
NORTHUMBRIAN WATER living water
DROUGHT PLAN 2019
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Exclusions on the Grounds of National Security

Northumbrian Water Limited (NW) has not excluded any information from this plan on the grounds that the information would be contrary to the interests of national security.

Under Section 37B(10)(b) of the Water Industry Act 1991, as amended by the Water Act 2003 ("the Act"), the Secretary of State can direct the company to exclude any information from the published plan on the grounds that it appears that its publication would be contrary to the interests of national security.

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What is Northumbrian Water's Drought Plan all about?

All water companies are required by law to produce a drought plan every 5 years. At its simplest, a drought plan details how a company will ensure that it can always provide sufficient water for its customer's basic needs, however bad a drought becomes. The document itself is rather complex as it has to reach a wide audience ranging from customers seeing how they may be affected, through to Government and regulators ensuring a balance has been reached between public water supply and environmental protection.

Defining exactly what is a drought and what is just a prolonged dry period is not possible. Knowing it was a drought is much easier to tell after the event. Additionally, not all droughts require a restriction on the use of water, although we would always ask our customers not to waste water regardless of the weather. Droughts that require us to take some form of action occur when a period of substantially below average rainfall coincides with a period of high demand for water. When these start to threaten our ability to keep meeting the demand for water, without reducing our stored supplies to very low levels, then we need to implement drought actions.

Every drought is different in the sense that rainfall may be very low at different times of year, for example, a dry winter or a dry spring. High demand for water in a hot summer may follow on from a dry winter or a wet winter. Depending how these different factors come together determines whether we need to adopt drought actions.

Our customers are in a rather unique situation for England when it comes to droughts. Our investment in Kielder reservoir, the largest man made reservoir in Europe, means that restrictions on customers use of water, even during the most severe droughts, is not necessary. However, we do require our customers to use water wisely at all times and especially during droughts. This is necessary to allow us to leave as much water possible in the natural environment, to reduce the energy used in cleaning and delivering the tap water and in treating the waste water. These actions are tied into the Level of Service we provide.

Our **Levels of Service (LoS)** are:-

Drought Action	Frequency
Appeal for restraint	1 in 20 years
Temporary Water Use Ban (Hosepipe Ban)	1 in 150 years
Restrictions on non-essential use	1 in 200 years
Rota Cuts	1 in 250 years

Where does our water come from?

The Company's area is divided into two Water Resource Zones (WRZ). The Kielder and Berwick WRZs accounts for 99% and 1% of water demand respectively.
Kielder WRZ is predominantly fed by a large number of impounding reservoirs that feed water treatment works directly or feed into rivers which then feed the water treatment works. It is also fed by a number of groundwater sources known as the Sunderland boreholes and by a number of isolated springs that supply small communities in rural West Northumberland.

Berwick WRZ is fed by boreholes with sufficient excess licensed capacity to satisfy any drought year demand for water.

How does Kielder Reservoir help supply water?

Kielder reservoir, when full and with no new water entering it, holds sufficient water to supply all of our customer demand for a full year. This is clearly a hypothetical situation as there will be natural inflows of water into the reservoir from the upstream catchment. However, it illustrates the colossal volume of water held in Kielder reservoir.

During normal to wet years we do not generally need any of its water. However, during dry years, Kielder reservoir water is released into the North Tyne and then transferred into the Tyne-Tees Tunnel. This water can then supplement the Rivers Tyne, Wear and Tees, all of which we abstract from to supply our treatment works.

Kielder reservoir water can also be used if required to replace water being released from the upstream reservoirs to maintain minimum river flows, or to feed the water treatment works. Even under the most severe droughts, and when making a drought supply available to Yorkshire Water, only 20% of the water in Kielder reservoir would be required.

What about the small spring supplies?

The very small spring supplies in rural Northumbria can run dry in a hot summer. They cannot be supported directly from any other water treatment works or by Kielder transfers and so we tanker water to their supply reservoirs from surface water treatment works. Even in a drought, we only have to supply a maximum of three tankers a week which is an insignificant volume of water from the surface treatment works. From a customer point of view, it just seems like business as usual.

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1 INTRODUCTION

1.1 Purpose of this Drought Plan

This document is our Northumbrian Water (NW) Drought Plan 2019 and has been prepared following the Environment Agency's "Water Company Drought Plan Guideline" (2016).

The Environment Agency (2008) defines drought as "...a period of low rainfall [which] creates a shortage of water for people, the environment, agriculture, or industry". Beran (1985) defines drought as, "A decrease of water availability in a particular period and over a particular area". These definitions reflect the very unique nature of every drought in terms of depth and duration but also spatial distribution.

The purpose of this plan is to demonstrate how, during a drought period, we will continue to supply sufficient quantities of water to meet demand without the necessity to impose customer water use restrictions. The Plan presents the actions and measures which will be required to reduce demand and, where necessary, supplement supply from alternative sources primarily The Kielder Supply Scheme. It also outlines how the effects of a drought and drought actions will be communicated to customers.

1.2 Regulatory Framework

The requirement for water companies to produce Drought Plans is formally set out in Section 39B of the Water Industry Act 1991, as defined by the Water Act, 2003. The drought planning process is effectively regulated by the Secretary of State and the Environment Agency.

In producing this Drought Plan, reference was made to the following guidance and legislation:

- Water Company Drought Plan Guideline 2016, Environment Agency
- The Drought Plan (England) Direction 2016
- Water Industry Act 1991
- Water Act 2003 where s.63 inserts new sections 39B & 39C into the Water Industry Act 1991 and s.62 inserts new sections 37B-D into Water Industry Act 1991
- Drought Plan Regulations 2005
- Flood and Water Management Act 2010 where s.36 amends the Water Industry Act 1991 by substituting a new s.76
- Water Use (Temporary Bans) Order 2010
- Environmental Assessment of Plans and Programmes Regulations 2004
- Conservation of Habitats and Species Regulations 2010
- Wildlife and Countryside Act 1981 as amended by the Countryside and Rights of Way Act 2000, Section 28G.

This document is supported by our NW Water Resources Management Plan. This shows how we will meet future demand over the next 40 years (2020 to 2060). By contrast, the Drought Plan considers what measures can be

implemented in the short term to address temporary shortages of water resources during drought conditions.

1.3 Draft Drought Plan Consultation

We pre-consulted with the Environment Agency, Natural England, Ofwat and our Customer Challenge Group known as the Northumbrian Water Water Forum. We also pre-consulted with our neighbouring water companies but the Drought Plan does not rely on receiving increased supplies from any of these companies.

Consultee	Consultation Details
Environment Agency	Letter sent to Environment Agency dated 10th February 2017 seeking views on what should be included in the draft drought plan. Meetings with the Environment Agency held on 1st November 2016 and 13th February 2017. Also updates given at quarterly Liaison meetings the last of which was on 8th March 2017.
Natural England	Letter sent to Bradley Tooze dated 10th February 2017 seeking views on what should be included in the draft drought plan.
Ofwat	Letter sent to Peter Hetherington dated 10th February 2017 seeking views on what should be included in the draft drought plan.
Water Forum	Paper circulated 9th February 2017.
Other Water Undertakers	Meetings with United Utilities and Yorkshire Water held.

We completed a consultation on the draft version of this Drought Plan. The consultation took place over an eight week period which ended on 20th October 2017. The draft Drought Plan was available for review on our website (https://www.nwl.co.uk/your-home/environment/drought-plan.aspx).

All Statutory consultees were consulted in accordance with the requirements of the Regulations.

The Statutory Consultees were:-

- The Secretary of State, Defra
- Ofwat
- Environment Agency
- Consumer Council for Water
- Natural England
- Local Authorities within company's supply area
- National Park Authority
- English Heritage
- Navigation Authorities

We then updated this Plan and prepared a Statement of Response. This presented all of the consultation comments and explained how each response was taken into account in this final plan.

2 NORTHUMBRIAN WATER INFORMATION

2.1 Background

In accordance with our NW Water Resource Management Plan (WRMP), the supply area comprises of two Water Resource Zones (WRZ) known as the Kielder WRZ and the Berwick & Fowberry WRZ. A WRZ is defined as the largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customer's experience the same risk of supply failure from a resource shortfall.

For the purpose of this Drought Plan, the Kielder WRZ, which is extensive and covers the majority of our supply area, has further been divided into six Operational Areas (OA) (see Figure 1 below). These OAs have been devised by considering the raw water network between various sources and the potable distribution network that allows water to be transferred between areas.

There are three main OAs within the Kielder WRZ, namely Tyne, Wear and Tees. They can all be supported by Kielder reservoir via the Kielder Transfer Scheme. In addition there are potable link mains between the Tyne and Wear OAs as well as between the Tees and Wear OAs. The other three OAs are small independent areas of supply that are reliant upon spring sources. This is one less than the last Drought Plan as we have since laid mains to the Slaggyford area which is now supplied by a water treatment works. In the event of a drought, these three areas would be indirectly supported from Kielder reservoir via tankering potable water from Whittle Dene Water Treatment Works (WTW).

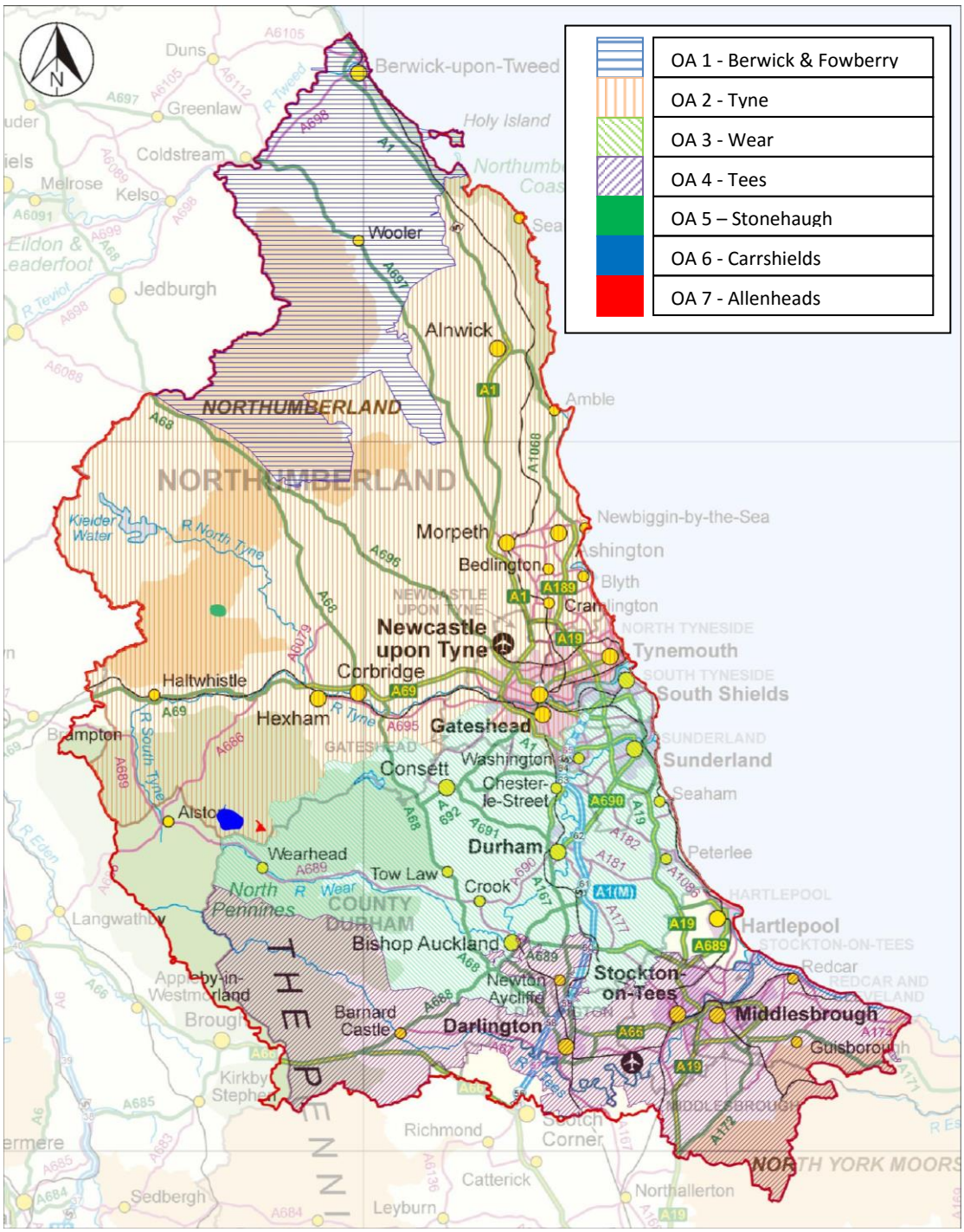


Figure 1 Operating Areas (OA)

2.2 The Kielder Supply Scheme

The Kielder Transfer scheme (see Figure 2 below) consists of:

- the Kielder Dam and associated headworks including release valves and hydropower plant;
- Bakethin Dam;
- a weir and pumping station at Riding Mill on the River Tyne;

- a rising main from Riding Mill to Letch House;
- Airy Holm pond;
- a tunnel from Letch House to Frosterley on the River Wear and Eggleston on the River Tees (called the Tyne -Tees tunnel);
- a connection from the tunnel into the River Derwent and an abstraction into Mosswood WTW; and
- a licensed abstraction from the Tyne Tees tunnel air shaft at Waskerley.

The Kielder Transfer Scheme comprises of all the assets including and beyond the pumping station at Riding Mill in the River Tyne.

The North Supply Zone utilises the Rivers North Tyne and Tyne taking water at Barrasford and Ovingham intakes, whilst the Central and South Zones use the Kielder Transfer Scheme.

Riding Mill pumping station contains four pump units, each with a nominal fixed capacity of 90 Ml/day. A combination of up to three units can be used to supply 270 Ml/day which is around 50% of total raw water requirements for the Central and Southern areas. The rising main from Riding Mill to Letch House is 6.2km in length and 2 metres in diameter and the pumping head is approximately 205 metres. The gravity tunnel from Letch House to Eggleston on the River Tees is 34km long and 2.91 metres in diameter. The rising main and tunnel are designed to remain charged.

A dam forms a head pond on the tunnel system to correct any imbalance between rates of pumping and outlet discharge. It has a capacity of 450 Ml and inflow to and draw-off from the tunnel is by means of a five metre diameter shaft connected to the reservoir floor.

A cross connection linking the tunnel with Mosswood WTW can provide a substitution for the Derwent Reservoir resource and thus support water resources in mid-Durham.

The principal objective in the design of the Kielder Scheme was to augment the water resources of the Tees basin to meet the then rapidly increasing demand for water, primarily for industrial use. Although the forecast industrial demands have not materialised, there are clearly advantages of a strategic regional back up. Whilst the volume of transfer through the tunnel to the Tees has been limited to small amounts, the availability of support has enabled the cheaper local sources to be used more effectively, and to be drawn down further, without the necessity to place restrictions on water use.

The principal regulating reservoir in the Tees catchment is Cow Green which provides the full required support for prescribed flows and abstractions under normal conditions. During drought and future higher abstractions, releases may be made from the Lune/Balder reservoirs or the Kielder transfer scheme as required. The outlet portal for the Tyne-Tees tunnel to the River Tees is located at Eggleston.

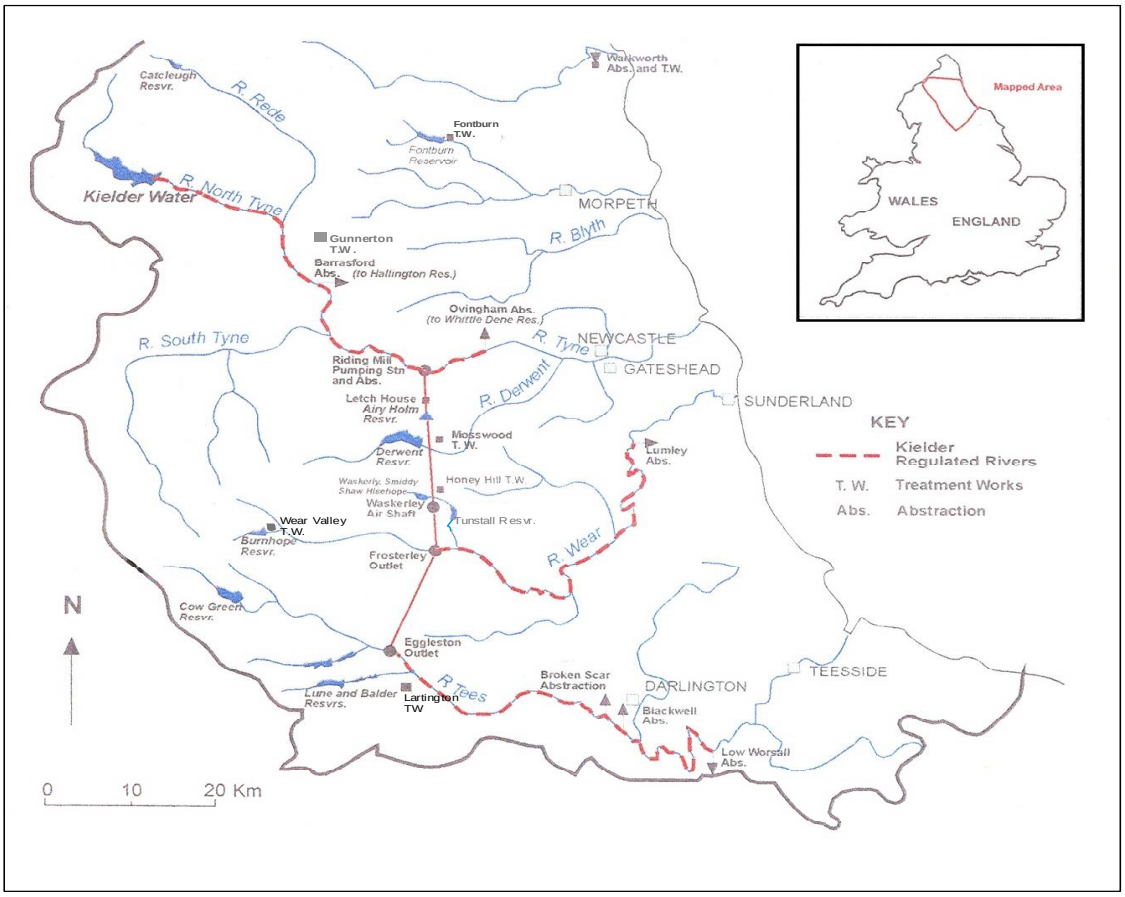


Figure 2 Kielder Transfer Scheme

2.3 North Tyne and Northumberland Resources

The northern part of this system is supplied from Warkworth WTW on the River Coquet, a reservoir and treatment works at Fontburn and from Tosson springs and treatment works. These are linked to the Tyne system with a potable water main and full flow from Warkworth can be replaced with potable water from the Tyne water treatment works.

For the remainder of the area, water is supplied from six works, three very small works supplying Otterburn, Redesdale and Byrness with a slightly larger works at Gunnerton which supplies the area west of Hexham. The majority of the water is treated at Horsley and Whittle Dene which jointly meet the majority of Tyneside and SE Northumberland demands. Raw water for this area is obtained by abstractions from the River North Tyne at Barrasford which is stored in a series of reservoirs and the River Tyne at Ovingham. These are also supplemented by raw water from other impounding reservoirs. There are also spring supplies at Carrshields and Allenheads.

2.4 Wear Area Resources

Wear Area Zone resources include an abstraction from the River Wear at Lumley WTW and two reservoirs, Derwent and Burnhope, which supply two water treatment works. Three smaller reservoirs, Smiddy Shaw, Hisehope and Waskerley supply Honey Hill Water Treatment Works. Additionally, there are a number of groundwater sources (boreholes abstractions mainly from the Magnesian limestone aquifer) which are situated to the east of the zone and two small spring sources to the west.

Transfers from the Tyne-Tees tunnel can be made directly to Mosswood WTW or into the River Derwent in substitution for the prescribed compensation flow from Derwent Reservoir, thus reserving water in Derwent for future use. Discharges from the Tyne Tees tunnel can be made into the River Wear to maintain the flow in the river guaranteeing water is available for abstraction at Lumley. Water can also be abstracted from the Tyne-Tees tunnel to support Honey Hill WTW.

Tunstall reservoir is also located within the zone but no longer supplies a treatment works and is used exclusively for compensation and regulatory releases into the River Wear.

2.5 Tees Area Resources

Water is pumped from the River Tees to supply Broken Scar WTW. Additional raw water abstractions are made from the River Tees to supply industrial Teesside.

Cow Green reservoir sits at the head of the River Tees and along with statutory compensation releases can be used for river regulation to support abstractions at Broken Scar and the industrial demand.

The Lune and Balder reservoirs consist of Selset, Selset Weir and Grassholme on the River Lune, and Balderhead, Blackton, Hury Subsidiary and Hury on the River Balder. This group of reservoirs supply Lartington WTW and can also be used for regulation releases in support of the River Tees.

2.6 Update on change from *i-Think* model to Aquator model

For our Water Resource Management Plan 2014 and the previous Drought Plan, we used a software package called i-Think to undertake water resource modelling. In the mid-1990s, in conjunction with the Environment Agency, three i-Think models were built to represent the three main areas of the Kielder Water Resource Zone (WRZ) i.e. the previously described Operating Areas (OA).

The main disadvantage with the i-Think software for water resource modelling was that due to data limitations, the Kielder WRZ zone could not be represented in a single model. This meant that DO analysis of the system as a

whole could not be carried out, instead each Water Treatment Works (WTW) DO was tested against its yield independently of each other.

In 2014, working with the Environment Agency, we began the process of moving over to Aquator to carry out its water resource modelling and DO analysis for the Kielder WRZ.

For this Drought Plan, the DO of the Kielder WRZ is calculated using Aquator. Aquator is a windows-based water resource modelling system that utilises Microsoft Access to store information and data, and Microsoft Visual Basic for Applications (VBA) programming to explicitly define the behaviour of the components which are used to represent the hydrological entities in a water resources system.

The key features included within the Aquator model are catchment time series flows, minimum maintained flow conditions for the rivers, daily and annual licence conditions, treatment works minimum and maximum capacities, transfer main capacities, raw water pumping capacities, reservoir control curves, compensation flows and VBA coding to define the behaviour of components under certain circumstances, such as a control curve being crossed.

In addition to moving from i-Think to Aquator to carry out all water resource modelling, the following updates have also been made since publishing the previous Drought Plan:

- In partnership with the Environment Agency, reservoir inflows have been remodelled using Catchmod, to derive inflows for the majority of the reservoirs from 1926 to 2014;
- River flow naturalisation was carried out using gauged river data and abstraction data where available. Where gauged data was not available the previously modelled river flow data (done by JBA is 1998) was adjusted to fit the parameters of the naturalised data.; and
- Given an integrated model for the Kielder WRZ is now available and updated flow data has been generated, a review and update of the current control curves has been carried out.

The English & Welsh Method Deployable Output (DO) module in Aquator has been used to determine the system's DO. DO is defined as:

"The output for specified conditions and demands of a commissioned source, group of sources or water resource systems as constrained by:

- *hydrological yield;*
- *licensed quantities;*
- *environment (represented through licence constraints);*
- *pumping plant and/or well/aquifer properties;*
- *raw water mains and/or aqueducts;*
- *transfer and/or output main;*

- *treatment;*
- *water quality; and*
- *levels of service."*

The DO module runs the model over the critical drought period, under a range of demands, to identify the maximum yield of the system, i.e. the maximum demand that can be continually met throughout the critical drought period.

The Aquator model calculated the DO of the Kielder WRZ to be 836 Ml/d.

2.7 Baseline Water Resources and Levels of Service

Levels of Service (LoS) are expressed in terms of expectations about the frequency of restrictions on use of water during dry years, and set out the standard of service that customers can expect to receive from their water company.

LoS are generally grouped into the following categories:

Level 1: Appeal for restraint
Level 2: Temporary Use Ban
Level 3: Drought Order Ban
Level 4: Reduced supply at customer tap

A level 1 restriction is when we ask our customers to use water wisely. For example, watering plants at night and not watering the lawn because grass is resilient to drought.

A level 2 restriction (Temporary Use Ban) applies mainly to the domestic use of water and stops the use of a hosepipe or sprinkler for any garden watering or cleaning. For household customers, this would be referred to as a hosepipe ban.

A level 3 restriction (Drought Order) bans what has been applicable to the domestic customer under the Temporary Use Ban, to non-domestic or commercial customers. These bans have economic consequences for businesses and have to be used as sparingly as possible.

A level 4 restriction results in a temporary reduction or nil supply of water at the customer tap. Examples of level 4 restrictions include:

- Reduced pressure at the customer tap (and therefore reduced flow);
- Rota cuts (e.g. 12 hours normal supply, 12 hours no supply); or
- Standpipes where supplies to customer's taps are turned off leaving customers to fill containers from an in pavement standpipe tap.

Our PR19 'planned' levels of service for our customers (both Kielder and Berwick and Fowberry WRZs) are as follows:

Level 1: Appeal for restraint	1 in 20 years (5% probability in any one year)
Level 2: Temporary Use Ban	1 in 150 years (0.66% probability in any one year)
Level 3: Restriction on non-essential use	1 in 200 years (0.5% probability in any one year)
Level 4: Rota cuts	1 in 250 years (0.4% probability in any one year)

We supply a volume of water to United Utilities from our Wear Valley WTW and this volume is included in the overall DO for that works under all scenarios. We are therefore certain that supplies can be maintained during a drought.

The LoS we have adopted can be maintained in the small areas of the zone that cannot be directly supported by Kielder. These are small populations that rely on springs and these supplies can be supplemented by the tankering of potable water into their service reservoirs from a Kielder supported surface water treatment works.

Although the Berwick & Fowberry WRZ cannot be supported by Kielder reservoir, we believe these customers should have the same LoS as all other customers. Currently this is achievable as the licensed volumes are sufficiently in excess of dry year demand.

Further details can be found in 4.1.1 below.

3 DROUGHT MANAGEMENT STRATEGY

3.1 Objectives

The overall objectives of the Company's Drought Management Strategy are:

- To present the Company's drought management plans and to identify potential drought measures that may be required in response to a range of drought conditions;
- To provide a comprehensive package of information and procedures that will enable the company to respond in a timely manner to drought conditions.
- To enable early discussion with regulators, customers and other stakeholders on the proposed response to a drought; and
- To ensure that our Company management will be provided with detailed, relevant and reliable information on which to make decisions.

3.2 Formation of Drought Management Group & Responsibilities

We have a number of procedures in place to cover various emergency events including drought. In the case of droughts, which typically begin to define themselves over a longer period of time than other 'emergencies', the process begins with the formation of a 'Drought Management Group' (DMG). The trigger for forming the group will be based on ambient supply and demand conditions, and will be particularly influenced by when resource monitoring starts to indicate a potential worsening of hydrological conditions, particularly in terms of key indicators such as reservoir storage and pumping groundwater levels. These indicators are discussed further in Chapter 5 of this document, and are reviewed on a regular basis by the Company's Water Resources Team.

The decision to form the DMG will ultimately be made by the Company's Head of Technical Strategy & Support and the Water Director.

The DMG is chaired by the Head of Technical Strategy and Support who will also ensure the appropriate external bodies are sufficiently consulted and informed.

The Group will meet as frequently as needed to evaluate the water resource situation and the balance between demand and supply. Drought actions should be identified and implemented before a major resource difficulty occurs. Such actions will be reviewed on a regular basis in response to daily reporting of the resource situation.

No single trigger is used to decide when the Appeal for Restraint, as defined in our LoS will be instigated. Droughts are complex mixtures of low rainfall depleting resources and hot, dry conditions increasing demand. The two types of event often do not occur simultaneously. In recent dry periods the droughts have been caused by very low autumn / winter rainfall not replenishing stored and ground water supplies, whilst the intervening summers have tended to be much cooler than usual and often much wetter. Therefore judging when an

Appeal for Restraint will have a significant impact on conserving water has to be a dynamic decision. In reality we often increase messages about the importance of “using water wisely” to encourage reduced consumption of water outside the more formal Appeal for Restraint.

In order to provide an indication of when the DMG may be formed a curve has been derived based on the possibility of stock levels dropping below the LOS 1 curve in extremely dry weather, and applied to the stock level graph. Examples of this for a number of drought scenarios are shown in Section 4.1.1 below.

The final decision for selecting and implementing a drought action lies with the Management Team and Board, but in the early stages this is delegated to the DMG. As a drought intensifies, the DMG will brief the Management Team and Board with increasing frequency. When a trigger level is reached, the Management Team and Board will already be fully briefed and aware of its implications. They will therefore be able to grant immediate approval.

The DMG will be formed from individuals both representing ‘affected departments’ and/or able to provide the necessary expertise in relation to various areas of drought management. The roles with key areas of responsibility and/or expertise that form the Drought Management Group are indicated below.

Northumbrian Water Drought Management Group

Area of Responsibility	Job Title	Department
Overall Management	Water Director	Management Team
Water Resources Strategy	Head of Technical Strategy & Support	Technical Strategy & Support
Water Production	Water Supply Manager	Water Supply
Raw Water Resources	Water Resources Manager	Technical Strategy & Support
Environment Agency Liaison	Water Resources Specialist	Technical Strategy & Support
Communication	Corporate Affairs Manger	Corporate Affairs
Customer Contact	Customer Contact Manager	Customer Services
Water Efficiency	Water Efficiency Manager	Technical Strategy & Support
Distribution & Leakage	Head of Customer & Network Services	Customer & Network Services
Metering	Metering Manager	Metering
Water Resources System Modelling & Hydrology	Senior Technical Advisor (Resources & Reservoirs)	Technical Strategy & Support
Water quality issues	Water Quality Manager	Water Quality
Engineering Schemes	Asset Delivery Manager	Asset Delivery

Area of Responsibility	Job Title	Department
Emergency Planning	Business Continuity Manager	Business Continuity
Maintenance and Planning	Maintenance Manager	Maintenance Operations

A chairman of the Group and a secretary will be appointed. The secretary will take minutes of the Group meetings which will be widely circulated within the Company.

The Group will meet regularly to consider the water resource situation and the balance between supply and demand. Appropriate drought measures (e.g. publicity campaign) will potentially be considered early on in the development of a drought, in order that the impacts of a deepening drought may be limited later on.

During the course of a drought, a range of drought measures will be reviewed on a regular basis in response to daily reporting of the resource situation. Extensive liaison with the Environment Agency will be required when deciding on any particular course of action that may impact the environment. Communication with the Environment Agency is covered under Chapter 10 of this document (Communications Plan).

3.3 External Partners

In normal circumstances contact with the Environment Agency is regular and often with various information being passed on a daily, weekly and monthly basis. The frequency of this communication, both written and verbal will increase during drought conditions.

Recent experience of the drought in the south of England in 2012 has shown the importance of water companies, their regulators and Defra working in a collaborative, fully informed manner. We have, through our Essex & Suffolk Water subsidiary, gained a good insight into the importance of collaborative working during droughts. Our intention would be to work closely with Defra, the Environment Agency and, if formed, a National Drought Management Group, as well as the other water companies either in drought or in close proximity to us.

One of the most important lessons learnt from the 2012 drought was that discussion amongst all of the “partners” prior to any release of information to the public is essential. Coordination of the timing and content of messages to customers helps considerably in removing confusion about what is happening, and what we want our customers to do.

At the beginning of drought situations we would be encouraging and facilitating the formation of these relevant collaborative communications amongst the affected parties.

3.4 Drought Management Process

During meetings of the Drought Management Group, decisions on the potential implementation of drought measures will be made by reference to the process summarised in the diagram below. Figure 3 below also references specific sections of the Drought Plan.

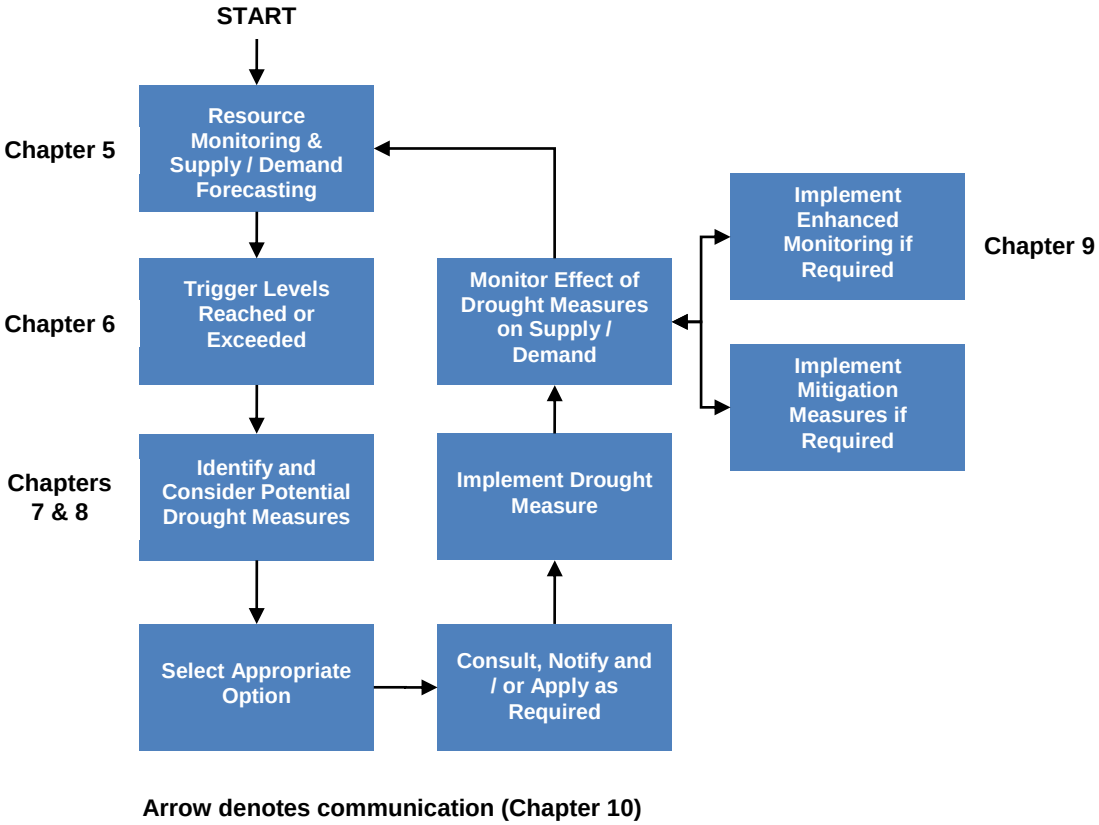


Figure 3. Drought Management Process

The key elements of the above process are represented in the various chapters in this plan.

In addition to the above steps, a post drought review mechanism is included as detailed in Chapter 11. The post drought review will provide an opportunity to identify lessons learnt and also consider potential improvements both to the Drought Plan and wider drought management strategy.

3.5 Decisions & Consultation in a Drought

The final decision for selecting and implementing a drought action lies with the Management Team and Board. As a drought intensifies, the Drought Management Group will brief the Management Team and Board with increased frequency. When a trigger level is reached, the Management Team and Board will already be fully briefed and aware of its implications. They will therefore be able to grant immediate approval.

Once an action has been selected, consultation with the Environment Agency and other consultees including the Consumer Council for Water and Natural England will be initiated as appropriate.

4 DROUGHT SCENARIOS AND DROUGHT PLAN TESTING.

4.1 Kielder WRZ

4.1.1 Kielder WRZ Supply

To test the resilience of the Kielder WRZ against droughts not represented within the Aquator model, in addition to the baseline deployable output assessment, the Scottish Method DO module in Aquator was utilised. This module, unlike the English and Welsh Method, permits multiple failures to occur during the analysis period. This allows a return period to be calculated based on the number of failures and total length of the inflow data used in the model.

Once the model has been run multiple times, each time with an incrementally increased demand, two column series are produced comprising of an increasing number of failure years paired with increasing overall demand. The return period of each of the demands can then be calculated assuming a General Extreme Value (GEV) distribution as set out in Low Flow Studies Report, Institute of Hydrology, January 1980, Report Number 1.

The results of this analysis for the Kielder WRZ are shown in the Table 1 below.

Demand, Ml/d	Number of Failure Years	Return Period, Years
837	1	154
839	2	55
841	3	34
843	4	24
845	6	15
847	7	13
849	9	10
851	11	8
854	17	5
855	18	5
856	19	5
857	25	4

Table 1 Kielder WRZ Return Period

Interpolation of the GEV plot, Figure 4, shown below, enables the failure demand at any intermediate return period to be estimated. Specifically the DO that could be achieved during a drought with at least an approximate 0.5% chance of annual occurrence (i.e. approximately a 1 in 200 year drought

event) is 835Ml/d with no restriction on customer use. Therefore the Kielder WRZ is sufficiently resilient to withstand a 1:200 year drought event without any changes to our stated levels of service.

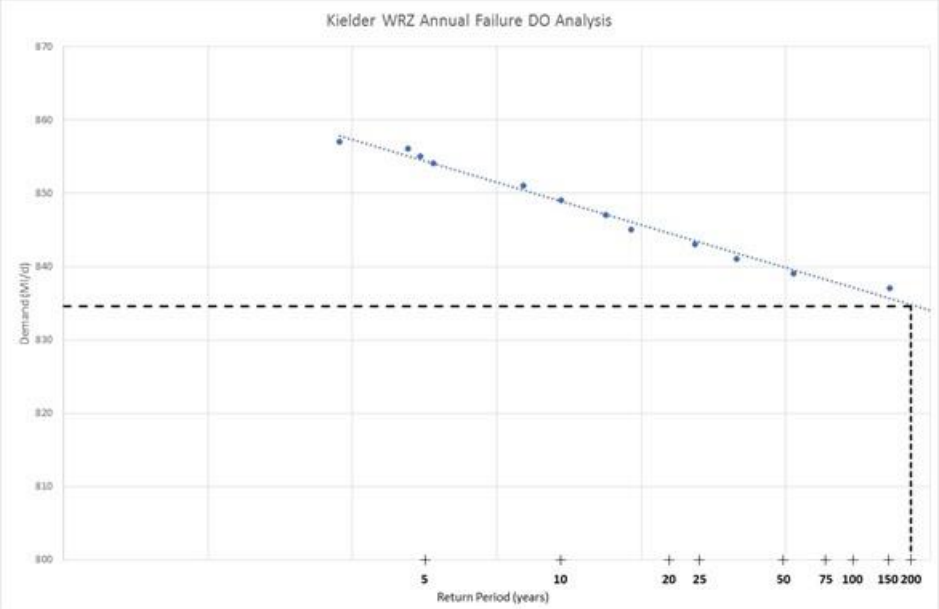


Figure 4 GEV Plot

Given the level of Kielder remains above 78% during the design drought year with a demand in the model of 836Ml/d (17% above any dry year forecast demand plus target headroom in the planning period), we feel that the likelihood of imposing any level 2, 3 or 4 restriction on our customers is negligible unless an extreme drought coincides with a prolonged period of extraordinarily high demand. Therefore, low return periods for levels 2, 3 and 4 restrictions are appropriate.

Sensitivity testing of the Kielder WRZ DO, shows that a DO of 837Ml/d has a return period of 1 in 154 years. It is therefore reasonable to set our level 2 restriction at 1 in 150 years (0.66% probability in any one year), as should we ever experience an annual average demand of 837Ml/d during a dry year it is feasible that level 2 restriction would need to come into force to reduce demand below the 836Ml/d DO of the Kielder WRZ.

Similarly, the sensitivity testing shows that the DO of 835Ml/d has a return period of 1 in 200, therefore it is rational to need restrictions beyond level 2, i.e. level 3 restrictions, once every 1 in 200 years (0.5% probability in any one year).

We do not consider the use of standpipes or rota cuts to be viable options as they are unacceptable in modern society. Our customers in the North East are justifiably proud of Kielder reservoir and are fully aware of its importance to their water supplies. Neither they, nor many other important stakeholders in

the region, would accept any form of temporary reduction to supply without very good reason.

To demonstrate these levels of service are appropriate the Kielder WRZ Aquator model was run in full with the peak annual demand in the planning horizon and the resulting storage for Burnhope, Waskerley, Smiddy Shaw and Hisehope reservoirs combined. This group of reservoirs was chosen as a suitable representation of when the WRZ would be stressed as these reservoirs are in the area that is least capable of being supported by Kielder. The minimum combined stock for each month was then extracted and ranked from low to high. This enabled a distribution to be fitted to the data and the 1 in 20 year (5%) return period to be calculated. This gives a curve for when level 1 restrictions would be enabled.

The level 1 curve was then incorporated into the model and assigned a demand reduction of 7% based on previous experience.

The Kielder WZR Aquator model was then run again with peak annual demand in the planning horizon and the level 1 restriction curve in place. The resulting minimum monthly group storage for Burnhope, Waskerley, Smiddy Shaw and Hisehope reservoirs was again ranked. Extreme Value Analysis of the monthly ranked annual minimum storage levels was then carried out to obtain a fitted distribution that could be extrapolated to estimate storage levels for a range of return periods. This allowed the curves for Level 1 and 2 restrictions to be developed.

We have undertaken an Aquator modelling assessment to determine the frequency of temporary use bans in the Kielder WRZ. Reservoir storage volumes for the Burnhope, Waskerley, Smiddy Shaw and Hisehope group were modelled using the maximum dry year demand forecast for the planning period, 665Ml/d. The number of occasions that reservoir storage was below the reservoir curves was calculated and used to determine the actual level of service customers could expect. The Level 1 curve is crossed 7 times during the 86-year period of analysis giving a return period of 8%. The Level 2, 3 are never crossed.

Figures 5 and 6 below show how our drought actions would have been triggered in two previous modelled drought years, namely 1959 and 1989. It can be seen that in both instances we did not pass through the curve for Level 2 actions but would have set up the Drought Management Group and issued an Appeal for Restraint.

Figure 7 shows a theoretical drought as an indication of when potentially we may have to trigger Level 2 actions.

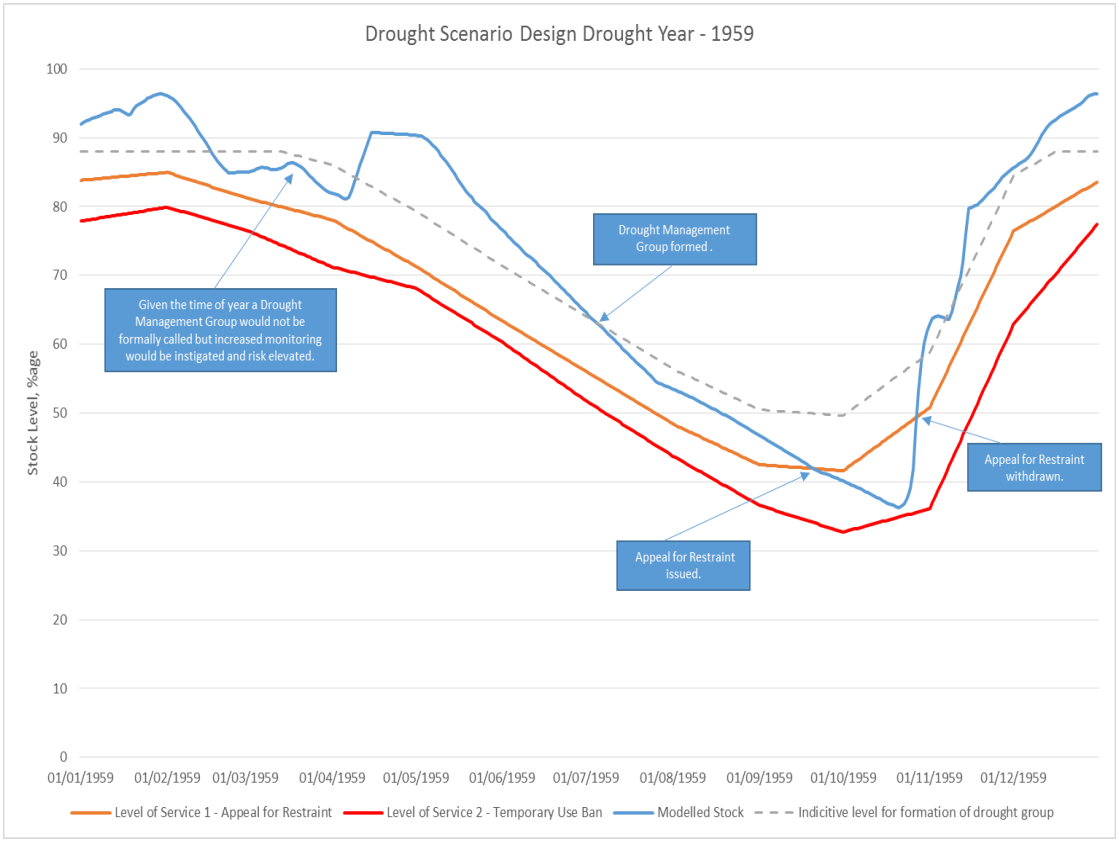


Figure 5 Design Drought Year 1959

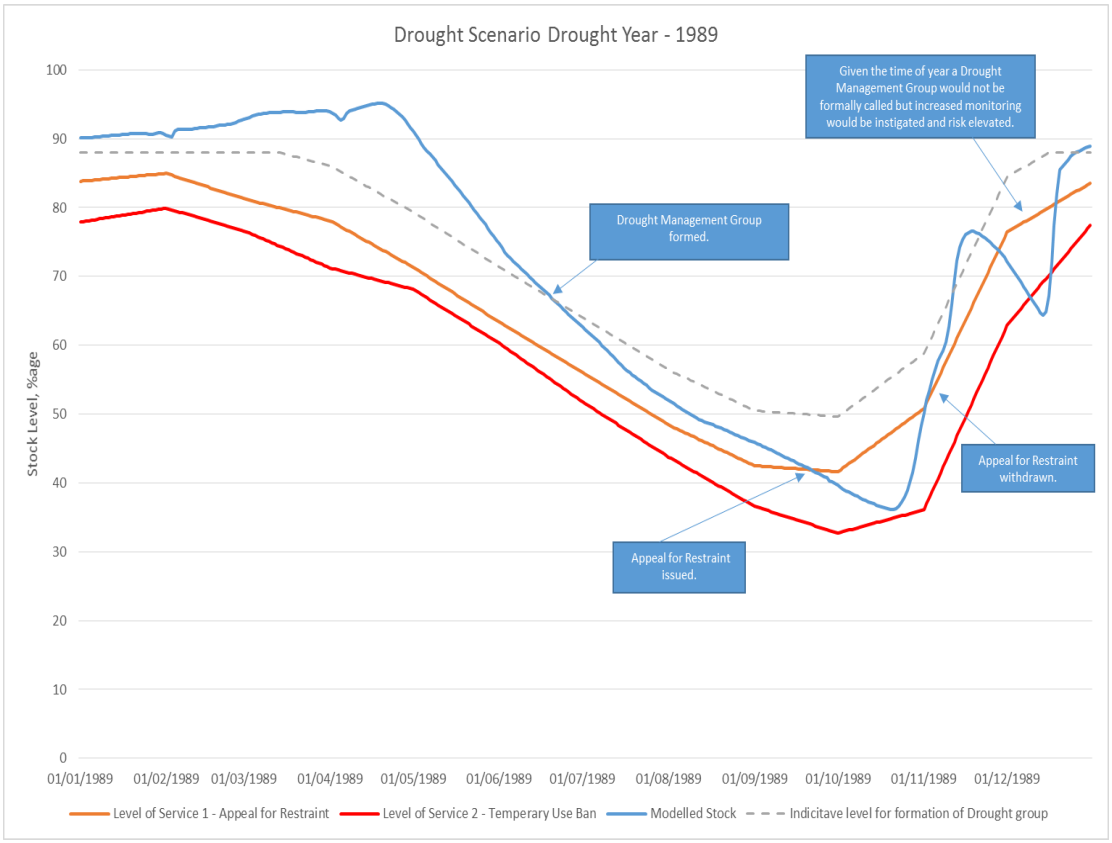


Figure 6 Drought Year 1989

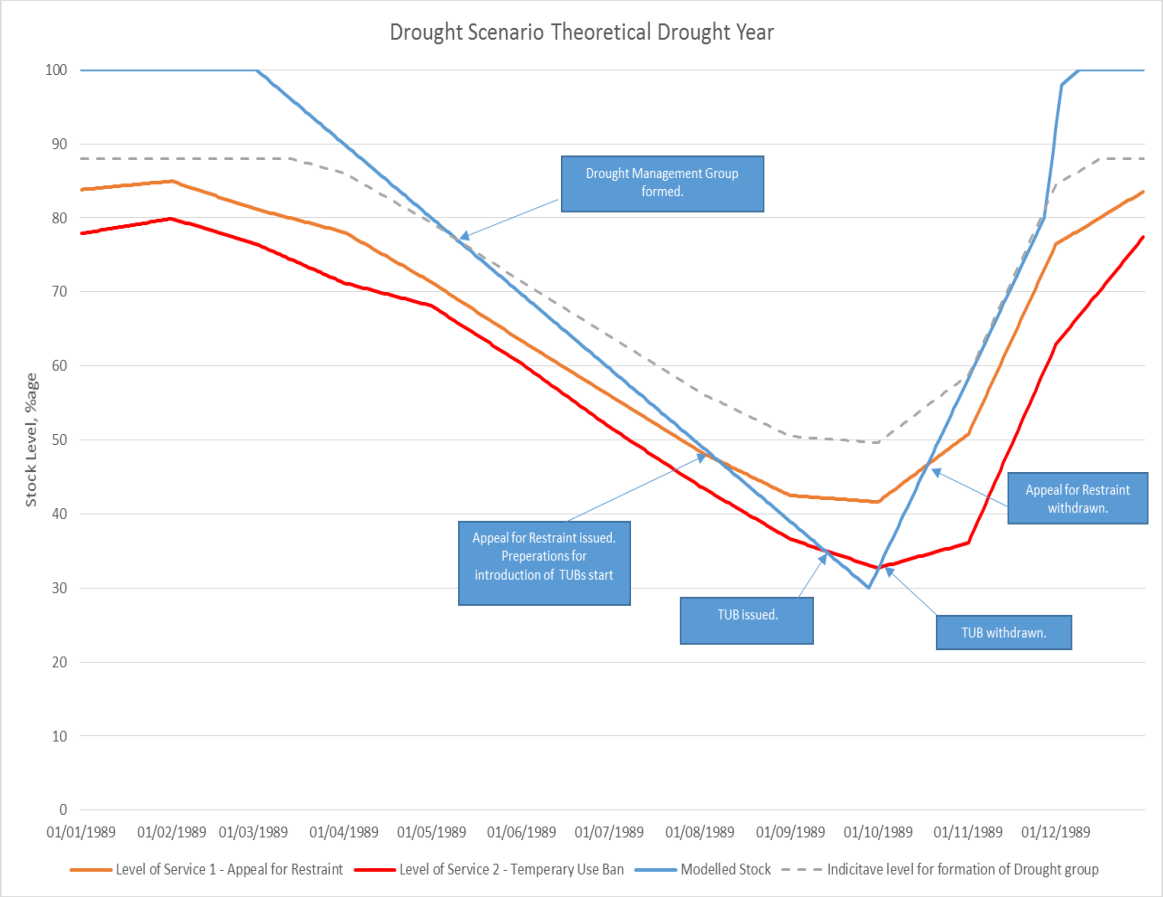


Figure 7 Theoretical Drought Year

4.1.2 Kielder WRZ Demand

Overall demand has fallen within our operating area. Figure 8 below shows the decline in annual Distribution Input (DI) which shows how much water we are putting into the supply network and Figure 9 below shows similar declines in 3 year average demand.

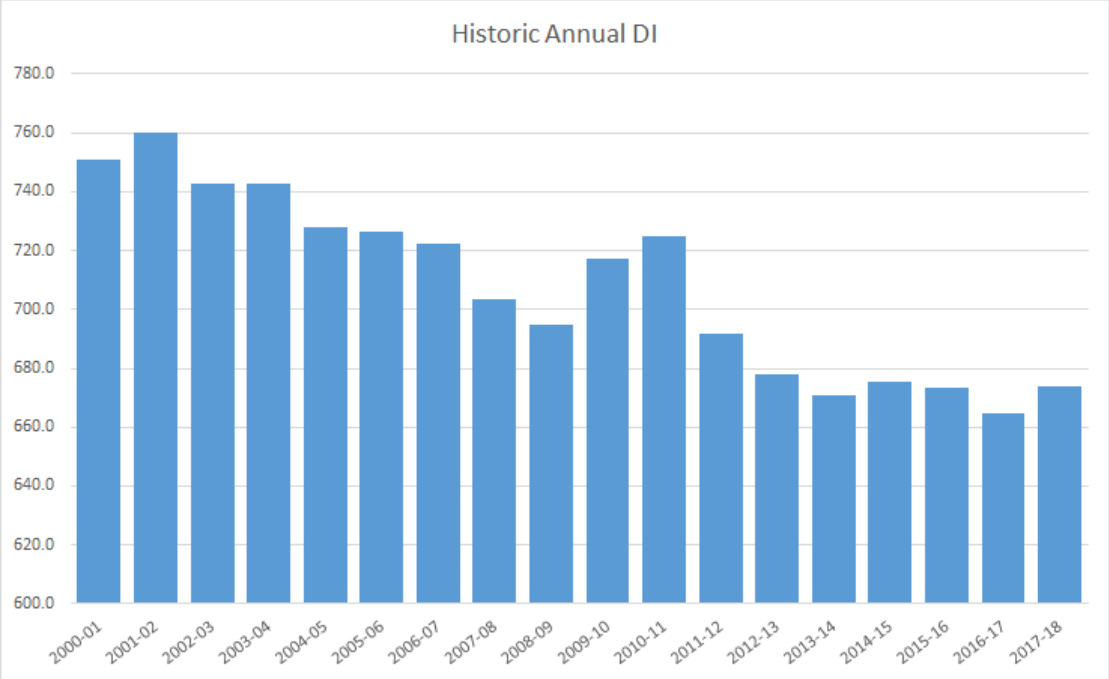


Figure 8. Decline in Annual Daily demand

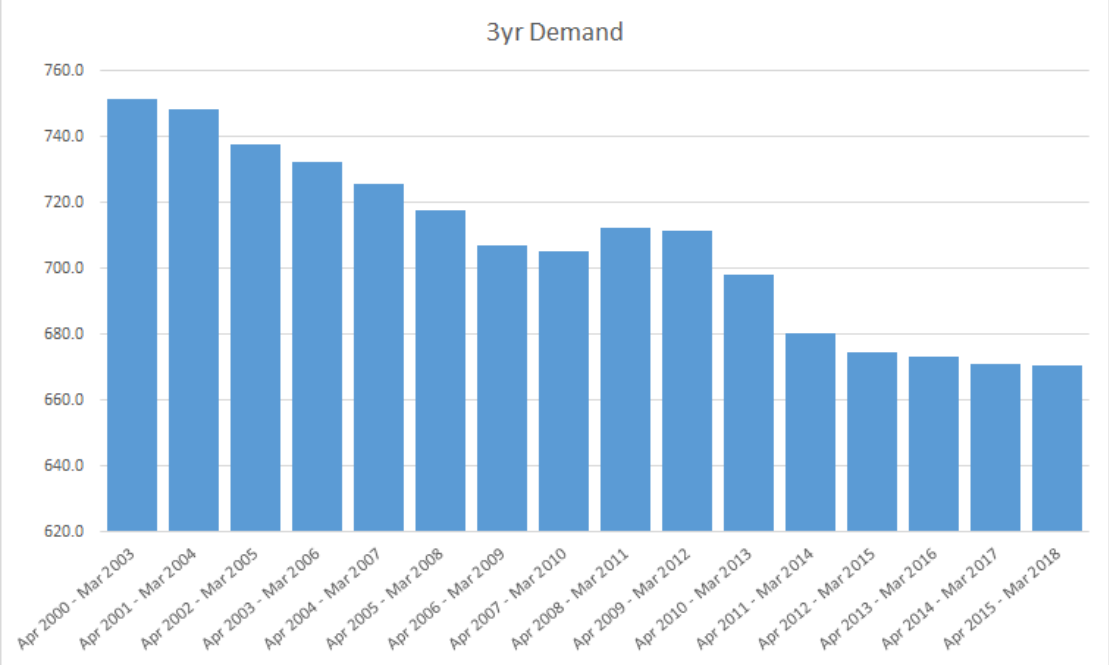


Figure 9. Decline in 3 Yearly demand

In considering potential demand during a drought, we have chosen to use 1995/96, the worst drought year for which data is available. As shown in the Figures 8 and 9, demand has been gradually falling and therefore we believe that using the demand for 1995/96 provides resilience as it is unlikely that those drought demands would be reached again.

Table 2 below shows the 1995/6 demand against our most recent figures for each of the Operating Areas.

Operating Area	2015/16 Demand (Ml/d)	1995/96 Demand (Ml/d)
OA1- Berwick and Fowberry	7.0	9.0
OA2 - Tyne	250	268.9
OA3 - Wear	229	266.2
OA4 - Tees	183	262
OA5 - Stonehaugh	0.014	0.022
OA6 -Carrshields	0.001	0.006
OA7 - Allenheads	0.022	0.03

Table 2. Comparison of current demand against 1995/6 drought demand

From Table 2 it can be seen that the 1995/96 demand for the OAs in the Kielder WRZ (i.e. OA2-7), is 797 Ml/d, which is significantly greater than current demand of 662 Ml/d. As explained above we believe, given the falling trend in demand as shown in Figure 5, it is extremely unlikely that even in a drought year we would experience demand at the level of 1995/96 again. However, we are using this figure as a worst case to provide a robust test of the resilience of the system.

4.1.3 Kielder WRZ Supply Demand Balance

The output of the Aquator model gives a DO for the Kielder WRZ of 836 Ml/d (see section 2.6). Set against the demand of 797 Ml/d it can be seen that there is a surplus of 39 Ml/d.

The Water available for Use (WAFU) for the Kielder WRZ is based on updated reservoir control curves which have been agreed with the Environment Agency, and the existing pumping station infrastructure. It should be noted that with different control curves to call on support from the Kielder Transfer Scheme and the potential to add additional pumping capacity, given the remaining storage at the end of the design drought, the Kielder WAFU and therefore supply surplus could be significantly higher than that which we currently report.

4.1.4 Isolated Operational Areas within the Kielder WRZ

As described in section 2.1 there are three small discrete Operational Areas (OA) which in the event of a failure of supply due to drought would be supported by tankering from Whittle Dene WTW. Below is an indication of the quantities of water required in this event.

Stonehaugh is a small hamlet on the south east boundary of Wark forest to the north west of Hexham. Water is abstracted from a borehole and after treatment is pumped to a service reservoir from which it gravitates into supply. The system is isolated and there is no potential to import water. In the event of a failure in order to meet demand a tanker would be required once per day.

Carrshield is a small hamlet located in south west Hexhamshire and is supplied from springs. The system consists of the spring, a treatment plant and a small reservoir which supplies the distribution system by gravity. The yield from the spring has become more unreliable recently and tankering operations have been carried out during summer months typically requiring 1 tanker a week, which could potentially rise to one tanker every five days to meet the anticipated drought demand.

Allenheads is a spring supply in South West Hexhamshire which feeds a small rural area around the village of Allenheads. With an estimated drought demand of 30m^3/d it is expected that a tanker would be required approximately every day.

4.2 Berwick and Fowberry WRZ

The Berwick & Fowberry system represents the most northern area of our supply operations, supplying the principal towns of Berwick and Wooler. In all aspects of supply (resource / treatment / networks), the area can be considered as being physically isolated from all other systems. The Berwick area is supplied from the Berwick, Fowberry and Fowberry Mains boreholes. There is a transfer between the network supplied by the Berwick Boreholes and the Fowberry boreholes although this is hydraulically limited to approximately 0.25Mld.

Berwick's drinking water comes entirely from groundwater, water that is stored underground in fractures and pore spaces within the Fell Sandstone aquifer. The Fell Sandstone is made up of grains of sand that are cemented together. Because of the way the sand grains pack together, there are small spaces, or pore spaces, between the grains. The pore spaces in the Fell Sandstone of the Berwick area make up about 25% of the volume of the rock. So 25% of the volume of the rock may be water – this makes up a huge reservoir of water underground.

In the Berwick area, the main Fell Sandstone aquifer from which we abstract most of our groundwater is around 70m thick, 10 km wide and around 10km long – a gross simplification but one that indicates the scale of groundwater resources in the area. Based on these numbers there is an underground reservoir holding around 1.75 thousand million cubic metres of water.

All of the sources in this OA are from the ground waters and come from boreholes drilled into the Fell Sandstone. The sandstone is tilted and layered with impermeable clays separating the sandstone strata's. This aquifer system has previously been little understood. However, we have completed an investigation into the sustainability of our fell sandstone abstractions as part of our AMP6 National Environment Programme (NEP). Phase 1 investigations indicate that all except one groundwater abstraction (Borehole 6) are sustainable. Consequently, we have completed an options appraisal to see how all of the sources could be made sustainable. Our preferred solution is to redistribute some of the abstraction from Borehole 6 to another source and / or also consider replacing the Borehole 6 with a new borehole to be drilled

away from the current boreholes. This will spread the abstraction which in turn will reduce the overall draw down in groundwater levels caused by our abstraction. If permitted by the EA, the replacement borehole would be constructed in the first half of AMP7. The investigations also concluded that our abstraction from the Fell sandstone does not effect base flow to the River Till.

Further investigations (Phase 2) will be undertaken in 2019/20 including the development of a Fell Sandstone groundwater model. Until these further sustainability investigations have been completed, we have agreed a voluntary cap on the annual licensed quantity of one of the Berwick WRZ abstraction licences. The cap on abstraction of 9.5 Ml/d does not alter the Deployable Output (DO) from the boreholes as the licenced volumes were not the constraining factor on the DO for the area, rather they are constrained to 9.5 Ml/d due to treatment. Even with the voluntary reduction being applied to the annual licensed quantity, we forecast a supply surplus in the Berwick WRZ of 2.29Ml/d in 2019/20 and 2.54Ml/d in 2024/25. The increase in the supply surplus reflects a reduction in distribution input due to the Company's proposed target to reduce leakage in the Berwick WRZ by 15% by 2024/25. Given the forecast supply surplus, we do not consider that the voluntary licence reductions pose a significant risk to drought resilience.

4.2.1 Berwick and Fowberry Drought Resilience

We have previously had no adequate mechanism in place to test and evaluate the resilience of our Berwick and Fowberry Water Resource Zone (WRZ) boreholes drought. As part of our AMP6 National Environment Programme, we undertook a study into the sustainability of our groundwater abstractions in the Berwick and Fowberry WRZ. As a result of this study, we commissioned the British Geological Survey (BGS) to develop a groundwater model of the Fell Sandstone aquifer in the Berwick area, together with a groundwater infiltration model. This work was completed in March 2019.

It will now be possible for us to prepare a series of drought scenarios (including droughts of longer duration and severity than those experienced in the historic record), and to model the impact of these scenarios on groundwater resource availability (including sustainability, abstraction rates, groundwater levels and water quality constraints). We commit to preparing a series of drought scenarios, in consultation with the EA Groundwater Team (Newcastle) and to model the impact of these on groundwater resources by December 2019. The evidence and outputs of the Berwick modelling will be shared with the EA. We commit to reassessing what drought options are required and when to manage a range of droughts in this resource zone when this modelling work has been completed. The results of this reassessment will subsequently be reported in the next version of the Drought Plan.

A Borehole Performance Graph for Murton borehole show that it is drought resilient. Drought action trigger levels for the Berwick Water Resource Zone have been applied to the Murton Borehole Performance Graph which will be

reviewed following the completion of the drought scenario modelling described above.

For the Murton borehole (see Figure 10 below), groundwater levels at an abstraction rate of 2 Ml/day are 20m above the pump intake level of -46mOD.

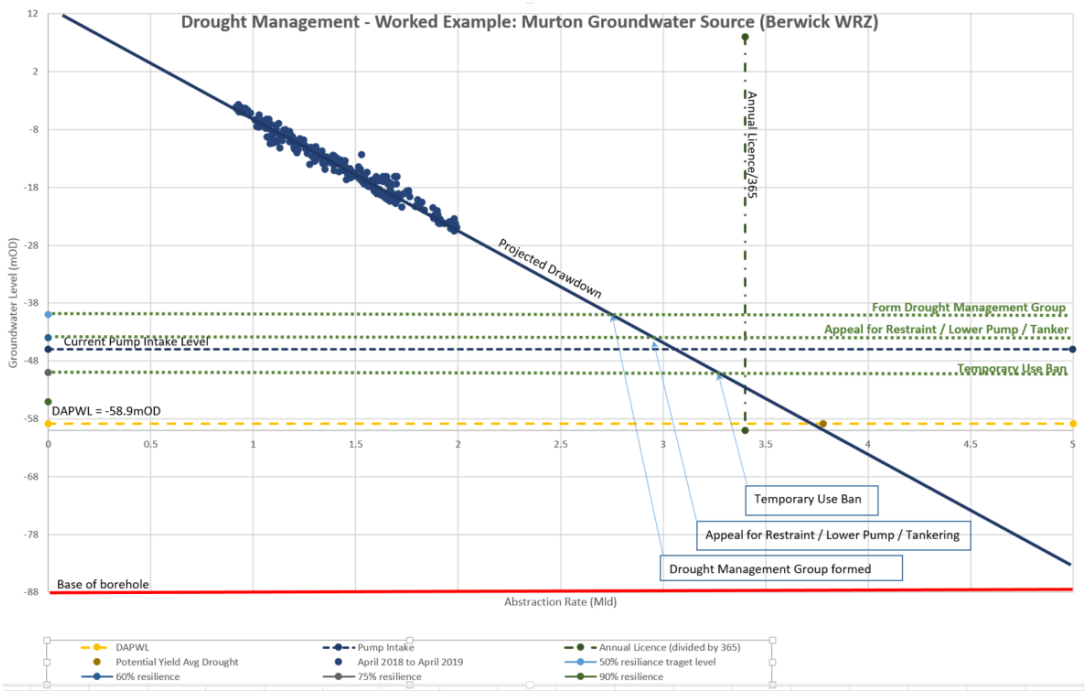


Figure 10: Deployable Output (DO) curve for the Murton borehole.

Drought action trigger levels for the Murton borehole have been established as follows:

Drought Action	Trigger (Pumped Water Level mAOD))	Rationale
Form Drought Management Group	-40	~50% of resilience headroom
Appeal for restraint and lower pump intake	-44	~60% of resilience headroom
Commence tankering (if required)	-50	~75% of resilience headroom
Temporary Use Ban	-55	~90% of resilience headroom

5 RESOURCE MONITORING & DROUGHT INDICATORS

5.1 Background

An important requirement of the Drought Plan is to regularly monitor the status of water resources in terms of key indicators such as rainfall, reservoir levels and groundwater levels. We routinely undertake such monitoring to enable the water resources situation leading up to, during and following a drought to be established. Once parameter trigger levels are approached (as detailed in section 6), consideration will actively be given to implementing appropriate drought measures (sections 7 and 8), once the triggers are breached.

Section 5.2 details the classification of drought indicators and the type and length of record of monitoring data collected.

5.2 Drought Indicators & Monitoring

There is no single method of assessing and describing drought severity which will be suitable for all circumstances and users. Although one of the definitions of a drought is a period greater than 15 days without rain, this has little meaning in a water resources context and a more useful definition would be “a decrease of water availability in a particular period and over a particular area”.

Drought indicators can be classified as two types:

- Hydrological and meteorological indicators that measure the direct effect on the hydrological cycle. These include rainfall, temperature, evapo-transpiration, weather patterns, effective rainfall, soil moisture deficit, groundwater recharge, groundwater level, river flow, reservoir inflows and reservoir storage.

- Demand, consumption, and socio-economic indicators measure severity in terms of the impact of the drought on the use of water in its broadest sense. For example, impact on water supply for domestic, commercial or agricultural use, impact on fisheries or recreation.

5.3 Rainfall

Rainfall is the primary indicator of drought severity. It has a direct effect on many hydrological parameters (river flows, soil moisture deficit and groundwater recharge) and thus can directly impact on the quantities of water available for abstraction. Rainfall can therefore be used to establish the effect of drought on Northumbrian Water’s water sources.

Rainfall is measured at rain gauges throughout the north east, and is independently recorded by Northumbrian Water at the following sites:

Northumbrian Water Weather Stations with Rain Gauges

Site	Period Data Covers
Kielder Reservoir	1969 to date
Catcleugh Reservoir	1969 to date
Fontburn Reservoir	1980 to date
Colt Crag Reservoir	1949 to date
Hallington Reservoir	1927 to date
Derwent Reservoir	1967 to date
Waskerley Reservoir	1900 to date
Burnhope Reservoir	1923 to date
Cow Green Reservoir	1969 to date
Balderhead Reservoir	1969 to date

This data is held by Northumbrian Water's Water Resources team. Under normal (non-drought) conditions rainfall data is analysed by the Water Resource team at the end of each month. In a drought, daily rainfall figures can be obtained directly as required.

Monthly rainfall data is also provided by the Environment Agency within a wider 'Hydrometric Bulletin'.

Additional local rainfall data may be available on request from the Environment Agency's database for most of our catchments.

5.4 Soil Moisture Deficit

Soil Moisture Deficit (SMD) is the amount of water required to raise a soil to field capacity. As a soil approaches field capacity, infiltration and ultimately aquifer recharge can potentially occur. The largest SMDs are found in the summer when rainfall is low and ambient air temperatures and evapo-transpiration rates are high. Aquifer recharge usually starts around late September/October when SMDs reach a critical threshold.

Similarly to rainfall, monthly SMD figures are quoted in the Environment Agency's monthly bulletins and summaries on an area basis.

5.5 Groundwater Levels

The monitoring of groundwater levels is of some importance in the our Berwick & Fowberry supply area, as well as the groundwater stations supplying Sunderland. We monitor groundwater levels in the boreholes either by Telemetry or data logger.

Although extremely unlikely at our borehole sites, groundwater level data can also potentially be used to optimise and adjust the position of borehole pump intakes as appropriate.

5.6 River Flows

The Environment Agency provides monthly river flow data on request. In addition on a daily basis we receive 15 minute flow data from all regulated rivers to ensure compliance with the requirement to maintain flows in those rivers.

Longer records for key gauging stations are already held in electronic format and are used for water resources system modelling and statistical analysis.

5.7 Reservoir Levels

Reservoir levels in all our impounding reservoirs are either available by telemetry or are recorded three times a week during operator checks of the dam structures. During a drought, reservoir levels are a critical element of monitoring the overall resource situation and therefore the frequency of these manual readings would be increased to daily. The reservoir levels would be monitored and compared to the control rule curves set out in the Kielder Operating Agreement and actions to alter abstractions would be made in accordance to those stipulations. Reservoir storage levels are widely circulated both internally and to external organisations such as the Environment Agency.

Reservoir levels are graphically presented to compare current levels with historic minimum, mean and maximum levels. Typical reservoir control curves are shown in Appendix 1.

5.8 Weather Forecasts

We have access to Met Office weather forecasts. In the event of the on-set of drought conditions weather forecasts are scrutinised more regularly, with a range of short and long range forecasts being reviewed to inform planning decisions.

5.9 Operational Reporting

Daily water availability and supply figures for all Operating Areas are provided in daily supply reports for internal purposes. These reports also consider daily demand and weather predictions.

Daily abstraction, transfer (raw water), reservoir levels and treated water volumes are regularly updated and used to optimise the use of the raw water system in accordance with the various reservoir rule curves. We use an internally developed model called Aquanow on a weekly basis to undertake this optimisation process. In the event of a drought, this model would be run more frequently.

5.10 Reporting & Analysis of Drought Conditions

Each drought in the UK has a unique spatial and temporal signature. Droughts are also unique in their depth, duration and severity, as well as their individual hydrological and consequential characteristics. It is important therefore to ensure that reporting and analysis of a drought situation takes account of the wide range of factors that potentially define it.

Historical data can be used to demonstrate:

- an exceptional shortage of rainfall
- that shortage of rain is affecting key sources, either for surface water or groundwater abstraction
- how our situation compares with neighbours and at a national level.

Our Water Resources team maintains data on the indicators described in Section 5.2. This data combined with that from other sources (e.g. Environment Agency hydrometric bulletins) can be used to achieve rapid analysis of water resources data during a drought. Weekly 'Water Resources Situation' (WRS) reports will be used to update the DMG on ambient drought conditions. WRS reports will comprise of the following elements:

- Comparison of recent rainfall data with long term mean and minima for different sites representative of either supply or catchment area (point and area rainfall);
- Comparison of rainfall trends, groundwater levels and river flows to assess the impact of low rainfall on sources (surface and groundwater);
- Assessment of trends in soil moisture deficit and groundwater levels and their impact on river base flows and prospects for recharge;
- Assessment of refill for of impounding reservoirs; and
- Comparison of relevant hydrometric data against applicable drought measure trigger levels.

6 DROUGHT TRIGGERS

6.1 Ground Water

For those areas supplied by an isolated spring or borehole, a declining spring yield or borehole drawdown greater than that observed in an average year will be the main drought trigger. Trigger levels are used mainly for guidance and input into making informed decisions on drought management actions, which are in turn based on operational knowledge and judgement. In the absence of any yield information for the spring sources, we will monitor flow into the distribution network. As the abstracted volume approaches the abstraction licence maximum, action will be taken to avoid over abstraction or supply shortages. In most cases, spring sources are remote from our main distribution network and in the event of a decline in yield, the supply will be maintained by tankering water from a surface water treatment works to the service reservoir which the spring normally supplies. The alternative to this practice would be to lay long lengths of mains to the area supplied which would not be economically viable.

6.2 Surface Water

For water treatment works supplied by reservoirs the trigger for a drought would be when the level of the reservoir approaches its Drought Control curve. All of our reservoirs (or group of reservoirs) have Drought Control curves assigned to them. These have been agreed with the Environment Agency as well as the procedures that should be followed if various control curves are crossed. These are set out within the Kielder Operating Agreement. Typical examples of the control curves are shown in Appendix 1.

We monitor reservoir levels weekly and plot values against the control curves for each reservoir and takes information on catchment inflows, rainfall and reservoir storage change and using these capacities predicts the potential reservoir levels in advance. This allows actions to be taken to manage reservoir storage using specific reservoir control curves. The trigger for drought actions is therefore the approach of reservoir levels to the relevant control curve. However, operation of the Kielder Transfer Scheme means that in most cases drought lines are avoided.

River flows are obtained either on a daily basis from the Environment Agency or using our data presentation system (MIPS) which provides readings generally on a 15 minute basis. Analysis of this data enables releases from reservoirs or discharge points, for example at Frosterly on the River Wear, to be made to maintain prescribed flows in the rivers thus ensuring river abstractions to treatment works can be guaranteed.

7 DROUGHT MEASURES: DEMAND SIDE ACTIONS

7.1 Background

This section details examples of the demand side drought measures/actions that could be employed were there ever to be any potential water supply shortages in a drought. However as all operational areas are currently in surplus even during drought, it is unlikely they would be required.

7.2 Public Relations Campaigns and Appeals for Restraint

Public relations campaigns and appeals for restraint are detailed in our Communication Plan presented in Chapter 10. This measure involves conveying key messages to customers in relation to using water wisely.

Appeals for restraint may result in average demand reductions ranging from 0 to 5% (UKWIR/Environment Agency, 1998) However, experience to date shows we can expect reductions in demand nearer to 7%. This may decrease in the future as meter penetration increases and customers have already altered their water use because of being on a measured supply.

7.3 Leakage Control

Prolonged periods of drought may result in soil shrinkage and increased ground movement causing mains to fracture and leakage values to increase. It is, therefore, vital to have a robust leakage detection strategy in order to control this potential demand increase.

We have made significant progress in the control of leakage over the recent years using appropriate levels of resources and investment, to both control and economically reduce the level of leakage. The impact of extreme winter weather events can impact the ability to achieve annual leakage targets, but we continue to strive to meet customer and environmental expectations.

We have worked closely with Customers, Ofwat and the Environment Agency to agree economically acceptable annual levels for leakage. The agreed targets are driven from the outputs of modelling work which defines the Sustainable Economic Level of Leakage (SELL). This is the point at which the marginal cost of saving an additional unit of water exactly equals the marginal benefit derived from the water saved. It is not necessary to go beyond this SELL value in a drought situation.

The supply network is divided up into District Metered Areas (DMAs) which are small managed areas of the network with flow meters monitoring inlet flows. All of our DMAs are reviewed on a weekly basis to prioritise the areas for leakage detection activities. This period can be shortened during drought or severe weather events and can be prioritised to address specific issues and areas of severe drought.

During drought periods we ensure that workloads are prioritised in order to repair all visible leaks as soon as possible, often the same day. In such periods, the number of bursts can easily increase by 30% over a month. If this is not prioritised the leakage value would rise by at least 2.3 Ml/day over this period. This is a key aspect of demonstrating to customers that we can all work together to reduce excessive levels of leakage.

We remain conscious of the customer perception of excessive leakage and fully recognise their poor view of company performance by asking them to conserve water whilst appearing to allow water to waste away. However, the majority of leakage from the network is coming from small leaks, typically from a proportion of the pipe joints, of which there are millions. These leaks almost invariably soak into the ground and are invisible from the surface. Leakage of this type is impossible to fix in an economic manner, a point which is recognised by Ofwat. To remove it by pipe replacement alone would result in significant increases to customer's bills. The less frequent, but decidedly more visible leaks, are the bursts that reach the surface, sometimes causing damage and disruption. These are the leaks that our customers rightly expect to be fixed promptly, especially when they are, themselves, striving to conserve water. We would increase the find and fix resource by employee an additional ten Leakage Technicians. Values for water saved by this activity is shown in Table 3 below.

7.4 Pressure Management

The relationship between pressure and leakage is well understood and, when managed effectively, can have a significant impact on the reduction of leakage levels. Pressure in the distribution network can be reduced by the installation of a Pressure Reducing Valve (PRV) which reduces the pressure at its outlet to a predetermined value, or daily profile of values. This means that the whole area downstream of the PRV is subjected to a reduced pressure. Pressure reduction reduces the flow rates from existing leakage sites as well as reducing the frequency of the outbreak of further leak events. A further benefit is the reduction of wastage at customers taps caused by reducing the flow rates.

We continually monitor network pressures and will continue both during and outside of a drought to identify locations where new pressure management schemes can be implemented or existing schemes optimised to a lower pressure value. This work has to be undertaken carefully to ensure that no new areas with poor pressure are created or unsatisfactory customer levels of service caused.

7.5 Metering

We have made considerable progress over recent years to increase meter penetration in order to support customers making savings on water consumption. This is predominantly based around encouraging customers to opt for a free meter by giving annual information on free meter installation in our billing documentation, providing information on our website on water

meters, and a programme of selective meter installations on non household properties.

Given the security of supply in the area, we have not adopted any selective domestic metering activity. In the unlikely event that a drought situation does present itself our experience is that appeals for restraint, being highly successful, are likely to get customers to save the water that they would have saved by having a meter installed. We will however continue to respond to all meter applications and aim to have the majority of meters installed within 30 days.

7.6 Water Conservation Measures

At times of drought, the water efficiency strategy will remain in place to keep customers informed of the key water-saving messages and the need to use water wisely. Under the campaign heading of Every Drop Counts, the programme includes a variety of initiatives aimed at helping customers to reduce their water consumption. The strategy includes encouraging customers to request water saving devices via appointments with customers, through the company website, and at events; undertaking households retrofit projects; a large scale educational programme aimed at primary schools; and providing information to customers on how to save water via the company website, in billing literature, in dedicated leaflets and through a wide spread radio campaign. In the event of a drought, the momentum of the campaign can be increased and focused particularly on the delivery of key water efficiency messages and encouraging customers to request free water saving devices.

Our efficiency target, of carrying out water efficiency activity with our customers to save 0.33Ml/d per annum over each of the 5 years of AMP6, means changes to this activity compared to previous drought plans with a key difference being the requirement to report measured water savings as opposed to assumed as per the AMP5 reporting guidance. The profile of general water efficiency has been dramatically raised with our customers as many campaigns have been used through Every Drop Counts to reach our annual target. This has the benefit of increased customer education about water but means many more customers have already become more water efficient. During future droughts we will use “Appeals for Restraint” to further promote water efficiency to our customers, focus on the delivery of key water efficiency messages and direct customers towards water efficient products, from NW or to buy. Water efficiency enhancement now becomes part of our Appeal for Restraint.

7.7 Operational Water Usage

Normal operation of the water distribution system can require additional use of water, for example flushing water mains and service reservoir cleaning. As drought triggers are approached a decision will be taken to reduce or cease this type of activity in specific Drought Management Areas where appropriate.

Based on current volumes of water used, postponing all routine flushing activities and Service Reservoir cleaning could amount to a potential saving of 1.12 Ml/d.

Activity	Week 1 Maximum Company Savings in Ml/d	Week 2 Maximum Company Savings in Ml/d	Week 3 Maximum Company Savings in Ml/d
Postpone all routine flushing and SR cleaning	1.12	1.12	1.12
Increase leakage find resource by 10 Leakage Technicians	0.29	0.29	0.29
Reduce 50% of PRVs by 10% (cumulative savings)	2.35	5.76	6.82
Increase Water Efficiency	0.17	0.34	0.34

Table 3. Summary of Water Savings

8 DROUGHT MEASURES: SUPPLY SIDE ACTIONS

8.1 Background

This section details the supply side drought measures/actions that may be employed to address potential water supply shortages in a drought.

8.2 Tankering

In some smaller isolated areas, the only option to provide additional supplies is to tanker potable water into the relevant service reservoir. We generally utilise tankers with a carrying capacity of 30m^3. Plant and procedures are already in place with dedicated fill points at Whittle Dene and Broken Scar WTW. The quantities of water required in tankering operations are minimal and has no impact on the overall deployable output of these works. In practice, due to the location of these areas, tankering will take place from Whittle Dene WTW. Analysis suggests that a maximum of two tankers a day would be required giving a volume of 60m^3. This is negligible in comparison to the DO of the works.

8.3 Operation of Kielder Transfer Scheme

As described previously this scheme allows us to maintain raw water supply to the majority of treatment works. It would be operated in accordance with the Kielder Operating Agreement Appendices.

8.4 Alterations to the Distribution System

As required water could be made available to the Wear OA and the supplement from the Wear OA to the Tees OA would cease. This would require minor valving operation on the distribution system.

8.5 Discussions on supplying neighbouring companies

8.5.1 Yorkshire Water

During the pre-consultation stage of the draft Drought Plan, we met with Yorkshire Water (YWS) to discuss the possibility of raw water from the River Tees being transferred into the YWS supply area. Since the 1995/96 drought, a pipeline has existed at our Blackwell Raw Water Pumping Station that just stops short of the River Wiske in Yorkshire. The pumping sumps and meters exist at Blackwell and a supply could be made available within two months of a request. The long term drought option is for us to provide 40 Ml/d to YWS.

This supply would be raw water (untreated) from our Industrial Water system thus providing this water has no impact on our DO. Given that demand on that system has declined from around 230 Ml/d in 2000/01 to a current level of 100 Ml/d, we do not foresee an issue in making 40 Ml/d available to YWS.

Upon receipt of such a request the required work at Blackwell would be undertaken to enable a supply to be provided and as stated above it is estimated this would take approximately two months.

In order for this transfer to be made available, appropriate Environmental Impact Assessments would need to be completed by Yorkshire Water.

8.5.2 United Utilities

In previous discussions with United Utilities (UU) two options have been considered. The first is a transfer directly from Kielder and we believe that a transfer of up to 100 Ml/day could be viable in a drought scenario given historic levels in the reservoir.

The second option is a supply from Cow Green reservoir which again based on historic reservoir levels, we believe that a transfer of 40 Ml/d would be available to UU.

Given both these options relate to raw water transfer they would not have any impact on our DO. However, they are both based only on water availability and take no account of any environmental assessments which may be required to enable such transfers to take place. UU have made no further approach on this matter hence at this stage no further work has been undertaken.

9 ENVIRONMENTAL ASSESSMENT

9.1 Environmental Assessment

The following is a list of Sites of Special Scientific Interest (SSSI) within our area of supply in which abstraction points or reservoirs are sited. None of the SSSI's will be affected by any drought action as no action involves increasing abstractions beyond agreed licensed limits.

- Lune Forest
- River Tyne at Ovingham
- Muggleswick, Stanhope & Edmondbyers Commons & Blanchland Moors
- Mere Beck Meadows
- Shipley & Great Woods
- River Coquet & Coquet Valley Woodland
- Kielderhead & Emblehope Moors
- Kielder Mires
- Appleby Fells
- Upper Teesdale
- Rigg Farm & Stake Hill Meadows
- Backstone Bank & Baal Hill Woods
- Hannah's Meadows

In addition the following SAC' s fall in our area of supply :-

- Border Mires, Kielder – Butterburn
- Castle Eden Dene
- Durham Coast
- Ford Moss
- Harbottle Moors
- Moor House – Upper Teesdale
- Newham Fen
- North Northumberland Dunes
- North Pennine Moors
- Roman Wall Loughs
- Simonside Hills
- Thrislington
- Tweed Estuary
- Tyne and Allen River Gravels

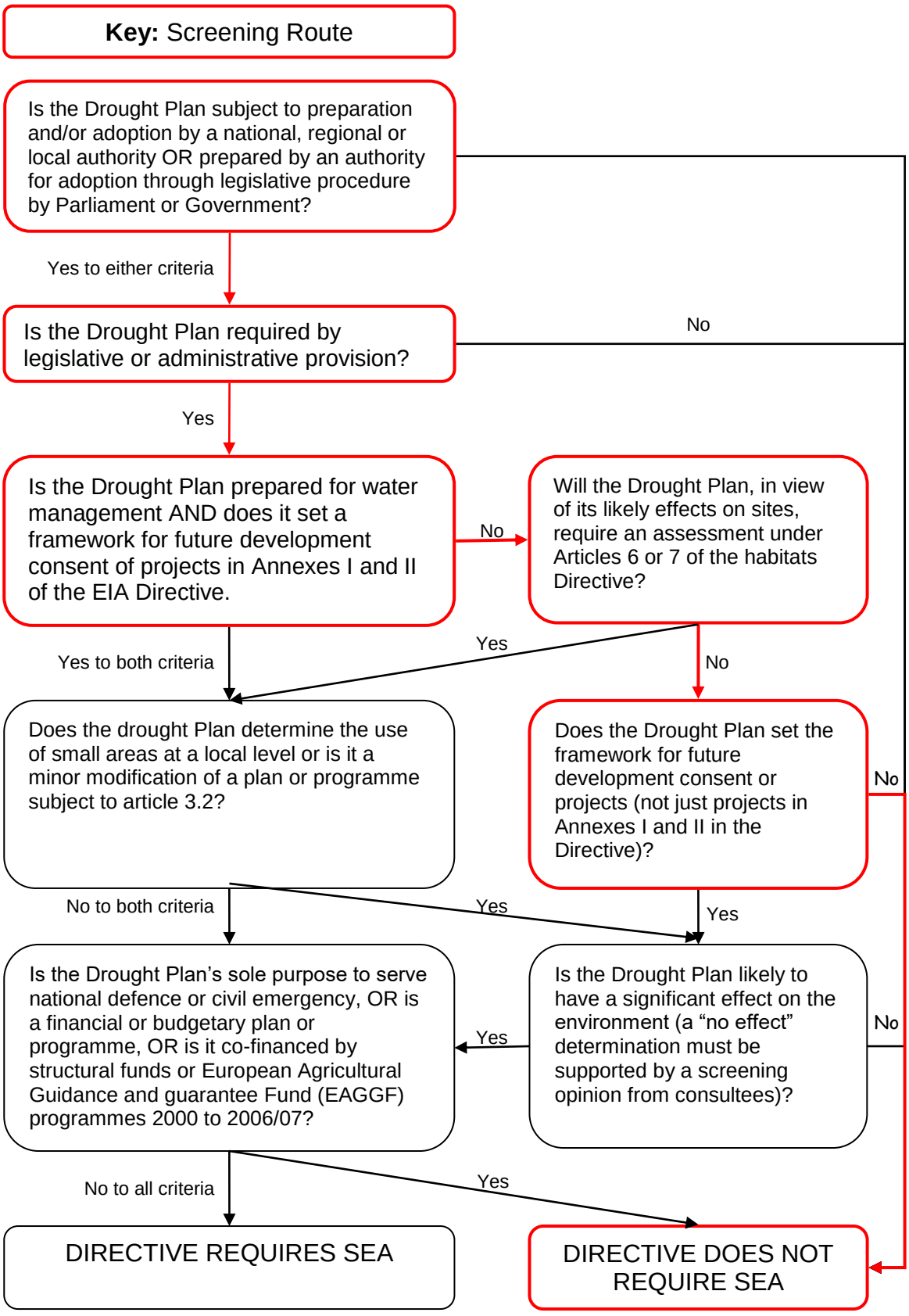
Where applicable abstraction licences set out Minimum Maintained Flows (MMF) in rivers which we have to adhere to. These MMF's are designed to eliminate areas of water stress during periods of increased abstraction. An example being water from Kielder Reservoir which is released at rates which, taking in to account other abstractions, maintain a minimum river flow below our most downstream point at Ovingham.

9.2 Habitats Regulations Assessment

There is not a requirement for a Habitats Regulation Assessment to be undertaken as none of the supply side actions involves increasing abstractions beyond existing licensed limits.

9.3 Strategic Environmental Assessment.

Figure 7 below illustrates the key stages and the results of our SEA screening exercise.



Source: UKWIR (2007) Guidance for Water Resources Mgt Plans & Drought Plans

Figure 10 Key Stages of Screening

The results of the screening exercise are as follows:

i. We will prepare and adopt the Drought Plan and under the EIA Directive, we are considered an "authority";
ii. The Drought Plan is required by legislative provision, being a statutory document under the Water Act 2003 amending the Water Industry Act 1991;
iii. The Drought Plan will be prepared for water management but does not set a framework for future development;
iv. None of the Drought Plan supply side actions involve increasing abstractions beyond existing licensed limits which are deemed sustainable. Therefore, there should be no significant environmental effects. Consequently, the Drought Plan, in view of its likely effects on sites, will not require an assessment under Articles 6 or 7 of the habitats Directive.
v. The Drought Plan does not set the framework for future development consent or projects (not just projects in Annexes I and II in the Directive).

Given the above, our Drought Plan does not fall within the remit of the SEA Directive and therefore does not requires an SEA to be undertaken and an Environmental Report to be prepared.

9.4 Water Framework Directive Assessment

The Water Framework Directive (WFD) requires all water bodies to meet Good Ecological Status (GES) or Good Ecological Potential (GEP). Overall ecological status or potential is made up of a number of biological, physiochemical, hydromorphological and chemical quality characteristics called elements. The overall status is determined by the lowest element status. For example, if biological status was 'moderate' and the rest of the components were 'good', the overall status of the water body would be 'moderate'.

Article 4.1 of the WFD sets the following 'Environmental Objectives':

- **WFD Objective 1:** No changes affecting high status sites
- **WFD Objective 2:** No changes that will cause surface water bodies to fail to achieve GES or GEP
- **WFD Objective 3:** No changes that will result in a deterioration of surface water bodies 'Ecological Status' or 'Ecological Potential'
- **WFD Objective 4:** No changes that will permanently prevent or compromise the 'Environmental Objectives' being met in other water bodies
- **WFD Objective 5:** No changes that will cause failure to meet good groundwater status, or result in a deterioration of groundwater status.

None of the supply side actions involve increasing abstraction beyond existing licensed limits. Consequently, the actions in this Drought Plan should not compromise any of the Environmental Objectives detailed above.

10 COMMUNICATIONS PLAN

10.1 Background

This section forms our Drought Communication Strategy.

Communication in a drought is essential and can be separated into that required with customers, and that required with regulators (principally the Environment Agency) and other stakeholders.

It is important to note that no two droughts are ever the same. Therefore, it is important there is flexibility in the drought communications plan. Communication tools and methods outlined below will be deployed taking into account prevailing conditions and adapting as appropriate as a drought develops.

10.2 Approach

We have a well-developed ongoing campaign to encourage customers to use water wisely.

The promotion of water efficiency to customers has been an important part of managing supplies of water since 1997, following the last major drought and during 2011 when water resources were significantly low. We have reviewed the CCW report 'Understanding drought and resilience' and taken into consideration the points they have made. Through our Every Drop Counts campaign our aim is to encourage behavioural change and build greater trust with them.

'Using water wisely' and 'taking care of a precious resource' messages are central themes in our communication plan. They are applied all year round and to different stakeholder and customer groups. A dedicated communications team works closely to ensure that all its activities enforce and do not dilute the need for water efficiency.

We would break communications into reactive and proactive with different messaging to specific audiences.

We run pro-active campaigns every year under the 'Every Drop Counts' banner with two sub-campaigns in the programme. This would run alongside reactive media responses based around our core central messages of 'Using water wisely' and 'taking care of a precious resource'.

Any communications plan is compiled to raise awareness, give timely and accurate information on the water resource situation and to offer advice and encouragement on using water wisely. The strategy also seeks to identify audiences for communications and to structure messaging aimed at specific groups and stakeholders. This strategy will make use of and seek to mirror the Environment Agency's Drought Communication messaging for reactive messages and link into our pro-active messaging aimed at key active

audiences responsive to those messages, effectively mobilising the support of our customers in response to climatic conditions.

The external communications team is part of and supported by a larger Northumbrian Water Group Corporate Affairs team working in Durham.

All the members of the team ultimately report to the Director of Corporate Affairs who in turn reports directly to the Chief Executive Officer. This enables access to key decision makers and a closer understanding of strategic issues and policies.

The Corporate Affairs team also includes specialists working in internal communications to ensure all employees are engaged, understand key messages and are able to act as advocates to our customers

The team works closely with our marketing team, which can produce readable and eye-catching materials in-house which might be needed to support a water efficiency campaign. The team also manage our website, which will be a key communication channel during drought. The marketing team is also able to provide specialist research support providing key audience insight to help shape communications activity.

The roles of the External Communications team cover:

- Pro-active and reactive media (print, broadcast and online)
- Public Affairs and NGO stakeholder communication
- Education, sponsorship and community support
- Social media and video

10.3 Audiences

The audiences for specific messaging around drought communications are:

- Household customers
- Employees
- Suppliers and partner
- Non-household customers
- External stakeholders and specialist interest groups
- Media

Messages will be tailored so that are relevant and impactful for each audience; while at the same time ensuring there is consistency.

Broad messaging will be developed that is appropriate for our staff and for use in direct customer communications. This messaging will be important to give our employees across the business the confidence to answer questions from customers they interact with on a daily basis, their neighbours, families and the public about the developing situation. Employees are powerful advocates and ambassadors for drought messages and we know from past experience

that often frontline employees are first to get questioned about any drought situation.

Some external stakeholder audiences are partner organisations and may benefit from a more detailed briefing about the current water supply situation or more specific information about particular aspects. This could range from a specialist interest group, charitable partner, environmental NGO, to MPs or local councillors or the water retailers.

The media audience will be targeted to primarily help communicate with domestic customers and the wider public about the developing drought situation and to allow for wider dissemination of the key messages.

By identifying the key audiences we have some flexibility, should it be necessary, to address different messages to different groups. This is most likely to involve more detailed briefing for stakeholder audience groups.

10.4 Key Messages

Messages need to be reinforced by the facts, so we continually and consistently repeats information about below average rainfall combined with the demands of a developing region.

In addition, messages are communicated regarding the need to manage water resources for a sustainable future that protects wildlife and habitats as well as customer needs.

Our responsibility to manage our water resources carefully and skilfully is emphasised. That means encouraging metering, reducing leakage and applying innovative and carefully researched planning to the use of our water resources.

Mirroring the Environment Agency's Drought Messaging structure, we have developed our own specific messaging for different stakeholder groups.

The key overall messaging is likely to be the same for all groups and it is important we give a consistent message to the public, customers, stakeholders and the media. Please see the tables below for the specific messages.

A list of top water saving advice would also be attached and used in-conjunction to these key messages where appropriate and these tips relate to garden and outdoor advice as well as inside the home

10.5 Key messages during a drought

The tables below set out our key messaging and the audiences.

Overview of primary reactive drought message for each drought stage

	Broad	Stakeholders	Media
Normal	The weather conditions are normal, and levels of water are fairly typical for the time of year.	The weather conditions are normal, and levels of water are fairly typical for the time of year.	The weather conditions are normal, and levels of water are fairly typical for the time of year.
Developing drought	We are continuing to monitor our water resources situation and the ongoing low rainfall - Please use water wisely.	We are working with all our partners including the Environment Agency and other water companies to try to minimise the potential impact of this dry weather to our customers	Robust and well tested plans are in place to help ensure that in times of abnormally dry weather we make the best use of the water available and minimise the potential impacts to our customers
Drought/Severe Drought	**Our water resources are below average for this time of the year following low rainfall – Please reduce your water usage**	**Our water resources are below average for this time of the year following low rainfall – Please reduce your water usage**	**Our water resources are below average for this time of the year following low rainfall – Please reduce your water usage**
Recovering from drought	After the recent rainfall, our reservoirs and resources are recovering. It takes time for levels of water to recover. Please continue to use water wisely.	After the recent rainfall, our reservoirs and resources are recovering. It takes time for levels of water to recover. Please continue to use water wisely.	After the recent rainfall, our reservoirs and resources are recovering. It takes time for levels of water to recover. Please continue to use water wisely.

During developing drought stage, escalating water efficiency messages – not appeals for restraint

	Broad	Stakeholder	Media
Developing drought	**Advice on water saving tips for example - Water butts are a great way to store water in the garden for dry periods and to help reduce your water bill.**	**We are working with all our partners including the Environment Agency and other water companies to try to minimise the potential impact of this dry weather to our customers**	**Robust and well tested plans are in place to help ensure that in times of abnormally dry weather we make the best use of the water available and minimise the potential impacts to our customers**
Sub-messages	**Please use water wisely and refer to our top water saving tips**	**Please use water wisely and refer to our top water saving tips**	**Please use water wisely and refer to our top water saving tips.**
	Our staff are prepared and working hard to keep leakage on our network of water supply mains low as this period of dry weather continues.	**We are able to use the network of rivers and transfer pipes to bring water to support our reservoirs and help keep customers supplied with drinking water.**	**We are working with all our partners including the Environment Agency and other water companies to try to minimise the potential impact of this dry weather to our customers**
		Our drought plans are approved by the Secretary of State following public consultation, and are assessed for resilience and protecting water supplies for the future.	**Our reservoirs are currently at x level full and this is below average for this time of year**
			Our drought plans are approved by the Secretary of State following public consultation, and are assessed for resilience and protecting water supplies for the future.

	Start of the drought period – appeals for restraint		
	Broad	**Stakeholder**	**Media**
Drought/severe drought	**Due to the prolonged dry weather we are asking customers to reduce their water usage.**	**Due to the prolonged dry weather we are asking customers to reduce their water usage.**	**Due to the prolonged dry weather we are asking customers to reduce their water usage.**
Sub-messages	**Please use water wisely and refer to our top water saving tips**	**Please use water wisely and refer to our top water saving tips**	**Please use water wisely and refer to our top water saving tips**
	Our staff are prepared and working hard to keep leakage on our network of water supply mains low as this period of dry weather continues.	**We continue to work with all our partners including the Environment Agency and other water companies to try to minimise the potential impact of this dry weather to our customers**	**Robust and well tested plans are in place to help ensure that in times abnormally dry weather we make the best use of the water available and minimise the potential impacts to people and the environment.**
			We are working with all our partners including the Environment Agency and other water companies to try to minimise the potential impact of this dry weather to our customers

Recovering from drought – water use restrictions lifted

Recovering from drought

Sub-messages

Broad	Stakeholder	Media
After the recent rainfall, our reservoirs and resources are recovering. It takes time for levels of water to recover. Please continue to use water wisely.	After the recent rainfall, our reservoirs and resources are recovering. It takes time for levels of water to recover. Please continue to use water wisely.	After the recent rainfall, our reservoirs and resources are recovering. It takes time for levels of water to recover. Please continue to use water wisely.
Please use water wisely and refer to our top water saving tips	**Please use water wisely and refer to our top water saving tips**	**Please use water wisely and refer to our top water saving tips**
Our staff are prepared and working hard to keep leakage on our network of water supply mains low as this period of dry weather continues.	**We continue to work with all our partners including the Environment Agency and other water companies to try to minimise the potential impact of this dry weather to our customers**	**Robust and well tested plans are in place to maximise the water resource and re-charge to our reservoirs during this period following the long-spell of dry weather**
		Our drought plans are approved by one of the regulators of the water industry in England and Wales, the Environment Agency, and are assessed for resilience and protecting water supplies for the future

10.6 Communication Methods

10.6.1 Water efficiency campaigns

Every Drop Counts is our water saving campaign. It takes an innovative and wide-reaching approach by offering customers the chance to participate in a range of initiatives that are usually delivered at different times and places throughout the year.

It uses a combination of targeted advertising and community based marketing to maximise participation in the wide range of water efficiency projects to help our communities not only save water, but energy and money too. Since the initial trial of the whole-town approach in 2014, we have completed 13,221 home retrofit audits and over 150 business audits in six towns.

Every Drop Counts offers water savings schemes, initiatives and solutions to households, businesses and schools within the targeted town. A key component of the campaign is the offer to householders of a free plumber-led home retrofit visit worth over £130. The water and energy saving visit includes the installation of a wide range of retrofit products alongside effective engagement with the householder to enact long-term behaviour change.

Every Drop Counts is the main campaign we use to pro-actively communicate our water efficiency programmes to customers and to make positive interventions to help customers use water wisely. The campaign is split into two strands:

- Every Drop Counts Gardening campaign – aimed at gardeners and encouraging them to use less water outdoors
- Every Drop Counts Home Audits campaign –targeted at all homes in specific towns and encourages home owners to install water saving devices and products within their homes reducing consumption

These programmes continue each year, even in non-drought years to help promote water efficiency in some of the driest areas.

10.6.2 Every Drop Counts Gardening Campaign

This proactive campaign has a message of reducing water use in the garden with a primary and secondary message aimed at a broad and keen interested gardener's audience.

We run this campaign each year during spring when water use in gardens typically increases across the drier months. It is primarily aimed at driving behaviour change in garden water use habits and increasing the use of water butts.

The primary message:

Use water wisely in the garden and take care of this precious resource.

The secondary message:

Keen gardeners can reduce their water use in the garden by following our helpful water saving tips and by installing a water butt, so water can be stored during a time of plenty and used later on for watering plants.

Experience during previous dry periods has found that gardeners are keenly interested in information on water resources and also highly motivated to store rain water for future use. There is evidence to show that it is better for plants rather than water drawn from the mains supply.

The gardening campaign allows us to start communications with an active and responsive group likely to reduce their water use at the start of spring with dry conditions likely before entering into a drought situation. This campaign usually features a discount water butts sale from our approved supplier and free talks about saving water in the garden.

It also allows for water saving messages to start being communicated with the wider public and information is readily and easily understood and available for different sources to help supplement this campaign.

10.6.3 Every Drop Counts Home Audits Campaign

This second element of our pro-active campaigning and would feature home water saving audits and general publicity around water saving at home, and helping customers to reduce their utility bills through saving water.

We run this campaign throughout the year and often focuses the promotion of home audits during the summer months.

The primary message:

Use water wisely in the home and take care of this precious resource.

The secondary message:

Water saving audits for the home can help customers reduce their utility bills and save money as well as helping to conserve a precious resource.

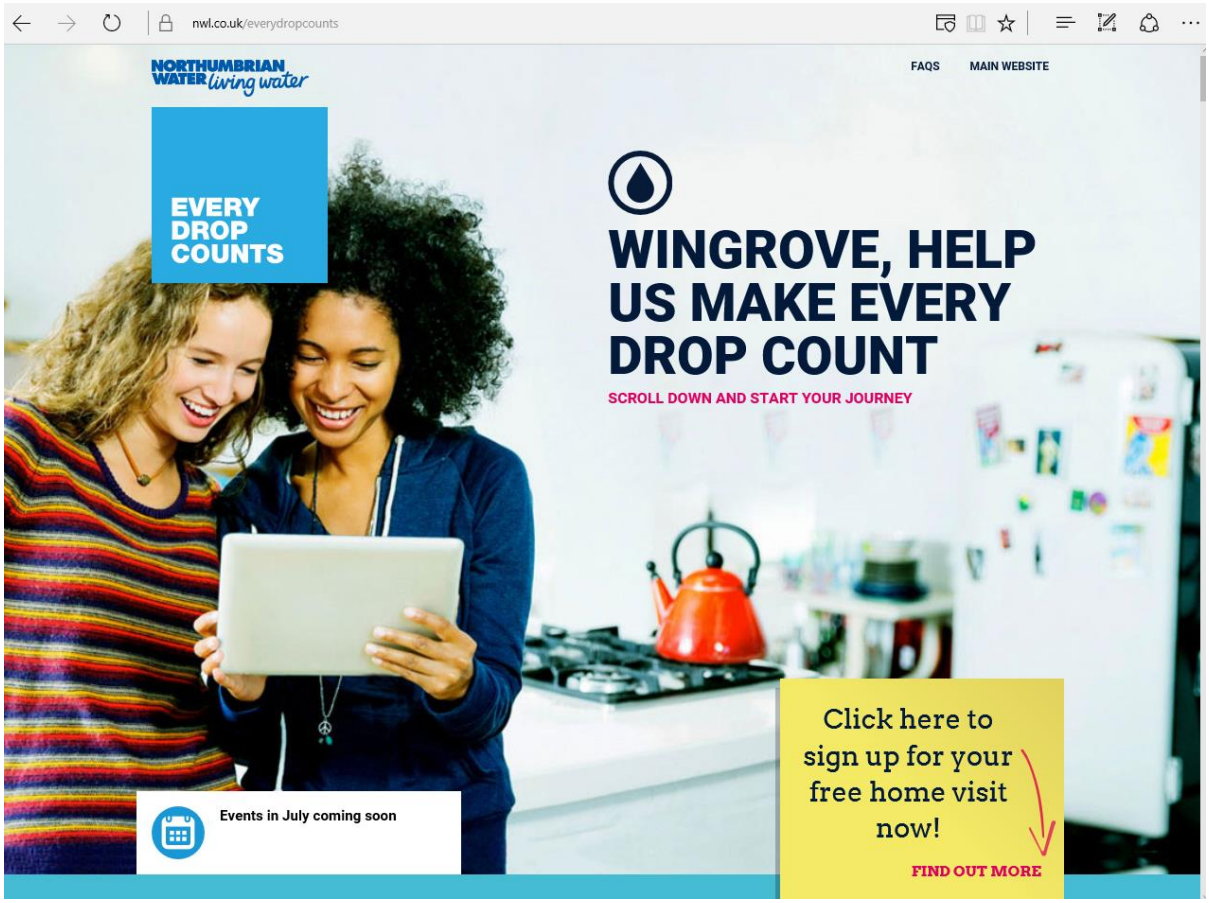
Linking our messaging to ‘Value for money’ helps to ensure that the widest possible number of customers are interested in and likely to take part in this scheme.

Marketing including mass mail shots to customer takes place and to invite customers to take part in a home audit. This is supported by billboard, newspaper and radio advertising.

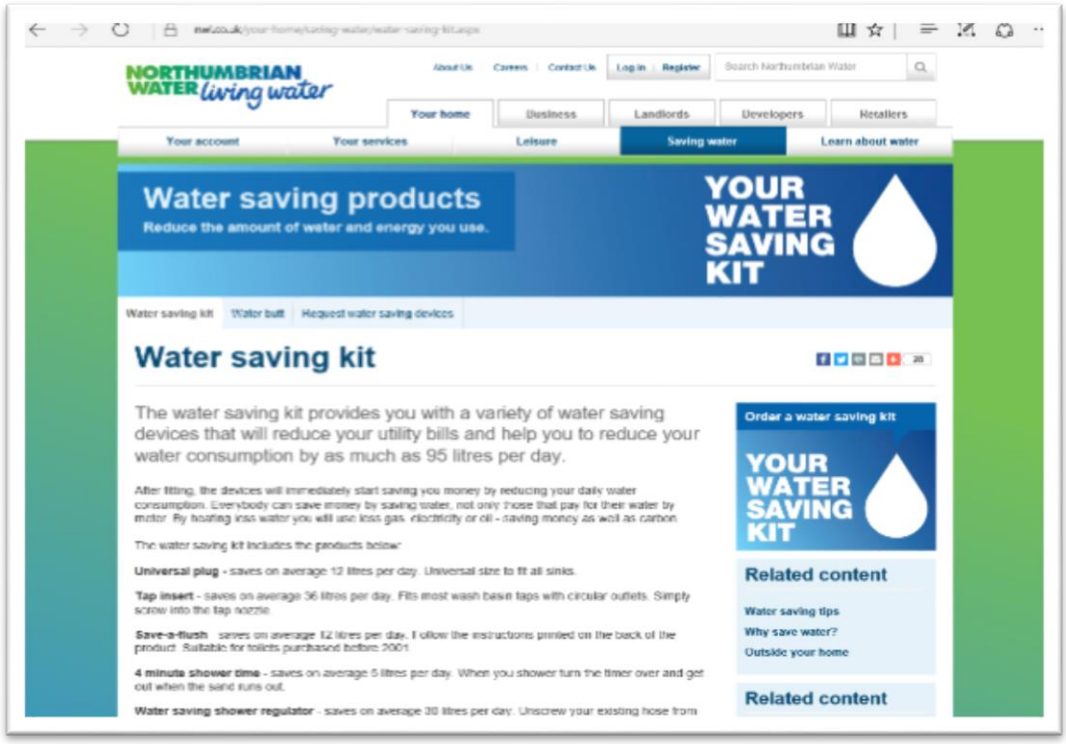
During a pro-longed dry period and with wider media messages about potential drought situations, it might be reasonable to expect an increase in participation as general awareness on water efficiency could be higher.

Depending on the nature of the dry period, the company would also consider increasing the number of locations involved in this programme.

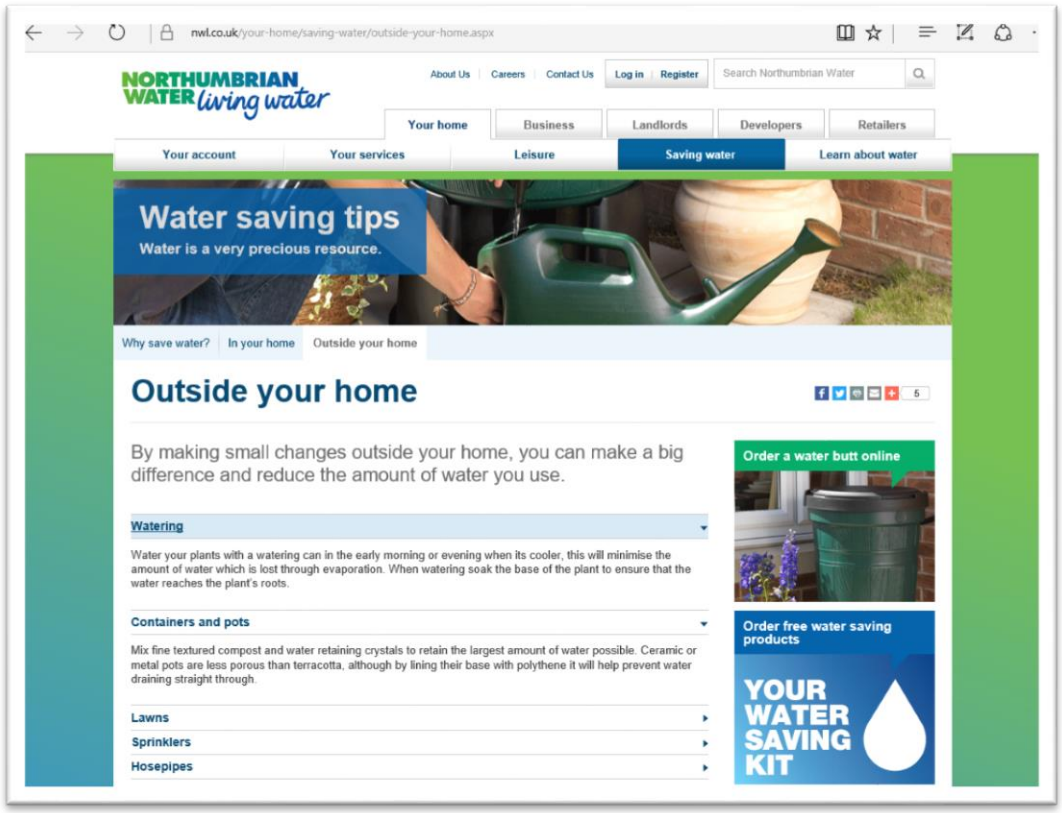
Below are examples of Northumbrian Water's websites for the two programmes:



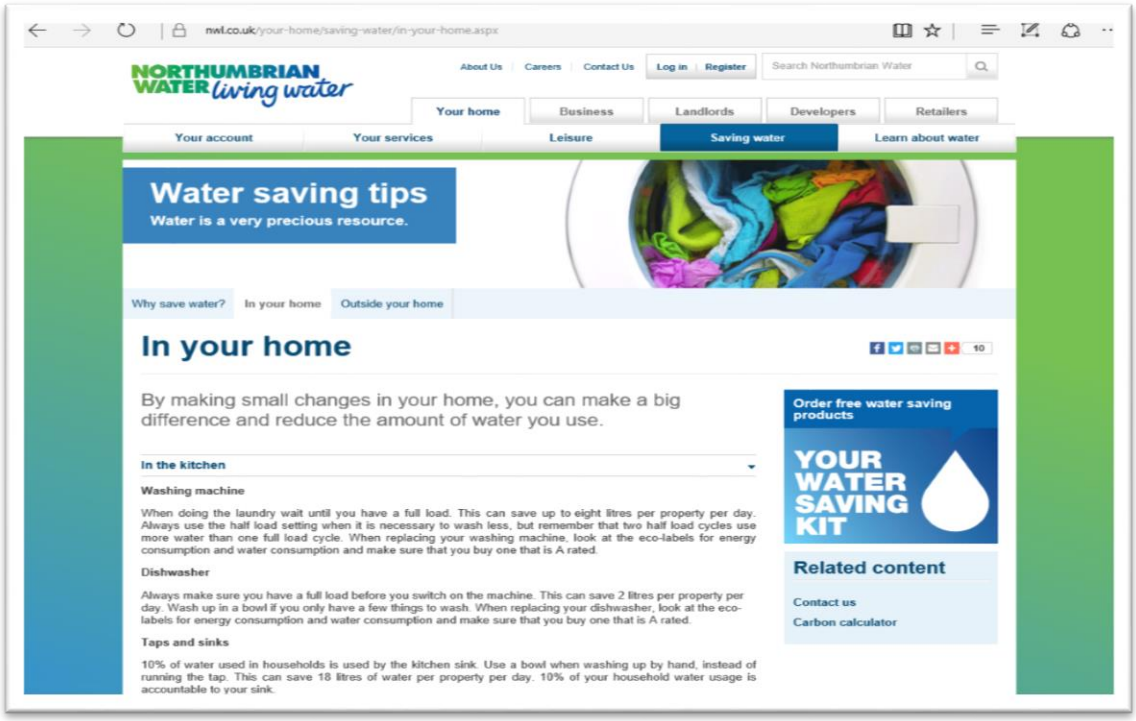
Sub-website for our Every Drop Counts home audit programme to allow customers to sign up for free home visits and water saving audits.



Page on Northumbrian Water's website for customers to request free water saving devices for their homes.



Page on Northumbrian Water's website for customers to order a garden water butt and find advice and tips for saving water whilst gardening.



Page on Northumbrian Water's website for customers to find advice and tips on saving water in their homes.

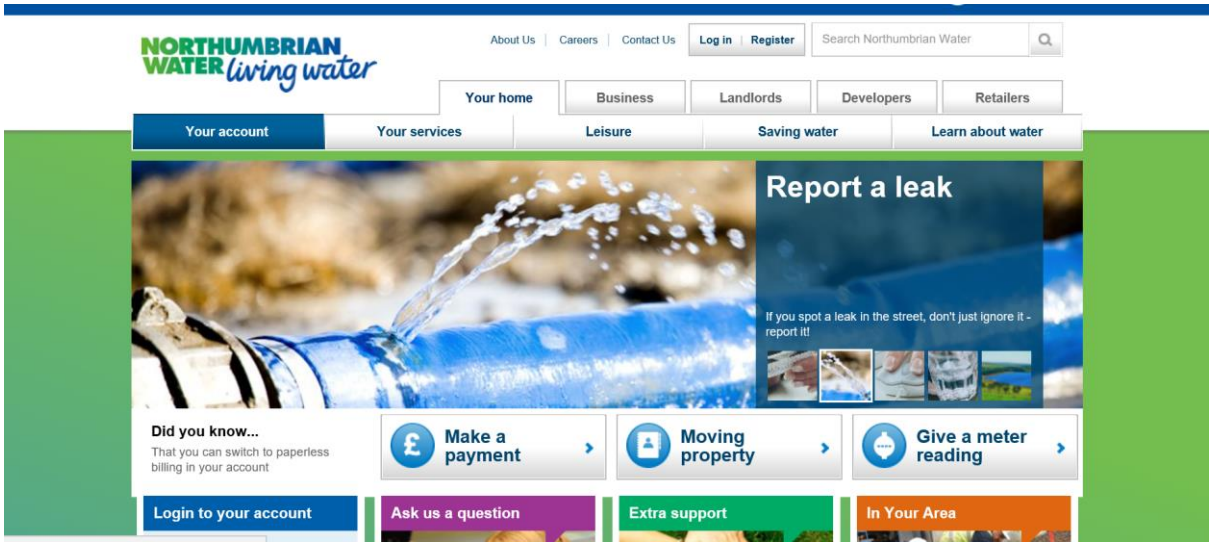
10.6.4 Website

Our website (www.nwl.co.uk) is a dynamic communications tool which is continually reviewed and updated.

Page:	Page Impressions:
Homepage (nwl.co.uk)	6,583,203
Saving water	21,161
Media centre	4,322

Our website has an internal web manager who is able to update and add information frequently and quickly. This facility enables the company to respond quickly to critical incidents, giving customers the information they need.

The home page of our website has a prominent message regarding water efficiency. This links to further details including all of the key messages.



Home page of our website (as of February 2017) showing prominent message around encouraging customers to report leaks for repair.

The website contains detailed explanation on the importance of using water wisely and the incentives for customers to do this. It also contains practical advice and tips on how customers can help save water in all parts of the home and garden.

The ability to request free water saving products, such as the water saving kit, is also available on the website. In addition, there are links to affiliate company's website where our customers can benefit from savings on water efficient products, such as water butts.

In the event of drought, the website can be adapted to give a raised profile of water efficiency messages, water saving product offers and to the current resource situation.

10.6.5 Media and social media

Regular press releases to local and regional media are used to inform and engage a wide audience about the key messages. Features in the local media can help to engage individuals/groups about water efficiency that might otherwise not have taken an active interest.

All media releases associated with water efficiency incorporate the key messages. Media releases highlighting specific water efficiency projects or free water saving products are circulated to the local media.

Media releases are issued regarding water efficiency projects, such as the as the Every Drop Counts campaigns.

The water efficient home audits carried out by the demand planning team are used to for offer practical advice to customers through the resulting press publicity.

In addition, opportunities to incorporate water efficiency messages during media interviews are also taken wherever possible. For example, we occasionally take part in local radio station 'phone ins' during which it is often a good opportunity to highlight water efficiency messages.

As part of our media partnerships, we have regular space in local newspapers for adverts and editorial copy in a sponsored page. These features are regularly used to promote the Every Drop Counts campaigns.

In a drought situation, this would be used to put relevant information and advice into publication about the drought situation.

Targeted local newspaper and occasionally radio advertising is also used to promote specific water saving products (such as water saving kits).

We have YouTube and Twitter accounts and would use these to push out key messages during a drought situation.

Our YouTube account has been viewed more than 145,000 times across the lifetime of the channel and a range of video content. Material includes water saving videos and the channel was set up in 2011. This content is available online for longer durations and is viewable during a period of dry weather. There are videos about water butts and tips for reducing water usage around the home to watch.

Our corporate twitter account (@NorthumbrianH2O) as of March 2017 had 9558 followers and the customer twitter account (@nwater_care) had 8,376 followers. Both accounts are seeing more followers added every week.

10.6.6 Public Affairs Stakeholders

We regularly communicate with stakeholders and opinion formers, such as local councillors, MPs, and NGOs.

Our External Communications team will ensure that drought communications are issued promptly and regularly to all opinion formers (including the Consumer Council for Water) to help reinforce water efficiency messages.

These key stakeholders will be emailed media releases and other information relating to water efficiency particularly if relevant to their area of influence and operation.

Stakeholders can have wide online circles of influence, such as a local MP, and often getting that individual to retweet or post on their website about water company communications can be a useful tool for getting a message out to customers and the public.

A key contact to be regularly updated through email and conference phone calls is one of our regulators, the Environment Agency and DEFRA. Members of the area

Environment Agency operations team have joined our incident teams for briefing and we have a close working relationship with the two organisations.

10.6.7 Educational activity

Education is a key element of our water efficiency strategy; incorporating help to educate all ages about the importance of using water wisely and how they help make a difference.

Our education resources are focused on the 'Super Splash Heroes', a group of water saving heroes. Online content and the website offers educational resources for teachers and schools, as well as supporting fun learning for children and families with online activities, worksheets, videos and even information about the broad range of careers available within the water industry.

Pupils from Key Stage 1 through to school leavers can find out more about the industry and the part it plays in the water cycle, interacting with nature to protect one of Earth's most important natural resources.

See: https://www.nwl.co.uk/your-home/learn-about-water.aspx

A short stage production aimed at schools and young children also tours our regions and promoting the key messages through the Super Splash Heroes.

We regularly have employees as speakers in schools and for interest groups to give a presentation about water. These presentations include the key messages about using water wisely targeted as appropriate for the age group.

10.6.8 Commercial customers

As of 1 April 2017, non-household customers will be able to choose their water retailer and it will be the responsibility of the water retailer to keep businesses updated about necessary messages around general water efficiency.

In a drought situation it would be the most efficient way to communicate with non-household customers through their water retailers and this would be done through our Wholesale Team.

Our External Communications team would prepare a briefing note for distribution to all water retailers fairly and in-line with regulations relating to conversations with water retailers and wholesale operators.

10.6.9 Roadshows/Exhibitions

Roadshows and exhibitions can be a useful tool to give domestic customers the opportunity to find out more about water efficiency, discuss this with our staff and provide water saving products as appropriate. This form of communication is an effective mechanism to provide a one-to-one service in a public environment.

We occasionally run or take part in road shows/external exhibitions to help communicate these messages and encourage customers to request available water saving products.

For example, during August 2016, TV gardener Christine Walkden gave four talks on saving water in the garden and these were attended by 150 people.

10.6.10 Newsletters

Newsletters are used to provide information but on a regular basis to a large number of people.

A series of newsletters called 'Water efficiency news' are produced to keep our regulators, stakeholders and other interested organisations up to date with our progress with water efficiency. The newsletter contains details of our many water efficiency campaigns, projects and initiatives.

During a drought situation, newsletters would be used to update external stakeholders on a regular basis.

10.7 Communication methods during a drought

In a drought, existing communication is increased and further integrated for maximum effect. Additional items may include, as appropriate:

- door to door mail shots
- local press and radio advertising campaigns
- regular media releases offering latest information and guidelines
- social media campaigns Twitter/YouTube
- joint TV campaigns with neighbouring water companies
- poster sites/billboards
- stakeholder workshops
- articles in parish council and borough magazines
- negotiated point of sale material at garden centres and DIY outlets
- fact sheets and drought themed activities distributed to all schools in critical supply areas
- prominent facts and tips on our websites
- message on bills, envelopes and company vehicles
- messages as standard footer on company emails.
- roving displays (libraries, village halls, shopping centres)

In addition, it is essential to keep our most valuable communication ambassadors, our employees, fully informed of the company's position, priorities and progress so they in turn can give accurate information and advice to any customers. Weekly bulletins are used, and employee briefings given to cascade information through the company.

10.8 Communication with the Environment Agency

Communication with the Environment Agency outside normal (non-drought) conditions is regular and often. The frequency of this communication will inevitably increase during drought conditions.

Public relations issues will also be dealt with at water company liaison meetings with the Yorkshire and North East area of the Environment Agency as required.

It is anticipated that the increased liaison with the Agency will also be required to discuss DMG decisions.

The Environment Agency (Yorkshire and North East Region) has its own Area Drought Plans.

The Plan sets out how the Environment Agency will plan for and manage drought in the area.

Key elements of the Environment Agency's Area drought plan are:

- The Area's drought management structure;
- the drought monitoring that will be undertaken by the Environment Agency;
- the drought management actions that the Environment Agency may need to take and the triggers for these actions;
- how the Environment Agency are involved with drought permit and drought order applications;
- the Area's drought communications actions; and
- how the Area will report on drought.

10.9 Data and Information Exchange with the Environment Agency

Data and information exchange with the Environment Agency occurs regularly and often under normal operating conditions, and it is anticipated that this will increase during the course of a drought.

Both organisations collect hydrometric data and fund/undertake studies and surveys that would feed into environmental monitoring required both under non-drought (baseline), drought and post-drought (recovery) conditions.

In general terms where requests for data are reasonable and necessary, there have historically been few restrictions in the flow of data and information between the two organisations, and we see no reason why this should not continue into the future.

10.10 Communication with Other Organisations

We recognise that in addition to communication with customers and the Environment Agency there are other organisations that we must keep informed during a drought.

As early as possible during such decision making, contact will be made with (but not restricted to) the following organisations as appropriate:

Organisation	Area of Interest/Responsibility
Consumer Council for Water	Customer representations, vulnerable groups etc.
Ofwat	Funding implications, levels of service
Neighbouring Water Companies	Opportunities for support; sharing of resources, modifications to bulk supply arrangements.
Fire Service	Securing water supplies for emergency fire and rescue needs.

Communications with all the organisations outlined above already occurs on an ongoing basis regardless of whether in a drought or not, and this is highlighted above.

The list of organisations above is not exhaustive. A wider range of stakeholders will also contacted by letter, electronic newsletter and personal briefing as appropriate; including:

- MPs, MEPs
- Councillors
- County, Borough and parish councils
- Regulators and authorities e.g. DWI.
- NGOs/ Interest groups– such as County Wildlife Trusts, RSPB, Royal Horticultural Society, National Farmers Union

11 POST DROUGHT ACTIONS

The true end of a drought can only be determined retrospectively. Recovery from drought will be manifested by drought trigger levels being approached from the direction of an improving situation of increasing reservoir levels and groundwater levels. The recovery or potential recovery from drought will be monitored by our Water Resources Team and the Drought Management Group (DMG).

The decision to reduce the drought actions described above must be carefully judged since an apparent ending of drought conditions could easily be confused with a temporary respite in a prolonged drought sequence. Trigger levels, the current resource situation, and operational experience of the DMG will be used in determining when drought actions can be reduced.

There are no additional actions proposed associated with drought recovery. Rather, existing procedures in terms of data collection and interpretation combined with communication with the Environment Agency will be continued until normal operations can resume.

When a drought has ended and normal operating conditions have resumed, we will, where appropriate, initiate an internal Post Drought Review (PDR). The review will enable an opportunity to identify lessons learnt and also consider potential improvements both to the Drought Plan and wider drought management strategy. Additionally and where appropriate the need for future investment to limit the impact of similar drought conditions occurring in the future will be considered, as will the need for any additional monitoring. Recommendations for improvement to the drought management process will be made where appropriate. Consultation would also take place with the neighbouring water companies to review any actions which had been required to provide them with additional water. The PDR will examine:

- The hydrological conditions leading up to the drought and the effectiveness of drought indicators.
- The effectiveness of drought trigger levels and any need for their review or redefinition.
- The management decisions made during the course of the drought in view of the timing of the drought actions.
- The effectiveness of actions in reducing demand.
- The effectiveness of the Communications Plan.
- The overall performance of the DMG.

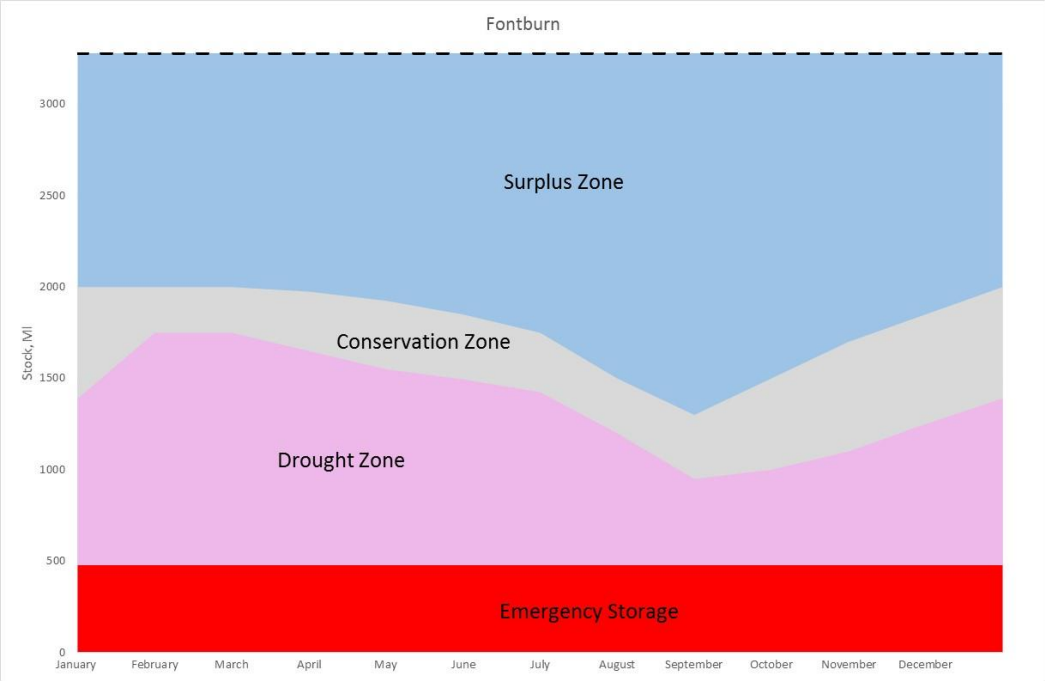
Appendix 1: Impounding Reservoir Control Curves

Control Curves

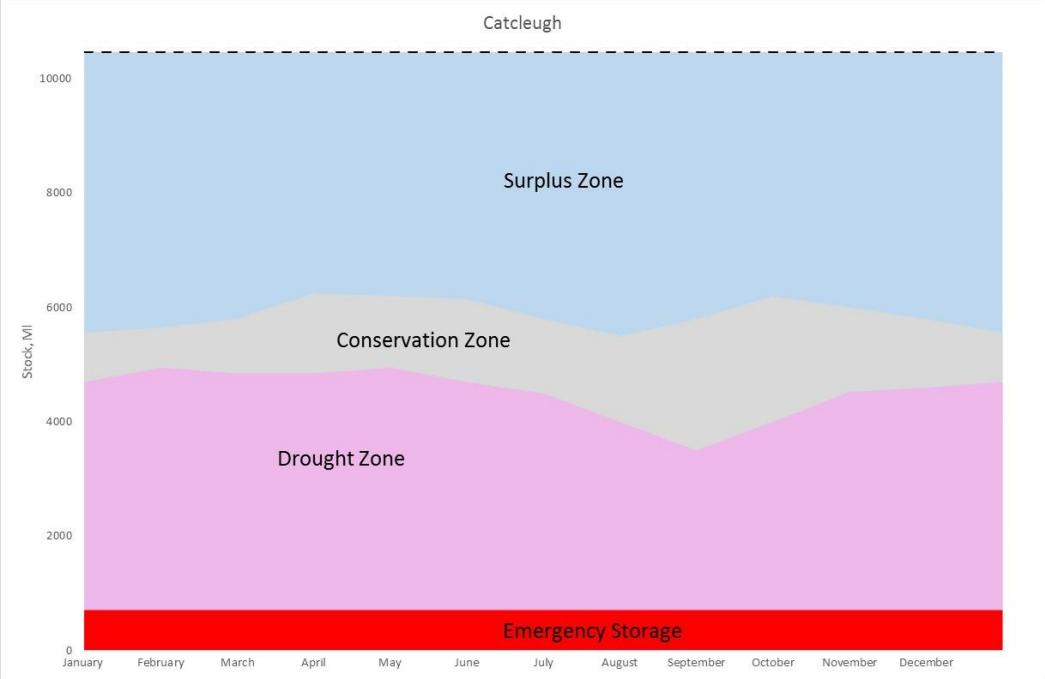
The following are examples of control curves which govern the operation of impounding reservoirs at various levels throughout the year. As the reservoir level drops through these curves specific actions have to be taken. Typically in the Surplus Zone water can be taken to the maximum licenced volume. When the level drops into the Conservation Zone abstraction has to be reduced. As the level continues to drop, falling into the Drought Zone further restrictions on abstraction are applied. The majority of these curves form part of the Kielder Water Resources Control Manual which has been drawn up in conjunction with the Environment Agency and which is an appendices to The Kielder Operating Agreement.

Emergency storage is calculated as 30 days of compensation flow plus 30 days of minimum operational flow from the reservoir plus dead water and also includes an estimation of lost storage due to sediment build up in the reservoir.

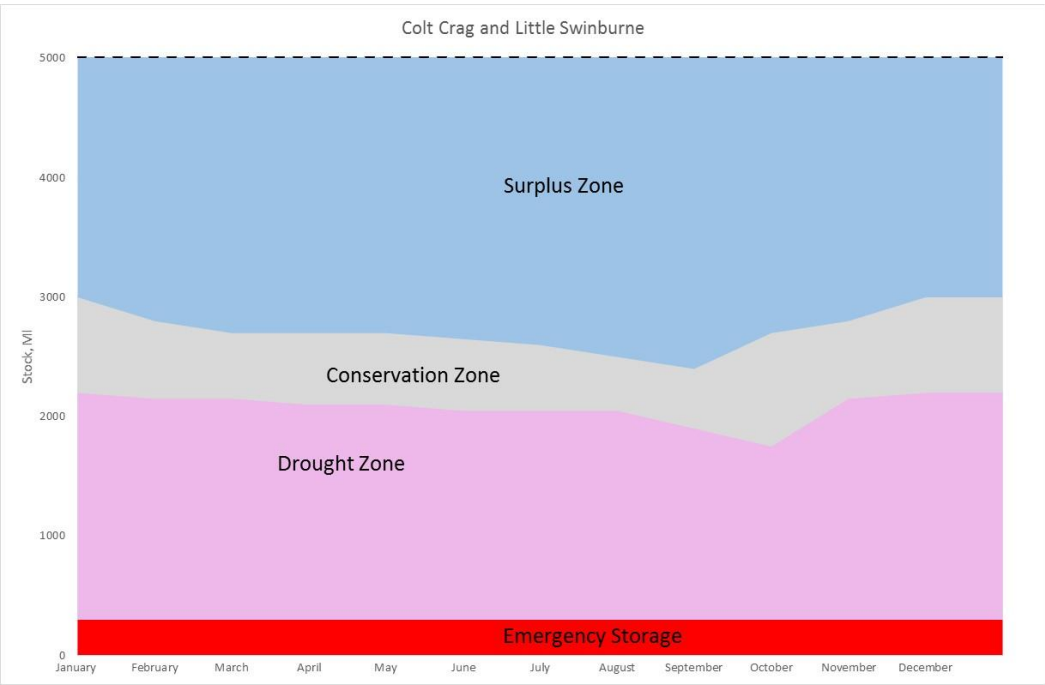
Fontburn: If the reservoir level is in the surplus zone the WTW can be maximised up to its maximum treatment capacity of 19Ml/d. When the reservoir level falls into either the conservation or drought zone then the WTW flow is restricted to a maximum flow of 16Ml/d, note the model will automatically reduce the WTW flow down to is minimum of 14Ml/d as the reservoir stock gets low.



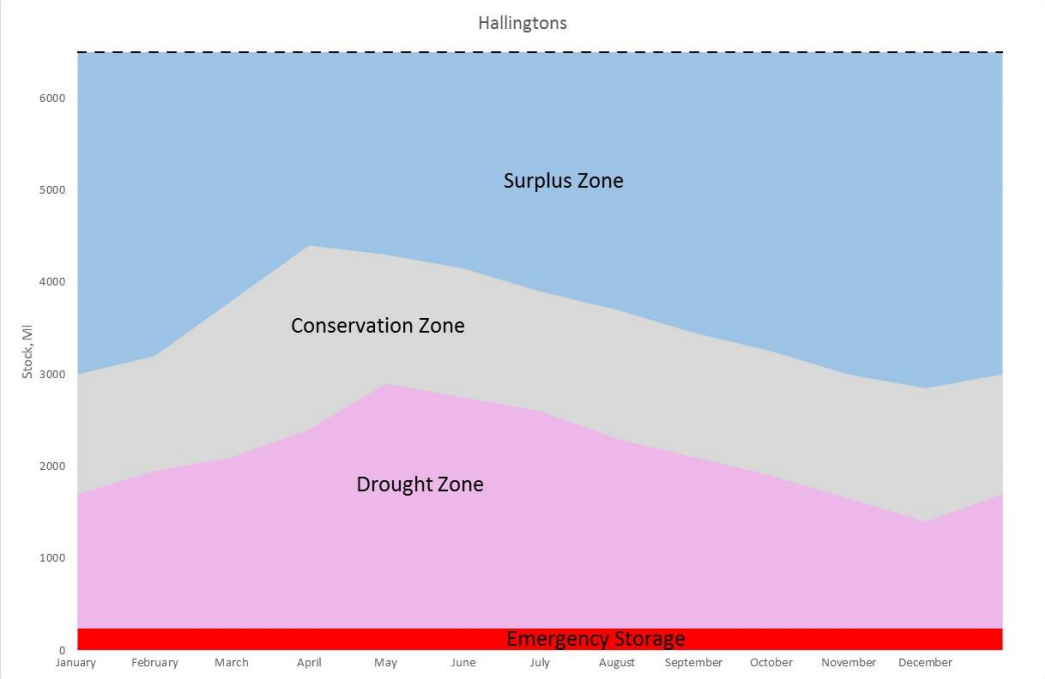
Catcleugh: If the reservoir level is in the surplus zone then the flow down the Rede pipeline is maximised at 62.5Ml/d. When the reservoir enters the conservation zone the flow is restricted to a maximum flow of 55Ml/d, and as the reservoir enters the drought zone the flow is restricted to a maximum flow of 20Ml/d.



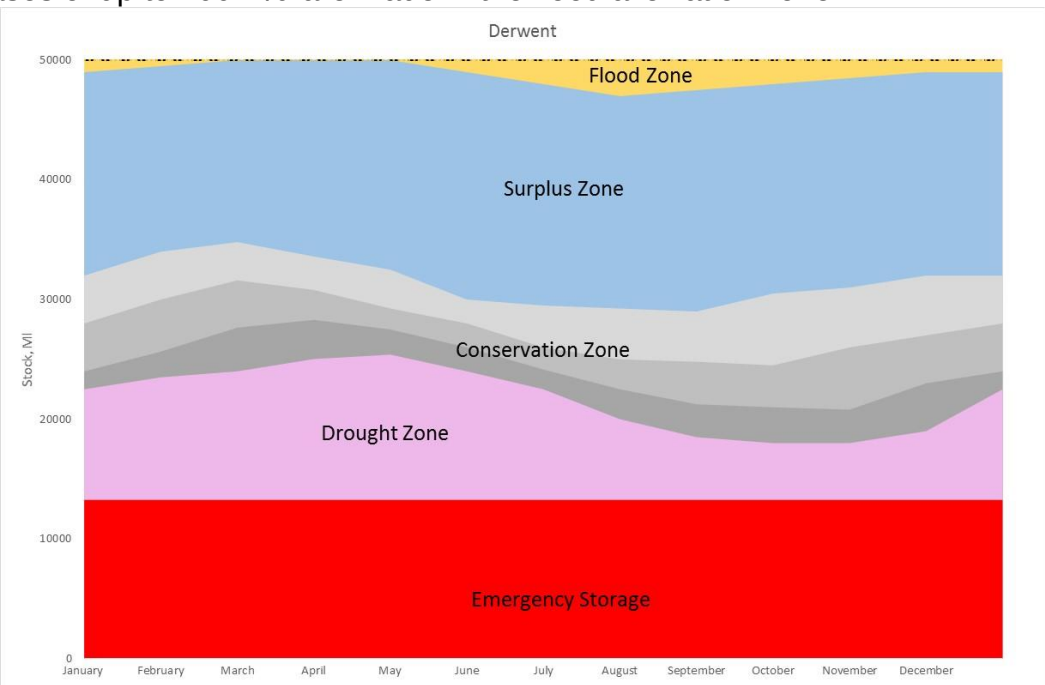
Colt Crag & Little Swinburne: If the reservoir level is in the surplus zone then the flow to Hallingtons is maximised at 20Ml/d. When the reservoir enters the conservation zone the flow is restricted to a maximum flow of 10Ml/d, and as the reservoir enters the drought zone the flow is restricted to a maximum flow of 5Ml/d.



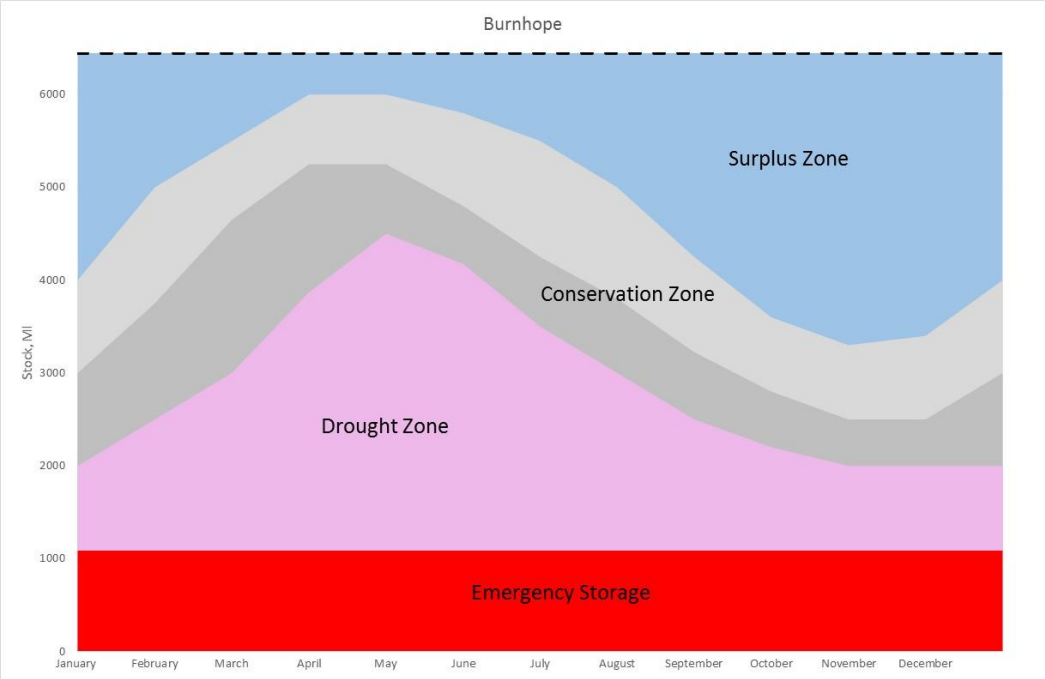
Hallington: If Hallington level is in the surplus zone then no pumping is done from Barrasford RWPS, if Hallington level is in either the conservation or drought zone then Barrasford RWPS runs between 40Ml/d and 56Ml/d.



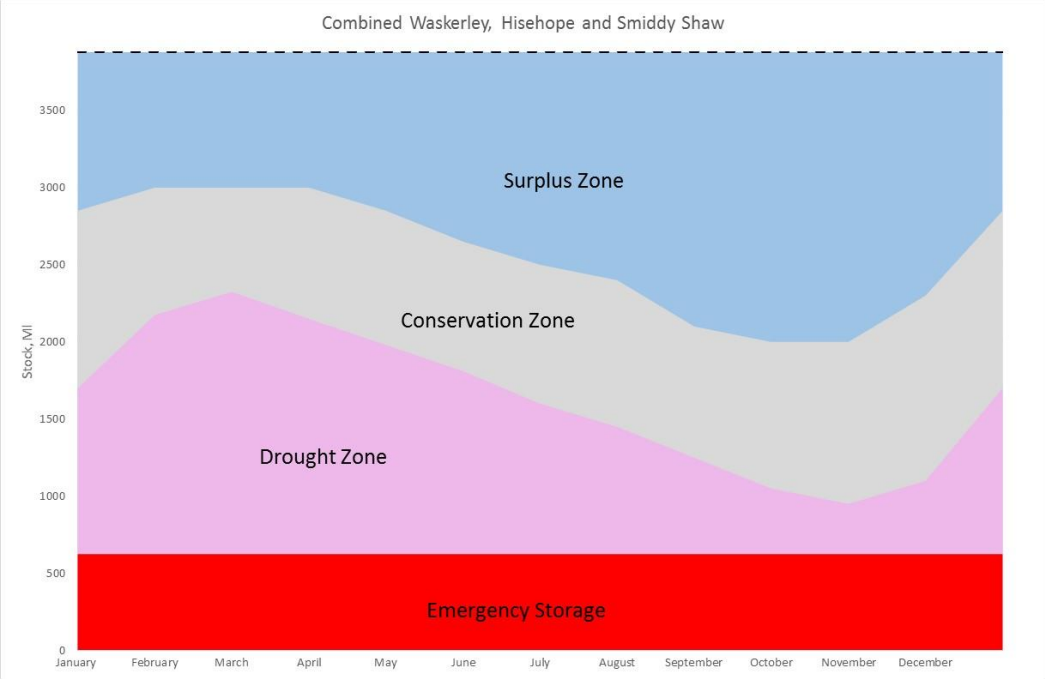
Derwent: If Derwent is in the surplus zone then there is no restriction on use apart from the licence limitations. When Derwent enters the first conservation zone Mosswood WTW is restricted to 110Ml/d, in the second zone Mosswood remains restricted to 110Ml/d and Derwent compensation water is replaced with water from the Tyne-Tees Tunnel (TTT). If the reservoir enters conservation zone three then flow from Derwent to Mosswood is restricted to 90Ml/d, Derwent compensation water is via the TTT and Mosswood WTW can also receive up to 70Ml/d of water from the TTT. In the drought zone flow from Derwent to Mosswood is restricted to 70Ml/d, Derwent compensation water is via the TTT and Mosswood WTW can also receive up to 70Ml/d of water from the TTT.
Releases of up to 200Ml/d are made in the flood alleviation zone.



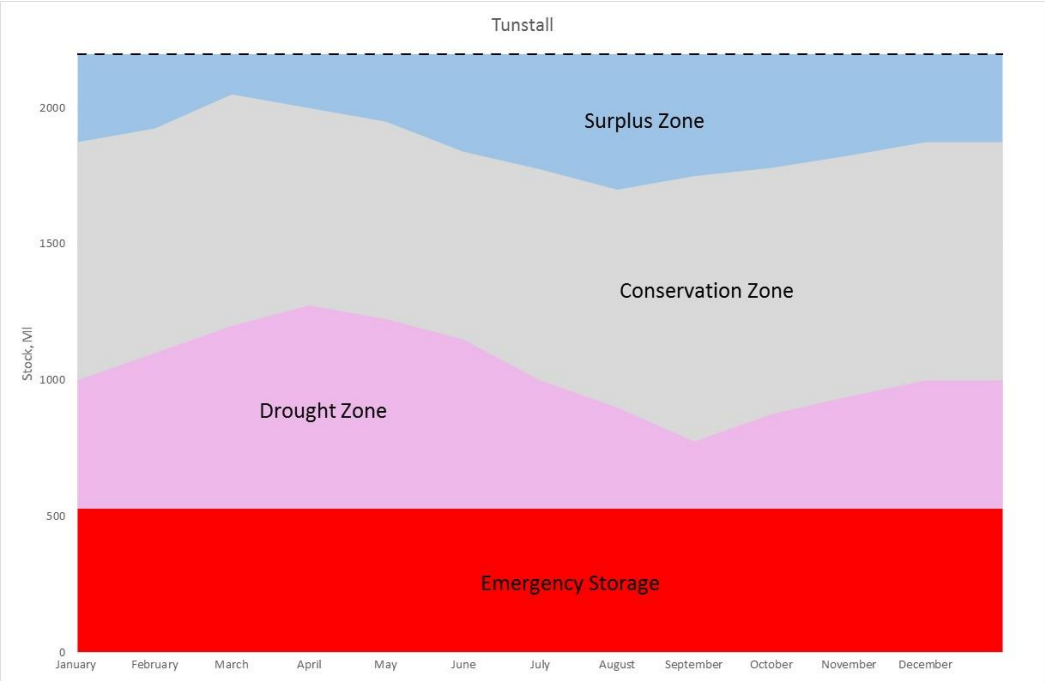
Burnhope: In the surplus zone Wear Valley WTW can be used up to its treatment capacity of 34Ml/d and the transfer across to Waskerley reservoir can run up to 20Ml/d. When the reservoir enters the first conservation zone flow from the WTW can still run at 34Ml/d but the flow to Waskerley is restricted to 10Ml/d. As the reservoir enters the second conservation zone the flow to Waskerley is switched off and the WTW flow is restricted to 25Ml/d. In the drought zone Wear Valley is restricted to 20Ml/d.



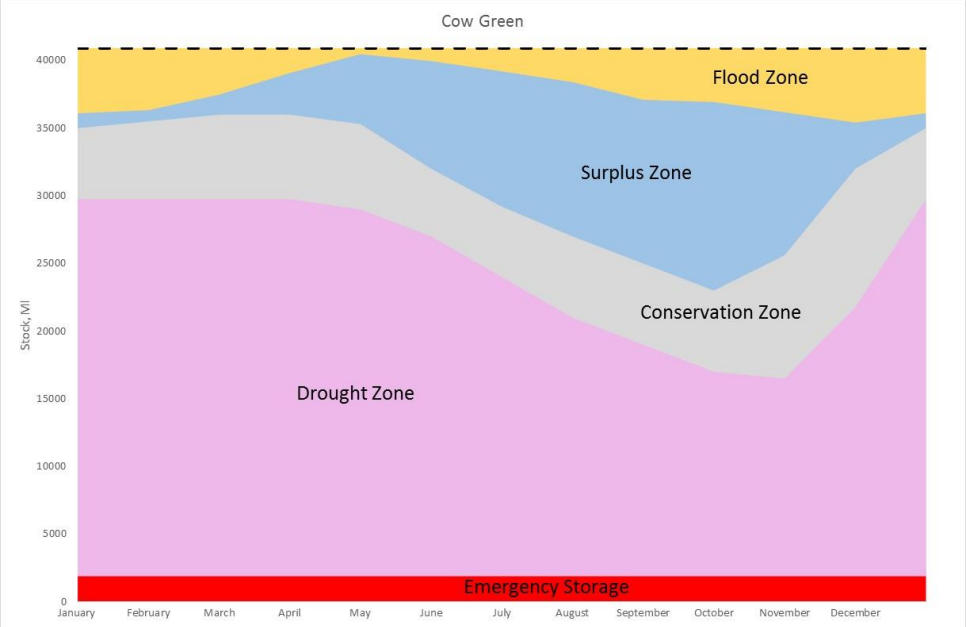
Honey Hill: Although Waskerley, Hisehope and Smiddy Shaw are individual reservoirs in the model they are also part of a reservoir group and the control curves apply to the reservoir group.
If the reservoir is in the surplus zone then Honey Hill WTW can operate at its treatment capacity of 45Ml/d, as the storage drops into the conservation zone then Waskerley Air Shaft (WAS) pump starts supporting the reservoir at a flow of 19.5Ml/d and Honey Hill WTW is restricted to 38Ml/d. In the drought zone Honey Hill WTW is restricted to 30Ml/d.



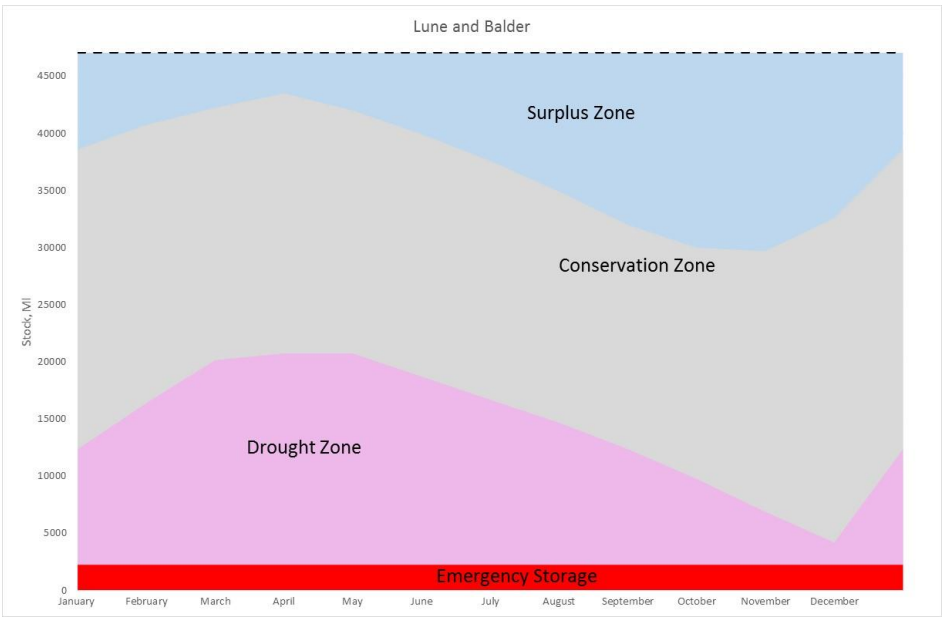
Tunstall: When the reservoir storage is in the surplus zone, river regulation releases can be made as required to support the MMF in the River Wear, up to a maximum of 30Ml/d. As the reservoir enters into the conservation zone, regulation support to the River Wear are gradually reduced to zero. In the drought zone only compensation releases are made.



Cow Green: When the reservoir is in the flood alleviation zone releases of up to 250Ml/d are made. In the surplus zone water is released from the reservoir to support downstream abstractions and prescribed flows as required. In the conservation zone water is released from the reservoir at flows up to 250Ml/d, and in the drought zone the maximum release is 200Ml/d.



Lune & Balder: Although Selset, Grassholme, Balderhead, Blackton and Hury are individual reservoirs in the model they are also part of a reservoir group and the control curves apply to the reservoir group.
In the surplus zone Lartington WTW can operate at its treatment capacity of 128Ml/d and river regulation releases can be made as required. When the total storage enters the second conservation zone then Lartington WTW is restricted to 121Ml/d, and in the drought zone Lartington WTW is restricted to 65Ml/d.



Selset: The hydro generation curves for Selset are included in the model, in regime 3 zone the hydro runs at 216Ml/d, in regime 2 zone the hydro runs at 173Ml/d and in regime 1 zone the hydro runs at 83Ml/d.