Affinity Water

Your local supply, on tap

Adapting to Climate Change

August 2015

Security

This document has been written in compliance with our Security Policy so that no redaction is required for publication.

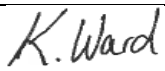
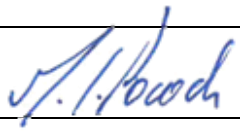
Location codes are therefore used when referring to specific abstraction sites.

Document Control Sheet

Document amendment history

Version	Status	Date	Amendment to this version
1.0	Issue	09/04/15	Issue for first review.
1.1	Issue	14/04/15	Modification following feedback from KW.
1.2	Issue	26/05/15	Modification following feedback from MP.
1.3	Issue	28/08/15	Modification following feedback from DEFRA.

Document approval

Document title	Adapting to Climate Change			
e-Document location				
	Name	**Signature**	**Title**	**Date**
Author/originator	Sophia Mountford		Asset Engineer	09/04/15
Reviewer	Katie Ward		Senior Asset Engineer	14/04/15
Approver 1 (internal use)	Mike Pocock		Physical Asset Strategy Manager	29/05/15
Approver 2 (external use)	Tim Monod		Director of Legal and Assurance, and Company Secretary	01/09/15

This page left intentionally blank

Executive Summary

Significant changes have taken place within our organisation over the last five years. In October 2012, we became Affinity Water following the unification of the three Veolia Water businesses and we took this as an opportunity to review and streamline our processes.

Our vision is to be the leading community focused water company. A key part of this is our responsibility to adapt to climate change and we have made significant progress in our organisational capability to meet this challenge:

– The importance of environment to our business has been reinforced through our strategic priorities and passions

– We have established more robust leadership and governance of our environmental activities through our 'Our Environment' Working Group

– We have published our Environment Policy[1] which includes our commitment and strategic vision for addressing climate change.

We have taken care to understand and assess potential implications of climate change on our business. We have clear processes in place to manage strategic risks and these have been embedded as part of our business and operational planning.

We have identified three key risks to our business posed by climate change – drought, flooding, and peak water demand conditions. To mitigate these risks we have:

– Implemented a flood mitigation programme for 35 of our highest priority sites

– Reviewed our drought management plans and monitoring processes

– Commenced the measures identified in our Water Resources Management Plan (WRMP) in order to ensure supply continues to be sufficient for demand whilst leaving more water in the environment.

Since our first round reporting we have improved our understanding of climate change thresholds. Specifically, these include practical operational thresholds, design thresholds and level of service thresholds. New drought and flood triggers have been installed and the company aims to define thresholds for triggering investment beyond that which we are currently planning in our business plan.

Recent extreme weather events including the prospect of unprecedented drought in 2011-12 and flooding in 2013-14, have provided key opportunities for learning and for assessing any areas for vulnerability within our business. Our monitoring and evaluating processes have enabled us to take on board the successes and lessons learned from these events.

[1] Environment Policy, Affinity Water, https://stakeholder.affinitywater.co.uk/docs/environment-policy-april15-v1-2.pdf

A table of completed and new climate change adaptation actions has been compiled and is presented in Section 5. Affinity Water will undertake future actions under the following categories;

– Further increase our adaptive capability
– Understand our customers' appetite for resilience investment
– Undertake targeted projects to address specific climate risks.

Included in these targeted projects, we have a challenging programme of work for the future including our Water Saving Programme. This encompasses a 14% leakage reduction – the highest percentage reduction of any water company over the next five years. It also involves a customer metering programme and focused support to help our customers use water wisely. These measures are an important foundation for us so that we are in a strong position to any challenges that climate change may pose in the future. We will also continue to engage with our customers to ensure that we understand their views on resilience, and their willingness to pay for future investment.

In summary, we believe the progress we have made over the last five years and our plans for the future will allow us to proactively take the right course of action, ensuring our business is well prepared for the future impacts of climate change.

This page left intentionally blank

Table of Contents

Page

1 Introduction 10
1.1 Affinity Water 10

2 Understanding Climate Risk 12
2.1 Risk Assessment 13
2.1.1 Risk Management Process 13
2.1.2 Risks from Climate Change 13
2.2 Supply Demand Balance 16
2.2.1 Effect of Climate Change on Deployable Output 17
2.2.2 Demand 18
2.2.3 Peak Demand 18
2.2.4 Risk of Outages - Flooding 19
2.3 Water Quality 22
2.3.1 Catchment Management 22
2.3.2 Water Treatment 22
2.4 Coastal Conditions 23
2.4.1 Saline Intrusion 23
2.4.2 Coastal Flooding 23
2.5 Ground Conditions 24
2.5.1 Sink Holes 24
2.5.2 Burst Rate 24
2.6 Daily Operations 24
2.6.1 One Minute Risk Assessment 24

3 Thresholds 26
3.1 Drought Thresholds 26
3.2 Flooding Thresholds 26
3.2.1 Level of Service Threshold 26
3.2.2 Practical and Design Thresholds 27

4 Understanding Uncertainties 28
4.1 Supply Demand Uncertainties 28
4.2 Flooding Uncertainties 29

5 Actions 30
5.1 Actions Tables 31
5.2 Actions Summary – AMP5 and AMP6 Flooding 39
5.2.1 Resistance - Flood Protection 39
5.2.2 Reliability - Capital Maintenance 39
5.2.3 Redundancy 39
5.2.4 Response and Recovery 39
5.3 Actions Summary – Water Resources 40
5.3.1 AMP5 Actions 40
5.3.2 Future Actions 40

6 Addressing Barriers and Understanding Interdependencies 42
6.1 Interdependencies 42
6.1.1 Power 42
6.1.2 Other Water Organisations 43
6.1.3 Transport/Road Access 44
6.1.4 SCADA/Telemetry 44
6.1.5 Telecoms 44
6.1.6 Wider Supply Chain 45
6.2 Barriers 45

6.2.1 Organisational Capability to Adapt 46
7 Monitoring and Evaluating 51
7.1 Embedding Climate Change Consideration 51
7.2 Handling of Drought 2011-12 52
7.3 Handling of Flooding 2013-14 52
7.4 Abstraction Reform and Market Reform 53
8 Opportunities and Benefits 54
9 Conclusions 56

List of Figures

Figure 1: Affinity Water's Supply Area 11
Figure 2: Our Water Saving Programme 41
Figure 3: Our Environment Policy 49
Figure 4: Corporate Responsibility Steering Group Structure 50
Figure 5: Climate Change Considerations for Water Balance 52
Figure 6: Baseline Micro-Component Profile (Unmeasured Households) 63
Figure 7: Baseline Micro-Component Profile (Measured Households) 64
Figure 8: PACT Levels of Preparedness 68

List of Tables

Table 1: Strategic Risks 14
Table 2: Components of Uncertainty for Target Headroom 28
Table 3: Implemented Actions 31
Table 4: New Actions 35
Table 5: Repeat Reporters' Template 62

1 Introduction

This report is Affinity Water's response to the second round of Adaptation Reporting Power (ARP). This provides an update on our progress since the first round reports in 2011.

The document follows the guidance to repeat reporters on how to report progress in planning for climate change. This gives particular focus to how our understanding of climate change implications has developed and what actions have been implemented to address these risks.

The structure of the document is:

- Section 2: How we assess the risk from climate change on our assets, and areas where we have improved our understanding of climate risks
- Section 3: Thresholds for action and investment
- Section 4: Uncertainties remaining in our understanding of the effects of climate change on our business
- Section 5: Progress on existing actions from 2011 reports, and new actions identified
- Section 6: Barriers we face in adapting, and interdependencies with other organisations
- Section 7: How we monitor our climate change adaptation, and our handling of recent extreme weather event
- Section 8: Opportunities and benefits we have realised through adapting to climate change
- Section 9: Summary.

We have included a schedule in Appendix A showing where the answers to the questions in DEFRA's guidance document '*How to report your progress in planning for climate change'* are located in this report.

1.1 Affinity Water

Affinity Water supplies drinking water to approximately 3.6 million people and 1.5 million properties in the South East of England. Our supply area still comprises three distinct geographic regions, as shown in Figure 1.

- ***Central*** provides water to north London and extends into rural parts of Essex, Hertfordshire and Buckinghamshire, with a population of 3.3 million people
- ***Southeast*** provides water to the towns of Folkestone and Dover, together with surrounding rural areas including Romney Marsh and Dungeness, with a population of 180,000 people
- ***East*** provides water to north east Essex including the towns of Harwich and Clacton on Sea, with a population of 151,000 people.

In October 2012, the water licenses and management of Veolia Water Central, Veolia Water Southeast, and Veolia Water East were unified under the new name – Affinity Water. This report covers progress in all three of these regions and refers to the three individual first round reports that we submitted in 2011.

To move towards fulfilling our vision of being the leading community focused water company, we have divided our water resource zones into eight communities. The idea behind this geographical split is that our communities differ greatly from one another and their diverse needs must be understood if we are to serve them in the best way. Each community is named after a local river to further strengthen the link between the service we provide to our customers and the local environment from which we source water.

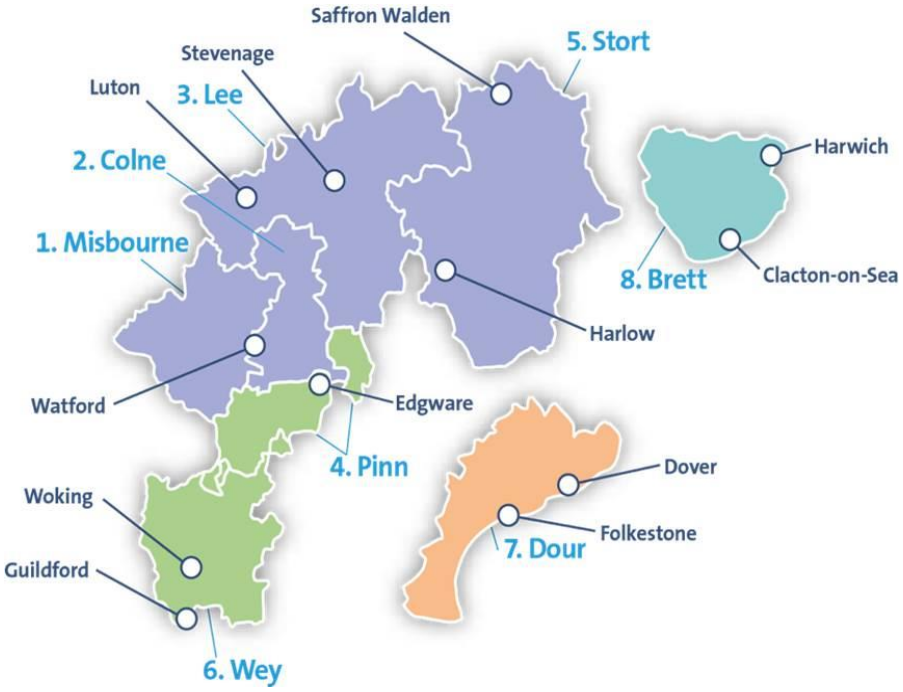


Figure 1: Affinity Water's Supply Area

We are privileged to be the supplier of an essential public service and to be a steward of a precious resource for future generations. One of our four customer expectations, which were determined after consultations with over 12,500 customers, was to:

"Make sure our customers have enough water, whilst leaving more water in the environment."

With this privilege comes an important responsibility to minimise the impact we have on our local environment. We undertake a number of programmes to manage the effect of taking water from sensitive habitats and to maintain flows in local rivers. Through the National Environment Programme (NEP) we help the rivers in our area meet good ecological status in line with the Water Framework Directive (WFD). It is also highly important to us to take into account conserving biodiversity during our operations in line with the Natural Environment and Rural Communities Act (NERC) and the UK Biodiversity Action Plan (UK BAP).

Details of our programme of flow investigations, morphological mitigation measures, augmentation & river support, and biodiversity surveys can be found the WRMP Technical Report 1.4.1*: AMP5 NEP Progress and Summary of PR14 Schemes*.

2 Understanding Climate Risk

Since our first round report, we have significantly increased our understanding of how climate change may affect our operations. We have used this understanding to revise our quantified risk assessment in line with new risk management procedures.

Climate change risks are not identified in isolation in our corporate strategic risk register. Rather, we have chosen to score the effects of climate change on our operations in the wider context of other risks to ensure we can effectively prioritise our risks. We have used our risk management procedures to look at the key areas of our business that climate change may challenge. This is outlined in Section 2.1.

The key areas where we have improved our understanding are:

- **Supply / Demand Balance**
  - Deployable Output (DO)
  - Long Term Demand
  - Peak Demand
  - Risk of Outages – Flooding.
- **Water Quality**
  - Catchment
  - Treatment.
- **Coastal Conditions**
  - Saline Intrusion
  - Coastal Flooding.
- **Ground Conditions**
  - Sink Holes
  - Burst Rate.
- **Daily Operations**

Within each of these areas, we specifically considered the following as our highest priority risks:

- Increased variability in precipitation patterns leading to **droughts** and **floods**
- Increased temperature variability leading to **peak summer demand**

We have undertaken studies to improve our understanding of high risks areas, and planned appropriate actions. We have looked to industry best practise and research groups to further improve our understanding and modelling of the effects of these risks.

2.1 Risk Assessment

We reviewed our risk management process to ensure that it was appropriate for our unified business, and effective for our operations. While direct comparison with our original reports is not possible, our latest risk assessment in Table 1 quantifies the level of threat posed to our operation by the risks listed in our first round reports.

2.1.1 Risk Management Process

Our risk management process is a cyclical process made up of five key phases, placing emphasis on establishing the context and environment within which we operate.

Risks identified are scored for severity and likelihood, and the highest severity score is multiplied by the likelihood to generate the risk score (in a five by five matrix, hence the scores range from 1 to 25). The risk score is a measure of the level of threat and is used for prioritising our key risks.

When describing risks through this process the following definitions have been used:

– The ‘raw’ (gross) risk is that before any controls are put in place
– The target risk is our objective risk level
– The ‘residual’ (net) risk accounts for controls being in place.

2.1.2 Risks from Climate Change

We have identified that climate change could cause failure to three crucial areas of business operation if appropriate measures are not in place:

1. Abstraction
2. Treating water effectively
3. Distributing sufficient volume, pressure and quality water.

Climate change risks are therefore listed on our strategic risk register as a risk against these areas, and have been scored for their likelihood of causing supply failure, and the scale of severity of the subsequent failure.

Having climate change listed alongside other potential causes of failure allows us to easily compare the level of risk posed by climate change and prioritise our adaptation and investment choices.

Risks on our strategic risk register are designated at departmental level and assigned owners and timescales to ensure that we are able to effectively evaluate and monitor the mitigation actions assigned.

Table 1 shows an extract from our strategic risk register, and shows where more information can be found within this document.

Table 1: Strategic Risks

Strategic Risk	Climate Change Cause	Raw Risk (1-25)	Implemented Actions	Severity (1-5)	Likelihood (1-5)	Residual Risk (1-25)	New Actions	Target Risk (1-25)
1. Failure to Abstract	Flooding (Section 2.2.4) & Coastal Flooding (Section 2.4.2) Power (Section 6.1.1) Water Availability - Drought (Section 2.2.1)	15	Section 5.1: Flood Mitigation & Coastal Adaptation No original actions identified for power. Section 5.1: Water Resources – Ensure supply Section 5.1: Drought Management Planning	2	4	8	Section 5.2: Understanding customer appetite for resilience investment & Increase Adaptive Capability Section 5.2: Targeted projects: Site Auto Restart Section 5.2: Targeted projects: DO Assessment & Groundwater model updates	8
2. Failure to Treat Water Effectively	Flooding (Section 2.2.4) & Coastal Flooding (Section 2.4.2) Power (Section 6.1.1) Water conditions outside design capacity - Water Quality (Section 2.3) and Saline Intrusion (2.4.1)	25	Section 5.1: Flood Mitigation & Coastal Adaptation No original actions for power. No original actions for water conditions outside design capacity.	4	3	12	Section 5.2: Understanding customer appetite for resilience investment & Increase Adaptive Capability Section 5.2: Targeted projects: Site Auto Restart Section 5.2: Targeted projects: Pesticide Programme	8

3 a. Failure to distribute sufficient volume, pressure and quality water (pumping)	Flooding (Section 2.2.4) & Coastal Flooding (Section 2.4.2) Power (Section 6.1.1) Excessive demand (Section 2.2.3) PCC Increase (Section 2.2.2)	25	Section 5.1: Flood Mitigation & Coastal Adaptation No original actions identified for power. Section 5.1: Drought Management Planning Section 5.1: Water Resources – Reduce demand	3	3	9	Section 5.2: Understanding customer appetite for resilience investment & Increase Adaptive Capability Section 5.2: Targeted projects: Site Auto Restart Section 5.2: Targeted projects: Met Office Demand Prediction Tool	6
3 b. Failure to distribute sufficient volume, pressure and quality water (network)	Asset Failure through Ground Movement (Section 2.5.3)	25	Section 5.1: Network Improvement	4	4	16	Continuation of network improvement. Section 5.1: Targeted projects: Thresholds	9

2.2 Supply Demand Balance

At the time of our first round reports, the organisation had a strong understanding of the climate risks as they relate to our supply and demand balance, as demonstrated through *Section 4: Risk to Business Functions from Climate Change* of our first round reports, and our 2010 Water Resources Management Plans (WRMP).

Since that time we have strengthened our understanding of climate change impacts by carrying out additional research and improving our modelling.

Our 2010 WRMP showed that a supply deficit would occur in 2026 for critical period conditions and 2035 under annual average conditions. Our NEP studies and discussions with the Environment Agency (EA) have helped us to identify a number of local rivers that are impacted by abstraction. To mitigate this impact we are committed to reducing the amount of water we abstract at 13 sources between 2015 and 2025. These proposals are described in our WRMP Technical Report 1.4: *Sustainability Reductions*.

Taking into account these sustainability reductions, our baseline supply and demand balance (our balance prior to any investment or further intervention) shows a deficit in five of our eight water resource zones at the beginning of the planning period, and in seven zones by 2040.

Given that these deficits in our supply / demand balance are relevant to the Dry Year Critical Period (DYCP) planning scenario, we have undertaken further research to more fully understand the specific risks posed by climate change. This is so that we are clear on the action we need to take to address climate change impacts and maintain resilient supplies.

To understand our long term supply demand balance, we compare our water available for supply with the forecast demand and include the planning allowance known as target headroom to include uncontrollable variance effects and to give flexibility in case actual demand exceeds our forecast (described in more detail in Section 4.1).

Our supply / demand balance is calculated by:

	Deployable output (DO) of all points of abstraction
Plus	**Bulk Imports**
Minus	**Exports**
Minus	**Climate change impacts**
Minus	**Sustainability reductions** (SR) at specific sources
Minus	**Outage and process losses** (water available for use, WAFU)
Minus	**Water demand** (distribution input, DI)
Minus	**Target headroom** (THR)

As well as looking at the potential long term impacts of climate change on our water available for supply, within our DO assessment we also look at how recent extreme weather conditions has affected our current understanding of how our sources perform under these conditions.

2.2.1 Effect of Climate Change on Deployable Output

The DO from our sources can be affected in two primary ways by the weather pattern changes predicted due to climate change. Greater variance in rainfall may result in changes to groundwater levels leading to longer term reductions in the DO from our sources, as well as the impact of successive dry winters in causing extreme events i.e. drought.

We have improved our understanding of the effect of climate change on source outputs, and have estimates of future reductions in source DO for our Central and Southeast groundwater sources. We continue to use a nominal allowance of 1% reduction in output in our East region following confirmation that these are not sensitive to climate change.

2.2.1.1 Long Term Reductions in Deployable Output

In general, our assessment of the effect of climate change on source outputs has been based on the latest climate change projections published by DEFRA (UKCP09 scenarios). We employed specialist consultants to take samples from the 10,000 UKCP09 scenarios projections for the 2030s Medium emissions scenario and to forecast the range of variance of groundwater levels (this can be found in our WRMP Technical Report 1.3: *Assessment of Climate Change Impacts on Deployable Output*). This work was based on an initial vulnerability assessment of which sources are vulnerable to climate change and then the impact of the varied groundwater levels on the quantity of water that could be abstracted from those vulnerable sites.

In our Central region, mid-range climate change estimates for groundwater sources resulted in a reduction in output at 19 of our sources, equating to 20.54 Ml/d.

Our surface water abstraction licences from the River Thames do not include any flow or other constraints as Thames Water has the legal obligation for maintaining minimum flows in the river; there are therefore no climate change impacts on our Thames abstractions.

In addition to this, we have also made an allowance for a potential long term reduction in deployable output at a surface water reservoir which we have an agreement with Anglian Water for shared supply to our Central region (WRZ3). Taking account of recent correspondence with the EA regarding a change in river flow gauging on the Bedford Ouse and Anglian Water's reassessment of DO from the reservoir and water treatment works we have agreed to include for a potential reduction in deployable output in drought conditions to ensure our plans are consistent.

In the East region, climate change impacts have been assessed for the surface water reservoir we share with Anglian, concluding that there would be no impact on the water available. Groundwater sources in the area are also not considered to be sensitive to climate change due to groundwater levels being significantly higher than borehole pump levels in the confined chalk aquifer. Nominal allowances, as used for the previous WRMP, of 1% reduction in output have been made for our chalk sources.

In the Southeast region, climate change impacts have been assessed using the East Kent groundwater model resulting in reductions at seven of our sources, equating to 5.10 Ml/d.

For all of our water resource zones, the 50th percentile estimate of climate change impacts has been used for our DO assessment and the range from the worst case to a best case has been used in the headroom appraisal to evaluate the uncertainty as detailed in Section 4.1 of this report.

2.2.1.2 Extreme Events - Drought

In light of the 2011/12 drought which was caused by two winters of very low rainfall, we incorporated the impacts of changing groundwater levels due to climate change in our drought assessments. Groundwater level data was assessed to see whether 2011/12 or 2005/06 represented a more extreme case, as 2005/06 data had previously been used to assess the DO of our sources. In general, across our aquifers, the 2005/06 water levels were still more extreme although at a few sources there were exceptions. At these 'exceptional' sources we have reviewed and, where appropriate, modified the DO values. We have also re-assessed groundwater source DOs where there have been asset or operational changes made. This information has improved our understanding of how our system will respond to lower groundwater levels during droughts.

Increased frequency and intensity of rainfall events and thus droughts will also affect demand for water and how we act to restrict use of water in drought conditions. We reviewed our levels of service as part of our WRMP and confirmed that stated Level of Service (LoS) for Temporary Use Bans (TUBs) will remain 1 in 10 years, our level of service for drought orders restricting essential use has been updated to <1 in 40 years (previously 1 in 20) and assessed the likelihood of unprecedented drought at >1 in 118 year return period. We have deemed emergency drought orders for standpipes or rota cuts as unacceptable.

We reviewed our levels of service return periods to determine our ability to achieve these targets using a hindcasting approach. We explain our analysis in detail in the WRMP Technical Report 1.2: *Levels of Service Hindcasting*.

2.2.2 Demand

We updated our demand forecast to account for the publication of UKWIR's *Impact of Climate Change on Demand* (2013). Our latest analysis identifies that the impact of climate change on demand is lower than assessed in our previous WRMP, despite recent evidence that suggests our climate is changing to warmer, drier summers and milder, wetter winters.

We have included a baseline level of the impact of climate change on demand in our demand forecast, and have accounted for the uncertainty of that forecast in our headroom assessment as described in Section 4.1. This was done in accordance with the WRMP Guidelines and DEFRA's *Climate Change and the Demand for Water* report 2003.

Through our micro-component assessment, we found that the small increase in demand as a result of climate change largely applies to garden watering, which was verified by the micro-component study we undertook in the summer of 2013. Our micro-component assessment and study is discussed further in Appendix B.

2.2.3 Peak Demand

For our 2014 WRMP, we modelled the increase in demand from a normal year to both the dry year annual average and DYCP by applying different factors to each micro-component, as we believe that some micro-components are more sensitive to dry and peak conditions than others.

We undertook a specific micro-component study in summer 2013 which found that:

- Peak demand was driven by a small number of households using considerably more water in hot periods than they do under normal weather conditions
- The majority of this change in use between average and peak demand was driven by garden watering.

Further details of this study and the findings can be found in Appendix B.

To assist our operational teams in being prepared for more frequent peak demand conditions, we undertook a successful trial of a Met Office demand prediction tool. This tool allowed for improved forward planning in periods of prolonged high demand, and gave advanced warning of high demand. Future development of this tool will incorporate operational triggers and corresponding actions. This tool has been implemented into standard business practices to monitor predicted short term peak demand.

Following this demand prediction trial, we hosted the first meeting of the Water Demand Forecasting Group. The group's aims are to share best practice demand prediction techniques within the Water Industry, and to shape the direction of research and development in weather derived demand forecasting through AMP6.

2.2.4 Risk of Outages - Flooding

2.2.4.1 Site Risk Assessments and Protection

Since our 2011 report, site specific flood risk assessments have been undertaken at sites identified as being potentially vulnerable to flooding. Criticality ratings and cost-benefit analysis has been undertaken on the suggested mitigation actions.

The Final Determination for AMP5 set out the requirement to reduce the risk of supply interruptions, as a result of flooding, for 80,000 properties from 1 in 20 (5%) to effectively zero at 29 sites in our Central area, and increase the security of supply to 9,300 properties at seven of our sites in our Southeast area.

We undertook a structured approach to assessing and quantifying flood risk on all sites to define the actual requirements to provide operational resilience against the chosen design flood level. The study confirmed the 29 critical sites which supply a total of approximately 800,000 properties if each site was to fail without the ability to transfer from zone to zone. In practise we do have sufficient resilience to supply customers under reduced demand scenarios. However, in the case of flooding we have assumed that the flood severity will be uniform across our region and therefore we are protecting all susceptible sites regardless of a zone transfer option being available. These flood protection works at these sites were undertaken in 3 phases:

- **Phase 1:** We started constructing phase 1 of the work early in AMP 5 in order to protect 19 sites including the intake for our largest treatment plant at HWFS and these were completed by March 2015 at a cost of £1.3M
- **Phase 2:** This comprised our large treatment works on the River Thames. These works were completed in April 2015 and we used lessons learnt from the flooding experienced in February 2014 to influence the design and our understanding of future operation of the sites during a flood event. Phase 2 cost a total of £1.8M

- **Phase 3:** This is currently in construction at the remaining seven groundwater sites and is due for completion in September 2015 at a cost of £0.7M. One site was removed from scope as it was identified as a site that needed new configuration at Price Review 2014 (PR14) for the main supply to the Stevenage area following cessation of pumping at our WHIH source works.

Works in our Southeast area were also completed by the end of the AMP period at a cost £170k.

2.2.4.2 Design Flood Level

The design flood level chosen as our adopted standard was based on the 1 in 100 (1%) annual likelihood flood level (Q100) specific to the site in question.

Q100 + CC + freeboard

– *CC is a factor for allowance for climate change, calculated as +20% flow, which is the accepted standard for the period 2025 to 2115.*

– *+300mm is the UK design standard for freeboard allowance.*

therefore,

Q100 + 20% flow + 300mm

We anticipate that this adopted level of flood protection will be generally equal to or exceed the 1 in 200 (0.5%) annual likelihood flood level recommended in the Pitt Review[2]. Further work is currently on-going to verify this initial assessment.

The Q100 + 20% flow level was assessed for each site from either:

1. Detailed flood levels from the latest modelling information available from the EA
2. Where modelled flood levels were not available, levels were taken from flood risk assessments for sites where deemed appropriate
3. Where neither of the above were available, individual assessments were undertaken and flood levels determined in consultation with flood engineers.

2.2.4.3 Flooding Winter 2013/14

Our understanding of the risks posed to Affinity Water through flooding was strengthened as a result of our experience of flooding during winter 2013/14.

We created an internal Flood Management Group to identify and mitigate the risk that groundwater and surface water flooding posed to our assets. The objective of the group was to review and seek completion of outstanding actions from surface and groundwater flooding that occurred. The group reviewed flood risk and protection work and monitored progress on outstanding works to ensure it was completed on schedule.

[2] Pitt Review: Learning Lessons from the 2007 Floods, 2008

Representatives of the group formed a clear line of communication through the business in accordance with our Emergency Plan so that information was quickly and accurately conveyed and decisions reached.

Actions arising from the February 2014 event were collated in two broad categories; tactical (short term actions) and strategic (actions requiring longer term implementation). These have been regularly reviewed following the incident to make sure they have been fully implemented.

2.3 Water Quality

2.3.1 Catchment Management

The potential for more intense rainfall events can lead to increased run-off and leaching from agricultural land, which can pose a threat for water quality. Particular examples of this are:

– A possibility that there will be higher nitrate levels in surface and groundwater. Sites that currently have a stable or gradually increasing trend could experience rises in levels or a quicker rate of increase.

  • Sites that are already identified as having increasing nitrate trends, within 10ml/g of the Prescribed Concentration or Value (PCV) during their peaks, will be more frequently sampled. In the Affinity Water Southeast region, two online nitrate monitors have been purchased and installed on sites that have seen nitrate increases up to the PCV in the past two years. This means that levels can be seen live on telemetry and action can be taken if nitrate levels get too high, for example, blending with water from other sources.

  • Also in Affinity Water Southeast region, a submersible pump was purchased which allows for observation boreholes (OBH) to be sampled. This enables monitoring of the seasonal nitrate fluctuations, as online monitoring and usual sampling can only be done when the site is running. The ability to sample these OBH means that there is no risk of putting the site into supply before the nitrate peak has passed.

– Increased temperatures are likely to mean an increase in field pests and hence an increase in the use of crop protection products. This increase is likely to be reflected in the water we abstract.

  • Currently most pesticides can be removed by water treatment processes, but in future, higher peaks in chemicals could mean that removal is more difficult. Catchment Risk Assessments have been completed for all our sites. Those that are high risk for pesticide contamination (due to high levels of arable land in the catchment or historic water quality data) will be more regularly sampled in the future. Monitoring programmes are being drawn up for these high risk sites which will include catchment monitoring and increased sampling of water at treatment works.

– Increased turbidity is another likely water quality issue associated with increased rainfall variability. Sites that currently experience turbidity problems in the winter months, often during pump start up, will be assessed for their need, e.g. for smaller pumps which will cause less disturbance of sediment on start up, or variable speed pumps so that the start up is a more gentle process.

2.3.2 Water Treatment

Our first round report identified further research being undertaken in co-operation with UKWIR to assess possible adaptation actions for our water treatment works.

The UKWIR Report *Climate Change Implications for Water Treatment* was published shortly after our first round report, and *Practical Methodologies for Monitoring and Responding to the Impacts of Climate Change on Industry Treatment Processes* a couple of years later. The findings of these reports were assessed and showed that the effect of climate change on our water treatment processes were currently largely neutral with no applicable recommendations. As described in Section 2.3.1, changing levels of contaminants are regularly reviewed as part of our catchment management process, and any impacts will be reviewed if changes are noted.

2.4 Coastal Conditions

Sea level rise is predicted as a result of rising carbon dioxide (CO_2) levels in the atmosphere and hence rising global temperatures. CO_2 levels are now at 400 parts per million (ppm) which is higher than for millions of years. The latest climate research suggests this level of CO_2 will cause significant waxing and waning of the polar ice sheets causing release of fresh water into the oceans, potentially leading to significant sea level rise. The part of our supply area at risk from sea level rise is in the Affinity Water Southeast region.

2.4.1 Saline Intrusion

2.4.1.1 Deal Sites

A project was undertaken to improve our understanding of the likelihood of saline intrusion occurring at the coastal sites of SKIN, SLIG and SSTM. There was concern that saline intrusion may occur into the Deal aquifer, and a number of historic OBH were suspected to be drawing saline water further inland. Investigation outcomes led to a number of boreholes being backfilled to mitigate the risk of saline water being further drawn in to the aquifer.

A monitoring borehole was also drilled as part of this project between a pumping site and the coast, so that levels of salinity could be monitored and act as an early warning system if salinity levels increase as a result of climate change or other factors.

2.4.1.2 SDNG

The boreholes for SDNG are located on the shingle beach of a peninsula in our Southeast region and are therefore very vulnerable to saline intrusion.

In 2012, telemetered conductivity meters were installed in the more vulnerable wells so that salinity levels could be monitored in real time. In the event that saline water is seen to be intruding into the well field, our Operations Centre receives an alarm so that appropriate action can be taken. Slight rises in conductivity also means that the abstraction pattern on the beach can be manually changed and monitored, so that saline water isn't drawn further inland, or blending of water from different parts of the beach can lower the overall conductivity entering the treatment works.

2.4.2 Coastal Flooding

The peninsula is predicted to experience an amount of coastal flooding due to predicted sea level rise. Although the SDNG site will be unaffected, the well field will likely experience flooding and potential loss of wells if they become inundated with sea water.

The EA are currently in the process of implementing a million pound sea defence project which includes the protection of the peninsula. We have been approached to work collaboratively on this project, assisting with the cost of the project and/or the provision of data to prove the project benefits for the local community. The project will involve all stakeholders on the peninsula including a local power station, the RSPB who have a reserve on site, and the Ministry of Defence who own ranges on the beach. Collaboration between stakeholders will help ensure that appropriate protection for all interested parties is achieved.

2.5 Ground Conditions

2.5.1 Sink Holes

Sink holes are features in chalk which occur when slightly acidic runoff from clay interfluves causes chalk dissolution. Over time the hole may increase in size until it is no longer able to support the ground above, which collapses into the hole and exposes the sink hole. The rate of this process may increase under climate change with more intense storm events and additional ground movement from shrink/swell. Sink holes may leave our below ground infrastructure unsupported or unstable, making them more prone to bursts.

2.5.2 Burst Rate

We continue to invest in a number of ways to reduce our leakage level and burst rate in line with our customers' expectations.

– An active leakage control programme including leakage detection and repair activity, to ensure we respond effectively to leakage on our network

– Renewing aging iron mains to reduce the number of bursts we experience on our network, which may be acerbated by ground movement.

Increasingly variable weather patterns e.g. freeze/thaw or wet/dry will increase the rate of ground movements potentially causing an increase in bursts and therefore higher levels of leakage.

2.6 Daily Operations

Climate change may lead to increased severity and intensity of extreme weather events, which have the potential to impact the daily operation of the business. Where these result in unexpected and severe interruptions in supply or difficulties in access, transport, worsened working conditions, or additional workload, our well established Emergency Plan will be invoked. The Emergency Plan was enacted in 2014 during the flooding of the Lower Thames, and we were able to continue to function with normal operations, however it is continually reviewed to make use of lessons learned and improved understanding.

Enhanced usage of our one minute risk assessment process in daily operation will ensure Health & Safety of our staff while operating in extreme weather conditions, and we have an established procedure whereby extreme weather warnings are shared with all relevant staff to increase awareness of risks.

2.6.1 One Minute Risk Assessment

The purpose of the one minute or dynamic risk assessment is to allow colleagues to evaluate an activity or work area immediately prior to or during work where the environment cannot be known before hand or where the environment changes, i.e. weather conditions, site changes or simultaneous operations. This assessment is carried out using specific team forms and once completed, allow teams to identify any additional risks and control measures over-and-above known risks and existing control measures identified on any other risk assessment, i.e. role based or task based risk assessments.

It is essential that teams have the necessary knowledge and experience to make judgments on potential risks, suitability of controls and where necessary, the escalation process if any

risks are still deemed high risk and have the potential to cause harm to colleagues, members of our Supply Chain or members of the public.

Once complete, assessments are stored for future reference and where appropriate, any additional learning is identified and incorporated into the relevant role or bask based risk assessments.

Examples of team specific one minute risk assessments can be found in Appendix C.

3 Thresholds

The UKWIR *Climate Change Adaptation Handbook* (2011) outlines the following types of thresholds for the water industry when considering climate change.

"Thresholds can be considered in terms of the following:

- *Practical operation thresholds - where operational difficulties start to arise*
- *Design thresholds - up to which operation is optimal*
- *Level of services thresholds - where services to customers may become affected*
- *Business process thresholds - All of the above thresholds may have implications for business viability, so this type of threshold may be most useful as a way to evaluate and communicate risk implications for the water company."*

During AMP6 we will undertake analysis of sensitivities and thresholds relating to climate change impacts on water supply and treatment.

We will examine evidence to understand whether and when the thresholds defined above may be exceeded in the future using trend analysis. We also aim to define thresholds which have investment requirements beyond that which we are currently planning in our business plan.

3.1 Drought Thresholds

Following work carried out for our 2014 WRMP, detailed in our Technical Report 1.2: *Levels of Service Hindcasting*, we have updated our drought management trigger zones by introducing a 5th zone for unprecedented drought conditions.

Water levels within this zone have never been seen before and consequently it is not possible to predict the actual behaviour of the chalk and abstraction in this range. To estimate a possible level of service for emergency drought orders, a decrease in water level of one metre below the lowest recorded groundwater level, Drought Zone 4 (Drought Orders for Additional Abstraction) was applied. This resulted in a calculated return period of 1 in 118 years. It must be noted that this return period is highly uncertain and should be considered with a broad confidence range (i.e. 1 in 120 +/- 30 years). This represents an improved understanding of the potential risk of more severe droughts than seen on record. Within the Drought Management Plan (DMP), we have identified the measures we would take if groundwater levels were to decrease to this level.

3.2 Flooding Thresholds

3.2.1 Level of Service Threshold

As mentioned in Section 2.2.4 we have implemented a programme of protection for 35 of our most vulnerable or critical sites to the 1 in 100 (1%) annual likelihood of flood event (Q100) + 20%flow + 300mm design flood level. Review is currently underway to compare this to the 1 in 200 (0.5%) annual likelihood of flood protection. For those sites which have been assessed, the Q100 + 20% flow + 300mm level has been found to exceed the 1 in 200 year (0.5%) annual likelihood.

This is a level of service threshold, above which there would be potential asset failure. At other sites deemed less vulnerable or critical, the flood resistance level may be lower. No

loss of supply to customers would be anticipated if these less critical sites were flooded, as resilience measures are in place to supply water from elsewhere.

3.2.2 Practical and Design Thresholds

Issues which may make the operation of sites more difficult under flood conditions include:

- Access for staff to operate sites as described in Section 2.6. Site access itself has been considered as part of the flood protection works so operations can continue as normal until the flood defences are breached. Problems may be encountered if staff are prevented from accessing the sites by flooding in the wider surrounding area.
- Deterioration of raw water quality under flood conditions as described in Section 2.3.1
- Groundwater flooding can cause problems to supply if the production boreholes become artesian. Level alarms are installed in all production boreholes which give a warning at a set groundwater level threshold below the borehole head plate. It was this which allowed the 2014 flooding incident to be managed effectively by changing pumping regimes such that no significant adverse impacts from artesian boreholes were encountered. Since the 2014 flooding, a telemetered and alarmed early warning system has been designed and is currently being installed which will monitor regional groundwater levels. A trigger level has been set at a groundwater level at which more frequent monitoring of levels will be required.

4 Understanding Uncertainties

The work we have done to further our understanding of climate change risks (Section 2) has enabled us to make significant headway in removing the uncertainties we originally identified in our first round reports. Also, as a sector a large amount of research into the impacts of climate change has been undertaken to address information gaps, in particular through UKWIR (Section 6.1.2).

We continue to improve our understanding of some of the areas of uncertainty identified such as:

– Supply demand balance (see Section 4.1)
– Climate change impact on water quality (see Section 2.3)
– Flooding (see Section 4.2)
– Risks to administrative operations (see Section 2.6) and our interdependencies with other suppliers (see Section 6.1).

We plan to reduce the financial uncertainty remaining in adapting to climate change through the actions described in Section 5.1 (Understanding customer appetite for resilience investment). This will make it clearer for us to justify the investment required to adapt to a level that our customers would like and are willing to pay for.

Where uncertainties remain, for example in external data and using this for understanding the effects of climate change, we make allowances for these.

We continue to operate in a changing legal and regulatory environment, where uncertainties will always exist in our future requirements. We engage with key regulatory bodies and take an active part in influencing developments in the sector.

4.1 Supply Demand Uncertainties

There are inevitably uncertainties in forecasting supply and demand values over a 25-year period. Actual demands could exceed our assumptions or water supply availability could be reduced by more extreme climate variability or changes in environmental standards. We therefore include an allowance known as target headroom (THR) to act as a buffer between our forecast demand and our supply capability to cater for specified uncertainties.

There are a range of components of uncertainty in our THR assessment (as found in our WRMP) however two components specifically concerned with climate change are in Table 2.

Table 2: Components of Uncertainty for Target Headroom

Components	Explanation
Uncertainty of impact of climate change on source yield	UKCP09 projections for the Medium Emissions scenario 2030s (2020-2049) for the Thames basin was used to determine the impact of climate change on DO. The values produced by the climate change analysis are applicable to the 2030s, so these were interpolated and extrapolated across the planning horizon using the scaling factors specified in the EA's Water Resources Planning Guide (WRPG) (section 3.3.6, stage 3). This was repeated for both the Dry Year Annual Average and Dry Year Peak Week planning scenarios. The mean values were applied to the baseline supply / demand balance as

Components	Explanation
	the projected change in deployable output over the planning horizon, for each planning scenario. The difference of the minimum below the mean and the maximum above the mean is taken as the range of uncertainty to incorporate within the headroom allowance.
Uncertainty of impact of climate change on demand	We have made an allowance for this uncertainty based on Technical Report 1.3.2: *the Impact of Climate Change on Demand*. The report suggests that that the projected changes on demand as a result of the impact of climate change will be in the following ranges for the 2030s: Lower = 0.7% of DI Mid = 1.3% of DI Upper = 2.2% of DI

Additionally, there is still an information gap present in our groundwater modelling of an area of our Affinity Water Southeast region (around SDNG). The source is not included in the East Kent Groundwater Model and consequently the impacts of climate change on deployable output at this source have been estimated using expert judgment. We will continue to review the information available about the peninsula, and will undertake DO assessment when sufficient information is available to address the current uncertainty.

4.2 Flooding Uncertainties

There are inherent uncertainties in certain aspects of the data used to calculate the design protection flood level: 1 in 100 (1%) annual likelihood flood (Q100) + 20% flow + 300mm.

- The Q100 level itself has uncertainties associated with it, as this will make use of the best data available. This will generally be either modelling information from the EA, or flood risk assessments
- The +20% flow for climate change is the accepted standard for the period 2025 to 2115. This is therefore an assumption based on the best available data
- The freeboard allowance of +300mm is the UK design standard for freeboard allowance to allow for wave action and uncertainty.

This calculation remains the most practicable way of establishing a suitable flood protection level. This gives a minimum level based on Q100 with additional protection to take into account climate change, wave action and uncertainty.

Review is currently underway to compare the design protection level at specific sites to the 1 in 200 (0.5%) annual likelihood of flood protection. For those sites which have been assessed, the Q100 + 20% flow + 300mm level has been found to exceed 1 in 200 year (0.5%) annual likelihood.

The return period analysis itself will continuously change under climate change and therefore there may be deterioration in the return period level we are protected against. For example, a 1 in 100 annual likelihood flood level today may be only a 1 in 80 annual likelihood flood level in 20 years time. There will therefore be a need to build re-assessment of the flood protection levels into the long term 25 years.

5 Actions

This section provides an update on our progress against the actions identified to address climate change risks or increase resilience.

In line with the DEFRA's guidance document '*How to report your progress in planning for climate change'*, we have used two tables:

– The first (Table 3: Implemented Actions) lists the actions from our first round reports and lists the progress made against these since 2011

– The second (Table 4) lists actions which were not identified in our first round reports.

For actions from our first round reports, we have outlined:

– The actions taken, and the progress against them

– An assessment of how effective each action has been in mitigating risks

– Any benefits achieved in green text (financial or otherwise)

– Any challenges experienced in implementing actions in red text.

Section 5.2 and 5.3 provide specific update summaries on Flooding and Water Resources action respectively as these are significant areas of progress.

5.1 Actions Tables

Table 3: Implemented Actions

Summary of actions	Timescale over which actions were planned	Progress on implementation of actions	Assessment of extent to which actions have mitigated risk	Benefits / challenges experienced
Water Resources - Ensure supply For further detail on actions undertaken and planned actions related to supply & demand, see section 5.3.				
Assessment of supply options	AMP5	As part of our WRMP options appraisal process we identified 240 unconstrained supply options. Of these, 81 options were screened through to our feasible list and a full review of the yields, environmental impacts and costs associated with these options was carried out. This included an assessment of the impacts that CC are likely to have on the future yield of the options. These options were then assessed alongside our demand management options using our EBSD model to ensure the most cost effective plan was put forward.	Improving our knowledge of our options, along with our supply / demand balance allows us to ensure that we propose the best solution for our customers to ensure that there is enough water to meet demand for the next 25 years and beyond including provision for climate change uncertainty.	– Improvement in our understanding of both the scope and benefits associated with the options. – Confidence that the plan proposed in our WRMP is the best plan for our customers.
Review of WRMP	AMP5	We have fully reviewed and updated our WRMP which was accepted by the Secretary of State on 14 May 2014. We also publish an annual update to our plan each June.	As above.	– Action has provided many benefits and challenges outside the scope of this work. However in terms of our understanding of the impacts of CC on our long term supply / demand balance and associated options it was a major driver in updating our assessments and reviewing available research and literature.
Water imports	AMP5	As part of our WRMP we spoke with all of the water companies with whom we share a border during 2012 and 2013 to confirm the availability of existing transfer and explore the opportunity for new agreements. Further detail can be found in WRMP technical report 3.5 *Water Company & Third Party Bulk Transfers*. We worked with other companies on the Water Resources in the South East project as part of our WRMP preparation. More details can be found in Section 6.1.2.	As above	– Confirmation with neighbouring companies over the availability of supply under different conditions. – Conversations occurred at the same time as all companies were doing lots of work for their WRMP and therefore this was not the sole focus of the conversations.

Summary of actions	Timescale over which actions were planned	Progress on implementation of actions	Assessment of extent to which actions have mitigated risk	Benefits / challenges experienced
Water Resources – Reduce demand For further detail on actions undertaken and planned actions related to supply & demand, see section 5.3.				
Leakage reduction	AMP5	We met our OFWAT leakage targets in each year of AMP5, and have set out significant reductions for AMP6.	One of a number of factors significantly contributing to maintaining our supply demand balance.	– Challenges still remain in predicting the occurrence of 'winter outbreaks' due to variable temperature and ground conditions and in particular extreme events.
Promotion of water efficient behaviour	AMP5	AMP5 projects completed. Base service regulatory water efficiency target met every year throughout AMP5. Assessment based on performance against regulatory targets. Water savings of 10.0 Ml/d achieved, exceeding AMP5 target by 48.1%.	One of a number of factors significantly contributing to maintaining our supply demand balance through managing demand.	– Positive public reception to the promotion of water efficiency. – The challenge will be to ensure sustainable behavioural change following interventions – this is a focus of our AMP6 work.
Increased metering	AMP5	The metering penetration across our central, southeast and east regions is now at 47%, 93% and 79% respectively.	Increased metering penetration, particularly in our southeast and east regions has resulted in a decline in long-term DI and dramatically reducing the peaking effect observed during periods of warm, dry weather.	– The overall reduction in demand helps to delay the breach of our drought trigger thresholds, reduce the frequency of breaches, thus deferring investment, and also reduces the constraints on our infrastructure during these periods. – The change of hands metering programme for our central region proposed in our PR09 WRMP was not supported by Ofwat so we did not receive funding to proceed with this. This meant that we have not increased our metering penetration as much in our central region as we would have liked over AMP5.
Water tariff trials – higher summer charges etc.	AMP5	Trials have been carried out in both our central and southeast region but there is little evidence that higher tariffs reduce the demand for water. However, we will continue to explore the possible benefits water tariffs could have throughout the next AMP.	Limited benefit identified from trials and this is not a measure that we have proposed as part of our PR14 WRMP. As our metering penetration increases there is potential that such tariffs will have more of an impact in the future.	– Gained a greater understanding of customer behaviour in relation to water efficiency, and whether tariffs have a significant impact on behavioural change.

Summary of actions	Timescale over which actions were planned	Progress on implementation of actions	Assessment of extent to which actions have mitigated risk	Benefits / challenges experienced
Flood Mitigation For further detail on actions undertaken, and planned actions related to flood mitigation, see section 5.2.				
Assessment and monitoring of vulnerability to flooding	Early in AMP5	Detailed site specific flood risk assessments undertaken at the 29 most critical sites. This identified a greater schedule of investment required compared to our plan for AMP5.	These assessments have directly fed into the design level for flood protection as in Section 2.2.4.	– Some sites have neither EA modelling information nor site specific levels from flood risk assessments available. These sites have required individual assessments with flood engineers.
Flood protection measures (includes raising equipment, flood defences and other appropriate measures)	AMP5	Phases 1 and 2 are completed to the design flood level as in Section 2.2.4. Residual programme (Phase 3) for our vulnerable groundwater sites will be completed by 30/09/15.	Benchmarking underway to compare this level to the 1:200 flood level at each site.	– Benefits seen associated with increased resilience of our water treatment works.
Analysis of localised effects of flooding	If a flooding event occurred within the AMP5 period.	We were able to look at localised events of flooding during the flood incident in winter 2013-14, in particular in February 2014, and modified our investment plan accordingly.	We achieved a good response to this flooding event with no loss of supply to customers.	– Lessons learnt were captured and a programme of improvement measures developed and implemented based on any areas of vulnerability. – We have developed specific contingency plans to manage loss of supply from our major works in the Thames valley.
Monitoring of flood trigger thresholds	AMP5	Groundwater flood trigger levels identified and telemetered triggers have been installed at vulnerable sites.	Gives advanced warning of groundwater flooding to allow time to respond proactively.	Installed post 2014 flooding, and therefore haven't yet been tested.
Drought Management Planning				
Drought Planning and Review of Drought Management Plan	AMP5	We have produced an annual update of our DMP every year since its publication in 2012.	Updates allow us to review proposed actions and ensure readiness in the event of a drought. It also allows us to review and update our monitoring plans in light of new evidence and experience coming from our NEP work.	– Incorporated lessons learnt from the 2011/12 drought. The threat was caused by unprecedented low winter rainfall but solved by unprecedented high summer rainfall.

Summary of actions	Timescale over which actions were planned	Progress on implementation of actions	Assessment of extent to which actions have mitigated risk	Benefits / challenges experienced
Monitoring of drought trigger thresholds	AMP5	We constantly monitor our ground water positions and report these to our management team on a monthly basis. This is plotted on graphs which clearly identify our drought trigger thresholds so that the business has early warning if we are approaching a drought situation.	This ensures the business is ready for the onset of a drought as well as providing a tool to monitor the increased severity.	– Familiarity in the business of drought monitoring procedure. – Early sight available of increasing risk of drought.
Assessment of potential increased storage options	AMP5	We have considered the options available to us in a drought and recognise that increased storage options are long term options that would potentially provide greater resilience for a number of extreme events. These have been considered as part of our PR14 WRMP but due to the high costs associated with these options and the large environmental impact they would have, have not been selected as part of our AMP6 preferred plan. We will continue to review the potential for such options throughout the next AMP.	N/A	– Lack of stakeholder understanding of the issues related with these options in particular under unprecedented drought conditions as stakeholders find it difficult to visualise conditions never experienced. – Lack of funding streams for long term resilience options.
Network Improvement – Mitigation of changing ground conditions				
Continued replacement of network	AMP5	A targeted Mains Renewals programme was undertaken over AMP5 to cost effectively replace those mains with a high burst rate. Almost 700km of distribution and trunk mains renewals were undertaken across all three regions, with 650km in Central (Community 1-6), 20km in Southeast (Community 7) and 28km in East (Community 8).	One of a number of factors significantly contributing to maintaining our supply demand balance.	– Continued replacement of aging cast iron within our network which is particularly susceptible to bursts. This process is well established, and will continue in AMP6 to ensure continued serviceability of our network.
Improvements in monitoring and prediction of leaks	On-going	We have undertaken trials of the use of network telemetry for network event detection over AMP5 to establish our approach, as well as looking at a number of event detection providers. We will be deploying further network telemetry to enable real-time monitoring and proactive event detection in AMP6.	Monitoring and prediction of leaks will enable us to respond more quickly when an incident occurs, reducing the severity of the risk, but will not impact the likelihood.	– Have not yet rolled out network event detection throughout our network. – Good progress made through trials of various options, and procurement investigation.

Summary of actions	Timescale over which actions were planned	Progress on implementation of actions	Assessment of extent to which actions have mitigated risk	Benefits / challenges experienced
Coastal Adaptation				
Monitoring	AMP5	A monitoring borehole was drilled between a pumping site and the coast, so that levels of salinity could be monitored and act as an early warning system if salinity levels increase.	Gives advanced warning of changes in salinity allowing time to respond proactively, and to ensure the quality of the water we supply.	– Will allow monitoring both of specific extreme weather events impacting on salinity, as well as long term trends in the area.

Table 4: New Actions

Actions planned	Description	Risks addressed by action	Timescale for new/further actions planned	Owner
Increase Adaptive Capability of Organisation	Giving Climate Change Adaptation clear leadership through a dedicated role, or clear inclusion within an existing related role.	Not being organisationally prepared to respond to changing climate and increased extreme weather events.	July 2015	Mike Pocock Asset Management Physical Assets
	Update our Climate Change Action Plan to address climate change issues, and continue to regularly review and assess progress at the 'Our Environment' Working Group.		On-going.	Mike Pocock Asset Management and Chair of Environment Group
	Consider repeating an assessment method such as PACT or similar, to evaluate how our organisational capability has changed.		Throughout AMP6	Claire Beloe Asset Management Physical Assets
	Promote climate change awareness and implications for implementation of adaption measures through team briefings of work programmes within the company to raise awareness at all levels, technicians to senior managers and directors.		Throughout AMP6	Mike Pocock Asset Management and Chair of Environment Group

Actions planned		Description	Risks addressed by action	Timescale for new/further actions planned	Owner
		Establish an Organisational Resilience Strategy, Flood Resilience Action Plan and Drought Resilience Action Plan to build on existing flood protection work undertaken. Aim to have a programme of work for each of the Resilience Rs (Resistance, Reliability, Redundancy, Response and Recovery)		Early on in AMP6 – 2015	Mike Pocock Asset Management Physical Assets
Understanding customer appetite for resilience investment		Undertake cost benefit analysis for flood resilience measures to a range of return periods for sites to determine which level of flood resilience, above that already implemented is achievable, proportionate or desired.	Failure to safely, efficiently and effectively deliver investment in our assets.	2015 – 2017 to feed into PR19	Claire Beloe Asset Management Physical Assets
		Undertake customer focus groups to understand the willingness of customers to pay for future resilience measures which may be required to adapt to climate change.		2016 – 2017 to feed into PR19	Emma Grigson Corporate Affairs
Targeted Projects to Address Specific Climate Change Risks	Sustainability Reductions	Affinity Water has announced in its latest Business Plan 70 Ml of sustainability reductions, 42 Ml of which will be delivered within AMP6 so prior to 2020. This is water we are licenced to abstract that we are voluntarily giving up to return to the environment. Affinity Water has been proactive in proposing to introduce these sustainability reductions to maintain more water in the environment to mitigate against possible abstraction impacts on the environment during droughts which may possibly be a result of or worsened through climate change.	Mitigation against the possible impact of Affinity Water's abstractions on the environment, particularly under drought conditions.	AMP6 and AMP7	Maria Teneke Catchment Sponsor Asset Management

Actions planned		Description	Risks addressed by action	Timescale for new/further actions planned	Owner
	Met Office Demand Prediction Tool	Further discussions with the Met Office regarding bespoke CC predictions which can feed into the WRMP, Drought Plans etc. and tailored bespoke weather forecasts of greater detail to assist daily operations and preparedness.	Greater extremes in weather leading to supply issues.	March 2017	Katie Ward Asset Management Physical Assets
		Graduate placement underway to look at actions that should be triggered based on predicted demand levels or multi-day weather occurrences.	Greater extremes in weather leading to supply issues (dropping res levels etc.).	October 2015	Rebecca Carlisle Asset Management Control Room
	Site Auto Restart	Gap analysis of coverage of site auto-restart. Proactive scheme to roll out improvements to key sites identified i.e. high risk or remote to reduce frequency of staff call-outs to site.	Interruptions in the power supply network – with predicted increased intensity / frequency of electrical storms (summer) and winter storms (lightning), then the frequency of both brief and prolonged power supply failures may increase.	March 2016	Gerald Doocey Asset Management Production & Supply
	Pesticide Programme	Undertake a Pesticide Programme to enhance our pesticide treatment capability in accordance with our DWI regulatory requirements. The projects included in this programme are to install additional pesticide treatment at 2 key treatment works, undertake trials on existing processes at another key site, and to undertake maintenance and enhancement of the existing processes at a strategic reservoir. This works in conjunction with our catchment management approaches in these high risk abstraction areas.	Increased pesticides including metaldehyde due to increased rainfall and storm intensity.	Phased delivery 2017-20	Debbie Loftus Asset Management Physical Assets

Actions planned		Description	Risks addressed by action	Timescale for new/further actions planned	Owner
	Thresholds	Define thresholds for triggering investment beyond that which is currently planned as part of preparation of our next Water Resources Management Plan	Failure to safely, efficiently and effectively deliver investment in our assets.	March 2018	Katie Ward Asset Management Physical Assets
	DO Assessment	Undertake DO assessment for SDNG sources when sufficient information is available.	Reduction in groundwater level leading to reduced abstraction.	When sufficient information available.	Ellie Powers Asset Management Physical Assets
	Groundwater model updates	Request climate change scenarios from EA for all groundwater models in our supply area based on updated UKCIP projections when available.	Reduction in groundwater level leading to reduced abstraction.	When updated UKCIP projections available.	Ellie Powers Asset Management Physical Assets

5.2 Actions Summary – AMP5 and AMP6 Flooding

Climate change scenarios predict that flooding will become more frequent and severe through increased number and severity of storm events. We have engaged in a programme of work to improve our resilience to flooding through the principle components set out by Government of:

- Resistance
- Reliability
- Redundancy
- Response and Recovery.

5.2.1 Resistance - Flood Protection

Flood resistance concerns the direct physical protection of assets to resist flooding. Significant flood protection work has been undertaken at vulnerable sites.

Site specific flood risk assessments have been undertaken at vulnerable sites since 2011 including criticality ratings and cost-benefit analysis on suggested mitigation actions. We have implemented a capital delivery programme in AMP5 to improve flood protection at 29 priority sites in our Central area, and seven sites in our Southeast area to an adopted design standard of 1 in 100 (1%) annual likelihood flood + climate change + freeboard. It is anticipated that this adopted level of flood protection is generally equal to or exceeds the 1 in 200 (0.5%) annual likelihood flood level. Further verification work is currently on-going to verify this initial assessment.

5.2.2 Reliability - Capital Maintenance

Reliability is the capability of infrastructure to maintain operations during flood conditions. Planned maintenance programmes since 2011 have delivered significant improvements to infrastructure reliability during flood conditions. Examples include a programme to ensure borehole headworks at risk of fluvial or groundwater flooding are sealed in chambers so abstraction can continue. There is an on-going programme to review access to sites at risk of flooding to ensure staff can safely access sites operations can continue under flood conditions.

5.2.3 Redundancy

Redundancy refers to having a degree of adaptability within the system, for example the presence of back-ups for key assets or processes. We have begun a review of our reliance on power supplied from power companies during flood events. Back up generators have been installed in the South East area of the Company where necessary to ensure continuation of supply if the power supply fails. Power interdependencies relating to flood risk within the rest of the Company will be reviewed during AMP6.

5.2.4 Response and Recovery

This is the ability to respond and recover from disruption if it occurs. Lessons were learnt from the February 2014 flood event. Emergency procedures were initiated and advanced planning and preparedness led to effective outcome on this occasion with no loss of service. We recognised there was no place for complacency however, and undertook thorough debriefing sessions and workshops to capture the lessons learnt. Reports were subsequently written to

capture the knowledge and experience gained during the management of the event which would feed into further planned preparedness training for future flooding events. We have subsequently prepared “loss of supply” contingency plans for our major works to ensure maximum customer supplies are protected at any time.

5.3 Actions Summary – Water Resources

5.3.1 AMP5 Actions

Over AMP5, we successfully undertook a number of actions from our WRMP to ensure our supply / demand balance despite economic growth, pollution risk and climate change. As described in Table 2, actions were identified and completed including:

- Water efficiency
- Education
- Tariff trials
- Optant metering, and metering in new build properties
- Water imports.

5.3.2 Future Actions

Our future Supply / Demand actions are set in a challenging environment of making sure our customers have enough water while leaving more in the environment. We have committed to reducing the amount of water we take from the environment by 42 Ml/d less by 2020 and 69 Ml/d by 2025 through Sustainability Reductions, to ensure flow in precious chalk stream environments.

In order to ensure we continue to supply our customers with high quality water, we have a number of demand reduction actions planned for AMP6 as part of our Water Savings Programme (WSP).

As shown in Figure 2, our WSP consists of three streams:

– **Saving Water**
  - Saving around 4Ml/d from the distribution of water efficient devices and in-home water efficiency audits, and approximately 2Ml/d from water efficiency targeted at our non-household customers from 2015 to 2020
  - Education and community programmes aimed at improving water efficiency.

– **Metering**
  - More than 280,000 properties metered by 2020 and 524,000 properties by 2025
  - Saving around 18Ml/d from universal metering by AMR from 2015 to 2020.

– **Reducing Leakage**
  - Reduce leakage by 14% by 2020 and 17% by 2025
  - Saving 27 Ml/d including 20Ml/d in distribution network leakage through a number of methods and 7Ml/d from the repair of leaking customer supply pipes from 2015 to 2020.

- Continuing our investment in infrastructure including mains renewals and pressure management to reduce the number of bursts on our network.

Figure 2: Our Water Saving Programme

6 Addressing Barriers and Understanding Interdependencies

We believe that both as an organisation, and as a sector, we have made significant headway in ensuring that we are adapted for changing future climate.

Our first round reports identified a number of barriers to implementing adaptation actions which we may face, and we have found that some of these have posed challenges to progress. We have additionally identified a number of new barriers which we have sought to address. These are described in Section 6.2.

Through our climate change adaptation activities we have also identified interdependencies both within and outside of our sector. We have entered into dialogue in order to more fully understand these interdependencies, and will be looking into the reliability of power supplies as a key issue in our stakeholder programme for AMP6 as in Section 6.1.1.

We work collaboratively with other water companies through a number of different work streams that relate to climate change adaptation which can be found in Section 6.1.2.

6.1 Interdependencies

6.1.1 Power

When considering flood protection on some of our critical sites, we have planned for flood resilience at our facilities to our adopted level in Section 2.2.4. However, we determined that the flood protection on the incoming power supply system, notably the flood protection of incoming power transformers belonging to the Distribution Network Operators (DNOs), is a perceived risk.

Plans to protect our own assets and electrical transformers on a number of our sites were hindered due to comparative risk of DNO transformers outside of our compounds and the absence of plans to protect them. When considering the protection of DNO transformers within our own compounds, this was often prohibitively expensive due to the need to replace transformers with new specification in order to install protection or make changes. In this way we would be cross-subsidising DNO costs in the long term and we will discuss an equitable method of cost sharing during AMP6.

The quality of power can also pose a risk to our operations in a number of ways:

1. Momentary power supply losses, known as glitches, are likely to become more frequent.
   - This can cause widespread failures to the water supply network, which can take hours to resolve especially when this occurs several times over a night during a stormy period. A company-wide gap analysis of our auto-restart capability has been identified as a new action in Table 4, and a number of sites were assessed during AMP5.
2. Power cuts lasting over several hours may become more common.
   - These commonly require a manual reset or attendance to site. In general, our interdependency with power supplies has not hindered our approach in this area, which consists of updating existing plans to supply water from our other nearby sources, or using fixed or temporary power generators on a local scale.

The impact of other interdependencies with power is not yet fully understood due to unknowns in future plans for the power sector, and therefore our plans are still in progress. These include:

– The potential migration of the power supply grid to using more ad-hoc short term cost drivers to penalise use of electricity at times of supply stress to reduce demand on the grid

– The potential for increases in weather related demand, leading to increased power supply requirements at peak times

– Increased prevalence and duration of rota disconnections (rotating planned power supply cuts, due to insufficient national generation capacity) leading to increased risk of water supply failure. Rota disconnections may become more common if we see more power supply overloads on local grids due to hot weather and high air conditioning load.

We will be looking into the reliability of power supplies as a key issue in our stakeholder programme for AMP6.

6.1.2 Other Water Organisations

We work collaboratively with other water organisations through a number of different work streams that relate to climate change adaptation including:

– Water Resources in the South East (WRSE) – an alliance of the six South East water companies, the Environment Agency, Ofwat, Consumer Council for Water and DEFRA together with other NGOs that has existed since the late 1990s. The group meets to consider future risks and uncertainties facing water resources in the South East of England, such as climate change, population growth and reductions in water availability. This group facilitates conversations between these water companies in order to allow them to consider long-term resilient strategic solutions for the water stressed South East to ensure that the available water resources are shared, used and managed wisely. For PR14, the WRSE model recommended the implementation of a number of significant cross-border company transfers that were developed as part of the WRSE work programme, six of which were included in companies' WRMPs.

– Water Resources East Anglia (WREA) – We are participating in the WREA project, which is led by Anglian Water, and has similar objectives to WRSE. Although it did not have any outputs to inform our PR14 WRMP, our Central and East regions are part of WREA and we expect to have results to inform our WRMP in 2019.

  The following is an extract from Anglian Water's summary of WREA:

  > *"In response to the challenge of climate change, population growth and the reductions in deployable output that are needed to restore abstraction to sustainable levels, the water companies in East Anglia have been working to develop a robust, long-term water resources strategy. This work is being progressed through the WREA project."*

– UKWIR - Set up by the UK water industry in 1993 to provide a framework for the procurement of a common research programme for UK water operators on 'one voice' issues. We are an active member of this group which comprises members from 21 water and sewerage undertakers in England and Wales, Scotland and Northern Ireland. As referenced throughout this report the outputs from studies orchestrated by this group has vastly helped improved our knowledge and understanding of climate risks.

– Water UK – a group which represent all major statutory water and wastewater service supply organisations in England, Wales, Scotland and Northern Ireland. Water UK helps to instigate and facilitate the development of sustainable water policy that ensures lasting

economic, social and environmental benefits for the UK. Water UK facilitate a number of networks, including the climate change network which allows discussions innovations and best practice approaches to tackling climate risks. We also participate in the Water Resources Strategic Liaison Group which reviews policy matters with DEFRA, Ofwat and the EA.

As well as participating in these collaborative projects, we also held one-to-one discussions with all our neighbouring water companies as part of our PR14 WRMP preparatory work. These discussions explored the potential to create new cross-border supplies between companies as well as opportunities to vary existing agreements for water supply imports and exports from or to our operating area. Such water trading can offer the most efficient way of sharing regional resources for the benefit of all customers. Our discussions with Anglian Water also considered the use of our shared assets and existing transfer arrangements.

Further details of these discussions can be found in our PR14 WRMP Technical Report 3.5: *Water Company & Third Party Bulk Transfers*.

6.1.3 Transport/Road Access

Following the flooding we have now purchased two boats that reside at our surface works (WALS, CHERS & EGHS). We also have a database of 4 wheel drive vehicles and hi-axle wheelbase vehicles for use on flooded roads and sites. Staff at sites where access routes are at high flood risk have also attended flood driving courses, and ropes and waders for use in flooded areas are available.

6.1.4 SCADA/Telemetry

Our Operations Control Centre makes use of a control system – Supervisory Control and Data Acquisition (SCADA) – in order to control our remote assets centrally through telemetry. This utilises our own scanning radio, the mobile phone network, telecoms and our IT systems. We make use of our secure corporate wide area network (WAN) for SCADA rather than the internet, however if required, this connection can be divorced very quickly.

In order to safeguard the reliability and security of our SCADA network we maintain dialogue with both the Centre for the Protection of National Infrastructure (CPNI) and the Security Services. We recently took part in a workshop with DEFRA, CPNI and Government Communications Headquarters (GCHQ) to review our SCADA resilience with the subsequent report showing no areas of concern.

6.1.5 Telecoms

Ofcom standards set stringent requirements for reliability of the telecoms sector, requiring that service is 99.99% available. However, where as situation of civil contingency or a national emergency arises there are measures to ensure those involved in managing the situation have communication methods in place including private extranets, priority access to mobile phone networks and emergency transportable telecoms hubs.

As an additional contingency measure, AW has purchased a number of satellite phone handsets for strategic staff and permanent base satellite phones have been installed in all of our major hubs.

6.1.6 Wider Supply Chain

A key step in the management of our supply chain is the identification and the management of risk, with particular effort given to prioritising suppliers categorised as high risk. Our procurement policies, procedures and category management approach are specifically designed to enable this risk assessment and mitigation process. Any significant climate change impact on the supply chain is captured through this risk-based approach.

Suppliers who have been identified as high risk go through a rigorous pre-qualification process, including external audit, in addition to other risk mitigation strategies.

Thereafter, depending on the supplier's risk profile, the supply chain management process actively manages and monitors the risk(s). This can include regular third party audit, contractual or collaborative commitments to report, manage and reduce existing or emerging risk, and access to market information

6.2 Barriers

We believe that both as an organisation, and as a sector, we have made significant headway in ensuring that we are adapted for changing future climate. Our first round reports identified a number of barriers to implementing adaptation actions which we may face, and we have found that some of these have posed challenges to progress. We have also identified additional barriers we have encountered.

Of the original barriers, the ones that had the most significant impact on implementing adaptation actions were:

– **Resources**

- Identified adaptation actions may not have been included within price limits, and therefore we may be unable to devote resources to ensure successful completion of actions. However where need was great and the risk imminent we have mobilised additional investment e.g. flood protection works.
- This was a challenge for us in implementing some of the demand management tools that we identified for example change of hands metering.
- To address this, continual monitoring of existing and emerging climate change adaptation actions should continue to be undertaken to ensure that any relevant adaptation actions are included in our business planning process. We will also continue to ensure that we have undertaken sufficient cost benefit analysis of proposals to provide justification.

– **Knowledge**

- Uncertainties can prevent us from acting as devoting substantive resources on projects based on qualitative or indicative data is unwise.
- Addressing knowledge gaps will enable appropriate adaptation actions. We continue to undertake research and collaboration with relevant authorities to overcome this.

New barriers which have also been identified while implementing adaptation actions have been:

– **Climate change is a multiplying factor not individual driver**
  - In general, climate change adaptation is not able to drive investment on its own. Climate change will often be a multiplying factor when considered in the wider context of our supply demand challenges including sustainability reductions and population growth.
  - There is no specific action to address this barrier, as climate change adaptation requirements should always be considered in the wider business context.

– **Customer affordability**
  - Willingness to Pay research undertaken in the development of our PR14 Business Plan identified that there were affordability concerns for our customers, and that while customers are keen for us to invest in increased resilience for example to drought, not all are willing to pay for this investment.[3]
  - To address this barrier, we have committed to doing further work to understand customer appetite for resilience investment, as described in Section 5.1.

– **Lack of national standards on appropriate levels of adaptation actions i.e. proposed levels from Pitt review to ensure all key sectors are equally resilient.**
  - To address this barrier, we will continue to engage with government, and sector forums to ensure appropriate guidelines are created.

6.2.1 Organisational Capability to Adapt

We believe that a current strength in our approach to climate change is the capability of our organisation to adapt. We are however aware that if we don't continue to develop our business capability, this could pose a future barrier to adaptation.

In 2011, we chose to undertake self-assessment against the PACT (Policy Action on Climate Toolkit) Framework in line with the description in Appendix D. The PACT assessment was taken to understand our organisational capability to adapt to climate change and be flexible in our response, and to identify any scope for improvement.

The assessment undertaken showed that our organisation was beginning to show the advanced level of practise required to operate with strategic resilience. Given the responsibility and long term influence of our business, this is the level which we should continue at. It was also identified that there were also areas of opportunity to continue to improve which could enhance our capability and ensure that we are leading in our response to climate change adaptation.

[3] 87% of respondents agree that Affinity Water should go ahead with investment to improve resilience to severe drought. However opinion was divided on how much they would be willing to contribute with over half (55%) saying they would be prepared to pay about £2.00 after 5 years; just under a quarter (23%) they want less frequent restriction but are not prepared to pay anything extra to improve resilience; and 9% said they want to have enough water all the time and are prepared to pay for it at any price.
From Panel survey findings - Findings from 6 panel surveys conducted in 2013

The areas identified in 2011 where further developing our approach could lead to significant gain were:

– Leadership
– Working Together and Learning
– Programme Scope and Coherence.

As part of the unification process within the business in 2012, we undertook alignment of working practises and took the opportunity to re-assess our company vision, priorities and passions as well as our approach to environmental considerations. The actions we have since taken to look at our areas of development need are in the sections below. During AMP6 we will consider repeating an assessment method such as PACT or similar, to evaluate how our organisational capability has changed.

6.2.1.1 Leadership

Affinity Water is committed to responsible business practice. A Corporate Responsibility Steering Group has been established to ensure we are consistent in our approach to responsible business practice. Within this, we have also formed our 'Our Environment' Working Group to formalise the leadership structure around key environmental issues for our business. The remit of the group is to provide vision, leadership and governance around the key environmental issues within our business:

– **Climate change**
  - Forecasting
  - Mitigation
  - Adaptation.
– **Water resources**
  - Demand management
  - Catchment management
  - Resilience
  - Sustainability reductions.
– **Land management & premises**
  - Managing our sites
  - Managing our impacts.
– **Resources**
  - Procurement
  - Supply chain
  - Waste management.

To publicly make clear the importance of the environment to our business, one of the key actions of the 'Our Environment' Working Group has been to publish our Environment Policy for customers and external stakeholders[4]. This outlines our commitment and strategic vision for

[4] Environment Policy, Affinity Water, https://stakeholder.affinitywater.co.uk/docs/environment-policy-april15-v1-2.pdf

addressing climate change, and is something that we have committed to report against. Our Environment Policy can be found in Figure 3.

We recognise that responding to climate change includes an appreciation of how our operations may contribute to climate change itself and a commitment to reduce this impact. Our Environment Policy states that we are committed to optimising our energy use and reducing our greenhouse gas emissions. In addition we are implementing a strategy for carbon accounting across our procurement process.

ENVIRONMENT POLICY

Affinity Water

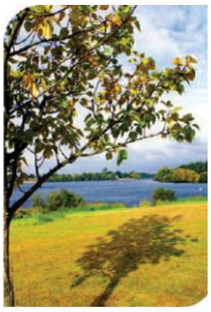
Our vision is to be the leading community focused water company. We are working with our communities, our regulators and government to manage the effect of taking water from sensitive habitats and to maintain flows in local rivers.

We understand the significant impacts of our operations to abstract, treat and distribute high quality safe water to customers. We are committed to continual improvement, prevention of pollution and compliance with environmental legislation, regulations and other requirements applicable to us. We will manage and report on our business plan environmental commitments through our integrated management system.

OUR ENVIRONMENTAL COMMITMENTS

Managing our water resources:

- We are committed to reducing the amount of water we take from the environment by 42 million litres per day by 2020 and by 70 million litres per day by 2025
- We are actively monitoring the health of local rivers and the natural water environment through our National Environment Programmes
- We will promote pollution prevention by raising awareness of how agricultural activity affects water quality
- We have set a target to reduce leakage levels by 14% by 2020, the equivalent of 27 million litres each day
- We will implement a water saving programme to encourage customers to 'save water, save energy, save money', supported by metering of most households within our 'water stressed' area



Managing our land and assets:

- We have put in place programmes to maintain and enhance biodiversity on our landholdings
- We will have special regard to biodiversity conservation on our Sites of Special Scientific Interest
- We are committed to maintaining the recreation and amenity facilities on our landholdings for the benefit of local communities
- We will report annually on our conservation, access and recreation performance

Managing our materials and natural resources:

- We are committed to reducing the amount of waste generated from our activities
- We will minimise, where possible chemical use in treatment processes whilst maintaining water quality standards

Responding to climate change:

- We are adapting to climate change by ensuring our services and infrastructure are resilient
- We prepare drought management plans and we will manage future drought related events to maintain resilience to extreme weather conditions
- We are committed to optimising our energy use and reducing our green house gas emissions

Working with our contractors and suppliers:

- We will set a strategy for carbon accounting across our procurement processes
- We will work collaboratively to reduce the amount of material sent to landfill

Issued: April 2015

AW0110 Apr 2015 v1.2

Figure 3: Our Environment Policy

6.2.1.2 *Working Together and Learning*

We have a strategic priority to create an engaged, team-based organisation that delivers pioneering performance. We understand the importance of working together and making continuous improvement to our understanding, strategy and mission. This is of heightened importance in an area such as Climate Change Adaptation which is embedded across a number of our functions. It requires cross-departmental collaboration to present an effective response.

These are also addressed in our passions for Innovation, Improvement and Collaboration. These have been developed and implemented within the business to develop our corporate culture and capability in our people. These passions are reflected in *how* our people go about contributing to corporate objectives.

- **Improvement:** We understand, challenge and measure our current and predictive performance, to improve the business' efficiency and generate additional revenue
- **Innovation:** We continue to create an environment where all team players are fully engaged to contribute feely within and across teams to identify and confidently deploy creative ideas in a digital world
- **Collaboration:** Team players listen, contribute and act on feedback that helps us all understand, learn and take action to improve the team and the business.

6.2.1.3 *Programme Scope and Coherence*

The 'Our Environment' Working Group is led by a senior Affinity Water representative who will have responsibility for managing the programme and reporting progress to the Corporate Responsibility Steering Group.

This structure provides transparency of the strategic actions related to our environment, and feeds up to the Affinity Water Limited Board. This will provide governance to our environmental programme of work and ensure the responsible delivery of our Business Plan. An additional benefit is an increase in our ability to report against performance indicators and assess the effectiveness of our programmes.

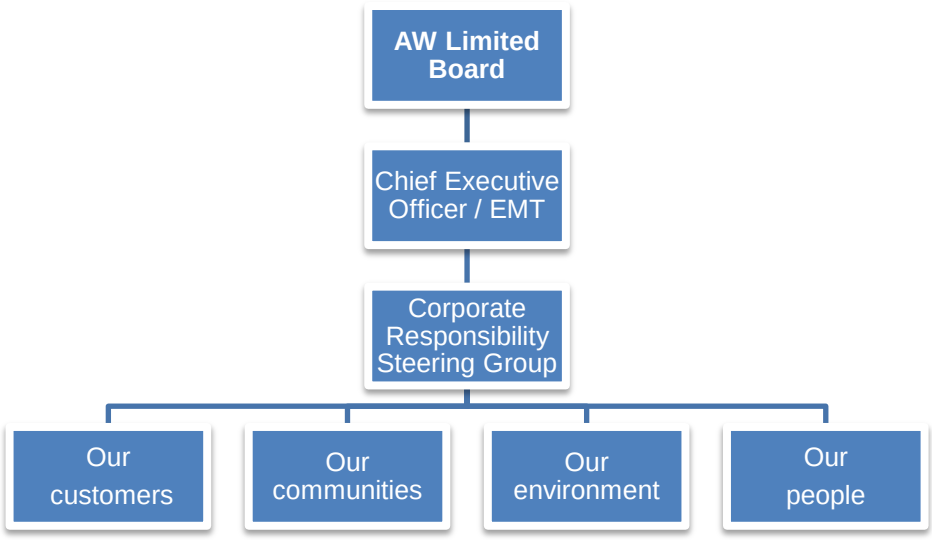


Figure 4: Corporate Responsibility Steering Group Structure

7 Monitoring and Evaluating

Consideration of climate change adaptation requirements has been well embedded within our processes, as this plays a key part in a number of our regulatory submissions.

The actions that have therefore been identified through this reporting process, and our monitoring and evaluating of climate change risks have been managed through our organisational processes as described throughout this report.

Through AMP5, programmes of work including climate change adaptation actions have been monitored and evaluated through our organisational programme and project management procedures as described in Section 7.1.

The monitoring required, and the process for evaluating our performance and any lessons learned during recent extreme weather events such as the drought (Section 7.2) and flooding (Section 7.3) has demonstrated the approach we take and opportunities for further review.

7.1 Embedding Climate Change Consideration

As highlighted throughout our report, climate change risks are embedded within all areas of our organisation, in particular through our WRMP and Business Planning process.

The predicted impacts of lowering groundwater levels due to climate change impacts are incorporated in our WAFU assessment. The impacts that warmer, drier summer will have on our customers demand for water is captured within our micro-component assessment which is used to derive our long term demand forecast. Finally, the uncertainty surrounding both of these is incorporated into our headroom assessment.

Figure 5 presents our baseline supply/demand balance assessed for our PR14 WRMP. The gap between the blue bars and red line is the deficit that we needed to address through the plan. The shaded green areas of this graph highlight the impact that our assessment of climate change has had on the overall balance.

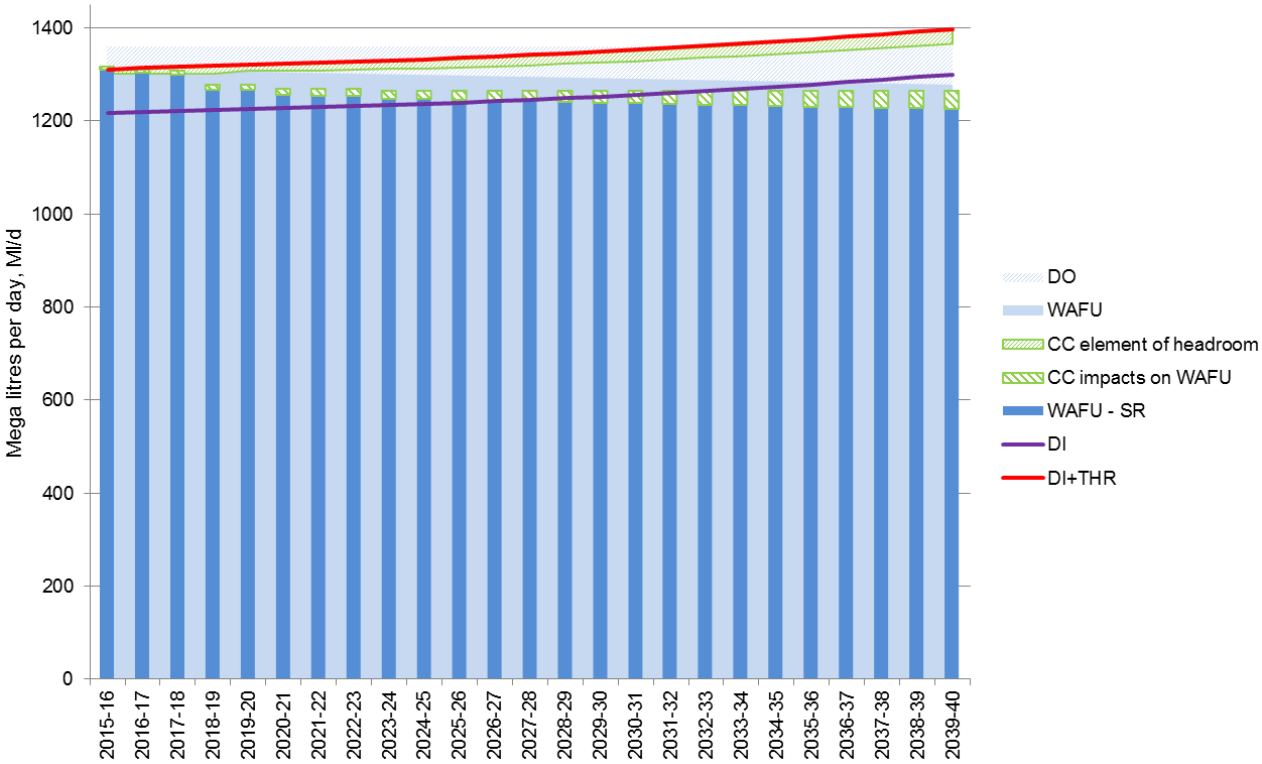


Figure 5: Climate Change Considerations for Water Balance

Climate change considerations are also being reviewed and addressed by the water sector as a whole. As an organisation, we continue to actively support industry and academic research and development groups in order for the water sector to understand the risk and opportunities posed by climate change. This also benefits the sharing of information and best practice throughout the industry.

Through AMP5, programmes of work including climate change adaptation actions have been monitored and evaluated through our organisational programme and project management procedures. Adaptation actions have generally been parts of wider programmes of work aimed at addressing a number of risks (of which climate change is one).

We have well structured governance of our projects and programmes. We have utilised industry best practice for programme management including the Office of Government Commerce's Managing Successful Programmes and Association of Project Management (APM) to develop a programme methodology that is tailored to deliver our initiatives. This programme management has been an effective tool in ensuring that our actions are on track.

We have found that when considering climate change actions across programmes and functions, we have more limited strategic oversight. To ensure transparency of the climate change programme going forward, actions will also be monitored through our 'Our Environment' Working Group as described in Section 6.3.1.

7.2 Handling of Drought 2011-12

The 2011-12 drought affected most of south east England for a period of approximately 12 months. Our Drought Management Group (DMG) was set up to monitor and evaluate the situation, and its first meeting was held on 4 January 2012 along with the sub-groups that reported to it regularly. Our response followed the established procedures set out in our DMP.

In order to preserve supplies and reduce demand, a Temporary Use Ban imposing various restrictions on water use was put in place by Affinity Water on 5 April 2012, as was implemented across the majority of the water companies in south east England. These restrictions remained in place until 9 July 2012, when sufficient rainfall had fallen to replenish our sources and lift the drought conditions. Environmental monitoring was in place in accordance with the Plan; however, it was not required to support the application of Drought Permits or Orders.

Through effective monitoring and transfer of supplies between regions, we were able to supply all of our customers with an uninterrupted supply of water at all times during the drought.

Communication was a key component of our response to the drought. Effective channels of communication were set up between Affinity Water, the EA and other water companies. Maintaining consistent external messaging to all customers was very important, and various channels were used for this purpose.

7.3 Handling of Flooding 2013-14

Between December 2013 and February 2014 we experienced the wettest winter since records began with upwards of 300mm rain in the catchment area for the River Thames following on from a relatively wet autumn 2013. This led to significant flooding of our Central region in particular.

During this period, there were some emerging issues concerning a small number of our groundwater sites however these were successfully managed locally, had no effect on customers and did not generate any press interest and therefore are not described in any detail here. Exceptional high water level conditions in the River Thames however posed a risk to a number of our surface water treatment works close to the Thames, and became a high profile incident.

We experienced minor flooding of parts of our River Thames water treatment works (WTWs) (grounds and building basements) in January 2014 when the River Thames flooded local areas. To deal with the health and safety issues this created, we built a number of temporary bridges. Within at risk buildings we installed multiple sump pumps in case of pump failure. Around-the-clock site inspections were initiated at this point to ensure that any deterioration of the situation could be identified quickly and the appropriate remedial action taken.

On 10 February 2014, following heavy rainfall over the weekend and continued rising water levels (with an extra 300mm forecasted over the next 36 hours) we invoked our Emergency Plan and set up our Gold, Silver and four Bronze Command Units. We liaised with DEFRA and Surrey Gold and Silver Command Units that were co-ordinating the efforts of local resilience teams, emergency services and the military to deal with the effects of flooding.

Following the incident, an Emergency Incident Review was undertaken to understand the lessons learned, and to capture any outstanding actions required to maintain and improve our resilience to flooding. These have been regularly reviewed following the incident to ensure their implementation.

The challenge of the floods also offered an opportunity to review emergency and alternative water procurement and deployment plans, which has led to a thorough review of our specific resilience plans for the loss of our River Thames WTWs. This site specific resilience planning work is planned to be additionally rolled out for all our large sites and for large trunk mains and reservoirs as well as WTWs.

7.4 Abstraction Reform and Market Reform

In 2012 DEFRA launched a reform of the abstraction licencing system in England with the purpose of moving to a more flexible system that will protect the environment in the future in particular in the face of climate change. We welcomed this initiative as this is consistent with the substantive adaption we have begun in AMP6 to implement sustainability reductions to meet Water Framework Directive objectives in a number of Chalk catchments in our operating area and have contributed to this programme of work as part of industry input with a view to ensure change in access to water does not adversely affect the resilience of public water supplies and that change is properly reflected in our future investment planning. We also participated in an UKWIR study by contribution a case study to explore how change in abstraction licencing may affect our operations. We will continue supporting the on-going programme in AMP6.

We have also been asked by Ofwat to join other companies to develop an implementation plan for an Abstraction Incentive Mechanism (AIM). This follows our proposals for an AIM in our Business Plan submission for PR14. This mechanism is likely to influence operating decisions relating to both operating and investment expenditure in the medium term but in the longer term will doubtless make a contribution to the longer terms strategy for climate change adaption.

8 Opportunities and Benefits

Although there were no opportunities identified in our first round reports, we have since identified a number of opportunities which we have begun to explore, and plan to exploit where possible going forward.

Climate change adaptation reporting itself gives us the ideal opportunity to talk to our customer about climate change and the impacts it may have on their community. This opportunity may be exploited in a number of ways:

– Influencing customer behaviour towards being more sustainable i.e. reducing demand

– Influencing customer appetite for resilience investment where vulnerabilities exist within their local environment

– Providing transparency on the actions that the business has implemented and plans to implement around climate change adaptation.

Climate change adaptation provides the opportunity to:

– Share resources, and provide an integrated local response to severe weather events within the water sector, and the wider utility sector.

  • We plan to build on the communication channels utilised through our response to recent extreme weather events (for example 2013-14 flooding) to ensure that we have an efficient response

  • We plan to continue to be involved with water sector, and wider forums related to climate change adaptation.

– Explore innovative ways of adapting to changing weather conditions to ensure our company's resilience in the future.

  • As discussed in Section 7.1, we continue to actively support industry and academic research and development groups in order for the water sector to understand the risk and opportunities posed by climate change. We continue to communicate within the water sector to understand industry best practice.

– Leave more water in the environment through encouraging our customers to reduce their demand.

  • This will have environmental benefits, in particular for the chalk stream environments within our communities, where flow levels can have particular impacts on biodiversity.

– Address the broader issue of resilience within our organisation.

  • Actions taken to address flooding or drought resilience through climate change adaptation will generally also provide supply resilience in a wider context, and provides additional justification for resilience investment.

The weather changes that may take place due to climate change could also provide either opportunities or incidental benefits such as:

– Wetter winters providing the opportunity for winter storage to aid with higher summer demand. This is explored through our WRMP as described in Section 5.1

– Milder winters leading to less of a 'winter outbreak' of bursts caused by frosts

– Increased demand for recreational access to sites e.g. reservoirs.

  - Where future opportunities may arise from a changing climate we will continue to work together our strategic partners and local communities on the land we own to help us shape our plans for conservation, access and recreation. We continue to develop our estate and catchment management activities in order to achieve improved biodiversity and conservation outcomes. These range from public access and recreational use of our lakes, volunteering from Affinity Water team members and activities undertaken by our award winning environment and education service
  - Many of our activities are linked with our strategic partners such as Wildlife Trusts and river groups which provide expert knowledge on the local environment, key species and habitats. We believe that by working with our regulators, team members and wider communities, involving them in constructive dialogue and increasing awareness of challenges we all face, we will achieve the best balance to minimise the impact of our essential activities and protect the environment.

9 Conclusions

The following conclusions can be drawn from this report:

1. Climate change risks are embedded within all areas of Affinity Water, in particularly through our Water Resources Management Plan and Business Planning processes.
2. We have significantly progressed our organisational capability to adapt to climate change in the following areas:
   - **Leadership** - through the formation of an 'Our Environment' Working Group. This group has provided vision, leadership and governance around key environmental issues and enforces our Environment Policy.
   - **Working Together and Learning** - through the development of passions for innovation, improvement and collaboration within the business.
   - **Programme Scope and Coherence** through the 'Our Environment' Working Group having oversight of our climate change programme. This has increased our ability to report against performance indicators and assess the effectiveness of our programmes.
3. Affinity Water has improved its understanding of climate risk over the last five years through further detailed consideration of the following key areas;
   - **Supply Demand Balance**; specifically deployable output, long term and peak demand and risk of outages through flooding
   - **Water Quality**; specifically catchment management and treatment
   - **Coastal Conditions**; specifically saline intrusion and coastal flooding
   - **Ground Conditions**; specifically sink holes, tree fell and burst rate
   - **Daily Operations.**
4. Climate change risks have been incorporated into our strategic risk register and have been scored according to the risk they pose to the key areas of operations.
5. We have improved our understanding of climate change thresholds, specifically practical operational thresholds, design thresholds and level of service thresholds. New drought and flood triggers have been installed and the company aims to define thresholds for triggering investment beyond that which we are currently planning in our business plan.
6. We have engaged in a programme of work to improve our resilience to flooding through the principle components of resistance, reliability, redundancy, response and recovery. This is detailed in Section 5.2.
7. A table of completed and new climate change adaptation actions has been compiled and is presented in Section 5. Affinity Water will undertake future actions under the following categories;
   - Further increase our adaptive capability
   - Understand our customers' appetite for resilience investment

- Undertake targeted projects to address specific climate risks.

8. The following barriers to climate change adaptation have been encountered.

   - Climate change is a multiplying factor not an individual driver and is not generally able to drive investment on its own.
   - While our customers are keen for us to invest in increased resilience, not all are willing to pay for this investment. To address this barrier we have committed to undertaking further work to understand customer appetite for resilience investment.
   - There is a lack of national standards on appropriate levels of adaptation actions to ensure all key sectors are equally resilient.

Glossary of Terms

AMP – Asset Management Plan

AMP5 – Asset Management Planning Period (2010-2015)

AMP6 - Asset Management Planning Period (2015-2020)

ARP - Adaptation Reporting Power

AW – Affinity Water

CC – Climate Change

CHERS - Redacted Site Name

CPNI - Centre for the Protection of National Infrastructure

DEFRA - Department for Environment, Food & Rural Affairs

DI – Distribution Input

DMG – Drought Management Group

DMP – Drought Management Plan

DNO - Distribution Network Operators

DO – Deployable Output

DYCP – Dry Year Critical Period

EA – Environment Agency

EBSD – Economic Balance of Supply and Demand

EGHS - Redacted Site Name

ELL – Economic Level of Leakage

EMT – Executive Management Team

GCHQ - Government Communications Headquarters

LoS – Level of Service

NERC – Natural Environment and Rural Communities Act

NEP – National Environment Programme

NGO - Non-Governmental Organisation

OBH – Observation Boreholes

PACT – Policy Action on Climate Toolkit

PCC – Per Capita Consumption

PCV - Prescribed Concentration or Value

PR – Price Review

PR09 – Price Review 2009

PR14 – Price Review 2014

PR19 – Price Review 2019

RSPB - Royal Society for the Protection of Birds

SCADA - Supervisory Control and Data Acquisition

SDNG – Redacted Site Name

SKIN – Redacted Site Name

SLIG – Redacted Site Name

SoS – Secretary of State

SR – Sustainability Reductions

SSTM – Redacted Site Name

THR – Target Headroom

TUB – Temporary Use Ban

UK BAP – UK Biodiversity Action Plan

UKCP09 - UK Climate Projections (2009)

UKWIR – UK Water Industry Research

WAFU – Water Available for Use

WALS - Redacted Site Name

WAN – Wide Area Network

WFD – Water Framework Directive

WRc – Water Research Centre

WREA - Water Resources East Anglia

WRMP – Water Resources Management Plan

WRPG – Water Resources Planning Guidelines

WRSE - Water Resources in the South East

WRZ – Water Resource Zone

WSP – Water Savings Programme

WTW – Water Treatment Work

Appendices

Appendix A – Guidance for Reporting

Attribute	Sub-Attribute	Report Reference
Understanding Climate Risk	How has your understanding of climate risks, impacts and their effects on your sector organization and stakeholders advanced since your first round report?	2.2, 2.3, 2.4, 2.5, 2.6
	What climate change evidence or research have you used to better understand the implications for organizational functions?	2.2, 2.3, 2.4, 2.5, 2.6
	Has your understanding of thresholds of climate change impacts advanced to better pinpoint organizational vulnerability? If so, how?	3
	How have you developed your quantified assessment and analysis of risk likelihood and impacts?	2.1
Understanding Uncertainties	What uncertainties remain in monitoring and evaluating climate risks to your sector's/organisation's functions?	4
	What new uncertainties have come to light?	4
	What further implications do uncertainties have on action your sector/organisation has taken or plans to take?	4
	What progress have you made to address information gaps?	2.2, 2.3, 2.4, 2.5, 2.6, 4
	What are the strategic business and methodological assumptions that underpin your analysis of impacts and risks?	Throughout
Details of Actions: Implemented and New	Table of actions: implemented actions	5.1, 5.2, 5.3
	Table of actions: new actions	5.1, 5.2, 5.3
Addressing Barriers and Understanding Interdependencies	Where you've identified interdependencies, how have these assisted or hindered action to address climate risk?	6.1
	What were the main barriers to implementing adaption actions and why?	6.2

Attribute	Sub-Attribute	Report Reference
	Have new barriers been identified? Are these being addressed? If so, how?	6.2
Monitoring and Evaluating	How effectively has consideration of climate change risks been embedded within your sector or organisation?	7.1
	How effective have organisational monitoring and evaluation processes been to ensure adaptation responses are implemented and on track? If these have not been effective, what barriers prevented this?	7.1
	How effective were monitoring and evaluation processes in determining how the organisation/sector handled recent extreme weather conditions?	7.1
	Has the sector/organisation identified any financial benefits from implementing adaptation actions? Perhaps through cost benefit analysis, fewer working days lost, more efficient operations etc.?	7.1
	Has there been sufficient flexibility in the approach to adaptation within the sector/organisation, which allowed you to pursue alternative courses of action? If not, what remedial measures could you take to ensure flexibility?	6.3, 2.1
Opportunities and Benefits	What action have you taken to exploit opportunities?	8
	How effective were your efforts?	8

Table 5: Repeat Reporters' Template

Appendix B – Micro-Components

Micro-Component Assessment

Our micro-component assessment accounts for predictions about future changes in how our customers will use water. For instance, these changes may be driven by an increase in the proportion of metered customers who on average use less water then unmeasured customers. Or as a result of replacement of existing appliances with more efficient dishwashers, washing machines and WCs etc..

The plots in Figure 6 and Figure 7 show the change in water consumption for each micro-component of water use for measured and unmeasured customers respectively, as well as the change in water use that may be attributed to climate change. The figures reflect the fact that our metered (measured) customers use less water than our unmeasured customers do, supporting our roll-out of metering in our Water Savings Programme.

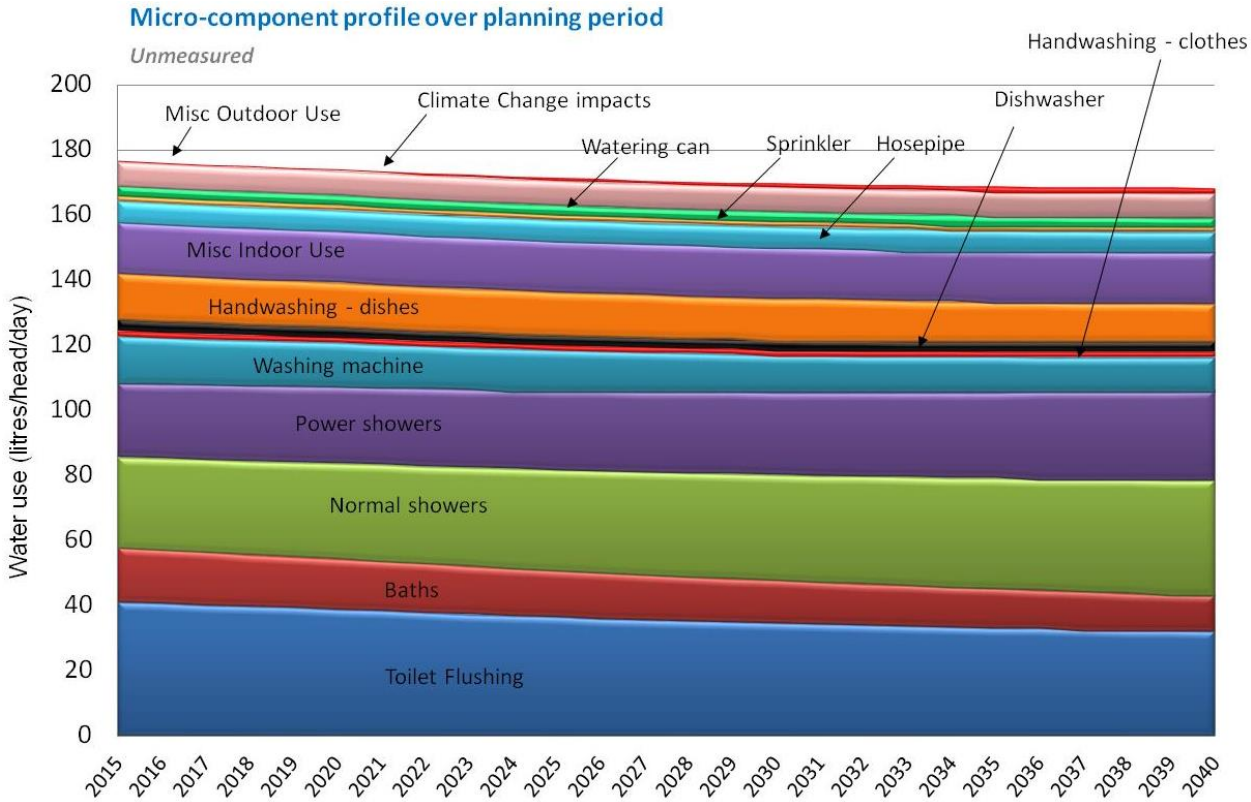


Figure 6: Baseline Micro-Component Profile (Unmeasured Households)

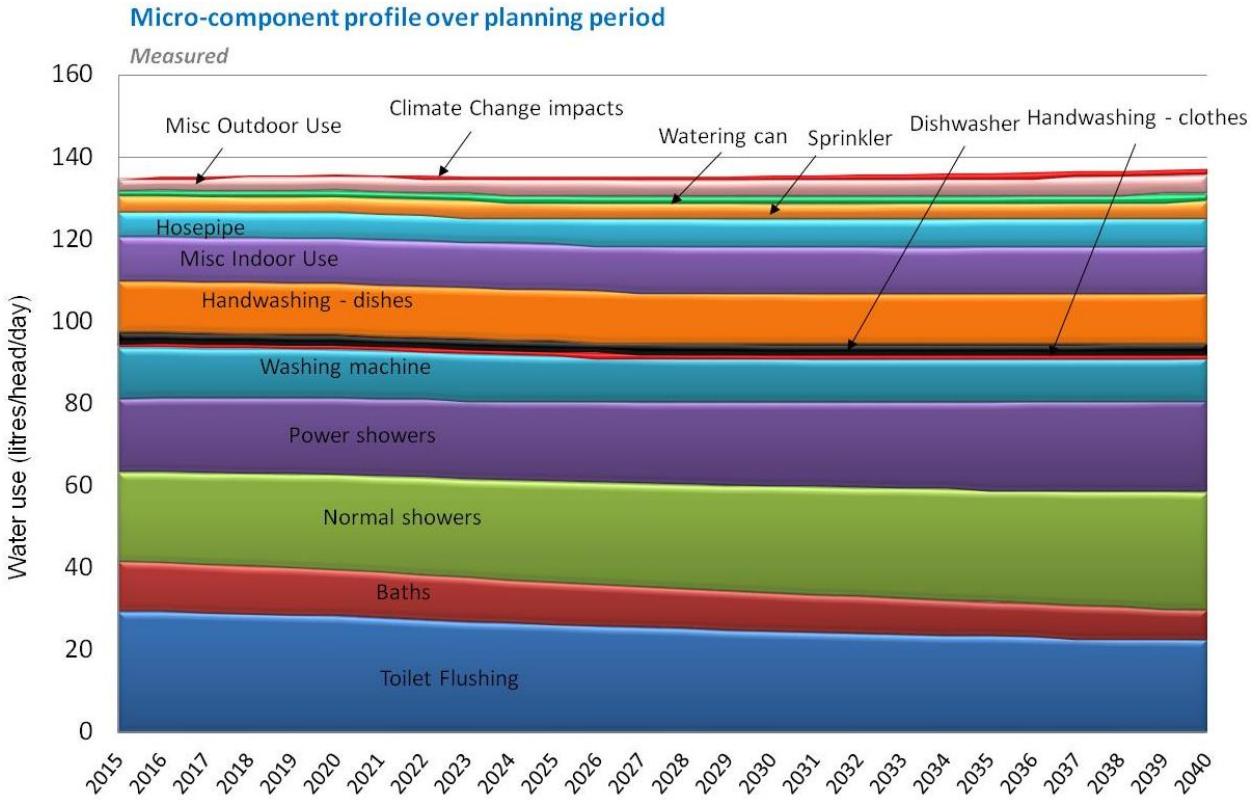


Figure 7: Baseline Micro-Component Profile (Measured Households)

Micro-Component Study

We undertook a study in summer 2013 of around 20 properties from our unmeasured consumption monitor in the north-west London area (WRZ4 in our Central region) using WRc's Identiflow system. Identiflow is capable of determining household consumption by individual micro-components by analysing the volume of water taken through a property's supply pipe together with the duration of the water use 'event'. After post-processing the data, it is also possible to establish if there is a leak at the property, whether on the customer's supply pipe or within their property's plumbing.

A key objective of this study was to assure our peak factors analysis, subject to weather conditions, and to understand the relationship between demand and potential changing weather conditions. Throughout the study, DI tracked temperature very closely. Our maximum DI of 1070Ml/d coincided with the maximum temperature of 31.2°C on Wednesday 17 July, although we recorded 11 consecutive days when DI was in excess of 1000Ml/d. Our minimum DI of 809Ml/d was recorded on Tuesday 30 July, a day that saw a sharp drop in average temperature to 17.5°C with 7.2mm of rainfall.

We plan to undertake more detailed analysis of the datasets from the study, but we have been able to draw the following conclusions:

– Peak demand was driven by a small number of households using considerably more water in hot periods than they do under normal weather conditions.

– The majority of this change in use between average and peak demand was driven by garden watering.

Further details of our analysis of the Identiflow study can be found in our WRMP Technical Report 2.0: *Demand Forecast*.

Appendix C – One Minute Risk Assessment Templates

AWC "One Minute" Risk Assessment

Document: OCS1
Issue : 1.3
Page: 1 of 1

Printed copies uncontrolled unless stamped 'Controlled ' in red

LOCATION:	DATE and TIME:
ASSESSORS NAME:	AMIS No:
NATURE OF WORK:	

RISK	Yes	No	N/A
Are you and your vehicle safe from other traffic?	☐	☐	
Are you qualified / trained to do the task?	☐	☐	
Have you informed the Ops Centre of your location- Loneworker / Verbally (circle)	☐		☐
Are you wearing the correct PPE	☐	☐	☐
Is the PPE in an acceptable condition?	☐	☐	☐
Is the working temperature ok?	☐	☐	☐
Does the area have adequate lightning?	☐	☐	☐
Do you need a permit of any kind?	☐	☐	☐
Are the necessary permits in place?	☐	☐	☐
Are the required isolations in place?	☐	☐	☐
Are you aware of any chemical hazards?	☐	☐	
Has the area been made safe?	☐	☐	☐
Have you walked the job?	☐	☐	☐
Is there safe access and egress?	☐	☐	
Is the area fit to work in?	☐	☐	
Are you fit to carry out the task?	☐	☐	
Is the guarding adequate?	☐	☐	☐
Do you need lifting equipment?	☐	☐	
Are you working at height?	☐	☐	
Will there be people affected by your work?	☐	☐	
Have you informed the people affected?	☐	☐	☐
Will your work affect plant operations?	☐	☐	☐
Are all required parties on site and / or available	☐	☐	
Do you have the correct tools for the job?	☐	☐	
Do you have a safe method of doing the job?	☐	☐	
Is a more detailed risk assessment required?	☐	☐	
Are there any H&S issues that need to be escalated? – Near miss etc	☐	☐	

DETAIL BELOW ANY ISSUES / OR ANOMOLIES **THAT NEED FURTHER ACTION**

☐ Found and Fixed Checked:

Author: Gerald Doocey - Operational Control Systems Manager	
Approver: Jeff Thomas – Head of Production and Supply	Approval Date: 10/09/2008

O P E R A T I O N S

TAKE 5 FOR SAFETY	Check Vehicle	Check Weather	Log onto site/ Permission	Check PPE and think about task	Look for danger and assess risk	Comments	Call 2291 to report a Near Miss
Date: Site: Task:							
Date: Site: Task:							
Date: Site: Task:							
Date: Site: Task:							
Date: Site: Task:							

Appendix D – PACT Framework

Figure 8 shows the PACT climate change resilience levels. These levels increase in complexity and capacity with the most resilient and well prepared organisations being ranked towards the higher levels. According to the PACT creators, most organisations of any size would be assessed as active at the first and second levels of response: *"core business focused*" and *"stakeholder responsive*".

Figure 8: PACT Levels of Preparedness

Defining how organisations perform at the highest level, Response Level 6: *"champion organisation",* is still work in progress since few organisations have reportedly managed to consistently operate at this level. Following successful completion of the PACT survey, participants are rated for resilience levels in a number of key categories. These are:

- **Awareness.** The grasp of what climate change means for society, for the organisation and its mission, and for particular areas of responsibility, now and into the future.
- **Agency.** The capacity to spot, prioritise and develop opportunities for meaningful and timely action on climate change.
- **Leadership.** The extent to which a formal leadership team has developed a strategic vision and engages with, supports and legitimises its implementation.
- **Agents of Change**. How an "ecosystem" or group of champions is identified, developed, empowered and supported so that they can be effective agents of change.
- **Working Together.** The capacity to participate in, learn from, and act in collaborative partnerships with internal and external groups.
- **Learning.** The extent to which the organisation generates and responds to feedback from innovation, even on a small scale, and makes sense of and communicates new informat9on to improve procedures, strategies and mission.
- **Managing Operations**. The embedding of procedures to get to grips with climate change in a systematic way to ensure that intentions and policies turn into action.
- **Programme Scope and Coherence.** How far projects sit within a strategic programme of action suited to the scope of what the organisation is trying to achieve.
- **Expertise and Evidence.** Ability to identify, access and deploy the necessary technical and change "know-how" and information to make the biggest difference.

Appendix E – Has adaptation reporting helped you?

This information will not be published, and is therefore stored as a separate document.