Appendix 9

Drought Permit Application Ready Documents

Contents

1. Introduction

This Appendix provides supporting information to meet government guidance regarding the preparation of drought permits, which states 'applications for drought permits and orders should, where possible, be ready to submit before they're needed'[1].

The document provides information to support applications for the following proposed drought permits, which are presented as separate sections:

- River Nene Intake (Pitsford Reservoir)
- River Nene Intake (Rutland Reservoir)
- River Great Ouse Intake (Grafham Water)
- Alton Water
- River Colne Augmentation (Ardleigh Reservoir)
- Wellington Wellfield (Marham)
- River Wensum (Costessey Boreholes)
- River Trent

Although presented here as a single document, the application ready packs are structured so that they can be read separately.

For each proposed drought permit, the recommendations set out by the Environment Agency[2] have been followed. Where information cannot be provided at this stage, we have described what our approach to obtaining and presenting the required detail would be.

All our drought permits have accompanying Environmental Assessment Reports (EARs) which assess the potential environmental impact of the drought permit and propose associated monitoring and mitigation requirements. These have been reviewed and updated for the Drought Plan 2019. The EARs for the Wellington Wellfield and Alton Water drought permits are still in the process of being updated, but we are committed to completing these as soon as possible in close liaison with the Environment Agency. The drought permit at Alton Water is also currently under review, and will be included in the next Drought Plan update, currently due to be published as draft in 2021.

From our environmental assessments, we do not currently consider compensation is required as a result of the implementation of any drought permits except for the Wensum (Costessey boreholes) permit. This has been assessed during a review of mitigation requirements and details are included in the EARs, which are available on request. A summary of the EARs is also included in Appendices 7 and 8. We will continue to review compensation requirements for all sites during EAR/mitigation updates that are routinely undertaken. Any changes will be included in the next Drought Plan update.

[1] *https://www.gov.uk/government/collections/how-to-write-and-publish-a-drought-plan*
[2] *Drought plan guideline extra information - Drought permit and order application ready (Environment Agency, November 2016).*

2. River Nene intake (Pitsford Reservoir)

2.1 Current licence and proposed drought permit

2.1.1 Current Licence

Anglian Water is licenced to abstract from the River Nene for Pitsford reservoir.

The licence is subject to maintaining a Minimum Residual Flow (MRF) of 34.1 Ml/d in the River Nene immediately downstream of the abstraction point.

2.1.2 Proposed drought permit

The following permit application would be made for the River Nene:

- Reduction of the MRF by 50%, from 34.1Ml/d to 17.05Ml/d

As per current guidance, the drought permit would initially cover a six month period[3] of either October to March (inclusive) for a winter permit or April to September (inclusive) for a summer permit. Subsequent reapplication for a further six months would be considered if required, depending on the drought situation at the time.

The proposed drought permit would be triggered when storage in Pitsford Reservoir is reduced and flows in the River Nene are low, although other factors such as water quality and rainfall will also play a factor.

Under the most likely scenario, a winter drought permit would be sought after a dry winter and summer, enabling us to refill the reservoir during the following winter. This typically corresponds to a natural increase in flows (and hence water available for abstraction) and a reduced sensitivity for the majority of potential environmental receptors. However, should drought conditions continue to present a significant risk to supply, a summer drought permit may also be considered as an option.

We have developed triggers to guide us through the different stages of the drought permit application process, and these are detailed in Appendix 4.

A copy of our current abstraction licence and a draft permit is available on request.

[3] *https://www.gov.uk/guidance/apply-for-a-drought-permit*

2.2 Justification of the need

2.2.1 Exceptional shortage of rain

For a drought order or permit to be granted, there is a legal requirement to demonstrate that '...by reason of an exceptional shortage of rain, a serious deficiency of supplies of water in any area exists or is threatened...'.

Environment Agency guidance[4] states that it is not appropriate to set a prescriptive approach to assessing the exceptional shortage of rain (ESOR) as each drought and each situation is unique. The guidance provides a range of matters to consider when building the case for ESOR. This section provides an overview of our process for demonstrating an exceptional shortage of rain, following the guidance.

Rainfall is a key indicator in assessing drought conditions. Drought events vary in their duration, the time of year they commence and their magnitude (the extent of the rainfall deficit). Soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, streamflow and reservoir storage reflect the longer-term precipitation anomalies. These factors combine to produce a wide range of impacts on water resources. As such, it is not possible to define the exact process of rainfall assessment in advance of a drought occurring. The following data sources and methods would be used:

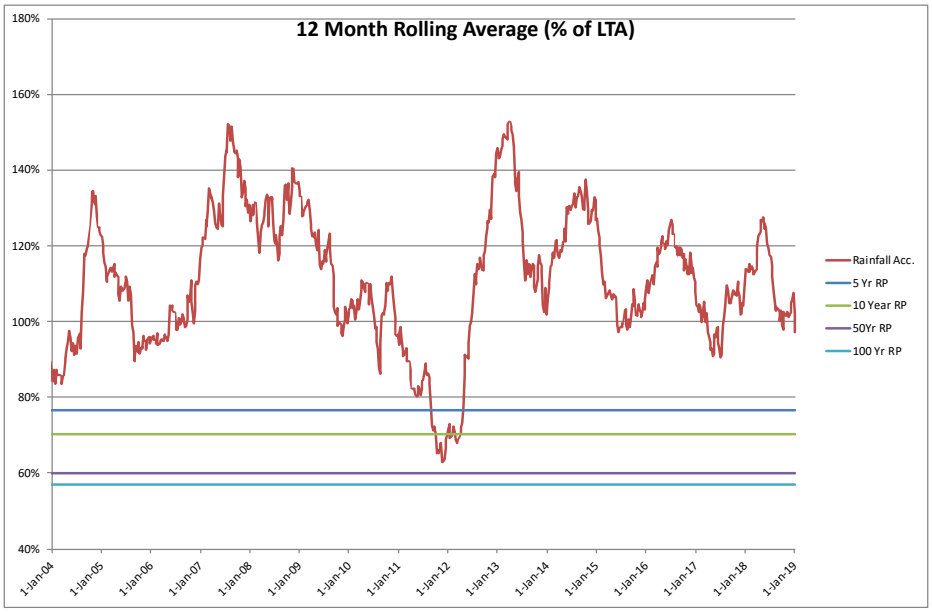
Rainfall accumulation data

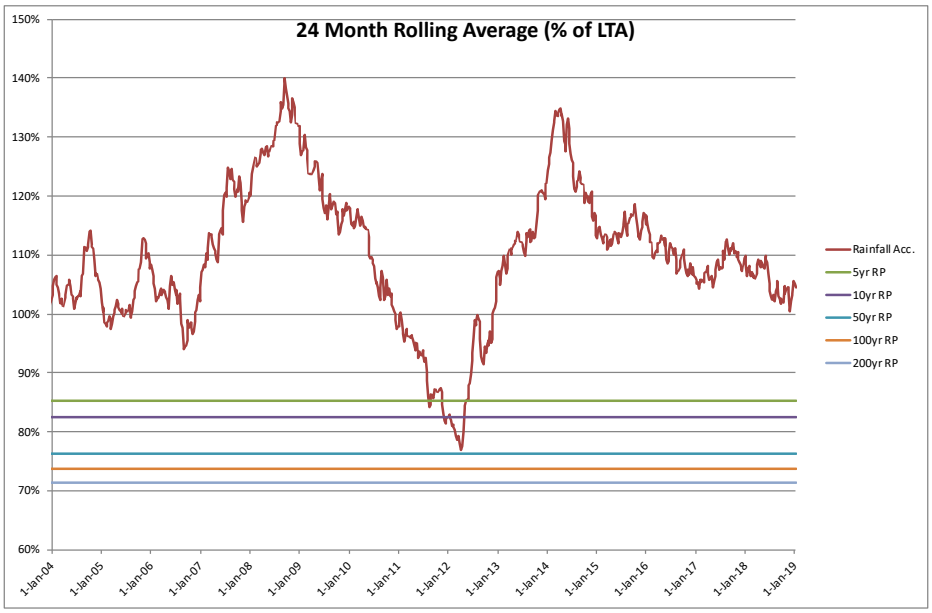
We have used Bayesian Extreme Value Analysis, carried out by the Met Office[5] to determine 1:5, 1:10, 1:50, 1:100 and 1:200 return periods (RPs) of 12, 24 and 36 month rainfall accumulation totals for the Ruthamford, Lincolnshire, Trent, Affinity, Norfolk and Suffolk sub-regions.

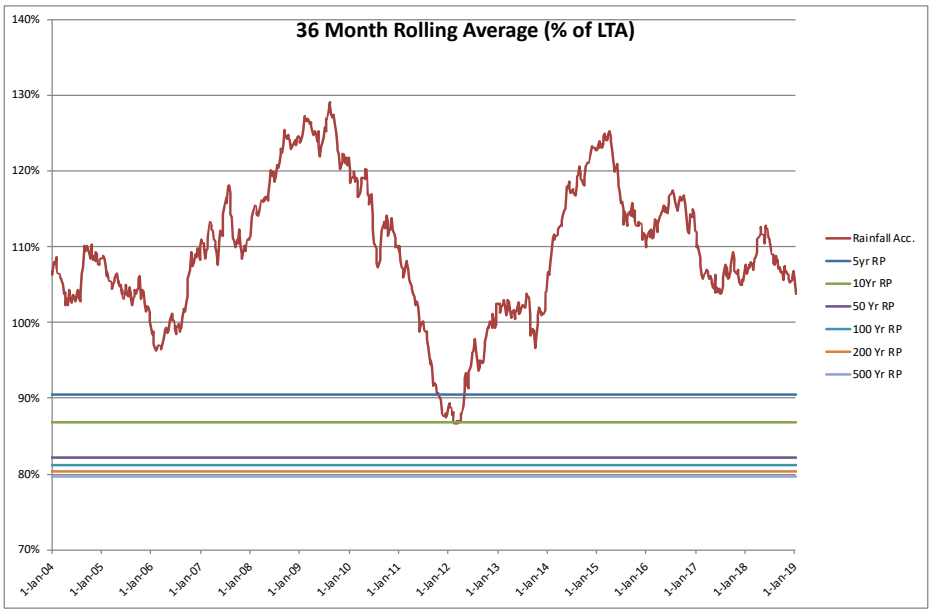
For the River Nene, we would use rainfall accumulations from the regional MORECS squares which cover the River Nene catchment upstream of the abstraction point (137 and 138). Deviation from the long term average would be monitored and compared to the Met Office return periods (Figure 2.1). The use of 12, 24 and 36 month timescales allows the pattern and magnitude of both annual and longer term rainfall deficits (e.g. 1 or 2 dry winters) to be measured.

[4] *EA Drought Planning Guideline: Exceptional shortage of rain*
[5] *Technical Note: Extreme Value Analysis of long duration droughts using Bayesian methods (Met Office, Oct 2017)*

Figure 2.1: 12, 24 and 36 month rolling rainfall accumulation (as a % of 1900-1990 long term average) with Met Office return periods plotted (MORECS Square 137 and 138)







Atkins has carried out analysis of rainfall accumulation of historic and representative stochastically generated droughts at the sub-regional scale for the Anglian Water region[6]. We would compare the pattern and timings of contemporary rainfall accumulations with these historical and stochastic droughts in our assessment.

Standardised Precipitation Index

To support a drought permit application we would also use the Standardized Precipitation Index (SPI) to indicate the rarity of a current drought. This would be calculated for a range of timescales (12, 24 and 36 months). The relevant MORECS square for the Nene catchment (138) would be used as the base data.

SPI values can be classified as shown in Table 2.1 following McKee et al. (1993)[7]. The World Meteorological Organisation's user guide[8] defines a drought event as occurring any time the SPI is continuously negative, and reaches an intensity of -1.0 or lower. The drought event ends when the SPI becomes positive. The sum of the SPI for all the months within a drought event can be termed the drought's 'magnitude'. The guide also provides an estimate of the return periods of a drought by SPI (Table 2.2).

Table 2.1: SPI Values

2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

Table 2.2: SPI probability of recurrence

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

Other indicators of ESOR

We would support a case for exceptional shortage of rain by presenting other measures of effective rainfall, such as soil moisture deficit, temperature, river flows and groundwater levels. This would include comparison to the long term average and trend analysis.

We would also describe our current and forecast operational water supply situation, to include reservoir storage levels against normal operating curves, and forecast projections for a range of rainfall scenarios. Relevant impacts and mitigation actions carried out in the wider supply system would also be detailed.

2.2.2 Order of Use

Not applicable in circumstances where multiple permits are not required.

[6] *Drought Selection Process and Criteria - Anglian Water Services (Atkins, 2017)*
[7] *McKee, T.B., N.J. Doesken and J. Kleist, 1993: The relationship of drought frequency and duration to time scale. In: Proceedings of the Eighth Conference on Applied Climatology, Anaheim, California, 17-22 January 1993. Boston, American Meteorological Society, 179-184.*
[8] *World Meteorological Organization, 2012: Standardized Precipitation Index User Guide (M. Svoboda, M. Hayes and D. Wood). (WMO-No. 1090), Geneva.*

2.3 Environmental Assessment

The March 2020 Environmental Assessment Report by Mott MacDonald/Atkins assessed the potential environmental impacts of implementing the proposed drought action, following Defra and Environment Agency guidance. The findings are summarised in Appendix 7 and 8, with a brief overview here.

Impact on river water level was perceived to be minimal, although there is a greater potential for impact under a summer permit should lock operation peak significantly. There is a risk of increased Phosphate and Ammonia concentration, as well as a reduction in Dissolved Oxygen. This may impact upon fish communities, macroinvertebrates, macrophytes, navigation, and aesthetics.

The report concluded that there is a potential for low impacts of a winter permit, and moderate impacts of a summer permit. The Habitat Regulations Assessment (HRA Stage I: Screening Assessment) concluded that there are no likely significant effects of the proposed drought permit upon European designated sites.

Monitoring and mitigation requirements were identified in the environmental assessment and informed the Environmental Monitoring Plan.

The key findings of the environmental assessment are summarised in Table 2.3.

Table 2.3: Summary of potential impacts to environmental receptors as a result of the proposed drought permit on the Nene for Pitsford

Issue	Predicted Impact (Winter)	Predicted Impact (Summer)	Commentary
Impacts on Navigation and Recreation	Low	Moderate	Water levels controlled by locks, tilting gates and weirs. Navigation peaks in summer months, lock operations and demand for water will be higher. Algal blooms and weed choking may impact navigation and reduce aesthetic appearance.
Impacts on Water Quality	Moderate	Moderate - High	Reduced dilution capabilities. Phosphate concentrations risk increasing. Ammonia release from CSOs following storm conditions. DO decrease through reduced flows and algal blooms.
Fisheries Health (main river)	Low - Moderate	Moderate	Deterioration in water quality may impact fish communities. Effects are more pronounced in summer.
Fish spawning (backchannels)	Low	Moderate	Both early and summer spawners potentially affected by reduction in MRF. Gravel spawners most likely to be impacted.
Fish passage	Low	Moderate	Impact on eel migration during winter drought. Other species will be migrating in summer, a reduction in MRF may impact summer fish migration.
Impacts on macroinvertebrates	Low - Moderate	Moderate	Reduction in water quality may impact communities. Impacts on water quality more significant in summer. Risk of sedimentation and reduced flows already stressors for community.
Macrophytes	Low	Moderate	Water quality deterioration may alter communities.
Diatoms	Low	Moderate	Algal blooms possible risk in summer with phosphate levels already high.
Impacts on abstractors	Low	Low - Moderate	No perceived significant impacts on other abstractors during winter. Spray irrigators could be affected by reduced water levels.

Table 2.4 shows baseline, pre-drought, during drought, mitigation measures and post drought surveys for the proposed drought action on the Nene for Pitsford.

Table 2.4: Monitoring and mitigation measures

Baseline surveys and outstanding actions (normal/ non-drought conditions) • Routine monitoring • Continuous water quality monitoring at Duston Mill.
Pre-drought surveys (commence in potential drought) • Increased biological monitoring, including macroinvertebrates, macrophytes and fish surveys as well as water quality. • Communication with the Environment Agency and other key stakeholders.
During drought (commence in drought period) • Water quality monitoring upstream of Duston Mill, and downstream of Broadhome and Great Billing (Water Recycling Centres (WRC). • Enhanced monitoring of the biological community (macroinvertebrates, macrophytes and fish). • Monitoring of water levels at South Bridge and Bedford Road Sluice.
Mitigation measures (commence on implementation of drought permit) • Funding towards weed cutting and dredging in response to any navigational impacts • Variable abstraction • Reduce abstraction during busy navigation periods and cease abstraction if water quality or water levels deteriorate below acceptable levels. • Flow support to backchannels if required.
Post drought (commence after drought permit has been lifted) • Continued flow monitoring in the River Nene to ensure that drought permit actions are no longer required. • Continued water quality and biological community monitoring to assess the need for continuation of mitigation measures.

2.4 Stakeholder consultation and implementation strategy

2.4.1 Stakeholder consultation

We have obtained pre-consultation advice from the Environment Agency and Natural England (where required) on our Environmental Assessment Reports, including the Water Framework Directive (WFD) assessments, HRA Stage I Screening reports, and the proposed mitigation and monitoring measures, as part of the development of the Drought Plan 2019. We have also obtained statutory consultation advice from the Environment Agency, Natural England, and Historic England on the SEA Scoping report. Any concerns have been addressed through the Environmental Assessment Reports and SEA report, and fed into the Environmental Assessment Summary and Environmental Monitoring Plan as summarised above.

Other relevant stakeholders will be consulted during the Drought Plan 2019 consultation period, with any concerns being addressed for the final Drought Plan. Other stakeholders include:

- The Navigation Authority (Environment Agency)
- Other abstractors
- Recreational user groups
- Other interested parties

No significant concerns are anticipated for this proposed drought permit, as it has been made available for consultation in previous drought plans.

For our full drought permit application we would include the following, as recommended by the guidance:

- Written consent from the Environment Agency;
- Comments from those consulted about the application;
- Details of any objections received or agreements reached with objectors;
- A copy of the notices and advertisements relating to our application; and
- A description of our arrangements for the public inspection of the application.

2.4.2 Advertising the application

Our drought permit application would by published in the local newspaper circulating in the area affected by the permit (Northampton Chronicle and Echo). The newspaper also has a website. We would also advertise it in the London Gazette, as recommended by the guidance. We would consider publishing targeted social media updates in line with our communications strategy (Drought Plan 2019 Appendix 10).

2.4.3 Planning for all outcomes

We plan to engage with relevant stakeholders and address concerns in the creation of our drought plan and as part of the consultation process. In the event of a public hearing, we would confirm arrangements closer to the time. We have a number of regional Anglian Water offices which could be used as a venue or would seek alternative venues as appropriate.

We would liaise closely with the Environment Agency before and during any permit application to ensure we have their support. We have agreed a robust mitigation programme with the Environment Agency and do not anticipate significant issues which may result in a public hearing.

In event of unsuccessful permit we would need to consider other supply side options, such as rezoning or tankering, as well as increasing demand saving activities.

2.4.4 Drought Permit review strategy

We would review our drought plan on an annual basis as part of our Water Resources Management Plan Annual Review. Required changes to drought permits would be reported as part of this. Baseline monitoring data would be reviewed on an annual basis and associated updates to the environmental assessment completed as required.

Appendices (on request):

- Draft permit
- Existing abstraction licence - plus a copy of any statutory instrument or local act connected to it or to a discharge permitted by the drought permit

Supporting Information

- Appendix 7: Environmental Assessment Summary
- Appendix 8: Environmental Monitoring Plan.

3. River Nene intake (Rutland Reservoir)

3.1 Current licence and proposed drought permit

3.1.1 Current licence

Anglian Water is licenced to abstract from the River Nene for Rutland Reservoir.

Between December and April inclusive, no abstraction must take place if the rate of flow in the River Nene immediately downstream of the authorised point of abstraction is less than a Minimum Residual Flow (MRF) of 125,000 m^3/d and abstraction would not cause the downstream flow to fall below that rate.

Between May and November inclusive, no abstraction must take place if the rate of flow in the River Nene immediately downstream of the authorised point of abstraction is less than a Minimum Residual Flow (MRF) of 150,000 m^3/d and abstraction would not cause the downstream flow to fall below that rate.

3.1.2 Proposed drought permit

The following permit application would be made for the River Nene abstraction:

- 50% reduction in the summer and or winter MRF (from 125Ml/d to 62.5Ml/d for December to April and from 150Ml/d to 75Ml/d for May to November).

Anglian Water would consider applying for the drought permit in a severe, possibly multi-season drought, if there is a risk of compromising our ability to refill Rutland Water. This is likely to only occur in a severe, multi-season drought. Under the most likely scenario, a winter drought permit would be sought after a dry winter and summer, enabling Anglian Water to refill Rutland Water during the following winter. This typically corresponds to a natural increase in flows (and hence water available for abstraction) and a reduced sensitivity for the majority of potential receptors. We have developed triggers to guide us through the different stages of the drought permit application process, and these are detailed in Appendix 4.

As per current guidance, the drought permit would initially cover a six month period[9] of either October to March (inclusive) for a winter permit or April to September (inclusive) for a summer permit. Subsequent reapplication for a further six months would be considered if required, depending on the drought situation at the time.

A copy of our current abstraction licence and a draft permit is available on request.

[9] *https://www.gov.uk/guidance/apply-for-a-drought-permit*

3.2 Justification of the need

3.2.1 Exceptional shortage of rain

For a drought order or permit to be granted, there is a legal requirement to demonstrate that '...by reason of an exceptional shortage of rain, a serious deficiency of supplies of water in any area exists or is threatened...'.

Environment Agency guidance[10] states that it is not appropriate to set a prescriptive approach to assessing the exceptional shortage of rain (ESOR) as each drought and each situation is unique. The guidance provides a range of matters to consider when building the case for ESOR. This section provides an overview of our process for demonstrating an exceptional shortage of rain, following the guidance.

Rainfall is a key indicator in assessing drought conditions. Drought events vary in their duration, the time of year they commence and their magnitude (the extent of the rainfall deficit). Soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, streamflow and reservoir storage reflect the longer-term precipitation anomalies. These factors combine to produce a wide range of impacts on water resources. As such, it is not possible to define the exact process of rainfall assessment in advance of a drought occurring. The following data sources and methods would be used:

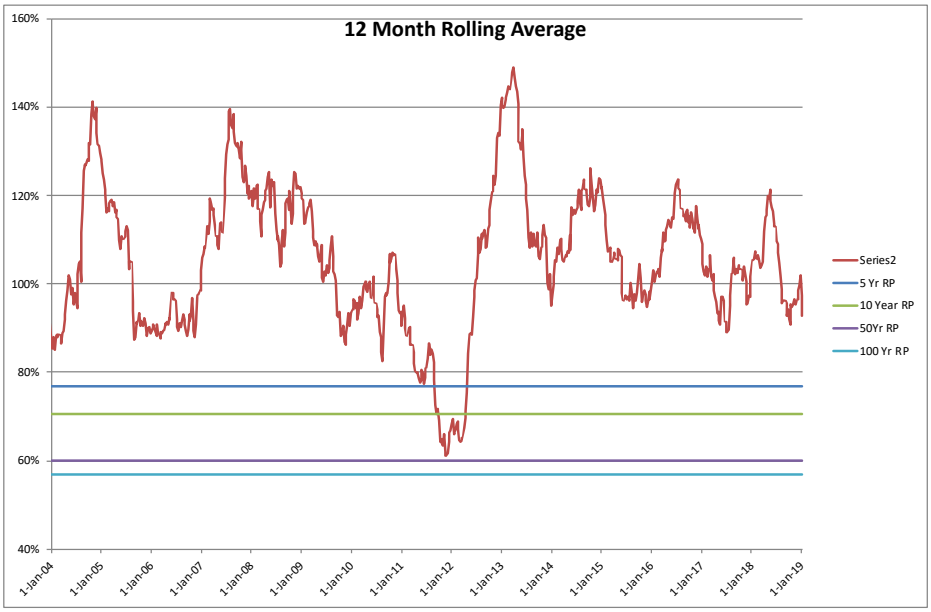
Rainfall accumulation data

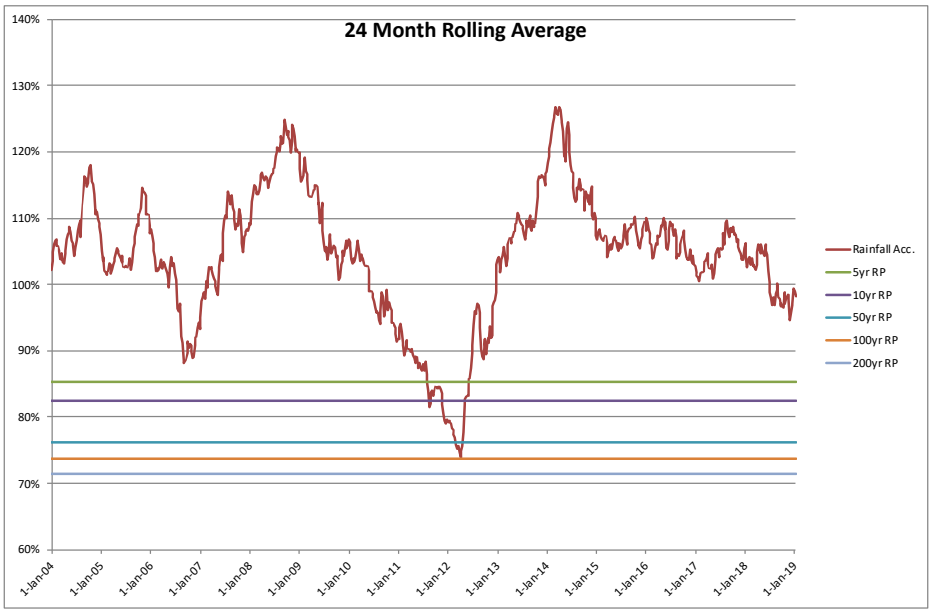
We have used Bayesian Extreme Value Analysis, carried out by the Met Office[11] to determine 1:5, 1:10, 1:50, 1:100 and 1:200 return periods (RPs) of 12, 24 and 36 month rainfall accumulation totals for the Ruthamford, Lincolnshire, Trent, Affinity, Norfolk and Suffolk sub-regions.

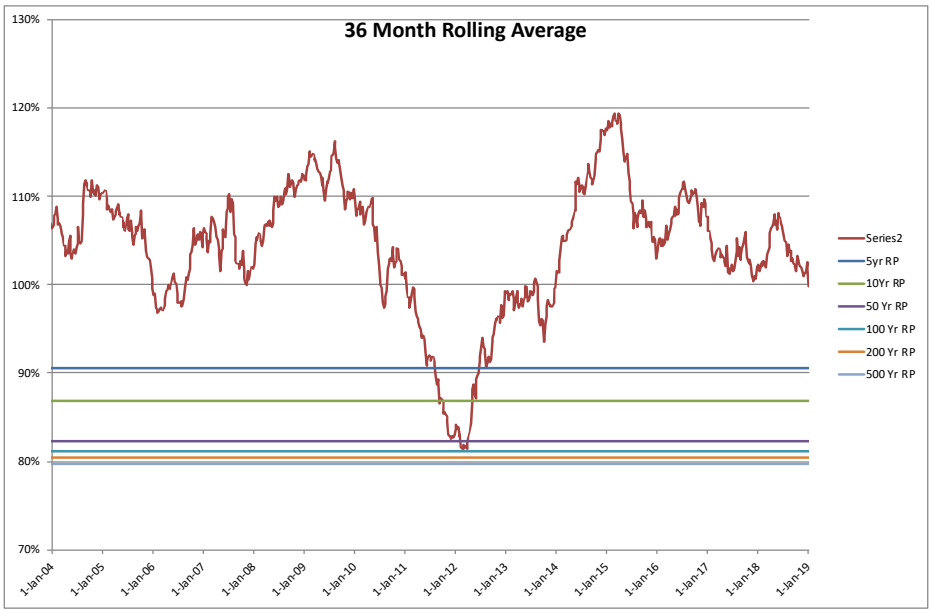
For the River Wissey, we would use rainfall accumulations from the regional MORECS squares which cover the majority of the Nene catchment (127, 128 and 138). Deviation from the long term average would be monitored and compared to the Met Office return periods (Figure 3.1). The use of 12, 24 and 36 month timescales allows the pattern and magnitude of both annual and longer term rainfall deficits (e.g. 1 or 2 dry winters) to be measured.

[10] *EA Drought Planning Guideline: Exceptional shortage of rain*
[11] *Technical Note: Extreme Value Analysis of long duration droughts using Bayesian methods (Met Office, Oct 2017)*

Figure 3.1: 12, 24 and 36 month rolling rainfall accumulation (as a % of 1900-1990 long term average) with Met Office return periods plotted (MORECS Square 127, 128 and 138)







Atkins have carried out analysis of rainfall accumulation of historic and representative stochastically generated droughts at the sub-regional scale for the Anglian Water region[12]. We would compare the pattern and timings of contemporary rainfall accumulations with these historical droughts in our assessment.

Standardised Precipitation Index

To support a drought permit application we would also use the Standardized Precipitation Index (SPI) to indicate the rarity of a current drought. This would be calculated for a range of timescales (12, 24 and 36 months). The relevant MORECS squares for the Nene catchment (127, 128 and 138) would be used as the base data.

SPI values can be classified as shown in Table 3.1 following McKee et al. (1993)[13]. The World Meteorological Organisation's user guide[14] defines a drought event as occurring any time the SPI is continuously negative, and reaches an intensity of -1.0 or lower. The drought event ends when the SPI becomes positive. The sum of the SPI for all the months within a drought event can be termed the drought's 'magnitude'. The guide also provides an estimate of the return periods of a drought by SPI (Table 3.2).

Table 3.1: SPI Values

2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

Table 3.2: SPI probability of recurrence

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

Other indicators of ESOR

We would support a case for exceptional shortage of rain by presenting other measures of effective rainfall, such as soil moisture deficit, temperature, river flows and groundwater levels. This would include comparison to the long term average and trend analysis.

We would also describe our current and forecast operational water supply situation, to include reservoir storage levels against normal operating curves, and forecast projections for a range of rainfall scenarios. Relevant impacts and mitigation actions carried out in the wider supply system would also be detailed.

3.2.2 Order of use

Not applicable in circumstances where multiple permits are not required.

[12] *Drought Selection Process and Criteria - Anglian Water Services (Atkins, 2017)*
[13] *McKee, T.B., N.J. Doesken and J. Kleist, 1993: The relationship of drought frequency and duration to time scale. In: Proceedings of the Eighth Conference on Applied Climatology, Anaheim, California,17-22 January 1993. Boston, American Meteorological Society, 179-184.*
[14] *World Meteorological Organization, 2012: Standardized Precipitation Index User Guide (M. Svoboda, M. Hayes and D. Wood). (WMO-No. 1090), Geneva.*

3.3 Environmental Assessment

The March 2020 Environmental Assessment Report by Mott MacDonald/Atkins assessed the potential environmental impacts of implementing the proposed drought action, following Defra and Environment Agency guidance. The findings are summarised in Appendix 7 and 8, with a brief overview here.

Impact upon water level should be negligible, assuming that lock operation does not exceed the volume of water reaching the locks. Although no water quality impacts were found following the application of the winter drought permit in 2011/2012, there is a potential that a more severe drought may lead to water quality impacts, particularly in the summer. Potential algal blooms and dissolved oxygen sags may negatively impact upon navigation and ecology respectively. These impacts will be reduced due to sporadic high flows and phosphate stripping at Water Recycling Centres.

The report concluded that the potential water quality deterioration, particularly in relation to phosphate concentration, may have a significant effect on some features of the Nene Washes European sites. As such, a HRA Stage II Appropriate Assessment has been carried out.

Monitoring and mitigation requirements were identified in the environmental assessment and the HRA Stage II Appropriate Assessment and informed the Environmental Monitoring Plan.

The key findings of the environmental assessment are summarised in Table 3.3.

Table 3.3: Summary of potential impacts to environmental receptors as a result of the proposed drought permit at Wansford

Issue	Predicted Impact (Winter)	Predicted Impact (Summer)	Commentary
Impacts on Navigation and Recreation	Low - Moderate	Moderate	Water levels should be maintained in both winter and summer, meaning navigation should remain functional Risk of river choking through algal blooms in summer Lock usage may be limited in summer
Impacts on Water Quality	Low	Low - Moderate	Phosphate, DO, ammonia and iron concentrations may increase further. Siltation may occur with reduced flows.
Fisheries Health (main river)	Low	Low - Moderate	Increases in temperature in summer may cause water quality deterioration which may impact fisheries health. It is unlikely there would be a detrimental impact on fish health.
Fish spawning (backchannels)	Low	Low- Moderate	Both early and summer spawners potentially affected by reduction in MRF. Gravel spawners most likely to be impacted.
Fish passage	Low - Moderate	Moderate - High	Winter migratory behaviour may be impacted due to reduced flows Reduction in 'trigger' flows may cause eel and trout mortalities in the estuary Deterioration in water quality may also impact trout migration
Impacts on macroinvertebrates	Low	Moderate	Reduced water quality may impact macroinvertebrate community DO sags, stagnation and algal blooms may impact species of interest that have a high oxygen demands
Macrophytes	Low	Low	Impact on rare macrophyte species in the reach is considered negligible
Diatoms	Low	Moderate	Increased phosphate levels and reduced flows significantly increase the risk of algal blooms in summer months when temperature and sunlight are not limiting factors
Impacts on abstractors	Moderate	Moderate - High	Without variable abstraction and communication with other parties, there is potential for licences to be impacted by a reduction in the MRF

Table 3.4 shows baseline, pre-drought, during drought, mitigation measures and post drought surveys for the proposed drought action at Wansford.

Table 3.4: Monitoring and mitigation measures

Baseline surveys and outstanding actions (normal/ non-drought conditions) • Baseline monitoring as per existing monitoring programme and frequent monitoring of flow data during periods of low flow
Pre-drought surveys (commence in potential drought) • Increase frequency of biological monitoring of macroinvertebrates, macrophytes, fish, water quality and siltation to ensure accurate baseline of conditions. • Liaison with the Environment Agency and other key stakeholders
During drought (commence in drought period) • Frequently monitor flow against temporary drought permit MRF and cease abstraction at Wansford if flows drop below MRF • Enhanced monitoring of water quality, siltation and biological community • Abstraction to be halted if water quality deteriorates below acceptable levels, or if water levels are affected by greater than expected amounts • Records of daily abstraction quantities and flow submitted weekly to the Environment Agency
Mitigation measures (commence on implementation of drought permit) • Cease abstraction if lock operation is compromised or water quality deteriorates below acceptable levels • Dynamic, varied MRF according to downstream demands • Temporary phosphate stripping at Wittering and Stibbington Water Recycling Centres • Maintenance of sewerage network, if required (prior to drought) • De-silting around key structures, if required.
Post drought (commence after drought permit has been lifted) • Continued biological community monitoring to assess the need for continuation of mitigation measures • Continued additional water quality and flow monitoring if required.

3.4 Stakeholder consultation and implementation strategy

3.4.1 Stakeholder Consultation

We have obtained pre-consultation advice from the Environment Agency and Natural England (where required) on our Environmental Assessment Reports, including the WFD assessments, HRA Stage I Screening reports, and the proposed mitigation and monitoring measures, as part of the development of the Drought Plan 2019. We have also obtained statutory consultation advice from the Environment Agency, Natural England, and Historic England on the SEA Scoping report. Any concerns have been addressed through the Environmental Assessment Reports and SEA report, and fed into the Environmental Assessment Summary and Environmental Monitoring Plan as summarised above.

Other relevant stakeholders will be consulted during the Drought Plan 2019 consultation period, with any concerns being addressed for the final Drought Plan. Other stakeholders include:

- The Navigation Authority (Environment Agency)
- Other abstractors
- Recreational user groups
- Other interested parties

During the implementation of the 2011/2012 drought permit, the Angling Trust Regional Forum raised concerns about potential impacts on angling locations. Concerns were addressed at the time via a hydraulic survey, and communication should be carried out in the event of a permit application to ensure that this is still the case.

No significant concerns are anticipated for this proposed drought permit, as it has been made available for consultation in previous drought plans.

For our full drought permit application we would include the following, as recommended by the guidance:

- Written consent from the Environment Agency;
- Comments from those consulted about the application;
- Details of any objections received or agreements reached with objectors;
- A copy of the notices and advertisements relating to our application; and
- A description of our arrangements for the public inspection of the application.

3.4.2 Advertising the application

Our drought permit application would by published in the local newspaper circulating in the area affected by the permit (Peterborough Telegraph (circulation 22,581[15]). The newspaper also has a website. We would also advertise it in the London Gazette, as recommended by the guidance. We would consider publishing targeted social media updates in line with our communications strategy (Drought Plan 2019 Appendix 9).

3.4.3 Planning for all outcomes

We plan to engage with relevant stakeholders and address concerns in the creation of our drought plan and as part of the consultation process. In the event of a public hearing, we would confirm arrangements closer to the time. We have a number of regional Anglian Water offices which could be used as a venue or would seek alternative venues as appropriate.

We would liaise closely with the Environment Agency before and during any permit application to ensure we have their support. We have agreed a robust mitigation programme with the Environment Agency and do not anticipate significant issues which may result in a public hearing.

In event of unsuccessful permit we would need to consider other supply side options, such as rezoning or tankering, as well as increasing demand saving activities.

3.4.4 Drought Permit review strategy

We would review our drought plan on an annual basis as part of our Water Resources Management Plan Annual Review. Required changes to drought permits would be reported as part of this. Baseline monitoring data would be reviewed on an annual basis and associated updates to the environmental assessment completed as required.

Appendices (on request):

- Draft permit
- Existing abstraction licence - plus a copy of any statutory instrument or local act connected to it or to a discharge permitted by the drought permit

Supporting Information

- Appendix 7: Environmental Assessment Summary
- Appendix 8: Environmental Monitoring Plan

[15] *https://www.abc.org.uk/product/18629 (June ,2018)*

4. River Great Ouse Intake (Grafham Water)

4.1 Current licence and proposed drought permit

4.1.1 Current licence

Anglian Water is licenced to abstract from the River Great Ouse for Grafham Water.

The licence is subject to the following conditions:

- Abstraction may only take place when the water level in the River Great Ouse (as measured at the gauge board upstream of the Offord Sluice) is equal to or greater than 11.05 m above Ordnance Datum.
- No abstraction must take place when the net flow in the River Great Ouse at Offord Sluice is equal to or less than 136.4 Ml/d (the Minimum Residual Flow (MRF)). Abstraction is permissible for 75% of flow in excess of the MRF.
- During the period 1 June to 30 September each year if the sum of the average rate of net flow in the River Great Ouse at Offord Sluice, during the weekly period expiring at 9am (Greenwich Mean Time) on Friday and beginning at 9am on the previous Friday (being the average in the weekly period of the rate of flow at Offord), is less than 227,305 m^3 per day then no water shall be abstracted during the following weekend.

4.1.2 Proposed drought permit

The permit application would be considered for the River Great Ouse abstraction in the following two stages:

- Stage 1: Existing MRF, abstraction at up to 100% of the flow in excess of the MRF
- Stage 2: 50% reduction MRF to 68Ml/d, abstraction at up to 75% of the flow excess of the MRF

Stage 2 allows greater abstraction than Stage 1 when the flow is below 340Ml/d, so would be likely to be applied for in the later stages of a drought. Usage would be expected to revert to Stage 1 when sufficient flow recovery has occurred. It has been assumed that instantaneous, hourly, daily and annual totals would remain unchanged from those currently licenced.

Anglian Water would be likely to consider applying for the drought permit in a severe, possibly multi-season, drought, if there is a risk of compromising our ability to refill Grafham Water.

Under the most likely scenario, a winter drought permit would be sought after a dry winter and summer, enabling Anglian Water to refill Grafham Water during the following winter. This typically corresponds to a natural increase in flows (and hence water available for abstraction) and a reduction in the sensitivity of physico-chemical and biological receptors to impact.

We have developed triggers to guide us through the different stages of the drought permit application process, and these are detailed in Appendix 4.

However, should drought conditions continue to present a significant risk to supply, a summer drought permit may also be considered as an option. Note that summer is defined as April to September (inclusive) and winter as October to March (inclusive).

A copy of our current abstraction licence and a draft permit is available on request.

4.2. Justification of the need

4.2.1 Exceptional shortage of rain

For a drought order or permit to be granted, there is a legal requirement to demonstrate that '...by reason of an exceptional shortage of rain, a serious deficiency of supplies of water in any area exists or is threatened...'.

Environment Agency guidance[16] states that it is not appropriate to set a prescriptive approach to assessing the exceptional shortage of rain (ESOR) as each drought and each situation is unique. The guidance provides a range of matters to consider when building the case for ESOR. This section provides an overview of our process for demonstrating an exceptional shortage of rain, following the guidance.

Rainfall is a key indicator in assessing drought conditions. Drought events vary in their duration, the time of year they commence and their magnitude (the extent of the rainfall deficit). Soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, streamflow and reservoir storage reflect the longer-term precipitation anomalies. These factors combine to produce a wide range of impacts on water resources. As such, it is not possible to define the exact process of rainfall assessment in advance of a drought occurring. The following data sources and methods would be used:

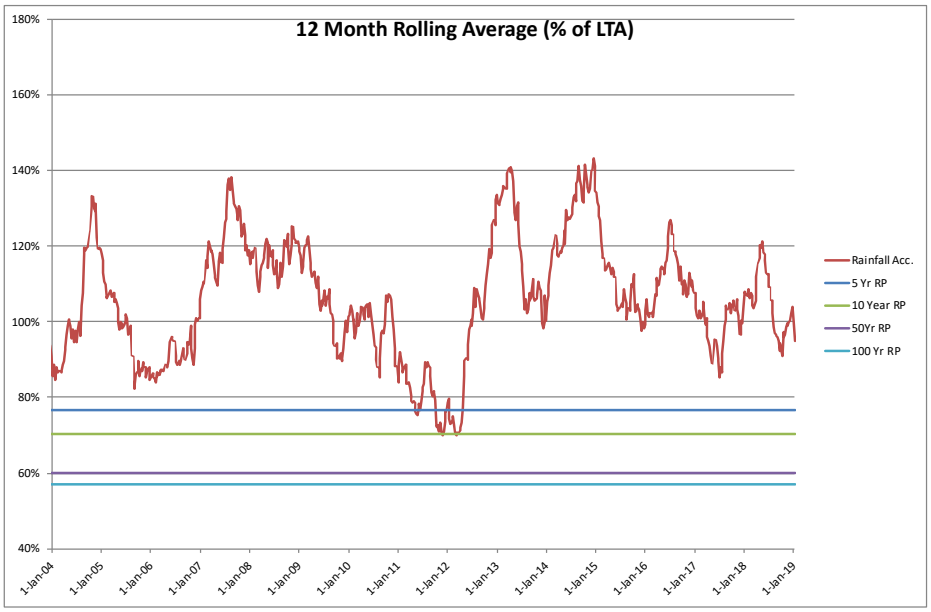
Rainfall accumulation data

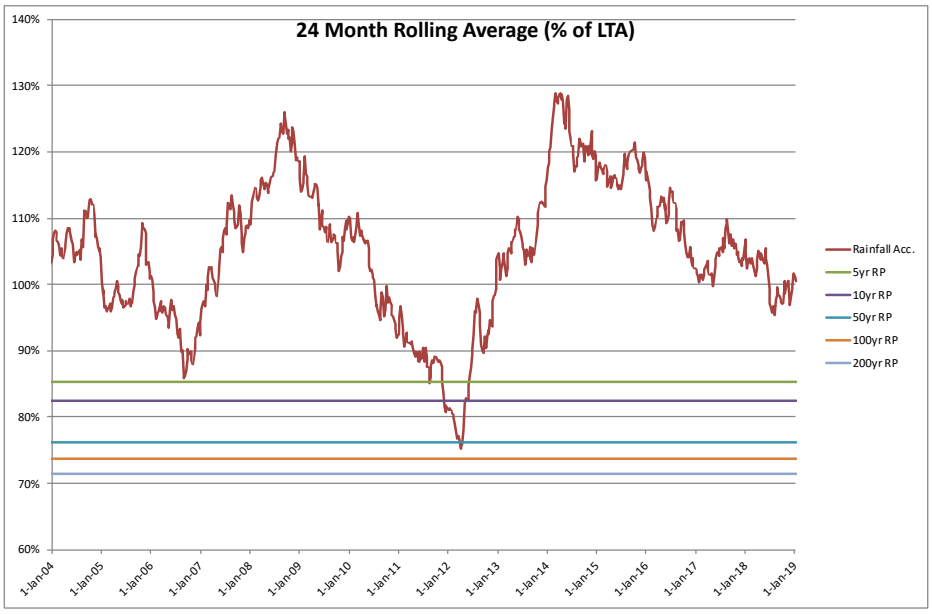
We have used Bayesian Extreme Value Analysis, carried out by the Met Office[17] to determine 1:5, 1:10, 1:50, 1:100 and 1:200 return periods (RPs) of 12, 24 and 36 month rainfall accumulation totals for the Ruthamford, Lincolnshire, Trent, Affinity, Norfolk and Suffolk sub-regions.

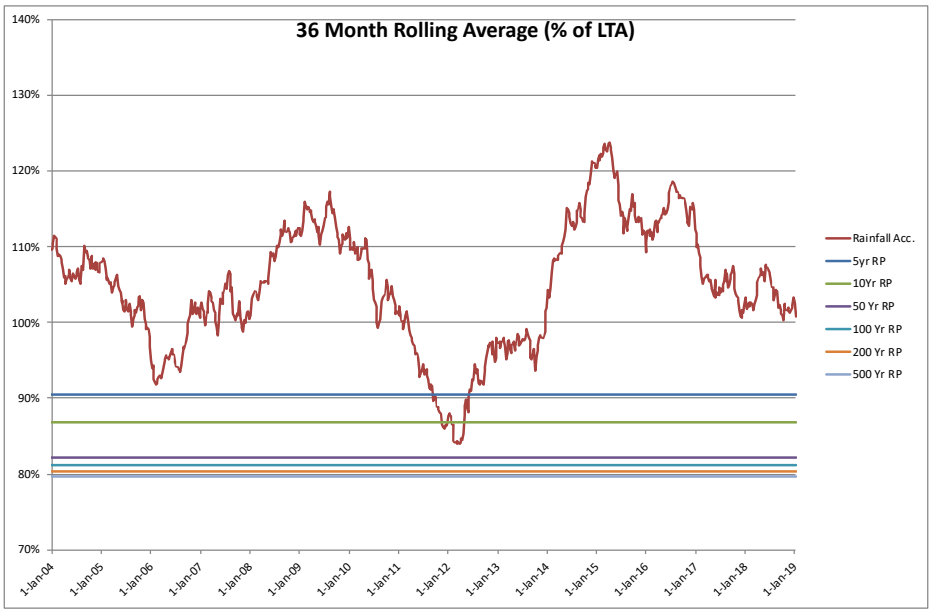
For the River Great Ouse, we would use rainfall accumulations from the regional MORECS squares which cover the majority of the Great Ouse catchment (139 and 151). Deviation from the long term average would be monitored and compared to the Met Office return periods (Figure 4.1). The use of 12, 24 and 36 month timescales allows the pattern and magnitude of both annual and longer term rainfall deficits (e.g. 1 or 2 dry winters) to be measured.

[16] *EA Drought Planning Guideline: Exceptional shortage of rain*
[17] *Technical Note: Extreme Value Analysis of long duration droughts using Bayesian methods (Met Office, Oct 2017)*

Figure 4.1: 12, 24 and 36 month rolling rainfall accumulation (as a % of 1900-1990 long term average) with Met Office return periods plotted (MORECS 139 and 151)







Atkins has carried out analysis of rainfall accumulation of historic and representative stochastically generated droughts at the sub-regional scale for the Anglian Water region[18]. We would compare the pattern and timings of contemporary rainfall accumulations with these historical droughts in our assessment.

Standardised Precipitation Index

To support a drought permit application we would also use the Standardized Precipitation Index (SPI) to indicate the rarity of a current drought. This would be calculated for a range of timescales (12, 24 and 36 months). The relevant MORECS squares for the River Great Ouse catchment (139 and 151) would be used as the base data.

SPI values can be classified as shown in Table 4.1 following McKee et al. (1993)[19]. The World Meteorological Organisation's user guide[20] defines a drought event as occurring any time the SPI is continuously negative, and reaches an intensity of -1.0 or lower. The drought event ends when the SPI becomes positive. The sum of the SPI for all the months within a drought event can be termed the drought's 'magnitude'. The guide also provides an estimate of the return periods of a drought by SPI (Table 4.2).

Table 4.1: SPI Values

2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

Table 4.2: SPI probability of recurrence

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

Other indicators of ESOR

We would support a case for exceptional shortage of rain by presenting other measures of effective rainfall, such as soil moisture deficit, temperature, river flows and groundwater levels. This would include comparison to the long term average and trend analysis.

We would also describe our current and forecast operational water supply situation, to include reservoir storage levels against normal operating curves, and forecast projections for a range of rainfall scenarios. Relevant impacts and mitigation actions carried out in the wider supply system would also be detailed.

4.2.2 Order of use

Not applicable in circumstances where multiple permits are not required.

[18] *Drought Selection Process and Criteria - Anglian Water Services (Atkins, 2017)*

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

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

4.3 Environmental Assessment

The March 2020 Environmental Assessment Report by Mott MacDonald/Atkins assessed the potential environmental impacts of implementing the proposed drought action, following Defra and Environment Agency guidance. We have developed triggers to guide us through the different stages of the drought.

A reduction in flow of up to 32% in a Stage 2 permit and 20% for a Stage 1 permit may result in reduced water quality and, therefore, a temporary reduction in WFD status. Impacts are perceived to be greater in the summer when detrimental effects on water quality may exert pressure on fish and macrophytes, and cause algal blooms. However, these impacts will be reduced by the higher flows in the recovery period which will help to reduce nutrient and pollutant concentration.

The report concluded that there is potential for likely significant effects on the Ouse Washes European sites due to water quality deterioration. A HRA Stage II Appropriate Assessment has been carried out, which concluded that the proposed monitoring and mitigation measures will ensure no adverse effects on the integrity of the site.

Monitoring and mitigation requirements were identified in the environmental assessment and the HRA Stage II Appropriate Assessment and informed the Environmental Monitoring Plan.

The key findings of the environmental assessment are summarised in Table 4.3 and Table 4.4.

Table 4.3: Summary of potential impacts to environmental receptors as a result of the proposed Stage 1 drought permit at Wansford

Issue	Predicted Impact (Winter)	Predicted Impact (Summer)	Commentary
Impacts on Levels and Velocity	N/A - velocity/level are impact mechanisms rather than receptors		A dry reference proxy period was selected for assessment of environmental impacts.
Impacts on Navigation and Recreation	Low - Moderate	Moderate	Water levels controlled by locks, tilting gates and weirs. Navigation reduces during winter meaning Environment Agency's ability to maintain the navigation retention level of 11.12mAOD should increase. Navigation peaks in summer months, lock operations and demand for water will be higher.
Impacts on Water Quality	Low - Moderate	Moderate	Phosphate, orthophosphate and Ammonia concentrations risk increasing to a level that has potential to impact the WFD status.
Fisheries Health (main river)	Low	Moderate	Deterioration in water quality may impact fish communities. Effects are more pronounced in summer.
Fish spawning (backchannels)	Low - Moderate	Moderate	Some species may be spawning as early as February, whilst nearly all species would be likely to spawn during summer period. A winter drought may affect early spawning species, however, the impacts on spawning are likely to be higher in a summer drought.
Fish passage	Low	Moderate	Impact on eel and lamprey migration during winter drought though reduction in flows not substantial. Reduced flow and water quality may impact the passage of fish species in summer months.
Impacts on macroinvertebrates	Low - Moderate	Moderate - High	Reduction in water quality may impact communities and rare species. Impacts on water quality more significant in summer. Stagnation in backchannels could be significant in summer, though flows may not decrease substantially.
Macrophytes	Low - Moderate	Moderate	Community adjusted to high nutrient levels.
Diatoms	Low - Moderate	Moderate	Algal blooms possible risk in summer.
Impacts on abstractors	Low	Moderate	No perceived significant impacts on other abstractors.

Table 4.4: Summary of potential impacts to environmental receptors as a result of the proposed Stage 2 drought permit at the River Great Ouse

Issue	Predicted Impact (Winter)	Predicted Impact (Summer)	Commentary
Impacts on Levels and Velocity	N/A - velocity/level are impact mechanisms rather than receptors		A dry reference proxy period was selected for assessment of environmental impacts.
Impacts on Navigation and Recreation	Low - Moderate	Moderate- High	Water levels controlled by locks, tilting gates and weirs. Navigation reduces during winter meaning Environment Agency's ability to maintain the navigation retention level of 11.12mAOD should increase. Navigation peaks in summer months, lock operations and demand for water will be higher.
Impacts on Water Quality	Moderate	Moderate - High	Phosphate, orthophosphate and ammonia concentrations risk increasing to a level that would impact the WFD status.
Fisheries Health (main river)	Low - Moderate	Moderate - High	Deterioration in water quality may impact fish communities. Effects are more pronounced in summer.
Fish spawning (backchannels)	Moderate	Moderate - High	Some species may be spawning as early as February, whilst nearly all species would be likely to spawn during summer period. A winter drought may affect early spawning species, however, the impacts on spawning are likely to be higher in a summer drought.
Fish passage	Moderate	Moderate - High	Impact on eel and lamprey migration during winter drought. Reduced flow and water quality may impact the passage of fish species in summer months.
Impacts on macroinvertebrates	Low- Moderate	Moderate - High	Reduction in water quality may impact communities and rare species. Impacts on water quality more significant in summer. Stagnation in backchannels could be significant in summer.
Macrophytes	Low - Moderate	Moderate	Community adjusted to high nutrient levels.
Diatoms	Low - Moderate	Moderate- High	Algal blooms possible risk in summer.
Impacts on abstractors	Low	Moderate	No perceived significant impacts on other abstractors.

Table 4.5 shows baseline, pre-drought, during drought, mitigation measures and post drought surveys for the proposed drought action at the River Great Ouse.

Table 4.5: Monitoring and mitigation measures

Baseline surveys and outstanding actions (normal/non-drought conditions) • Baseline monitoring of hydrology, water quality, and ecology • Initial consultation with the Environment Agency and other stakeholders
Pre-drought surveys (commence in potential drought) • Enhanced flow and water quality monitoring, including spot flow gauging at key sites along the River Great Ouse • Conduct ecological walkovers for fish, macrophyte and macroinvertebrate sampling to ensure accurate baseline • Contact all licensed abstractors within the potentially affected reach. • Regular liaison with the Environment Agency, navigational and recreational users.
During drought (commence in drought period) • Frequently monitor flow against temporary drought permit MRF • Continued monitoring of water quality and biological community to quantify the immediate impact of the drought and the response of the biological community in the recovery period • Regular liaison with the Environment Agency, navigational and recreational users.
Mitigation measures (commence on implementation of drought permit) • Reduce or cease abstraction should lock operation become compromised • Variable abstraction to allow occasional flushing of pollutants and prevent stagnation • Phosphate removal at Huntingdon and Cotton Valley Water Recycling Centres (WRCs), and possibly others • Ammonia removal at larger WRCs • Weed clearance or dredging if required • Maintenance of sewerage network • Bubblers to enhance dissolved oxygen (last resort option, more likely to reduce or cease abstraction) • Pump water into stranded backchannels (last resort option, more likely to reduce or cease abstraction)
Post drought (commence after drought permit has been lifted) • Continued flow monitoring in the River Great Ouse • Continued water quality and biological community monitoring to evaluate recovery and to assess the need for continuation of mitigation measures

4.4 Stakeholder consultation and implementation strategy

4.4.1 Stakeholder Consultation

We have obtained pre-consultation advice from the Environment Agency and Natural England (where required) on our Environmental Assessment Reports, including the WFD assessments, HRA Stage I Screening reports, and the proposed mitigation and monitoring measures, as part of the development of the Drought Plan 2019. We have also obtained statutory consultation advice from the Environment Agency, Natural England, and Historic England on the SEA Scoping report. Any concerns have been addressed through the Environmental Assessment Reports and SEA report, and fed into the Environmental Assessment Summary and Environmental Monitoring Plan as summarised above.

Other relevant stakeholders will be consulted during the Drought Plan 2019 consultation period, with any concerns being addressed for the final Drought Plan. Other stakeholders include:

- The Navigation Authority (Environment Agency)
- Other abstractors
- Recreational user groups
- Other interested parties

No significant concerns are anticipated for this proposed drought permit, as it has been made available for consultation in previous drought plans.

For our full drought permit application we would include the following, as recommended by the guidance:

- Written consent from the Environment Agency;
- Comments from those consulted about the application;
- Details of any objections received or agreements reached with objectors;
- A copy of the notices and advertisements relating to our application; and

A description of our arrangements for the public inspection of the application.

4.4.2 Advertising the application

Our drought permit application would by published in the daily local newspaper circulating in the area affected by the permit (Cambridgeshire News (circulation 8005[21]) and The Hunts Post).

The newspaper also has a website. We would also advertise it in the London Gazette, as recommended by the guidance. We would consider publishing targeted social media updates in line with our communications strategy (Drought Plan 2019 Appendix 9).

4.4.3 Planning for all outcomes

We plan to engage with relevant stakeholders and address concerns in the creation of our drought plan and as part of the consultation process. In the event of a public hearing, we would confirm arrangements closer to the time. We have a number of regional Anglian Water offices which could be used as a venue or would seek alternative venues as appropriate.

We would liaise closely with the Environment Agency before and during any permit application to ensure we have their support. We have agreed a robust mitigation programme with the Environment Agency and do not anticipate significant issues which may result in a public hearing.

In event of unsuccessful permit we would need to consider other supply side options, such as rezoning or tankering, as well as increasing demand saving activities.

4.4.4 Drought Permit review strategy

We would review our drought plan on an annual basis as part of our Water Resources Management Plan Annual Review. Required changes to drought permits would be reported as part of this. Baseline monitoring data would be reviewed on an annual basis and associated updates to the environmental assessment completed as required.

Appendices (on request):

- Draft permit
- Existing abstraction licence - plus a copy of any statutory instrument or local act connected to it or to a discharge permitted by the drought permit

Supporting Information

- Appendix 7: Environmental Assessment Summary
- Appendix 8: Environmental Monitoring Plan

[21] *https://www.abc.org.uk/product/9730 (June ,2018)*

5. Alton Water

5.1 Current licence and proposed drought permit

We are licenced to abstract from the River Gipping and previously included details of a drought permit which proposes a 50% reduction in the Minimum Residual Flow (MRF) immediately downstream of the intake to help refill Alton Water during drought conditions. However this is considered to potentially cause damaging adverse effects on the environment and we are currently working with the Environment Agency to explore a new drought permit option and associated Environmental Assessment Report. This will be detailed in the next Drought Plan update, due to be published as a draft in 2021.

6. River Colne Augmentation (Ardleigh Reservoir)

6.1 Current licence and proposed drought permit

6.1.1 Current licence

Our current licence for the Lower Colne allows us to abstract from the Aldham, Balkerne and Cook's Mill groundwater sources, and discharge it to the River Colne in order to augment the flow at the East Mill intake.

A total combined quantity of 10,000Ml of water can be abstracted from the boreholes over a five-year period. In addition, there are also conditions on maximum quantities which can be abstracted in any 24-hour period (6Ml/d each at Aldham, Balkerne and Cook's Mill), and an instantaneous rate not exceeding 70 litres per second.

An additional condition on the licence is that no more than 34,095Ml in aggregate can be abstracted between April and September during any five-year period.

The abstraction licence includes water quality conditions to restrict discharge into the River Colne when quality is poor (based on concentrations of chloride, sodium and iron and temperature). Aeration of the abstracted water is required prior to discharge.

6.1.2 Proposed drought permit

The following permit application would be made for the Lower Colne borehole sources:

- Temporarily increase the licenced abstraction at the Aldham and Balkerne groundwater sources by 3 Ml/d each to provide additional augmentation to the River Colne. This would increase the total daily potential augmentation from these groundwater sources from 12 to 18Ml/d.

There would be no change to the aggregate quantity of water that can be abstracted in a five-year period.

It is assumed that augmentation would cease when flows are higher than the maximum abstraction at East Mills. Therefore, when flows are higher than 36Ml/d, baseline augmentation and thus drought permit abstraction would not be implemented.

As per current guidance, the drought permit would initially cover a 6-month period[22]. Subsequent reapplication for a further 6 months would be considered if required, depending on the drought situation at the time.

We have developed triggers to guide us through the different stages of the drought permit application process, and these are detailed in Appendix 4.

A copy of our current abstraction licence and a draft permit application is available on request.

[22] *https://www.gov.uk/guidance/apply-for-a-drought-permit*

6.2 Justification of the need

6.2.1 Exceptional shortage of rain

For a drought order or permit to be granted, there is a legal requirement to demonstrate that '...by reason of an exceptional shortage of rain, a serious deficiency of supplies of water in any area exists or is threatened...'.

Environment Agency guidance states that it is not appropriate to set a prescriptive approach to assessing the exceptional shortage of rain (ESOR) as each drought and each situation is unique. The guidance provides a range of matters to consider when building the case for ESOR. This section provides an overview of our process for demonstrating an exceptional shortage of rain, following the guidance.

Rainfall is a key indicator in assessing drought conditions. Drought events vary in their duration, the time of year they commence and their magnitude (the extent of the rainfall deficit). Soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, streamflow and reservoir storage reflect the longer-term precipitation anomalies. These factors combine to produce a wide range of impacts on water resources. As such, it is not possible to define the exact process of rainfall assessment in advance of a drought occurring. The following data sources and methods would be used:

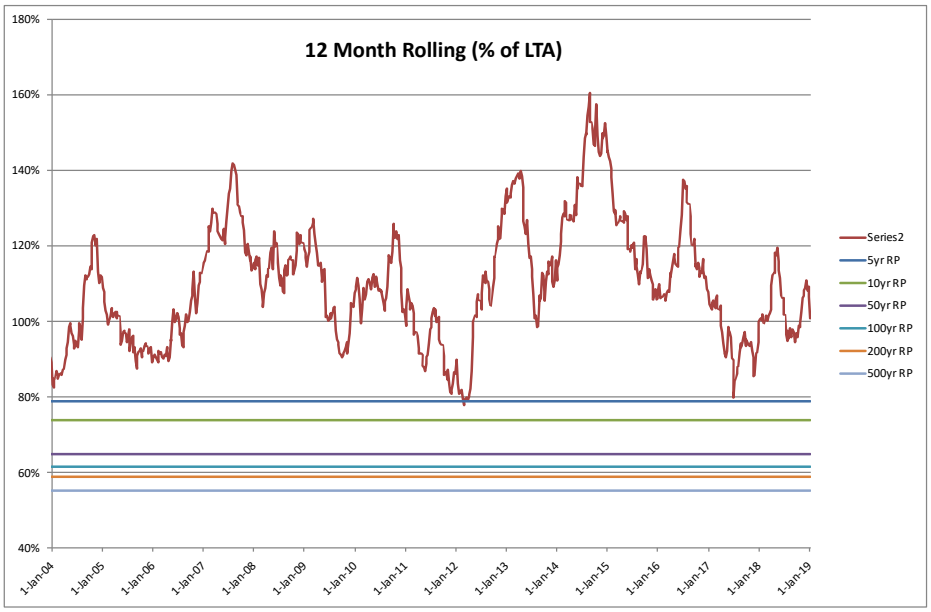
Rainfall accumulation data

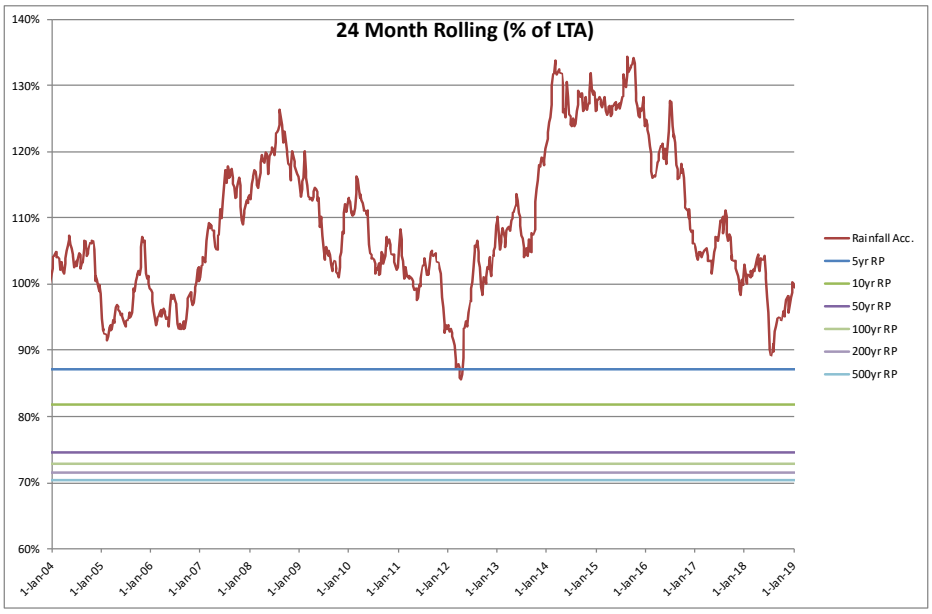
We have used Bayesian Extreme Value Analysis, carried out by the Met Office[23] to determine 1:5, 1:10, 1:50, 1:100 and 1:200 return periods (RPs) of 12, 24 and 36 month rainfall accumulation totals for the Ruthamford, Lincolnshire, Trent, Affinity, Norfolk and Suffolk sub-regions.

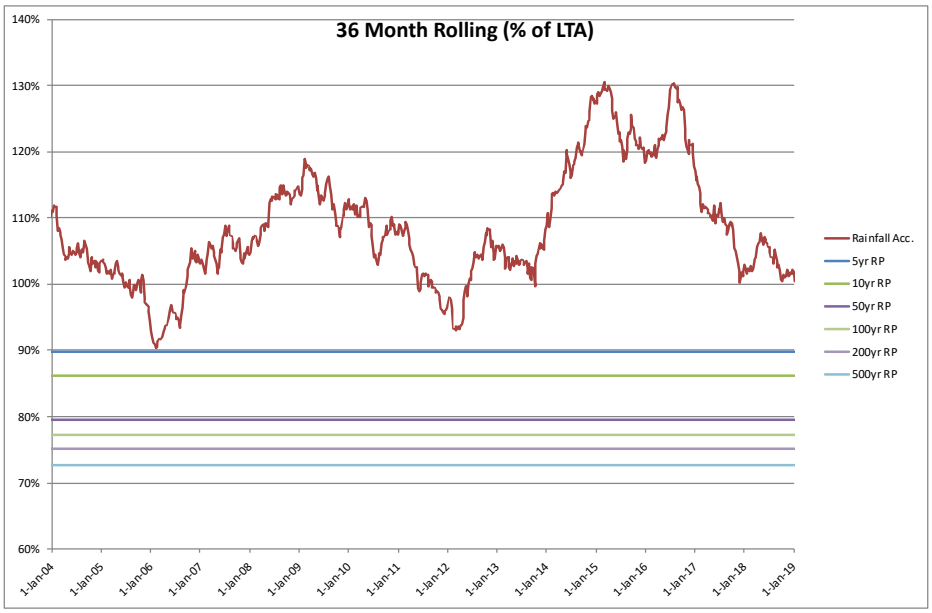
For the River Colne, we would use rainfall accumulations from the regional MORECS squares which cover the majority of the Colne catchment (152 and 153). Deviation from the long term average would be monitored and compared to the Met Office return periods (Figure 6.1). The use of 12, 24 and 36 month timescales allows the pattern and magnitude of both annual and longer term rainfall deficits (e.g. 1 or 2 dry winters) to be measured.

[23] *Technical Note: Extreme Value Analysis of long duration droughts using Bayesian methods (Met Office, Oct 2017)*

Figure 6.1: 12, 24 and 36 month rolling rainfall accumulation (as a % of 1900-1990 long term average) with Met Office return periods plotted (MORECS 152 and 153)







Atkins has carried out analysis of rainfall accumulation of historic and representative stochastically generated droughts at the sub-regional scale for the Anglian Water region[24]. We would compare the pattern and timings of contemporary rainfall accumulations with these historical droughts in our assessment.

Standardised Precipitation Index

To support a drought permit application we would also use the Standardized Precipitation Index (SPI) to indicate the rarity of a current drought. This would be calculated for a range of timescales (12, 24 and 36 months). The relevant MORECS squares for the Colne catchment (152 and 153) would be used as the base data.

SPI values can be classified as shown in Table 6.1 following McKee et al. (1993)[25]. The World Meteorological Organisation's user guide[26] defines a drought event as occurring any time the SPI is continuously negative, and reaches an intensity of -1.0 or lower. The drought event ends when the SPI becomes positive. The sum of the SPI for all the months within a drought event can be termed the drought's 'magnitude'. The guide also provides an estimate of the return periods of a drought by SPI (Table 6.2).

Table 6.1: SPI Values

2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

Table 6.2: SPI probability of recurrence

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

Other indicators of ESOR

We would support a case for exceptional shortage of rain by presenting other measures of effective rainfall, such as soil moisture deficit, temperature, river flows and groundwater levels. This would include comparison to the long term average and trend analysis.

We would also describe our current and forecast operational water supply situation, to include reservoir storage levels against normal operating curves, and forecast projections for a range of rainfall scenarios. Relevant impacts and mitigation actions carried out in the wider supply system would also be detailed.

[24] *Drought Selection Process and Criteria - Anglian Water Services (Atkins, 2017)*
[25] *McKee, T.B., N.J. Doesken and J. Kleist, 1993: The relationship of drought frequency and duration to time scale. In: Proceedings of the Eighth Conference on Applied Climatology, Anaheim, California,17-22 January 1993. Boston, American Meteorological Society, 179-184.*
[26] *World Meteorological Organization, 2012: Standardized Precipitation Index User Guide (M. Svoboda, M. Hayes and D. Wood). (WMO-No. 1090), Geneva.*

6.3 Environmental Assessment

The March 2020 Environmental Assessment Report by Mott MacDonald/Atkins assessed the potential environmental impacts of implementing the proposed drought action, following Defra and Environment Agency guidance. The findings are summarised in Appendix 7 and 8, with a brief overview here.

The assessment concluded that the proposed drought action will only have a localised impact. The impact upon the River Colne is assessed to be positive and minimal, and there are no mechanisms by which significant effects on European sites will occur. A 0.2m drawdown is predicted within a 3km radius, and hence there is a small possibility of impact upon 14 other groundwater abstractors. These abstractors will be contacted and the potential for impact will be confirmed, along with any required mitigation measures, prior to the application for a drought permit. Flow data indicates that the need for a drought permit for the River Colne intake would be short and infrequent.

It was determined that a HRA Stage II Appropriate Assessment was not required. Monitoring and mitigation requirements were identified in the environmental assessment and informed the Environmental Monitoring Plan.

The key findings of the environmental assessment are summarised in Table 6.3.

Table 6.3: Summary of potential impacts to environmental receptors as a result of the proposed drought permit at the River Colne

Issue	Predicted Impact *	Commentary
Surface flow and water levels	Low	Although the augmentation has a positive impact on flow between Cook's Mill discharge point and East Mill intake, it does not appear that the augmentation makes a significant difference. However, when the augmentation is considered against a background of very low flows in the River Colne, the significance of the impact becomes more obvious.
Groundwater	Negligible	No significant change was predicted by the model in groundwater-surface water interaction due to an increase in abstraction following the application of the proposed drought permit for a three-month period during drought conditions.
Water quality	Low	The impact of nutrients and other pollutants delivered to the augmented reach via flows from upstream, tributaries and other sources during drought permit implementation will be reduced due to greater dilution. Consequently, water quality improvements can be expected when the proposed permit is in action.
Fisheries health (main river)	Negligible	Through the mechanisms of increased flows and dilution capacity, the drought permit is considered to have negligible to low, non-permanent positive impacts.
Fish spawning (backchannels)	Negligible	During periods of drought, a reduction in water levels may leave eggs exposed to desiccation stress and low flows could cause sedimentation of spawning gravels, particularly in the back channels. The augmentation of flows in the summer with abstracted groundwater may limit the stress on spawning fish species and eggs.
Fish passage	Negligible	Flow augmentation of 12 to 18Ml/d will have minimal effect on overall flows and water levels within the augmented reach of the River Colne and thus will have a negligible impact on fish passage. The weir structure at East Mills also presents a barrier to fish migration, regardless of flow conditions. Therefore, application of the proposed drought permit is not expected to improve fish passage conditions in the River Colne during drought conditions.

Issue	Predicted Impact *	Commentary
Macroinvertebrates	Negligible	Flows, levels and water quality unlikely to be significantly, permanently impacted as a result of the drought permit. Thus, impacts on the macroinvertebrate community is considered negligible.
Macrophytes	Negligible	Flows, levels and water quality are unlikely to be significantly, permanently impacted as a result of the drought permit. Thus, impacts on the macrophyte and diatomaceous communities is considered negligible.
Phytobenthos	Low	Flows, levels and water quality are unlikely to be significantly, permanently impacted as a result of the drought permit. Thus, impacts on the phytobenthos community are considered low.
Navigation and recreation	Negligible	The River Colne is not navigable in the affected reach. Recreational activities may become more viable when the proposed drought permit is in action than they would otherwise be during periods of low flow due to augmentation by abstractions from groundwater.
Other abstractors	Moderate	Additional drawdown of 0.2m is determined within a 3km radius as a result of the drought permit. Fourteen other groundwater abstraction licences fall within the radius of influence, and it is possible that these abstractors may be adversely impacted by the drought action. However, without further knowledge of the abstractions licence conditions or infrastructure it is not possible to quantify this potential impact.

* both summer and winter impacts assumed to be the same.

Table 6.4 shows baseline, pre-drought, during drought, mitigation measures and post drought surveys for the proposed drought action at the River Colne.

Table 6.4: Monitoring and mitigation measures

Baseline surveys and outstanding actions (normal/ non-drought conditions) • Monitoring of flow data during periods of low flow to identify the trigger for initiating a drought permit application • Initiation/continuation of campaigns to reduce the distribution input in the surrounding area.
Pre-drought surveys (commence in potential drought) • Biological monitoring of macroinvertebrates, macrophytes, fish survey and water quality to ensure accurate baseline of conditions. • Contact all licensed abstractors within the potentially affected area.
During drought (commence in drought period) • Monitoring of water quality and biological communities to quantify the immediate impact of the drought and the response of the biological communities in the recovery period.
Mitigation measures (commence on implementation of drought permit) • Slow start and slow stop of augmentation discharge if possible • Mitigation measures to rectify any potential impact upon other groundwater abstractors, if required • Restriction of augmentation to the River Colne if groundwater quality is poor, as per the current licence conditions.
Post drought (commence after drought permit has been lifted) • Continued increased frequency of water quality monitoring for six months, or until water quality has returned to pre-drought conditions. • Continued increased frequency of ecological monitoring for three years.

6.4 Stakeholder consultation and implementation strategy

6.4.1 Stakeholder Consultation

We have obtained pre-consultation advice from the Environment Agency and Natural England (where required) on our Environmental Assessment Reports, including the WFD assessments, HRA Stage I Screening reports, and the proposed mitigation and monitoring measures, as part of the development of the Drought Plan 2019. We have also obtained statutory consultation advice from the Environment Agency, Natural England, and Historic England on the SEA Scoping report. Any concerns have been addressed through the Environmental Assessment Reports and SEA report, and fed into the Environmental Assessment Summary and Environmental Monitoring Plan as summarised above.

Other relevant stakeholders will be consulted during the Drought Plan 2019 consultation period, with any concerns being addressed for the final Drought Plan. Other stakeholders include:

- The Navigation Authority (Colchester Borough Council)
- Other abstractors
- Recreational user groups
- Other interested parties

No significant concerns are anticipated for this proposed drought permit, as it has been made available for consultation in previous drought plans.

For our full drought permit application we would include the following, as recommended by the guidance:

- Written consent from the Colchester Borough Council;
- Comments from those consulted about the application;
- Details of any objections received or agreements reached with objectors;
- A copy of the notices and advertisements relating to our application; and
- A description of our arrangements for the public inspection of the application.

6.4.2 Advertising the application

Our drought permit application would by published in the daily local newspaper circulating in the area affected by the permit (Colchester Gazette (circulation 8,230[27]). The newspaper also has a website. We would also advertise it in the London Gazette, as recommended by the guidance. We would consider publishing targeted social media updates in line with our communications strategy (Drought Plan 2019 Appendix 9).

6.4.3 Planning for all outcomes

We plan to engage with relevant stakeholders and address concerns in the creation of our drought plan and as part of the consultation process. In the event of a public hearing, we would confirm arrangements closer to the time. We have a number of regional Anglian Water offices which could be used as a venue or would seek alternative venues as appropriate.

We would liaise closely with the Environment Agency before and during any permit application to ensure we have their support. We have agreed a robust mitigation programme with the Environment Agency and do not anticipate significant issues which may result in a public hearing.

In event of unsuccessful permit we would need to consider other supply side options, such as rezoning or tankering, as well as increasing demand saving activities.

6.4.4 Drought Permit review strategy

We would review our drought plan on an annual basis as part of our Water Resources Management Plan Annual Review. Required changes to drought permits would be reported as part of this. Baseline monitoring data would be reviewed on an annual basis and associated updates to the environmental assessment completed as required.

Appendices (on request):

- Draft permit
- Existing abstraction licence - plus a copy of any statutory instrument or local act connected to it or to a discharge permitted by the drought permit

Supporting Information

- Appendix 7: Environmental Assessment Summary
- Appendix 8: Environmental Monitoring Plan

[27] *https://www.abc.org.uk/product/2331-colchester-daily-gazette (June ,2018)*

7. Wellington Wellfield (Marham)

7.1 Current licence and proposed drought permit

7.1.1 Current licence

Wellington Wellfield

Anglian Water is licenced to abstract from chalk strata at five boreholes which comprise the Wellington Wellfield.

The following restrictions on maximum quantities of water abstracted apply at individual abstraction points:

Abstraction Point No.	Hourly quantity in m^3	Daily quantity in m^3	Yearly quantity in m^3	Instantaneous rate in litres per second
1	834	5,000	1,000,000	232
2	834	5,000	1,000,000	232
3	834	5,000	1,000,000	232
4	834	5,000	1,000,000	232
5	84	2,000	730,000	23.15

The aggregate quantity of water authorised to be abstracted under the licence must not exceed 15,000 m^3 per day and 1,500,000 m^3 per year.

The aggregate quantity of water authorised to be abstracted under the licence between April and October inclusive must not exceed 1,000,000 m^3.

The aggregate quantity of water authorised to be abstracted under the licence in any period of 90 days must not exceed 1,000,000 m^3.

The aggregate quantity of water authorised to be abstracted under this licence and the licence for Stoke Ferry must not exceed 6,570,000 m^3 per year.

The aggregate quantity of water authorised to be abstracted under this licence and the licence for Denton Lodge must not exceed 3,655,000 m^3 per year.

Denton Lodge

Anglian Water is licenced to abstract from chalk strata at two boreholes at Denton Lodge.

The following maximum quantities of water permitted to be abstracted apply:

- Abstraction Point 1: No more than 2,655,000 m^3 per year at rates not exceeding 7,274 m^3 per day and 303 m^3 per hour
- Abstraction Point 2: No more than 2,655,000 m^3 per year at rates not exceeding 7,274 m^3 per day and 303 m^3 per hour

The aggregate quantity of water authorised to be abstracted under the licence must not exceed 1,655,000 m^3 per year and 7,274 m^3 per day.

7.1.2 Proposed drought permit

The following permit application would be proposed (subject to operational testing) to increase abstraction from the Wellington Wellfield and Denton Lodge sources:

- Wellington Wellfield licence increase from 15 Ml/d to 17 Ml/d
- Denton Lodge licence increase from 7.3 Ml/d to 11.1 Ml/d.

As per current guidance[28], the drought permit would initially cover a 6-month period. Subsequent reapplication for a further 6 months would be considered.

A copy of our current abstraction licence and a draft permit is available on request.

[28] *https://www.gov.uk/guidance/apply-for-a-drought-permit*

7.2 Justification of the need

7.2.1 Exceptional shortage of rain

For a drought order or permit to be granted, there is a legal requirement to demonstrate that '...by reason of an exceptional shortage of rain, a serious deficiency of supplies of water in any area exists or is threatened...'.

Environment Agency guidance[29] states that it is not appropriate to set a prescriptive approach to assessing the exceptional shortage of rain (ESOR) as each drought and each situation is unique. The guidance provides a range of matters to consider when building the case for ESOR. This section provides an overview of our process for demonstrating an exceptional shortage of rain, following the guidance.

Rainfall is a key indicator in assessing drought conditions. Drought events vary in their duration, the time of year they commence and their magnitude (the extent of the rainfall deficit). Soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, streamflow and reservoir storage reflect the longer-term precipitation anomalies. These factors combine to produce a wide range of impacts on water resources. As such, it is not possible to define the exact process of rainfall assessment in advance of a drought occurring. The following data sources and methods would be used:

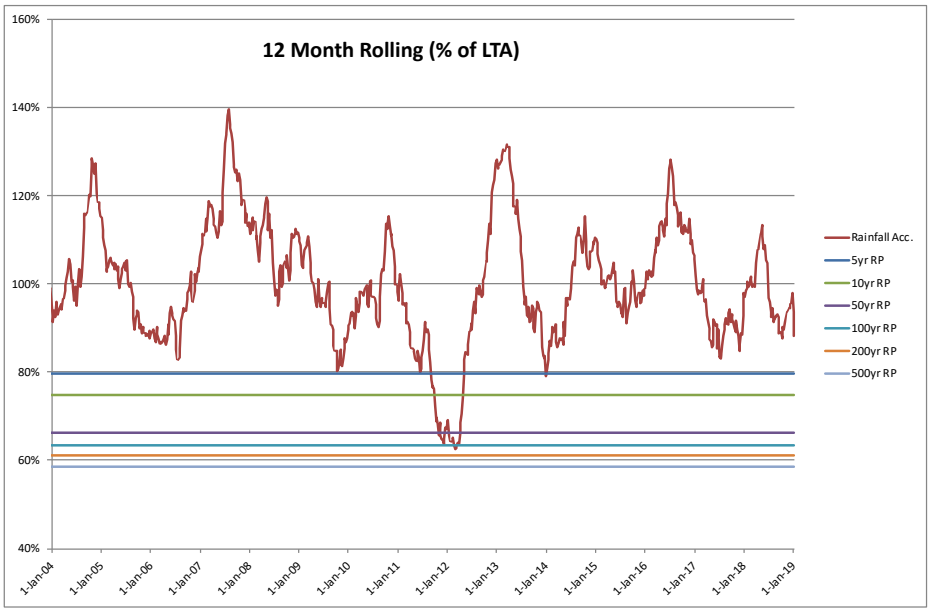
Rainfall accumulation data

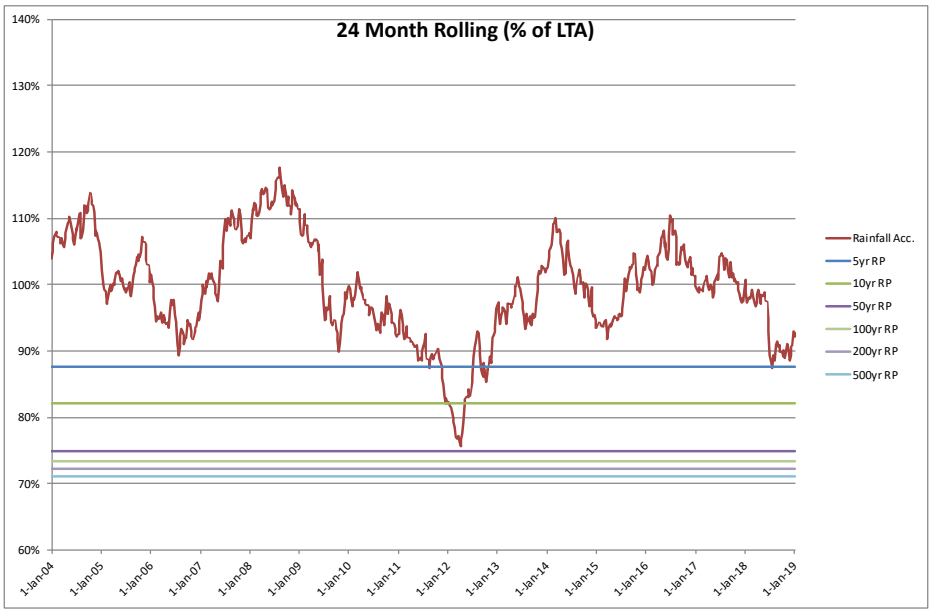
We have used Bayesian Extreme Value Analysis, carried out by the Met Office[30] to determine 1:5, 1:10, 1:50, 1:100 and 1:200 return periods (RPs) of 12, 24 and 36 month rainfall accumulation totals for the Ruthamford, Lincolnshire, Trent, Affinity, Norfolk and Suffolk sub-regions.

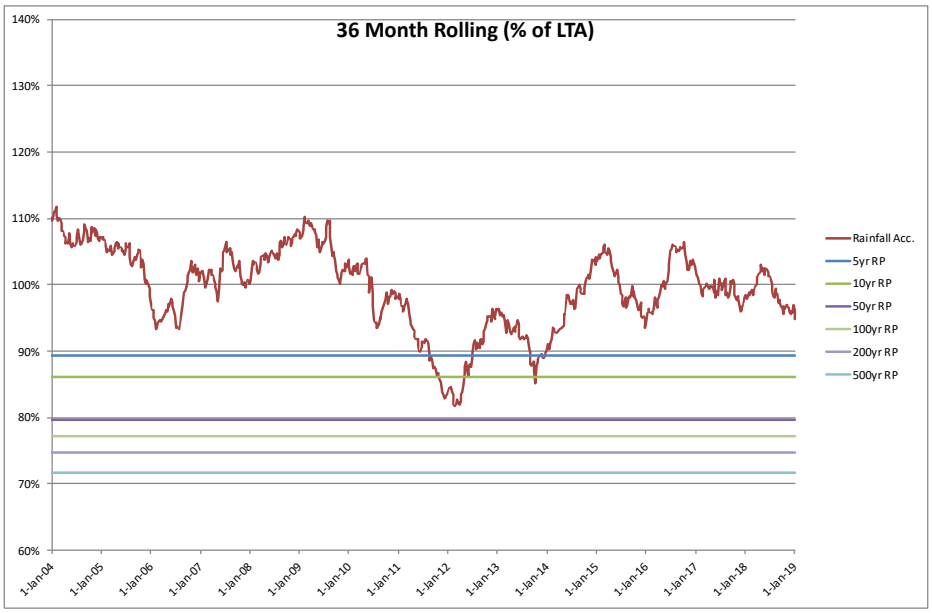
For the River Wissey, we would use rainfall accumulations from the regional MORECS squares which cover the majority of the catchment (129 and 130). Deviation from the long term average would be monitored and compared to the Met Office return periods (Figure 7.1). The use of 12, 24 and 36 month timescales allows the pattern and magnitude of both annual and longer term rainfall deficits (e.g. 1 or 2 dry winters) to be measured.

[29] *EA Drought Planning Guideline: Exceptional shortage of rain*
[30] *Technical Note: Extreme Value Analysis of long duration droughts using Bayesian methods (Met Office, Oct 2017)*

Figure 7.1: 12, 24 and 36 month rolling rainfall accumulation (as a % of 1900-1990 long term average) with Met Office return periods plotted (MORECS 129 and 130)







Atkins has carried out analysis of rainfall accumulation of historic and representative stochastically generated droughts at the sub-regional scale for the Anglian Water region[31]. We would compare the pattern and timings of contemporary rainfall accumulations with these historical droughts in our assessment.

Standardised Precipitation Index

To support a drought permit application we would also use the Standardized Precipitation Index (SPI) to indicate the rarity of a current drought. This would be calculated for a range of timescales (12, 24 and 36 months). The relevant MORECS squares for the Wissey catchment (129 and 130) would be used as the base data.

SPI values can be classified as shown in Table 7.1 following McKee et al. (1993)[32]. The World Meteorological Organisation's user guide[33] defines a drought event as occurring any time the SPI is continuously negative, and reaches an intensity of -1.0 or lower. The drought event ends when the SPI becomes positive. The sum of the SPI for all the months within a drought event can be termed the drought's 'magnitude'. The guide also provides an estimate of the return periods of a drought by SPI (Table 7.2).

Table 7.1: SPI Values

2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

Table 7.2: SPI probability of recurrence

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

Other indicators of ESOR

We would support a case for exceptional shortage of rain by presenting other measures of effective rainfall, such as soil moisture deficit, temperature, river flows and groundwater levels. This would include comparison to the long term average and trend analysis.

We would also describe our current and forecast operational water supply situation, to include reservoir storage levels against normal operating curves, and forecast projections for a range of rainfall scenarios. Relevant impacts and mitigation actions carried out in the wider supply system would also be detailed.

7.2.2 Order of use

Not applicable in circumstances where multiple permits are not required.

[31] *Drought Selection Process and Criteria - Anglian Water Services (Atkins, 2017)*
[32] *McKee, T.B., N.J. Doesken and J. Kleist, 1993: The relationship of drought frequency and duration to time scale. In: Proceedings of the Eighth Conference on Applied Climatology, Anaheim, California,17-22 January 1993. Boston, American Meteorological Society, 179-184.*
[33] *World Meteorological Organization, 2012: Standardized Precipitation Index User Guide (M. Svoboda, M. Hayes and D. Wood). (WMO-No. 1090), Geneva.*

7.3 Environmental Assessment

The November 2018 Environmental Assessment Report by Mott MacDonald assessed the potential environmental impacts of implementing the proposed drought action, following Defra and Environment Agency guidance. This report is currently being updated to reflect ongoing test pumping and groundwater modelling activities. The updated results will be included in the next Drought Plan update which is due to be published as draft in 2021. We are working closely with the Environment Agency to complete the update.

The predicted impact upon river flows and levels is negligible, and there are no mechanisms by which ecology, water quality, or fisheries can be impacted. Drawdown of 1m is predicted in a 3.5km radius, and hence there is a small potential for negative impacts upon five other abstractions. These abstractors will be contacted in order to assess the potential for impact and put in place any required mitigation measures prior to any drought permit application. There are is potential for likely significant effects upon European sites, and hence a HRA Stage II Appropriate Assessment has not been carried out.

Monitoring and mitigation requirements were identified in the environmental assessment informed the Environmental Monitoring Plan.

The key findings of the environmental assessment are summarised in Table 7.3.

Table 7.3: Summary of potential impacts to environmental receptors as a result of the proposed drought permit at the River Wissey

Issue	Predicted Impact (Winter)	Commentary
Impacts on River Levels and Flow	Negligible	Simulations suggest minimal change to river flows and surface water levels during periods of increased groundwater abstraction (Atkins, 2013a).
Impacts on Groundwater	Moderate	Drawdown is predicted to increase under drought permit conditions relative to the fully licenced baseline. Levels at water dependent designated sites in the vicinity of the boreholes will not be significantly impacted.
Impacts on Navigation and Recreation	Negligible	No mechanisms for potential impact
Impacts on Water Quality	Negligible	No mechanisms for potential impact
Fisheries Health (main river)	Negligible	No mechanisms for potential impact
Fish spawning (backchannels)	Negligible	No mechanisms for potential impact
Fish passage	Negligible	No mechanisms for potential impact
Impacts on Macroinvertebrates	Negligible	No mechanisms for potential impact
Macrophytes	Negligible	No mechanisms for potential impact
Diatoms	Negligible	No mechanisms for potential impact
Impacts on Abstractors	Low to Moderate	Five abstractors within a 3.5km radius of the Wellington Wellfield and Denton Lodge boreholes may be impacted by an additional 1m drawdown in groundwater levels.

Table 7.4 shows baseline, pre-drought, during drought, mitigation measures and post drought surveys for the proposed drought action at the River Wissey.

Table 7.4: Monitoring and mitigation measures

Baseline surveys and outstanding actions (normal/ non-drought conditions) • Baseline hydrology, water quality, and ecological monitoring.
Pre-drought surveys (commence in potential drought) • Increased frequency of groundwater monitoring and water quality monitoring.
During drought (commence in drought period) • No additional monitoring compared to pre-drought surveys.
Mitigation measures (commence on implementation of drought permit) • Mitigation measures related to other abstractors if required.
Post drought (commence after drought permit has been lifted) • Continued enhanced frequency of water quality monitoring for six months or until the water quality has returned to baseline conditions • Annual fish surveys for the first three years

7.4 Stakeholder consultation and implementation strategy

7.4.1 Stakeholder Consultation

We have obtained pre-consultation advice from the Environment Agency and Natural England (where required) on our Environmental Assessment Reports, including the WFD assessments, HRA Stage I Screening reports, and the proposed mitigation and monitoring measures, as part of the development of the Drought Plan 2019. We have also obtained statutory consultation advice from the Environment Agency, Natural England, and Historic England on the SEA Scoping report. Any concerns have been addressed through the Environmental Assessment Reports and SEA report, and fed into the Environmental Assessment Summary and Environmental Monitoring Plan as summarised above.

Other relevant stakeholders will be consulted during the Drought Plan 2019 consultation period, with any concerns being addressed for the final Drought Plan. Other stakeholders include:

- The Navigation Authority (Environment Agency)
- Other abstractors
- Recreational user groups
- Other interested parties

No significant concerns are anticipated for this proposed drought permit, as it has been made available for consultation in previous drought plans.

For our full drought permit application we would include the following, as recommended by the guidance:

- Written consent from the Environment Agency;
- Comments from those consulted about the application;
- Details of any objections received or agreements reached with objectors;
- A copy of the notices and advertisements relating to our application; and
- A description of our arrangements for the public inspection of the application.

7.4.2 Advertising the application

Our drought permit application would by published in the daily local newspaper circulating in the area affected by the permit (Eastern Daily Press (circulation 26,788[34]). The newspaper also has a website. We would also advertise it in the London Gazette, as recommended by the guidance. We would consider publishing targeted social media updates in line with our communications strategy (Drought Plan 2019 Appendix 9).

7.4.3 Planning for all outcomes

We plan to engage with relevant stakeholders and address concerns in the creation of our drought plan and as part of the consultation process. In the event of a public hearing, we would confirm arrangements closer to the time. We have a number of regional Anglian Water offices which could be used as a venue or would seek alternative venues as appropriate.

We would liaise closely with the Environment Agency before and during any permit application to ensure we have their support. We have agreed a robust mitigation programme with the Environment Agency and do not anticipate significant issues which may result in a public hearing.

In event of unsuccessful permit we would need to consider other supply side options, as set out in the 2019 Drought Plan Appendix 3.

7.4.4 Drought Permit review strategy

We would review our drought plan on an annual basis as part of our Water Resources Management Plan Annual Review. Required changes to drought permits would be reported as part of this. Baseline monitoring data would be reviewed on an annual basis and associated updates to the environmental assessment completed as required.

Appendices (on request):

- Draft permit
- Existing abstraction licence - plus a copy of any statutory instrument or local act connected to it or to a discharge permitted by the drought permit

Supporting Information

- Appendix 7: Environmental Assessment Summary
- Appendix 8: Environmental Monitoring Plan

[34] *https://www.abc.org.uk/product/2302-norwich-eastern-daily-press (June 2018)*

8. River Wensum (Costessey Boreholes)

8.1 Current licence and proposed drought permit

8.1.1 Current licence

Anglian Water is licenced to abstract from the Costessey groundwater source.

8.1.2 Proposed drought permit

The following permit application would be made for the River Wensum intake:

- Increase the annual abstraction quantity for the Costessey groundwater source from 2,000Ml/yr to 4,800Ml/yr at a maximum instantaneous abstraction rate of 30Ml/d (347l/s).

It is possible that during a severe drought, flows in the River Wensum may be reduced, such that use of the intake is compromised. In the event of a severe drought, it is proposed that the groundwater source could be used to support supply. To achieve this, the drought permit would support a temporary increase in the maximum annual licensed abstraction rate at the groundwater abstraction if required.

As per current guidance, the drought permit would initially cover a 6-month period[35] of either October to March (inclusive) for a winter permit or April to September (inclusive) for a summer permit. Subsequent reapplication for a further 6 months would be considered, if required, depending on the drought situation at the time.

We have developed triggers to guide us through the different stages of the drought permit application process, and these are detailed in Appendix 5.

A copy of our current abstraction licence and a draft permit is provided in the Appendix.

[35] *https://www.gov.uk/guidance/apply-for-a-drought-permit*

8.2 Justification of the need

8.2.1 Exceptional shortage of rain

For a drought order or permit to be granted, there is a legal requirement to demonstrate that '...by reason of an exceptional shortage of rain, a serious deficiency of supplies of water in any area exists or is threatened...'.

Environment Agency guidance[36] states that it is not appropriate to set a prescriptive approach to assessing the exceptional shortage of rain (ESOR) as each drought and each situation is unique. The guidance provides a range of matters to consider when building the case for ESOR. This section provides an overview of our process for demonstrating an exceptional shortage of rain, following the guidance.

Rainfall is a key indicator in assessing drought conditions. Drought events vary in their duration, the time of year they commence and their magnitude (the extent of the rainfall deficit). Soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, streamflow and reservoir storage reflect the longer-term precipitation anomalies. These factors combine to produce a wide range of impacts on water resources. As such, it is not possible to define the exact process of rainfall assessment in advance of a drought occurring. The following data sources and methods would be used:

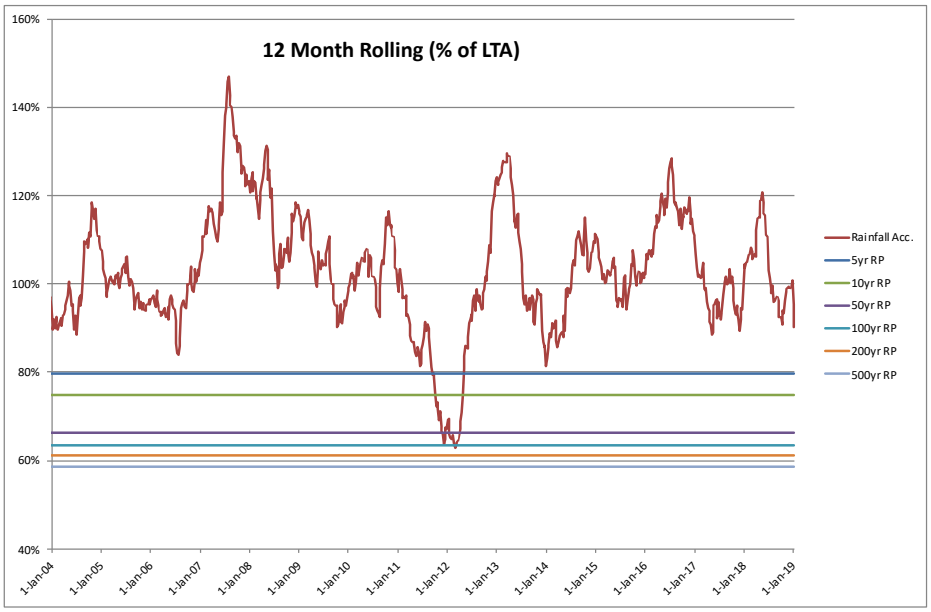
Rainfall accumulation data

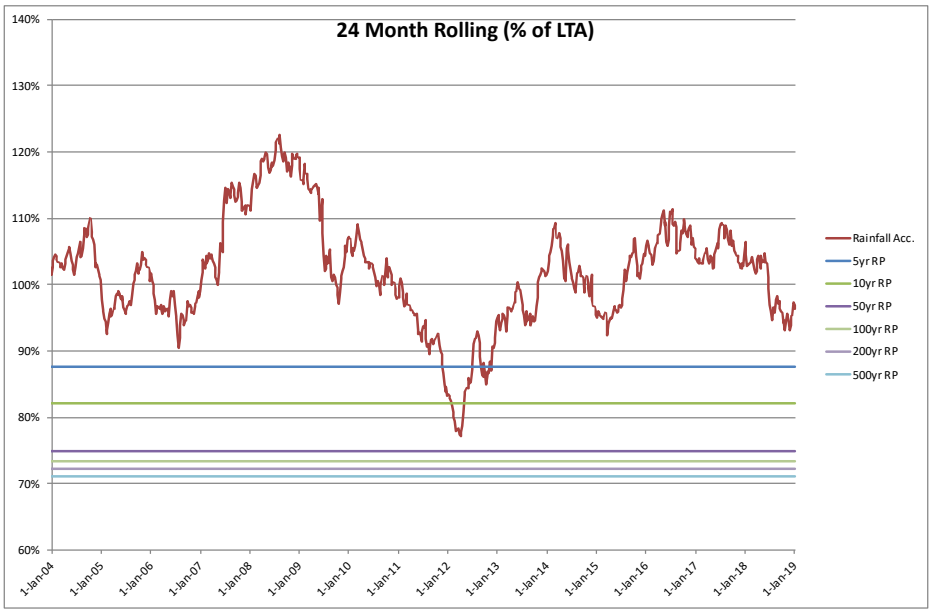
We have used Bayesian Extreme Value Analysis, carried out by the Met Office[37] to determine 1:5, 1:10, 1:50, 1:100 and 1:200 return periods (RPs) of 12, 24 and 36 month rainfall accumulation totals for the Ruthamford, Lincolnshire, Trent, Affinity, Norfolk and Suffolk sub-regions.

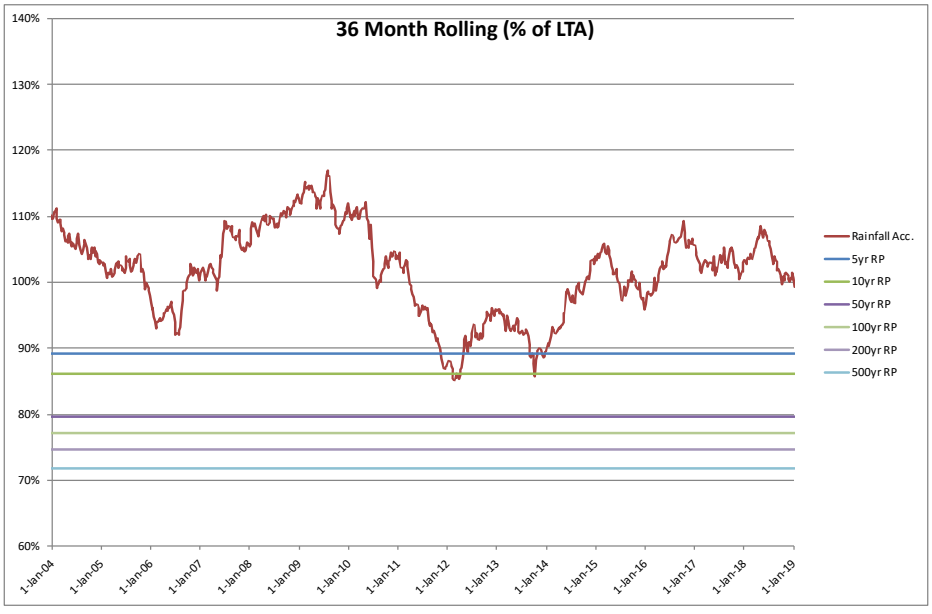
For the River Wensum, we would use rainfall accumulations from the regional MORECS squares which cover the Wensum catchment (120 and 130). Deviation from the long term average would be monitored and compared to the Met Office return periods (Figure 8.1). The use of 12, 24 and 36 month timescales allows the pattern and magnitude of both annual and longer term rainfall deficits (e.g. 1 or 2 dry winters) to be measured.

[36] *EA Drought Planning Guideline: Exceptional shortage of rain*
[37] *Technical Note: Extreme Value Analysis of long duration droughts using Bayesian methods (Met Office, Oct 2017)*

Figure 8.1: 12, 24 and 36 month rolling rainfall accumulation (as a % of 1900-1990 long term average) for MORECS squares 119, 120 and 130 (averaged)







Atkins has carried out analysis of rainfall accumulation of historic and representative stochastically generated droughts at the sub-regional scale for the Anglian Water region[38]. We would compare the pattern and timings of contemporary rainfall accumulations with these historical droughts in our assessment.

Standardised Precipitation Index

To support a drought permit application we would also use the Standardized Precipitation Index (SPI) to indicate the rarity of a current drought. This would be calculated for a range of timescales (12, 24 and 36 months). The relevant MORECS squares for the Wensum catchment (120 and 130) would be used as the base data.

SPI values can be classified as shown in Table 8.1 following McKee et al. (1993)[39]. The World Meteorological Organisation's user guide[40] defines a drought event as occurring any time the SPI is continuously negative, and reaches an intensity of -1.0 or lower. The drought event ends when the SPI becomes positive. The sum of the SPI for all the months within a drought event can be termed the drought's 'magnitude'. The guide also provides an estimate of the return periods of a drought by SPI (Table 8.2).

Table 8.1: SPI Values

2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

Table 8.2: SPI probability of recurrence

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

Other indicators of ESOR

We would support a case for exceptional shortage of rain by presenting other measures of effective rainfall, such as soil moisture deficit, temperature, river flows and groundwater levels. This would include comparison to the long term average and trend analysis.

We would also describe our current and forecast operational water supply situation, to include reservoir storage levels against normal operating curves, and forecast projections for a range of rainfall scenarios. Relevant impacts and mitigation actions carried out in the wider supply system would also be detailed.

8.2.2 Order of use

Not applicable in circumstances where multiple permits are not required.

[38] *Drought Selection Process and Criteria - Anglian Water Services (Atkins, 2017)*
[39] *McKee, T.B., N.J. Doesken and J. Kleist, 1993: The relationship of drought frequency and duration to time scale. In: Proceedings of the Eighth Conference on Applied Climatology, Anaheim, California,17-22 January 1993. Boston, American Meteorological Society, 179-184.*
[40] *World Meteorological Organization, 2012: Standardized Precipitation Index User Guide (M. Svoboda, M. Hayes and D. Wood). (WMO-No. 1090), Geneva.*

8.3 Environmental Assessment

The March 2020 Environmental Assessment Report by Mott MacDonald/Atkins assessed the potential environmental impacts of implementing the proposed drought action, considering the river in the vicinity of the boreholes within a 5km radius, as well as other receptors, following Defra and Environment Agency guidance. The findings are summarised in Appendix 7 and 8, with a brief overview here.

Impacts on river water levels were perceived to be minimal (maximum 0.02m reduction). River flows are expected to reduce by an average of 7.5% and up to 12.1% in the River Wensum SAC. This is within the acceptable range of deviation from natural flows in order to comply with Good status under the WFD, but it is not in the range of acceptable deviation from natural flows to comply with the flow targets of the River Wensum SAC. Groundwater levels are expected to reduce as far as the SSSI land parcels that have been identified as optimum habitat for Desmoulins's whorl snail (i.e. Land Parcels 38-44). Modeled drawdown is up to 2.5m at Land Parcels 38-39, although the land parcels are also thought to be in hydrological connectivity with the river. Further monitoring is in place and will be used to support the modeling results and further understand the contributions of groundwater and surface water to the land parcels.

The report concluded that there is potential for up to moderate adverse effects on ecology including designated features as a result of the predicted reduction in flows on the River Wensum and adjacent groundwater levels, and that a HRA Stage II Appropriate Assessment was required to fully assess the predicted impacts on the qualifying features of the River Wensum SAC. Monitoring and mitigation requirements were identified in the environmental assessment and the HRA Stage II Appropriate Assessment and informed the Environmental Monitoring Plan.

The key findings of the environmental assessment are summarised in Table 8.3.

Table 8.3: Summary of predicted environmental impacts of the proposed drought permit on the River Wensum

Issue	Predicted Impact Winter	Predicted Impact Summer	Commentary
Impacts on Levels and Velocity	N/A - velocity/level are impact mechanisms rather than receptors		A dry reference proxy period was selected for assessment of environmental impacts.
Navigation	Negligible	Negligible	No mechanisms for potential impact.
Recreation	Moderate	Moderate	Drawdown at Costessey Pits 1, 2 and 3 and Taverham Lake may impact fish stocks and water sports.
Water Quality	Low - Moderate	Moderate	Adverse effects on water quality are minor and temporary. Phosphate contaminants from STWs are unlikely to increase significantly. Temperatures and BOD may increase in summer months, however a significant deterioration in water quality is not expected.
Fish	Moderate - High	Moderate - High	Potential impact on ecological structure including fish migration, passage and spawning behaviours as a result of reduced river flow.
Macroinvertebrates	Moderate	Moderate	The macroinvertebrate community present in the lower Wensum waterbodies is tolerant to changes in the flow regime. Changes in water level and flows could result in reduced dilution capacity and/or deterioration in water quality.
Macrophytes	Low - Moderate	Moderate	The macrophyte community present in the lower Wensum waterbodies is tolerant to changes in the flow regime. Changes in water level and flows could result in reduced dilution capacity and/or deterioration in water quality.
Water vole	Moderate - High	Moderate - High	Changes in the water level could affect water vole refuges in the River Wensum as well as causing changes to the availability of food in the form of emergent and marginal vegetation.
River Wensum SAC/SSSI feature: Desmoulin's whorl snail	Moderate - High	Moderate - High	Previous modelling concluded that groundwater levels could drop substantially at Land Parcel 38-44, which could result in changes to water quality and habitat loss for the Desmoulin's whorl snail without appropriate mitigation. Thus, there is potential for adverse effects on this species which should be investigated further through Appropriate Assessment.
Other abstractors	Moderate	Moderate	Groundwater drawdown may impact other licensed groundwater abstractors.

Table 8.4 shows baseline, pre-drought, during drought, mitigation measures and post drought surveys for the proposed drought action at Costessey.

Table 8.4: Monitoring and mitigation measures

Baseline surveys and outstanding actions (normal/non-drought conditions) • River flow and water levels to be recorded at 15-minute intervals • Groundwater monitoring at River Wensum SSSI units 38 and 39 • Investigation into current use of licenced and private abstractions · Produce a water level management plan for River Wensum SSSI units 40-44
Pre-drought surveys (commence in potential drought) • Monitoring of macroinvertebrates, macrophytes, fish survey and water quality to ensure accurate baseline of conditions • Contact other abstractors
During drought (commence in drought period) • Water level monitoring at Cotessey Pits and Taversham Lake as well as Land Parcels 40-44 • Enhanced phosphate, dissolved oxygen, ammonia, temperature and turbidity monitoring in River Wensum and Costessey Pits • Increased macroinvertebrate and macrophyte sampling during the drought permit application and implementation
Mitigation measures (commence on implementation of drought permit) • Spray or drip irrigation to increase the humidity of the Desmoulin's whorl snail habitat and maintain water levels at SSSI units 38 to 39 (provided appropriate land management is in place at the time of the permit) • Implementation of the Water Level Management plan on SSSI units 40-44 • Fish removals to take place at Costessey Pits or Taverham Lake if water levels drop or water quality deteriorates significantly and that the fish are relocated to a suitable nearby receptor • Mitigation of derogation through actions such as pump lowering, borehole deepening or compensation at potentially impacted other abstractors
Post drought (commence after drought permit has been lifted) • Continued ground and surface water monitoring at River Wensum SSSI units 38 to 44, Costessey Pits and Taverham Lake to assess when mitigation measures are no longer required • Surface water and groundwater quality monitoring will revert back to baseline sampling levels • Additional ecological monitoring should continue up to three years after the cessation of the drought permit

8.4 Stakeholder consultation and implementation strategy

8.4.1 Stakeholder Consultation

We have obtained pre-consultation advice from the Environment Agency and Natural England (where required) on our Environmental Assessment Reports, including the WFD assessments, HRA Stage I Screening reports, and the proposed mitigation and monitoring measures, as part of the development of the Drought Plan 2019. We have also obtained statutory consultation advice from the Environment Agency, Natural England, and Historic England on the SEA Scoping report. Any concerns have been addressed through the Environmental Assessment Reports and SEA report, and fed into the Environmental Assessment Summary and Environmental Monitoring Plan as summarised above.

Other relevant stakeholders will be consulted during the Drought Plan 2019 consultation period, with any concerns being addressed for the final Drought Plan. Other stakeholders include:

- The Navigation Authority (Broads Authority)
- Other abstractors
- Recreational user groups
- Other interested parties

No significant concerns are anticipated for this proposed drought permit, as it has been made available for consultation in previous drought plans.

For our full drought permit application we would include the following, as recommended by the guidance:

- Written consent from the Broads Authority
- Comments from those consulted about the application
- Details of any objections received or agreements reached with objectors
- A copy of the notices and advertisements relating to our application; and
- A description of our arrangements for the public inspection of the application

8.4.2 Advertising the application

Our drought permit application would by published in the daily local newspaper circulating in the area affected by the permit (Norwich Evening News (circulation 7,507[41]) and the Eastern Daily Press). The newspaper also has a website. We would also advertise it in the London Gazette, as recommended by the guidance. We would consider publishing targeted social media updates in line with our communications strategy (Drought Plan 2019 Appendix 9).

8.4.3 Planning for all outcomes

We plan to engage with relevant stakeholders and address concerns in the creation of our drought plan and as part of the consultation process. In the event of a public hearing, we would confirm arrangements closer to the time. We have a number of regional Anglian Water offices which could be used as a venue or would seek alternative venues as appropriate.

We would liaise closely with the Environment Agency before and during any permit application to ensure we have their support. We have agreed a robust mitigation programme with the Environment Agency and do not anticipate significant issues which may result in a public hearing.

In event of unsuccessful permit we would need to consider other supply side options, such as rezoning or tankering, as well as increasing demand saving activities.

8.4.4 Drought Permit review strategy

We would review our drought plan on an annual basis as part of our Water Resources Management Plan Annual Review. Required changes to drought permits would be reported as part of this. Baseline monitoring data would be reviewed on an annual basis and associated updates to the environmental assessment completed as required.

Appendices:

- Draft permit
- Existing abstraction licence - plus a copy of any statutory instrument or local act connected to it or to a discharge permitted by the drought permit

Supporting Information

- Appendix 7: Environmental Assessment Summary
- Appendix 8: Environmental Monitoring Plan

[41] *Press Gazette, 2018 (https://pressgazette.co.uk/regional-abcs-print-steep-circulation-falls-for-dailies-the-yorkshire-evening-post-and-carlisle-news-star/2/)*

9. River Trent

9.1 Current licence and proposed drought permit

9.1.1 Current licence

Anglian Water is licenced to abstract from the River Trent at Hall WTW.

The licence is subject to a Hands Off Flow (HOF) condition, which restricts abstraction when the flow of the River Trent is equal to or less than 1,700 Ml/d, as gauged by the Environment Agency at its flow gauging station at North Muskham.

The abstraction is also subject to a Hands Off Level (HOL).

9.1.2 Proposed drought permit

The following permit application would be made for the River Trent intake:

- Reduction of the Hands Off Flow (HOF) from 1700Ml/d to 1450Ml/d

As per current guidance, the drought permit would initially cover a 6-month period[42] of either October to March (inclusive) for a winter permit or April to September (inclusive) for a summer permit. Subsequent reapplication for a further 6 months would be considered if required, depending on the drought situation at the time.

The proposed drought permit application would be triggered when flows at North Muskham fall below 2100Ml/d, although considerations of the rate of decline in river flow and rainfall will also be relevant. The drought permit will not seek to change the HOL.

The permit would be required if the flows in the Trent reduced to a level that compromised the maintenance of supply. We have developed triggers to guide us through the different stages of the drought permit application process, and these are detailed in Appendix 5.

A copy of our current abstraction licence and a draft permit is available on request.

[42] *https://www.gov.uk/guidance/apply-for-a-drought-permit*

9.2 Justification of the need

9.2.1 Exceptional shortage of rain

For a drought order or permit to be granted, there is a legal requirement to demonstrate that '...by reason of an exceptional shortage of rain, a serious deficiency of supplies of water in any area exists or is threatened...'.

Environment Agency guidance[43] states that it is not appropriate to set a prescriptive approach to assessing the exceptional shortage of rain (ESOR) as each drought and each situation is unique. The guidance provides a range of matters to consider when building the case for ESOR. This section provides an overview of our process for demonstrating an exceptional shortage of rain, following the guidance.

Rainfall is a key indicator in assessing drought conditions. Drought events vary in their duration, the time of year they commence and their magnitude (the extent of the rainfall deficit). Soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, streamflow and reservoir storage reflect the longer-term precipitation anomalies. These factors combine to produce a wide range of impacts on water resources. As such, it is not possible to define the exact process of rainfall assessment in advance of a drought occurring. The following data sources and methods would be used:

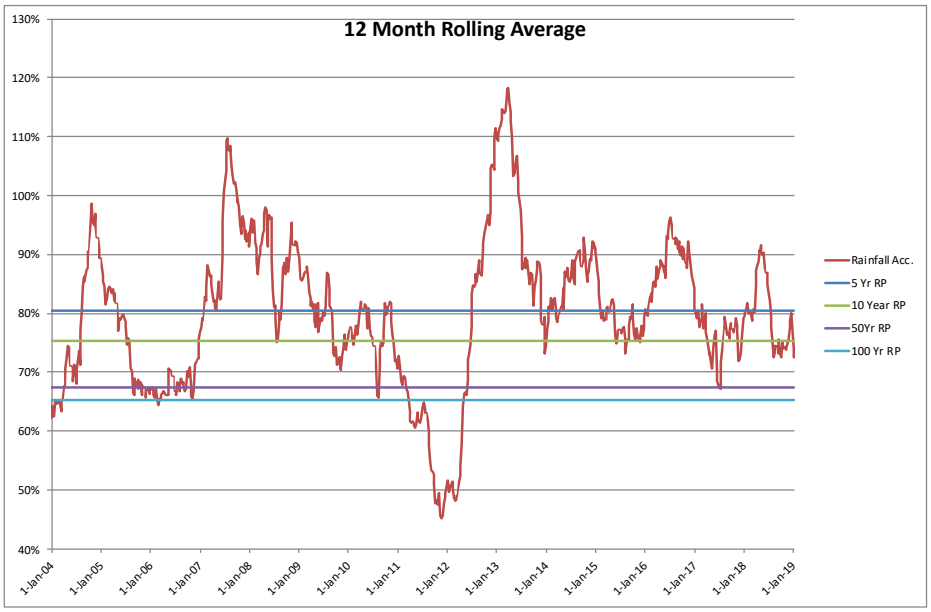
Rainfall accumulation data

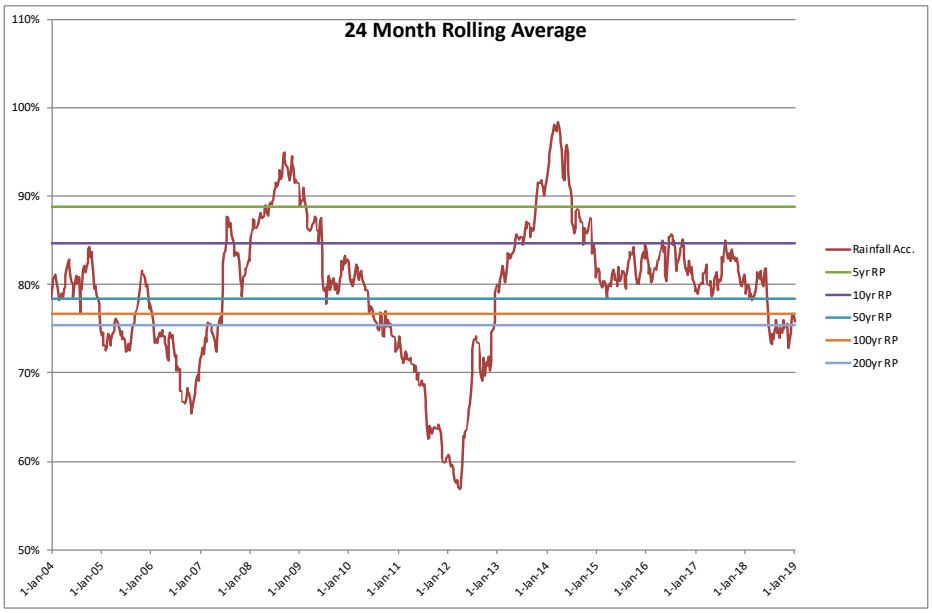
We have used Bayesian Extreme Value Analysis, carried out by the Met Office[44] to determine 1:5, 1:10, 1:50, 1:100 and 1:200 return periods (RPs) of 12, 24 and 36 month rainfall accumulation totals for the Ruthamford, Lincolnshire, Trent, Affinity, Norfolk and Suffolk sub-regions.

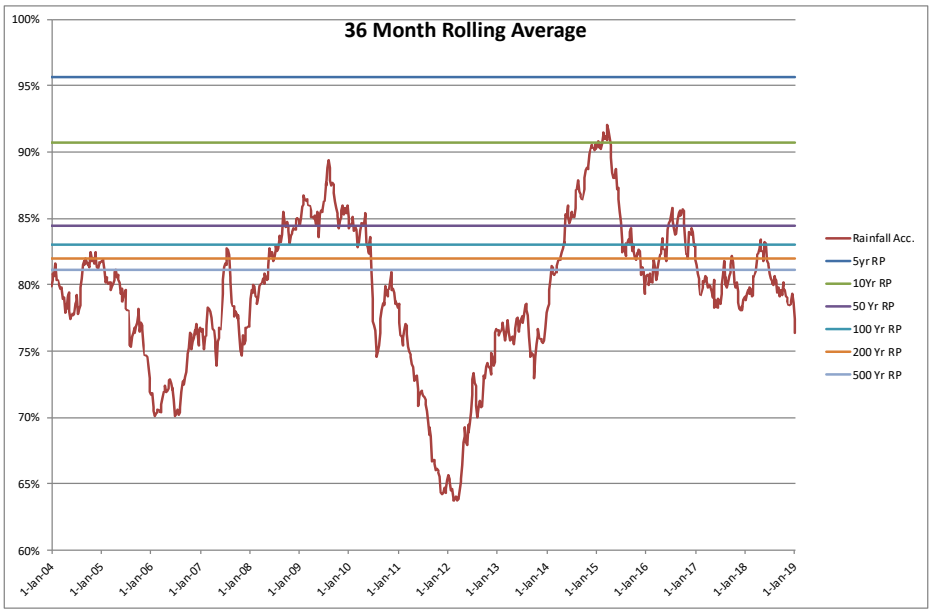
For the River Trent, we would use rainfall accumulations from the regional MORECS squares which cover the majority of the Trent catchment upstream of our abstraction (106, 115, 116, 117, 125 and 126). Deviation from the long term average would be monitored and compared to the Met Office return periods (Figure 9.1). At present we do not have MORECS data for 106, 115 and 125, but are in the process of obtaining this data and would include these squares in a case to support an ESOR. The use of 12, 24 and 36 month timescales allows the pattern and magnitude of both annual and longer term rainfall deficits (e.g. 1 or 2 dry winters) to be measured.

[43] *EA Drought Planning Guideline: Exceptional shortage of rain*
[44] *Technical Note: Extreme Value Analysis of long duration droughts using Bayesian methods (Met Office, Oct 2017)*

Figure 9.1: Example 12, 24 and 36 month rolling rainfall accumulation (as a % of 1900-1990 long term average) with Met Office return periods plotted (MORECS 116, 117, and 126)







Atkins has carried out analysis of rainfall accumulation of historic and representative stochastically generated droughts at the sub-regional scale for the Anglian Water region[45]. We would compare the pattern and timings of contemporary rainfall accumulations with these historical droughts in our assessment.

Standardised Precipitation Index

To support a drought permit application we would also use the Standardized Precipitation Index (SPI) to indicate the rarity of a current drought. This would be calculated for a range of timescales (12, 24 and 36 months). The relevant MORECS squares for the Trent catchment (106, 115, 116, 117, 125 and 126) would be used as the base data.

SPI values can be classified[46] as shown in Table 9.1 following McKee et al. (1993). The World Meteorological Organisation's user guide[47] defines a drought event as occurring any time the SPI is continuously negative, and reaches an intensity of -1.0 or lower. The drought event ends when the SPI becomes positive. The sum of the SPI for all the months within a drought event can be termed the drought's 'magnitude'. The guide also provides an estimate of the return periods of a drought by SPI (Table 9.2).

Table 9.1: SPI Values

2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

Table 9.2: SPI probability of recurrence

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

Other indicators of ESOR

We would support a case for exceptional shortage of rain by presenting other measures of effective rainfall, such as soil moisture deficit, temperature, river flows and groundwater levels. This would include comparison to the long term average and trend analysis.

We would also describe our current and forecast operational water supply situation, to include reservoir storage levels against normal operating curves, and forecast projections for a range of rainfall scenarios. Relevant impacts and mitigation actions carried out in the wider supply system would also be detailed.

9.2.2 Order of use

Not applicable in circumstances where multiple permits are not required.

[45] *Drought Selection Process and Criteria - Anglian Water Services (Atkins, 2017)*
[46] *McKee, T.B., N.J. Doesken and J. Kleist, 1993: The relationship of drought frequency and duration to time scale. In: Proceedings of the Eighth Conference on Applied Climatology, Anaheim, California,17-22 January 1993. Boston, American Meteorological Society, 179-184.*
[47] *World Meteorological Organization, 2012: Standardized Precipitation Index User Guide (M. Svoboda, M. Hayes and D. Wood). (WMO-No. 1090), Geneva.*

9.3 Environmental Assessment

The March 2020 Environmental Assessment Report by Mott MacDonald/Atkins assessed the potential environmental impacts of implementing the proposed drought action, following Defra and Environment Agency guidance. The findings are summarised in Appendix 7 and 8, with a brief overview here.

Impact on river flow was perceived to be minimal (up to 4.4%). Impact on water level is considered to be negligible. The impact on water quality is regarded as insignificant, and ecological impacts are not expected. However, monitoring has been proposed to ensure that the drought permit does not have any significant impacts upon the environment or other activities.

The Habitats Regulations Assessment (HRA) Stage I Screening Assessment concluded that the proposed drought permit will not have any likely significant effects on European designated sites. However, due to uncertainties around the sensitivity of sea and river lamprey to flows, and the passability of Cromwell weir, a HRA Stage II Appropriate Assessment has been completed.

Monitoring and mitigation requirements were identified in the environmental assessment and the HRA Stage II Appropriate Assessment and informed the Environmental Monitoring Plan.

The key findings of the environmental assessment are summarised in Table 9.3.

Table 9.3: Summary of predicted environmental impacts of the proposed drought permit on the River Trent

Issue	Predicted Impact Winter	Commentary
Impacts on river levels and flow	Negligible	Water levels are predicted to reduce by less than 1cm downstream of the abstraction point.
Navigation and recreation	Low	Negative impacts on navigation and other recreational uses of the River Trent are not expected.
Other abstractors	Low	Because of the small scale of the reduction it is considered highly unlikely that there would be any adverse impact to other abstractors.
Water Quality	Negligible	The proposed drought permit is not expected to affect water quality or the overall status of the WFD waterbodies within and downstream of the River Trent.
Fish	Low - Moderate	Certain structures, such as the Cromwell Weir, may become less passable due to a potential drop in river level, which could affect the migration of Atlantic salmon and lamprey.
Macroinvertebrates	Negligible	No significant adverse effects on the communities of macroinvertebrates present in the River Trent are predicted.
Macrophytes	Negligible	No significant adverse effects on the communities of macrophytes present in the River Trent are predicted.
Diatoms	Negligible	No significant adverse effects on the communities of diatoms present in the River Trent are predicted.
WFD status	Negligible	The proposed drought permit is not expected to affect water quality or the overall status of the WFD waterbodies within and downstream of the River Trent.

Table 9.4 shows baseline, pre-drought, during drought, mitigation measures and post drought surveys for the proposed drought action at the River Trent intake.

Table 9.4: Monitoring and mitigation measures

Baseline surveys and outstanding actions (normal/ non-drought conditions) • Cromwell Weir survey to identify the suitability for migration and the likely magnitude of impact related to the drought permit • Lamprey survey upstream of Cromwell Weir and downstream of Cromwell Weir
Pre-drought surveys (commence in potential drought) • Continuation of routine water quality monitoring • Fish, macroinvertebrate and macrophyte sampling
During drought (commence in drought period) • Enhanced water quality monitoring • Macroinvertebrate sampling • Observation of Cromwell Weir (depending on survey outputs)
Mitigation measures (commence on implementation of drought permit) • Abstraction suspended if the flow drops below the temporarily-reduced HOF, or if unacceptable impacts upon lamprey occur
Post drought (commence after drought permit has been lifted) • Water quality monitoring • Additional ecological monitoring should be conducted for up to 3 years after the cessation of the drought permit

9.4 Stakeholder consultation and implementation strategy

9.4.1 Stakeholder Consultation

We have obtained pre-consultation advice from the Environment Agency and Natural England (where required) on our Environmental Assessment Reports, including the WFD assessments, HRA Stage I Screening reports, and the proposed mitigation and monitoring measures, as part of the development of the Drought Plan 2019. We have also obtained statutory consultation advice from the Environment Agency, Natural England, and Historic England on the SEA Scoping report. Any concerns have been addressed through the Environmental Assessment Reports and SEA report, and fed into the Environmental Assessment Summary and Environmental Monitoring Plan as summarised above.

Other relevant stakeholders will be consulted during the Drought Plan 2019 consultation period, with any concerns being addressed for the final Drought Plan. Other stakeholders include:

- The Navigation Authority (Canal and River Trust)
- Other abstractors
- Recreational user groups
- Other interested parties

No significant concerns are anticipated for this proposed drought permit, as it has been made available for consultation in previous drought plans.

For our full drought permit application we would include the following, as recommended by the guidance:

- Written consent from the Canal and River Trust;
- Comments from those consulted about the application;
- Details of any objections received or agreements reached with objectors;
- A copy of the notices and advertisements relating to our application; and
- A description of our arrangements for the public inspection of the application.

9.4.2 Advertising the application

Our drought permit application would by published in the local newspaper circulating in the area affected by the permit (Gainsborough Standard). The newspaper also has a website. We would also advertise it in the London Gazette, as recommended by the guidance. We would consider publishing targeted social media updates in line with our communications strategy (Drought Plan 2019 Appendix 9).

9.4.3 Planning for all outcomes

We plan to engage with relevant stakeholders and address concerns in the creation of our drought plan and as part of the consultation process. In the event of a public hearing, we would confirm arrangements closer to the time. We have a number of regional Anglian Water offices which could be used as a venue or would seek alternative venues as appropriate.

We would liaise closely with the Environment Agency before and during any permit application to ensure we have their support. We have agreed a robust mitigation programme with the Environment Agency and do not anticipate significant issues which may result in a public hearing.

In event of unsuccessful permit we would need to consider other supply side options, such as rezoning or tankering, as well as increasing demand saving activities.

9.4.4 Drought Permit review strategy

We would review our drought plan on an annual basis as part of our Water Resources Management Plan Annual Review. Required changes to drought permits would be reported as part of this. Baseline monitoring data would be reviewed on an annual basis and associated updates to the environmental assessment completed as required.

Appendices

- Draft permit
- Existing abstraction licence - plus a copy of any statutory instrument or local act connected to it or to a discharge permitted by the drought permit

Supporting Information

- Appendix 7: Environmental Assessment Summary
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Cover photo - Anglian Water's Grafham Water reservoir, an 806-hectare biological Site of Special Scientific Interest, southwest of Huntingdon in Cambridgeshire. It was designated an SSSI in 1986.