Drought Plan 2022

Final version

April 2022

Utility Week AWARDS 2021 WINNER Utility of the Year

THE QUEEN'S AWARDS FOR ENTERPRISE: SUSTAINABLE DEVELOPMENT 2020

Foreword

This report is Anglian Water's final Drought Plan 2022. It provides an overview on how we propose to manage water resources during a drought to protect public water supplies, whilst minimising any environmental impacts that may arise as a result of our activities. It is an update of our previously published revised draft Drought Plan 2022.

This final version is the last stage of the Drought Plan 2022 update process. In line with the Drought Plan Direction 2020[1] and associated guidance, we updated our Drought Plan 2019. The draft Drought Plan 2022 underwent eight weeks of statutory public consultation in the summer of 2021. We then considered all representations in a revised draft Drought Plan 2022 published in September 2021, along with a Statement of Response to explain how the representations have been addressed.

We presented the revised draft Drought Plan to the Secretary of State for Environment, Food and Rural Affairs, and have now been granted permission to publish the final Plan.

Our Drought Plan sets out the management actions that we will take before, during and after a drought. It provides an overview of the operational and tactical actions for managing a drought were it to occur in the period 2022-2027. It also describes how we work with other water companies and regional water resources planning groups.

The final Drought Plan 2022 aligns with our Water Resources Management Plan 2019[2], which was published as a final version in December 2019.

The Water Resources Management Plan 2019 presents a revision to our Levels of Service (LoS), ensuring that by the end of AMP7 no customer will be exposed to rota cuts during a severe drought. A severe drought is defined a drought event with an approximate 1 in 200-year return period. To ensure alignment of the two Plans, we have reviewed the measures included in the Drought Plan 2022 to maintain secure water supplies, during both the worst recorded drought and 1 in 200-year drought, for all our water sources. There have been no major drought events since the Drought Plan 2019 so the 2010-12 drought period still remains our most recent reference drought.

Since the opening of the water retail market in April 2017, business customers no longer buy water services from us directly and we work with retailers via our Wholesale Service Centre. As the wholesaler, we maintain our commitment to ensuring a secure supply of water for all customers.

Our final Drought Plan 2022 is structured in three parts:

- Part 1: Drought Plan framework, regional overview and technical background
- Part 2: Drought Plan monitoring, triggers and forecasting
- Part 3: Drought Plan response actions

These can be read in order or separately.

[1] *Department for Environment, Food and Rural Affairs (2020) The Drought Plan (England) Direction 2020*
[2] *anglianwater.co.uk/about-us/our-strategies-and-plans/water-resources-management-plan*

Contents

Part One

Drought Plan framework, regional overview and technical background

Part One: Drought Plan framework, regional overview and technical background

Part One of our Drought Plan 2022 presents the framework and relevant regulation for water company drought planning as well as an overview of our region and water sources. It also provides the technical background which includes our drought vulnerability analysis and historic drought investment and how this links to our Water Resources Management Plan 2019.

1.1 Introduction

There is a statutory requirement for all water companies to prepare and maintain a Drought Plan that sets out how we will ensure continued supply to customers when water resources may become depleted during periods of low rainfall.

This is Anglian Water's final Drought Plan 2022 that has been prepared to update our Drought Plan 2019. It builds on developments in our drought and water resources planning approaches, as well as responses received during the public consultation phase.

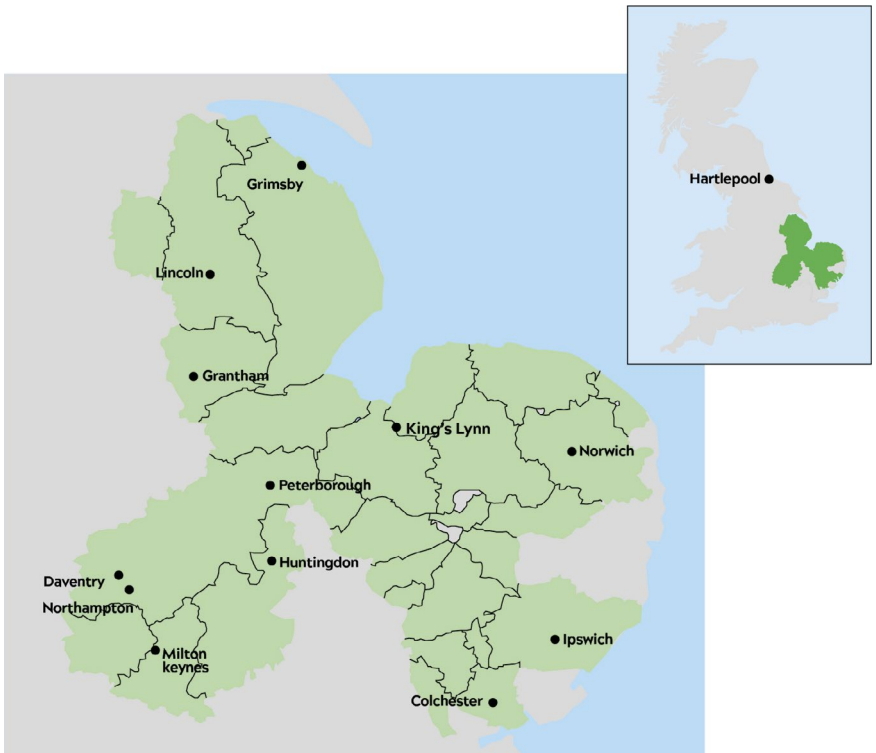
This is the sixth formal Drought Plan that we have produced since the first in 2000. This Plan has been prepared following the Environment Agency's 'Water Company Drought Plan Guideline' (as updated in December 2020). In accordance with the guidelines we completed the statutory consultation and produced a Statement of Response (SoR).

We presented the revised draft Plan to the Secretary of State for Environment, Food and Rural Affairs, and have now been granted permission to publish this final Plan.

The final Drought Plan 2022 is consistent with our Water Resources Management Plan (WRMP) 2019 which sets out how we intend to secure water supply over the next 25 years. Our final Drought Plan 2022 considers our drought response for the Anglian Water region and Hartlepool, as shown in Figure 1.1 below.

The Drought Plan is a technical document written primarily for our regulators, as well as other technical stakeholders, following principles set out in the guidelines. A separate summary document provides a non-technical overview of our Plan and is available alongside our final Drought Plan 2022.

Figure 1.1: The Anglian Water region including Hartlepool



Our final Drought Plan 2022 is structured in three parts; these can be read in order or separately.

Table 1.1: Structure of our final Drought Plan 2022

Drought Plan Part	Title	Content
Part One	Drought Plan framework, regional overview and technical background	• Purpose of Plan • Regulatory framework • Regional overview • Links to the WRMP 2019 • Previous drought management and investment • Drought vulnerability and testing
Part Two	Drought Plan monitoring, triggers and forecasting	• Our drought management strategy • Drought monitoring • Drought triggers • Drought forecasting
Part Three	Drought Plan response actions	• Demand and supply actions • Drought permits • Extreme drought management actions • Communications • Environmental mitigation • End of drought
Appendices		1. Water Resource Zone characteristics 2. Demand-side drought management options 3. Supply-side drought management options 4. Drought management for Anglian Water reservoirs 5. Drought management for Anglian Water direct supply river intakes 6. Drought management for Anglian Water groundwater sources 7. Environmental assessment summary 8. Environmental monitoring plan 9. Drought permit application ready documents 10. Drought communications strategy 11. Temporary Use Bans & Non-Essential Use Bans - Representation and Exceptions 12. Extreme drought management actions 13. Lessons identified from previous droughts and dry weather

1.2 Purpose of Plan

Our Drought Plan has been developed in accordance with the requirements of the Water Industry Act 1991, as amended by the Water Act 2003, to describe how we as a "water undertaker will continue, during a period of drought, to discharge our duties to supply adequate quantities of wholesome water, with as little recourse as reasonably possible to Drought Orders or drought permits". The purpose of our Drought Plan is, therefore, to protect public water supplies whilst minimising any environmental impacts that may arise, as a result of our activities, during a prolonged period of low rainfall.

Every water company in England and Wales is required, by law, to prepare and maintain a statutory Drought Plan. Whilst Drought Plans are prepared in accordance with prescribed guidelines, they will each be different due to the different supply system characteristics of each water company. We carefully follow the legislation regarding water restrictions, and seek as an industry to ensure consistent interpretation and application through an increased focus on regional water resources planning and liaison with Water UK and the Environment Agency managed National Drought Group. However,

approaches to demand management will vary between different water companies.

We will always seek to work together with other water companies, and especially with our neighbouring companies and regional water resources groups. We would ensure that we are collaborating on joint actions, water transfers and communication with customers and stakeholders. This is especially important during times when we may need to impose water use restrictions, for example during the 2011-12 drought. Further detail is included in **Section 1.5.4**.

In April 2017 the water retail market opened. As a result, business customers no longer buy water services from us directly and we work with retailers via our Wholesale Service Centre. As the wholesaler, we maintain our commitment to ensuring a secure supply of water for all customers.

Each drought varies in terms of intensity, duration, geographical coverage and impact. Our Drought Plan draws on previous experience in our region, alongside consideration of stochastically generated drought events, to represent both historical droughts and those worse than historically experienced. This is in line with water resource planning guidance from the Environment Agency and Defra requiring water companies to consider system resilience to the effects of severe drought (defined as an event with an approximate 1 in 200 year return period).

We have reviewed the measures that we have in place to maintain secure water supplies during both the worst recorded drought and 1 in 200 year drought for all of our water sources. The Drought Plan sets out the management actions that we will take before, during and after a drought. The Drought Plan is not strategic but outlines a framework for managing a drought were it to occur under present circumstances with existing infrastructure.

The Environment Agency is responsible for producing its own Drought Plan to protect the environment, water abstractors and the interests of other users of the environment. It has both a strategic drought response framework[3] and individual area specific Drought Plans which we seek to engage and align with as much as possible.

The Environment Agency acts as a technical advisor to government and as such, advises government on water companies' Drought Plans and publishes technical guidance on preparing Drought Plans. They are a statutory consultee in the development and review of both our Water Resources Management Plan and Drought Plan.

It should be recognised that a water resources drought will usually only develop after several months of below-average rainfall. This is different from an agricultural drought when unseasonably dry soils may arise from only weeks of dry weather over the growing season. It is possible, therefore, that the Environment Agency may choose to announce that a catchment or the region is in drought due to wider environmental or agricultural concerns, as opposed to a concern over the security of public water supplies. We will continue to work closely with the Environment Agency during such times to explain and clarify our individual roles and responsibilities to our customers.

The effectiveness of our management in previous droughts can be measured by the adoption of timely measures and responses that have enabled us to maintain the security of public water supplies. We believe that this current Drought Plan provides a robust approach to drought management and we are confident that it provides the flexibility we require to maintain future public water supplies.

[3] *Environment Agency, 2017. Drought response: our framework for England*

1.3 Regulatory framework

Drought Plans are a statutory requirement under Section 39B of the Water Industry Act 1991, as amended by the Water Act 2003. Our Drought Plan 2022 has been prepared in line with the legal framework for drought planning as set out in:

- Water Industry Act 1991
- Water Act 2003
- Water Act 2014
- Drought Plan (England) Direction 2020
- Drought Plan Regulations 2005
- Flood and Water Management Act 2010
- Water Use (Temporary Bans) Order 2010
- Environmental Assessment of Plans and Programme Regulations 2004; from Strategic Environmental Assessment Directive 2001
- Conservation of Habitats and Species Regulations 2017
- Wildlife and Countryside Act 1981; as amended by the Countryside and Rights of Way Act 2000.

In accordance with the Security and Measures Direction 1998 (SEMD), the final Drought Plan has been formally reviewed by an independent SEMD certifier who has provided a certified statement of compliance. This confirms that our final Drought Plan 2022 meets the requirements of 'The Control of Sensitive Water Company Information - Advice Note 11 Edition 1,' as published by Defra in November 2006.

No information has been excluded from our final Drought Plan 2022 on the grounds that it is commercially confidential or would be contrary to the interests of national security.

Section 5 of the Drought Plan (England) Direction 2020 states that, for the purpose of section 37B(8)(a) of the Water Industry Act 1991, a water undertaker must publish its final Drought Plan within 30 days beginning with the date on which the Secretary of State confirms it should do so.

1.4 Consultation

1.4.1 Pre-consultation

In line with guidance, we undertook a pre-consultation phase in August 2020. This was shared with the Environment Agency, Natural England and Defra as well as key stakeholders including inset suppliers in our region. Comments were received from the Environment Agency.

In addition, we have and continue to work closely with the Environment Agency, Natural England and Historic England to assess the potential environmental impact of the measures in our Drought Plan and to develop detailed Environmental Assessment Reports (EARs) for our drought permit options.

We have also carried out consultation on our Strategic Environmental Assessment (SEA) screening and scoping phases to inform the SEA report. Responses on the SEA approach were received from the Environment Agency, Natural England, and Historic England.

1.4.2 Public consultation

We carried out an eight week public consultation (8th June 2021 - 3rd August 2021) following confirmation from the Secretary of State to publish our draft Drought Plan 2022.

We considered all the representations from key stakeholders and customers and produced a revised draft Drought Plan to reflect them. We also prepared a Statement of Response to outline any changes in response to the consultation, which was published on our website, along with the revised draft Drought Plan 2022 in September 2021. The revised draft Plan was sent to the Secretary of State for permission to publish. This has been granted and this Plan is the final version.

1.5 Regional overview

1.5.1 Our Region

Anglian Water currently provides water or wastewater services to more than 6 million customers in the east of England and the town of Hartlepool in the north-east. The region we supply, in the east of England, covers 22,000km^2 and is bounded to the north by the Humber Estuary and extends west to Northampton and Milton Keynes.

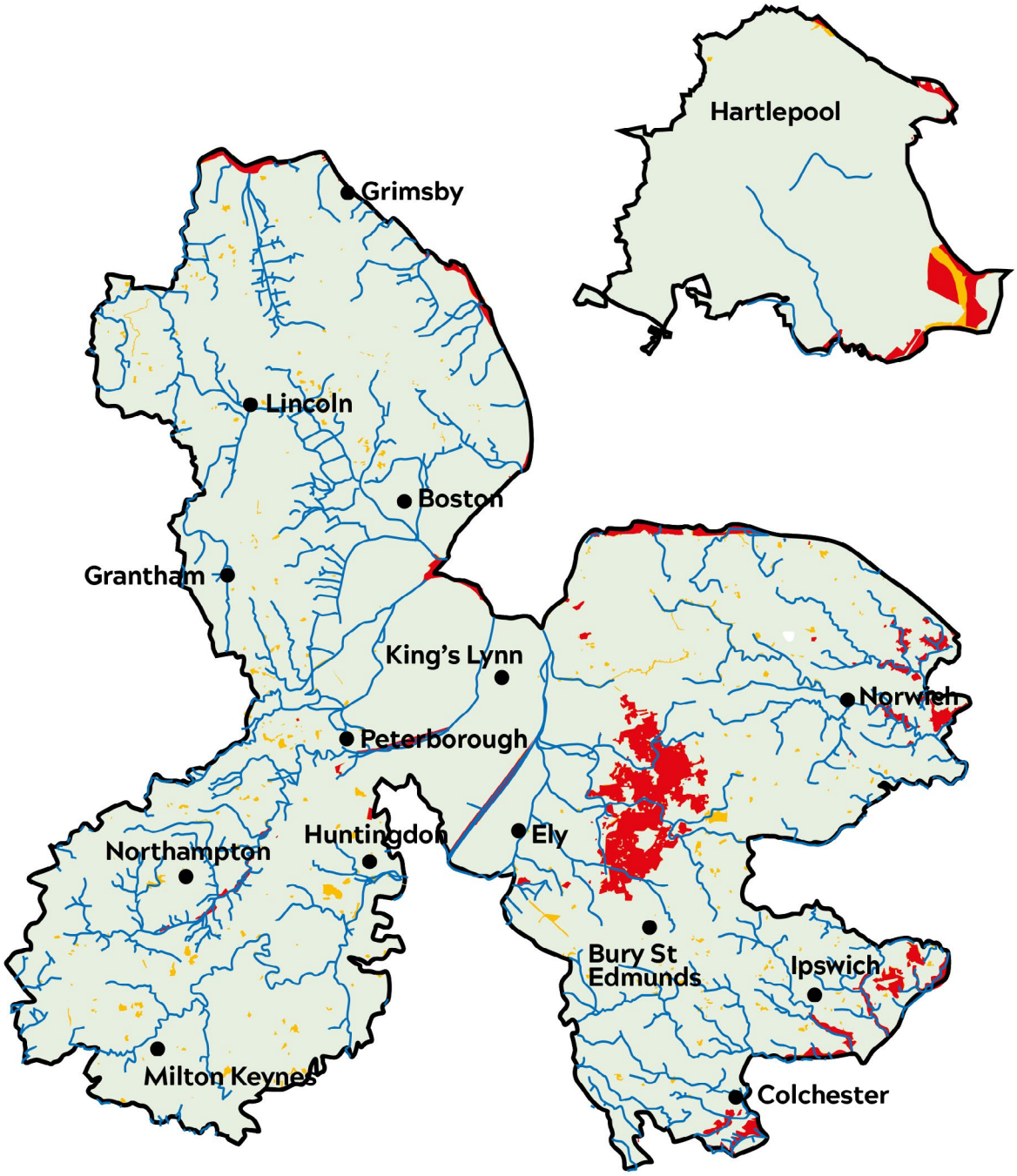
The east of England is the driest region in the UK, with low rainfall (71 per cent of the UK average) and high evaporation losses. Our water resources are already under pressure: the region is designated by the Environment Agency as an area of serious water stress, and opportunities for new water resources are limited. Therefore, effective water resource planning and drought management is vital to ensure that we achieve and maintain the security of our public water supplies during drought events and peak demands, whilst taking due consideration of any associated environmental concerns.

Our region is predominantly agricultural, producing half of the UK's sugar beet, a third of its potatoes and a quarter of its wheat. It is also one the fastest growing. The number of households we supply has grown by over 30 per cent since the water industry was privatised in 1989, and is expected to grow rapidly in coming decades.

In addition, it is recognised as being particularly vulnerable to the impacts of climate change. Climate change projections show our region is expected to experience lower summer rainfall and increased evaporation, leading to lower groundwater recharge in the future. More frequent and intense downpours are also predicted. These could result in increased nitrate and pesticide run-off from fields, impacting the water quality of our region's rivers and groundwater.

We have an ever increasing responsibility to maintain secure supplies of water. However, it is essential we do this in a sustainable way. Our business depends on a healthy, flourishing environment to supply clean water and receive recycled water after treatment. The region is characterised by a high number of internationally designated wetland conservation sites (see Figure 1.2). In addition, many unique habitats are located within our area, including reedbeds, inter-tidal mudflats, and grazing marshes. We work closely with the Environment Agency, Natural England and environmental groups to ensure we continue to manage water resources and the environment across our region in a sustainable way.

Figure 1.2: Map of conservation sites across the Anglian region*



Legend	
	Anglian Region
	Rivers
	National Site Network (Comprising SAC[4], SPA[5] & Ramsar)**
	SSSI[6]

* Rutland Water is also designated as a Site of Special Scientific Interest (SSSI), SAC and Ramsar site, but sits just outside the Anglian region and is not included on the map.

** Where the conservation sites overlap with one another, the sites with greater protection are shown.

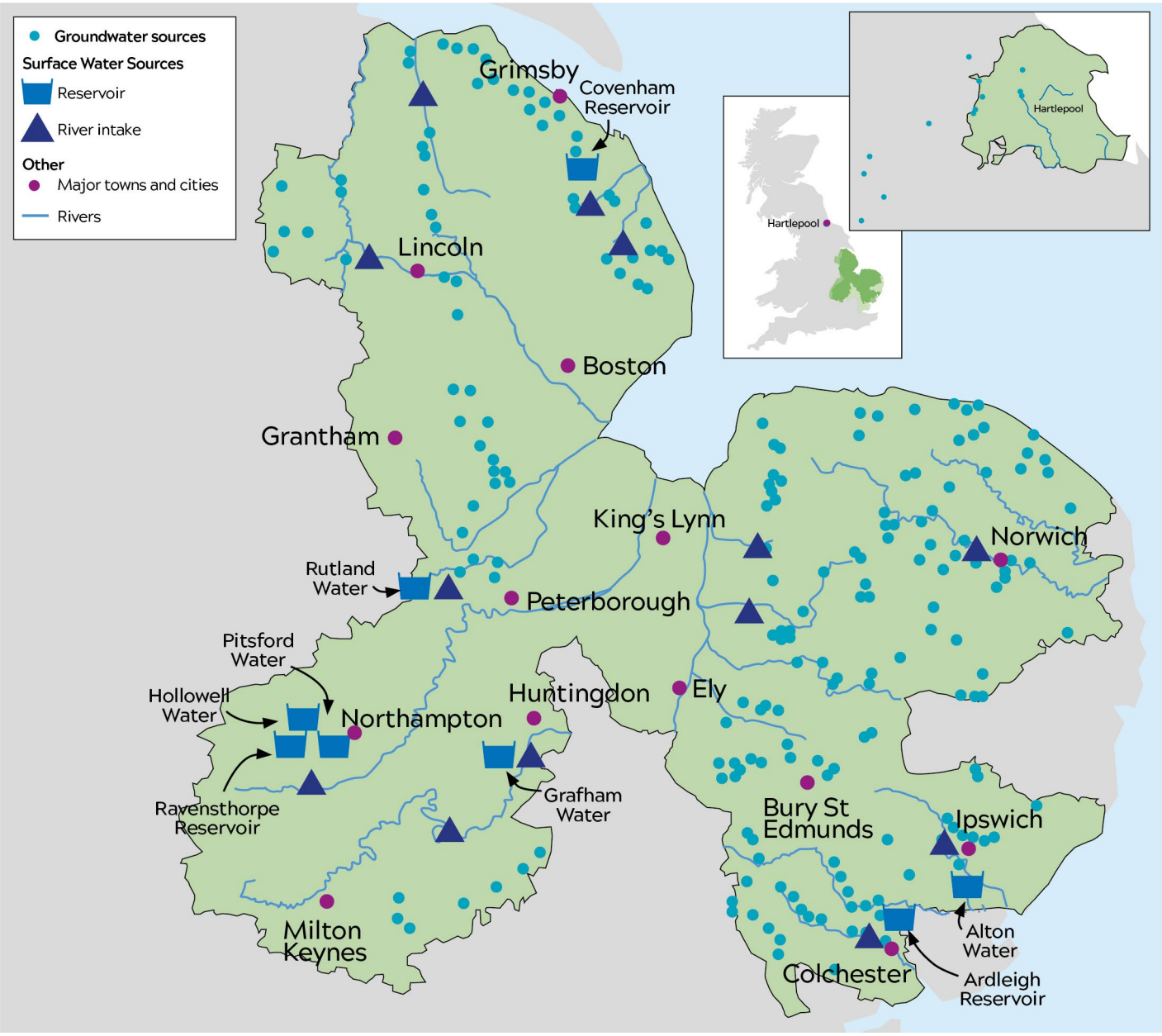
[4] *SAC is an area classified under the EC Habitats Directive and agreed with the EU to contribute to biodiversity by maintaining and restoring habitats and species.*
[5] *SPA is an area classified under the EC Birds Directive to provide protection for birds, their eggs, nests and habitats.*
[6] *An area of international conservation importance classified at the 'Convention on Wetlands of International Importance' 1971, ratified by the UK Government in 1976.*

1.5.2 Our water sources

We abstract from a combination of groundwater and surface water sources across the region, as displayed below in Figure 1.3. On average we supply over 1,100 million litres of water per day (Ml/d) to our customers.

This can peak at more than 1,400 Ml/d during high demand periods, as was experienced during the recent hot, dry weather of summer 2018 and spring 2020.

Figure 1.3: Map of Anglian Water's water sources



In the west of our region, water supply is mainly provided by the large pumped storage reservoirs of Rutland Water, Grafham Water and Pitsford Water, and two natural catchment reservoirs, Ravensthorpe and Hollowell. These form a partially integrated supply system known as Ruthamford, whereby the reservoirs can be used to support each other if needed. We provide supplies from Grafham Water to Affinity Water (Central) under the provision of the Great Ouse Water Act 1961.

We also operate pumped storage reservoirs at Covenham, Alton Water and Ardleigh. Ardleigh Reservoir is jointly owned with Affinity Water (East) and operated under the provisions of the Ardleigh Reservoir Order under the governance of the Ardleigh Reservoir Committee.

We hold abstraction licences for seven operational direct supply river intakes, which along with the reservoirs account for approximately 50 per cent of our supply.

The remaining 50 per cent of supply is provided by groundwater abstracted from 200 sources comprising over 450 operational boreholes. These range in depth from 10 m to 500 m, and penetrate several principal aquifers across the region, each of which will respond differently in a drought.

Our principal source of groundwater is from the Chalk, but the other aquifers we abstract from include the Lincolnshire Limestone, Sherwood Sandstone, Magnesian Limestone, Lower Greensand, Spilsby Sandstone, Sandringham Sands and a combination of Crag, sands and gravels.

The Hartlepool Water supply area to the north of the region generally has higher average annual rainfall than the rest of our supply area. In Hartlepool we abstract water from the deeply confined aquifer of the Magnesian Limestone. The nature of this aquifer combined with more rainfall means it is more resilient to changes in climate or water quality issues, and historically there have been no reported issues with low rainfall conditions affecting the availability of supplies.

Water Resource Zone integrity

The uneven nature of climate, drought, growth and environmental impacts across our region means we have developed Water Resource Zones (WRZs). WRZs are the geographical areas used to develop forecasts of supply and demand and supply-demand balances. The WRZ describes an area within which supply infrastructure and demand centres are linked such that customers in the WRZ experience the same risk of supply failure. From the WRMP 2019 we have 28 WRZs including South Humber Bank which is a non-potable WRZ that sits within Central Lincolnshire (see Figure 1.4 below).

Figure 1.4: Anglian Water Water Resource Zones as defined in the WRMP 2019

1.5.3 Bulk supply agreements and inset appointments

We have long-standing statutory agreements for bulk exports with Affinity Water (Central) and Severn Trent Water. It has been agreed with both water companies that these arrangements will remain in force as reported in our WRMP 2019. We also have agreements for bulk imports from Essex and Suffolk Water and Cambridge Water. The quantities are detailed in Table 1.2.

Table 1.2: Bulk supply agreements in the WRMP 2019

Transfer type	Associated WRZ	Company	Volume (Ml/d)	
			Average	Peak
Bulk export	Ruthamford North (Rutland - Wing)	Severn Trent Water	18	18
Bulk export	Ruthamford South (Grafham)	Affinity Water	84.6	109
Bulk import	South Essex (Tiptree)	Essex and Suffolk Water	3	4.5
Bulk import	Thetford (Barnham Cross)	Cambridge Water	0.25	0.25
Shared resource	South Essex (Ardleigh)	Affinity Water	26* (shared)	36** (shared)

Grafham - Affinity Water

Note that the bulk export from Grafham to Affinity Water is governed by the Great Ouse Water Act 1961. Affinity Water have capped the average capacity of this export to 50 Ml/d until 2023/24 when conditioning treatment is due to be installed. This will allow Affinity to take greater volumes for use during average demand periods.

Ardleigh - Affinity Water

Ardleigh is a shared water resource with Affinity Water. The reservoir is used to meet customer demand in Affinity Water's (East) region once their groundwater sources have been fully utilised. Ardleigh currently has an average deployable output of 26 Ml/d (*) pending an operational review and WRMP 2024 analysis. The peak output is 36 Ml/d (**) but this will be confirmed following an operational trial. The reservoir is typically able to be re-filled each winter, even in a dry winter.

For normal operation and during a drought, either company can take extra water from Ardleigh not required by the other company. In an extreme event, either Anglian Water or Affinity Water could take all of the output available from Ardleigh, provided the water was not required by the other company. At present Affinity Water are able to supply all of their customers in the East region over sustained periods with limited use of Ardleigh.

Barnham Cross - Cambridge Water

The Barnham Cross import is a continuously operated bulk transfer between Cambridge Water and Anglian Water, available up to and including drought management **Level 3**. We do not expect the transfer to exceed the 0.25 Ml/d volume agreed.

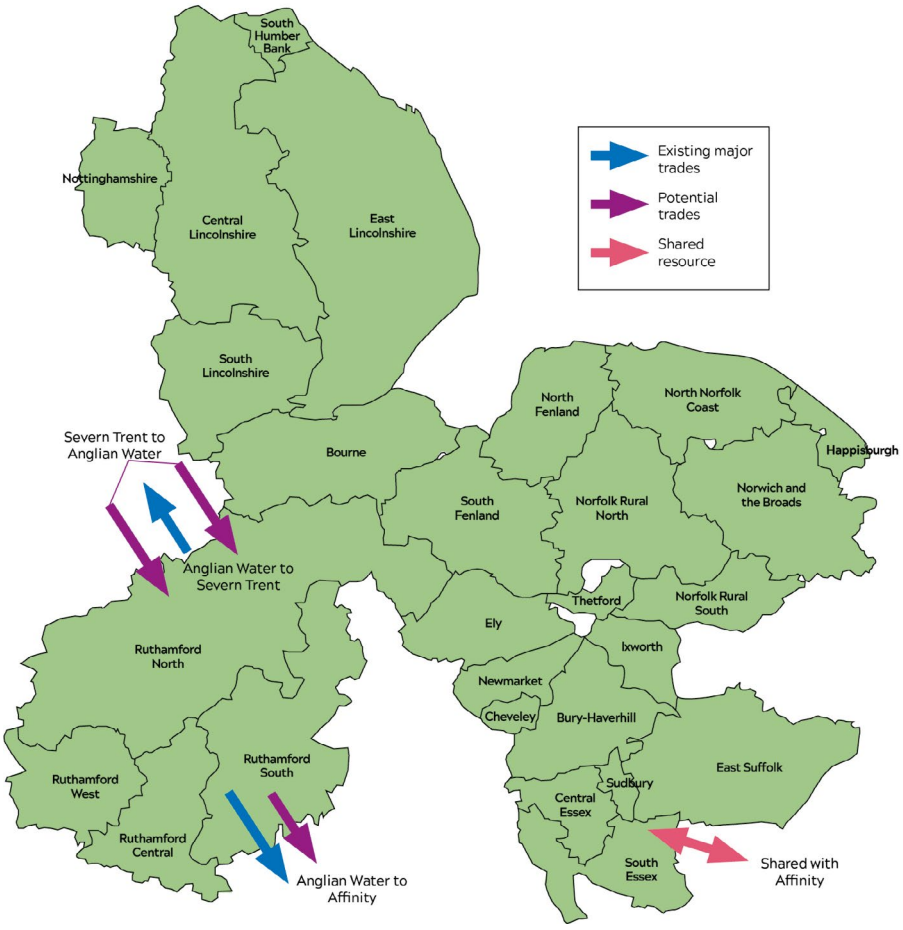
In addition, we have a number of small net transfers with Yorkshire Water, Cambridge Water, Thames Water and inset appointments with Independent Water Networks Limited (IWNL) Icosa, Scottish and Southern Energy (SSE) and Albion Water.

Under the terms and conditions of the bulk supply arrangements, there is a requirement for these companies to impose the same restrictions, that Anglian Water imposes on their domestic customers. These activities will be managed by our dedicated Wholesale Market Services team.

In the event of a drought the imports and exports in Table 1.2 would be subject to the same Levels of Service (LoS) as our customers (i.e. a 1 in 200 year drought). We have agreed with our neighbouring water companies that regular communication and close liaison will be very important during the onset of drought and actual drought itself to minimise any impacts to the respective supply areas.

Details of our current major trades and trading options considered in the WRMP 2019 are presented in Figure 1.5.

Figure 1.5: Existing and future trades considered in the WRMP 2019



1.5.4 Regional drought planning

The 2011-12 drought led to a high degree of collaboration and cooperation within the water industry and with the Environment Agency and Defra. The Secretary of State set up the National Drought Group (NDG) in February 2012 in which Anglian Water took a leading role. The purpose and remit of the NDG was to create a single coherent, cross sector team, which was able to manage coordinated delivery of drought management activities, communications and risk mitigation. The NDG was chaired by the Chief Executive of the Environment Agency and other attendees included the Cabinet Office, Defra, National Farmers Union, UK Irrigation Association, Association of Drainage Authorities, Natural England, Blueprint for Water, Water UK, Anglian Water, Thames Water and the Country Land and Business Association.

The key recommendations from the NDG included:

- Improve resilience for future droughts
- Promote best practice in communications
- Improve operational management and environmental protection
- Develop governance arrangements for national water resource management
- Prepare for future droughts.

This need for collaborative and joined-up drought thinking has continued to grow. We remain part of the NDG, attending regular meetings as required and providing input into the Prospects reports. We continue to work closely with the Environment Agency and other stakeholders, as well as our water company neighbours through groups such as Water Resources East (WRE), Water Resources South East (WRSE) and Water Resources North (WReN). Further detail of our involvement with WRSE is included in the statement below.

South east companies - joint statement

Water companies in the south east regional drought collaboration

The water companies of the south east of England recognise that as an industry we need to work collaboratively to share knowledge and best practice, coordinate and align communication to customers and stakeholders, and promote the efficient use of water resources. Therefore, we work closely with other water companies in our region as part of the WRSE and WRE groups. For example, we participate in the regular WRSE "dry weather" meetings which focus on the risk of any potential future water shortages. In these meetings all water companies share information about their available water resources, weather forecasts, and any communication needed with customers about any emerging drought situation. These meetings are held all year round and stepped up in frequency when a risk of water shortages across the south east starts to emerge. The meetings facilitate collaboration between water companies and actions to ensure an effective regional response to a developing drought. By working together and following a joined-up approach to communication, we aim to reduce confusion so our customers clearly understand the pressure on water supplies and the environment during water shortages, what we are doing, how they can use water wisely, and what water restrictions may need to be, or are being, imposed.

This process is implemented through the Dry Weather Monitoring Group (DWMG) for which ToR have been agreed. The DWMG fulfils a purpose of provision of a regular update and information sharing forum when companies are operating in business as usual mode but when near term risks can be observed, and a heightened level of preparedness is desirable. It will draw information from a national, regional and local perspective and in turn provide updates which will help inform regional and national awareness and early preparedness.

The basis for the variability of responses to water use restrictions from water companies in south east England

In the south east region water companies source their supplies of raw water in the following ways:

1) River abstraction;
2) Reservoirs filled by river abstraction or impoundment of river water;
3) Groundwater abstraction from boreholes and springs.

The percentage balance of these varies from company to company, and even within company areas and this causes variability in drought resilience and response.

The impact of drought is felt in different areas and over different timescales. An agricultural drought affecting crop growth, for example, can occur after a few weeks of dry and sunny weather over the growing season causing unseasonably dry soil. In contrast, a water resources drought affecting the availability of water for potable supplies, take much longer to develop, after several months of below average rainfall, particularly winter rainfall which is critical for replenishing most water resources. The low groundwater levels, reservoir levels, and river flows that result from this type of dry period reduce the water available and poses a risk to a water company's ability to supply its customers.

To manage this risk, water use restrictions are an important measure that water companies can use to reduce demand during drought. They not only enable companies to maintain essential supplies but also help to conserve water resources in periods of water shortages and reduce the environmental impacts of abstraction.

Water companies will only impose water use restrictions upon their customers if they are absolutely necessary, and in accordance with their LoS for water supply. Water companies fully appreciate the confusion that can be caused when one company introduces restrictions but a neighbouring company does not. One of the reasons for this is the spatial extent of the drought: it may be very localised and not extend beyond the area served by an individual water company. Clearly from a customer point of view, if water use restrictions need to be imposed then a simple and consistent approach should be adopted across the south east.

At the regional level, one water company may need to impose water use restrictions earlier in a drought than its neighbours, while another water company is able to withhold the imposition of restrictions until much later or not at all.

The reasons why companies may have to react differently in terms of restrictions and their timing are explained below:

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 amount may cause differing levels of water shortage across the region. In other words, the need to impose restrictions for one company may not equally apply to another.

Differing vulnerabilities at Water Resource Zone level: Due to the way the water supply system has developed over time, 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;
- Various combinations of the above.

This mix of WRZ types means that even if there were not a significant difference in drought severity across the region, WRZs will tend to react differently to the same drought, with certain zones experiencing higher levels of risk to potable supplies than others. That means in similar drought conditions, rivers, groundwater sources and reservoirs across the region can respond differently in terms of risk to supply. For example, a WRZ dependent on combined river abstraction and reservoir storage for supply may have a different level of risk to one based on groundwater abstraction. This difference in WRZ vulnerability has an impact both at the company level and regional level. A water company may need to introduce water use restrictions in its more vulnerable WRZs but not need to extend the ban to the remaining zones in its area of supply.

The introduction of the new powers in the form of the Temporary Use Ban in 2011 provided an opportunity for the water companies in the south east to review their Drought Plans with a view to finding a clearer, more consistent and more unified approach to introducing water use restrictions across the region than in the past.

The water companies in the south east have had formal meetings to discuss the development of their plans and ensure that they are implementing the powers as consistently as possible.
The companies are committed to working collaboratively during periods of water shortages. In this context they have worked together to align the drought levels in their plans and to align as closely as possible the restrictions and exemptions that would be imposed when a TUB and a NEUB are implemented. However, due to the local differences highlighted above, the timing of Drought Plans and actions will vary across the region.

1.6 Technical background

1.6.1 Water resource planning

1.6.1.1 Relationship with the Water Resources Management Plan

Water companies have a statutory obligation to prepare and maintain a Water Resources Management Plan (WRMP), published every five years. In the WRMP, companies must set out how they will ensure that they have sufficient water resources to meet the current and future demands of their customers, over a minimum 25 year period.

We published our draft WRMP 2019 in March 2018 for consultation, and our final version was published in December 2019. The overall aim of our WRMP is to develop a system of supply that is reliable, affordable and sustainable. This includes meeting customer and government expectations and complying with all statutory obligations. We achieve this through a twin track approach of an ambitious demand management programme and investing to improve the resilience of public water supplies to climate change, more severe drought and environmental pressures.

The WRMP ensures we have a long term plan to be resilient to drought, and sets out how we will secure supplies for a drought event of up to a 1 in 200 year severity from 2025. This is in line with new guidance, requiring water companies to consider droughts beyond the historic record.

Our Drought Plan 2022 complements this, setting out actions we will take if a drought of 1 in 200 year severity occurs before this time, as well as considering droughts worse than this. Our Drought Plan 2022 also details the shorter-term management actions that we will take as a drought progresses.

1.6.1.2 Levels of Service (LoS)

Since the 2011-12 drought, we have been concerned that parts of our system are vulnerable to drought and we would not be able to maintain supplies to customers without imposing severe restrictions, such as rota cuts.

As a result, in preparing our WRMP 2019 we thought carefully about what LoS are appropriate for our customers and our region. The return period of all the following LoS can be found in Table 1.3. We believe that our LoS for Temporary Use Bans (1 in 10 years) and Non-Essential Use Bans (1 in 40 years) are appropriate and do not make any changes to them in either our WRMP 2019 or Drought Plan 2022.

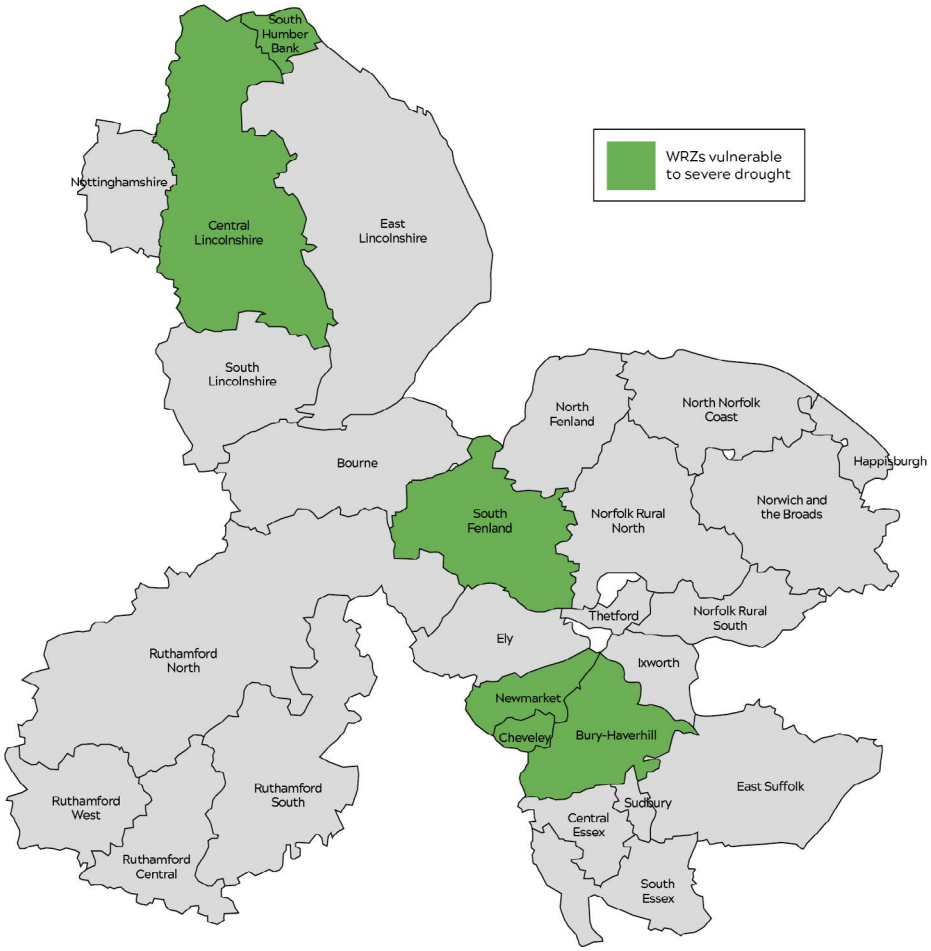
However, we do not believe that our current LoS for severe restrictions (1 in 100 years) is appropriate or acceptable - this is supported by our customers as demonstrated through our WRMP 2019 consultation. As a result, our objective is to ensure that from 2025 onwards, our customers will not be at risk of rota cuts in droughts up to 1 in 200 year severity. We are therefore proposing to move to a new LoS for severe restrictions (no more than 1 in 200 years) by 2025.

Through analysis in our WRMP 2019, we identified that the majority of our WRZs are resilient against a 1 in 200 year drought event, as a result of previous drought investment. We have identified five WRZs which remain at risk of severe restrictions before we have completed additional investment by 2025. These are shown in Figure 1.6. Please note that the South Humber Bank area is not a separate WRZ and sits within the Central Lincolnshire WRZ.

Table 1.3: Levels of Service (LoS)

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

Figure 1.6: WRZs identified as at particular risk of severe restrictions before 2025



We have developed interim options to support these WRZs should a 1 in 200 year drought occur before the AMP7 investment is completed. Additional analysis on these zones has identified existing supply surplus within either the zone itself or adjacent zones, which can be utilised to mitigate this risk. This is detailed further in **Appendix 3**. As well as the interim options we could also implement the extreme drought management actions detailed in **Appendix 12** to support these WRZs if appropriate.

1.6.2 Previous drought management and investment to date

Our water resources and supply systems have been developed over the last 150 years to meet increasing demands for water and to cope with severe droughts. This has been achieved through the construction of strategic storage reservoirs with long retention periods and development of local groundwater supplies. The volume of water that we have supplied to our customers is referred to as Distribution Input.

There have been a number of droughts that have affected the Anglian region in the last 60 years (1975-76, 1988-92, 1995-97 2005-06 and 2011-12). Each of these periods of exceptionally low rainfall affected water supplies to various extents, with some affecting parts of our region more severely than others. The prolonged drought experienced in 1975-76 was the first that received widespread attention and began to underpin future water resource drought planning for the Anglian region. The most recent drought to test our response was during 2011-12.

The lessons we have identified from our response to previous droughts as well as the period of dry weather and high demand in 2018-19 have been used to inform our current Drought Plan. This is further detailed in **Appendix 13**. We are confident that our Drought Plan provides a robust framework to enable us to maintain supplies to our customers.

Parts of the region are well served through the interconnection of strategic trunk water mains, adding to the security and flexibility of the system. We continue to invest in the distribution system in order to improve integration that will enable us to meet local growth in demands, improve security of supply and manage groundwater quality, notably as a result of increasing diffuse source contaminants such as pesticide compounds and nitrates. One of the biggest projects that we are currently working on is the creation of nearly 500 km of new pipelines which will provide increased interconnectivity and drought resilience throughout the region. This work is due to be completed by 2025.

1.6.3 How drought affects our resources

Our resources are dependent on both the intensity and the duration of a rainfall deficit. The type of drought also influences the response of our sources. This is because of the different characteristics of each source and how it reacts to drought conditions.

We have summarised the different drought responses of our sources in Table 1.4.

Table 1.4: Water resource type summary and drought response

Resource	Source of water	Resource type	Response to rainfall	Drought resilience*
Reservoirs	Water pumped from nearby rivers / natural inflow / direct rainfall	Small and single-season secure e.g. Ardleigh reservoir	Storage responds quickly to changes in rainfall and reservoir levels can quickly drop. However they also tend to recover quickly once river flows pick up	Low
		Large multi-season secure e.g. Rutland Water	Greater storage volume means reservoir storage depletes slower and can withstand longer periods of low flows. However it takes longer to recover once levels have declined	High
Rivers	Surface water runoff from land and groundwater base flow	Overland runoff dominated e.g. River Welland, River Trent	Flashy and responds quickly to high or low rainfall situations. This means flows can decline quickly but also refill quickly	Typically low, except for larger rivers or those supported by effluent returns
		Overland runoff / base flow split	Combination of overland and baseflow rivers	Medium
		Base flow dominated e.g. River Wensum	Slower response to rainfall changes as these rivers are bolstered by groundwater. This means they can maintain higher flows for longer but take longer to recover from low flows	Medium
Groundwater	Underground aquifers	Chalk e.g. Marham Sandstone e.g. Raithby Limestone e.g. Aslackby Confined e.g. Spilsby Sandstone Unconfined e.g. Chalk outcrop	Groundwater responds more slowly to rainfall patterns because there is a lag time between rain falling on the ground and percolating through to the aquifer. This generally means groundwater sources are more resilient to shorter dry spells, but it depends on the type of aquifer and its degree of confinement. We have identified within this Plan where sources are drought vulnerable.	Generally high (except for drought vulnerable boreholes).

* Drought resilience refers to resilience against dry winters. A source with low resilience indicates it is more vulnerable to shorter drought events and is more likely to be affected more often.

1.6.4 Drought vulnerability and testing

The full details of the technical methods and scenario testing used to assess the drought vulnerability of our water resources can be found in the **WRMP 2019 Supply Forecast Report**. The following text provides a summary of this work.

1.6.4.1 Reference drought

We assess the drought vulnerability of our sources against a reference drought. In previous drought and water resources planning cycles, this has always been the worst historic drought on record. However, guidance[7] now requires water companies to consider droughts beyond the historic record, specifically droughts of 1 in 200 year severity.

During our WRMP 2019 preparations, we undertook a drought vulnerability analysis to understand and quantify the risk to our system from a range of drought events. This included developing a suite of stochastically generated drought events to test droughts more severe than historically experienced **(WRMP 2019 Supply Forecast Report)**. This analysis showed that many of the historic drought events experienced in our region were more severe than previously understood and, due to significant investment in drought schemes, many of our systems are already resilient.

Table 1.5 below displays the reference drought and associated return periods for all of our WRZs except Hartlepool (resilient to a severe drought) and South Humber Bank (non-potable supply). We have maintained the historic reference drought where our system modelling showed there was no additional drought impact from a stochastic severe drought. Where the sources within a WRZ have different reference droughts at source level, the WRZ reference drought has been selected based on the dominant resource type in the zone.

Reference drought terminology

Historic drought - refers to the worst historic drought on record, which we planned to in our 2015 WRMP and Drought Plan. This was previously assumed to be drought events with approximately a 1 in 100 year return period, which we describe as having a 25 % chance of occurring over a 25 year planning period.

Severe drought - refers to drought events with approximately a 1 in 200 year return period. We describe these events as having a 12 % chance of occurring over a 25 year planning period.

Extreme drought - refers to a drought events with approximately a 1 in 500 year return period. We describe these events as having a 5% chance of occurring over a 25 year planning period.

[7] *EA. 2017. Water Resources Planning Guideline: Interim update. Environment Agency, April 2017.*

1.6.4.2 Managing the impact of drought

Our WRMP 2019 drought analysis identified that there are some parts of our system where vulnerabilities remain and during a severe drought event there is a risk that we would have to implement demand restrictions such as rota cuts in order to maintain supplies. In Cheveley, Bury St Edmunds, Newmarket and South Fenland WRZs, there are modelled impacts on groundwater that reduce baseline supplies at WRZ level. There is also an impact in the Central Lincolnshire WRZ, due to vulnerability at our River Trent surface water intake.

To ensure we can maintain supplies to all of our customers, without having to impose severe restrictions such as rota cuts, in our WRMP 2019 we have proposed the investment we need to develop an equivalent capacity from new supplies by the end of AMP7. In the interim, we are able to manage this risk through localised options or supply-demand surplus in the WRZ, between now and 2025. These are detailed in **Appendix 3**. In addition to these options we can also support these zones with our set of possible extreme drought management actions (**Appendix 12**).

We have also considered our drought risk to extreme drought events, up to 1 in 500 year severity, to which nearly the entire region shows some degree of vulnerability. However, the nature of these droughts makes them both extremely unlikely and uncertain and therefore we will continue to develop our understanding of our system to such events, and are not at present proposing to invest against this level of risk. This will be considered in the WRMP 2024.

However, to manage this risk, we have considered wider WRZ level options such as conjunctive use, bulk supplies, inter-catchment transfers and tankering. All of these possible options are detailed within **Appendix 12**. In an extreme drought, we may also have to consider employing severe restrictions such as rota cuts. We do not consider standpipes to be a practicable option.

1.6.4.3 Drought and climate change

The combined effect of drought with increasing climate change also needs to be considered. We have looked at this in the WRMP 2019 through a climate change yield assessment of all Anglian Water's groundwater and surface water sources. We considered the elements conjunctively to assess the combined impact throughout the WRMP analysis.

An allowance for climate change impacts was included in the WRMP 2019. Further analysis is underway to better understand the representation of climate change, drought and Potential Evapotranspiration (PET) in the WRMP 2024.

Table 1.5: Summary of up to 1 in 200 year drought DO impact, reference design drought and estimated return period

WRZ	Severe drought vulnerable sources	Drought type	Reference drought (reported worst year)	Estimated return period
Bourne		Historical	1989-92	>1 in 200 year
Bury-Haverhill	Risby	Stochastic	Nominal Year 1949	>1 in 200 year
Central Essex		Historical	1989-92	1 in 50 to 1 in 150 year
Central Lincs	Trent intake	Historical	1976	>1 in 200 year
Cheveley	Lower Links	Stochastic	Nominal Year 1949	1 in 200 year
East Lincs		Historical	1989-92	>1 in 200 year
East Suffolk		Historical	1997	1 in 200 year
Ely		Historical	1991-3	1 in 50 to 1 in 150 year
Happisburgh		Historical	1990-92	1 in 50 to 1 in 100 year
Ixworth		Historical	1996-98	1 in 50 to 1 in 150 year
Newmarket	Newmarket AR, Long Hill, Southfields, Moulton	Stochastic	Nominal Year 1949	1 in 200 year
Norfolk Rural North		Historical	1991-2	1 in 50 to 1 in 100 year
Norfolk Rural South		Historical	1991-2	1 in 50 to 1 in 100 year
North Fenland		Stochastic	Nominal Year 1923	1 in 200 year
North Norfolk Coast		Historical	1990-92	1 in 50 to 1 in 100 year
Norwich and the Broads		Stochastic	1992	1 in 50 to 1 in 100 year
Nottinghamshire		Historical	1975-6	~1 in 200 year
RHF Central		Historical	1934	~1 in 200 year
RHF North		Historical	1934	~1 in 200 year
RHF South		Historical	1934	~1 in 200 year
RHF West		Historical	1934	~1 in 200 year
South Essex		Historical	1934	1 in 50 to 1 in 150 year
South Fenland	Marham (GW)	Stochastic	Nominal Year 1923	1 in 200 year
South Lincs		Historical	1989-92	>1 in 200 year
Sudbury		Historical	1989-92	1 in 50 to 1 in 150 year
Thetford		Historical	1996-98	1 in 50 to 1 in 150 year

Part Two

Drought Plan monitoring, triggers and forecasting

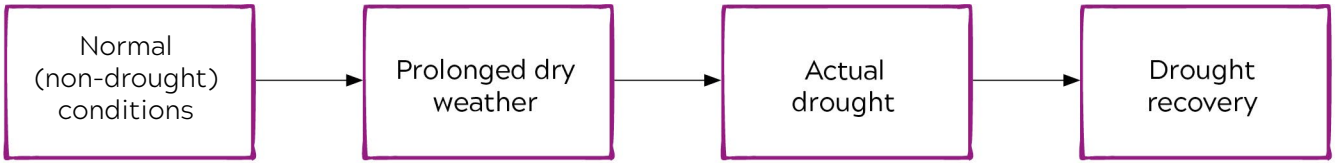
Part Two: Drought Plan monitoring, triggers and forecasting

Part Two and Part Three are the operational sections of our Drought Plan. They present the tactical strategy and operational detail around how we propose to manage public water supplies during the onset and prevailing conditions of a drought. Part Two focuses on our drought monitoring, triggers and forecasting.

2.1 Drought management process overview

Droughts differ in terms of location, intensity, duration and severity. Therefore our drought management process needs to provide a flexible framework of options that will allow us to respond most effectively to a drought for a wide range of situations. Our drought management process has been developed for our region; it is relevant and realistic for our unique operating systems and circumstances.

Figure 2.1: Drought management framework



We consider the development of a drought to have four key stages (see flow chart above).

These require different responses, so we have developed drought triggers to help identify when we cross into these stages and when actions need to be taken in a timely fashion, from its onset to its end. We further split prolonged dry weather into two parts, the first being dry weather and the second being potential drought. We also classify our actual drought stages into two different periods according to length, the first is when we are approaching our 2nd dry winter and the second is when we are approaching and looking forward from a 3rd dry summer. This is to allow differentiation of seasonally specific activities.

The drought triggers and actions associated with each stage are summarised in Table 2.1.

During normal (non-drought) conditions we routinely monitor weather metrics and our resources to understand our baseline conditions and what rainfall we need to ensure secure supplies.

We have early warning indicators to signpost changes to weather that may indicate a drought is developing.

Aquifer recharge and reservoir refill are the most critical issues in autumn and winter, whereas surface water flows are the most critical in spring and summer. Prolonged dry weather with low rainfall during winter and spring provide an early indication of potential drought conditions. In this second part of the prolonged dry weather stage the drought is not yet fully established, and it could be that the dry weather breaks and does not progress into an actual drought. Alternatively dry weather could continue, leading to potential impact on supplies and triggering further actions.

We have developed a drought framework (Table 2.1) with a number of triggers and actions to allow us to utilise all the information available to make informed drought management decisions. These triggers are a guide only, as each drought is different. The actions are phased in as the drought continues, dependent on its severity. The actions are cumulative and routine measures or those introduced during less severe drought conditions will continue to be in place as further actions are considered and implemented.

We will consider the time of year, complexity, lead times, implications on customers and the environment when developing and implementing this phased approach. This is especially important for the following drought management actions:

- Customer communications strategy
- Implementation of temporary restrictions
- Application process for drought permits and Drought Orders

Part 2 of the Drought Plan 2022 discusses these drought stages, triggers and forecasting. Part 3 discusses the associated actions in detail.

Experience from previous droughts in our region has outlined the importance of effective internal and external management, enabling us to respond efficiently and responsibly to the onset and development of a drought. One of the first management actions that results from a move to potential drought status is to convene the Drought Management Team (DMT). The DMT represents all areas of the business and is experienced in drought management. The DMT is chaired by the Director of the Water Business Stream and includes senior representatives from across the organisation. It is responsible for making key business decisions that may be required as a direct result of the impact of drought. This enables us to respond effectively and responsibly to the onset and development of a drought.

Building on the baseline water efficiency dialogue that we will have already had with our customers is essential at this stage in order to update on drought conditions and our activities. The DMT includes a communications lead that will deliver key drought messages and actions both rapidly and effectively. More on the structure and remit of the DMT, along with a summary of our Communications Plan are in **Section 3.5**. Further details of our Communications Plan are included in **Appendix 10**.

We work closely with the Environment Agency, and it is possible that there will be occasions when the environmental indicators are such that the Environment Agency may request us to complete drought actions ahead of our own indicators due to wider pressures on water resources across the country.

There is also increased expectation of regional cooperation for water resources planning and management. We routinely liaise with our colleagues in other water companies, especially neighbouring companies, and would increase this during potential drought to discuss cross-border issues, coordinated demand measures and resource sharing. We also attend the NDG and WRSE "dry weather" meetings to ensure we are aware of the wider water resource situation and can align actions or provide support as appropriate.

Table 2.1: Drought Response Framework

Drought development

Drought status		**Normal (non-drought) conditions**	**Prolonged dry weather**		**Drought approaching 2nd dry winter**	**Drought approaching 3rd dry summer and onwards**			
			Dry weather	**Potential drought**					
Drought scenario		Normal / wet	Dry summer, looking to dry winter	1st dry winter looking to 2nd dry summer	2nd dry summer looking to 2nd dry winter	2nd dry winter looking to 3rd dry summer onwards			
Drought trigger	Early warning indicators	All indicators at or above average for the time of year	Declining trend towards indicator triggers	River flows close to historic drought year(s)	Indicators at or lower than historic drought year(s) highlighting limited to no recharge				
		SPI > 0	SPI 0 to -1.0	SPI -1.0 to -1.5	SPI continuously < -1.5				
		Winter SMD < 20mm	Winter SMD > 20mm	Winter SMD >> 20mm and prohibiting recharge					
	Regional resource classifications (GW & SW indicator sites**)	Normal or above for time of year	A number of indicator sites below normal for time of year	Majority of indicator sites below normal, and / or a number of sites notably low for time of year	Majority of indicator sites notably low for time of year	Majority / all of sites exceptionally low for time of year			
	Reservoirs	Reservoir storage above or at Target curve	Reservoir storage starting to show declining trend from Level 1	Reservoir storage sees continued decline from Level 1 towards Level 2	Reservoir storage crossed winter drought permit trigger	Reservoir storage crossed summer drought permit trigger	Reservoir storage crossed Level 2	Reservoir storage crossed Level 3	Reservoir storage crossed Level 4
	River flows	River flows well above MRF	River flows declining to MRF	Some river intakes approaching MRF / HOF earlier than normal (abstraction potential affected)	Some river intakes unable to abstract due to low winter flows (abstraction potential affected)	Some river intakes unable to abstract due to low summer flows (abstraction potential affected)			
	Drought Vulnerable Boreholes (DVBs)	Groundwater levels all above Level 1	Groundwater levels starting to decline towards Level 1	Groundwater levels cross Level 1	Low groundwater levels starting to impact operational DVB / approaching DAPWL. Observation boreholes declining towards Level 2	No / Limited groundwater recovery. Low groundwater levels impacting operational DVBs and DAPWLs crossed. Continued low groundwater levels cross Level 2 and head towards lowest historic levels			
Indicative response / actions*	Drought Management Team	n/a	Prepare to covene DMT	Monthly DMT meetings	DMT + Drought Response Team				
	Resource monitoring	Baseline monitoring: daily abstraction data and weekly rainfall and reservoir levels		Increase to weekly monitoring, start tracking against early warning indicators and resource trigger curves, enhanced water level and quality monitoring	Daily monitoring and resource tracking				
	Forecasting / Projections	Monthly update on reservoirs, river flows and groundwater to business	Commence 3-monthly forward look resource projections	Increase to monthly resource projections	Projections on request (by DMT)				
	River support, drought permits and restrictions	Manage river support, comply with Section 20 agreements	Activate river support if required	Determine likely need for winter drought permits and prepare application	Apply for and then implement winter drought permits	Prepare summer drought permits	Implement TUBs, followed by summer drought permits	Impose NEUBs	Impose rota cuts
	Environmental monitoring	Baseline environmental monitoring for licence compliance and drought permit sites	Identify drought permit specific environmental monitoring and mitigation measures	Identify and commence 'baseline' drought permit monitoring in the spring for sites at risk	Prepare for site specific actual permit monitoring. Implement when winter permit is actioned	Commence drought permit monitoring for summer permit			
	EA liaison	Routine EA liaison	Initiate EA area / dry weather liaison	Increasing EA area / drought liaison, National Drought Group attendance					
	Communications	Ongoing 'water wise' messaging	Dial up tone in communications and target key areas with owned and earned channels	Dial up tone in communications, target key areas including paid for activity and increase frequency	Combination of reach and targeted activity across all paid / owned and earned channels on a frequent basis with escalations as and when required				
	Leakage	Baseline leakage activities	Consider opportunities to reduce leakage	Enhanced leakage detection and repair					
	Operations	Routine operations	Review need for proactive maintenance, abstraction regimes	Prioritise drought related investment, optimise abstraction regimes	Implement supply-side options and drought related investment as required				

*actions in each stage are cumulative and include the previous stage action

** The classification is based on the Environment Agency's monthly classification for that specific site

2.2 Normal (non-drought) conditions

2.2.1 Routine monitoring

During normal (non-drought) conditions we routinely receive and collate various meteorological (Table 2.2) and hydrometric (Table 2.3) data to allow us to monitor the resource situation in the rivers, reservoirs, boreholes and aquifers across the Anglian region. We also closely monitor our groundwater levels and reservoir storage levels through telemetry and liaise with operational staff, to assess the status of resources available for water supply. By monitoring the resource situation, we can identify any regional or sub-regional variations in climate that may indicate the potential onset of drought.

These data are used to routinely monitor the state of our resources, summarised in a monthly water resources situation report shared within Anglian Water. We also review the Environment Agency's own monthly situation reports, the Met Office's three-month weather forecast, Centre of Ecology and Hydrology (CEH) reports and the National Hydrological Summary to provide a comprehensive overview of the current climatic conditions.

Table 2.2: Meteorological and climatic data collected routinely under normal (non-drought) conditions

Parameter	Definition	Frequency	Source	Purpose
Mean Rainfall (mm)		Weekly	Met Office MORECS data	Compare to long term average (LTA) rainfall to track rainfall patterns
EA Rainfall by Hydrological Area (mm)	A measure of total rainfall across the hydrological catchment	Weekly and Monthly	Environment Agency	To understand rainfall variations across the region and particular catchments
Mean Potential Evapotranspiration (PET) (mm)	A measure of the ability of the atmosphere to remove water from the surface through the processes of evaporation and transpiration	Weekly	Met Office MORECS data	Understand water demand from soils and vegetation and as an indicator of water balance
Mean Actual Evapotranspiration (AET) (mm)	The quantity of water that is actually removed from a surface owing to the processes of evaporation and transpiration	Weekly	Met Office MORECS data	Understand water demand from soils and vegetation and as an indicator of water balance
Mean Soil Moisture Deficit (SMD) (mm)	The amount of rainfall required to replenish water loss due to plant growth and evaporation	Weekly	Met Office MORECS data	Understand water demand from soils and vegetation and as an indicator of water balance
Mean Temperature (°C)		Weekly	Met Office MORECS data	Demand profiling, water quality issues
Effective Precipitation (mm)	A measure of the amount of precipitation that is available for use in the environment after losses by evaporation	Weekly	Met Office MORECS data	To understand areas where we may be seeing recharge to groundwater and rivers.

Table 2.3: Hydrometric data collected routinely under normal (non-drought) conditions

Parameter	Frequency	Source	Purpose
Groundwater levels from EA observation boreholes	Monthly / Daily	Manual dips from EA / telemetry where available	Monitor groundwater levels at indicator boreholes
Groundwater levels from AW observation boreholes	Monthly / Daily	Manual dips from operational staff / telemetry where available	Monitor levels at AWS drought vulnerable operational boreholes
River flows	Monthly / Daily	River flows from EA gauging stations / telemetry where available	Monitoring changes in river levels for routine abstraction
Reservoir levels (% storage and Ml/d)	Daily	Telemetry	Monitoring fluctuations in reservoir storage against a normal 'target' reservoir storage curve

2.2.2 Environmental drought monitoring and triggers

We monitor the environmental impacts of a drought with guidance from the Environment Agency. We are in close contact with our local Environment Agency colleagues across the region. In a normal year, discussions are held at the end of the recharge season heading into the summer and the start of the recharge season in Autumn, to assess the current situation across each of the hydrological catchments. Collating all the information at these times allows for a thorough outlook to be produced which will advise us how the environment along with various stakeholders such as agriculture and navigation will be affected in the coming season.

The Environment Agency provides an indication of environmental drought by assessing each catchment under the following classifications: Normal, Prolonged dry weather, Drought, Severe drought and Recovering drought. The water resources situation but also ecological and water quality factors are considered before a change in drought classification occurs. When the Environment Agency changes an area's drought classification status from Normal to Prolonged dry weather, due to ecological and water quality reasons, this is a trigger that our river support boreholes are likely to be required that year or earlier than normal to support the environment (**Section 2.2.3**). We are currently working with the Environment Agency to align their drought classifications with our upper drought management curves; at present this sits within our new **Level 1** curve detailed in **Section 2.4**.

Each year we also review a number of other schemes which help the environment, agricultural sector, NGOs and other key stakeholders. Examples of these are detailed below:

Lower Nene working group

Anglian Water has built up a good relationship with the agricultural users and NGOs in the Lower Nene. At the start of the spring / summer period we collectively come together alongside the Environment Agency, to review the resources situation in the Lower Nene and assess the need for river support for the downstream users during that summer. For a number of years we have reviewed the surface water situation at Rutland and where possible reduced abstraction at our Wansford abstraction point to provide water downstream for agriculture and the environment during the key irrigation period.

Water re-use from borehole rehabilitations

Borehole rehabilitations take place as part of ongoing maintenance of our groundwater assets. Water is usually discharged when doing rehabilitations to a local river (as per Environment Agency guidelines) or tankered to local treatment works. During spells of prolonged dry weather Anglian Water will work with the Environment Agency and local agriculture users to identify if the water that is being discharged could be provided for irrigation purposes rather than run to waste, thereby supporting the local abstractor and the environment. This is considered business as usual for all our rehabilitations.

2.2.3 Abstraction licence compliance

We monitor our daily abstraction data to manage abstraction licence compliance and to monitor the approach of any cessation limits or associated licence conditions. The implementation of licence cessation conditions are triggered by notification from the Environment Agency, based on data gathered via their hydrometric network.

To maintain our abstraction, a number of our abstraction licences have clauses requiring us to operate river support schemes where otherwise we may be having an environmental impact. We have 15 river support schemes across the region (as listed in Table 2.4). The triggers are usually conditions written into our abstraction licences and are based on river flows or water quality as monitored and advised by the Environment Agency. The schemes comprise non-public water supply boreholes or surface water sources that provide water to a local river to support flows and river ecology at times of stress. Owing to the localised nature of these schemes, it is possible that some may be operational during times that we would classify as normal (non-drought) conditions.

Table 2.4: River support schemes across the Anglian region

River support source	Source type	Supported river	Associated AWS source
Scole	Groundwater	River Waveney	Billingford
Laceby WRC	Groundwater	Laceby Beck	Laceby
Barnoldby borehole	Groundwater	Laceby Beck	Barnoldby
Debenham WRC	Groundwater	River Deben	Winston
Dunston Common - Stoke Holy Cross	Groundwater	River Tas	Caistor St Edmunds and Bixley
Houghton borehole 3	Groundwater	River Stiffkey	Binham and Houghton St Giles
Great Yeldham	Groundwater	River Colne	Colne sources
Balkerne	Groundwater	River Colne	Ardleigh
Coldham Hall	Groundwater	Ditch system adjacent to River Bure	Coldham Hall
Cley Hall Farm borehole	Groundwater	Cley Hall Marshes	Glandford
Bowthorpe borehole 1	Groundwater	West Earlham and Bowthorpe Marshes	Bowthorpe
Cornard (BR)	Groundwater	Cornard Mere	Cornard (BR)
Tinwell to Stamford Mill Stream	Surface water	Stamford Mill Stream	Tinwell
Costessey Pit No.2	Surface water	Taverham Mill Lake	Costessey
Cut-Off Channel	Surface water	River Wissey	Stoke Ferry

2.3 Recognising the start of a drought

2.3.1 Early warning indicators

We have developed a number of hydrometric indicators to provide an early warning that a drought could be developing. These are discussed in detail below. As each drought is unique, there is no single metric that will indicate a change of status from normal to prolonged dry weather to potential drought status, and a combination of factors need to be considered.

We therefore consider all the early warning indicators in conjunction with resource status to monitor a developing drought situation. We have developed a Drought Response Framework (Table 2.1) to identify triggers to assist in drought decisions and management actions.

The time of year influences the significance of the early warning indicators. Groundwater resources and reservoir storage are dependent upon winter rainfall for recharge and refill. Low rainfall during winter and spring provide an early indication of potential drought conditions. High SMD and low rainfall in the autumn is an indicator the recharge season is slow to start, causing us to review our resource situation and commence drought response actions as needed.

We may also commence drought actions, such as resource forecasting, before crossing early warning indicator triggers, as a reflection of wider drought impacts elsewhere in the country.

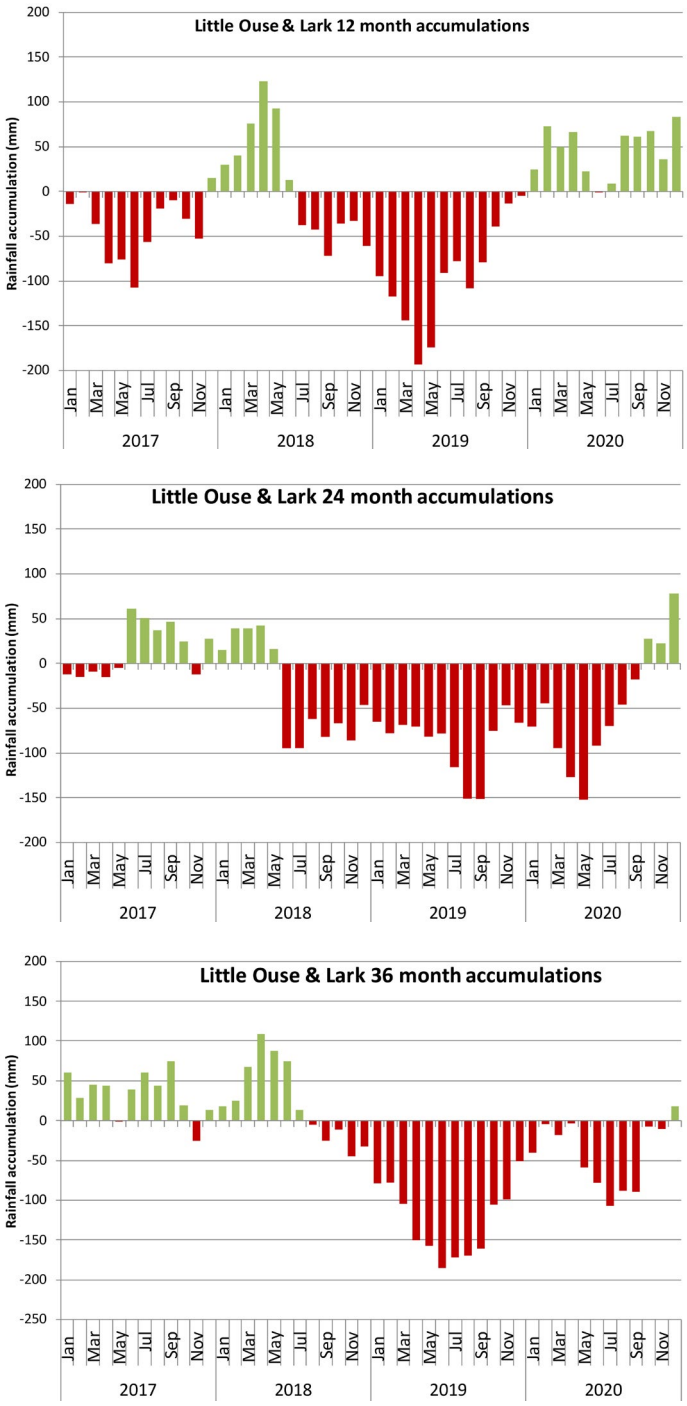
Rainfall

Historical rainfall records are used to identify periods of exceptionally low rainfall events that may precede a drought. We have used historic rainfall accumulations and extreme value analysis carried out by the Met Office[8] and Atkins[9] for our WRMP 2019 to identify 1:5, 1:10, 1:50, 1:100 and 1:200 return period (RP) drought events for the Ruthamford, Lincolnshire, Trent, Norfolk and Suffolk sub-regions.

Rainfall data for each of the Environment Agency's hydrological catchments within the region is monitored by looking at the 1, 6, 12, 24 and 36 month accumulations. We look at deviations from the LTA and compare to the Environment Agency classifications. These rolling rainfall accumulations allow the review of patterns and the magnitude of both annual and longer term rainfall deficits (e.g. 1 or 2 dry winters) to be measured.

Examples of these can be seen in Figure 2.2.

Figure 2.2: Example 12, 24 and 36 month rolling rainfall accumulation (mm) departures from the Long Term Average in the Little Ouse and Lark catchment



[8] *Technical Note: Extreme Value Analysis of long duration droughts using Bayesian methods (Met Office, Oct 2017)*
[9] *Drought Selection Process and Criteria - Anglian Water Services (Atkins, 2017)*

Standardised Precipitation Index

We can also use the Standardised Precipitation Index (SPI) to indicate the severity of low rainfall and if a drought may be developing. SPI is calculated for a range of timescales (12, 24 and 36 months), using the recently released CEH Water Resources Portal, at a catchment scale.

SPI values can be classified as shown in Table 2.5 following McKee et al. (1993)[10]. The World Meteorological Organisation (WMO)'s user guide[11] defines a drought event as occurring any time the SPI is continuously negative, and reaches an intensity of -1.0 or lower. The drought event ends when the SPI becomes positive. The sum of the SPI for all the months within a drought event can be termed the drought's 'magnitude'. The guide also provides an estimate of the return periods of a drought by SPI (Table 2.6). Table 2.7 indicates how the WMO SPI values and scenarios relate to Anglian Water's sources and supply system. As SPI is a meteorological metric an impact on our supply system would come at the equivalent point to a more severe meteorological drought.

Table 2.5: SPI values (as per McKee et al. (1993)[10])

SPI	Rainfall scenario
2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-0.99 to 0.99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

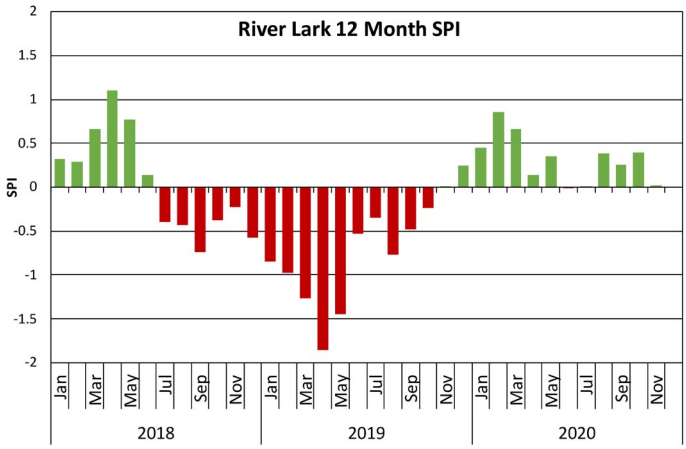
Table 2.6: SPI probability of recurrence[10]

SPI	Category	Severity of event
0 to -0.99	Mild dryness	1 in 3 yrs.
-1.00 to -1.49	Moderate dryness	1 in 10 yrs.
-1.5 to -1.99	Severe dryness	1 in 20 yrs.
< -2.0	Extreme dryness	1 in 50 yrs.

Table 2.7: Anglian Water SPI triggers

SPI	Category
0 to 2.0	Normal (non-drought)
-1.0 to 0	Dry weather
-1.5 to -1	Potential drought
Continuous <-1.5	Actual drought

Figure 2.3: SPI plot for the River Lark at Fornham



Soil Moisture Deficit and Effective Precipitation

Soil Moisture Deficits (SMDs) reported for our region are monitored against historical seasonal variations. We consider SMD below 20mm as an indication that recharge is commencing; high SMDs during winter would indicate delayed seasonal recharge to groundwater resources. We use Effective Precipitation figures to indicate if we are likely to be seeing recharge. This helps identify during the winter months where we may see issues in the following spring and summer, due to lack of recharge.

Standardised Streamflow Index

As part of the ENDOWS About Drought[12] project we have worked with CEH to produce graphs which use the Standardised Streamflow Index (SSI) as an indicator to the onset of drought. We monitor 14 rivers from across our region. The historical flow record for each river have been categorised in the SSI at 1 month and 3 months intervals. We are able to plot current river flow SSI against the historic flow range and compare this to flows in the lowest drought years. This allows a relative assessment of the severity of the SSI value. The use of the WMO standardised indices metric as detailed above also allows classification of the current SSI.

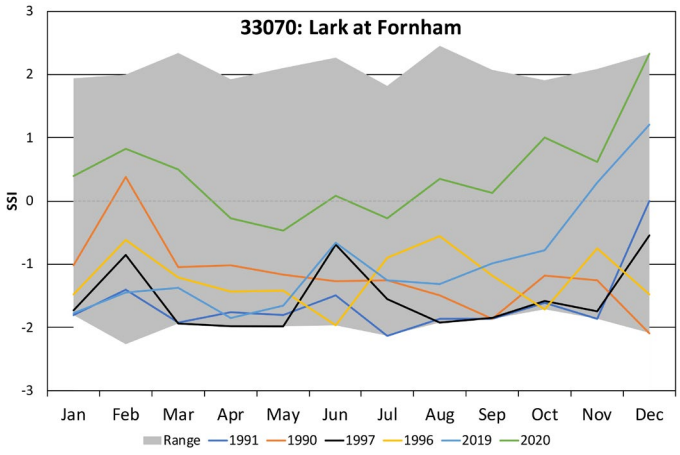
[10] *McKee, T.B., N.J. Doesken and J. Kleist, 1993: The relationship of drought frequency and duration to time scale. In: Proceedings of the Eighth Conference on Applied Climatology, Anaheim, California,17-22 January 1993. Boston, American Meteorological Society, 179-184.*

[11] *World Meteorological Organization, 2012: Standardized Precipitation Index User Guide (M. Svoboda, M. Hayes and D. Wood). (WMO- No. 1090), Geneva.*

[12] *Barker, L.J.; Smith, K.A.; Svensson, C.; Tanguy, M.; Hannaford, J. (2018). Historic Standardised Streamflow Index (SSI) using Tweedie distribution with standard period 1961-2010 for 303 UK catchments (1891-2015). NERC Environmental Information Data Centre. (Dataset). https://doi.org/10.5285/58ef13a9-539f-46e5-88ad-c89274191ff9*

This provides a metric to track river flows against historic flows. This data is available from the recently released CEH Water Resources Portal, at the same scale as SPI. Where the current river flow SSI is approaching known historic drought SSI curves, or a drought SSI indicator, this would trigger a review of the drought situation. See the example of the River Lark at Fornham approaching historic SSI values in Figure 2.4. These plots also indicate the historic range of all SSI values.

Figure 2.4: Example SSI plot for River Lark at Fornham



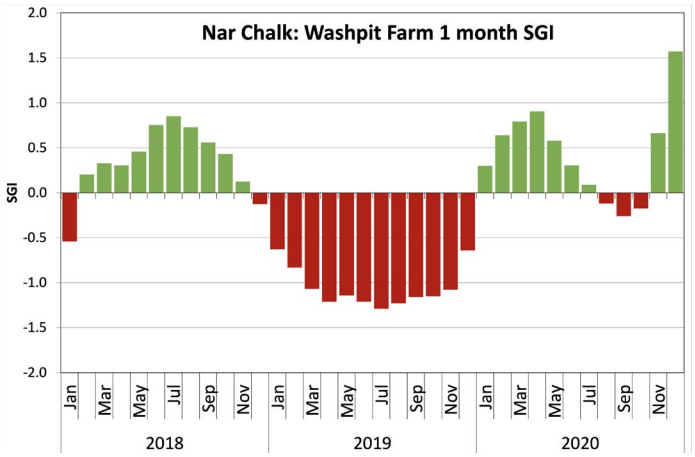
Standardised Groundwater Index

In a similar way to the SSI the Standardised Groundwater Index (SGI) was developed as part of the ENDOWS About Drought project alongside the BGS and CEH. SGI is a measure of the historical groundwater level record for each observation borehole which have met the criteria. Due to the nature of groundwater levels they have been classified as 1 month accumulations only. We are able to plot current groundwater level SGI values and compare them to the reference drought years. This allows a relative assessment of the severity of the SGI value.

This data is available from the recently released CEH Water Resources Portal, at the same scale as SPI.

Figure 2.5 is an example of one of the sites we monitor in the Nar Chalk - Washpit Farm.

Figure 2.5: SGI Chart 1 month accumulations for Washpit Farm Observation Borehole (TF81/2A)



2.4 Drought triggers and scenarios

We have created drought triggers for our operational sources to allow us to identify where our sources deviate from their normal operating range due to low rainfall and subsequent low inflows, so we can respond appropriately in line with our drought actions to maintain security of supply.

Not all our sources will respond to drought in the same way, so we have developed source specific triggers for our reservoirs, direct abstraction river intakes and vulnerable groundwater sources.

2.4.1 Reservoir drought triggers

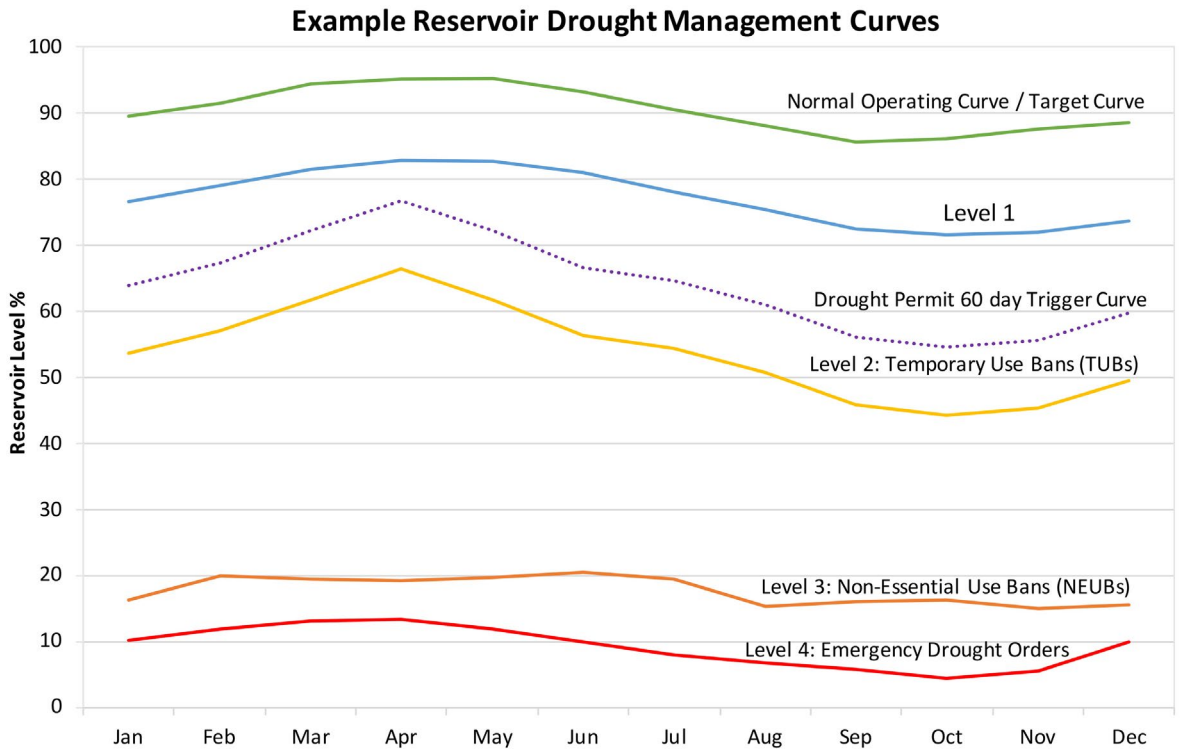
2.4.1.1 Control curves

We have redefined drought management control curves for each of our reservoirs for this Drought Plan as part of the new Environment Agency Drought Plan guidelines. The control curves act as a reference against which we can track changes in reservoir storage levels. The curves also define the refill target and response to drought and are demonstrated in Figure 2.6.

Continuous monitoring records the storage levels at each of our operational reservoirs and the data are collated to provide a continuous profile of historical storage levels. Understanding the potential onset of a drought is achieved by assessing the current storage relative to the target level expected for that time of year. Where reservoir storage sees a continued decline due to low rainfall and subsequent low inflows, this is evidence that our supplies may be affected by drought.

Details of the methodology used to produce the reservoir control curves are provided in **Appendix 4**.

Figure 2.6: Example of reservoir control and trigger curves



2.4.1.2 Normal operating curve or target curve

The normal operating curve is an optimum storage 'target' or 'control' to ensure security of water supply should the reservoir subsequently experience a drought equivalent to its reference drought (Table 1.5, **Part 1**). It also aims to avoid overfilling the reservoir resulting in costly over-pumping and loss of water to wind and wave action. We do not expect our reservoirs to always be on target, various factors can affect the ability for the reservoir to be at this level. Maintenance on our abstraction systems, raw water quality and supply network changes are the key operational influences which affect the level in our reservoirs. These are planned in when possible with the aim to reduce the overall impact on the reservoir from these changes.

2.4.1.3 Drought permit trigger curve

We have created a 'drought permit trigger curve' to provide an indication of when we would think about applying for a drought permit. We have carried out analysis on historic and stochastic drought scenarios to develop an indicative trigger specific for each reservoir with a respective drought permit. For most reservoirs, this equates to approximately 60 days, or two months, before we might need the drought permit to be implemented. This period will allow us to prepare the permit application based on the permit-ready material presented in **Appendix 9**, carry out early engagement and ensure we have sufficient environmental monitoring in place. Further detail on the development of this trigger is included in **Appendix 4**.

2.4.1.4 Drought management curves

For each pumped storage reservoir there are four drought management curves which have been developed to enable effective and timely responses to the onset of drought conditions. The curves have been updated to align with the latest Environment Agency Drought Plan guidelines. The main differences between this Drought Plan and the WRMP 2019 are listed below:

- The LoS 1, 2 and 3 curves have been renamed and renumbered to drought management curves **Level 2, 3 and 4** respectively.
- The Drought Alert Curve (DAC) has been replaced by a new **Level 1** curve.

The natural inflow reservoirs (Hollowell and Ravensthorpe) have three drought management curves as per the WRMP 2019 LoS curves and as above have been renumbered to **Level 2, 3 and 4**. A **Level 1** curve was not derived for these reservoirs due to their nature and relatively small contribution to the Ruthamford system.

The three drought management curves now aligned with our WRMP 2019 LoS are:

Level 2: Temporary Use Bans (TUBs)

Level 3: Non-Essential Use Bans (NEUBs)

Level 4: Emergency Drought Orders

The Drought Alert Curve from Drought Plan 2019 was replaced as it no longer reflected the actions which would already be taking place before reaching this point. The new **Level 1** curve is a reflection of these actions.

Level 1:
We have developed a curve for demand-side actions and supply-side actions with minor environmental impact. This curve has been derived for each individual reservoir based on historic declines in level. Crossing this curve would firstly initiate demand-side actions e.g. increased customer communication and water efficiency campaigns, followed by increased leakage control and supply-side actions such as source optimisation. The demand-side actions are discussed further in **Section 3.1**. After crossing **Level 1** environmental actions such as switching on river support boreholes and reviewing rehabilitations plans would be considered.

Level 2:
Crossing the **Level 2** curve would result in enacting TUBs at a sub-regional level in the areas affected.

Level 3:
Crossing the **Level 3** curve would result in enacting NEUBs at a sub-regional level in the areas affected. All possible actions including extreme actions (**Section 3.4**) would be taken to avoid crossing **Level 4**.

Level 4:
Crossing the **Level 4** curve would result in Emergency Drought Orders e.g. rota cuts.

If storage declines such that we cross **Level 2**, we would consider the situation to have moved from potential to actual drought. Further actions would be required to reduce demand and prolong the security of supply. These are discussed in **Section 3.2**. The actions would be subject to approval by the DMT and / or the Anglian Water Management Board, following close liaison with the Environment Agency, other regulators and our customers.

We are also currently in the process of reviewing and updating our reservoir target and **Level 2, 3 and 4** curves for the WRMP 2024. This uses our water resources system model and is considering extreme droughts and a more conjunctive system.

More details on our reservoir drought management curves for each reservoir can be found in **Appendix 4**.

2.4.2 Testing the reservoir curves and actions

The worst historical drought (reference drought) has been used to demonstrate how our drought management actions for surface water reservoirs would be implemented. The reference droughts for our reservoir sources are detailed in Tables 2.8 and 2.9.

Table 2.8: Reservoir reference drought year and associated drought vulnerability

Reservoir	Reference drought	Drought vulnerability
Alton Water	1997	Medium
Ardleigh	1934	Short*
Covenham	1989-92	Long
Grafham Water	1934	Long
Rutland Water	1934	Long
Pitsford Water	1934	Medium
Ravensthorpe and Hollowell	1934	Short

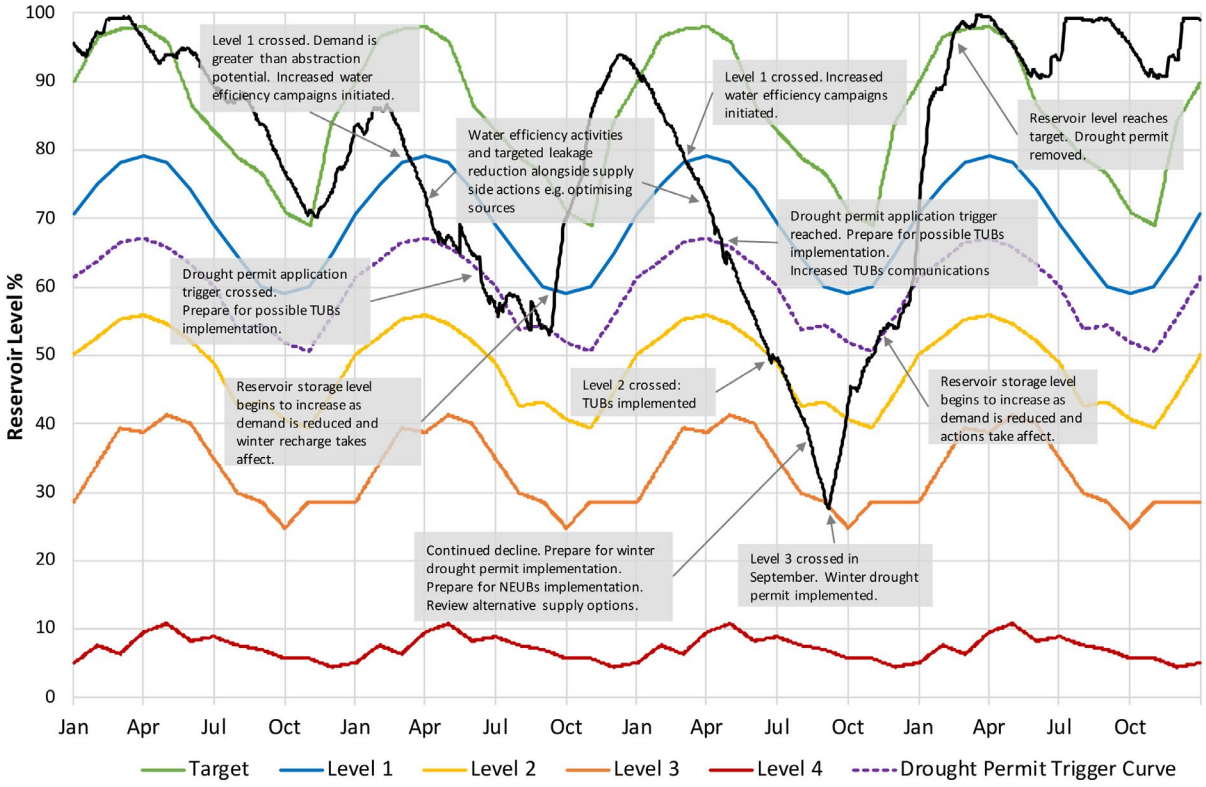
**This is a reflection of Ardleigh's small size but due to its large catchment it recovers quickly.*

Table 2.9: Drought vulnerability

Drought vulnerability	Drought type
Short	Single-season drought (typically 6 to 12 months)
Medium	Multi-season drought (1-2 years, typically 2 dry summers and an intervening dry winter)
Long	Multi-season drought (typically lasting over two years)

An annotated reservoir example is presented below in Figure 2.7. Worked examples for all reservoirs are included in **Appendix 4**.

Figure 2.7: Worked example showing drought management curves and associated actions



Scenario testing:

We have also tested our reservoir drought response over a range of drought scenarios. We have considered the following scenarios:

- Short duration, single-season drought (typically 6 to 12 months).
- Medium duration, multi-season drought (1-2 years, consisting of two dry summers and an intervening dry winter).
- Long-term drought (typically lasting over two years).

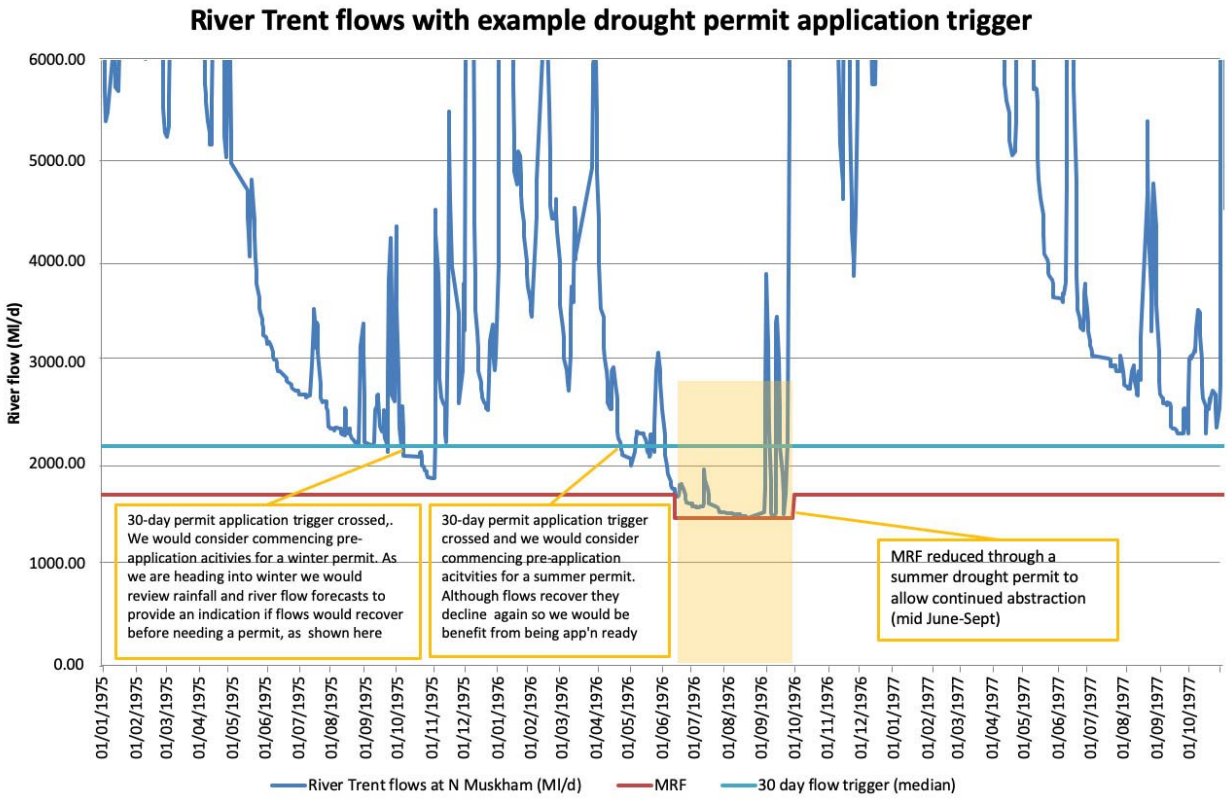
These assessments are detailed in **Appendix 4**.

2.4.3 Direct supply river intakes drought triggers

Direct river abstractions rely on river flows and have no associated seasonal storage in the form of reservoirs. These sources react quickly to changes in rainfall and are more vulnerable to other influences such as outages due to water quality. To protect the environment, our river intakes have a licence condition that specifies a Minimum Residual Flow (MRF) or Hands Off Flow (HOF), and Hands Off Level (HOL), below which we are not authorised to abstract water. During periods of low flows we liaise closely with the Environment Agency and monitor flow or level conditions associated with the licences at each of our direct river intakes.

To ensure the output of our direct intakes remains secure against a severe drought event, we have drought permit options in the event river flows decline to the MRF / HOF. As for our reservoirs, we have developed triggers for each intake based on the 60-day expected time taken for a permit application, to ensure any applications are made in a timely fashion. Please note that after review the River Trent direct intake drought permit trigger was revised to a 30-day application period. We have included in Figure 2.8 an annotated example using modelled historic river flows for the River Trent during its reference drought (1976). Further information on the derivation of the trigger, examples for our other intakes and the minimum flow year for each intake are included in **Appendix 5**.

Figure 2.8: Worked example for River Trent direct intake showing drought permit trigger and activation



When the drought permit trigger is crossed we would start to consider the implementation of TUBs. The water resources status in this, and surrounding, WRZs will also be reviewed.

Crossing the trigger would also initiate the creation of the drought permit application which would be implemented if flows continued to show decline towards the MRF.

2.4.4 Need for drought permits

Whilst our WRMP 2019 indicates that all our zones will be secure to our planned LoS of droughts up to 1 in 200 year severity without needing a drought permit, we continue to include them as options to maintain supply. This allows us to follow a proactive approach to resource management, ensuring that if we begin to enter a drought whereby we consider our resources to be at risk, we have the opportunity of progressing a drought permit option, as we will not know at that early stage of the drought how severe it may end up being.

All our drought permits have an associated Environmental Assessment Report (EAR) which reviews the potential environmental impact. This is discussed further in **Sections 3.3** and **3.6**, and **Appendices 7** and **8**.

2.4.5 Groundwater systems triggers

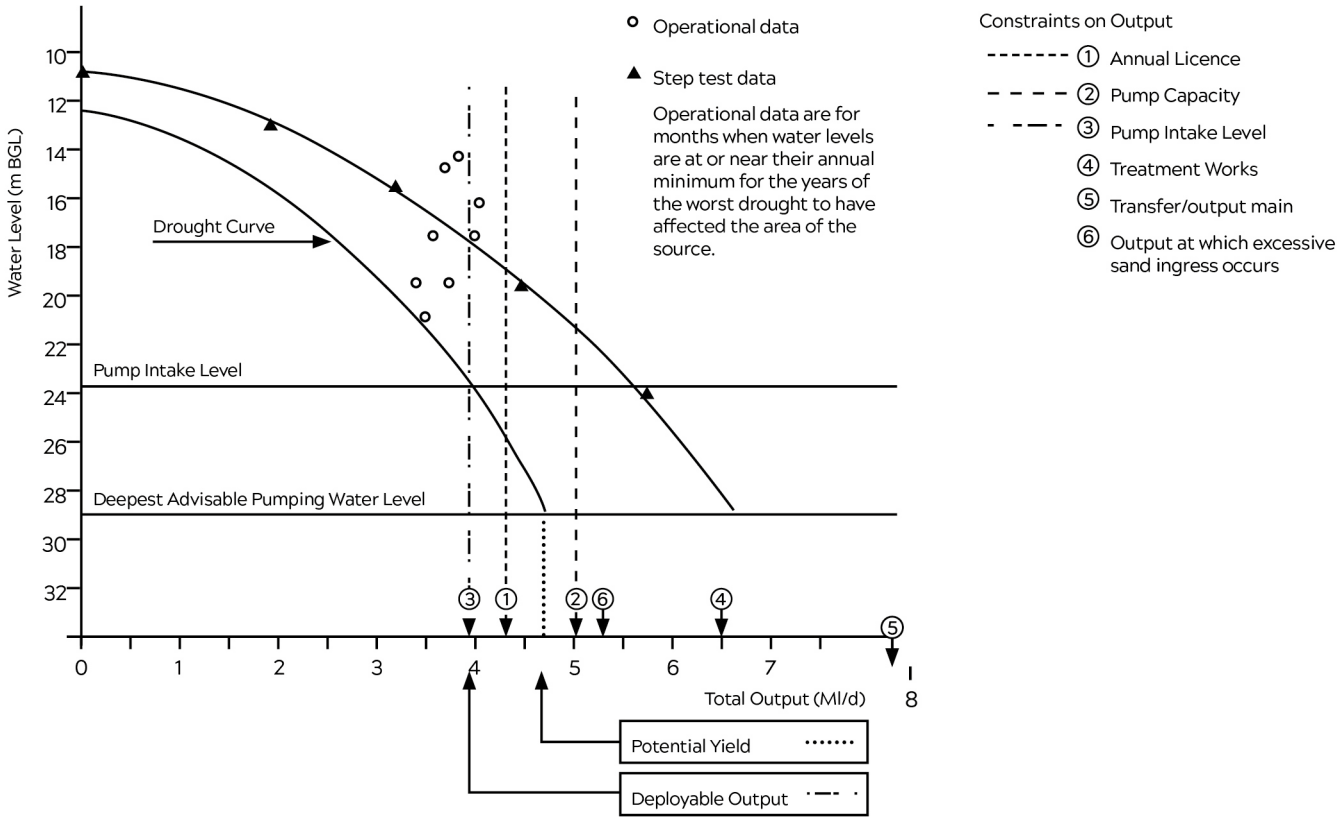
We have 200 groundwater abstraction sources comprising, in total, 450 operational boreholes. These range in depth from 10 m to 500 m and penetrate a variety of aquifers.

The potential yield for each of our groundwater sources is calculated in accordance with the industry-accepted UKWIR methodology[13], and we have calculated this for both the worst historic drought experienced and a 1 in 200 year event, in line with our revised LoS (as detailed in the WRMP 2019). In Lincolnshire where we have historically already experienced a 1 in 200 year groundwater drought event, we have also calculated yields for a drought worse than 1 in 200. Detail of the assessment methodology is included in **Appendix 6**.

All of our groundwater sources are continuously monitored and regularly reviewed for indications of any changes in key parameters. Where groundwater levels begin to decline in combination with early warning indicators described in the Drought Response Framework (Table 2.1), we will begin to increase this monitoring and potentially undertake drought actions.

The potential for reductions in yields for groundwater supplies is particularly acute during periods of drought when low groundwater levels increase the risk of operational pumping water levels approaching or breaching their defined deepest advisable pumping water levels (DAPWLs) as illustrated in Figure 2.9. The DAPWL may be set at the point where a principal flow horizon starts to dewater when the piezometric surface lowers. Groundwater sources that rely on discrete high level flow horizons may be particularly vulnerable to the onset of a drought.

Figure 2.9: UKWIR summary diagram for drought vulnerable groundwater sources



2.4.5.1 Drought vulnerable groundwater sources

We have identified 46 operational sources that are considered to be drought vulnerable to varying degrees; we split these into three tiers with tier 1 including the sources at most risk. The risk that drought may result in a loss of yield or supply at each of these sources has been reviewed for 1 in 200 year drought, for both the WRMP 2019 and this Drought Plan 2022. The drought vulnerability has been evaluated based on previous behaviour of the sources under drought conditions, drought investment and groundwater modelling.

A list of the tier 1 sources is in Table 2.10. Further details and the full list of drought vulnerable sources are included in **Appendix 6**.

[13] *A methodology for the determination of outputs Groundwater sources, UKWIR, 1995*

Table 2.10: Tier 1 drought vulnerable groundwater sources

Source	Aquifer unit	Water Resource Zone	Notes
Risby	East Anglia Chalk	Bury-Haverhill	Source added to the drought vulnerable tier 1 list due to severe drought risk to yield and supply impacts identified in the WRMP 2019
Goxhill 2	Lincs Chalk	Central Lincs	No change
Welton	Lincs Limestone	Central Lincs	No change
Winterton Holmes	Lincs Limestone	Central Lincs	Reviewing and monitoring groundwater level data to establish the new borehole's susceptibility to drought following its recent commissioning in 2018
Lower Links	East Anglia Chalk	Cheveley	Severe drought risk to yield and supply impacts identified in the WRMP 2019
Belstead	East Anglia Chalk	East Suffolk	General risk due to saline intrusion particularly at peak demand / low groundwater levels
Westerfield	East Anglia Chalk	East Suffolk	No change
Whitton	East Anglia Chalk	East Suffolk	No change
Newmarket AR	East Anglia Chalk	Newmarket	Severe drought risk to yield and supply impacts identified in the WRMP 2019
Long Hill	East Anglia Chalk	Newmarket	Severe drought risk to yield and supply impacts identified in the WRMP 2019
Moulton	East Anglia Chalk	Newmarket	Severe drought risk to yield and supply impacts identified in the WRMP 2019
Southfields	East Anglia Chalk	Newmarket	Severe drought risk to yield and supply impacts identified in the WRMP 2019
Congham	East Anglia Chalk	North Fenland	Spring flow licence condition
Gayton	East Anglia Chalk	North Fenland	No change
Metton	East Anglia Chalk	North Norfolk Coast	No change
North Walsham	East Anglia Chalk	North Norfolk Coast	Source added to the drought vulnerable tier 1 list due to severe drought risk to yield and potential supply impacts identified in the WRMP 2019
Marham	East Anglia Chalk	South Fenland	Severe drought risk to yield and supply impacts identified in the WRMP 2019

Groundwater drought management curves

The Environment Agency has a network of observation boreholes that are used to monitor regional groundwater levels across various aquifer units. Groundwater drought management curves have been developed to replace the existing Drought Alert Curves (DACs) for the majority of observation boreholes that are close to one of our drought vulnerable (DV) sources. The observation boreholes that these curves have been created for have been selected due to their proximity to our DV source boreholes, whilst ensuring they are not affected by the operation of nearby source boreholes, together with the length of record and frequency of their data. We are looking into expanding our network of observation boreholes that we monitor. This is to not only increase coverage in our DV aquifers but to also include all aquifer units in our region.

Figure 2.10 shows all the observation boreholes that we currently monitor, not just the ones that are associated with our DV sources. It also displays the observation boreholes that we are looking to add to our monitoring list. For more info on how the observation boreholes match up to all of our sources please see **Appendix 6**.

The aim of these drought management curves is to provide an early indication of the potential onset of drought at least 3-4 months in advance, taking into account natural seasonal variation.

The three drought management curves are as follows and have been calculated by determining the worst level experienced in each month that is:

- **Level 1** - Exceeded once on average every 5 years
- **Level 2** - Exceeded once on average every 10 years
- **Historic Minimum** - Lowest historic water level by month

More information on how these were derived can be found in **Appendix 6**.

These groundwater curves have been developed to align with the latest Environment Agency Drought Plan guidelines. However, given the complex nature of most of the distribution systems supplied by groundwater sources, these curves are indicative and are not designed to directly result in specific drought actions or restrictions at the respective levels. Crossing a groundwater curve would be used in conjunction with other indicators in the drought management framework to determine relevant actions.

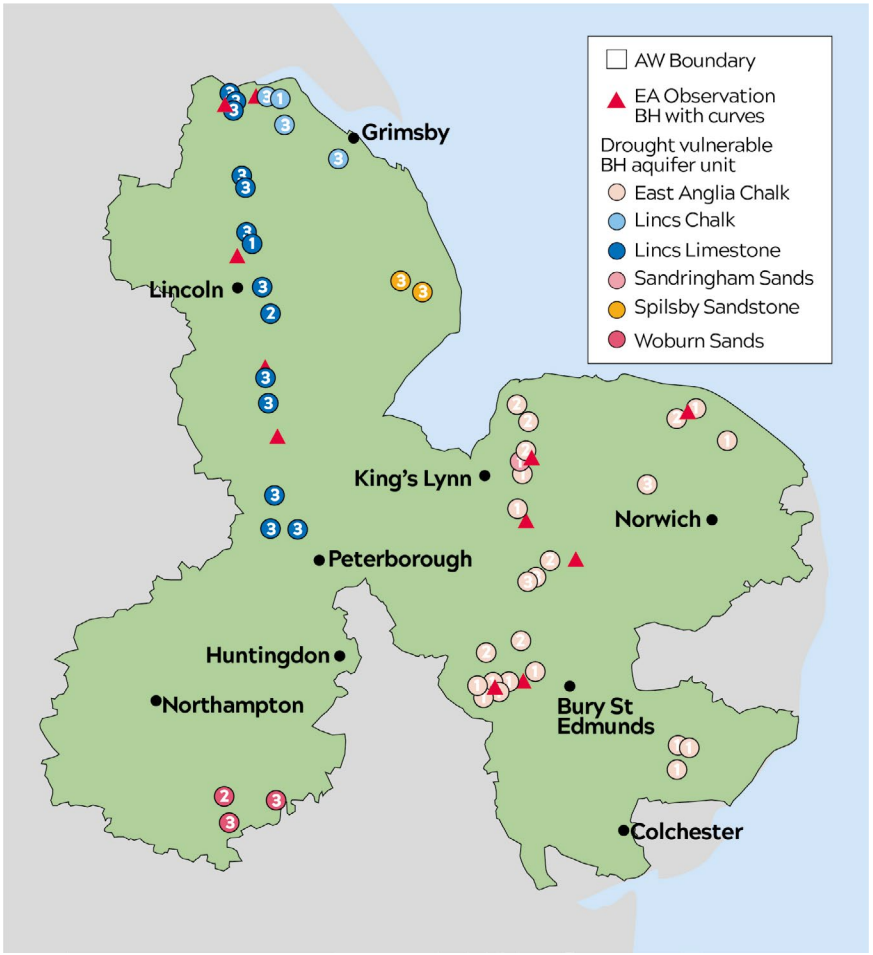
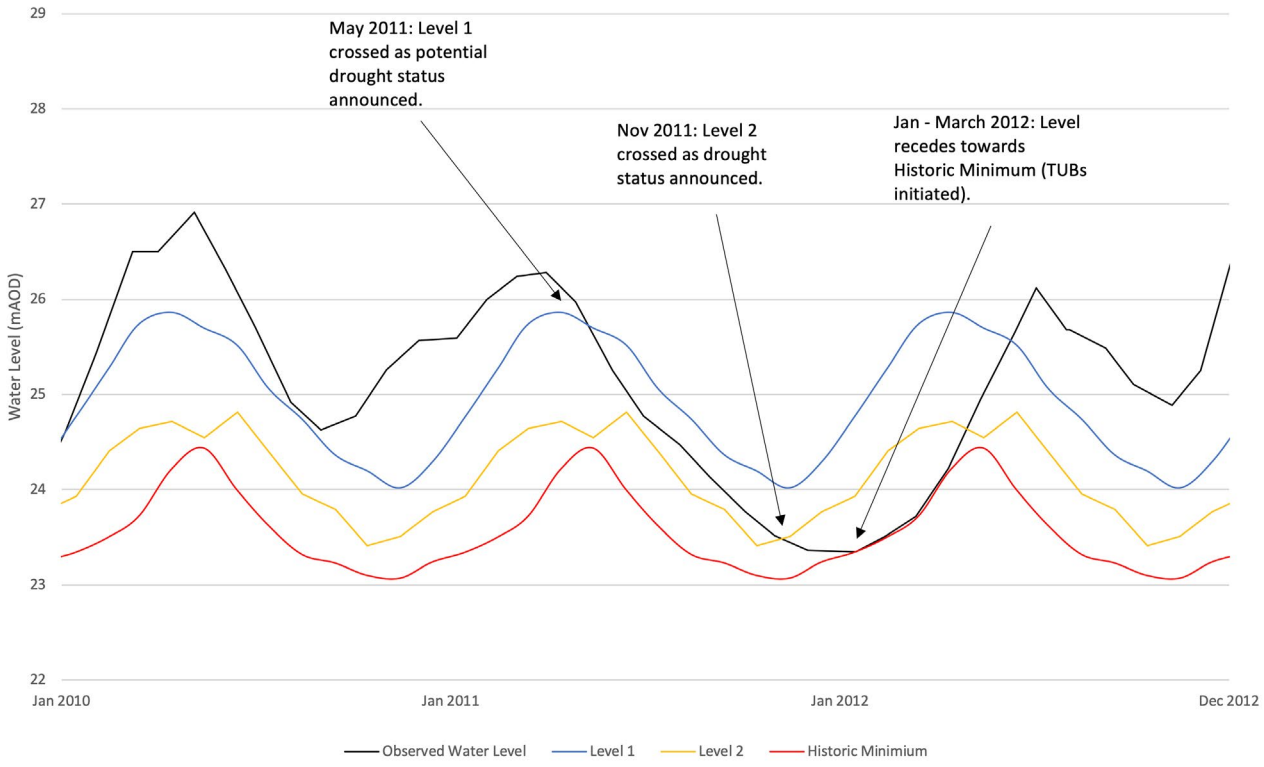


Figure 2.10: Locations of our drought vulnerable boreholes (number indicates tier and colour indicates aquifer unit) and all the Environment Agency observation boreholes that we currently monitor as well as the ones that we are looking to add to our monitoring list.

For each Environment Agency observation borehole the drought management curves have been assessed by examining previous drought scenarios when the levels would have been crossed, and reviewing drought management actions that were taken at the time, to determine whether they will be appropriate within the new framework. Figure 2.11 shows a worked example of one such scenario.

However, it is worth noting that due to the complex nature of groundwater systems and our groundwater distribution systems, these curves are indicative and will be used in conjunction with other indicators in the drought management framework before actions are decided. We will continually review the use of these curves to ensure that they are indicative of drought actions being taken in the future.

Figure 2.11: Worked example showing the drought management curves and the possible associated actions



We have previously commissioned a pilot study to develop a curve to reflect a 1 in 200 year or worse than historic drought. We are looking into developing this method to create worse than historic curves by adapting our new **Level 2** drought management curves. Further details of this can be found in **Appendix 6**.

2.4.6 Drought recovery triggers

This section describes how we identify the end of a drought and return to 'normal' conditions.

We determine the end of a drought to be when our water resources have returned to what would be considered 'normal' for the time of year. We use multiple indicators to help us gauge when we have reached this point, the key ones being:

- Reservoirs have returned to their normal operating targets
- Groundwater levels are in the normal range and recharge rates are recovering
- River flows have returned to normal
- Elimination of an accumulated rainfall and SMD deficit
- SSI, SPI and SGI return to normal

The return to 'normal conditions' will be determined by the analysis of multiple indicators, with only recovery of all or the majority of sources signifying the end of a drought. In some cases the return to normal conditions can be difficult to determine and could be confused with a short respite in a prolonged drought sequence. Where necessary we will model a range of possible rainfall scenarios to assess if we are still at risk of a drought, using the methodology described in **Section 2.5**.

2.5 Drought forecasting

To report on the impact of prolonged dry weather and potential drought on our security of supply, we undertake drought forecasting for each of the resource types. The timing and frequency of when we undertake these forecasts will depend on how the drought develops. To guide this, we have developed a framework in Table 2.11 below.

The Environment Agency and NDG can also request a Prospects report during periods of prolonged dry weather. This report pulls together a view of the current situation and forecasts under different rainfall scenarios, as well as current actions such as communications and supply-side which may have already been initiated.

Table 2.11: Drought forecasting framework

	Normal (non-drought) conditions	Prolonged dry weather		Drought approaching 2nd dry winter	Drought approaching 3rd dry summer and onwards
		Dry weather	Potential drought		
Reservoirs	Baseline forecasting, spring and autumn outlook	Commence 3-monthly projections of reservoir storage in MISER using EA rainfall scenario forecasts	Increase to monthly projections	Increased frequency - on request of DMT	
River intakes		Commence 3-monthly projections in river flows, using latest seasonal weather forecasts in rainfall-runoff models	Increase to monthly projections		
Groundwater		Commence 3-monthly projections of groundwater levels in GWLF tool using EA rainfall scenario forecasts at DVBs	Increase to monthly projections		

We are starting to utilise seasonal weather forecasts that we currently receive on a monthly basis, into a reliable river flow forecasting system that can be assessed with regards to reservoir storage and direct river intakes. The 4 seasonal forecasting systems, from Earth System Data, include ECMWF, DWD, UKMO, and METEO FRANCE. These are used to produce 3-month total rainfall and mean temperature on a daily timestep, which can be converted to HadUK rainfall and PET inputs to the rainfall runoff model GR6J, producing simulated forecasted flows. These can be assessed against historical time series data, or run in water resource simulation models under current operational conditions at any given time i.e. during a dry period. Although this process is in its infancy, we are currently exploring a pilot study for the Ardleigh catchment. We aim to utilise this data during the lifetime of this Plan.

2.5.1 Reservoir drought forecasting

We report on the potential impact of a drought by assessing current or predicted storage relative to the target level expected for that time of year.

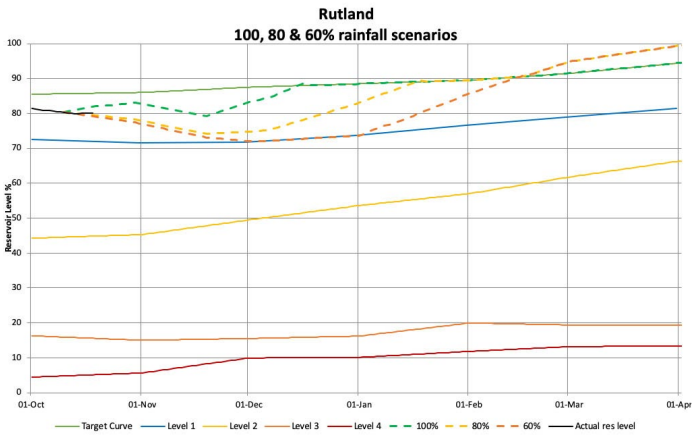
Forecasting future reservoir levels allows us to assess the potential impacts of a drought and take proportionate action.

In periods of prolonged rainfall deficit we would complete reservoir projections on a routine basis to inform the DMT. The results of the modelling are used as part of our decision analysis when assessing the future drought risk and required actions.

We use a water system model of our reservoirs (MISER) to project reservoir storage under a range of river flow and rainfall scenarios, to inform our assessment of the security of our supplies to the respective supply areas. Storage is modelled using current river abstraction pumping constraints, licence constraints, current demand and expected planned asset outages.

We input river flows and rainfall to reflect lower percentage rainfall scenarios. These are compared to average rainfall and resulting storage for the time of year. Lower rainfall is used to stress test the reservoir allowing us to forecast different potential futures.

Figure 2.12: Example reservoir forecast at 80% and 60% rainfall scenarios



2.5.2 Direct river intake drought forecasting

River forecasting is completed on all our direct surface water intakes using the ensemble stream flow method. This method uses simulated flows from our rainfall runoff models (described in the **WRMP 2019 Supply Forecast Report**) and rainfall scenarios which we calculate from MORECS data received from the Met Office. The new rainfall runoff models mentioned above will also provide short term forecasts utilising 3 month rainfall forecasts provided through Earth System Data.

Abstraction potential (i.e. the volume of water available above the MRF / HOF and within abstraction limits) is another indicator metric we use as part of our river intake forecasting. The output would then be compared to the historic river flow events for that river to identify if there is any risk under the forecast conditions.

The direct intake forecasts are compared to Environment Agency river flow categories to report the relative severity of the low flows. These are summarised in Table 2.12.

Table 2.12: Environment Agency river flow categorisation with associated colours

Category	Return period
Exceptionally Low	>1 in 20 year
Notably Low	1:8 - 1:20 year
Below Normal	1:4 - 1:8 year
Normal	1:4 year
Above Normal	1:4 - 1:8 year
Notably High	1:8 - 1:20 year
Exceptionally High	>1 in 20 year

Figure 2.13: Example of river intake forecasting at the start of the Summer for the River Wensum (NH = Notably high, AN = Above normal, N = Normal, BN = Below normal, NL = Notably low and ExL = Exceptionally low)

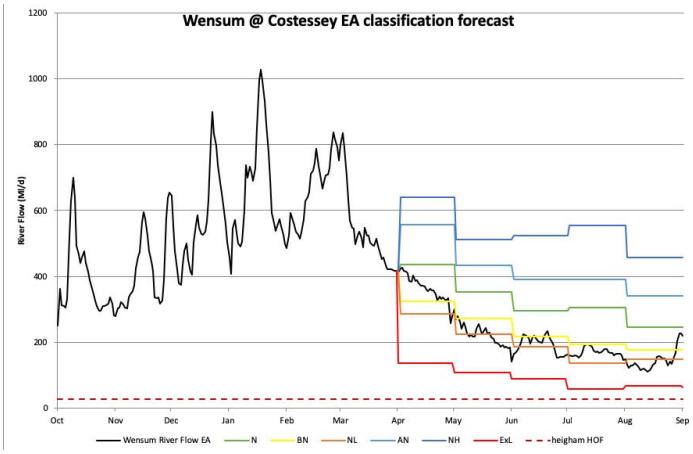
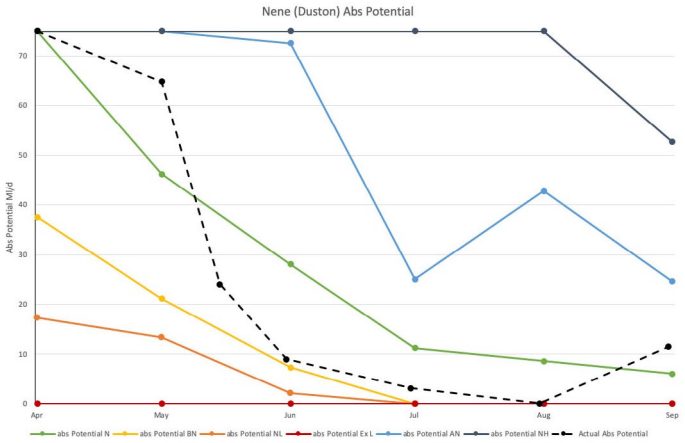


Figure 2.14: Example of Abstraction potential forecast and actual values completed at the start of the the summer (NH = Notably high, AN = Above normal, N = Normal, BN = Below normal, NL = Notably low and ExL = Exceptionally low)



2.5.3 Groundwater source drought forecasting

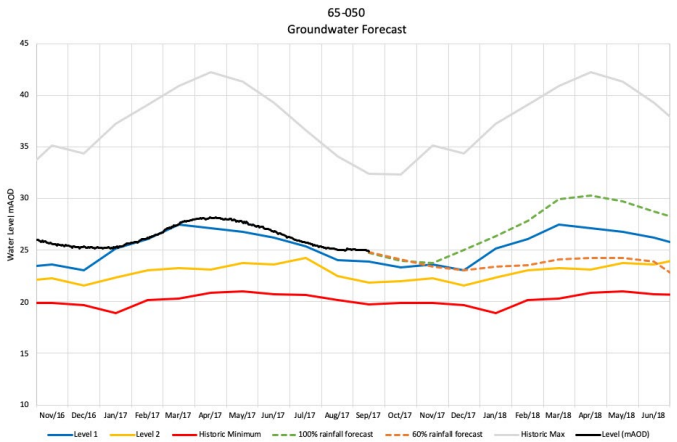
Groundwater forecasting is completed using the groundwater level forecasting tool (GWLF) on the Environment Agency's observation boreholes that are associated with our drought vulnerable groundwater sources. This tool relies on the collection of accurate historical water level data which we receive via our own telemetry systems and monthly from the Environment Agency. It also uses rainfall accumulations which we calculate from MORECS data received from the Met Office.

The GWLF uses recession analysis to predict groundwater levels in the short and medium term (up to 18 months). The output is then compared to the drought management curves for the respective source to identify if there is a risk to the source yield under the forecast conditions. An example output is below in Figure 2.15.

The GWLF tool can't be used on all observation boreholes due to the availability and quality of the historic data. However, we would still carry out manual forecasts on any of our groundwater sources that were experiencing decline during drought, even if they were not covered by the tool.

We are in the process of developing a new groundwater forecasting technique alongside the BGS which is currently in the testing phase and will be rolled out within the lifespan of this Plan.

Figure 2.15: Example GWLF output with 100% and 60% rainfall scenario



The groundwater level forecasts are also compared to Environment Agency groundwater level categories to understand the relative severity of the water level. These are summarised in Table 2.13.

Table 2.13: Environment Agency groundwater level categorisation with associated colours

Category	Return period
Exceptionally Low	>1 in 20 year
Notably Low	1:8 - 1:20 year
Below Normal	1:4 - 1:8 year
Normal	1:4 year
Above Normal	1:4 - 1:8 year
Notably High	1:8 - 1:20 year
Exceptionally High	>1 in 20 year

Part Three

Drought Plan response actions

Part Three: Drought Plan response actions

Part Two and Part Three are the operational sections of our Drought Plan. They present the tactical strategy and operational detail around how we propose to manage public water supplies during the onset and prevailing conditions of a drought. Part Three details the drought management actions we would undertake as a drought develops.

At the stage when a drought develops to the extent that it is having an impact on our operations, or when we may have to implement drought restrictions, we will have entered actual drought conditions. At this time our efforts to safeguard public water supplies will increase significantly.

The overall responsibility for agreeing these actions will rest with the DMT, informed by technical experts.

As with long term water resources management planning, we will follow a twin-track approach to managing our supplies during a drought. In the first instance we will seek to manage demand, before we instigate any of the available supply-side measures. The exception to this is through use of winter drought permits, whereby it may not be beneficial to engage in particular types of demand restriction activities during the wintertime.

Any demand- or supply-side measures will be implemented as a result of timely and proportionate decisions taken by the DMT. Actions will aim to secure supplies during the drought period with minimal disruption to customers, the environment and other water users.

In **Section 3.1** we detail the activities that we would undertake to manage demand, during drought. These include:

- enhanced customer communications,
  - this would include household customers, retailers and NAVs,
- water efficiency activities,
- metering (including activities associated with smart metering) and
- leakage and pressure optimisation, through to the
- implementation of restrictions on customer use through application of powers afforded to water companies under the Water Use (Temporary Bans) Order 2010.

Section 3.2 details the supply-side drought management actions we would undertake for our surface water and groundwater sources.

The timing of these actions is guided by the Drought Response Framework in Table 2.1 and the DMT.

A number of these actions may have potential environmental impacts and as such will require a drought permit or Drought Order. In **Section 3.3** we provide further detail regarding our drought permits, and **Section 3.6** presents the associated environmental assessments and monitoring requirements.

In addition to our "standard" demand and supply actions we also have **Section 3.4** which details the possible extreme drought management actions that we could put in place to limit the need for the **Level 4** Emergency Drought Orders.

Demand management strategy

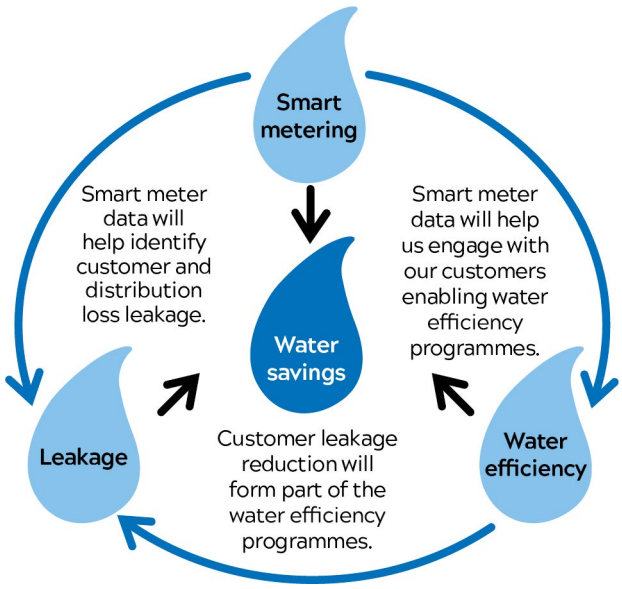
In developing the Drought Plan we have considered how demand management might be implemented, to anticipate and mitigate potential drought and how demand management programmes might be implemented in times of actual drought.

In this regard, we have developed an approach that should allow for the gradual increase of interventions, prior to full drought conditions being in effect, whilst also considering how we might address summer peak demand during these periods of extreme water stress.

Our commitment to demand management and, in particular, the promotion of water efficiency is demonstrated as a central objective in our WRMP 2019. We have, consequently, developed an ambitious, integrated, cost beneficial demand management strategy that has been designed to more than offset the impact of growth.

This ambitious plan comprises three strongly interlinked programmes: smart metering, leakage reduction and water efficiency measures, linked by an overarching communications strategy.

Figure 3.1: Our holistic demand management plan



3.1 Demand-side management actions

The following sections outline all our demand-side management actions. These range from our ongoing commitment to 'water wise' behaviour, to increased activities as a drought progresses; from communication campaigns, through to more formal restrictions on demand and ultimately rota cuts.

During periods of potential and impending drought (as forecasts indicate that drought conditions may be approaching) and actual drought there are a number of demand management interventions that will be considered. These will include targeted and agile communication campaigns, additional leakage control and pressure optimisation and may ultimately require more restrictive interventions, such as TUBs. Many of the options listed will be able to be applied progressively, becoming more extensive as the drought conditions develop.

3.1.1 Demand-side drought management levels

As part of our revised approach, we intend to implement demand-side drought management more proactively, instituting a new 'impending' **Level 1**. Consequently, the initial **Level 1** activities will be expanded to include enhanced communications as drought conditions are approached (see Table 3.2 which details our proposed **Level 1** activities). This fully aligns with the Environment Agency guidelines, as described in Table 3.1.

Table 3.1: Drought levels and actions

Severity of drought	Level	Demand-side actions
Drought Plan	Level 1	Communications campaign, increased leakage control
	Level 2	Temporary Use Bans
	Level 3	Non-Essential Use Bans
		All possible actions to avoid Emergency Drought Orders
Emergency Plan	Level 4	Emergency Drought Orders

Whilst addressing long term trends with respect to drought we would also need to anticipate the impacts of peak demand, due to periods of high temperature (and freeze-thaw events). At such times we would increase our messaging in order to mitigate consumption and discretionary use.

This would be implemented in a targeted way, using our communications continuum to enable us to educate and deliver action in a coordinated and consistent way to achieve 'impactful awareness' with our customers, at a time when it really matters. Communications would be deployed across media channels in order to deliver 'outreach' in the most appropriate areas.

3.1.2 Business as usual (BAU) and our ambitious demand management strategy

Anglian Water has developed an ambitious programme for reducing demand to mitigate growth and meet our sustainability and resilience commitments. This will positively affect our baseline position with regard to drought as these programmes progress through AMP7 and beyond.

Smart metering

We are currently implementing a smart metering programme which will significantly increase consumption data for our customers and ourselves. Smart meter installation will enable a step change in customer communications, allowing the development of more effective behavioural change programmes and consequent reductions in demand. Additionally, smart meters will significantly enhance our ability to detect and react to leaks in customer properties. This will include both internal plumbing losses and external Customer Supply Pipe Leakage (CSPL).

Leakage reduction

Our target for AMP7 is to reduce leakage by 17.5% by 2024-25. By 2045 we will have reduced our leakage by 42% in total from our WRMP 2019 baseline.

We will invest in new detection noise logging technologies and pressure optimisation systems, including our effective new Integrated Leakage and Pressure Management (ILPM) systems and actively pursue the possibilities for leakage detection that should emerge from the introduction of smart meters.

Water efficiency programmes and communication campaigns

A consistently high level of water efficiency-related communications is maintained with our customers. This overarching communication 'continuum' is designed to target audiences and specific areas with support both inside and outside the home in order to educate customers on ways in which small changes in behaviour can deliver significant reductions in consumption. Thus, water efficiency programmes will involve communicating key initiatives across a number of areas that all audiences can get involved with.

We have additionally outlined a significant programme of water efficiency measures as part of WRMP 2019, which are now being progressed, as we embark on the AMP7 programme including the addition of the smart meter My Account web-portals to inform our customers of water efficiency initiatives and to provide up to date information on their own water consumption.

By 2045 we have predicted that our average per capita consumption (PCC) will be 120 litres/head/day, a reduction of 12% (17 litres/head/day) compared with 2017/18 regional average of 137 litres/head/day.

Non-household (NHH) - Retailers and NAV companies

Anglian Water works with 22 retailers who offer valuable insight about our NHH customers. We foster close relationships with the retailers as well as the NAVs that operate in the region, all year round, not just at a time of drought. Activities includes providing the retailers and NAVs with regular situation reporting updates. This rhythm of communication means there is a strong existing relationship from which we can then progress activities when needed.

Some of our joint communication strategies include:

- Early consultation with retailers and NAVs on water resources position within our region.
- Sharing quarterly updates on the water resources position via a dedicated Retailer Information Hub, including autumn and spring forecasts to provide retailers and NAVs with context for discussions with their customers.
- Inviting retailers and NAVs to an annual water resources and drought webinar to provide an update on the current water resource position.
- Sharing other relevant information around abstraction reform, climate change and areas of water stress (including as a result of peak summer demand) to provide retailers with wider context on water use within the NHH sector.
- Provision of dual branded (retailer and wholesaler) water efficiency material to targeted customer segments to ensure clear and consistent messaging to NHH customers on water use.
- Working collaboratively with retailers and their NHH customers on potential water saving initiatives.

We recognise that NHH customers will also pick up messaging from the broader media communications so messages must be aligned to the regional and national picture.

As part of our WRMP 2024 demand management strategy, we are currently working on the next iteration of our engagement with retailers and NAVs on demand management. This will include a dedicated section on our wholesale website providing targeted information for retailers and NAVs as well as content which can be directed towards end user NHH customers.

Additionally, we are working in collaboration with our retail partners and NAVs on how we can utilise the benefit of our smart meter roll out for business customers, as well as, the household sector. As we develop these interventions, we will analyse how appropriately they might apply to different NHH sectors.

3.1.3 Demand-side drought management actions (in addition to BAU)

The majority of the demand-side actions that could be implemented for each of the drought management levels are based upon the three strongly interlinked programmes described in **Section 3.1.2** and are designed to follow on from these BAU activities. Table 3.2 displays these possible actions alongside the legal instruments that can be used.

We consider the encouragement of customers to become measured 'billed' customers (meter opting) as a useful potential option to reduce demand (measured customers exhibit lower usage patterns (15% reduction) than those on an unmeasured bill). Despite the high level of meter penetration, there are still some customers who have meters, but are not paying measured charges (and therefore, still display high consumption). Additionally, accelerated installation of smart meters with their associated savings would be considered. These would be seen as tactical options, as encouragement of optants and the accelerated installation of smart meters could be implemented within the timescales that would be pertinent to the Drought Plan. This would be dependent upon progress of current smart meter programmes in the affected areas.

Appendix 2 contains further information on the demand management actions as well as the potential savings for the key options that would be realised in each WRZ. However, it is important to note that the savings in the **Appendix 2** tables are currently based upon the WRMP 2019 assessment. All the options described in this Plan are currently being assessed and quantified as part of the WRMP 2024 demand management option modelling. Once the modelling has been completed, the options, actions and potential savings will be fully realigned and updated as part of the WRMP 2024 process.

Legal instruments

We would aim to use many of the approaches described as part of **Level 1** first (Table 3.2), in order to avoid the necessity for the introduction of TUBs and NEUBs. However, if the drought escalated then the following measures could be required.

Temporary Use Ban (TUBs)

- **Level 2** - restriction of the domestic use of hosepipes and sprinklers.

Non-Essential Use Ban (NEUBs)

- **Level 3** - restriction on non-essential use of water via a Drought Order.

Emergency Drought Orders

- **Level 4** - introduction of the use of rota cuts via a Drought Order.

Additional options for demand reduction

Further consideration will be given to additional potential options for demand reduction that might be feasible. These options listed below are not currently associated to a specific drought level.

Introduction of special fees / tariffs subject to contemporary regulatory approval

- Introduction of separate additional fees for: sprinkler users, hosepipe users, outside tap users, swimming pools (these might be feasible as smart meters are introduced).
- Introduction of lower charges for users with significant storage.
- Introduction of spot pricing for selected customers.
- NHH incentivisation and tariffing.

Interruptible supplies

- For large industrial users with storage capacity to manage peak demands during a drought.

Providing non-potable water for certain uses

- Delivering water in tankers e.g. to golf courses, garden centres, country estates, farmers for livestock use.

Table 3.2: Drought management levels and associated demand-side actions

Level	Demand-side actions	Detail
Level 1	Communication campaigns & messaging	Drought related communication campaigns to use water wisely would be implemented. This would be a key area where enhanced communication programmes could be scaled up as the severity of impending / actual drought increases. These will be significantly enhanced with the rollout of the smart meter programme and the potential to utilise associated mobile apps and websites to directly understand and target customer communications. A range of communications channels will be utilised to increase public engagement and request customers to use less water voluntarily. We will also focus on collaborative communications campaigns with retailers, in terms of joint branded communications to ensure consistent messaging. Additional interventions could include: • Competitions and challenges promoted in specific areas. • Running joint campaigns with retailers and NAVs to promote water efficiency or to provide information on an impending drought e.g. targeting large discretionary users such as golf courses and plant nurseries, as well as stakeholders such as National Trust and Network Rail, to manage water use.
	Water efficiency activities	Water efficiency and behaviour change interventions could include: • Increased promotion of water saving devices e.g. in areas under pressure. • Free or subsidised repairs of internal plumbing losses. • Joint activities with retailers for NHH, such as water use audits / efficiency visits. • Behavioural: gamification-based initiatives offering non-financial incentives e.g. community based water saving competitions with Anglian Water donating money or sponsoring environmental or educational projects that are important for the local community.
	Customer metering	Further efforts would be made to encourage meter opting (i.e. switching from being an 'unmeasured' to 'measured' billed customer; note that measured customers exhibit lower usage patterns (15% reduction) than those on an unmeasured bill). Despite the high level of meter penetration, there are still some customers who have meters, but are not paying measured charges (and therefore, typically still display high consumption). Additional interventions could include: • Targeted activity to demonstrate the benefits of customers switching to measured tariffs. • Encouraged metering of remaining unmetered customers. • Encouraged 'switching' of metered but unmeasured customers. • Accelerated upgrade of 'standard' Automated Meter Reading (AMR) meters to 'smart' Advanced Metering Infrastructure (AMI) meters e.g. in targeted zones.

	Targeted leakage reduction	As drought conditions approach and become more apparent, we would look to implement additional targeted leakage reduction. As with the enhanced communication programmes, leakage reduction would be scaled up as the severity of impending / actual drought increases.
		Note that we would fully assess any implications of additional pressure optimisation (beyond normal operations) at a sub-regional level. Consideration would be given to assessing water quality impacts as well as other consequences for example pressure at hydrants (for which we would liaise with local fire services as requested by Part 5 of the 2004 Fire and Rescue Services Act). More extreme pressure optimisation would require significant modelling before implementation.
		Leakage reduction could include the following programmes:
		• Active Leakage Control (ALC)
		  • Increase in resources for leak detection (e.g. additional contractors, focused noise logging).
		  • Divert resources from other activities on to 'find' activities.
		• Leak repairs
		  • Increase in resources for repairs (e.g. additional contractors).
		  • Enhanced activity to fix leaks.
		  • Quicker repair of non-visible leaks (reduced leak run-times).
		  • Quicker repair of visible / reported leaks (reduced leak run-times).
		  • Divert resources from other activities on to 'fix' activities.
		• CSPL reduction
		  • Identification of supply pipe leaks.
		  • Fixing (major or all) supply pipe leaks at Anglian Water expense.
		  • Offer subsidies / other help for customers in repairing leaks to their own pipes.
		• Pressure optimisation
		  • Enhancements in optimising pressure in the network (this option may reduce both leakage and consumption).
		  • Advanced replacement of infrastructure for leakage reasons
		  • Additional leakage-driven mains replacement.

Level	Demand-side actions	Detail
Level 2	**Temporary Use Ban (TUBs)**	**Restriction of the domestic use of hosepipes and sprinklers (further detail provided in Section 3.15).**
	Communication campaigns & messaging	Enhanced communication campaigns would be scaled up as the severity of impending / actual drought increases (**Appendix 10**).
	Water efficiency activities	Further promotion of water saving devices e.g. in areas under pressure. Additional joint activities with retailers for NHH, such as water use audits / efficiency visits.
	Customer metering	Additional interventions could include: • Further targeted activity to demonstrate the benefits of customers switching to measured tariffs. • Accelerated upgrade of 'standard' AMR meters to 'smart' AMI meters e.g. in targeted zones.
	Targeted leakage reduction	Accelerated targeted leakage reduction including ALC and pressure optimisation.
Level 3	**Non-Essential Use Ban (NEUBs)**	**Restriction on non-essential use of water via a Drought Order (further detail provided in Section 3.1.6).**
	Communication campaigns & messaging	Enhanced communication campaigns would be scaled up as the severity of actual drought increases (**Appendix 10**).
	Water efficiency activities	Further promotion of water saving devices e.g.in areas under pressure. Additional joint activities with retailers for NHH, such as water use audits / efficiency visits
	Customer metering	Additional interventions could include: • Further targeted activity to demonstrate the benefits of customers switching to measured tariffs. • Accelerated upgrade of 'standard' AMR meters to 'smart' AMI meters e.g. in targeted zones.
	Targeted leakage reduction	Accelerated targeted leakage reduction including ALC and pressure optimisation.
	All other possible actions including extreme drought management actions to avoid Emergency Drought Orders (further detail provided in **Section 3.4**)	
Level 4 (Emergency Plan)	**Emergency Drought Orders**	**Introduction of the use of rota cuts via a Drought Order.** Rota cuts would involve temporary cuts to the water supply for parts of the day in the areas affected.

3.1.4 Visualising the implementation programme

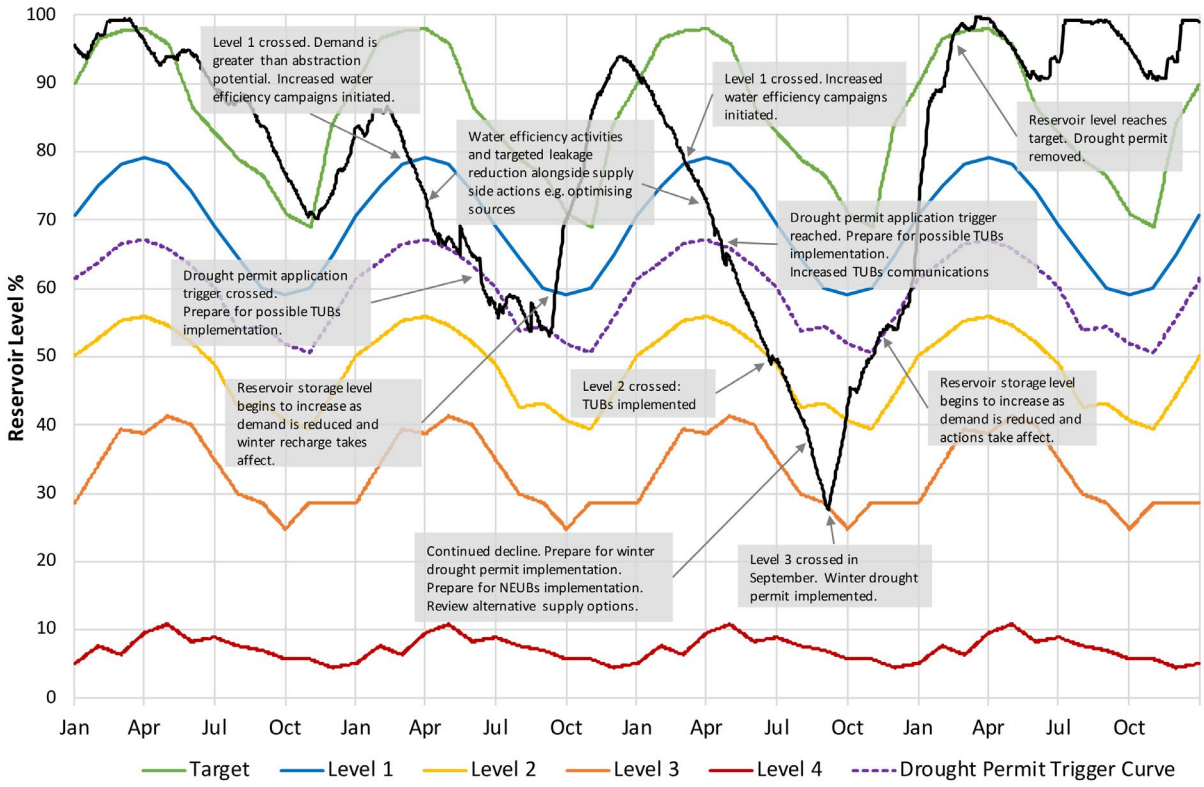
Extensive work has been conducted with regard to developing drought management curves for our surface water and groundwater sources. A reservoir example is included below which shows when, and in which order, the actions described above are likely to be implemented, as drought conditions become more severe. The actions would be phased in, as required, starting with dry weather communications and water efficiency campaigns which would be intensified and followed by increased leakage and pressure optimisation.

It is very difficult to say exactly when and where we would implement demand actions as that decision will need to be tailored specifically to the conditions in the affected areas, at the time of dry weather or drought.

For example, leakage will need to be assessed at a sub-regional level in order to assess the type and scale of interventions that might be appropriate (e.g. pressure optimisation, leakage control). As an additional example, we would also need to take into account local demographics and areas where smart meters have been installed so that we could tailor communication plans and utilise smart meter communications where available.

We will work together with the relevant Anglian Water teams to implement the demand actions that will give the greatest benefit to our customers, the environment and our water supply system.

Figure 3.2: Drought management curves with example actions



3.1.5 Temporary Use (hosepipe) Bans (Level 2)

Once the drought conditions reach **Level 2** further demand restrictions may be implemented. Demand restrictions may be imposed on domestic customers via a hosepipe ban under the Water Use (Temporary Bans) Order 2010.

The original 'hosepipe use' restriction under Section 76 of the Water Industry Act (WIA) 1991 applied only to the watering of private gardens and the washing of private motor cars. Other activities such as filling a paddling pool or cleaning windows using a hosepipe were still permitted. Following the imposition of hosepipe bans by some water companies during the 2004-06 drought it was recognised that the existing legislation did not provide water companies or their customers with suitable transparency on restricting activities that involved the use of hosepipes.

Defra and the Welsh Assembly Government undertook a comprehensive review of these powers and in October 2010 approved amendments to Section 36 of the Flood and Water Management Act 2010. This updated legislation on temporary use restrictions now extends the activities that may be prohibited and allows us to take proportionate action to protect public water supplies. These powers may allow us to delay or avoid the need for a drought permit or Drought Order under the Water Resources Act 1991 and will ensure a balance is struck between the needs to conserve water for essential domestic purposes, whilst ensuring that any potential environmental impacts are minimised.

The Water Use (Temporary Bans) Order 2010 has modernised and widened the scope of the hosepipe ban powers to enable water companies to potentially realise more water savings without the need to apply for Drought Orders. The activities that can be restricted under these powers primarily affect domestic customers.

In accordance with the Water Use (Temporary Bans) Order 2010 the activities that may be restricted are as follows:

- Watering a garden using a hosepipe.
- Watering plants on domestic or other non-commercial premises using a hosepipe.
- Cleaning a private motor-vehicle using a hosepipe.
- Cleaning a private leisure boat using a hosepipe.
- Filling or maintaining a domestic swimming pool or paddling pool.
- Drawing water using a hosepipe for domestic recreational use.
- Filling or maintaining a domestic pond using a hosepipe.
- Filling or maintaining an ornamental fountain.
- Cleaning walls or windows of domestic premises using a hosepipe.
- Cleaning paths or patios using a hosepipe.
- Cleaning other artificial outdoor surfaces using a hosepipe.

Most of the uses of water that may be prohibited under these powers only apply to the use of water drawn through a hosepipe or similar apparatus (by definition this would include sprinklers and pressure washers). The exception to this is filling or maintaining a domestic swimming pool or paddling pool and filling or maintaining an ornamental fountain, in which the use of water which may be prohibited extends to all means of filling (except for handheld containers), including fixed or permanent plumbing.

The new powers do not:

- Restrict commercial, agricultural or horticultural use.
- Include any activities that are necessary for health and safety reasons (i.e. necessary to remove or minimise any risk to human or animal health / safety or prevents / control the spread of causative agents of disease).

Before imposing any temporary restriction, we must be confident that a serious deficiency of water for distribution exists or is under threat. Hosepipes and sprinklers use large amounts of water and are often left unattended, so a restriction would be effective in conserving water for public water supplies. The temporary ban would restrict use of domestic hosepipes and sprinklers; however, these powers do not restrict any of the above activities being undertaken using:

- A bucket or watering can filled by hand.
- Grey water use (bath / wash water).
- Rainwater collected in a water butt.

Implementation of the 2010 powers

Our interpretation is in accordance with the guidance presented in the UK Water Industry Research (UKWIR) Code of Practice, as updated in 2013 to incorporate lessons from the 2011-12 drought. Under the new powers water companies have the flexibility to prioritise and sequence different categories of restrictions. This would mean the restriction of different activities at different times and in different areas, which we understand would involve complexities regarding consultation with our customers in order to consider comments and requests for exemptions.

We understand that effective management of this approach would be challenging, however, due to our updated approach to steadily increasing drought communications and activities, we feel that these should be targeted at a sub-regional level, reflecting localised conditions.

Additionally, given the range of communications channels that we would seek to utilise (and the potential for targeted communications due to the introduction of smart metering), we would have additional confidence that we could ensure an effective consultation process and implement any phasing of restrictions without bias or prejudice to any specific groups.

If the situation deteriorates further and requires us to consider the application for NEUBs through a Drought Order, this early restriction on all hosepipe usage would demonstrate that we as a water company had taken all necessary steps to conserve water supplies and protect the environment in a timely and effective manner. Any temporary restriction would be preceded by a rigorous communications campaign that would proactively engage with our customers about the deteriorating situation and the need to conserve water.

We would allow an appropriate consultation period in which any representations could be made via our website, contacting a customer services representative or writing directly to us. Following the consultation period, we would formally publish a Statement of Response outlining our consideration to any representations received. Restrictions would be imposed for the minimum period required and would be lifted with immediate effect once the situation sufficiently improved.

3.1.6 Non-Essential Use Ban (Level 3)

This section details the demand restrictions that we may impose on domestic and non-domestic customers and how these would be implemented as drought conditions worsen.

Drought Orders can be sought by a water company to restrict the use of water in the form of a restriction of non-essential use. In addition to domestic customers, these restrictions would also affect commercial customers and businesses. Drought Orders to restrict non-essential use must be granted by the Secretary of State. Further details on this process are included in **Section 3.3**.

Restrictions on non-essential use are determined by our reservoir control curves at a frequency of not more than 1 year in 40 on average. Our reservoir control curves are discussed in **Section 2.4**. The application of Drought Orders to restrict the use of water in areas supplied by groundwater and direct river intakes is determined in response to local conditions of supplies and demands.

Activities that potentially would be restricted under a NEUB are as follows:

- Watering outdoor plants on commercial premises.
- Filling or maintaining a non-domestic swimming or paddling pool.
- Filling or maintaining a pond.
- Operating a mechanical vehicle washer.
- Cleaning any vehicle, boat, aircraft or railway rolling stock.
- Cleaning non-domestic premises.
- Cleaning a window of a non-domestic premises.
- Cleaning industrial plant.
- Suppressing dust.

Under drought conditions we would liaise with the NHH retail sector, regarding the potential imposition of such restrictions and would only apply for specific restrictions where we were confident that we would realise appropriate demand savings.

3.1.7 Concessions and exceptions - TUBs and NEUBs

As a water undertaker we plan on the basis that on occasion, we may have to impose restrictions during long periods of very dry weather or drought.

Water companies can grant exceptions from these restrictions for customers and businesses.

We have liaised with companies in the regional planning groups (WRSE and WRE) in order to ensure the alignment of treatment of concessions and exceptions.

Full details of the TUBs and NEUBs concessions and exceptions as well as the customer and NHH representation process including how we will consider and respond can be found in **Appendix 11**.

3.1.8 Monitoring and review of restrictions

A post-implementation review of the impacts and demand savings of these provisions will be completed after a drought period. The review will identify predicted and actual water savings achieved through these powers. Analysis of representations and evidence of impacts received throughout the onset of a drought will support future restrictions and give customers and businesses confidence that their interests are being considered and that effective measures will be taken to minimise the impact on water supplies and on the environment during future droughts in our region.

We currently assume a demand saving of 3-10 per cent as a result of the temporary use restrictions and associated activities. The review of savings following the restrictions that were imposed in 2012 proved a demand saving of 6 per cent. The estimated demand savings for non-essential use restrictions range from 14-20 per cent. Both the TUBs and NEUBs savings are further detailed in **Appendix 2**.

3.1.9 Emergency Drought Order (Level 4)

This section details the most severe customer restrictions that we could impose in a drought. These would only ever be considered in the event that water supplies were severely depleted due to an exceptional shortage of rain.

Under the scope for 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 or the introduction of rota cuts to conserve water supplies. Further details on this process are included in **Section 3.3**.

The application and enactment of rota cuts would result only if the drought was of sufficient intensity and duration to exceed the worst recorded conditions. These are currently included in our reservoir control curves at a frequency of not more than one year in 200 and form the basis of the **Level 4** curve. From 2024/25 we have committed to avoiding the need for severe restrictions for any event less than a 1 in 200-year drought.

These severe restrictions would only be implemented in the most extreme of circumstances and only where it would be necessary to impose the use of rota cuts as a result of drought conditions. Where customers experience interruptions to supply as a result of an Emergency Drought Order we would award compensation, in accordance with Condition Q in our Instrument of Appointment.

Appendix 2 estimates demand savings that would result from the use of rota cuts as ranging from 34-52 per cent.

Through analysis in our WRMP 2019, we identified the majority of our WRZs are already resilient against 1 in 200-year drought event, as a result of drought investment we have previously completed. WRZs which are not yet fully resilient are shown in Figure 3.4. We have completed additional analysis on these zones and have identified existing supply surplus within either the zone itself or adjacent zones, which can be utilised to mitigate this risk.

Figure 3.4: WRZs identified as at particular risk of severe restrictions before 2025

3.1.10 Other demand management options

During periods of drought we may consider the suspension of our planned maintenance programmes including mains flushing. Some level of flushing is required to maintain water quality and to ensure health and safety is not jeopardised; however, we would undertake a review to understand if there was potential to minimise this to conserve water supplies.

In the event of a drought, we would also minimise the test pumping of boreholes, minimise treatment losses and review blend options.

3.2 Supply-side drought management actions

Supply-side management actions are the measures that we may employ to maintain supply during a dry weather or drought period, over and above the activities that we ordinarily undertake. As well as the actions detailed within this section we might also look to implement actions with minor environmental impact as part of our new **Level 1** curve such as optimising sources and winter drought permits.

We have developed supply-side options at source and WRZ level. We discuss the source level options below. These are actions which will allow resource to be maintained when river flows or groundwater levels are low. They provide localised, temporary options to maintain supply during a drought, beyond our normal operations. Some actions require a change to our abstraction licence, and therefore require a Drought Order or permit application. Where required these are highlighted and are discussed further in **Section 3.3**.

Implementation of these actions would be decided by the DMT, after consideration of the drought management actions and drought triggers described in **Section 2.4**.

More general WRZ level supply-side drought management options have been outlined in **Appendix 3** where we provide details on the option implementation assessment, triggers, implementation timeframe, permissions and yield saving in each zone.

We will also make sure to communicate with our customers if any of the supply-side drought management actions are likely to result in a change to the aesthetic quality of the water.

3.2.1 Reservoir drought management actions

Actions have been developed for all our reservoirs, with the exception of the small and naturally filled Ravensthorpe and Hollowell, which are part of our wider Ruthamford system.

Table 3.3: Drought management actions for our reservoirs

Reservoir	Water Resource Zone	Drought management action
Alton Water	East Suffolk	Additional transfer of water from the Bucklesham abstraction point on the Mill River (dependent on river levels).
Ardleigh	South Essex	River augmentation scheme using Balkerne and Aldham boreholes.
		Drought permit to increase river augmentation volumes by 50%.
		Utilise Ely-Ouse Essex Transfer Scheme (EOETS) - this is operated by the Environment Agency and would need further discussion. In an extreme drought the EOETS could be supported by a Drought Order (**Section 3.3**)
		Potential transfer from Essex and Suffolk Water using a direct discharge from the EOETS transfer pipeline to Abberton Reservoir, owned by Essex and Suffolk Water. Discussions with Essex and Suffolk Water have been previously held to identify opportunities to use this transfer to support Ardleigh Reservoir.
Covenham	East Lincs	Section 20 management agreement with the Environment Agency to utilise transfer scheme from Great Eau into the Louth Canal, for abstraction at Covenham.
Grafham Water	Ruthamford South	Two stage drought permit to alter the minimum residual flow condition at the abstraction point on the River Great Ouse.
Rutland Water	Ruthamford North	Drought permit to reduce minimum residual flow condition by 50% at the abstraction point on the River Nene.
Pitsford Water	Ruthamford North	Drought permit to reduce minimum residual flow condition by 50% at the abstraction point on the River Nene .
Ruthamford reservoirs	Ruthamford	Conjunctive use of reservoirs in our partly integrated Ruthamford region, to allow optimisation of storage across the region. This would be modelled using our water resource system model.

3.2.2 Direct intakes drought management actions

We have assessed our direct intakes against the worst historic and 1 in 200 year drought events, which has identified that there are occasions at our Wissey and Nar intakes when we would not be able to rely on these intakes during a drought, under existing abstraction licence constraints. We also have concerns at our Wensum intake. We have therefore identified supply-side drought permit options for these locations.

Drought management actions for our direct intakes, to ensure supply remains secure, are detailed in Table 3.4 below. A map of the drought permit locations is included in **Section 3.3**.

Table 3.4: Drought management actions for our direct intakes

Direct intake	Water Resource Zone	Drought management action
River Ancholme at Cadney	Central Lincs	Supported by the Trent-Witham-Ancholme scheme (TWAS). Analysis shows this intake is secure against the worst historic and modelled 1 in 200 year droughts.[14] In an extreme drought the TWAS could be supported by a Drought Order (**Section 3.3**)
River Great Ouse at Clapham	Ruthamford South	Low flows do not generally occur at this abstraction point owing to the extent of effluent returns in the upstream catchment; therefore, abstraction is unlikely to be affected during drought. Should low levels threaten abstraction supplies we would switch to Grafham Water.
River Wensum at Heigham	Norwich and the Broads	We have invested in a new membrane treatment plant to increase the resilience of our Heigham intake. The HOF at Heigham is very low, and flow analysis of worst historic and modelled 1 in 200 yr droughts suggest it is unlikely we would reach this HOF and the intake is reliable. However in the event of a more extreme drought or unknown water quality concerns we propose a drought permit to increase the annual abstraction quantity from the groundwater sources at Costessey, allowing us to utilise the adjacent bankside Pits.
River Nar at Marham	South Fenland	Water can be pumped from neighbouring North Fenland WRZ to support demand. This action was tested during the 2018 dry summer. We have previously considered the Marham groundwater resources could be used to augment river flows, but WRMP 2019 analysis has shown this source is vulnerable to a 1 in 200 year drought and therefore strategic investment is proposed for this (South Fenland) WRZ, which also reflects the effective loss of the Marham surface water intake due to a sustainability reduction in 2025.
River Wissey at Stoke Ferry	North Fenland	Transfer of water from the adjacent Cut-Off Channel for release as compensation to the River Wissey, depending on water quality. This resource is considered to be resilient during a drought. We can also utilise the drought permit at Wellington Wellfield if required.
River Trent at Hall	Central Lincs	We have assessed it to be resilient against a 1 in 100 year drought event but for anything more severe we would seek a drought permit to lower the MRF to increase our abstraction. This is a short-term measure (until 2025) whilst the WRMP 2019 strategic investment is completed.
Bath Spring, Saltersford and Cringle Brook	South Lincs	During normal operation these intakes are not operated because supplies are used from Rutland Water. There are no current plans to reinstate the intakes due to water quality issues.

[14] *Atkins (2017) Trent Witham Ancholme Assessment Memo*

3.2.3 Drought management actions for groundwater sources

The majority of groundwater sources tend to be more resilient against drought as the aquifers act as a buffer against rapid changes in rainfall. However as detailed in **Section 2.4.5** we have identified a number of drought vulnerable boreholes. The drought management curves developed in relation to these boreholes provide an indication of the potential onset of drought at least 3-4 months in advance, up to 12-18 months dependent on the aquifer unit. These curves can help instigate drought management actions for the vulnerable sources. However, the actions listed below can also be used for any of our 200 groundwater sources if they show decline during drought conditions:

- Additional monitoring (e.g. the frequency of water level dips and water quality measurements would increase).
- Maximise conjunctive use from more secure sources to alleviate pressure on the drought vulnerable source.
- Assign drought mitigation schemes as required; these could include fast-tracking borehole maintenance, replacement schemes, utilising surface water or commissioning new schemes.

We have also developed drought management actions specific to the tier 1 drought vulnerable boreholes (Table 3.5), to ensure the source remains resilient up to a 1 in 200 year drought event. For the majority, this is through investment in supporting boreholes, or utilising other sources within the WRZ.

Moving to a 1 in 200 year LoS has increased the drought risk associated with a small number of boreholes. Where this has resulted in a reduction to supply at a WRZ level, we have proposed drought investment in the WRMP 2019. To mitigate the risk to supply before this investment is completed in 2025, we have identified interim options, which are detailed in **Appendix 3**.

Table 3.5: Tier 1 drought vulnerable groundwater sources and associated actions

Source	Aquifer unit	Water Resource Zone	Drought management action
Risby	East Anglia Chalk	Bury-Haverhill	Interim options until 2024 WRMP investment.
Goxhill 2	Lincs Chalk	Central Lincs	Support from sources in the adjacent East Lincolnshire zone.
Welton	Lincs Limestone	Central Lincs	Support from sources in the adjacent East Lincolnshire zone.
Winterton Holmes	Lincs Limestone	Central Lincs	New borehole to support continued abstraction - became operational in 2018 following implementation of pesticide scheme. Support from sources in the adjacent East Lincolnshire zone.
Lower Links	East Anglia Chalk	Cheveley	Interim options until 2024 WRMP investment.
Belstead	East Anglia Chalk	East Suffolk	Monitoring of sentinel boreholes. Utilise surface water within zone if low water levels cause salinity to spike.
Westerfield	East Anglia Chalk	East Suffolk	New borehole drilled and commissioned in 2006 to support continued abstraction.
Whitton	East Anglia Chalk	East Suffolk	Three new boreholes drilled and commissioned in 2006 to support continued abstraction, new WTW also installed.
Newmarket AR	East Anglia Chalk	Newmarket	New borehole drilled and commissioned in 2006 to support continued abstraction. Import from Cambridge Water also available for this WRZ. Severe drought risk managed by interim options until 2024 WRMP investment.
Long Hill	East Anglia Chalk	Newmarket	New borehole drilled and commissioned in 2006 to support continued abstraction. Import from Cambridge Water also available for this WRZ. Additional severe drought risk managed by interim options until 2024 WRMP investment.
Moulton	East Anglia Chalk	Newmarket	New borehole drilled and commissioned in 2006 to support continued abstraction. Import from Cambridge Water also available for this WRZ. Severe drought risk managed by interim options until 2024 WRMP investment.
Southfields	East Anglia Chalk	Newmarket	New borehole drilled and commissioned in 2006 to support continued abstraction. Import from Cambridge Water also available for this WRZ. Severe drought risk managed by interim options until 2024 WRMP investment.
Congham	East Anglia Chalk	North Fenland	Support from adjacent sources within supply zone.
Gayton	East Anglia Chalk	North Fenland	Support from adjacent sources within supply zone.
Metton	East Anglia Chalk	North Norfolk Coast	Satellite borehole drilled and commissioned in 2006 to support continued abstraction.
North Walsham	East Anglia Chalk	North Norfolk Coast	AMP7 investment to join up vulnerable works.
Marham	East Anglia Chalk	South Fenland	Emergency standby from Wellington Wellfield. Severe drought risk managed by interim options until 2024 WRMP investment.

3.2.4 Additional supply-side management options

Management of inter-company transfers and shared resources

We maintain liaison with all neighbouring water companies in the preparation of our Drought Plans and WRMPs. One of the key areas of collaboration is the management of transfers and shared resources. This is further detailed in **Section 1.5.3**.

We are a net exporter of water through the historical provision of statutory bulk supplies from Grafham Water to Affinity Water (Central) and from Rutland Water to Severn Trent Water. There is a small net import of water from Essex and Suffolk Water in the Braintree and Colchester areas and from Cambridge Water in the Thetford area.

There are no other specific cases where additional water supplies could be provided between Hartlepool Water and Northumbrian Water and no existing provisions for emergency cross connections.

However, companies would provide mutual assistance dependent upon the characteristics of the prevailing drought and their respective availability of water resources and treated water supplies.

Conjunctive use

Some of our WRZs contain both groundwater and surface water sources which can be used conjunctively. In these zones, it may be possible to take more water from groundwater in order to reduce abstraction from reservoirs to conserve storage, or vice versa, depending on the type of drought and resources affected. During a drought these scenarios would be modelled using our water resources supply system model, AQUATOR.

3.3 Drought permits and Drought Orders

Drought permits and Orders can be sought by a water company to secure additional water resources or to restrict the use of water. These would only be considered under periods of exceptional shortages of rainfall[15] which result in serious deficiencies in our water supplies. These are all drought management actions that if granted can allow greater flexibility to manage water resources and minimise the effects of a drought on public water supply and the environment.

The Water Resources Act 1991 as amended by the Environment Act 1995 and the Water Act 2003 allows for three legislative ways for dealing with drought situations:

- Drought permits
- Drought Orders - ordinary
- Drought Orders - emergency

There are a number of key differences between drought permits and Drought Orders that have been summarised in Table 3.6[16].

Before we apply for a drought permit or Drought Order we will have taken the necessary measures to conserve supplies and reduce demand on the affected sources, as detailed in **Section 3.1**. In particular we would have increased engagement with our customers through communication campaigns, imposed temporary restriction on domestic hosepipe use, and increased leakage control.

Table 3.6: Summary of drought permit and ordinary and emergency Drought Orders

	Drought permit	Ordinary Drought Order	Emergency Drought Order
Legislation	WRA 1991 Section 79a	WRA 1991 Section 74	WRA 1991 Section 75
Applicant	Water company	Water company or Environment Agency	Water company or Environment Agency
Authorised by	Environment Agency	Secretary of State	Secretary of State
Powers	To modify or suspend conditions on an abstraction in order to increase water supply during a drought	Can increase both supply and restrict non-essential use of water. This is over and above temporary restriction powers to restrict domestic hosepipe use	To set up and supply by means of stand pipes or water tanks
Duration	Up to 6 months	Up to 6 months	Up to 3 months
Extensions	For a further 6 months	For a further 6 months	For a further 2 months
Period for powers to be granted	Normally within 12 days from date of application	Normally made within 28 days from date of application	Normally made within 28 days from date of application

Drought permits

In accordance with the Water Act 2003, we have identified all possible drought permits that we would seek to secure additional supplies during a drought. Table 3.7 provides a summary of the proposed drought permits we would apply for and their benefit expressed in yield. Note these yield quantities are from the Drought Plan 2014 but they are being updated for the WRMP 2024.

Where our surface water supply drought management actions require a change to our abstraction licence, we would seek to apply for a drought permit. We have not identified any drought permits required to maintain supply for our groundwater sources. However, we do have groundwater related augmentation and permits that support surface water abstractions. A map of the drought permit locations is in Figure 3.5.

[15] *EA (2021) Hydrological guidance for the assessment of an Exceptional Shortage of Rain (ESoR)*
[16] *Based on the summary included in the 'Drought permits and drought orders' Defra document, May 2011*

This also does not reflect the wider benefit to deployable output of the source, as this can be constrained by WTW output or other operational factors. Analysis for the WRMP 2019 identified that there was limited WRZ level benefit; rather drought permits offer localised source-level benefits. The permits offer resilience against more severe droughts, and we would consider applying for a permit where river flows and our resources have been affected by prolonged low rainfall.

The proposed drought permit options for Alton were reviewed with the Environment Agency and the decision was made to remove the Alton drought permit from this Drought Plan. More information regarding this decision is detailed in **Appendix 9**.

Figure 3.5: Anglian Water potential drought permit locations and associated sources

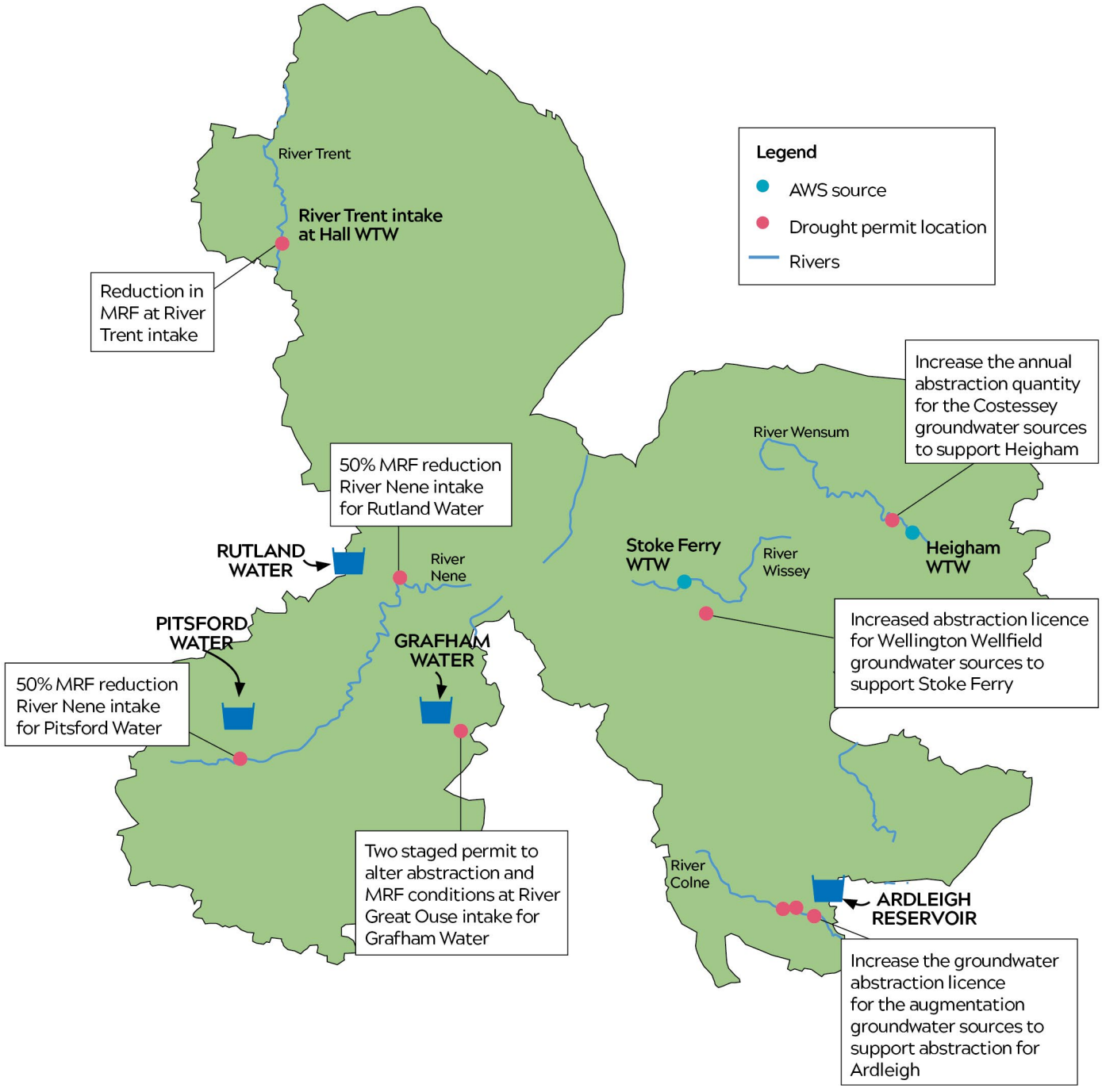


Table 3.7: Summary of potential drought permits with associated maximum potential yield

Source	Drought permit application	Maximum potential yield (Ml/d) (from Drought Plan 2014)
Ardleigh Reservoir	Increase the groundwater abstraction licence for the augmentation boreholes	6
River Wensum intake	Increase the annual abstraction quantity for the Costessey groundwater sources	24
Grafham Water	Two staged permit to alter the abstraction and MRF conditions at the intake on the River Great Ouse	68
Pitsford Water	50% MRF reduction at intake on River Nene	17
Rutland Water	50% MRF reduction at intake on River Nene	62
River Wissey / River Nar intake	Increased abstraction licence for the supporting groundwater sources	10
River Trent intake	Reduction to MRF	20

Whilst we have two drought permits on the River Nene, we do not expect there to be in-combination effects on the environment if the two permits were in use at the same time. Hydrological impacts are implicit in the flow regime, because abstraction at Duston will influence flow availability at Wansford downstream, but post-drought analysis from the 2011-12 drought, when we activated both permits, indicated no in-combination environmental effects.[17]

Therefore, there is not a prepared sequence of application for the permits and they would be applied for based on the needs of the reservoir storage or wider drought and environmental concerns at the time.

All our drought permits have an associated Environmental Assessment Report (EAR) which reviews the potential environmental impact. We have improved and updated assessments of the environmental impacts relating to each of the individual drought permits, and a summary of the assessments is presented in **Appendix 7**. We have produced an environmental monitoring plan which identifies the monitoring that would be required to support a future application, which is detailed in **Appendix 8**. We are completing these assessments in close liaison with the Environment Agency, Natural England and Historic England to ensure environmental impacts are fully identified and assessed. Further details can be found in **Section 3.6**.

We have assessed the drought permits against a 1 in 200 year drought event, but for most of our sources our reference drought remains the worst historic drought event (Table 1.5, **Part 1**). Therefore, we do not expect the frequency of applications to increase.

We may also need to use the Grafham drought permit for supply-demand purposes. Our WRMP 2019 has identified a residual planning deficit from the start of our planning period in 2020, until 2024 when we complete a large investment in a strategic grid. We have identified the Grafham drought permit as a potential option to offset this residual deficit in Ruthamford South. The residual deficit is driven by potential climate change impacts, which are unlikely to materialise immediately, but to ensure our supplies are secure we will be investing in a strategic scheme to remove this risk by 2024. The drought permit option would be a temporary winter only permit to alleviate the planning deficit. As such we have developed a bespoke higher reservoir trigger for activating the permit under this scenario. Application for the drought permit would follow standard procedures. However, the winter only timing of this permit and use at higher flows would cause less impact to the environment and therefore the current environmental assessment in **Appendix 7** remains valid for this use.

Winter drought permits

Winter drought permit application can be made to increase winter abstractions in order to:

- Reduce the risks of drought permits or Drought Orders the following summer.
- Assist recovery of water supply resources that have been depleted as a result of drought.
- Assist the maintenance of water supply in drought affected areas.

[17] *Atkins (2012) River Nene Winter Drought Permit Reviews - Wansford Intake (Rutland Water)*

Any winter drought permit application must satisfy the criteria for drought permits and must be applicable to circumstances where a threat to public supplies is significantly greater than the normal risk to supplies for the time of year. In these cases, we would still take appropriate mitigation measures to protect the impact on the environment and other abstractors. For any application we will work closely with the Environment Agency, Natural England and Historic England.

Application process

Drought permits must be approved by the Environment Agency. Any drought permit application we submit will be fully aligned with the requirements and will only be granted when the Environment Agency is satisfied with appropriate evidence that there is a serious deficiency of supplies of water in a given area due to an exceptional shortage of rain.

In line with the guidance, we have prepared background material to ensure we are 'application ready' for all our permits, should we need to apply for one. These are included in **Appendix 9**. They detail the methodology we will follow and evidence we will provide to justify the permit and demonstrate an exceptional shortage of rain. This will use the rainfall early warning indicators described in **Section 2.3**. The documents also detail all the necessary arrangements for advertising and stakeholder engagement.

We have developed application triggers for each of the permits, to reflect the likely 60-day application time and ensure we apply for any permit in a timely fashion. Examples of these triggers have been presented in **Section 2.4**, with further information in **Appendices 4** and **5**.

Drought Orders

The environmental assessments completed for each of the permits listed in Table 3.7 have highlighted some cases where the environmental impacts of the proposed drought measure may be more significant during the summer. In these instances the Environment Agency may advise that it would be necessary to apply to the Secretary of State for a Drought Order.

Environment Agency Drought Orders

We have identified options that could be considered in preparing for a more extreme drought alongside the extreme actions discussed in **Section 3.4**. These options are detailed in Table 3.8 and would require changes to Environment Agency abstraction licences and therefore an application for a Drought Order.

Table 3.8: Environment Agency Drought Orders

Scheme	Water Resource Zone	Ordinary Drought Order
Ely-Ouse to Essex Transfer Scheme (EOETS)	South Essex	Temporarily increasing the licenced volume transfer from the River Great Ouse (and ultimately to the River Colne)
Trent-Witham-Ancholme Transfer Scheme (TWAS)	Central Lincolnshire	Temporarily increasing the licenced volume transfer from the River Trent and / or River Witham (and ultimately into the River Ancholme)

The EOETS would require approval and discussion with Essex and Suffolk Water and the Environment Agency. The TWAS would need approval and discussion with the Environment Agency. As these schemes are extreme actions we would start to communicate with the key stakeholders mentioned above as we head towards **Level 3**. We would then look to apply and implement the actions before **Level 4**.

We have not undertaken environmental assessments for these schemes at this stage. However, as mentioned above, we would ensure pro-active communication with the Environment Agency to determine the data requirements, scheme timescales and any environmental concerns. This is to make sure that all of the required assessments are completed in advance of a Drought Order application.

3.4 Extreme drought management actions

Our Drought Plan provides a framework for drought management against the worst historical droughts experienced in our region to date, as well as those of a 1 in 200 year drought severity (if not previously experienced). As part of our continued long-term water resource and drought planning, we are also considering the feasibility of additional demand- and supply-side actions that we may need in future should a more extreme drought occur, such as a 1 in 500 year return period or beyond.

In Drought Plan 2019 the following demand and supply actions were considered to secure additional supplies; however, specific details of the location, cost and technical complexity were not assessed:

- Extreme pressure management
- Desalination
- Effluent re-use
- Inter-catchment transfers
- Bulk transfers from other water companies
- Groundwater and surface water - conjunctive use
- Sea tankering

Extreme actions

This extreme action section is a continuation of the previous Drought Plan and wider company work. We have generated a suite of possible extreme demand- and supply-side actions that could be implemented during an extreme drought scenario. **Level 4** Emergency Drought Orders such as rota cuts are deemed unacceptable in our society. Therefore, extreme actions are to be used as "more before 4" measures which means that they will be applied after **Level 3** (NEUBs), to prevent **Level 4** being reached.

- **Level 1**
- **Level 2** - TUBs
- **Level 3a** - NEUBs
- **Level 3b - Extreme actions**
- **Level 4** - Rota cuts

For the identification of the actions, we have used the four key criteria given by the Environment Agency's Drought Plan guidelines:

- be practical to implement during an extreme drought.
- likely to be temporary.
- be technically feasible.
- generally not result in permanent increases to deployable output i.e. usually distinct from a WRMP option.

The full list of identified extreme actions can be found in the tables in **Appendix 12**.

We will always prioritise the use of demand-side management actions first before supply-side actions are considered. However, due to the variability of a drought, and the changing intricacies of each WRZ, the exact order and prioritisation of the implementation of extreme drought actions will be reviewed on a case-by-case basis to determine what strategy is the most beneficial to a specific WRZ during a given scenario. This review will be carried out by subject matter experts within the DMT and will identify more precisely the possible quantitative benefits, as well as any environmental impacts and barriers to implementation. For all extreme drought actions identified we would ensure compliance with the relevant water quality regulations and that any impacts to customers (including acceptability of water) are fully assessed and managed. It is important to note that due to the characteristics of the Anglian Water region, we are able to identify a potential oncoming drought at an early stage, allowing for planning time to determine the most suitable actions. This time also allows us to discuss our plans with the Environment Agency and other key stakeholders, including the Drinking Water Inspectorate.

As mentioned above the specific details of the location, cost and technical complexity of these actions are still in the process of being assessed. Therefore, only the general environmental impacts of the possible extreme actions listed in **Appendix 12** will be assessed as part of our Strategic Environmental Assessment (SEA). We will continue to review extreme actions, as mentioned through the SEA, but also through further work on a prioritisation of actions, based on operational constraints and costs, SEA outputs and by exploring customer preferences.

3.5 Drought management and communication

Experience from previous droughts in our region has outlined the importance of effective internal and external management and communication. The following sections provide details on the management structure that would be mobilised at the onset of a drought and how this team will be best placed to manage drought actions both internally and externally.

Our Communications Plan sets out the actions we would undertake before, during and after a drought event and how we would communicate these with our customers, regulators and key stakeholders.

3.5.1 Drought Management Team (DMT)

One of the first management actions that results from being in the potential drought status is to convene the DMT.

The DMT will be responsible for making key business decisions that may be required as a direct result of the impact of drought. Our management structure covers all areas of the business and members are experienced in drought management. This enables us to respond effectively and responsibly to the onset and development of a drought.

Our DMT is chaired by the Director of the Water Business Stream and includes senior representatives from across the organisation. The roles and responsibilities of the core members of the DMT are defined in Table 3.9.

Table 3.9: Roles and responsibilities of the core members of the DMT

Role	Drought management action
Director of the Water Business Stream	All activities relating to water supply, water networks, process science, leakage management and local capital delivery. Specific drought responsibility to ensure that the water supply system is operating at full capacity. All activities relating to the management of our extensive asset base, the associated investment requirements, investment programme delivery and supply chain management. Specific drought responsibility to assess appropriate investment requirements for key assets (abstraction sources, networks and water treatment works).
Director of Strategy and Regulation	Ensuring that we adhere to all the requirements of our economic, environmental and quality regulators.
Director of Brand and Communications	All internal and external communications. Specific drought responsibility to ensure that we adhere with the Communications Plan.
Head of Water Resources	To ensure that we maintain the security of upstream water resources to effectively manage all aspects of the supply demand balance and regulatory compliance. Specific drought responsibility to produce and update the Drought Plan, to monitor available water resources, to report on drought status, to address environmental concerns and to identify investment requirements.

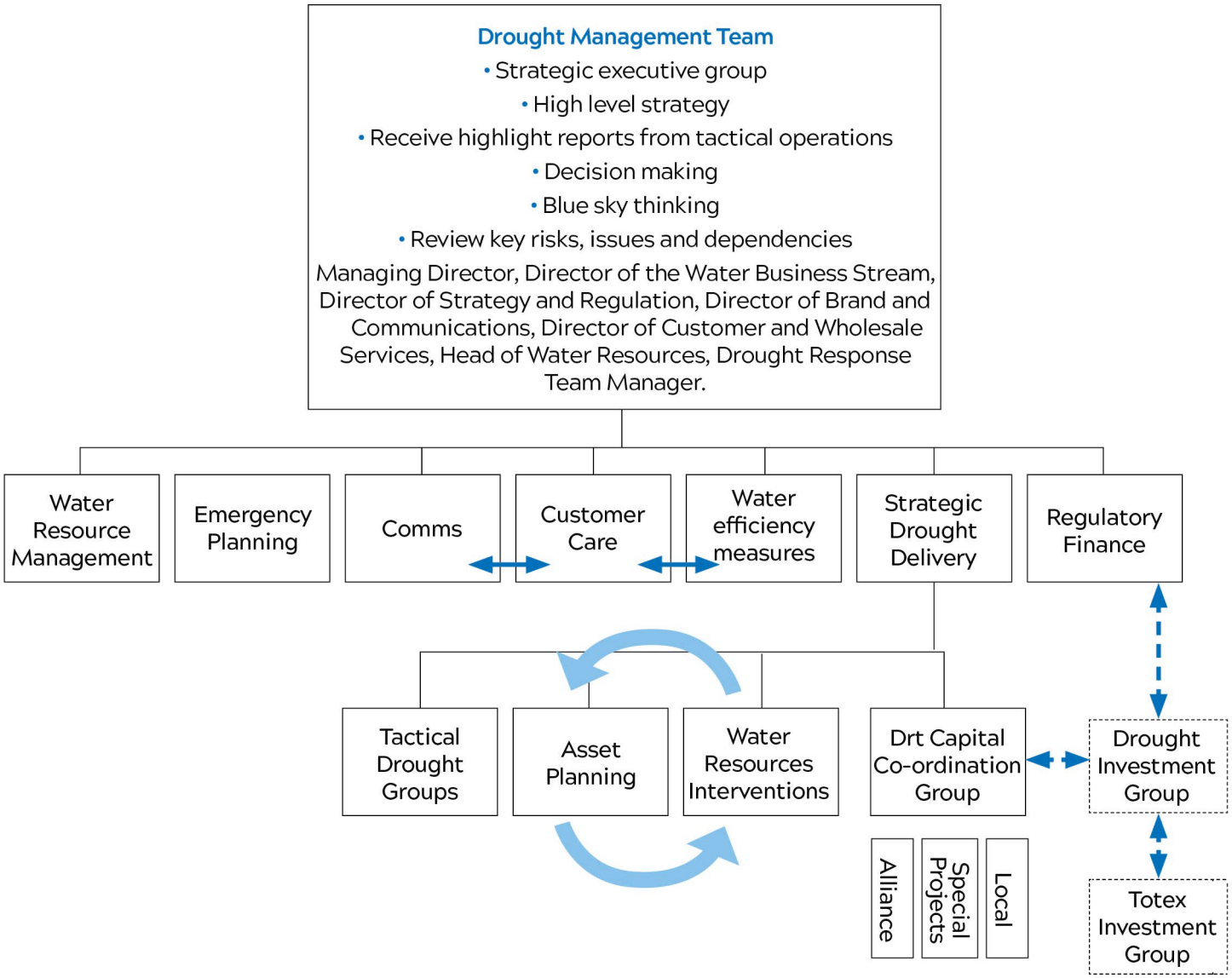
The DMT will convene on a regular basis, as required, with minutes being maintained by a technical secretary. The DMT is supported by wider input from Emergency Planning, Water Quality, Strategic Investment Management and Asset Planning & Delivery teams, and other technical experts from across the business. Where necessary, as the drought progresses, sub groups will be set up for the delivery of specific demand- and supply-side drought schemes.

Experience from the 2011-12 drought highlighted the importance of creating a central team with dedicated resources to help coordinate the drought response.

Depending on the severity of the drought, the DMT may choose to form a central Drought Response Team, with experts seconded from across the business. These resources will be made available as drought conditions develop.

The Head of the Drought Response Team would have responsibility for coordinating the various subgroups and multiple activities being carried out across the business, reporting directly to the DMT. The drought governance structure that was adopted during the 2011-12 drought is presented for reference in Figure 3.6.

Figure 3.6: Drought governance structure during the 2011-12 drought



Once convened, the DMT has overall responsibility for managing the drought through to a point when resources have been recovered to normal operating levels.

Early communications to our customers is essential at this stage in order to communicate the potential drought situation and the impacts that this could lead to in due course. The DMT includes a communications lead that will deliver key drought messages and actions both rapidly and effectively. Our Communications Plan is summarised in **Section 3.5.4** with full details in **Appendix 10**.

3.5.2 Emergency planning

As a water and wastewater company, Anglian Water has a statutory obligation to satisfy our customers' needs, and that includes protecting the vital services that we provide for them. The role of our Business Resilience Team is to work closely with our operations teams on a variety of resilience plans in order that our obligations are met under the Security and Emergency Measures Direction (SEMD) 1998. They will be called upon by the DMT to support our operational response in a drought.

Response and recovery plans have been prepared for every public water supply zone and these documents also include reference to plans developed to manage high summer water demands. The summer demand plans are produced and reviewed by key personnel across the business to ensure that all contingency measures are met in accordance with our obligations.

At the start of each year meetings are held in preparation for the summer months and associated increased water demand. The meeting participants consist of:

- Head of Tactical Operations or (OMC) Senior Operations Manager.
- Regional Supply Manager for the area (Chair) or nominated deputy.
- Regional Network Service Manager for the area or deputy.
- Emergency Planner.
- Water Managers - Supply and Network Managers for the area or deputy.
- Leakage Delivery Manager for the area (or representation).
- Water Asset Planner for the area.
- Operational Systems (Modelling) representative.
- Tactical Restoration team representative.
- System Risk Programme Manager.

The activity over the summer period is reviewed in October and a meeting is arranged, if required, to cover significant issues for subsequent resolution during the following winter.

3.5.3 External drought management

Key stakeholders will be involved in the management of all stages of a drought in the Anglian region as follows:

- A drought planning liaison group will be established with the Environment Agency and regular liaison will allow collaborative management of any potential drought. Increased reporting requirements will be agreed to manage each individual drought and we work closely with the Environment Agency to secure consistency with their area Drought Plans.
- We will consult closely with the Environment Agency, Natural England and Historic England, when appropriate, to understand and mitigate any potential impacts on the environment in relation to any drought permit or Drought Order applications.
- Liaison with other licensed water undertakers will continue to occur bilaterally and via regional liaison led by the Environment Agency and other groups such as WRE and WRSE.
- Appropriate public communication will be maintained throughout all stages of a drought to inform and engage our customers in a timely and effective manner.

3.5.4 Communications Plan

We have ongoing engagement with our customers about water resource issues in our region, and have developed our Love Every Drop campaign to raise awareness about the value of water. We want to get people thinking as responsibly about water as millions already do about recycling. One of our key Love Every Drop goals is to increase customer awareness about the value of water in our region and to encourage water efficient attitudes and behaviours. It is important, via our continuum of communications on how to save water and be water efficient, that we reach as many of our customers as possible, targeting at appropriate times, through a range of channels. Accompanying the need to reach more people, is the addition of educating customers on why taking action it is important. Visibility is key, to be seen and heard landing what we have to say to ensure our customers understand how they can help.

However, in order to resonate and effect change our communications need to mean something too. We also acknowledge the repeatability and 'always on' drumbeat of our continued activity will mean we are more present in customers lives.

We consider the encouragement of 'water wise' behaviour to be a central theme to our demand management strategy. Our drought Communications Plan has been developed to be consistent with our Love Every Drop campaign and our water efficiency strategy. It aims to provide a flexible framework of communications that will ensure effective and timely communications with regulators and customers during a range of scenarios and allows us to be responsive to individual drought characteristics.

Our communication messages are tailored to respond as required to normal conditions, prolonged dry conditions and actual drought. The approach to our communications strategy is presented in **Appendix 10**.

Effective communications that engage customers in a timely manner are essential to reduce demand to conserve water for water supplies and to protect the environment during a drought.

The key stakeholders that we liaise with are detailed in Table 3.10. Our Communications Plan outlines our liaison with regulators, customer interest groups and other partners at the different stages of a drought.

Our Communications Plan clearly demonstrates the link between the proposed demand management actions that we would take as we move from normal, to prolonged dry into actual drought.

We recognise that timely communications are key for effective consultation, advertising and encouragement of any customer-led demand restrictions, as well as the implementation of the temporary water use restrictions. **Appendix 11** provides further detail on what restrictions are included in a TUB or NEUB, how they will be phased in as well as what the exemptions are. The Communications Plan considers the appropriate lead-in times for any communications actions directly linked to demand.

The DMT will develop an appropriate drought communication package and also develop links with other bodies as necessary. The Communications Plan may be delivered separately for a WRZ or the region as a whole depending on the individual drought. Whilst the supply-demand planning for drought management options is based on our WRZs, we will implement demand management options on a sub-regional level, utilising Local Resilience Fora, as we consider this the most effective way of reaching our customers.

We must also consider communications with our retailers and NAVs. Anglian Water works with 22 retailers who offer valuable insight about our NHH customers. We communicate regularly with retailers and NAVs all year round, meaning there is a strong existing relationship and points of contact in place between the water company and the retailer or NAV.

We will adopt a communications approach which is appropriate and relevant for the individual retailer and NAV, rather than adopting a one-size-fits-all approach. NHH customers will also pick up messaging from the broader media communications so messages must be aligned to the broader picture.

Our Communications Plan has identified the most appropriate and cost-effective methods of communication. Where a drought affects our neighbouring water companies we will actively work together with them and the Environment Agency to share information and best practice. We will collaboratively develop and implement collective responses and activities where appropriate, such as through the NDG.

We propose to monitor and evaluate the effectiveness of drought communication during a drought to inform ongoing actions and our post-drought review detailed in **Section 3.7**. This would consider feedback from representatives of customer groups and other organisations, social media and website response rates, requests from customers for information on water efficiency or water saving devices and the associated change in demand for water during the period of drought.

The effectiveness of liaison in previous droughts can be measured in the adoption of timely measures and responses in order to maintain the security of public water supplies and effective communication with our customers and regulators.

Table 3.10: Key stakeholders in our Communications Plan

Audience	Liaison	Communication means
Our people	Briefings to employees. Updates to customer-facing staff.	Lighthouse (internal intranet), business bulletins, talkback and Team talk
Customers	Deliver continuous indirect and direct communication of the importance of 'water wise' behaviour and education.	Our website, our social media channels (Facebook, Twitter and Instagram) organic posts, emails, text messages, local events, direct mail, water efficiency product offers. Paid for radio and press advertisements. Paid digital activity on social media (Facebook).
Media	'Water wise' messages and interviews. Offers of briefings and interviews. Situation updates and advice as required.	Proactive and reactive press statements; organising media interviews with senior managers; provision of media packages for use by media and online
Environment Agency	Close ongoing liaison at all levels. Sharing of data. Discussion of potential drought / drought issues and collaborative working to ensure effective and timely actions are taken.	Phone calls, emails, meeting when / if necessary
Defra		
Ofwat		Phone calls, emails
Drinking Water Inspectorate / Public Health England		
Water UK	Industry liaison and interface with key stakeholders.	Phone calls, emails, meeting when / if necessary
Local authorities / MPs / CCW	Regular and open dialogue maintained. Drought situation updates available on our website. Liaison to enable the message to be communicated to a wider audience.	Letter, phone calls, emails, newsletters
Local Resilience forums		Newsletter cascade via LA contacts
Local environmental and stakeholder groups including local businesses / National Parks / neighbouring water companies	Implement regional and / or national drought groups to promote collaboration and consistent messaging.	Letter, phone calls, emails, newsletters
NHH / Retail supplier / NAVs	Maintain liaison regarding current situation via Wholesale Service Centre. Encourage water conservation through water efficiency assessments, leakage audits and process optimisation.	Working collaboratively with retailers and NAVs and provision of dual branded communications, tailored toolkit, website, social media channel extended reach

3.6 Minimising the impact of drought on the environment

An important part of the drought planning process is to ensure that the environmental impacts of any of the drought actions that we propose are minimised.

3.6.1 Environmental assessments

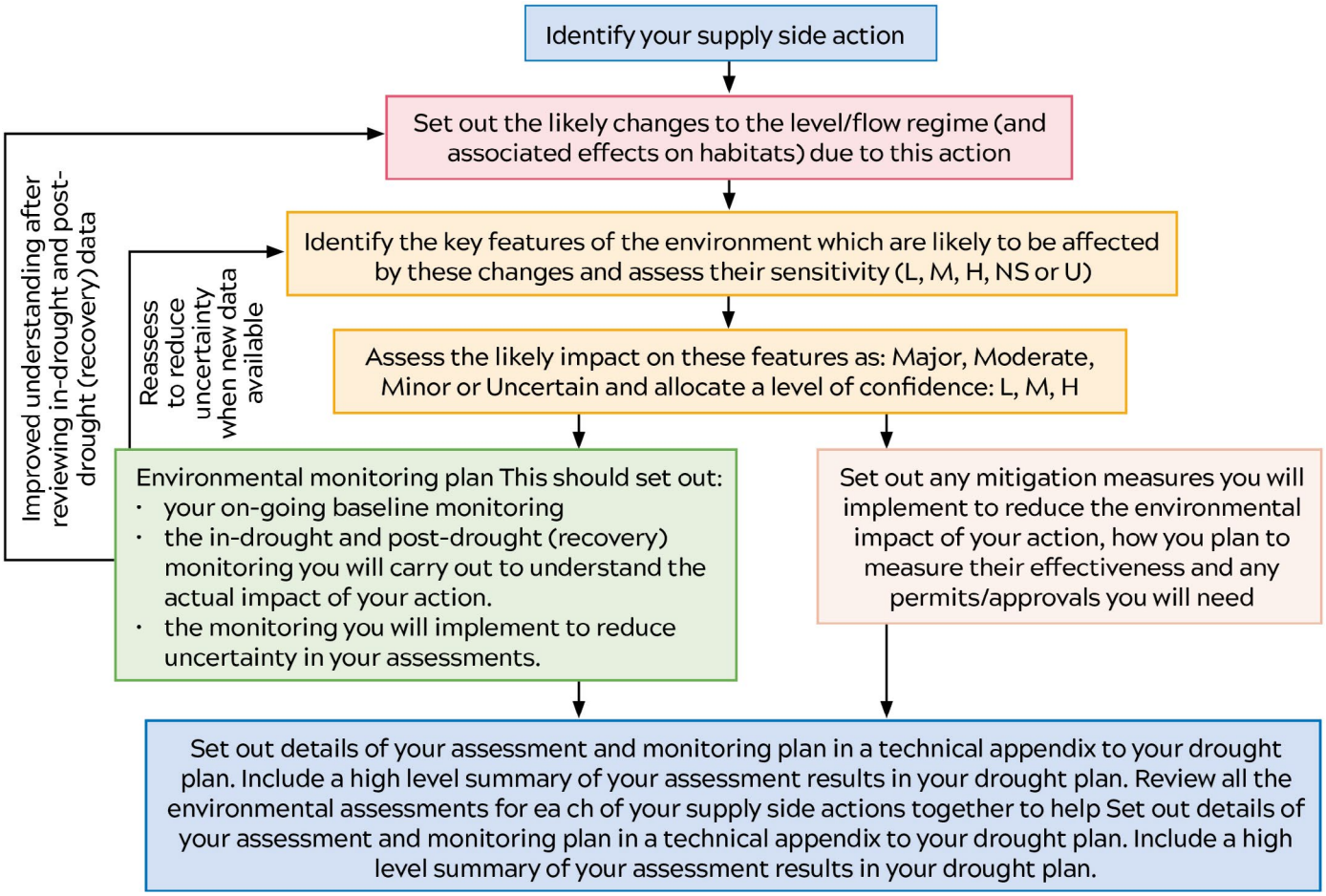
In accordance with the Environment Agency's guidelines, we have completed environmental assessments for our drought management activities. An EAR has been completed for each of the supply-side drought measures where we consider that there may be a requirement to apply for a drought permit. These have been updated from our last Drought Plan. Input from the Environment Agency has been obtained throughout the update process and we continue to work with them closely.

These assessments are used to determine the environmental sensitivity of affected areas, the likely impact of the proposed action, compliance with environmental regulations and the Water Framework Directive (WFD), and any mitigation measures that may be required to protect the environment. They are also used to develop an environmental monitoring plan and to identify any additional information that we would require to support a future application.

We currently have seven sources where we have identified drought measures that would require an application for a drought permit to secure additional supplies in a drought, as detailed in Table 3.7. A summary of the individual environmental assessments is provided in **Appendix 7**. Full environmental assessments have been completed for each permit identified and are available upon request.

In accordance with the Environment Agency's guidelines, the assessment process includes the following stages:

Figure 3.7: Approach to environmental assessment[18]



[18] *Environmental assessment for water company drought planning supplementary guidance, EA, July 2020*

3.6.2 Environmental monitoring plan

The environmental monitoring plan considers the output of the environmental assessments completed for all the potential drought permit sites. The report provides a summary of the monitoring that is routinely undertaken, additional monitoring that would be needed before a permit is applied for, once in use and once the permit has been lifted. It also identifies mitigation measures required in order to limit environmental impact as a result of the permit. Consideration has been given to the timing and availability of data during the lead into a drought.

The environmental monitoring plan is presented in **Appendix 8**.

3.6.3 Water Framework Directive (WFD) assessment

We have undertaken WFD assessments for all our supply-side actions that require a drought permit application. The WFD assessments are included in each EAR, and review the potential for drought permit options to impact upon River Basin Management Plan (RBMP) objectives or to cause deterioration in waterbody status.

The potential for abstraction from existing sources to be constrained over the next six years to meet WFD requirements has been reviewed in the WRMP 2019. Whilst we are expecting a significant number of constraints to be put into place for groundwater abstractions in 2022 and 2024, investment has been identified in the WRMP 2019 to address any resultant deficits. In addition, our peak abstraction at these sources will not be affected, and we therefore do not consider there to be potential impact with respect to Drought Plan 2022.

3.6.4 Habitats Regulations Assessment (HRA)

All supply-side actions that require a drought permit application have been subject to a HRA Stage 1 screening assessment to review the requirement for a Stage 2 Appropriate Assessment (AA). HRA Stage 1 assessments are included within the Combined Habitats Regulation Report.

Where significant effects on European designated sites cannot be ruled out at the screening stage, an AA has been carried out. The following sites have been subject to an AA:

- River Great Ouse at Offord (Grafham Water)
- River Nene at Wansford (Rutland Water)
- River Wensum at Heigham

The AAs have been updated from the previous assessments completed in March 2020. The assessments are included in the Combined Habitats Regulation Assessment report which is available upon request.

The AAs outline the mitigation measures required to ensure that any likely significant effects of drought permit option upon European sites are reduced, mitigated, or avoided.

3.6.5 Strategic Environment Assessment (SEA)

We have undertaken an SEA for our Drought Plan. The SEA process will support the development of our Drought Plan by identifying environmental impacts of individual options and of the Plan overall. The historic environment and heritage assets and their settings have also been assessed as part of the SEA. The SEA scope underwent a 5 week formal consultation from 3rd February 2021, with the Environment Agency, Natural England and Historic England. Consultation responses have been used to inform the SEA Environmental Report.

3.7 Post drought actions

This section outlines the comprehensive review of the drought management process that will be undertaken at the end of a drought and how this will be used to inform future drought management.

We have ensured consistency between our drought triggers and drought management actions to ensure our drought management actions reflect the return to 'normal' conditions. Return to 'normal' conditions will be agreed formally in liaison with the Environment Agency. In a situation where we have implemented demand restrictions, these will be lifted with immediate effect, with communications as detailed in our communication strategy in **Section 3.5** and **Appendix 10**.

Once normal conditions have been resumed and all restrictions lifted, the DMT will undertake a review of our drought management processes against those as outlined in the Drought Plan. This will be achieved through evaluating the actions taken during the drought period and identifying the lessons learned for use in managing and informing future droughts.

The review will be completed in liaison with the Environment Agency together with input from other key consultees. In accordance with the guidelines, the post-drought review will include:

- A lessons learned report within 3-6 months of return to normal conditions; this will be followed up within a year with evidence that recommendations have been implemented.
- A review of the environmental impacts of drought in reference to baseline, in-drought and post-drought data.
- Assessment of whether the environmental monitoring during and after the drought was appropriate to measure the impact of any drought permits.
- A review of the effectiveness of any mitigation measures that were implemented during the drought.
- An appraisal of the success, effectiveness and costs of all drought management actions, including drought permit and Drought Order applications.
- An assessment of how well individual sources delivered additional water and outline where reassessments of yields are required or investment needed.
- An assessment of the estimates of demand reductions from the implementation of demand-side drought management actions.
- Analysis to understand if any changes are required to our demand forecast or our longer-term demand management strategy if demand patterns experienced during a drought differ from those assumed in the Drought Plan.
- Identification of future investment schemes required to improve the security of the upstream and treated water resources.

Abbreviations and acronyms

Abbreviations	Definition
ADSO	Average Daily Sourceworks Output
AET	Actual Evapotranspiration
ALC	Active Leakage Control
AMP	Asset Management Plan
AQUATOR	Strategic water supply system model
ARC	Ardleigh Reservoir Committee
ASR	Aquifer Storage and Recovery
AWS	Anglian Water Services
BAU	Business As Usual
BOD	Biological Oxygen Demand
CAMS	Catchment Abstraction Management Strategy
CCW	Consumer Council for Water
CROW	Countryside and Rights of Way Act
CSPL	Customer Supply Pipe Leakage
DAC	Drought Alert Curve
DAPWLs	Deepest Advisable Pumping Water Levels
Defra	Department for Environment, Food and Rural Affairs
DI	Distribution Input
DMT	Drought Management Team
DO	Deployable Output
EA	Environment Agency
EAR	Environmental Assessment Report
ELL	Economic Level of Leakage
EOETS	Ely-Ouse to Essex Transfer Scheme
GWLF	Groundwater Level Forecasting Tool
HOF	Hands Off Flow
HOL	Hands Off Level
HRA	Habitats Directive Assessment

Abbreviations	Definition
ILC	Integrated Lake and Catchment
ILPM	Integrated Leakage and Pressure Management
IWNL	Independent Water Networks Limited
LoS	Levels of Service
MISER	Strategic water supply system model
Ml/d	Megalitre per day = million litres per day
MRF	Minimum Residual Flow
NALD	National Abstraction Licence Database
NAVs	New Appointments and Variations
NEUBs	Non-Essential Use Bans
NEP	National Environment Programme (replaced by WINEP)
NHH	Non-household
NOC	Normal Operating Curve
NRA	National Rivers Authority (replaced by Environment Agency)
OBH	Observation Borehole
Ofwat	The Water Services Regulation Authority
OMC	Anglian Water Operations Management Centre
ONS	Office of National Statistics
OSAY	Operating strategies method of assessing yield
PCC	Per capita consumption - consumption per head of population
PET	Potential Evapotranspiration
PPC	Per Property Consumption
PR	Periodic Review
PWS	Public Water Supply
PZ	Planning Zone
RCS	River Corridor Surveys
RHS	River Habitat Surveys
RSA	Restoring Sustainable Abstractions

Abbreviations	Definition
SAC	Special Area of Conservation
SAGIS	Source Apportionment Geographical Information System modelling tool
SDS	Strategic Direction Statement
SEA	Strategic Environmental Assessment
SELL	Sustainable Economic Level of Leakage
SEMD	Security and Emergency Measures Direction
SGI	Standardised Groundwater Index
SMD	Soil Moisture Deficit
SoSI	Security of Supply Index
SPA	Special Protection Area
SPI	Standardised Precipitation Index
SSI	Standardised Streamflow Index
SSSI	Site of Special Scientific Interest
SWORPS	Source Works Output Reporting System
TUBs	Temporary Use Bans
TWAS	Trent-Witham-Ancholme scheme
UKCP	United Kingdom Climate Projections
UKWIR	United Kingdom Water Industry Research
UWWTD	Urban Wastewater Treatment Directive
WAFU	Water Available for Use
WEMs	Water Efficiency measures
WET	Water Efficiency Target
WFD	Water Framework Directive
WIA	Water Industry Act
WINEP	Water Industry National Environmental Programme
WRC	Water Recycling Centre
WREP	Water Resources Environment Programme
WRMP	Water Resource Management Plan
WRZ	Water Resource Zone
WTW	Water Treatment Works
WWTW	Waste Water Treatment Works (we now call them WRCs)

Glossary

Term	Description
Abstraction Licences	The authorisation granted by the Environment Agency to allow the removal of water from a source.
Aquifer	A geological formation that can store and transmit water in significant quantities.
Available headroom	The difference between water available for use (WAFU) and total demand resulting in a resource surplus or deficit.
Deepest advisable Pumping Water Levels (DAPWL)	The deepest level to which water in a borehole should be allowed to decline to prevent undesirable effects were the level to decline further.
Demand Management	The implementation of policies or measures which serve to control or influence consumption of water.
Department of Environment, Food and Rural Affairs (DEFRA)	The government department responsible for water resources in England and Wales.
Deployable Output	The quantity of water that can be produced at a water treatment works on average and at maximum output as limited by abstraction licence, plant capacity or other constraints.
Economics of Balancing Supply and Demand (EBSD)	A method to assess the balance between a company's available water resource and the demand for water by customers.
Extreme drought	Drought events with approximately a one in 500-year return period. These events are described as having a 5 per cent chance of occurring over a 25-year planning period.
Level of Service	Frequency with which the water companies can impose different types of water restrictions during water shortages.
Mega litre	1 million litres of water, enough to supply near 7,000 customers.
Minimum Residual Flow	The minimum amount of water that must be allowed to flow past a specified point in a river in order to maintain downstream flows. A condition applied to an abstraction licence to protect the environment.
Outage Allowance	Describes an allowance of water which represents the risk of short-term (less than 3 months) supply-side failure. This may be caused for example by pollution incidents or an unexpected need to repair a water treatment works.
Per Capita consumption (PCC)	The amount of water typically used by one person per day.
Potential yield	The yield of a source or group of sources as constrained only by hydrologic or well/aquifer properties for specified conditions and demands.
Recharge	Natural or artificial replenishment of an aquifer.
Resilience	Ability of asset networks and systems to anticipate, absorb, adapt to and/or rapidly recover from a disruptive event.
25-year Strategic Direction Statement (SDS)	Water company strategic direction for the next 25 years. A framework that supports the sustainable delivery of the outcomes our customers value most.

Term	Description
Severe Drought	Refers to drought events with approximately a one in 200-year return period. We describe these events as having a 12 per cent chance of occurring over a 25-year planning period.
Source	A named input to a Water Resource Zone. A source may contain more than one abstraction point (boreholes or intakes).
Sourceworks	All assets between and including the point of abstraction and the point at which it is first fit for purpose.
Strategic Environmental Assessment (SEA)	Generic term used internationally to describe environmental assessment as applied to policies, plans and programmes. In this report, 'SEA' is used to refer to the type of environmental assessment required under the SEA Directive.
Sustainability Reductions	It is the reduction in water company deployable output due to a sustainability change (licence change). A sustainability reduction is calculated by the water company and included in its WRMP. Note that a sustainability change may not lead to a sustainability reduction if the source deployable output is limited by another constraint, such as hydrological yield or pump capacity.
Target headroom	A minimum allowance - taking into account critical risk and uncertainties- required to maintain LoS for the supply-demand situation with a given level of confidence.
Water available for use (WAFU)	Deployable output plus any bulk supply imports, take away any bulk supply exports and subtract any reductions made by outage allowance.
Water efficiency measures (WEMS)	A proactive policy promoting water saving in the home, which is closely associated with our enhanced metering programme. Water saving advice is provided with the option for customers to request retro-fit of water-saving devices.
Water Industry National Environment Programme (WINEP)	How the Environment Agency set out the environmental improvements that water companies are required to make over the following Asset Management Period.
Water Resource East (WRE)	A partnership from a wide range of industries, including water, energy, retail, the environment, land management and agriculture working together to safeguard a sustainable supply of water for the East of England.
Water Resource Zone	The WRZ is the principal building block used by companies to develop forecasts of supply and demand and produce a supply-demand balance (SDB). UKWIR/ Environment Agency defines the WRZ as: "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."
Water Resources Management Plan (WRMP)	A company's plan for supplying water to meet demand over a 25-year period.
WFD Directive 2000/60/EC	A piece of EU legislation that requires all member states (including the UK) to make certain steps to protect and improve the quality and quantity of water within water bodies such as lakes, rivers and groundwater.
Worst Historic drought	Refers to the worst historic drought on record, which we planned for in our 2015 WRMP. This was previously assumed to be drought events with approximately a one in 100-year return period.

Cover photo - Anglian Water's Rutland Water reservoir, a 1,555-hectare biological Site of Special Scientific Interest (SSSI), east of Oakham in Rutland. It was designated a SSSI in 1984.