Draft Water Resources Management Plan

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Asset Management document control sheet

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Author/originator	C Beloe		Asset Manager	28/02/2018
Technical contributors	N Honeyball M Islam I Karapanos K Ruda A Farcomeni M Correia E Powers R Carruthers		Asset Manager Asset Specialist	28/02/2018
Reviewer	A Panayiotou		Head of Water Strategy	28/02/2018
Legal reviewer	T Monod		Director of Legal and Assurance	28/02/2018
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CEO Foreword

We are pleased to present our draft Water Resources Management Plan (dWRMP19) from 2020 to 2080. This sets out how we plan to maintain the balance between the supply and demand for water, for customers, for up to 60 years into the future. Within our plan we address our long term strategic needs to ensure a resilient, wholesome and sustainable supply of water to customers based on our unique set of challenges.

Our vision is to be the leading community-focused water company in the UK, understanding the local needs of the communities we serve in our three regions and ensuring that our service reflects our customer priorities. It was this vision that demonstrated our commitment to customers which helped us achieve 'enhanced' status in our AMP6 Business Plan, which was founded on our last Water Resources Management Plan (WRMP14); we were one of only two companies to achieve this accolade.

This plan is a continuation and augmentation of our previous Water Resources Management Plan (WRMP14) and includes a Preferred Plan and Alternative Plan as well as stakeholders' aspirational scenarios for consultation with customers.

Resource management is at the heart of our business and our dWRMP19 is the foundation of our next Business Plan for 2019. We are publishing this draft plan to seek customer and stakeholder views on both our Preferred and Alternative Plans with their environmental benefits and associated costs. We will consider the feedback gained when deciding on our Preferred Plan for our final WRMP19. This will include a range of measures across our eight water resource zones to ensure the security of water supplies into the future whilst reducing the environmental impact of our operations and improving the resilience of our infrastructure to cope with climate variations. The Alternative Plan is higher cost and has a greater risk of delivery and includes what additional requirements are needed should customers support the adoption of improved levels of service in drought, greater leakage reductions and higher levels of environment protection through sustainability reductions.

A key challenge for our business will be how we adapt to the reduction in our abstractions from a number of our groundwater sources to improve flows and environmental habitats in local chalk streams. We are currently delivering sustainability reductions of 42 Ml/d with the Environment Agency in our Central region by 2020 and planning a further 10 Ml/d reduction by 2025, representing an overall reduction of nearly 7% of our resource base since 1993. The Environment Agency have indicated that they would like us to reduce abstraction by 39Ml/d and this has been included in our Alternative Plan proposals.

We have worked in close collaboration with other water companies in the East and South East of England to explore the potential for sharing regional water resources in the interests of resilience, sustainability, cost and energy efficiency. We are at the frontier of development of regional coordination and have taken a leading role. This work has been valuable and we have ensured our draft plan is in line with this work. We have worked closely with neighbouring companies to explore water trading opportunities and our plan features two such transfers.

In our Preferred Plan we manage our supply demand balance through demand management options (e.g. metering and reducing leakage), some groundwater development options and making best use of existing transfers from neighbouring water companies. The plan assumes a substantial level of water savings through continuation of our water savings programme, metering and water efficiency activities plus further leakage reduction that we consider overall to be a balanced, feasible and deliverable demand strategy for AMP7 and AMP8 coupled with groundwater options and trade/transfers.

We are committed to providing high quality customer service and take this opportunity to ask customers and stakeholders for their views on our proposed plans and support the level of service offered.

Simon Cocks
Chief Executive Officer, Affinity Water Ltd.

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Executive Summary

Water companies in England and Wales are required by law to produce a Water Resources Management Plan (WRMP) every five years. The plan must set out how a water company intends to maintain the balance between water supply and demand over a minimum of a 25-year period. It also takes account of and supports government policy and aspirations for providing resilient, sustainable and affordable water supplies to customers.

Our dWRMP19 plans beyond the statutory period, up to 60 years into the future (up to 2080) to address our long term strategic needs to ensure a resilient and sustainable supply of water to our supply area based on our unique set of challenges.

Our dWRMP19 Objectives

Our dWRMP19 builds on our last plan published in June 2014, which was a 'ten year plan'. It states how we propose to address the challenges for 2020 to 2025 and beyond whilst maintaining our ambition to be **the leading community-focused company**. We have a number of objectives for our dWRMP19.

The plan has the following objectives to:

- meet the **water supply needs** of customers over the next **25 years** (within an extended **60 year** planning window)
- continue to **work collaboratively** with **other water companies** in our regions, in order to **share water resources** and promote **regional coordination**
- be **consistent with Water Resources South East** (WRSE) outputs and informed by Water Resources East (WRE)
- ensure that our water abstractions are **sustainable**
- ensure that we can meet the **long-term challenges** that we face, including **drought resilience** to our worst historic drought on record
- meet the **expectations of customers** for restrictions of supply in severe drought conditions
- **reduce leakage** from water pipes where the savings justify the expenditure and to meet customer expectations.
- continue to promote **water efficiency** to support customers to reduce demand.
- facilitate economic growth by **planning for housing and population** needs
- extend customer water **metering and promote smart metering** innovation, where it is cost beneficial
- take account of potential future **uncertainties** including growth in customer demand, climate change and higher environmental standards
- make best use of existing resources whilst maintaining **water quality** at all times
- support our vision to be the **leading community focused company**.

Themes of our dWRMP19

The themes for our dWRMP19 are presented in the diagram below. We have increased our planning horizon from 25 to 60 years. We will continue water saving through demand measures, aiming for a metering penetration of 90% by 2025 and undertaking a re-assessment of our Water Saving Programme benefits to inform our revised plan. We will continue to reduce leakage from water pipes where the savings justify the expenditure. We will continue our focus on leaving more water in the environment, through further sustainability reductions. We evaluate best value for customers up to 2080, testing resilience and our levels of service. We capitalise on opportunities to improve resilience by planning to a worse historic drought than before. We ensure alignment and consistency with national and regional strategies to ensure collaboration and sharing between companies. For example, in our Preferred Plan we are proposing to reduce our import of water from Anglian Water allowing Anglian Water to utilise more of this resource.

Key Features of our dWRMP19 Plan

We present a **Preferred Plan (PP)** which we believe is balanced and **best value** for customers and the environment and an **Alternative Plan (AP)** which includes options for improved level of service under severe drought, greater leakage reduction and higher sustainability reductions meeting government and stakeholder aspirations with associated higher cost and greater risk in delivery. Our **PP** and **AP** provide an envelope of possible future solutions, upon which we will consult with our stakeholders and customers in the public consultation phase, to ensure that our final plan represents best value to customers and the environment. This is presented in summary in Chapter 2 and in detail in Chapters 15 and 16. Key features of our plan include:

- completion of our metering programme by 2025.
- greater resilience of supply through more robust assessment of our supply capacity going beyond historic drought conditions, resulting in a 42 Ml/d reduction in our supply capacity since WRMP14
- innovative demand management option and further reduction in consumption of 14 Ml/d by 2025
- changes in import / export agreements to Anglian Water (ANGL), South East Water (EGHS and BARI), and Southern Water (DEAI)
- long term water resource development to allow a new import from the Thames catchment by 2039 in our **AP** and 2055 in our **PP**. The date is sensitive to small changes in supply/demand balance but we expect our work to contribute to the scheme to commence during AMP7, between 2020 and 2025
- further reductions in leakage of 18 Ml/d by 2025 in our **PP** and 25 Ml/d in our **AP**
- water quality treatment of some of our bulk supply imports so these can be used in all zones
- further sustainability reductions of 10 Ml/d by 2025 in our **PP** and 39 Ml/d in our **AP** and reductions in output to meet Water Framework Directive (WFD) objectives and prevent deterioration of water bodies
- further protection of the quality of our water resources through our catchment management programme
- further improvements to the biodiversity and morphology of our rivers to improve habitats.

We will be consulting on the following key issues:

- levels of drought resilience and use of drought permits and orders for additional abstraction.
- further leakage reduction.
- the different options for sustainability reductions to improve the water environment.
- whether our key stakeholders and community partners are willing to commit to working in partnership with us to work towards ambitious targets for lower water consumption.

Our Approach to WRMP19

At the beginning of the WRMP process we undertook a problem characterisation exercise to assess our vulnerability to various strategic issues, risk and uncertainties. This allowed us to choose the best decision making process and technical methods for dealing with risks in our WRMP. We provide a documented and auditable trail to explain our decisions on methods and approaches to regulators and stakeholders which is further discussed in Chapter 6.

Our approach to drought resilience shows that the levels of service (or 'return period') we present in both our **PP** and **AP** for dWRMP19 are a significant improvement to fWRMP14. A drought 'return period' is an estimate of the likelihood of a drought occurring at any time. For instance, a 1 in 10 drought return period means there is a 10% chance or risk in any year of that severity of drought occurring. Table below describes the different drought return periods and probability of occurring in any year and what it means in reality for customers.

Drought return period	Description
1 in 10	**A drought of this severity has a 10% chance of occurring in any year.** At this level of drought severity, we would have implemented TUBs (formally known as hosepipe bans). These restrict activities such as using a hosepipe for watering gardens or washing cars. In practice, it is likely we will implement measures such as TUBs more frequently than 1 in 10 years, as we will need to act to implement precautionary measures in anticipation of those conditions occurring.
1 in 40	**A drought of this severity has a 2.5% chance of occurring in any year.** Prior to this level of drought severity occurring we would introduce ordinary drought orders (ODOs), also known as non-essential use bans. These cover a wider range of uses than TUBs. An ODO has only been obtained but not implemented once before by Affinity (1991)
1 in 60/80	**A drought of this severity has a 1.7% chance of occurring in any year.** Under our **PP** we would to maintain TUBs and ODOs up to and including this level of drought severity. Once this level of drought severity is exceeded, we would implement drought permits and orders for additional abstraction if required. These conditions are equivalent to the worst historic drought experienced although we have never applied for drought orders or permits for additional abstraction. If these conditions do occur this means we would apply for permission to either abstract additional water from dormant groundwater sources (notably those where output has been reduced under the Restoring Sustainable Abstraction Programme) or reduce river support from some of our groundwater sources. Under our **AP** we plan to maintain TUBs and ODOs up to severity of approximately 1 in 200 years, without the need for drought permits and orders for additional abstraction or use of emergency drought orders for restrictions on essential use.
1 in 200	**A drought of this severity has a 0.5% chance of occurring in any year.** In this situation, under our **PP** we would maintain TUBs, ODOs and drought permits and orders for additional abstraction and may require emergency drought orders for essential use and provision of standpipes and rota cuts for short periods of time, in areas of significant water stress managed under our Drought Management and Emergency Plans. Our **AP** includes measures to allow us to continue water supply up to this level of drought severity by maintaining TUBs and ODOs only. We expect that at the 1 in 200 year drought severity, we may require the use of drought permits and drought orders for additional abstraction and emergency drought orders for restriction on essential use.

Both our **PP** and **AP** for dWRMP19 move to a more resilient position of 1 in 60/80 year for **PP** and 1 in 200 year drought event for **AP,** which in turn reduces the disruption to customers for particular drought severities. Further descriptions of each of the drought management measures and comparison of our levels of service proposed in our **PP** and **AP** are discussed in Chapter 2.

In Chapter 7 of this report, we further explain our approach to resilience. We describe how much water we have available to supply customers per annum for a planning period of 60 years, including a calculation of climate change impacts on supply and sustainability reduction changes (Chapter 8).

We present how much demand there will be for water per annum for a planning period of 60 years, involving calculations of household demand from population growth, commercial demand from industry and an estimation of future leakage rates in Chapter 9. We have allowed for uncertainty in our supply and demand calculations and forecasts. This is known as our headroom assessment and is discussed in Chapter 10.

In Chapter 11 we compare supply with demand in our supply/demand balance to show that without action being taken there would be less supply of water available than demand (a deficit) within our supply area. We have therefore identified options to reduce demand in the short term and increase supply in the longer term so that we achieve a secure supply of water for at least 60 years into the future, presented in Chapter 12.

Our feasible options include schemes to reduce leakage, install more customer meters including smart meters and encourage better use of water with minimal wastage. These are consistent with Government aspirations to reduce per capita water consumption. In addition, we have also identified possible schemes to provide additional water resources from groundwater, surface water and transfers from neighbouring water companies and third parties within and in close proximity to our boundaries. Each of these options has been defined and priced in accordance with the methodology set out in the Water Resources Planning Guidelines (WRPG). For each option we have undertaken a Strategic Environmental Assessment (SEA) and, where necessary, a Habitats Regulation Assessment (HRA), in order to consider whether the option remains feasible should there be environmental concerns.

Our water balance shows that seven of our eight zones are predicted to be in deficit by 2064. We have therefore undertaken an investment appraisal to identify the best portfolio of options to either increase the amount of water available, reduce water demand or both. Chapter 13 presents our investment appraisal using a least cost model known as the Economic of Balancing Supply and Demand (EBSD) model.

This dWRMP document is supported by 29 Technical Reports and details of these can be found in Appendix D.

Regional Coordination

An important strategic element of resilience in water resources is the regional context, discussed in detail in Chapter 14. We have taken a leading role in the Water Resources in the South East (WRSE) project, supported Water Resources East (WRE) and participated on the steering group of the Water UK Long Term Water Resources Plan, working with the Environment Agency and other water companies to assess strategic water supply opportunities across the regions. We have undertaken significant inter–company and third party collaboration to support potential regional solutions. Identifying options and cross border supplies, from all our neighbouring water companies, has been a crucial component in the development of our plan.

We have for some time recognised the water scarcity issues in the South East presented by longer term drivers such as population growth, climate change and the environment, but we also appreciate that shorter term extreme weather and climatic events are becoming increasingly prevalent. These, as well as the longer term drivers, threaten the economic and resilient supply of water to customers.

The on-going regional work helps to show how our dWRMP19 and our problem characterisation aligns with and reflects the regional water resource strategies, and where the differences occur. At this stage the comparisons to date indicate that we are broadly aligned with the results that have been issued by WRSE. We will further verify consistency during our dWRMP19 consultation period following the final phase of modelling from WRSE. We have also been working with the WRE project which is attempting to address water resource planning issues in a new and innovative way, and we aim to support that work in an appropriate way going forward. We believe this approach moves us closer to a proposition of Regional Coordination in the future. We have been instrumental in promoting collaboration and an extension of the scope of the WRSE to include development of regional strategic plans with a decision-making authority.

Our dWRMP19 plans allow for enough scope to be able to progress with some of the necessary long term needs that might ensue from the need for a regional multi-company solution in a timely manner.

We believe that a System Operator function could operate within the water industry as a key enabler to promote water trading as an economic and resilient solution to water scarcity in the South East. We discuss this further in Section 14.7.

Our Preferred Plan and our Alternative Plan

We will consult on both our **PP** and **AP** in the public consultation phase, to ensure that our final plan represents best value to customers and the environment. Our plans are introduced in Chapter 2 and then discussed in greater detail in Chapters 15 and 16. Full discussion of our engagement programme is provided in Chapter 5. We will take into consideration public and stakeholder opinion on the environmental benefits and associated costs of various solutions when deciding on our **PP** for our final WRMP19. Our **AP** and aspirational scenarios presented in Chapter 16 allow stakeholders to see what additional measures are needed to move to their particular aspirational position and at what cost.

In developing our dWRMP19 plans, we have sought to:

- further **reduce household consumption** through a range of demand management options in line with government aspirations
- further **reduce abstraction** from existing sources where there is evidence that this will deliver environmental benefit
- **share resources** with neighbouring companies and third party licence holders
- explore a wide range of possible futures using scenarios to develop a **'resilience tested plan'**
- **promote resilience** by having a balanced programme of investment that does not rely on any one single option type.

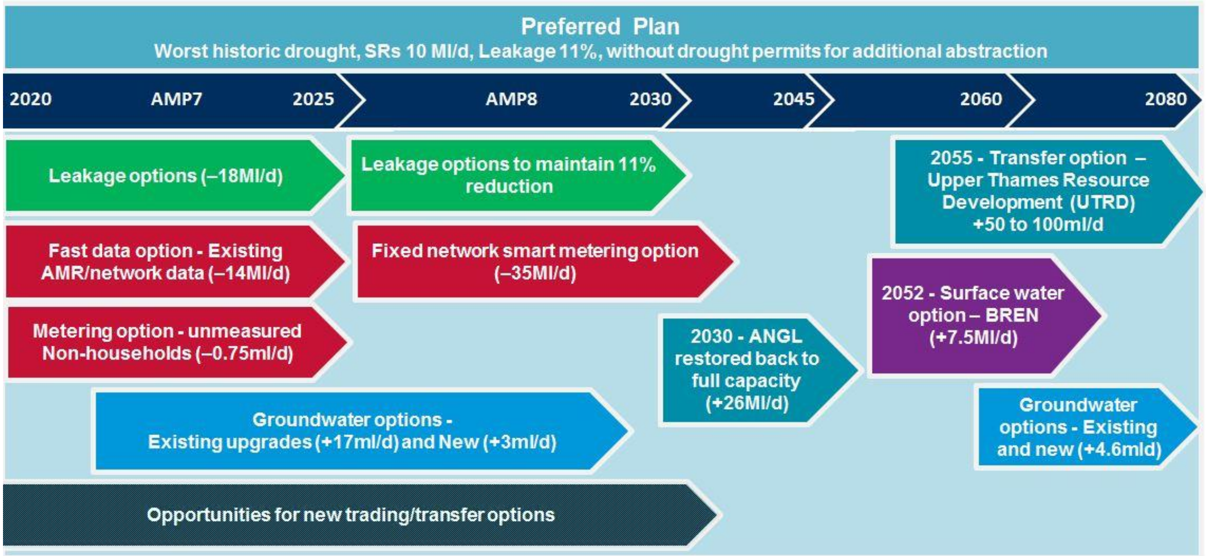
There are steps we will take to better manage the amount of water that is used, for example further reducing leakage and installing smart meters to help customers reduce their water usage. During times of drought we will temporarily restrict demand if necessary. We include a substantial level of water savings through continuing our Water Savings Programme

(WSP), metering and water efficiency activities plus further leakage reduction which we consider to be a feasible and deliverable demand strategy for AMP7 and AMP8.

We will also take steps to ensure we have enough water to supply. In the short to medium term we will make best use of the resources we already have, exploring development of existing resources and opportunities for securing transfers of water from our neighbouring water companies and others. In the longer-term we will seek to secure additional reliable water by transferring water from a new regional reservoir in the Upper Thames catchment promoted in partnership with Thames Water and other companies in the South East of England. The timing of the reservoir is sensitive to small changes in the supply/demand balance but we recognise this means we will step up our involvement in securing this resource from 2020.

We will reduce abstractions where there is evidence to show that the environment will benefit. These are known as sustainability reductions. Our **PP** includes 10 Ml/d and our **AP** includes 39 Ml/d of sustainability reductions upon which we will be seeking stakeholder and customer views during public consultation.

An overview of our preferred delivery strategy is shown in the figure below.



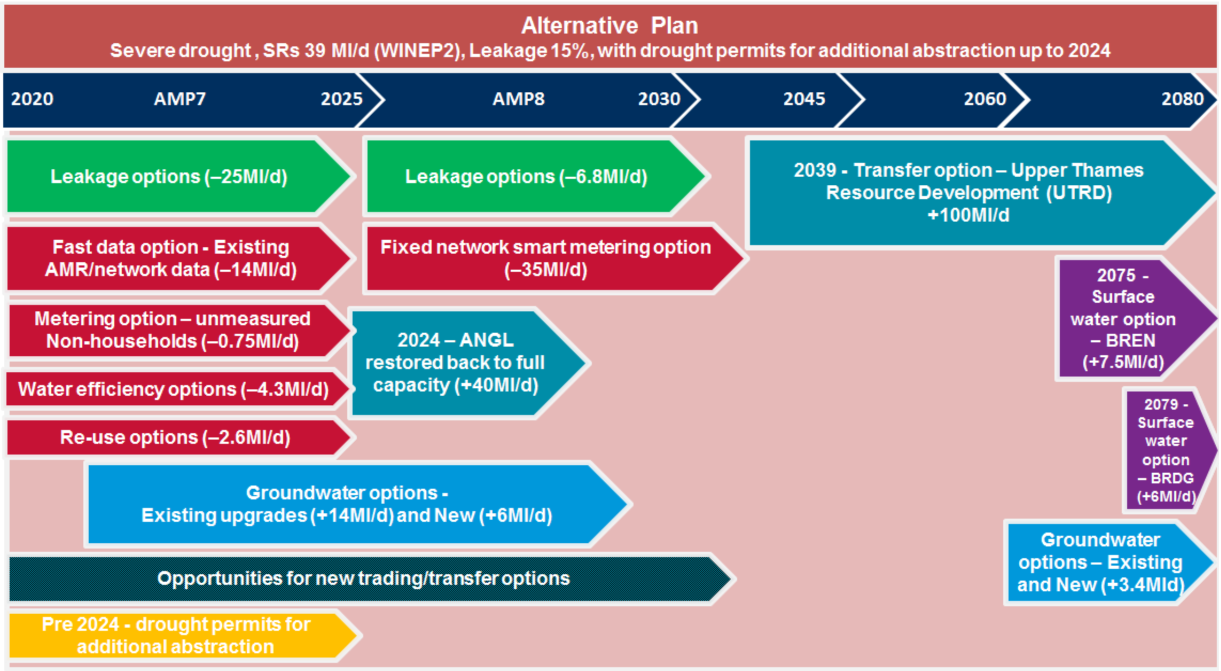
PP demand and supply side options for dWRMP19 delivery programme

In the immediate **five years** (2020-2025), our **PP** includes:

- a leakage reduction of **18 Ml/d** from a variety of leakage interventions
- savings of **14 Ml/d** from engaging with customers on their water usage (Fast Data Option) and from better use of our existing AMR meters and network data
- **0.75 Ml/d** lower consumption from metering unmeasured non-household properties
- an additional **17 Ml/d** of available supply by optimising existing groundwater abstractions and licences with minimal environmental effects
- an extra **3 Ml/d** from a new abstraction licence
- up to **12 Ml/d** of proposed new bulk imports

- **26 Ml/d** lower utilisation of our ANGL resource shared with Anglian Water until 2030, taking a lower risk profile for climate change in the water available to potentially enable to supply deficits in the Anglian region
- an investment in a cost effective treatment solution to enable the use of water from ANGL in any of our zones at full capacity from 2030.

An overview of our alternative delivery strategy is shown in the figure below.



AP demand and supply side options for dWRMP19 delivery programme

Our **AP** shows some notable difference to our **PP** including:

- further demand management options with a leakage reduction of **25 Ml/d** by increasing the intensity and variety of leakage interventions
- **40 Ml/d** lower utilisation of our import from ANGL until 2024 taking a higher risk profile for climate change in the water available to potentially enable to supply deficits in the Anglian region
- avoidance of drought permits and orders for additional abstraction after 2024 for all drought severities up to a 1 in 200 year event. This will mean greater resilience of our supply and reduce the risk of disruption to customers should a severe drought occur
- increasing resilience through investment of a cost effective treatment solution to enable the use of water from ANGL in any zone at full capacity from 2024
- an earlier requirement for groundwater options and UTRD transfer option (from 2039).

Additional Steps

Additional steps we plan to take between our draft and revised draft plans include the following:

- continuing our discussions regarding trading and potential bulk transfers from neighbouring water companies and third parties, we will also take into consideration further developments from the regional modelling groups
- integrating our final Plan with Ofwat's Price Review 2019 programme and our Business Plan modelling
- we are keen to move towards a more resilient position in terms of drought and will take onboard customer and stakeholder views regarding the cost of that service improvement and the environmental benefit and costs, especially regarding the use of supply-side drought order and permits
- we will update our demand forecasts and options to reflect recent changes in the classification of properties as a result of retail reform and the adoption of consistent leakage calculation methodology across the industry from 2020.

Consultation Approach

We expect to publish our draft plan in March 2018 for consultation. We will consider the feedback we receive when producing our revised draft plan which will be submitted in mid-2018. In particular, we will be:

- informing customers and stakeholders about our consultation programme, which we will develop and share with our CCG for challenge and review and how they can influence our plans
- considering feedback from customers and stakeholders to take account of their views on our **PP** and **AP**. We expect to submit a statement of response in summer 2018
- continuing our discussions with the EA regarding sustainability reductions for 2020 to 2025. We will consult with customers on whether they support the environmental improvements suggested and we will adapt our plan in light of the outcome of that consultation.

What do we want to know from customers and stakeholders?

Customers will be affected by our plan and we are keen to hear their views to influence what we do in the future.

We are consulting with customers and stakeholders on both our draft **PP**, which we believe represents best value to customers and the environment, and our **AP** which sets out some additional options for improved levels of service under severe drought, greater leakage reductions and higher sustainability reductions. Throughout our consultation material there are questions which ask customer and stakeholder views on the different options set out in our **PP** and **AP**. The figure below illustrates our key options included in our **PP** and **AP**.

† Ml/d means millions of litres of water per day.

* PCC means Per Capita Consumption (how much water each person uses per day). l/p/d means litres per person per day.

Key options for our PP and AP

Cost of Preferred Plan (PP) and Alternative Plan (AP)

Plan	AMP7 investment (£million NPV)	AMP8 investment (£million NPV)	Total investment at 2044 (£million NPV)	Total investment at 2079 (£million NPV)
PP	£228.04	£109.88	£475.03	£1,001.45
AP	£308.29	£160.99	£1,046.35	£1,788.44

Cost difference between Preferred Plan (PP) and aspirational scenarios

Portfolio comparison	Cost difference (£million NPV)	Key change
PP to **AP**	£786.99	To move from a worst historic DO with 10 Ml/d of SRs to a 1 in 200 year DO with 39 Ml/d of SRs with supply side drought measures available in AMP7
PP to 110 l/h/d PCC	-£194.27*	To move from a PCC of 126 l/h/d to 110 l/h/d by 2045

*The very low costs of this scenario are due to avoided operational and investment costs. This option requires wider collective societal and regulatory action to enforce the use of high efficiency appliances and therefore a higher risk strategy. We will only be able to move forward with this option if we obtain commitment from Government, regulators and community partners through joint action.

Key areas are we consulting on

We are keen to consult with customers and stakeholders to get their views on what we are proposing before reaching a final decision on our Plan to ensure that our final Plan represents best value to customers and the environment.

Further information on the range of activities to be utilised during the public consultation phase is given in Section 5.5, and further information on our approach to the public consultation is given in Section 17.

How to take part?

Full details of how to take part in our consultation including the questions we are asking in the consultation document, will be available at: [www.affinitywater.co.uk/haveyoursay.](www.affinitywater.co.uk/haveyoursay)

Our overall approach

We are seeking customer and stakeholder views if they support or oppose the approach and balance of measures we have presented in our **PP** compared to the higher cost and higher risk in our **AP**. The estimated cost of our **PP** is £228 million for AMP7 and total cost to 2080 of £1,001 million. In comparison our **AP** would cost £308 million in AMP7 with a total cost of £1,788 million to 2080.

In particular, we will be consulting on the following key issues:

What happens if it doesn't rain enough.

Our resilience to drought.

Drought can have an impact on customers' lives and this may become more noticeable as a drought becomes more severe. In the early stages of a drought, TUBs (formerly known as hosepipe bans) may be introduced which temporarily restricts the use of a hosepipe for 11 different activities. These are primarily domestic restrictions and include activities such as using a hosepipe for watering gardens, filling up paddling pools or washing cars. As a drought becomes more severe, ordinary drought orders, formerly known as non-essential use bans, may be implemented. This is a temporary measure which would restrict 10 activities, including filling swimming pools or ponds, operating vehicle-washers and cleaning windows. These restrictions would have some commercial implications, such as for car washes or window cleaners.

In a severe drought we may apply to abstract additional water or reduce river support through the use of drought permits or drought orders. The possible effect of additional abstraction at this stage of a severe drought may be an extension in the amount of time it takes for the river to recover, after the drought has ended.

Our **PP** and current Drought Management Plan, enable us to continue to supply water to meet demand for longer than we are currently able to without the need to take more water from sources we would not normally use (through use of drought permits and orders for additional abstraction).

In our current position, there is a 2.5% chance every year that we may need to use this additional water. Our **PP** proposes we reduce this to a 1.7% chance every year during a drought. The estimated cost is £295 million by 2080.

Our **AP** explores the possibility of putting extra supply capacity and pipes to transfer water across our area in place so that we are resilient to a severe drought which has a 0.5% chance of occurring every year, equivalent to a 1 in 200 year drought event. This would be without the use of standpipes in the streets or rationing the supply of water in a severe drought. The estimated cost of this additional drought resilience is approximately an additional £410 million by 2080.

We are asking customers and stakeholders whether they support or oppose our position to become more resilient. There is a choice to specify preference to move to a 1.7% or 0.5% chance of needing additional water through drought permits and orders during a severe drought.

Managing leakage, keeping bills low

Reducing leakage further.

Our regulator, Ofwat, would like us to reduce leakage by 15% by 2025, saving 25 million litres of water each day, and this has been included in our **AP.** This will cost an additional £12 million compared to our **PP** option of 11% which we believe is a balanced proposal following the 14% reduction in leakage we included in our previous plans – a total reduction of 25% since 2015. We know leakage is wasteful and that customers feel strongly that we should be reducing leakage as much as possible. The challenge for us is weighing up the cost of finding and repairing leaking pipes verses the cost of the production and delivery of more water. This is called the economic level of leakage. We do our best to strike the balance between these two things to keep bills as low as possible and to keep traffic disruption to a minimum.

We are asking customers and stakeholders whether they would like us to reduce leakage by 11% as set out in our **PP** at a cost of £46 million by 2025 and a cost of £208 million by 2080 or like us to reduce leakage by 15% as set out in our **AP** at a cost of £58 million by 2025 and a cost of £374 million by 2080?

Using less water

Reducing Per Capita Consumption (PCC).

We believe we can reduce how much water customers use down from 160 litres per person per day to 126 litres in our **PP** and 120 litres in our **AP**. This is a 23% reduction or 31 to 37 litres per person per day from our current levels. These forecast savings are based on the evidence of consumption reductions from our continuing water savings programme but we have also included within our plans options to provide customers with more frequent information about their water use to facilitate further stretching consumption reductions. The government would like us to reduce this even further towards 110 litres per person per day, that's a reduction of 50 litres per person per day from our current levels. This would mean that more customers in our supply area would need to significantly reduce their water use through changes in behaviour.

Reducing PCC in the long term to meet government aspiration we believe requires a willingness from stakeholders to commit to working in partnership to further reduce consumption. This will require integrated communications from all parties with the public at large, better consumption data and changes in regulations including point of sale control, building codes, local authority planning, water regulations and incentives for developers. We are consulting to establish if there is partnership support to deliver this challenging target.

We are asking customers whether they support or oppose our partnership approach to reduce per capita consumption of water to 110 litres per person per day. We are also asking our stakeholders whether they are prepared to commit to join us in partnership to achieve this objective.

Balancing the needs of the environment and customers

The different options for sustainability reductions.

We are consulting on reductions in abstractions of 10 or 39 million litres of water per day. There is a cost to customers associated with sustainability reductions.

In our **PP** we have included reductions in abstraction that in our view are based on robust evidence that they will achieve environmental benefits and that are cost beneficial. The **AP** has a higher cost and we consider this plan to also be higher risk. The **AP** represents a greater challenge to operational resilience by including a higher level of sustainability reductions requested by the Environment Agency by 2024 with little time to mobilise reliable alternative demand management or supply measures in a region of water scarcity.

We are asking customers and stakeholders firstly whether they support or oppose our phased approach to sustainability reductions. Secondly, whether they support or oppose our **PP** option of a reduction of 10 million litres of water per day at a cost of £93 million by 2080 or our **AP** option of a reduction of 39 million litres of water per day at a cost of £123 million by 2080.

Collaboration and sharing

Working with other water companies and third parties.

Our plan commits us to sharing water and water resources. In some cases, over the long term, this includes building new assets, such as pipes and reservoirs, with other water companies across our region. This is important to help us address the shortage of water and support the growing population in both our area and in neighbouring water company areas.

We are asking customers and stakeholders whether they support or oppose this type of joint approach.

What happens next?

The Secretary of State will forward responses on to us. At the end of the consultation we will consider all the comments made. In summer 2018 we aim to publish our Statement of Response – a document that details how we have changed the plan because of the comments made, or provide an explanation if we have not been able to.

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Table of Contents

Table of Figures

List of Tables

Abbreviation List and Glossary

ADO	Average Deployable Output – the average output of a source
AIM	Abstraction Incentive Mechanism
ALF	Alleviation of Low Flow
AMP	Asset Management Period – five-yearly cycle used by water companies for management of water resources, during which price limits are set
AMR	Automated Meter Reading
ANOB	Area of Outstanding Natural Beauty
AP	Alternative Plan
BMA	Bulk Metered Area
ALF	Alleviation of Low Flow Scheme
AMP	Asset Management Period – 5 year investment period
AMR	Automatic Meter Reading
Annual Return	Annual update on our Water Resources Management Plan
BVA	Basic Vulnerability Assessment
CPPW	Critical Period Peak Week
DD11	The Drought Direction 2011
DI	Distribution Input – the amount of water entering the distribution system at the point of production
DO	Deployable Output – the output of a commissioned source or group of sources assessed under drought conditions
Drought Order	An authorisation granted by the Secretary of State under drought conditions which imposes restrictions upon the use of water and/or allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis
Drought Permit	An authorisation granted by the Environment Agency under drought conditions which allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis
DMA	District Metered Area
DMG	Drought Management Group
DMP	Drought Management Plan – Operational plan which sets out how the company will deal with a drought situation

DrWPA	Drinking Water Protection Area
DTZ	Drought Trigger Zone – a trigger line for groundwater levels at specific points which indicate stages at which different drought actions need to be carried out
DWI	Drinking Water Inspectorate
DYAA	Dry Year Annual Average
DYCP	Dry Year Critical Period
EA	Environment Agency
EAR	Environmental Assessment Report – report to support drought permit applications, which investigates and predicts environmental impacts of permits, as well as setting out the associated monitoring and mitigation actions
EP	Effective Precipitation – the amount of precipitation which is actually added and stored in the soil. Used as an indicator of recharge
EBSD	Economics of Balancing Supply and Demand
FPPS	Ferric Phosphate Product Substitution
FRMP	Flood Risk Management Plan
GWL	Groundwater level – level of groundwater above ordnance datum
HDZ	Hydraulic Demand Zone – zone characterised by having discrete supply and storage arrangements with strategic inter zone transfers
HMWB	Heavily Modified Water Body
HMWT	Herts and Middlesex Wildlife Trust
HRA	Habitats Regulations Assessment
HS2	High Speed 2
HWEC	Home Water Efficiency Check
INNS	Invasive Non-Native Species
LTA	Long Term Average – average monthly rainfall or groundwater level calculated over a 30 year period
LTWRPF	Long Term Water Resources Planning Framework
mAOD	Metres Above Ordnance Datum – the height of a point in metres above average sea level
MC	Multi-criteria

MLR	Multi-linear Regression
MORECS	Meteorological Office Rainfall and Evapotranspiration Calculation System – operational system which provides estimates of evaporation, soil moisture deficit and effective precipitation under British climatic conditions
MOU	Memorandum of Understanding
MTP	Market Transformation Programme
MUR	Meter Under Registration
NEP	National Environment Programme – a programme of investigations and actions for environmental improvement schemes to ensure that water companies meet their statutory environmental obligations
NERC	National Environment Research Council
NYAA	Normal Year Annual Average
OASIS	Operational Assessment of Summer Impacts and Stress
OBH	Observation Borehole – a borehole drilled to monitor groundwater levels
Ofwat	The economic regulator of the water sector in England and Wales
PCC	Per Capita Consumption
PES	Payment for Ecosystem Services
PET	Potential Evapotranspiration - the amount of evaporation that would occur if a sufficient water source were available
PDO	Peak Deployable Output – the maximum output of a commissioned source, as constrained by (if applicable): • Environment • Licence, if applicable • Pumping plant and/or aquifer properties • Raw water mains and/or aquifers • Transfer and/or output main • Treatment capabilities • Water Quality
PHC	Per Household Consumption
PP	Preferred Plan
PR	Periodic Review
PR19	Price Review 2019
RBMP	River Basin Management Plans

RSA	Restoring Sustainable Abstraction
SAC	Special Area of Conservation – defined in the European Union's Habitats Directive, to protect habitats and species considered to be of European interest
SEA	Strategic Environmental Assessment
SMD	Soil Moisture Deficit – the amount of rain needed to fully saturate the soil
SPA	Special Protection Area – a designation under the European Union Directive on the Conservation of Wild Birds
SPL	Supply Pipe Leakage
SoN	Statement of Need
SR	Sustainability Reductions
SSSI	Site of Special Scientific Interest – a conservation designation denoting a protected area in the United Kingdom
THR	Target Headroom
TUB	Temporary Use Ban – demand management action which temporarily restricts non-essential use of water by customers during a drought (formerly a 'hosepipe ban')
TWUL	Thames Water Utilities Limited
UKWIR	UK Water Industry Research
UTRD	Upper Thames Resource Development
WAFU	Water Available For Use
WAPCC	Weighted average per capita consumption – overall average of household measured and unmeasured consumption.
WATCOM	Water Consumption Monitor – our stratified sample of unmeasured households established in 1997 and since used to assess unmeasured household consumption.
WET	Water Efficiency Target
WFD	Water Framework Directive – a European Union directive which commits EU member states to achieve good status of all water bodies by 2027
WINEP	Water Industry National Environment Programme
WISER	Water Industry Strategic Environmental Requirements

WRMP	Water Resources Management Plan – 25 year plan which water companies use to plan ahead and manage their water resources
WRPG	Water Resources Planning Guidelines
WRE	Water Resources East
WRSE	Water Resources South East
WRZ	Water Resource Zone – the largest possible zone in which all resources, including external transfers, can be shared and, hence, the zone in which all customers will experience the same risk of supply failure from a resource shortfall
WSP	Water Saving Programme

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1 Introduction

1.1 The Need for a Water Resources Management Plan

Water companies in England and Wales are required by law to produce a Water Resources Management Plan (WRMP) every five years. The Plan must set out how a water company intends to maintain the balance between water supply and demand over a minimum of a 25-year period. The Plan must been compiled in accordance with the Water Resources Planning Guidelines (WRPG) developed by government and water industry regulators. It also takes account of and supports government policy and aspirations for providing secure, sustainable and affordable water supplies to customers.

Our dWRMP19 sets out how we plan to maintain the balance between supply and demand for water not just during the statutory planning period of 25 years (2020 to 2045) but going beyond this, up to 60 years into the future (up to 2080). This enables us to address our long term strategic needs to ensure a secure and sustainable supply of water to our supply area based on our unique set of challenges.

Our plan is focused on delivering the outcomes that customers want, whilst balancing the needs and societal value of the environment. In our dWRMP19 we have:

- calculated how much water we have available to **supply** customers per annum for a planning period of **60 years**
- calculated how much **demand** there will be for water per annum for a planning period of **60 years**
- allowed for **uncertainty** in our supply and demand calculations and forecasts
- compared supply with demand to show that without taking action, there will be less water available for supply than demand, (a deficit) within our supply area. We have therefore **identified options** to **reduce demand** in the short term and **increase supply** in the longer term so that we achieve a secure supply of water for at least 60 years into the future
- considered how our current and future operational system will be **resilient** to a range of **droughts and non-drought hazards** across the planning period
- provided the above information at a water resource zone (WRZ) level and at a company level according to the water resources planning tables and instructions.

Our dWRMP19 promotes **solutions** to balance supply and demand under dry year annual average and critical peak planning conditions in order to:

- be **sustainable** for the environment
- be cost effective for **customers**
- control demand whilst promoting **supply** solutions that are feasible, making best use of existing sources and maintaining water quality
- be **resilient** to future pressures and uncertainties taking into account the long term pressures beyond the statutory 25 year planning period.

Our dWRMP19 is published ahead of our business plan, where the key investment case is made. The implementation of solutions identified in our dWRMP19 will underpin our next regulatory Business Plan, which will determine our future water charging price limits.

Our dWRMP19 builds on our last plan published in June 2014, which was a **'ten year plan'.** It states how we propose to address the challenges for 2020 to 2025 and beyond whilst maintaining our ambition to be **the leading community-focused company**. The plan has the following objectives to:

- to meet the **water supply needs** of customers over the next **25 years** (within an extended **60 year** planning window)
- to continue to **work collaboratively** with **other water companies** in our regions, in order to **share water resources** and promote **regional coordination**
- to be **consistent with Water Resources South East** (WRSE) outputs and informed by Water Resources East (WRE)
- to ensure that our water abstractions are **sustainable**
- to ensure that we can meet the **long-term challenges** that we face, including **drought resilience** to our worst historic drought on record
- to meet the **expectations of customers** for restrictions of supply in severe drought conditions
- to **reduce leakage** from water pipes where the savings justify the expenditure and to meet customer expectations
- to continue to promote **water efficiency** to support customers to reduce demand
- to facilitate economic growth by **planning for housing and population** needs
- to extend customer water **metering and promote smart metering** innovation, where it is cost beneficial
- to take account of potential future **uncertainties** including growth in customer demand, climate change and higher environmental standards
- to make best use of existing resources whilst maintaining **water quality** at all times
- to support our vision to be the **leading community-focused company**.

Our plan follows guidance from the Environment Agency, which sets out the process, pre-consultation timeline for draft and final plan, technical methods, expectations on consultation and changes from WRMP14. The latest guidance was released in May 2016, with an update in April 2017.

The key guidance documents are:

- Final Water Resources Planning Guideline. Environment Agency. May, 2016 (Interim Updates)
- Defra Guiding Principles for Water Companies. May, 2016
- Environment Agency/ Natural England. 2017. Water Industry Strategic Environmental Requirements (WISER): Strategic steer to water companies on the environment, resilience, flood risk for business planning purposes. Draft
- Environment Agency. 2017. Water Industry National Environment Programme 1 (WINEP1). March 2017
- Environment Agency. 2017. Water Industry National Environment Programme 2 (WINEP2). September 2017.

We have continued to challenge the rigour of our approach to water resources planning. We have contributed to national policy development and regional and local planning to improve and innovate our planning to maintain the resilience of supplies for customers and seek improvements in the level of service we offer.

1.2 Affinity Water's Vision

Our vision is to be the leading community-focused water company in the UK, understanding the local needs of the communities we serve in our three regions and ensuring that our service reflects the priorities of customers. It was this vision that demonstrated our commitment to customers to Ofwat, who awarded our AMP6 Business Plan 'enhanced' status; we were one of only two companies to achieve this accolade. Our dWRMP19 is a key building block of our Business Plans. Since our last plan we have been working hard to deliver a range of measures across our eight water resource zones to ensure the security of water supplies is maintained into the future, whilst reducing the environmental impact of our operations and improving the resilience of our infrastructure to cope with climate variations.

1.3 Our Last Plan (WRMP14)

Our last WRMP in 2014 was a key building block of our Business Plan in PR14. Since then we have continued our commitment to delivering customers' expectations. We are continuing from our ten year plan set out at WRMP14 (Affinity Water Final WRMP, 2014), in which we included the following key programmes:

- ensuring customers have enough water, whilst **leaving more water in the environment;**
- supplying **high quality water** that can be trusted;
- prioritising **leakage reduction**;
- undertaking a **universal metering programme**;
- continuing to promote **water efficiency**.

In addition, since then we have:

- improved information to customers and stakeholders about our plans and the service they can expect to receive
- secured partnerships with key stakeholders to deliver our plan
- investigated ways to increase efficiency and flexibility in the delivery of WRMP14 preferred plan
- launched our early start programme under the PR14 transitional arrangements
- supported the development of River Basin Management Plans and achievement of WFD targets
- maintained and improved our assets to increase resilience, and developed operational plans to change the way we operate our system to facilitate continued sustainability reductions, whilst ensuring resilience of supplies is maintained at all times
- translated the improvements in methodology and intelligence achieved in preparing our plans into 'business as usual'

- published for consideration a revised draft Drought Management Plan maintaining consistency with our Water Resources Management Plan.

Implementing WRMP14 is an ongoing challenge for our business, and has meant a significant change in our operations.

Appendix A provides a brief update on our progress in relation to the main programmes set out at WRMP14.

1.4 Draft WRMP19 Challenges, Approach and Key Themes

Our dWRMP19 continues to build on our PR14 commitments and the ten year plan set out in our last WRMP published in 2014. Our main challenge is to continue to supply sufficient water to customers into the future whilst facing an increase in demand through a rising population, at the same time as leaving more water in the environment, coping with climate change and historic pollution of groundwater sources and pollution of surface water.

Our approach is to:

- continue **water saving** through demand measures, aiming for a metering penetration of 90% by 2025 and undertaking a re-assessment of our Water Saving Programme benefits to inform our revised plan
- continue our focus on leaving more water in the environment, through **sustainability reductions**
- use a new economic modelling approach to evaluate **best value** for customers up to 2080, **testing resilience** and our **levels of service**
- ensure **alignment and consistency** with national and regional strategies to ensure collaboration and sharing between companies. For example we are considering **reducing** our import of water from Anglian Water allowing Anglian Water to utilise more of this resource
- capitalise on opportunities to improve **resilience** by planning to a worse historic drought than before and consult on options to extend that further and avoid the use of emergency drought orders (restrictions on essential use, rota cuts an standpipes) for all droughts up to a 1 in 200 year severity for which there is a 0.5% probability of occurring
- increase our planning horizon from **25 to 60 years**
- ensure **alignment** with our Business Plan, Drought Management Plan and other major plans.

Our key themes for WRMP19 are illustrated in Figure 1.

Figure 1: Our key themes for customers and dWRMP19

1.5 The WRMP Structure and Planning Scenarios

The suite of documents making up our dWRMP19 comprises:

- a summary of our dWRMP19 main plan document, (public document)
- our dWRMP19 main plan document, (public document)
- our Water Resource Planning data tables (available on request)
- a series of supporting Technical Reports (available on request)
- our Strategic Environmental Assessment Report (public document).

The Water Resource Planning (WRP) tables have been submitted to the Environment Agency and Defra with full plan data. For our public consultation, this report along with the Environmental Statement will be available on our website www.affinitywater.co.uk.

Figure 2 illustrates at a high level the process we took to develop our strategy and highlights the components which make up the supply and demand forecasts.

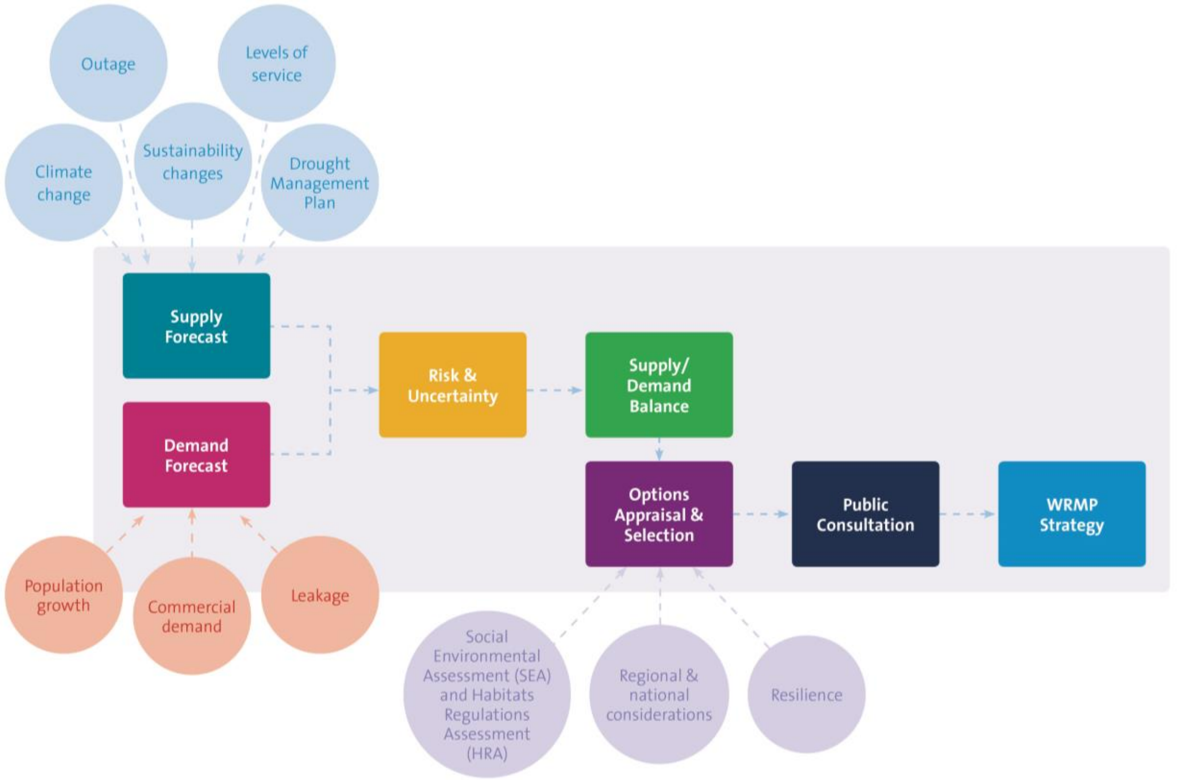

Figure 2: Key components of the supply and demand forecasts

We calculate a baseline supply/demand balance which reflects the water resources situation now and into the future without any interventions. Our supply forecast includes an assessment of factors such as climate change, outage and sustainability changes. Our levels of service (LoS) for drought actions influence our available supply under drought conditions, which is set out in detail in our Drought Management Plan. Our demand forecast considers population growth, changes in non-household demand and assessments of leakage. There is a degree of uncertainty in our estimates and therefore an allowance is made to mitigate this uncertainty, known as headroom. Consideration of all these components makes our baseline supply/demand balance as illustrated in Figure 2. We are forecasting future deficits in our supply area, i.e. demand is likely to be greater than supply in the future without action. We have therefore undertaken an options appraisal to identify solutions to ensure we balance our supply and demand over a 60 year period, up to 2080.

Our dWRMP19 sets out the Preferred Plan (**PP**) and Alternative Plan (**AP**) we have developed for our WRMP strategy plus other scenarios exploring options for change, upon which we will consult with customers and stakeholders. It explains the journey we have taken to reach this point and the methods and decisions behind our plan. We will incorporate feedback from the public consultation into our revised plan. The timeline for the WRMP19 process is presented in Figure 3.

Figure 3 illustrates the timeline we will work towards in regards to our WRMP19. The whole WRMP process will last over two years. We began developing our WRMP in 2016 and we undertook a pre-consultation between July and September 2017, which overlapped with our Drought Management Plan consultation. We intend to publish our dWRMP19 in March 2018 and undertake a public consultation for approximately 10 weeks. We will also consider the learning outcomes from our PR19 customer engagement programme. We will then submit our revised draft to the Secretary of State late summer 2018 with a view to publishing our final WRMP19 in early 2019.

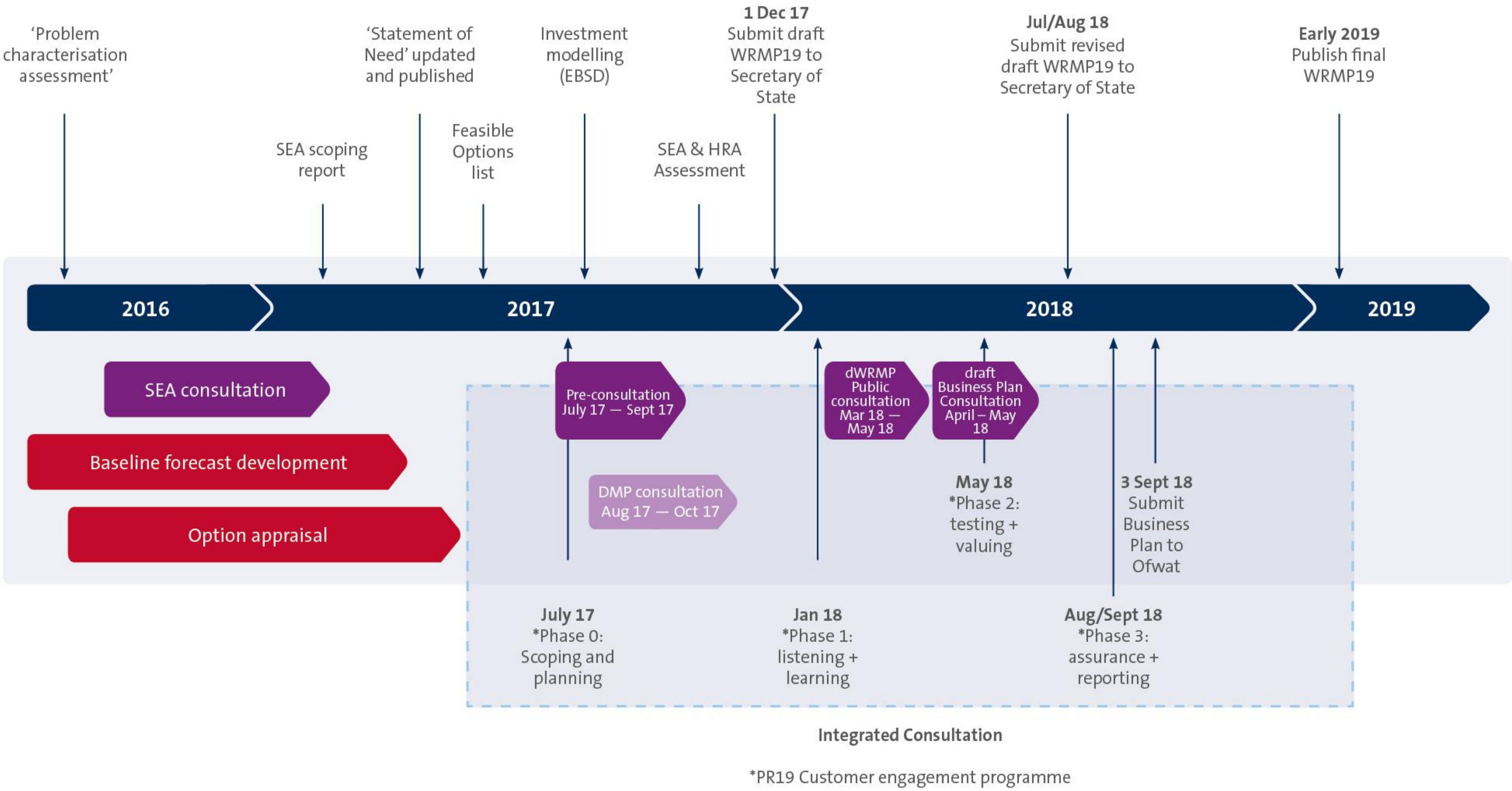

Figure 3: Timeline for the WRMP19 process

Figure 4 highlights the various work strands of our WRMP and their relationships with each other. This is how we set about preparing the plan.

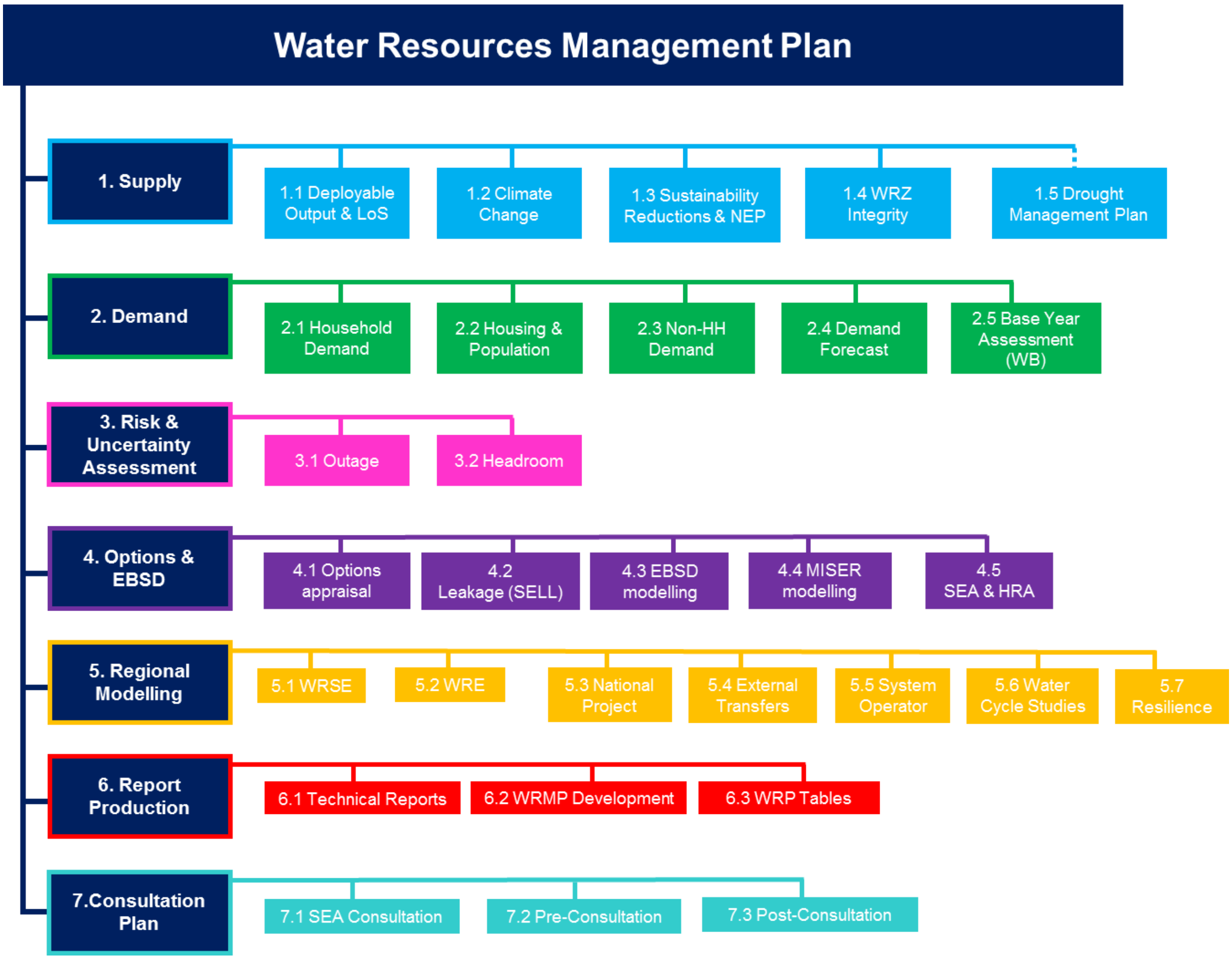

Figure 4: Work breakdown structure of our WRMP programme

Figure 4 shows how we organised our work programme to produce our dWRMP19.

Full results and conclusions from the detailed studies undertaken to produce this plan are compiled into separate Technical Reports as listed in Appendix D. The key details from each Technical Report are transposed into this dWRMP document and referenced accordingly. The Technical Reports will be available on request.

A brief description of each section of the report, along with its purpose, is presented in Table 1 below to aid the reader to navigate the document. This report is written to allow the reader to achieve a good level of appreciation of our plan even if time is short. The Executive Summary stands alone and allows the reader to assimilate the key points of our plan. Chapters 1 and 2 cover the key points of our plan and provide a greater level of detail and background than the Executive Summary alone. The complete document allows full appreciation of the background, context, methodology, outcomes, proposals and next steps.

Table 1: Structure of our dWRMP19 main report

Section	Chapter Number	Title	Purpose
Introduction	1	Introduction	Explains the need for a WRMP, the process, timeline and key themes.
Summary of our draft Plan	2	Summary of our draft plan for WRMP19	Presents a summary of key points in our **Preferred Plan (PP)** and **Alternative Plan (AP)**. We will **consult** on both our **PP** and **AP** in order to be guided as to the best course of action for the future by considering public and stakeholder opinion. Full discussion of our **PP** and **AP** is presented in Section 15 and 16.
Background and context	3	Affinity Water Supply Area	Description of our geographic supply area and the customers we serve.
	4	Affinity Water Policies	Introduction to our policies regarding **demand management** (**leakage, metering and water efficiency**) and **levels of service.**
	5	Engagement programme: pre-consultation phase	We describe the **pre-consultation** process and how this has influenced our dWRMP19 strategy. We will undertake a **public consultation** phase in March 2018 from which the feedback and results will be fundamental to our decision making in setting our final WRMP19 preferred strategy and in developing our Business Plan for PR19.
	6	Problem Characterisation	Description of our 'Problem Characterisation which states the context and **scale of the challenge** we face to maintain supply into the future.
	7	Resilience	Explanation of our approach to resilience.
Supply / Demand balance and components	8	Supply Forecast	This section provides as description of how much water we have available to **supply** customers per annum for a planning period of 60 years, including a calculation of **climate change** impacts on supply and **sustainability reduction** changes. It describes our approach to catchment management and discusses water quality.

Section	Chapter Number	Title	Purpose
	9	Demand Forecast	We present how much **demand** there will be for water per annum for a planning period of 60 years, involving calculations of **household demand** from **population growth, commercial demand** from industry and an estimation of future **leakage** rates.
	10	Risk and Uncertainty	We have allowed for **uncertainty** in our supply and demand calculations and forecasts. This is known as our **headroom**.
	11	Supply / Demand balance	We have compared supply with demand in our **supply/demand balance** which shows that without action being taken there would be less supply of water available than demand (a deficit) within our supply area.
Options and future planning	12	Future Options	We have identified **options** to **reduce demand** in the **short term** and **increase supply** in the **longer term** so that we achieve a secure supply of water for at least 60 years into the future. Our feasible options include schemes to **reduce leakage**, **install more customer meters** including **smart meters** and encourage **better use of water** with minimal wastage. We have also identified possible schemes to provide **additional water resources** from groundwater, surface water and transfers from neighbouring water companies and third parties within and in close proximity to our boundaries. Each of these options has been defined and priced in accordance with the methodology set out in the WRPG. For each option we have undertaken a **Strategic Environmental Assessment** (SEA) and, where necessary, a **Habitats Regulation Assessment** (HRA), in order to consider whether the option remains feasible should there be environmental concerns.
	13	Our Economic Modelling and Scenario Testing	We describe our approach to **balancing supply and demand** and exploring a wide range of scenarios using an enhanced stochastic approach. We present how our current and future operational system will be **resilient** to a range of droughts and non-drought hazards across the planning period.

Section	Chapter Number	Title	Purpose
	14	Regional Collaboration and Third Party Options	We explain our leading role in the **Water Resources in the Southeast** (WRSE) project, **Water Resources East** (WRE) and the **National Project**, working with the Environment Agency and five other water companies to assess strategic water supply opportunities across the region. These explore potential options and cross border supplies from all the water companies and has been a crucial component in the development of our plan.
	15	Our Draft Preferred Plan for dWRMP19	We present a discussion of our **PP** together with information on financial, environmental, social and carbon costs.
	16	Our Alternative Plan and Aspirational Scenarios	We present an **AP and aspirational scenarios** including up to the 1 in 200 year drought situation and various aspirational scenarios. We will **consult** on both our **PP** and **AP**.
	17	Public Consultation on our Draft Plan	Public consultation on our Draft Plan
	18	Next Steps	We describe the steps we will take after publication of our draft plan to prepare for our revised plan to be submitted to the Secretary of State in summer 2018.

1.6 Engagement with Regulators, Customers and Interested Parties

Our **engagement with customers and communities and stakeholders** is central to delivering our vision to become the leading community-focused water company. To support this vision, our ongoing engagement programme has been significantly expanded both in scale and scope and incorporates a range of methods and channels designed to reach as many customers, communities and stakeholders as possible.

We do not see engagement as an isolated activity but rather an essential part of our **core business**, delivered via a programme that drives day to day operations, strategic and business planning. Therefore we have implemented an integrated approach to our strategic Business Planning for Price Review (PR) 19, the Water Resources Management Plan, Drought Management Plan and Business Plan, building on the success of our PR14 customer consultation process.

Through this proactive engagement we aim to ensure that we deliver outcomes that customers value and support. Section 5 of this plan details the engagement activities, methods and results of this work to date to inform and influence our dWRMP19 and gives an overview of the next steps in terms of the public consultation planned for March 2018.

1.7 Legal Requirements

We are following the latest Water Resource Planning Guideline (WRPG) which was published by the Environment Agency, in collaboration with Ofwat and Defra, in April 2017. We have used the compliance checklist provided to develop and publish our draft Plan. Through following the WRPG and compliance checklist we are confident that our plan takes account of the following legislation, as set out in the WRPG:

- Water Industry Act 1991, in particular sections 37A – 37D
- Water Resources Management Plan Regulations 2007
- Water Resources Management Plan Direction 2012
- Strategic Environmental Assessment Directive (2001/42/EC)
- Habitats Directive (92/43/EEC)
- Wild Birds Directives (2009/147/EC)
- Water Framework Directive (WFD) (2000/60/EC)
- Water Resources Act 1991
- Environment Act 1995
- Eels (England and Wales) Regulations 2009
- Wildlife and Countryside Act 1981
- Countryside and Rights of Way Act 2000
- Natural Environment and Rural Communities Act 2006
- EU Regulation (1143/2014) on invasive alien (non-native) species (2015)

We have taken account of the advice given in the supplementary documents to the WRPG.

We have assessed the links between our dWRMP19 and River Basin Management Plans and Strategic Flood Risk Management Plans for our area. This is described more in Section 2.6. We have considered links to our Business Plan, our Drought Management Plan, the Environment Agency's Drought Plan and Local Authority plan, which are also described in detail in Section 2.6.

1.8 Drought Resilience

Our approach to drought resilience shows that the levels of service (or 'return period') we present in both our **PP** and **AP** for dWRMP19 are a significant improvement to fWRMP14. A drought 'return period' is an estimate of the likelihood of a drought occurring at any time. For instance, a 1 in 10 drought return period means there is a 10% chance or risk in any year of that severity of drought occurring.

Table 2 below describes the different drought return periods and probability of occurring in any year and what it means in reality for customers.

Table 2: Drought return periods and description of what it means

Drought return period	Description
1 in 10	**A drought of this severity has a 10% chance of occurring in any year.** At this level of drought severity, we would have implemented TUBs (formally known as hosepipe bans). These are primarily domestic restrictions and include activities such as using a hosepipe for watering gardens or washing cars. In practice, it is likely we will implement measures such as TUBs more frequently than 1 in 10 years, as we will need to act to implement precautionary measures in anticipation of those conditions occurring.
1 in 40	**A drought of this severity has a 2.5% chance of occurring in any year.** Prior to this level of drought severity occurring we would introduce ordinary drought orders (ODOs), which were formerly known as non-essential use bans. This is a temporary measure which would restrict 10 activities, including filling swimming pools or ponds, operating vehicle-washers and cleaning windows. These restrictions would have some commercial implications, such as for car washes if they do not fully recycle water. An ODO has only been implemented once before by Affinity (1991).
1 in 60/80	**A drought of this severity has a 1.7% chance of occurring in any year.** Under our **PP** we would to maintain TUBs and ODOs up to and including this level of drought severity. Once this level of drought severity is exceeded, we would seek drought permits/drought orders for additional abstraction if required. These conditions are equivalent to the worst historic drought experienced although we have never yet applied for drought orders or permits for additional abstraction. If these conditions do occur this means we would apply for permission to either abstract additional water from dormant groundwater sources (notably those where output has been reduced under the Restoring Sustainable Abstraction Programme) or reduce river support from some of our groundwater sources. The environmental impact of these actions can extend the amount of time it takes for rivers to recover after the drought has ended. Under our **AP** we plan to maintain TUBs and ODOs up to severity of approximately 1 in 200 years, without the need for drought permits/orders for additional abstraction or use of emergency drought orders for restrictions on essential use.
1 in 200	**A drought of this severity has a 0.5% chance of occurring in any year.** In this situation, under our **PP** we would maintain TUBs, ODOs restricting non-essential use and drought permits/drought orders for additional abstraction and may require emergency drought orders for restriction on essential use, as well as may need to use emergency drought orders for standpipes and rota cuts for short periods of time, in areas of significant water stress managed under our Drought Management and Emergency Plans. Our **AP** includes sufficient investment to allow us to continue water supply up to this level of drought severity by maintaining TUBs and ODOs only. We expect that at the 1 in 200 year drought severity, we may require the use of drought permits/orders for additional abstraction and emergency drought orders for restriction on essential use.

Both our **PP** and **AP** for dWRMP19 move to a more resilient position of 1 in 60/80 year for **PP** and 1 in 200 year drought event for **AP,** which in turn reduces the disruption to customers for particular drought severities. Further description of each of the drought management measures and comparison of our levels of service proposed in our **PP** and **AP** are described in Table 12 in Section 2.

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2 Our Preferred Plan and our Alternative Plan for dWRMP19

Summary

We present both a **Preferred Plan (PP)** which we believe is balanced and **best value**[1] for customers and the environment and an **Alternative Plan (AP)** which includes options for improved level of service under severe drought, greater leakage reduction and higher sustainability reductions.

Our **PP** and **AP** provide an envelope of possible future solutions, upon which we will consult with our stakeholders and customers in the public consultation phase, to ensure that our final plan represents best value to customers and the environment.

This chapter presents the key points of our **PP** and **AP**. Full discussion of our draft plans and aspirational scenarios is presented in Chapters 15 and 16. Details of the background, context, calculations and decisions involved in developing our plans are described in the main body of this report.

2.1 Approach to Developing our Plan

We have built our draft **PP** and **AP** by:

- undertaking **economic analysis**, to find the costs of alternative planning scenarios
- assessing the **risks and uncertainties** of selected options and checking that the objectives selected meet the objectives of our plan
- ensuring that the **PP** meets the **Strategic Environmental Assessment** (SEA) **objectives**

In developing our **PP** and **AP**, we have sought to:

- further **reduce household consumption** and **leakage** through a range of demand management options
- further **reduce abstraction** from existing sources where there is evidence it would deliver environmental benefit
- **share resources** with neighbouring companies and third party abstraction licence holders
- **promote resilience** by having a balanced programme of investment that does not rely on any one single option type.

We will consult on our **PP** and **AP** in the public consultation phase and take into account responses to our consultation on our dWRMP19 when deciding on our final WRMP19.

[1] Following guidance offered in the UKWIR Report Ref No 16/WR/02/10.

2.2 Our Preferred Plan (PP)

Our **PP** is balanced and **best value** for customers and the environment as it is a **feasible and deliverable** plan which moves us to a more resilient position in terms of security of supply as well as enhancing our environmental resilience. We have focused on building a 'resilience tested plan' with a range of measures to balance the risk in delivery and benefit. We consider the provision of flexibility and resilience to maintain security of supplies to customers is of paramount importance. Overall, we believe the additional social, environmental and economic benefits offered by our **PP** offers best value to customers, stakeholders and the environment.

We consider best value to mean, a plan that incorporates objectives other than least cost when both filtering down the potential options that could form the basis for the plan, and as part of the sensitivity analysis, where we have embedded a range of metrics within our EBSD extended methods approach (e.g. environmental, uncertainty, portfolio resilience).

A summary of the planning conditions of our **PP** are illustrated in Table 3.

Table 3: Our PP scenario

Scenario	Demand	Drought permits/orders for additional abstraction	Drought return period resilience included	Total investment costs 2020-2080 (£million NPV)
PP	Medium	Not-required until drought conditions worse than historic	Up to worst historic 1 in 60 / 1 in 80)	£1001

In the **PP** strategy we present the options we have explored to address and mitigate our foreseen future supply deficits to ensure we have sufficient supply of water to meet demand into the future to meet what we expect to be the level of future demand.

There are steps we will take to manage the amount of water that is used, for example further reducing leakage and installing new meters. These will help people reduce their water usage. During times of drought we will seek to temporarily restrict demand if necessary. We include a substantial level of water savings through our continuing water savings programme (WSP), metering and water efficiency activities plus further leakage reduction which we consider to be feasible and deliverable demand strategy for AMP7 and AMP8.

We will also take steps to ensure we have enough water to supply. In the short-medium term we will make best use of the resources we already have, exploring development of existing resources and opportunities for securing transfers of water from our neighbouring water companies and others. In the longer-term we will seek to secure additional reliable water by transferring water from a new regional reservoir in the Upper Thames catchment (by 2055 in our **PP**) promoted in partnership with Thames Water and other companies in the SE of England. We also make use of water from the existing BREN Reservoir.

We will reduce abstractions where there is evidence to show that the environment will benefit. These are known as sustainability reductions which in our **PP** includes 10 Ml/d.

An overview of our delivery strategy is shown in Figure 5.

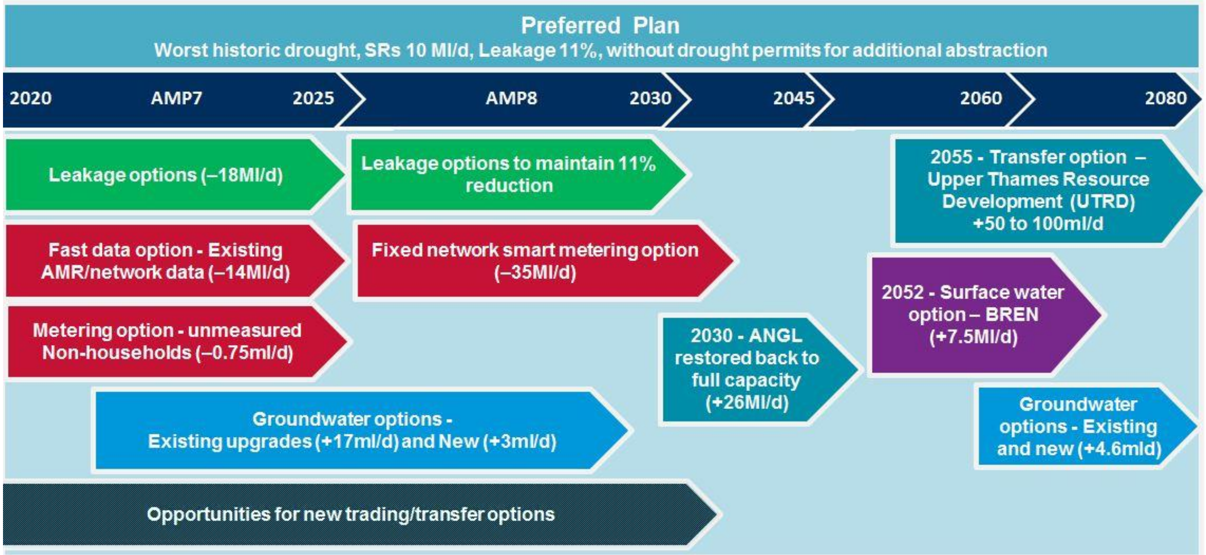

Figure 5: PP delivery strategy

In the immediate **five years** (2020-2025), our **PP** includes:

- a leakage reduction of **18 Ml/d** from a variety of leakage interventions
- savings of **14 Ml/d** from engaging with customers on their water usage (Fast Data Option) and from better use of our existing AMR meters and network data
- **0.75 Ml/d** lower consumption from metering unmeasured non-household properties
- an additional **17 Ml/d** of available supply by optimising existing groundwater abstractions and licences with minimal environmental effects
- an extra **3 Ml/d** from a new abstraction licence
- up to **12 Ml/d** of proposed new bulk imports
- **26 Ml/d** lower utilisation of our ANGL resource shared with Anglian Water until 2030
- an investment in a cost effective treatment solution to enable the use of water from ANGL in any of our zones at full capacity from 2030.

Our **PP** is our balanced and **best value plan** using a supply base calculated for our revised worst historic drought situation without drought permits or drought orders for additional abstraction being required. The benefits of the options can extend beyond the delivery programme timescales. We discuss the chosen options in further detail in Section 15.4.

We will be undertaking further work between our draft and final submissions to validate our assumptions to ensure our estimation of water savings for this draft plan is as accurate and realistic as possible, based on actual savings from our current programme.

Our ability to deliver this is based on calculations at WRZ level through EBSD modelling. Additional investment on top of this will also be required to ensure efficient movement of water within each WRZ (eight zones) at a finer hydraulic demand zone (HDZ) level (36 zones). It may take a number of years to ensure true resilience can be achieved at the HDZ level. Estimates of the HDZ level investment required have been undertaken for this draft plan but there is a need to refine these requirement and costs further for the final plan.

2.3 Demand for Water

Our **PP** assumes "medium" growth in demand for water. This is explained further in Chapter 9 of this report. In this "medium" scenario, demand is predicted to fall slightly in the period to 2030 and to increase in the long-term. We add headroom, which provides a margin to address uncertainties in our predictions. We have used the industry standard value of 95% for the headroom assessment at the start of our plan for AMP7. Our demand profile assumes savings of 18% of water through our Water Savings Programme and encouraging water efficiency. The graph presented in Figure 6 illustrates the balancing of supply and demand in our **PP**.

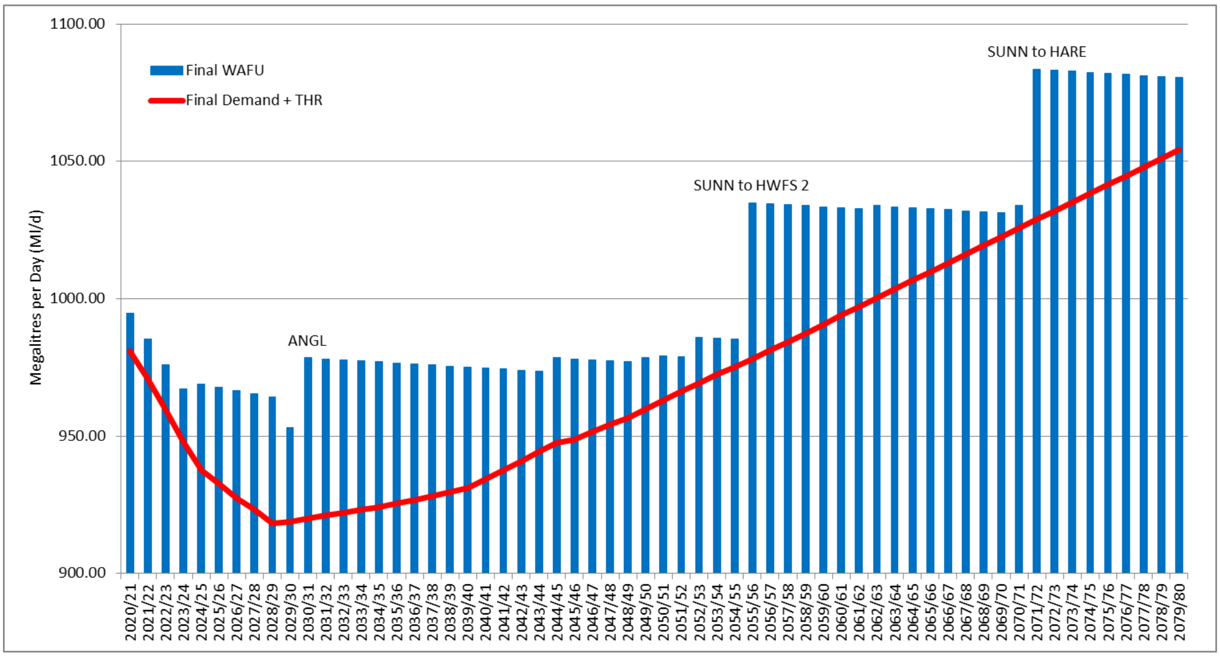

Figure 6: Final Supply / Demand balance for our PP

2.3.1 PP Leakage

In our **PP** we intend to reduce leakage by 11% in AMP7 and maintain that level in AMP8 beyond 2025. We believe this is an ambitious target that builds on our current delivery of 14% leakage reduction in AMP6 (2015-2020), which is the most demanding reduction target in the industry resulting in a level of leakage of 3.3 Ml/d below our economic level of leakage (ELL) of 166.02 Ml/d (excluding trunk mains leakage)[2].

As a company we are already operating below the ELL and our **PP** takes us even further below it. At the beginning of 2020, four WRZs out of eight will already operate below the ELL. By the end of AMP7 (2025), five WRZs out of eight will be below the ELL for our **PP**.

[2] The ELL excludes trunk mains leakage as trunk mains and service reservoir (TMSR) costs for detection & repair differ considerably to DMA cost-leakage relationships. Similarly the policies for managing leakage on TMSR assets also differ greatly from those for DMAs. For further explanation please refer to Technical Report 4.8.1.

2.3.2 PP Metering and Water efficiency

We will continue with our water saving programme which includes household level water efficiency support as well as implementing a new innovative demand management option called Fast Data Option at the outset of our **PP**. This makes use of existing AMR meters in combination with new fast logging and live network hydraulic models to provide customers with surrogate information about their water use. Metered customers will be able to get a much more detailed picture of their water consumption than they currently receive through their six monthly bills and we anticipate this will encourage greater water savings than our meter programme alone. We will also install meters for non-household premises that do not already have them.

In the longer term, from 2025 - 2035 as our existing meters reach the end of their asset life, we will roll out the fixed network smart metering option with the aim to have installed smart meters at all properties where possible by the end of the programme and anticipate benefits to extend to 2050. We believe these step changes in metering are the most economic way to meet our supply and demand balance in the immediate future. The savings we are expecting to see from our water saving programme have been embedded in the demand baseline and we have explored further options to continue reducing demand beyond the WSP.

2.3.3 PP Drought restrictions

Our **PP** assumes that a drought of severity in line with our worst historic, will occur once every 60 to 80 years on average, or in other words there is a 1.25% to 1.7% chance of a drought of this severity occurring in any year.

We intend to make appropriate use of temporary use bans and demand side drought orders which allow us to impose restrictions on water use in the event of a serious drought. We anticipate using temporary use bans on average once every 10 years and demand side drought orders for restrictions on non-essential use on average once every 40 years, as stated in our current Drought Management Plan.

Further descriptions of each of the drought management measures and comparison of our levels of service proposed in our **PP** and **AP** are presented in Table 12 in Section 2.11.

We predict that the use of temporary drought restrictions will result in an annual reduction in average demand of 3%, based on our experience during the 2007 drought and is explained in Technical Report 4.9: Economics of Balancing Supply and Demand Modelling.

2.4 Supply of Water for our Preferred Plan

This section describes the options chosen for our **PP** to increase supply capacity.

2.4.1 PP Optimisation of existing sources

Our **PP** includes options that will further optimise our existing groundwater abstractions and licences, where we are aiming to deliver an additional **17 Ml/d** of water supply between AMP7 and AMP8. This resource will comprise of a combination of schemes such as an option to amend and dis-aggregate a groundwater licence in WRZ2 (of 10Ml/d at ADO). There are also groundwater options to increase a licence rate in WRZ3 (by 3 Ml/d at ADO), and an upgrade at a source works in WRZ5 (to deliver a benefit of 2Ml/d at ADO). The remaining resource allocation is made up of a source optimisation scheme in WRZ2, and licence variations in WRZ7. These schemes are proposed at sites where there is no effect of abstraction on surface water such as greensand sources and confined aquifer locations.

We believe that making best use of our existing groundwater supply base is in the first instance the most cost effective and efficient way to balance deficits, alongside demand management measures. For us, they are most often selected because they are the near least cost. They also provide near term solutions that have smaller lead in times, and therefore are available earlier in the modelling.

2.4.2 PP Development of new sources

In our **PP** we also anticipate a gain of an extra **3 Ml/d** from a new abstraction licence in WRZ3. This option is to licence a new borehole in the Lower Greensand (LGS) aquifer within an existing site boundary to allow an increased abstraction at this site. It is dependent upon the outcome of AMP6 groundwater investigations and borehole testing at the same site, this scheme includes upgrades to existing non – infrastructure.

We believe the LGS aquifer, which is confined below the Chalk in parts of our supply area, offers a relatively feasible new source of water that, where proven to be confined, should not be at risk from causing future impacts on surface water flows. We recognise however that groundwater flows across our northern area could be better understood, and for this reason we have not proposed to include any further new abstractions in the Lower Greensand (until we are better placed to provide evidence for other future LGS abstraction locations with supporting hydrological risk assessments).

2.4.3 PP HWFS and ANGL treatment capacity

The new HWFS treatment option identified in our **PP** allows utilisation of the transfer option from the Upper Thames Resource Development (UTRD) from 2055 and offers additional resilience to the existing treatment works, which in the longer term is potentially a single point of failure. Expansion of the existing HWFS treatment works was not seen as the preferential option going forward, due to potential site constraints that meant the site expansion was not necessarily the ideal solution. Therefore, the options appraisal identified a potential new site within WRZ4 which will provide additional treatment capacity at HWFS of 50 Ml/d (DYAA / DYCP) linked to a new raw water import from the River Thames. The new HWFS option is coupled with the new raw water import from the River Thames (as a dependency in the modelling) and would therefore not form part of the WRMP solution unless it was linked to a new raw water transfer import. There is an additional need for treatment in WRZ1, but that is not required until post 2070 at HARE (and not at HWFS, which is in WRZ4).

Our **PP** shows that the ANGL import will be required at a capacity of 76 Ml/d (DYAA) from 2030 in order to meet the supply demand balance. In our **PP** dWRMP modelling we have therefore reduced the ANGL import to a rate of 50 Ml/d (DYAA) until 2030 as this is consistent with ongoing water quality constraints, which means we cannot deploy water from ANGL to some zones without treatment or a DWI undertaking. This modelling assumption allows for the resumption of the ANGL import at the end of AMP8. The delivery of the **PP** sustainability reduction is however reliant on the implementation of a treatment solution to allow ANGL import water into the zones currently supplied by chalk groundwater. We have therefore assumed that some form of the treatment solution will be required from 2024.

The specification for treatment of the import of water from ANGL is being considered as part of our business planning process, but an estimated total cost summary has been included in the cost table for our **PP**.

2.4.4 PP Transfers of water

In the longer-term our forecasts show that we will not be self-sufficient in terms of water resources and we will therefore collaborate with our neighbouring water companies to develop new resources. In the nearer term we will continue with existing arrangements. In addition to which we are exploring a number of other options to trade around these agreements more flexibly, with our neighbouring companies shown in Table 4. The dialogue with these companies will continue throughout the draft plan consultation period, around contractual matters and costs. It is our aim to have concluded these initial discussions with ‘in-principle agreements’ in time for our final plan submission.

Table 4 shows a list of opportunities that we are exploring. In addition we support the regional solution linked to UTRD, and are modelling linked imports into the Affinity Water supply area.

Table 4: New transfer opportunities

Water Company / Third Party	Proposal	Anticipated effects	Actions needed to realise transfer	Date for delivery
Anglian	To reduce our take to 50Ml/d for 10 months of the year, allowing 26Ml/d to be reversed and available to Anglian at the reservoir.	26 Ml/d for 10 months of the year	No infrastructure. Contractual and costs. Agree implementation with Anglian Water.	2020 until 2030
South East Water	Decrease existing transfer from EGHS to South East Water by 10 Ml/d (from 36 Ml/d to 26 Ml/d).	10 Ml/d Increase in available DO, enhancing Egham Works resilience and providing additional DO for WRZ6 and WRZ4. We have included continuations of our BARI and DEAI imports from SEW to WRZ7 post 2020.	No infrastructure. Contractual and costs. Agree implementation with South East Water.	2020 until 2030

Table 5 shows what we intend to do to increase water availability in the long-term.

Table 5: Longer term potential transfers

Proposal	Anticipated benefits	Description	Timescale
Upper Thames Resource Development (UTRD)	50-100 Ml/d	Raw water imports from the River Thames, treated by Affinity. Linked to regional infrastructure development on the Upper Thames	By 2039 in our **AP** and 2055 in our **PP**
BREN Reservoir	7.5 Ml/d	A third party option to abstract from an existing reservoir in WRZ4	2052

2.4.5 PP Drought permits and orders for additional abstraction

Drought permits and orders allow us to apply to the EA and the Secretary of State respectively to take additional water from the environment in the event of a drought. Our **PP** does not include any additional resource as a result of the use of drought permits and orders because as our Drought Management Plan consultation and WRMP pre-consultation with stakeholders suggests, customers would prefer us to minimise our effect on the environment in severe drought. We would only expect to use these as a short-term measure in the event of a drought that occurs on average once every 60 to 80 years and in accordance with our DMP.

We have recently consulted on our draft DMP, (see Section 5.4.1.3), which refers to use of these once every 40 years on average. We would intend to update this to ensure consistency between our **PP** and our DMP in the annual update of our DMP in February 2019. Our DMP consultation concluded that 61% of customers considered drought order frequency of 1 in 40 years were acceptable and 65% said we should not spend more to reduce the frequency of drought orders. The timing of our public consultation on our revised Drought Management Plan (DMP) and the underlying work for dWRMP19 has meant that by the time the return period of our new worst historic situation was estimated, the consultation on our DMP has already begun. In this we stated a level of service (LoS) for drought permits and drought orders for additional abstraction of no more than 1 in 40 years on average.

Our resilience to maintain this new level of service will depend on improving our network connectivity at the local scale, within each water resource zone as discussed in Section 15.3.6. We have considered the outcome from our DMP consultation that customers are satisfied without current drought plan level of service to set our **PP** such that drought orders for additional abstraction will be required in droughts only when they are worse than our worst historic. Further description of each of the drought management measures and comparison of our levels of service proposed in our **PP** and **AP** are described in Table 12 in Section 2.

If after consultation our final WRMP19 is not precisely consistent regarding level of service for drought permits and orders we will update our DMP as soon as there is an opportunity, to reflect decisions in our fWRMP19. This is likely to be at the first annual update of the DMP in February 2019.

2.4.6 PP Improving network connectivity

Our ability to deliver our **PP** is based on calculations at a water resource zone (WRZ) level to determine there is sufficient water to meet supply at this scale. Additional investment will be required to ensure sufficient and efficient movement of water within each WRZ at a finer scale. It may take a number of years post 2020 to ensure true resilience at this level can be achieved with the aim to eliminate the need for drought permits under our new worst historic drought. Estimates of the investment required have been undertaken for this draft plan but there is a need to refine these requirement and costs further for the final plan.

2.4.7 PP sustainability reductions

We intend to reduce our abstractions from our most environmentally sensitive sources by a further 10 Ml/d by the end of AMP7 (2025). This is lower than our forecasts at PR14. Further detail about this is provided in Chapter 8 of this report.

2.5 Our Alternative Plan (AP)

In addition to our **PP** we present an **AP** that is higher cost and greater risk as it offers solutions to a more challenging future and one that meets Government aspirations for improved resilience to severe drought to reduce leakage further.

Table 6: Our AP scenario

Scenario	Demand	Drought permits/orders for additional abstraction	Drought return period resilience included	Total investment costs 2020-2080 (£million NPV)
AP	Medium	Required in AMP7 only	Up to a severe drought (1 in 200)	£1,788.44

An overview of our alternative delivery strategy is shown in

Figure 7 below.

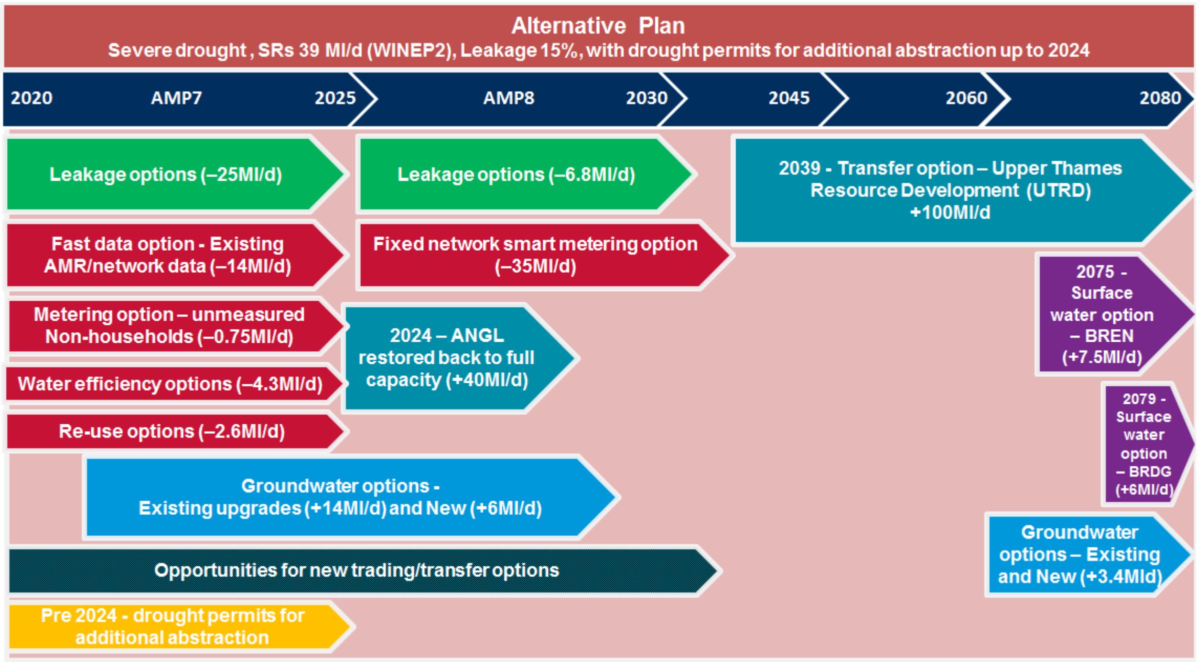

Figure 7: AP delivery strategy

Our **AP** shows some notable differences to our **PP** including:

- further demand management options with a leakage reduction of **25 Ml/d** by increasing the intensity and variety of leakage interventions
- **40 Ml/d** lower utilisation of our import from ANGL until 2024 taking a higher risk profile for climate change in the water available to potentially enable to supply deficits in the Anglian region
- avoidance of drought permits/orders for additional abstraction after 2024 for all drought severities up to a 1 in 200 year event. This will mean greater resilience of our supply and reduce the risk of disruption to customers should a severe drought occur
- increasing resilience through investment of a cost effective treatment solution to enable the use of water from ANGL in any zone at full capacity from 2024

- an earlier requirement for groundwater options and UTRD transfer option (2039).

Our modelling for the **AP** shows that very high levels of demand management options are needed in AMP7 along with the use of drought permits and orders for additional abstraction to have sufficient supply to meet demand under a severe drought. The risk of this approach is that this level of demand management over such a short timeframe may not be achievable. This is why we have not selected this level of demand management in our **PP**.

The investment cost for our **AP** (as shown in the Table 6) increases the total investment by £787 million at 2079 from that of our **PP**. These costs exclude the operating costs of existing sources and existing bulk imports and highlights the need for drought permits and orders for additional abstraction in the early years to provide the extra resilience necessary.

2.6 Demand for Water within our Alternative Plan

Our **AP** includes a final DI+THR of 924 Ml/d in 2045 and 1027 Ml/d in 2080 as depicted in Figure 8. As our **AP** depicts a more challenging future, the SUNN to HWFS2 option is triggered earlier in 2039 rather than 2055 in our **PP**.

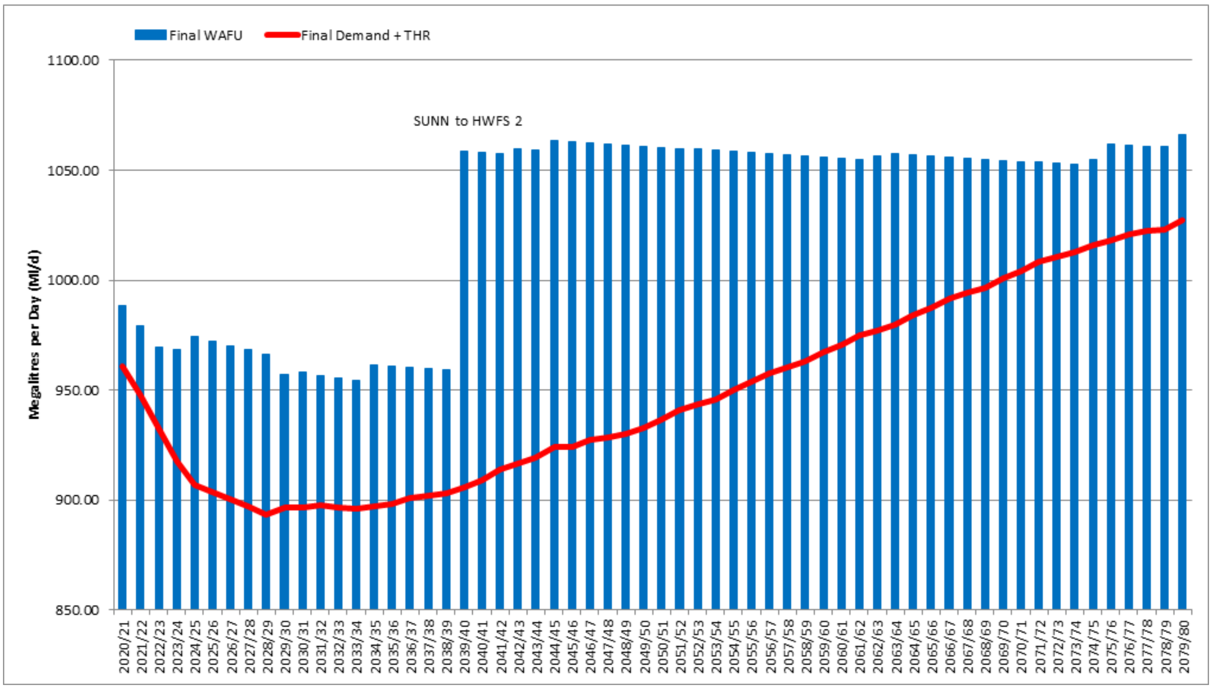

Figure 8: Supply / Demand balance for our AP

2.6.1 AP Leakage

In our **AP** we intend to reduce leakage by 15% in AMP7 (by 2025) and to then keep reducing leakage in subsequent AMPs reaching a 33% reduction by 2080. This is a further 7Ml/d leakage reduction compared to our **PP**. We will consult on this higher level of leakage reduction, seeking customers' views during our public consultation.

2.6.2 AP Metering and Water efficiency

As with our **PP**, we will continue with our water saving programme as well as implement a new innovative demand management option called 'fast data'. This makes use of existing AMR meters in combination with new fast logging and live network hydraulic models to provide customers with surrogate information about their water use. Metered customers will be able to get a much more detailed picture of their water consumption than they currently receive through their six monthly bills. We will also install meters for non-household premises that do not already have them.

Our **AP** further includes a variety of water efficiency options in AMP7, typically for large water users (non-households) which will have some uncertainty in being able to deliver these schemes due to retail separation.

In the longer term, from 2025 - 2035 we plan to roll out the fixed network smart metering option with the aim to have installed smart meters at all properties where possible by the end of the programme and anticipate benefits to extend to 2050. We believe these step changes in metering are the most economic way to meet our supply and demand balance in the immediate future. Metering and leakage are a core part of our demand management strategy and we will continue to explore further options and ways we can reduce demand.

2.6.3 AP Drought demand restrictions

Our **AP** provides solutions to a drought of 1 in 200 annual return period severity. We intend to make appropriate use of temporary use bans and drought orders which allow us to impose restrictions on water use in the event of a serious drought. We anticipate using temporary use bans on average once every 10 years and demand side drought orders on average once every 40 years, as stated in our current Drought Management Plan which provides further detail about our use of these measures.

We predict that the use of temporary drought restrictions will result in a reduction in demand of 3%. This is based on our experience during the 2007 drought and is explained in Technical Report 4.9: Economics of Balancing Supply and Demand Modelling.

2.7 Supply of Water for our Alternative Plan

2.7.1 AP Groundwater sources

Our **AP** selects more groundwater options and earlier (AMP7) than in our **PP**. It is also recognised that some of these groundwater schemes would require careful consideration with regard to the potential environmental impacts of implementing the option, such as option AFF-NGW-WRZ3-0548 (HART borehole replacement for PORT) which does not feature in our **PP**. Option AFF-NGW-WRZ1-1050 (Canal & River Trust - Cow Roast) would also require further attention as there remains some uncertainty over whether this scheme could be developed in the time available and we are also aware that there are planned abstraction reductions in this catchment.

The inclusion of these schemes results from the additional deficits driven by the more severe planning conditions (e.g. 1 in 200 year DO), in effect the risk is a trade – off with moving towards additional resilience, whereby eventually we would be resilient to a more severe drought in the future. In order to manage the risks around the inclusion of these options we propose to carry out further sensitivity modelling to explore whether the schemes could be delayed and what the alternative options are, however it is most likely that the modelling will show the need for additional demand measures and a further reliance on drought measures in the interim period, in order to allow us to deliver the necessary investment.

For further information on our environmental assessment of our **AP** and scenarios please see our SEA Environmental Report.

2.7.2 AP HWFS and ANGL treatment capacity

The new HWFS treatment option identified in our **AP** allows utilisation of the transfer option from the Upper Thames Resource Development (UTRD) from 2039 and offers additional resilience to the existing treatment works, which is potentially a single point of failure (as it does in the **PP**, but sooner in the **AP**). In the **AP** the new HWFS treatment option to provide additional treatment capacity is also upsized to 100 Ml/d and remains linked to new raw water imports from the River Thames (but does not import directly to WRZ1). The earlier timing and the need is presumably triggered by the more severe planning conditions in the **AP** and the additional sustainability reductions.

Our **AP** shows that the ANGL import will be required at full capacity of 90 Ml/d (DYAA) by 2024 in order to meet the supply demand balance. The resumption of the ANGL import to fuller capacity is sooner than required under our **PP** (2030). In our **AP** modelling we have also reduced the ANGL import to a rate of 50 Ml/d (DYAA) but only until 2024 when we are planning to have additional full capacity treatment capability in place to address current water quality constraints. This is being considered under our business planning process.

We have lobbied our regulators and Government extensively on the issue of metaldehyde and latest intelligence suggests that a targeted ban on metaldehyde may be introduced in some catchments. Should that be the case then we would expect to see a lessening of metaldehyde concentrations in water from ANGL over time and this would obviate the long term need for some of the treatment, but the corrosivity effects would still need to be addressed.

2.7.3 AP Transfers of water

In the longer-term our forecasts show that we will not be self-sufficient in terms of water resources and we will therefore collaborate with our neighbouring water companies to develop new resources. In the nearer term we will continue with existing arrangements.

In addition we support the regional solution linked to UTRD, and are modelling linked imports into our supply area. Table 7 shows what we intend to do to increase water availability in the long-term.

Table 7: Longer term potential transfers

Proposal	Anticipated benefits	Description	Timescale
Upper Thames Resource Development (UTRD)	100 Ml/d	Raw water imports from the River Thames, treated by Affinity. Linked to regional infrastructure development on the Upper Thames	2039
BREN Reservoir	7.5 Ml/d	A third party option to abstract from an existing reservoir in WRZ4	2075

Our **AP** meets a 1 in 200 return period drought. Due to the increased severity, the 100 Ml/d transfer to HWFS is selected earlier than in our **PP**. In addition our **AP** requires additional storage in the long term; hence one reservoir scheme is selected in the last year of our modelling (2079).

2.7.4 AP Drought permits and orders for additional abstraction

Supply-side drought permits and orders allow us to apply to the EA and the Secretary of State respectively to take additional water from the environment in the event of a drought. Our **AP** tests a scenario where, in the medium to long term we have sufficient other measures in place which does not require the need to use these supply side drought permits and orders under a severe drought. This will involve the introduction of additional water resource measures and an improvement of our network connectivity at the local scale, within each water resource zone as discussed in Section 16.3.6.

We have an aspiration to become sufficiently resilient to be able to withstand a severe drought without using supply-side drought permits and orders, but our modelling shows that this will need investment in infrastructure (mainly treatment at SUND) which will take some years to build and thus our **AP** includes using drought permits and orders for additional abstraction for the first four years.

2.7.5 AP Improving network connectivity

Our ability to deliver the **AP** is based on calculations at a water resource zone (WRZ) level to determine if there is sufficient water to meet supply at this scale. Additional investment will be required to ensure sufficient and efficient movement of water within each WRZ at a finer hydraulic demand zone (36 zones) level to ensure true resilience can be achieved. It may take a number of year's post 2020 to ensure true resilience at this level can be achieved with the aim to eliminate the need for drought permits and drought orders under our new worst historic drought. Estimates of the investment required have been undertaken for this draft plan but will be refined further for the final plan.

2.7.6 AP Sustainability reductions

Our **AP** includes sustainability reductions reflecting the WINEP2 'amber' sustainability changes. We will consult and be refining this element of our plan during consultation. Further details about these reductions are provided in Chapter 8 of this report.

2.8 Innovation in our dWRMP19

Our new innovative demand management option called Fast Data Option at the outset of our **PP** is described in Section 2.6.2. This makes use of our existing network data systems in combination with new fast logging and live network hydraulic models to provide customers with bespoke information about their water use. Customers will be able to get a much more detailed picture of their water consumption than they currently receive through their six monthly bills.

Continuing our innovative implementation of fast logging to better calculate the usage of customers through the night at DMA level. This in turn has provided a truer assessment of leakage to increase efficiency by accurately targeting areas where leaks are likely to be occurring. We continue to further trial new leakage methods from satellite images to using conductivity methods to find leaks.

Launching our new behaviour change programme called #TapChat through an independent company called Hubbub. The programme has been joined by other water companies and water wise programme which we aim to maintain and build on in AMP7. This complements water efficiency messaging such as our 'Keep Track of the Tap' campaign which was launched in June 2017 to communicate to customers that water resources were below average and to request that they reduced their water use by changing their behaviour. The #Tapchat campaign featured a news release, online website, quiz and social media promotion and resulted in significant increases of visits to our website and an increase in orders of water saving devices – peaking at an increase of orders close to 300% at the height of the door drop mailing. To date, #Tapchat has resulted in over 190 pieces of national coverage.

2.9 How our dWRMP19 Plan Compares to our Last Plan (fWRMP14)

In Table 8 we provide an indicative comparison between the baseline supply components for WRMP14 and dWRMP19 for DYAA. In Table 10 we compare our WRMP14 final planning demand components with our baseline WRMP19 demand components.

We have not attempted to provide an exact comparison between our modelled supply demand balance, so is not comparable with our baseline modelling which includes bulk transfers and other adjustments, but it does provide an indication of the difference in our starting position (e.g. 2020/21).

The following is a brief explanation of each of the components:

- The new worst historic DO effectively reduces our DO by approximately 42 Ml/d, which incorporated the AMP6 sustainability reductions (42Ml/d), whilst accounting for the exclusion of the AMP6 reductions and inclusion of ANGL (which is not included within the new ANGL allowance is 50Ml/d for dWRMP19 as oppose to 91 Ml/d in WRMP14, to account for the treatment constraint on its use. When including this and also accounting for the other components (e.g. outage, headroom, climate change and treatment losses) the overall difference in our supply base equates to approximately -40 Ml/d.

- In WRMP14 the adjustments through treatment process and metering differences were incorporated into our DO assessment, outage has only risen because of the change in the annual average period (offset by a reduction in peak outage) and climate change has remained similar.

- Our estimate of demand is forecasting a reduction of approximately -28Ml/d, this is due to a calculated saving from our Water Saving Programme (18%), and also results from our new peak factor assessment.

Overall, the comparison shows that our starting position is worse than we planned for at WRMP14 (i.e. with the new DO assessment for the worst historic drought), but that it is offset by what we are planning to save from our Water Saving Programme and what we forecast demand will be in the future.

Our assessment of the uncertainty relating to the savings from our Water Saving Programme means that our Headroom assessment has risen since WRMP14.

Table 8: Comparison of base year component values between WRMP14 and dWRMP19

Base year Components - DYAA	Unit	WRMP14 Baseline 2020/21	WRMP19 Baseline 2020/21 (first year of AMP7)	Difference
Supply forecast WAFU (DO minus Supply Components)	Ml/d	998	958	**-40**
DO	*Ml/d*	1184	1009	
Outage	*Ml/d*	44	72	
CC	*Ml/d*	10	9	
Water Treatment Works adjustments	*Ml/d*	N/A	19	
SRs (AMP6 and 7 cumulative)	*Ml/d*	42	N/A	
ANGL (DO)	*Ml/d*	91	50	

Table 9: Comparison of final planning demand between WRMP14 and dWRMP19

Base year Components - DYAA	Unit	WRMP14 Final Plan 2020/21	WRMP19 Baseline 2020/21 (first year of AMP7)	Difference
Demand forecast DI + HDR	Ml/d	1034	1005	-29
DI	*Ml/d*	954	911	
Leakage forecast	*Ml/d*	168	162	
Household demand	*Ml/d*	592	569	
Non-household demand	*Ml/d*	183	167	
Headroom	*Ml/d*	80	95	

2.10 Comparing our Preferred Plan and Alternative Plan

As mentioned at the start of this chapter we have taken the decision to present a **PP** which is best value for customers and the environment and an **AP** in our dWRMP19, which includes additional requirements to meet government and stakeholder aspirations, upon which we will consult with our stakeholders and customers.

In order to help articulate for our stakeholders and customers the way that our **PP** compares with our **AP**, we have included a visual representation that shows each of the plans against the key components that we test within our dWRMP19 (WAPCC, drought and drought measures, leakage and sustainability reductions), see Figure 9. We also provide a cost comparison of each plan in Table 10 and Table 11.

† Ml/d means millions of litres of water per day.

* PCC means Per Capita Consumption (how much water each person uses per day). l/p/d means litres per person per day.

Figure 9: Key options for PP and AP

Table 10: Cost of our Preferred Plan (PP) and Alternative Plan (AP)

Plan	AMP7 investment (£million NPV)	AMP8 investment (£million NPV)	Total investment at 2044 (£million NPV)	Total investment at 2079 (£million NPV)
PP	£228.04	£109.88	£475.03	£1,001.45
AP	£308.29	£160.99	£1,046.35	£1,788.44

Table 11: Cost difference between Preferred Plan and aspirational scenarios

Portfolio comparison	Cost difference (£million NPV)	Key change
PP to **AP**	£786.99	To move from a worst historic DO with 10 Ml/d of SRs to a 1 in 200 year DO with 39 Ml/d of SRs with supply side drought measures available in AMP7
PP to 110 l/h/d PCC	-£194.27*	To move from a PCC of 126 l/h/d to 110 l/h/d by 2045

*The very low costs of this scenario are due to avoided operational and investment costs. This option requires wider collective societal and regulatory action to enforce the use of high efficiency appliances and therefore a higher risk strategy. We will only be able to move forward with this option if we obtain commitment from Government, regulators and community partners through joint action.

2.11 Risk

During our draft plan consultation phase we will encourage all interested parties to explore how our **PP** compares to the **AP**, especially how cost and risk can be understood to be linked and how the trade-off between those factors and our ambition to continue to provide least environmental impact are at the centre of the decision making.

When we think of risk within this context and how it can affect our plans, we can think of it as the potential for us to either not meet our plan objectives, in terms of the deliverability of the plan, or conversely that we are not ambitious enough with our objectives and follow a strategy that readily meets our own expectations or those of our stakeholders and customers. Neither of these outcomes would be acceptable, so we aim to balance the risks associated with each of the plans and the key aspects that make up these risks.

There is also an inherent risk with selecting a strategy that is imbalanced in terms of diversity of supply and demand measures. For instance, a plan that is heavily reliant on demand side measures and customer lifestyle choices which may not materialise at a critical time could be considered high risk compared to one which utilises supply side measures also.

There is an inherent risk that if we implement a strategy to work with customers to drive down PCC from where it currently is to an aspirational target in the first ten years of the plan, we may fall short of that target, in the absence of social cohesion in that respect. Therefore, we propose to continue to reduce PCC towards that longer term target, whilst proposing what we believe is an ambitious reduction compared to where our PCC is currently. Similarly, for leakage we are currently planning an 11% reduction in leakage which is below our economic level but we recognise our regulators have asked us to consider a 15% target as included in our **AP**.

We have endeavoured to capture the risk dimension of our plans and option scenarios in Figure 9 which includes:

- **PCC Ambition** - We have assessed a range of modelling for NYAA WAPCC for different scenarios. The lower the WAPCC target the higher the risk to the plan. Our base line already assumes savings from our current WSP from 160 l/h/d to 126 l/h/d by 2045 in our **PP** and 120 l/h/d in our **AP** whilst also considering higher underlying rates of demand growth due to population increasing. Therefore the risk is greater with further levels of targeted WAPCC reduction.
- **Drought permits and orders for additional abstraction** - Risk to the supply/demand balance is greater when supply side drought measures are off as this means supply side capacity is not complimented by additional abstraction in severe drought conditions up to the historic drought severity of a 1 in 60 to 80 year return event.
- **Drought return period** is the severity of drought during which supplies can be maintained without recourse to emergency drought measures including rota cuts and standpipes. Thus if customers would like that level of drought protection this is a higher risk scenario to be accommodated by greater demand reductions or increased supply capacity.
- **Leakage** - A higher leakage target to be achieved by 2030 represents a higher risk as the challenge to reduce leakage is greater going beyond our economic level of leakage.
- **Sustainability Reductions (SRs)** - Increasing SRs also presents greater risk to resilience of supply as our resource base is reduced and means we may need to apply greater demand reduction measures or replace the lost resources with other supplies.

Taking account of the above issues we have considered the balance of risk versus cost in each plan. We are of the view that our **PP** offers an appropriate balance of risk, whilst maintaining our commitments to continue to reduce leakage, PCC and safeguarding the environment.

Chapter 17 futher discusses these range of options and how we are seeking our stakeholders and customers' views over our **PP** and **AP**.

2.12 Comparing our dWRMP19 Plans to Drought Resilience

Table 12 compares the levels of service proposed in our **PP** and **AP** with that of our previous plan (fWRMP14). A description of each of the drought management measures within Table 12 are presented below.

Temporary Use Bans:

Temporary Use Bans (TUBs) were formerly known as hosepipe bans. This measure would temporarily restrict the use of a hosepipe for 11 different activities. These restrictions include activities such as using a hosepipe for watering gardens or washing cars.

Ordinary Drought Orders:

Ordinary drought orders imposing non-essential use bans are a temporary measure which would restrict a greater range of activities than TUBs.

Drought permits/ orders for additional abstraction:

Under drought permits or drought orders we would apply for permission to either abstract additional water or reduce river support from some of our groundwater sources.

Emergency Drought Orders for restrictions on essential use:

Under the scope of emergency drought orders we can apply to the Secretary of State to place more extreme restrictions on customers, extending to some essential uses.

Emergency Drought Orders for rota cuts and standpipes:

We can also apply to use rota cuts or standpipes, which would severely restrict customers' water supply. Standpipes would be set up to supply customers with water from strategically placed points in communities. Note that this would only be implemented in particular areas of significant water stress.

Table 12: Summary of the current and two proposed future levels of service

Normal year	Extended periods of dry weather	Plan	Drought					
			Increasing drought severity →					
			1 in 10 years	Between 1 in 10 years to 1 in 40 years	1 in 40 years	1 in 60 to 80	Between 1 in 60/80 years to 1 in 200 years	1 in 200 years
No likelihood of restrictions	Monitor groundwater levels. Raise awareness and appeal for voluntary usage reductions as situation worsens.	Final plan WRMP14	Introduce Temporary Use Bans (TUBs)	Introduce Ordinary Drought Orders (ODOs) for non-essential use	Maintain: • TUBs • ODOs	Maintain: • TUBs, • ODOs Introduce: • Drought permits/orders for additional abstraction • Emergency Drought Orders for restrictions on essential use	Maintain: • TUBs • ODOs • Drought permits/ orders for additional abstraction • Emergency Drought Orders for restrictions on essential use	Potential for use of Emergency Drought Orders for standpipes and rota cuts in areas of significant water stress
		Preferred plan dWRMP19	Introduce Temporary Use Bans (TUBs)	Maintain: • TUBs	Introduce Ordinary Drought Orders (ODOs) for non-essential use	Maintain: • TUBs • ODOs	Maintain: • TUBs • ODOs Introduce: • Drought permits/orders for additional abstraction • Emergency Drought Orders for restrictions on essential use	Potential for use of Emergency Drought Orders for standpipes and rota cuts in areas of significant water stress
		Alternative plan dWRMP19	Introduce Temporary Use Bans (TUBs)	Maintain: • TUBs	Introduce Ordinary Drought Orders (ODOs) for non-essential use	Maintain: • TUBs • ODOs	Maintain: • TUBs • ODOs	Maintain: • TUBs • ODOs Introduce: • Drought permits/orders for additional abstraction • Emergency Drought Orders for restrictions on essential use

N/B: As stated in our Drought Management Plan we consider the use of emergency drought orders for rota cuts and standpipes to be unacceptable. We consider that standpipes would only ever be deployed as a last resort in the event of a civil emergency and more than likely at a very local level for a short period of time to deal with a significant threat. In an event that the drought was to reach a level of severity requiring this action we would enact our Emergency Plan and restrictions would likely only need to be implemented in particular areas of significant water stress.

The planning condition for our **PP** in dWRMP19 uses a 'worst historic' deployable output (DO) which is equivalent to a 1 in 60/80 year drought severity. Whereas our **AP** is even more ambitious and uses DO's in our baseline planning conditions that are even more severe, equivalent to a 1 in 200 year drought event. The difference in the starting position of our 'worst historic' PP (1 in 60/80) and our 'severe' AP (1 in 200) DO's is a reduction of 41 Ml/d. This means our AP must solve a more severe supply-demand balance situation.

Table 12 shows that the levels of service we present in our dWRMP are an improvement on our fWRMP14. Both our PP and AP for dWRMP19 have the same level of service for TUBs as our fWRMP14 stated as 1 in 10 years on average, or a 10% chance every year of TUBs being required. From then on both our PP and our AP in our dWRMP19 put forward a more resilient position. This is shown in Table 12 through the fact ordinary drought orders for non-essential use are not required in our PP until a drought severity of 1 in 40 years in reached, whilst in fWRMP14 these would have been required earlier. The same applies to the introduction of drought permits and orders for additional abstraction. In fWRMP14 these were required in a 1 in 75 year drought event, whilst in our PP for dWRMP19 these would not be required until drought severity is greater than 1 in 80 years and in our AP for dWRMP19 would not be required until the 1 in 200 year drought event.

2.13 Links to Other Plans

2.13.1 Our Business Plan

Throughout the development of our dWRMP19 we have maintained effective communication and liaison with those responsible for undertaking our business planning for PR19. Regular meetings have taken place to ensure the future investment requirements forecast from the dWRMP19 process are captured within the Business Planning process. Outcomes from the process will either be a continuation from the AMP6 programme or have strong regulatory, statutory or business critical drivers. Our Business Plan will be built on the solid foundations of our WRMP meaning that the implementation of solutions required in our final WRMP will be taken into account in preparing our next regulatory Business Plan. Figure 10 shows the main components of our Business Plan for PR19.

Figure 10: Main components of our PR19 Business Plan

Our WRMP outputs are linked to a number of work packages in the business plan including strong links with customer engagement programme (e.g. long terms issues such as resilience) and attitudes towards the selection of regional solutions.

The Water Industry Strategic Environmental Requirements (WISER) document, provides steer from Natural England and the Environment Agency on strategic priorities for the next Price Review. It describes the environmental, resilience and flood risk expectations for Water Company business plans. Appendix B shows the expectations in the WISER document relating to our WRMP and how we already meet or plan to meet these objectives.

2.13.2 Our Drought Management Plan

Our draft Drought Management Plan (DMP) provides a full update to our last DMP. The final plan will be published in February 2018 following approval of our revised draft submitted in December 2017. This plan covers all eight of our Water Resource Zones (WRZs) across our three regions ensuring a consistent approach to drought management is taken throughout the business and providing clarity to customers and stakeholders about the actions we would take to manage a drought. In updating our DMP we have worked closely with the Environment Agency regarding the scenarios modelling work which has been carried out, and provided them with the opportunity to comment.

Our DMP is built on our experience of managing a range of droughts over the last 20 years, in particular the multiple year groundwater droughts of 1990 to 1992, 1996 to 1998 and 2005 to 2007, as well as 2011 to 2012. We have a pro-active approach to managing drought and our objective is to provide secure, resilient, high quality public water supplies at all times.

Our DMP details the operational process that will be used to manage drought events. Our Drought Management Group (DMG) is responsible for implementing actions to ensure public water supply is maintained through the drought. Our DMP links with the WRMP, which addresses investment issues relating to drought.

Our DMP defines individual roles and responsibilities within Affinity Water during a drought and the required levels of interaction/liaison with third parties, in particular the Environment Agency. It contains details of our environmental monitoring and communication plans and the actions that would be initiated under this Plan in response to breaching the drought triggers. Finally, our Plan provides an outline of how the company will identify the end of a drought and describes the associated actions required at this point.

Our resilience to maintain our supply demand balance over a range of different drought return periods have been analysed and presented. Our modelling within WRMP has been used to understand the investment costs with or without drought plan measures permits and orders, in place. This is discussed more in Section 13.

Since publication of our DMP for consultation, our worst historic drought has been re-estimated to have between a 1 in 60 to 1 in 80 return period, please refer to section 8 for further detail. In our DMP we proposed and consulted on a level of service (LoS) for use of drought permits and orders as a 1 in 40 year return period. Therefore, to be consistent with our DMP, drought measures would be used under the worst historic drought scenario. However, we recognise the benefits of becoming more resilient to droughts and so have tested scenarios at the worst historic and 1 in 200 year return period events with and without drought permits and orders in place to identify the investment required to improve resilience in this area, and we are consulting customers n their preferences in this plan. The dWRMP19 envelope of scenarios includes scenarios consistent with our DMP. We will update our DMP to reflect decisions in our fWRMP19 which is likely to be at the first annual update in February 2019. Our dWRMP19 includes investment requirements for our DMP.

2.13.3 Environment Agency Drought Plan

Where our WRMP links to our DMP, this in turn links to the EA drought planning process. We work closely with the EA in the development of our DMP, and this ensures consistency between actions identified within the respective plans. One of the key areas of alignment is in the need for communication in the lead up to and during a drought event. We aim to maintain a regular dialogue with the EA and other stakeholders to ensure a close working relationship and effective management of a developing drought event.

In addition to communication with the EA, we also recognise the importance of consistency of external messaging. For example, in accordance with Defra's direction to the EA not to use the word 'drought' until a drought situation has been agreed, we ensure that all our publicity and communications to customers uses consistent terminology with the EA, alerting customers to 'prolonged dry weather'. This enables a clear message to the public.

The processes for applying for drought permits and orders are aligned with EA procedures, to ensure applications are dealt with as smoothly as possible.

2.13.4 Flood Risk Management Plans

Within the WRMP process, a Strategic Environmental Assessment (SEA) is carried out to provide a high level assessment of the potential environmental impacts of options and to contribute to the integration of environmental considerations in the preparation of our plan. The SEA is comprised of 14 objectives against which our options are screened. One of these objectives looks specifically at flooding and if options will lead to the loss of floodplain and / or potentially increase rates of surface water run-off. In addition to this level of assessment in-bedded within our process, the EA is running a programme to assess the potential increase in flood risk from our reductions in abstraction.

2.13.5 River Basin Management Plans

We are required by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 to have regard to the River Basin Management Plan when exercising our functions, in this case producing our dWRMP19. The purpose of a River Basin Management Plan (RBMP) is to provide a framework for protecting and enhancing the benefits provided by the water environment. RBMPs are published by the EA, and the last publications were in 2015.

The last RBMPs presented the ideal opportunity for consultation on our last Plan. Our confirmed sustainability reductions in AMP6 set out in our last Plan (fWRMP14) were consulted on both with stakeholder and the public. Consultees shared their views and over 71% of respondents were willing for bills to rise to enable the proposed sustainability reductions to be achieved.

We have strongly supported the development of the current RBMPs, published in 2015. Our supply area covers three river basin districts (RBD); the Thames, South East and Anglian RBD. The **environmental objectives** of WFD are to:

- **prevent deterioration** of the status of surface waters and groundwater
- achieve **objectives and standards** for protected areas
- aim to achieve **good status** for all water bodies or, for heavily modified water bodies and artificial water bodies, **good ecological potential** and **good surface water chemical status**.

We have regard to these objectives when making decisions that could affect the quality of the water environment. In particular, our dWRMP19 recognises that:

- the objective of no deterioration requires that new or modified abstractions should not adversely affect the status of a water body
- the aim of achieving good status should not be inhibited by existing abstractions.

The objectives of these three RBMPs have been reviewed in conjunction with our dWRMP19 options and proposed sustainability reduction strategy for AMP7. In combination with the abstraction reductions, we are also delivering in partnership with the EA and other catchment partners, an extensive programme of morphological mitigation (river restoration and habitat enhancement works). We consider that the morphological works will help improve natural resilience of the Chalk streams within our supply area and contribute significantly to WFD objectives. We are monitoring the effectiveness of these works through our NEP monitoring programme. There are also strong links with our Catchment Management Programme. Further details on this work are included in Technical Report 1.3 AMP6 NEP Progress and AMP7 WINEP.

2.13.6 Local Authority Plans

Our supply area is expected to witness significant population growth in the future as a result of forthcoming housing developments. We have estimated that our population is forecast to increase in the order of 8% by 2025, 20% by 2045 and 38% by 2080 (equivalent to approximately 1.4 million more people in our supply area). As a result, we have undertaken work to forecast the total water demand in our supply area over our chosen planning period, in order to assess whether an imbalance exists between supply and demand.

In order to do this, we commissioned Experian to produce housing and population forecasts for our supply area and as a result decided to use plan-based forecasts, which are based on dwelling targets published within Local Plans published by our Local Authorities. Experian contacted each Local Authority within our supply area to obtain the latest available information on dwelling numbers and local plans, and had a total response rate of 76.9% across our three supply regions. Plan-based population projections were not collected, as local authorities appear to have adopted different assumptions and inconsistent methodologies. Therefore the analysis by Experian dealt with dwelling targets set at local authority district level only. For this reason, plan-based dwelling forecasts were not able to be allocated to specific census output areas to determine where growth hotspots may be. However, we are currently undertaking a further study to determine growth at a much more granular geographical level, looking at the actual spatial distribution of future housing developments as set out in the housing site allocations within all of our Local Authorities' Local Plans. This analysis also includes assessing the planned phasing of the bigger developments, so that we have a good understanding of when new large scale developments are expected to need a connection to our network.

To ensure we are working with the most up to date projections we are also analysing all of our Local Authorities' latest housing targets following the initial data gathering by Experian in winter 2016. This is especially important following indication from central government in autumn 2017 that Local Authorities will now need to use an updated methodology to calculate housing need within their local boundary. We recognise this is likely to increase the amount of housing each Local Authority will propose within their Local Plans, and so our previously collected data may need adjusting.

The outcomes of this work will not be available to feed into our draft WRMP19 due to timing but will be fully considered within our final WRMP19. It will provide a more detailed evidence base for our local growth projections through using the best available data, which will help validate our WRMP19 demand forecasts and decrease the uncertainty associated with our housing and population forecasts in our supply area. Meanwhile we have included an allowance for increased growth in our headroom analysis.

2.13.7 Assurance

We conducted a **third party audit** and **assurance of our methods, data, modelling** and **interpretation** in October 2017. Only five areas were identified for improvement for our final plan and these will be addressed alongside any feedback from stakeholders as a result of the consultation on our dWRMP. Our Board has monitored the development of our water resources strategy and has approved this dWRMP19. The process undertaken is illustrated in Figure 11.

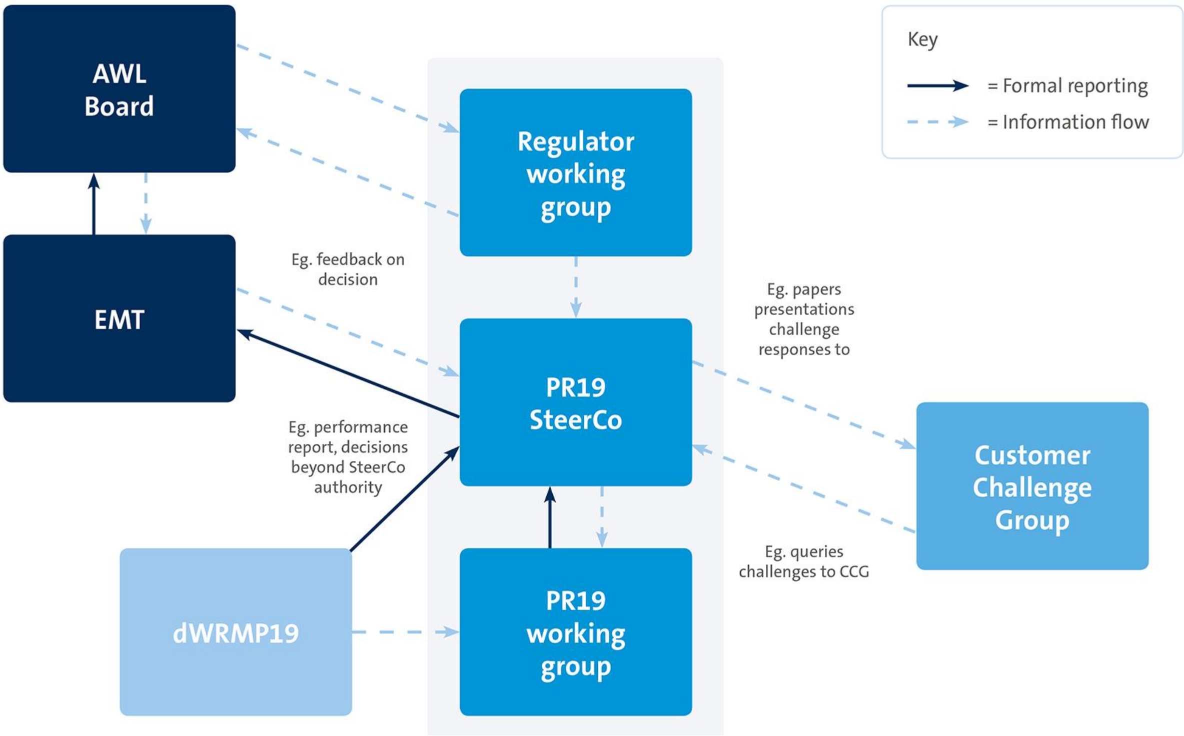

Figure 11: Assurance process

2.14 Delivering Our Plan

We will publish our dWRMP19 in March 2018 and will seek feedback during our public consultation in both our **PP** and **AP,** which outline solutions to meet a 60 year planning horizon. Our final revised WRMP19 plan will be published post consultation and approved by the Secretary of State.

The remainder of this report sets out the process behind developing our draft plan for WRMP19, the methods used, the decisions taken and the context in which the work was undertaken. Towards the end of the report we describe the next steps we will take to develop our revised plan to be submitted in summer 2018.

3 Affinity Water Supply Area

Summary

This section provides a description of our geographic water supply area and the customers we serve. It provides information about the water resources available and population in each of our water supply regions.

We have three distinct supply regions, Central, Southeast and East. Our Central Region has six water resource zones (WRZs) which includes the Misbourne, Colne, Lee, Pinn, Stort and Wey Communities. Our East and Southeast regions represent one WRZ each (Brett and Dour communities respectively), resulting in a total of eight WRZs across the company area. There are differences in the baseline water resource situation and the water usage of customers in each of the three regions, described in Section 3.2.

Our supply area is situated across a number of globally rare Chalk streams and we abstract approximately 65% of water from groundwater sources and the remainder is from surface water. We have 130 groundwater sources, four river intakes on the River Thames, one impounding reservoir and a number of bulk supply imports from neighbouring water companies. We also provide bulk supply exports to other water companies.

At the start of the next planning period (2020), we forecast to have a supply deficit in three of our eight WRZs. This rises to deficits in four of our eight WRZs by 2045.

3.1 Our Supply Regions

Our supply area comprises three distinct geographic regions, as shown in Figure 12.

- ***Central*** provides water to parts of Bedfordshire, Berkshire, Buckinghamshire, Essex, Hertfordshire, Surrey, the London Boroughs of Harrow and Hillingdon and parts of the London Boroughs of Barnet, Brent, Ealing and Enfield, with a population of 3.3 million people.
- ***Southeast*** provides water to the towns of Folkestone and Dover, together with surrounding rural areas including Romney Marsh and Dungeness, with a population of 170,000 people.
- ***East*** provides water to the Tendering peninsula, north east Essex including the towns of Harwich and Clacton on Sea, with a population of 158,000 people.

Figure 12: Affinity Water supply areas

For water resource planning purposes, we are required to identify the largest possible zone in which all resources, including external transfers, can be shared, and, hence the zone in which all customers will experience the same risk of supply failure from a resource shortfall. For our Central Region, we have six water resource zones (WRZs) whilst our East and Southeast regions represent one WRZ each, resulting in a total of eight WRZs across the company area. Each WRZ represents one of the communities we serve and has been named after the major river serving the zone to reflect our vision to be the UK's leading community-focused water company. We refer to these when sharing information with members of the communities and other stakeholder:

- Affinity WRZ 1 (Central) is also known as the Misbourne.
- Affinity WRZ 2 (Central) is also known as the Colne.
- Affinity WRZ 3 (Central) is also known as the Lee.
- Affinity WRZ 4 (Central) is also known as the Pinn.
- Affinity WRZ 5 (Central) is also known as the Stort.
- Affinity WRZ 6 (Central) is also known as the Wey.
- Affinity WRZ 7 (Southeast) is also known as the Dour.
- Affinity WRZ 8 (East) is also known as the Brett.

Figure 13 gives the WRZ boundaries and labels.

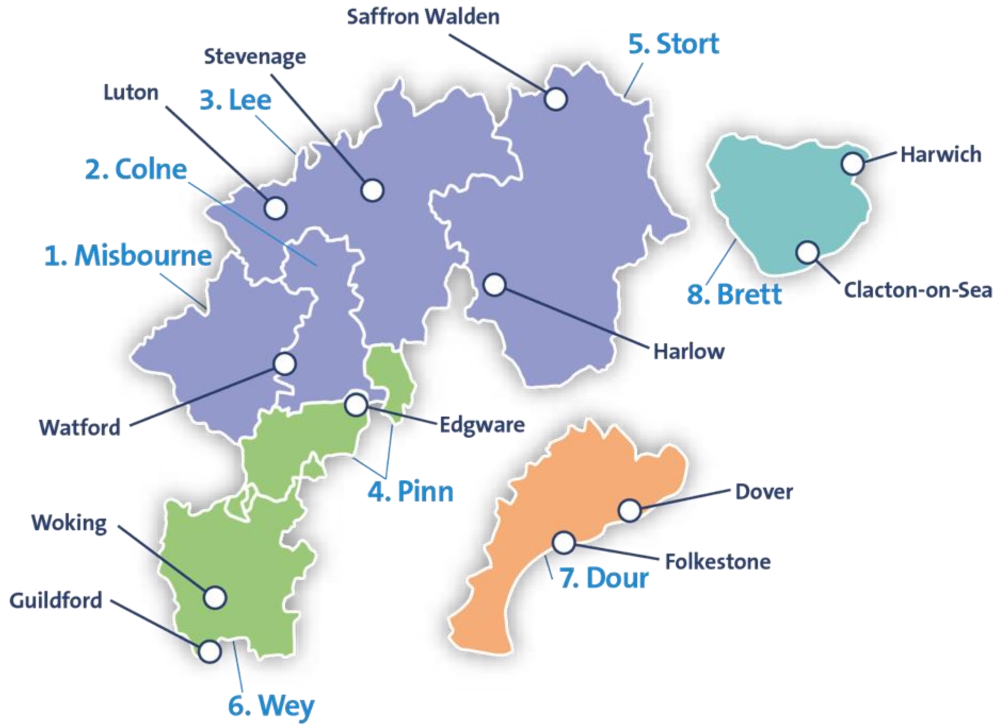

Figure 13: Map of the Affinity Water Operating Area and Water Resource Zones 1 – 8

We manage our water resources efficiently to maintain a continuous supply of high quality water to meet the demands of customers, while ensuring the sustainability of our resources and minimising any impact on the environment. There are differences in the baseline water resource situation and the water usage of customers in each of the three regions, and to some extent within the WRZs of our Central Region.

3.2 Water Resources

3.2.1 General

We have 130 groundwater sources, four river intakes on the River Thames, one impounding reservoir, shared resources and major imports from Anglian Water (ANGL) and TARD, and a number of other bulk supply imports from neighbouring water companies. We also provide bulk supply exports to other water companies, notably South East Water. These are described in detail in Chapter 4.

Approximately 65% of the water we abstract is from groundwater sources and the remainder is from surface water. Groundwater is the predominant source of water in all three of our supply regions. It is variable in character, ranging from high quality sources requiring little treatment other than disinfection to sources in karstic areas where groundwater is influenced by surface water, requiring more treatment. Overall, groundwater is of higher quality and more local to the point of consumption so has a lower cost than surface water. Generally, groundwater is used in preference to surface water and bulk imports, and, on average, our abstraction and utilisation of our groundwater sources is higher than our surface water utilisation during non-critical periods.

Despite groundwater being our primary source of water, both our Central and East regions utilise surface water sources to meet customers demand. Water abstracted from surface water sources generally requires more treatment than groundwater sources and often requires pumping over greater distances from the point of abstraction to the point of supply.

The majority of our surface water is taken via our intakes on the River Thames in our Central region. Our surface water source in our East region is a resource that we share with Anglian Water, with the arrangement that we take an equal share. In view of the continuing surplus in our East region, we sell our unused capacity to Anglian Water so we have a 30% share of the total.

We are required to update our assessments of the amount of water we can abstract from our sources following any significant changes in our sources or supply system. As part of the work for this WRMP, we have fully reviewed and, where necessary, updated our assessments of the yield of our groundwater sources, which is described in detail in Chapter 8. This methodology is focused on determining deployable outputs for groundwater sources under drought conditions only.

At the start of the next planning period (2020), we will have a supply deficit in three of our eight WRZs. This rises to deficits in four of our eight WRZs by 2045. The following sections identify the key differences in the baseline water resource position for each of our operating regions. They include diagrams identifying our major water sources and trunk mains as well as providing a representation of the transfers between our WRZs and Hydraulic Demand Zones (HDZs), smaller supply zones within each WRZ. The key to our HDZs is not publicly available for security reasons. They also identify the connections we have with our neighbouring water companies which are explained in detail in section 8.4. As a result, customers benefit from a highly integrated and resilient network.

3.2.2 Central region water resource position

In our Central Region we abstract 60% of water supply from groundwater sources. The remaining 40% is abstracted from surface water sources or is imported from neighbouring water companies. We also export water to neighbouring water companies, and in particular South East Water, as seen in Figure 14 and Section 8.4.

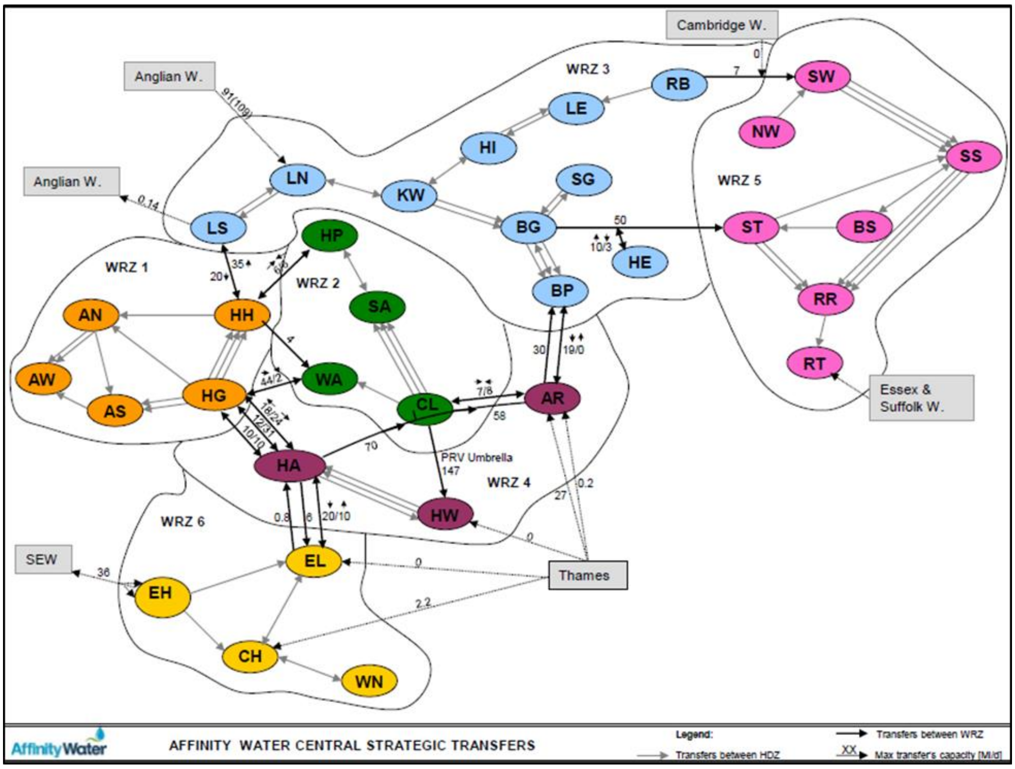

Figure 14: Map of the Water Resource Zones, connectivity and transfers in our Central region

We abstract surface water from the River Thames, which is treated at our four river water treatment works; HWFS, EGHS, CHERS and WALS. The treatment works are also fed by groundwater wells, principally the gravel wells at CHERS. When combined, these are capable of providing sufficient quantities of raw water following prolonged dry spells, such as the dry period encountered during the long hot summers of 1995 and 2003 which represent our historic high demand years. We import 10% of our water from Anglian Water from ANGL which is a shared cost surface derived resource under the Great Ouse Water Act.

3.2.3 Southeast region water resource position

In our Southeast region we abstract 90% of water supply from Chalk boreholes, with the remaining 10% supplied from the shallow gravel aquifer of the Dungeness peninsula. We continue to hold licences for small abstraction from a number of greensand sources in the Folkestone area, although these have not been used for water supply for some years. The connections between HDZs and bulk imports from Southern Water and Southeast Water can be seen in Figure 15.

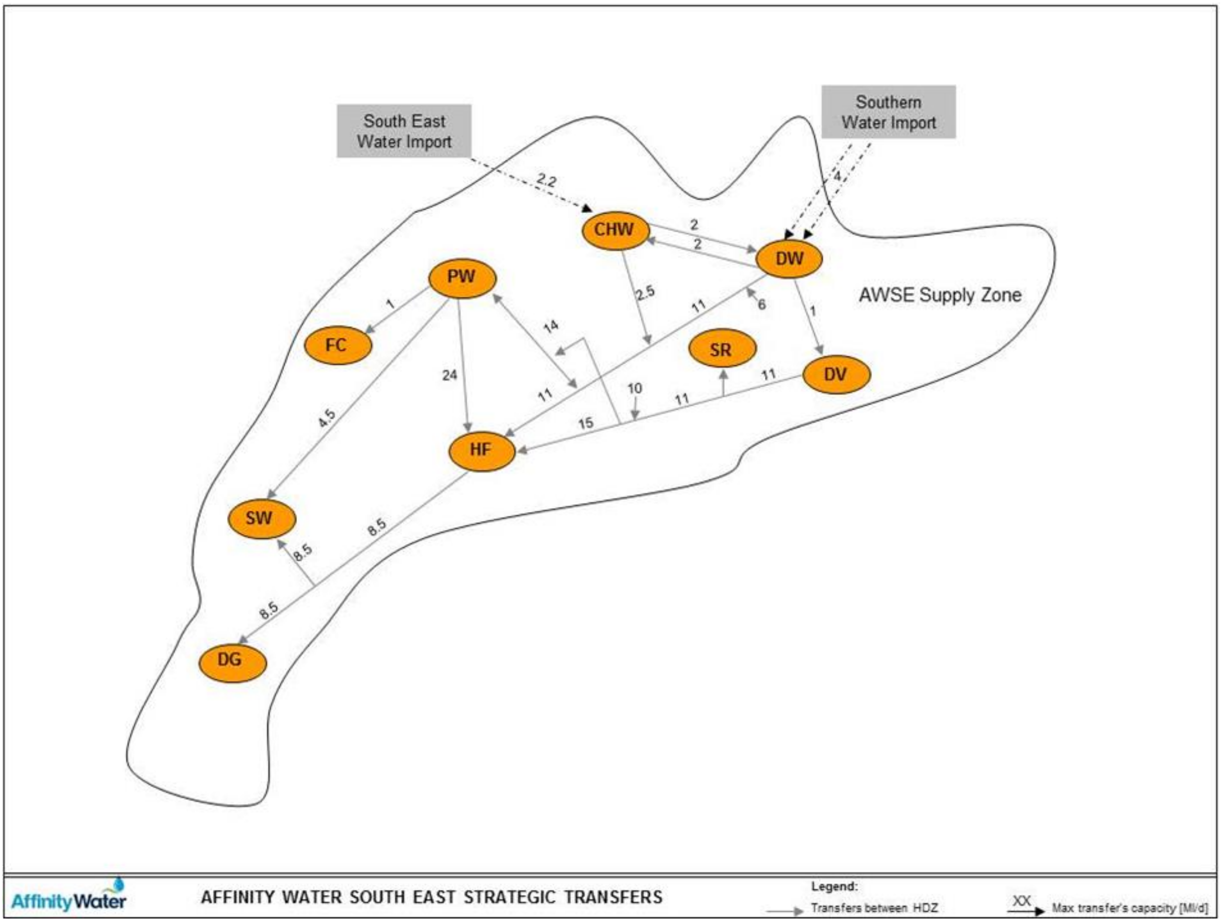

Figure 15: Map of the Water Resource Zone, connectivity and transfers in our Southeast region

There are no significant rivers in this region and therefore no surface water abstractions or surface water storage are available. Locally, the River Dour is subject to a Restoring Sustainable Abstraction scheme, which limits abstraction from a number of our groundwater sources at times of low flow.

3.2.4 East region water resource position

In our East region, 80% of supply comes from groundwater, drawn from confined Chalk aquifer boreholes in the River Stour and River Brett valleys in Essex and Suffolk. The boreholes have proved robust and reliable during the groundwater drought conditions of 1990-1992, 1996-1998, 2006-2007 and more recently in 2011-2012. The remaining 20% is sourced from the River Colne and stored in TARD reservoir, which is jointly owned with Anglian Water. The connections between the HDZs can be seen in Figure 16.

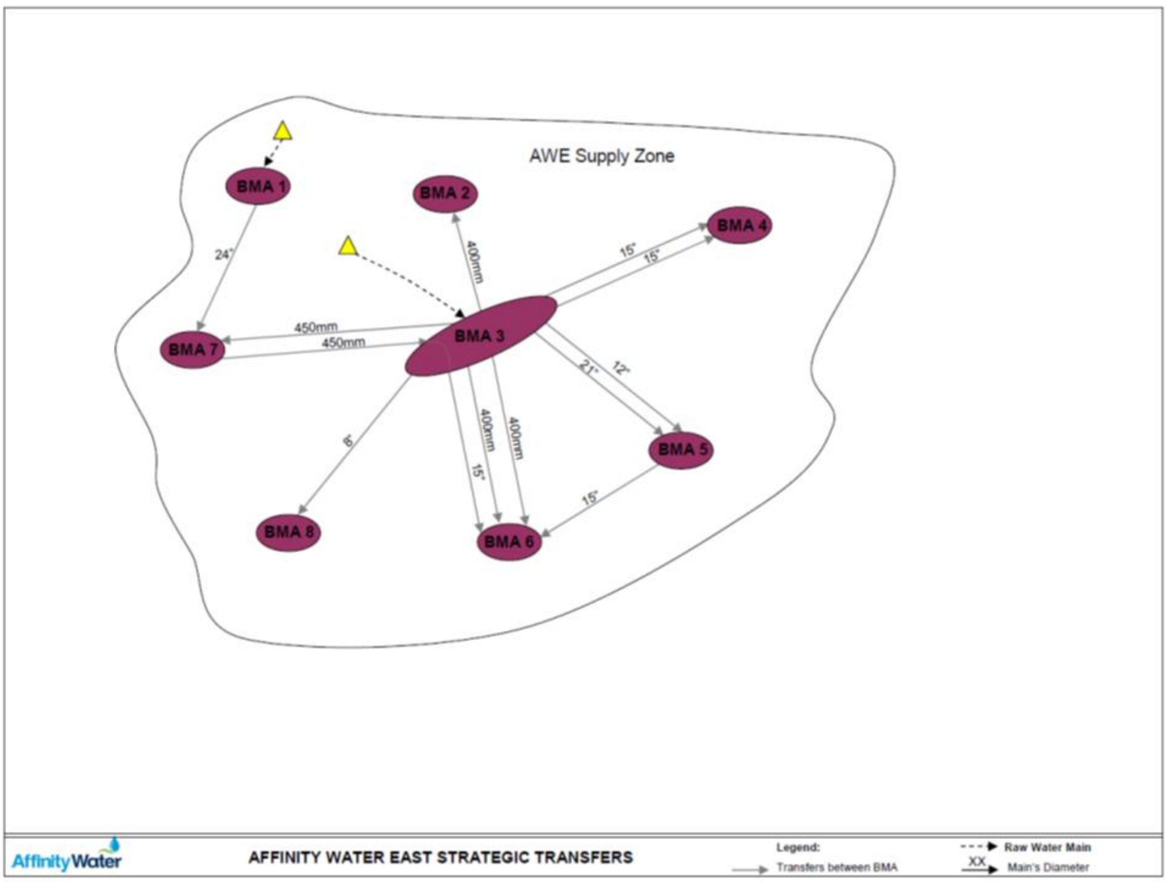

Figure 16: Map of the Water Resource Zone, connectivity and transfers in our East region

The surface water from TARD reservoir is used to meet the balance of demand with the utilisation of our groundwater sources prioritised. TARD has a reliable output of 26.1 Ml/d (ADO) and can be re-filled each winter, even in a dry winter.

We have an agreement with Anglian Water to vary the statutory water sharing arrangements at TARD from an equal 50:50 share to 70:30 in favour of Anglian Water. This variation currently extends to 2025. The drought yield assumed available to us from TARD is therefore 7.8 Ml/d (ADO).

For normal operation and during a drought, either company can take extra water from TARD not required by the other company. In an extreme event, either Anglian Water or ourselves could take all of the output available from TARD, provided the water was not required by the other company, although at present we are able to supply all customers in our East region over sustained periods without using TARD.

In our East region, we have not needed to resort to formal restrictions on customer demand.

4 Affinity Water Levels of Service and Policies

Summary

This section provides an introduction to our policies regarding levels of service and demand management (leakage, metering and water efficiency).

Water supply **levels of service** (LoS) are a measure of the likelihood of actions during droughts such as applying temporary use bans or taking additional measures such as increasing abstraction from a particular source. They set out how often on average we expect that we will need to take a specified step in response to a drought and discussed in Section 4.1. Our current and proposed LoS are presented in**Table 13**.

Our **leakage** policy is discussed in Section 4.2. We are continuing our programme of leakage reduction for AMP6 to reduce leakage by 14% by 2020, which was the most demanding reduction target in the industry. We present how we target, manage and control leakage as well as our progress since publishing our fWRMP14 from consecutively meeting our annual leakage reduction target set by Ofwat to implementing new leakage techniques and methods to increase leakage targeting efficiency.

All three of our regions remain designated as 'seriously water stress' areas and so **metering** continues to remain a key feature of our demand management strategy to help manage demand and reduce per household consumption in the long term. We continue our Business Plan target to achieve 90% meter penetration by 2025 by installing approximately 525,000 meters across our Central region. Metering is discussed in detail in Section 4.3.

We recognise that some of our communities have the highest unmeasured per capita consumption (PCC) in the country and so we continue to support customers to reduce demand. Our water efficiency programme launched in 2014 has been and will continue to be a pivotal part of our efforts to help to reduce overall customer consumption. It is a significant part of our Water Saving Programme (WSP) and our demand management strategy and is discussed in Section 4.4.

4.1 Planned Levels of Service

Water supply **levels of service** (LoS) are a measure of the likelihood of applying restrictions on customers during drought conditions or taking additional measures such as increasing abstraction from a particular source or reducing augmentation (additional flow added to a river from a groundwater abstraction at times of low flow); they set out how often on average we expect that we will need to take a specified step in response to a drought, illustrated in Table 13.

Our current Drought Management Plan (DMP) states that we intend to make appropriate use of temporary use bans (TUBs) and demand side drought orders which allow us to impose restrictions on water use in the event of a serious drought. We anticipate using TUBs on average once every 10 years and ordinary drought orders restricting non-essential use on average once every 40 years. Our current Drought Management Plan which provides further detail about our use of these measures.

Drought permits and orders allow us to apply to the Environmental Agency and the Secretary of State respectively to take additional water from the environment in the event of a drought. Our

DMP consultation and WRMP pre-consultation with stakeholders suggest, customers would prefer us to minimise our effect on the environment in severe drought. We have recently consulted on our draft DMP, and will update this to ensure consistency between our fWRMP19 and our DMP in the annual update in February 2019.

Table 13:Current levels of service in our DMP

Affinity Water Drought Zone	Restrictions on customers	Current frequency in our DMP
2	Temporary Use Ban restrictions	1 in 10 years on average
3	Ordinary Drought Orders restricting non-essential users	1 in 40 years on average
4	Drought Permits / Orders for temporary abstractions	1 in > 40 years on average

A comparison of our current levels of service with that of our fWRMP14 and dWRRMP19 is presented in Table 12 in Section 2.11.

We consulted with a range of customers for our current draft Drought Management Plan between February and October 2017. The outcomes of our consultation were taken into consideration when setting our planned LoS. These confirmed that there is a high degree of customer acceptance for our current LoS. An improvement requires investment in the network in order to improve resilience and flexibility. Therefore, investment for any changes is sought through the WRMP and Business Plan process. We have tested the soundness of our levels of service through drought scenario modelling, up to a 1 in 200 year return period event and we are consulting customers in this plan to seek their views on an improvement in our LoS.

We have a statutory duty to supply water to all households. Our supply base is reducing as we are leaving more water in the environment and due to climate change. Under drought situations the Environment Agency expects us to use non-essential use demand restrictions in drought situations before seeking temporary additional abstractions. Our water resource planning includes significant amounts of demand reductions through metering and leakage reduction and later by bringing in more resources including transfer and regional reservoir options in the longer term. If customers would like less restrictions in drought conditions this will require more resources development in the future.

4.1.1 Temporary use restrictions

Temporary use bans (TUBs) on water use are an important measure that water companies can use to reduce demand during a drought. They not only enable companies to maintain essential supplies but also help to conserve water resources for later in a drought, and reduce the environmental impacts of abstraction during this critical period. TUBs, often referred to as hosepipe bans have been implemented across our regions three times in the last 30 years: in 1991, 2006 and 2012. Our LoS for TUBs is no more than 1 in every 10 years on average, equating to a 10% annual probability, which means there is a ten percent chance every year of TUBs being implemented.

4.1.2 Ordinary drought orders

Ordinary drought orders restrict the use of water for those categories set out in the Drought Direction 2011, or in a simplified term, restrictions on non-essential use. We have only once applied to the Secretary of State for restrictions on the use of water for specified purposes, in 1991. Our LoS for ordinary drought orders is less than 1 in 40 years on average or a 2.5% annual probability.

4.1.3 Drought permits and orders for additional abstraction

Drought permits or orders would only be used under a very severe drought scenario and would involve applying to increase abstraction or to remove a licence constraint. Our LoS for drought permits and orders is currently 1 in 40 years on average or a 2.5% annual probability. We have reassessed our resilience to historic drought for this plan and this has confirmed we would have 42 Ml/d less resource available in the event of a 60 to 80 year return period drought. This is consistent with our current LoS for drought orders for additional abstraction as action would be necessary in anticipation of a drought. We have adopted these revised values for consultation on this plan.

4.1.4 Emergency drought orders for restrictions on essential use

Under the scope of emergency drought orders we may apply to the Secretary of State to limit or prohibit the use of water for any purpose we consider appropriate. Emergency drought orders have not been implemented in the UK by any water company since 1976, since then there has been significant investment across the water industry. If those drought conditions were experienced again there would be no need for an emergency drought order.

4.1.5 Emergency drought orders for rota cuts and deployment of standpipes

Our view is that the use of standpipes is no longer an appropriate drought response, although there remains a power under the WRA for the Secretary of State to authorise a water undertaker to supply water by tankers or standpipes. Our initial customer feedback is also strongly opposed to the use of standpipes; the majority of customers believe that standpipes are unacceptable in a modern civilised society. As a result, the level of service for emergency drought orders as stated in our Drought Management Plan remains correct, in that we consider them unacceptable. We consider that standpipes would only ever be deployed as a last resort in the event of a civil emergency and more than likely at a very local level for a short period of time to deal with a significant threat.

In an event that the drought was to reach this level of severity then we would enact our Emergency Plan and restrictions would likely only need to be implemented in particular areas of significant water stress.

4.2 Leakage

4.2.1 Introduction

Customers continue to expect us to do more around reducing leakage. We continue our challenging programme of leakage reduction for AMP6 and towards achieving the following objectives:

- a continuation in the reduction in leakage
- control of leakage year on year below a predetermined leakage target
- continual improvement towards increasing efficiency in managing and controlling leakage
- continuing our innovative implementation of fast logging to assess legitimate night use on a weekly basis to improve our assessment of net night use and therefore improve the efficiency of our leakage reduction targeting
- confirmation of our non-household logging programme to verify non-household night use
- continuing the monitoring of leakage activities compared to benefits at DMA level. This will enhance our understanding of the natural rate of rise and the cost of reducing leakage further
- implementing leakage monitoring on our critical mains
- improved assessment of leakage reduction from mains renewals
- improved assessment of supply pipe leakage associated with our integrated metering programme.

4.2.1 Leakage target setting

At the start of the next planning period (2020), we will have a supply deficit in three of our eight WRZs. This rises to deficits in four of our eight WRZs by 2045, and as such, we will therefore commit more resource to managing leakage levels.

Setting a leakage strategy is a challenging process when some zones can have a surplus of water and others with deficits. A true economic approach would suggest we should let leakage rise in some of our WRZ; however, our regulators have indicated that leakage should not be allowed to rise.

One of the key factors in managing leakage in the most economic way is the establishment of the background level of leakage. This is the leakage level at which costs to detect and repair are regarded as infinite as collectively the leaks are too small to be detected by modern technology. The closer we are to the background level of leakage, the more difficult it is to detect the leaks that we can repair. An added factor is the cost of working in the public highway, as we are required to pay additional charges that are set by the local authorities; the busier the road, the more expensive it is to work in to undertake repairs

In our last plan we set ourselves leakage targets for each of our three regions, for the maximum amount of water that can be lost from our network. This volume target includes water lost from our network and from supply pipes that are owned by customers. To set this target, we consider all of the costs involved, including those of fixing leaks and the cost of producing more water. The final decision on our target is based on what would be the lowest cost for customers – we call this the economic level of leakage. Operating at this level of leakage means that the total cost of supplying water is minimised and we are operating efficiently.

Now that we are forecasting deficits, we must consider the cost benefit of reducing leakage further against other measures to increase supply and reduce demand. This is the long-run economic level of leakage, and, as we have deficits in the supply and demand balance, it is derived by our water resources planning modelling. More information is available in Technical Report 4.8.1: ELL and SELL Determination 2016.

In order to remain below a maximum level of leakage in all conditions, we will need to control leakage to much lower levels during benign weather periods to allow for potentially severe winters, when freezing and thawing give rise to an increase in leakage. Equally, customers have indicated a strong preference for an increased response to leakage during times of drought. Under both of these transient conditions, leakage operations may be sub-economic.

Having a flexible approach to leakage may differ from Ofwat's expectations for leakage reduction of 15%. However, we consider it is important that we have a balanced investment programme to manage the supply and demand deficit. Relying solely on high levels of leakage reduction presents significant risks to customers if these cannot be achieved in a sustainable and cost beneficial manner.

We will reduce leakage level through the careful monitoring and response to leakage outbreaks and the 'natural rate of rise' of leakage encountered together with controlled implementation of leakage reduction measures from one level to another.

4.2.2 Leakage management and control

Management and control of leakage is primarily achieved by active leakage control (ALC). This is the detection of non-visible leaks, as well as optimised pressure control to reduce the flow from any live leaks and reduction in bursts and the early repair of leaks. This is combined with accurate reporting of our performance to ensure efficient delivery of regulatory targets.

We have over 800 District Metered Areas (DMAs), covering in excess of 80% of our network and customers. These are monitored on a daily basis in order to review performance and identify potential leakage. In order to comply with the new Water UK consistent method of reporting leakage, we will be increasing our coverage to 95% by 2019/20 such that 90% of these are available for reporting at all times.

Software tools are used to assess daily flows and pressures in these areas and to check to see if any significant changes are identified. Minimum night flows are calculated to quantify leakage and determine daily leakage levels.

During AMP6 we have implemented a new leakage management tool called WaterNet. This has significantly improved targeting of our resources and accuracy of our leakage reporting.

4.2.3 Leakage reduction improvement programmes

Customers supported our plans to reduce leakage beyond the economic level together with a preference for a greater response to leakage management in times of water scarcity. We have learnt a significant amount about how to manage leakage reduction during this time. Some of our activity will have been visible to customers, but much has gone unnoticed as we strive for more efficient ways to find leaks.

Since publishing our fWRMP14, we have met our annual leakage reduction target set by our regulator, Ofwat and continue to work towards achieving a saving of 20Ml/d from our distribution network leakage through a number of methods. The principal methods we have employed are outlined below.

- **improved accuracy in the calculation of allowances.** A key piece of work was undertaken to better calculate the usage of non-households and household customers through the night. This included our innovative 'fast logging' system that allowed us to accurately calculate the amount of usage at DMA level. This in turn provided a truer assessment of leakage to increase efficiency by accurately targeting areas where leaks are likely to be occurring

- **deployment of permanent acoustic loggers.** We lead the UK industry and the world when we deployed 20,000 noise loggers across our network in 2017 to constantly listen for leaks. When such a noise is detecting that indicated a potential leak, data is transmitted to our control room, this means that we can now respond to leaks quicker than ever before, and as a result we are more efficient at finding leaks. This has helped us significantly drop leakage rates in the areas in which the loggers are installed

- **training of our operatives.** We have increased the number of directly employed highly trained expert leakage technicians and created our own leakage training site, where we can teach and hone the skills and techniques needed to find leaks as quickly as possible. We have also sought a commitment from our supply chain to ensure that our contractor resource is trained to a high standard. Additionally, we have improved our reporting systems to enable operatives to receive further training quickly if required

- **innovation.** To achieve the challenging target we have set ourselves in the past three years we have had to change the way in which we work and the tools that we use. We have trialled many new methods from satellite images to using conductivity methods to find leaks. Not all have been successful, but our framework to evaluate new technology has also developed alongside enabling us to determine the benefits of new technologies more effectively. In addition we have continued to build and develop a more comprehensive and integrated leakage reporting and monitoring system

- **pressure management**. We have completed a number of pressure management schemes. These have helped to reduce leakage and further helped reduce the burst rate in these areas. We have also divided up several large DMAs into smaller areas so that leakage is more manageable

- **water saving programme – customer supply side leakage detection.** By installing AMR meters at properties, we have had the opportunity to detect leaks on customers' pipes, also know as customer supply side leakage. This includes finding and fixing leaks both at installation and offering free repairs later in the WSP customer journey. This information has helped us locate a significant amount of leakage even quicker and helped customers save money from their water and energy bills at the same time.

4.2.4 Customer and stakeholder support for leakage

Following consultation from our last draft Water Resources Management Plan and more recent engagement on our current plan during pre-consultation phase, we are acutely aware that many customers and stakeholders react adversely to leakage and expect us to continue to do more to reduce leakage.

Our regulators have aspirations for us to reduce leakage by a further 15%, and we have explored the sensitivity and cost benefit of this in our investment modelling in Chapter 13.

On the other hand, our regulators appreciate that maintaining levels of leakage in all weather conditions is neither possible nor sensible, so, in practice, a temporal rise in leakage as a result of severe weather is taken account of in our strategy.

We will continue to engage with customers and stakeholders on our draft WRMP19 as we publish our plan for public consultation in early 2018. We want to ensure that our plans address the needs of customers, whilst balancing the aspirations of our regulators with the benefits to the environment. Therefore we will be seeking customer's preference for leakage levels of 11%, as our preferred and **AP**, or 15% in line with Ofwat's views.

4.3 Metering

4.3.1 Introduction

All three of our regions remain designated as 'seriously water stress' areas and so metering continues to remain a key feature of our demand management strategy to help manage demand and reduce household consumption in the long term.

We have implemented metering across all our three operating regions in accordance with local conditions and continue our Business Plan target to meter approximately 525,000 properties in 10 years, between 2015 and 2025 (AMP6 and AMP7) across our Central region with the aim to achieve 90% meter penetration by 2025.

A summary of our current household meter penetration across our three regions (as of our base year 2015/2016) is shown below:

- Our **Southeast** region was designated an area of water scarcity in 2006 and we have now completed our metering programme with **90%** of properties fitted with a meter.
- In our **East** region customers choosing to opt for a meter has been high with **72%** of households metered. We will continue to progressively increase metering in this region as we have a supply surplus in this zone.
- In our **Central** region, we have **45%** of households currently metered but continually increasing as we progressively meter unmeasured properties as part of our ongoing Water Saving Programme (WSP).

The proportion of households with meters in each of our three regions as of our base year 2015/16 is shown in Figure 17.

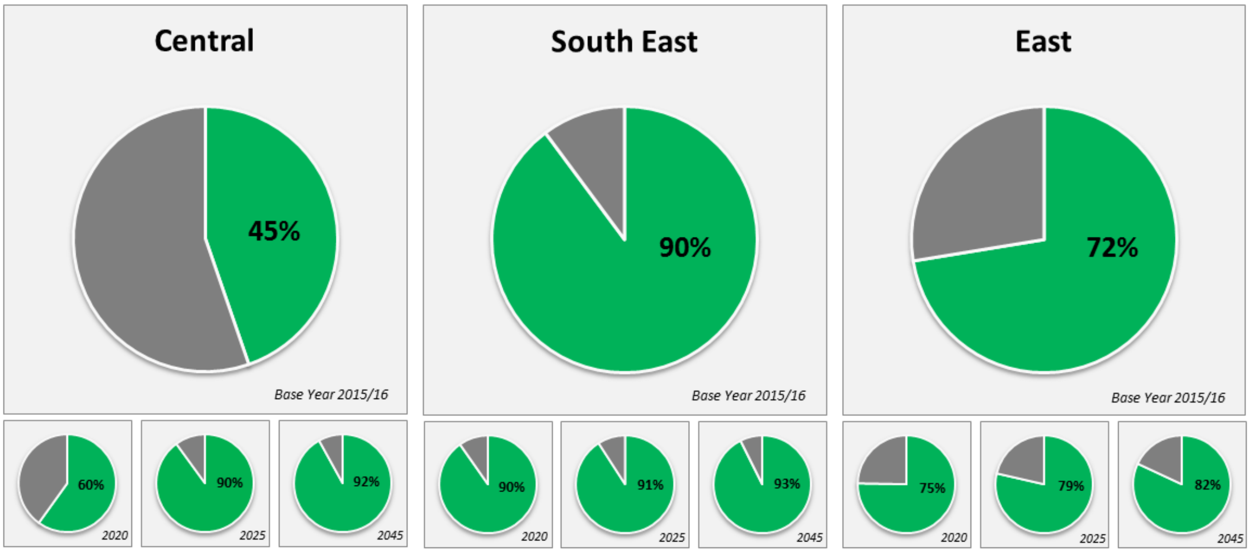

Figure 17: Household metering in Affinity Water's three regions for our base year of 2015/16 and forecast up to 2045

We report the percentage of household and non-household properties that have a meter in our Annual Return; please refer to the most recent Annual Return for the latest information.

In regards to non-household properties, it is our policy to meter all non-household properties wherever feasible and practical working with the retailer as required following Market Reform.

4.3.2 Water Saving Programme (WSP)

The WSP includes our ongoing universal metering programme implemented in AMP6, which is our largest demand management project ever undertaken. It is expected to contribute significantly to reducing the company supply and demand deficit in the near term, reducing customer demand by an estimated 56 Ml/d between 2015 and 2025.

The water meters we are installing at household premises are Automatic Meter Reading (AMR) meters which means we are able to read meters remotely in either walk-by or drive-by mode increasing our meter reading efficiency. The consumption data we collect will then be used for billing purposes or to let customers know if we detect any leaks on their pipework, which in most cases we will repair free of charge if no additional excavation is required and within the boundary of customers' premises.

Since the WSP started in 2015 in our Central region, over 12,000 customers have chosen to move onto a metered account early during their two year transition period. The two year transition period gives customers time to understand their usage and charges by giving them a choice to switch early or keep paying non-metered charges for up to two years whilst we send comparison bills to support their decision and help adjust before switching to a metered account.

Further details of our progress on our Water Saving Programme (WSP) during AMP6 can be found in Appendix A.

4.3.3 Customer and stakeholder support for metering

In our last WRMP consultation period there was widespread support from customers for a universal metering programme and that it was the fairest way to pay for water. The majority of customers also believed a meter would help reduce the amount of water they used.

In our dWRMP19 pre-consultation phase stakeholders continued to support our metering proposals and were keen to know how much we are saving from the programme. Currently, in view of the two year transition period allowed, it is too early to confidently estimate the yield savings on consumption from metering due to the limited availability of data from WSP and the need for a longer time frame to better understand behavioural change around customers' water use.

We intend to re-evaluate the consumption data from WSP during the consultation period for our dWRMP19 by which time we should have a wider timespan of data to analyse. We will however be reporting our overall estimated consumption in our Annual Return in 2019 to assess our progress compared to the ODI target we set for weighted average per capita consumption (WAPCC).

We will seek customers' views once again on our continued metering strategy and Water Savings Programme during the consultation phase of this dWRMP19. We will then be able to incorporate the views from customers and results on water savings into our final strategy for fWRMP19.

4.4 Water Efficiency

4.4.1 Introduction

We recognise that some of our communities have the highest unmeasured per capita consumption (PCC) in the country and we face a major challenge to support customers to reduce demand. Our water efficiency programme has been and will continue to be a pivotal part of our efforts to help to reduce overall customer consumption. It is a significant part of our Water Saving Programme (WSP) and our demand management strategy.

With the WSP expanding progressively, it has been vital for the water efficiency team to engage and educate customers prior to the install of their meter and so we have continued our community focused water efficiency activities. This includes our enhanced water efficiency engagement and awareness campaign launched in 2014 to pave the way for our metering programme and provide information, free water saving products and water audits to support customers during their two year transition to a metered account.

We have looked to improve our water efficiency programme by utilising many different avenues to promote our water efficiency campaigns. This includes more educational awareness at our Education Centre team in Bushey working with local schools to launch our new innovative behaviour change programme in 2017 called #TapChat through an independent company called Hubbub. This is planned as a long term change and the programme has been joined by other water companies and Water Wise which we aim to maintain and build on in AMP7.

We are also involved in SaveWater South East, which is an exciting collaboration between Waterwise, Environment Agency and six water companies (Affinity Water, Portsmouth Water, Thames Water, South East Water, Southern Water and Sutton & East Surrey Water). It was established with the aim of increasing the awareness of water as a finite resource and creating a water saving culture in the South East of England. By working together, SaveWater South East aims to promote water efficiency across the region to help people save water and money.

Further details of our progress on our water efficiency programme during AMP6 can be found in Appendix A.

4.4.2 Our education services

Our Education Centre has expanded providing services to a number of primary and secondary schools in our area. Our Education Team aims to support teachers in our communities by providing a stimulating hands-on learning experience about the importance of water and the environment, such that it can enrich the curriculum. Further details of our educational services programme during AMP6 can be found in Appendix A.

4.4.3 Customer feedback on water efficiency

In our last WRMP customers indicated support for movement towards reducing the demand for water and therefore we consider this to be the right approach to further address the supply deficits we face over the next 25 years, as well as continuing our long-term commitment in reducing PCC to meet government aspirations.

The majority of customers supported our water efficiency activity plans in our last WRMP consultation and we received similar feedback in our pre-consultation phase. We have maintained this position in our forward planning and will consult on our approach again in our consultation for dWRMP19.

4.5 Natural Capital and Eco-system Services

Natural capital assets are the goods and services, often called ecosystem services, which underpin our economy and society and some of which even make human life possible. The term 'services' is usually used to encompass the tangible and intangible benefits that humans obtain from the natural environment, which are sometimes separated into 'goods' and 'services'. The most obvious ecosystem services include the food we eat, the water we drink and the plant materials we use for fuel, building materials and medicines. There are also many less visible ecosystem services such as climate regulation, purification of water and air, natural flood defences, and the pollination of crops by insects. Even less visible are the cultural, spiritual and inspirational ecosystem services we take from wildlife and the natural environment, (Capital Forum, 2017).

We seek to reduce the impact we have on the environment through our operations and value the natural environment, by understanding the risks as well as the opportunities to preserve this 'natural capital'. In addition to reducing our groundwater abstractions to leave more water in the environment, we have many projects which serve to monitor and protect the groundwater and surface water in our company area, which is vital in providing wholesome potable water for customers. We undertake catchment risk assessments to determine land use risks to drinking water quality, capture hotspots for pollution and contaminant inputs to the water environment and are leading the way in our stakeholder engagement with farmers with our agricultural pesticide reduction schemes and nitrate reduction pilot trials. Our reductions in abstraction, morphological mitigation programme and biodiversity projects although regulatory under the National Environment Programme (NEP) similarly have multiple benefits. The morphological enhancement of the globally rare chalk streams in our company area seek to reconnect them to their natural flood plain, alleviate flood risk, enhance biodiversity and create new habitats. The more natural a river is, the more resilient to climatic extremes and future pressures it will be. This work is increasingly recognised for its environmental, social and economic benefits.

The river corridor also provides an area of tranquillity, which is considered to be an important cultural service delivered by the natural environment and linked to enhanced health and mental wellbeing. The IUCN National Committee report (Addy, et al., 2016) suggests an ecosystem services assessment of an urban river restoration project could see a long-term return to society of at least £7 for every £1 spent.

Our biodiversity projects will implement the maintenance and habitat management plans for designated landholdings such as Sites of Special Scientific Interest (SSSI) and Local Nature Reserves (LNR) in partnership with key stakeholders. These sites will also provide an educational and recreational resource to be enjoyed by customers and local communities.

4.6 Biodiversity 2020

4.6.1 Introduction

Published in 2011, Biodiversity 2020: A Strategy for England's wildlife and ecosystem Services is the Government's strategy for people and wildlife. The main aim of the strategy is to;

> *'halt overall biodiversity loss, support healthy well-functioning ecosystems and establish coherent ecological networks, with more and better places for nature for the benefit of wildlife and people'. DEFRA, 2011.*

Biodiversity 2020 forms part of the UK's commitments under the United Nations Convention of Biological Diversity. We must, in exercising its functions as a water undertaker, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity. This includes management of designated sites, ecological monitoring and working collaboratively with stakeholders.

4.6.2 Current action

One of the main ways we have been working towards this strategy is through working with strategic partners, including Herts and Middlesex Wildlife Trust (HMWT), through developing management plans and increasing community engagement for our Local Nature Reserve (LNR) sites. This will significantly benefit the biodiversity at these sites which include nationally important habitats such as inland water bodies, which are important for migratory wildfowl. A similar approach has been taken regarding the management plan for a Site of Special Scientific Interest (SSSI) we own near Wraysbury, Surrey and with White Cliffs Countryside Partnership in Kent.

We have undertaken ecological surveys at many of our sites which include Local Wildlife Sites (LWS), reservoirs and pumping stations. Baseline data has been collected which can be used to assess if biodiversity has increased through land management initiatives. For instance, we have carried out a number of moth trapping surveys at sites which are currently not in a favourable state but we hope to see an increase in species diversity and abundance through implementing habitat enhancement techniques.

To achieve all outcomes of the Biodiversity 2020 strategy, it is important that we converse with stakeholders through cross-sectoral engagement. We have undertaken a number of biodiversity events to date, and we have supported many events with local conservation charities and organisations. This has been fundamental in raising awareness of the threat to biodiversity at a landscape-scale approach.

4.6.3 Consideration of Biodiversity 2020 in our WRMP

The Biodiversity 2020 strategy has the following three priority actions in relation to water management:

- **Priority action 3.6:** Align measures to protect the water environment with action for biodiversity, including through the river basin planning approach under the EU Water Framework Directive.
- **Priority action 3.7:** Continue to promote approaches to flood and erosion management which conserve the natural environment and improve biodiversity.
- **Priority action 3.8:** Reform the water abstraction regime. The new regime will provide clearer signals to abstractors to make the necessary investments to meet water needs and protect ecosystem functioning. We will also take steps to tackle the legacy of unsustainable abstraction more efficiently.

We will continue to work with partnership organisations to protect water ecosystems, including habitats and species, through a river basin planning approach. We will continue our work to reduce diffuse pollution and further encourage catchment sensitive farming through our catchment programme. Our continued programme of sustainability reductions throughout AMP6 and AMP7 to reduce the volume of water we plan to take from the environment supports priority actions 3.6. We will continue our programme to enhance biodiversity at our sites.

Appendix C shows the company benefits and wider environmental, social and economic benefits of our Catchment Management Programme of works.

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5 Engagement Programme: Pre-Consultation Phase

Summary

This chapter describes our engagement and pre-consultation process for dWRMP19 and how this has influenced our strategy envelope. We will undertake our **public consultation** phase in March 2018 from which we will consider all the feedback and results to inform our final WRMP19 water resources strategy and in developing our Business Plan for PR19.

The continuous and **effective engagement of customers and stakeholders** is essential to deliver our vision to become the leading **community-focused water company.** To support this vision we have a range of activities and channels within our engagement programme to reach as many customers and stakeholders as possible. Our wider engagement approach has been multi-faceted with a variety of methods being used to reach and actively involve customers, regulators and stakeholders. These are presented in Section 5.3.

The pre-consultation has identified a number of key themes that customers and stakeholders view as important. These are:

- **improving water efficiency** – supporting customers and educating children and young people to use less water
- providing customers with **high quality water**
- **water metering** – continue to install more meters in peoples' homes to help them save water
- **reducing leakage** through early identification, innovation and better use of technology
- ensuring there is enough water - addressing the **growth in population**, new housing developments and drought
- **environmental impact** – taking less water and leaving more, protecting designated sites and reducing pollution
- supporting **vulnerable customers** to cope with their bill payments
- **resilience and uncertainty** – how our current and future operational system will be resilient to a range of droughts and non-drought hazards. See Chapter 7 on resilience
- **partnership** – working with regulators, other water companies and local communities.

We are currently planning for our public consultation to start early 2018 running for a period of approximately 10 weeks to give customers and stakeholders plenty of opportunity to comment on our draft plan. The learning and outcomes from our public consultation will link closely to the development of our Business Plan.

5.1 Introduction

This section of the plan details the **engagement activities**, methods and results that have been undertaken to date to inform and influence our dWRMP19 and gives an overview of the next steps in terms of the public consultation planned for early 2018.

An integrated approach to consultation and engagement with our stakeholders and customers is an essential part of our core business that drives day to day operations and strategic business planning. Our WRMP is directly connected with a number of areas and programmes central to our business. This includes our Business Plan and Drought Management Plan and is illustrated in the diagram below:

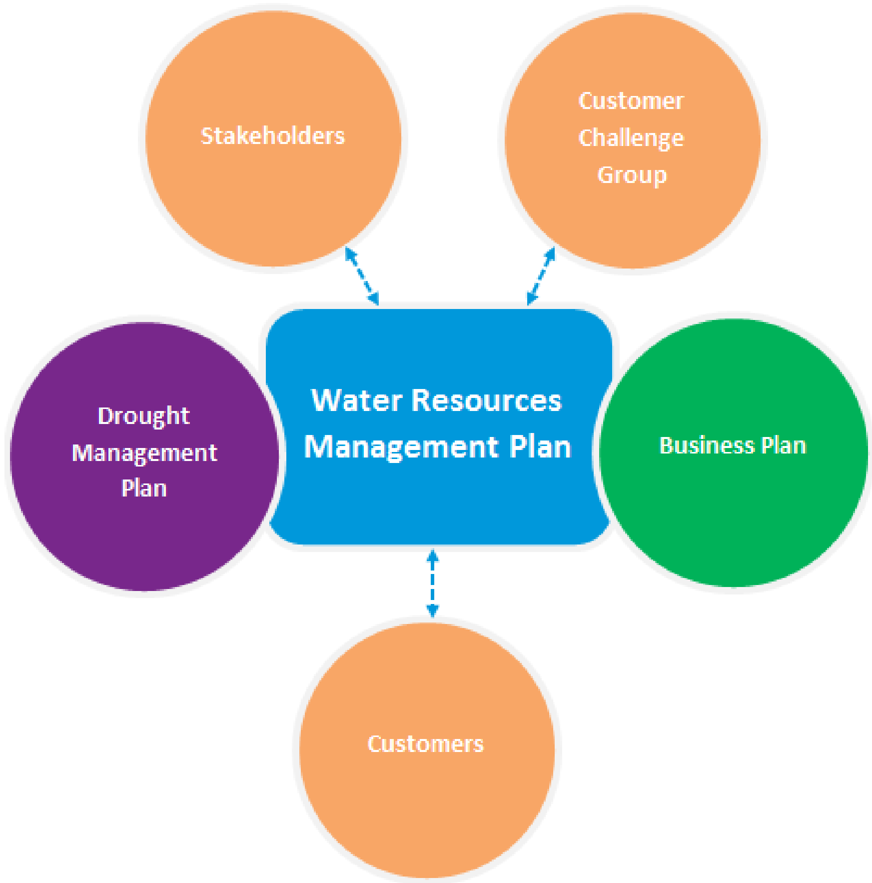

Figure 18: An integrated approach to consultation and engagement

The continuous and **effective engagement of customers and stakeholders** is essential to deliver our vision to become the leading **community-focused water company.** To support this vision we have a range of communication methods and channels within our engagement programme to reach as many customers and stakeholders as possible.

Our range of activities is broad and innovative. For example, a **phased approach** to our PR 19 Customer Engagement Programme; the work of the Water Saving Squad and Education Centre to support current and future customers improve their water effeciency; use of social media via our Hubbub project and regular discussions with our stakeholders and Customer Challenge Group (CCG). Further detail on these activities and their findings is given throughout this section. Evidence of their impact on our dWRMP19 is described in Chapter 15.

5.2 Key Attributes of our Engagement Programme

The engagement programme builds on what was achieved during our engagement phased work at PR14. In designing the programme our approach has utilised some traditional engagement techniques whilst implementing a more innovative and long term strategy to actively engage with customers and stakeholders to better understand their needs, behaviour and priorities.

The specific attributes of our wider engagement programme include:

- bespoke market research
- testing each engagement activity against our design criteria (Customer Challenge Group challenges) and customer segmentation
- analysis of operational customer contact data
- using ongoing customer engagement to build our evidence base, educate and influence to long term behaviour change e.g. Education Centre, Water Saving Squad, Social Media, surveys and focus groups
- continuous improvement and learning within five phases (0 to 4)
- end-of-phase triangulation and validation with our Customer Challenge Group
- working with a wide variety of national and local stakeholders to understand their key priorities.

Our stakeholders have been identified, mapped and categorised. They include customers; national regulators such as Ofwat, the Environment Agency, the Consumer Council for Water (CCW) and the Drinking Water Inspectorate; national bodies such as Natural England; our CCG and a number of local organisations such as local authorities, environmental and interest Groups.

The views of all of our stakeholders are important to us and we understand they need to be engaged using the appropriate methods, recognising their different levels of knowledge and interests. Section 5.3 provides further information of our approach and methods.

5.3 Engagement Approach

Our wider engagement approach has been multi-faceted with a variety of methods being used to reach and actively involve customers, regulators and stakeholders. These are detailed below.

5.3.1 Customers

Arup and Ipsos MORI have been appointed to work with us to deliver our customer engagement programme. Our programme is delivered in five distinct Phases and incorporates bespoke market research, integrates customers' views from our operational customer contact data and triangulates this with our economic research. Triangulation and validation with our CCG and continuous improvement within phases is central to our approach.

A comprehensive framework of different engagement methods has been developed featuring qualitative and quantitative research tools to explore customers' views and provide evidence of customers' support for our dWRMP19. It includes 'traditional' methods such as focus groups and online surveys, as well as more innovative ones such as ethnography and online discussion groups.

Each method is assessed against our ‘design criteria’. This is based on the criteria that Ofwat expects CCGs to use to assess companies’ customer engagement.

The five phases are described below.

Phase 0: Scoping & Immersion

Ethnographic interviews were undertaken which:

- provided insights into customers’ worlds
- had a behavioural component
- built appreciation of the way customers currently perceive water services, what they know and what they care about/what really matters to them.

Pre-SDS ‘signpost’ focus groups enabled:

- foundational understanding of customers’ immediate issues and priorities
- the opportunity to explore and understand how to frame conversations with customers.

Phase 1: Listening & Learning

Establishing a community of customers will:

- create an online community of 2,000 customers via our customer database and other means
- provide a forum for ongoing conversations with a group of customers.

In-depth interviews and mini-groups will be held to:

- target customer groups and key issues
- survey future customers and paired depths to supplement engagement by the Education Centre.

Phase 2: Testing & Valuing

Phase 2 will have two key aims:

- acceptability - to test acceptance of our proposed dWRMP19 and Business Plan and options, including investments and bill profiles
- dWRMP19 Customer focus groups - provide qualitative insights with 50 participants
- dWRMP19 Customer survey - provide quantative insights with 1,000 participants.

Phase 3: Revisiting & Assuring

The outcome of this phase will be final reporting of customer engagement activities and assurance that the dWRMP19 and Business Plan has been robustly tested and informed by customers.

Phase 4: Transition to Business as Usual

Integrating the learning into business as usual activities and informing our wider business customer interaction strategy. A particular emphasis will be to develop targeted projects to better support disadvantaged customers.

Hubbub

In partnership with Hubbub, an award-winning environmental charity, we have conducted a UK wide poll on water usage habits to generate insights into patterns amongst the population as a whole and demographic subsets in order to inform behaviour change interventions. This can also produce new statistics to providing points of interest for media releases to further generate awareness of water usage issues.

The following activity has taken place or is planned:

- national polling carried out by Censuswide via an online survey amongst a representative sample of 3,000 UK adults in June 2017
- 40 in-depth home visits with households in Watford and Harlow to better understand people's lifestyles and water use habits. Followed by provision of a Water Saving Kit
- ongoing support and conversation with the 40 households via a closed Facebook group for two months following the home visits
- online questionnaire at the end of the two month period.

Value for money survey

As part of our commitment to monitor customer perceptions of value for money and to drive improvement, we carry out over 1,900 telephone surveys each year with customers. The survey deals with key topics that are often based on perceptions and there is a planned project to see if we can map these findings to our customer relations data to improve our service.

Social media

We have ongoing engagement with, and insight from, customers across multiple social media platforms. Our approach is to collaborate with community stakeholders and influencers to help us engage our shared online audiences. Alongside organic reach we also use paid campaigns targeted to reach new audiences across our supply area.

5.3.2 Stakeholders

Customer challenge group (CCG)

We continue to work closely with our CCG which is a requirement of Ofwat. The group was formed in 2012, is independently chaired and meets regularly. The role of the group is to:

> *'Provide independent challenge to companies and provide independent assurance to Ofwat on: the quality of a company's customer engagement; and the degree to which this is reflected in its business plan.'*

Information on the development of our dWRMP19 was presented to the CCG at their meeting on 13 September 2017.

In terms of the Customer Engagement Programme, we have had regular dialogue with our CCG. Engagement, including triangulation and validation meetings, is planned at the end of each customer engagement phase to help us develop our bespoke performance commitments, such as those for resilience and vulnerable customers.

Other water companies

We have had regular engagement on our approach with neighbouring water companies, and participate in two regional groups, Water Resources South East (WRSE) and Water Resources East (WRE), and third parties.

Water industry regulators

We have worked closely with all of our regulators in the development of this plan. The purpose of this was to set out our challenges for the next planning period and to discuss the priorities of these organisations as we develop our dWRMP19.

Our approach to this has been to engage in an open and honest dialogue on a regular basis. This has proved highly effective and enabled areas of concern to be addressed and additional information to be provided where clarity was needed.

Other stakeholders

A number of additional stakeholders were contacted to seek their early views on the issues that are dealt with in our current plan and in particular whether there were any new issues that they felt should be considered in our new plan.

These stakeholders included:

- Local authorities
- Environmental groups
- Local interest groups
- Water Retailers

Drought management plan consultation

An extensive consultation using multiple channels of engagement was undertaken with regulators, stakeholders and customers. This included:

- non-technical summary produced and used throughout the consultation. Around 100 hardcopies of the summary were sent out to local authority environmental and planning officers
- a social media campaign, targeted around our drought order / permit sites
- direct email to key local authority officers
- emails to a wider stakeholder list, using mail chimp to track the email analytics
- publication of the consultation on our website
- online panels with 300 customers using a statistically robust approach which helped inform the draft plan phase in terms of giving evidence for acceptability
- water retailers were informed via the Wholesale Operations Service Desk
- 500 leaflets were produced and distributed at Water Saving Squad and other company events. At these we spoke directly to customers about the plan and asked them to look on the website for further information
- meeting held with the River Ver Society and offered meetings to other groups.

In addition to the above, two engagement events were held. The objective was to encourage informed participation in a public consultation about the dDMP. The first was for 33 purposely sampled customers from the area served by Affinity Water and the second was for a group of seven stakeholders directly invited by Affinity Water. Both events allowed participants to engage with the contents of the dDMP. The events sought to improve participants' understanding of the dDMP and encourage them to share their views.

The events covered the same topics including: the impacts of various water restrictions, exemptions from water restrictions, levels of service and their acceptability. While the events required different methods, given the differing level of expertise and the size of the groups, some of the comments made at both events were notably comparable.

5.4 Results of the Pre-consultation Phase

5.4.1 Customer feedback from pre-consultation

What did we learn from Phase zero of the PR19 customer engagement programme

The following key aspects were brought out of this pre-consultation exercise.

- customers appreciate that their water supply is essential
- water is good value for money compared to other utilities and is generally affordable
- there is a lack of engagement with the product and little connection to paying for what comes from the tap – customers are not customers, they are users
- there is a lack of information and choice. Customers can't choose their supplier as they can with energy, so we are viewed similarly to council tax i.e. no option not to pay, no choice
- leakage remains an emotive issue. Customers perceived it as not fair to ask them to save when we have high leakage which is very wasteful
- we do not make water efficiency 'easy' enough for customers. They want us to fit devices for them, send them out without customers having to ask for them
- the water industry isn't a particularly innovative sector and customers want us to 'play it safe' so we don't risk wasting their money
- customers want a more transparent relationship to build trust – when there's no choice; customers want more information to believe they are getting good value for money
- there will be less water in future: an increasing awareness of scarcity, customers citing population growth and climate change causing lower rainfall
- collaboration with others: customers think there should be a 'national grid' for water. Customers want water companies to work together to share ideas to improve the effectiveness and efficiency of the water service
- fairness between generations is important. Customers don't want future generations to bear the full cost of meeting future water supplies, so support a small bill increase now to reduce the burden on their children and grandchildren
- more information for and engagement with future generations: customers think we have a role to educate future generations about the need to conserve water.

What conclusions did we draw?

- customers recognise the essential nature of the water service
- there is a lot of disengagement about water, it's 'boring' and not often thought about
- water quality and resilience are not 'top of mind' for most customers. Interestingly, hard water didn't come up as a prominent issue as it did at PR14
- customers do make the connection between water use and the environment, but it takes time. Austerity (affordability) and waste seem to be more front-of-mind
- water is generally affordable, particularly when compared to other utilities
- we do not communicate enough with customers – or we don't do it in the right way.

What did we learn from Hubbub?

The poll revealed a surprisingly high lack of thought around water usage and a number of areas where savings could easily be made, despite only three in ten respondents believing their household could use less water if needed.

The following findings relate to the UK population as a whole.

Overall attitudes to water usage/saving:

- only 24% said they take water for granted, but…
- 76% are not concerned about the amount of water their household uses
- only 31% said their household could use less water if needed.

A number of key issues were identified by customers. These are:

- why is water an issue? The home visits revealed how water use is not really something people think about or talk about, and how most water use happens in private. Thus, habits can often go unchecked
- lack of awareness of water usage. There is little knowledge about where water comes from and how much water different activities use
- people are open to changing behaviours. The home visits suggested that the main cause of excessive water use is a lack of awareness, rather than a lack of willingness to change or do things differently.

In light of these findings the following approaches have been recommended:

- increase awareness that there is a water shortage in the South East and of the support available to save water i.e. free water saving devices
- ensure interventions are positive and simple and fit with people's everyday activities
- improve products, making sure they are to nicely designed, easy-to-implement, effective and something people want to have in their homes
- increase communications on usage and products. There is little shared understanding of what's "normal" when it comes to water use and therefore tailored approaches are better than 'one size fits all'
- meet people where they are i.e. utilise Facebook, 39 out of the 40 households have a Facebook account, thereby strongly suggesting that this is a suitable platform for engaging with people
- to achieve lasting behaviour change, people need to be exposed to reminders and nudges over a period of time.

What did we learn from the drought management plan consultation?

Three hundred customers responded to the online survey. Key findings are provided below:

- over half (55%) of respondents said they try to use water wisely, regardless of whether there is a drought. Just under a third (32%) of respondents stated that in the event of a drought they would try to reduce the amount of water use, such as taking shorter showers and re-using water in the garden. Metered respondents stated that they use water wisely more so than un-metered respondents
- most respondents thought the last drought (60%) and temporary use ban (59%) occurred more recently than 5 years ago (when the last drought in which temporary use bans were imposed)
- over three quarters (76%) of respondents thought that imposing temporary use bans no more than 1 in every 10 years is acceptable or perfectly acceptable. On describing their response, respondents' explanations focused on: the necessity of the ban to preserve the environment or water supplies; no significant hardship coming as a result of the ban's restrictions; the frequency of the ban; the bans potential to encourage responsible use; and the collective and social responsibility of customers
- over three quarters (76%) of respondents did not think that we should spend more to reduce the likelihood of temporary use bans, and would rather experience these restrictions than see their water bill increase. Respondents who may be most affected by a temporary use ban, i.e. those with a higher self-reported daily water use or those who use hosepipes, are more prepared to pay more to reduce the occurrence of these bans
- the large majority of respondents (83%) stated that temporary use bans should apply to all customers equally, though just under a fifth (17%) thought that these bans should not apply to metered customers who pay for the volume of water they need and who therefore should be able to continue using that amount. Metered respondents were more likely to state the latter than un-metered respondents
- respondents' suggestions as to how to encourage customers to voluntarily use less water during a drought focused on four main themes: education and awareness raising; providing incentives and disincentives; media channels; and providing practical measures such as water butts or meters
- almost two thirds (61%) of respondents thought that imposing drought orders no more than 1 in every 40 years is acceptable or perfectly acceptable. Respondents who identified themselves as being more environmentally friendly found this frequency of drought orders more acceptable than those who identified as being less environmentally friendly. Metered respondents also found this frequency more acceptable than un-metered respondents
- over two thirds (68%) of respondents did not think that we should spend more to reduce the likelihood of drought orders, and would rather experience drought orders than see their water bill increase. Respondents who may be most affected by a drought order, i.e. those with a higher self-reported daily water use, were more prepared to pay more to reduce the occurrence of these bans
- just less than three quarters (74%) of respondents thought it is important to save water for the sake of the environment. Three quarters (75%) of respondents thought it is important to save water for future generations
- the large majority of respondents (93%) stated that the survey improved their understanding of our plans to some extent. Respondents open-text comments

highlighted four main areas around which their knowledge was improved: droughts; water; Affinity Water and its work; and general improvements in knowledge

- the preferred methods for informing respondents about a drought and possible water use restrictions were via letters (59%), emails (59%) and local TV news (53%)
- younger respondents (under the age of 55) had a greater preference for being informed via social media and text message than older respondents (55+).

A summary of the outcomes from the two engagement events is given below.

Most participants at the events acknowledged that a temporary use ban would impact customers' gardens as well as the ability to clean buildings and vehicles, although at the customer event participants noted that the impacts would not be significant. At the stakeholder event, participants emphasised the communication needs during a temporary use ban, calling for more detailed information to be issued sooner.

Participants at both the customer and the stakeholder events commented that drought orders could impact on businesses and leisure activities. Additionally, participants at both events commented on the secondary, less immediate impacts of a drought order. In the discussion about drought permits and orders, participants at the stakeholder events focused mostly on environmental impacts, whereas the impacts of a drought permit and order as viewed by participants at the customer event included other factors, for example an impact on leisure and family activities.

While it was not discussed in great length at the stakeholder event, participants at the customer event engaged in an activity allowing them to grant exemptions to water restrictions. Participants were granted the majority of exemptions to protect employment and community projects.

The acceptability of levels of service was discussed at both events. At the customer event, participants were generally happy with the current levels of service, although several agreed that they would not be greatly impacted if temporary use bans occurred more frequently. They felt that the level of service for drought orders should not decrease as this could have a big economic impact.

Discussions about levels of services at the stakeholder event focused on pricing, communication and the environment. There was a strong emphasis on whether new pricing models and different communication strategies could help to influence customer behaviour which was heavily debated among participants.

Both events ended with an encouragement to take part in the Defra consultation. Feedback collected from the customer event was submitted directly to Defra as part of a consultation response.

5.4.2 Stakeholder feedback from pre-consultation

Our dWRMP19 **PP** and **AP** have been significantly influenced by our pre-consultation. This is described in detail in Section 13.3 of this report.

We have received a variety of informative and challenging responses to our pre-consultation from a range of stakeholders. These have been acknowledged, logged and reviewed.

The pre-consultation has identified a number of key themes that customers and stakeholders view as important. These are:

- **improving water efficiency** – supporting customers and educating children and young people to use less water
- providing customers with **high quality water**
- **water metering** – continue to install more meters in peoples' homes to help them save water
- **reducing leakage** through early identification, innovation and better use of technology
- ensuring there is enough water - addressing the **growth in population**, new housing developments and drought
- **environmental impact** – taking less water and leaving more, protecting designated sites and reducing pollution
- supporting **vulnerable customers** to cope with their bill payments
- **resilience and uncertainty –** how our current and future operational system will be resilient to a range of droughts and non-drought hazards. See section 7 on resilience
- **partnership** – working with regulators, other water companies and local communities.

Other water companies

These discussions have explored the potential to create new cross-border supplies between companies, as well as to vary existing agreements for water supply exports and imports from or to our operating area. Such water trading has the potential to offer the most efficient way of sharing regional resources for the benefit of customers.

Our Need and Availability of Water Statement has been issued to neighbouring companies, third parties and other interested stakeholders. This outlines the challenges we face and how they have changed since our last plan.

Ofwat

A pre-consultation meeting was held with Ofwat and a representative of the Environment Agency was also in attendance. The purpose of this meeting was to allow Ofwat to provide early feedback on our approach and identify areas where more clarity was required.

At the meeting, we presented our WRMP key challenges and methods to address future supply and demand forecasts. Also shared at this meeting was our Needs and Availability of Water Pre-consultation dWRMP19 document. Discussions covered a number of areas which included:

- our plans to select the preferred options from the range of portfolios
- consideration of new technologies and innovation for options
- proposed imports.

These discussions have informed the development of our dWRMP19.

Environment Agency

Engagement with the Environment Agency has been particularly strong via regular meetings and ongoing dialogue. This has enabled our technical approach and assessments to be discussed in detail.

By sharing our unconstrained options, work packages and methodology from the early stages of development we have ensured that we are following the correct approach and received some excellent feedback covering a number of key areas including:

- importance of working regionally
- testing leakage
- expectations of model testing
- sustainability reductions.

Consumer Council for Water (CCW)

We have held two pre-consultation meetings with the CCW. The key issues raised were:

- we need to show how our plan is consistent with both WRE and WRSE due to our unique situation to be involved in both
- the CCW feel customers support the drive to reduce leakage further but need more awareness about the costs of delivering this
- we need to ensure we have a clear rationale to our approach on tariffs
- customers are open to suggestions of water conservation but first need an awareness of what the issues are
- customers may feel the financial value of saving water does not warrant the effort made
- how will we involve water retailers in the public consultation?
- how close are we to understanding non-household customers' growth needs?
- suggestion for us to hold an annual stakeholder session
- need to incorporate the views of customers from the PR19 Customer Engagement Programme phases into the dWRMP19 consultation.

This feedback has been taken into account in the development of our dWRMP19 and will form part of our plans for the dWRMP19 public consultation.

Natural England

We held a pre-consultation meeting with Natural England ahead of the draft plan submission to provide a progress update on the dWRMP19, the Habitats Regulations Assessment and the Strategic Environmental Assessment. This meeting was an opportunity for us to provide Natural England with a summary of the SEA and HRA of the options in the **PP**.

Natural England welcomed the update and had no specific questions at the time. Going forward, we agreed to hold regular discussions, ideally with the Environment Agency joining these, as the preferred engagement method for the dWRMP19 Public Consultation, where the SEA and HRA reports will be made available for comment.

Customer challenge group (CCG)

Our CCG was presented with an overview of the WRMP process. At the same meeting it gave feedback on the PR19 Customer Engagement Programme Phase 0 findings which were:

- there seem to be no surprises, a lot of this is similar to customers' views at PR14
- low engagement from customers means a fairly high satisfaction with the service
- there is more work to do to engage with customers on things Ofwat expects, but are not front-of-mind for customers.

The CCG would like to see us do more in terms of lobbying government on water efficiency i.e. rating scheme for washing machines and subsidy scheme in relation to customers adopting more water efficient devices. We will seek to further update the CCG on the dWRMP19 and hear their views on our draft Non technical summary (or consultation document).

Members of Parliament

We have regular dialogue with MPs and respond to their concerns as part of our day to day engagement with them. Some examples of the issues discussed have related to drought management, sustainability abstraction reductions, social tariffs, community engagement, our community engagement fund, leakage and bursts. In particular we have discussed extensively the environmental impact and strategic resource trade offs between resilience and demand increases through housing growth, usage trends and product efficiency. We are keen to involve MPs in our public consultation going forward, particularly via stakeholder forums.

Local Authorities

A number of Local Authorities responded to our pre-consultation. Some key concerns are detailed below:

Essex County Council and Hertsmere, Guildford and Dacorum Borough Councils welcomed the commitment from us to have ongoing communication and collaborative working with local authorities and other bodies to ensure appropriate levels of investment in water infrastructure meets future planned growth needs.

Hounslow Council welcomed our metering proposals and urged that this programme is accelerated and it recognised the importance of educating people of all ages to save water.

We have recently contacted all 39 district and borough councils in our supply area to undertake a further study to determine growth at a much more granular geographical level, looking at the actual spatial distribution of future housing developments as set out in the housing site allocations within all of our local authorities' local plans. The outcomes of this work will not be available in time to feed into our dWRMP19 but will be considered within our final WRMP19.

Environmental and local interest groups

The key feedback from a these groups in response to our pre-consultation is detailed below.

Sustainable abstraction is a key concern for The Ver Valley Society and they are pleased we are pursuing a programme of sustainability reductions.

Kent Downs ANOB noted the substantial challenges we face due to future population growth. They, and the Buckinghamshire County Councillor, Chalfont St. Peter Division, support the proposed restoration of sustainable abstractions in ecologically sensitive chalk stream habitats.

Kent Downs ANOB were supportive of our proposals to construct new regional solutions such as large scale reservoirs or raw water transfers but these need to be located outside of areas of protected landscapes.

Members of the Ver Valley Society stated that:

- they would like to see specific targets adopted in the WRMP for water efficiency gains. They also asked if we should be considering how resilient our pumping stations and supply networks will be if wide scale and catastrophic floods were to become more frequent
- they are supportive of any measures we can take to minimise leakage and dealing with reported leaks promptly
- they welcomed our metering proposals and urged that this programme is accelerated.

Herts and Middlesex Wildlife Trust stated that:

- they welcomed our efforts to reduce leakage but felt that controlling leakage above the economic level should be considered if reduction targets are not being met
- it is important to have ongoing communication and collaborative working with local authorities
- they felt we should exhaust all possible alternatives before implementing drought permits and orders at sites where sustainable reductions have taken place
- that the point at which we respond to drought should be reviewed and that we should implement earlier drought restrictions
- they welcomed the commitment from us for ongoing communication and collaborative working with local authorities and other bodies to ensure appropriate levels of investment in water infrastructure meets future planned growth needs.

Both the Herts and Middlesex Wildlife Trust and The Ver Valley Society recognised the importance of educating people of all ages to save water and were supportive of an increase in this activity.

Retailers

We did not receive any responses to the pre-consultation on the dWRMP19 or the dDMP from retailers who have contracts with us. We recognise we need to better engage with retailers more effectively and will ensure they have the opportunity to participate during consultation of our draft plan.

5.5 Next steps

We are currently planning for our public consultation to start in March 2018, running for a period of approximately 10 weeks to give customers and stakeholders plenty of opportunity to comment on our draft plan. The learning and outcomes from our public consultation will link closely to the development of our Business Plan.

The desired outcome of the public consultation is:

To enable customers, regulators and stakeholders to have an active engagement in the development of our WRMP; utilising a variety of activities and providing the appropriate level of knowledge for them to undertake this effectively.

A consultation overview document has been produced which outlines the approach to be taken and this will be supported by a detailed action plan and a communications plan.

The range of activities and channels to be utilised will include:

Table 14: Range of activities to be utilised during the public consultation phase

Activity	Channel
dWRMP customer focus group discussions x 8	Face to face
dWRMP customer survey 1,000 customers	On line
Stakeholder forums x 10	Face to face
Consultation document (customers and stakeholders, including retailers)	On line
Stakeholder meetings and events	Face to face

In addition, we will be seeking customer and stakeholder views relating to the dWRMP via our Business Plan consultation. This will include the following activities and include consultation on potential customer bill impact.

Activity	Channel
Business Plan focus group discussions x 8	Face to face
Business Plan Acceptability survey 800 customers	Face to face
Stakeholder forums x 10 (same forums as above)	Face to face
Consultation document (customers and stakeholders, including retailers)	On line
Future customer focus group discussions x 6	Face to face
Stakeholder meetings and events	Face to face

The PR19 Customer Engagement Programme, Hubbub Campaign and the other projects described have produced a number of informative initial findings. These will be further investigated, tested and developed through the phased approach and will form an integral element of the public consultation in 2018.

A non-technical version of the plan (our consultation document) will be produced to enable people to better understand the purpose and key proposals of the dWRMP19 and be equipped with the background knowledge to give a more effective response to it.

The CCG, national bodies and regulators will continue to be engaged via regular updates and dialogue through face to face discussions.

Customers will be consulted via a representative online survey and a number of focus groups. They will also be able to respond to the consultation document. The findings from the survey and focus groups will be analysed by an independent third party.

The majority of stakeholder engagement will take place on a face to face basis, supported by the consultation document. Independently facilitated stakeholder forums will be localised and held across our Central, East and Southeast regions. The findings from the forums will be independently analysed.

In addition to these events, we are currently identifying any existing/planned stakeholder events being run by our partners i.e. local authorities, local economic partnerships and local interest/environmental groups, Affinity Water Saving Squad and internal staff events.

The Environment Agency guidance states that all responses should be sent to the Secretary of State at Defra.

All responses received via the customer survey, focus groups, stakeholder forums and meetings/events will be collated using a consistent method and logged. Agreement has been reached with Defra that findings from these activities can be analysed and a report sent to Defra at the end of the consultation period.

Individual responses to the consultation document will be automatically sent to both Defra and Affinity Water to enable the data to be collated and analysed by us.

All other responses will be sent directly by respondents to Defra who will send copies to us.

Feedback to participants and other interested parties will take place via the Statement of Response which will be published on our website and promoted via our website and social media.

A ‘Lessons Learnt Review’ will be undertaken to check that the process and outcomes have been effective. This will be shared across the business to shape future practice.

6 Problem Characterisation

Summary

This chapter describes the context and our assessment of the scale of the challenge we face to maintain supply into the future. The problem characterisation exercise seeks to answer two main questions:

1. How big is the problem? – known as the strategic needs, and
2. How difficult is it to solve? – known as the complexity factors.

The challenges and issues that we need to meet whilst undertaking our WRMP19 are presented in Table 8. These challenges include uncertainties from sustainability reductions, along with potential impacts of WFD requirements and a potentially significant no-deterioration risk, which may restrict abstraction licences further. Abstraction reform poses an additional challenge to how we supply water to customers. This could significantly change the available resources and required investment for the future. Our supply area is also expected to witness high population growth in response to future development, migration and major infrastructure projects (HS2, cross rail and airport expansions). A concern exists that additional population may drive a sustained deficit, even with a reduced average per capita consumption. These challenges are compounded by the uncertainty in behavioural change in response to our Water Saving Programme, which is a core part of how we plan to reduce demand.

The key conclusions drawn from the problem characterisation exercise are that the scale of the planning problem facing us ranges from ‘Low’ to ‘Medium’, and that our Central Zones (1-6) represent our most challenging areas for both strategic needs and the complexity of the challenge. We conclude that overall we face a ‘Moderate’ level of concern that correlates with Risk Composition 2.

Overall the problem characterisation exercise has resulted in us adopting a methodology for our dWRMP that is consistent with improvements to the way we have forecasted and planned for long term supply demand estimates (from fWRMP14). For dWRMP19 we therefore concluded that we required the development of a Resilience Tested Plan.

6.1 Introduction

The problem characterisation exercise is a tool for assessing a company’s vulnerability to various strategic issues, risk and uncertainties. This exercise allows companies to do the following:

- Characterise and explain the problem that requires a solution and choose the best decision making process for appraising the options available;
- Determine the technical methods approach for dealing with the risks in the WRMP; and
- Determine the relevant technical methods for supply, demand, outage and headroom calculations that are consistent with the chosen approach and risk composition.

In line with UKWIR (2016) we undertook a problem characterisation exercise to support the development of our dWRMP19. It has provided a documented and auditable trail to explain our decisions on methods and approaches to regulators and stakeholders. The full process is provided in UKWIR, 2016, where the guidance is set out for companies to use.

In basic terms it comprises:

- **Strategic Needs** ("How big is the problem") – which includes three questions that seek to provide a high – level assessment of the scale of need for new water resources; and
- **Complexity factors** ("How difficult is it to solve") – this comprises a series of questions relating to supply, demand and investment that provide an assessment of the complexity of issues that affect investment in a particular WRZ or area.

Our approach was to undertake two assessments, iteratively, as follows:

- An **initial assessment** ahead of the dWRMP19, in order to define the methods and tools to be used in advance of the development of the dWRMP19; and a
- Further **iteration** prior to main plan submission stage in order to understand whether the risk composition has changed, during the development of the dWRMP19.

Here we explain the strategic challenges and issues that we face, along with the risks that they pose to our operations. We also provide a summary of the results from our most up to date problem characterisation exercise alongside our chosen decision making approach and our chosen risk composition.

The assessments are discussed further in Technical Report 1.7: Problem Characterisation.

6.2 Introducing our Key Challenges for dWRMP19

Our key challenges and issues are similar in nature to those experienced at WRMP14 but our understanding of how they **differ in scale** and **complexity** has changed since WRMP14, it is therefore appropriate to set these challenges out.

Table 15 provides a list of challenges and issues that we need to meet whilst undertaking our WRMP19.

These challenges include uncertainties from potential sustainability reductions, along with potential impacts of WFD requirements and a potentially significant [3]no-deterioration risk, which may restrict abstraction licences further. Abstraction reform poses an additional challenge to how we supply water to customers. This could significantly change the available resources and required investment for the future. The potential need for significant investment, combined with uncertainty over requirements to plan to a particular level of service, could raise concerns over the impact on customer bills.

Our supply area is also expected to witness high population growth in response to future development, migration and major infrastructure projects (HS2, cross rail and airport expansions). A concern exists that additional population may drive a sustained deficit even with a reduced average per capita consumption.

These challenges are compounded by the uncertainty in behavioural change in response to our Water Saving Programme, which is a core part of how we plan to reduce demand.

[3] No-deterioration is assessed by the Environment Agency as the potential risk of deterioration of the status of a water body through potential use of a licence above its recent actual value (average abstraction between 2007 and 2012 excluding extended outage periods) but within licence value.

Table 15: A list of challenges our WRMP19 seeks to meet

Challenge	Description
Growth in population and reducing demand	We face substantial future challenges from **population and household growth**. Our latest company-wide projections show that the rate of population increase is still rising and is forecast to increase a further **8.5% by 2025 and 20% by 2045.** Currently more than 48% of the households we serve pay metered charges. We know these households use less water than households without a meter which can represent a **significant water saving.** One of our key challenges is to continue to reduce demand through metering.
Challenging climate conditions and drought	Climate change and the effect of varying climate conditions from **drought to flood** could mean a **loss of resource**. We are facing significant levels of risk from drought. Current drought planning extends to the operations needed to manage drought under conditions seen previously. In WRMP the risk to supply from droughts worse than those seen in the **historic record** can result in additional risk to our supply base.
Sustainable abstraction	In the WINEP guidance the Environment Agency notified us that in addition to the sustainability reductions we are already making we should evaluate the effect of **further reductions**. We face the challenge to **demonstrate no deterioration** to both the quality and quantity of our water resources, the presence of which would further erode our resource base.
Leakage	**Controlling leakage** on our pressurised network is one of the ways we ensure we have enough water to satisfy demand. The challenge for us is getting the balance right between how much we invest to renew our network in order to prevent leakage rising compared to the value of the water we save in doing that. Ofwat has indicated that companies should reduce leakage by 15% in each successive AMP.
Water efficiency	Customers continue to use more than the national average. Ofwat has suggested that all companies should achieve an average level of consumption of 110 litres per person per day by 2035.
Pollution	Our water sources remain under threat from many sources of **pollution** including agricultural pesticides, in particular, metaldehyde and herbicides and from historical industrial use.
Major infrastructure projects	The nature of our regions and their proximity to London means that **development** is inevitable and we must cope with changes to the way we supply water to customers, whilst maintaining their security of supply. There are some major infrastructure projects occurring in our supply area over the coming years which present significant challenge and risk, these include: • the **High Speed 2** rail link between London and the North traverses our Central region. It passes very close to a number of our sources, which need to be protected against damage • a new **western rail link from Slough to Heathrow** • the investigation of shale gas fields in the South East of England and the associated development of hydraulic fracturing ("**fracking**"). This currently particularly affects our Southeast region • regional **airport expansions.**

6.3 Drought Risk

6.3.1 Nature of droughts

The risk to supply from drought is one of our key risks, and it is worth just providing a bit more background to the nature of drought risk.

A drought in water resources terms occurs after a number of months of below average rainfall. The amount of winter rainfall is particularly important in assessing the severity and likelihood of a drought, as it is this that replenishes most water resources. The low groundwater levels and river flows that result from such a dry period reduces water availability from rivers and aquifers, and reservoir levels fall. This poses a threat to water supply to customers.

A drought is a naturally occurring event. As a result, no two drought scenarios are ever the same in terms of severity, location, nature, duration and ultimately impact, and can lead to different responses from neighbouring water companies as a result of the following:

- **differing levels of drought severity across the region:** Whilst droughts across the South East will generally be caused by a regional trend of several months of below average rainfall, sub-regional differences in rainfall may cause different levels of drought severity across the region. The need to impose restrictions for one company may not equally apply to another company in the South East
- **differing vulnerabilities at water resource zone level:** Due to the way the water supply system has developed over the years, many water company supply areas are sub-divided into water resources zones (WRZs). These are defined as the largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which customers experience the same risk of supply failure from a resource shortfall. WRZs can be divided into those dependent upon:
    - river abstraction only;
    - groundwater abstraction only;
    - reservoirs filled by abstracting local river water or by impounding river water; and
    - various combinations of the above.

Companies with a mix of WRZ types often find that even if there was no significant difference in drought severity across the region, WRZs will tend to react differently. Depending on the conditions, certain zones will experience higher levels of risk to supplies than others as a result of how the supply is supported. This difference in WRZ vulnerability has an impact both at the company level and at a regional level. It can result in a water company needing to introduce water use restrictions in its more vulnerable WRZs whilst not needing to extend the ban to the remaining zones in its area of supply. Similarly, at the regional level, it can mean that one water company may need to impose water use restrictions earlier in a drought than its neighbours as the system is more vulnerable to the observed drought conditions. As a result, flexibility needs to be built into the DMP to allow for the most efficient and effective way of responding to different drought situations.

More details regarding how we manage the risk of drought can be found in our Drought Management Plan (DMP) Technical Report 1.6.

6.3.2 Drought triggers

Within our DMP we have developed drought triggers that allow us to identify when we should consider implementing specific drought actions to either reduce demand or obtain extra resource to increase supply. Drought triggers are designed to allow appropriate lead in time for the preparation and implementation of specific actions. This is particularly important for the following actions:

- Customer communications;
- The implementation of temporary use restrictions; and
- Applications for drought permits and orders.

Drought triggers can be based on a number of different parameters including historic rainfall pattern, reservoir levels, flow levels in rivers, and groundwater levels. As identified in Chapter 4, approximately 65% of our resources are derived from groundwater sources with 35% derived from river sources, most notably the River Thames. Our licences for abstraction from the Thames are not limited by flow conditions and therefore our DMP triggers focus on the behaviour of our groundwater sources. Groundwater supplies are totally dependent on local climatic conditions providing sufficient rainfall during the autumn and winter months to naturally recharge aquifers. Groundwater droughts typically arise as a consequence of low winter rainfall. We therefore use a combination of historical rainfall and measured groundwater levels on which to base our drought trigger levels.

These triggers provide a decision making tool that we use as part of our framework for drought management, allowing us to monitor the effect of low rainfall on groundwater levels and instigate drought management actions as the severity of a drought increases and recedes.

6.3.3 Drought risk assessment

Our worst historic drought has been identified as our ‘design drought’ for planning purposes. More explanation of this is given in section 8.3 of this report and links with our DMP are discussed in section 8.3.5.

6.4 Problem Characterisation Results

Our problem characterisation exercise focused on the key challenges that we face and the following is a summary of the scale and complexity of the challenges set within the context of the assessment that we undertook:

Assessment of Strategic Needs:

Central Region

- At WRMP14 our understanding of the risks associated with large potential sustainability reductions that could affect our supply base was not as well defined as it is now. The risk of further reductions in licence capability through sustainability reductions and no-deterioration is now better defined, reducing the uncertainty around this risk. However, through our work on WINEP, the unknown volume at risk remains significant (61.5 Ml/d), and our indicative work on no-deterioration suggests a further c.12 Ml/d might be at risk.

- Our dWRMP19 Deployable Output (DO) methodology has decreased the worst historic deployable output available by 42Ml/d at DYAA.

For our score for our Central region we assigned a moderate level of concern. We assigned our Southeast and East regions a low level of concern.

Supply-side Complexity Factor:

Central Region

- any step changes that may occur from sustainability reduction changes in the Central Region could result in step changes in new investment to offset the reduction in our supply base

- our revised worst historic DO assessment has resulted in a loss of 42 Ml/d, and has changed our planning risk to average conditions (from WRMP14 where it was peak). This will add additional pressure on our supply/demand balance forecasts, where the DO is reduced. However, conversely the reduction in DO can be seen as an improvement in our understanding of the worst historic drought on record, and as such increases our certainty in the method and DO availability

- our near term supply system performance is good and well understood. In addition we have a new and even more robust Drought Management Plan which is due for final publication in early 2018.

Demand-side Complexity Factor:

- inherent concerns over savings from our (10 year) WRMP14 demand side measures remain. It should be noted that this could have a knock-on effect with post AMP7 supply demand needs; should there be a shortfall in savings.

Investment Complexity Factor:

- some moderate uncertainty over large scale 'regional' options that would need long lead in times could require complex funding mechanisms. This is also linked to our potential need to plan for more severe drought events

- the timing of any new transfers and infrastructure would need to be aligned with other infrastructure and planning projects with our region (e.g. HS2).

Our complexity score reflects some of the additional complexity that we recognise including other water companies and sectors. For this reason, and when taking into account the uncertainty relating to savings from our Water Saving Programme, we have assigned a moderate level of concern to our complexity score. Though it should be noted that we assigned a high level of concern for the step changes that might occur over the long term planning horizon.

The assessment strategic needs and complexity matrix and score assessments are presented in

Table 16 and Table 17. Figure 19 provides an explanation of how the scoring is used to define the modelling complexity (outlined in the following section).

The scores in Table 16 and Table 17 are a combination of the complexity and strategic needs scores. These are categorised as No, Moderately and Very significant concerns (Green = 0, Yellow = 1and Amber = 2). Each risk is assessed according to a question, the actual scoring assessment behind the results can be found in Technical Report 1.7: Problem Characterisation.

Table 16: Draft Final Assessment Results Matrix

draft Final Assessment for Draft Plan - 2017 (Sept)					
Problem Characterisation		Strategic needs score			
		0-1 (None)	2 -3 (Small)	4 -5 (Medium)	6 (Large)
Complexity factors score ("How difficult is it to solve")	Low <7	East	Southeast		
	Medium 7-11			Central	
	High (11+)				

Table 17: Draft Final Assessment Scoring Matrix

draft FinalAssessment for Draft Plan- 2017 (Sept)					
	Strategic score	Complexity scores			Complexity total score
		Supply	Demand	Investment	
Central	5	5	3	3	11
Southeast	3	3	1	2	6
East	1	1	0	0	1

Low level of concern	Current approaches (EBSD) should be adequate and specific complexities can be examined through steps recommended in the parallel UKWIR Risk Based Planning Methods project (to assist in derivation of DO, incorporation of uncertainty etc).
Moderate level of concern	Extended' approaches to modelling may add considerably to a company's understanding. 'Extended' refers to methods not previously widely used in WRMPs, but which have been tested to at least the 'proof' concept stage for actual UK water resource systems and have outputs that can be readily unnderstood by planners. For example, for Aggregate approaches this may mean the use of Real Options Analysis, whilst for Systems Simulated approaches this may mean the use of non-scheduled methods, or methods that examine limited portfolios without optimisation.
High level of concern	More than one of the 'Extended' approaches to decision making could be applied or even the use of the 'Complex' approaches, as these could add considerably to the company's understanding. Here, 'complex' approaches refers to more advanced, conceptually complex methods not yet applied to the UK water resources context, although these may be under current investigation.

Figure 19: Taken from UKWIR (2016) Appendix B: Using the results to define the modelling complexity

6.5 Problem Characterisation Conclusions

We concluded that our assessment scores correlated to **Risk Composition 2**, which translates into a plan that requires resilience testing (a **Resilience Tested Plan**). Our EBSD modelling methodology was judged to require an ‘extended methods’ approach.
On this basis of our understanding of our risk composition, we also chose the following technical methods:

- a stochastic approach to determining source deployable outputs (consistent with Risk Composition 2 & 3);
- a demand forecasting methodology that is appropriate for Risk Composition 2:
    - Micro-component model (plus Multi-Linear-Regression model)
    - Non-household demand based on historic trend analysis
- a conventional methodology for Outage and Headroom (both of which are consistent with Risk Composition 1 & 2)

Some of the wider benefits of using the new UKWIR (2016) problem characterisation methodology for the development of our dWRMP19 are further summarised in our Technical Report 1.7: Problem Characterisation.

Table 18 provides a summary of what a 'Resilience Tested Plan' includes, in terms of the methods and components; we also provide a comparison with our WRMP14 methods to help highlight the main differences.

We believe that our improvement in our understanding of the strategic risks and uncertainties that we face has now enabled us to select a more appropriate set of technical methods for the challenges that we face.

Table 18: Comparison between key technical methods used in WRMP14 and dWRMP19

WRMP14 'The Least Cost and Preferred Plan'		dWRMP19 'The Resilience Tested and Best Value Plan'	
Method / Component	**Comment**	**Method / Component**	**Comment**
Supply – side Deployable Output (DO)	Basic approach (worst historic drought event DO) with climate change impact	Supply – side Deployable Output	Revised DO modelling (1 in 60/80, 1 in 200 & 1 in 500 DOs) for resilience testing. New DO methodology and climate change assessment (based on simulated data)
Demand – side	Micro-component model re-build Non-household demand (flat-line projection)	Demand – side	Micro-component model (plus Multi – Linear – Regression model) Non-household demand based on historic trend analysis
Risk and uncertainty	Conventional Outage and Headroom	Risk and uncertainty	Conventional Outage and Headroom (extended to 2080)
Sustainability Reductions	Confirmed (AMP6/7)	Sustainability Reductions	Confirmed (AMP6/7) plus Uncertain SRs (WINEP 1 & 2)
Regional	WRSE – Alignment and comparison analysis	National / Regional	National Study, WRSE & WRE – Alignment and comparison analysis
Options Appraisal	Full appraisal	Options Appraisal	Full Appraisal plus enhancements (for MCA)
EBSD – Least Cost and Preferred	Worst historic DO, DI Standard least cost (with scenario testing)	EBSD – Extended Methods	163 scenario tests (simulations), e.g. 1 in 60/80, 1 in 200 & 1 in 500 DO; Low/Med/High DI, WQ Impacts, U/C SRs (3 levels)
EBSD – MCA	N/A	EBSD – MCA	Portfolio shortlisting (env +/-, deliverability, yield and cost uncertainties)
EBSD – Resilience Testing	N/A	EBSD – Resilience Testing	Info Gap – Resilience stress testing (on shortlisted portfolios)
Drought Plan / WRMP links	N/A	Drought Plan / WRMP links	Order/Permits (On/Off); DP modelling links
SEA / HRA	SEA/HRA Assessment of options	SEA / HRA	SEA/HRA Assessment of options (pus MCA)
Investment strategy	Preferred	Investment strategy	Preferred and alternative strategies (including potential for adaption planning in the future).

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7 Resilience in the Water Industry

Summary

This chapter explains our approach to resilience in our dWRMP19. Although resilience has always been a key issue for customers and our industry, in recent years the focus has shifted from the traditional views of infrastructure, operational and financial resilience onto new challenges - climate change, population growth, sector skill gaps, supply chain failure and cyber threat. Ofwat have introduced the term of 'Resilience in the round' for PR19 to capture these threats and to ensure customers and the natural environment is at the heart of resilience proposals.

Government has known for some time that climate change and population growth is putting pressure on the water sector in England (DEFRA, 2016). The sector needs to adapt to ensure that it can continue to meet the needs of people, businesses and the environment. The roadmap set out in (DEFRA, 2016) is aimed at enhancing the policy framework to secure long term resilience of the sector. The Water UK (2016) study is an important step on the roadmap, for developing long term resilience to such pressures within a national context, and the findings are relevant for the identification and inclusion of WRMP options. We discuss further how our dWRMP19 fits within both a national and regional context in Chapter 14 of this report.

We present our interpretation of 'resilience in the round', showing how planning in the short, medium and long-term feeds into different aspects of resilience, keeping the customer at the heart of decision making and the role the WRMP process has in this. We have a long term adaptive resilience strategy.

7.1 Definition of Resilience

The Task and Finish group (Ofwat, 2015) definition of resilience by the Water and Wastewater Resilience Action Group is the official definition now adopted by the whole water industry:

"Resilience 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."

Although resilience has always been a key issue for customers and our industry, in recent years the focus has shifted from the traditional views of infrastructure, operational and financial resilience onto new challenges - climate change, population growth, sector skill gaps, supply chain failure and cyber threat. Ofwat have introduced the term of 'Resilience in the round' for PR19 to capture these threats and to ensure customers and the natural environment is at the heart of resilience proposals.

Most hazards are dormant or carry potential threat, with only theoretical risk, however once 'active' can or will create an emergency situation. It is possible to categorise hazards into resilience hazards such as the following (UKWIR, 2013):

- rare natural events;
- rare man-made accidents/disasters; and
- rare cascade failures.

Resilience hazards can be short or near term (e.g. one hot dry summer drought, or a flood event), medium term (e.g. three dry winter drought) or long term (e.g. climate change or increasing population growth).

Government has known for some time that climate change and population growth is putting pressure on the water sector in England (DEFRA, 2016). The sector needs to adapt to ensure that it can continue to meet the needs of people, businesses and the environment. The roadmap set out in (DEFRA, 2016) is aimed at enhancing the policy framework to secure long term resilience of the sector.

The Water UK (2016) study is an important step on the roadmap, for developing long term resilience to such pressures within a national context, and the findings are relevant for the identification and inclusion of WRMP options. We discuss further how our dWRMP19 fits within both a national and regional context in Chapter 14 of this report and in detail within our Technical Report 5.1 National and Regional Water Resources Modelling.

7.2 Current Key Resilience Challenges for the Water Sector

The current key challenges for resilience in the water sector are:

- climate change and extreme weather events resulting in droughts or floods, extreme cold events
- population growth
- environmental degradation and impact on water quality
- economic and social change (including Brexit) – affordability and austerity
- ageing infrastructure
- planning uncertainty due to all the above
- cyber attacks.

The Water Act 2014 adds a new duty to Ofwat's primary duties: to 'further' the resilience objective. It highlights the need for long-term resilience of water and wastewater systems and service provision when faced with increasing external stresses, such as environmental pressures, population growth and changes in customer behaviour. It also highlights the need to:

- promote long-term planning and investment and the use of a range of measures to manage water resources in sustainable ways
- increase efficiency in the water use
- reduce demand for water to minimise pressure on water resources.

We are seeking to understand the customer, environmental and societal priorities in our area; understanding the risks to resilience and acting appropriately to deliver for our communities. We are looking at the macro systems, our own as well as how they interact with other built infrastructure such as energy, transport, communications and also the natural environment.

7.3 Why is resilience important for us and customers?

The Water Act 2014 highlights the need for long-term resilience of water and wastewater systems and service provision when faced with increasing external stresses, such as environmental pressures, population growth and changes in customer behaviour. The WRMP process is a potential mechanism to deliver certain aspects of resilience.

In PR19 Ofwat wants companies to show more ambition than ever to deliver:

- great customer service;
- long-term resilience;
- affordable bills that offer value for money; and
- innovation and new ways of doing things.

Further investment may be required to deliver an ever more resilient sector. Ofwat recognises that there may be considerable expenditure for “hard” infrastructure for new water transfer schemes, for flooding resilience, for service continuity.

We are seeking to understand customers’ and stakeholders’ opinions on environmental and societal resilience priorities in our area, through our engagement work. Specifically we are enhancing our understanding of the risks to our resilience and plan to act appropriately to deliver security of supply and meet our levels of service for our communities.

Figure 20 below illustrates our interpretation of ‘resilience in the round’. It shows how planning in the short, medium and long-term feeds into different aspects of resilience, keeping the customer at the heart of decision making and the role the WRMP process has in this. We have a long term adaptive resilience strategy which incorporates aspects from the whole business in terms of WRMP, Business Plan and operational requirements. Our dWRMP19 looks to secure long term water resources resilience.

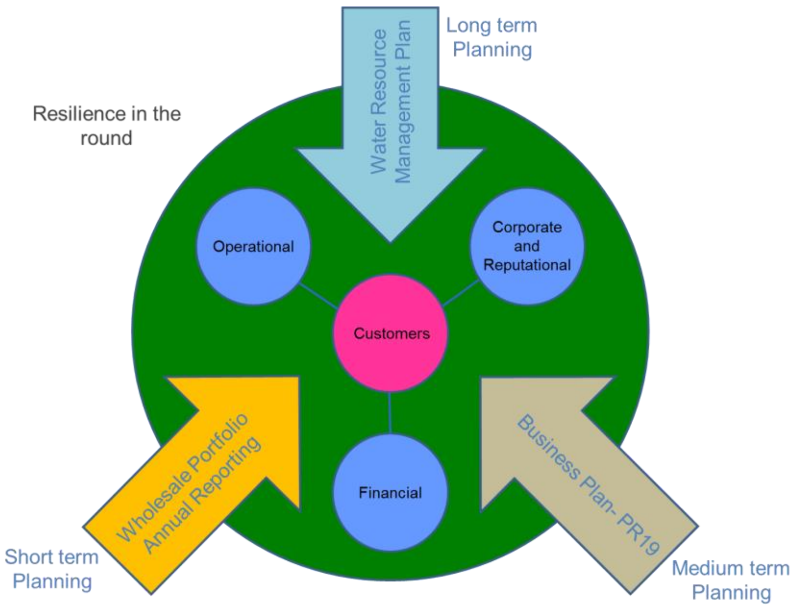

Figure 20: Resilience in the round

We have developed our methodology and reviewed our risk registers, created a resilience steering group and held a workshop with internal stakeholders.

Our PR19 resilience work to date has included a workshop with key stakeholders in the business (steering group) to discuss our strategic and corporate risks. A risk assessment of our current resilience is ongoing leading to draft mitigation schemes. Our next steps include a proposal of our strategy and standards for resilience which will include engagement with customers, CCG, stakeholders and external communities (e.g. local authorities) regarding on resilience and the need to define resilience metrics and performance commitments.

7.4 Resilience within our WRMP

Government policy for WRMP19 points to the need for options that can secure the long term resilience of the water sector. Also the WRPG states that WRMP19 must consider how our current and future operational system will be resilient to a range of droughts and non-drought hazards across our planning period.

Resilience is a thread through our whole dWRMP plan working to ensure sufficient supply over the planning period to meet customer demand at average and peak conditions under various drought conditions. Specifically for dWRMP19, we focus on our worst historic drought and the 1 in 200 return period droughts.

Our dWRMP19 has greater resilience than previous plans and there are several key areas of our plan that have an emphasis on securing long term water resource resilience. These aspects of our plan include the following:

- **drought resilience** - new methodologies for drought impact on our supplies have been developed and tested, these include drought planning for the worst historic event on record and more severe drought events
- **regional solutions** – assessed options offering improved connectivity with neighboring companies and third parties. Our plan is aligned with a regional strategy and forms part of a wider regional resilience solution, offering resilience to multiple companies
- **long term planning** – our EBSD extended methods approach takes our water resource planning beyond the 25 year horizon to 2080, and offers an **AP** that enables adaptation to future uncertainties
- **strategic schemes that offer linked solutions** - within our optioneering we have included schemes that offer solutions for single points of failure and are linked to strategic schemes that deliver 'new' source water or new treatment solutions
- **emphasis on demand management strategies** – demand management strategies are an essential aspect of long term resilience, and our commitment to a continuation of our water saving programme (including metering and water efficiency initiatives to reduce per household consumption in the long term) will ensure this remains a key area of our long term strategy
- **further leakage reduction** – reductions in leakage below the economic level will also help to improve our resilience to drought and population growth.

These aspects of our plan will help to assist in addressing the following long term drought and non-drought hazards and planning risks:

- reduced availability of supply due to climate change, pollution risk, and possible impact of major infrastructure projects on our sources of supply and sustainability reductions
- increase in demand through climate change and population growth
- uncertainty relating to large scale infrastructure planning to meet drought hazards, where supply demand deficits may occur beyond the minimum 25 year period.

The resilience of our DO has been particularly improved by a significant downgrade of our baseline DO due to the fact we are now planning to a higher return period drought in our baseline deployable output. Further details can be found in Chapter 8. Resilience is also inherent in our new ESBD extended methods approach (Section 13.0).

The less uncertainty associated with our methodology for assessing drought severity and the more we do to explore a range of potential futures, the more resilient our plan is.

7.5 Aspects of Resilience Outside the WRMP Remit

The following aspects of resilience are considered as part of business planning and business as usual activities (BAU):

- Floods and storms
- Critical asset failure (incl. power, fuel, materials or skill shortage)
- Contamination of water in distribution
- Unavailability of supply (due to drought, pollution event or exceptional demand)
- Malicious damage and terrorism
- Telemetry, telecoms and IT failure (incl. cyber threat)
- Financial (cash flow, debt, customer bad debt),
- Governance / Corporate (data/information assurance, process/systems, people and skills, regulatory, supply chain)

The unavailability of supply and some of the catchment /environment aspects are included in our dWRMP19. The other categories in the above list will be covered more widely in the Business Plan. Terrorism is covered by security and emergency measures, and is well embedded in business as usual.

Our operational system has high resilience in that we currently have a diversity of water sources from both groundwater and surface water together with an interconnected pumping network. This means that customers have low vulnerability to operational failure events or single year droughts that affect surface water dominated systems, but longer term low rainfall events can still result in the need to impose restrictions on use. Our level of service is such that should restrictions on water use be required, the restrictions can be introduced progressively as outlined in our Drought Management Plan.

A key theme that came out of the dWRMP19 stakeholder pre-consultation process regarding resilience was how we are ensuring resilience against terrorism and Brexit. The WRMP process is about ensuring we have enough water to meet customer demand at a macro scale into the future and issues such as terrorist activity are not dealt with under WRMP. Ensuring resilience of this kind is dealt with at an operational level and investment for this is sought within the business plan process.

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8 Water Supply

Summary

This chapter provides as description of how much water we have available to supply customers per annum for a planning period of 60 years, including a calculation of climate change impacts on supply and sustainability reduction changes. It describes our approach to catchment management and discusses water quality.

For the purpose of this WRMP our supply forecast is the amount of water we can reliably supply to customers during our chosen 'design drought'. We face a number of key challenges in our area regarding our supply base, presented in Section 8.2. We have recalculated our supply forecast for dWRMP19 based upon a new methodology and evaluated this in line with our worst historic drought since 1900. As a result our calculation of available supply known as deployable output (DO) has reduced by 84 Ml/d relative to WRMP14, largely owing to the sustainability reductions in AMP6 and a shift to a more severe worst historic drought. Our 'worst historic drought' which we propose to plan to has been evaluated to be representative of between a 1 in 60 to 1 in 80 year event which accounts for 42 Ml/d of the 84 Ml/d reduction in DO between fWRMP14 and dWRMP19.

Our existing bulk transfers with other water companies are presented in Section 8.4.

We discuss our National Environment Programme (NEP) in Section 8.5, which is a list of environmental improvement schemes defined by the Environment Agency (EA) to ensure that water companies meet European and national targets related to water bodies. Our current NEP includes investigations, options appraisals and implementation schemes relating to the environmental impact of our abstractions, including 'morphological mitigation works' (river restoration and habitat enhancement) and fish screening. Our NEP also includes our Sustainability Reduction Programme, where we will be reducing abstraction by 42 Ml/d by 2020.

We present our dWRMP19 sustainability reductions in Section 8.6.4 and WFD and no-deterioration risk in Section 8.6.5. Drinking water quality and catchment management are discussed in Section 8.8, water treatment adjustments in Section 8.9 and the impact of climate change on supply in Section 8.11.

8.1 Introduction

Our supply forecast is the amount of water we can reliably supply to customers during our chosen 'design drought'. We also calculate the amount of water we can supply during specific parts of the design drought, known as 'critical periods' which are likely to be during the summer, when the customer demand for water is significantly higher than during other parts of the year. The calculation of our supply forecast is presented in detail in Technical Report 1.1: Deployable output and climate change impact assessment of which a summary is provided in this section.

8.2 Key Issues and Challenges

We face the following key challenges in our area regarding our supply base:

- uncertainty over the amount by which we may be required to reduce our abstractions, known as sustainability reductions. We are working with the EA to define both water resources and water quality elements of the Water Industry National Environment Programme (WINEP) for AMP7, to determine the volume of our sustainability reductions
- sustainable catchments assessments to meet WFD objectives. This is a possible reduction in abstraction at existing sources where our recent actual abstractions have been less than the licence volume
- contamination of groundwater supplies in certain areas from point and diffuse sources
- uncertainty regarding the estimation of yields of borehole sources at groundwater levels lower than ever before recorded due to the complexities of the way water flows through the Chalk. It is concentrated in various fissures (seams) which can be highly unpredictable in their location and behaviour, which increases the uncertainty around the predictions at low groundwater levels
- uncertainty regarding the impact of major infrastructure projects on yield and quality of water in some of our nearby sources.

8.3 Deployable Output

8.3.1 Definition of deployable output

Deployable output (DO) is the amount of water that can be abstracted from a range of conditions but notably under dry year conditions and delivered into supply. The reliable supply over the course of a year is known as average DO (ADO) and the reliable supply during the summer is known as peak DO (PDO). Both ADO and PDO are presented in the units of 'millions of litres per day' (or 'Ml/d').

There will be a number of constraints on supply which are incorporated into the calculation of DO such as the licence, or hydrogeological or physical constraints (such as the pump depth in a borehole, or a dewatering an adit[4], or the capacity of the treatment works). A comparison of the DO assessment for this plan and our last plan in WRMP14 is showed in Table 19.

[4] An adit is a horizontal tunnel extending typically several hundred metres away from the vertical abstraction borehole. This is to enlarge the capture zone and hence the yield of the borehole.

Table 19: Groundwater Deployable Output (DO) Assessment

	WRMP14	WRMP19
DO assessment methodology	Basic assessment DO assessed using historic water level data against output data (UKWIR 1995, 2000).	Enhance assessment for drought vulnerable sources (c.65 sites) and DO re-assessed per source by developing source models and assessed in WRZ models.
Worst historic drought period	Assessments based on drought conditions in the 1990s, 2006 and 2012.	Assessments based on the worst historic drought in the hindcast record (1930s and 1940s) through an automated DO curve shifting approach.
Levels of service (LoS) and return periods	Qualitative link between DO, drought return period and LoS.	It follows that existing LoS with explicit links between DO drought return periods and LoS. A range of DOs for different return periods (derived from WRSE stochastic climate data) and impact of drought conditions will be tested in our EBSD model with or without demand restrictions and drought permits/orders (linking to Drought Plan).

8.3.2 DO methodology

A revised and improved methodology has been used to calculate DO for this WRMP which is explained in detail in the Technical Report 1.1 Deployable output and climate change impact assessment.

8.3.3 DO assessment

In order to reassess our DO values for each source, records of groundwater levels and abstractions have been analysed. These, along with a review of constraints information have been used to predict the reliable supply that can be achieved when groundwater levels in the wider aquifer are high, average or low. Models have been developed in order to predict the groundwater levels and reliable supplies that might be available in plausible droughts that are more severe than those experienced in the recent past (i.e. more severe than those experienced in the 1990s, 2006 and 2012).

The 'design drought' (referred to in the regulator's guidance) is expected to be based on the worst historic drought; this was defined through analysis of observed data, which was subsequently extended within calibrated lumped parameter models. The worst drought varies by WRZ (owing to the use of different observation boreholes), although the events fall within the 1930s and 1940s. The DOs from the last plan (WRMP14) were based on data for less severe droughts (e.g. 1990s, 2006 and 2012) and for this reason a number of source DOs have lowered compared with WRMP14 (particularly those in WRZ2).

A second key reason for a reduction of worst historic drought DOs since WRMP14 is 'sustainability reductions'; these are reductions in licensed abstraction volumes and rates that have been agreed between Affinity Water and the Environment Agency, in order to protect river flows and ecology. Only those occurring within Asset Management Period 6 (AMP6) are included within the DO assessment (i.e. those implemented before 2020).

The Environment Agency has also requested that water companies test a 'reference' drought within the WRMP that might occur once every 200 years (i.e. a severe drought), in addition to the design drought selected by the water company. This drought condition has been defined through analysis of groundwater levels derived from stochastically generated climate data and subsequently the 'severe drought' DOs were calculated. DOs have also been calculated for a drought event that might occur once every 500 years (i.e. an extreme drought) using the same approach.

The 'severe' and 'extreme' drought DOs are generally lower than the 'worst historic' drought DOs owing to the drought sensitivity of certain groundwater sources (particularly those in WRZ2).

8.3.4 DO results

The 'worst historic', 'severe' and 'extreme' drought DOs are provided in Table 20 for the company area.

Table 20: Summary of water resource zone deployable outputs

Region	Plan	Worst historic ADO (Ml/d)	1 in 200 year ADO (Ml/d)	1 in 500 year ADO (Ml/d)	Worst historic PDO (Ml/d)	1 in 200 year PDO (Ml/d)	1 in 500 year PDO (Ml/d)
Central	WRMP14	1,002	N/A	N/A	1,155	N/A	N/A
	dWRMP19	919	882	874	1089	1068	1048
South East	WRMP14	52	N/A	N/A	61	N/A	N/A
	dWRMP19	51	46	46	58	55	51
East	WRMP14	38	N/A	N/A	53	N/A	N/A
	dWRMP19	38	38	38	53	53	53
Company Total	**WRMP14**	**1,093**	**N/A**	**N/A**	**1,269**	**N/A**	**N/A**
	dWRMP19	**1,009**	**968**	**958**	**1,201**	**1,177**	**1,153**

The worst historic DO values have reduced relative to WRMP14, largely owing to the sustainability reductions and shift to a more severe worst historic drought.

The severe and extreme drought DOs demonstrates the level of drought sensitivity for the company area. Further detail at a source and WRZ level is provided within the Technical Report 1.1. Deployable output and climate change impact assessment WRZs 4, 6 and 8 are assessed as not being sensitive to drought. In the case of WRZs 4 and 6, the DO is dominated by abstraction from the River Thames and the adjacent river gravels; We can abstract up to the licensed volumes and rates with no low-flow constraints. In WRZ 8 the outputs of TARD reservoir and the groundwater sources in the confined aquifer are also assessed to be not sensitive to drought.

As the recalculation of DO using the new methodology has resulted in such a large downgrade of DO, we commissioned further analysis to understand the severity of the mid-1930s and mid-1940s droughts, upon which our new worst historic drought is based and how this compares to more recent droughts (2006, 2012 or 1997) that underpin the fWRMP14 DOs. In short how severe were the mid-1930s and mid-1940s droughts relative to the more recent droughts?

The results indicated that the 1997 drought is only representative of a 1 in 10 year to 1 in 20 year event in the context of the 13,600 years of stochastic based annual minima and July groundwater level data (i.e. it is not particularly severe). The drought years of 2006 and 2012 are even less severe.

The droughts used to define the 'worst historic drought' are the mid-1930s and the mid-1940s. According to the analysis of the observed dataset these are representative of between a 1 in 60 to 1 in 80 year event. Evidence for this for each WRZ can be found in Section 5.2 of the Technical Report 1.1 Deployable output and climate change impact assessment.

Additional evidence has been sought for defining the mid-1930s and mid-1940s as a 'worst historic drought'. Information presented at the Historic Droughts Symposium March 2016, states that the 1930s and 1940s droughts are the critical design droughts for Anglian Water's largest reservoirs.

8.3.5 DO assessment link with our 2017 Drought Management Plan

The groundwater level sequences behind the dWRMP19 DO assessment were compared with the 2017 Drought Plan trigger levels to identify whether the DO assessment scenarios would have led to drought plan measures being implemented based on the existing trigger levels e.g. Temporary Use Bans (TUBs), Ordinary Drought Orders restricting non-essential use and Drought permits and orders.

Based on the modelled groundwater levels behind the dWRMP19 'Worst Historic Drought' scenario ('ADO' and 'PDO'), TUBs would be in use, and for the Worst Historic 'ADO' scenario, it can be assumed that Drought Orders would also have been in place. In the case of supply side permits, it is perhaps borderline as to whether these would have been implemented (although water levels do lower into Drought Zone 4 (DZ4) during spring months, and it can be argued that they would have been implemented).

8.3.5.1.1 Impact of drought order and permits on DO

Within our recent DMP work we analysed groundwater levels with the 2017 drought plan triggers, to validate assumptions around impacts of switching on or off TUBs and demand side Ordinary Drought Orders to meet our planned Levels of Service. Their use requires a percentage demand restriction to be applied. We have chosen a level of 3% reduction in demand from applying TUBs and demand side Ordinary Drought Orders, based on evidence from the 2007 drought (UKWIR 2006 report[5]) and that our metering penetration will have increased. This is likely to impact the overall effectiveness of demand restrictions as demand will have already been suppressed, such that experience from previous droughts may not accurately reflect behaviour in a modern drought. This is in line with our new DMP.

Full impacts on our supply/demand balance modelling of using demand-side and supply-side drought options are explored in our Technical Report 4.9: Economics of Balancing Supply and Demand Modelling.

Additional to the detailed work presented in Technical Report 4.9, we have also populated Table 10 of the Water Resource Planning (WRP) tables to reflect and display

[5] UKWIR, 2006, Drought and Demand: Modelling the Impact of Restrictions on Demand During Drought. 07/WR/02/3

how drought orders and permits impact DO. Table 10 is split into two sections whereby the first half looks at numerical data such as Ml/d benefits, DO numbers and restricted/unrestricted demand.

The second half acts as a short narrative where we were able to include commentary around the components used (DO, demand, supply-demand balance) and more importantly offer a location whereby the predominantly WRMP focused document could interlink with the drought plan work. We used this opportunity to provide a short drought plan overview and then highlight some of the key specifics of this work.

8.4 Existing Bulk Transfers

8.4.1 Introduction

To meet our supply demand balance, we have a number of existing agreements with neighbouring companies and third parties for bulk imports. Additionally, we also have agreements to export to assist other companies where possible.

This section aims to identify the existing transfer arrangements and provide an explanation for additional import/export options which have been derived through a comprehensive options appraisal process as part of dWRMP19.

Our Central region does not have a coastline and is entirely surrounded by neighbouring water companies. There is an existing strategic network of pipes across the region which can be utilised to transfer substantial volumes of water to certain demand centres, often at a significant cost, providing resilience for emergency scenarios. Our Central region shares borders with the following water companies;

- Thames Water
- Anglian Water
- Cambridge Water (South Staffs Water)
- Essex & Suffolk Water (Northumbrian Water)
- Sutton & East Surrey Water
- South East Water

Our Southeast region consists of only one water resource zone (WRZ), sharing a company boundary with South East Water, Southern Water and Independent Water Networks Limited, as well as a portion of the Kent coastline. Similar to our Central, existing transfers link this region to neighbouring water companies which provide resilience to the region when extra water is required.

Our East region is surrounded on its Northern and Western boundaries by Anglian Water, and a coastline along its East and Southern sides. There are no strategic imports nor exports in this region owing to the presence of a shared asset with Anglian Water which provides the operational resilience for this area (TARD Reservoir).

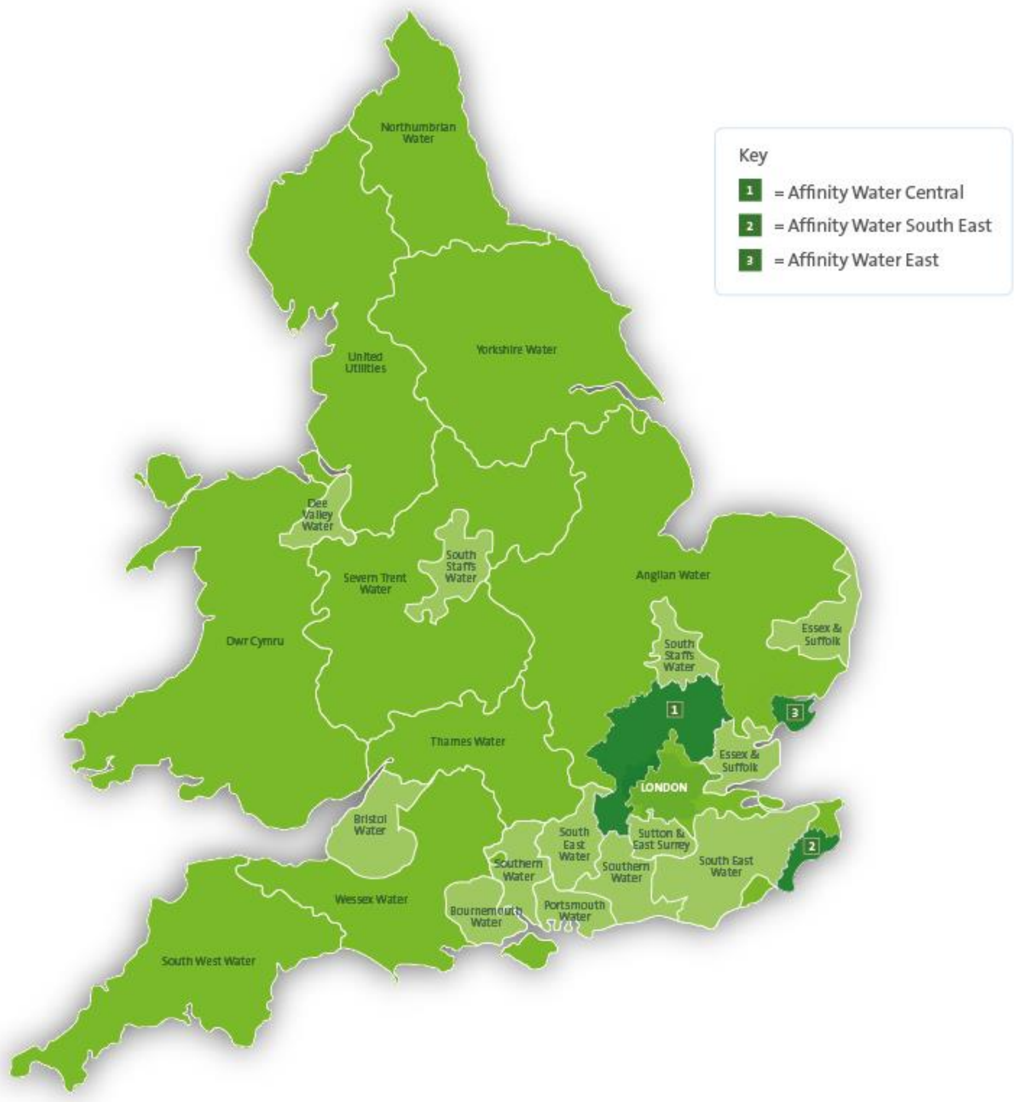

Figure 21: Map of Water Companies in England and Wales

The national-level map in Figure 21 shows the location of Affinity Water in a wider geographic context where our company boundaries are shared with no fewer than seven water companies. In a region which is so densely populated, the levels of resilience provided by bulk supply agreements can be vitally important. This importance has been reflected in the detailed discussions between ourselves and our neighbouring water companies within this report.

A comprehensive review of our knowledge of cross company transfer has been recently undertaken providing a detailed summary of all existing intra-company transfers and a strong basis for additional options to be built on.

The existing transfers are built into the EBSD model for it to determine how much of the maximum capacity it can utilise to balance supply and demand. The model will aim to utilise existing transfers first, before opting for new transfer options if the situation requires them.

We currently have arrangements with six of our neighbouring companies, where we either share assets, and import or export water.

Table 21 provides the volumes for each of the arrangements, as capacity based figures (not utilisations which can vary depending on needs).

For our Business Plan, we will provide our neighbouring companies forecasts based on most likely utilisation, derived from our weighted average annual demand, but including additional allowances for specific project outage, efficiency and risk.

Table 21: List of existing bulk transfer capacities for our dWRMP19

ID	Existing transfer	Donating Company	Receiving Company	Maximum capacity at average Ml/d	Maximum capacity at peak Ml/d
1	Existing	Anglian	Affinity Water WRZ3	76.0	94.0
2	Existing	Thames	Affinity Water WRZ4	27.0	27.0
3	Existing	Thames	Affinity Water WRZ4	0.2	0.2
4	Existing	Thames	Affinity Water WRZ4	2.0	2.0
5	Existing	Thames	Affinity Water WRZ6	2.27	2.27
6	Existing	Cambridge	Affinity Water WRZ5	0.30	0.30
7	Existing	Affinity WRZ3	Anglian Water	0.14	0.14
8	Existing	Affinity WRZ6	South East Water	36.0	36.0
9	Existing	South East Water	Affinity Water WRZ7	2.0	2.0
10	Existing	Southern Water	Affinity Water WRZ7	0.0714	4.0

The Anglian import (No1) is our ANGL import, which has been reduced by 15Ml/d since WRMP14, due to a recent re-evaluation of the ANGL yield by Anglian Water. We view this a worst case estimate pending a review for our final plan. For further information refer to Section 14.6. The Anglian export from WRZ8 is TARD is based on a 70/30 apportionment to 2025.

The Thames import of 27 Ml/d relates to our FORT agreement. Figure 22 shows the indicative locations of our existing transfers, which are numbered according to Table 21.

We also retain a number of emergency cross-company connections that can also provide additional resilience but are not included here. These cross connections are not subject to a formal supply contract and only one of these is maintained in a state of readiness.

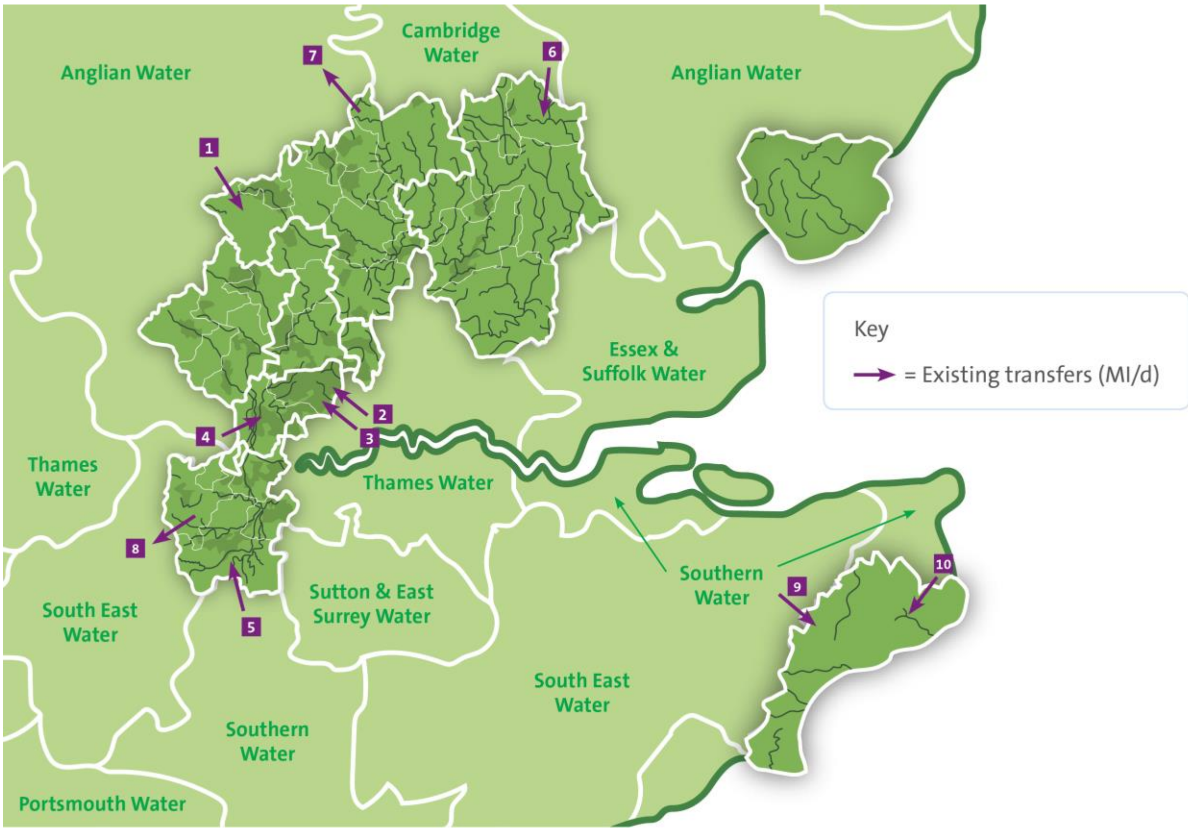

Figure 22: Location of existing import and export arrangements (numbers relate to transfer IDs

A number of meetings have been held with neighbouring water companies and third parties to discuss existing and potential new transfers. The main points have been summarised within this report in Chapter 14 to highlight the fact that shared options have been discussed and water company feasible option lists align prior to plan development.

We have regularly attended and participated in regional group meetings with regards to inter-company relationships allowing opportunities to discuss existing agreements and the ability to create, share and align feasible options for modelling.

We have cross-border bulk supplies to help meet customer demand in instances when our normal supplies are insufficient for example due to drought, high demand or outage. We have explored the development of new transfer options for use in modelling our options using the Economics of Balancing Supply and Demand model (ESBD). Further detail around these options can be found within Technical Reports 4.1, 4.2, 4.5 and 4.6.

8.4.2 Existing Transfer Arrangements

8.4.2.1.1 Affinity Water Central

We have a statutory arrangement with Anglian Water for a shared supply from ANGL, a surface water reservoir located within the Anglian Water supply area that transfers water to our WRZ3. The day to day costs of maintaining and operating the reservoir, treatment works, pipeline and all investments to maintain the assets shared under the terms of this arrangement.

There are a cluster of locations along the east of our WRZ4 whereby we have connections with Thames Water and are able to receive imports: FORT, KEMP, HAMPL. We also have an import at LAYM, which enters the our Central region in WRZ6 nearby Guildford.

An import agreement with Thames Water allows us to receive water at FORT, WRZ4. It has been tested to a capacity of 42 Ml/d but the current agreement in place states that the quantity of supply is not to exceed 27.28Ml in any one day, except with the consent of Thames Water.

HAMPL is a relatively small import from Thames Water which feeds into the south of the Arkley HDZ and feeds local demand. This import is controlled through a pressure release valve at a low volume which will only increase should other boosters fail.

The LAYM statutory arrangement entitles us to a maximum of 2.27Ml/d from Thames Water under the terms of a priority bulk supply arrangement. Our agreement at KEMP states that Thames Water will not supply more than 420m^3 per hour (or 10Ml/d) except in the case of emergencies where they will attempt to provide increased supplies where available.

We have an agreement with South East Water to export from our WRZ6 during average conditions. The agreement between the two companies for this bulk supply of water was signed in July 1995 reserving up to 36Ml/d for South East Water from the nominal 103Ml/d capacity. If the capacity at EGHA is less than half due to pollution, drought, flood or industrial action, the works would be split 36/103 for South East Water and 67/103 for Affinity Water.

8.4.2.1.2 Affinity Water East

There are no imports to, or exports from WRZ8 in our East region. This resource zone is supplied on a daily basis by a mix of groundwater sources and from a jointly owned reservoir with Anglian Water.

The shared reservoir, TARD, has a currently agreed split of 70/30 in favour of Anglian Water owing to a current surplus within WRZ8. We continue to forecast a surplus into the next planning period. We are entitled to take 50% of the reservoir outputs as we are joint owners, but under the current agreement we take less.

8.4.2.1.3 Affinity Water Southeast

We have two existing imports to our WRZ7 in our South East region; one from South East Water at BARI and one from Southern Water at DEAI. These imports are both subject to agreements which end on 31 March 2020. Section 3.3 highlights new options to be modelled which will continue these agreements as well as providing alternative means of supply.

The agreement with South East Water for an import to our WRZ7 was originally signed in July 1999 (updated in 2014) and entitles us to take an average daily supply of 2Ml and a maximum annual supply of 730Ml. Barring an event or incident outside of the control of South East Water, this supply is required to be available at all times.

The agreement with Southern Water for the DEAI import to our WRZ7 was signed in May 2014. On a day-to-day basis, this covers a small sweetening flow of 0.5Ml per week (0.0714Ml/d) for water quality purposes to allow use when required. Unless there is an emergency, we should give Southern Water at least 7 days notice of its requirements for supply i.e. volume required and the duration required for.

The availability of the DEAI supply from Southern Water is entirely dependent upon whether a surplus is available at the time of request; this type of agreement is not unusual between water companies. The instantaneous flow rate should not exceed 4Ml/d at any point.

8.4.3 Receiving area water quality considerations

Transfers from surface water sources need to be carefully monitored at a detailed hydraulic demand zone level and to avoid the wider use of water with elevated levels of the pesticide metaldehyde, to maintain high quality drinking water. Metaldehyde is the active ingredient in slug pellets which can leach into surface water systems after heavy rainfall events if recent application of pellets to the soil has taken place. Where metaldehyde is present in supplies above the standard we restrict the areas which can receive water from these sources in order to maintain water quality. We can only lift these restrictions if the supplies are compliant with water quality standards. We have an undertaking in place with DWI to allow water to be supplied to some zones. However, conversely we are constrained by no deterioration principles to supply only those zones with an undertaking.

Potential future bulk transfers are discussed in detail in Chapter 14.

8.5 National Environment Programme

Abstraction influences on river flows within our supply area are a legacy of post war water resources development. Finding a sustainable balance between the provision of public water supply and the environmental requirements of nationally rare habitats like chalk streams, continues to be a challenge.

We have been investigating the impact of our public water supply abstractions over the last six Asset Management Plan (AMP) periods and at present we have a programme of nine studies and ten implementation schemes to be delivered between 2015 and 2020. Not all of these projects were included in the price limits of PR14, as these were identified after the submission of our Plans. We have therefore had to include these additional schemes within the existing funding envelope, through generating efficiencies.

The National Environment Programme (NEP) is a list of environmental improvement schemes defined by the Environment Agency (EA) to ensure that water companies meet European and national targets related to water bodies. Our current NEP includes investigations, options appraisals and implementation schemes relating to the environmental impact of our abstractions. The implementation schemes include ‘morphological mitigation works’ (river restoration and habitat enhancement) and fish screening. Our NEP also includes our Sustainability Reduction Programme, where we will be reducing abstraction by 42Ml/d by 2020; these works are included in the Technical Report 1.4 Sustainability Reductions. Our Biodiversity project aims to meet our duties under the Natural Environment and Rural Communities (NERC) Act and our Catchment Management programme (NEP for Water Quality) seeks to protect the quality of the sources from which we abstract. Technical Report 1.4.1 provides a summary of the current progress with our AMP6 schemes and those under consideration.

The Water Resources NEP has been replaced by the Water Industry NEP (WINEP) which includes both Water Resources and Water Quality. The EA have identified 15 new investigations and options appraisals and 12 implementation schemes for our PR19 submission for the WINEP.

This work includes morphological mitigation measures to help improve the functioning of chalk river habitats on rivers where an environmental impact of our groundwater abstraction has been identified. Additional information on these new schemes will be provided by the EA following the completion of their studies and we will continue to work closely with the EA to refine and agree work required over the coming months. We will also be exploring opportunities to align these into integrated catchment schemes and developing a holistic catchment management approach to deliver wider benefits to improve water quality and drought resilience which will ultimately improve the resilience of the natural environment.

We are working in partnership with Herts & Middlesex Wildlife Trust (HMWT) and White Cliffs Countryside Partnership and Up on the Downs to deliver work on our landholdings to meet requirements of the NERC Act, Wildlife & Countryside Act. This also includes the identification and management of invasive non-native species (INNS) on our landholdings.

Drivers for the NEP include:

- Water Framework Directives (WFD)
- Natural Environment and Rural Communities Act (NERC) Act
- Sites of Special Scientific Interest
- Eels Regulation
- Drinking Water Inspectorate (DWI) Undertakings

Our current National Environment Programme is progressing well and we will continue to work with the EA and key stakeholders over the remainder of AMP6 to identify sustainable solutions to balance the demand for water and the environment. Our AMP7 schemes will include a combination of investigations and options appraisal, as well as implementation schemes involving abstraction licence changes, morphological mitigation measures and provision of river support subject to approval from the EA.

Our programme of work under the NEP for the AMP7 period has been developed based on information provided by the EA in its WINEP Phase 1 tables and associated discussions. We have also included biodiversity enhancement works on our landholdings, to meet our duties under the NERC Act and our catchment management planned work.

8.6 Sustainability reductions

8.6.1 Introduction

Sustainability reduction is the term used to describe a reduction in deployable output for the purpose of protecting or improving internationally or nationally designated conservation sites or species; to protect or improve locally important sites (undesignated sites) or, to deliver Water Framework Directive (WFD) environmental objectives in River Basin Management Plans (RBMP). These reductions may be identified through the AMP6 National Environment Programme (NEP) or review of the Environment Agency's (EA) abstraction pressures spreadsheets (EA, 2017).

New licences to abstract water are issued by the EA and are time-limited. These time limits are usually set to coincide with the relevant Catchment Abstraction Management Strategy (CAMS) for that area. Many existing licences were issued in 1965 and are known as Licences of Right and had no expiry date. These entitled owners to abstract in perpetuity and had limited consideration for environmental impact. The EA now has powers to change or revoke licences held by water companies without compensation. We have been working with the EA and their precedessor since 1990 to improve flows in local chalk streams, implementing schemes in the Rivers Ver, Misbourne, Hiz, Oughton and Dour catchments from 1993 onwards.

We have delivered 78% of our AMP6 sustainability reductions and remain on target for implementing the 42.09Ml/d reduction by April 2018. This remains the largest reduction in percentage terms of any of the water companies. The business is fully supportive of sustainable water resources management, taking a holistic approach to managing our catchments by first understanding their complexities and interdependencies.

Our approach to sustainability reductions in AMP7 builds on knowledge gained from our AMP6 programme and a desire to ensure we are making reductions in locations where there is evidence that they will benefit the environment and represent good value for customers. Through our NEP projects we are gaining detailed knowledge of Chalk hydrogeology which will assist in decision making. We consider it is from this evidence based approach that we will be best placed to contribute to meeting the objectives of the Water Framework Directive. A period of evaluation is required to assess the benefit from the AMP6 reductions and allow these assessments to inform future reductions. The phasing of reductions through AMP7 and AMP8 will allow for benefits and flood risk to be assessed, time for ecology to establish following the morphological works and necessary investment made, to ensure cost effective solutions are delivered.

Since March 2015 we have reduced abstraction by 32.69Ml/d across four river catchments. We are monitoring the benefits of these reductions on groundwater levels, river flows and ecology and have presented our intitial findings to the EA through a series of technical workshops. We have further workshops planned over next 12 months as we continue monitoring and analysing data. A further reduction of 9.4Ml/d is planned for April 2018, which will complete our programme of reductions for AMP6 (42.09Ml/d). This result will amount to a total reduction since 1993 of 63Ml/d, some 7% of our resource base at that time.

We have included sustainability reductions in our **PP and AP**. Our **PP** includes reductions of 10.22Ml/d (average DO) and our **AP** includes reductions of 39.81Ml/d. We have also sensitivity tested a further scenario of 61Ml/d reductions against our **PP** (to include an assessment of WFD risk of deterioration) spread over AMP7 and AMP8 (this is further described in Section 16). We have had a number of discussions with the EA local area teams and will continue to work with them.

We have also modelled the effect of the reductions in our preferred and **AP** on transfers within and between zones using Miser, our bespoke model that simulates water transfers between our 33 hydraulic demand zones (HDZ) in Central region.

8.6.2 Our AMP6 sustainability reductions

Our 2015-20 WRMP (June 2014) included sustainability reductions at groundwater abstraction sources in three of our eight zones. Table 22 shows the average and peak sustainability reductions by water resource zone. The AMP6 reductions affect seven of our sources; with cessation of abstraction at three sources, reduced outputs at a further three locations and the redistribution of abstraction to one downstream source. By the end of AMP6 we will have implemented reductions of 42.09Ml/d in our Central region. No sustainability reductions were required for our East or Southeast Regions (Brett and Dour Communities) and therefore this section focuses on our Central Region only.

Our PR14 plan also included proposed reductions for AMP7 delivery (2020-25). These were based on the best available information at the time we have reviewed these during preparation of this dWRMP taking into account additional information and evidence collected during AMP6. We will make sustainability reductions where there is confidence that they will realise environmental improvements and are cost beneficial.

Table 22: Groundwater abstraction sustainability reductions, as planned at PR14

Water Resource Zone	Reduction Average DO Ml/d		Reduction Peak DO Ml/d	
	AMP6 (implementation)	AMP7 (proposed at PR14)	AMP6 (implementation)	AMP7 (proposed at PR14)
WRZ 1 - Misbourne	11.00	2.00	6.15	2
WRZ 2 - Colne	5.82	8.84	5.82	0
WRZ 3 - Lee	25.27	16.87	27.09	10.49
WRZ 4 - Pinn	0	0	0	0
WRZ 5 - Stort	0	0	0	0
WRZ 6 - Wey	0	0	0	0
Sub-total (Central region)	**42.09**	**27.71**	**39.06**	**12.49**
WRZ 7 (Southeast region)	0	0	0	.0
WRZ 8 (East region)	0	0	0	0
Company Total	**69.80**		**51.55**	

A review of the AMP6 sustainability reduction for the Ver, Beane, Mimram, Hughenden Stream, Gade and Misbourne catchments is available in Technical Report 1.4: Sustainability Reductions.

8.6.3 Our dWRMP19 sustainability reductions

8.6.3.1.1 Background

At PR14 we identified potential further sustainability reductions of 27.71 Ml/d (average DO reduction) for implementation in AMP7. This was based on the best available information at the time. We have continued to work with the EA and seek to ensure that any sustainability reductions are made where benefits to river flow and ecology will be realised.

Our current AMP6 NEP includes investigations and options appraisals in five catchments (Rivers Chess, Bulbourne, Purwell, Ivel and Cam). Investigations have been completed on the Purwell, Ivel and Cam, with the Bulbourne, Ivel and Cam progressing to options appraisal. As these studies have not concluded we have not included these in our **PP** but have included them in our **AP**. The EA have prepared their Water Industry National Environment Programme (WINEP) and issued two copies of their spreadsheet, referred to as WINEP1 and WINEP2.

8.6.3.1.2 Environment Agency WINEP

WINEP1

The EA issued their WINEP1 spreadsheet in March 2017, detailing sources for sustainability change, investigations, options appraisals and adaptive management (morphological mitigation works). This spreadsheet along with our knowledge of our catchments has been used in the preparation of our draft plan. The investigations, options appraisal and adaptive management are covered in Technical Report 1.4.1: AMP6 NEP Progress and Summary of WINEP PR19 Schemes. We discussed these with the EA and have used this information to inform our approach for the dWRMP19. WINEP 1 also listed sustainability changes against sources with two levels of certainty; *indicative* (amber) and *unconfirmed* (red). No changes were listed as *certain* (green) or given as an indication of *direction of travel* (purple).

The WINEP1 *indicative* sustainability changes comprised of the AMP7 reductions proposed at PR14 but listed as reduction in licence volume rather than DO. The *unconfirmed* sustainability changes included sources undergoing AMP6 NEP investigation and options appraisal, plus further sources in the Rivers Pant, Chelmer and Brett catchments but with no volume provided.

WINEP2

We received the WINEP2 spreadsheet on 29 September 2017 and reviewed this against our **PP**. WINEP2 included a greater number of amber (uncertain) sustainability changes totalling 39.8Ml/d average and 54.86Ml/d peak. This sustainability change was transposed into a sustainability reduction against deployable output and a reduction included in our **AP**. We have sensitivity tested our **PP** with a greater level of reductions of 61Ml/d (further described in Section 16). We also clarified with the EA Area teams the level of certainty applied to a number of listed sustainability changes in WINEP2 and reflected this in our approach. We are in regular dialogue and are continuing to work closely with the EA regarding this.

8.6.3.1.3 Our approach

The PR14 AMP7 sustainability reductions have been reviewed and cross referenced with the EA's WINEP1 table issued in March 2017. WINEP2 was issued in September 2017 and included a greater number of sustainability changes. We consider that the environmental benefit of implementing abstraction reductions at a number of these sources has yet to be evidenced and we will continue to work with the EA over the coming months.

Our preferred approach reflected in our **PP** would allow for a period of evaluation in AMP7 to assess the benefit of the AMP6 reductions to inform the requirement for any further reductions. Our **AP** is based on the assumption that all WINEP2 reductions will be implemented in AMP7.

We will arrange a series of technical meetings with the EA area teams over the coming months to review WINEP3 (March 2018).

8.6.3.1.4 Our assumptions

We planned at PR14 to continue the programme of sustainability reductions in AMP7, recognising the need to balance public water supply with protecting the environment. We therefore considered that it was not appropriate to include zero reductions in our dWRMP19 modelling scenarios, which would have been the outcome of using the 'green' status reductions from WINEP. We have identified a minimum level of reductions for AMP7 where there is considered to be a reasonable certainty of environmental benefit and have included this in our **PP**, whilst we continue to evaluate the benefit of the AMP6 reductions.

We have made the assumption that as these sustainability reductions relate to groundwater abstractions, it is a reduction at average that will have the most environmental benefit. Our **PP** and **AP** delivers reduction of 10.22Ml/d and 39Ml/d respectively (average reduction in DO) by 2025. We have sensitivity tested a greater level of reductions (61Ml/d) spread over AMP7 and AMP8.

Table 23: Sustainability Changes included in dWRMP19

Status of Measure included in EBSD runs	AMP7		AMP8		Comment
	Average DO Ml/d	Peak DO Ml/d	Average DO Ml/d	Peak DO Ml/d	
Certain (green)	0.00	0.00	0.00	0.00	Not included in EBSD runs but Modelled in Miser
PP	10.22	0.00	4.71*	2.00*	HOLY / MUDL & DIGS
AP	39.81	26.59	0.00	0.00	WINEP2 amber
"upper scenario" (amber+red+volume at risk from 'No Deterioration')	46.87	34.75	14.60	2.00	Includes 11.6Ml/d no deterioration risk

*We have included a sustainability reduction volume for implementation in AMP8 as an indicative direction of travel. This has not been costed in the preferred plan.

8.6.4 Review of fWRMP14 AMP7 sustainability reductions

We have reviewed the sustainability reductions included in fWRMP14 as shown in Table 22, to ensure that they take into account of the best available information (this review can be found in Technical Report 1.4). Reductions were identified for Central region in four river catchments, three of which have already seen significant reductions in the last 25 years. We support the objectives of the River Basin Management Plans and WFD and consider that a long term approach to water resources management is important. We therefore propose to continue with our programme of sustainability reductions in AMP7 and AMP8 in combination with morphological works where evidence supports this. The four river catchments in Central region which were identified for reductions at PR14 have therefore been reviewed. These fWRMP AMP7 sustainability changes are included on WINEP1 and WINEP2 as amber (indicative) reductions. We have included selected reductions of 10.22 Ml/d in our **PP** and all fWRMP AMP7 reductions in the **AP**.

8.6.5 WINEP2 Amber Sustainability Reductions

The WINEP2 amber sustainability reductions included the fWRMP AMP7 sustainability reductions along with other sources. We have included these unconfirmed (amber) sustainability reductions in our **AP** and sensitivity tested our **PP** and **AP** to a high level of sustainability reductions including indicative (red) reductions.

AMP6 NEP schemes

Through our work on the AMP6 NEP, the potential for further sustainability reductions has been identified. We are currently progressing options appraisals on the Rivers Bulbourne, Ivel and Cam. We have included reductions in our **AP** for BALD and UTTL sources. These volumes are based on our understanding of the flow deficit in these catchments which has been used in the options appraisal. We are also progressing a further options appraisal on the Bulbourne for the implementation of morphological works.

An investigation is also ongoing on the Upper Chess and we have included a reduction from CHAR and CHES in our **AP**.

Additional WINEP2 reductions

The EA have included additional sustainability changes for a number of our sources in North Essex (River Pant and Chelmer catchments) and Suffolk (River Brett catchment). A number of these sources were investigated at AMP3 in collaboration with Anglian Water Services (AWS) and Essex and Suffolk Water (ESW). We will be working with the EA area team, AWS and ESW over the coming months to review the EA's evidence supporting the need for a reduction in abstraction. We have translated these sustainability changes to sustainability reductions, resulting in a reduction in DO for our ARMI source which is included in our **AP**.

We have a robust supply demand balance for East region (WRZ8) with a surplus of 5.82Ml/d. As this is greater than the proposed sustainability change for this catchment if this change were to be pursued by the EA and there is evidence that it will deliver environmental benefit we would be able to accommodate it. We would, however, need to discuss the share of our jointly owned resource at ARDL with AWS.

Water Framework Directive no deterioration risk

The EA notified all water companies in September 2016 of their revised approach to sustainable abstraction. Regulation 3 of the WFD Regulations provides that the EA must in particular determine environmental permits and abstraction licence applications so as to prevent deterioration of the surface water status or ground-water status of a body of water and otherwise to support the achievement of the environmental objectives set. Deterioration is measured from the date on which the WFD came into effect, 22 December 2003.

The methodology for the assessment of deterioration risk has been revised and the EA now requires us to consider the consequence of licences being used at full capacity. The EA recognises that assessing deterioration risk in this way could have a significant impact on security of supply and drive unnecessary investment. It has worked with a water industry task and finish group to identify a pragmatic approach to managing the risk of deterioration caused by abstraction.

We have undertaken a thorough review of all our sources in collaboration with colleagues from the EA area teams. All licensed abstractions were assessed for their sustainability and where potential effects on water bodies were identified, we have set out how we plan to manage this using a set of predefined categories and information has been used by the EA to inform WINEP.

Our assessment of deterioration risk was calculated using recent actual abstraction data which was adjusted for any periods of unusual abstraction e.g. a prolonged outage due to equipment failure or planned works. This assessment identified a fairly small number of sites where there was potential to increase abstraction within licence, as we are fully utilising many of our sources already.

Table 24. This volume has been captured as an uncertain volume in our Upper Scenario for the EBSD modelling for our draft Plan, for implementation by end of AMP8 (2030).

Table 24: No deterioration Risk at Average Deployable Output by WRZ

Water Resource Zone	Loss of Average DO (Ml/d)
1	0.63
2	1.24
3	3.83
4	0.00
5	0.57
6	0.75
7	0.53
8	4.05
Total	**11.60**

8.6.6 Other unknown deployable output reductions

We remain concerned over the potential impact that historic contamination poses on raw water quality, notably in the unconfined Chalk aquifer. In light of this and the potential for development of brownfield sites within our groundwater sources protection zones (SPZ).

We will be undertaking a review of sites identified for development within the various local authority Local Plans. In the last 30 years we have lost approximately 25Ml/d of DO due to historic contamination of raw groundwater. These were sources that were considered not to have an impact on river flows, or in catchments where mitigation had been implemented and therefore would have provided a sustainable source of water. We are keen to work with the EA and local authorities to minimise this risk and restore operational capacity to ensure that it does not impact our ability to address environmental pressures elsewhere in our catchments. We are seeking a commitment from the EA and the affected local authorities to achieve this in our dWRMP consultation.

8.6.7 Network modelling

We recognise the importance of assessing the effect of reducing abstraction on a sub-water resource zone level and have therefore used both our EBSD (WRZ level model) and Miser (HDZ i.e. within WRZ zonal model) to review implications on supply to customers.

Our Miser model is a bespoke model that simulates water transfers between our 33 hydraulic demand zones (HDZ) in Central region, taking into account sources within each HDZ, the demand for water within the HDZ and imports and exports of water to and from that HDZ.

Optimisation runs produce volumes of water, flows, schedules and cost results. The model optimises on cost of operation and selects the cheapest operational solution for any given demand pattern. This allows an estimate of the total operational costs to be understood and differences between runs can be used to illustrate the likely changes in operational costs.

Where a deficit was encountered, this was analysed to see if it was a lack of water or a transfer capability that was preventing demand from being met. The next stage of modelling will look into identifying the solutions, incorporating them into the model, and repeating the run to ensure that all deficits are resolved as appropriate.

More detailed information regarding our EBSD modelling can be found in our Technical Report 4.9: Economics of Balancing Supply and Demand.

8.6.8 Cost benefit and necessary investment

We have made significant investment in AMP6 to deliver our programme of sustainability reductions, a clear demonstration of our commitment to leaving more water in the environment. Delivery of this programme is supported by our Water Saving Programme, ensuring leakage and demand management are addressed. We are currently working on solutions for the implementation of the sustainability reductions, utilising information from our EBSD and Miser modelling. This has highlighted a number of network constraints in addition to the water quality restriction associated with utilising surface water sources in areas historically supplied with groundwater.

We propose to continue with our environmental monitoring in catchments subject to sustainability reductions, as we consider this fundamental to the implementation of this programme. This is detailed along with the associated morphological mitigation works in our Technical Report, 1.4.1: AMP6 NEP Progress and Summary of WINEP PR19 Schemes.

The River Basin Management Plan Economic Appraisals (2015) included the cost for implementing the AMP6 and AMP7 sustainability reductions based on our PR14 business plan costs. These assessments were completed for the Upper Lee and Colne catchments and included a bundle of measures to achieve good ecological status/potential.

A full cost benefit assessment (CBA) will be completed once schemes have been identified for implementation of the AMP7 reductions. At present a high level assessment was completed at a catchment scale by the EA and cost benefit ratios provided. These cost benefit assessments were made using an indicative average cost per mega litre of water and not be representative of the true cost of implementing further reductions. We have provided updated figures to the EA so that they can update their assessment.

8.7 WRZ Integrity

We continue to operate within eight Water Resource Zones (WRZ), six within our Central region (Misbourne, Colne, Lee, Pinn, Stort, Wey) and the individual water resource zones in our East and Southeast regions.

We have reviewed our water resource zones in accordance with the WRPG and the Environment Agency's WRZ assessment methods (Water Resources Zone Integrity, 2016). Water Resource Zone Integrity Report 1.5.

Some of our zones are characterised by chalk streams and sit across the Chilterns AONB in water stressed areas and so the need to import water will be crucial. Within each WRZ there are no isolated demand centres not connected to the supply network. Connectivity between the trunk main system and the 33 Hydraulic Demand Zones (HDZ) within Central region ensure network resilience.

Boundary changes between the Pinn & Misbourne WRZ have been made to ensure true WRZ integrity. Source availability and storage within each Water Resource zone reviewed and amended. Taking into account changes related to sustainability reduction.

Schematics produced represent the recorded strategic transfers between each WRZ, used to calculate zonal demand balance. Zonal peak demand and storage capacity values have been updated.

8.8 Drinking Water Quality

8.8.1 Introduction

We have seen a significant effect of diffuse and point source pollution on our resources and we have been proactive in both monitoring pollution and investigating pollution threats to encourage polluters to take responsibility for their actions. We have also been proactive in catchment management to improve water quality and have undertaken an enhanced programme for AMP6. We have extended our partnering arrangements and our activities in both Central and Southeast regions to mitigate the effect of pesticides and nitrate use. We recognise the importance of this programme to support 'no deterioration' to meet WFD objectives.

We support the use of enforcement to control the catchment use of pesticides and herbicides such as the designation of Drinking Water Protected Areas (DrWPA) and Safeguard Zones (SgZ) by the Environment Agency under the Water Framework Directive.

We have developed a twin track approach to managing pesticides in our abstractions, via catchment management and treatment. We see it as important to control the future use of pesticides by both voluntary and targeted enforcement measures and we will continue to work with our neighbouring water companies, the Environment Agency, the agricultural community, agrochemical manufacturers and local highway authorities to reduce pesticide loading of water resources in vulnerable catchments.

8.8.2 Ensuring continuation of wholesome water supply

The Drinking Water Inspectorate (DWI) released its 'Long term Planning Guidance' guidance on 8 September 2017. This guidance highlights the DWI's expectations for water companies to strive towards 100% compliance and there is a clear focus on lead, nitrates, discolouration, catchment management and pesticides including metaldehyde.

This guidance also reiterates our responsibility under the Water Industry Action section 68 where *'It shall be the duty of a water undertaker.........so far as reasonably practicable, to ensure, in relation to each source or combination of sources from which water is so supplied, that there is, in general,* ***no deterioration*** *in the quality of the water which is supplied from time to time from that source or combination of sources.'*

It is our responsibility to ensure that we continue to supply customers with wholesome water, that there must be no deterioration in the quality of the supply and we must always plan to meet our water quality obligations. Our catchment management for water quality programme for AMP7 is being developed based on these principles. This is a particular issue for pesticides such as metaldehyde and aesthetics of water quality.

We have considered the potential water quality implications of the sustainability reductions and have fully risk assessed the use of replacement of water to ensure there is no increase in risk to customers of receiving unwholesome water.

Metaldehyde and pesticides

Metaldehyde is a mollusicide used for slug control in agriculture and the amenity sector, primarily in the autumn and winter months. Existing treatment is ineffective at removing this particular pesticide to meet the drinking water standard for individual (0.1µg/l) and total (0.5µg/l) pesticides periodically. As such we have agreed Undertakings with the DWI to investigate and implement catchment management activities to reduce the risks from pesticides at our treatment works on the River Thames, vulnerable groundwater sources in Hertfordshire, at our TARD works shared with Anglian Water and in some of our bulk imports. This limits the movement of water from both supplies significantly.

Our metaldehyde and other pesticide Undertakings given to DWI identify specific water supply zone areas where we may experience intermittent exceedances. We are required to prevent any deterioration in other water supply zones not listed in the Undertaking and therefore any transfers of water within a company's supply area and exports and imports across company boundaries must also be carefully managed so that the supplies remain wholesome. This can therefore restrict resilience of transfers through our trunk mains networks even where this is physically possible.

Aesthetic water quality

Historically, we have observed changes in taste, odour and discolouration of supplies when we have substituted our groundwater-fed supply zones with surface derived waters particularly from ANGL WTW. The different processes in the water can be identified by customers and can generate some concern as well as taste and odour complaints. Groundwater and surface water also differ greatly in their chemical nature, with surface water being more aggressive chemically. Introduction of ANGL supply into a normally groundwater supplied areas can result in discoloration of customers' supplies even over a short timescale of 4-7 days. To prevent any discolouration we are very careful in how and when we allow any changes in our strategic supplies across the company. This ensures that we can maintain the wholesomeness of drinking water in those areas.

AMP7 water quality strategy

Our long term water quality strategy is being developed to meet DWI expectations as per their Long Term Planning Guidance and our long term water resource needs. We have adopted a twin track approach to managing water quality risks with catchment management at the source and treatment at the abstraction point.

Whilst we recognise that catchment management may provide sufficient mitigation to meet 100% compliance with drinking water standards this will take a long period of time and may not provide sufficient mitigation in the absence of raw water storage under all weather and subsequent water quality conditions.

Our Drinking Water Safety Plan risk assessments have identified a number of risks to our sources including pesticides, lead, nitrates and discolouration. Our methodology builds on our PR14 approach including:

- investigating and quantifying these risks using catchment surveys, water quality monitoring, nitrate source apportionment modelling and groundwater level and abstraction data
- exploring optioneering mitigation solutions using complex cost models assessing catchment management, optimising existing treatment, additional new treatment where appropriate and/or a combination of the above
- appropriate and/or a combination of the above.

Our Catchment Management programme for water quality was established in 2010 to help deliver our commitment given in our Undertakings for metaldehyde agreed with the DWI. Our AMP6 programme has moved on significantly since then and is now aligned to the WFD National Environment Programme (water quality). This programme is significantly larger in terms of scale and focus (pesticides, nitrates etc.) compared to AMP5. Since 2010 we have:

- developed a detailed understanding of our catchments and the risks to our sources through activities including, but not limited to: detailed river sampling, catchment walkovers, remote sensing, field-scale risk mapping, solution-feature mapping and point source pathway identification
- through this catchment characterisation, we have identified the high risk sub-catchment areas to focus our pesticide reduction schemes where they are needed most
- established a continuous pesticide monitoring of the Thames River Basin District including catchments outside our company boundaries in partnership with Thames Water Utilities and South East Water generating pesticide risk maps for the 10,000km^2 river basin catchment area upstream of our abstractions
- developed a 'Payment for Ecosystem Services' model to incentivise farmers as producers of clean water in our upstream catchments at risk from diffuse metaldehyde pollution
- developed strong relationships and have aligned our programme with key stakeholders including neighbouring water companies, farming initiatives

(Catchment Sensitive Farming; Campaign for the Farmed Environment), Environment Agency and National Farmers Union.

Since the start of AMP6 in 2015, our catchment management for water quality programme has developed pesticide reduction schemes focusing on metaldehyde that incorporate c.600km^2 of high risk catchment area for diffuse pesticide pollution. This includes more than 17,000ha of eligible arable land of which the crops that use metaldehyde are grown. We have trialled a range of measures and incentive mechanisms to determine the most effective approach and inform our AMP7 programme. Our Payment for Ecosystem Services approach incentivises farmers by paying a participation fee as a commitment from farmers to undertake measures to reduce pesticide losses to water. A clean water bonus is awarded at the end of the high risk season where pre-determined targets for water quality improvements are agreed. This is supported by a funded range of measures to support farmers to achieve best practice including: pesticide applicator training, spreader and sprayer machinery servicing and calibration, pesticide amnesties for safe removal and disposal of unwanted pesticides, bespoke workshops, training events and specialist farm visits for all eligible farm businesses.

Whilst this programme has been very successful, we have experienced pesticide exceedances during AMP5 and AMP6. We have made process improvements at some of our surface water treatment works and capital works are being delivered in AMP6. Our catchment management programme is crucial in delivering water quality improvements in surface water catchments. Unlike other water companies, our surface water treatment works have no bankside storage (raw water reservoir) to enable us to practice an abstraction management regime. We will consider additional treatment stages as part of our long term water quality strategy and as there is technological innovation in this area. Other risks identified such as nitrates, are directly linked to our water resources situation and our catchment management investigations conclude that it could take more than 50 years to see the benefits of catchment management activities in those areas. In 2013 we lost a groundwater source due to increasing nitrate concentrations and there is a significant risk of further loss of groundwater supplies between now and 2040 as a result of increasing nitrate concentrations.

Therefore further mitigation will be required to reduce these risks to ensure we can meet water quality standards and maintain supply of our sources in AMP7 and beyond.

We are developing investment proposals for these sites, including HWFS WTW and our bulk import from ANGL WTW to support our long-term water quality and water resources needs. These include:

- enhanced catchment management activities including: long term nitrate mitigation schemes, pesticide reduction schemes incorporating all “at risk” pesticides, investigations into risks of faecal indicator organisms and investigations into the risks and affect of historic contamination (e.g. contaminated land and landfills)
- enhanced water quality monitoring using advanced methods in the catchment (including in situ monitoring, spot and passive sampling) and at the works
- application of advanced modelling tools, catchment and treatment works, to enable us to predict and forecast scenarios
- optimisation of existing treatment assets via improved asset health and continued proactive maintenance
- installation of new treatment assets where appropriate.

We believe that this approach best supports our long term water quality and resources planning needs as part of our PR19 Business Planning.

Our investigations and interventions will be targeted towards priority pollutants including pesticides and nitrates and is expanding on our current AMP6 (DrWPA) schemes, implementing new schemes based the outcomes of our AMP6 NEP investigations on emerging water quality risks. We will investigate pollution risks to public water supply including new and emerging trends which have been identified through our Drinking Water Safety Plans. We will continue to improve our pollution incident response and investigation process, both internally and with our external stakeholders. In addition to this, we are also undertaking a review to identify potential additional investigations to be put forward for AMP7 in advance of WINEP3. We have developed a scoring methodology based on reviewing water quality data, hydrogeological risk, source criticality and also drought and flood resilience. This tool will identify opportunities where we can focus our investigations and interventions and protect water quality from deterioration and provide an opportunity for improvement.

We intend on expanding our catchment intervention measures for our existing DrWPA schemes focusing on “at risk” and total pesticide risk, and will be engaging with all potential pesticide users in defined identified and/or expanded high risk areas. We are also planning to identify, develop and improve existing planning application screening process and review and investigate planning applications and significant land use changes that may impact on drinking water supply, to assess the impact that the increasing demand may have on water quality.

The British Geological Survey (BGS) has undertaken some work for us on the mapping of swallow holes, stream sinks and other solution features to identify preferential pathways for our groundwater catchments subject to NEP investigations in AMP6. The aim of this work is to better understand our catchments in order to define the natural processes that take place. This is with a view to undertaking holistic catchment management to safeguard water quality for our sources and also to undertake proper water resources management. This will allow us to further understand the influence of such solution features and how this primarily affects the water quality at our abstractions to help better target our catchment management schemes where the greatest benefit can be derived. The outcomes of this work will also support the development of our Water Resources Management Plan, looking into both safeguarding our existing resources in the various catchments (c. 20% of resource base) and identifying new resources in areas of water stress. We will also be exploring opportunities to align these into integrated catchment schemes and developing a holistic catchment management approach to deliver wider benefits to improve water quality, flood risk management and drought resilience which will ultimately improve the resilience of the natural environment.

Catchment management for water quality

Our catchment management for water quality programme for AMP7 is a series of catchment-based pesticide and nitrate mitigation schemes with the objective of reducing diffuse and point source agricultural pollution at the source rather than relying solely on water treatment. It is a continuation of our current AMP6 investigations into nitrate and pesticide affected sources and DrWPA schemes for metaldehyde, delivered under the National Environment Programme. The scope of this programme will extend existing metaldehyde schemes to mitigate the impacts of key "at risk" pesticides in high risk catchments of the Thames River Basin District identified during AMP6.

The programme is delivered in partnership with Thames Water and South East Water through the Thames Catchment Management Steering Group (TCMSG) formed in 2010.

Due to the scale of the problem, the TCMSG produces aligned plans developed collaboratively through the Water Industry National Environment Programme for Water Quality (WINEP WQ) and shares the targeting of catchment schemes in high risk catchments identified in AMP5 and AMP6 to ensure that the greatest proportion of high risk areas with the Thames River Basin are covered by catchment intervention measures.

We currently lead on catchment schemes in the Loddon, Lower Wey and Colne catchments and provide monitoring and technical support to Thames Water in the Lea catchment and to South East Water in the Lower Thames catchment. This collaborative approach is unique in the UK and enables us to maximise coverage of our schemes, share knowledge, resources, research costs and promote a partnership message which is viewed positively by our regulators and stakeholders. The key objective of the programme is to develop an effective "Payment for Ecosystem Services" mechanism which aims to empower farmers as producers of clean water in our upstream catchments. The schemes will incentivise farmers to go beyond compliance with their legal obligations, to adopt best practice controls where the need is greatest. The project will support research and prevent further deterioration in water quality.

There are a number of our groundwater sources that are affected by increasing long term trends in nitrate. A large proportion of this nitrate originates from agricultural fertiliser applications, poor storage of manures, leaking sewer pipes and septic tanks. During AMP6, we have carried out investigations into potential sources of this diffuse pollution and undertaken modelling to determine when the highest concentrations are likely to be observed. Our AMP7 catchment management programme aims to build on the investigations carried out in AMP6 and work in partnership with landowners, regulators and other stakeholders to identify and implement ways of reducing the current inputs of nitrate to groundwater. The objective is to develop a sustainable long term solution to reduce the need for future treatment investment and where treatment is already in place, to reduce the period in which the treatment is required.

We will also be undertaking a range of investigations into sources where emerging trends in contaminants have been observed through our Drinking Water Safety Plan risk assessments. These investigations will be carried out through the WINEP WQ and will inform the need for future catchment management schemes in accordance with the development of a long term plan for catchment management in line with DWI guidance.

8.9 Treatment Works Adjustments

8.9.1 Introduction

Every year we review our assessment of water treatment works balance, report on this and confirm any changes in configuration in each treatment plant with our operational colleagues. For our dWRMP19 we have accounted for the metering differences at our sites separately to that of DO.

8.9.2 Methodology

We have abstraction and distribution input meters at each treatment works and pumping station. These have varying configurations depending on the specific requirements of each site. All meters are calibrated in accordance with the Environment Agency's best practice guidance and operate continuously. Instantaneous and integrated readings are collected both on site and through our telemetry system. We have assessed each site for losses and summarise how we take these into account below.

At our surface water treatment works, we have both abstraction meters and output meters. We use abstraction meters primarily to monitor compliance with abstraction licences and use output meters to measure distribution input. The majority of the volume we report represents a difference in the reading of two flowmeters measuring the same flow. The accuracy of each meter is industry best practice at 2 to 3 percent and calibrated regularly but this means any pair of meters could have up to plus or minus 6 percent combined discrepancy within a legitimate range. Often these will be less. The volume is the total difference in such meter readings for sites operating at their abstraction limits but as distribution input is this amount lower than the total for abstraction meters then this is in effect a further constraint on supply capacity. Other losses such as waste is either measured or assessed and taken into account in the calculations.

We also measure significant waste flows, such as water discharged to waste. We have progressively reduced treatment works losses by adding secondary treatment in many cases with supernatant returning to the head of the works after abstraction metering, therefore total losses are small. Only the waste from small water quality monitors such as residual chlorine or turbidity instruments are unmetered. The majority of these monitors operate continuously at constant flow rate and we include an assessment for this element under an adjustment for minor losses in our water balance.

We have a small number of groundwater treatment sites that are subject to the influence of surface water, raw water pollution and two-stage pumping and therefore these have complex treatment. These sites are configured in the same way as our surface water sites.

We have a large number of groundwater sites where raw water quality is generally good, so that it requires minimal treatment. These sites have single stage pumping and continuous treatment such as disinfection. In this case there are one set of flow meters at the point of abstraction. These meter readings are monitored continuously through our telemetry system. Waste at these sites has only two elements: pumping to waste at start up or as a result of maintenance and continuous water quality monitoring instruments. Records are kept at each site for periods of pumping to waste and copied to our control room who record adjustments to daily integrated flow reports. An assessment has been made of the waste from sampling instruments and included in the water balance minor losses volume adjustment.

8.10 Regulatory Legislation

8.10.1 Invasive Non-Native Species (INNS)

We do not believe we currently have any situations were invasive non-native species could be imported into our supply area through raw water transfers as all our imports are of either pre-treated water or are imported directly into a treatment works for distribution within our supply network. There are no raw water transfers between catchments or up catchment that risk spreading invasive species.

We adhere to strict internal policies and procedures regarding invasive species when undertaking our monitoring field work such as spot gauging, especially when working between catchments. These procedures are in line with EA guidelines.

There is potential risk of invasive non-native species (INNS) related to new schemes in our feasible options list abstracting from a neighbouring catchment and transferring the water for storage in another reservoir before discharging to the environment or treatment. Schemes with the potential for this risk have been identified and this will be considered further if the option is chosen within our **PP**. Additional information on this can be found in our Technical Report 4.5: Supply side & constrained options Report Volume 1.

8.10.2 Abstraction Incentive Mechanism

The Abstraction Incentive Mechanism (AIM) has been proposed by Ofwat with the objective to encourage water companies to reduce the environmental impact of abstracting water at environmentally sensitive sites during low flow periods.

We have put forward a total of 23 groundwater sources to be included in AIM, which have been deemed as potentially environmentally sensitive by previous studies. AIM has been in force in a reputational form since 1 April 2016.

Of the 23 groundwater sources under AIM identified as sensitive, seven will have sustainability reductions implemented in AMP6 and six proposed at PR14 for AMP7. The remaining ten sources have an operating agreement, other licence conditions, or are currently under National Environment Programme (NEP) investigation. The AIM taskforce guidelines as proposed by Ofwat were followed to calculate the triggers and abstraction baseline figures. The AIM triggers selected were based on the EA's Restoring Sustainable Abstraction assessments, NEP investigations or other environmental impact assessment work. Where current investigations were in place, the preferred trigger points on river flows were adopted, based on environmental flow indicators in consultation with the Environment Agency. In the absence of these, Q95 flows (flow occurring 95% of the time in the waterbody) were adopted as best indication of low flow conditions for the AIM triggers.

Baseline abstraction values were calculated based on the 20-year period of 1 April 1995 to 31 March 2015 as this period is considered representative enough to include a number of droughts with and without demand restrictions. The 23 sites selected under AIM were submitted to Ofwat in September 2015. Since then a number of sources have sustainability reductions implemented, hence these sources will have the AIM performance calculated until the timing of the reduction. After the abstraction reductions are implemented, the AIM will cease to apply for such sources. Also, for sources that have augmentation schemes, the volume into supply will only be calculated under AIM, not the river support volume, since the latter is benefiting the environment.

Following the Ofwat guidance, two equations were used to calculate the AIM performance and the normalised AIM performance. We met and exceeded the AIM baseline figures for the financial year 2016-17.

The annual review of the AIM triggers and baseline abstractions, indicates they are robust and representative of the catchment status. The validity of the triggers and baseline abstraction is constantly monitored and the next AIM performance review will take place in July 2017 for the first quarter of 2017-18.

We will be reviewing the list of sources included in AIM for our PR19 business plan submission.

8.10.3 Abstraction reform

The latest proposals with respect to abstraction reform were outlined at the CIWEM Water Resources Panel meeting (14 September 2017). A joint vision by Defra and EA to reform abstraction management was set out with a number of actions to achieve this.

The objectives identified include: achieving sustainable catchments through focusing on catchment scale solutions, using approaches outlined in the 2016 Abstraction Reform consultation and modernising the abstraction licence service.

We believe that our holistic approach to assessing the environmental impacts of our abstractions and other anthropogenic influences in the catchment, is the most appropriate way to achieving these objectives and to realise benefits. A collaborative approach with catchment partners, land owners and users, as well as local authorities and the waste water sector is paramount in achieving this. Our work with Water Resources East (WRE) and Water Resources South East (WRSE) is an important component of this collaboration. We support the need for local leadership from catchment abstractors rather than a top down approach, with voluntary changes backed up by regulation if required. Our AMP6 sustainability reductions will benefit downstream receptors outside our supply area and thus balancing water needs across the region.

We have gained a depth of knowledge of our catchments over the last 20 years but there is still further work to do to fully quantify interdependencies, environmental, social and economic trends, if we are to establish a truly sustainable system. We look forward to our part in contributing to these assessments and delivery of relevant objectives.

8.11 Impacts of Climate Change on Supply

8.11.1 Vulnerability to Climate Change

The 'worst historic', 'severe' and 'extreme' drought DOs are representative of the reliable outputs that could have been achieved in the past (but with current levels of demand and abstraction). However the DOs that might be available in a current or future drought could vary in response to the changing climate.

A draft climate change vulnerability assessment was completed and the results are presented within this report. None of the resource zones are assessed as having a high vulnerability to climate change. However a climate change impact assessment has been undertaken nonetheless as the vulnerability assessment was based on WRMP14 data.

One hundred sets of climate change factors for the 2080s have been used to adjust climate data, so that climate change impacts on groundwater levels can be estimated for the 2080s; consequently the impacts on groundwater levels have been translated into climate change impacts on DO for the 2080s. The average impact on DO has been scaled back to 2020 to derive profiles (covering the period 2020 to 2080) for use by us in further supply and demand balance modelling work. Also the uncertainty around the impact of climate change on DO (the maximum and minimum estimates) is used within our headroom assessment capturing uncertainty across the wider set of assessments from demand forecast to the potential long term deterioration of water quality.

8.11.2 Results of the Climate Change impact assessment

The impact of climate change on the 'worst historic' DO is provided in Table 25 for 2020 and for the 2080s. Further detail at the WRZ level is provided within Technical Report 1:1 Deployable output and climate change impact assessment. WRZs 4, 6 and 8 are assessed as being not sensitive to climate change (for the same reasons as given above with respect to drought sensitivity). There are impacts presented for WRZ 1, 2, 3, 5 and 7, with the greatest impact occurring in WRZ2.

Scaling of climate change impacts from the 2080s to the 2020s has been undertaken using two approaches; one is based on a revised equation within the regulators' Water

Resources Planning Guideline (WRPG) for the dWRMP19 and the other is based on the equations within the WRPG for WRMP14.

The impact in the year 2020 is more significant when applying the new equation for dWRMP19 (compared to the equations for WRMP14). Both approaches recognise that climate change has already been occurring, although the WRMP14 equations are designed to avoid a major step change between baseline deployable output and the underlying climate change trend.

Table 25: Summary of climate change impacts on WRZ deployable outputs

Region	Median Impact on ADO (Ml/d) in 2020 (WRMP14 equations)	Median impact on ADO (Ml/d) in 2020 (dWRMP19 equation)	Median impact on ADO (Ml/d) 2079/80	Median impact on PDO (Ml/d) in 2020 (WRMP14 equations)	Median impact on PDO (Ml/d) in 2020 (dWRMP19 equation)	Median impact on PDO (Ml/d) 2079/80
Central	-9.42	-17	-38.76	-6.2	-11	-25.53
Southeast	0	0	0	0	0	0.95
East	0	0	0	0	0	0
Company Total	**-9.42**	**-17**	**-38.76**	**-6.2**	**-11**	**-24.58**

8.12 Outage Allowances

8.12.1 Introduction

Outage is a temporary loss of DO, temporary in the sense that it is retrievable. The application of an outage allowance as a reduction to our source outputs ensures that a realistic assessment of our overall supply capability is made.

The source DO, can be constrained by the following factors:

- License
- Treatment capacity
- Raw water mains
- Pumping plants
- Aquifer properties
- Transfer constraints
- Water quality
- Environmental issues

For a fuller understanding of our dWRMP19 Outage assessment see Technical Report 3.1 Outage. We have continued to log source downtime routinely since WRMP14. The raw data is obtained via an outage recording system and our dWRMP19 assessment covers the period 2012-2017. Our dWRMP19 assessment took into account actual durations and magnitudes of recorded outage events.

The historic data is recorded in our outage pro-forma for each water resource zone was then subjected to modelling using Monte-Carlo techniques (through @Risk). Normalised distributions were assigned to each event and totalled to provide an outage estimate for each water resource zone. Our dWRMP19 results are shown in Table 26 alongside the PR14 and PR09 outage figures for a direct comparison.

Table 26: Summary of outage allowance (Ml/d)

	PR09			PR14			PR19	
	Average	Peak		Average	Peak		Average	Peak
WRZ1	2.96	6.69		5.82	7.36		9.74	2.88
WRZ2	7.02	9.38		6.31	4.83		8.04	0.92
WRZ3	4.82	10.36		14.59	13.77		15.50	4.02
WRZ4	24.05	8.86		6.28	4.56		16.85	1.42
WRZ5	2.45	6.35		2.76	2.6		6.95	1.01
WRZ6	20.21	9.13		6.05	6.7		9.08	6.65
WRZ7	3.6	2.2		2.02	1.58		6.23	2.35
AWC	61.51	50.77		41.81	39.82		66.16	16.89
AWC & AWSE	65.11	52.97		43.83	41.40		72.39	16.24

8.12.2 Comparative analysis with WRMP14 and WRMP09

Water Resource Zones 4 and 6 have large surface water abstractions and therefore an outage event at one of these sites would produce higher figures for those zones which means we would expect to see fluctuation between AMP5, AMP6 and AMP7. This is in direct comparison to a zone with smaller groundwater sites such as WRZ 5, where we see fluctuations between a few megalitres only (between the three WRMP assessments).

For the dWRMP19 average demand outage has been calculated at 72Ml/d, whilst at critical period it is 17Ml/d. The critical period was defined as the peak week with a two week buffer either side. This compares closely to the sum of both average and critical period outage figures from the WRMP14 assessment, but we feel that it now better represents the split between average and peak periods.

A comparison of the Affinity Water Central figures (e.g. a combination of average and peak) shows a large decrease in outage allowance between AMP5 and AMP6, with the values stabilising between AMP6 and AMP7 (81.63Ml/d and 81.09Ml/d respectively). Potential reasons for this may include a heightened emphasis placed on recording outage with the company forecasting supply-demand deficits in WRMP09 and WRMP14.

Analysis indicated that water quality contributed toward the greatest magnitude of outage losses for the Central region. Catchment management and treatment strategies may play a large part in reducing this type of outage in the future.

8.13 Final Outputs

Final supply outputs are presented in the WRP tables submitted alongside this report.

9 Water Demand

Summary

In this chapter we present how we have determined the demand for water per annum for our chosen planning period of 60 years. This involves assessing a number of components which make up demand including household demand from population growth, non-household demand from industry and estimation of future leakage rates, as well as considering the impact of climate change on demand.

A key change since WRMP14 includes introducing a multiple linear regression model along with our micro-component model to provide further accuracy and validation to our household demand forecast as we continue to experience substantial housing and population growth in our area. We have also considered the impact of our compulsory metering programme with over 150,000 meters installed as part of our Water Saving Programme (WSP).

9.1 Introduction

The demand for water in our region is expected to significantly increase mainly as a result of continued substantial housing and population growth across our area, as well as impact from climate change affecting customers' demand for water.

We have estimated that our population is forecast to increase by 8% by 2025 and in the order of 20% by 2045 and 38% by 2080. That's equivalent to approximately 1.4 million more people in our supply area. As a result, we have undertaken work to forecast the total water demand in our supply area over our chosen planning period of 60 years, in order to assess whether an imbalance exists between supply and demand for water.

The demand for water is made up of a number of components as illustrated in Figure 23.

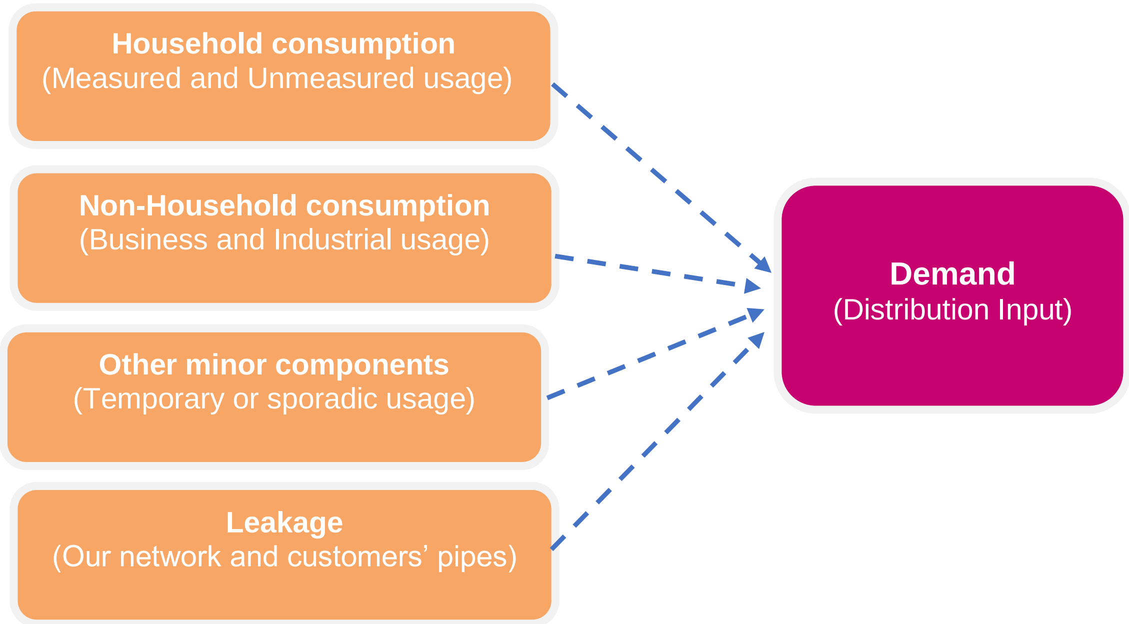

Figure 23: Components of demand

We measure the quantity of water supplied from all our water treatment works into our pipe network using flow meters; this volume of water supplied is also known as our distribution input (DI).

Within our pipe network we also measure flows going into specific areas known as district metered areas (DMAs), which are effectively local zones covering urban areas, towns and villages, where each DMA generally covers a few thousand homes.

DMA flows are monitored continuously and enable us to daily assess changes in demand and consumption at a detailed level. This in turn allows us to vary our source outputs if needed and helps identify and tackle leaks on our network.

Demand comprises water used by households and non-households. A further split of household demand is undertaken between measured (metered) properties and unmeasured; the split is relevant because we know the consumption of measured customers from meter readings. We also know from experience that metered households use, on average, less water than unmeasured customers; this is due to a better awareness of minimising wastage, as well as having greater control over their water and energy bills.

For household customers with meters, cumulative flows are taken from meter readings that are typically taken every 6 months, coinciding with our bi-annual billing cycle. For household customers who do not have a water meter, we determine unmeasured demand via our water consumption monitor (Watcom), a sample of customers metered to understand and determine characteristics of unmeasured water use.

For larger non-household customers, meter readings are taken more frequently and, in some cases flows are logged continuously to better mange demand. For other elements of demand, including unmeasured non-household customers (those without a meter), we have to estimate demand. As the vast majority of our non-household customers are metered, the unmeasured component is very small; non-household demand is explained in this chapter in Section 9.5.

We account for leakage in our demand forecast whilst considering the impact of any current or future baseline leakage reduction programmes.

Other minor components of demand include usage such as builders' temporary supplies from standpipes, water for fire fighting purposes and water we use for operational purposes such as flushing of hydrants.

All these components make up our water balance where we assess how closely the water we put into supply (our DI) matches the sum of household consumption, non-household consumption and the other components of demand. We seek to reconcile the water balance to within a few per cent and are required to report this as part of our Annual Return.

9.2 Approach to Demand Forecast

Our demand forecasting process has been undertaken in line with the latest EA WRPG and UKWIR technical guidance and uses the latest industry best practice methods.

We assess how future water demand may change over the next 25 years and beyond by reviewing how each component of demand in the base year may change in future years: this sets our baseline demand forecast.

Our base year is our starting position for the assessment which we have selected as 2015/16. More information on our base year selection can be found in this chapter in Section 9.4.3 Base Year.

We have forecasted our demand beyond the minimum statutory 25 year period up to 60 years (2020 to 2080), covering 13 AMP periods aligning with WRSE group commitment to forecast up to 2080.

Key changes since our last WRMP (fWRMP14) are:

- for **household consumption** along with a micro-component model which assesses how much water a customer uses for each purpose, e.g. clothes washing, we further introduced a multiple linear regression (MLR) model which combines occupancy, property type, socio-demographics and weather in a dynamic model to forecast household consumption based on real data from a wider sample of properties

- for **non-household consumption** we have improved our analysis to better predict year on year demand based on historic trend

- our compulsory metering programme is now well under way with over 150,000 meters installed as part of WSP within Water Resource Zones 3 and 5. The potential impact from this programme has been considered and incorporated within our household forecast.

The WRPG requires water companies to balance supply and demand at dry year annual average (DYAA) and dry year critical period (DYCP), where applicable. We build our normal year forecast based on the demand in a recent ‘normal’ year before applying factors to generate our DYAA and DYCP demand profiles.

A total of 30 forecasts have been developed covering individual water resource zones to regional and company level whilst satisfying the following three planning conditions:

- NYAA (Normal Year Annual Average)
- DYAA (Dry Year Annual Average)
- DYCP (Dry Year Critical Period)

The process map in Figure 24 shows the interaction between the various models and components of demand to develop the demand forecast.

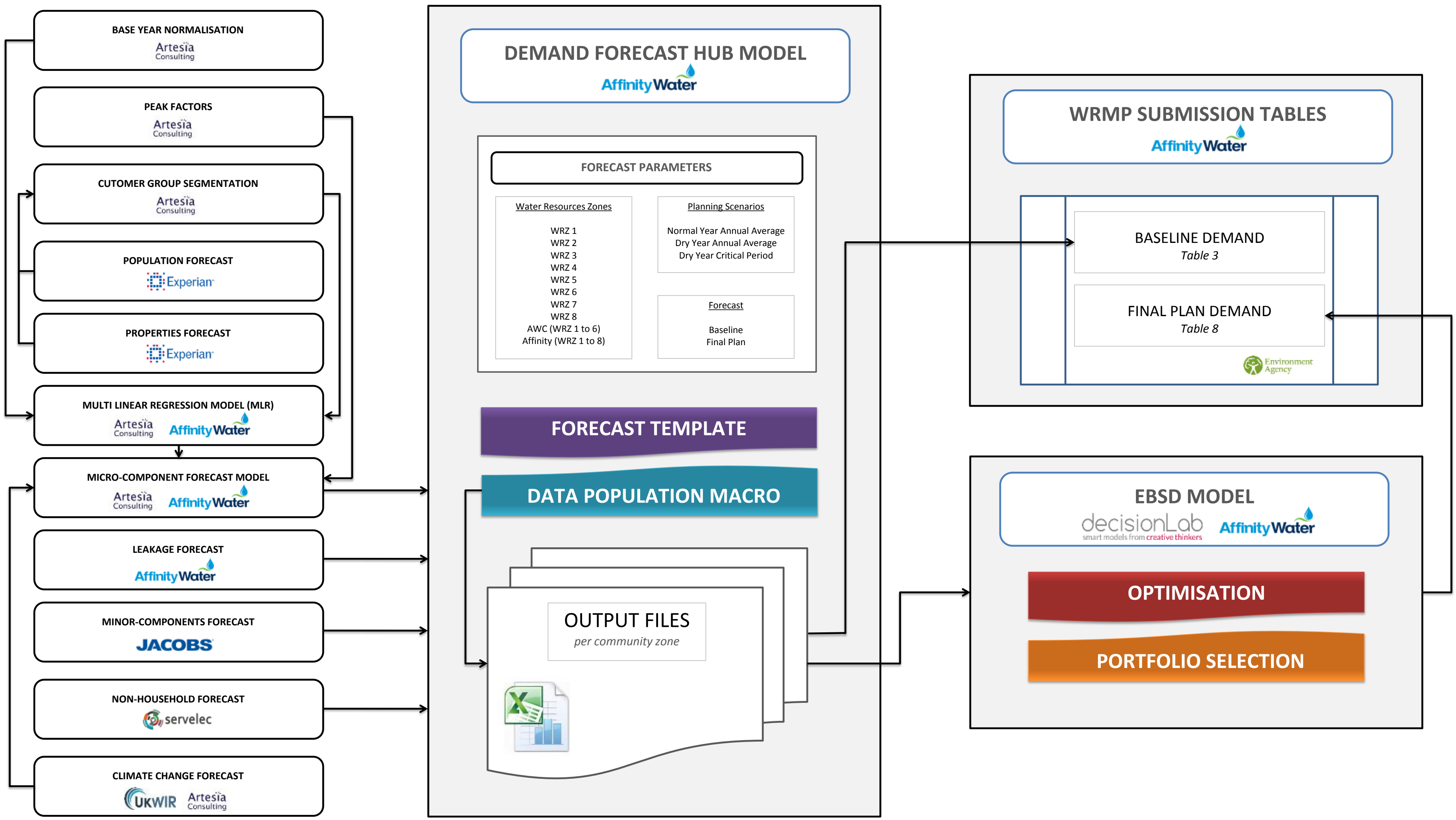

Figure 24: Process map to develop demand forecasts

9.3 Key issues and challenges for demand forecast

We face the following key challenges regarding the demand for water:

- **continued substantial population and household growth** – Population is forecast to increase in the order of 20% by 2045 and 38% by 2080 (equivalent to approximately 1.4 million more people in our area)
- **non household demand forecast** - We have hade to change how we collect and assess non-household consumption data following the opening of the non-household retail market in April 2017
- **leakage forecast, targets and consistency** – We continue our programme of leakage reductions set in AMP6 and assumed in the baseline. We also plan to test and incorporate the new base year leakage method outlined in the Consistency of Reporting Performance Measures (UKWIR 2017) for final plan
- **water saving programme (WSP)** – With our programme still in the early stages in terms of customers switching to a metered bill and with the data challenges there is still some uncertainty in determining long term savings from the programme
- **continue to improve water balance assumptions** – We continue to face challenges to improve the water balance such as assessing occupancy data due to the recent changes in population behaviour.

9.4 Household Consumption

9.4.1 Introduction

Since our last plan (WRMP14), there have been various changes to the household consumption forecast. The key differences are outlined below:

- **Social tariff households** - Evidence shows that such households although metered, consume water like unmetered households. This, along with the way in which social tariff properties are accounted for in the Annual Returns, means that adjustments to household properties and population forecasts are needed to account for them. Social tariff adjustments were not accounted for in PR14 household forecasts.
- **Water savings programme (WSP) –** Since PR14, a compulsory metering programme was rolled out in our Central region, meaning increased meter penetration with c.90% of households expected to switch to a metered bill by AMP8.
- **Peak Factors** - A single dry year annual average (DYAA) and dry year critical period (DYCP) ratio was applied across the Central region; in PR14 each community zone had its own peak factor. We believe this represents better the behaviour of customer base across our Central region.
- **Modelling procedure –** Micro-component modelling was used to derive the household consumption forecast in PR14. Due to a greater focus on model uncertainty, multi linear regression (MLR) modelling has additionally been used to validate trends and assist with the base year calibration.

9.4.2 Customer Group Segmentation

Our household customer base has been taken in account in every analysis which considers the following groups:

- **metered customers** – Those customers having a meter installed and billed on the basis of the metered data collected twice a year
- **unmetered customers** – Customers from properties without a meter, who are billed a constant bill calculated on the basis of the rateable value (RV) of their property
- **optants** – Former unmetered customers who opt for having a meter installed and are billed as metered (i.e. on the basis of the meter reads taken) straight away
- **WSP customers** – For WSP properties after a meter is installed, customers are given a two year transition period before being billed on the basis of measured consumption. Customers may choose to switch early or continue to be billed as unmetered until automatically switched at the end of the two year transition period
- **social tariff customers** – Customers that, irrespective of having a meter installed at their property or not, are billed according to a lower fare, either for economic reasons (low income) or due to special health conditions by which a higher water use is needed
- **new builds** – These group includes all new buildings under the supply area of Affinity Water, where possible all properties will be metered.

Figure 25 to Figure 27 depicts the distribution of the various **customer groups** for base year 2015/2016 across three of our regions and overall company.

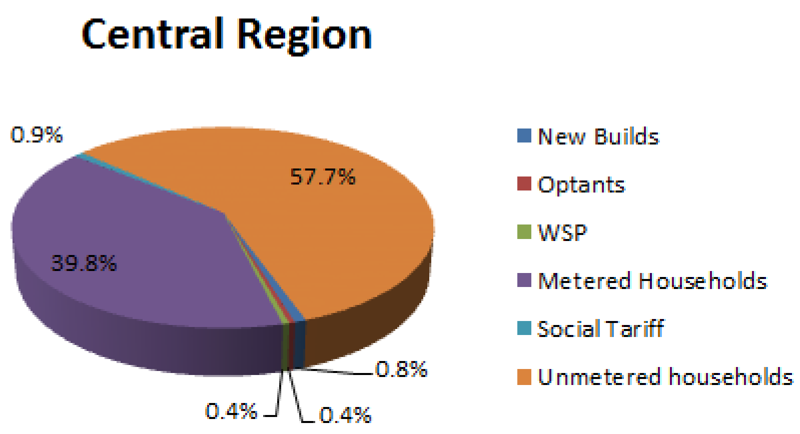

Figure 25: Distribution of the different customers segments in our Central Region

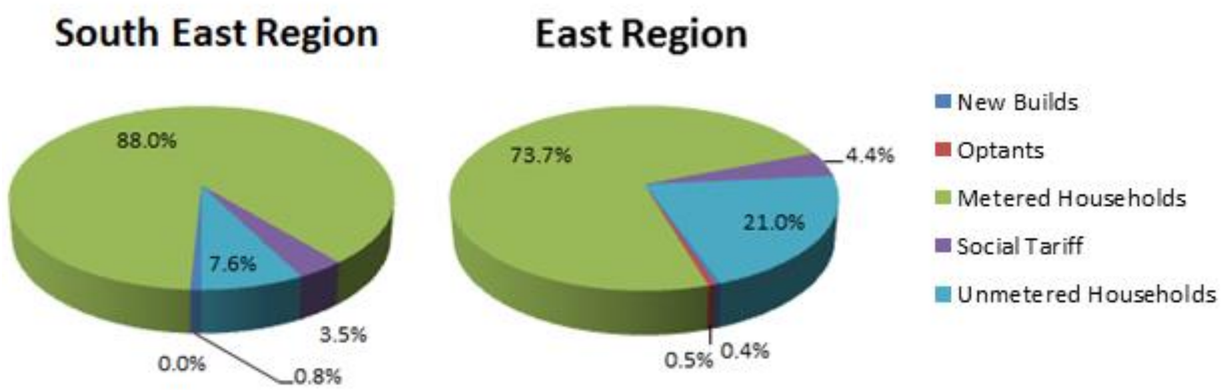

Figure 26: Distribution of the different customers segments in our South East and East Region

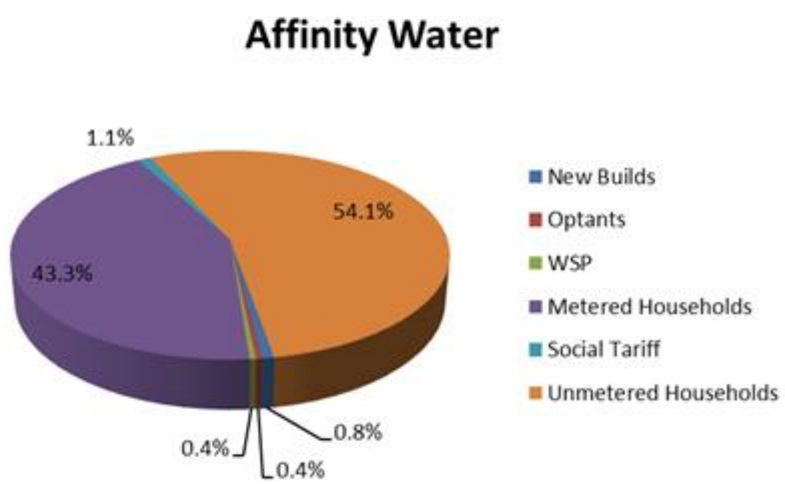

Figure 27: Distribution of the different customers segments for the Company as a whole

9.4.3 Base Year

We have chosen **2015/16** as our base year over 2016/17 for the following reasons:

- **Non-household retail market** – The introduction of the non-household retail market in April 2017 affected how we collect and assess non-household consumption.
- **Key Water Balance Assumptions** – Supply pipe leakage (SPL) and meter under registration (MUR) factors were reassessed during 2016/17. A sensitivity analysis on the implications of these updates on the water balance indicated no significant change; however such updates would underpin our ODI commitments for average water use and leakage. Therefore, the company is undertaking further validation throughout 2017/18 to provide additional evidence to justify updates for both SPL and MUR factors.

9.4.4 Method Selection

The appropriate method used to determine household consumption forecast is dependent upon on a number of factors such as the scale and complexity of the planning challenges that exist within our supply area, how they differ between water resource zones, what data is available and which method (or methods) will be most suitable.

The method chosen for household consumption forecasting was appropriate to the scale, complexity and degree of vulnerability of the challenges we face. The method was:

- accepted by stakeholders;
- able to assess uncertainty;
- based on valid data;
- understood, commands confidence and can be replicated by others;
- able to be validated (checked); and
- able to take account of the different factors which drive household demand, and different segments of customers with respect to household water use.

An assessment was made of the available methods and concluded for Central region to be high vulnerability, South East region to be medium vulnerability and the East region to be low vulnerability. The outcome was to use a combination of two approaches, the multi-linear regression model and the micro-component model. The detail regarding this choice is presented in the Technical Report 2.2 Household Demand Forecast -Micro-component Report.

9.4.5 Population and Properties Forecast

Forecasting the growth in housing and population is a fundamental element that underpins the assessment of future household demand. Water companies supplying customers wholly or mainly in England are required to base their own forecasts on local plans published by local councils or unitary authorities as per WRPG.

The methodology and detailed explanation of the population and housing growth figures used in our dWRMP19 are set out in Technical Report 2.3 Domestic Housing and Population Forecast, which sets out how we have incorporated housing and population forecast into dWRMP19.

We participated in a group project (Experian, 2016) aimed at developing a range of different housing and population forecasts. The group commissioned Experian to produce a set of different forecasts for the period 2020-2045:

- Trend-based forecast
- Plan-based forecast
- Econometric forecast
- Hybrid forecast

Housing and population forecasts have been produced by Experian in accordance with the methods in the WRPG and UKWIR guidance on population, properties and occupancy forecasts (UKWIR, 2016). These are plan-based forecasts i.e. using information from local plans published by local authority district councils. As there has been no evidence so far that plan-based forecasts have been inaccurate or that local authorities in our supply area have not delivered the number of new properties published in their local plans, we believe that using plan-based forecasts is appropriate to accurately forecast household demand.

We have adjusted the plan-based forecasts to take into account our knowledge of historic trend in housing formation and our own billing system. The results show that the forecasts used for dWRMP19 for both properties and population are generally higher than those used in our last plan.

The average household annual growth in our zones ranges from 0.87 to 1.14 per cent per annum compared with 0.72 per cent for the WRMP14 forecast. The average population growth ranges from 0.65 to 0.83 per cent per annum compared with 0.37 per cent for the WRMP14 plan-based forecast.

The population and household forecasts for each water resource zone are shown in Table 27 and Table 28.

Table 27: Current and forecast population numbers

Water Resource Zone	Base Year Population (2015/16)	Total population forecast by 2025	% increase by 2025	Total population forecast by 2045	% increase by 2045	Total population increase by 2080	% increase by 2080
1	326,771	343,045	5%	362,303	11%	394,211	21%
2	443,276	474,951	7%	498,131	12%	534,141	20%
3	700,837	776,253	11%	890,643	27%	1,077,711	54%
4	972,387	1,050,176	8%	1,127,418	16%	1,260,255	30%
5	293,871	330,742	13%	386,349	31%	475,541	62%
6	524,316	562,029	7%	626,039	19%	734,343	40%
Central region	3,261,458	3,537,195	8%	3,890,883	19%	4,476,204	37%
7 (Southeast region)	164,381	179,202	9%	202,015	23%	241,547	47%
8 (East region)	143,821	154,207	7%	173,649	21%	206,840	44%
Company total	**3,569,660**	**3,870,605**	**8%**	**4,266,547**	**20%**	**4,924,591**	**38%**

Table 28: Current and forecast number of households

Water Resource Zone	Base Year number of properties (2015/16)	Total number of properties forecast by 2025	% increase by 2025	Total number of properties forecast by 2045	% increase by 2045	Total number of properties forecast by 2080	% increase by 2080
1	131,712	138,943	5%	150,649	14%	174,452	32%
2	168,342	180,928	7%	195,898	16%	225,210	34%
3	271,183	306,662	13%	370,244	37%	496,742	83%
4	333,090	373,280	12%	426,121	28%	529,179	59%
5	116,259	133,770	15%	164,088	41%	223,215	92%
6	195,839	215,220	10%	255,955	31%	338,968	73%
Central region	1,216,426	1,348,803	11%	1,562,955	28%	1,987,764	63%
7 (Southeast region)	69,851	79,868	14%	96,868	39%	130,886	87%
8 (East region)	67,808	73,877	9%	86,630	28%	112,621	66%
Company total	**1,354,085**	**1,502,549**	**11%**	**1,746,453**	**29%**	**2,231,272**	**65%**

9.4.6 Multi Linear Regression (MLR)

A baseline household consumption forecast has been produced using multiple linear regression (MLR) modelling and forecasting. It combines occupancy, property type, socio-demographics and weather in a dynamic model which can be used to forecast household consumption. Model error has been quantified and model performance has been tested.

The model has been developed using the best available data. The model has been segmented by property type using unmetered and metered categories, with explicit treatment of Water Saving Programme (WSP) metered properties, and social tariff households.

The results of the forecast give a 36.55 Ml/d increase in household consumption for Normal Year Annual Average (NYAA), over the period 2015/16 to 2044/45; this represents a 6.79% increase for the company. The increase is largely driven by the upward trend in property forecast. Average per household consumption (PHC) and per capita consumption (PCC) decrease up to 2034/35, which is dominated by the effects of the Water Saving Programme (WSP).

PHC figures for measured and unmeasured households for dWRMP19 are lower than those given in the last plan. The updated unmeasured PHC for the company in 2039/2040 is 488 litres per property per day, in comparison with 503 l/property/day in our last plan. Likewise, the final updated measured PHC for dWRMP19 is 323 litre l/property/day s per property per day for 2039/2040 in comparison with 339 l/property/day in our last plan.

WSP adjustment

The Water Saving Programme (WSP) includes a compulsory metering programme, in which approximately 500,000 properties will be fitted with a meter over the next 8 years. This will have dramatic implications on the meter penetration at both zonal, and company level. The customer journey is outlined in Figure 28.

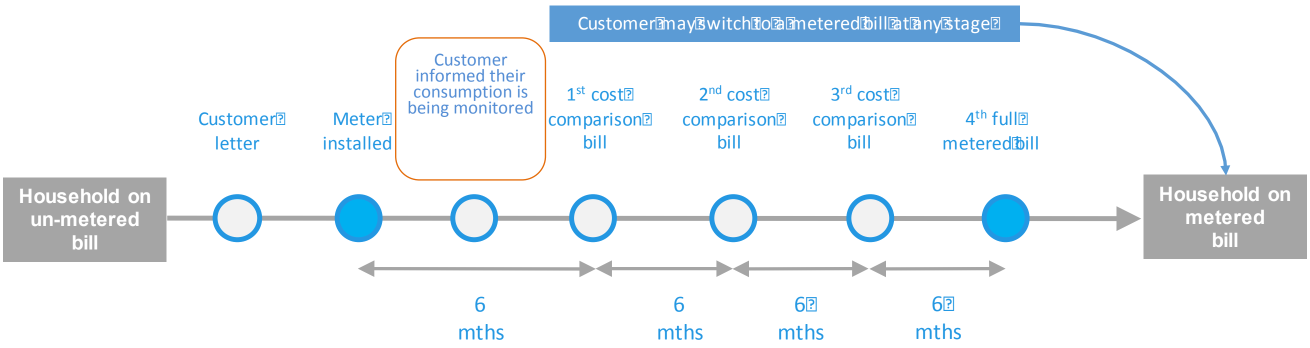

Figure 28: WSP Customer journey

As the figure illustrates, customers can switch to a measured bill at any stage in the process. Analysis of recent WSP data was undertaken to understand and model the effects of the consumption used by these properties. The data from the WSP that we have now includes a large number of customers that have been metered (from which we get monthly metered data) but have not switched, a very small number of customers who already had a meter, and a set of customers who have already switched to a measured bill. This latter cohort of customers has switched (or opted for a meter) early in the programme (before the two year period when they are moved automatically to a measured bill).

We reconciled between our limited WSP data and findings from a case study by Southern Water, a value of 18% saving has been applied for all WSP properties when compared with the unmeasured population, as no long term evidence exists. It is not possible to conclude exactly how these households will respond in the future since the initial value of 18%, as well as the long term savings are uncertain, provisions will be taken in target headroom calculations to account for savings of between 10 and 22%. More information on WSP savings can be found in the Technical Report 2.1 Household Demand Forecast - MLR Modelling Report..

The result of this analysis provides PHC and PCC values per year, per zone, for both measured and unmeasured household consumption forecasts.

With the implementation of WSP, meter penetration for the company increases from 48.5%, to over 92% in 2045. Throughout this period, population and properties are steadily increasing, with total occupancy coming down. In terms of consumption, the WSP has had a dramatic effect to total consumption and thus to the PHC/PCC for the company. It is anticipated that the WSP will conclude by 2025 and, therefore, the total consumption reduces for the first few years of the forecast. The shift from unmeasured to measured properties as a result of WSP, results in the average household PCC (mean of all household types) to reduce from 151 to135 l/person/day. The PHC reduces from 398 to 328 l/property/day over the planning period.

9.4.7 Micro-component (MC) model analysis

Introduction

The Micro-component (MC) model adopts a bottom-up approach by estimating household use at component level i.e. per equipment type such as a shower or toilet use, then calculates per capita use based on the population and property forecast by unmetered and metered bill type to build a water demand model. For more details of the methodology applied can be found in the Technical report 1.2 Household Demand Forecast -Micro-component Report.

Micro-component models have been used for water demand forecasting in England and Wales from the late 1990s. They quantify the water used for specific activities (e.g. showering, bathing, toilet flushing, dishwashing, garden watering, etc.) by combining values for ownership (O), volume per use (V) and frequency of use (F).

By forecasting changes in each of the variables (O, V, F or daily water use for each micro-component) over time, a water demand forecast can be created. Hence, the micro-component forecast model requires estimates of changes in these variables to reflect future changes in technology, policy, regulation, and behaviour. The micro-component model for the base year is built on the data collected in the customer survey for PR14.

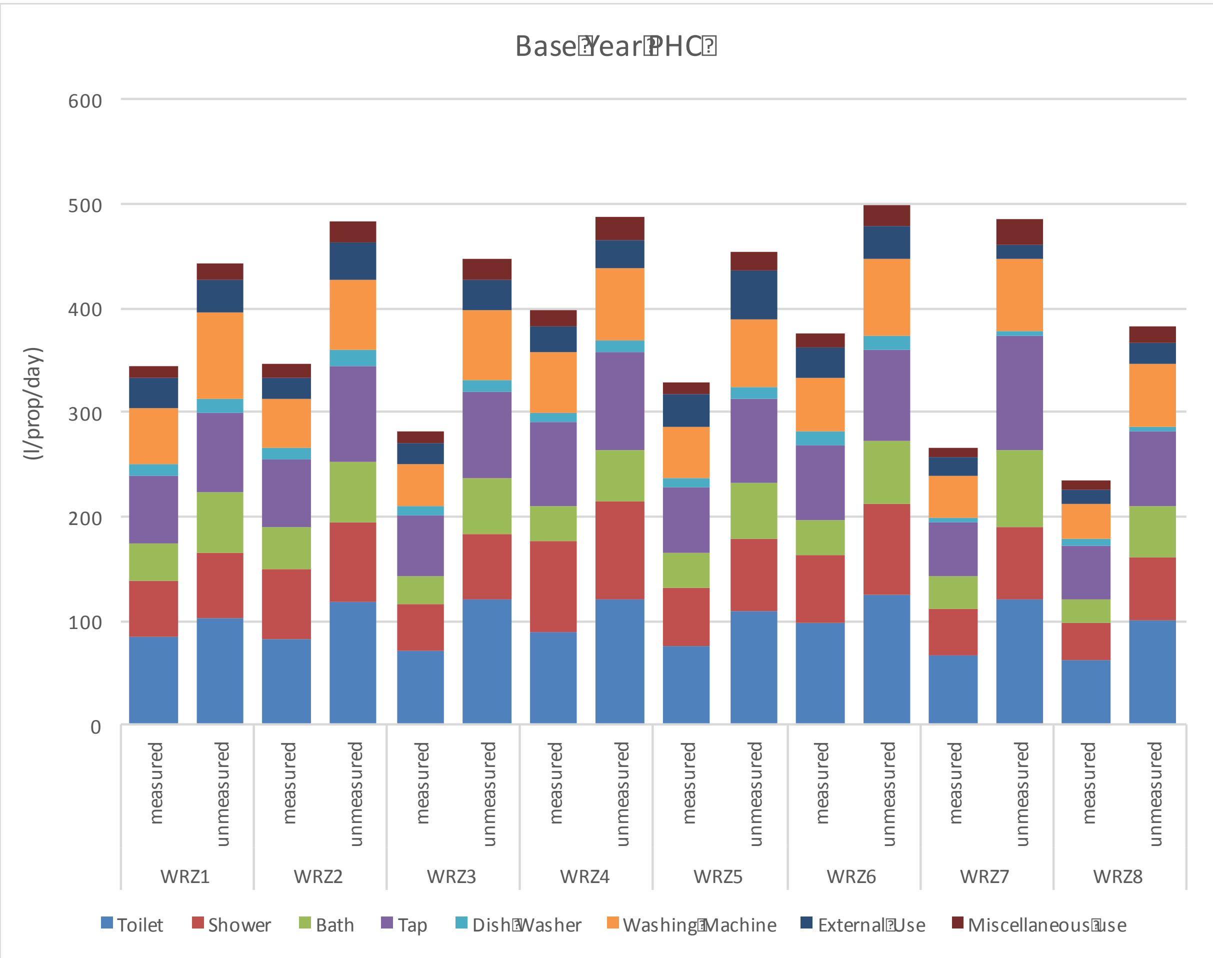

Figure 29: Micro-components after calibration

Climate change forecast

The MC model makes the required adjustments for climate change based on the latest UKWIR guidance[6]. Table 29 summarises the uplift applied for climate change impacts on household demand.

Table 29: Climate change forecast

		Unit	2015/16	2020/21	2025/26	2030/31	2035/36	2040/41	2045/46	2050/51	2055/56
CC Forecast	WRZ1	%	0.00%	0.18%	0.36%	0.53%	0.71%	0.89%	1.07%	1.25%	1.43%
	WRZ2	%	0.00%	0.18%	0.36%	0.53%	0.71%	0.89%	1.07%	1.25%	1.43%
	WRZ3	%	0.00%	0.18%	0.36%	0.53%	0.71%	0.89%	1.07%	1.25%	1.43%
	WRZ4	%	0.00%	0.18%	0.36%	0.53%	0.71%	0.89%	1.07%	1.25%	1.43%
	WRZ5	%	0.00%	0.18%	0.36%	0.53%	0.71%	0.89%	1.07%	1.25%	1.43%
	WRZ6	%	0.00%	0.18%	0.36%	0.53%	0.71%	0.89%	1.07%	1.25%	1.43%
	WRZ7	%	0.00%	0.18%	0.36%	0.53%	0.71%	0.89%	1.07%	1.25%	1.43%
	WRZ8	%	0.00%	0.18%	0.36%	0.53%	0.71%	0.89%	1.07%	1.25%	1.43%
	Central Region	%	0.00%	0.18%	0.36%	0.53%	0.71%	0.89%	1.07%	1.25%	1.43%
	Company	%	0.00%	0.18%	0.36%	0.53%	0.71%	0.89%	1.07%	1.25%	1.43%

Base year normalisation and peak factors

The latest WRPG identifies the need for water companies to use methods for supply and demand analysis that are appropriate to the level of planning concern in their water resources zones.

Part of the process for producing household demand forecasts requires the forecasts to be adjusted to normal year annual average (NYAA), dry year annual average (DYAA) and critical period (DYCP) scenarios. This has been carried out making use of existing best practice guidance.

This is only applied to household demand as non-household demand has little or no impact as they tend to continue to operate under normal conditions.

The derivation of the peak factors is described in Technical Report 2.5: Dry Year Annual Average and Critical Period Factor Analysis.

Demand has been calculated for the following range of planning scenarios:

- **Normal Year Annual Average (NYAA) –** the demand in a typical “normal” weather year. To determine a normal year historic assessments against the company’s demand profiles per region are carried out. To further normalise the NYAA condition historic weather data is used to generate a normalisation factor

- **Dry Year Annual Average (DYAA)** - represents the dry weather demand and is used to identify whether any dry year deficits occur. DYAA is defined as: “The level of demand, which is just equal to the maximum annual average, which can be met at any time without introducing demand restrictions. This should be based on continuation of current demand management policies”.

[6] UKWIR 13/CL/04/12 Impact of Climate Change on water demand.

- **Dry Year Critical Period (DYCP)** – is the period during which water resources zone demand balances are at their lowest. Critical period does not necessarily occur in the period of peak demand. Typically for us the peak demand is usually in July and we use 10 days as our typical window of assessment but the 10 days are not necessarily consecutive.

Results

Table 30: Peak factors dWRMP19

	AWC	AWE	AWSE
BYAA to NYAA – measured Household	0.991	0.927	1.001
BYAA to NYAA- unmeasured household	0.974	0.946	0.995
NYAA to DYAA	1.068	1.025	1.063
NYAA TO DYCP	1.398	1.678	1.484

Household consumption forecasts derived from the multiple linear regression model (MLR) and were fed into the micro-component model as per household consumption figures (PHC) for measured and unmeasured households in each water resource zone.

The micro-component (MC) model takes the PHC values as inputs and then splits the household consumption into micro-components each year, based on the micro-component split for household consumption in each year calculated from the MC model.

9.5 Non-household demand

In our last WRMP, the non-household demand was assumed to be constant over the planning period, with any increases in demand from one sector assumed to be balanced by reduced demand in another. Although non-household demand compromises a small percentage of approximately 18% of overall demand, for dWRMP19, a more detailed non-household water demand forecast has been developed.

9.5.1 Approach

The non-household customers have been divided by geographical area (WRZ) and industry sector and then separate models developed to forecast consumption based on one or more explanatory factors such as numbers in employment or the level of economic activity.

Some individual large users are seen to have significant influences on total consumption, notably:

- **Heathrow Airport** has an average total consumption of approximately 5 Ml/d which is split between WRZ 4 and WRZ 6. There is likely to be a substantial increase in consumption associated with construction of a third runway, currently planned to start in 2020
- **Dungeness Power Station** in the Southeast region is scheduled to be decommissioned by 2028. The current consumption is 1.5 Ml/d. There is unlikely to be a replacement, with the generation capacity instead met through the planned nuclear reactor at Hinkley Point

- **Stansted Airport** in WRZ5 has an average consumption of slightly less than 2 Ml/d. It is unlikely that there will be a major expansion at the site since current plans have not been approved
- **Luton Airport** in WRZ3 has an average consumption of approximately 0.45 Ml/d. There is a current expansion plan to increase passenger numbers by 50% by the year 2020.

9.5.2 Major Future Developments

There are a number of major developments proposed in the area which could individually have a sizeable impact on future demand.

- **High Speed Rail 215** – the construction of a new high speed rail line into London could have similar demands to the current Crossrail project, currently 0.2 Ml/d
- **Crossrail 216** – running from Ealing Broadway to Maidenhead through the centre of the Central region. This would most likely have a similar impact to the current Crossrail project
- there is a new rail link from Slough to Heathrow linking the airport to the Great Western main line proposed.

However the impact of the infrastructure projects is more likely to be that they will enable the expansion in employment projected in the current forecasts. The forecasts for employment already show levels of growth that are consistent with these and other projects taking place, and therefore the impacts of these (or alternative similar developments) are arguably already taken into account within the forecasts.

9.5.3 Non-household retail market

The non-household retail market was launched in April 2017. In terms of dWRMP19 this has meant some adjustment in properties and occupants moving from our household category to non-household e.g. connections smaller than 25mm to non-household premises and others from non-household to household e.g. nursing homes. Our forecasts for the dWRMP19 are based on property numbers and occupancy data for 2015/16 so before separation. These adjustments will be applied for our final WRMP19 but we do not consider these changes significant.

9.5.4 Unmeasured Non-Household Demand

The estimated unmeasured non-household demand represents approximately 5% of the total and has remained relatively constant in recent years. Limited information is available regarding unmeasured non-household demand.

In the absence of any evidence to the contrary, it is reasonable to assume that unmeasured non-household demand per property will remain constant.

9.5.5 Results

The overall non-household consumption has shown a sustained downwards trend over the period and this is forecast to continue initially and then start to increase again from approximately half way through the forecast period.

Overall, demand in the service sector has been forecast to increase, whereas demand from the non-service sector will decrease over the forecast period. Demand in the unknown sector is forecast to remain relatively constant.

The South East in particular is forecast to continue reducing its demand substantially. This is driven by the forecast reductions at Dungeness power station. The site has reduced its demand substantially in recent years and is planned to be decommissioned during the forecast period. There is some uncertainty about whether the demand will continue to reduce, in particular after its planned decommission date.

These results have been based on modelling the whole non-household customer base, whereas the previous WRMP assumed non-household demand to be constant over the forecast period.

Note that the historical datasets represent a period when the UK was a member of the European Union. The decision for the UK to leave the European Union adds substantial uncertainty regarding impacts on the economy and population and therefore future non-household water demand.

9.6 Other minor components forecast

Our assessment of other components of demand shown in Table 31 , comprises operational uses (such as hydrant and mains flushing) and water taken unbilled (which includes water taken legally for fire fighting purposes and water that is taken illegally). This accounts for 1% of our total DI and is reflected in the last assessment carried out for our Annual Return in 2009.

Table 31: Other components of demand

Region	Operational Use Ml/d	Water taken unbilled Ml/d	Total Ml/d
Central	0.71	11.47	12.18
Southeast	0.06	0.24	0.3
East	0.02	0.01	0.03
Company	**0.79**	**11.72**	**12.51**

9.7 Leakage forecast

We have incorporated our AMP6 ODI targets in our leakage forecast. This means that we are forecasting to meet our 14% leakage reduction target by the end of AMP6. The forecasted value for the last year of AMP6 (2019/20) is then kept constant throughout our chosen planning period. By doing that, we assume that, as a baseline, we will maintain the same level of leakage in the future. The leakage forecast is then offered to the EBSD model alongside the other components of demand. The EBSD model will select the appropriate leakage reduction based on the cost-effectiveness of the leakage intervention in each water resource zone.

9.7.1 Impact of change of leakage reporting

Water companies have been working together, co-ordinated by Water UK, to improve the consistency of reporting performance measures, so that performance can be compared between companies more easily.

This work is supported by Ofwat, the Environment Agency, Natural Resources Wales and the Consumer Council for Water.

Companies need to make changes to their current reporting to align with the new, more consistent, reporting definitions, and for some of these changes it will take some time to have robust data.

One of the measures of performance this applies to is leakage. Each company's draft Water Resources Management Plan explains how the company is implementing the new reporting definition for leakage and the extent to which it might impact on their future plans for balancing supply and demand for water. The change in reporting of leakage is purely a change in reporting; it does not affect the actual amount of water lost through leakage.

Each company will be making different changes to their current reporting to come into line with the more consistent definition, and so the impact will be different for each company.

We have assessed the impact of applying the new method to forecast leakage for 16/17. The assessment indicated approximately a 2% increase in our base year leakage and a slight increase in DI and smaller reduction in WAPCC as a result of smaller water balance closure and thus smaller adjustments to DI and WAPCC. We have tested the sensitivity of measuring leakage through this new method via our sensitivity analysis in the EBSD model. We consider the effects of these changes to be small and they are insensitive with regard to our plan and range of uncertainty already embodied. We plan to carry out further tests of the new method and will look to incorporate new method to estimate our base year leakage for final WRMP19 demand forecast.

9.8 Stable components of our demand forecast

Demand components that remain stable over the planning period are summarised in Table 32.

Table 32: Summary of base year stable components for each WRZ

Water Resource Zone	Water Delivered Unmeasured Non- Household Ml/d	Minor components Ml/d
1	0.76	1.05
2	1.28	1.81
3	2.24	2.49
4	2.92	3.23
5	1.16	1.29
6	0.80	2.31
Sub-total (Central region)	9.16	12.18
7 (Southeast region)	0.05	0.30
8 (East region)	0.01	0.03
Company Total	9.23	12.51

9.9 Demand forecast outputs

The starting point for our demand forecast is the base year that is represented by our most recent outturn data. This ensures that the current metered and unmeasured household numbers and non-household customer numbers are up to date.

Table 33 and Table 34 shows baseline forecast for key parameters such as Distribution Input (DI), Leakage and Weighted Average Per Capita Consumption (WAPCC) for DYAA and DYCP planning scenarios.

Table 33: DI, Leakage and WAPCC baseline forecast for DYAA

DYAA

Distribution Input (DI) (Ml/d)

DYAA	2015/16	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45	2049/50	2054/55	2059/60	2064/65	2069/70	2074/75	2079/80	TREND
WRZ1	96.00	93.85	88.12	88.39	88.94	89.55	90.51	91.14	91.92	92.66	93.44	94.20	94.96	95.72	
WRZ2	128.67	123.62	119.54	120.05	120.93	121.83	123.29	124.22	125.40	126.51	127.67	128.81	129.96	131.10	
WRZ3	165.93	156.26	158.27	162.78	167.42	172.20	177.47	182.25	187.27	192.22	197.22	202.20	207.18	212.17	
WRZ4	249.36	253.78	240.98	243.90	247.06	250.50	254.98	258.48	262.44	266.27	270.19	274.07	277.96	281.85	
WRZ5	79.15	77.07	77.46	79.90	81.86	83.80	85.93	87.88	89.92	91.93	93.96	95.98	98.00	100.03	
WRZ6	147.56	146.23	139.51	142.29	145.84	149.54	153.99	157.71	161.78	165.75	169.79	173.81	177.83	181.85	
Central Region	**866.67**	**850.81**	**823.88**	**837.31**	**852.04**	**867.41**	**886.17**	**901.68**	**918.74**	**935.34**	**952.26**	**969.06**	**985.89**	**1002.71**	
WRZ7	38.30	38.00	38.11	38.26	38.59	39.12	39.86	40.38	41.00	41.60	42.21	42.82	43.42	44.03	
WRZ8	28.93	29.09	29.36	30.00	30.71	31.45	32.34	33.09	33.90	34.70	35.50	36.31	37.11	37.91	
Company	**933.90**	**917.90**	**891.35**	**905.56**	**921.34**	**937.99**	**958.38**	**975.16**	**993.64**	**1011.63**	**1029.98**	**1048.18**	**1066.43**	**1084.66**	

Leakage (Ml/d)

DYAA	2015/16	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45	2049/50	2054/55	2059/60	2064/65	2069/70	2074/75	2079/80	TREND
WRZ1	181.50	159.49	156.24	153.14	149.84	146.71	144.29	140.82	137.90	134.88	131.97	129.00	126.05	123.09	
WRZ2	173.19	150.60	146.98	144.00	140.92	138.10	135.39	132.53	129.74	126.94	124.15	121.35	118.55	115.76	
WRZ3	101.76	88.15	82.90	78.57	74.72	71.19	67.98	64.42	61.02	57.59	54.19	50.78	47.36	43.95	
WRZ4	125.87	107.52	103.41	99.63	96.25	93.04	90.04	86.81	83.68	80.54	77.41	74.27	71.14	68.00	
WRZ5	113.47	97.09	91.41	86.03	81.63	77.62	73.96	69.90	66.03	62.13	58.25	54.36	50.48	46.59	
WRZ6	113.17	98.32	94.29	89.96	85.74	81.95	78.47	74.64	70.97	67.27	63.60	59.92	56.24	52.56	
Central Region	**129.78**	**112.13**	**107.45**	**103.15**	**99.18**	**95.50**	**92.08**	**88.90**	**85.93**	**83.16**	**80.55**	**78.11**	**75.81**	**73.61**	
WRZ7	76.42	73.25	68.61	64.81	61.33	58.20	55.38	52.22	49.22	46.18	43.18	40.16	37.14	34.13	
WRZ8	55.20	53.68	51.91	49.90	47.88	46.03	44.31	42.44	40.64	38.82	37.02	35.21	33.40	31.60	
Company	**123.29**	**107.22**	**102.67**	**98.47**	**94.60**	**91.01**	**87.67**	**84.58**	**81.70**	**79.01**	**76.49**	**74.12**	**71.90**	**69.78**	

WAPCC (litres/head/day)

DYAA	2015/16	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45	2049/50	2054/55	2059/60	2064/65	2069/70	2074/75	2079/80	TREND
WRZ1	170.44	168.34	148.35	147.58	147.91	148.43	149.71	150.29	151.18	151.99	152.85	153.69	154.54	155.39	
WRZ2	171.27	160.92	147.97	146.91	147.00	147.35	148.56	148.94	149.70	150.36	151.09	151.79	152.50	153.21	
WRZ3	146.77	131.11	124.82	124.23	124.85	125.62	127.00	127.83	128.91	129.91	130.96	131.99	133.03	134.07	
WRZ4	164.71	164.48	146.70	147.52	147.77	148.07	149.01	149.39	150.02	150.56	151.17	151.75	152.34	152.92	
WRZ5	164.12	152.51	143.60	142.70	142.45	142.45	143.13	143.19	143.52	143.78	144.09	144.38	144.67	144.96	
WRZ6	173.87	172.31	154.36	154.52	156.15	157.81	160.26	162.01	164.07	166.04	168.07	170.08	172.09	174.10	
Central Region	**163.74**	**157.36**	**143.16**	**142.91**	**143.35**	**143.93**	**145.21**	**145.87**	**146.83**	**147.72**	**148.68**	**149.63**	**150.59**	**151.56**	
WRZ7	128.73	126.56	125.81	126.60	128.00	129.39	131.41	132.87	134.57	136.20	137.89	139.55	141.22	142.88	
WRZ8	130.32	126.70	123.50	123.13	123.31	123.61	124.53	124.89	125.51	126.05	126.64	127.22	127.80	128.37	
Company	**160.78**	**154.72**	**141.57**	**141.36**	**141.83**	**142.42**	**143.71**	**144.40**	**145.38**	**146.29**	**147.28**	**148.25**	**149.24**	**150.24**	

Table 34: DI, Leakage and WAPCC baseline forecast for DYCP

DYCP

Distribution Input (DI) (Ml/d)

DYCP	2015/16	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45	2049/50	2054/55	2059/60	2064/65	2069/70	2074/75	2079/80	TREND
WRZ1	113.11	111.16	103.74	104.17	104.98	105.85	107.17	108.07	109.16	110.20	111.28	112.34	113.41	114.47	
WRZ2	152.01	146.46	141.14	141.83	142.98	144.15	146.04	147.25	148.79	150.23	151.73	153.21	154.70	156.19	
WRZ3	197.50	185.68	188.00	193.66	199.50	205.51	212.22	218.25	224.59	230.85	237.18	243.48	249.78	256.08	
WRZ4	298.63	305.41	288.37	292.49	296.56	300.97	306.69	311.17	316.23	321.13	326.14	331.10	336.08	341.05	
WRZ5	93.95	91.58	92.03	95.12	97.64	100.14	102.91	105.42	108.06	110.66	113.29	115.90	118.52	121.14	
WRZ6	175.56	174.95	166.16	169.80	174.40	179.16	184.85	189.65	194.86	199.96	205.14	210.29	215.45	220.60	
Central Region	**1030.77**	**1015.24**	**979.44**	**997.08**	**1016.06**	**1035.78**	**1059.88**	**1079.80**	**1101.70**	**1123.03**	**1144.76**	**1166.32**	**1187.94**	**1209.53**	
WRZ7	46.59	46.47	46.95	47.45	48.16	49.09	50.27	51.19	52.22	53.23	54.26	55.28	56.30	57.33	
WRZ8	40.88	40.76	41.17	42.18	43.29	44.43	45.79	46.95	48.20	49.43	50.67	51.90	53.14	54.38	
Company	**1118.25**	**1102.47**	**1067.56**	**1086.70**	**1107.51**	**1129.30**	**1155.95**	**1177.94**	**1202.13**	**1225.68**	**1249.68**	**1273.51**	**1297.38**	**1321.24**	

Leakage (Ml/d)

DYCP	2015/16	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45	2049/50	2054/55	2059/60	2064/65	2069/70	2074/75	2079/80	TREND
WRZ1	181.50	159.49	156.24	153.14	149.84	146.71	144.29	140.82	137.90	134.88	131.97	129.00	126.05	123.09	
WRZ2	173.19	150.60	146.98	144.00	140.92	138.10	135.39	132.53	129.74	126.94	124.15	121.35	118.55	115.76	
WRZ3	101.76	88.15	82.90	78.57	74.72	71.19	67.98	64.42	61.02	57.59	54.19	50.78	47.36	43.95	
WRZ4	125.87	107.52	103.41	99.63	96.25	93.04	90.04	86.81	83.68	80.54	77.41	74.27	71.14	68.00	
WRZ5	113.47	97.09	91.41	86.03	81.63	77.62	73.96	69.90	66.03	62.13	58.25	54.36	50.48	46.59	
WRZ6	113.17	98.32	94.29	89.96	85.74	81.95	78.47	74.64	70.97	67.27	63.60	59.92	56.24	52.56	
Central Region	**129.78**	**112.13**	**107.45**	**103.15**	**99.18**	**95.50**	**92.08**	**88.90**	**85.93**	**83.16**	**80.55**	**78.11**	**75.81**	**73.61**	
WRZ7	76.42	73.25	68.61	64.81	61.33	58.20	55.38	52.22	49.22	46.18	43.18	40.16	37.14	34.13	
WRZ8	55.20	53.68	51.91	49.90	47.88	46.03	44.31	42.44	40.64	38.82	37.02	35.21	33.40	31.60	
Company	**123.29**	**107.22**	**102.67**	**98.47**	**94.60**	**91.01**	**87.67**	**84.58**	**81.70**	**79.01**	**76.49**	**74.12**	**71.90**	**69.78**	

WAPCC (litres/head/day)

DYCP	2015/16	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45	2049/50	2054/55	2059/60	2064/65	2069/70	2074/75	2079/80	TREND
WRZ1	223.16	220.41	194.24	193.22	193.66	194.34	196.02	196.78	197.95	199.00	200.13	201.24	202.35	203.46	
WRZ2	224.25	210.70	193.74	192.35	192.47	192.92	194.51	195.01	196.01	196.87	197.82	198.74	199.67	200.60	
WRZ3	192.17	171.66	163.42	162.66	163.47	164.48	166.28	167.37	168.78	170.09	171.47	172.82	174.18	175.54	
WRZ4	215.65	215.35	192.08	193.15	193.48	193.87	195.10	195.60	196.42	197.14	197.92	198.69	199.46	200.22	
WRZ5	214.89	199.68	188.02	186.85	186.51	186.52	187.40	187.48	187.92	188.25	188.65	189.04	189.42	189.81	
WRZ6	227.65	225.62	202.10	202.31	204.45	206.62	209.84	212.12	214.83	217.40	220.06	222.69	225.32	227.96	
Central Region	**214.39**	**206.03**	**187.44**	**187.12**	**187.69**	**188.45**	**190.12**	**191.00**	**192.25**	**193.42**	**194.67**	**195.91**	**197.17**	**198.44**	
WRZ7	179.64	176.61	175.57	176.68	178.63	180.57	183.38	185.42	187.80	190.07	192.42	194.74	197.07	199.40	
WRZ8	213.47	207.55	202.31	201.70	201.98	202.48	203.99	204.59	205.60	206.48	207.45	208.39	209.34	210.29	
Company	**212.75**	**204.74**	**187.48**	**187.22**	**187.85**	**188.64**	**190.37**	**191.29**	**192.61**	**193.83**	**195.14**	**196.44**	**197.77**	**199.11**	

AffinityWater

10 Risk and Uncertainty Assessment

Summary

This chapter explains how we have allowed for uncertainty in our supply and demand calculations and forecasts. This is known as our headroom which is an allowance of water (or buffer) that is additional to our supply demand balance, which is representative of the uncertainties in the overall supply demand balance.

10.1 Headroom

10.1.1 Introduction

Due to the long term planning nature of WRMPs, inevitably they will contain forecasts that are uncertain. They are based on the best available and most appropriate data and methods, and this will vary for each water company. There is therefore uncertainty in all forecasts and planners need to analyse and estimate this uncertainty in their estimates for both dry year and critical period planning scenarios.

Previous WRMPs accounted for uncertainty using the target headroom method, in which target headroom is defined as:

"…the minimum buffer to cater for supply-side and demand-side uncertainties in the overall supply demand balance".

Essentially this means that planners calculate and allow for a volume of water (or buffer) that is additional to our supply demand balance, which is representative of the uncertainties in the overall supply demand balance.

The current WRPG indicates that there is now a range of approaches available to analyse and quantify the variability and uncertainty built into the calculations for dry year annual average and critical period supply-demand balance scenarios. The guidance states that:

"You may assess individual components of uncertainty and variability using risk-based planning techniques, through your decision making tool or assess uncertainty separately from individual components using the target headroom approach."

The chosen approach will depend on the nature of the planning problem – based on the problem characterisation and the risk composition. Our risk composition is risk composition 2, which is compatible with either the basic Target Headroom approach or scenarios based methods.

We chose to select the basic target headroom approach, as it is consistent with both our existing understanding of uncertainty and also our new EBSD extended methods approach.

We have ensured there is no overlap between the risks and uncertainties allowed for in headroom, and those modelled within the EBSD extended methods modelling (for drought, sustainability reductions and the impacts of modelling drought permits and orders). In this way headroom captures intrinsic uncertainty, within our components, whilst the wider risk based modelling captures the extrinsic uncertainties.

Please see our Technical Report 3.2 Headroom for a detailed reporting of our headroom analysis.

10.1.2 Target Headroom Components

Target headroom comprises of the following components: (S = Supply; D = Demand)

- S1 & S2 Vulnerabilities to sources (surface water licences & groundwater licences)
- S3 Time limited licences
- S4 Bulk transfers
- S5 Gradual Pollution (causing reduction in abstraction)
- S6 Accuracy of supply side sources (DO)
- S8 & D3 Uncertainty around climate change (supply and demand)
- S9 Uncertain output from new resource development (Final Plan only)
- D1 Accuracy of sub-component data
- D2 Demand forecast variation and uncertainty in the data from which demand is calculated
- D4 Uncertain outcome from demand management methods (Final Plan only)

Of the above categories, S1 and S2 are identified by the EA (EA, 2017) as not being required for the assessment of target headroom uncertainty.

10.1.3 Target Headroom Methodology and Risk Profile

Our target headroom assessment is based on the UKWIR 2002 methodology, ‘An Improved Methodology for Assessing Headroom’. The uncertainties for each component are defined as probability distributions and modelled in Monte Carlo simulation software (@Risk).

Each of the components of headroom have been analysed and our explanations of the component level analysis are summarised in Table 35.

Table 35: Headroom components

Components	Distribution	Explanation
S1: Vulnerable surface water licences	N/A	The Water Resources Planning Guidance (EA, 2017) states that water companies “should not include any allowance for uncertainty related to sustainability changes to permanent licences, as the Environment Agency or Natural Resources Wales will work with you to ensure that these do not impact your security of supply.”
S2: Vulnerable groundwater sources	N/A	
S3: Time-limited licences	Triangular	All of Affinity Water’s time-limited licences were identified and reviewed by Affinity Water’s water resources team to determine the uncertainty associated with them. Following this review it was determined that only one licence – Blackford Group should be considered in headroom for WRMP19 as the expiry date of this licence is 2020.

Components	Distribution	Explanation
S4: Bulk Transfers	Triangular	Nine bulk imports were considered for this component in resource zones 4, 5, 6 and 7. Five of these were considered to have uncertainty associated with them, ranging from 0.005 to 0.41 Ml/d in the dry year scenario. Following discussion between Anglian and Affinity Water in July 2017 it was agreed that Affinity Water would model a reduction in baseline deployable output (DO) 2019/20 (as a worst case scenario) and remove any uncertainty associated with the ANGL import from headroom. This is a change from the WRMP14 methodology where a potential reduction of 15Ml/d in ANGL yield was accounted for in headroom uncertainty. A triangular distribution is used based on the understanding of our bulk transfers. A triangular distribution was applied to these uncertainties with minimum and maximum loss as the minimum and maximum, and average daily loss as most likely.
S5: Gradual pollution of sources causing a reduction in abstraction	Exponential	The risk of gradual pollution for each source was determined as high, medium or low risk. This risk evaluation was used to determine the percentage of source DO at risk, as a proportion of total zonal DO at risk, so that: • High risk sources carried a weight of 60% of the DO at risk in the zone; • Medium risk sources carried a weight of 30% of the DO at risk in the zone; and • Low risk sources carried a weight of 10% of the DO at risk in the zone. Thus the loss in DO was distributed according to a percentage split (60% high, 30% medium, 10% low risk), further apportioned by the fraction of total DO in the WRZ. The assessment of risks from gradual pollution carried out for the WRMP14 headroom assessment was also reviewed. This analysis used historic patterns of gradual pollution to derive an estimate of loss of resource over time. The pollution loss parameters used in WRMP14 were considered to still be an appropriate representation of total zonal DO at risk of loss from gradual pollution. Therefore the gradual pollution risks identified in this plan were apportioned to total the zonal risk parameter. An exponential function is used to model this uncertainty.
S6: Accuracy of supply side data	Triangular	Affinity Water provided updated DO estimates for all sources in their region, based on the worst drought on record, together with the constraining factor on DO and a confidence grade for the DO estimate. The DO assessment of a source is graded as good, fair or poor based on the confidence grade of the DO assessment. This grading is a qualitative assessment made by experts who have carried out quantitative assessment of the deployable outputs. This confidence grading is then converted into a percentage uncertainty of the DO based on the constraint that is the primary cause of the uncertainty. The combination of DO constraint and confidence grade were used to define supply-side uncertainties by source. All licence constrained sources will have a DO uncertainty of ±1%. Higher levels of uncertainty are associated with different constraints,

Components	Distribution	Explanation
		and this varies according to confidence grade. Treatment/process, hydrology and network constraints are all assumed to be equally uncertain. 'Environmental issues' are assumed to be more uncertain constraint and therefore have the highest assumed level of uncertainty. All non-licence constrained sources have a confidence grade of 'Fair', based on the uncertainty associated with shifting the DO curve to the worst historic drought for groundwater sources. The percentage uncertainties derived from the DO constraint / confidence grade table were used to determine upper and lower values of DO. These were then used to define a triangular distribution for each source, with a most likely value of zero, with the maximum and minimum determined by the percentages applied to the DO values (with a scaling factor of 0.6 on the minimum).
S8: Uncertainty of Impact of Climate Change on source yield	Triangular	A sample of 100 scenarios were derived from the UKCP09 climate projections for climate change analysis, based on the 2080s time-slice, under the medium emissions scenario, based on the three relevant UKCP09 areas for the company's three main regions (Thames, South East England and East of England). Climate forecasts were applied to water resources models for five of the eight Affinity Water WRZs, to produce 100 climate change-influenced DO values for each zone. Zones 4, 6 and 8 were assessed as not sensitive to climate change uncertainty, so were not modelled in this way. The results (for the five climate change-influenced zones) are for the 2080s (i.e. 2085 specifically), and were interpolated to the base year using a two-stage linear interpolation, between the years 2030 and 2080 the change in DO is interpolated using the formula: Scale factor = (Year-1975)/(2085-1975) Applied to the shifts in 2085. Which models the climate change distribution as sitting along the linear interpolation from the shifts in 2085 to zero shift in 1975. The trend is adjusted from the base year to 2030 to follow the trend: Scale factor = (Year-2012)/(2035-2012) Which is applied to the interpolated figure in 2035. This is an interpolation between zero change in 2012 and the aforementioned figure for 2035. This uses the method from WRMP14 and allows for steeper growth in the distribution in the near term with a shallower gradient in the long term. This is necessary due to the calculation of impact in the 2080s. It produces a lower gradient of climate change impact (compared to a single interpolation), and results in a loss of DO by the start of the planning period – it accepts that some climate change has already occurred. These 100 DO values were entered into the headroom model as a discrete distribution in the form of a change from the median figure, from which the climate change uncertainty was sampled (each run outcome was assigned an equal probability). This was done because there was neither a clear structure to the distribution nor a well-defined model to produce a forecast distribution from. The samples were

Components	Distribution	Explanation
		therefore seen as the correct modelling framework for the calculation. The interpolation was performed on each point in the distribution, effectively scaling every point in the distribution toward zero change from the median.
S9: Uncertain output from new resource development	N/A	*Used to assess supply side uncertainties associated with the Final Plan; not included in our baseline assessment. See Technical Report 3.2*
D1: Accuracy of sub-component data	Normal	A small allowance is included to represent the uncertainty in the accuracy of distribution input (DI) meters. A percentage uncertainty of +2.1% & -2.0% for Normal and +4.1% & -4.0% for peak has been used to represent the accuracy of sub-components demand data.
D2: Demand forecast variations	Triangular	There are three principal elements to demand forecast: Household demand, which has been derived from a multiple linear regression model for household consumption (i.e. how much each household uses per day), taking account of the effects of the planned Water Savings Programme (WSP), and forecasts of population and properties.. Non-household demand, which has been forecast using regression modelling, with a range of scenarios derived. Leakage forecasts, which are based on estimates of the social and economic levels of leakage. The household consumption forecast includes an estimate of the effect of the WSP on water use in zones 1-6, where this programme will result in a 95% meter penetration by 2025. The reduction in consumption due to the WSP has to be estimated based on relatively limited data from Affinity Water customers (who have chosen to switch to metered billing already) and evidence from similar programmes conducted by other companies, such as Southern Water. Based on this evidence, the central estimate of savings due to the WSP is 18% with an range of savings between 10% and 23%. The demand forecast was extrapolated out to 2080 using linear models for both the mean and the standard deviation - the demand forecast along with uncertainty showed this to be sufficiently close to the model to provide a reasonable estimate at this point. The intercepts of the models were adjusted to avoid any step changes, and these were applied in the same manner as the previous forecast
D3: Uncertainty of impact of climate change on demand	Triangular	The UKWIR report on the effect of climate change on demand was used to determine the uncertainty for this component. "Impact of Climate Change on Water Demand", UKWIR (2013). We summarise the implementation by saying that the climate change uncertainty was modelled as a triangular distribution using guideline percentages of the demand forecast as parameters.
D4: Uncertain outcome from demand measures	*N/A*	*Used to assess supply side uncertainties associated with the Final Plan; not included in our baseline assessment. See Technical Report 3.2*

The outputs from the assessment are calculated as Ml/d values for each WRZ. Before headroom can be applied we determine an appropriate risk profile that we think applies to our uncertainty. The risk profile quantifies how much risk and uncertainty we think we should account for in our supply demand balance.

For example, if we adopt a 95% value, we will be including all but 5% of the total modelled uncertainty. This is an important step in our assessment, as too much headroom might drive unnecessary investment. Conversely if we were to underestimate the headroom then we may be accepting too much risk which may mean it would be very difficult to meet levels of service.

We have chosen the following risk profile as depicted in Table 36.

Table 36: The risk profile chosen for our draft plan

WRZ	2015/16	2019/20	2024/25	2029/30	2034/35	2039/40
Percentile	99%	95%	95%	90%	85%	80%
WRZ	**2044/45**	**2049/50**	**2054/55**	**2059/60**	**2069/70**	**2079/80**
Percentile	75%	75%	70%	70%	65%	60%

The risk profile represents an allowance for more risk towards the end of the planning period on the basis that there will be more time to resolve any uncertainties over further AMP periods (i.e. at the end of the planning period). We may choose to amend the percentile for the later AMPs as our risk profile is sensitive to a number of factors, such as the S/D balance, the utilisation of existing sources and timing of new schemes.

We have chosen to apply this to our DO for the worst historic drought on record. The level of risk used to define headroom will be higher for lower return periods, this reflects the fact that greater risk and uncertainty should be accounted for when DOs are more certain (or shorter return periods) and less risk applied when they are less certain. This means that if we apply a risk profile to our 1 in 200 year and 1 in 500 year DO's we will apply a profile that would allow for less risk.

10.1.4 Our Target Headroom Results

Table 37 and Table 38 present our baseline (BL) and final planning (FP) target headroom figures for DYAA (per WRZ) in Ml/d at the end of each five-year period throughout the 25 year planning period as well as including the final year of the 60 year period.

Table 38 presents the equivalent DYCP (per WRZ) in Ml/d figures.

Table 37: Headroom provision in Ml/d per WRZ for DYAA at the end of each five-year period

Year	2019/20		2024/25		2029/30		2034/35		2039/40		2044/45		2079/80	
Percentile	95%		95%		90%		85%		80%		75%		60%	
	BL	FP	BL	FP	BL	FP	BL	FP	BL	FP	BL	FP	BL	FP
WRZ1	11.86	11.92	11.60	11.68	11.34	11.44	11.08	11.19	10.82	10.95	10.56	10.71	8.73	9.00
WRZ2	15.71	15.74	15.26	15.54	14.82	15.35	14.38	15.16	13.94	14.97	13.50	14.78	10.40	13.44
WRZ3	16.54	16.51	16.15	16.21	15.76	15.92	15.37	15.63	14.99	15.34	14.60	15.04	11.88	13.00
WRZ4	26.53	26.44	25.49	25.33	24.45	24.22	23.41	23.11	22.37	22.01	21.34	20.90	14.07	13.15
WRZ5	7.29	7.34	7.14	7.20	7.00	7.05	6.85	6.90	6.71	6.76	6.56	6.61	5.54	5.59
WRZ6	10.53	11.20	10.30	11.00	10.08	10.80	9.85	10.60	9.62	10.40	9.39	10.20	7.80	8.81
Affinity Water Central	88.46	89.15	85.94	86.96	83.45	84.78	80.94	82.59	78.45	80.43	75.95	78.24	58.42	62.99
WRZ7	3.32	3.09	3.12	2.92	2.92	2.75	2.72	2.58	2.52	2.41	2.32	2.24	0.92	1.06
WRZ8	3.66	3.65	3.64	3.62	3.62	3.60	3.60	3.58	3.58	3.55	3.56	3.53	3.42	3.37
Company	95.44	95.89	92.7	93.5	89.99	91.13	87.26	88.75	84.55	86.39	81.83	84.01	62.76	67.42

Table 38: Headroom provision in Ml/d per WRZ for DYCP at the end of each five-year period

Year	2019/20		2024/25		2029/30		2034/35		2039/40		2044/45		2079/80	
Percentile	95%		95%		90%		85%		80%		75%		60%	
	BL	FP	BL	FP	BL	FP	BL	FP	BL	FP	BL	FP	BL	FP
WRZ1	16.35	16.36	15.87	15.90	15.38	15.45	14.89	14.99	14.41	14.54	13.92	14.09	10.51	10.90
WRZ2	26.01	26.05	25.69	25.87	25.37	25.69	25.05	25.50	24.73	25.32	24.41	25.14	22.18	23.87
WRZ3	23.94	23.92	23.14	23.20	22.35	22.48	21.55	21.76	20.76	21.04	19.96	20.32	14.40	15.27
WRZ4	34.90	35.46	33.45	33.78	32.00	32.10	30.55	30.42	29.09	28.74	27.64	27.07	17.49	15.32
WRZ5	11.17	11.07	10.83	10.80	10.49	10.53	10.14	10.26	9.80	9.99	9.46	9.72	7.07	7.83
WRZ6	24.18	24.79	23.40	24.05	22.62	23.30	21.84	22.56	21.06	21.82	20.28	21.07	14.82	15.87
Affinity Water Central	136.55	137.65	132.38	133.60	128.21	129.55	124.02	125.49	119.85	121.45	115.67	117.41	86.47	89.06
WRZ7	5.25	6.76	4.99	6.51	4.74	6.25	4.48	5.99	4.23	5.74	3.97	5.48	2.18	3.68
WRZ8	6.23	6.29	6.13	6.17	6.02	6.06	5.92	5.94	5.81	5.83	5.71	5.71	4.98	4.90
Company	148.03	150.70	143.50	146.28	138.97	141.86	134.42	137.42	129.89	133.02	125.35	128.60	93.63	97.64

The reasons for the differences in target headroom between WRMP14 and the current plan vary depending on the zone, but most commonly they are driven by greater uncertainty in target headroom associated with demand forecast uncertainty (D2). This by a much more detailed assessment of the uncertainties in the demand forecast, including a relatively large allowance for the uncertainty associated with the WSP programme, As well as specific uncertainties for population and property forecasts, leakage and non-household demand. In contrast, the uncertainty due to climate change on DO (S8) has decreased. Therefore the zone-by-zone differences are driven by the relative changes in these components.

Final plan headroom in the dry year scenario is greater than baseline in five out of the eight zones. It is less than baseline target headroom in three zones: RZ4, RZ7 (until 2059/60) and RZ8. Where it is lower it is due to a combination of the uncertainties in the supply options, with the reduction in the risk profile throughout the forecast, as described below.

Most of the uncertainties around the supply-side option yields are symmetrical, i.e. there is equal probability of achieving more or less water than the central figure. However, for some options (in zone 4 in particular), the uncertainties are positively skewed. This means that there is a higher probability of achieving **more yield** than predicted. Again, thinking in terms of losses, the distribution is skewed toward the minimum loss, which is a negative value.

Therefore when sampling from the skewed distribution, the resulting value is negative which brings the overall headroom down. This, coupled with the reducing risk profile in the later years of the planning period (which now extends beyond the minimum 25-year period), means that the overall target headroom can decrease.

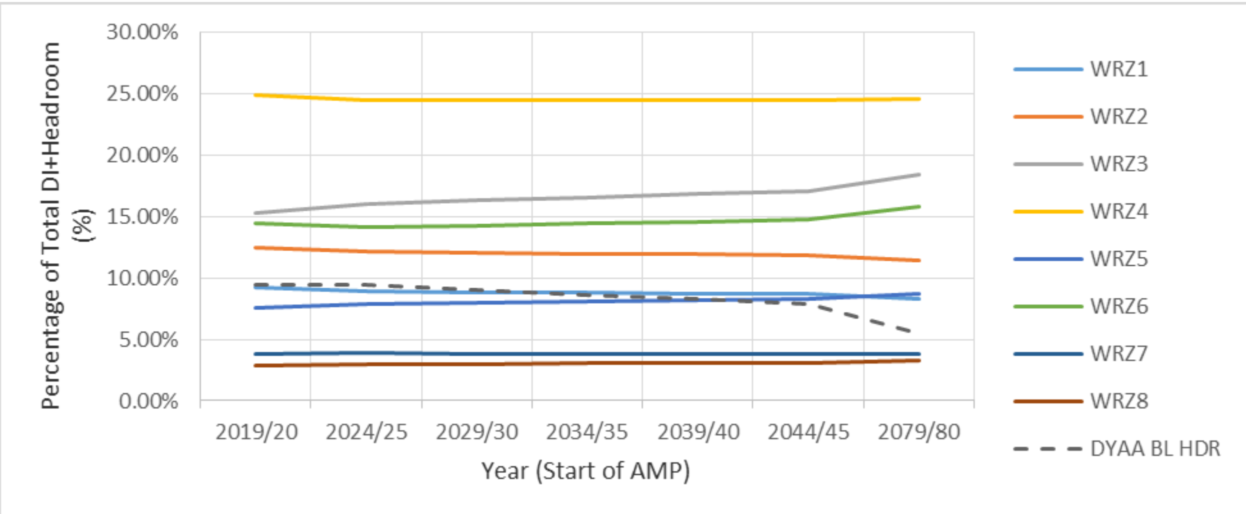

Figure 30 : Baseline headroom as a percentage of our total baseline distribution input (DI) at DYAA

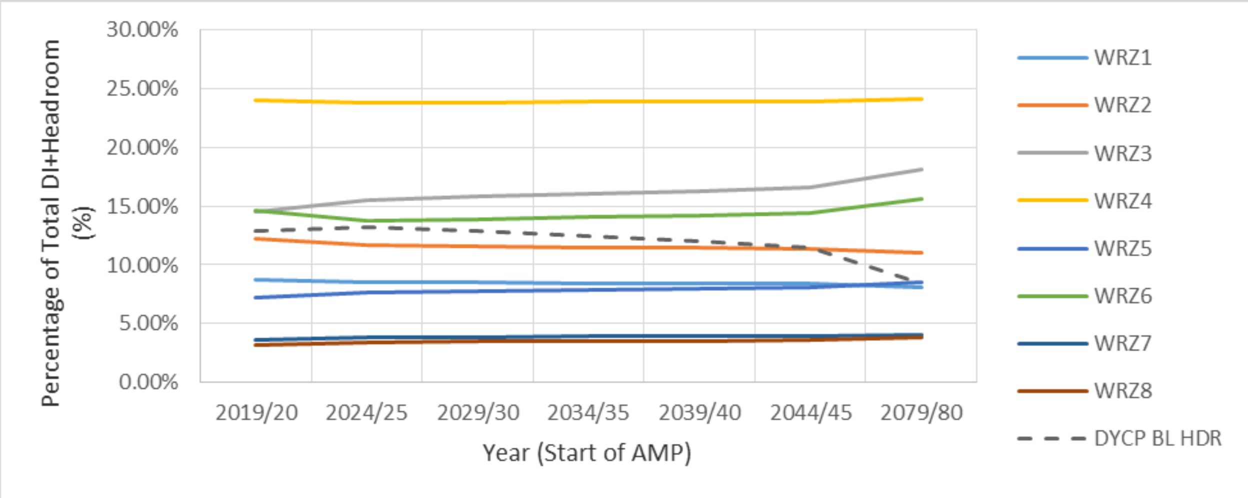

Figure 31: Baseline headroom as a percentage of our total baseline distribution input (DI) at DYCP

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11 Supply / Demand Balance

Summary

This chapter presents a comparison of supply with demand to show that without action being taken there would be less supply of water available than demand (a deficit) within our supply area. Our assessment of water available identifies that our Central and Southeast regions do not have sufficient water for the whole of the planning period to meet customers' need for water. Our baseline supply and demand assessments show that we have deficits in all of our water resource zones by 2059 and three of them are in deficit from the first year of our modelling. The total deficit at the end of the planning period (2080) for the whole company is forecast to be **177.52 Ml/d** for DYAA.

We will take action to remove the deficits. We do this through undertaking an options appraisal described in Chapter 12. Our approach to modelling and scenario testing to resolve this deficit is explained in Chapter 13.

The following sections of our plan explain our approach to the resolution of supply deficits in our company area.

11.1 Introduction

Our supply / demand balance is calculated by:

	Deployable output (DO)
Minus	**Climate change impacts**
Minus	**Sustainability reductions**
Minus	**Outage and process losses** (to give water available for use)
Minus	**Water demand** (distribution input, DI)
Minus	**Target headroom**

Where supply is less than demand, there is a deficit that must be overcome by developing options to reduce demand or increase supply. We must ensure that there are no deficits in any year of the planning period, for all planning conditions.

11.2 Distribution Input

The quantity of water supplied from all our treatment works is measured using flow meters; this is known as distribution input (DI). The water balance is used to compare the bottom up measure of the component parts of demand to the top down measure of DI. The difference in the two methods is known as the water balance error. The error tolerance within our regional water balances is 5%, which is a standard allowance across the industry. However, due to the complexity of our network and spatial granularity of available data we allow a 10% error tolerance within our WRZ balances. Our continuous improvement plan includes actions to improve the WRZ closure error.

11.3 Components of the Water Balance

Our water balance for dWRMP19 has an extended planning horizon to 2080, in order to align with the regional work. It includes planning risks, headroom and outage by applying a similar methodology to that used at fWRMP14 with comparable results. Components of the water balance are shown in Figure 32.

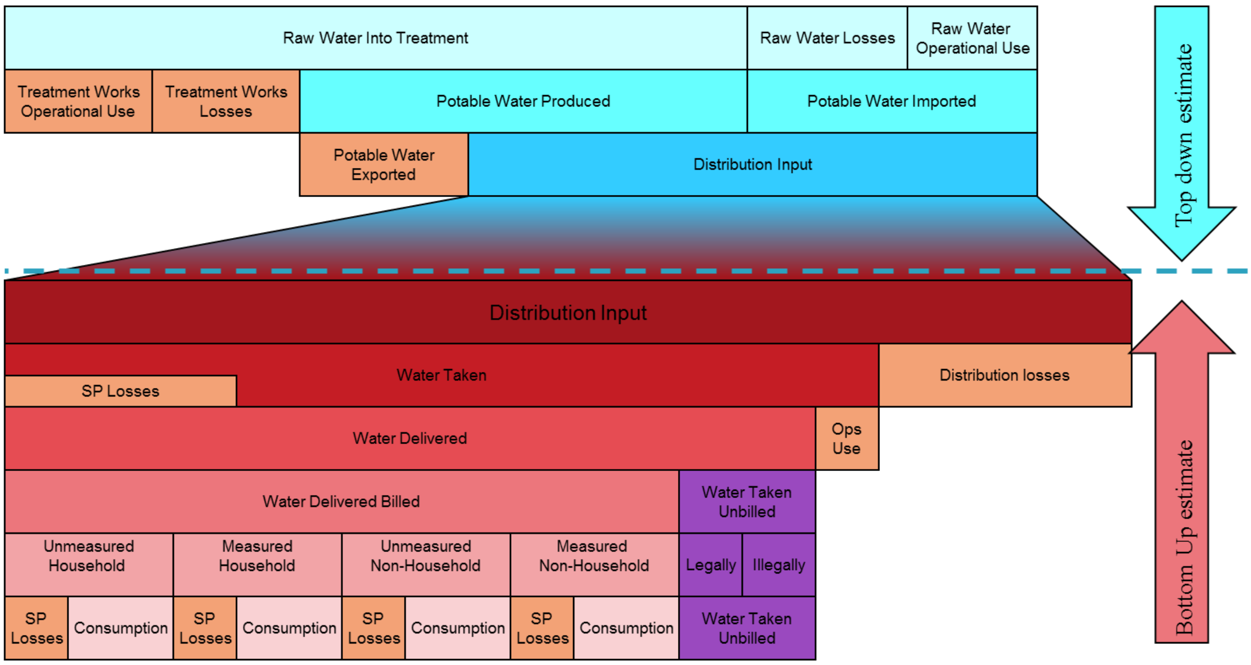

Figure 32: Components of the water balance

11.4 Constrained and Unconstrained Balances

11.4.1 Introduction

We show the baseline supply / demand balances at Dry Year Annual Average for each of our three regions in the following graphs:

- Figure 33 shows WRZ1 – 6, our Central region;
- Figure 34 shows WRZ7, our Southeast region;
- Figure 35 shows WRZ8, our East region.

Figure 36 shows the baseline supply / demand balance for the whole company (Dry Year Annual Average).

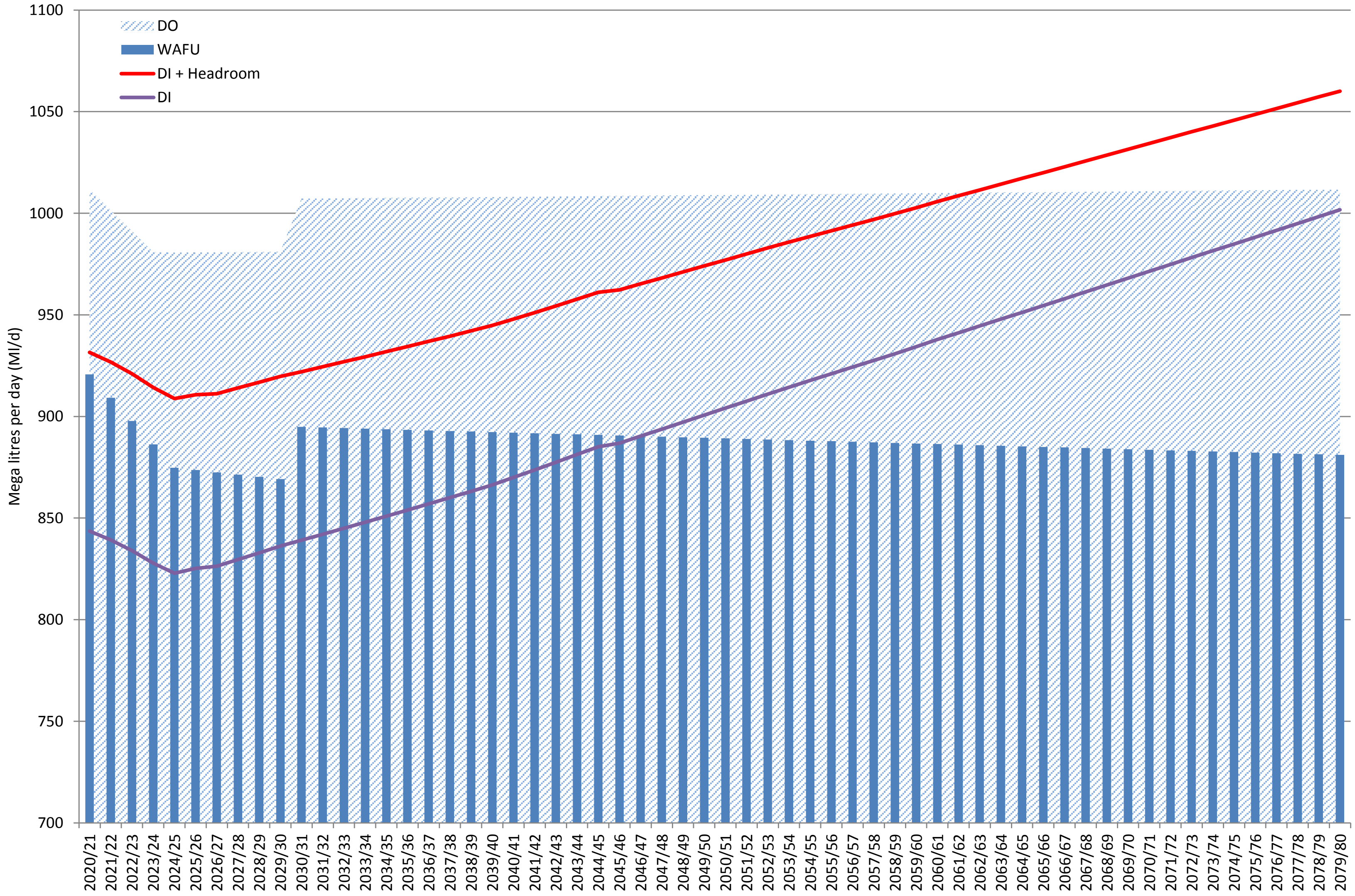

Figure 33: Our Central region Dry Year Annual Average supply / demand balance

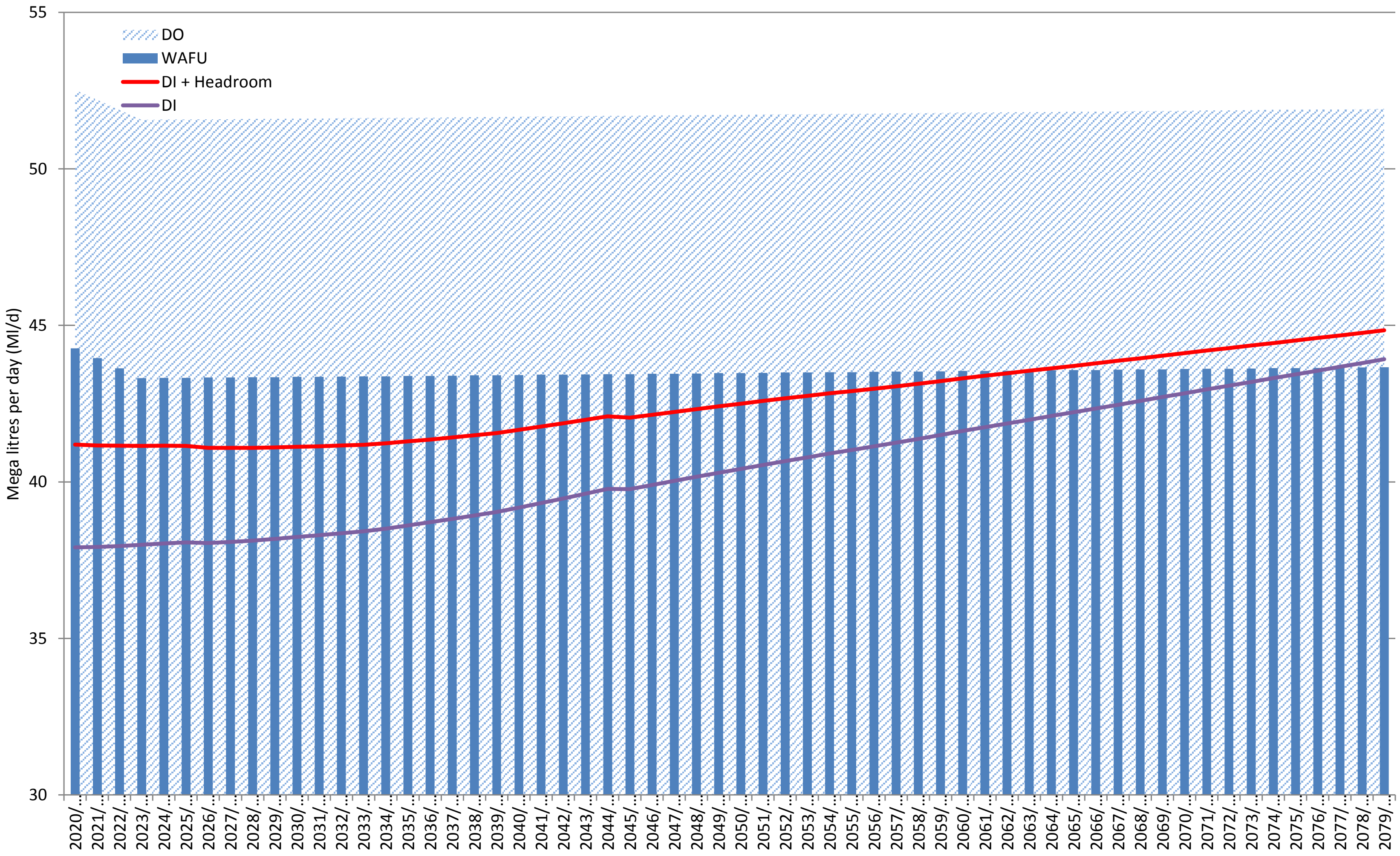

Figure 34: Our South-East region Dry Year Annual Average supply / demand balance

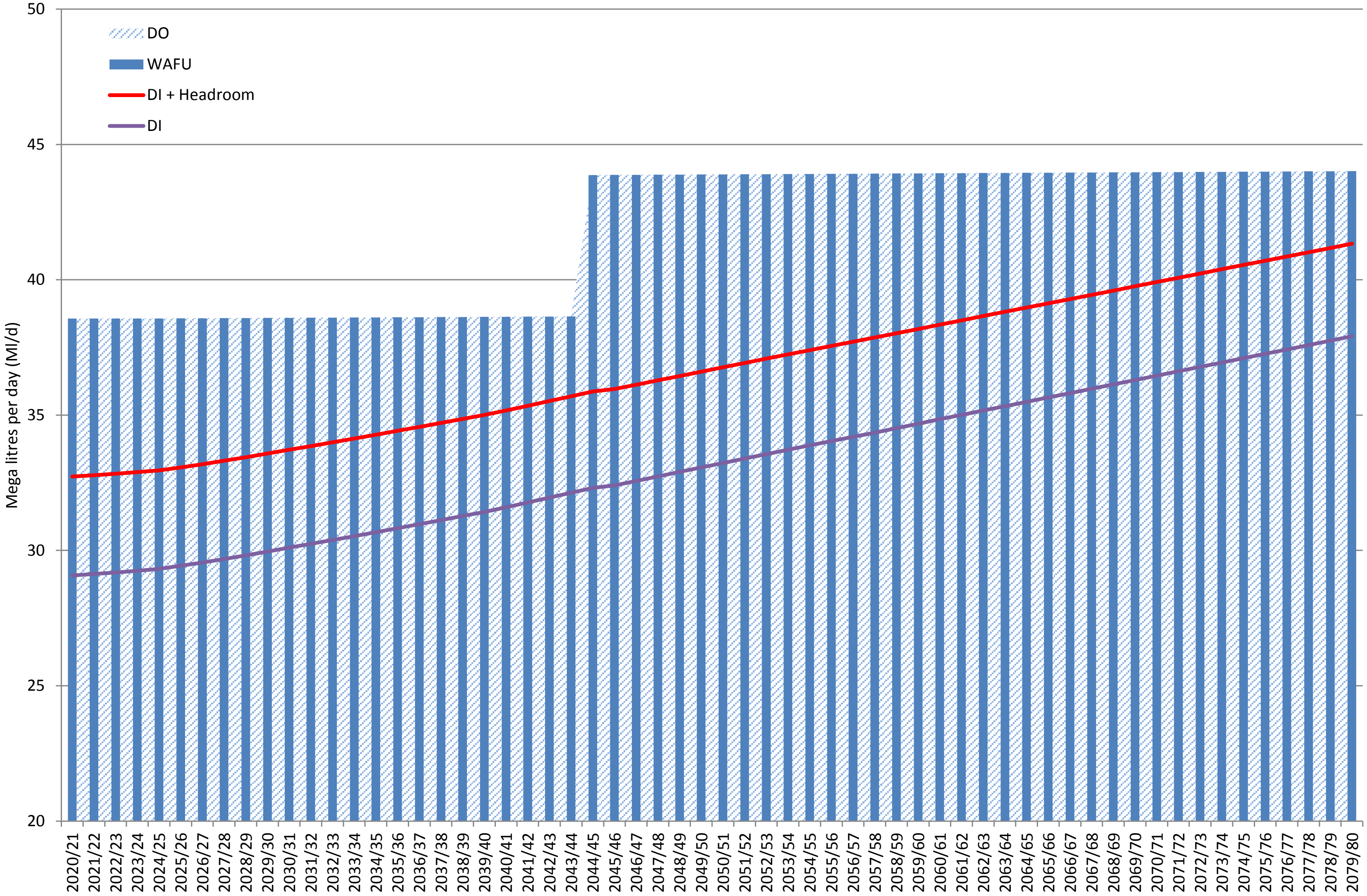

Figure 35: Our East region Dry Year Annual Average supply / demand balance

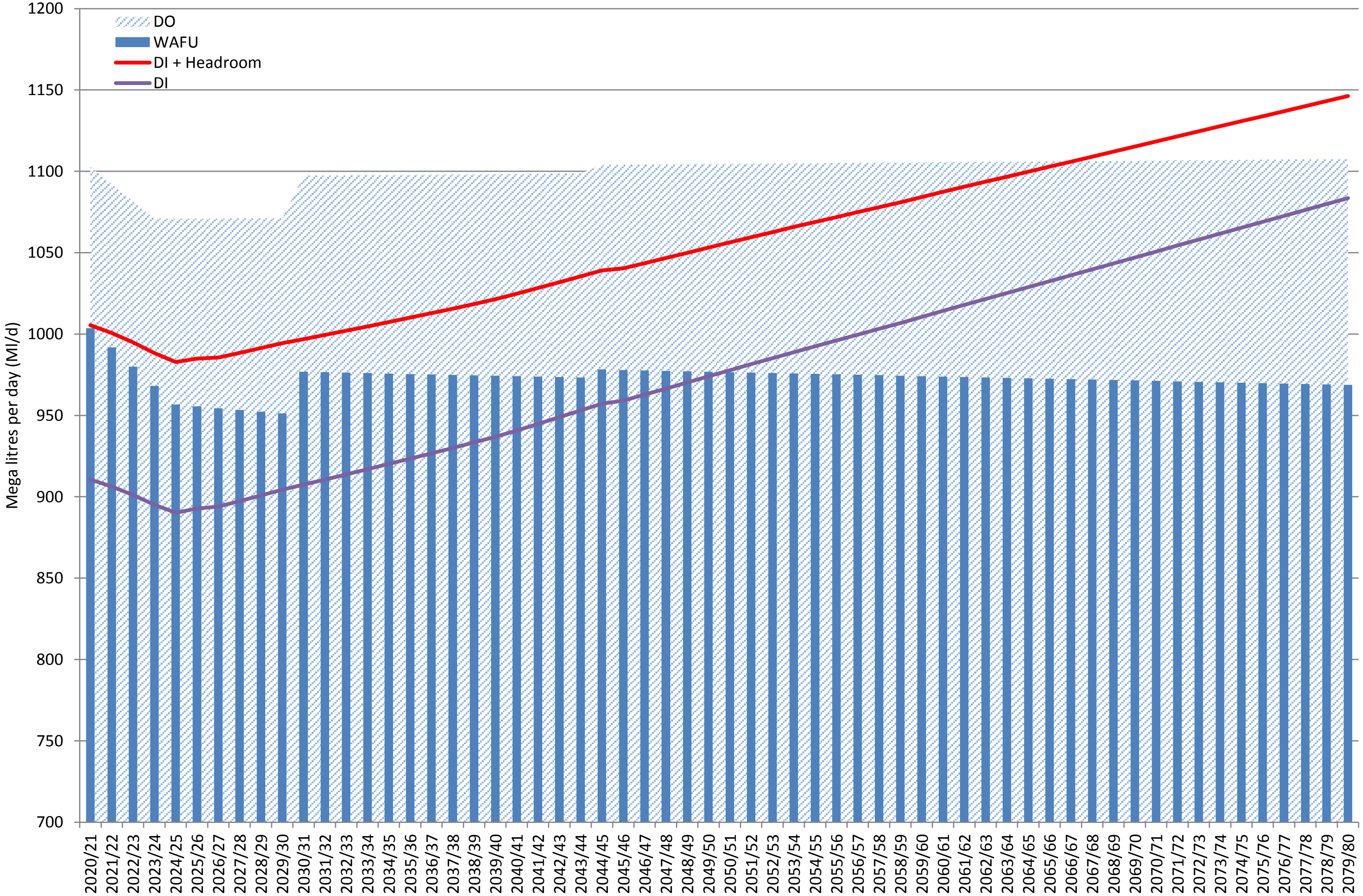

Figure 36: Final supply / demand balance for Affinity Water (Dry Year Annual Average)

11.5 Baseline Supply / Demand Balance 2020 – 2080

11.5.1 Overview

Our assessment of water available identifies that our Central and Southeast regions do not have sufficient water for the whole of the planning period to meet customers' need for water.

Table 39 and Table 40 show the baseline supply / demand balance for Affinity Water as a whole, combining the regional balances to give the overall position that this WRMP must resolve at a zonal level for the 60-year planning period. The deficit is between the blue 'water available for use (WAFU)' bars and the red 'Distribution Input plus Target Headroom' line in Figures 33, 34, 35 and 36. Our water available for use (WAFU) is calculated from our baseline deployable output (DO), which includes bulk transfers from neighbouring companies, less the impacts of climate change, sustainability reductions and outage.

Our baseline supply and demand assessments show that we have deficits in seven of our eight water resource zones by 2064 and three of them are in deficit from the first year of our modelling. The total deficit at the end of the planning period (2080) for the whole company is forecast to be **177.52 Ml/d** for DYAA.

In accordance with the WRPG, we must take action to remove the deficits, as there is not enough supply to meet demand, including target headroom. Figure 37 to Figure 44 show the zonal balances between supply and demand in 2020, 2040, 2060 and 2080 at DYAA and DYCP. Our options appraisal is described in Chapter 12. Our approach to modelling and scenario testing is explained in Chapter 13. The following sections of our plan explain our approach to the resolution of supply deficits in our company area.

Table 39: Baseline zonal supply demand / balance for DYAA

WRZ	2020/21	2039/40	2059/60	2079/80
1	-4.26	-6.59	-8.54	-10.43
2	15.92	-19.37	-29.06	-38.66
3	10.71	7.84	-10.67	-29.11
4	-5.65	2.65	-8.54	-19.55
5	-33.30	-43.45	-50.76	-58.05
6	5.77	6.40	-8.47	-23.21
Central total	**-10.81**	**-52.51**	**-116.04**	**-179.02**
7	3.08	1.84	0.32	-1.18
8	5.83	3.62	5.75	2.68
Company total	**-1.91**	**-47.05**	**-109.97**	**-177.52**

Table 40: Baseline zonal supply demand / balance for DYCP

WRZ	2020/21	2039/40	2059/60	2079/80
1	8.07	9.97	6.45	3.01
2	13.29	8.19	0.84	-6.40
3	51.39	31.99	9.59	-12.70
4	-41.57	-31.68	-45.48	-59.05
5	-37.17	-45.56	-54.42	-63.23
6	22.31	21.85	4.75	-12.19
Central total	**16.32**	**-5.24**	**-78.26**	**-150.55**
7	3.12	2.02	-0.74	-3.46
8	6.90	3.78	6.63	2.22
Company total	**26.34**	**0.55**	**-72.37**	**-151.79**

11.5.2 WRZ surplus and deficits in 2020

The plots in Figure 37 to Figure 44 show the surplus or deficit available to each of our WRZ in 2020, for average and peak respectively.

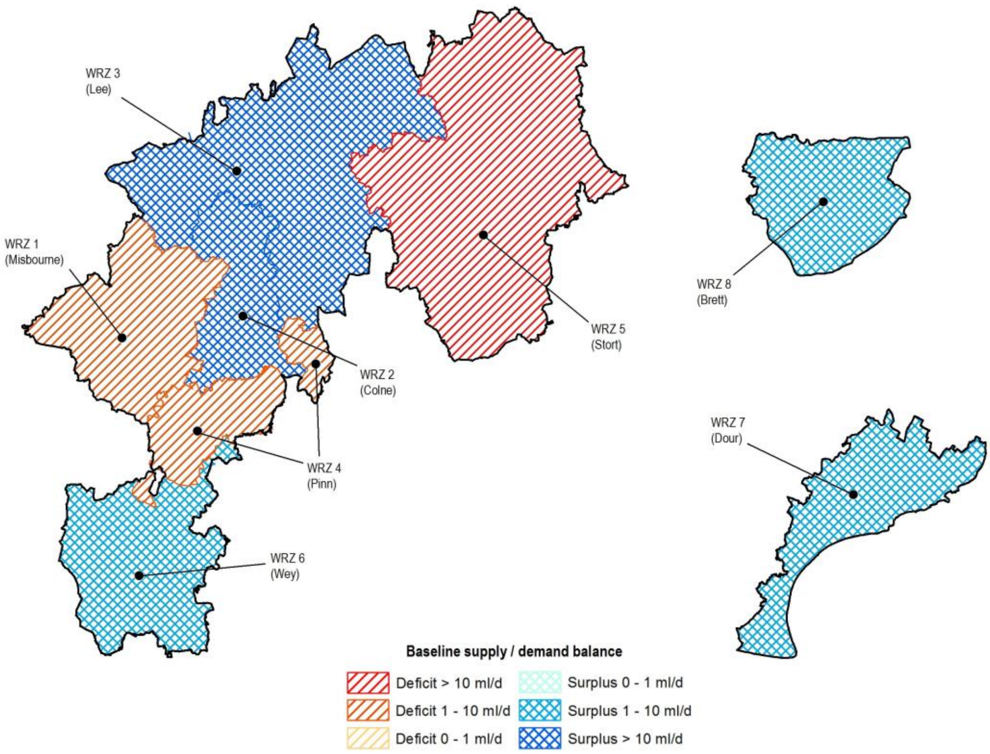

Figure 37: Water available at DYAA in 2020

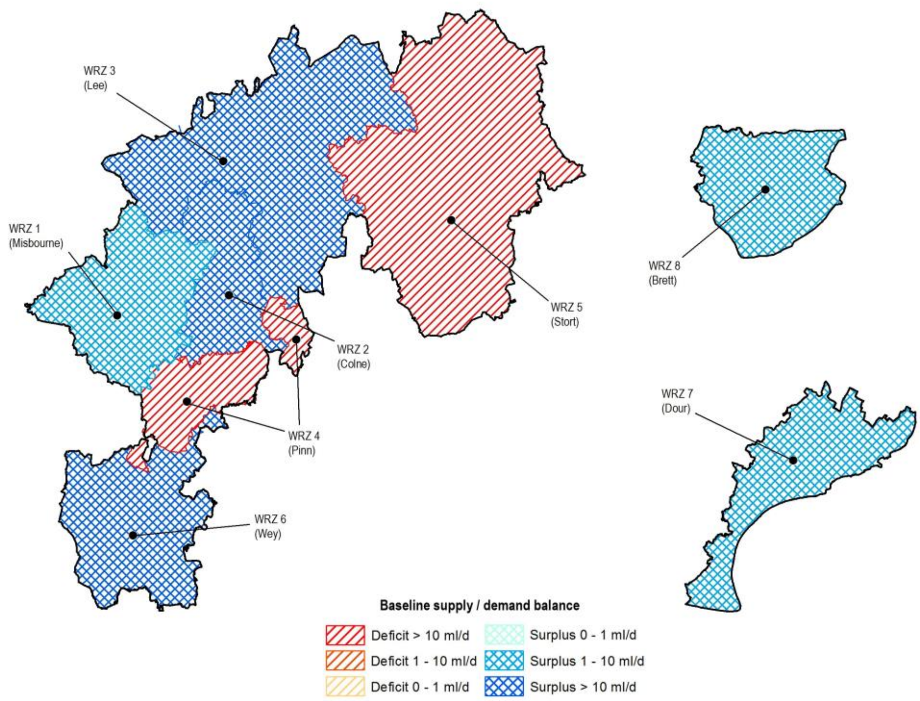

Figure 38: Water available at DYCP in 2020

11.5.3 WRZ surplus and deficits in 2040

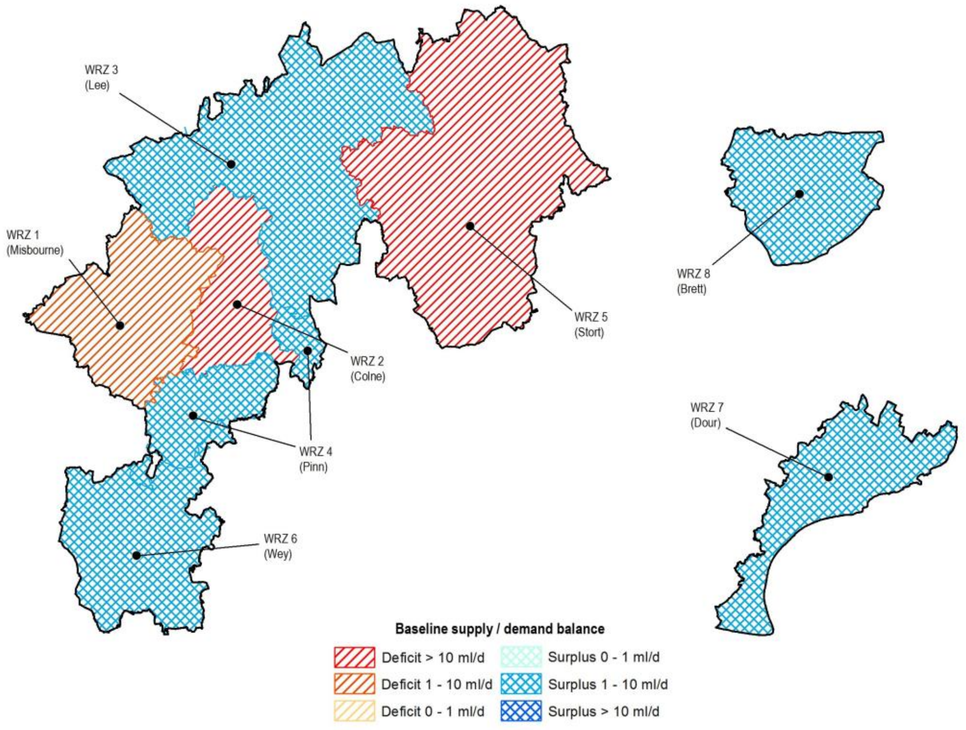

Figure 39: Water available at DYAA in 2040

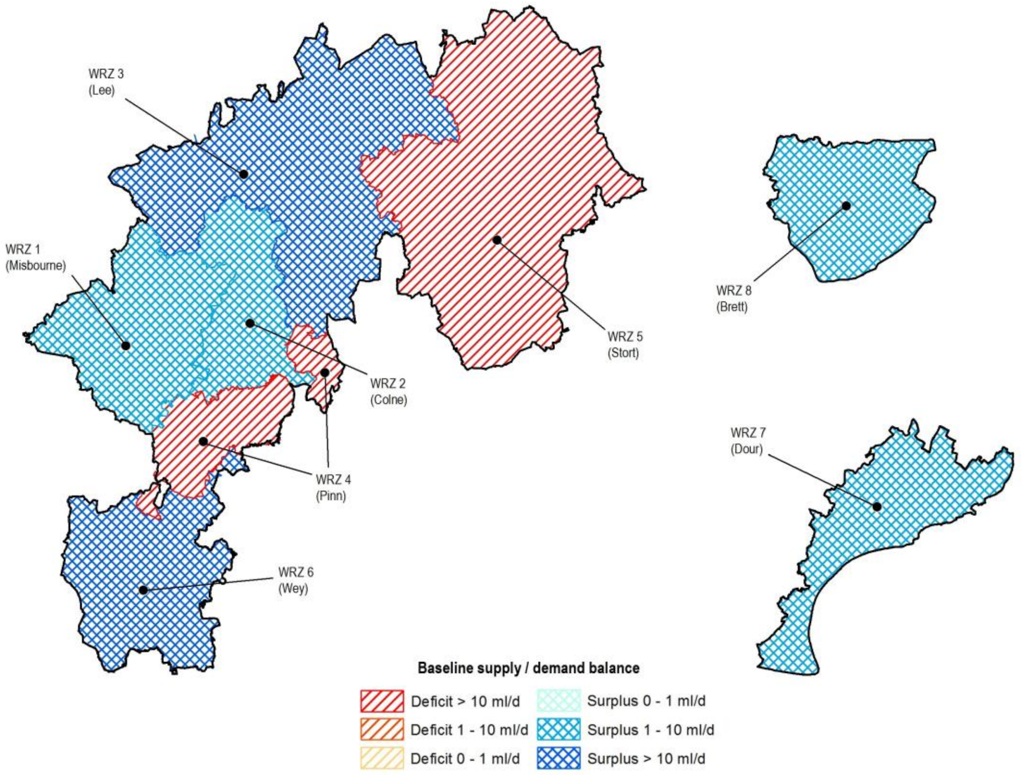

Figure 40: Water available at DYCP in 2040

11.5.4 WRZ surplus and deficits in 2060

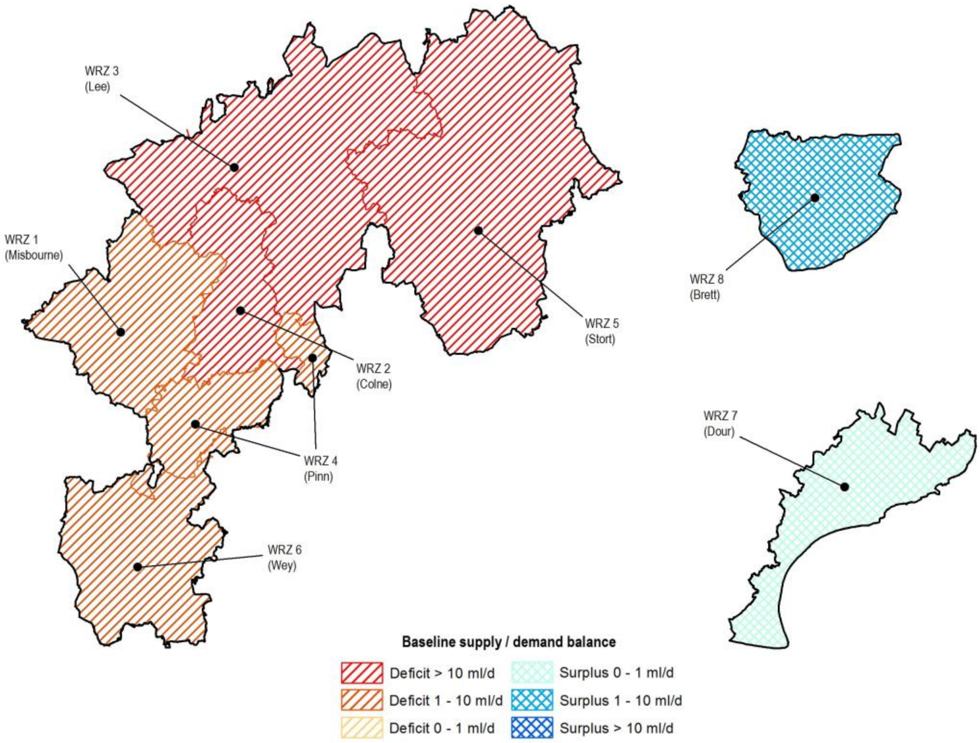

Figure 41: Water available at DYAA in 2060

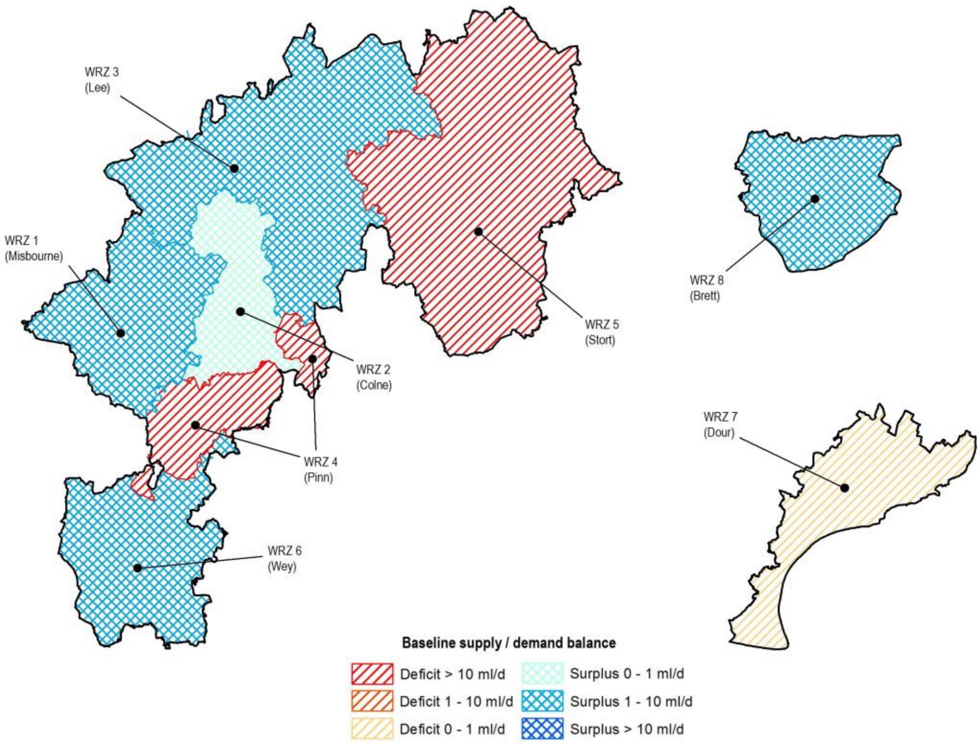

Figure 42: Water available at DYCP in 2060

11.5.5 WRZ surplus and deficits in 2080

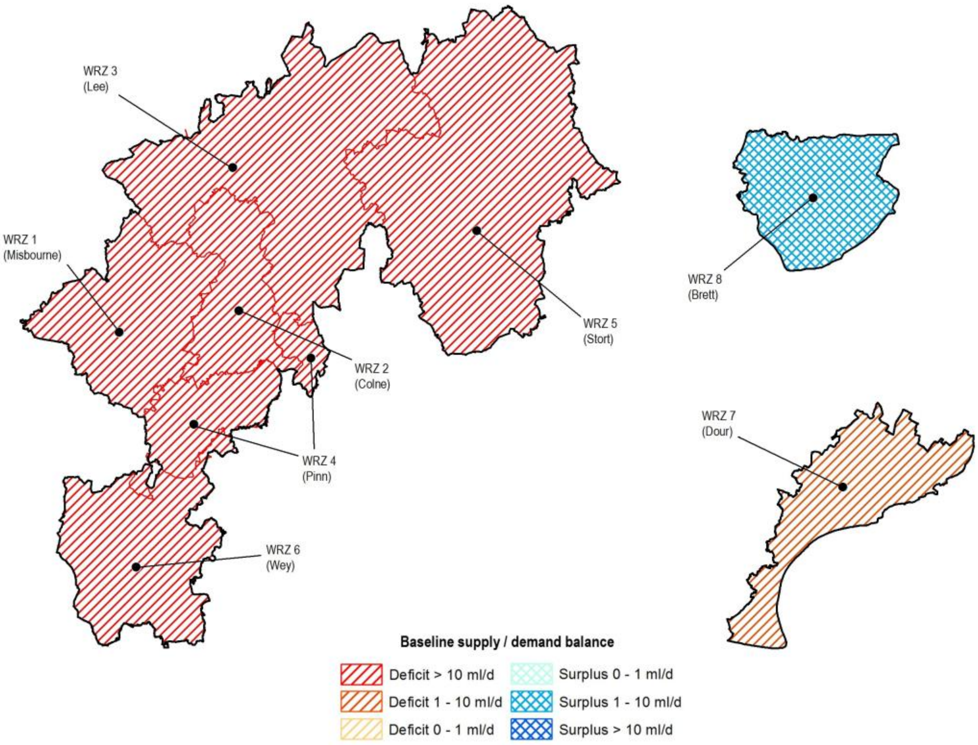

Figure 43: Water available at DYAA in 2080

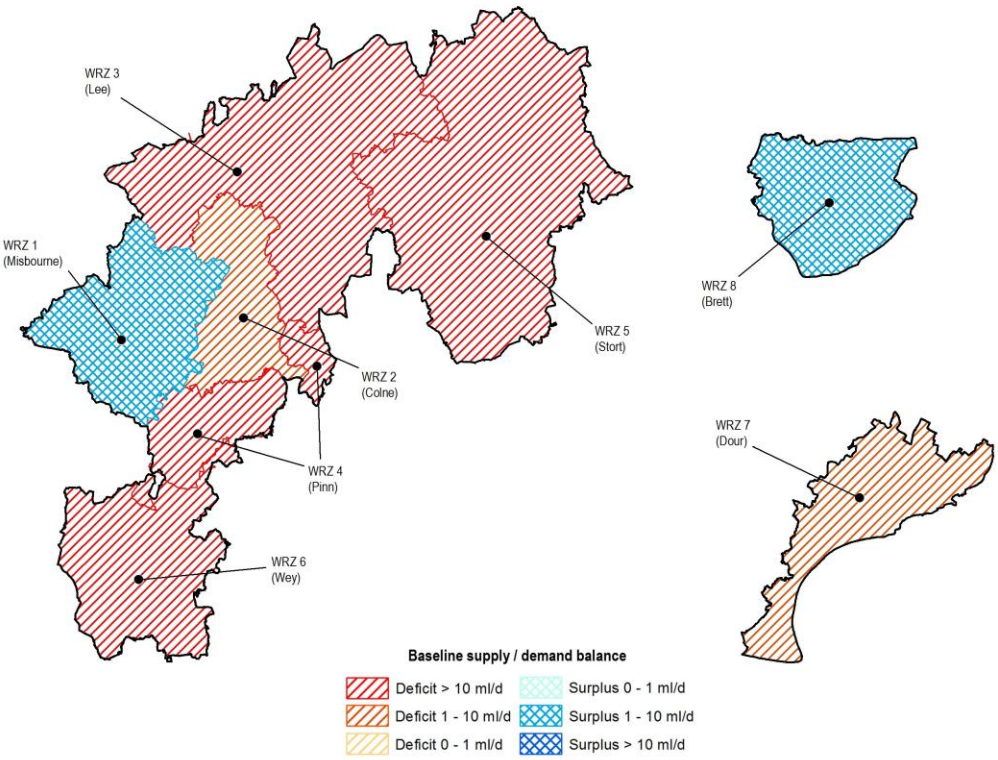

Figure 44: Water available at DYCP in 2080

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12 Future Options

Summary

This chapter explains the process of identifying options to reduce demand in the short term and increase supply in the longer term so that we achieve a secure supply of water for at least 60 years into the future. Our feasible options include schemes to reduce leakage, install more customer meters including smart meters and encourage better use of water with minimal wastage. These are consistent with Government aspirations to reduce per capita water consumption.

We have also identified possible schemes to provide additional water resources from groundwater, surface water and transfers from neighbouring water companies and third parties within and in close proximity to our boundaries. Each of these options has been defined and priced in accordance with the methodology set out in the WRPG.

For each option we have undertaken a Strategic Environmental Assessment (SEA) and, where necessary, a Habitats Regulation Assessment (HRA), in order to consider whether the option remains feasible should there be environmental concerns.

12.1 Options Appraisal Stages

In support of our dWRMP19 economic modelling we have undertaken a full options appraisal, where we have re-considered all of our options and where necessary developed new options in line with changes in the WRMP guidance.

There is an established approach in the water industry for identifying, evaluating and selecting options for meeting water resource needs. That approach is based on industry best practice guidance as set out in UKWIR (2002).

The EA, in the WRMP Guidelines (2017), suggest companies follow the industry standards, and also indicate that companies should refer to UKWIR WRMP 2019 Methods – decision making process guidance (2016), which provides an updated framework for appraising options for the overall assessment of appraising potential solutions.

Our options appraisal follows the industry standard approach as set out in UKWIR (2002), which has four stages, that we have linked to our EBSD methodology within the context of UKWIR (2019) and our extended methods approach.

The options appraisal process is divided into the following stages:

- **Stage 1 Unconstrained options** – where we compile a list of all possible options which are technically credible, but which have not been assessed for any constraints on development. An initial assessment of potential yield and cost is attempted
- **Stage 2 Options screening** – where we subject all of the unconstrained options to an agreed screening process with the goal of creating a shorter list of 'feasible options' that can be constrained and costed for evaluation
- **Stage 3 Feasible options** – a feasible list of options is created (as an output from the previous stage) and we develop the options scoping in more detail, and the options are costed for capital expenditure, operational costs and environmental and social costs.

Additionally we develop non – monetised criteria, such as uncertainty of yield and deliverability

- **Stage 4 Programme appraisal and environmental assessment** – this is where we undertake an assessment of the impact of our options on programmes, plans and the environment. This is carried out as part of our Strategic Environmental Assessment (SEA) and Habitats Regulation Assessment (HRA)
- **Stage 5 Economic modelling** – once we have developed a mix of options that we feel offers a good balance of feasible different option types and we have understood the potential impacts of implementing these options, we undertake our economic modelling in EBSD
- **Stage 6 Preferred programme and final supply / demand balance** – select the preferred programme of options for the company's water resources strategy.

Figure 45 sets out how these stages follow one another and where to find them within this report. The remainer of this section of the report includes a summary of Stages 1 to 4, where we also expand on our third party options and collaboration. Should further detail be required then Technical Reports 4.1-4.6 provide additional information.

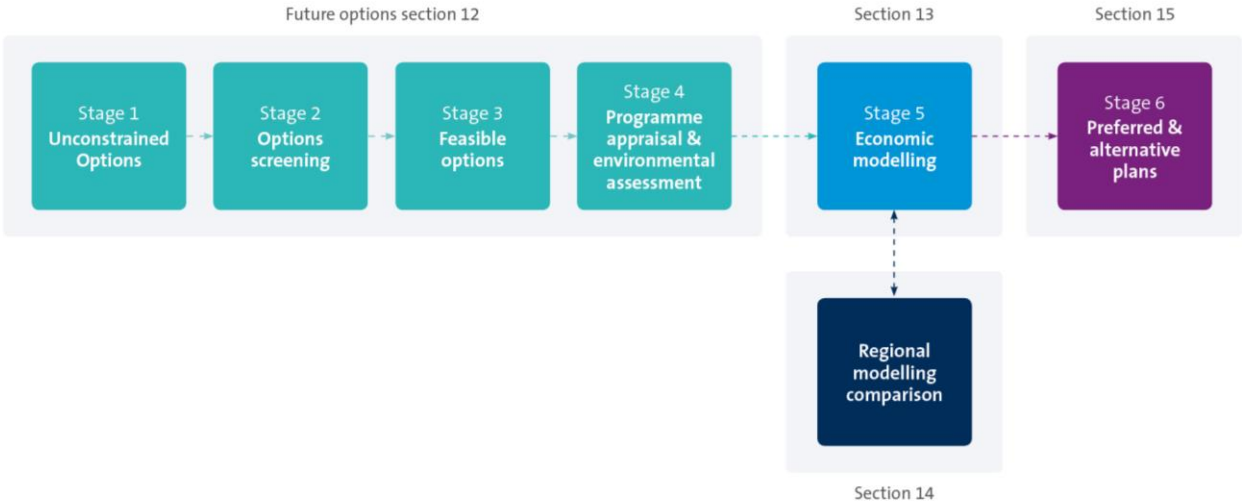

Figure 45: Detailed component diagram of the options appraisal Stages 1 – 6

12.2 Stage 1 – Unconstrained Options

12.2.1 Key requirements

Our review of the guidance identified the following key option requirements that we needed to appraise and consider during our unconstrained options:

- aligning with government policy, customer preferences, cost and benefit, impacts on the environment and long term best value
- attempting to increase efficiency and reduce the impact of company operations on the environment
- that would enhance connectivity with neighbouring companies and increase resilience (e.g. to droughts, single points of failure)

- third parties and other sectors should be considered.

The following two documents were used to understand the key policy requirements, which set out what the government expects WRMPs to address during the options appraisal stage:

- Department for Environment Food and Rural Affairs (DEFRA). Guiding Principles for Water Resources Planning (May, 2016). In (EA, Final Water Resource Planning Guidelines, May 2016)
- Department for Environment Food and Rural Affairs (DEFRA). Creating a Great Place for Living. Enabling Resilience in the Water Sector (March, 2016).

Both documents re-iterate the need for water companies to promote the following as part of their WRMP options appraisals:

- take a long term, strategic approach to protecting and enhancing resilient water supplies
- consider every option to meet future public water supply needs
- protect and enhance our environment, acting collaboratively
- promote efficient water use and reduce leakage.

The degree to which each company can develop options that meet all the requirements will depend upon the way the company operates and distributes its resource base, its environmental constraints, its boundaries and its potential for developing connectivity with its neighbouring companies. All of these will be unique to each company.

12.2.2 Unconstrained options types

Unconstrained supply option types

The supply option types are as follows:

- surface water (including reservoir and augmentation options)
- groundwater (including new boreholes, borehole optimisation, and drought options)
- conjunctive use (e.g. integrated use of surface water and groundwater, and storage and recovery)
- transfers (Intra and Inter zonal, and new bulk supply schemes and shared solutions)
- treatment (e.g. New treatment works and process losses)
- effluent reuse (e.g. wastewater reuse) and desalination
- third party options (including licence trading).

It was also important to consider options that might provide additional resilience to our operations or networks. Within our unconstrained options review these types of options are often to replace or twin an existing asset, this might be a new treatment works, or a new mains connection. These options are often linked to other options, such as bulk transfers or intra – zonal connections and will not account for new DO. They are therefore not delineated as a type on their own.

Unconstrained demand option types

Before developing the unconstrained list of options for screening it was important to take account of what demand management options are already being undertaken. Our 'business as usual' already consists of significant water efficiency, metering and leakage activities. Details of progress on these activities are documented in Appendix A of this report.

The aim was to identify a set of unconstrained options that includes leakage, water efficiency, metering, tariff and small scale reuse schemes for both households and non-households.

The unconstrained option list was developed by considering a range of information sources including:

- Recent water industry work to update the water efficiency evidence base:
- The typical option types for consideration, such as those set out in UKWIR (2002);
- Options we have considered in previous WRMPs;
- Options proposed by the project team and other Affinity Water stakeholders; and
- Options that may have been developed for other water companies.

12.2.3 Summary of unconstrained options by type

The number of options considered for each type at the unconstrained stage are presented in Table 41.

Table 41: Unconstrained option numbers by option type.

	Unconstrained Options	
	Option Types	Number of Options
Supply	Catchment Management	1
	Desalination	17
	Effluent Reuse	12
	Groundwater	98
	Outage	4
	Surface Water	55
	Third Party	18
	Transfer	105
	Treatment	19
Demand	Leakage	18
	Metering	6
	Reuse	7
	Water Efficiency	7
	Tariff	6
	Total options	373

12.3 Stage 2 – Option Screening

12.3.1 Screening criteria

Our screening methodology was shared and discussed with the EA as part of our pre-consultation engagement on options in 2016.

Our unconstrained supply options were initially screened against the following criteria, to identify technically non – feasible schemes, a high-level traffic light shading system was used:

- **Green –** no major issues or sensitivities identified for this option.
- **Amber –** some issues or sensitivities identified, which may not be showstoppers but which could result in risks or complicated design and implementation strategies. For example, this could be an option located within an Area of Outstanding Natural Beauty (AONB), where the option may need to be designed in a more sensitive way to gain approval.
- **Red –** significant issues or sensitivities that affect the ability to implement this option. This could include options in areas where there is no further water available (under the EA Catchment Abstraction Management Strategies or CAMS) or where the option may have a significant detrimental impact on a designated site.

Where an unconstrained option passed through the initial technical screening, it was subject to secondary screening under the following main headings:

- **Technical feasibility:** Whether there are any major risks or uncertainties that impact on the viability of implementing an option, such as whether there is water available to support the option, or whether the option faces significant challenges based upon underlying geology and other site conditions. In the case of surface and groundwater options, the water availability assessment takes into account sustainability reductions and (WINEP) studies.
- **Environmental considerations:** Whether the option would affect a designated environmental site and the environmental feasibility of options (SEA), assessed by using desk based information and mapping data.
- **Stakeholder acceptability:** Whether the option is likely to be contentious or liable to objections based on previous experience and knowledge of the area.

Where new supply options were identified CAMS resource and water availability status was assessed, along with licencing policy. Further considerations included option yield, land availability and potential water quality issues.

Our unconstrained demand management options were also screened, using a qualitative screening methodology for the following criteria:

- Yield uncertainty;
- Lead in time;
- Flexibility;
- Security of supply;
- Environmental impact;
- Sustainability and promotability;

- Suitability; and
- Technical difficulty.

A score was applied that ranged from 1 to 5, from very certain to very uncertain (depending on the criteria it might be e.g. very flexible or inflexible).

12.3.2 Summary of feasible options by type

The number of options considered for each type at the feasible option stage are presented in Table 42.

Table 42: Constrained option numbers and options 'screened-out' by option type.

	Constrained options		
	Option types	Number of Constrained options	Number of options 'Screened-out'
Supply	Catchment Management	0	1
	Desalination	3	14
	Effluent Reuse	2	10
	Groundwater	25	73
	Outage	0	4
	Surface Water	8	47
	Third Party	3	15
	Transfer	37	68
	Treatment	6	13
Demand	Leakage	11	7
	Metering	4	2
	Reuse	4	3
	Water Efficiency	4	3
	Tariff	0	6
	Total options	107	266

12.4 Stage 3 – Feasible Options

12.4.1 Feasible option development

For each of our feasible options (including third party options) we developed the following:

- a description of the option including and any links or dependencies to other options
- a profile of the yield (based on the capacity of the solution) or water saved over 80 years
- an estimate of the time needed to investigate and implement the option, including the earliest start date

- an assessment of the risks and uncertainty associated with the option yield and deliverability (for our supply options)
- any factors or constraints specific to the option
- a profile of the option costs over 80 years, for Capex and Opex (NPV)
- an assessment of the potential environmental and social impacts of the option and an assessment of the Habitats Regulations Assessment (HRA) if an option could affect any designated European site.

Further to the above we also developed option level criteria that were used to help inform the decision making and portfolio shortlisting in the EBSD modelling, which were linked to our options:

- **Option deliverability:** Which considered the option from the initial design phase up to commissioning and operation. It includes assessment of the risk around obtaining planning permission, construction, technology and other implementation risks
- **Option yield / Cost uncertainty:** Thresholds were produced for each option, based on expert engineering input.
- **Environmental Impacts:** The SEA objectives were translated into numerical ranges that represented negative and positive impacts.

Please see our Technical Reports 4.9 and 4.10 on our EBSD modelling and our SEA Environmental Report for further details.

Our option price base year was projected forward to 2017, to align our option costs with our business plan costs. Any infrastructure cost that delivers yield or capacity benefits is calculated as the Net Present Value (NPV) of the option capacity or output.

The Average incremental Cost (AIC) and the Average Incremental Social Cost (AISC) is provided in our WRP tables for each of the feasible options. We have applied the following discount rates as per the WRP Guidance:

- 3.5% for years 0-30; 3% for years 31-75 and 2.5% for years 76 and beyond.

With regard to impacts of climate change on our options, the majority of our supply options are groundwater schemes that may involve the optimisation of a borehole or amendment to a licence. We can plan to effectively 'engineer out' any impacts on the option yield from climate change. Our bulk supply import schemes place the emphasis on the supplier or the third party to provide a security of supply. However, we do recognise that where regional or multi – company solutions are developed, there is a need to further understand that the source of that water is resilient to climate change.

Effluent re-use and desalination options are generally climate and drought resilient.

We also assume that our demand management options (e.g. leakage and metering) are not sensitive to climate change.

12.5 Stage 4 – Strategic Environmental Assessment (SEA) of Options and Plans

12.5.1 Introduction

The requirement to undertake an SEA arises from an EC Directive which is transposed into English law through the Environmental Assessment of Plans and Programmes Regulations 2004 (the 'SEA Regulations'). The SEA Directive and associated regulations require a SEA to be undertaken for certain plans and programmes which are likely to have significant effects on the environment.

The purpose of SEA is to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation of plans with a view to promoting sustainable development. It is a systematic assessment tool to support and inform decision-making.

The Environmental Report sets out the method, findings and recommendations of the SEA process and is available for review and comment alongside this plan (please refer to Technical Report 4.11 Strategic Environmental Assessment (SEA) Environmental Report).

12.5.2 Strategic Environmental Assessment

SEA Process

The SEA has informed decision making at each key stage of our options appraisal process:

- **Unconstrained options -** SEA criteria formed part of the detailed screening assessment of unconstrained options, informing our decision to either reject or progress options to the next stage
- **Constrained options -** At this stage each of the supply and demand options were assessed against the full SEA Framework of objectives and assessment questions. Predicting the likely residual effect, taking mitigation into account, for each assessment question during construction and operation
- **Programme appraisal -** The findings of the SEA for each constrained option were fed into the EBSD model and formed part of the multi-criteria analysis. This allowed us to:
    - visually track and compare the performance of portfolios across a range of variables, including any significant positive and negative effects identified through the SEA of constrained options
    - do SEA model runs where any options identified as having a significant negative effect could not be selected by the model and therefore not included in any portfolios.

SEA of dWRMP19

As outlined above, the findings of the SEA informed the development of the preferred programme. Building on the assessment of constrained options, the SEA identified the likelihood for significant effects as a result of the schemes proposed in our plan.

Where any negative effects are predicted the SEA proposed mitigation measures or areas for further investigation to either avoid or help to reduce the significance of that effect.

The SEA also considered potential interactions between schemes proposed within our plan as well as with other plans and programmes, which could result in cumulative effects. The assessment included consideration of interactions with other Affinity Water plans, such as the

Draft Drought Plan, as well as other plans, such as River Basing Management Plans or infrastructure development plans.

The method used to assess cumulative effects is in line with the approach recommended by WRSE, who are carrying out a study to identify potential cumulative effects arising as a result of interactions between schemes being proposed through emerging dWRMPs (2019) within their area. Initial findings of this work were provided to us in October 2017 and were incorporated into the SEA.

12.5.3 Habitats Regulation Assessment (HRA)

The purpose of the HRA is to assess constrained options and portfolios which have the potential for linking pathways to Natura 2000 or European Sites (Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites) and could therefore cause a likely significant effect on one or more of these sites.

The HRA follows a four stage process of evidence gathering (1), screening for likely significant effects (2), ascertaining the effect of those ‘screened in’ (3) and identifying mitigation measures and alternative solutions (4).

A summary of the results of our assessment can be found in Section 15.6.

12.5.4 Water Framework Directive (WFD)

As part of the options appraisal process, a preliminary Water Framework Directive (WFD) assessment is carried out to identify the potential for supply side dWRMP19 constrained options to result in deterioration of water body status and prevent future target status of the water bodies.

This assessment looks at constrained options only as the preceding option screening stage has screened out options which could be of major detriment to WFD. The preliminary WFD assessment is detailed within Technical Report 4.13 Water Framework Directive. The purpose of this assessment is to identify any options that would require further investigation or assessment to demonstrate compliance with the WFD.

A summary of the results of our assessment can be found in Section 15.6.

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13 Our Economic Modelling and Scenario Testing

Summary

This chapter describes our approach to balancing supply and demand and exploring a wide range of scenarios using an enhanced stochastic approach. We present how our current and future operational system will be resilient to a range of droughts and non-drought hazards across the planning period.

Our water balance shows that seven of our eight zones are predicted to be in deficit by 2064.

We have undertaken an investment appraisal to identify the best portfolio of options to either increase the amount of water available, reduce water demand or both, using a least cost model known as the Economic of Balancing Supply and Demand (ESBD) model. The model identifies the least cost solution to ensure the deficit is met in all zones, in all years of the planning period, under every planning condition. Multi-criteria analysis was used to shortlist the 163 portfolios obtained through the EBSD least-cost optimisation process based on an agreed set of criteria. The shortlisted portfolios were subjected to further modelling iterations during which their resilience was assessed and compared.

Based on the results of our modelling, we have identified our **Preferred (PP)** and **Alternative (AP) plan** that we would like to consult our stakeholders and customers on:

- Our **PP** meets a worst historic drought and a medium DI without relying on drought permits and orders.
- Our **AP** meets a severe drought (1 in 200), a mediumDI and WINEP2 sustainability reductions. Drought permits and orders are available in early years only.

13.1 Introduction

As part of the WRMP process, we have produced supply and demand forecasts for our water resource zones, see Chapters 8 and 9, and assessed our baseline supply-demand balance position throughout our chosen 60 year planning period (2020 to 2080), see Chapter 10. The balance shows that seven of our eight zones are predicted to be in deficit by 2064. According to the latest WRPG, when a deficit is forecasted, an investment appraisal is needed to identify the best portfolio of options to either increase the amount of water available, reduce water demand or both. This chapter presents our investment appraisal using a least cost model known as the Economic of Balancing Supply and Demand (EBSD) model.

To build our **PP** and **AP** we have:

- undertaken modelling to identify a shortlist of scenarios to present as part of a preferred and alternative 'envelope' on which we will consult with the public. Understand the risks and uncertainties of selected options and check that they meet the objectives of our plan
- ensured that our **PP** meets the SEA objectives
- included demand management options to reduce household consumption and leakage in line with government aspirations

- included abstraction reductions where it is considered they would benefit the environment and have been found to be cost beneficial
- explored sharing of resources with neighbouring companies and third party licence holders in developing a regional strategy
- followed a flexible approach to option development to develop a 'resilience tested plan' to move towards a position of enhanced resilience that does not rely on a single option type.

13.2 Our Methodology

13.2.1 EBSD extended methods

We have completed a problem characterisation to understand the scale and complexity of the planning problem that we are solving, explained in Chapter 6, and selected an appropriate decision-making and modelling approach consistent with these results. This is known as the EBSD Extended Methods approach. It allows us to use an aggregate supply-demand modelling method but also to test the resilience of our chosen plan. The method is consistent with the modelling exercise carried out by Water Resources in the South East (WRSE) regional group. It is comprised of the EBSD modelling and Info-Gap stress testing coupled with a Multi-Criteria Analysis.

13.2.2 Enhanced EBSD model

Overview

We have adopted the same modelling platform that we used in our last plan (fWRMP14). The aim of the EBSD model is to identify the least cost solution to ensure the deficit is met in all zones, in all years of the planning period, under every planning condition. It does this by determining annually whether an option should be implemented and to what extent supply and demand schemes are utilised (including existing sources and existing bulk imports).

Each scheme has a set of costs that the model compares to determine whether the scheme should be activated or not. The cost components that the model considers are:

- NPV annual capex
- NPV fixed annual opex
- NPV variable opex
- NPV one-off environmental and social costs
- NPV fixed annual environmental and social costs
- NPV one-off carbon costs
- NPV fixed annual carbon opex

If the model selects an option, all costs will be incurred at a fixed rate (either one-off or annual), with the exception of the variable opex component which depends on the utilisation of the scheme. Therefore, the model will also determine the optimal utilisation of the available options based on the average of the variable opex for the planning conditions taken into account (DYAA and DYCP). The solution identified is a combination of options, utilisations and delivery years that meet the supply/demand balance in the most economical way compared with all other possible solutions.

In addition, the new EBSD Extended Methods allows us to generate and then model multiple scenarios simultaneously, thereby greatly reducing the need for post-modelling scenario testing. Through scenario generation, we can offer the model a range of planning conditions by adjusting the parameters that influence trends in future supply and demand. These parameters are described below and shown in Table 43.

- **Distribution Input** (DI): the volume of water that we put into supply
- **Deployable Output** (DO): testing the influence of different drought return periods
- **Sustainability Reductions** (SRs): reductions in licensed abstraction volumes to protect river flows and improve water ecology
- **Water quality impact**: loss in deployable output due to water quality
- Implementation of supply-side **drought permits and orders.**

Table 43: Input parameters to the EBSD model

Parameter	Lower level	Mid-level	Higher level
Distribution input (DI)	Low DI	Medium DI	High DI
Deployable output (DO)	Worst historic drought (1 in 60 to 1 in 80)	Severe drought (1 in 200)	Extreme drought (1 in 500)
Sustainability reductions	Planned	Indicative	Unconfirmed
Water quality impact	None	Half	Full
Availability of supply-side drought permits and orders	On / Off		

WRZ input parameters

Values for DO, outage, headroom, treatment losses and climate change, for all WRZs that are included in the EBSD modelling can be found in the Water Resource Planning tables for DYAA and DYCP.

Sustainable economic level of leakage (SELL)

The EBSD model incorporates the Active Leakage Control (ALC) cost curves of moving from one leakage level to another and optimises the amount of leakage reduction needed against the cost of other supply and demand schemes. Using a starting leakage position and the assessment of the supply/demand imbalance year-by-year through the planning period, any deficits that occur at some point in the future are satisfied through either additional water into supply or a reduction in demand, or a combination of the two. The least cost scenario then identifies the optimal mix of supply and/or demand options and their timing in order to achieve the objective of meeting demand in all conditions, in every year of the planning period. Leakage reduction below the short-run SELL (or base-line leakage assumption) will be one such intervention option that is a result of the modelling process.

13.2.3 Process summary

The following stages are taken within the EBSD modelling:

- scenario generation
- least-cost optimisation for each scenario
- shortlisting through Multi-Criteria Analysis
- stress testing

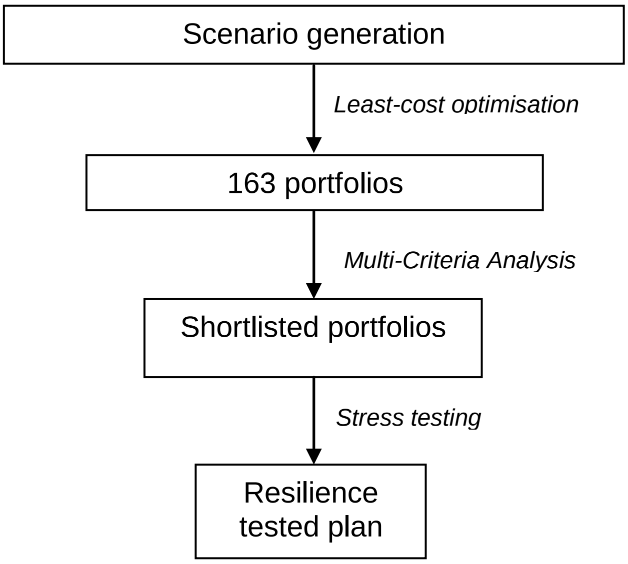

Figure 46: EBSD modelling stages

13.2.4 Scenario generation

The scenarios have been compiled based on changes to the factors shown in

Figure 46. All possible permutations of these parameters generate 163 scenarios (SU-0 to SU-162). Based on our methodology, we run the EBSD model for all 163 scenarios to identify an equivalent number of portfolios that represent the least-cost solutions.

Distribution input

We consider three different demand scenarios: Low, Medium, High. Our Medium forecast is taken directly from our baseline demand forecast for both dry year annual average (DYAA) and dry year critical period (DYCP) planning conditions and includes all the demand components that make up distribution input (household demand, non-household demand and leakage).

The Low and High forecasts are generated by applying change factors to the demand components of the Medium forecast: the 2020-2044 demand trend is either decreased or increased by the specified change factor at 2044 and the new trend extended out to 2079. The change factors applied are shown in Table 44. The same change factor is applied in every water resource zone and consistent with WRSE regional modelling.

Table 44: Distribution input change factors

Demand component	Low	Medium	High
Household demand	-5%	*0%*	45%
Non-household demand	-5%	*0%*	10%
Total leakage (including USPL)	0%	*0%*	10%

Distribution input is further adjusted in all three demand scenarios by the simulated impact of demand restrictions. The change factor applied depends on the drought severity taken into consideration as shown in Table 45.

Table 45: Impacts of demand restrictions as percentage of total demand

Water Resource Zone	Drought impacts		
	Worst historic (1 in 60 to 1 in 80)	Severe (1 in 200)	Extreme (1 in 500)
WRZ1	-3%	-6.20%	-6.20%
WRZ2	-3%	-6.20%	-6.20%
WRZ3	-3%	-6.20%	-6.20%
WRZ4	-3%	-6.20%	-6.20%
WRZ5	-3%	-6.20%	-6.20%
WRZ6	-3%	-6.20%	-6.20%
WRZ7	-3%	-5.60%	-5.60%

Deployable output

Our DO assessment in Technical Report 1.1 produced DO forecasts based on drought return periods. For EBSD modelling, we use three different DO forecasts corresponding to a worst historic (1 in 60 to 1 in 80), a severe (1 in 200) and an extreme (1 in 500) drought. The reduction in DO between drought severities is applied in the model to derive three DO scenarios (Table 46).

Table 46: DO reduction from the worst historic drought (Ml/d)

Water Resource Zone	Worst historic (1 in 60 to 1 in 80)		Severe (1 in 200)		Extreme (1 in 500)	
	DYAA	DYCP	DYAA	DYCP	DYAA	DYCP
WRZ1	0	0	0	-1	0	-1
WRZ2	0	0	-33	-15	-41	-34
WRZ3	0	0	-3	-5	-5	-7
WRZ4	0	0	0	0	0	0
WRZ5	0	0	0	0	0	0
WRZ6	0	0	0	0	0	0
WRZ7	0	0	-5	-3	-5	-6

Our ‘design drought’ is based on the worst historic drought that has been defined by modelling historic groundwater levels. The resulting DO figures for this drought are lower than those presented in our WRMP14, in which DOs were based on less severe droughts occurring in more recent years. For this reason, we have allowed for a short transition period in our modelling to avoid any sudden step change in our supply-demand balance. Starting from our end of AMP6 position, the DOs for our WRZs have been gradually adjusted to match the new worst historic values in 2023/24.

Sustainability reductions

Following our review of the EA WINEP list, we included sustainability reductions in our **PP** and **AP**. In accordance with the latest EA guidance on sustainability reductions (EA, 2017b). Planned sustainability reductions are applied directly to the baseline assessment thereby contributing to the baseline supply-demand balance. On the contrary, the unconfirmed (red)) sustainability reductions are tested through scenarios only. In all cases, sustainability reductions are deducted from DO to simulate the loss of source outputs and thus decrease the total water available for use in our modelling runs.

Table 47 shows the three levels of sustainability reductions used to generate our scenarios.

Table 47: Sustainability reductions modelled in EBSD (Ml/d)

Scenarios	Sustainability reductions (Ml/d)	
	DYAA	DYCP
Preferred Planned SRs	10.22	0
Alternative Plan (WINEP2 SRs)	39.81	31.66
Unconfirmed SRs	61.47	36.75

The reductions shown for planned are assumed to be fully implemented by the end of AMP7 (2024) whilst the reductions applied to the Indicative and Unconfirmed levels are modelled with a full implementation by the end of AMP8 (2029). We have also included an assessment of Indicative sustainability reductions included within WINEP2.

Water quality impact

Potential losses of water available for use due to water quality issues are simulated by creating three levels of severity (None, Half, Full). Change factors are applied at zonal level in 2044 to simulate a reduction in DO. The new DO value for that year is then linearly interpolated with the base year.

Table 48 shows the nominal impacts applied in the model. We chose to maintain the same value in all our water resource zones.

Table 48: Water quality impact

Water Resource Zone	None	Half	Full
WRZ1	0%	5%	10%
WRZ2	0%	5%	10%
WRZ3	0%	5%	10%
WRZ4	0%	5%	10%
WRZ5	0%	5%	10%
WRZ6	0%	5%	10%
WRZ7	0%	5%	10%

Drought permits and orders

Drought permits and orders are switched on and off depending on the scenario being modelled. This last parameter produces pairs of scenarios in which all conditions are identical but the availability of drought permits and orders differ. Table 49 shows the total zonal yield of drought permits and orders modelled in EBSD.

Table 49: Yield of drought permits and orders (Ml/d)

Resource zone	DYAA	DYCP
WRZ1	9.75	9.75
WRZ2	18.52	18.52
WRZ3	29.30	31.12
WRZ4	0	0
WRZ5	6	6
WRZ6	0	0
WRZ7	6.27	8.27
Total	**69.84**	**73.66**

13.2.5 Shortlisting process through multi-criteria analysis

The shortlisting process reduced the 163 portfolios to a smaller number of portfolios by using upper and lower limits of a number of metrics. Portfolios which have metrics values falling outside of these defined limits were screened out.

We have used a Multi-Criteria Analysis (MCA) tool to make informed decisions by evaluating several conflicting criteria. In the process, decision makers expressed their own preferences for the parameters taken into consideration and reach an agreed solution weighting the trade-offs between them. In our decision-making framework, the MCA shortlisted the 163 portfolios obtained through the EBSD least-cost optimisation process to 11 final portfolios.

The portfolio filtering used the following criteria:

- cost
- environmental impacts (positive and negative)
- deliverability
- uncertainty on cost
- uncertainty on yield

The decision-making framework follows an iterative process to define the acceptability of metric values, during which trade-offs between metrics are made. The following constraints were applied as a result:

- the total cost of the portfolio has been restricted to £1.8 billion (NPV 80 year assessment period)
- the range on yield uncertainty has been narrowed to 0 – 90 Ml/d
- the metric on environmental benefit has not been restricted
- the range on negative environmental impacts has been restricted between lowest (best) score of -2 and -5
- we have allowed for a maximum cost uncertainty of £150k.

As a result of applying the agreed shortlisting thresholds, a total of 11 portfolios were derived. Table 50 and Table 51 show what these 11 portfolios were and provide the scenario settings, along with the results (including the MCA scores).

Table 50: Shortlisted portfolios and corresponding scenarios

Portfolio ID	DI	Drought	SRs	WQ impact	Permits & Orders
P-0	Medium	Worst Historic	Planned	None	Yes
P-1	Low	Worst Historic	Planned	None	No
P-2	Low	Severe	Planned	None	Yes
P-3	Low	Severe	Planned	None	No
P-4	Low	Extreme	Planned	None	Yes
P-46	Medium	Worst Historic	Planned	None	No
P-47	Medium	Severe	Planned	None	Yes
P-48	Medium	Severe	Planned	None	No
P-139	Low	Worst Historic	Uncertain	None	Yes
P-145	Medium	Worst Historic	Planned	None	Yes
P-148	Medium	Worst Historic	Uncertain	None	Yes

Portfolio 0 is the least cost portfolio from the shortlist, as shown in Table 51. This portfolio represents our base case and meets a Medium DI and a worst historic drought with the use of drought permits and orders. The planning conditions that this portfolio meets and the reliance on supply-side drought options explain its relative low cost. Although this portfolio is least cost, it does not perform better than other shortlisted portfolios with regard to environmental impacts or uncertainty on yield. We can also see that the most expensive portfolio (Portfolio 4) has a high uncertainty on cost and yield. This shows that a more expensive and more uncertain plan would be required to meet extreme conditions, in this case an extreme drought (1 in 500 return period).

Table 51: Results of the 11 portfolios

Portfolio ID	NPV (£k)	Significant Negative MCA Score Count	Significant Positive MCA Score Count	Deliverability	Uncertainty on cost (£k)	Uncertainty on yield (Ml/d)
Portfolio-0	£1,252,093	3	1	7.40	£59,296	67.10
Portfolio-1	£1,347,969	2	2	7.42	£92,182	59.06
Portfolio-2	£1,447,971	2	2	7.44	£107,714	68.75
Portfolio-3	£1,500,101	3	2	7.18	£143,989	61.75
Portfolio-4	£1,647,851	3	2	7.42	£137,405	84.23
Portfolio-46	£1,406,939	3	2	7.35	£99,676	59.31
Portfolio-47	£1,515,303	2	2	7.32	£122,691	78.12
Portfolio-48	£1,563,331	4	2	7.00	£151,944	66.64
Portfolio-139	£1,446,791	2	2	7.28	£112,675	78.50
Portfolio-145	£1,376,226	2	2	7.26	£88,534	64.90
Portfolio-148	£1,516,465	3	2	7.27	£124,411	85.17

13.2.6 Stress testing

The WRPG states that water companies should consider the ability of the solution to cover a range of possible futures and provide resilience. We have met this requirement through stress testing for a range of future scenarios. Modelling iterations were undertaken on the shortlisted portfolios to test their resilience. Using the base case and the most extreme supply-demand balance scenario, the model generates five levels of increasing uncertainty (Info-Gap Level 0 to Info-Gap Level 4). Each Info-Gap level simulates planning conditions that are increasingly more extreme by progressively increasing DI, illustrated in Figure 47 and decreasing DO, illustrated in Figure 48.

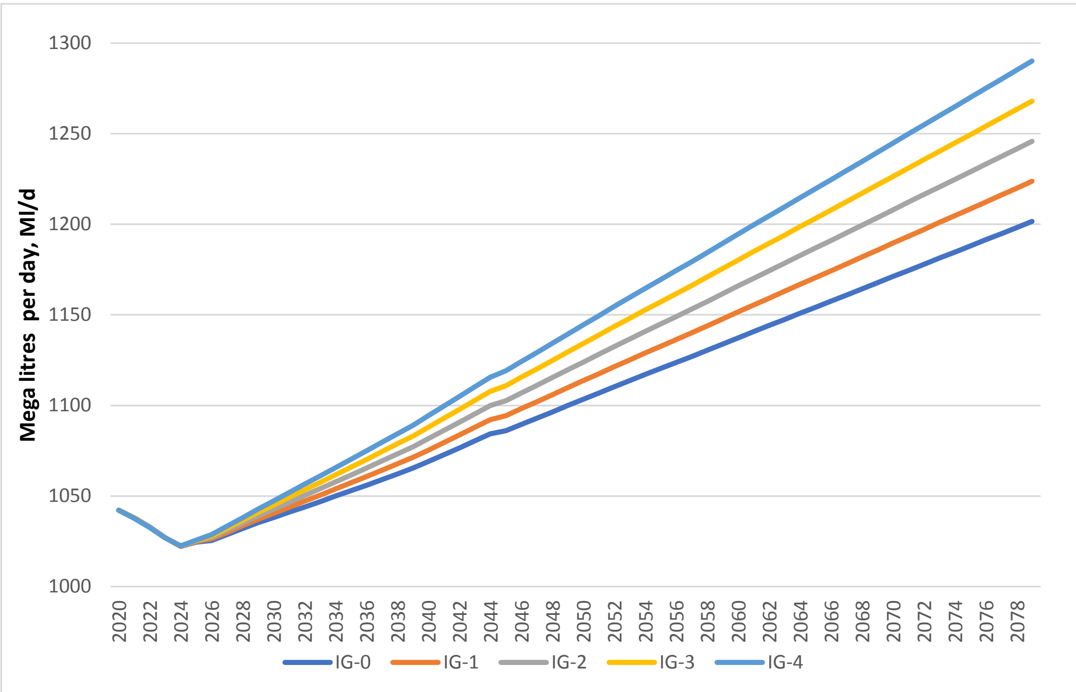

Figure 47: DI trend for each Info-Gap level

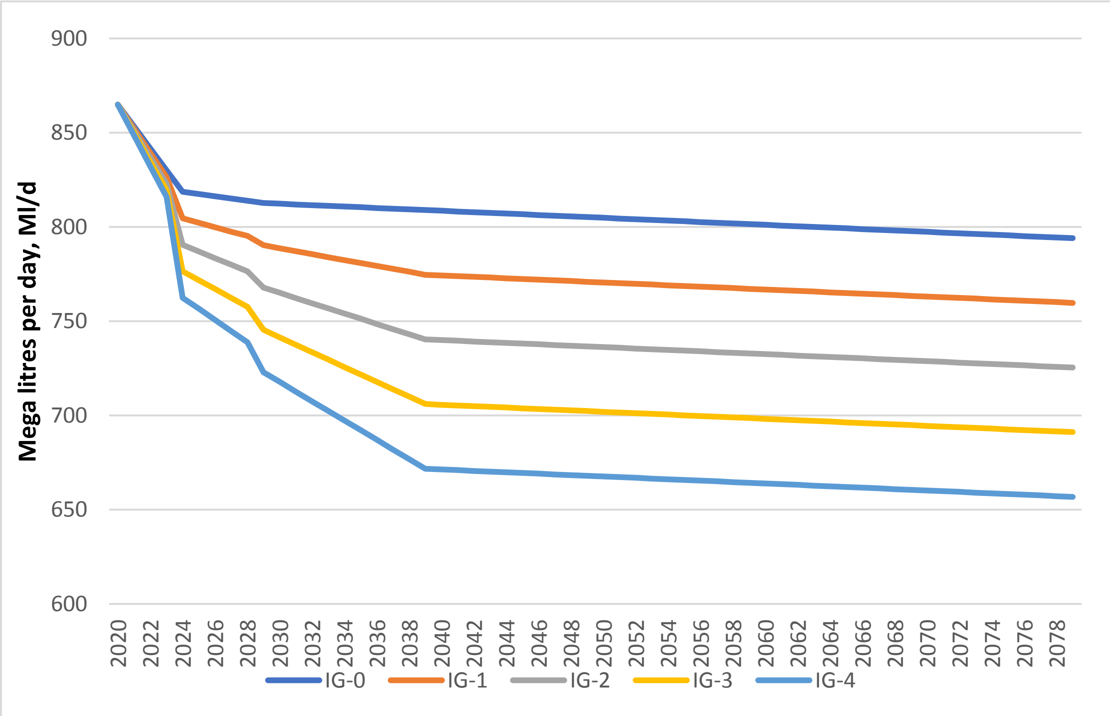

Figure 48: Decrease in DO at each Info-Gap level

The model ran for each shortlisted portfolio under each Info-Gap level. During these modelling runs, the portfolio of options is fixed whilst the scheduling may change in response to the increasingly more extreme supply-demand conditions.

The performance of the candidate programmes are described through four resilience metrics:

- **Reliability**: the degree to which the portfolio does not show failures (score 0 to 1).
- **Recovery**: rate of recovery after a deficit (score 0 to 1).
- **Vulnerability**: average maximum yearly deficit across the period considered (Ml/d).
- **Demand failure**: percentage of demand not met (%).

The 11 shortlisted portfolios have been subjected to further modelling iterations to test their resilience. The relative performance of these portfolios have been assessed and compared.

Table 52 to Table 55 and Figure 52 show the reliability and vulnerability of the shortlisted portfolios at 2044 and 2079. The reliability is an index that measures how frequently the portfolio can satisfy the supply-demand balance throughout the entire planning period. A very reliable portfolio will score 1 whereas a very poor performance will be marked by a 0. The vulnerability provides an indication of the average maximum yearly deficit across the planning period and it is expressed in mega litres per day (Ml/d).

All the portfolios that we have stress tested show a good level of resilience at 2044. By 2044 there are no deficits up to Info-Gap level 3 and deficits no greater than 1.63 Ml/d at Info-Gap level 4. However, the same portfolios show less resilience at 2079, when failures become more frequent and the metrics display a poor performance from Info-Gap level 2.

Table 52: Reliability scores of the shortlisted portfolios (2044)

Portfolio ID	Info-Gap level				
	IG-0	IG-1	IG-2	IG-3	IG-4
P-0	1	1	1	1	0.94
P-1	1	1	1	1	0.95
P-2	1	1	1	1	1
P-3	1	1	1	1	0.99
P-4	1	1	1	1	1
P-46	1	1	1	1	0.95
P-47	1	1	1	1	0.99
P-48	1	1	1	1	0.99
P-139	1	1	1	1	0.95
P-145	1	1	1	1	0.95
P-148	1	1	1	1	0.95

Table 53: Reliability scores of the shortlisted portfolios (2079)

Portfolio ID	Info-Gap level				
	IG-0	IG-1	IG-2	IG-3	IG-4
P-0	1	1	0.94	0.85	0.77
P-1	1	1	0.97	0.88	0.79
P-2	1	1	1	0.94	0.84
P-3	1	1	1	0.92	0.81
P-4	1	1	1	0.97	0.87
P-46	1	1	0.97	0.88	0.80
P-47	1	1	1	0.93	0.83
P-48	1	1	1	0.93	0.83
P-139	1	1	0.97	0.90	0.81
P-145	1	1	0.97	0.89	0.81
P-148	1	1	0.97	0.91	0.83

Table 54: Vulnerability at 2044 (Ml/d)

Portfolio ID	Info-Gap level				
	IG-0	IG-1	IG-2	IG-3	IG-4
P-0	0.00	0.00	0.00	0.00	1.59
P-1	0.00	0.00	0.00	0.00	1.63
P-2	0.00	0.00	0.00	0.00	0.00
P-3	0.00	0.00	0.00	0.00	0.16
P-4	0.00	0.00	0.00	0.00	0.00
P-46	0.00	0.00	0.00	0.00	1.63
P-47	0.00	0.00	0.00	0.00	0.16
P-48	0.00	0.00	0.00	0.00	0.16
P-139	0.00	0.00	0.00	0.00	1.63
P-145	0.00	0.00	0.00	0.00	1.63
P-148	0.00	0.00	0.00	0.00	1.63

Table 55: Vulnerability at 2079 (Ml/d)

Portfolio ID	Info-Gap level				
	IG-0	IG-1	IG-2	IG-3	IG-4
P-0	0.99	0.00	20.18	54.54	58.64
P-1	0.00	0.00	3.75	36.17	50.21
P-2	0.00	0.00	0.00	22.31	45.65
P-3	0.00	0.00	0.00	32.32	50.04
P-4	0.00	0.00	0.00	19.53	45.10
P-46	0.00	0.00	1.51	35.65	50.76
P-47	0.00	0.00	0.00	21.19	45.05
P-48	0.00	0.00	0.00	27.78	49.07
P-139	0.00	0.00	0.83	24.15	46.14
P-145	0.00	0.00	0.83	25.45	49.81
P-148	0.00	0.00	0.83	15.41	43.12

The vulnerability of each portfolio was related to the total demand each was trying to meet. The demand failures metric follows a similar trend, with failures occurring for some portfolios at Info-Gap level 4 in 2044, seen in Figure 49. Portfolio 0 is the worst performing portfolio with 0.29% of demand as deficit at Info-Gap level 4 in 2044. Portfolio 2 and Portfolio 4 show no demand failures at any Info-Gap levels.

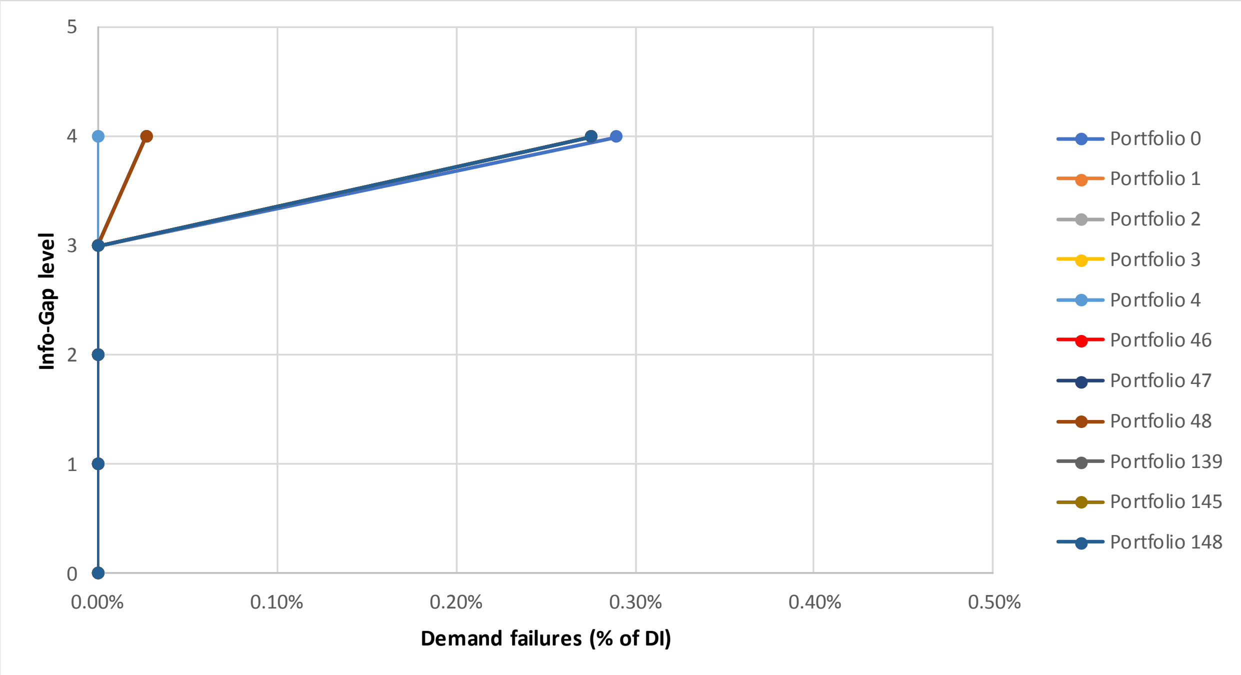

Figure 49: Demand failures (2044)

The performance of the portfolios worsens considerably by 2079, when demand failures appear from Info-Gap level 2 and widen from subsequent Info-Gap levels. Figure 50 illustrates how portfolios diverge from 0% demand failures at different Info-Gap levels. Again, Portfolio 0 is the worst performing portfolio with 15% of unmet demand at Info-Gap level 4.

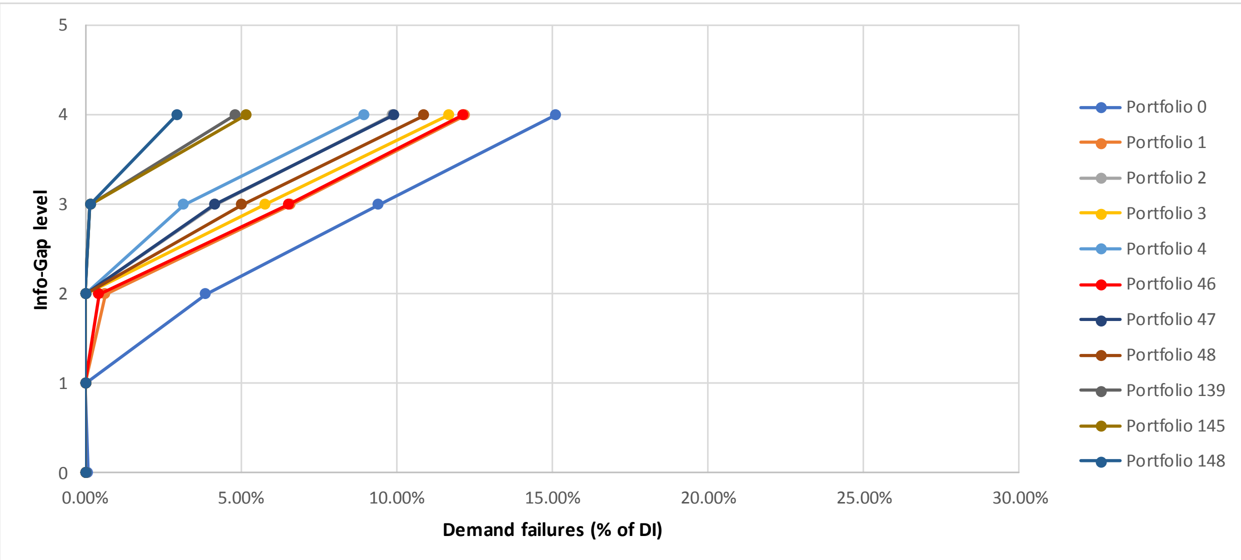

Figure 50: Demand failures (2079)

13.3 Final Modelling Runs

Following stress testing, a limited number of candidate portfolios were selected to further refine and improve the robustness of portfolio selection, with the aim to improve portfolio outcomes to reflect aspirational targets and expectations on per capita consumption and leakage reduction. Based on these results of further modelling iterations, we have identified our **PP** and **AP**.

An additional phase of stress testing on the **PP** and **AP** has been completed to compare the performance with that of the shortlisted portfolios. This further modelling iteration has been deemed necessary to fully test the resilience of our plans and consider them in relation to the initial unconstrained modelling run.

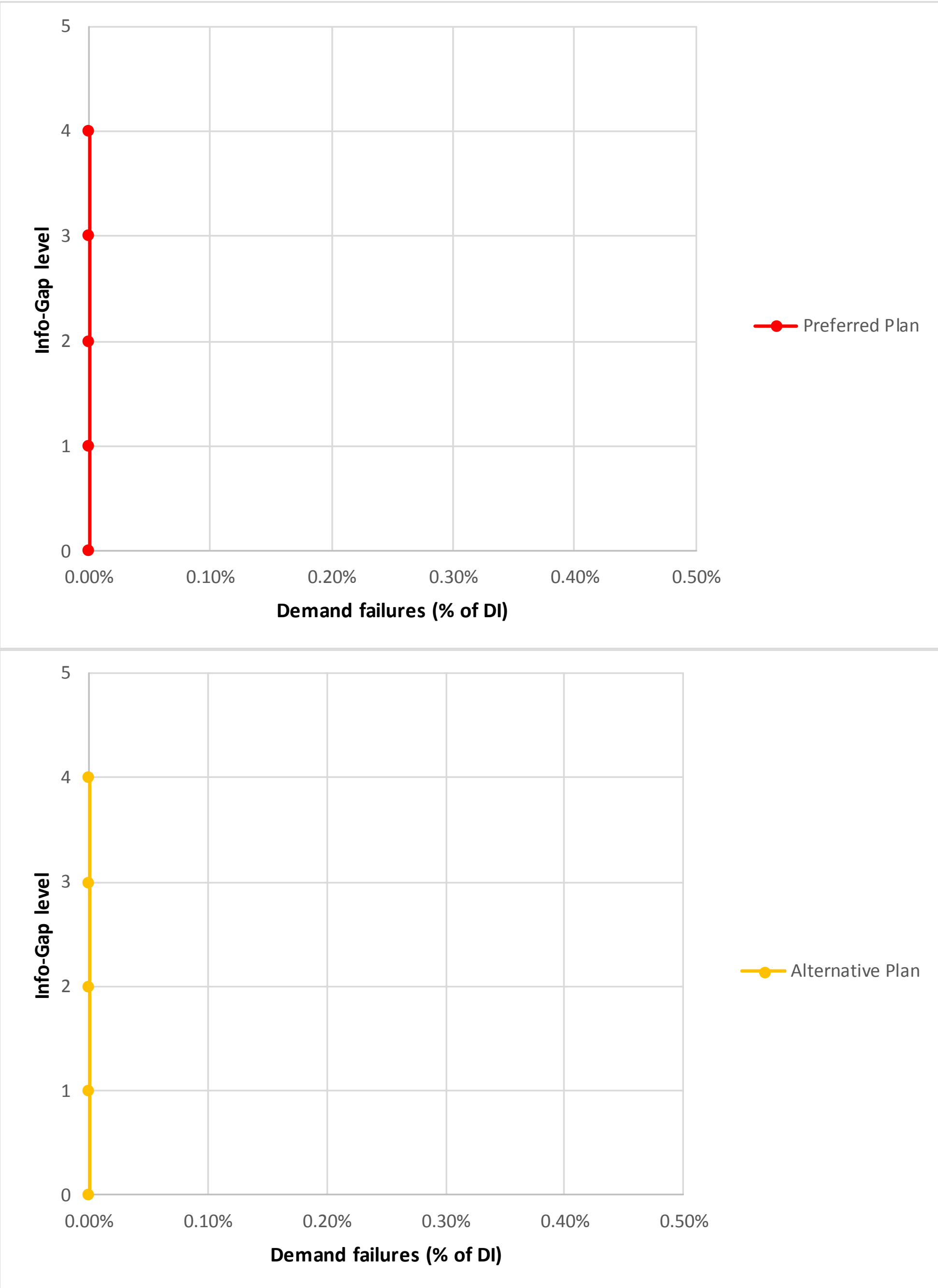

Figure 51: Demand failures of our PP and AP (2044)

Demand failures for our **PP** and **AP** are shown in Figure 51 and Figure 52. There are no demand failures at any info-gap level in 2044 whilst they range between 0.2% and 12% of total demand in 2079 depending on the info-gap level and the scenario considered.

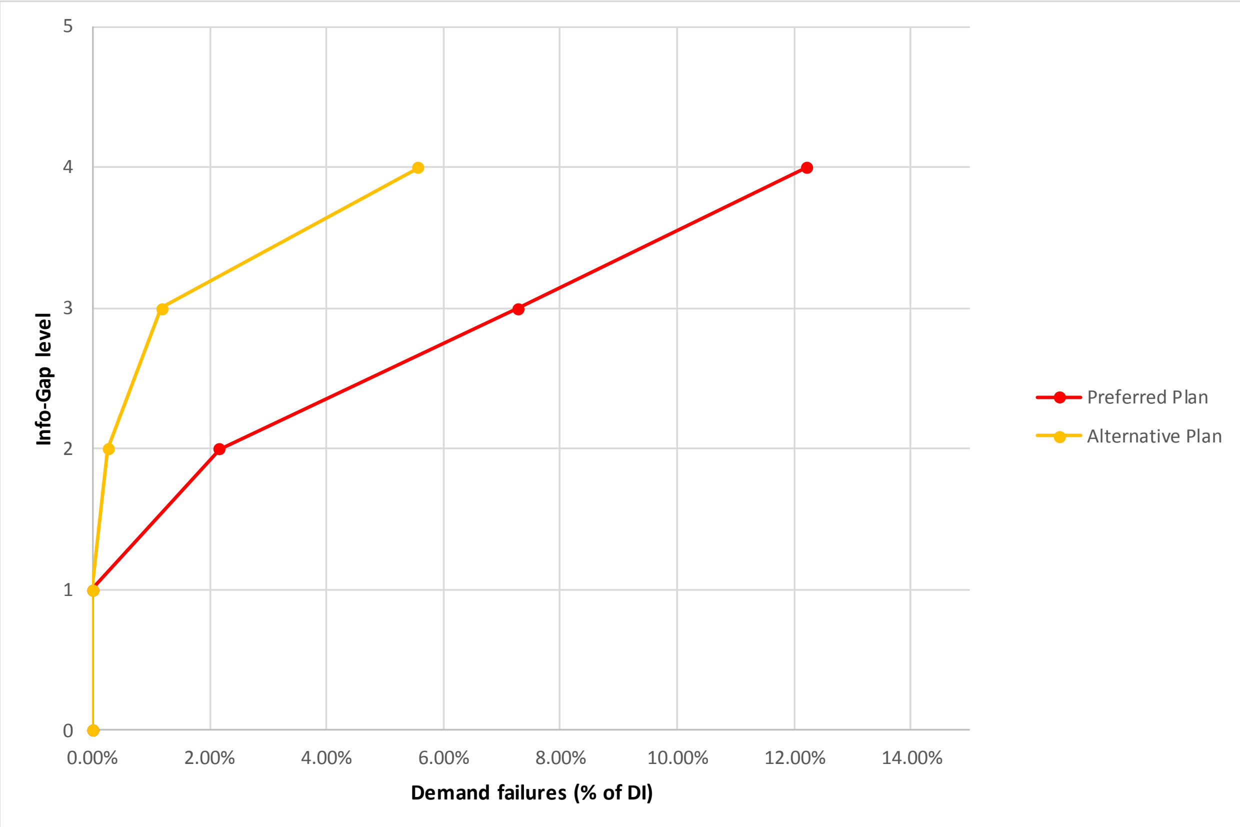

Figure 52: Comparison between demand failures in 2079: PP and AP

The results show that our chosen portfolios are resilient to changes in supply and demand in the short to medium term (25 year statutory period), seen in Figure 51. The same portfolios display less resilience at the end of our chosen planning period (2079/80), Figure 52. Given the long planning horizon and the uncertainty embedded in it, we believe that vulnerabilities shown in the long-term can be understood and addressed through an adaptive planning approach in future AMP cycles.

13.4 Additional Sensitivity Testing

Our **PP** and **AP** represents the scenarios on which we have tested other sensitivities. We assessed the sensitivity of factors such as ANGL water import at full capacity and applying the revised approach to calculating base year leakage.

We further assessed the sensitivity of factors such as reducing per capita consumption and greater sustainability reductions as per Government and stakeholder aspirations, these scenarios are further discussed in Section 16.6.

13.4.1 Sensitivity S1: ANGL Water import at full DO (76 Ml/d)

Due to water quality constraints, in all of our modelling we have reduced the DO of our import from ANGL Water to 50 Ml/d. Sensitivity S1 was modelled to understand the implications of having our import from ANGL Water available at full DO (76 Ml/d). Having this additional 26Ml/d available defers investment in groundwater and transfer options during AMP7 and AMP8 for our **PP**. The purpose of running this sensitivity test was to understand the impact on the investment profile in AMP7 and AMP8 from having full ANGL import available.

13.4.2 Sensitivity S2: revised approach to calculating base year leakage

We have not adopted the approach outlined in consistency of reporting performance measures (ref UKWIR) when forecasting leakage in our dWRMP19. We have explored the sensitivity of our leakage forecast by assessing the impact of this new methodology on our base year water balance which resulted in a 2% increase in our base year leakage. We then used the new leakage forecast in our EBSD model. The initial results show some deficits in the early years of the modelling that could potentially be solved by allowing more demand management options to be selected. We believe that the level of demand management options in our **PP** and **AP** is already challenging and adding more options of this kind will increase our risk profile. We intend to fully incorporate the revised approach to calculating base year leakage in our final WRMP19.

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14 Regional Collaboration and Third Party Options

Summary

An important strategic element of resilience in water resources is the regional context, discussed in detail in this section. We have a leading role in the **Water Resources in the South East** (WRSE) project, **Water Resources East** (WRE) and participated on the steering group of the Water UK **Long Term Water Resources Plan**, working with the Environment Agency and other water companies to assess strategic water supply opportunities across the regions. We have undertaken significant inter–company and third party collaboration to support potential regional solutions, identifying options and cross border supplies, from all our neighbouring water companies, has been a crucial component in the development of our plan.

We have for some time recognised the water scarcity issues in the South East presented by longer term drivers such as population growth, climate change and the environment but we also appreciate that shorter term extreme weather and climatic events are becoming increasingly prevalent. These, as well as the longer term drivers, threaten the economic and resilient supply of water to customers.

The on-going regional work helps to show how our dWRMP19 and our problem characterisation aligns with and reflects the regional water resource strategies, and where the differences occur. At this stage our comparisons indicate that we are consistent with the results that have been issued by WRSE. We will further verify consistency during our dWRMP19 consultation period. Once the consultation has concluded and the WRSE strategy reported, both will inform our final plan. We support the aims and objectives of WRE, and look forward to further collaborative involvement in the future. The project is attempting to address water resource planning issues in a new and innovative way, and we aim to support that work in an appropriate way going forward.

We believe this approach moves us closer to a proposition of Regional Coordination in the future. We have been instrumental in promoting Regional Coordination and an extension of the scope of the WRSE to include development of regional strategic plans with decision-making authority.

Our dWRMP19 Preferred Plan (**PP**) allows for enough scope to be able to progress with some of the necessary long term needs that might ensue from the need for a regional multi company solution in a timely manner.

We believe that a System Operator function could operate within the water industry as a key enabler to promote water trading as an economic and resilient solution to water scarcity in the South East. We discuss this further in Section 14.7.

14.1 Introduction

Resilience of the water sector specific to WRMP is introduced in Chapter 7. An important strategic element of resilience in water resources is the regional context. This chapter explains this in more detail and how we have engaged and developed opportunities to enhance resilience for ourselves and other water companies in our regions.

Here we also introduce the national work on resilience and we have provided some initial comparisons of our own modelling with the regional modelling. We have also included a summary of our collaborations with neighbouring water companies and third parties as part of our dWRMP development.

In support of the national and regional water resources modelling, we have and are continuing to undertake the following activities:

- pro-active membership of the **Water UK National Modelling Study, WRSE** and **WRE** (at technical, programme management and senior management levels) along with membership at multi company working groups such as the **Trent** and **Ouse** Working Groups
- **interactive analysis of phased regional outputs** (e.g. used in option screening) and baseline vulnerability analysis (to provide confidence in pre-modelled characterisation)
- **inter–company and third party collaboration** to support potential regional solutions (at option and EBSD level)
- **EBSD comparative modelling** with regional strategies.

This work helps to show how our dWRMP19 and our own problem characterisation aligns within and reflects the regional water resource strategies, and where the differences occur.

Further, we believe that the collaboration of companies that has been undertaken since WRMP14 in support of the regional modelling agenda, together with the national study, is now moving us closer to a proposition of Regional Coordination in the future. We have been instrumental in promoting collaboration and an extension of the scope of a regional body such as WRSE to include development of regional strategic plans with decision-making authority (see Section 14.7).

14.2 National and regional water resource modelling

The National Water UK Study (2016) covers water companies in England and Wales, which includes Affinity Water. Where companies are located in the more water stressed parts of the country, regional water resource groups exist in order to try to consider how to optimize the sharing of water resources across company boundaries. These regions include the East and South East of England.

We are the only water (or water and sewerage) company with company boundaries that exist within Water Resources in the South East (WRSE), whilst also actively collaborating within the Water Resources in the East (WRE) group. Figure 53 shows the extent and coverage of both regional groups.

The WRSE group comprises six water companies: Affinity Water (Central and Southeast), Portsmouth Water, Southern Water, South East Water, SES Water and Thames Water, working alongside the Environment Agency, Ofwat, the Consumer Council for Water, Natural England, the Department for the Environment, Food and Rural Affairs (Defra), the Canal and River Trust, the Greater London Authority, and other partners.

The WRE group includes Anglian Water, Cambridge Water (South Staffs), Essex and Suffolk Water and Affinity Water (Central and East). WRE is multi-sector, with a range of stakeholders (see Section 14.5 for further information). Severn Trent Water (STW) is a key stakeholder for both regional studies, and within a national context, as the water resources on the River Trent are of crucial importance to any national scale 'cascading' of water to both the East and South East of England.

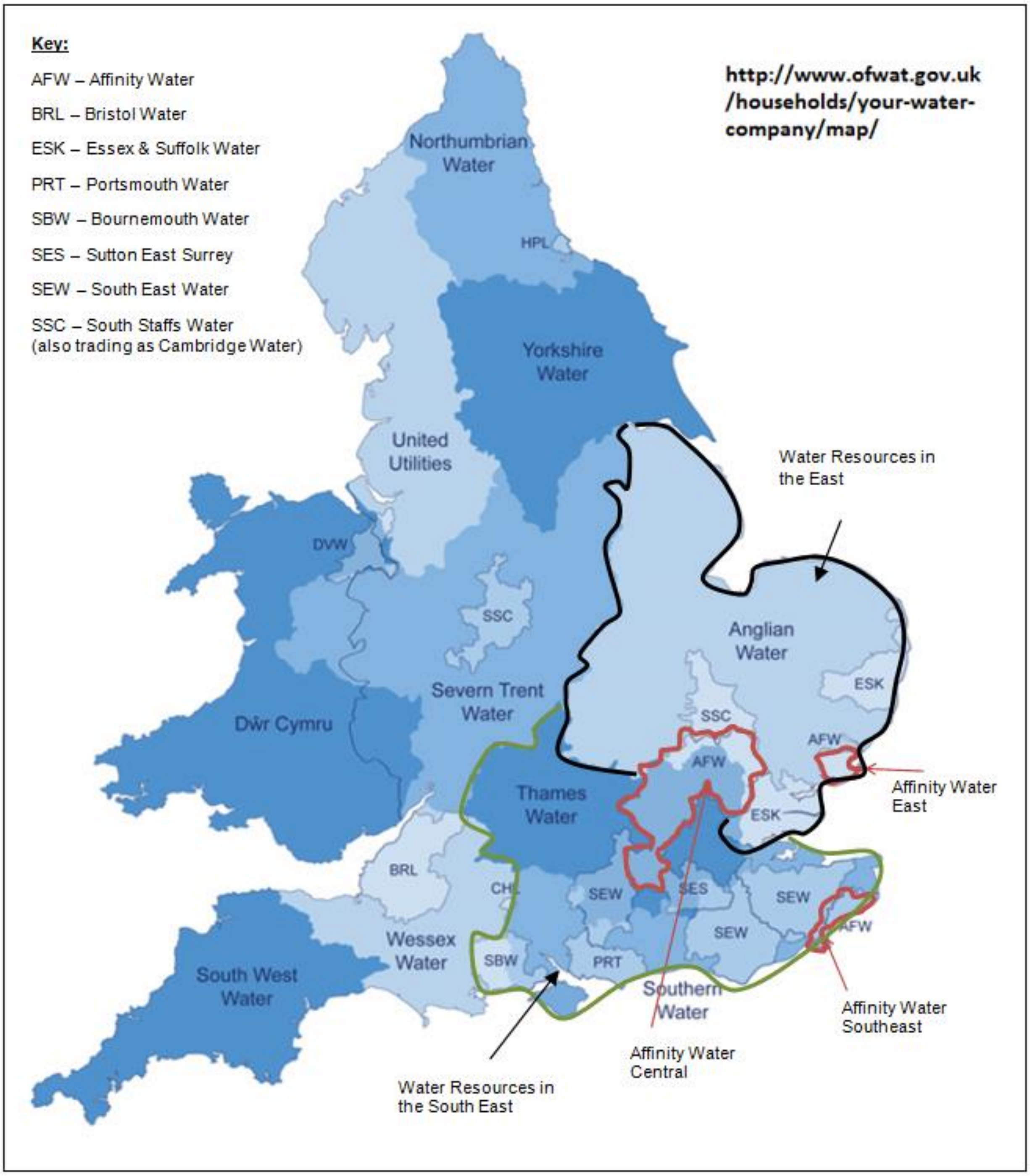

Figure 53: Map of Water Companies in England and Wales (Ofwat.gov.uk, 2017).

There are two technical reports that provide further information regarding our analysis of the three studies (National, WRSE and WRE), they are as follows:

- **Technical Report No 5.1:** National and Regional Modelling Report
- **Technical Report No 5.2:** External Transfers

Within these reports we provide a more detailed audit trail.

14.2.1 Overview of the study

The National Water UK Study (Water UK, 2016) project was established to provide analysis to support a national, strategic and long-term view of water needs across the whole country. The project modelled the resilience of water resources at a national level to explore future risks and uncertainties particularly related to drought severity, along with the potential consequences for the industry, its customers and stakeholders.

Over the last 40 years there have been a number of droughts; further back in time, some of these droughts are thought to have been worse than the basis for current water resource planning (Water UK, 2016).

If a drought were to occur now, and it was more severe than the current level of service planned for, the consequences and impacts for customers would likely be unacceptable. Additionally, droughts in the future may well be different, due to the impacts of climate change. Given the uncertainties with future growth in demand and the likelihood that abstractions will be reduced (for environmental concerns), there are real future pressures on water supply resilience over the long-term.

The National Water UK Study is the first study to look at this picture for public water supply nationally in England and Wales. It took a longer term (50 years) perspective than most current WRMPs. The study undertook new modelling of droughts, assessed climate change impacts and provided conclusions on the national scale resilience of water supplies.

The primary aim of the study was to develop a strategy and framework for the long-term planning of water resources at a national level, and in doing so to assess the long-term water needs and the available options to meet them. The study was not able to cover all details related to water resources planning, thus does not replace company WRMP and also is less detailed than the regional water resources management projects WRSE and WRE.

14.2.2 Overall conclusions

A number of overall conclusions were drawn by the study, not least that there is a significant and growing risk of severe drought impacts arising from climate change, population growth and environmental drivers. The conclusions were:

- that there is a strong case for government to promote a consistent national minimum level of resilience for water resources
- the investment needed to increase resilience is 'modest' compared to the potential costs from drought and flood and therefore there is an economic benefit of increased resilience
- a twin-track approach is required by companies, which includes supply enhancement and transfer (between companies) and demand management, as being the best strategic mix for the future resilience to drought
- there is a strong case for 'adaptive planning' to support company WRMPs, including 'trigger points' at 2040 and 2065 for key investment whilst recognising that some risks will eventuate in investment within the next 25 year planning horizon, depending on the company specific needs
- the study considered the average cost of achieving a national strategy for long term resource development but did not consider the distribution of costs to region or at water company level.

The study provided a first, high level assessment, and points to company WRMPs as the vehicle for verifying the results, and the place where detailed plans that align with customer needs will occur.

The study also points towards WRSE and WRE as the inter-company planning platforms for cross company and multi-sector stakeholder initiatives, where the risks involved and commercial / institutional arrangements can be explored further as part of the alignment with WRMPs.

14.2.3 Conclusions relevant to Affinity Water and broad alignment with the dWRMP19

The report concluded that our area is among five areas in the country where the impacts of reduction in abstraction, in licence reduction to protect the aquatic environment, would be most felt (along with Anglian, Severn Trent, Southern and Thames).

The report also concluded that the modelled demand management savings relied on significant behavioural change and that they were ambitious and potentially risky. This is consistent with our own uncertainty over the potential future savings modelled within our own fWRMP14 and our dWRMP19.

Enhanced demand management options will be needed as part of the strategy. Strategic scale transfers were also highlighted by the report as offering an important solution to the national problem, as part of the wider solution mix. Both option types have been explored in dWRMP19, and enhanced demand management already forms part of our future plans.

In terms of large scale resource development, we did not have any such schemes in fWRMP14 although these were explored as long term feasible options. The options appraisal for the dWRMP19 has shown that these do now feature within our option set, which include large scale inter-company transfers, storage and treatment schemes. That means at national level for Affinity Water, the long term national strategy and direction of travel is based on developing solutions that are provided by large scale cross – boundary transfers potentially between Affinity Water via Thames Water (as UTRD) and / or Affinity Water (and WRE).

14.3 WRSE

14.3.1 Overview of the study and modelling phases

Water Resources in the South East (WRSE) is a sector-wide partnership that, every five years, develops a south-east strategy for water. It was formed in 1996 as a direct result of a recommendation from the Monopolies and Mergers Commission which (in reviewing a proposed merger of two small water companies in Kent) suggested there should be better regional co-operation when it came to sharing water.

Today, it is still going strong, and covers an area of 21,000 km^2 with a population of some 19 million people, and 2 million businesses.

The group uses advanced modelling techniques within a regional water resource model context, to solve supply demand balances across all the companies' water resource zones and thus its purpose is to increase resilience across the southeast – we believe there is an increased role for a group of this type in regional coordination and are pushing the agenda to achieve this (see Section 14.7).

The WRSE planning work helps us to understand which options might be best for the South East in the long-term (such as strategic schemes that are not necessarily justifiable on a single company basis but would be beneficial on a regional scale).

Since fWRMP14, the group has extended its modelling approach to testing resilience, both in terms of modelling supply and demand to beyond worst historic drought severity and testing the resilience of regional portfolios of options to increasing demand, uncertain sustainability reductions, water quality risks and outage, along with and without drought order and permits.

We have been involved with WRSE since its inception, and we carried out similar analysis to that contained within this report, for the fWRMP14 submission.

The following phases of work have taken place, which show how the modelling process is iterative, allowing for output reviews, modifications and additional options to be added.

Table 56: WRSE sequence of modelling and reporting (*taken from Table 3. WRSE, May 2017*)

Date	Rationale	Result	Affinity Water Comment
2015 – early 2016	Data inputs	Data assurance for modelling Phase 1	This phase took place over a number of months at technical level (TSG). Affinity Water provided data inputs
May 2016	Initial Phase 1 results	Phase 1 results	Key observations by Affinity Water included regional transfer option links
September 2016	Agreement on modelling assumptions and scenarios	Modelling authorisation	Affinity Water attendance on TSG and PMB
End September 2016	Phase 2 – First results	Issues with constraints. Opportunities to enhance options.	Key additional Affinity Water options added, uncertain sustainability inputs revised and BVA initial review
October to November 2016	Re-run Phase 2	Identification of vulnerable zones (updated and reported again in December, 2016)	
December 2016	Stress testing Portfolios using Info-Gap	Authorisation	Affinity Water attendance on TSG and PMB
January 2017	Cumulative Effects Assessment (CEA) (Phase 2)	Report (consideration)	Incorporated in SEA
January 2017 to May 2017	Stress testing results and reporting	Summary of results	Affinity Water comments and input at PMB and CEO level
October 2017	Cumulative Effects Assessment (CEA) (Phase 3)	Report (consideration)	Incorporated in SEA (Environmental Report)
September to November 2017	Phase 3: Input data supplied September 2017	Phase 3 Initial results October – November 2017	Affinity Water supplied all their SDB an dWRMP19 options data in full (September 2017)
December 2017 to January 2018	Phase 3 Initial Results	Initial modelling outputs, included within the dWRMP19	Phase 3 results used for dWRMP19 comparisons and analysis
January 2018	Reporting	Public facing document	Input and funding
Post January 2018	Scenario Testing	Outputs may include modelled results – dependant on PMB modelling specifications	Any post draft plan modelling will be included in our analysis for the revised and final plan

In partnership with Natural England, the WRSE has examined the potential cumulative (or in-combination) effects of the options being considered by the member companies for their upcoming draft WRMPs.

This is the first time that a collaborative regional appraisal of the potential for cumulative environmental impacts has been undertaken on a regional scale, by water companies.

The WRSE commissioned the consultancy, Ricardo, to undertake this work. After having developed a robust methodology, Ricardo first looked at the WRMPs produced for the Periodic Review 2014 (Phase 2), and determined that no significant issues had been overlooked.

Then Ricardo used the methodology to scrutinise the feasible options under consideration by the WRSE member companies for their draft WRMP19s.

The assessment found that there is potential for cumulative effects from most WRSE companies, on particular receptors and catchments. The findings included the potential inter-relationships between schemes and the impact pathway. A report of results of Phase 3 plus a narrative of the project to date are due for publication in January 2018.

The integration within our SEA can be found within our SEA Environmental Report (Technical Report 4.11). The group has also been testing the EBSD methodology with a phase of Robust Decision Making (RDM) analysis, this occurred during Phase 2, and had the following objectives:

- Identification of combinations of future uncertainties that can cause the system to fail.
- Comparing the robustness of different investment portfolios to uncertainty.
- Providing a quantitative understanding of vulnerabilities.
- Exploring improved understanding of conjunctive use benefits.

It is important to note that RDM for WRSE was actually a 'hybrid' approach using EBSD, as it was based on the shortlisted portfolios, and ultimately provided limited benefit for the alignment process. Going forward that may change, as the Phase 3 work becomes available to re-test.

The WRSE partners plan to hold a stakeholder event in early 2018 to communicate the regional water resources strategy to interested and influential stakeholders. Alongside which there will be a public facing report available.

14.3.2 WRSE EBSD modelling methodology and Affinity Water alignment

WRSE EBSD methodology

The WRSE approach uses the EBSD least cost optimisation routine, where portfolios of options are produced, one portfolio per scenario, which are a list of schemes or options that result in a sum of costs that are attributed to the overall solution required in order to meet the planning condition (or scenario) from 2019/20 to 2079/80 (60 years).

There have been two phases of the EBSD optimisation modelling work allowing member organisations to continuously inform the group knowledge and better their own understanding. This work was undertaken by CH2M, on behalf of the Group. The WRSE model is populated with the supply demand data, option information and costs. Table 57 shows with what information the WRSE model is populated. The least cost portfolios are then produced by running the model for each different scenario.

Table 57: Information populating the WRSE model

Input Type	Setting
WRZ Level Supply / Demand	Deployable output (DO), Distribution Input (DI), Target headroom including climate change, Outage, Loss from treatment works, and Baseline and uncertain sustainability reductions
Network and Constraints	Existing bulk transfers (without costs to allow free movement of water), Separately modelled source zones, to allow DO (such as the Anglian Import for Affinity), Mutually exclusive, dependent and capacity constraints, Optional source and transfer capacities are allowed; and Demand management options are included as time series projections (water efficiency only in Phase 2 for Affinity, as the WRMP14 savings are netted off the DI)
Cost	Cost information for options is included as annuities for construction, static yearly values for fixed annual operating costs and volumetric costs for water utilised. Costs are given for the financial, environmental and social and carbon costs.

The model solves in two stages, firstly by addressing the deficit and secondly by optimising the cost. Runner up solutions are reported, but were not used in the May 2017 reporting by WRSE.

The Info-Gap stress testing is then applied to a shortlist of portfolios. Info-Gap or Information-Gap Decision Theory (IGDT) quantitatively assess the robustness of various supply side and demand side management options over a broad range of plausible futures. Info-Gap seeks to assist in decision-making under uncertainty, as uncertainty increases over time, so may the possible futures that we face, and ultimately the possible severity of those futures.

Where the portfolios are tested against these possible futures, that testing is referred to as stress testing. The main benefit of the stress testing is to test a given portfolio to increasingly more severe planning conditions, this helps to understand at what point the portfolio fails to solve the more severe conditions. By comparing portfolios we can also understand whether an adaptive approach to long term planning can be taken and where a “least regrets” strategy can be adopted.

Affinity Water alignment with the WRSE EBSD methodology

Earlier (in Chapter 6) we set out our own problem characterisation, and determined that we required an extended EBSD methods approach. In order to use the findings from our dWRMP19 problem characterisation assessment within the national and regional context, we also undertook a brief exercise to align our assessment and findings with the approaches at national and regional level. This included a comparison between the various strategic issues, risks and uncertainties, and our EBSD extended methods modelling approach. This exercise was not undertaken to directly compare the modelled vulnerabilities or results, it is simply to show how our aims and objectives using the EBSD modelling approach (or our technical methods) compared with the three studies.

Table 58 shows the comparison of our approach to EBSD modelling (based on the problem characterisation) with the national and regional studies.

Our decision to use the EBSD extended methods was based on the fact that it is appropriate for our risk profile, which determined that the EBSD approach and Info-Gap analysis methodology is appropriate for the challenges we face at a company level. Our approach is consistent with the WRMP guidelines, and at WRZ level-scale over a planning horizon from 2020-2045 and includes an extension to 2080.

We also chose to develop a modelling approach that was also consistent with WRSE, on the basis that the methodology was appropriate for our own company risks and was consistent with a regional modelling study that also had determined that EBSD extended methods and Info-Gap analysis was appropriate to explore the regional context within which our company boundaries exist. The key advantage is that WRSE is using WRMP level supply demand estimates and options data, the same data that is being used by the companies.

Table 58: Comparison of the Affinity Water approach to EBSD modelling with the national and regional studies.

Modelling study	Key objectives	Key drivers	Modelling approaches	Key outcomes of the study	Affinity Water (key issues from problem characterisation)	Affinity Water modelling approach	Comment on alignment and context
National Water UK Study	A sector wide view of future long term resilience and options for improving resilience (2015 - 2065) Assessment of variation in levels of service, and cost benefits at national, regional and sub-regional level. Identification of potential barriers to trading and identification likely infrastructure for national level planning	Changing climate, increasing demand, pressure to reduce abstraction and risks of droughts beyond the historic record Inconsistent levels of service across companies and regions. The need to understand long term water needs, the costs, impacts and benefits on a national scale.	Stochastic weather generator (for droughts) Conventional demand projections. Perturbation techniques for climate change EBSD for identifying options (least cost).	Assessment of the impacts of the drivers of differing scenarios. Scale of deficits (240 & 2065) across the range of futures. High level portfolios of options and costs Improved understanding of trade-offs (e.g. resilience v. cost). High level strategy to meet resilience.	Future long term changes in demand, supply and drought beyond the worst historic record. Step changes in investment. Uncertainty over reliance on demand management savings.	EBSD extended methods (2020 - 2045 & 2080) for testing changes in demand, supply and drought beyond the worst historic record. At WRZ level in accordance with WRMP guidelines Uses conventional approaches such as outage and headroom.	The scale of the national study means that it is difficult to align accurately, but broadly our EBSD approach can be set within its context and compared with the findings.
Water Resources in the South East	A regional understanding of how resilient water resources are to current and future pressures, risks and uncertainties (2020 - 2080) What are the most strategic influences to ensure future resilience, and the implications of moving to alternative solutions. What are the strategic options for ensuring resilience? What are the likely 'best value' solutions for resilience?	Drought impacts on supply; uncertainty over sustainability reductions; water quality impacts and likelihood and impact of storm and flood hazard events. Changes in future demand.	EBSD extended methods and info-gap analysis. Incorporates company supplied estimates of supply demand balances and climate change impacts. Uses existing company network settings and constraints.	Assessment of the long term trends on water security for the South East and guidance of long term investment in infrastructure. The outcomes include the following: An assessment of regional supply-demand deficits at WRZ level and transfer connectivity. An indication of which options are selected as common options in portfolios. The scale of investment to alleviate long term deficits. An indication of the most resilient solutions.			Alignment between the two modelling approaches and use of company level options means the two approaches are compatible.
Water Resources in the East	To provide a framework for collaboration and shared decision making. To deliver a resource strategy to meet threat from growth and climate change. To provide a reliable, affordable supply of water to all sectors which are resilient to drought. To protect and enhance the environment and develop a strategy that supports Government policy (Water for Life'.	Investment in the future and its spatial and temporal distribution. Climate change, population growth. Supply demand risks. Uncertainty over future scenarios and how the trade-offs are met. Multi-sector opportunities and efficiencies .	A regional system simulation model of the WRE water resources system used to support multi-criteria searches and Robust Decision Making (RDM).	The study aims to be able to answer the following: What is the full range of climate and growth impacts available? How resilient are existing water supplies? How much supply demand risk can be mitigated by more effective investment, water trading and demand strategies? What is the effect of multi-season droughts, in-combination with environmental impacts? What levels of service will be acceptable to customers in the future? What are the supply and demand side options available, and how should the mix look? and What are the opportunities and efficiencies that arise from multi sector collaboration?			The use of full stochastic methods in WRE and the use of modelled options above a threshold mean that it is more difficult to align with this study at this point in WRMP. The regional simulator modelling is not compatible with EBSD and is not at WRZ level. The stochastic approach is not entirely consistent with the Affinity Water risk profile as set out in our problem characterisation.

14.3.3 Aligning our EBSD modelling with WRSE Phase 2 and Phase 3

WRSE Phase 2 scenarios and Affinity Water alignment

This phase incorporated over 1000 potential options into the EBSD optimisation model from all member water companies, covering demand management, resource developments and transfer schemes to allow the model to select from a very wide range of choices.

The purpose of this phase of modelling was to take a broad, extensive examination of all the options that have been outlined or defined but not yet implemented, taking a ‘blank sheet’ approach, to see what might be useful to meeting future water demand.

Twelve different possible future scenarios were scrutinised, based on different combinations of the key influencing factors. Each scenario would require a different amount of water in the future, and the EBSD optimisation model created a portfolio of options that together would meet the demand.

Figure 54 provides a screenshot of the scenarios that WRSE modelled during Phase 2, and also provides the rationale for selecting these scenarios.

Each scenario includes a letter to indicate the inclusion of uncertain sustainability reductions and the availability of drought measures, as follows:

- **A** does not include uncertain sustainability reductions and includes drought measures.
- **B** includes uncertain sustainability reductions and drought measures.
- **C** includes uncertain sustainability reductions and does not include drought measures.
- **D** does not include uncertain sustainability reductions and drought measures.

The drought measures for Affinity Water are the same drought orders and permits as those put forward in the draft Drought Plan (2017).

Scenario ID	Set	Model of Outcome	Uncertain SR and Drought Permit and Other Groupings	Rationale for Scenario	Change made if a derivative scenario	DI	Drought	Uncertain SR	Permits and Orders	WQ Impace	Stress test Portfolios
Set 1 - A1	1	Succeeded	A - Without Uncertain SR, With Permits and Orders	The WRMP 2014 baseline forecasted situation	n/a	Medium	Worst	No	Yes	No	P1
Set 1 - A2	1	Demand failures at 2075 in 2 zones	A - Without Uncertain SR, With Permits and Orders	Tests the influence of a Severe drought and High DI to identify any vulnerables.	n/a	High	Severe	No	Yes	Half	
Set 2 - A3	2	Succeeded	A- Without Uncertain SR, With Permits and Orders	New scenario to test High DI and Worst Drought	New scenario to test High DI and Worst Drought	High	Worst	No	Yes	No	
Set 2 - A4	2	Succeeded	A- Without Uncertain SR, With Permits and Orders	New scenario to test Medium DI and Extreme Drought	New scenario to test Medium DI and Extreme Drought	Medium	Extreme	No	Yes	Full	
Set 1 - B1	1	Succeeded	B - With Uncertain SR, With Permits and Orders	Test the influence of Uncertain SR	n/a	Medium	Worst	Full	Yes	No	
Set 1 - B1 -Var	1	Succeeded	Group 5 but a variant simiar to Group C as it is without Permits and Orders	Tests the influence of a Severe Drought and High DI with Uncertain SR without drought permits and orders	n/a	Medium	Worst	Full	No	No	P2
Set 1- B2	1	Succeeded	B - With Uncertain SR, With Permits and Orders	Test the influence of a Severe Drought and High DI with Uncertain SR	n/a	High	Severe	Full	Yes	Half	
Set 1 - B3	1	Demand failures in 7 zones; 3 starting in 2055, 1 in 2060, 1 in 2065 and 2 in 2070	B - With Uncertain SR, With Permits and Orders	The most extreme scenario. Tests the influence of an Extrmeme Drought and high DI with Uncertain SR	n/a	High	Extreme	Full	Yes	Full	P3
Set 1 - B4	1	Demand failures in 2070 in 2 zones	B - With Uncertain SR, With Permits and Orders	Tests the influence of an Extreme Drought and Medium DI with Uncertain SR	n/a	Medium	Extreme	Full	Yes	Full	
Set 1- C1	1	Demand failures in 9 zones; 1 starting in 2050, 1 in 2055, 1 in 2060, 3 in 2070, 2 in 2075 and London from 2015 to 2020 and then again starting in 2065	C - With uncertain SR, Without Permits and Orders	Test the influence of a Severe Drought and High DI with Uncertain SR without drought permits and orders	n/a	High	Severe	Full	No	Half	
Set 1 - D1	1	Demand dailures in 7 zones; 3 starting in 2055, 1 in 2060, 1 in 2065 and 2 in 2070	D - Without Uncertain SR, Without Permits and Orders	Test the influence of a Severe drought and High DI without drought permits and orders	n/a	High	Severe	No	No	Half	
Set 1 - D1 - Var	1	Demand failures in 8 zones; 1 starting in 2055, 1 in 2060, 1 in 2065, 4 in 2075 and London from 2015 to 2020 and then again starting in 2070	D - Without uncertain SR, Without Permits and Orders	Test the influence of a Severe drought and high DI without drought permits and orders	n/a	Medium	Worst	No	No	No	P4

Figure 54: WRSE Phase 2 scenarios (taken from WRSE, May 2017).

Alignment on WRSE phase 2 input data and options

Phase 2 included fWRMP14 company data, and was therefore consistent with our own data ahead of revisions for the draft WRMP19, at which point the supply demand balance and option data has changed.

This meant that we were able to use the outputs from Phase 2 to help guide us in our option development in an iterative manner. For example with inter-company transfer schemes we were able to model them in Phase 2 in order to see if they were selected (as they were de-selected at WRMP14 because the agreements were not in place to continue modelling them). The Phase 2 work also helped us to understand potential zonal vulnerabilities, and we were able to include options to explore potential 'pinch points' between zones.

However, it is worth noting the main changes between the two data sets, which have been aligned for Phase 3. These are key differences relating to input model data and worth keeping in mind when interoperating any Phase 2 analyses, and are as follows:

- changes to our DO, as our estimate of worst historic DO is now lower than it was at fWRMP14
- our DI now incorporates the latest planning estimates of forecast growth, which are different to those used at fWRMP14.
- WINEP 2 estimates of sustainability reductions are now using updated estimates of planned, indicative and unconfirmed figures which are different to those used in Phase 2
- our dWRMP19 options are different to those offered to WRSE previously, because of the options appraisal and screening process which derived a new set of options. Further, the option costs for both the new options and those that are the same have been updated and re-based to 2017/18 to remain in line with the business plan cost.

For dWRMP19 we have provided a full set of new or updated demand management options. For Phase 2 the fWRMP14 savings are built into the baseline, and apart from water efficiency there were no new Affinity demand management options available.

Most of our existing bulk supply agreements have largely remained the same and the options that we modelled have remained the same. The notable differences are where we have progressed collaboration with neighbouring companies since Phase 2, such as reducing our ANGL take which we share with Anglian Water and our export from Egham to South East Water. These discussions have been ongoing and will need to be incorporated into Phase 3 once we have been able to conclude the discussions satisfactorily.

Where key parameters and modelling constraints are different, we have identified these differences and are able to say that in Phase 3 we will be able to compare scenarios more directly (see the next Section 14.4.3.3 for further detail).

WRSE Phase 2 scenario alignment

In Phase 2 WRSE shortlisted four portfolios for stress testing, these were Set1-A1 (the WRMP14 'base case'), Set1-B1 (mid case with uncertain sustainability reductions as a variant without drought measures), Set1-B3 (an extreme case) and Set1-D1 (mid case without sustainability reductions).

Table 59 shows how our dWRMP19 **PP** scenario compares to each of the four shortlisted scenarios.

Table 59: dWRMP19 Preferred Plan scenario comparison to shortlisted scenarios

Scenario	DI	Drought	Uncertain SRs	Drought measures	WQ Impact	Comment
dWRMP19 Preferred Scenario	Medium	Worst	No	No	No	This is SU-46 and does not have drought measures. Planned SRs are included.
Set1A1	Medium	Worst	No	Yes	No	Our SU-0 is equivalent, but we do not include drought measures in our preferred plan. The planned SRs will be different.
Set1-B1-v	Medium	Worst	Full	No	No	Our equivalent is SU-60
Set1-B3	High	Extreme	Full	Yes	Full	Our equivalent is SU-132
Set1-D1-v	Medium	Worst	No	No	No	This case is equivalent and most closely resembles SU-46

Though the input data in Phase 2 is different to our dWRMP19 data and our preferred planning scenario, there is good alignment between the planning conditions with Set1-A1 and Set1-D1-v. We have also provided the reference to the equivalent scenarios that we do have model results for as outputs from our EBSD model.

Comparisons and discussion on WRSE phase 2 results for Affinity Water

As explained above, this is an iterative process as we move towards our final plan, but here we can provide some comparative assessment that provides important information related to the direction of travel of our WRMP to date within the regional context.

Table 60 provides a simple comparison of our dWRMP19 with the Phase 2 Set1-A1 scenario.

Table 60: Comparison of our dWRMP19 with the Phase 2 Set1-A1 scenario.

Option type	dWRMP19 Preferred Plan	Set1-A1 (WRMP14 Base Case)	Comment on timing of options
Demand Management	8 options: 4 x 6 zones 2 x 2 zones 1 x 4 zones 1 x 7 zones	Inclusive of WRMP14 demand management savings in baseline DI	New demand management options in dWRMP19 in AMP7 & AMP8. These are additional to the baseline
Groundwater	10	12	7 groundwater options in dWRMP19 in AMP7. In Set1-A1 these are generally later presumably because of the drought permits availability
Network Constraint Removals	1	2	All are in WRZ7 and occur post 2045
Company transfers (inta-company)	1	0	These generally relate to new imports where links are required to move water between WRZs and are post 2045
Inter-company transfers	5	10	Includes extensions of existing agreements. Where new transfers occur they are post 2045
Surface water schemes	1	1	Post 2045
ASR	0	1	2075 and 2060 respectively
Effluent re-use, desalination	0	0	

For both Set1-A1 and Set1-D1-v water efficiency options are selected but these offer only a small benefit.

Scenario **Set 1-A1** observations:

- 10 external transfers are selected, 5 of which are new Thames Water transfers, an increase in import from Anglian water is selected but at 2065. If ignoring existing options and drought permits, the earliest utilisation of options is at 2050 with three groundwater options and one Thames Water transfer;
- 12 groundwater options groundwater options are selected along with one surface water scheme.

The difference between the need for external transfers between the two sets of results relates to the fact some of the WRMP14 options are now not feasible, and that the need for imports are reduced to fewer feasible options. Further, with demand management options available for the dWRMP19 there is less need for imports. Table 61 provides a comparison between the two sets of results by WRZ.

Table 61: Comparison between dWRMP19 and Set1-A1 (Phase 2)

Water Resource Zone	Comparison between dWRMP19 and Set1-A1 (Phase 2)
1	**Set1-A1:** Groundwater and Water Efficiency, and drought permit **dWRMP19 Preferred Plan**: Metering and Leakage, and bulk transfers
2	**Set1-A1:** ASR and Water Efficiency, and drought permit **dWRMP19 Preferred Plan**: Metering and Leakage, and Groundwater
3	**Set1-A1:** Groundwater and Water Efficiency, bulk transfers and drought permit **dWRMP19 Preferred Plan**: Metering and Leakage, and Groundwater
4	**Set1-A1:** Water Efficiency and bulk transfers **dWRMP19 Preferred Plan**: Metering and Leakage, Groundwater, surface water and bulk transfers
5	**Set1-A1:** Groundwater and Water Efficiency, bulk transfers and drought permit **dWRMP19 Preferred Plan**: Metering and Leakage, and Groundwater
6	**Set1-A1:** Groundwater and Water Efficiency, surface water and bulk transfers **dWRMP19 Preferred Plan**: Metering and Leakage, Groundwater, and bulk transfers
7	**Set1-A1:** Groundwater and Water Efficiency, and network constraint removal **dWRMP19 Preferred Plan**: Metering and Leakage, Groundwater, network constraint removal

Generally though there is a good degree of consistency between the two sets of results; the reduced DO available in the new worst historic DO is probably offset by the availability of drought measures in Set1-A1 (which are not available in dWRMP19 and therefore can result in a different portfolio of options). ASR was deemed less viable than at WRMP14 in our feasible least, and though remains available at dWRMP19 only one scheme is selected very late on. It can be seen that a similar mix of option types are selected in both our own modelling and the regional modelling across our WRZs.

We recognise the WRSE Phase 2 shortcomings related to differences between input data with our dWRMP19 option set, however we did feel it was important to present some comparisons with Phase 2 in order to show how, due the iterative nature of the work, our understanding of our **PP** within a regional context has developed alongside our draft plan submission.

WRSE phase 3 scenarios and Affinity Water alignment

After the completion of Phase 2, further modelling was undertaken to take advantage of datasets that had been updated, such as population forecasts and potential Sustainability Reductions or Changes. For Phase 3, the options were also updated, in line with those which have been screened as feasible by each water company, and which were being considered for inclusion in the dWRMP19. Further, new options or schemes that had been developed for dWRMP19 by the water companies were also incorporated.

Phase 3 modelling was performed on a new set of scenarios to see what groups of options were the best choices to satisfy the deficit, and to test their resilience. The scenarios are based on a medium population forecast and incorporate known sustainability changes, but differ according to the severity of the droughts (severe or extreme) and whether sustainability changes have been included. One scenario explored a situation that met demanding regional targets for the reduction of leakage by 15% by 2025 and a reduction in water consumption to 110 litres per person per day by 2050. The other scenarios examined future situations using existing plans for reducing leakage and per capita consumption.

The outputs of this modelling phase have been used to set a strategy for the WRSE area, based around the central planning scenario where there is medium population growth in the south east, drought becoming severe in nature, and where water companies are not permitted to abstract more water from the environment during drought episodes.

For Phase 3 we have therefore been able to move closer to comparative scenario generation in the shortlisted WRSE Phase 3 scenarios, with our own EBSD modelling. Table 62 shows nine of the scenarios proposed for EBSD modelling (WRSE draft results, November 2017).

Phase 3 model output runs were made available on 17 November 2017 (with a further update in December 2017 / January 2018) so there has been very little opportunity to compare outcomes. However, the following is a list of the WRSE Phase 3 scenarios that are either directly comparable or very close to being comparable to the preferred and alternative dWRMP19 scenarios:

- The dWRMP19 **PP** is directly comparable to WRSE Phase 3 **Scenario 3**, with the exception that our worst historic DO is between a 1 in 60 to 1 in 80 year event as opposed to a 1 in 100 year DO; and
- WRSE **Scenario 2** also offers some compatibility with the 1 in 200 year **AP**, where in **Scenario 2** drought options are available, as they are in in our **AP** (but in the **AP** they are only available at the start in order to meet early year deficits), whereas in **Scenario 6** drought permits and orders are not available.

For Phase 3 therefore we present a comparison of our dWRMP19 **PP** to Scenario 3, and our alternative 1 in 200 plan 2 to WRSE Scenario 6.

For Phase 3 we present a comparison of our dWRMP19 **PP** to Scenario 3. It is also worth noting that **Scenario 4** is similar to Scenario 3, excepting that the demand side drought measures are not available.

Table 62: Nine WRSE Phase 3 scenarios proposed for EBSD modelling (Nov, 2017).

Number	SDB Tag	Scenario	2079-80 SDB	Scenario description	DI	Drought	Uncertain SR	Permits and Orders	Regional Targets met
41	M-RT-200	Scenario 1	-888.48	Medium DI, 1:200 drought and regional targets for PCC (110 by 2050) and Leakage (15% reduction by 2025) met - No Drought actions (demand or supply side)	Medium	Severe	No	No	Yes
29	M-200DP O	Scenario 2	-1310.38	Medium DI, 1:200 drought - all Drought actions (drought demand and supply side permits and orders)	Medium	Severe	No	Yes	No
145	M-100-DR	Scenario 3	-1576.57	Medium DI: 1:100 drought- only drought demand side reudctions for all except Thames	Medium	Worst	No	Only demand reductions	No
1	M-100	Scenario 4	-1756.00	Medium DI, 1: 100 drought - no Drought actions (demand or supply side)	Medium	Worst	No	No	No
55	M-500-DPO-SR	Scenario 5	-1906.29	Medium DI, 1: 500 drought, with Uncertain SR- All Drought actions (drought demand reductions and supply side permits and orders)	Medium	Extreme	Yes	Yes	No
25	M-200	Scenario 6	-2009.05	Medium DI , 1: 200 Drought- No Drought actions (demand or supply side)	Medium	Severe	No	No	No
27	M-200-SR	Scenario 7	-2342.51	Medium DI, 1: 200 drought, with uncertain SR - no Drought actions (demand or supply side)	Medium	Severe	Yes	No	No
51	M-500-SR	Scenario 8	-2604.96	Medium DI, 1: 500 drought , with uncertain SR- No Drought actions (demand or supply side)	Medium	Extreme	Yes	No	No
146	M-200-DR	Scenario 9	-1829.62	Medium DI, 1: 200 drought - only drought demand side reductions for all except Thames	Medium	Severe	No	Only demand reductions	No

WRSE Phase 3 portfolio comparisons (November, 2017)

Table 63 provides a comparison of our **PP**and **AP** solutions with each of the relevant Phase 3 scenarios. It should be noted that these are initial results, which are subject to change.

Table 63: Comparison of our Preferred Plan solutions with WRSE Phase 3 Scenario 3 (November, 2017)

Option type	dWRMP19 Preferred Plan (worst historic DO)	WRSE Phase 3 Scenario 3 (1 in 100 Year DO)	Scenario 3 Comment
Demand Management	7 (x 6 zones) As updated per Table 60.	3 (x6 zones) 2 (x7 zones)	Option 1007 Enhanced SP free repair policy. No FNM, and TM Leakage post 2060
Groundwater	10	3	In WRZ7 & WRZ2 post 2030. Only 1 GW option in AWC
Network Constraint Removals	1	1	
Company transfers	1	0	
Inter-company transfers	5	4	Continuation of WRZ7 bulk transfers and new import from UTRD at 2065
Surface water schemes	1	0	
Aquifer Storage Recharge (ASR)	0	0	
Effluent re-use, desalination	0	0	

For the **PP** comparison with the WRSE Phase 3 **Scenario 3** we have noted the following:

- the general mix of schemes are demand management, groundwater and transfers which are consistent with our own dWRMP19 and WRSE Phase 3, though groundwater are not utilised as much and are later than in our **PP**
- the number of demand management proposed is similar to our **PP**, though there are differences between the types of options selected and the timing. In Phase 3 fixed network metering is not selected, and Trunk Mains Leakage is selected late on (as oppose to AMP7 in our **PP**)
- one new large scale import is selected in 2065, a new River Thames abstraction that transfers water to WRZ1. No other post 2045 large scale infrastructure is selected. The Egham reduction scheme is selected
- most of the options selected are for five or more of the nine selected portfolios, indicating that a core group of options are emerging, that are selected across many of the WRSE Phase 3 scenarios.

It was observed that in **Scenario 4** new imports from the River Thames to WRZ4 were selected in 2045, along with onward movement to WRZ1.

For the regional targets, the following provides a brief summary of our initial observations:

- All demand management options are assumed to have been delivered in order to meet the regional targets, for Affinity Water there remains a gap to achieving the targets.

Further work will be undertaken to understand the Phase 3 supply demand balances. To support our revised and final plans it will be feasible to compare our own EBSD sensitivity work to the WRSE scenarios with aspirational regional targets, and some of the more extreme scenarios.

WRSE Phase 3 Portfolio Comparisons (December / January, 2018)

Subsequent to our initial analysis, based on the WRSE Phase 3 outputs provided in November (2017), further results were provided to companies, in December (2017).

Table 64 provides a comparison of our **PP** with Phase 3 Scenario 3 and Scenario 6. It should be noted that these are also initial results, and therefore subject to change.

Table 64: Comparison of our PP solutions with Phase 3 Scenario 3 and Scenario 6 (December 2017 / January 2018)

Option type	dWRMP19 Preferred Plan (worst historic DO)	WRSE Phase 3 Scenario 3 (1 in 100 Year DO)	Scenario 3 Comment	WRSE Phase 3 Scenario 6 (1 in 200 Year DO)	Scenario 6 Comment	WRSE Phase 3 Scenario 9 (1 in 200 Year DO)	Scenario 9 Comment
Demand Management	7 (x 6 zones) As updated per Table 60.	59 (14 options over 7 zones)	ALC options are selected from 2050, WEFF options 2065 (airports) but all other LEA & MET options from 2020 onwards.	93 (21 options over 7 zones)	Three options selected in 2055, 2065 and 2075. The remaining 90 are all selected in 2020 or 2025.	86 (21 options over 7 zones)	Majority of 86 selected in first two AMPs. Four options selected post 2050.
Groundwater	10	14	One scheme (0120) selected in 2025, the rest are post 2035.	16	Four options selected in 2025, the rest post 2035.	14	Three options selected in 2030, all in WRZ7.
Network Constraint Removals	1	1	Only in WRZ7	1	Only in WRZ7	1	Only in WRZ7
Company transfers	1	1	Involves moving water around internally within AFF supply area.	1	Involves moving water around internally within AFF supply	0	Involves moving water around internally within AFF supply area.

Option type	dWRMP19 Preferred Plan (worst historic DO)	WRSE Phase 3 Scenario 3 (1 in 100 Year DO)	Scenario 3 Comment	WRSE Phase 3 Scenario 6 (1 in 200 Year DO)	Scenario 6 Comment	WRSE Phase 3 Scenario 9 (1 in 200 Year DO)	Scenario 9 Comment
					area.		
Inter-company transfers	5	7	Involve transfers with neighbouring water companies.	9	Involve transfers with neighbouring water companies.	8	Involve transfers with neighbouring water companies.
Surface water schemes	1	1	One reservoir scheme, selected in 2075.	0	-	0	-
ASR	0	0	-	0	-	0	
Effluent re-use, desalination, treatment works	0	0	-	1	New treatment works for WRZ3 selected for 2050.	1	New treatment works for WRZ3 selected for 2075-

For the **PP** latest comparison with WRSE Phase 3 **Scenario 3**, **Scenario 6 and Scenario 9** we have noted the following:

- In the latest WRSE Phase 3 results, WEFF and PRV options are included, which is why there are more demand management options in WRSE Phase 3
- There are more groundwater options selected in WRSE Phase 3, though most are later than in our **PP**

With regard to the selection of large scale imports over the course of the planning horizon, linked to UTRD, our latest understanding suggests that the earliest start date for this type of option remains in the 2040s, and that this type of option is selected in both Scenario 3 and Scenario 6 (and Scenario 9) in the latest WRSE Phase 3 modelling results.

In our **AP** the earliest start date for large scale imports is 2039, which remains broadly consistent with the timing in the regional modelling results.

In order to compare our **AP** with WRSE Phase 3, we have compared it to WRSE Phase 3 Scenario 6, as for most of the planning horizon in our **AP** supply side drought measures are not available. Table 65 provides a comparison of our AP with Phase 3 Scenario 6. It should be noted however that demand side savings are included, which they are not in Scenario 6.

Table 65: Comparison of our AP solutions with Phase 3 Scenario 6 (December 2017 / January 2018)

Option type	dWRMP19 Alternative Plan (1 in 200 Year DO with supply side drought measures only available for AMP7)	WRSE Phase 3 Scenario 6 (1 in 200 Year DO without supply or demand side drought measures)	Scenario 6 Comment
Demand Management	94 options over 7 zones	93 (21 options over 7 zones)	Three options selected in 2055, 2065 and 2075. The remaining 90 are all selected in 2020 or 2025.
Groundwater	19	16	Four options selected in 2025, all others post 2035.
Network Constraint Removals	1	1	Only in WRZ7
Company transfers	0	1	Involves moving water around internally within AFF supply area.
Inter-company transfers	4	9	Involve transfers with neighbouring water companies.
Surface water schemes	2	0	-
ASR	0	0	-
Effluent re-use, desalination, treatment works	1	1	New treatment works for WRZ3 selected for 2050.

The following key observations summarises the **AP** comparison with WRSE Phase 3:

- There generally remains good alignment between the two sets of options, though in Scenario 6 there appears to be more demand management options and they are selected earlier (in AMP7) than in our **AP**, this might be due to the removal of demand side savings which results in the selection of the only options that can be modelled without long lead in times
- There are more groundwater and surface water options in our **AP**, but less inter-company transfers than in Scenario 6.

Alignment between WRSE phase 3 and company dWRMPs

Our current understanding is that several companies in the South East have also supplied long term needs that are linked to a regional solution sourced by a UTRD source of water. It is expected that the strategy will become clearer over the course of the current WRMP, however Figure 55 provides a schematic representation of what that strategy might look like between 2045 and 2080.

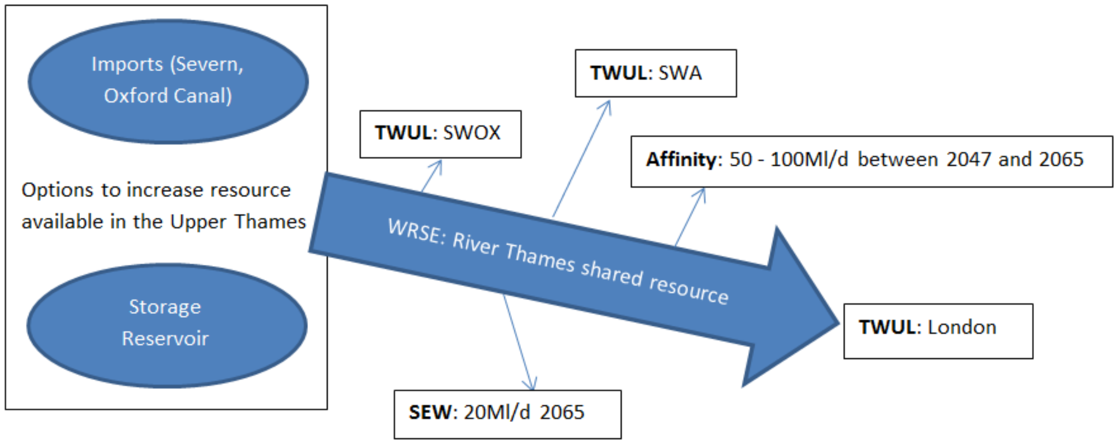

Figure 55: Upper Thames Resource Development (UTRD): Potential benefits, timing and needs

Figure 55 is not an indication of Phase 3 results, but is indicative of the potential needs which could develop into a long term strategy.

14.3.4 WRSE Phase 2 and Phase 3 Summary and next steps

The Phase 2 and Phase 3 results have helped us to understand the similarity of our dWRMP19, which focuses on addressing water requirements of our area and customers, against a regional perspective.

In our water resource planning work, we have considered similar scenarios to those of the WRSE, over the same timeframe. Our future water deficits align to those of the regional approach of our WRZ's.

In Phase 2, there is a notable difference between the data sets being used for dWRMP19 and Phase 2. However, it can be seen for WRSE Phase 2 that the resultant option lists are very similar to those in our dWRMP19 **PP**, when adjusting for the new worst historic DO and the inclusion of supply side drought measures.

Generally in Phase 2 the mix of option types being selected, across the WRZs and their timing is comparable, though for demand management options (which were not available in Phase 2) there are differences. In our dWRMP19 **PP** we plan to implement these in AMP 7 and AMP8, alongside a number of groundwater options, in Set1-A1 these are chosen later (presumably due to the availability of supply side drought measures).

For Phase 3, we have identified reasonable alignment between the following and our own modelling:

- The different types of options being selected in our **PP** and WRSE Phase 2 and Phase 3 (demand management, groundwater and transfers)
- The continuation of current bulk supply agreements (e.g. WRZ7)
- There is good alignment between the timing of the different option types, with demand management and groundwater options being selected first, then longer term strategic infrastructure later (post 2040)
- Of particular note is the fact that new imports linked to UTRD are selected between 2040 and 2080 in various scenarios, which are also selected in our **PP**

We have examined the differences between the Phase 3 work and our own work, and why the WRSE model has selected some of the options in our **PP**, and some not, as our modelling is based on similar conditions to WRSE. We note that our **PP** is different from WRSE in the following aspects:

- There are discrepancies between the scale of groundwater being selected in our **PP** and Phase 3.
- Some of the demand management options (such as FNM) are not selected in Phase 3, and the 'Street level PHC' option has not been included.
- The timing of the UTRD related imports for Affinity Water appears to be a little later than in our **PP**.
- In some scenarios no other large scale infrastructure schemes are selected in Phase 3, which suggests that there may be an over-reliance on the savings from the demand management options.

There are a number of possible reasons why our plan may differ from the WRSE regional perspective, these are briefly listed as follows:

- There is a difference between our worst historic DO, and the worst historic DO being used in WRSE. Our modelling uses 1 in 60 to 1 in 80 DO, whereas the WRSE modelling uses a 1 in 100 DO.
- WRSE Phase 3 applies a 7.7% demand reduction at DYAA (for TUBs) based on a regional average. Whereas our modelling applies a 3% demand reduction to each of our WRZs.

Nevertheless, we will continue to explore the regional results relevant to our supply area to ensure we consider all available data and evidence to inform our work going forward. This work may include further modelling iterations, which can include additional options (e.g. 'Fast Data Option', or other option interventions), along with the application of direct constraints, to enable further improvements in comparative analysis to take place.

We will also like to understand what the results mean for the other companies, and we may want to compare our stress testing with that of WRSE. This should be achievable, along with any further model runs that the EA would like, within the consultation period, to allow for a more complete alignment prior to final plan.

We feel at this stage the comparisons to date indicate that we are broadly aligned with the results that have been issued by WRSE to date, and can be adjusted once our own dWRMP19 consultation has concluded and the Phase 3 results have been better understood and the WRSE strategy reported.

Our dWRMP19 **PP** therefore allows for enough scope to be able to progress with some of the necessary long term needs that might ensue from the need for a regional multi company solution in a timely manner.

14.4 WRE

14.4.1 Overview of the Study

The WRE vision is to provide an integrated long-term water resource strategy, prepared through multi-sector collaboration and planning, that takes account of the needs of all of those in the WRE region with an interest in the management and use of water (WRE Revised DRD, March 2017). WRE's overall aim is to deliver a reliable, sustainable and affordable system of water supply to meet multi-sector requirements (including the environment) across the East of England for the next 50 years and beyond towards the end of the century. Within this overall aim, the objectives for the WRE project are to:

- provide a framework for collaboration and shared decision-making by stakeholders from across key sectors (water companies, agriculture, energy and environment) together with regulators (e.g. Environment Agency, Natural England)
- deliver a water resource strategy to meet unprecedented threats from growth and climate change. The challenge is to provide reliable, affordable supplies of water from sustainable sources which are resilient to the effects of severe drought
- to protect and enhance the environment beyond statutory requirements such as the Habitat Regulations and the Water Framework Directive to provide where possible a net gain in biodiversity
- develop a strategy that supports the policy objectives of government described in the water white paper "water for life"; in particular, supporting economic growth while simultaneously protecting the environment.

We have collaborated as a member of the group and contributed regularly through the Technical, Delivery and Leadership groups to ensure the best possible outcome of the Study.

We have also attended two sub–groups, as they relate to the regional and national supply of new water, 1) The Trent Working Group, and 2) The Ouse Working Group. These working groups facilitated important discussions regarding options and water resource studies undertaken by relevant companies on areas of interest that don't immediately fall within the remit of WRE, such as the feasibility of additional abstraction from catchment outside of WRE (on the River Trent).

14.4.2 The Simulator, Baseline Vulnerability and Portfolio Selection

The development of a regional simulator has been central to the implementation of WRE. A model has been developed (in Pywr) that simulates the key supplies of water and demands for water based on the system configured to start at the end of AMP7 (i.e. 2025). The simulator will have the ability to turn on interventions (e.g. demand interventions, new supplies and transfers).The purpose of the simulator is to help inform the decision making process. It is the means of assessing the vulnerability of the 'current' system (at the end of AMP7), initially testing whether the AMP7 system will perform adequately for a range of future scenarios. It has then been used to identify and short-list portfolios of interventions and for the stress testing of these candidate portfolios.

The regional simulator is used to identify a set of portfolios which (1) meet the constraint thresholds of the searched metrics and (2) performs well across a range of the potential scenarios, a process referred to as a Multi-criteria Search (MCS).

Thousands of candidate portfolios will be assessed in this process. Each portfolio identified by the MCS will be efficient/Pareto-optimal when tested against a suite of metrics. The 'efficiency' of the solutions means that for each solution identified, improvement in the performance of one metric must result in the degradation of one or more of the other metrics. Recording performance in this way allows potential trade-offs to be defined supporting shared decision making.

It is important to firstly note that this approach is very different to EBSD, in the following ways:

- An important innovation in the WRE modelling is that groundwater abstraction for PWS and its impact on rivers is calculated as part of the simulation, and not just using a single non-variable input value as in other regional Water Resource models;
- WRE does not use WRZ based Supply Demand Balance calculations, the model is dynamic where there is a relationship between recharge, groundwater storage, and groundwater abstractions. Recharge, evaporation and abstractions are linked to each climate sequence being simulated, and the base flow component to rivers is simulated by a statistical relationship between recharge and storage, which has been derived from comparisons with relevant Modflow outputs;
- Availability of water is then linked to MRFs (minimum requirement of flow) on watercourses, and where there are minimum MRFs they will constrain the availability of groundwater for PWS; and
- Options below a threshold (c.10Ml/d) are not supplied by the companies or sectors, but are 'generated' to meet demand, these therefore do not compare with the options in dWRMP19 in type or scale.

We note that the point on minimum requirement of flow is inconsistent with evidence from our NEP study programme which indicates MRFs are inadequate surrogates for environmental inputs. Also, that the regional strategy being written is not contiguous with the modelling.

Understanding how the dynamic modelling and the resultant availability of water impacts on candidate portfolios and a potential strategy has underpinned our technical work in WRE. That work was not concluded ahead of this draft plan.

For the above reasons it has initially been difficult to compare our dWRMP19 with the WRE regional modelling and to select candidate portfolios. On that basis, at this time, we have elected not to include a fuller comparison in our dWRMP19, though Technical Report 5.1 does provide a more detailed exploration of the collaborative work that we undertook as part of WRE.

14.4.3 The work ahead and next steps

We support the aims and objectives of WRE, and look forward to further collaborative involvement in the future. The project is attempting to address water resource planning issues in a new and innovative way, and we aim to support that work appropriately going forward.

For example, our understanding of the initial modelling suggests that future demand could lead to increased discharges in certain catchments, which may in time form the basis for future options to re-circulate this water for supply and thus create more sustainable catchments.

We think that the way the model represents 'boundary conditions' is also very important, especially the boundary between WRE and WRSE, and Affinity Water could potentially play a future role in helping to determine cross-regional boundary conditions that better reflect the differences between the two modelling approaches.

Finally, Integrating company dWRMP19 plans into future WRE works would also appear to be an important step towards alignment on a baseline condition (from 2024/25).

14.5 Options for Water Trading and New Bulk Supplies

14.5.1 Neighbouring companies

We currently already trade with our neighbouring companies, and a number of existing bulk supply agreements are in place that governs these agreements (outlined in Section 3.3 and 8).

To support both the development of our dWRMP19 and the regional strategies we have pro-actively engaged with all of our neighbouring companies and third parties.

This work included holding meetings and workshops to develop new options for trading, and also included sharing EBSD modelling results and offering opportunities to include new trading and bulk supply schemes within respective dWRMPs. As part of this work we also shared our Statement of Need with all of our neighbouring companies.

Where the transfers are a continuation of an existing agreement we have used the existing cost in our EBSD model for that transfer. If the option was a new transfer for potable water then we have used a Large User Tariff, taken from the supplier website. If it was for raw water, then we have attempted to apply an upstream infrastructure cost outside of our boundary, though this was not possible for all of our feasible new inter-company transfer schemes.

This work is ongoing and will continue post draft plan. This section of the plan provides a summary of the work to date, please refer to Figure 22 which shows the actual boundaries.

Anglian Water

Our boundaries with Anglian Water are shared on the north and eastern sides of WRZ3 and WRZ5, we also share a boundary at WRZ8.

We discussed the possibility of varying our entitlements at our shared resources at ANGL and TARD Reservoirs. We also liaised with Anglian on potential reductions to existing licence at both assets.

Anglian Water provided us with their latest understanding of the current licensed DO for ANGL, which indicated that the DO at ANGL is subject to a reduction from 2020. We have agreed for dWRMP19 to reduce our DO by 15Ml/d at both average and peak from 2020. This reduction is viewed as a 'worst case' reduction and subject to release of the Anglian Water supporting work. Our understanding of the basis for this reduction is that it is largely a function of climate change impacts (scaled from 2080) and a gauging error at Denver Sluice. There are two ways to model the reduction, one is to 'flatline' the reduction from 2020 the lower risk position as this presumes the effect of the climate change has fully materialised from 2020 (as we have in our **PP**). Alternatively the reduction can be 'scaled' from zero at 2020 to -15Ml/d at 2080 a higher risk position (as we have in our **AP**). We consider the difference in risk position adopted between the two plans is consistent with the balance of service and conditions planned for. In the **AP** we are planning for a 1 in 200 year drought and this will require greater capacity in a low probability event. The scale of the reduction may change by final plan as we learn more about this work, but will not worsen.

We also explored the opportunity to share more of our ANGL entitlement with Anglian at average conditions between 2020 and 2030, whilst retaining our peak. The share would allow Anglian Water a further 18 Ml/d above their existing entitlement, and our entitlement would be 'capped' at 50Ml/d for 10 months of the year. These discussions are ongoing, but for the draft plan we have included this reduction within our baseline DO for our **PP** as we have ongoing undertaking constraints which restricts the use of ANGL supplies to specific zones.

Our EBSD modelling has in some cases indicated a surplus that might be available in our draft plan, it is that modelled surplus which forms the basis for potential additional volume availability for Anglian Water, in essence the ANGL option for Anglian Water to take more (18 Ml/d) above their current take. The **AP** modelling is suggesting that there are also sets of circumstances where this proposal is not viable. Ultimately the decision will be related to ongoing risk based modelling, in the meantime we have been assured by Anglian Water that their dWRMP work also contains 'No Trade' type scenarios thereby avoiding any inter-company issues ahead of the final plans.

It is our understanding that Anglian Water are modelling baseline deficits in their Ruthamford Zone, which borders our WRZ3. They are resilient to a loss of ANGL, but any future 'new import' to Affinity Water would need to be supported by new investment, which currently has not been planned for. At this stage our modelling is not supporting the need for a 'new import' from Anglian Water above our current entitlement either within the 25 year statutory planning horizon or within our **PP**.

TARD is governed by a statutory arrangement that apportions 50 / 50 of the DO to both parties. Currently Affinity Water and Anglian Water have agreed an apportionment of 70 / 30 in favour of Anglian Water. At WRMP14 we modelled a 80 / 20 split from 2030, though Anglian Water are now modelling a 50 / 50 apportionment from 2030. Our baseline assessment for WRZ8 suggested that we could offer a 70 / 30 apportionment from 2030 to 2044. This offer of a trade is currently available, however should there be further changes to our baseline assessment (e.g. from the outcomes of WINEP 3) then it is possible that the continuation of the split will not be available post 2030 (with a reversion to 50 / 50), or earlier (i.e. 2025). We understand Anglian Water have also modelled a 'No Trade' scenario in their dWRMP that explores alternatives to a continuation of the current share at Ardleigh.

As part of our options appraisal we also developed an unconstrained option where we attempted to share our remaining surplus in TARD with Anglian Water, in an attempt to 'cascade' this into our WRZ5, using existing Anglian Water infrastructure near to Braintree and new mains to SIBL. This scheme was not progressed because of resilience concerns with our WRZ8 and potential issues with importing water with high metaldahyde concentrations into new supply areas.

Cambridge Water (South Staffs Water)

Cambridge Water borders our WRZ3 and WRZ5 boundaries for a small area. There is existing infrastructure in place between the two companies that allows for emergency supplies.

During our options appraisal work we explored opportunities to both continue and enhance the existing infrastructure, for resilience, and also discussed the possibility of developing new connections to meet supply demand balance needs.

Cambridge Water stated that they did not have a surplus that could be shared, but were keen to develop options that could move water between the two companies as part of a regional movement of water over the long term (60 years).

On that basis we created a number of relatively small interconnections (less than 5 Ml/d), that have subsequently not been selected in our **PP** or **AP**.

The existing infrastructure has been retained and could form part of a bi-directional resilience solution in the future.

Essex and Suffolk Water

We share a small boundary with Essex and Suffolk Water at the Southern end of our WRZ5, whom we also met with as part of our options appraisal.

Essex and Suffolk Water stated that at that time although they may be showing a short term surplus, they would not have a surplus to share with Affinity Water as they expected any surplus to be needed as part of their dWRMP19 development. We retained a transfer option between

Brentwood and Harlow for modelling purposes as we wanted to allow the model to move water across the boundary, thus reflecting any regional modelling (which also allows for this movement of water) but this was not selected in our **PP** modelling.

Our discussions therefore focused on resilience infrastructure and two small options were created in our unconstrained option list that could be developed further, one of which was at TARD to potentially allow for emergency resilience for a loss of TARD DO.

South East Water

We share boundaries with South East Water (SEW) in our Central Region, where we operate an export from our WRZ6 to SEW WRZ4 from our EGHA works, and we share a boundary at our WRZ7 in our South East Region.

We fully reviewed all of our existing transfers and options that remain from WRMP14 and developed new options for dWRMP19.

We have included a continuation of the existing BARI agreement between the two companies in WRZ7, beyond 2020 in all of our planning scenarios. There is an option to increase our existing agreement by 2 Ml/d to 4 Ml/d to meet supply demand balance needs, which does not feature in our **PP**. SEW are currently modelling this potential need, but any confirmation of the need would be subject to our consultation on the draft plan. One further new import features less frequently and is also subject to post draft plan modelling.

A new option for dWRMP19 included the potential for exploring flexibility of the existing export to SEW WRZ4 from our WRZ6. That bulk transfer currently allows for 36 Ml/d to be transported to SEW. We explored 10 and 20 Ml/d trade variations as part of WRSE and in our own respective EBSD modelling. As a result of that work, there is currently an agreement to include a 10Ml/d reduction in the export from our WRZ6, which both parties are including in their respective dWRMPs. This reduction is subject to further modelling, but is included at this stage within our **PP**.

Southern Water

There is only one small boundary that we share with Southern Water on the eastern side of our WRZ7. We have agreed to continue with the current bulk transfer agreement between the two companies, from 2020 onwards.

We explored other options, one of which was to increase the existing transfer at DEAI, which would be dependent on the availability of water on Southern Water's side, which in turn would likely be linked to any surplus that may arise from regional work between Southern Water and SEW. No new options between the companies were selected in our initial draft plan modelling.

Sutton and East Surrey Water

Our WRZ6 also shares a small boundary with Sutton and East Surrey Water. We discussed the opportunity to develop options between the two companies as part of WRSE. There is no existing infrastructure between the two companies which means that any new options would need to include new mains development.

Our WRZ6 was not forecasting a surplus in our near term baseline, we therefore discussed the opportunity to develop an option linked to a new regional scheme. This option was not included within our EBSD modelling, and we understood that Sutton and East Surrey were not in a position to offer a surplus to Affinity Water.

Thames Water (TWUL)

We share multiple boundaries with TWUL across several WRZs in our Central Region (WRZ1-6). We met with TWUL on several occasions as part of our options appraisal work, and also at regional level. TWUL also published their needs as part of their own options work. TWUL indicated that only a small surplus near term was available in their Kennet Zone, and that was subject to uncertainty and further modelling.

Our discussions explored both resilience and new supply/demand balance schemes, which resulted in the following schemes taken forward into our EBSD and WRSE modelling:

- new bulk raw water imports into our WRZ4 and WRZ1, linked to the River Thames and Upper Thames Resource Development (UTRD)
- variants of which included 50 M/d and 100Ml/d transfer and treatment schemes, capped at 100Ml/d for the 80 year planning horizon.

We understand that the timing and need of UTRD is dependent on TWUL's own need for near to medium term deficits, and also potentially needs from more than one other company in WRSE. No new potable water schemes were progressed.

No new potable water schemes were progressed and included within our **PP**. We are aware however that since the submission of the dWRMP in December 2017 Thames Water have included an option (LAYM) to increase an existing supply to our WRZ6. We have since advised Thames Water that the scheme is not required within our dWRMP. Thames Water have amended their dWRMP accordingly, and this amendment does not have a material impact on the draft plan and will be updated in the revised dWRMP accordingly.

The UTRD could be formed of either a transfer between the Severn and Thames, and / or a combination of reservoir development, which TWUL have considered as part of their own dWRMP19 development.

Currently our plan contains the following:

- Two transfers into our area that abstract from the River Thames, based on additional flows via UTRD, the timing and volume of these options are as follows:
    - To WRZ4 50Ml/d (2049) and to WRZ1 50Ml/d (2066).

TWUL were clear that no surplus would be available from their London WRZ, which meant some of the WRMP14 options were removed, and this was also a function of constraints in TWULs own treatment works which meant that expansion would not be possible (this was a feature of potential transfers with WRZ5).

We have raised the potential for enhancing resilience at our WALT works, where TWUL also own nearby assets. We have also raised the need to engage in future discussions to explore the viability of our effluent re-use schemes in our Central Region, which we feel merits further work (see Section 14.6.4 for further information).

All of the above have been incorporated within our dialogue with TWUL and we continue to share EBSD modelling results on a regular basis, so that alignment is maintained. It is possible that the timing might change between draft and final plan. Also, there is work for instance on HS2 contingency that is independent of WRMP.

The Trent and Ouse working groups

In order to understand the issues relating to upstream resource development, that could result in mis-alignment and availability of resources, we also participated in working groups on the Trent and the Ouse.

With regard to the Trent, our understanding from initial studies is that any future use of flows on the Trent appear to be capable of supporting more than one source for multiple transfers between companies. This work is ongoing, but at this stage companies and multi-sector stakeholders should not be concerned that the schemes being discussed between the companies were feasible, but that reporting would be available soon to support this initial analysis.

At this stage therefore it appears that options such as any option between Anglian Water and Affinity Water for new imports remain possible, but it is likely that further work will be required to support this initial understanding.

14.5.2 The Canal & River Trust (CRT)

At WRMP14 we included some unconstrained options and small groundwater based schemes within our feasible list, that was based on our options appraisal from WRMP14. Since WRMP14 we have been able to develop our CRT option base considerably. This work began with a water transfer study (Black and Veatch in 2016) where high level cost estimates for water transfer routes explored the viability of options to transfer water between and to multiple water companies. The study looked at several of the issues, such as engineering challenges and environmental constraints associated with the movement of water in the order of 50 Ml/d, 100Ml/d and 200Ml/d.

We followed that work up through dialogue with the CRT where we reviewed all the options that we could possibly include within our unconstrained and feasible option lists, which included borehole acquisition, groundwater licence trades, reservoir schemes, small offtakes from the Grand Union Canal (GUC) and options for larger scale GUC imports either direct or in combination with Anglian Water needs in their Ruthamford Zone.

As a result of which we were able to include a number of these within our feasible option list, and we have continued dialogue with the CRT throughout this process. For the development of our draft plan we shared our initial modelling results with the CRT and currently our **PP**and **AP** include the following schemes:

- a GW and a SW scheme in our WRZ4
- both of these schemes appear relatively late on (post 25 years).

There is one further GW licence trading scheme in WRZ1, this scheme was selected in our initial modelling but then was not selected in our **PP**. That scheme warrants further discussion prior to final plan, and appears in our **AP** (AFF-NGW-WRZ1-1050: CRT-Cow Roast).

There are challenges associated with large scale importing of the GUC water, such as water quality and security of supply in drought. The challenges associated with engineering such a transfer are also significant, including lock and pumping issues, and interactions with natural water courses where flows may be supporting local watercourses.

We will continue to liaise with the CRT and are committed to working on future studies that may explore some of the issues raised here, and going forward it may be the case that smaller offtakes from the GUC can be explored where they coincide with existing mains and treatment facilities that could be upgraded. Such schemes might offer some drought resilience in the future if the flows are secured.

14.5.3 Other potential suppliers

In addition we have also attempted to identify a number of other potential third party suppliers and options in the following ways, which are new for dWRMP19:

- Official Journal of European Union (OJEU): Where, in 2016, we submitted a notification and undertook a manual supplier database searches (Achilles)
- we carried out a comprehensive internal review of all existing third party options and historic company records of potential suppliers that we may have contact with in the past
- as part of our meetings with the EA, we researched for third party options via abstraction licence records
- we also published advertisements on a new website page, and through relevant journals and magazines (Figure 56 is a screenshot of our website page).

Our Technical Report 4.1 provides further information relating to particular opportunities that may have arisen from this aspect of our work.

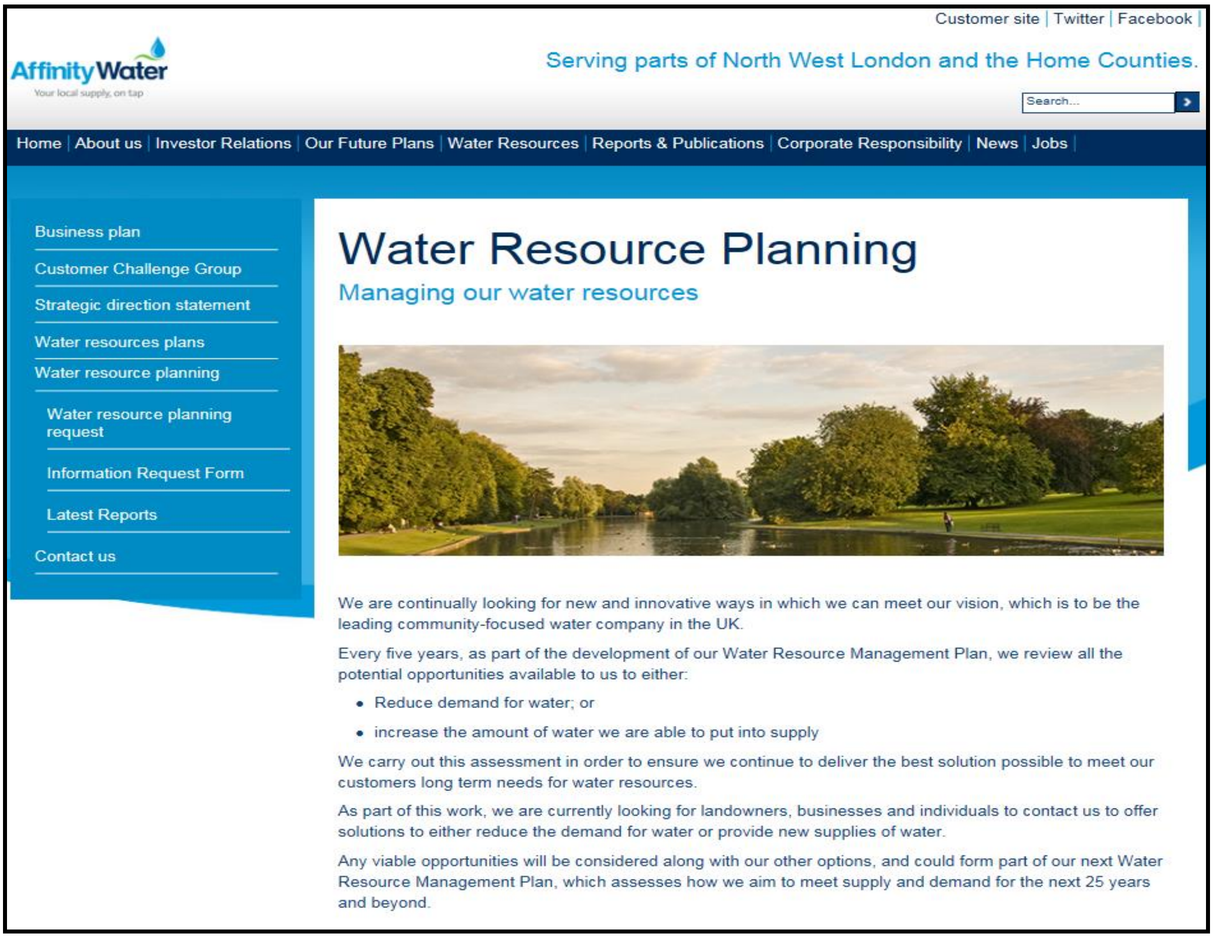

Figure 56: Screenshot of our website page for publishing advertisements

14.5.4 Opportunities for further collaboration

In 2016 we launched a report with KPMG considering whether new models could form part of the solution to the water resource challenges associated with climate change and a growing population (KPMG, 2016). In our options appraisal we have included a small number of indirect effluent re-use schemes, none of which were selected in our dWRMP19 **PP** or **AP**.

There are sizeable barriers to these schemes, one of which relates to clean water carriers not being able to be licensed to control a discharge, and the planning barriers that relate to different companies and how they plan future infrastructure investment (which has entirely separate drivers).

We believe over time that this has resulted in a lack of developed options that are linked, and can enable more effective long term catchment based solutions, where future demand growth is estimated. Such options could enable more effective local re-cycling of water that might currently have to be either imported into the area or might require new abstraction in already stressed catchments. We plan to meet with the waste carriers in our supply area, and see this as an essential part of any regional solutions that might also be developed (via WRSE or WRE).

We believe this will develop into a catchment management programme for AMP7 to involve all stakeholders, looking at catchment flows, balances, all users and owners plus reuse options; for instance our sustainability reductions have benefited downstream abstractors at no cost.

14.6 System Operator / Regional Coordinator

14.6.1 Introduction

We have for some time recognised the water scarcity issues in the south east presented by the longer term drivers such as population growth, climate change and the environment, but we have also been quick to appreciate that shorter term extreme events are becoming increasingly prevalent and these as well as the longer term drivers threaten the economic and resilient supply of water to customers.

We have been a long term advocate of the regional groups, WRE and WRSE and the benefits regional modelling can bring. We have welcomed the national study that provides additional evidence for the scarcity issues, which does suggest that the twin track approach of greater demand management and supply enhancement and transfer between companies as being the best strategic mix for future resilience and drought.

The national study does not however present detailed solutions nor do they present the weaknesses of the present planning and regulatory regime that will need to be overcome for the bulk transfers to take place.

14.6.2 Opportunities to improve the weaknesses of the present regime

The weaknesses span both long and short term access to spare water supplies. These include:

- planning timescales for water infrastructure projects tend to be much longer than other industries due to the lack of a National Policy Statement
- WRSE is able to provide solutions to meet a regional supply/demand balance but presently it relies on the individual companies to supply the options
- current joint studies produce total cost for a multilateral solution but in order to remain compliant with current competition rules do not disaggregate costs to company level thus

leaving arrangements to be negotiated through bilateral discussions which will almost certainly be less optimum than a multi-lateral modelled solution

- there is no vehicle for multilateral trading and no regional body that presently has decision-making authority that coordinates requirements across a region
- information on the need and availability of water is not kept in one place – presently individual companies have to analyse other companies WRMPs to identify opportunities for trades
- the nature and timing of the WRMP process means that the contract terms for transfers are interdependent with the WRMP and Business Plan determinations and are therefore hindered or sub-optimal
- the price of existing transfers often reflect average or shared cost of resources through to a proportion of large user tariffs and indeed full metered supply costs therefore are often not cost reflective or comparable which constrains efficient utilisation and may result in a cross subsidy from the customers of one company to another
- whilst there is an expectation companies will cooperate during short term water shortages, in practice it is difficult to access any potentially spare water without the appropriate contracts in place.

14.6.3 What is being done to address these weaknesses?

There are a number of initiatives that are being planned by regulatory and government bodies including:

- Ofwat are to introduce an information sharing platform in early 2018. Using the output from the WRMP process companies will be able to post information on the needs and availability of water and theoretically this should increase the propensity for bilateral trades of water
- Direct Procurement – Ofwat is keen to progress the model as adopted by Thames Tideway whereby large (Totex >£100 million) discrete projects would be competitively tendered
- Defra is keen to progress and implement a National Policy Statement (NPS) for water to ease the burden on planning and construction of large water infrastructure projects
- National Infrastructure Commission has consulted on the impact of the environment and climate change on future infrastructure supply and demand.

14.6.4 What is Affinity Water doing specifically to address these weaknesses?

Whilst we support the initiatives by Government and Regulators and the useful work of the regional bodies we feel that more should be done, especially in terms of collaboration to address the weaknesses of the present regime.

We were quick to respond to the evidence presented by the national study and the KPMG report mentioned in 14.6.4 looks at innovative and alternative business models that could benefit the water industry and unlock the potential for more water trading. One of these was the development of an Independent System Operator.

14.6.5 Development of an Independent System Operator/Regional Coordinator

Water companies do of course currently carry out their own system operation activities to move water around on a day to day basis within their company boundaries. A System Operator in the wider sense is a body that manages the transportation and balancing of a commodity across a system used by multiple users and has been in operation in the gas and electricity system in the UK over the last 10-15 years.

Due to the nature of gas and electricity, in that they are faster moving than water and they operate within fully traded systems the System Operator in energy has been largely used to manage the balancing of the system. In electricity this is being extended to include a longer term planning function.

We believe there is much that can be learnt from other sectors in this regard and have invested in resources to explore this further. Initial findings are that we believe that a System Operator function could operate within the water industry as a key enabler to promote water trading as an economic and resilient solution to water scarcity in the South East.

We think initially the role of the System Operator would concentrate on the conjunctive use of all available resources between water companies and other suppliers and be able to coordinate longer term requirements of the companies, and with access to holistic price information, would enable efficient multilateral trading. As more trading takes place over time the System Operator role might extend to seasonal, weekly and even daily optimisation of resources between suppliers but this could take many years. Initially the role would be more like a Regional Coordinator with decision-making authority and the Regional Coordinator would not necessarily have to own assets to carry out this function.

14.6.6 Regional hub

Our unique regional location, where we are located geographically between WRSE and WRE, means that we can play an important role inter – regionally. Our work since WRMP14 is aimed at meeting that role. Indeed it could be envisaged that through investment in internal and external interconnection, Affinity Water could act as a regional hub between supplies from the north and west and distributing it onwards to the south east. However this would not mean that Affinity would be the Regional Coordinator/System Operator, we would expect this to be an independent organisation.

Indeed, a scenario could be envisaged where an independent Regional Coordinator/System Operator identifies the needs and availability of the water resources in the East and South East and determines that a Regional hub is the most effective and efficient solution to meet water scarcity.

The individual companies with the requirements would then decide how best to provide the infrastructure and the asset ownership and could for instance use a Direct Procurement model to provide these assets. In this model the Regional Coordinator/System Operator therefore does not need to be the asset owner and in the first instance could simply be the coordinating body that identifies the need for the asset.

14.6.7 Latest developments

In order to move this initiative to a proof of concept stage we have made progress on a number of fronts:

- Affinity Water CEO is Chair of WRSE CEOs Group. In this role we have been keen to move the agenda forward and have shared some thoughts on Regional

Coordinator/System Operator with the group and the route map to achieve this for water in the South East

- we feel that the scope and responsibility of a group like WRSE could be developed towards a regional coordination role with decision-making authority, similar to that in energy and MOSL, the market operator for non-household retail competition. We are taking the lead in developing proposals to share with WRSE
- this will involve developing methodologies and codes to develop trading opportunities in the southeast and beyond
- we are developing a greater understanding of internal system operation costs that could be used to inform consistent use of average, marginal and long run marginal costs and use of a common cost platform that would make existing transfers transparent and bring them within market – we are developing proposals for an additional information sharing template for this purpose
- we have included adaptive and flexible schemes within dWRMP19 that could provide resilience for both Affinity's and surrounding networks.
    - Through the revised proposed bulk transfer arrangements with Thames, Anglian and South-East Water we have been able to demonstrate that we are an important link between these companies in the south-east and are able to increase and decrease supplies based on collective need. Details of the changes in the bulk transfer arrangements are detailed in Section 14.6.

As well as the initiatives that we are progressing with, we are encouraged by the number of other regional groups that are being formed in the North and West, that in time may also form and develop inter – regional relationships (as part of the national picture).

15 Our Draft Preferred Plan for dWRMP19

Summary

We present our **Preferred Plan (PP)** which we believe is balanced and **best value**[7] for customers and the environment in our dWRMP19. Together with our **Alternative Plan (AP)** and aspirational scenarios gives an envelope of possible future solutions, upon which we will consult with our stakeholders and customers.

This section describes options, costs and environmental factors involved in the delivery of our **PP.** Chapter 16 describes options identified for our **AP** and Government and stakeholder aspirations, upon which we will seek feedback.

15.1 Overview

Our **PP** is balanced and **best value** for customers and the environment as we believe this is a **deliverable** plan which moves us to a more resilient position in terms of security of supply as well as enhancing our environmental resilience through not planning to use supply-side drought permits and orders in our worst historic drought. We have focused on building a 'resilience tested plan' with a range of measures to balance the risk in delivery and benefit. We consider the provision of flexibility and resilience to maintain security of supplies to customers is of paramount importance. Overall, we believe the additional social, environmental and economic benefits offered by our **PP** offers best value to customers, stakeholders and the environment. We will consult on this plan envelope with customers and stakeholders and will consider feedback when preparing our revised dWRMP19.

We consider best value to mean, a plan that incorporates objectives other than least cost when both filtering down the potential options that could form the basis for the plan. As part of the sensitivity analysis, we have embedded a range of metrics within our EBSD extended methods approach (e.g. environmental, uncertainty, portfolio resilience).

A summary of the planning conditions and investment cost of our **PP** are illustrated in Table 66.

Table 66: Our PP scenario

Scenario	Demand	Drought permits and orders for additional abstraction	Drought return period resilience included	Total investment costs 2020-2080 (£million NPV)
PP	Medium	Not-required until drought conditions worse than historic	Up to worst historic (1 in 60 to 1 in 80)	£1,001.43

In our **PP** strategy we describe the options we have selected to address and mitigate our foreseen future supply deficits to ensure we have sufficient supply of water to meet what we expect to be the level of future demand.

There are steps we will take to manage the amount of water that is used, for example further reducing leakage and installing new meters. These will help people reduce their water usage. During times of drought we will temporarily restrict demand if necessary. We include a

[7] Following guidance offered in the UKWIR Report Ref No 16/WR/02/10.

substantial level of water savings through our continuing water savings programme (WSP), metering and water efficiency activities plus further leakage reduction which we consider being achievable and deliverable based on our current knowledge of water savings seen through metering. We believe this to be a feasible and deliverable demand strategy for AMP7 and AMP8. We will also take steps to ensure we have enough water to supply. In the short-medium term we will make best use of the resources we already have, exploring development of existing resources and opportunities for securing transfers of water from our neighbouring water companies and others.

In the longer-term we will seek to secure additional reliable water by transferring water from a new regional reservoir in the Upper Thames catchment (UTRD selected in 2055) promoted in partnership with Thames Water and other companies in the SE of England. We also make use of water from the existing BREN Reservoir. We will reduce abstractions where there is evidence to show that the environment will benefit. These are known as sustainability reductions which in our **PP** includes 10 Ml/d and our **AP** includes 39 Ml/d of sustainability reductions upon which we will be seeking stakeholder and customer views during public consultation.

An overview of our delivery strategy is shown in Figure 57.

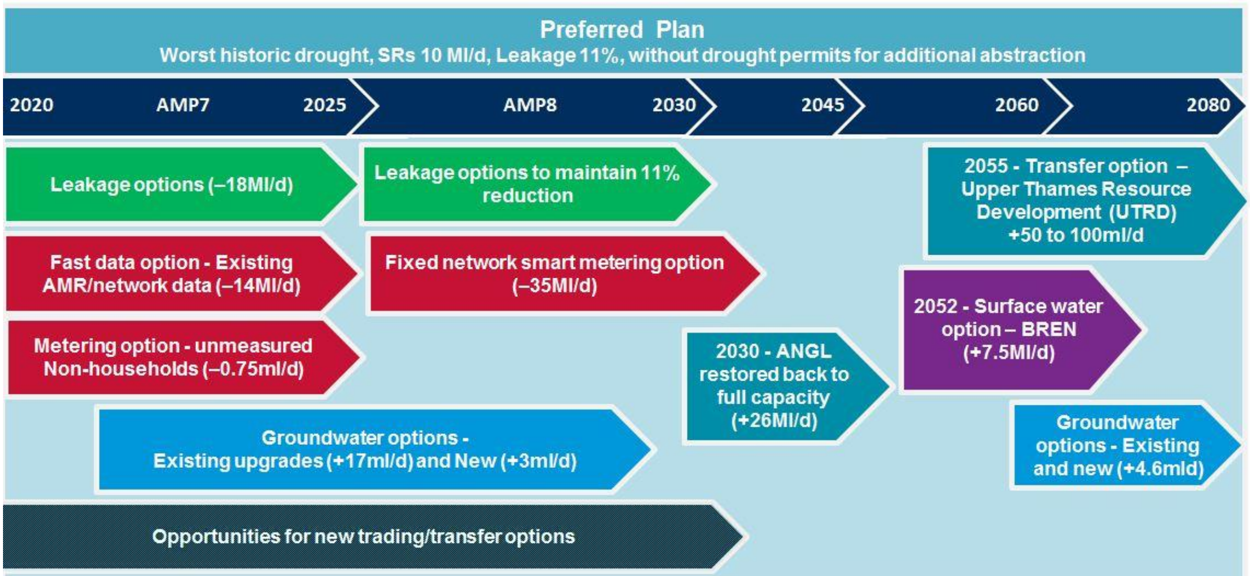

Figure 57: PP delivery strategy

In the immediate **five years** (2020-2025), our **PP** includes:

- a leakage reduction of **18 Ml/d** from a variety of leakage interventions
- savings of **14 Ml/d** from engaging with customers on their water usage (Fast Data Option) and from better use of our existing AMR meters and network data
- **0.75 Ml/d** lower consumption from metering unmeasured non-household properties
- an additional **17 Ml/d** of available supply by optimising existing groundwater abstractions and licences with minimal environmental effects
- an extra **3 Ml/d** from a new abstraction licence
- up to **12 Ml/d** of proposed new bulk imports

- **26 Ml/d** lower utilisation of our ANGL resource shared with Anglian Water until 2030 taking a lower risk profile for climate change in the water available to potentially enable to supply deficits in the Anglian region
- an investment in a cost effective treatment solution to enable the use of water from ANGL in any zone at full capacity from 2030.

Our **PP** is our **best value plan** using a supply base calculated for our revised worst historic drought situation without supply side drought restrictions being required. The benefits of the options can extend beyond the delivery programme timescales. We discuss the chosen options in further detail in Section 15.4.

We will be undertaking further work between our draft and final submissions to validate our assumptions to ensure our estimation of water savings for this draft plan is as accurate and realistic as possible, based on actual savings from our current programme.

Our ability to deliver this is based on calculations at WRZ level through EBSD modelling. Additional investment on top of this will also be required to ensure efficient movement of water within each WRZ (eight zones) at a finer hydraulic demand zone (HDZ) level (36 zones). It may take a number of years to ensure true resilience can be achieved at the HDZ level. Estimates of the HDZ level investment required have been undertaken for this draft plan but there is a need to refine these requirement and costs further for the final plan.

15.2 Demand for Water

Our **PP** assumes "medium" growth in demand for water. This is explained further in Chapter 9 of this report. In this scenario, demand is predicted to fall slightly in the period to 2030 and to increase in the long-term. We add headroom, which provides a margin to address uncertainties in our predictions. We have used the industry standard value of 95% for the headroom assessment at the start of our plan for AMP7. Our demand profile assumes water savings of 18% through our Water Savings Programme and encouraging water efficiency. The graph in Figure 58 illustrates the balancing of supply and demand in our **PP**.

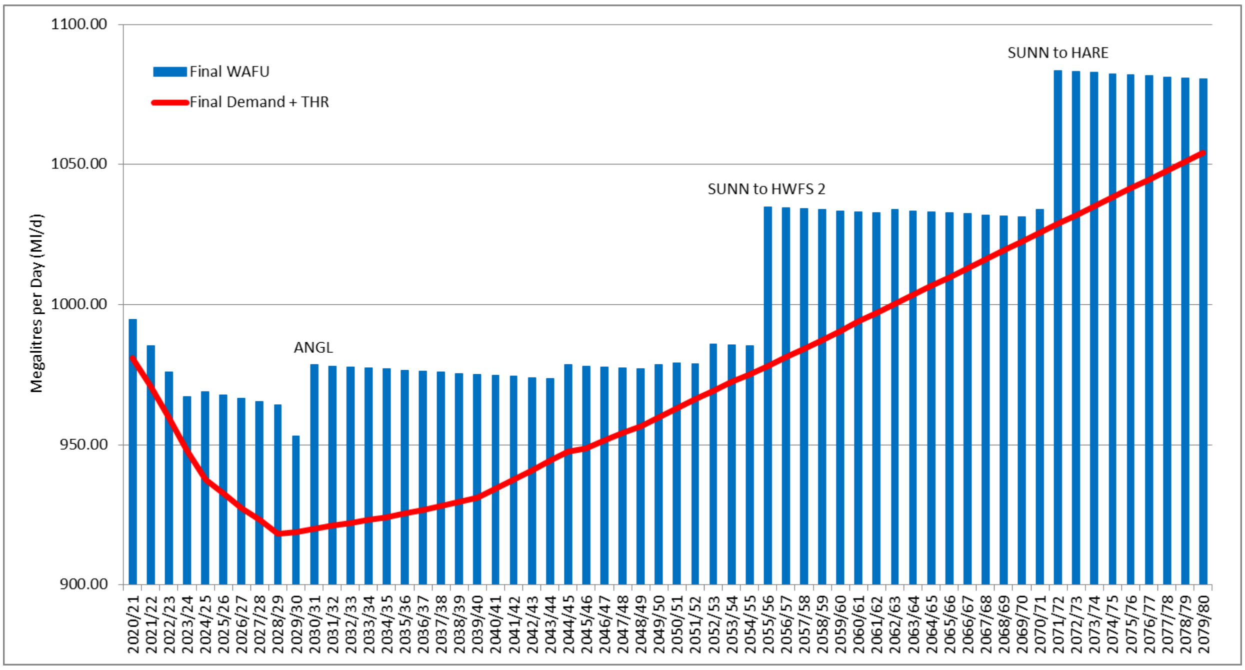

Figure 58: Final Supply / Demand balance for our PP

15.2.1 The impact on consumption

As a result of our demand management measures introduced we anticipate that the amount of water used by each person will fall by 2030. However due to population and housing growth we forecast a small increase in demand after 2030. This could also be due to occupancy rates gradually declining over the planning period whilst demand increases which causes a small increase in per capital consumption (PCC).

Table 67 to Table 69 show how PCC changes during the planning period at NYAA, DYAA, and DYCP as our draft **PP** is implemented. We show the weighted average PCC, which takes into account the difference in PCC of our metered and unmetered customers. The changes in PCC in our Central region are driven by our metering options and WSP Programme. In our Southeast and East regions, we continue to offer optant meters and water efficiency devices under our baseline water efficiency programme, gradually reducing PCC over time to the end of AMP8. There is a slight increase in PCC post AMP8 due to a fall in occupancy rates and increased demand. We believe that we can reduce our current DYAA per capita consumption of 160.78 litres/person/day to 133.97 litres/day/person by 2045 by implementing the measures included in our **PP**. We would like to achieve more and will continue looking at how household technology can help with this. We believe, however, that meeting the Government's aspiration level of 90 to 110 litres/day/person cannot be achieved by us acting alone but will need concerted action by all water companies, regulators and Government.

Table 67: Changes in NYAA weighted average PCC at the end of each five-year period

Water Resource Zone	Base Year 2015/16 l/h/d	End of AMP7 2024/25	End of AMP8 2029/30	End of AMP9 2034/35	End of AMP10 2039/40	End of AMP11 2044/45
1	159.66	134.42	127.78	127.20	126.68	127.86
2	160.44	135.39	128.27	127.34	126.52	127.79
3	137.49	115.64	113.73	113.97	114.25	116.12
4	154.29	132.28	125.58	125.66	125.67	126.67
5	153.74	132.73	128.93	128.00	127.31	128.40
6	162.88	135.47	129.67	131.13	132.43	135.00
Central region weighted average PCC	**153.39**	**129.80**	**124.48**	**124.50**	**124.53**	**126.02**
7 (Southeast Region)	121.05	124.43	125.36	126.80	128.23	130.28
8 (East Region)	127.20	120.55	120.19	120.36	120.66	121.55
Company weighted average PCC	**150.84**	**129.19**	**124.35**	**124.44**	**124.55**	**126.04**

Table 68: Changes in DYAA weighted average PCC at the end of each five-year period

Water Resource Zone	Base Year 2015/16 l/h/d	End of AMP7 2024/25	End of AMP8 2029/30	End of AMP9 2034/35	End of AMP10 2039/40	End of AMP11 2044/45
1	170.44	144.15	135.98	134.60	133.44	134.81
2	171.27	144.00	138.14	136.18	134.50	135.75
3	146.77	120.18	117.90	119.31	117.94	119.68
4	164.71	142.48	134.13	133.20	132.39	133.42
5	164.12	139.65	137.13	134.76	132.83	133.57
6	173.87	150.07	141.85	142.18	142.60	145.20
Central region weighted average PCC	**163.74**	**138.56**	**132.88**	**132.90**	**132.94**	**134.53**
7 (Southeast Region)	128.73	125.81	126.60	128.00	129.39	131.41
8 (East Region)	130.32	123.50	123.13	123.31	123.61	124.53
Company weighted average PCC	**160.78**	**137.37**	**132.20**	**132.29**	**132.39**	**133.97**

Table 69: Changes in DYCP weighted average PCC at the end of each five-year period

Water Resource Zone	Base Year 2015/16 l/h/d	End of AMP7 2024/25	End of AMP8 2029/30	End of AMP9 2034/35	End of AMP10 2039/40	End of AMP11 2044/45
1	223.16	190.04	181.63	180.35	179.35	181.12
2	224.25	189.77	183.58	181.65	180.08	181.70
3	192.17	160.11	158.69	157.63	156.90	158.74
4	215.65	187.87	179.76	178.91	178.19	179.51
5	214.89	184.07	181.27	178.82	176.89	177.84
6	227.65	197.82	189.64	190.48	191.42	194.77
Central region weighted average PCC	**214.39**	**181.43**	**173.99**	**174.01**	**174.06**	**176.14**
7 (Southeast Region)	179.64	175.57	176.68	178.63	180.57	183.38
8 (East Region)	213.47	202.31	201.70	202.98	202.48	204.99
Company weighted average PCC	**212.75**	**181.99**	**175.22**	**175.35**	**175.51**	**177.62**

15.2.2 PP Leakage

We intend to reduce leakage by 11% in AMP7 whilst maintaining that level of leakage is AMP8. We believe this is an ambitious target that builds on our current delivery of 14% leakage reduction in AMP6 (2015-2020), which is the most demanding reduction target in the industry resulting in a level of leakage of 3.3 Ml/d below our economic level of leakage (ELL) of 166.02 Ml/d (excluding trunk mains leakage)[8].

As a company we are already operating below the ELL and our **PP** takes us even further below it**.** At the beginning of 2020, four WRZs out of eight will already operate below the ELL. By the end of AMP7 (2025) , five WRZs out of eight will be below the ELL for our **PP**.

15.2.3 PP Metering and Water efficiency

We will continue with our water saving programme which includes household level water efficiency support as well as implementing a new innovative demand management option called Fast Data Option at the outset of our **PP**. This makes use of existing AMR meters in combination with new fast logging and live network hydraulic models to provide customers with surrogate information about their water use. Metered customers will be able to get a much more detailed picture of their water consumption than they currently receive through their six monthly bills and we anticipate this will encourage greater water savings than our meter programme alone. We will also install meters for non-household premises that do not already have them.

In the longer term, from 2025 - 2035 as our existing meters reach the end of their asset life, we will roll out the fixed network smart metering option with the aim to have installed smart meters at all properties where possible by the end of the programme and anticipate benefits to extend to 2050. We believe these step changes in metering are the most economic way to meet our supply and demand balance in the immediate future. The savings we are expecting to see from our water saving programme have been embedded in the demand baseline and we have explored further options to continue reducing demand beyond the WSP.

15.2.4 PP Drought restrictions

Our **PP** assumes that a drought of severity in line with our worst historic, will occur once every 60 to 80 years on average, or in other words there is a 1.25% to 1.7% chance of a drought of this severity occurring in any year.

We intend to make appropriate use of temporary use bans and demand side drought orders which allow us to impose restrictions on water use in the event of a serious drought. We anticipate using temporary use bans on average once every 10 years and demand side drought orders for restrictions on non-essential use on average once every 40 years, as stated in our current Drought Management Plan. The incidence of implementing restrictions is more frequent that the worst historic drought because operational decisions are taken before it is known how severe the drought will become. Further description of each of the drought management measures and comparison of our levels of service proposed in our **PP** and **AP** are presented in Table 12 in Section 2.11.

We predict that the use of temporary drought restrictions will result in an annual reduction in average demand of 3%, based on our experience during the 2007 drought and is explained in Technical Report 4.9: Economics of Balancing Supply and Demand Modelling.

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[8] The ELL excludes trunk mains leakage as trunk mains and service reservoir (TMSR) costs for detection & repair differ considerably to DMA cost-leakage relationships. Similarly the policies for managing leakage on TMSR assets also differ greatly from those for DMAs. For further explanation please refer to Technical Report 4.8.1.

15.3 Supply of Water

This section describes the options chosen for our **PP** to increase supply capacity.

15.3.1 PP Optimisation of existing sources

Our **PP** includes options that will further optimise our existing groundwater abstractions and licences, where we are aiming to deliver an additional **17 Ml/d** of water supply between AMP7 and AMP8. This resource will comprise of a combination of schemes such as an option to amend and dis-aggregate a groundwater licence in WRZ2 (of 10Ml/d at ADO). There are also groundwater options to increase a licence rate in WRZ3 (by 3 Ml/d at ADO), and an upgrade at a source works in WRZ5 (to deliver a benefit of 2Ml/d at ADO). The remaining resource allocation is made up of a source optimisation scheme in WRZ2, and licence variations in WRZ7.

We believe that making best use of our existing groundwater supply base is in the first instance the most cost effective and efficient way to balance deficits, alongside demand management measures. For us, they are most often selected because they are the near least cost. They also provide near term solutions that have smaller lead in times, and therefore are available earlier in the modelling.

15.3.2 PP Development of new sources

In our **PP** we also anticipate a gain of an extra **3 Ml/d** from a new abstraction licence in WRZ3. This option is to licence a new borehole in the Lower Greensand (LGS) aquifer within an existing site boundary to allow an increased abstraction at this site. It is dependent upon the outcome of AMP6 groundwater investigations and borehole testing at the same site, this scheme includes upgrades to existing non – infrastructure.

We believe the LGS aquifer, which is confined below the chalk in parts of our supply area, offers a relatively feasible new source of water that, where proven to be confined, should not be at risk from causing future impacts on surface water flows. We recognise however that groundwater flows across our northern area could be better understood, and for this reason we have not proposed to include any further new abstractions in the Lower Greensand (until we are better placed to provide evidence for other future LGS abstraction locations with supporting hydrological risk assessments).

15.3.2 PP HWFS and ANGL treatment capacity

The new HWFS treatment option identified in our **PP** allows utilisation of the transfer option from the Upper Thames Resource Development (UTRD) from 2055 and offers additional resilience to the existing treatment works, which in the longer term is potentially a single point of failure.

Expansion of the existing HWFS treatment works was not seen as the preferential option going forward, due to potential site constraints that meant the site expansion was not necessarily the ideal solution. Therefore, the options appraisal identified a potential new site within WRZ4 which will provide additional treatment capacity at HWFS of 50 Ml/d (DYAA / DYCP) linked to a new raw water import from the River Thames. The new HWFS option is coupled with the new raw water import from the River Thames (as a dependency in the modelling) and would therefore not form part of the WRMP solution unless it was linked to a new raw water transfer import. There is an additional need for treatment in WRZ1, but that is not required until post 2070 at HARE (and not at HWFS, which is in WRZ4).

Our **PP** shows that the ANGL import will be required at a capacity of 76 Ml/d (DYAA) from 2030 in order to meet the supply demand balance. In our **PP** dWRMP modelling we have therefore reduced the ANGL import to a rate of 50 Ml/d (DYAA) until 2030 as this is consistent with ongoing water quality constraints, which means we cannot deploy water from ANGL to some zones without treatment or a DWI undertaking. This modelling assumption allows for the resumption of the ANGL import at the end of AMP8. The delivery of the **PP** sustainability reduction is however reliant on the implementation of a treatment solution to allow ANGL import water into the zones currently supplied by chalk groundwater. We have therefore assumed that some form of the treatment solution will be required from 2024.

The specification for treatment of the import of water from ANGL is being considered as part of our business planning process, but an estimated total cost summary has been included in the cost table for our **PP**.

We have lobbied our regulators and Government extensively on the issue of metaldehyde and latest intelligence suggests that a targeted ban on metaldehyde may be introduced in some catchments. Should that be the case then we would expect to see a lessening of metaldehyde concentrations in water from ANGL over time and this would inform the need for treatment, but the aesthetic water quality issues would still need to be addressed through an appropriate solution.

15.3.3 PP Transfers of water

In the longer-term our forecasts show that we will not be self-sufficient in terms of water resources and we will therefore collaborate with our neighbouring water companies to develop new resources. In the nearer term we will continue with existing arrangements. In addition to which we are exploring a number of other options to trade around these agreements more flexibly, with our neighbouring companies shown in Table 70. The dialogue with these companies will continue throughout the draft plan consultation period, around contractual matters and costs. It is our aim to have concluded these initial discussions with 'in-principle agreements' in time for our final plan submission.

The following are a list of opportunities that we are exploring. In addition we support the regional solution linked to the Upper Thames Resource Development UTRD, and are modelling linked imports into our supply area.

Table 70: New transfer opportunities

Water Company / Third Party	Proposal	Anticipated effects	Actions needed to realise transfer	Date for delivery
Anglian	To reduce our take to 50Ml/d for 10 months of the year, allowing 26Ml/d to be reversed and available to Anglian at the reservoir.	26 Ml/d for 10 months of the year	No infrastructure. Contractual and costs. Agree implementation with Anglian Water.	2020 until 2030
South East Water	Decrease existing transfer from EGHS to South East Water by 10 Ml/d (from 36 Ml/d to 26 Ml/d).	10 Ml/d Increase in available DO, enhancing Egham Works resilience and providing additional DO for WRZ6 and WRZ4. We have included continuations of our BARI and DEAI imports from SEW to WRZ7 post 2020.	No infrastructure. Contractual and costs. Agree implementation with South East Water.	2020 until 2030

Table 71 shows what we intend to do to increase water availability in the long-term.

Table 71: Longer term potential transfers

Proposal	Anticipated benefits	Description	Timescale
Upper Thames Resource Development	50-100 Ml/d	Raw water imports from the River Thames, treated by Affinity. Linked to regional infrastructure development on the Upper Thames	2055
BREN Reservoir	7.5 Ml/d	A third party option to abstract from an existing reservoir in WRZ4	2052

The model is able to choose how much of these imports to use under each scenario, values for which are discussed in more detail in Technical Report 4.9: Economics of Balancing Supply and Demand.

15.3.5 PP Drought permits and orders for additional abstraction

Drought permits and orders allow us to apply to the EA and the Secretary of State respectively to take additional water from the environment in the event of a drought. Our **PP** does not include any additional resource as a result of the use of drought permits and orders because as our Drought Management Plan consultation and WRMP pre-consultation with stakeholders suggests, customers would prefer us to minimise our effect on the environment in severe drought. We would only expect to use these as a short-term measure in the event of a drought that occurs on average once every 60 to 80 years and in accordance with our Drought Management Plan (DMP).

We have recently consulted on our draft DMP, (see Section 5.4.1.3), which refers to use of these once every 40 years on average and would intend to update this to ensure consistency between our **PP** and our DMP in the annual update in February 2019. Our DMP consultation concluded that 61% of customers considered drought order frequency of 1 in 40 years was acceptable and 65% said we should not spend more to reduce the frequency of drought orders. The timing of our public consultation on our revised Drought Management Plan (DMP) and the underlying work for dWRMP19 has meant that by the time the return period of our new worst historic situation was estimated, the consultation on our DMP has already begun in which we stated a level of service (LoS) for supply side drought permits and orders of no more than 1 in 40 years on average.

Our resilience to maintain this new level of service will depend on improving our network connectivity at the local scale, within each water resource zone as discussed in Section 15.3.6, which will be dependent on investment being approved following submission of our next Business Plan PR19. We have considered the outcome from our DMP consultation that customers are satisfied with our current drought plan level of service to set our **PP** such that drought orders for additional abstraction will be required in droughts, only when they are worse than our worst historic.

If after consultation our final WRMP19 is not precisely consistent regarding level of service for drought permits and orders we will update our DMP as soon as there is an opportunity, to reflect decisions in our fWRMP19. This is likely to be at the first annual update of the DMP in February 2019.

15.3.6 PP Improving network connectivity

Our ability to deliver our **PP** is based on calculations at a water resource zone (WRZ) level to determine if there is sufficient water to meet supply at this scale. Additional investment will be required to ensure sufficient and efficient movement of water within each WRZ at a finer scale. Investment for this will be included in our PR19 Business Plan. It may take a number of years post 2020 to ensure true resilience at this level can be achieved with the aim to eliminate the need for drought permits/orders under our new worst historic drought. Estimates of the investment required have been undertaken for this draft plan but there is a need to refine these requirement and costs further for the final plan.

15.3.7 PP Sustainability reductions

In our **PP w**e intend to reduce our abstractions from our most environmentally sensitive sources by a further 10 Ml/d by the end of AMP7 (2025). This is lower than our forecasts at PR14. Further detail about this is provided in Chapter 8 of this report.

15.4 Individual Schemes by Water Resource Zone

We have set out below a list of the individual schemes that we propose to implement organised by the water resources zone (for DYAA) to which they relate, along with a brief scheme description.

15.4.1 Water Resource Zone 1

The options in WRZ1 for our **Preferred Plan (PP)** are presented in Table 72.

Table 72: PP options for WRZ1

Option Type	Scheme Name	Delivery Year	Scheme Description
Leakage	AFF-LEA-WRZ1-1008 : OPTION 1008 policy 3: comm pipe renewal	2033	Associated communication pipe replacement (as part of distribution mains renewal)
Leakage	AFF-LEA-WRZ1-1009 : OPTION 1009 policy 2: mains & comm pipe renewal	2045	Complete pipe mains renewal (distribution and communication pipe) at DMA level
Leakage	AFF-LEA-WRZ1-1011 : Option 1011 Trunk Mains Leakage	2020	This option considers more points at which to measure leakage and improvements in how it is measured
Leakage	AFF-LEA-WRZ1-ALCS1	2020	Active leakage control, planned increases in manpower and resources to detect leakage
Leakage	AFF-LEA-WRZ1-ALCS2	2025	Active leakage control, planned increases in manpower and resources to detect leakage
Metering	AFF-MET-WRZ1-0531 : Metering of unmeasured non-household properties	2020	Installation of meters in non-household premises
Metering	AFF-MET-WRZ1-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (as automated meter readings), preceded by AFF-MET-WRZ1-1010
Metering	AFF-MET-WRZ1-1010 : Street level PHC	2020	Use of existing network data, fast logging and live network hydraulic models to estimate consumption at sub-DMA (street level)
Company transfer	AFF-CTR-WRZ1-1097 : BATC to BOXT	2071	An intra-zonal (WRZ1) transfer to transfer water (north) post treatment, linked to (AFF-NTW-WRZ1-1011)
New treatment works	AFF-NTW-WRZ1-1011 : HARE New Treatment Works	2071	An increase in treatment capacity to accommodate a new raw water transfer (AFF-RTR-WRZ1-1007)
Import/export transfer	AFF-RTR-WRZ1-1007 : SUNN to HARE Transfer (50Ml)	2071	A new raw water import to WRZ1 linked to a new River Thames abstraction (and a regional solution). Treated at AFF-NTW-WRZ1-1011

By the end of 2025 demand is reduced by 2.8 Ml/d through leakage options involving trunk mains leakage, communications pipe renewal and active leakage control (which is searching for unseen leaks). This takes WRZ1 below the economic level of leakage by 9 Ml/d. Metering options include metering unmeasured non-household properties, street level PHC (Fast Data Option) and compulsory fixed network metering reducing demand by a 1.5 Ml/d by the 2025.

15.4.2 Water Resource Zone 2

The options in WRZ2 for our **PP** are presented in Table 73.

Table 73: PP options for WRZ2

Option Type	Scheme Name	Delivery Year	Scheme Description
Existing groundwater	AFF-EGW-WRZ2-0087 : SHAK Road Source Optimisation	2022	Licence disaggregation & infrastructure upgrade.
Leakage	AFF-LEA-WRZ2-1008 : OPTION 1008 policy 3: comm pipe renewal	2020	Associated communication pipe replacement (as part of distribution mains renewal)
Leakage	AFF-LEA-WRZ2-1011 : Option 1011 Trunk Mains Leakage	2020	This option considers more points at which to measure leakage and improvements in how it is measured
Leakage	AFF-LEA-WRZ2-1012 : OPTION 1012 POLICY 2: MAINS & COMM PIPE RENEWAL - on selected DMAs	2024	Communication pipe replacement as part of mains renewal
Leakage	AFF-LEA-WRZ2-ALCS1	2020	Active leakage control, planned increases in manpower and resources to detect leakage
Leakage	AFF-LEA-WRZ2-ALCS2	2025	Active leakage control, planned increases in manpower and resources to detect leakage
Metering	AFF-MET-WRZ2-0531 : Metering of unmeasured non-household properties	2020	Installation of meters in non-household premises
Metering	AFF-MET-WRZ2-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (as automated meter readings), preceded by AFF-MET-WRZ2-1010
Metering	AFF-MET-WRZ2-1010 : Street level PHC	2020	Use of existing network data, fast logging and live network hydraulic models to estimate consumption at sub-DMA (street level)
New groundwater	AFF-NGW-WRZ2-0120 : POOR, RUIS & NORT Treatment Scheme	2024	Licence disaggregation and recommissioning of existing boreholes

By the end of 2025 demand is reduced by 4.7 Ml/d through leakage options involving trunk mains leakage, communications pipe renewal and active leakage control (which is searching for unseen leaks). Metering options include metering unmeasured non-household properties, street level PHC and compulsory fixed network metering reducing demand by a 2 Ml/d by the 2025. Groundwater options deliver 11.6 Ml/d additional supply to WRZ2 by the end of 2025.

In order to close the predicted future demand deficit in the CLAY, WAT and STAL HDZs, in WRZ 2 it is recommended to increase the capacity of the ICKE booster from 70Ml/d to 75Ml/d. This will maximise the HWFS surface water output to its full capacity. ICKE booster transfers water from the HARE HDZ into the ARKL HDZ and pumps directly into the ARKL trunk main. The trunk main runs through the CLAY HDZ and has several cross connections with that zone. To enable increased transfer from the ARKL trunk main into the CLAY zone it is also recommended to upsize three of those cross connections to a maximum combined transfer capacity of 48Ml/d from the ARKL trunk main into the CLAY zone. CLAY zone has a direct connectivity with other two zones (WAT and STAL) with potential future demand deficits. Increased transfer into the CLAY zone will enable the water to be moved further into the other two zones in order to close the future demand deficits.

15.4.3 Water Resource Zone 3

The options in WRZ3 for our **PP** are presented in Table 74.

Table 74: PP options for WRZ3

Option Type	Scheme Name	Delivery Year	Scheme Description
New groundwater	AFF-NGW-WRZ3-1068 : RUNGS (AMP7 LGS Borehole)	2024	A new borehole in the Lower Greensand aquifer
New groundwater	AFF-NGW-WRZ3-1075 : NOMA Increased Abstraction	2023	Increasing licence rate (licence amendment).
Metering	AFF-MET-WRZ3-0531 : Metering of unmeasured non-household properties	2020	Installation of meters in non-household premises
Metering	AFF-MET-WRZ3-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (as automated meter readings), preceded by AFF-MET-WRZ3-1010
Metering	AFF-MET-WRZ3-1010 : Street level PHC	2020	Use of existing network data, fast logging and live network hydraulic models to estimate consumption at sub-DMA (street level)
Leakage	AFF-LEA-WRZ3-1011 : Option 1011 Trunk Mains Leakage	2020	This option considers more points at which to measure leakage and improvements in how it is measured
Leakage	AFF-LEA-WRZ3-1008 : OPTION 1008 policy 3: comm pipe renewal	2022	Associated communication pipe replacement (as part of distribution mains renewal)
Leakage	AFF-LEA-WRZ3-1009 : OPTION 1009 policy 2: mains & comm pipe renewal	2026	Complete pipe mains renewal (distribution and communication pipe) at DMA level
Leakage	AFF-LEA-WRZ3-ALCS1	2020	Active leakage control, planned increases in manpower and resources to detect leakage
Leakage	AFF-LEA-WRZ3-ALCS2	2025	Active leakage control, planned increases in manpower and resources to detect leakage

By the end of 2025 demand is reduced by 2.7 Ml/d through leakage options involving trunk mains leakage, communications pipe renewal and active leakage control (which is searching for unseen leaks). Metering options include metering unmeasured non-household properties, street level PHC and compulsory fixed network metering reducing demand by a 2.7 Ml/d by the 2025. Groundwater options deliver 6 Ml/d additional supply to WRZ3 by the end of 2025.

15.4.4 Water Resource Zone 4

The options in WRZ4 for our **PP** are presented in Table 75.

Table 75: PP options for WRZ4

Option Type	Scheme Name	Delivery Year	Scheme Description
New groundwater	AFF-NGW-WRZ4-0624 : Canal and River Trust and GSK Boreholes	2070	Obtaining Lower Greensand water from third parties.
Reservoir	AFF-RES-WRZ4-0832 : BREN Reservoir	2052	Using a third party reservoir within the Affinity Water supply area.
Import / export transfer	AFF-RTR-WRZ4-1038 : SUNN to HWFS 2 (50Ml/d)	2055	A new raw water import to WRZ4 linked to a new River Thames abstraction (and a regional solution). Treated at AFF-NTW-WRZ4-1003 : HWFS 2
New treatment works	AFF-NTW-WRZ4-1003 : HWFS 2 New Treatment Work	2055	Option to treat an increase in raw water. Resilience scheme too.
Metering	AFF-MET-WRZ4-0531 : Metering of unmeasured non-household properties	2020	Installation of meters in non-household premises
Metering	AFF-MET-WRZ4-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (as automated meter readings), preceded by AFF-MET-WRZ4-1010
Metering	AFF-MET-WRZ4-1010 : Street level PHC	2020	Use of existing network data, fast logging and live network hydraulic models to estimate consumption at sub-DMA (street level)
Leakage	AFF-LEA-WRZ4-1011 : Option 1011 Trunk Mains Leakage	2020	This option considers more points at which to measure leakage and improvements in how it is measured
Leakage	AFF-LEA-WRZ4-1012 : OPTION 1012 POLICY 2: MAINS & COMM PIPE RENEWAL - on selected DMAs	2021	Communication pipe replacement as part of mains renewal
Leakage	AFF-LEA-WRZ4-ALCS1	2020	Active leakage control, planned increases in manpower and resources to detect leakage
Leakage	AFF-LEA-WRZ4-ALCS2	2025	Active leakage control, planned increases in manpower and resources to detect leakage

By the end of 2025 demand is reduced by 3 Ml/d through leakage options involving trunk mains leakage, communications pipe renewal and active leakage control (which is searching for unseen leaks). This takes WRZ4 below the economic level of leakage by 1.7 Ml/d. Metering options include metering unmeasured non-household properties, street level PHC and compulsory fixed network metering reducing demand by a 4.7 Ml/d by the 2025. Groundwater options and a reservoir scheme are selected later in the planning period to deliver additional supply to WRZ4. A new import scheme is selected, which is linked to a regional source of water, comprising of a new River Thames abstraction with new transfer and treatment capacity.

15.4.5 Water Resource Zone 5

The options in WRZ5 for our **PP** are presented in Table 76.

Table 76: PP options for WRZ5

Option Type	Scheme Name	Delivery Year	Scheme Description
Existing groundwater	AFF-EGW-WRZ5-0882 : WEND Upgrade	2021	Removal of network/demand constraint.
Metering	AFF-MET-WRZ5-0531 : Metering of unmeasured non-household properties	2020	Installation of meters in non-household premises
Metering	AFF-MET-WRZ5-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (automated readings), preceded by AFF-MET-WRZ5-1010
Metering	AFF-MET-WRZ5-1010 : Street level PHC	2020	Use of existing network data, fast logging and live network hydraulic models to estimate consumption at sub-DMA (street level)
Leakage	AFF-LEA-WRZ5-1011 : Option 1011 Trunk Mains Leakage	2020	This option considers more points at which to measure leakage and improvements in how it is measured
Leakage	AFF-LEA-WRZ5-1008 : OPTION 1008 policy 3: comm pipe renewal	2047	Associated communication pipe replacement (as part of distribution mains renewal)
Leakage	AFF-LEA-WRZ5-ALCS1	2020	Active leakage control, planned increases in manpower and resources to detect leakage
Leakage	AFF-LEA-WRZ5-ALCS2	2025	Active leakage control, planned increases in manpower and resources to detect leakage

By the end of 2025 demand is reduced by 1.3 Ml/d through leakage options involving trunk mains leakage and active leakage control (which is searching for unseen leaks). Metering options include metering unmeasured non-household properties, street level PHC and compulsory fixed network metering reducing demand by a 1.3 Ml/d by the 2025. A groundwater option delivers 2 Ml/d additional supply to WRZ5 by 2025.

15.4.6 Water Resource Zone 6

The options in WRZ6 for our **PP** are presented in Table 77.

Table 77: PP options for WRZ6

Option Type	Scheme Name	Delivery Year	Description
Import/ export transfer	AFF-RTR-WRZ6-1094 : EGHS to Surrey Hills Reduction (10Ml/d)	2020	A reduction to an existing export licence
Metering	AFF-MET-WRZ6-0531 : Metering of unmeasured non-household properties	2020	Installation of meters in non-household premises

Option Type	Scheme Name	Delivery Year	Description
Metering	AFF-MET-WRZ6-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (automated readings), preceded by AFF-MET-WRZ6-1010
Metering	AFF-MET-WRZ6-1010 : Street level PHC	2020	Use of existing network data, fast logging and live network hydraulic models to estimate consumption at sub-DMA (street level)
Leakage	AFF-LEA-WRZ6-1011 : Option 1011 Trunk Mains Leakage	2050	This option considers more points at which to measure leakage and improvements in how it is measured
Leakage	AFF-LEA-WRZ6-ALCS1	2020	Active leakage control, planned increases in manpower and resources to detect leakage
Leakage	AFF-LEA-WRZ6-ALCS2	2025	Active leakage control, planned increases in manpower and resources to detect leakage
Groundwater	AFF-EGW-WRZ6-0173	2054	Optimising an existing source.

By the end of 2025 demand is reduced by 1 Ml/d through leakage options involving trunk mains leakage and active leakage control (which is searching for unseen leaks). This takes WRZ6 below the economic level of leakage by 8 Ml/d. Metering options include metering unmeasured non-household properties, street level PHC and compulsory fixed network metering reducing demand by a 2.5 Ml/d by the 2025. We are also modelling a reduction to an existing export transfer to a neighbouring water company from WRZ6.

15.4.7 Water Resource Zone 7

The options in WRZ7 for our **PP** are presented in Table 78.

Table 78: PP options for WRZ7

Option Type	Scheme Name	Delivery Year	Scheme Description
Existing groundwater	AFF-EGW-WRZ7-0306 : COWL Upgrade	2062	Upgrade existing source to meet licenced quantity.
Existing groundwater	AFF-EGW-WRZ7-0629 : LYEO Licence Variation	2021	To obtain agreement to increase abstraction equal to the amount 'returned'
Existing groundwater	AFF-EGW-WRZ7-0908 : TAPS-Licence Variation	2022	Recommissioning of existing source for resilience purposes.
Removal of network constraint	AFF-RNC-WRZ7-0900 : Dover Constraint Removal	2050	Removing a constraint to improve operational use
Import/export transfer	AFF-RTR-WRZ7-0639 : DEAI Continuation After 2020	2020	A continuation of an existing inter-company supply agreement
Import/export transfer	AFF-RTR-WRZ7-0909 : BARI Continuation (After 2019/20)	2020	A continuation of an existing inter-company supply agreement
Leakage	AFF-LEA-WRZ7-1011 : Option 1011 Trunk Mains Leakage	2073	This option considers more points at which to measure leakage and improvements in how it is measured

By the end of 2025 supply is increased in WRZ7 through groundwater options by 1 Ml/d. WRZ7 will operate below the economic level of leakage by 1 Ml/d by 2025. We intend to continue with our existing bulk supply agreements from 2020 onwards.

15.5 Water Balance

Table 79 shows the overall impact of chosen options within our **PP** on the balance between demand for water and the water that is available for use, to show the overall impact of each of the types of measure that we are proposing.

Table 79: Impact of option measures in our PP on the overall water balance (Ml/d)

Component	First year 2020/21	End of AMP7 2024/25	End of AMP8 2029/30	25 year period 2044/45	40 year period 2059/60	80 year period 2079/80
Baseline Demand (BL DI)	**910.57**	**889.14**	**902.47**	**957.40**	**1010.08**	**1082.76**
Leakage reduction	2.88	15.71	24.78	26.37	28.76	28.90
Metering reduction	6.01	14.81	35.86	49.96	50.67	50.67
Final Plan Demand (FP DI)	**901.68**	**858.61**	**841.82**	**881.08**	**930.65**	**1003.19**
Final Plan Target Headroom (THR)	95.69	93.79	91.44	84.40	77.43	68.22
Final Plan (DI + THR)	**997.37**	**952.40**	**933.26**	**965.48**	**1008.08**	**1071.41**
Baseline Water Available for Use (BL WAFU)	**1003.55**	**956.65**	**977.18***	**978.27**	**974.16**	**968.76**
Groundwater	0	20.44	20.44	20.44	20.54	25.06
Surface water	0	0	0	0	7.5	7.5
Transfers	10.07	10.07	10.07	0.07	50.97	100.97
Final Plan Water Available for Use (FP WAFU)	**1013.62**	**987.16**	**1007.69**	**998.78**	**1053.17**	**1102.29**

**Includes additional 26 Ml/d from ANGL*

15.6 Costs of our Preferred Plan

The following table shows our overall planned level of capital investment in our **PP** over different time-frames. The costs are shown in the five-year period in which they are incurred, and are presented in 2017/18 prices. The costs shown include capital investment, operational expenditure, capital maintenance, and environmental, social and carbon costs.

Table 80: Summary of draft PP costs

Total Expenditure, £million	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35	AMP10 2035-40	AMP11 2040-45	25 year Total 2020-45	60 year Total 2079/80
Baseline WSP	**67.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**67.00**
Leakage	46.32	29.74	26.82	22.00	18.00	142.88	208.57
Unmeasured non-household metering	0.28	0.22	0.19	0.16	0.13	0.98	1.50
Smart Metering	0.00	39.74	43.79	43.42	25.79	152.74	255.47
Water efficiency	6.94	4.36	0.02	0.01	0.01	11.34	11.38
Demand schemes	**53.54**	**74.06**	**70.80**	**65.59**	**43.94**	**307.93**	**476.92**
Supply (ground & surface water)	4.68	11.06	9.31	7.84	6.62	39.52	94.20
Bulk transfers	0.18	0.00	0.00	0.00	0.00	0.18	131.60
Network improvements	0.00	0.00	0.00	0.00	0.00	0.00	0.22
Supply schemes	**4.86**	**11.06**	**9.31**	**7.84**	**6.62**	**39.70**	**226.33**
Total per AMP for Supply and Demand	**58.40**	**85.12**	**80.12**	**73.43**	**50.56**	**347.63**	**703.25**
Capital and network reinforcements	17.70	0.00	0.00	0.00	0.00	17.70	17.70
Sub HDZ reinforcements	20.00	0.00	0.00	0.00	0.00	20.00	20.00
Estimated treatment at SUND	30.94	24.76	0.00	0.00	0.00	55.70	55.70
Delivery of SRs	**68.64**	**24.76**	**0.00**	**0.00**	**0.00**	**93.40**	**93.40**
Morphological works	22.00	0.00	0.00	0.00	0.00	22.00	22.00
WINEP studies and monitoring	12.00	0.00	0.00	0.00	0.00	12.00	12.00
Estimated treatment at HWFS 2	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Estimated treatment at HARE	0.00	0.00	0.00	0.00	0.00	0.00	3.80
GRAND TOTAL	**228.04**	**109.88**	**80.12**	**73.43**	**50.56**	**475.03**	**1001.45**

15.6.1 Draft Preferred Plan Cost Breakdown

In this section we breakdown the costs for CAPEX, OPEX and environmental and social carbon costs. The costs for treatment and deliverability of sustainability reductions are not included within this breakdown.

Customer bills are affected differently by capital and operational expenditure. The total cost of our **PP** is made up of a number of components:

- capital investment;
- operational expenditure;
- capital maintenance;
- environmental, social and carbon costs.

In this section, we provide a more detailed breakdown of these components. The costs shown in the five-year period in which they occur are displayed in 2017/18 prices.

Capital investment costs

The Capex investment costs to deliver our **PP** throughout the planning period is presented in Table 81.

Table 81: Capital investment of our PP by five-year period

Capital Expenditure, £million	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35	AMP10 2035-40	AMP11 2040-45	25 year Total 2020-45	60 year Total 2079/80
Baseline WSP	**60.93**	**0.00**	**0.00**	**0.00**	**0.00**	**60.93**	**60.93**
Leakage	31.69	8.88	7.12	5.71	4.58	57.97	73.83
Unmeasured non-household metering	0.34	0.28	0.24	0.20	0.17	1.23	1.89
Smart Metering	0.00	29.69	25.00	21.05	17.72	93.47	162.68
Water efficiency	0.02	0.02	0.02	0.01	0.01	0.08	0.12
Demand schemes	**32.05**	**38.87**	**32.37**	**26.97**	**22.48**	**152.74**	**238.51**
Supply (ground & surface water)	3.22	7.08	5.96	5.02	4.23	25.51	61.84
Bulk transfers	0.00	0.00	0.00	0.00	0.00	0.00	113.66
Network improvements	0.00	0.00	0.00	0.00	0.00	0.00	0.12
Supply schemes	**3.22**	**7.08**	**5.96**	**5.02**	**4.23**	**25.51**	**175.62**
Total per AMP for Supply and Demand	**35.27**	**45.95**	**38.33**	**31.99**	**26.71**	**178.25**	**414.13**

NB: These costs do not include a Capex costs for network reinforcements at HDZ level, delivery of sustainability reductions, treatment at HWFS2, treatment at SUND or treatment at HARE.

Operational Expenditure

The Opex costs to deliver our **PP** throughout the planning period is presented in Table 82.

Table 82: Operational expenditure of our PP by five-year period

Operational Expenditure, £million	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35	AMP10 2035-40	AMP11 2040-45	25 year Total 2020-45	60 year Total 2079/80
Baseline WSP	**5.87**	**0.00**	**0.00**	**0.00**	**0.00**	**5.87**	**5.87**
Leakage	13.49	20.95	19.77	16.36	13.48	84.05	133.83
Unmeasured non-household metering	-0.06	-0.06	-0.05	-0.04	-0.04	-0.25	-0.39
Smart Metering	0.00	10.04	18.78	22.37	8.07	59.27	92.80
Water efficiency	6.92	4.34	0.00	0.00	0.00	11.26	11.26
Demand schemes	**20.35**	**35.27**	**38.50**	**38.69**	**21.51**	**154.32**	**237.49**
Supply (ground & surface water)	0.90	1.90	1.60	1.34	1.13	6.87	15.13
Bulk transfers	0.18	0.00	0.00	0.00	0.00	0.18	16.39
Network improvements	0.00	0.00	0.00	0.00	0.00	0.00	0.11
Supply schemes	**1.08**	**1.90**	**1.60**	**1.34**	**1.13**	**7.05**	**31.63**
Total per AMP for Supply and Demand	**21.43**	**37.17**	**40.10**	**40.03**	**22.64**	**161.37**	**269.12**

NB: These costs do not include a Capex costs for network reinforcements at HDZ level, delivery of sustainability reductions, treatment at HWFS2, treatment at SUND or treatment at HARE.

Environmental, Social and Carbon Costs

The environmental, social and carbon costs to deliver our **PP** throughout the planning period are presented in Table 83.

Table 83: Environmental, social and carbon costs of our PP by five-year period

Environmental, Social & Carbon costs, £million	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35	AMP10 2035-40	AMP11 2040-45	25 year Total 2020-45	60 year Total 2079/80
Baseline WSP	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Leakage	1.14	-0.08	-0.07	-0.07	-0.06	0.86	0.92
Unmeasured non-household metering	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Smart Metering	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water efficiency	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Demand schemes	**1.14**	**-0.08**	**-0.07**	**-0.07**	**-0.06**	**0.86**	**0.92**
Supply (ground & surface water)	0.55	2.09	1.76	1.48	1.26	7.14	17.23
Bulk transfers	0.00	0.00	0.00	0.00	0.00	0.00	1.86
Network improvements	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Supply schemes	**0.55**	**2.09**	**1.76**	**1.48**	**1.26**	**7.14**	**19.08**
Total per AMP for Supply and Demand	**1.69**	**2.00**	**1.69**	**1.41**	**1.21**	**8.00**	**20.00**

NB: These costs do not include a Capex costs for network reinforcements at HDZ level, delivery of sustainability reductions, treatment at HWFS2, treatment at SUND or treatment at HARE.

15.7 What our Preferred Plan means for Customers

15.7.1 Overview

Our **PP** is best value for customers and the environment as we believe this is a deliverable plan which moves us to a more resilient position in terms of security of supply. Our **PP** shows we can maintain our supply demand balance for our growing population under our newly defined worst historic drought with a 1 in 60 to 80 annual probability of occurrence (or 1.25% to 1.7% chance of occurring in any given year) under a changing climate, whilst maintaining our levels of service for use of drought restrictions such as temporary use bans and non essential use bans to not more than 1 in every 40 years on average.

Our **PP** includes a balanced and varied set of options such as demand management through leakage and metering to resource optimisation and new transfers which we believe delivers the best value plan for customers. Our **PP** incorporates objectives other than least cost when considering the potential options.

15.7.2 Balancing supply and demand

Our **PP** resolve the supply/demand balance with the implementation of a range of option types as illustrated in Figure 59.

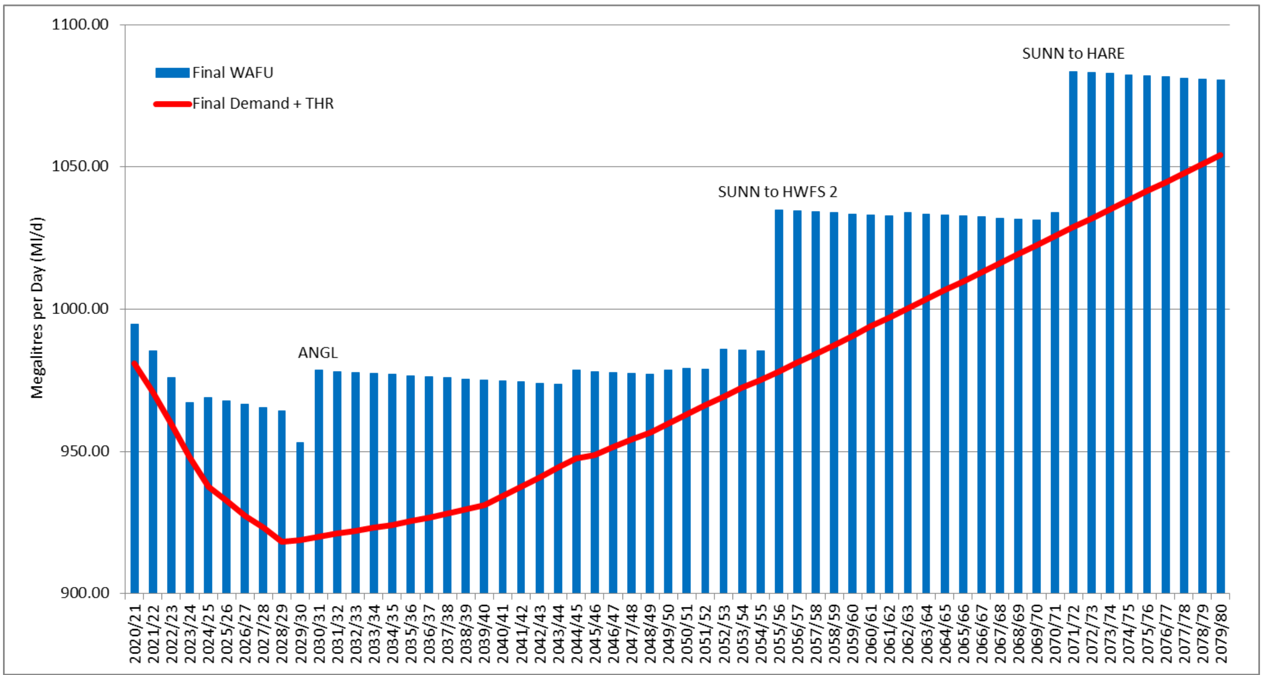

Figure 59: Supply / Demand balance for our PP

15.7.3 Impact on Customer Bills

The impact on customer bills will be calculated and consulted on separately as part of the Business Plan consultation as it is too early and uncertain to determine the impact on customers' bills of our dWRMP19 proposals.

15.8 What our Preferred Plan means for the Environment

15.8.1 Overview

Our **PP** includes options such as demand management through leakage, metering, resource optimisation and development and new transfers. Our **PP** will be able to withstand our newly defined worst historic drought (1.25% to 1.7% chance of occurring in any given year) whilst leaving an additional 10 Ml/d of water in the environment in locations which benefit river flows and ecology to meet River Basin Management Plan and WFD objectives. It also means we will work towards being resilient to withstand our worst historic drought without the use of supply-side drought permits and drought orders. This means we will try not to use additional supplies granted under a drought permit/order more than one in every 60 years on average. This is a move from 1 in every 40 years on average in our previous WRMP and DMP. This is dependent upon improvements in network connectivity at the sub WRZ scale, as described in Section 15.3.6.

We have undertaken a Strategic Environmental Assessment to ensure our **PP** has fully taken account of environmental consideration in the decision making process.

15.8.2 SEA: Informing the decision making

An important aspect of the development of our **PP** and **AP**, is where we have integrated our SEA, to enable information flows to occur within our decision making process. A shortlisting exercise was undertaken as described in Chapter 13 as part of the options appraisal. We were then able to re-model with the exact same planning conditions, but excluding all options which were assessed as having a major or moderate (significant) negative impact on operational effects for any SEA objective.

The results from this SEA-modelling exercise are in Table 84 which presents the initial model run portfolios (IR) alongside the SEA portfolios (shortlisted 11 portfolios only). It can be noted that in the SEA model run, there are no significant negative effects.

The objective with this modelling is to prevent the model from selecting options with a significant negative effect, where this occurs it can be seen that more than one replacement option is required to offset the loss of yield or saving that the initial option was providing. This results in an increased cost to the portfolio.

The following is a list of key information that we used to inform our decision making on the selection of our **PP**:

- when we reviewed the results of the SEA modelling, we were able to say that our **PP** portfolio was the least cost of all those modelled as part of SEA and resolved the planning deficits with a deliverable set of options
- the main difference between our **PP** portfolio and the next least cost portfolio was that the 100 Ml/d import from the River Thames was de-selected, and split between the 50 Ml/d import from the River Thames and an Anglian import to WRZ3
- generally there seemed to be more of a reliance on regional imports in our next least cost portfolio, possibly to offset some of the new local source options.

Table 84: Number of options selected in both initial portfolios (IR) and SEA ran portfolios (SEA) with significant positive and negative effects.

Short-listed Portfolio	Total supply options within each WRZ							Total supply options	Total demand options	sig -ve effects	sig +ve effects
	WRZ1	WRZ 2	WRZ 3	WRZ 4	WRZ 5	WRZ 6	WRZ7				
IR 0	2	2	7	2	2	4	6	25	72	3	1
SEA 0	2	1	5	2	2	4	6	22	78	0	1
IR 1	2	2	5	3	2	4	6	24	72	2	2
SEA 1	2	1	5	2	2	4	6	22	80	0	1
IR 2	2	2	5	2	2	4	7	24	73	2	2
SEA 2	2	1	4	2	2	4	7	22	77	0	2
IR 3	2	2	7	3	2	4	7	27	78	3	2
SEA 3	2	1	5	2	2	4	8	24	84	0	2
IR 4	2	2	6	2	2	4	8	26	73	3	2
SEA 4	2	1	4	2	2	4	7	22	81	0	2
IR 46	3	2	2	3	1	2	6	19	72	3	2
SEA 46	2	1	5	3	2	4	6	23	69	0	2
IR 47	2	2	5	2	2	4	7	24	68	2	2
SEA 47	2	1	4	2	2	4	7	22	68	0	2
IR 48	2	2	7	4	2	4	7	28	83	4	2
SEA 48	2	1	5	2	2	4	8	24	85	0	2
IR 139	2	2	5	3	2	4	6	24	65	2	2
SEA 139	2	1	4	3	2	4	6	22	61	0	2
IR 145	2	2	5	3	2	4	6	24	60	2	2
SEA 145	2	1	5	2	2	4	6	22	78	0	1
IR 148	2	2	7	3	2	4	6	26	74	3	2
SEA 148	2	1	4	3	2	4	6	22	61	0	2

Our **PP** portfolio had the lowest investment cost compared to all of the shortlisted portfolios, but also the highest cost on existing water available for use, or use of existing sources. This means that it makes full utilisation of existing sources prior to development of new sources, and is likely to be the most efficient with regard to use of existing sources. This means we consider the **PP** portfolio to be best value, as it was not only least cost, but also:

- offered a portfolio of options which was shortlisted on a range of criteria, including SEA objectives; and
- offered a more deliverable mix of demand management and groundwater in the near term, and larger infrastructure schemes in the longer term than the SEA alternatives.

It is important to note that SEA helps to inform the plan making, and along with cost, planning judgements, uncertainty on deliverability and feedback from consultation, forms part of the overall decision making.

15.8.3 Water Framework Directive

As part of the Strategic Environmental Assessment (SEA) process, our constrained options list was screened to identify options which may require preliminary assessment. 53 options were taken forward for this preliminary WFD assessment which found that 28 of the 53 had the potential for a risk in deterioration in status or potential, or where measures to achieve good status may be prevented. These indicate where further investigation or discussion with the Environment Agency would be required to ensure compliance with WFD.

Seven of the constrained options were identified that may provide a potential improvement to status/potential or may allow good status/potential to be achieved, and six options actually offered both negative and positive impacts. Our Technical Report 4.11: Strategic Environmental Assessment Report, provides further details regarding the actual options.

Where options are taken forward into the final WRMP19 that have the potential to impact on the WFD status, the next steps will be to undertake surveys and a more comprehensive WFD assessment prior to the detailed design stage. This would allow for appropriate mitigation to be incorporated within the options detailed design.

15.8.4 Habitats Regulations Assessment

The HRA initially found 13 constrained options that would require further assessment before they could be dismissed as posing no risk of likely significant effect when considered alone. There were an additional eight options that could have a cumulative effect on water levels within the River Lee and River Thames catchments as they are associated with increased abstraction.

This does not mean that a significant effect is expected, but rather that appropriate assessment was required to explore the potential for effects in more detail.

Following this assessment, it was considered that the majority of constrained options will not result in adverse effects on European sites, however three constrained options were still considered to have potential for an adverse effect that cannot be dismissed without further investigation at scheme development stage, these options relate to WRZ7

Similarly, five schemes within the River Lee catchment involve proposals to increase peak demand abstraction while reducing average abstraction. They are based on a conclusion that the combinations of reduction in average abstraction and sustainability reductions upstream will collectively result in a net increase in water within the Lee catchment even after these peak demand schemes are implemented.

A combination of these schemes may prove to be deliverable without an adverse effect on the Lee Valley SPA or Ramsar site, but this cannot be confirmed until more detailed investigations are undertaken as these schemes are developed. Our Technical Report 4.12 provides more detail with regard to the actual options and next steps.

15.8.5 Carbon

The Climate Change Act 2008 sets out legally binding commitments to cut greenhouse gas emissions in order to reduce the effects of climate change. Water companies have a part to play in this overall ambition, and accounting for the cost of carbon in decision making is a key way of achieving this.

We have calculated the carbon footprint of our baseline and compared it to our **PP**. The results in Figure 60 shows that carbon emissions from our **PP** remain below the baseline for the entire planning period with the exception of the first year. This is due to a heavy emphasis on leakage reduction options for which carbon costs are predominantly applied in the first year, when in reality they would be spread out over a number of subsequent years.

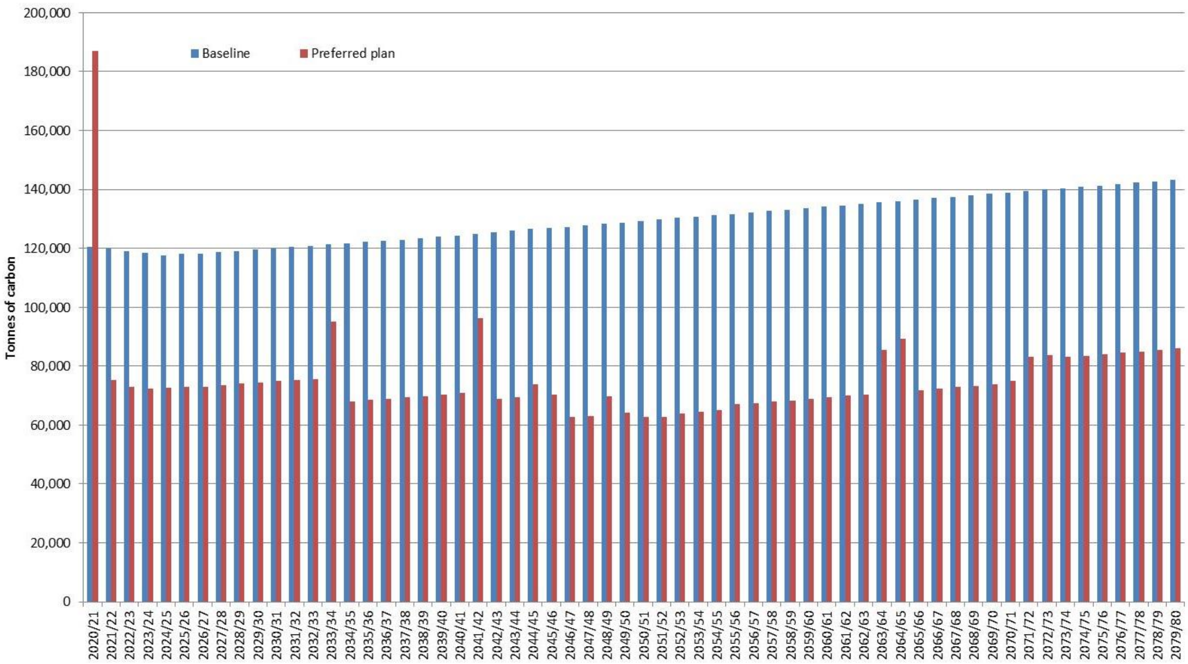

Figure 60: PP carbon footprint, DYAA

15.9 Future Challenges and Uncertainties of our PP

15.9.1 Introduction

We are required to consider the uncertainty of our **PP**. The final planning headroom assessment accounts for the uncertainties that relate to our **PP** solution, for both supply side and demand side options.

15.9.2 Uncertainty of our Preferred Plan in headroom

As part of the EBSD methodology we only shortlisted portfolios that met thresholds that had the lowest aggregated uncertainty on yield and cost, through engineering judgement. Alongside that exercise, we also assessed our **PP** options for best estimates of yield (or water saved), bounded by upper and lower values, which represented the minimum and maximum yield per option. These uncertainties are detailed in Technical Report 3.2: Headroom.

The application of final planning headroom resulted in three types of headroom change on a zonal level: upwards, downwards or none at all. It would be expected that some upward change may occur, to account for an increased level of uncertainty, where they are negatively skewed. In some instances there may be little or no change, depending on the options (which may be small or may cancel each other out) and the bounded values are symmetric. However, in other cases, the uncertainties around supply-side options are positively skewed. This means that there is a higher probability of achieving more yield than predicted. This will result in a negative final planning headroom. This, coupled with reducing headroom in the later years of the planning horizon (post 2060) has in some cases led to increasing certainty, which is somewhat counter intuitive and an unexpected outcome. Table 85 and Table 86 summarises the effect of the supply side option uncertainties on final plan target headroom.

Table 85: DYAA - Supply option uncertainties

	Symmetric	Non symmetric		Headroom change
		Negatively skewed	Positively skewed	
WRZ1	Y			None
WRZ2		Y		UP
WRZ3		Y		UP
WRZ4			Y	DOWN
WRZ5	Y			None
WRZ6		Y		UP
WRZ7		Y		UP
WRZ8				

Table 86: DYCP - Supply option uncertainties

	Symmetric	Non symmetric		Headroom change
		Negatively skewed	Positively skewed	
WRZ1	Y			None
WRZ2		Y		UP
WRZ3		Y		UP
WRZ4			Y	DOWN
WRZ5		Y		UP
WRZ6		Y		UP
WRZ7		Y		UP
WRZ8				

Final plan headroom in the dry year scenario is greater than baseline in five out of the eight zones. It is less than baseline target headroom in three zones: WRZ4, WRZ7 (until 2059/60) and WRZ8.

The differences between baseline and final plan headroom for the dry year scenario in WRMP19 are generally smaller than observed in our last plan (fWRMP14). The main driver for this is the reduction in climate change uncertainty.

Final plan headroom in the critical period scenario is greater than baseline throughout the planning period in five out of the eight water resource zones. Final plan headroom in WRZ5 is only greater than baseline for the first 10 years of the planning period in this scenario. Final plan headroom becomes greater than baseline in WRZ4 in 2034/35. Final plan headroom becomes greater than baseline in WRZ8 in 2049/50.

The differences in critical period headroom between baseline and final plan in WRMP19 are similar to WRMP14 for resources zones 1 and 2. The differences are smaller for WRMP19 for resources zones 3, 4 and 8. The differences are larger for WRZs 5, 6, 7. The reasons for these differences vary from zone to zone but include the effect of climate change (zones 3 and 4), reduced supply-side uncertainty (zone 8) and a combination of factors in the remaining zones.

15.10 Conclusion – How Our PP Delivers Our Objectives

Our **PP** is a deliverable plan which moves us to a more resilient position in terms of security of supply whilst delivering significant environmental benefits such as providing further reductions in abstractions as well as avoiding increasing those abstractions in time of drought. In doing so, we believe our **PP** delivers best value for customers and for our environment. We believe our **PP** meets all of our objectives as shown in Table 87.

Table 87: Measures in our PP against each objective

Objective	Our Preferred Plan (PP)
To meet the water supply needs of customers over the next 25 years (within an extended 60 year planning window).	Our **PP** satisfies the supply-demand balance for each of our eight water resource zones in both average and peak conditions.
To continue to work collaboratively with other water companies in our regions, in order to share water resources and promote regional coordination.	We have taken a leading role in the Water Resources South East (WRSE), Water Resources East (WRE) and the National Project, working with the Environment Agency and five other water companies to assess strategic water supply opportunities across the region. These explore potential options and cross border supplies from all the water companies, has been a crucial component in the development of our plan. A number of meetings have been held with neighbouring water companies and third parties to discuss existing and potential new transfers.
To be consistent with Water Resources South East (WRSE) outputs and informed by Water Resources East (WRE).	We feel at this stage the comparisons to date indicate that we are broadly aligned with the results that have been issued by WRSE to date, and can be adjusted once our own dWRMP19 consultation has concluded. Our dWRMP19 therefore allows for enough scope to be able to progress with some of the necessary long term needs for a regional multi company solution in a timely manner.
To ensure that our water abstractions are sustainable. .	Our **PP** will deliver a total reduction in abstraction of 10 Ml/d from sources where evidence shows this is most likely to result in tangible environmental improvement. Our **PP** does not use drought permits/orders. This means we would prefer not to use drought permits in a worst historic drought estimated to have a 1 in 60 to 1 in 80 return period. This represents a change in our levels of service for drought permits/orders relating to water supply from greater than one in every 40 years on average to not more than one in every 60 years on average.
To ensure that we can meet the long-term challenges that we face, including drought resilience to our worst historic drought on record.	Our **PP** shows we can maintain our supply demand balance for our growing population under our newly defined worst historic drought with a 1 in 60 to 80 annual probability of occurrence (or 1.25% to 1.7% chance of occurring in any given year) under a changing climate, whilst maintaining our levels of service for use of drought restrictions such as temporary use bans and non essential use bans to not more than 1 in every 40 years on average.
To reduce leakage from water pipes where the savings justify the expenditure and to meet customer expectations.	Our **PP** will deliver reductions in leakage of 11% for the period 2020 to 2025 and maintain 11% for the period 2025 to 2030.

Objective	Our Preferred Plan (PP)
To meet the expectations of customers for restrictions of supply in severe drought conditions.	Our **PP** ensures we have sufficient infrastructure in place to meet our defined levels of service regarding supply restrictions in severe drought conditions. We anticipate using temporary use bans on average once every 10 years and demand side drought orders on average once every 40 years, as stated in our current Drought Management Plan. We have recently consulted on our latest DMP which showed customers were satisfied with these levels of service regarding demand restrictions under drought conditions. If customers would like less restrictions in drought conditions this will require more resources development into the future.
To continue to promote water efficiency to support customers to reduce demand.	Water efficiency is a key part of our water saving programme, providing bespoke advice to households through our continued water saving programme.
To facilitate economic growth by planning for housing and population needs.	We have a statutory duty to supply water to all households within our supply area. Therefore, we undertake a Water Resources Management Plan every five years to plan for population growth in our supply area up to 60 years into the future. Our water supply base is reducing as we are leaving more water in the environment and due to climate change. Therefore, our water resources planning includes significant amounts of demand reductions through metering and leakage reduction and brings in more resources including regional transfers and reservoir options in the longer term.
To extend customer water metering and promote smart metering innovation, where it is cost beneficial.	Continued metering and development of smart metering as well as innovative Fast Data Option which will encourage efficient use of water at a household level.
To take account of potential future uncertainties including growth in customer demand, climate change and higher environmental standards.	The final planning headroom assessment accounts for the uncertainties that relate to our **PP** solution, for both supply side and demand side options from a range of factors.
To make best use of existing resources whilst maintaining water quality at all times.	Maintaining high quality water supply is always a key priority and requirement for us. We have ensured all the water we plan to use meets the water quality standards. Our catchment management programme developed holistic integrated schemes to deliver wider benefits to improve water quality and drought resilience. We have extended our partnering arrangements to mitigate the effect of pesticides and nitrate use.
To support our vision to be the leading community focused water company.	Being community focused is at the heart of what we do. Many of our activities are community focused, such as our water saving programme, water efficiency and catchment management programmes. We regularly liaise closely with community groups regarding important strategic issues central to this plan such as reductions in abstraction, metering and drought restrictions. Our aim is to produce a plan which represents the priorities of customers in each of our communities. We have undertaken a pre-consultation exercise to understand the key priorities for our stakeholders. We will consult publically on our draft WRMP in March 2018 and will take on board feedback before we publish our final WRMP19 in early 2019.

15.10 Details of our PP Parameters

The parameters are as follows in our **PP**:

- **supply** has been recalculated and there has been a significant reduction in available DO to reflect the worst historic drought since 1900

- **headroom** is specified at 95% which is the industry standard value, and reduces across the planning horizon to 60% at 2079/80

- **import/export** allowances have changed linked to regional coordination; -26 Ml/d to Anglian, +10 Ml/d from SE Water, +0.0714 Ml/d from DEAI and + 2 Ml/d at BARI. The EBSD model is able to choose how much of these imports to use under each scenario. These values are discussed in more detail in Technical Report 4.9: Economics of Balancing Supply and Demand Modelling

- **a leakage reduction rate** of 11% for AMP7 only, and maintaining this low level into the future. This is to be reassessed between draft and final following consultation on both our **PP** and **AP**

- **sustainability reductions (SRs) –** planned SRs of 10 Ml/d by the end of AMP7 are included. The values for these parameters are described in detail in Chapter 8 of this report

- **drought return period** is tested at new worst historic of around 1 in 60 to 1 in 80 annual return period

- **demand** uses a medium demand profile into the future with a final DYAA per capita consumption value of 133.97 l/h/d in 2045 which represents a 17% reduction from 2020. This assumes a 18% level of water savings through our WSP, metering and water efficiency activities

- **demand side drought restrictions (TUBs / Drought orders)** is specified at a 3% reduction in household consumption. This is included as part of our new worst historic drought in which our Levels of Service (LoS) for temporary use bans (TUBs) and drought orders for non-essential use is set at 1 in 40 as in our DMP and therefore would be activated in our worst historic drought. The demand savings of 3% is justified from our experience during the 2007 drought. This is discussed in more detail in Technical Report 4.9: Economics of Balancing Supply and Demand Modelling

- **supply side drought measures (drought permits and orders for additional abstraction)**. Our **PP** avoids use of drought permits/orders in a worst historic drought increasing the resilience of our supply. This represents a change in our levels of service for drought permits from a 1 in 40 year return period event to a 1 in 60 to 1 in 80 year return period. Further description of each of the drought management measures and comparison of our levels of service proposed in our **PP** and **AP** are presented in Table 12 in Section 2.11.

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16 Our Alternative Plan and Aspirational Scenarios

Summary

We present an **Alternative Plan (AP)** which includes options for an improved level of service under a severe drought (1 in 200), greater leakage reduction and higher sustainability reductions meeting government and stakeholder aspirations.

We also explore additional aspirational scenarios to reach very low PCC rates and further sustainability reductions going beyond our draft plans. Our Preferred Plan (**PP**) and **AP** along with these aspirational scenarios provide an envelope of possible future solutions, upon which we will consult with our stakeholders and customers in the public consultation phase, to ensure that our final plan represents best value to customers and the environment. This chapter describes the options and costs identified for the **AP** and aspirational scenarios.

16.1 Our Alternative Plan

In addition to our **PP** we present an **AP** that offers solutions to a more challenging future and one that meets Government aspirations for improved resilience to a severe drought to reduce leakage further. Table 6 show the planning conditions of our **AP**.

Table 88: Our AP scenario

Scenario	Demand	Drought permits and orders for additional abstraction	Drought return period resilience included	Total investment costs 2020-2080 (£million NPV)
AP	Medium	Required in AMP7 only	Up to a severe drought (1 in 200)	£1,788.44

An overview of our alternative delivery strategy is shown in the Figure 61.

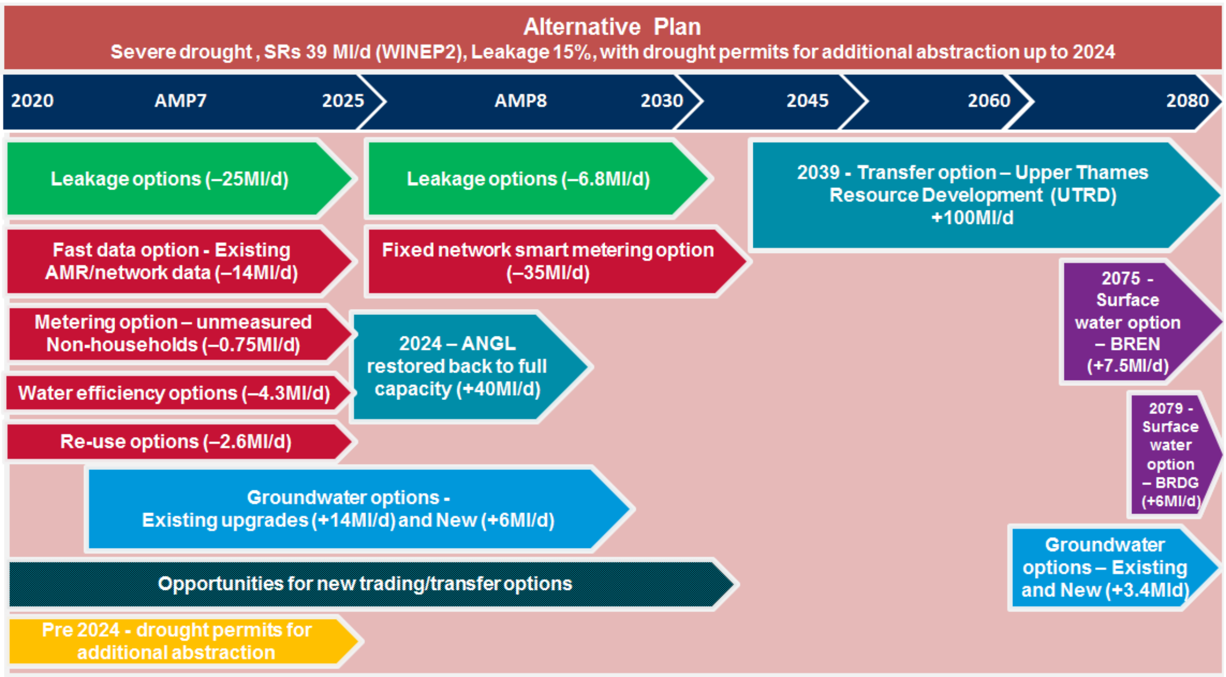

Figure 61: AP delivery strategy

Our **AP** shows some notable differences to our **PP** including:

- further demand management options with a leakage reduction of **25 Ml/d** by increasing the intensity and variety of leakage interventions
- **40 Ml/d** lower utilisation of our import from ANGL until 2024 taking a higher risk profile for climate change in the water available to potentially enable supply deficits in the Anglian region
- avoidance of drought permits and orders for additional abstraction after 2024 for all drought severities up to a 1 in 200 year event. This will mean greater resilience of our supply and reduce the risk of disruption to customers should a severe drought occur
- increasing resilience through investment of a cost effective treatment solution to enable the use of water from ANGL in any zone at full capacity from 2024
- an earlier requirement for groundwater options and UTRD transfer option (from 2039).

Our modelling for the **AP** shows that very high levels of demand management options are needed in AMP7 along with the use of drought permits and orders for additional abstraction to have sufficient supply to meet demand under a severe drought. The risk of this approach is that this level of demand management over such a short timeframe may not be achievable. This is why we have not selected this level of demand management in our **PP**. The investment cost for our **AP** (as shown in the Table 88) increases the total investment by £787 million at 2079 from that of our **PP**. These costs exclude the operating costs of existing sources and existing bulk imports and highlights the need for drought permits and orders for additional abstraction in the early years to provide the extra resilience necessary.

16.2 Demand for Water within our Alternative Plan

Our **AP** includes a final DI + THR of 924 Ml/d in 2045 and 1027 Ml/d in 2080 as shown in Figure **62**. As our **AP** depicts a more challenging future, the SUNN to HWFS2 option is triggered earlier in 2039 rather than 2055 in our **PP**.

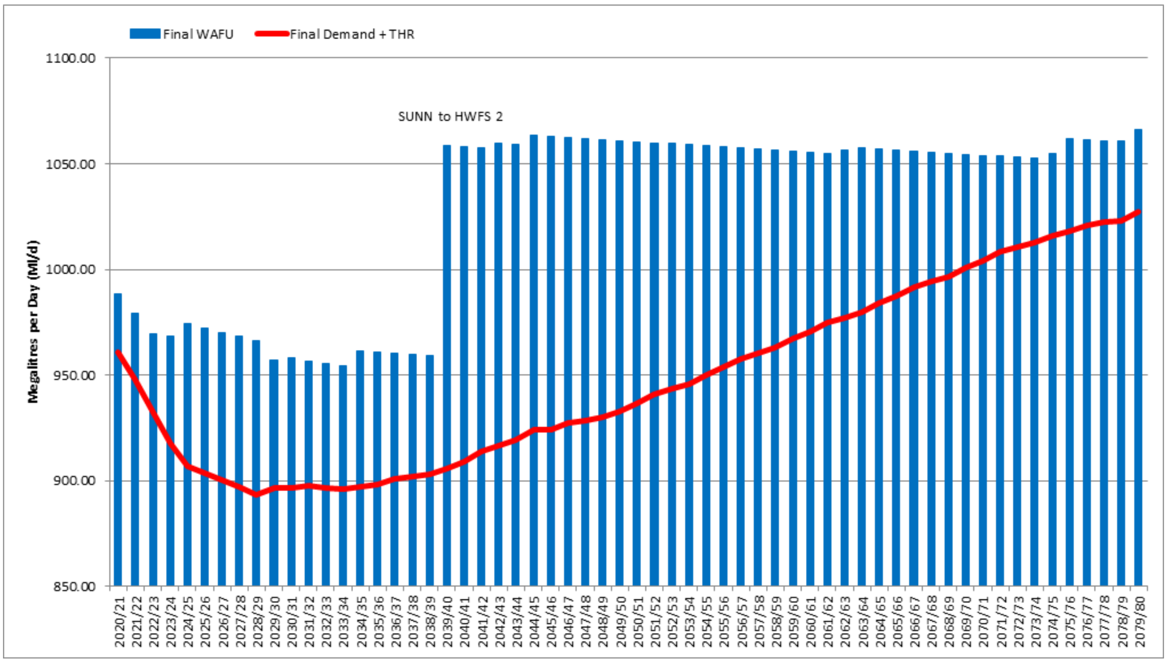

Figure 62: Supply / Demand balance for our AP

16.2.1 AP Leakage

In our **AP** we intend to reduce leakage by 15% in AMP7 (by 2025) and to then keep reducing leakage in subsequent AMPs reaching a 33% reduction by 2080. This is a further 7Ml/d leakage reduction compared to our **PP**. We will consult on this higher level of leakage reduction, seeking customers' views during our public consultation.

16.2.2 AP Metering and Water efficiency

As with our **PP**, we will continue with our water saving programme as well as implement a new innovative demand management option called 'fast data'. This makes use of existing AMR meters in combination with new fast logging and live network hydraulic models to provide customers with surrogate information about their water use. Metered customers will be able to get a much more detailed picture of their water consumption than they currently receive through their six monthly bills. We will also install meters for non-household premises that do not already have them.

Our **AP** further includes a variety of water efficiency options in AMP7, typically for large water users (non-households) which will have some uncertainty in being able to deliver these schemes due to retail separation.

In the longer term, from 2025 - 2035 we plan to roll out the fixed network smart metering option with the aim to have installed smart meters at all properties where possible by the end of the programme and anticipate benefits to extend to 2050. We believe these step changes in metering are the most economic way to meet our supply and demand balance in the immediate future. Metering and leakage are a core part of our demand management strategy and we will continue to explore further options and ways we can reduce demand.

16.2.3 AP Drought demand restrictions

Our **AP** provide solutions to a drought of 1 in 200 annual return period severity.

We intend to make appropriate use of temporary use bans and drought permits and orders for additional abstraction which allow us to impose restrictions on water use in the event of a serious drought. We anticipate using temporary use bans on average once every 10 years and demand side drought orders on average once every 40 years, as stated in our current Drought Management Plan which provides further detail about our use of these measures.

We predict that the use of temporary drought restrictions will result in a reduction in household demand of 3%. This is based on our experience during the 2007 drought and is explained in Technical Report 4.9: Economics of Balancing Supply and Demand Modelling.

16.3 Supply of Water for our Alternative Plan

16.3.1 AP Groundwater sources

Our **AP** selects more groundwater options and earlier (AMP7) than in our **PP**. It is also recognised that some of these groundwater schemes would require careful consideration with regard to the potential environmental impacts of implementing the option, such as option AFF-NGW-WRZ3-0548 (HART borehole replacement for PORT) which does not feature in our **PP**. Option AFF-NGW-WRZ1-1050 (Canal & River Trust - Cow Roast) would also require further attention as there remains some uncertainty over whether this scheme could be developed in the time available and we are also aware that there are planned abstraction reductions in this catchment.

The inclusion of these schemes results from the additional deficits driven by the more severe planning conditions (e.g. 1 in 200 year DO), in effect the risk is a trade – off with moving towards additional resilience, whereby eventually we would be resilient to a more severe drought in the future. In order to manage the risks around the inclusion of these options we propose to carry out further sensitivity modelling to explore whether the schemes could be delayed and what the alternative options are, however it is most likely that the modelling will show the need for additional demand measures and a further reliance on drought measures in the interim period, in order to allow us to deliver the necessary investment.

For further information on our environmental assessment of the **AP** and scenarios please see our SEA Environmental Report.

16.3.2 AP HWFS and ANGL treatment capacity

The new HWFS treatment option identified in our **AP** allows utilisation of the transfer option from the Upper Thames Resource Development (UTRD) from 2039 and offers additional resilience to the existing treatment works, which is potentially a single point of failure (as it does in the **PP**, but sooner in the **AP**). In the **AP** the new HWFS treatment option to provide additional treatment capacity is also upsized to 100 Ml/d and remains linked to new raw water imports from the River Thames (but does not import directly to WRZ1). The earlier timing and the need is presumably triggered by the more severe planning conditions in the **AP** and the additional sustainability reductions.

Our **AP** shows that the ANGL import will be required at full capacity of 90 Ml/d (DYAA) by 2024 in order to meet the supply demand balance. The resumption of the ANGL import to fuller capacity is sooner than required under our **PP** (2030). In our **AP** modelling we have also reduced the ANGL import to a rate of 50 Ml/d (DYAA) but only until 2024 when we are planning to have additional full capacity treatment capability in place to address current water quality constraints. This is being considered under our business planning process.

We have lobbied our regulators and Government extensively on the issue of metaldehyde and latest intelligence suggests that a targeted ban on metaldehyde may be introduced in some catchments. Should that be the case then we would expect to see a lessening of metaldehyde concentrations in water from ANGL over time and this would obviate the long term need for some of the treatment, but the corrosivity effects would still need to be addressed.

16.3.3 AP Transfers of water

In the longer-term our forecasts show that we will not be self-sufficient in terms of water resources and we will therefore collaborate with our neighbouring water companies to develop new resources. In the nearer term we will continue with existing arrangements.

In addition we support the regional solution linked to UTRD, and are modelling linked imports into our supply area. Table 89 shows what we intend to do to increase water availability in the long-term.

Table 89: Longer term potential transfers

Proposal	Anticipated benefits	Description	Timescale
Upper Thames Resource Development (UTRD)	100 Ml/d	Raw water imports from the River Thames, treated by Affinity. Linked to regional infrastructure development on the Upper Thames	2039
BREN Reservoir	7.5 Ml/d	A third party option to abstract from an existing reservoir in WRZ4	2075

Our **AP** meets a 1 in 200 return period drought. Due to the increased severity, the 100 Ml/d transfer to HWFS is selected earlier than in our **PP**. In addition our **AP** requires additional storage in the long term; hence one reservoir scheme is selected in the last year of our modelling (2079).

16.3.4 AP Drought permits and orders for additional abstraction

Supply-side drought permits and orders allow us to apply to the EA and the Secretary of State respectively to take additional water from the environment in the event of a drought. Our **AP** tests a scenario where, in the medium to long term we have sufficient other measures in place so as not to require the use of drought permits and orders for additional abstraction under a severe drought. This will involve the introduction of additional water resource measures and an improvement of our network connectivity at the local scale, within each water resource zone as discussed in Section 16.3.6, which will be dependent on investment being approved in prices following submission of our next Business Plan PR19.

We have an aspiration to become sufficiently resilient to be able to withstand a severe drought without using supply-side drought permits and orders, but our modelling shows that this will need investment of infrastructure (mainly treatment at SUND) which will take some years to build and thus our **AP** includes using drought permits for additional abstraction for the first four years.

16.3.5 AP Improving network connectivity

Our ability to deliver the **AP** is based on calculations at a water resource zone (WRZ) level to determine if there is sufficient water to meet supply at this scale. Additional investment will be required to ensure sufficient and efficient movement of water within each WRZ at a finer hydraulic demand zone (36 zones) level to ensure true resilience can be achieved. Investment for this will be included in our PR19 Business Plan. It may take a number of year's post 2020 to ensure true resilience at this level can be achieved with the aim to eliminate the need for drought permits and orders under our new worst historic drought. Estimates of the investment required have been undertaken for this draft plan but will be refined further for the final plan.

16.3.6 AP Sustainability reductions

Our **AP** includes sustainability reductions reflecting the WINEP2 'amber' sustainability changes. We will consult and be refining this element of our plan during consultation. Further details about these reductions are provided in Chapter 8 of this report.

16.4 Individual Schemes by Water Resource Zone

16.4.1 Water Resource Zone

The options in WRZ1 for our **Alternative Plan (AP)** are presented in Table 90.

Table 90: AP options for WRZ1

Option Type	Scheme Name	Delivery Year	Description
Leakage	AFF-LEA-WRZ1-1008 : Option 1008 policy 3: comm pipe renewal	2020	Associated communication pipe replacement (as part of distribution mains renewal)
Leakage	AFF-LEA-WRZ1-0423 : Option 423 New PRVs	2020	
	Communication pipe replacement as part of mains renewal		
Leakage	AFF-LEA-WRZ1-ALC1	2020	Active leakage control, planned increases in manpower and resources to detect leakage
Leakage	AFF-LEA-WRZ1-1007 : Option 1007 Enhanced SP free repair policy	2059	Enhanced supply pipe repair policy.
Leakage	AFF-LEA-WRZ1-1011 : Option 1011 Trunk Mains Leakage	2074	This option considers more points at which to measure leakage and improvements in how it is measured
Leakage	AFF-LEA-WRZ1-0424 : Option 424 Better control of PRVs	2074	Enhanced PRV control.
Leakage	AFF-LEA-WRZ1-0423 : Option 423 New PRVs	2074	New PRV.
Metering	AFF-MET-WRZ1-0531 : Metering of Unmeasured non-household premises	2020	Installation of meters in non-household premises
Metering	AFF-MET-WRZ1-1010 : Street level PHC	2020	Use of existing network data, fast logging and live network hydraulic models to estimate consumption at sub-DMA (street level)
Metering	AFF-MET-WRZ1-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (automated readings), preceded by AFF-MET-WRZ1-1010
Water Efficiency	AFF-WEF-WRZ1-0567 : Community Water Efficiency Scheme	2020	Community led water efficiency scheme.
Water Efficiency	AFF-WEF-WRZ1-0901 : Comprehensive household water audit and retrofit	2020	Home water efficiency visit and retrofitting devices.
Water Efficiency	AFF-WEF-WRZ1-0569 : Housing Associations – targeted programme	2020	Liaison works with housing associations on ongoing basis to promote efficiency to residents.
Water Efficiency	AFF-WEF-WRZ1-1000 : Water Audits Retail – non process	2020	Provision of correctly installed water efficiency devices.
Reuse	AFF-REU-WRZ1-603 : Communal rainwater use	2020	Greywater reuse.
Groundwater	AFF-NGW-WRZ1-0062 : CHART Relocation	2023	The transfer of existing licence to another existing source.

The key difference between the preferred and **AP** for WRZ1 are that there are more demand management options in the **AP**, which include water efficiency solutions that are implemented in year 1 (2020). The EBSD model is also optimising on groundwater options in the **AP**, which is substituted for imports from WRZ4 (which were selected in the **PP** for WRZ1).

16.4.2 Water Resource Zone 2

The options in WRZ2 for our **AP** are presented inTable 91.

Table 91: AP options for WRZ2

Option Type	Scheme Name	Delivery Year	Description
Existing groundwater	AFF-EGW-WRZ2-0087 : SHAK Road Source Optimisation	2022	Licence disaggregation & infrastructure upgrade.
Leakage	AFF-LEA-WRZ2-1011 : Option 1011 Trunk Mains Leakage	2020	This option considers more points at which to measure leakage and improvements in how it is measured
Leakage	AFF-LEA-WRZ2-0424 : Option 424 Better control of PRVs	2020	Enhanced PRV control.
Leakage	AFF-LEA-WRZ2-0423 : Option 423 New PRVs	2020	New PRV.
Leakage	AFF-LEA-WRZ2-ALC1	2025	Active leakage control, planned increases in manpower and resources to detect leakage
Leakage	AFF-LEA-WRZ2-1007 : Option 1007 Enhanced SP free repair policy	2054	Enhanced supply pipe repair policy.
Leakage	AFF-LEA-WRZ2-1008 : Option 1008 policy 3: comm pipe renewal	2074	Associated communication pipe replacement (as part of distribution mains renewal)
Metering	AFF-MET-WRZ2-0531 : Metering of unmeasured non-household properties	2020	Installation of meters in non-household premises
Metering	AFF-MET-WRZ2-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (automated readings), preceded by AFF-MET-WRZ2-1010
Metering	AFF-MET-WRZ2-1010 : Street level PHC	2020	Use of existing network data, fast logging and live network hydraulic models to estimate consumption at sub-DMA (street level)
Water Efficiency	AFF-WEF-WRZ2-0901 : Comprehensive household water audit and retrofit	2020	Home water efficiency visit and retrofitting devices.
Water Efficiency	AFF-WEF-WRZ2-0569 : Housing Associations – targeted programme	2020	Liaison works with housing associations an ongoing basis to promote efficiency to residents.
Water Efficiency	AFF-WEF-WRZ2-1000 : Water Audits Retail – non process	2020	Provision of correctly installed water efficiency devices.
Water Efficiency	AFF-WEF-WRZ2-0567 : Community Water Efficiency Scheme	2021	Community-led water efficiency scheme.
New groundwater	AFF-NGW-WRZ2-0120 : POOR, RUIS & NORT Treatment Scheme	2023	Licence disaggregation and recommissioning of disused sources.

Within WRZ2, for the **AP**, the difference with the **PP** options is that more demand management options are selected (including leakage, metering and water efficiency).

16.4.3 Water Resource Zone 3

The options in WRZ3 for our **AP** are presented in Table 92.

Table 92: AP options for WRZ3

Option Type	Scheme Name	Delivery Year	Description
New groundwater	AFF-NGW-WRZ3-1068 : RUNGS (AMP7 LGS Borehole)	2024	A new borehole in the Lower Greensand aquifer
New groundwater	AFF-NGW-WRZ3-1075 : NOMA Increased Abstraction	2023	Increasing licence rate (licence amendment).
Metering	AFF-MET-WRZ3-0531 : Metering of unmeasured non-household properties	2020	Installation of meters in non-household premises
Metering	AFF-MET-WRZ3-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (automated readings), preceded by AFF-MET-WRZ3-1010
Metering	AFF-MET-WRZ3-1010 : Street level PHC	2020	Use of existing network data, fast logging and live network hydraulic models to estimate consumption at sub-DMA (street level)
Leakage	AFF-LEA-WRZ3-1011 : Option 1011 Trunk Mains Leakage	2020	This option considers more points at which to measure leakage and improvements in how it is measured
Leakage	AFF-LEA-WRZ3-0424 : Option 424 Better control of PRVs	2020	Enhanced PRV control.
Leakage	AFF-LEA-WRZ3-1008 : Option 1008 policy 3: comm pipe renewal	2068	Associated communication pipe replacement (as part of distribution mains renewal)
Leakage	AFF-LEA-WRZ3-1009 : Option 1009 policy 2: mains & comm pipe renewal	2071	Complete pipe mains renewal (distribution and communication pipe) at DMA level
Leakage	AFF-LEA-WRZ3-0423 : Option 423 New PRVs	2074	New PRV.
Leakage	AFF-LEA-WRZ3-ALC1	2020	Active leakage control, planned increases in manpower and resources to detect leakage
Water Efficiency	AFF-WEF-WRZ3-0901 : Comprehensive household water audit and retrofit	2020	Home water efficiency visit and retrofitting devices.
Water Efficiency	AFF-WEF-WRZ3-0569 : Housing Associations – targeted programme	2020	Liaison works with housing associations on ongoing basis to promote efficiency to residents.
Water Efficiency	AFF-WEF-WRZ3-1000 : Water Audits Retail – non process	2020	Provision of correctly installed water efficiency devices.
Reuse	AFF-REU-WRZ3-620 : Large user – rainwater harvesting (Luton Airport)	2020	Greywater reuse – airport.
Reuse	AFF-REU-WRZ3-621 : Large user – surface water reuse (Luton Airport)	2020	Greywater reuse – airport.
Reuse	AFF-REU-WRZ3-603 : Communal rainwater use	2020	Greywater reuse.
New groundwater	AFF-NGW-WRZ3-1053 : KNGW	2029	New Lower Greensand borehole & abstraction.
New groundwater	AFF-NGW-WRZ3-0548 : HART borehole replacement for PORT	2023	Resilience scheme to support existing licenced abstraction.
New groundwater	AFF-TPO-WRZ3-0134 : VAUX (IBC Vehicles) Groundwater	2024	Purchase a bulk supply or partial licence trade.

For WRZ3 the **AP** options for metering and leakage are similar to those selected in the **PP**, in addition to which however there are water efficiency and reuse options that are selected in AMP7. Further, within the **AP** there are also three additional groundwater options, one of which (KNGW) is in the Lower Greensand and is timed to follow the RUNGS option (should the impacts on the environment be shown to be negligible).

The other two new groundwater schemes (HART borehole replacement for PORT and VAUX (IBC Vehicles) Groundwater) are in the chalk aquifer and would be subject to environmental impact assessments.

16.4.4 Water Resource Zone 4

The options in WRZ4 for our **AP** are presented in Table 93.

Table 93: AP options for WRZ4

Option Type	Scheme Name	Delivery Year	Description
New groundwater	AFF-NGW-WRZ4-0624 : Canal and River Trust and GSK Boreholes	2074	Obtaining Lower Greensand water from third parties.
Reservoir	AFF-RES-WRZ4-0832 : BREN Reservoir	2075	Using a third party reservoir within the Affinity Water supply area.
Import / export transfer	AFF-RTR-WRZ4-1040 : SUNN to New treatment Works (100Ml/d)	2039	A new raw water abstraction and import.
New Treatment Works	AFF-NTW-WRZ4-1005 : WRZ4 New Treatment Works (100 Ml/d)	2039	Option to treat an increase in raw water. Resilience scheme too.
Metering	AFF-MET-WRZ4-0531 : Metering of unmeasured non-household properties	2020	Installation of meters in non-household premises
Metering	AFF-MET-WRZ4-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (automated readings), preceded by AFF-MET-WRZ4-1010
Metering	AFF-MET-WRZ4-1010 : Street level PHC	2020	Use of existing network data, fast logging and live network hydraulic models to estimate consumption at sub-DMA (street level)
Leakage	AFF-LEA-WRZ4-0424 : Option 424 Better control of PRVs	2020	Enhanced PRV control.
Leakage	AFF-LEA-WRZ4-1012 : Option 1012 policy 2: mains & comm pipe renewal - on selected dmas	2020	Communication pipe replacement as part of mains renewal
Leakage	AFF-LEA-WRZ4-ALC1	2020	Active leakage control, planned increases in manpower and resources to detect leakage
Leakage	AFF-LEA-WRZ4-1007 : Option 1007 Enhanced SP free repair policy	2054	Enhanced supply pipe repair policy.
Leakage	AFF-LEA-WRZ4-1011 : Option 1011 Trunk Mains Leakage	2074	This option considers more points at which to measure leakage and improvements in how it is measured

Option Type	Scheme Name	Delivery Year	Description
Leakage	AFF-LEA-WRZ4-0423 : Option 423 New PRVs	2074	New PRV.
Water Efficiency	AFF-WEF-WRZ4-0569 : Housing Associations - targeted programme	2020	Liaison works with housing associations on ongoing basis to promote efficiency to residents.
Water Efficiency	AFF-WEF-WRZ4-0901 : Comprehensive household water audit and retrofit	2020	Home water efficiency visit and retrofitting devices.
Water Efficiency	AFF-WEF-WRZ4-1000 : Water Audits Retail - non process	2020	Provision of correctly installed water efficiency devices.
Water Efficiency	AFF-WEF-WRZ4-0567 : Community Water Efficiency Scheme	2023	Community-led water efficiency scheme.
Reuse	AFF-REU-WRZ4-603 : Communal rainwater use	2020	Greywater reuse.
New groundwater	AFF-TPO-WRZ4-0412 : HILG boreholes	2024	Purchase/lease and transfer of existing third-party groundwater abstraction.
New groundwater	AFF-EGW-WRZ4-1064 : ICKE Groundwater	2034	Group licence disaggregation and upgraded treatment.

Additional water efficiency and leakage schemes are introduced in the **AP** in AMP7, along with new groundwater schemes. The groundwater schemes would be subject to environmental impact assessments.

A new import scheme is selected, linked to a regional source of water, comprising of a new River Thames abstraction with new transfer and treatment capacity. This scheme is earlier than in the **PP** (2039).

16.4.5 Water Resource Zone 5

The options in WRZ5 for our **AP** are presented in Table 94.

Table 94: AP options for WRZ5

Option Type	Scheme Name	Delivery Year	Description
Existing groundwater	AFF-EGW-WRZ5-0882 : WEND Upgrade	2021	Removal of network/demand constraint.
Metering	AFF-MET-WRZ5-0531 : Metering of unmeasured non-household properties	2020	Installation of meters in non-household premises
Metering	AFF-MET-WRZ5-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (automated readings), preceded by AFF-MET-WRZ5-1010
Metering	AFF-MET-WRZ5-1010 : Street level PHC	2020	Use of existing network data, fast logging and live network hydraulic models to estimate consumption at sub-DMA (street level)
Leakage	AFF-LEA-WRZ5-1011 : Option 1011 Trunk Mains Leakage	2074	This option considers more points at which to measure leakage and improvements in how it is measured
Leakage	AFF-LEA-WRZ5-1008 : Option 1008 policy 3: comm pipe renewal	2065	Associated communication pipe replacement (as part of distribution mains renewal)
Leakage	AFF-LEA-WRZ5-1007 : Option 1007 Enhanced SP free repair policy	2054	Enhanced supply pipe repair policy.
Leakage	AFF-LEA-WRZ5-0423 : Option 423 New PRVs	2072	New PRV.
Leakage	AFF-LEA-WRZ5-0424 : Option 424 Better control of PRVs	2074	Enhanced PRV control.
Leakage	AFF-LEA-WRZ5-ALC1	2020	Active leakage control, planned increases in manpower and resources to detect leakage
Water Efficiency	AFF-WEF-WRZ5-0901 : Comprehensive household water audit and retrofit	2020	Home water efficiency visit and retrofitting devices.
Water Efficiency	AFF-WEF-WRZ5-0569 : Housing Associations – targeted programme	2020	Liaison works with housing associations on ongoing basis to promote efficiency to residents.
Water Efficiency	AFF-WEF-WRZ5-1000 : Water Audits Retail – non process	2020	Provision of correctly installed water efficiency devices.
Water Efficiency	AFF-MET-WRZ5-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (as automated meter readings), preceded by AFF-MET-WRZ4-1010
Reuse	AFF-REU-WRZ5-0606 : Large user – rainwater harvesting (Stansted Airport)	2020	Greywater reuse – airport.
Reuse	AFF-REU-WRZ5-0603 : Communal rainwater use	2020	Greywater reuse.
Reservoir	AFF-RES-WRZ5-0809 : BRDG Reservoir	2079	New river intake, pumping station and bankside storage reservoir.

Option AFF-LEA-WRZ5-1011 : Option 1011 trunk mains leakage is delayed until 2074 in the **AP** and only one ALC option is selected, additional water efficiency and communal reuse schemes are selected in AMP7 and AMP8.

One new reservoir scheme is selected in the **AP**, but this is in the final year of the planning horizon (2079).

16.4.6 Water Resource Zone 6

The options in WRZ6 for our **AP** are presented in Table 95.

Table 95: AP options for WRZ6

Option Type	Scheme Name	Delivery Year	Description
Metering	AFF-MET-WRZ6-0531 : Metering of unmeasured non-household properties	2020	Installation of meters in non-household premises
Metering	AFF-MET-WRZ6-0904 : Compulsory Metering fixed network	2025	Installation of meters in household premises (automated readings), preceded by AFF-MET-WRZ6-1010
Metering	AFF-MET-WRZ6-1010 : Street level PHC	2020	Use of existing network data, fast logging and live network hydraulic models to estimate consumption at sub-DMA (street level)
Leakage	AFF-LEA-WRZ6-1011 : Option 1011 Trunk Mains Leakage	2050	This option considers more points at which to measure leakage and improvements in how it is measured
Leakage	AFF-LEA-WRZ6-ALC1	2045	Active leakage control, planned increases in manpower and resources to detect leakage
Leakage	AFF-LEA-WRZ6-1007 : Option 1007 Enhanced SP free repair policy	2045	Enhanced supply pipe repair policy.
Leakage	AFF-LEA-WRZ6-0423 : Option 423 New PRVs	2072	New PRV.
Water Efficiency	AFF-WEF-WRZ6-0901 : Comprehensive household water audit and retrofit	2074	Home water efficiency visit and retrofitting devices.
Water Efficiency	AFF-WEF-WRZ6-0569 : Housing Associations - targeted programme	2074	Liaison works with housing associations on ongoing basis to promote efficiency to residents.
Water Efficiency	AFF-WEF-WRZ6-1000 : Water Audits Retail - non process	2074	Provision of correctly installed water efficiency devices.
Water Efficiency	AFF-WEF-WRZ6-0567 : Community Water Efficiency Scheme	2078	Community-led water efficiency scheme.
Groundwater	AFF-NGW-WRZ6-0005 : HORS recommissioning	2078	Recommissioning of existing source.
Groundwater	AFF-TPO-WRZ6-1083 : SU (Guildford)	2063	Obtaining water from a third party source.
Groundwater	AFF-EGW-WRZ6-0173	2054	Optimising an existing source.

In the **AP** the option AFF-RTR-WRZ6-1094 : EGHS to Surrey Hills Reduction (10Ml/d) is not utilised in the model, most likely because of the TUBS savings which are more in the **AP**, however we would retain the option as resilience and future modelling could include removing networks constraints to move the water into WRZ4.

Water efficiency is selected in the **AP**, however this is late on in the final years (2070s). All the groundwater related schemes are post 2054.

16.4.7 Water Resource Zone 7

The options in WRZ7 for our **AP** are presented in Table 96.

Table 96: AP options for WRZ7

Option Type	Scheme Name	Delivery Year	
Existing groundwater	AFF-EGW-WRZ7-0306 : COWL Upgrade	2034	Upgrade existing source to meet licenced quantity.
Existing groundwater	AFF-EGW-WRZ7-0629 : LYEO Licence Variation	2021	To obtain agreement to increase abstraction equal to the amount 'returned'
Existing groundwater	AFF-EGW-WRZ7-0908 : TAPS-Licence Variation	2022	Recommissioning of existing source for resilience purposes.
Removal of network constraint	AFF-RNC-WRZ7-0900 : Dover Constraint Removal	2023	Removing a constraint to improve operational use
Import/export transfer	AFF-RTR-WRZ7-0639 : DEAI Continuation After 2020	2020	Continuation of existing intra-company transfer.
Import/export transfer	AFF-RTR-WRZ7-0909 : BARI Continuation (After 2019/20)	2020	Continuation of existing intra-company transfer.
Leakage	AFF-LEA-WRZ7-ALC1	2045	Active leakage control, planned increases in manpower and resources to detect leakage
Leakage	AFF-LEA-WRZ7-1007 : Option 1007 Enhanced SP free repair policy	2053	Enhanced supply pipe repair policy.
Leakage	AFF-LEA-WRZ7-1011 : Option 1011 Trunk Mains Leakage	2073	This option considers more points at which to measure leakage and improvements in how it is measured
Leakage	AFF-LEA-WRZ7-0955 : Option 955 reduction in DMA sizes Zone R07 only	2060	Reduction in DMA sizes in WRZ7.
Import/export transfer	AFF-RTR-WRZ7-0301 : BARI Import Increase (of 2Ml/d) to 4 Ml/d	2062	An increase to the existing intra-company import.
Water Efficiency	AFF-WEF-WRZ7-0569 : Housing Associations - targeted programme	2073	Liaison works with housing associations on ongoing basis to promote efficiency to residents.
Water Efficiency	AFF-WEF-WRZ7-1000 : Water Audits Retail - non process	2073	Provision of correctly installed water efficiency devices.
Water Efficiency	AFF-WEF-WRZ7-0901 : Comprehensive household water audit and retrofit	2074	Home water efficiency visit and retrofitting devices.
Water Efficiency	AFF-WEF-WRZ7-0567 : Community Water Efficiency Scheme	2078	Community-led water efficiency scheme.

For WRZ7 the existing bulk supply agreements are continued, along with additional leakage and water efficiency options. An additional import option is selected, but not until after 2062.

16.5 The Cost of our Alternative Plan

Table 97 and Table 98 show the breakdown of total cost by component and expenditure type, for the **Alternative Plan** (**AP**) investment programme. The costs are shown in the five-year period in which they are incurred, and are presented in 2017/18 prices to be consistent with our Business Plan for PR19. The costs shown include capital investment, operational expenditure, capital maintenance, and environmental, social and carbon costs.

Table 97: Summary of draft AP costs

Total Expenditure, £million	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35	AMP10 2035-40	AMP11 2040-45	25 year Total 2020-45	60 year Total 2079/80
Baseline WSP	**67.00**	**0.00**	**0.00**	**0.00**	**0.00**	**67.00**	**67.00**
Leakage	58.62	55.74	53.67	35.18	29.92	233.13	374.52
Unmeasured non-household metering	0.51	0.42	0.35	0.30	0.25	1.83	2.80
Smart Metering	0.00	71.14	70.23	65.68	44.54	251.58	427.50
Water efficiency	25.02	4.31	-0.02	-0.02	-0.02	29.27	30.11
Reuse	7.73	7.54	6.35	5.35	4.50	31.48	49.06
Demand schemes	**91.87**	**139.15**	**130.58**	**106.49**	**79.19**	**547.28**	**884.00**
Supply (ground & surface water)	8.08	21.61	22.34	22.70	19.11	93.86	171.84
Bulk transfers	0.23	0.11	0.12	17.35	78.92	96.72	423.84
Network improvements	0.06	0.12	0.10	0.09	0.07	0.44	0.72
Supply schemes	**8.37**	**21.84**	**22.56**	**40.14**	**98.10**	**191.01**	**596.40**
Total per AMP for Supply and Demand	**100.24**	**160.99**	**153.14**	**146.63**	**177.30**	**738.30**	**1480.39**
Capital and network reinforcements	27.35	0.00	0.00	0.00	0.00	27.35	27.35
Sub HDZ reinforcements	40.00	0.00	0.00	0.00	0.00	40.00	40.00
Estimated treatment at SUND	55.70	0.00	0.00	0.00	0.00	55.70	55.70
Delivery of SRs	**123.05**	**0.00**	**0.00**	**0.00**	**0.00**	**123.05**	**123.05**
Morphological works	6.00	0.00	0.00	0.00	0.00	6.00	6.00
WINEP studies and monitoring	12.00	0.00	0.00	0.00	0.00	12.00	12.00
Estimated treatment at HWFS 2	0.00	0.00	0.00	100.00	0.00	100.00	100.00
GRAND TOTAL	**308.29**	**160.99**	**153.14**	**246.63**	**177.30**	**1046.35**	**1788.44**

Table 98: Summary of capital expenditure

Capital Expenditure, £million	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35	AMP10 2035-40	AMP11 2040-45	25 year Total 2020-45	60 year Total 2079/80
Baseline WSP	**60.93**	**0.00**	**0.00**	**0.00**	**0.00**	**60.93**	**60.93**
Leakage	37.00	20.91	15.79	1.51	1.27	76.48	86.25
Unmeasured non-household metering	0.57	0.48	0.40	0.34	0.29	2.08	3.20
Smart Metering	0.00	61.10	51.44	43.31	36.47	192.32	334.71
Water efficiency	0.02	0.02	0.02	0.01	0.01	0.08	0.12
Reuse	5.25	4.42	3.72	3.14	2.64	19.18	29.48
Demand schemes	**42.84**	**86.93**	**71.38**	**48.31**	**40.68**	**290.13**	**453.76**
Supply (ground & surface water)	5.48	15.00	16.05	16.76	14.11	67.40	124.51
Bulk transfers	0.00	0.00	0.00	15.91	71.83	87.74	368.47
Network improvements	0.03	0.06	0.05	0.04	0.04	0.23	0.38
Supply schemes	**5.51**	**15.07**	**16.10**	**32.71**	**85.98**	**155.36**	**493.36**
Total per AMP for Supply and Demand	**48.35**	**102.00**	**87.48**	**81.02**	**126.65**	**445.49**	**947.12**

Table 99: Summary of operational expenditure

Operational Expenditure, £million	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35	AMP10 2035-40	AMP11 2040-45	25 year Total 2020-45	60 year Total 2079/80
Baseline WSP	**5.87**	**0.00**	**0.00**	**0.00**	**0.00**	**5.87**	**5.87**
Leakage	20.56	34.38	37.31	33.52	28.51	154.28	285.16
Unmeasured non-household metering	-0.06	-0.06	-0.05	-0.04	-0.04	-0.25	-0.39
Smart Metering	0.00	10.04	18.78	22.37	8.07	59.27	92.80
Water efficiency	25.03	4.34	0.00	0.00	0.00	29.37	30.28
Reuse	2.47	3.12	2.63	2.21	1.86	12.30	19.58
Demand schemes	**48.01**	**51.82**	**58.67**	**58.05**	**38.41**	**254.97**	**427.42**
Supply (ground & surface water)	1.33	3.51	3.81	3.85	3.24	15.74	28.93
Bulk transfers	0.23	0.11	0.09	1.34	6.62	8.38	52.94
Network improvements	0.03	0.06	0.05	0.04	0.03	0.21	0.35
Supply schemes	**1.59**	**3.68**	**3.95**	**5.23**	**9.90**	**24.34**	**82.21**
Total per AMP for Supply and Demand	**49.60**	**55.50**	**62.62**	**63.28**	**48.31**	**279.31**	**509.64**

Table 100: Summary of carbon and environmental & social costs

Environmental, Social & Carbon costs, £million	**AMP7** 2020-25	**AMP8** 2025-30	**AMP9** 2030-35	**AMP10** 2035-40	**AMP11** 2040-45	**25 year Total** 2020-45	**60 year Total** 2079/80
Baseline WSP	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Leakage	1.06	0.44	0.57	0.16	0.13	2.37	3.11
Unmeasured non-household metering	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Smart Metering	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water efficiency	-0.04	-0.05	-0.04	-0.03	-0.03	-0.18	-0.30
Reuse	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Demand Management schemes	**1.02**	**0.40**	**0.53**	**0.12**	**0.11**	**2.18**	**2.81**
Supply (ground & surface water)	1.27	3.10	2.49	2.10	1.76	10.72	18.40
Bulk transfers	0.00	0.00	0.02	0.10	0.47	0.60	2.42
Network improvements	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Supply side schemes	**1.27**	**3.10**	**2.51**	**2.20**	**2.23**	**11.32**	**20.83**
Total per AMP for Supply and Demand	**2.30**	**3.49**	**3.04**	**2.32**	**2.34**	**13.50**	**23.64**

16.6 Exploring Government and Stakeholder Aspirations

Our **Alternative Plan (AP)** already considers Ofwat's aspiration to see leakage reduced by 15% as well as the Environment Agency's desire to see groundwater abstraction rates reduced to 39Ml/d. We have further undertaken additional scenarios to reflect Government, regulator and stakeholder aspirations beyond our **Preferred Plan (PP)** and **AP**, such as:

- **reducing demand** - to very low rates of PCC; and
- **greater sustainability reductions** – to meet Environment Agency's aspirations to see groundwater abstraction rates reduced even further.

These additional scenarios are explored under the same planning conditions as our **PP** (shown in Table 101) to be able to compare the additional requirements and costs to our **PP**.

Table 101: Aspirational scenarios

Scenario	Demand	Drought Permits and orders for additional abstraction	Drought Return Period
Low PCC of 110 l/h/d achieved by 2045	Medium	Not used	Worst historic
Unconfirmed SRs of 61.47 Ml/d by end AMP8	Medium		

16.6.1 Reducing demand further

In the low PCC scenario we offer a new water efficiency option to the model (AFF-WEF-1050 'Concerted action on Water Efficiency'). The aim of this option is for us to lead a concerted action of partnership with all water companies, Defra and regulators targeting water efficiency at a regional and national level that would generate savings outside of our direct control.

Water companies with an average household PCC greater than the industry average of 141 l/h/d are directed to reduce consumption and further expected to work towards Government aspirational target of 110 l/h/d in the long term. Our low PCC scenario reduces our demand towards this aspirational level through this new water efficiency option, it may be possible to achieve a greater reduction in per capita consumption by 2045 of 113 l/h/d for DYAA and 105 l/h/d for NYAA. Table 102 illustrates the cumulative yield of water saved from demand management (excluding leakage) for the low PCC scenario compared to our **PP**.

Table 102: Comparison of yield and cost for the PP and low PCC scenario

Option Type	Period	Cumulative yield in PP (Ml/d)	Cumulative yield low PCC scenario (Ml/d)
Demand management (excluding leakage)	2020-25	14.81	14.81
	2025-30	35.86	52.21
	2030-35	42.58	76.48
	2035-40	49.24	99.02
	2040-45	49.96	111.31
	Demand management cost, 2020-2045 (£million NPV)	**165.05**	**88.82**

When compared with our **PP**, the overall cost of the generated portfolio is cheaper. This is due to the combined effect of avoided opex costs associated with reduction in emissions and the absence of carbon capex because the water efficiency option is largely outside of the direct control of Affinity Water. The low cost is counterbalanced by the significant uncertainty around the 'concerted effort' with regulators and other stakeholders and the assumption that the costs will be partly incurred by third parties.

We also acknowledge that the reduction in PCC represents aspirational long-term targets that will only be achieved through engagement with multiple stakeholders and customers in an integrated and coordinated manner and with corresponding changes in regulation.

Reducing PCC further to meet aspirational scenarios relies on behavioural change, especially in drought situations, along with the introduction of revolutionary household technology. Reducing PCC to the aspirational value of 110 l/h/d cannot be achieved by Water Company action alone. It will require both government and regulators to act very strongly.

16.6.2 Greater sustainability reductions

We have tested scenarios with a higher level of sustainability reductions than in our **PP** or **AP**, the 'Unconfirmed' SRs as referred to in Chapter 8. The modelling results show that for us to deliver these additional 'Unconfirmed' sustainability reductions under the same planning conditions as our **PP** requires a wider array of options greater than our **PP** such as increasing the degree of demand management including greater levels of leakage reduction and water re-use in AMP7 as shown in Table 103.

Table 103: Comparison of demand savings and UTRD transfer delivery year with PP

EA Category	Scenario	Average DO Change (Ml/d)	Cumulative demand management savings up to 2080 (Ml/d)	UTRD transfer (delivery year)	Total investment cost up to 2080 (£million NPV)
"Lower"	**PP**	10.22	79.57	2055	1,001.43
"Upper"	Unconfirmed SRs	61.47	100.10	2049	1,321.94

17 Public Consultation on our Draft Plan

We are currently planning for our public consultation to start in March 2018 running for a period of approximately 10 weeks to give our stakeholders and customers plenty of opportunity to comment on our draft plan. The learning and outcomes from our public consultation will link closely to the development of our Business Plan to enable customers, regulators and stakeholders to have an active engagement in the development of our WRMP.

A non-technical version (our consultation document) of the plan has been produced to enable people to better understand the purpose and key proposals of the dWRMP19 and be equipped with the background knowledge to give a more effective response to it, as shown in Figure 63. Full details of how to take part in our consultation and the consultation document, which includes the questions we are asking, will be available at: www.affinitywater.co.uk/haveyoursay. Meanwhile we reflect here much of the content of that consultation document.

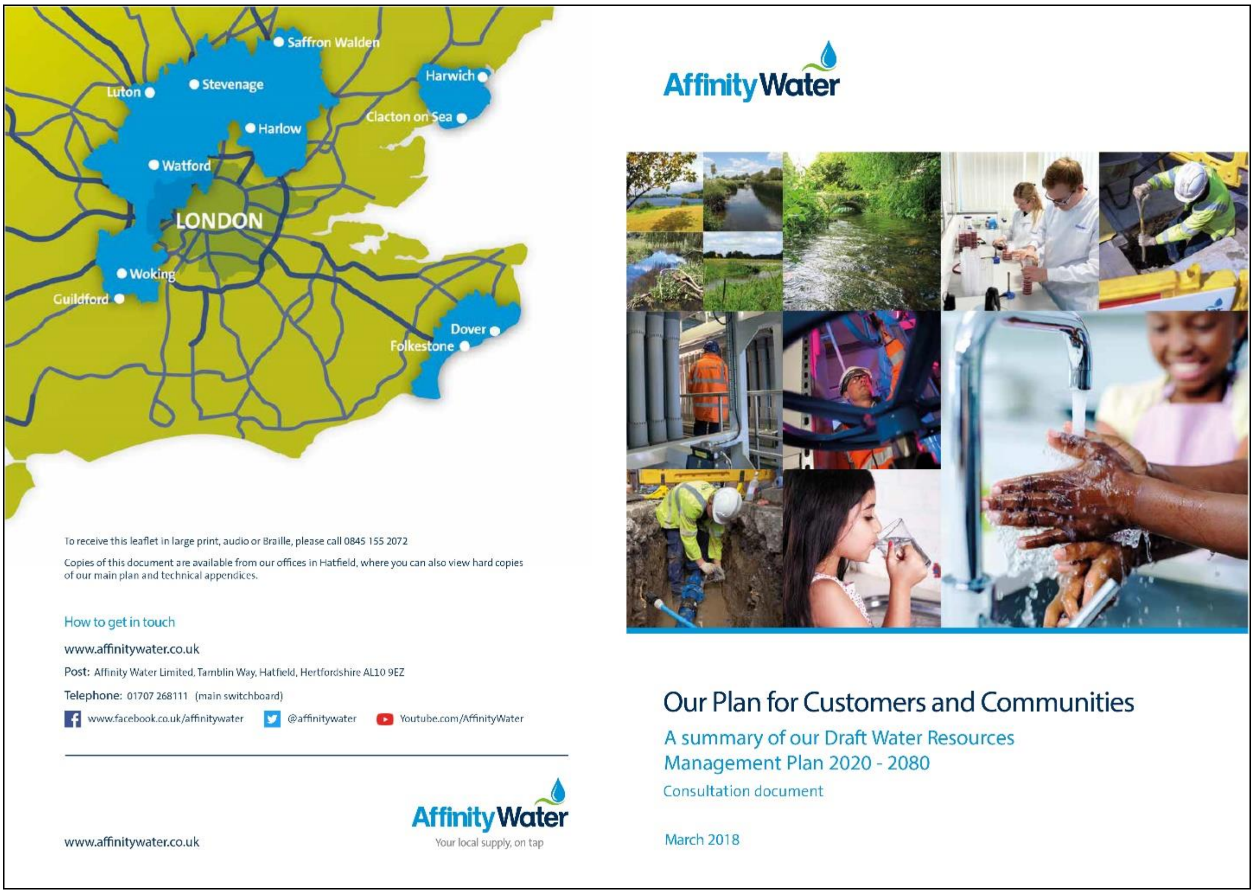

Figure 63: Consultation document rear/front cover

We are planning a comprehensive consultation process as part of our integrated approach to the dWRMP and our business plan. The CCG, national bodies and regulators will continue to be engaged via regular updates and dialogue through face to face discussions. The majority of stakeholder engagement will take place on a face to face basis, supported by the consultation document. Stakeholder forums will be localised, and take place across our Central, East and Southeast regions. In addition to these forums, we are currently identifying any existing/planned stakeholder events being run by our partners i.e. local authorities, local economic partnerships and local interest/environmental groups, Affinity Water Saving Squad and internal colleague events.

The Environment Agency guidance states that all responses should be sent to the Secretary of State at Defra. All responses received via the customer survey, focus groups, stakeholder forums and meetings/events will be collated using a consistent method and logged. Agreement has been reached with Defra that findings from these activities can be analysed and a report sent to Defra at the end of the consultation period.

Individual responses to the consultation document from our website link will be sent automatically to both the Secretary of State and to Affinity Water to enable the data to be collated and analysed by us. All other responses that are sent directly by respondents to Defra will be copied back to us so we can take them into account. Feedback to participants will take place via our Statement of Response which will be published on our website and promoted via our website and social media. A Lessons Learnt Review will be undertaken to check that the process and outcomes have been effective. This will be shared across Affinity Water to shape future practice.

A range of activities will be used including a representative customer survey, customer focus groups, the consultation document, stakeholder forums, events and meetings.

Our **PP** sets out the options which we believe represent a balanced and best value plan for customers and the environment and with a stretching level of risk. We have included reductions in abstraction that in our view are based on robust evidence that they will achieve environmental benefits and that are cost beneficial. Our **AP** includes some different options for improved levels of service under severe drought, greater leakage reductions and higher sustainability reductions. The **AP** has a higher cost and we consider this plan to also be higher risk compared to the **PP.** The **AP** represents a greater challenge to operational resilience by including a higher level of sustainability reductions requested by the Environment Agency by 2024 with little time to mobilise reliable alternative demand management or supply measures in a region of water scarcity. In order to achieve improved level of service under severe drought we will also have to ensure we have a greater quantity of resources available to meet demand under more severe conditions than we have seen through historic drought conditions.

Figure 64 illustrates our preferred and **AP**. The orange boxes illustrate our **AP** options.

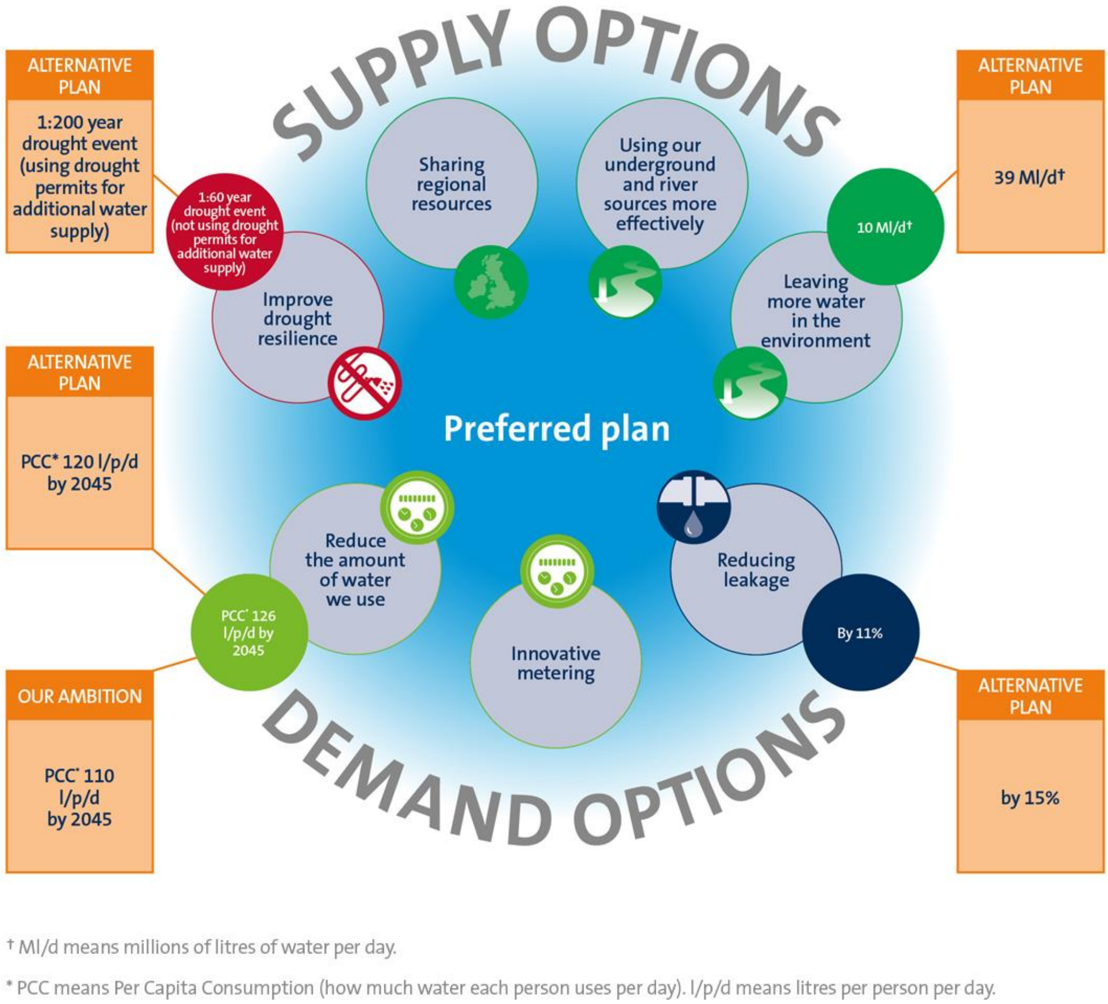

Figure 64: Our PP and AP options

Table 104: Cost of our Preferred Plan (PP) and Alternative Plan (AP)

Plan	AMP7 investment (£million NPV)	AMP8 investment (£million NPV)	Total investment at 2044 (£million NPV)	Total investment at 2079 (£million NPV)
PP	£228.04	£109.88	£475.03	£1,001.45
AP	£308.29	£160.99	£1,046.35	£1,788.44

Table 105: Cost difference between Preferred Plan (PP) and aspirational scenarios

Portfolio comparison	Cost difference (£million NPV)	Key change
PP to **AP**	£786.99	To move from a worst historic DO with 10Ml/d of SRs to a 1 in 200 year DO with 39Ml/d of SRs with supply side drought measures available in AMP7
PP to 110 l/h/d PCC	-£194.27*	To move from a PCC of 126 l/h/d to 110 l/h/d by 2045

*The very low costs of this scenario are due to avoided operational and investment costs. This option requires wider collective societal and regulatory action to enforce the use of high efficiency appliances and therefore a higher risk strategy. We will only be able to move forward with this option if we obtain commitment from Government, regulators and community partners through joint action.

We are keen to consult with our stakeholders and customers to get their views on what we are proposing before reaching a final decision on our **PP** to ensure that our final plan represents best value to customers and the environment.

Key areas are we consulting on

We are keen to consult with our stakeholders and customers to get their views on what we are proposing before reaching a final decision on our **PP** to ensure that our final plan represents best value to customers and the environment.

Further information on the range of activities to be utilised during the public consultation phase is given in Section 5.5 and further information on our approach to the public consultation is given in Section 17.

Our overall approach

We are seeking customer and stakeholder views if they support or oppose the approach and balance of measures we have presented in our **PP** compared to the higher cost and higher risk in our **AP**. The estimated cost of our **PP** is £228 million for AMP7 and total cost to 2080 of £1,001 million. In comparison our **AP** would cost £308 million in AMP7 with a total cost of £1,788 million to 2080.

In particular, we will be consulting on the following key issues:

What happens if it doesn't rain enough.

Our level of drought resilience and use of drought permits and orders for additional abstraction.

What we propose to do about this:

• we will make appropriate use of temporary use bans (what used to be known as hosepipe bans) and drought orders which allow us to impose restrictions on water use in the event of a serious drought

• we anticipate, on average, there is a 10% chance every year of using temporary use bans and 2.5% chance every year of using demand side drought orders. Our current Drought Management Plan provides further detail about our use of these measures

• our plan enables us to continue to supply water to meet demand in severe drought conditions for longer without the need to use additional water from sources where we would not normally take water, known as drought permits. Our current position is that there is a 2.5% chance every year that we may need to use this additional water. Our preferred plan enables us to be in a stronger position during a drought so there is only a 1.7% chance every year that this additional water may be required, equivalent to a 1 in 60 year drought event.

• our alternative plan explores the possibility of putting infrastructure (such as new pipes) in place so that we are resilient to a severe drought which has a 0.5% chance of occurring every year, equivalent to a 1 in 200 year drought event. This would be without the use of standpipes in the streets or rationing the supply of water in a severe drought. This is estimated to cost an additional £410 million by 2080.

Drought can have an impact on customers' lives and this may become more noticeable as a drought becomes more severe. In the early stages of a drought, TUBs (formerly known as hosepipe bans) may be introduced which temporarily restricts the use of a hosepipe for 11 different activities. These are primarily domestic restrictions and include activities such as using a hosepipe for watering gardens, filling up paddling pools or washing cars. As a drought becomes more severe, ordinary drought orders, formerly known as non-essential use bans may be implemented. This is a temporary measure which would restrict 10 activities, including filling swimming pools or ponds, operating vehicle-washers and cleaning windows. These restrictions would have some commercial implications, such as for car washes or window cleaners.

In a severe drought we may apply to abstract additional water or reduce river support through the use of drought permits or drought orders. The possible effect of additional abstraction at this stage of a severe drought may be an extension in the amount of time it takes for the river to recover, after the drought has ended.

Our **PP** and current Drought Management Plan, enable us to continue to supply water to meet demand for longer without the need to take more water from sources we would not normally use (through use of drought permits and orders for additional abstraction).

In our current position, there is a 2.5% chance every year that we may need to use this additional water. Our **PP** proposes we reduce this to a 1.7% chance every year during a drought. The estimated cost is £295 million by 2080.

Our **AP** explores the possibility of putting extra supply capacity and pipes to transfer water across our area in place so that we are resilient to a severe drought which has a 0.5% chance of occurring every year, equivalent to a 1 in 200 year drought event. This would be without the use of standpipes in the streets or rationing the supply of water in a severe drought. The estimated cost of this additional drought resilience is an additional £410 million by 2080.

Within the consultation document we are asking customers and stakeholders whether they support or oppose our position to become more resilient. There is a choice to specify preference to move to a 1.7% or 0.5% chance of needing additional water through drought permits and orders during a severe drought.

Managing leakage, keeping bills low

Reducing leakage further.

What we propose to do about this:

• we propose reducing leakage by 11% between 2020 and 2025, saving 18 million litres of water each day, at a cost of £46 million and maintain at 11% between 2025 and 2030. This continues to keep us below our economic level of leakage

• explore more ways that metering and other new technologies can help tackle and detect leakage on our network and customers' pipes

• our regulator, Ofwat, would like us to reduce leakage by 15% by 2025, saving 25 million litres of water each day, and this has been included in our **AP**. This will cost an additional £12 million compared to our **PP** option of 11% which we believe is a balanced proposal following the 14% reduction in leakage we included in our previous plan – a total reduction of 25% since 2015.

We know leakage is wasteful and that customers feel strongly that we should be reducing leakage as much as possible. The challenge for us is weighing up the cost of finding and repairing leaking pipes verses the cost of the production and delivery of more water. This is called the economic level of leakage. We do our best to strike the balance between these two things to keep bills as low as possible and to keep traffic disruption to a minimum.

Within the consultation document we are asking customers and stakeholders whether they would like us to reduce leakage by 11% as set out in our **PP** at a cost of £46 million by 2025 and a cost of £208 million by 2080 or like us to reduce leakage by 15% as set out in our **AP** at a cost of £58 million by 2025 and a cost of £374 million by 2080.

Metering, water efficiency and consumption

Using less water

Reducing Per Capita Consumption (PCC).

What we propose to do about this:

• continue to install meters in homes that do not already have them and implement a new innovative option which will provide customers with frequent information about their water use. As a result, customers will be able to get a much more detailed picture of their water use than they currently receive through their six monthly bills which will help them to reduce the amount they use

• in the longer term, from 2025 to 2035, we plan to implement smart metering that will help customers reduce usage and tackle leakage more effectively

• work more with existing and future customers to inspire them to value and protect our water resources so they use less water and help to ensure there is enough left for future generations

• continue to provide customers with free water saving devices such as shower heads and tooth timers to help them save water, save energy and save money

• we will strive to work together as a whole society through a partnership approach involving customers, water companies, Defra and regulators to support customers to use less water

• to achieve this challenging goal, customers will need to be supported to change their behaviours through a number of ways including a national water saving campaign and the introduction of new household technology such as water efficient products like washing machines.

We believe we can reduce how much water customers use down from 160 litres per person per day to 126 litres in our **PP** and 120 litres in our **AP**. This is a 23% reduction or 31 to 37 litres per person per day from our current levels. These forecast savings are based on the evidence of consumption reductions from our continuing water savings programme but we have also included within our plans options to provide customers with more frequent information about their water use to facilitate further stretching consumption reductions. The government would like us to reduce this even further towards 110 litres per person per day. That’s a reduction of 50 litres per person per day from our current levels. This would mean that more customers in our supply area would need to significantly reduce their water use through changes in behaviour.

Our ambition to further reduce PCC in the long term as per government aspiration we believe requires a willingness from multi stakeholders to commit to working in partnership to further reduce consumption. This will require integrated communications from all parties with the public at large, better consumption data and changes in regulations including point of sale control, building codes, local authority planning, water regulations and incentives for developers. We are consulting to establish if there is partnership support to deliver this challenging target.

Within the consultation document we are asking customers and stakeholders whether they support or oppose our partnership approach to reduce per capita consumption of water to 110 litres per person per day.

Sustainable abstraction

Balancing the needs of the environment and customers

The different options for sustainability reductions to improve the water environment.

What we propose to do about this:

• we have been working since the early 1990s to improve the flows in local chalk streams. We have reduced or altered our abstraction in many catchments including the Rivers Ver, Misbourne, Hiz, Oughton, Mimram, Beane, Hughenden Stream and the Dour. Our programme continues with further work planned to reduce the amount we abstract at several sources to ensure our water abstractions are sustainable for the local environment

• over the next five years we will look at how local habitats have responded to this programme of work so far and we will use this data to inform our decisions on future phases of activity to ensure we are spending customers' money wisely

• we are planning an additional 17 Ml/d of available supply over the next ten years by optimising existing groundwater abstractions and licences with minimal environmental effects and an extra 3 Ml/d from a new abstraction licence. These schemes are proposed at sites where there is no effect of abstraction on surface water such as Lower Greensand sources and confined aquifer locations. We believe that making best use of our existing groundwater supply base is, in the first instance, the most cost effective and efficient way to balance deficits, alongside demand management measures

• we are consulting customers on two options to further reduce abstraction from our most environmentally sensitive sources. We will select where to make reductions in partnership with the Environment Agency by considering all the evidence available to ensure it will deliver the most benefit

• we propose to continue with our river restoration and habitat enhancement work and we will choose this option where it makes most sense for customers and the environment

• we must continue to protect supplies to customers so we recognise that there may be an additional environmental cost (a carbon footprint) associated with replacing water in another way because we may have to pump it from further away.

We are consulting on reductions in abstractions of 10 or 39 million litres of water per day, with work phased over a ten year period. There is a cost to customers associated with leaving more water in the environment, so it is important that we understand their preference on the extent of this work.

In our **PP** we have included reductions in abstraction that in our view are based on robust evidence that they will achieve environmental benefits and that are cost beneficial. The **AP** has a higher cost and we consider this plan to also be higher risk. The **AP** represents a greater challenge to operational resilience by including a higher level of sustainability reductions requested by the Environment Agency by 2024 with little time to mobilise reliable alternative demand management or supply measures in a region of water scarcity.

Within the consultation document we are asking customers and stakeholders firstly whether they support or oppose our phased approach to sustainability reductions. Secondly, whether they support or oppose our **PP** option of a reduction of 10 million litres of water per day at a cost of £93 million by 2080 or our **AP** option of a reduction of 39 million litres of water per day at a cost of £123 million by 2080.

Collaboration and sharing

Working with other water companies and third parties.

Our plan commits us to sharing water and water resources. In some cases, over the long term, this includes building new assets, such as pipes and reservoirs, with other water companies across our region. This is important to help us address the shortage of water and support the growing population in both our area and in neighbouring water company areas.

Within the consultation document we are asking customers and stakeholders whether they support or oppose this type of joint approach.

What happens next?

The Secretary of State will forward responses on to us. At the end of the consultation we will consider all the comments made. In summer 2018 we aim to publish our Statement of Response – a document that details how we have changed the plan because of the comments made, or provide an explanation if we have not been able to.

18 Next Steps

18.1 Introduction

We expect to publish our draft plan in March 2018 for consultation. Our programme will include:

- informing customers and stakeholders about our consultation programme and how they can influence our draft plans by giving us their views on our **PP** and **AP**
- considering feedback from our stakeholders and customers to inform our final WRMP and expect to submit a statement of response in summer 2018
- continuing discussion regarding trading and potential bulk transfers from neighbouring water companies and third parties, plus take into consideration developments from the regional modelling groups to ensure our final plan is consistent with regional strategies
- integrating our **PP** with Ofwat's PR19 programme and our Business Plan modelling.

18.2 Our Approach to Sustainability Reductions

We are continuing discussions with the EA regarding sustainability reductions for 2020 to 2025. We want to make sure reductions are based on clear scientific evidence of ecological benefit and will continue our dialogue with the Environment Agency over this. We will consult with customers on whether they support the environmental improvements suggested and we will adapt our plan in light of the outcome of that consultation. We will continue to refine our cost calculations on intra-zonal upgrades required to deliver our planned SRs for AMP7.

18.3 Our Approach to Drought Resilience

We are keen to move towards a more resilient position in terms of drought and will take onboard customer and stakeholder views regarding environmental benefit and costs when considering our **PP** an **AP** including the use of drought permits and orders for additional abstraction. We will continue to refine our cost calculations on intra-zonal reinforcements to maintain resilience of supply following the changes in our operations required to deliver our **PP**and **AP** and use this information to inform our public consultation.

18.4 Our Approach to WSP Savings Reassessments

For our dWRMP19 baseline demand forecast we included an initial assessment estimating a saving of 18% from the Water Saving Programme (WSP). This was based on limited availability of consumption data we had at the time and evidence gained from Southern Water's Universal Metering Programme (UMP) case study. The study found that the average reduction in consumption attributed to metering was 18%, but may be anywhere between 16 and 20% depending on how much weight is attributed to leakage. As we progressively increase our metering coverage across our area through WSP and customers begin to switch to a metered account, we can better reassess the benefits from WSP, as we start to have a wider timespan of consumption data we can re-evaluate the savings expected from WSP which will in turn improve our final WRMP19 demand forecast.

18.5 Our Approach to Consistency of Reporting Performance Measures

As per UKWIR 2017 work undertaken to improve the consistency of reporting of performance measures, we assessed the impact of the new method to forecast baseline leakage. The change in reporting of leakage is purely a change in reporting; it does not affect the actual amount of water lost through leakage, although our initial assessment showed a 2% increase in our base year leakage.

We have tested the sensitivity of measuring leakage through this new method and plan to carry out further tests. We will subsequently look to apply the new method to estimate our final base year leakage and incorporate into our final WRMP19 demand forecast.

18.6 Our Approach to Re-assessment of LA Local Plans

Following the initial work by Experian to forecast the levels of future population growth across our supply area, which was undertaken in order to appropriately assess the future relationship between water supply and demand, we are now undertaking a further detailed study to determine growth at a much more granular geographical level. This will look at the actual spatial distribution of future housing developments as set out in the housing site allocations within all of our Local Authorities' Local Plans. This serves the benefit of allowing us to appropriately target our recommendations for specific geographical areas which will experience significant increases in demand as a result of new development over the plan period. In collecting this data, we will also be able to ensure that our forecasts are aligned with the most up to date growth projections, following the initial data collection by Experian. We are currently contacting all of our Local Planning Authorities to gather this information, and using information published within Local Plan documents where available.

Once we have completed this study, we will assess the figures against our existing projections, and appropriately adjust our forecasts and recommendations if there are considerable differences. This process will further validate our approach to assessing population growth, and reduce uncertainty associated with our current housing and population forecasts.

18.7 Local Water Re-use Opportunities

We propose to re-examine the water balance in the River Lee catchment. There needs to be a recognition that much of the water we import from ANGL is discharged to rivers which ultimately feed the River Thames downstream, thereby improving the resilience of downstream water companies. On that basis we propose to undertake discussions with ANGL and TWUL within the context of future increases in discharges to those water courses (as a result of future increase in demand). We believe that better local planning, between clean water supply and waste water companies could enable more effective water cycling in certain catchments and that this must be part of the long term solution for water resources, even though we may not have included these options within our draft plan.

18.8 Our Approach to HS2

We have been working with HS2 for nearly three years in preparation for the new railway. From the outset we approached this project with the perspective that HS2 should reimburse our costs for all work and asset changes needed to facilitate the railway whilst at all times maintaining resilience of water supplies. We have entered into agreements with HS2 to ensure this is achieved. We have also followed the principle that customers should not subsidise HS2. HS2 may affect at least three of our groundwater sources in terms of both quality and quantity of resources during the construction process and in the longer term a further three resources may be affected through derogation of yield. The agreements we have secured enable us to act to mitigate those affects should they arise such that we will be able to maintain our resource base at all times and therefore we have excluded any effects of HS2 from our dWRMP.

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Appendices

List of Appendices

Appendix A: Progress on our WRMP14 Programmes

A.1.1 Sustainability reductions

A.1.2 No deterioration

A.2 Supplying high quality water that can be trusted

A.3 Leakage reduction

A.4 Universal metering programme and Water Saving Programme

A.5 Water efficiency

Appendix B - WISER Expectations Relating to WRMP19

Appendix C - Benefits of Catchment Management and NEP Programmes

Appendix D - List of Associated Documents

Appendix E - Wider Consultation Activities

Appendix A: Progress on our WRMP14 Programmes

A.1.1 Sustainability reductions

Our supply area is home to many chalk streams that flow through areas of importance including the Chilterns Area of Outstanding Natural Beauty (AONB), Dedham Vale AONB and the North Downs. Chalk streams are a globally rare habitat, confined to North-west Europe and notably the UK. These streams are an integral part of our landscape and communities, providing valuable habitat for plants and animals. We have been actively working with the Environment Agency, Wildlife Trusts, Conservation Boards and other stakeholders for more than 20 years to improve and conserve these habitats.

In our last plan we have included 'certain' and 'likely' sustainability reductions with the Environment Agency for 2015 to 2025. We have also continued our studies under our National Environment Programme (NEP) to evaluate the impact of our operations on the environment and assess the benefits from sustainability reductions. This programme includes a number of areas where the requirements for further sustainability reductions remains uncertain.

We have continued to work in partnership with the EA to inform the River Basin Management Plan process so that further obligations under the Water Framework Directive are identified and not disproportionate.

We anticipate we will have to reduce abstraction further in future so we have placed an emphasis on demand management measures in the short term. If we are more successful in reducing demand than our plan forecast that would be more in line with what we have experienced in our Southeast region, then we will be well placed to be able to further reduce abstraction and improve the conditions in more local water catchments.

Our WRMP14 included sustainability reductions at groundwater abstraction sources in three of our eight water resource zones. Table A1.1 shows the average and peak sustainability reductions by water resource zone.

Table A1.1: Groundwater abstraction sustainability reductions

Water Resource Zone	Reduction Average DO Ml/d		Reduction Peak DO Ml/d	
	AMP6 (implementation)	AMP7 (proposed at PR14)	AMP6 (implementation)	AMP7 (proposed at PR14)
WRZ 1 – Misbourne	11.00	2.00	6.15	2
WRZ 2 – Colne	5.82	8.84	5.82	0
WRZ 3 – Lee	25.27	16.87	27.09	10.49
WRZ 4 – Pinn	0	0	0	0
WRZ 5 – Stort	0	0	0	0
WRZ 6 – Wey	0	0	0	0
Sub-total (Central region)	**42.09**	**27.71**	**39.06**	**12.49**
WRZ 7 (Southeast region)	0	0	0	0
WRZ 8 (East region)	0	0	0	0
Company Total	**69.80**		**51.55**	

The reductions affect 13 of our sources. Abstraction will cease at five sources and eight will have reduced outputs. During AMP6 we are planning to achieve reductions of 42 Ml/d under average conditions by 2020.

Table A1.2: AMP6 Sustainability reductions progress

Source	Reduction		Post Reduction		River Catchment	Timing of Reduction	Progress
	Ave DO (Ml/d)	Peak DO (Ml/d)	Ave DO (Ml/d)	Peak DO (Ml/d)			
BOWB	5.82	5.82	0	0	Ver	**2016**	Implemented 01/04/2016
WHIH	16.18	18.00	2.00 (1.96)	10.00 (8.10)	Beane	Voluntarily capped at 15 Ml/d in **2014**. Licence reduction **2018**	Implemented early 01/04/2017
FULL	9.09	9.09	0	0	Mimram	Capped at 5.6 Ml/d in **2015**. Licence to be revoked **2018**	Implemented early 01/04/2017
HUGH	1.60	1.75	0	0	Hughenden Stream	**2017**	Implemented 01/04/2017
PICC	10.00	5.00	5.72	10.72	Gade	**2018**	On target
MARL	-3.60	-3.60	8.34 (7.73)	8.34	Gade	**2018**	On target
AMER	3.00	3.00	4.00	9.00	Misbourne	**2018**	On target
Total reduction	**42.09**	**39.06**				**AMP 6**	Implemented to date **32.69Ml/d** (average DO)

A.1.2 No deterioration

Since the start of AMP6 we have a significantly increased our environmental monitoring programme to measure the overall effect our abstractions have on the environment particularly at all environmentally sensitive sites.

We recognise our obligations to ensure our proposals for future groundwater development do not cause deterioration. We have carried out an initial assessment of all supply options and rejected those with unacceptable impacts. We have fully investigated the impact of abstraction schemes identified for implementation in AMP6 in our **PP** to ensure we can verify no deterioration of the environment from their implementation in sufficient time that we will be able to switch to alternative schemes. We will do the same for schemes included in dWRMP19 and PR19 our Business Plan.

A.2 Supplying high quality water that can be trusted

We have seen a significant effect of pollution on our resources and we have been proactive in both monitoring pollution and investigating pollution threats to encourage polluters to take responsibility for their actions.

Since our last plan we have undertaken an enhanced programme for catchment management. We have extended our partnering arrangements and our activities in both Central and Southeast regions to mitigate the effect of pesticides, herbicides and nitrate use. Please see Section 8.8 for further information.

A.3 Leakage reduction

Customers continue to expect us to do more around reducing leakage. We continue our challenging programme of leakage reduction for AMP6 and towards achieving the following objectives:

- a continuation in the reduction in leakage
- control of leakage year on year below a predetermined leakage target
- continual improvement towards increasing efficiency in managing and controlling leakage
- continuing our innovative implementation of fast logging to assess legitimate night use on a weekly basis to improve our assessment of net night use and therefore improve the efficiency of our leakage reduction targeting
- confirmation of our non-household logging programme to verify non-household night use
- continuing the monitoring of leakage activities compared to benefits at DMA level. This will enhance our understanding of the natural rate of rise and the cost of reducing leakage further
- implementing leakage monitoring on our critical mains
- improved assessment of leakage reduction from mains renewals
- improved assessment of supply pipe leakage associated with our integrated metering programme.

Leakage management and control

Customers supported our plans to reduce leakage beyond the economic level together with a preference for a greater response to leakage management in times of water scarcity. We have learnt a significant amount about how to manage leakage reduction during this time. Some of our activity will have been visible to customers, but much has gone unnoticed as we strive for more efficient ways to find leaks.

Management and control of leakage is primarily achieved by active leakage control (ALC). This is the detection of non-visible leaks, as well as optimised pressure control to reduce the flow from any live leaks and reduction in bursts and the early repair of leaks. This is combined with accurate reporting of our performance to ensure efficient delivery of regulatory targets.

We have over 800 District Metered Areas (DMAs), covering in excess of 80% of our network and customers. These are monitored on a daily basis in order to review performance and identify potential leakage. In order to comply with the new Water UK consistent method of reporting leakage, we will be increasing our coverage to 95% by 2019/20 such that 90% of these are available for reporting at all times.

Software tools are used to assess daily flows and pressures in these areas and to check to see if any significant changes are identified. Minimum night flows are calculated to quantify leakage and determine daily leakage levels.

During AMP6 we have implemented a new leakage management tool called WaterNet. This has significantly improved targeting of our resources and accuracy of our leakage reporting.

Leakage reduction improvement programmes

Since publishing our fWRMP14, we have met our annual leakage reduction target set by our regulator, Ofwat and continue to work towards achieving a saving of 20Ml/d from our distribution network leakage through a number of methods. The principal methods we have employed are outlined below.

- **improved accuracy in the calculation of allowances.** A key piece of work was undertaken to better calculate the usage of non-households and household customers through the night. This included our innovative 'fast logging' system that allowed us to accurately calculate the amount of usage at DMA level. This in turn provided a truer assessment of leakage to increase efficiency by accurately targeting areas where leaks are likely to be occurring

- **deployment of permanent acoustic loggers.** We lead the UK industry and the world when we deployed 20,000 noise loggers across our network in 2017 to constantly listen for leaks. When such a noise is detecting that indicated a potential leak, data is transmitted to our control room, this means that we can now respond to leaks quicker than ever before, and as a result we are more efficient at finding leaks. This has helped us significantly drop leakage rates in the areas in which the loggers are installed

- **training of our operatives.** We have increased the number of directly employed highly trained expert leakage technicians and created our own leakage training site, where we can teach and hone the skills and techniques needed to find leaks as quickly as possible. We have also sought a commitment from our supply chain to ensure that our contractor resource is trained to a high standard. Additionally, we have improved our reporting systems to enable operatives to receive further training quickly if required

- **innovation.** To achieve the challenging target we have set ourselves in the past three years we have had to change the way in which we work and the tools that we use. We have trialled many new methods from satellite images to using conductivity methods to find leaks. Not all have been successful, but our framework to evaluate new technology has also developed alongside enabling us to determine the benefits of new technologies more effectively. In addition we have continued to build and develop a more comprehensive and integrated leakage reporting and monitoring system

- **pressure management**. We have completed a number of pressure management schemes. These have helped to reduce leakage and further helped reduce the burst rate in these areas. We have also divided up several large DMAs into smaller areas so that leakage is more manageable

- **water saving programme – customer supply side leakage detection.** By installing AMR meters at properties, we have had the opportunity to detect leaks on customers' pipes, also know as customer supply side leakage. This includes finding and fixing leaks both at installation and offering free repairs later in the WSP customer journey. This information has helped us locate a significant amount of leakage even quicker and helped customers save money from their water and energy bills at the same time.

A.4 Universal metering programme and Water Saving Programme

Approach

In recognition of water scarcity in our supply area we implemented a universal metering programme to help customers reduce their consumption. Through our PR14 WRMP and Business Planning process we have successfully secured funding for our Water Saving Programme. The Water Saving Programme is the biggest demand management project ever undertaken by Affinity Water and will contribute significantly to reducing the company supply / demand deficit between 2015 – 2040. The programme plans to reduce customer demand by 56 Ml/d between 2015 and 2025 through the installation of 525,000 water meters for customers in the Affinity Water Central region, by 2025. This has been supplemented by greater company and customer side leakage detection, and through enhanced water efficiency engagement targeted at domestic customers. We reduced our initial rate of the metering programme in response to Consumer Council for Water's concerns and will now deliver the programme across the next two AMP periods between 2015 and 2025.

During AMP 6 we aimed to save 29 Ml/d through our water saving programme (WSP) which implements automated meter reading (AMR). The savings include a 7Ml/d reduction from the repair of customer supply pipe leaks. As part of the WSP each house is offered a 'home water efficiency check' (HWEC) which involves a home audit and provision of water saving devices. The current HWECs estimate savings of 4Ml/d.

Increases in metering penetration during AMP6

In addition to our WSP, our on-going communication strategy with customers through our website and via the billing process has generated an optant meter rate broadly in line with expectations, resulting in 48.82% of our total domestic customer base now being charged based on their actual consumption with the regional summaries shown in Table A4.1.

Table A4.1: Percentage of properties metered in each region excluding voids 2015/16

Type	Central	Southeast	East	Company
Household	44.70	81.00	72.35	48.32
Non-household	87.17	76.00	99.31	89.55
% metered	**47.11**	**89.59**	**75.12**	**50.75**

A.5 Water efficiency

Approach

We have continued our baseline water efficiency promotional activities and now have a comprehensive programme of water efficiency support when customers transfer to metered charging. We launched an enhanced awareness campaign during 2014 to prepare the way for our metering programme and have provided information, products and audits to support customers during the optional transition period.

As stated above, as part of the WSP all homes have been offered a HWEC. Affinity expects to complete 25,000 HWEC's a year, in total 112,000 by April 2020. The HWEC offers a circa 45 minute check with free products, simple tap and toilet repairs undertaken and a customer report estimating the financial and water savings from the engagement and this initiative is industry leading. Our Water Efficiency programme has continued building upon the approach of leveraging community partnerships and exploring innovative solutions to help people save water. Working closely with many different teams, Water Efficiency team utilises innovative, creative solutions to raise awareness of the importance of saving water, helping to implement behaviour change and acceptance to Affinity Water's objectives.

We have improved our water efficiency programme to include more educational awareness. The future role of our Education Centre team in Bushey is expanding, as many customers expressed a desire to see Affinity working with local schools. The behavioural education activities include attendance at around 100 events, promotion of the wider metering programme, and a school engagement programme with approximately 50 schools each year.

With the Water Saving Programme expanding rapidly, it has been vital for the Water Efficiency team to engage and educate customers prior to the install of the meter, as well as engagement after the programme has left the area. By utilising many different avenues to promote our water efficiency awareness raising campaigns, customers can gain a wider understanding for the move towards meters and get help to reduce their water bills and consumption.

We have continued utilising the Water Saving Squad to engage with people at community events, handing out devices and educating customers on water efficient behaviours that they can utilise at home, as well as raising awareness of the value of water and the reasons behind saving water. At the same time, instigating partnerships with local councils, housing associations and local community groups has widened our engagement and allowed us to encourage water efficient behaviours to a vast range of customers.

The Water Efficiency team has forged many great partnerships over the last 12 months as well as continuing to grow existing ones. We have regularly worked with universities, colleges and schools in order to raise the awareness of water efficiency to a younger audience. A key outcome from a recent survey we undertook shows that the majority of teenagers were taking 20-30 minute showers. If we can implement behaviour change during teenage years, we hope this behaviour would continue through later years.

On top of these partnerships we are actively engaging with local river and community groups, the Environment Agency and various wildlife trusts. We regularly run competitions and campaigns, as well as utilising social media to raise the profile of water efficiency and to educate customers on the small changes they can make. By utilising creative methods of engagement such as our 3D street art, twitter/facebook, blogs, youtube videos and campaigns with external providers, we hope to make saving water fun, unintimidating and understandable to everyone

SaveWater South East

SaveWater South East is an exciting new collaboration between Waterwise, the Environment Agency and six water companies – Affinity Water, Portsmouth Water, Thames Water, South East Water, Southern Water and Sutton & East Surrey Water. It was established with the aim of increasing the awareness of water as a finite resource and creating a water saving culture in the South East of England. By working together, SaveWater South East aims to promote water efficiency across the region to help people save water and money.

In 2016/2017 we have been running a social media campaign with an engaging website and competition (www.thinkwater.org.uk). The idea of this was to portray a wider message across to a variety of customers, utilising the partnership between the water companies to showcase the aligned objectives and the ways in which customers can start to save water.

Figure A5 ThinkWater campaign

Our Education Services

Our Education Services Team aims to support primary and secondary school teachers in our communities by providing a stimulating hands-on learning experience about the importance of water and the environment, such that it can enrich their curriculum. Our award winning Education Team has been accredited with the Learning Outside the Classroom Quality Badge. We welcome more than 6,000 visitors a year to our Education Centre in Bushey and visit over 7,000 pupils each year by attending their schools. The team has also facilitated various teacher training workshops, attended specialist events and worked with third party organisations such as White Cliffs Countryside Partnership.

In addition, there is a specialist Education Service that is directly supporting the company's Water Saving Programme. In 2016/17, this service reached over 6,500 students and teachers. The programme, 'Water Saving Squad in Schools' is a free of charge curriculum-linked programme; it is led by students and empowers them to take action to save water at school and at home. Water Saving Squad in Schools is offered to primary schools in areas where meters are being installed to help customers understand practical ways in which they can save water and reduce their bills. There is also a 'Challenge: Water' programme supporting secondary schools; this is a STEM based initiative in partnership with WaterAid.

For more information please follow the links below:

The Affinity Water Education Services department: https://education.affinitywater.co.uk/

The Water Saving Squad in Schools programme: https://education.affinitywater.co.uk/water-saving-schools.aspx

Appendix B: WISER Expectations Relating to WRMP19

Programme of Works	Projects
Solutions to meet water resources management plan outcomes or measures to protect the environment form the supply-demand component of business plans.	Solutions will be developed as part of our optioneering and investment modelling (EBSD) approach being carried out to develop our WRMP preferred strategy in selecting "best value" portfolio of options.
Assess resilience of your water supply system to predicted droughts and other non-drought water supply hazards.	We regularly assess the potential risk derived from drought, flood, pollution incidents and lost in performance, minimising the risks and proposing alternative solutions in accordance with production team, EA and other external stakeholders
Measures to reduce demand and per capita consumption.	We have an ongoing programme of water savings through metering of household properties based on 90% target meter penetration by 2025 and aim to reduce leakage by 14% (27mld) by 2020. We also have an action plan to reduce the company’s average water use and improve the accuracy of our water balance.
Achieve a downward trend for leakage with rates at or below the sustainable economic level of leakage	Our Leakage ODI targets in our baseline is set at 14% by 2020 and we are planning a further downward trend of 11% reduction (a figure in line or close to WRSE) which takes us below the economic level of leakage.
Assess universal metering in water stressed areas.	We are currently re-assessing our WSP model and developing a module in Waternet which will allow us to understand and derive water saved from universal metering as part of our water saving programme.
Ensure agreed and up to date plans are place to manage a drought.	We carry out drought studies to minimise the risk of lower water resource availability to the production sources, liaise with the EA to ensure that during drought periods all the mitigation measures are in place and we submit drought permits to ensure the maximum sustainable exploitation of the resources during those periods. We undertake constant review of the performance of the sources during low groundwater periods to ensure longer resilience of the aquifers in the most vulnerable areas
Demonstrate that Defra’s Guiding principles for water resources planning have been met.	As part of the delivery of the dWRMP19 we have set up a compliance checklist which is being reviewed regularly by the team to ensure we are meeting our regulatory compliance.
Incorporate sustainability changes into supply forecasts.	We have included AMP6 and AMP7 sustainability reductions in our baseline supply forecast and will further test scenarios as part of the WINEP2 and 3 release.
Current abstractions and operations, and future plans support the achievement of Environmental objectives.	We undertake constant review and check of the source performances by engaging the production team in achieving the maximum exploitable volume of groundwater abstracted and liaise with the EA and other external stakeholder to minimise the effects of the abstractions on the environment

Affinity Water

Appendix C: Catchment Management Programme of works, the company benefits and the wider environmental, social and economic benefits

Programme of Works	Projects	Company Benefits	Wider Environmental and Community Benefits
Catchment Management	**Agricultural pesticide reduction schemes and nitrate reduction pilot trials** - Work with farmers in identified high risk catchments to identify and incentivise measures that reduce pesticides into surface and ground waters and nitrates into ground waters. This includes a Payment for Ecosystem Services philosophy that incentivises farmers as producers of clean water through: - Retention of soils on the land through cultural controls - Retention of rainfall in the catchment through increased soil organic carbon (e.g. cover crops) - To slow the over land flow and inputs to river systems - Spreader/sprayer testing and calibration of farmer pesticide application machinery in high risk catchments - Pesticide applicator training for farmers and their contractors in high risk catchments - Pesticide amnesty for farmers operating in identified high risk catchments to safely dispose of banned, out of date or unwanted crop protection products. - Hosting specialist workshops and training events for farmer in high risk catchments to adopt best practice in farming techniques focused on water protection Installation of a demonstration biobed to support farmers in retaining waste pesticides on land and preventing ingress to rivers **Monitoring groundwater** -Determine the current health of the aquifers used for public water supply. - Identify water quality issues to predict future trends in concentrations of contaminants and diffuse pollution. - Outcomes of monitoring used to identify pollutant source and determine pollutant pathway(s). **Monitoring surface water** - Capture concentration of Pesticides and other contaminants and future trends - Determine high risk catchments/sub-catchments for diffuse / point source pollution - Responding to, and investigating Pollution incidents **Catchment risk assessments** - Carry out land use surveys, wet-weather walkovers, catchment walkovers, remote sensing and desktop/water quality data reviews to determine land use risk to drinking water quality and capture hotspots for pollution and contaminant inputs to the water environment **Stakeholder engagement and collaboration** - To engage with landowners, farmers, businesses, river catchment partnerships and community groups to share knowledge and best practice in managing the river catchment and protecting groundwaters	**Economic** - Reducing the leaching/run-off of pesticides and nutrients into groundwater and surface to: - Reduce energy and chemical costs required for treatment - Able to predict future treatment requirements and appropriate levels of investment - To reduce the need for future treatment / blending schemes - Reduce the risk of loss of supply and the increased cost of importing water - Mitigate the risk of future pollution incidents through proactive engagement with land managers **Corporate Social Responsibility** - Enhanced reputation. Closer working relationship with customers and key stakeholders - Leader in best practice, knowledge and innovation - Reporting of pollution incidents - Better understanding of our catchments and the risks to public water supply **Regulatory compliance** - Drinking Water Inspectorate (Drinking Water Directive) Environment Agency – supports the National Environment Programme and WFD no deterioration	**Environment** - Raising awareness of pollution incidents and hotspots for further investigation and mitigation - Creating and enhancing habitats for birds, mammals, invertebrates and plants - Increasing biodiversity and population migration through green corridors in the catchment - Reduced use of energy and chemicals both by the landowner/farmer/business and water company - Better management of wastes generated by land use activities **Economic** - Value for money water bill - Less input of pesticides and fertiliser for farmers saving money - Reduced risk of pollution incidents and associated costs of remediation **Health** - Wholesome potable water - Reduced nutrification of the river environment **Food** - Retention of valuable soil on land for farming - Retention of nutrients in the soil - More sustainable farming systems

National Environment Programme of works, the company benefits and the wider environmental, social and economic benefits

Programme of Works	Projects	Company Benefits	Wider Environmental and Community Benefits
National Environment Programme	**Morphological Mitigation** - Restoring natural river processes - Increase the velocity of river flow and build in resilience to climate change - Reconnecting rivers to their natural flood plain to alleviate flood risk and building in extra river capacity - Enhance river habitat for fish to spawn and migrate - Increase biodiversity (fish, invertebrates, plants) - Treatment and eradication of Non-native Invasive Species **Biodiversity** - Maintenance and habitat management plans for designated landholdings such as Sites of Special Scientific Interest (SSSI) and Local Nature Reserves (LNR) - Treatment and eradication of Non-native Invasive Species on Company owned land - Tree surveys to track the health of trees on Company owned land - Stakeholder engagement with Wildlife Trusts - To preserve and enhance biodiversity on Company owned land **Sustainability Reductions** - Environmental impact assessments - Leaving more water in the environment - Efficient use of assets	**Regulatory compliance** - Regulatory requirement to implement the National Environment Programme - Compliance with Section 40 of the 2006 Natural Environment and Rural Communities (NERC) Act 2006 - Compliance with Countryside Rights of Way Act (CROW) - Water Framework Directive supporting the rivers to meet 'Good Ecological Status/potential' and no deterioration **Corporate Social Responsibility** - Enhanced reputation and fulfilling our vision to be the leading community focused water company, due to the wider environmental, social and economic benefits of our projects - Leader in best practice, knowledge and innovation - Identification of pollution incidents and no deterioration **Economic** - Morphological mitigation is a cheaper option than moving large quantities of water around the network - Less risk of further sustainability reductions - Reduced costs of land management - Reduce the risk of loss of supply and the increased cost of importing water	**Economic** - Value for money water bill - Rivers should be self sustaining and require less maintenance by landowners saving money - Pride in the area raised, therefore less anti-social behaviour and fly tipping - Flood alleviation - Increase in property prices **Recreation** - the aesthetic restoration will encourage local residents to use the park more for recreation and exercise, improving well being **Environment** - Creating and enhancing habitats for birds, mammals, fish, invertebrates and plants - Increasing biodiversity and population migration through green/blue corridors in the catchment - Eradication of non-native invasive species will give the opportunity for local native species to thrive - leaving more water in the environment - The rivers will be more resilient in times of low flows with increased capacity at times of high flows - Rivers will be more resilient to the changing climatic patterns of climate change **Education** - The improved river habitat provides a resource for local schools and local residents to visit and learn about Chalk Streams and their unique ecology **Health** - Improved health and mental well being of customers and local community - Healthy rivers keep urban areas cooler in summer and warmer in winter mitigating the urban heat island effect - Reduced impact of diffuse pollution from urban runoff

Affinity Water

Appendix D List of Associated Documents

Draft Water Resources Management Plan 2020-2080

List of associated documents

Component	ID	Document Title	Purpose	Redacted Version
Main Report	1.0	Draft Water Resources Management Plan 2020-2080	Regulator use and intend to make publically available	YES
1. Supply	1.1	Deployable Output and Climate Change Impact Assessment	Regulator use and not to be published*	NO
	1.2	Climate Change Assessment	Regulator use and not to be published*	NO
	1.3	Climate Change Vulnerability Assessment	Regulator use and not to be published*	NO
	1.4	Sustainability Reductions	Regulator use and not to be published*	NO
	1.4.1	AMP6 NEP Progress and Summary of WINEP PR19 Schemes	Regulator use and not to be published*	NO
	1.5	Water Resource Zone Integrity	Regulator use and not to be published*	NO
	1.6	Draft Drought Management Plan	Regulator use and not to be published*	NO
	1.7	Problem Characterisation Report	Regulator use and not to be published*	NO
2. Demand	2.1	Household Demand Forecast - MLR Modelling Report	Regulator use and not to be published*	NO
	2.2	Household Demand Forecast - Micro-Component Report	Regulator use and not to be published*	NO
	2.3	Domestic Housing and Population Forecast	Regulator use and not to be published*	NO
	2.4	Non-Household Demand Forecasting Summary Report	Regulator use and not to be published*	NO
	2.5	Dry Year Annual Average (DYAA) and Critical Period Factors Analysis	Regulator use and not to be published*	NO
3. Risk and Uncertainty	3.1	Outage	Regulator use and not to be published*	NO
	3.2	Headroom	Regulator use and not to be published*	NO
4. Options and EBSD	4.1	Unconstrained Options Study (Supply Side Options)	Regulator use and not to be published*	NO
	4.2	Unconstrained Options Study (Demand Management Options)	Regulator use and not to be published*	NO
	4.3	AECOM Screening Methodology (Supply Options)	Regulator use and not to be published*	NO
	4.4	LRMC Cost Model Update	Regulator use and not to be published*	NO
	4.5	Supply Side & Constrained Options Report Volume 1	Regulator use and not to be published*	NO
	4.6	Supply Side & Constrained Options Report Volume 2	Regulator use and not to be published*	NO
	4.7	Water Demand Management Framework- Assessment of Demand Side Options	Regulator use and not to be published*	NO
	4.8	Leakage Strategy Report (to be produced for fWRMP19)	N/A	N/A
	4.8.1	ELL and SELL Determination 2018	Regulator use and not to be published*	NO
	4.9	Economics of Balancing Supply and Demand Modelling	Regulator use and not to be published*	NO
	4.10	Strategic Environmental Assessment Scoping Report Volume 1	Regulator use and not to be published*	NO
	4.10.1	Strategic Environmental Assessment Scoping Report Volume 2	Regulator use and not to be published*	NO
	4.11	Strategic Environmental Assessment (SEA) Environmental Report	Regulator use and intend to make publically available	YES
	4.11.1	Strategic Environmental Assessment (SEA) Environmental Report Appendices	Regulator use and intend to make publically available	YES
	4.12	Habitat Regulations Assessment	Regulator use and not to be published*	NO
	4.13	Water Framework Directive Report	Regulator use and not to be published*	NO
5. Regional Modelling	5.1	National and Regional Water Resources Modelling Report	Regulator use and not to be published*	NO
	5.2	Water Company and Third Party Bulk Transfers	Regulator use and not to be published*	NO
6. Tables	6.1	WRP Tables: Commentary & Exception Report	Regulator use and intend to make publically available	YES
	WRZ1	Dry Year Annual Average	Regulator use and intend to make publically available	YES
		Dry Year Critical Period	Regulator use and intend to make publically available	YES
	WRZ2	Dry Year Annual Average	Regulator use and intend to make publically available	YES
		Dry Year Critical Period	Regulator use and intend to make publically available	YES
	WRZ3	Dry Year Annual Average	Regulator use and intend to make publically available	YES
		Dry Year Critical Period	Regulator use and intend to make publically available	YES
	WRZ4	Dry Year Annual Average	Regulator use and intend to make publically available	YES
		Dry Year Critical Period	Regulator use and intend to make publically available	YES
	WRZ5	Dry Year Annual Average	Regulator use and intend to make publically available	YES
		Dry Year Critical Period	Regulator use and intend to make publically available	YES
	WRZ6	Dry Year Annual Average	Regulator use and intend to make publically available	YES
		Dry Year Critical Period	Regulator use and intend to make publically available	YES
	WRZ7	Dry Year Annual Average	Regulator use and intend to make publically available	YES
		Dry Year Critical Period	Regulator use and intend to make publically available	YES
	WRZ8	Dry Year Annual Average	Regulator use and intend to make publically available	YES
		Dry Year Critical Period	Regulator use and intend to make publically available	YES
7. Consultation	7.1	Engaging with our Customers, Communities and Stakeholders (to be produced for fWRMP19)	N/A	N/A

Note:
*Documents will not be published on our website and unredacted as otherwise readers are not able to assess and comment on the documents. If requested, an unredacted paper copy will be provided to a name and address within our operational area by post or to a legitimate concern or make available for inspection at our offices in Hatfield, Folkestone and Manningtree. Electronic pdf copies will be provided only after verification of identity and under agreement for their own use and not for distribution.

Appendix E Wider Consultation Activities for PR19

Water saving squad

Our Water Efficiency programme works closely with many different teams to utilise creative solutions to raise awareness of the importance of saving water. It helps to implement behaviour change, leveraging community partnerships and exploring innovative solutions to help people save water. A key area of work has focused on our metering programme.

Our Water Saving Squad has engaged with people at community events, handing out devices and educating customers on water efficient behaviours that they can adopt at home, as well as raising awareness of the value of water and the reasons behind saving it. We have instigated partnerships with local authorities, housing associations, community groups, universities, colleges and schools which has widened our engagement and allowed us to encourage water efficient behaviours among a vast range of customers.

The popularity of the squad has grown and resulted in local communities requesting our presence at their events, rather than us seeking opportunities to attend. With a team of over 70 volunteers from various teams and departments, a broad range of topics can be address at squad events. An example of this is the inclusion of members from the Advanced Care Team being on hand to advise vulnerable customers about their bills.

To date in 2017/18, the Water Saving Squad has:

- Attended 44 events this year, distributing around 8,500 devices to the public.
- Distributed 33,000 devices through our free pack web page. This includes shower heads, tooth timers and the Kids Kit.
- Made a total saving of 538,649 litres of water (using Ofwat assumed savings).
- 1812 followers with an average of 40,000 impressions a month on the Water Saving Squad Twitter page.

There are plans for a Water Saving Squad mascot to be introduced for 2017/2018 which will be another great opportunity to engage with children.

SaveWater South East is an exciting new collaboration between Waterwise, the Environment Agency and six water companies – Affinity Water, Portsmouth Water, Thames Water, South East Water, Southern Water and Sutton and East Surrey Water. It aims to promote water efficiency across the region to help people save water and money and we have run a social media campaign with an engaging website and competition (www.thinkwater.org.uk).

All of these activities cement the Water Saving Squad as being a great way to engage with customers around water efficiency.

Education

The Education Centre works with future customers to inspire them to value and protect our water resources. Our work delivers a preventative role in terms of educating customers, children and young people to save water, leading to long term behavioural change.

The type of engagement is varied and includes:

- In reach visits with Key Stage 1-5 students (age 5-18) to the Education Centre in Bushey, Hertfordshire.

- Outreach visits to schools with Key Stage 1-5 students in the Affinity Water operating area.
- Partnership working with other organisations in the Affinity Water operating area to incorporate our activities and messages within their programmes.
- Free online education resources accessed via our website. These support key company messages and are linked to the national curriculum, suitable for Key Stage 1-5 students.
- Water Saving Programme Education Service targets schools and communities where metering is taking place. Using fun activities it challenges customers to reduce their per capita consumption. Table E1 below illustrates the number of people engaged through each method.

Table E1: Number of people engaged

Method	Jan – Dec 2015	Jan – Dec 2016	Jan – July 2017
In reach	3,005	3,928	2,342
Outreach	1,675	2,289	6,207
Third party partnerships	0	1,546	1,770
WSP Education Service	4,976	8,426	10,217
Total	**9,656**	**16,189**	**20,536**

Challenge water

This is an exciting STEM based water saving initiative for secondary schools. It encourages young people to use their creativity and skills to develop innovative solutions to water and sanitation issues in their area, as well as globally. The programme has been developed by WaterAid in partnership with Affinity Water.

A number of schools took part in this Key Stage 3 initiative last academic year and researched and developed a product and behaviour change campaign, whilst competing against other schools in their area.

Keep Track of the Tap

The Keep Track of the Tap campaign was launched in June 2017 to communicate to customers that water resources were below average and to request that they reduced their water use by changing their behaviour . The campaign offered free water saving devices via the Affinity Water website.

A local radio campaign was delivered, followed by a door drop mailing of 1.7 million leaflets to customers in our Central and Southeast regions. This was supported by bus back advertising in selected parts of our communities.

Affinity for Business the largest retailer in our water supply area, sent its own update to their customers.

These campaigns were complemented by the #Tapchat water saving campaign which featured a news release, online website, quiz and social media promotion.

The campaign resulted in significant increases of visits to Affinity Water's website water saving and resources pages and an increase in orders of water saving devices – peaking at an increase of orders close to 300% at the height of the door drop mailing.

To date, the #Tapchat water saving campaign has resulted in over 190 pieces of national coverage.

The initial response has been positive and encouraging, with extensive media coverage and social media activity. The campaign continues with a focus on promoting the online quiz, planning two community engagement events for Watford and Harlow and an employee event.

Customer data

Customer data provides management information and business intelligence which assist the business to make managerial decisions based on the statistical insights on trend, root cause and forecast. This information includes Service Incentive Mechanism *(*SIM), unwanted contacts, complaints and Customer Satisfaction (CSAT).

Hi-Affinity

This is a Customer Relationship Management (CRM) and billing system that is used by advisors to record customers' details (addresses, contact numbers, properties), communications between Affinity Water and customers and billing information. One or records can be raised related to the conversation an advisor has with the customer. These can be either:

- Wanted contact - positive from the customer's point of view – for example, to make a payment, provide basic account information such as change of occupier, or to request information such as a leaflet or an application form.
- Unwanted contacts – contact about an event or action that has caused the customer unnecessary aggravation, however mild. It also includes repeat or chase calls by the customer to the company.

Rant & Rave (R&R)

This is a third-party customer feedback system which allows customers to rate our service to them. Minutes after a conversation with us, a text message to ask for the customer's satisfaction rating (1 being very dissatisfied to 5 being very satisfied) will be sent to them.

Service incentive mechanism (SIM)

The Ofwat run incentive mechanism is designed to encourage water companies in England and Wales to provide better customer service. It allows comparison of company performance and measures the qualitative aspect of 200 customers per quarter who are randomly selected for a telephone survey from a particular week's worth of contacts, and the quantitative aspect, where customers have made contact either by telephone or by writing in when something has gone wrong or appears to have gone wrong.