taken or on whether assets are separately identified and their use specific to one party or the other. The costs and therefore revenue are analysed at a service chain activity level as defined in RAG 4.07.

All revenue projections are based on a demand profile consistent with current requirements.

Line 15: Bulk supplies - contract qualifying for water trading incentives (to be signed on or after 1 April 2020) - water resources

As per our Water Resources Management Plan, we are not anticipating any new bulk supplies during 2020 to 2025.

Line 16: Rechargeable works - water resources

Consistent with recent trends there is no rechargeable works revenue forecast.

Line 17: Other non-price control third party services - water resources

Other non-price control revenue from third party services includes fire hydrants and meter testing. The majority of this revenue relates to network plus services.

Projections for 2019/20 to 2024/25 are consistent with recent trends showing no material change in activity.

SECTION D: WHOLESALE WATER RESOURCES – NON-PRICE CONTROL INCOME (PRINCIPAL SERVICES)

Line 19: Wholesale water resources non-price control income (principal services)

Other non-price control revenue from principal services includes recreation and abstraction licence trades. Both services relate solely to water resources.

Projections for 2019/20 to 2024/25 are consistent with recent trends showing no material change in activity.

SECTION E: WHOLESALE WATER RESOURCES CHARGES

Lines 20 to 23: Wholesale water resources charges

The base year allocation between water resources and network plus is based on the principles applied in the cost allocation exercise undertaken annually for our tariff setting process and the boundaries between the controls as defined in RAG 4.07.

The output of this process analyses the revenue requirement across the service chain activities (water resources, raw water distribution, treatment and distribution) and by customer classes, using Activity Based Costing. This uses cost drivers to provide the link between cost data for each service activity and the measurable element of customer demand. Drivers therefore not only explain costs but also provide a measure for each customer class to explain their contribution to that cost within each service chain activity.

In assessing the revenue requirement, we allocate the Regulated Capital Value (RCV) to service activities and asset categories based on the Modern Equivalent Asset Values (MEAV). This allocates the return on RCV across the service chain on a straight-line basis, with a constant percentage return per £ of the RCV. This return (operating profit) along with operating costs and capital maintenance forms the revenue requirement which are allocated to activities, costs drivers and then to customer classes.

This approach therefore not only analyses the revenue requirement by water resources and network plus but also details the proportion of each by customer class.

Having established the base revenue customer class proportions we are able to project these up until 2024/25 on the basis that any changes in these proportions are driven solely by changes in the customer profile as forecast in table WS3 and their associated demand. There is a direct correlation between customers and demand and the revenue requirement of water resources. Therefore changes in unmeasured households due to the metering programme and changes in measured households due to the metering programme and new connections result in a corresponding change in the revenue to be recovered from each customer class.

Line 24: Total wholesale water resources allowed revenue

The projected wholesale water resources allowed revenue equals the building blocks income less third party and non price control income.

SECTION F: GRANTS AND CONTRIBUTIONS

Lines 25 to 28: Grants and contributions for price control and non-price control - operating expenditure / capital expenditure

As per the updated data table structure issued in January 2019, we have split grants and contributions by operating and capital expenditure as well as by price control / non-price control.

We are not anticipating receiving any Water Resources grants or contributions.

SECTION G: REVENUE CONTROL TOTAL – WHOLESALE WATER RESOURCES

Line 29: Total revenue - wholesale water resources control

The projected wholesale water resources revenue requirement includes all revenue, including grants and contributions, covered by the price control.

WR4 – COST RECOVERY FOR WATER RESOURCES

Please see Annex 15a - Evidence on the natural rate of RCV run-off (Reckon) for further information on the cost recovery for water resources.

WR5 - WEIGHTED AVERAGE COST OF CAPITAL FOR THE WATER RESOURCES CONTROL

We have used Ofwat's indicative Weighted Average Cost of Capital, as set out in the PR19 final methodology.

WR6 – WATER RESOURCES CAPACITY FORECASTS

SECTION A: CAPACITY – COMPANY FORECASTS

Lines 1 and 2: Pre-2020 capacity (DYAA and DYCP)

The total capacity is calculated as the water resources yield described in Appendix 5 of the PR19 Final Methodology. Hydrological yield, licence quantity and abstraction pump capacity have been considered but all treatment works capacity, losses and other constraints have been removed from the calculation. The most constraining of the yield, licence or pump capacity has been used as the reported capacity.

The pre-2020 capacity has been calculated in line with the Water Resources Management Plan (WRMP) baseline supply forecast for 2019/20. This has been calculated using versions of our in-house Deployable Output (DO) spreadsheet that supported the DO calculations for the WRMP. The reported DO in the WRMP also includes network constraints, which have also been removed from this yield capacity calculation.

Capacity has been forecast to 2044/45 to capture any known changes to the baseline. In line with the guidance, WRMP planning assumptions have been followed, such that changes to capacity as a result of Water Industry National Environment Programme (WINEP) sustainability reductions, climate change and additional drought impacts (one in 200 year severity) have been applied at source level, where they impact either yield or licence.

These impacts have been summarised per WRZ, and applied cumulatively to the baseline. In line with WRMP planning assumptions, climate change is applied from 2020, WINEP impacts in 2022/23 and any drought impacts in 2024.

In line with table guidance and WRMP planning assumptions, Dry Year Critical Period (DYCP) capacities are only included for those zones reported with a critical period deficit in the WRMP. As for the WRMP9, only drought and sustainability reductions resulting in full loss of source yield have been included in the DYCP forecast.

The naming and number of Water Resource Zones (WRZs) aligns with our WRMP.

Lines 3 and 4: Post-2020 incumbent cumulative capacity (DYAA and DYCP)

These lines capture the creation of a new water reuse scheme coming into supply in 2024/25. This is the only scheme funded under the water resources control after 1 April 2020. The scheme is included in our WRMP, and more details are in Wr7.

Lines 5 and 6: Post-2020 capacity (DYAA and DYCP)

We do not have any known third party bilateral cumulative capacity arrangements at this stage.

Line 9: Pre-2020 capacity (DYCP)

These lines are only applicable for the WRZs that we have listed, therefore some cells are blank.

Line 11: Post-2020 incumbent capacity (DYCP)

These lines are not applicable for all WRZs, therefore some cells are blank.

Line 13: Post-2020 third party bilateral capacity (DYCP)

These lines are not applicable for all WRZs, therefore some cells are blank.

SECTIONS B TO AC: CAPACITY – WRZ FORECASTS

Pre-2020 capacity in WRZ 1 reflects the water resources yield of Bourne WRZ. There are forecast changes to the pre-2020 water resources yield as a result of WINEP sustainability reductions. Only DYAA is reported, as DYCP is not reported in the WRMP 2019.

Pre-2020 capacity in WRZ 2 reflects the water resources yield of Bury Haverhill WRZ. There are forecast changes to the pre-2020 water resources yield due to WINEP sustainability reductions and severe drought impacts. Both DYAA and DYCP are reported.

Pre-2020 capacity in WRZ 3 reflects the water resources yield of Central Essex WRZ. There are forecast changes to the pre-2020 water resources yield as a result of WINEP sustainability reductions. Both DYAA and DYCP are reported.

Pre-2020 capacity in WRZ 4 reflects the water resources yield of Central Lincolnshire WRZ. There are forecast changes to the pre-2020 water resources yield due to WINEP sustainability reductions and severe drought impacts. Both DYAA and DYCP are reported.

Pre-2020 capacity in WRZ 5 reflects the water resources yield of Cheveley WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Both DYAA and DYCP are reported.

Pre-2020 capacity in WRZ 6 reflects the water resources yield of East Lincolnshire WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 7 reflects the water resources yield of East Suffolk WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 8 reflects the water resources yield of Ely WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 9 reflects the water resources yield of Happisburgh WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Both DYAA and DYCP are reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 10 reflects the water resources yield of Hartlepool WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 11 reflects the water resources yield of Ixworth WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 12 reflects the water resources yield of Newmarket WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 13 reflects the water resources yield of North Norfolk Coast WRZ. This capacity is forecast to change in 2021/22 due to loss of the Ludham source, as a result of a sustainability reduction. There are no forecast changes to the post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 14 reflects the water resources yield of Norfolk Rural North WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 15 reflects the water resources yield of Norfolk Rural South WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 16 reflects the water resources yield of North Fenland WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 17 reflects the water resources yield of Norwich and the Broads WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 18 reflects the water resources yield of Nottinghamshire WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 19 reflects the water resources yield of Ruthamford Central WRZ. This zone does not have its own DO and instead receives transfers from adjacent WRZs. There are no forecast changes to the pre- or post- 2020 water resources yield. Both DYAA and DYCP are reported, in line with the dWRMP 2019, although both are 0 Ml/d.

Pre-2020 capacity in WRZ 20 reflects the water resources yield of Ruthamford North WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 21 reflects the water resources yield of Ruthamford South WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 22 reflects the water resources yield of Ruthamford West WRZ. This zone does not have its own DO and instead receives transfers from adjacent WRZs. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019. .

Pre-2020 capacity in WRZ 23 reflects the water resources yield of South Essex WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 24 reflects the water resources yield of South Fenland WRZ. This capacity is forecast to change in 2025/26 due to loss of the Marham surface water source, as a result of a sustainability reduction. There are no forecast changes to the post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 25 reflects the water resources yield of South Lincolnshire WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 26 reflects the water resources yield of Sudbury WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 27 reflects the water resources yield of Thetford WRZ. There are no forecast changes to the pre- or post- 2020 water resources yield. Only DYAA is reported, in line with the dWRMP 2019.

Pre-2020 capacity in WRZ 28 reflects the water resources yield of South Humber Bank WRZ, a sub-zone within the larger Central Lincolnshire WRZ, to reflect non-potable demand. There are no forecast changes to the pre- 2020 water resources yield. The post-2020 yield includes a new water reuse scheme in 2024/25, which is the only scheme funded under the water resources control after 1 April 2020. The scheme is included in our dWRMP 2019, and more details are in Wr7.

WR7 - NEW WATER RESOURCES CAPACITY - FORECAST COST OF OPTIONS BEGINNING IN 2020-25

The Pyewipe Water Reuse for non-potable use option from the Water Resources Management Plan (WRMP) is the only scheme that provides new Water Resources capacity. Within this option the only element allocated to the Water Resources - Raw water abstraction price control is the pumping station which delivers raw water from the existing water recycling centre to the new treatment facilities. The rest of the scheme falls within the Water Network Plus price control.

SECTION A: COMPANY LEVEL

All costs for the pumping station delivering raw water to the new treatment facilities at Pyewipe WRC are categorised as Mechanical and Electrical with a 15 year asset life.

SECTION B: WRZ 1

For lines 4, 7, 8, 15 and 17 the validation flag is due to zero values, and the formula expecting values greater than zero.

The option name, reference and post 2020 cumulative capacity are consistent with the WRMP. The capacity increases from 6 Ml/d in 2024/25 to 20.4 Ml/d in 2030/31, as the requirement for new capacity increases in line with the WRMP.

B1: Option 1

The capex and opex associated with the pumping station are presented in the table.

The capex for the pumping station is all allocated in 2023/24, as this is when we anticipate this asset will be delivered. A quarter of the annual opex is then allocated in 2024/25, to account for the fact that the asset will only be utilised for a proportion of the year.

The 'Annualised unit cost of post-2020 capacity' has been calculated as the total cost over the period 2020/21 to 2044/45, divided by the number of years in operation within that period (23 years). The annualised cost is then divided by the capacity (line B7) in each year.

WR8 – WHOLESALE WATER RESOURCES SPECIAL COST FACTORS

We are not submitting any Wholesale Water Resources special cost factors.

WN1 – WHOLESALE NETWORK PLUS RAW WATER TRANSPORT AND WATER TREATMENT (EXPLANATORY VARIABLES)

Line 1: Total number of raw water transfer stations

This is a new line for 2017/18 as described in table Wr1, lines 20 to 21. In line with guidance, for 2017/18 onwards we are reporting:

- 9 transfer pumping stations including one gravity intake system at Ravensthorpe Reservoir.

This number is maintained throughout the reporting period.

Line 2: Total capacity of raw water transfer stations

The reported capacity has been recalculated from 2016/17 Information Request data to reflect the disaggregation of raw water transport from total pumping capacity.

River abstraction and reservoir capacities are referenced in a survey of the raw water abstraction assets (Atkins, 2012) and updated by the Energy Team. The most recent update was for year-end reporting purposes in 2016/17, and this data is still considered to be correct.

In correlation with line 1, this number is maintained throughout the reporting period.

Line 3: Average pumping head - Average pumping head ~ raw water transport

We are forecasting no significant change to our Distribution Input (DI) over the next AMP. Increases in demand from growth will be mitigated by a combination of demand management and leakage reduction. As such the forecast for average pumping head over the next AMP is for it to remain the same as 2017/18.

Lines 4 to 7: Water imports and exports

Our supply system does not include any raw water transport imports or exports with any third parties' raw water transport systems.

Line 8: Total length of raw and pre-treated (non-potable) water transport mains main for supplying customers

The classification for non-potable liquid types is now in the G/water (our corporate mapping system) and the data has been reviewed and refined for PR19. The line for 2017/18 has been calculated using the latest in-service company-owned non-potable water mains data out of G/water. The lengths have also been calculated using the guidance provided in RAG 4.07. The projected numbers are built using reported growth based upon C55 (our investment decision support tool) and lengths reported as part of our Water Resources Management Plan (WRMP). The 19km increase in year 2023/24 is due to a planned non-potable scheme.

Lines 9 to 23: Total water treated at SW and GW works

Historic volumetric Distribution Input (DI) data has been provided by the Leakage team for each of the WTW works in the region served, including imports / exports and sites which include combined sources (both BH and RA), for the years prior to 2016/17.

This has been used to attribute the volume of DI to respective WTW codes, based upon our interpretation of works complexity in accordance with Ofwat guidance (including imports, omitting exports and including an assessment for combined sources).

Forecast splits have been derived from the projected total DI for each year calculated for the WRMP (Demand Forecast Model v21 - NYAA) and the base-year split for volumes attributed to each WTW code.

We have noted combined sources at Elsham, Heigham, Marham and Stoke Ferry with DI being proportionally split in line with the base-year data from the Leakage Team, between GW and SW sources.

Lines 24 to 37: Total number of SW and GW works

Our WTW numbers are aligned with the information submitted annually in the details tables to the Drinking Water Inspectorate (DWI) in accordance with the Information Direction. WTW numbers may vary year on year due to changes in the configuration of the supply system and specifically, the location of the final water monitoring points. In 2017 and 2018 changes were made to ensure alignment with the revised Water Supply (Water Quality) Regulations 2016 and 2017 respectively.

Gayton WTW, Irby (Grimsby) Reservoir 1 and 2 WTWs and Little Saxham Reservoir WTW are designated to change from GW3 to GW4 codes in 2023/24 (new ion exchanges).

Two Mile Bottom WTW is designated to change code from GW2 to GW3 in 2023/24 (new PO4).

Elsham WTW is expected to change from SW5 to SW6 coding due to upgrade in 2024/25. Additionally, Elsham is expected to have an increase in DI due to new development for the SW6 coded WTW works.

Line 38: Number of treatment works requiring remedial action because of raw water deterioriation

In December 2017, we completed nitrate removal schemes at Twelve Acre Woods WTW and Stanton WTW.

In March 2018 a pesticide reduction scheme was completed at Winterton Holmes WTW.

A scheme has been proposed to address pesticide levels at Great Wratting WTW with a target completion date of March 2020.

Nitrate removal schemes have been proposed for Irby WTW, Little Saxham WTW and Wighton WTW, all with a planned completion date of December 2022. A further nitrate removal scheme has been proposed for Gayton WTW with a planned completion date of December 2023.

Line 39: Zonal population receiving water treated with orthophosphate

Population totals have been calculated in line with our WRMP and with an assessment of forecast areas receiving orthophosphate treatment.

Line 40: Average pumping head - treatment

We are forecasting no significant change to our Distribution Input (DI) over the next AMP. Increases in demand from growth will be mitigated by a combination of demand management and leakage reduction. As such the forecast for average pumping head over the next AMP is for it to remain the same as 2017/18.

Lines 41 to 56: Number of WTWs and Proportion of total DI by size band

Volumes per WTW have been calculated using base year values for MAXSO (maximum capacity for the works), in accordance with guidance. WTWs have then been grouped by size band, giving total numbers of WTWs per band and the percentage of DI associated with each band calculated for the projected period, based upon the baseline DI proportions and forecast Dry Year Annual Average (DYAA) DI.

N.B. Data in these lines for 2017-18 do not match those submitted in our Annual Performance Report in July 2018. This is because the line definition has been changed to allocate WTWs into bandings by MAXSO, where in the APR WTWs were banded by DI.

Line 57: Total number of treated water treatment imports

No imports are received from water treatment systems. These values are therefore zero.

Line 58: Water imported from 3rd parties' water treatment works

No imports are received from water treatment systems. These values are therefore zero.

Line 59: Total number of water treatment exports

No exports are sent from water treatment systems. These values are therefore zero.

Line 60: Water exported to 3rd parties' treated water works

No exports are sent from water treatment systems. These values are therefore zero.

WN2 – WHOLESALE WATER NETWORK PLUS WATER DISTRIBUTION (EXPLANATORY VARIABLES)

Line 1: Total length of potable mains as at 31 March

The projected numbers are built using lengths reported in Wn2, Line 4 (total length of new potable main). We anticipate a steady increase in total mains lengths with an overall increase of approximately 4.5% from 2017/18 to the end of AMP7.

Line 2: Total length of potable mains relined

No relining schemes are planned for AMP7.

Line 3: Total length of potable mains renewed

We plan to rehabilitate 352.5km (average of 70.5km per annum) of water mains during the AMP7 period. This is made up of a number of components:

- 253.4km from our forward looking mitigation risk based models to mitigate the risk of service failures due to asset deterioration
- 60.4km standalone projects included within our Plan
- 38.7km due to diversions (A14 etc).

It should be noted that this line is reported to zero decimal places and therefore the total km over AMP7 rounds to 355km in the data table, instead of 352.5km shown above.

Line 4: Total length of new potable main

The line is related to the provision of new or replacement mains which are intended to create additional capacity. The data from three areas have been used to determine and forecast this data:

- **Site Specific Water Mains** - these are the new mains directly attributable to a specific development site. This has been calculated based on historic data and proportionally forecast for future growth
- **Network Reinforcement** - these are the new and reinforced mains provided to meet new developments and chargeable to developers under the new "Variable" element of the Zonal Charge. The length of mains has been calculated following hydraulic modelling
- **Water Resource Management Plan** - these are the new Resource Zone water mains. These are large complex schemes and tie in with our long term planning and our Water Resource Management Plan (WRMP). The figures are provided in the year that the scheme is expected to be completed and therefore weighted towards 2023/24 and 2024/25.

Lines 5 to 8: Potable mains by diameter band

The line for 2017/18 has been calculated using the latest in-service company-owned potable water mains data out of G/water (our corporate mapping system). The projected numbers are built using lengths reported in Wn2, Line 4 (total length of new potable main).

Lines 9 and 31: Capacity and number of booster pumping stations

The number of pumps, rated power for each pump, location and asset status have been used where this information was held in corporate databases. The rated power of the remaining pumps, where data was not currently centrally held, were given the mode (most common) rated power. The number of sites has been calculated based on this more granular pump specific asset data. Line 9 also includes a proportional split of borehole rated power associated with distribution in line with the new requirement. Line 31 includes borehole sites where the borehole pumps both abstract

and boost into supply. It does not include all borehole pumps, or other abstraction pumps, excluding those which make no contribution to network pressure. Data for subsequent years is assumed to be consistent with current year, unless impacted upon by planned investment. The planned investment data was sourced from the corporate asset management system and rolling programme of work. Notably this has excluded a programme of 70 new single property boosters (based on the fact that they will be built on customer properties) and 27 new booster sets that will be built as part of our WRMP supply side strategy on the basis that these may be constructed on existing sites.

Line 10: Total capacity of service reservoirs

Service reservoir capacity was increased in 2018 with the commissioning of Diddington Reservoir near Grafham WTW in the Ruthamford supply system.

Line 11: Total capacity of water towers

Water tower capacity reduced in 2018 following the decommissioning of two water towers, Great Saling Tower in the Colchester Bures supply system and Soham Tower in the Ely-Mildenhall supply system.

Line 12: Distribution Input

Distribution Input (DI) has been derived from the WRMP - Normal Year Annual Average Demand - including Demand Management Option effects. This gives rise to decreasing values from 2019/20 to 2024/25 despite forecast increases in households and population, due to leakage reduction and demand management.

Lines 13 to 20: Proportion of distribution input from different sources

Historical and baseline DI has been used derive the proportional split is supplied to the SDST by the Leakage Team for year-end reporting purposes and the Information Request tables. This provides the yearly update.

The data used includes imports and water for non-potable use but exclude exports. This is in accordance with the guidance given for Chapter 12 of the June Return (2011).

Forecast values have been derived based upon regression analysis of historic trend for each of the proportionally split elements, reconciled with the ground water/surface water projections derived for the WTW coded forecast.

Ground Water (GW) and Surface Water (SW) coding for the plan period have been supplied the Regulation Department. These have been applied to the WRMP forecast for DI to derive GW / SW volumes for plan period. Consequently, the proportional splits have been reconciled to this forecast (see table Wn1).

It is noted that recent trend data has indicated a decline in DI from boreholes and an associated increase in DI from pumped storage reservoirs. This trend has been included in the forecast data leading to an overall transfer of approximately 2.6% from groundwater to surface water for the plan period.

Line 13: Proportion of distribution input from impounding reservoirs

The reported baseline estimates are based on DI from the following reservoir sources:

- Ravensthorpe WTW (Ruthamford North RZ): 100% yield from natural inflow (“natural”). WTW supplied from both Ravensthorpe Reservoir and Hollowell Reservoir
- Alton WTW (East Suffolk RZ): 31% natural yield from Alton Water
- Pitsford WTW (Ruthamford North RZ): 44% natural yield from Pitsford ReservoirThe splits for Alton and Pitsford.

Forecast proportional values show little change over the period to 2024/25, remaining at approximately 2.4%; this is in alignment with the Water Treatment Works GW / SW forecast and WRMP forecast DI totals (see table Wn1).

Line 14: Proportion of distribution input from pumped storage reservoirs

The reported baseline estimates are based on DI from the following reservoir sources:

- Alton WTW (East Suffolk RZ): 69% pumped yield from Alton Water
- Ardleigh WTW (South Essex RZ): 82% pumped yield from Ardleigh Reservoir
- Covenham WTW (East Lincolnshire RZ): 100% pumped yield from Covenham Reservoir
- Grafham WTW (Ruthamford South RZ): 99% pumped yield from Grafham Reservoir
- Pitsford WTW (Ruthamford North RZ): 56% pumped yield from Pitsford Reservoir
- Wing WTW and Morcott WTW (Ruthamford North RZ): 88% pumped yield from Rutland Water.

If the current trend continues, the proportion of DI from pumped storage reservoirs is predicted to increase slightly from 41.2% to 43.8%; this is in alignment with the Water Treatment Works GW / SW forecast and WRMP forecast DI totals (see table Wn1).

Line 15: Proportion of distribution input from river abstractions

The reported baseline estimates are based DI from the following river abstraction sources:

- Bedford WTW (River Ouse)
- Elsham WTW (River Ancholme) – (Combined site BH/SW)
- Hall WTW (River Trent)
- Heigham WTW (River Wensum) – (Combined site BH/SW)
- Marham WTW (River Nar) – (Combined site BH/SW)
- Stoke Ferry WTW (River Wissey) – (Combined site BH/SW).

Based upon current trend, the proportion of DI from river abstraction is predicted to increase from 6.6% to 6.7%, in alignment with the Water treatment Works GW / SW forecast and WRMP forecast DI totals (see table Wn1).

Line 16: Proportion of distribution input from boreholes, excluding managed aquifer recharge water supply schemes

Forecast values have been derived from WRMP forecast DI values and the Water Treatment works GW / SW forecast; this suggests a slight decrease in the proportion of DI from boreholes from 49.7% to 47.0%.

Lines 17 to 18: Proportion of distribution input from artificial recharge and artificial storage and recovery water supply schemes

No such schemes are operated by the company and forecast values maintained as zero.

Lines 19 to 20: Proportion of distribution input from saline abstractions and water reuse supply schemes

No such schemes are operated by the company and forecast values maintained as zero.

Line 21: Water delivered (non-potable)

The forecast figure for non-potable water demand has been maintained as a constant value as included in the WRMP.

Line 22: Water delivered (potable)

Potable water delivered has been derived from the WRMP demand forecast models, based upon base-line Water Balance and forecasts for population, metering and leakage. This value includes measured consumption, unmeasured consumption, non-household demand, water taken unbilled (WTUB) and meter under-registration (MUR).

Line 23: Water delivered (billed measured residential)

Measured consumption has been derived from the WRMP demand forecast (Normal Year Annual Average, including the effects of household/population growth, customer switching from unmeasured to measured and demand management). Measured consumption is forecast to increase of the plan period.

Line 24: Water delivered (billed measured business)

Non-household consumption has been derived from the WRMP forecast. Non-household consumption has been derived using regression analysis of the various industrial sectors and forecasting future consumption based upon the East of England Forecast Model (EEFM) and appropriate factors, Gross Value Added (GVA), employment and population growth. Non-household consumption is forecast to remain relatively static over the plan period, decreasing slightly.

Line 25: Total leakage

Total leakage has been derived for the WRMP. Initial forecast figures up to 2020 have been aligned with AMP6 forecast performance values. Total leakage losses are derived from the WRMP leakage forecast and are expected to decrease to approximately 142 Ml/d by 2024/25, once leakage and metering demand management options have been included.

Line 26: Distribution losses

Leakage distribution losses are derived from the WRMP leakage forecast and are expected to decrease to approximately 109 Ml/d by 2024/25, once leakage and metering demand management options have been included.

Line 27: Water Taken Unbilled

The value for water taken unbilled has been derived from water-balance data provided by the Leakage team and has been maintained as a constant for the plan period, as in the WRMP.

Lines 28 to 30: Communication pipes by type

Our communication pipe stock was last modeled in 2012 for PR14. That report has been used as a starting point and the number of replaced lead and galvanized iron communication pipe has been subtracted from the 2012 modeled totals.

For the year 2017/18, the numbers are constructed using the total number of reported water connections numbers, and any subsequent reported lead and galvanised iron replacements.

For years 2018/19 onwards, projections are built using the numbers reported in WS3, line 8 (total connected properties at year end), projected communication lead replacement numbers submitted to the Drinking Water Inspectorate (DWI) and an historical average for the replacement of galvanized iron communication pipes.

The biggest step change in the number of lead communication pipes takes place in years 2021 through to 2024. This is due to the largest number of planned lead communication pipe replacements occurring in that period.

Line 32: Total number of service reservoirs

The number of service reservoirs increased in 2018 with the commissioning of Diddington Reservoir as part of the Grafham resilience scheme in Ruthamford.

Line 33: Total Number of water towers

The number of water towers decreased in 2018 following the decommissioning of Great Saling Tower in the Ruthamford supply system and Soham Tower in the Ely-Mildenhall supply system.

Lines 34 to 41: Total length of mains laid or structurally refurbished

As per responses to Ofwat queries during the 2017 information request, only potable mains that are in-service and owned by the Company have been included in lines 34 to 41 for 2017/18. The projected numbers are built using lengths reported in Wn2, Line 4 (total length of new potable main).

Older age bands (lines 34 to 40) have been adjusted down based data in Wn2, line 3 (total length of potable mains renewed). These removed mains lengths from earlier age bands have then been re-allocated to the total length in line 41.

Line 42: Average Pumping Head - distribution

We are forecasting no significant change to our Distribution Input (DI) over the next AMP. Increases in demand from growth will be mitigated by a combination of demand management and leakage reduction. As such the forecast for average pumping head over the next AMP is for it to remain the same as 2017/18.

Line 43: Total number of treated water distribution imports

Our forecast values are estimated to maintain constant.

We are not currently anticipating any changes to the over-all number of treated water imports during AMP7. Consequently, we have maintained this figure as a constant for the planning period.

Line 44: Water imported from 3rd parties' treated water distribution systems

Baseline values reflect the current year average Ml/d. Forecast values have been derived to reflect a five year rolling average of previous years values, such that:

Line	Description	Unit	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
38	Bulk supply imports	Ml/d	2.71	2.91	2.59	2.44	2.48	2.62

Line	Description	Unit	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
38	Bulk supply imports	Ml/d	2.61	2.55	2.54	2.56	2.57	2.57	2.56

Where the forecast values have been calculated (2018/19 to 2024/25), fluctuations reflect historic variation.

Forecast values have been derived to reflect the historic trend.

Line 45: Total number of treated water distribution exports

Our forecast values are estimated to remain constant. We are not currently anticipating any changes to the overall number of treated water exports over the PR19 period.

Consequently, we have maintained this figure as a constant for the planning period.

Line 46: Water exported to 3rd parties' treated water distribution systems

Baseline values reflect the current year average Ml/d.

Forecast values have been derived to reflect a five year rolling average of previous years. Where the forecast values have been calculated for years 2018/19 to 2024/25 the forecast fluctuation is a function of the recently seen increase in exports, over the past two years.

WN3 – WHOLESALE REVENUE PROJECTIONS FOR THE WATER NETWORK PLUS PRICE CONTROL

SECTION A: WHOLESALE WATER NETWORK PLUS REVENUE REQUIREMENT AGGREGATED BY BUILDING BLOCKS

Line 1: PAYG - wholesale water network plus

Projected total pay as you go (PAYG) for wholesale water network plus costs equals table WS1 line 21 (Totex) (raw water distribution, water treatment and treated water distribution columns) multiplied by table Wn4 line 14 (Total PAYG rate ~ water network plus).

Line 2: Pension deficit repair contributions - wholesale water network plus

This has been set to equal table WS1 line 22 (pension deficit recovery payments) (raw water distribution, water treatment and treated water distribution columns).

Lines 3 to 11: Wholesale water network plus revenue requirement

These lines have been populated using the Ofwat PR19 financial model and Ofwat financial mapping tool.

Line 12: Total wholesale water network plus revenue requirement

2019/20 has been populated consistent with the customer projections in WS3 and the revenue cap. This has been split between Water Resources and Network Plus as detailed in section E.

For 2020/21 to 2024/25 the total represents the sum of lines 1 to 11.

SECTION B: WHOLESALE WATER NETWORK PLUS – OTHER PRICE CONTROL INCOME

Line 13: Third party revenue - wholesale water network plus

Third party revenue included within the price control relates to non-potable water supplies to non-households. This revenue has been analysed between water resources and network plus on the same basis as described in section E.

Projections for 2019/20 to 2024/25 are consistent with recent trends showing no material change in demand.

SECTION C: WHOLESALE WATER NETWORK PLUS – NON-PRICE CONTROL INCOME (THIRD PARTY SERVICES)

Line 14: Bulk supplies - contract not qualifying for water trading incentives (signed before 1 April 2020) - water network plus

Wholesale revenue from bulk supplies includes those supplies reflecting historic arrangements for local network top-up to bordering undertakers, new supplies to New Appointments and Variations (NAV's) and two cost sharing agreements negotiated between the parties.

The historic arrangements and NAV supplies are all based on standard wholesale tariffs and are therefore analysed between water resources and network plus as described for business revenue in section E.

The cost sharing agreements are designed to provide an appropriate allocation of operating, capital and financing costs between the parties. The costs are allocated based either on the proportion of the capacity reserved to each party, the volume of water taken or on whether assets are separately identified and their use specific to one party or the other. The costs and therefore revenue are analysed at a service chain activity level as defined in RAG 4.07.

All revenue projections are based on a demand profile consistent with current requirements.

Line 15: Bulk supplies - contract qualifying for water trading incentives (to be signed on or after 1 April 2020) - water network plus

As per the WRMP no new bulk supplies are anticipated during 2020 to 2025.

Line 16: Rechargeable works - water network plus

Consistent with recent trends there is no rechargeable works revenue forecast.

Line 17: Other non-price control third party services - water network plus

Other non-price control revenue from third party services includes fire hydrants, fluoridation, charges for repair of damage to company assets by another party and meter testing. The majority of this revenue relates to network plus services.

Projections for 2019/20 to 2024/25 are consistent with recent trends showing no material change in activity.

SECTION D: WHOLESALE WATER NETWORK PLUS – NON-PRICE CONTROL INCOME (PRINCIPAL SERVICES)

Line 19: Wholesale water network plus non-price control income (principal services)

Other non-price control revenue from principal services includes recreation and abstraction licence trades. Both services relate solely to water resources. The minor revenue on network plus relates to other miscellaneous revenue not allocated elsewhere.

Projections for 2019/20 to 2024/25 are consistent with recent trends showing no material change in activity.

SECTION E: WHOLESALE WATER NETWORK PLUS CHARGES

Lines 20 to 23: Wholesale network plus charges

The base year allocation between water resources and network plus is based on the principles applied in the cost allocation exercise undertaken annually for our tariff setting process and the boundaries between the controls as defined in RAG 4.07.

The output of this process analyses the revenue requirement across the service chain activities (water resources, raw water distribution, treatment and distribution) and by customer classes, using Activity Based Costing. This uses cost drivers to provide the link between cost data for each service activity and the measurable element of customer demand. Drivers therefore not only explain costs but also provide a measure for each customer class to explain their contribution to that cost within each service chain activity.

In assessing the revenue requirement, we allocate the Regulated Capital Value (RCV) to service activities and asset categories based on the Modern Equivalent Asset Values (MEAV). This allocates the return on RCV across the service chain on a straight-line basis, with a constant percentage return per £ of the RCV. This return (operating profit) along with operating costs and capital maintenance forms the revenue requirement which are allocated to activities, costs drivers and then to customer classes.

This approach therefore not only analyses the revenue requirement by water resources and network plus but also details the proportion of each by customer class.

Having established the base revenue customer class proportions we are able to project these up until 2024/25 on the basis that any changes in these proportions are driven solely by changes in the customer profile as forecast in table WS3 and their demand. There is a direct correlation between customers and demand and the revenue requirement of network plus. Therefore changes

in unmeasured households due to the metering programme and changes in measured households due to the metering programme and new connections result in a corresponding change in the revenue to be recovered from each customer class.

Line 24: Total wholesale water network plus allowed revenue

The projected wholesale water network plus allowed revenue equals the building blocks income less third party and non price control income.

It should be noted that the table formula for the period 2020 to 2025 has not been updated to reflect the latest revision to the table. The total value should be £2169.673m.

SECTION F: GRANTS AND CONTRIBUTIONS

Lines 25 to 28: Grants and contributions for price control and non-price control - operating expenditure / capital expenditure

As per the updated data table structure issued in January 2019, we have split grants and contributions by operating and capital expenditure as well as by price control / non-price control.

Line 25: Water network operating expenditure plus grants and contributions (Price control)

This represents the wholesale water network plus element of the total grants and contributions received for the wholesale water service contained in App28, lines 7 to 11.

We are not forecasting any contributions towards operating expenditure.

Line 26: Water network grants and contributions (non-Price control)

This represents the wholesale water network plus capital expenditure element of the total grants and contributions received for the wholesale water service contained in App28, lines 7 to 11.

Line 27: Water network operating expenditure grants and contributions (non-Price control)

This represents the wholesale water network plus element of the total "other" non-price control grants and contributions received for the wholesale water service contained in App28, line 12. We are not forecasting any contributions towards operating expenditure.

Line 28: Water network capital expenditure grants and contributions (non-price control)

This represents the wholesale water network plus element of the total "other" non-price control grants and contributions received for the wholesale water service contained in App28, line 12. We are not forecasting any contributions towards capital expenditure non-price control.

SECTION G: REVENUE CONTROL TOTAL – WHOLESALE WATER NETWORK PLUS

Line 29: Total revenue - wholesale water network plus control

The projected wholesale water network plus revenue requirement includes all revenue, including grants and contributions, covered by the plus price control.

WN4 – COST RECOVERY FOR WATER NETWORK PLUS

Please see Annex 15a - Evidence on the natural rate of RCV run-off (Reckon) for further information on the cost recovery for water network plus.

WN5 – WEIGHTED AVERAGE COST OF CAPITAL FOR THE WATER NETWORK PLUS CONTROL

We have used Ofwat's indicative Weighted Average Cost of Capital, as set out in the PR19 final methodology.

WN6 – WHOLESALE WATER NETWORK PLUS SPECIAL COST FACTORS

We submitting one special cost factor claim in Wholesale water network plus.

SECTION A: SPECIAL COST CLAIM 1

Name of claim	Maintain frontier leakage performance
Name and identifier of related claim submitted in May 2018	ANH01
Business plan table lines where the totex value of this claim is reported	Water network plus
Total value of claims for AMP7	£147.9million
Total opex of claim for AMP7	£112.9 million
Total capex of claim for AMP7	£35.0 million
Depreciation on capex in 2020-2025 (retail controls only)	N/A
Remaining capex required after AMP7 to complete construction	N/A
Whole life totex of claim	£ million
Do you consider that part of the claim should be covered by our cost baseline? If yes, please provide an estimate	No. Our assumption is that the cost baselines will allow for expenditure to maintain leakage at industry average levels. Our claim covers the additional expenditure that will be required to maintain leakage at the current frontier level rather than at our sustainable economic level (SELL)
Materiality of claim for AMP7 as percentage of business plan (5 year) totex for the relevant controls	5.6% of AMP7 Water network plus totex
Does the claim feature as a Direct Procurement for Customers (DPC) scheme?	No

Need for investment / expenditure

Our leakage level is at the frontier of the sector. In 2016/17 our leakage was around half that of the industry average in terms of l/km/day of water main and 70% when measured as leakage/property/day. This is shown in the figures below. Our relative position is even stronger on 2017/18 data, when more than half of the industry missed their leakage targets.

Figure 27 Leakage per kilometre per day (source: Ofwat 2017 Information Request, Anglian Water analysis)

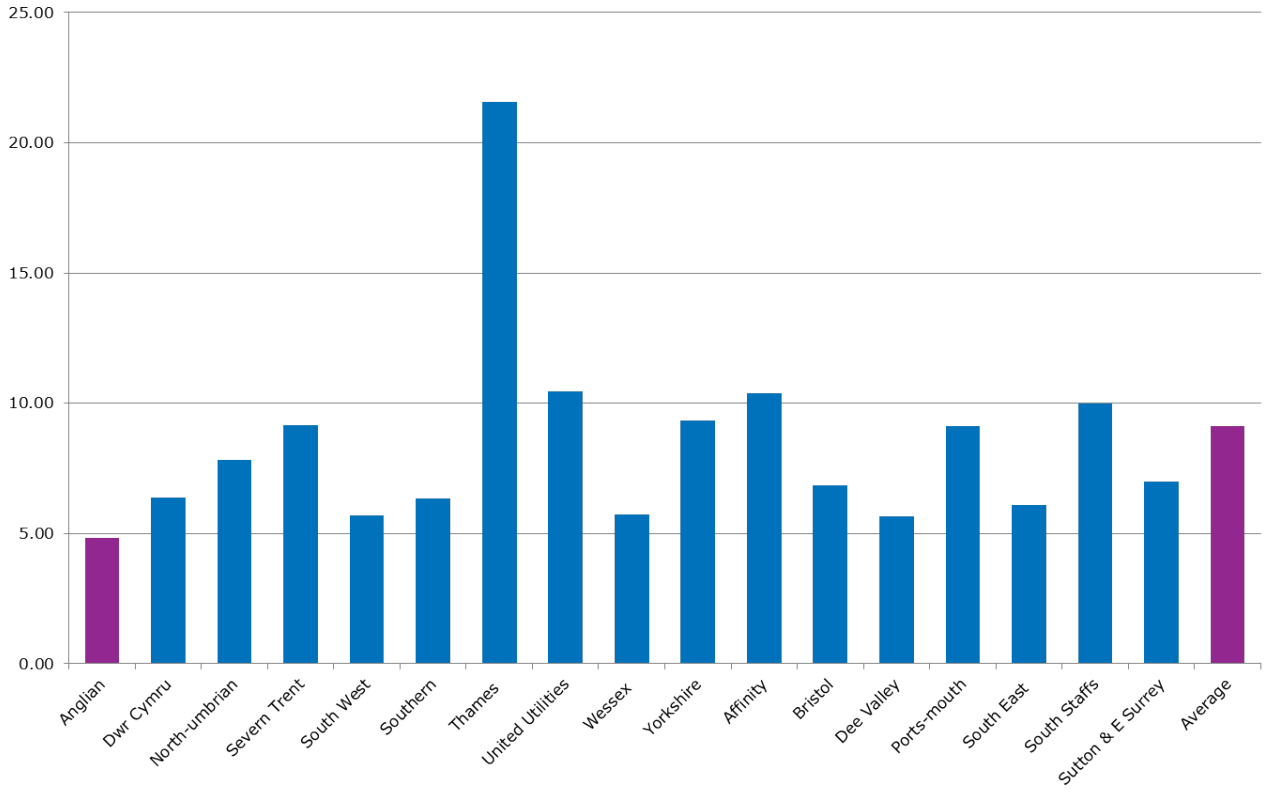
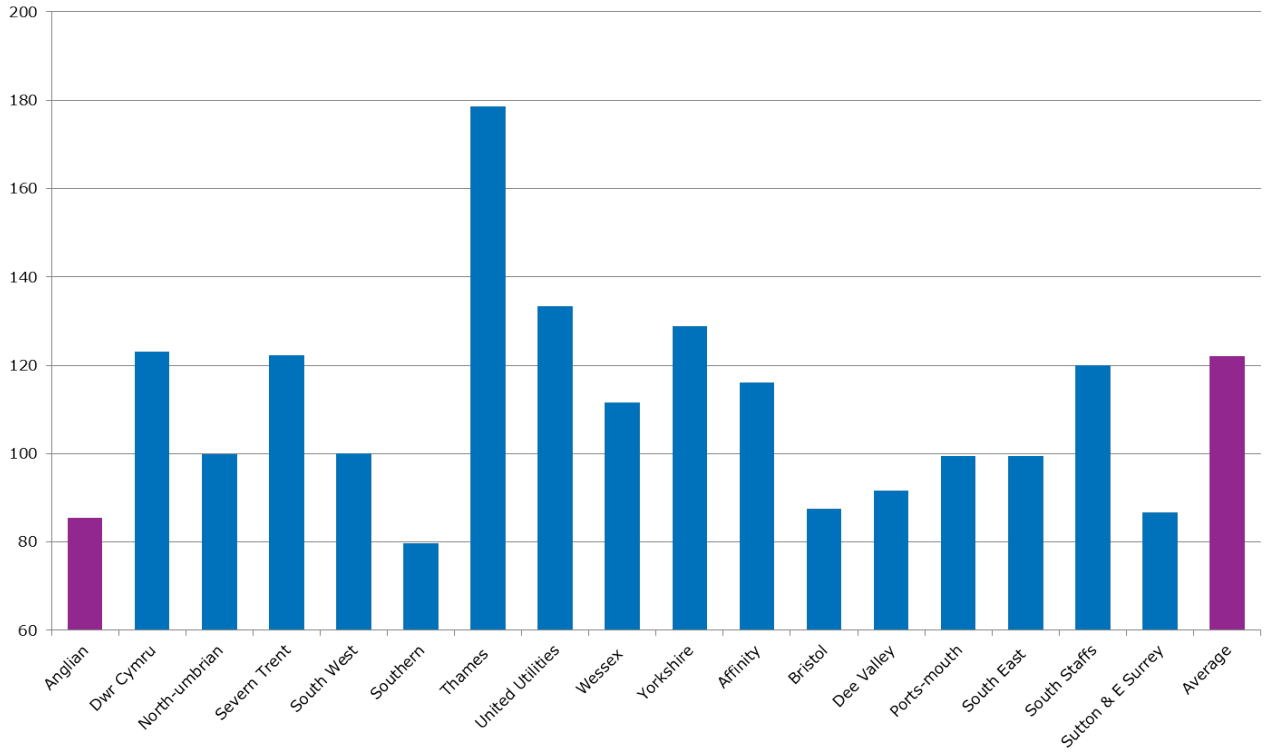


Figure 28 Leakage per property per day (source: Ofwat 2017 Information Request, Anglian Water analysis)



As with most endeavours for improving performance, the better your level of performance, the more work is required to sustain it and the more challenging any further improvements become. This is the principle of diminishing returns. Maintaining our level of leakage therefore requires greater expenditure compared to maintaining, for instance, the industry average level of leakage. Unless the PR19 cost assessment models account for this, the cost needed to maintain our end of AMP6 level of leakage will be underestimated.

This claim relates to base expenditure only, as the cost is only to maintain leakage at 172 Ml/d, our expected outturn in 2019/20. This claim focuses on the additional costs which we can be expected to incur in maintaining a level of leakage which is not only below that of our peers but also below the sustainable economic level of leakage (SELL). By definition, maintaining leakage beyond (that is, below) SELL incurs additional costs. We have estimated the value of this incremental cost £29.6 million per year. Details on the methodology used to arrive at this value are provided in the 'Robustness and efficiency of costs' section.

Our business plan includes proposals to continue driving down the leakage frontier, from 172 Ml/d in 2019/20 to 142 Ml/d in 2024/25. These proposals are supported by customers. Additional expenditure will be required achieve this. This expenditure will be treated as enhancement and is part of our enhancement plan. An enhancement case is included in our plan to describe and justify this.

Expenditure to maintain leakage at current levels is treated as base. Costs would be allowed by botex cost models if leakage levels were included as explanatory factors. However, we noted that leakage is not an explanatory factor in any of the relevant models reported in Ofwat's March consultation, including our own and Ofwat's eight Water Network Plus models. Thus, we have not been able to find an acceptable cost model that accounts for the additional unit cost (£ per Ml/day) we expect to incur as a result of maintaining leakage well below both our SELL and the industry average.

We know that our customers, Ofwat and Government have a shared desire for us to continue to improve from our frontier performance on leakage. For the reasons explained above, a cost adjustment will be required to enable this to happen.

Management control

Since the start of AMP5 in particular, reducing leakage has become a clear and united priority amongst government bodies and our customers. The catalyst for this was the severe winter of 2010/11 that caused a spike in our leakage up to 229.5 Ml/d. This refocused leakage as a key priority.

Ofwat's PR19 Final Methodology for all companies to reduce leakage by at least a further 15% by 2025. Other key stakeholders support this objective:

- **National Infrastructure Commission (NIC)**: Preparing for a Drier Future. Recommends that government should ensure plans are in place to deliver additional supply and demand savings of at least 4,000 Ml/d in England and advocates a twin-track approach to achieve this, highlighting that leakage reduction is a key component to the demand management side of maintaining the supply and demand balance
- **Environment Agency: The State of the Environment: Water Resources**. "action must continue to reduce demand, increase supply and minimise wasting of water to prevent future shortages and limit environmental damage."

In the face of this unanimous stakeholder opinion, avoiding leakage maintenance costs by allowing leakage to rise above our 2020 level is clearly not feasible, despite this level of leakage being well below our Sustainable Economic Level of Leakage (SELL) of 211 Ml/d (APR, 2018). It is the clear demand of our customers, Ofwat and government that leakage should continue to fall, especially in water stressed regions such as our own.

Need for investment

Reaching leakage of 172 Ml/d by 2020 was a commitment of our PR14 business plan. This acknowledged a running theme throughout our PR14 customer engagement report that customers wanted us to focus on substantial leakage reduction. It is important for the maintenance of trust and confidence of our stakeholders that this commitment continues to be honoured as we head into AMP7.

Maintaining leakage at 172 Ml/d also mitigates our impact on the environment by minimising the amount of water we need to abstract from river and groundwater sources in order to supply the customers and businesses we serve. Leakage therefore directly relates to our customer outcome of achieving 'a Flourishing Environment'.

In addition, because our region is considered to be under serious water stress by the Environment Agency, it is important that we manage our supply and demand balance in our region as far as possible by focusing on demand management, before looking at developing new sources of supply. This prioritisation is reflected in our WRMP.

A clear message from our customer engagement work (summarised in our Customer Research and Engagement Synthesis report) is that failure by a water company to control leakage from its own pipes can be a strong disincentive to customers adopting more water efficient behaviours. Avoiding this is critical because of the contribution we require of customers to off-set the increase in demand that is expected as a result of the forecast population growth in our region.

The results from the 'Options Survey for the Water Resources Second Stage research' in our Customer Research & Engagement Synthesis report provides evidence that our customers want us to continue focusing on leakage. Customers were introduced to a list of demand and supply side water resource options and asked to choose their top three options. Among household and non household customers, leakage reduction was the option most likely to be selected as one of the top options. When asked to explain their choices, both types of customers emphasised reasons around not wasting a precious resource and making the most of existing water resources. Although we are a top performer with regards to leakage, in our Customer Research & Engagement Synthesis report "leakage was considered by most respondents to be the worst aspect of the water service; only 13% felt it was the best and 41% felt it was the worst (n=301, combined sample)" (p58). This shows that our leading position relative to other companies does not negate the need for investment in this area.

In summary, investment to continue tacking leakage is needed because it is what our customers want and what our region needs. It is important with respect to maintaining trust and confidence, mitigating environmental damage from our abstractions and encouraging the adoption of crucial water saving behaviours amongst our customers.

In its PR19 Final Methodology document, Ofwat stated that companies should achieve forecast upper quartile performance in relation to both leakage per property per day and leakage per kilometre of main per day. As can be seen in the tables below, we have been in the upper quartile of leakage per kilometre of main per day for 13 out of the last 16 years. It also moved into the upper quartile of WaSCs on the basis of per property per day in 2015/16.

Upper quartile performance in terms of per kilometre per day (source: Ofwat 2017 information request, updated by 2018 A{R; analysis by AWS)

Year	UQ kl/km/day	ANH kl/km/day	ANH in UQ?
2003	5.45	5.23	Yes
2004	5.82	5.88	No
2005	5.78	5.82	No
2006	5.78	5.77	Yes
2007	5.52	5.46	Yes
2008	5.68	5.60	Yes
2009	5.65	5.62	Yes
2010	5.63	5.62	Yes

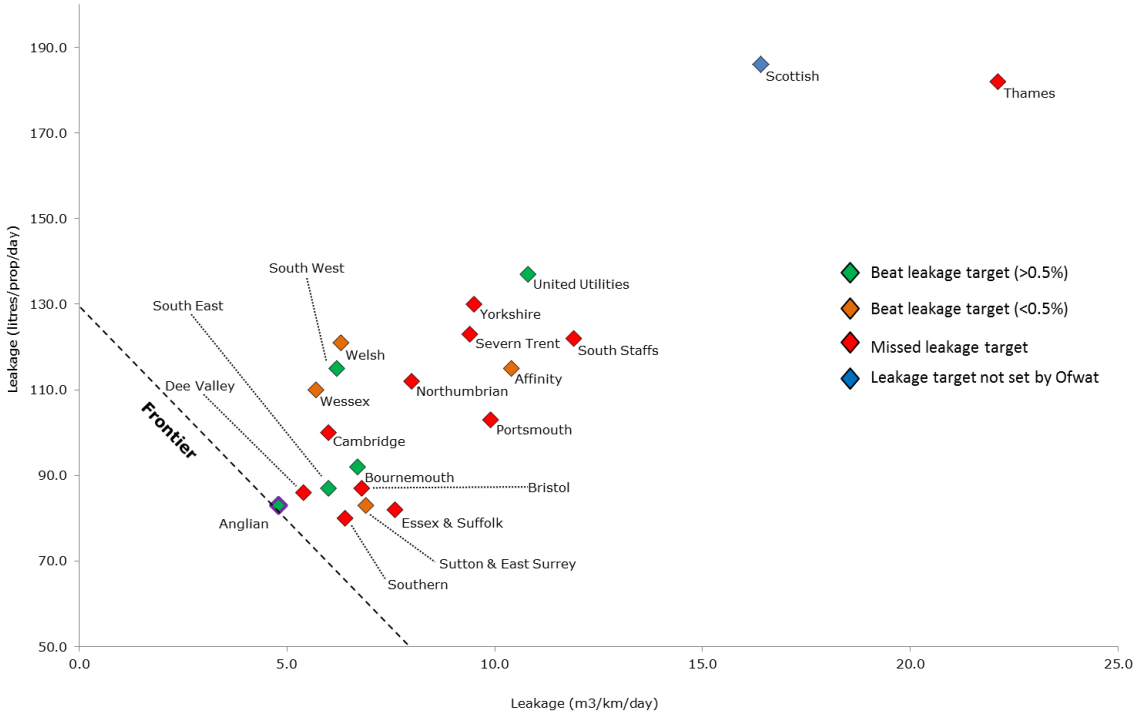
Year	UQ kl/km/day	ANH kl/km/day	ANH in UQ?
2011	5.91	6.10	No
2012	5.44	5.26	Yes
2013	5.32	4.98	Yes
2014	5.40	5.06	Yes
2015	5.35	5.04	Yes
2016	5.21	4.78	Yes
2017	5.27	4.82	Yes
2018	5.31	4.75	Yes

Upper quartile performance in terms of per property per day (source: Ofwat 2017 information request updated by 2018 APR; analysis by Anglian Water)

Year	UQ l/prop/day	ANH l/prop/day	ANH in UQ?
2003	99	100	No
2004	106	112	No
2005	104	110	No
2006	103	108	No
2007	95	100	No
2008	93	98	No
2009	95	99	No
2010	95	99	No
2011	98	107	No
2012	92	95	No
2013	88	90	No
2014	89	91	No
2015	88	90	No
2016	86	85	Yes
2017	87	86	Yes
2018	86	83	Yes

We are confident that the leakage reduction target we have set ourselves for AMP7 will continue to meet the upper quartile challenge.

Figure 29 Leakage frontier in 2018 (source: Anglian Water WRMP)



Best option for customers

It is clear that customers want us to tackle leakage. Our customer engagement process tells us that customers want us to conserve water and that they view leaks as an "emblematic issue". Examples of evidence for this from the Customer Research & Engagement Synthesis report v.12 are provided below:

> "In the main online community trial, customers felt the company's commitment to reducing leakage should take pride of place in communications from Anglian Water, as it should be the company's priority." (p174).
>
> "The Main Stage Willingness to Pay research suggests that customers think all of the attributes tested in the survey (relating to water, sewerage and wider services) are important. In relation to water services, tap water aesthetics (discolouration) and unplanned interruptions were the most important attributes for household customers (61% said these were very important), just marginally ahead of leakage (60%)...". (p46).
>
> "In selecting a package of improvements relating to the water service, the Willingness to Pay (DCE) choice task indicates that household customers gave the greatest weight to leakage (26%)." (p114).
>
> "In the Acceptability research, the element of the proposed plan concerning leaks was considered Acceptable by over 90% of all customer groups (with the exception of vulnerable customers). However, more respondents rated the leakage proposals as unacceptable (177 people) than any other individual element of the plan. The most commonly cited reasons for objection were that: more needs to be done to reduce leakage/waste (35%); some water leaks take too long to mend (19%); targets need to be lower (19%); 172 million litres a day is far too high (18%); and there should be zero tolerance on leakage (5%)." (p169).
>
> In terms of affordability and willingness to pay, "the PR14 Willingness to Pay Survey consistently identified positive and statistically significant willingness to pay for improved levels of service... if they were judged to offer 'value for money'." (p43). To this end, "in the Domestic Customer Survey, respondents were asked to choose three factors (from a given list of 11), which would most increase their assessment of the value for money offered by

Anglian Water. Fixing leaks (61%) was the aspect most likely to increase customers' assessment of the value for money they receive from Anglian Water." (p87). This shows that our customers are willing to pay more if it allows us to further tackle leakage.

In order to identify the best value demand management option for customers, we assessed the widest range of demand management options possible during the initial stages of our draft WRMP. The initial list of options therefore considered the following areas:

- Our current business practices and how we could improve them
- Current practices and plans of other UK water companies
- Practices in other sectors such as gas and electricity to encourage demand management and behaviour change
- Practices in other countries or localities that experience water stress
- Opportunities provided by technology and innovation, and,
- Latest academic research.

This unconstrained list was then assessed using the screening criteria set out in WR27 Water Resources tools (UKWIR, 2012) to identify feasible option-types. As a result of this process, a number of option-types were eliminated. For the remaining options, we went through a 'definition process' to develop the detail of each option, understand dependencies and exclusivities, and create options that are specific to Water Resource Zones (WRZs). Given the synergies between leakage reduction, smart metering and water efficiency activities, it was essential to consider the demand management options holistically during the development of strategic options. This approach is consistent with the approach to demand management in the Water Resources Long Term Planning Framework (WRLTPF).

All strategic demand management options were also assessed in the Strategic Environmental Assessment. This process yielded three potential strategic options, all of which underwent a cost-benefit analysis (CBA). This process identified the so-called 'Extended Plus' option as our preferred approach to demand management. A sensitivity analysis was also completed for this option and it was found to remain cost beneficial under all of the scenarios presented below.

- Increased costs of 10% capex and 5% opex
- Using the low estimate of the societal valuation results (our main CBA used the central estimate)
- Lower than expected water savings by 15% and 30%, and
- A combination of the higher cost and lower water savings scenarios (15%) while using the low estimate of societal valuation.

Thus, we are confident that the process detailed above has successfully identified the best value option for our customers. It is ambitious, yet achievable; best meets our customers' expectations and strikes the right balance between affordability and protecting the environment. The demand management identification process above has been subject to a detailed assurance process and has been approved by the AWS board (Draft WRMP Demand Management Strategy Technical Report).

Robustness and efficiency of costs

Our approach of encouraging collaboration and innovation in everything we do is clear from our Strategic Direction Statement. We believe this will allow us to maintain leakage at 172 Ml/d as cost effectively as possible. We are constantly trialling new leak-detection technologies such as thermal imaging drones and smart meters to help us locate otherwise elusive leaks in a time- and cost-efficient way. This enables us to prioritise repairs and fix small leaks before they develop into bigger problems. This also helps to reduce carbon, cost and disruption to our customers by removing the requirement for manual surveys and allowing us to accurately pinpoint leaks before excavation. These efficiencies will help to keep the cost of maintaining leakage at 172 Ml/d as low as possible.

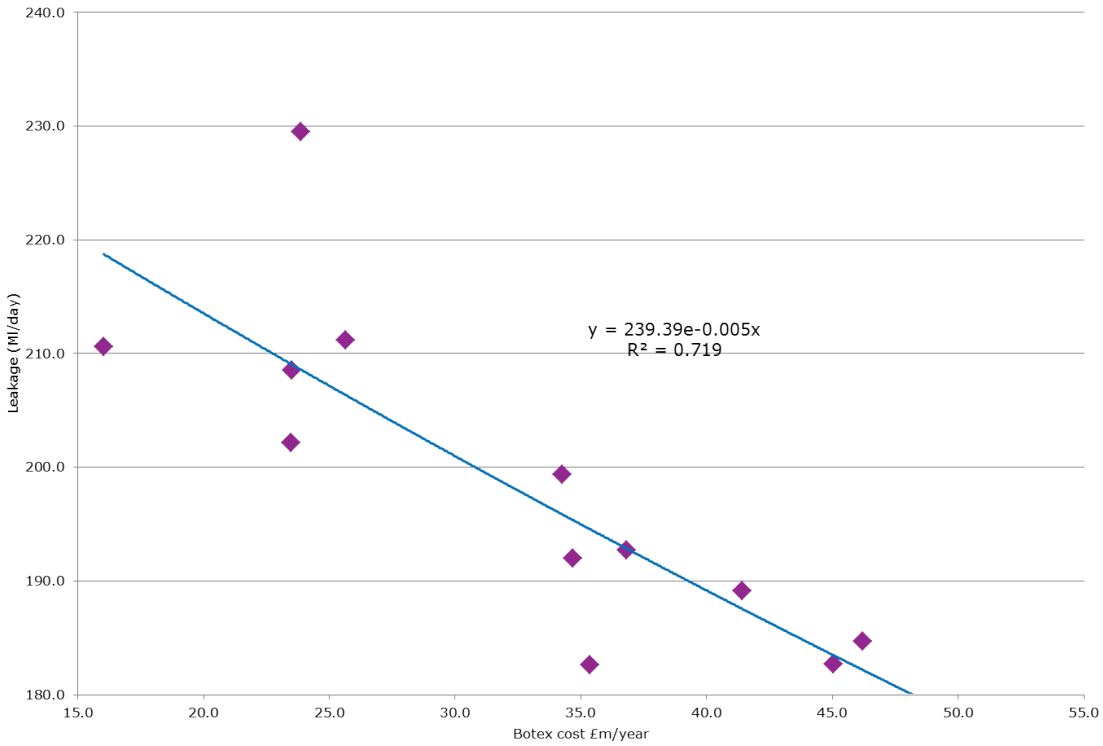
There is no established methodology with regards to how the additional cost of maintaining a lower than average level of leakage should be calculated. We have developed a methodology, based on Anglian Water historical data, to derive the relationship between leakage level and cost

of maintaining leakage. This methodology allows us to forecast the cost of maintaining leakage at 172 Ml/d. The value of our claim is the difference between this cost and the cost of maintain leakage at SELL. We have estimated this latter cost in two different ways which give similar figures.

It is important to note that the money spent on maintaining a particular level of leakage is viewed as being base capex and opex – that is to say, botex. By contrast, expenditure designed to drive down leakage to a lower level is viewed as enhancement capex and opex. The analysis which follows focuses only on the botex expenditure aimed at maintaining a particular level of leakage.

We have plotted our previous leakage levels in Ml/d against the expenditure (£m/year) to achieve this from the previous year. This is because the benefit of investment to control leakage made during any one year is not fully recognised until the following year. The data points used to establish this relationship range from 1997/98 to 2017/18. A best fit curve was then added to extrapolate the trend so that the cost of achieving a leakage value of 172 Ml/d could be forecasted. As the figure below shows, as leakage falls the cost required per additional unit of leakage reduction increases. This is consistent with our expectations and the principle of diminishing returns. The high outlying point (from 2010/11) clearly is reducing the quality of the fit.

Figure 30 Anglian Water leakage vs botex cost (source: Anglian Water, all costs are in 2017/18 price base



Because the components of leakage control have evolved within the business over time, a level of interpretation and assumption has been necessary in order to combine cost data from different sources and achieve the leakage level to cost relationship back to 1997/98. The costs from 1997/98 to 2010/11 have been obtained from the old June Returns. In these reports, the cost of leakage is captured by summing:

- capex (Table 35 commentary), and
- opex (Reactive and planned maintenance included in opex - water distribution – infra).

Post 2010/11, the cost of leakage control has been computed on a broadly similar basis to the June Return data. We are therefore confident that the data from these two sources can be combined in order to derive the relationship shown in the figure below.

Using the relationship described in the figure above, we can solve for x using the leakage level (y) as follows in the table below:

Computing leakage cost from graph (source: Anglian Water analysis)

Y: Leakage (Ml/d)	X: Cost (£m per annum)
SELL: 211	20.6
172	52.1
Difference	31.5

That is, the cost of maintaining leakage at 172 Ml/d is £31.5 million per annum greater compared to maintaining leakage at the SELL (equivalent to £157.4 million across the whole of AMP7).

We considered an alternative way of estimating the cost of maintaining leakage at SELL. During AMP4 (2005-10) we operated at, or close to, SELL with an average leakage rate across the AMP of 209.2 Ml/d. During that time, the actual spend reported for leakage costs in the June Returns (in 2017/18 prices) averaged £22.5 million per annum. Netting this figure off the modelled 172 Ml/d figure of £52.1 million gives a slightly lower difference figure than the table above: £29.6 million per annum (equivalent to £149.7 million across the whole of AMP7). We have used the lower figure for our claim.

As described, our claim is evaluated as the difference between the cost of maintaining leakage at 172 Ml/d and the cost to maintain leakage at our SELL of 211 M/d. Our assumption is that the cost baselines derived from botex modelling will allow for expenditure to maintain leakage at industry average levels. These are much higher than SELL; in the next section we estimate our leakage would be 238 Ml/d at industry average. Correspondingly, the cost of maintaining leakage at industry average would be much lower. Because we have not operated at industry average leakage levels in recent years we have no reliable way of assessing the cost of doing so which is why our claim is based on SELL. A claim based on maintaining leakage at industry average would clearly be significantly higher.

Conclusion

The approach we have taken is to derive a relationship between the level of leakage and the cost to maintain that level based on past performance. We have used that relationship to estimate the additional cost of maintaining our leakage at the target level for AMP7 (172 Ml/d) compared to the cost of maintaining leakage at our SELL. We have cross-checked this estimate with the actual cost of maintaining leakage in AMP4 when we operated very close to SELL. To be conservative, we used the lower of the two implied additional cost figures for the purpose of this cost claim.

Estimating costs for the industry

In its PR19 Methodology statement, Ofwat made it clear that, where possible, allowances for special factors should be applied symmetrically - that is, if one company required an uplift in its cost allowance to reflect a particular set of circumstances, those companies which did not face the same circumstances should see a countervailing reduction to balance the cost awarded.

We think a symmetrical application of cost adjustments to reflect the cost of maintain leakage at differing levels is appropriate and possible. An approach to estimating the claims / costs associated with leakage maintenance for all companies is set out below. The basis of the approach is to compute a cost per Ml/d difference between actual and average leakage based on Anglian data (the only detailed data we have available to us) and then apply it to all companies.

The table below sets out this approach. It summarises the 2016/17 values for Distribution Input (DI) and total leakage in Ml/d for the industry. This yields an industry average percentage leakage figure of 21.7%. If we had operated at that level of leakage, then our leakage level would have been 1,099 x 21.7% = 238 Ml/d.

We can use the annual value of our claim as the basis for computing the claims (positive and negative) for other companies. This is set out in the following table. The average leakage for each company is the industry average leakage rate (21.7%) multiplied by its DI. The adjustment value for each company is a share of the annual cost we have assessed for AW of £29.6 million pro rata to our gap to the industry average.

For example, for Northumbrian the value is 29.6 million x 38.5 / 53.7 = £21.2 million.

These values net to zero, achieving symmetrical application and zero net cost to customers.

Industry costs and claims based on Anglian Water data (source: IR17)

2016/17 data	DI (Ml/d)	Average leakage (Ml/d)	Actual leakage (Ml/d)	Average - actual leakage (Ml/d)	Cost (£m)
ANH	1099.5	238.4	184.7	53.7	40.9
NES	1108.6	240.4	201.9	38.5	29.3
NWT	1730.6	375.3	439.2	-63.9	-48.6
SRN	532.3	115.4	88.1	27.3	20.8
SVT	1848.1	400.8	431.6	-30.8	-23.4
SWT	427.9	92.8	84.4	8.4	6.4
TMS	2641.4	572.8	677.2	-104.3	-79.4
WSH	804.0	174.4	175.4	-1.1	-0.8
WSX	337.0	73.1	68.4	4.7	3.6
YKY	1261.3	273.5	295.2	-21.6	-16.5
AFW	901.9	195.6	173.0	22.6	17.2
BRL	272.8	59.2	46.4	12.7	9.7
SBW	141.5	30.7	19.1	11.6	8.8
DVW	66.1	14.3	11.3	3.0	2.3
PRT	170.1	36.9	30.4	6.5	5.0
SES	163.7	35.5	24.3	11.2	8.5
SEW	521.0	113.0	88.6	24.4	18.5
SSC	374.9	81.3	84.2	-2.9	-2.2
Total	**14,402.6**	**3,123.3**	**3,123.3**	**0.0**	**0.0**

We acknowledge that this approach uses gap to industry average leakage rather than gap to SELL which would be the appropriate approach given that our claim (and our £29.6 million) depends on gap to SELL. This is because we do not know companies' SELL values. These could be substituted in the analysis to recalculate the figures.

Customer protection

Our leakage performance commitment provides protection to our customers in the event that we do not deliver this level of performance. Penalty incentives will apply through the leakage performance commitment if our leakage rises above AMP7 starting point (177 Ml/d measured as a three year average). Enhanced penalty incentives will apply if our leakage rises above 192 Ml/d (measured as a three year average). The maximum underperformance penalty we can attract is £11.3 million each year in AMP7. This provides a very strong financial incentive. It is the largest of our individual ODIs and reflects the value that our customers place on reducing leakage.

Other powerful incentives exist to protect customers from the risk that leakage will rise. These include the reputational cost of missing our performance target in this critical area.

Affordability

The impact on bills and affordability of leakage reduction has been presented to stakeholders in our customer engagement programme and through our consultation on the draft WRMP. The CBA that has been completed and externally assured on our selected demand management option provides further assurance that our plans are affordable. Furthermore, there is evidence from our

customer engagement that customers are willing to pay more for defined service improvements, especially if these improvements are considered to provide value for money. For customers who struggle to pay their bills, we offer a comprehensive payment support programme.

Board assurance

Our third party assurance provider, Jacobs, has reviewed our special cost factor submissions. They concluded that we have compiled a robust claim for special costs which are unique to us as a company and are outside of management control.