Bournemouth Water

Climate Change Adaptation Plan

Update on progress
July 2015

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1 Overview

The Adaptation Reporting Power (ARP) that constitutes part of the Climate Change Act (2008) gives the Secretary of State the power to direct reporting authorities (organisations with functions of a public nature and statutory undertakers) to produce reports detailing the current and future predicted impacts of climate change on their organisation. This report constitutes a voluntary update on progress since the publication of Bournemouth Water's 2011 Climate Change Adaptation Plan Update (CCA11). The ARP requires an update on the following key areas:

- Proposals and policies for adapting to climate change
- an assessment of progress towards implementing the policies and proposals set out in the previous Climate Change Adaptation Plan (CCA 11).

The 2015 Climate Change Adaptation Update (CCAU) provides an update to the published CCA 11 plan and details new research undertaken as part of other statutory plans such as the Water Resources Management Plan (WRMP 14) and the company Strategic Business Plan (BP 14).

For the purposes of this update all risks identified as part of CCA 11 have been reassessed for the key areas of operation to ensure that none of these have changed. In the process no changes were identified nor have any new risks been identified subsequent to CCA 11. In addition to the review of risks this report details the new research relating to the impacts of climate change on company sources carried out as part of the 2014 Water Resources Management Plan (WRMP).

The key climate related risks faced by the company remain those related to the ability to carry out our duty to supply customers. The assessment of the vulnerability of company sources agrees with the conclusions reached in CCA 11. Namely that company sources will remain limited by license and therefore climate change impacts will not impact our ability to carry out our core function of supplying high quality wholesome water to our customers. This does not mean that we will be complacent. Climate change adaptation is embedded in company planning and therefore is kept under regular review while risks assessed on a yearly basis.

1.1 Company information

Bournemouth Water (BW) provides clean drinking water to over half a million people in an area from the outskirts of Poole to Southampton Water and from Bournemouth to just south of Salisbury. We supply 204,834 households and other properties, using a network of 2,829 km of water mains. We obtain up to 85% of our water from run of river abstractions on the Hampshire Avon and the Dorset Stour (see Figure 1 below), and the remainder from boreholes. We do not treat wastewater; in our area the sewerage services are provided by Wessex Water and Southern Water. We have a long and successful tradition of supplying water. Our predecessors Bournemouth and District Water and West Hampshire Water were established by Acts of Parliament in 1863 and 1893 respectively, and were merged in 1994.

Our company strategy is to maintain our excellent record and to continue to improve our performance in response to customers' requirements. Compared with most water companies, we are a small and local business. This has advantages in terms of responsiveness, but it also increases operational risk and our vulnerability to extreme climatic events.

We have recently changed ownership having been acquired by the Pennon group who also own South West Water. The 2 companies are geographically separate and so this does not impact our water resources and climate change management.

Our aim is to continue to be amongst the leading performers in the UK water industry by all measures, including sustainability, leakage, water quality, efficiency and customer service. We strive to position ourselves as a flagship organisation. By taking this approach we will benefit our stakeholders both now and in the future.

Figure 1: Company area and catchments used for supply.

2 Understanding climate risk

The section below provides an overview of how climate change risks are understood and the implications of these for the organisation.

2.1 Climate risks, impacts and their effects sector/organisation and stakeholders since CCA plan 2011.

The original risk assessment for company assets was undertaken based on Water UK's study, A Climate Change Adaptation Approach for Asset Management Planning (2008)[1]. All risks assessed in the 2011 Climate Change Adaptation Plan (CCA 11)[2] have been re-assessed and updated as required. In addition to this, a further review of the impacts of climate change on company sources was undertaken as part of the 2014 Water Resources Management Plan[3] In Appendix 2 of CCA 11 we list all the climate change impacts identified in the Water UK study. It was evident from the analysis that the most common risks facing the company were related to higher demands, reduced yields, temperature increases and surface flooding.

The Water UK study identified a common approach for assessing adaptation risks, and their incorporation into asset management planning. It also proposed a set of consistent strategic adaptation response options for the industry. Key climate variables for the water industry were highlighted in the study. These include drought, flood, sea level rise, and temperature rise. The study then identified how these variables may impact water industry assets and operations in seven key functions. The functions have been highlighted below:

- Water resources
- Water Treatment
- Water networks
- Wastewater networks
- Wastewater treatment
- Sludge
- Site wide services

[1] "A climate change adaptation approach for asset management planning" (2008) is a study prepared by MWH for Water UK. The report provided water companies with a consistent set of climate change adaptation information for asset management planning and the 2009 Price Review process (PR09). It also provided information on climate change impacts and adaptation options that can be fed into water companies' 25-year water resource plans, strategic direction statements and business plans where appropriate.

[2] http://www.bournemouthwater.co.uk/Uploads/Docs/climate_change_adaptation_report_final_12_01_11.pdf

[3] http://www.bournemouthwater.co.uk/company-information/economic-regulation/water-resources-plan-documents.aspx

Taking the above into account table 1 below provides a summary of the highest scoring risks identified in CCA 11. After subsequent review of all risks, those in table 1 remain the most significant faced by the company. Details of risk assessments are included in Part 3 of the first published Climate Change Adaptation Plan (CCA 11) where a three by three risk assessment matrix was used to quantify level of risk of "consequence for service" derived from the Water UK's study. The scores for all identified water only company risks are detailed in Appendix 3 of CCA 11[4].

[4]http://www.bournemouthwater.co.uk/Uploads/Docs/climate_change_adaptation_report_final_12_01_11.pdf

Table 1: Highest scoring climate change risks.

No	Area Impacted	Impact	Pressure	Consequence	Service
1	All Water Resources	Drought	Higher daily & peak demand for garden watering,	Lower security of supply	Reduction in levels of service
2	All Water Resources	Drought	Lower river & borehole yields or reduced water quality	Abstraction licences reduced or removed, reducing security of supply	Reduction in levels of service
3	All Water Treatment	Temp. Rise	Higher temperatures	More algal growth and micro-organisms in the water supply system	Higher drinking water quality risk
4	Treatment works	Temp. Rise	Higher temperatures	Lower raw water quality	Greater risk to drinking water quality
5	Distribution networks incl. ancillaries	Temp. Rise	More extreme wetting and drying cycles	Greater soil movement, more pipe movement and bursts	Reduction in levels of service
6	All Site wide Services	Temp. Rise	Higher average and peak temperatures	Accelerated deterioration of structures, buildings, machinery, equipment	Reduction in levels of service
7	All Water Resources	Flood	Direct asset flooding	Asset loss	Service failure
8	All Water Treatment	Flood	Direct asset flooding	Asset loss	Service failure
9	All Water Networks	Flood	Direct asset flooding	Asset loss	Service failure
10	All Water Resources	Sea level	Direct asset flooding, storm damage, coastal erosion or planned retreat	Asset loss	Service failure
11	All Water Resources	Sea level	Saline intrusion	accelerated asset deterioration	Service failure/ reduction

3 Climate change research used for a better understanding of the implications of the impacts on company functions

Climate change represents one of the greatest uncertainties facing a water company. The water industry is directly affected by climate change as a result of the impacts it has on weather patterns. Changes in rainfall and temperature will have widespread impacts on our ability to supply water and in addition an impact on customer demands. Subsequent to CCA 11 a new Water Resources Management Plan (WRMP) and Business Plan (BP) have been published. Due to the impacts of climate change being a critical factor in the ability to supply water, the impacts of climate change on company sources were reassessed. This was done using the Environment Agency Climate Change in Water Supply Planning project[5] as the framework for the assessment. This section provides an overview of the assessment comparing historic worst case scenarios against predicted future conditions and updated long term average conditions.

The predicted future conditions and their impact on company sources were reassessed as part of the current WRMP. This new research is detailed in section 3.3. The conclusion reached was, that from our current understanding of the climate change impacts we will be able to discharge our duty to our customers as all sources are limited by licence only. This is due in part to the nature of our sources as the company lies in an area of low water stress [6] and the fact that customer demands are trending downwards in spite of population growth.

Table 2: Information used for climate change impact vulnerability assessment.

Description	Comment
Critical drought years	1934 1976,1990 (from rainfall records)
Period used for analysis	1957-2012 and 1933-1934 for rainfall data; 1973-2012 River Stour; 1975-2012 River Avon (actual data) Modelled data used to hind cast flow data for both sources from 1883; 1942-2012 chalk groundwater sources
Sources	Limited by licence only
Supply demand balance (base year)	Positive
Security of supply and/or water scarcity indicators	100% security of supply

[5] Environment Agency Climate change approaches in water resources planning-Overview of new methods, Report SC090017/SR3

[6]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf

Critical climate variables	Rainfall and temperature
Climate change deployable outputs (dry, mid, wet scenarios)	Assessed using The Future Flows and Groundwater Levels (FFGWL) project[7]
Adaptive capacity	Embedded in company processes
Sensitivity	Low (due to the nature of sources and long term planning)
Vulnerability classification	Low vulnerability to climate change impacts
Overall vulnerability	Low vulnerability to climate change impacts.

3.1.1 Critical drought years

Figure 2 below indicates that over the period 1957-2015 we experienced the lowest April-August rainfall in 1976. In this section we provide an overview of the impacts of climate change on the deployable output (DO) of our surface and groundwater sources. Due to records only going back to the 1970's for our surface water sources, the analysis of surface water yields in WRMP 14 used correlation analysis to hind cast flows back to 1883[8]. The analysis of the flow sequences for the River Avon and River Stour indicated that the hydrological yield is defined by a single point in 1934. The flow duration curve for Knapp Mill indicates that the 1976 drought could be considered a more extreme event on the Avon and for Throop Mill on the River Stour where it indicates that 1934 and 1976 have very similar flow duration curves. As a result of the records prior to 1975 being derived by hind cast methods 1976 remains the most severe event on record and was very similar in severity to 1934.

Furthermore, comparing average rainfall data for October 1933 to August 1934[9] with October 1975 to August 1976[10] (see Figure 3) it indicates that average rainfall for 1975/76 was nearly half that of 1933-34 for the same period. For these reasons and in terms of the hydrological severity and spatial extent of its impacts we use 1976 event as the benchmark for our most severe drought. This is further supported by the assessment of deployable output in WRMP 14 where the same conclusions have been reached for both surface water and groundwater DO. Section 3.3 provides a detailed description of predicted future flows and groundwater levels used for this assessment.

[7] http://www.ceh.ac.uk/sci_programmes/Water/FutureFlowsandGroundWaterLevels.html#Future

[8] http://www.bournemouthwater.co.uk/Uploads/Docs/Water%20resources%20plan/Appendix%204a%20surface%20water%20DO%20PD.pdf

[9] From company records for Alderney treatment works

[10] From Met office Hurn station 4117E 978N

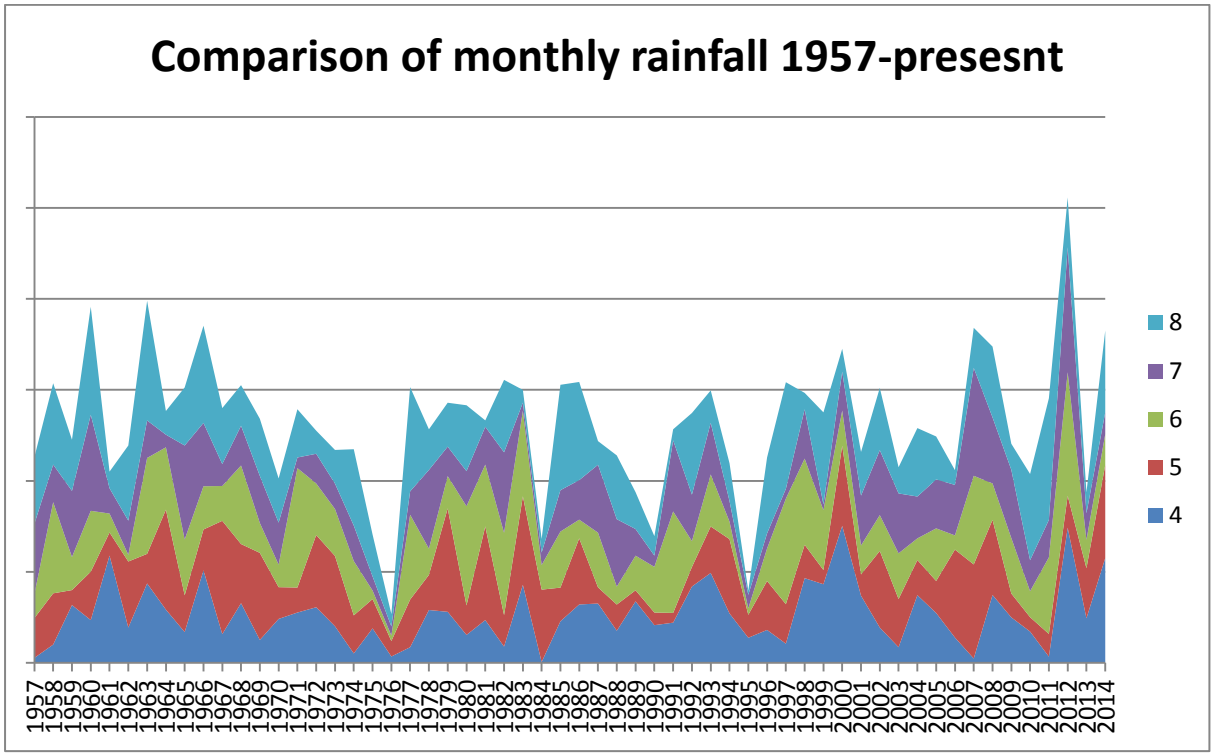

Figure 2: Comparison of April, May June July and August monthly rainfall 1957-present.

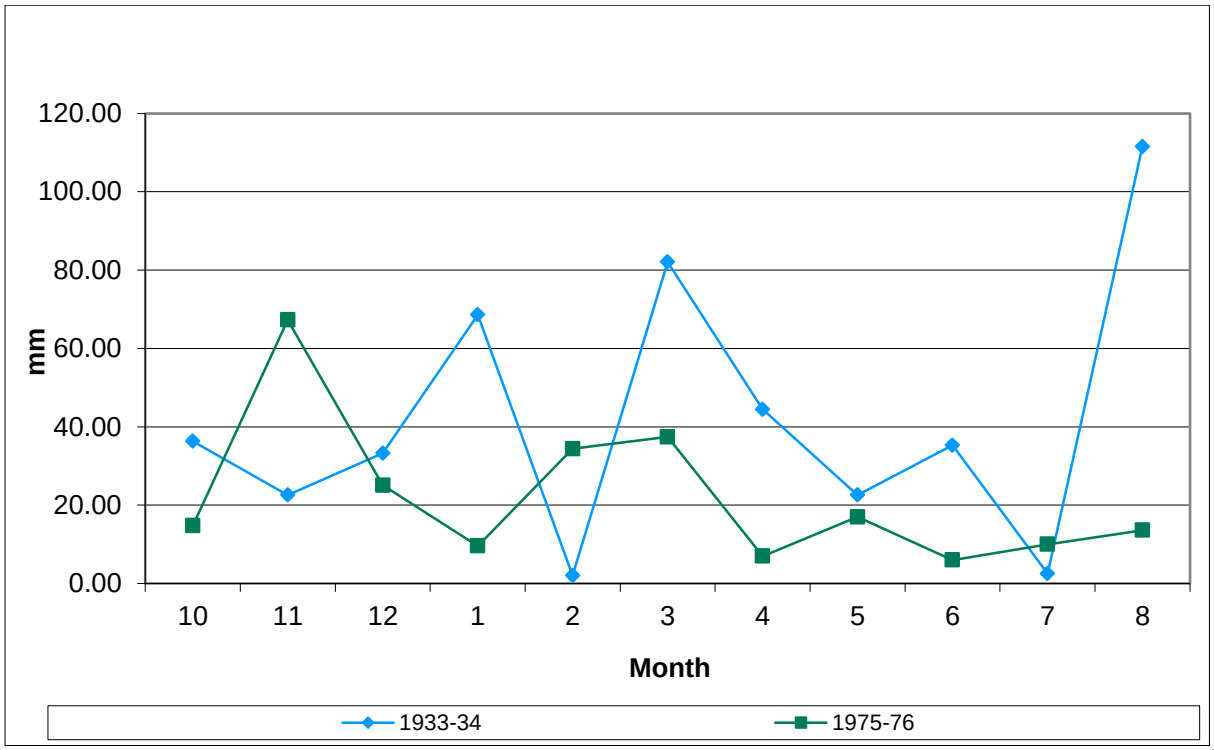

Figure 3 Comparison of monthly rainfall for 1933-34 and 1975-76.

3.1.2 Comparison of historic conditions with average

The table below compares the average flows and monthly rainfall experienced in 1976 with long term average. With regards to the impacts of climate change on our sources, rainfall is the single most important variable as it affects both groundwater levels and river flows. When the percentage difference from average conditions, in the tables below, is compared with the expected changes in rainfall from average conditions in section 3.2 it is evident that our system has coped with more extreme conditions than are currently predicted from future scenarios.

Table 3: Comparison of historic worst case with long term average (LTA).

	Rainfall mm 1976	LTA 1957-2015[11] mm	diff from LTA	1976 Knapp Mill Flow Cumecs[12]	LTA 1975-2015	diff from LTA	1976 Throop Flow Cumecs[13]	LTA 1973-2015	Difference from LTA
Apr	7	53	-87%	6.07	24.96	-76%	4.48	14.59	-69%
May	17	52	-67%	5.60	18.02	-69%	3.16	9.35	-66%
June	6	54	-89%	4.00	13.36	-70%	2.23	6.12	-65%
Jul	10	47	-78%	2.87	10.51	-72%	2.61	5.24	-50%
Aug	14	58	-77%	2.70	9.10	-70%	1.36	4.26	-68%

3.2 Future climate change predictions for South West England

In general terms the climate change predictions as set out in The UK Climate Projections[14] predict that:

- the UK will continue to get warmer,
- summers will continue to get hotter and drier for much of the UK,
- winters will continue to get milder and wetter,
- some weather extremes will become more common, others less common,
- sea level will continue to rise.

[12]From Met office Hurn station 4117E 978N

[12] Source: Environment Agency Knapp Mill Site ID 3320

[13] Source: Environment Agency Throop Site ID 303

[14] http://ukclimateprojections.defra.gov.uk/

The table below shows the expected magnitude of change from baseline conditions indicated by the UKCIP 09 climate change projections. Although these predicted changes will affect the business, from the perspective of being able to carry out our core function, the company has experienced worse conditions in the past.

Table 4: Key findings for South West England, 2050s[15].

Medium emissions 2050's	Central estimate	Change	Most likely range
Summer mean temperature	2.7ºC	Increase	1.3ºC to 4.6ºC
Summer mean daily maximum temperature	2.9ºC	Increase	1.2ºC to 5ºC
Annual mean precipitation	0%	No Change	–5% to 6%
Winter mean precipitation	17%	Increase	4% to 38%
Summer mean precipitation	–20%	Decrease	–42% to 7%
High emissions 2050's	**Central estimate**	**Change**	**Most likely range**
Summer mean temperature	3.1ºC	Increase	1.4ºC to 5.1ºC
Summer mean daily maximum temperature	4.3ºC	Increase	1.7ºC to 7.6ºC
Annual mean precipitation	0%	Increase	–6% to 6%
Winter mean precipitation	18%	Increase	3% to 41%
Summer mean precipitation	–20%	Decrease	–45% to 8%

3.3 Predicted future flows and groundwater levels

The Future Flows and Groundwater Levels (FFGWL) project conducted a consistent assessment of the impact of climate change on river flows and groundwater levels across England, Wales and Scotland using the latest projections from the UK Climate Impact Programme (UKCIP). These analyses provided a nationally consistent ensemble of 11 realisations of plausible future river flow and groundwater regimes.

[15] http://ukclimateprojections.defra.gov.uk

3.3.1 Surface water sources

Both the River Avon at Knapp Mill and the River Stour at Throop were included in this study and therefore were used for the analysis. For both locations none of the projections give flows less than the minimum observed in 1976. At Throop the climate change projected flows are consistently higher than the hydrological yield and at Knapp Mill the minimal of only 3 out of the 11 projections are marginally lower than the hydrological yield.

One of the limitations of using the FFGWL dataset is that it is only based on outputs from the Hadley Centre Regional Climate Model HadRM3 and therefore does not include uncertainty from other climate models. A comparison of the full 10,000 samples of UKCP09[16] for October[17] with October percentage change in flows (relative to the 1961–90 base year) for the relevant time period was also undertaken for the DO assessment in WRMP 14[18]. This was done to determine the validity of the FFGWL dataset used in the climate change impact assessment. The comparison was limited to the River Stour at Throop Mill for which UKCP09 data are available. Cumulative distribution factors (CDFs) were plotted for the 10,000 October percentage change flow factors along with October percentage change flow factors for the 11 climate projections. Figures 4 and 5 show the resulting plots for the 2050s and 2080s medium emissions respectively. A direct comparison with the 2030s was not possible as there were no UKCP09 samples available for that time period at the time this analysis was conducted. The comparison shows that the FFGWL percentage change flow factors fall within the 40th and 98th percentile of the UKCP09 CDF for the 2050s, and the 30th and 94th percentile of the UKCP09 CDF for the 2080s. This suggests that the 11-member ensemble from the FFGWL provides a reasonable representation of the full range of the UKCP09 projections. Therefore in conclusion, based on current data, climate change impacts do not reduce the DO of surface water sources. They therefore remain limited by license.

[16] Comparison undertaken for the UKCP09 medium scenarios for the 2050 and 2080 time slice.
[17] October was selected for this analysis as it was the most frequently occurring month for minimum flows in the 2030s time slice of the FFGWL dataset.
[18] http://www.bournemouthwater.co.uk/Uploads/Docs/Water%20resources%20plan/Appendix%204a%20surface%20water%20DO%20PD.pdf

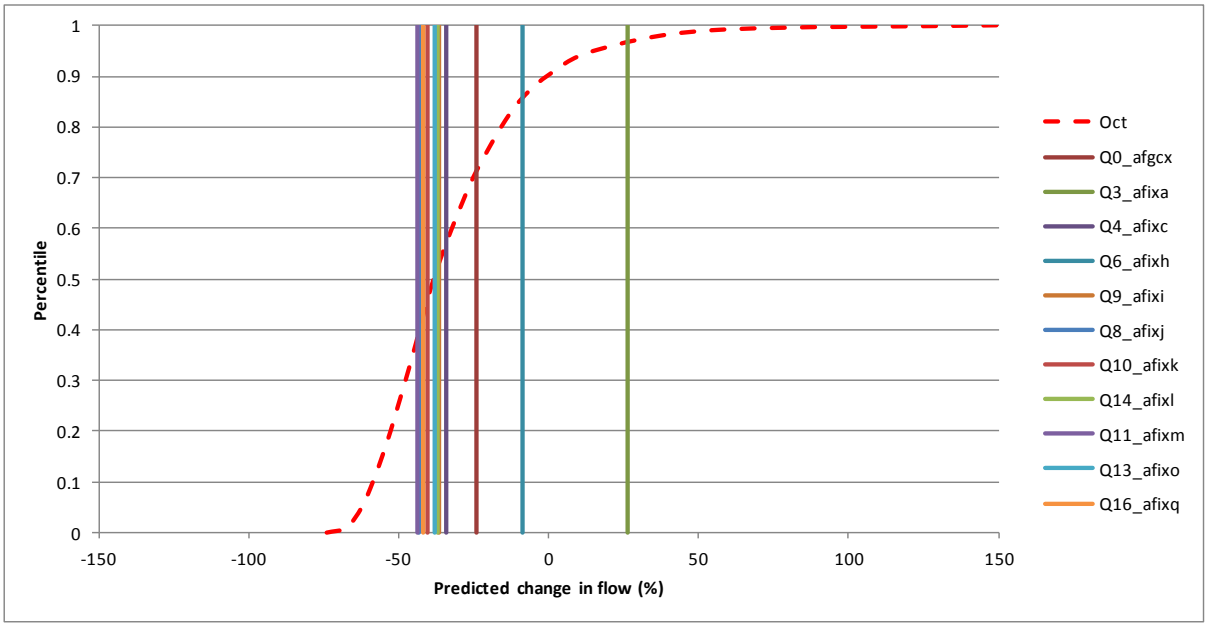

Figure 4: CDF plot of UKCP09 samples for medium emissions and 2050s time slice vs. calculated percentage change in flow in the 2050s (medium emissions) for the month of October for the River Stour at Throop Mill.

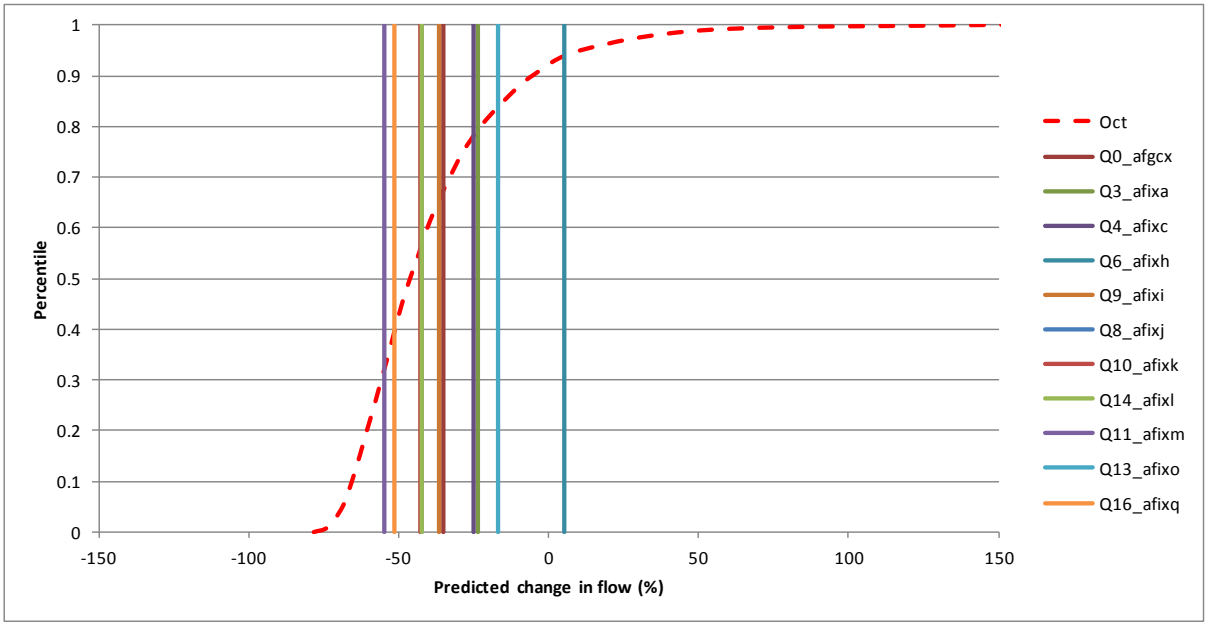

Figure 5: CDF plot of UKCP09 samples for medium emissions and 2080s time slice vs. calculated percentage change in flow in the 2080s (medium emissions) for the month of October for the River Stour at Throop Mill.

3.3.2 Groundwater sources

Linking groundwater deployable output (DO) and levels of service (LoS) was introduced in the latest WRMP process to bring groundwater DO assessment methodology more in line with that used for surface water DO. This was done by estimating the rate and duration of groundwater abstractions during dry period conditions that could lead to a failure of target LoS. In our circumstances, although we have never had to implement restrictions, our stated LoS is a temporary use ban in 1 out of every 20 years.

The observation borehole (OBH) at West Woodyates was used to determine the drought condition for BW's groundwater sources. From the analysis of historic records 1976 levels remained among the lowest levels recorded, with low levels prevailing over two consecutive recharge periods. This is concurrent with the analysis of surface water sources. A review of minimum annual water levels of notable dry years was conducted for previous WRMP's and analysis of years since WRMP09. These also confirm that 1976 levels still rank among the lowest minimum annual water levels. These were then compared against the predicted future scenarios.

The West Woodyates Manor OBH is one of 24 OBHs for which groundwater level projections for each of the 11 climate scenarios are available from The Future Flows and Groundwater Levels (FFGWL) project. The predicted water levels at the West Woodyates Manor OBH for the 2030s time period for each of the 11 climate projections were analysed to determine the month in which the annual minimum water level most frequently occurred. Predicted annual minima were most frequently observed in either October or November.

A comparison of the full 10,000 samples of UKCP09[19] for October[20] with FFGWL October groundwater level change factors for the relevant time period was also undertaken for the groundwater DO assessment to determine the validity of the FFGWL dataset used in the climate change impact assessment. Figure 6 shows a cumulative distribution function (CDF) plot for 10,000 October change factors for the UKC09 medium emissions 2050 scenario and October change factors for the 11 climate projections for the 2050 time slice. The comparison shows that the FFGWL change factors fall within the 20th and 98th percentile of the UKCP09 CDF for the 2050s. This suggests that the 11-member ensemble from the FFGWL provides a reasonable representation of the full range of the UKCP09 projections. When these were compared against historic minima it was concluded that the ability of company's groundwater sources to supply licensed volumes is not impacted by climate change based on current data. This means that groundwater sources remain constrained by license. A more detailed description of the groundwater DO assessment can be found in Appendix 4b of WRMP 14[21].

[19] Comparison undertaken for three UKCP09 scenarios - medium emissions 2050; high emissions 2050; and medium emissions 2080.
[20] October was selected for this analysis as it was the most frequent month in which minimum groundwater levels were observed for the 2030s time slice of the FFGWL dataset
[21] http://www.bournemouthwater.co.uk/Uploads/Docs/Water%20resources%20plan/Appendix%204b%20GW%20DO%20assessment%20PD.pdf

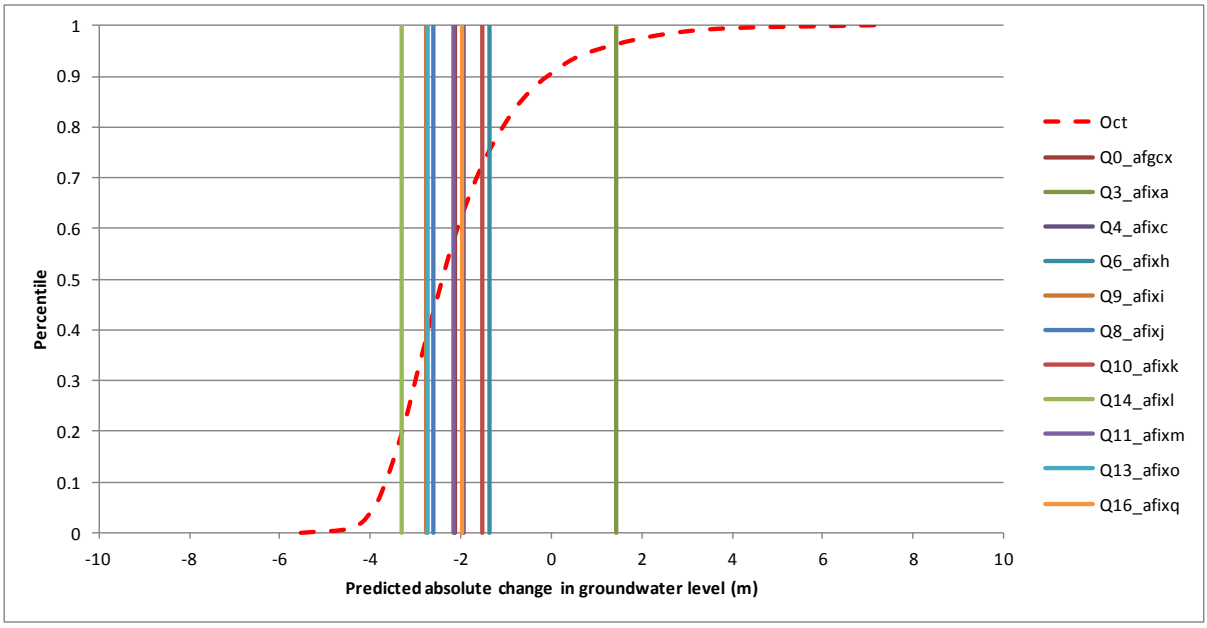

Figure 6: CDF plot of UKCP09 samples for medium emissions and 2050s time slice vs. calculated FFGWL change factors for groundwater levels in the 2050s (medium emissions) for the month of October for the West Woodyates Manor OBH.

3.4 Overview of thresholds of climate impacts and organisational vulnerability

This section provides an overview of climatic thresholds and impacts on the areas of operation identified in section 2.1. These include:

- Water resources
- Water Treatment
- Water networks
- Wastewater networks
- Wastewater treatment
- Sludge
- Site wide services

No new risks or thresholds were identified in the review of risks conducted for this report. Research undertaken subsequent to CCA 11 focussed on the evaluation of climate change impacts on company water resources. A description of this is provided in section 3.4.1 below.

3.4.1 Water resources

As a water company the ability to supply customers is of key concern. A summary of the impacts of climate change on sources is provided below.

Table 5: Surface water sources.

Source	Q95 flow	Peak DO	Average DO	Effect of climate change mid scenario on DO
River Stour	179.3	44.3 (Excludes surface storage)	44.3	None
River Avon	459.7	177.2	154.5	None

Both surface water sources long term flow sequences have been derived based on the relationship with flows on the river Thames at Teddington[22].

Our surface water sources have a large base flow component and therefore have a more stable flow regime that is not subject to large fluctuations such as those experienced in fully surface runoff fed rivers. This means that flows are maintained for longer during extended dry periods experienced in the summer. The predicted future conditions indicate that we are to expect drier summers, however the higher predicted winter rainfall means that we should have greater winter recharge than in the past mitigating the impacts of reduced summer rainfall.

Table 6: Groundwater Sources.

Source	Estimated reduction in annual minimum groundwater levels	Effect of climate change mid scenario on DO
Ampress	0.1 m	None
Stanbridge	0.3 m	None
Wimborne	0.2 m	None
Woodgreen	0.2 m	None

Deployable output for all groundwater sources is constrained by the licence or pump capacity, not by resource availability. In addition to the analysis in the sections above, we have recently completed test pumping and geophysical analysis on our groundwater sources to confirm our assumptions on the groundwater yields. The results of this work confirmed that:

- yields are only constrained by pump hydraulics and licence quantity, even under drought conditions, and

[22]http://www.bournemouthwater.co.uk/Uploads/Docs/Water%20resources%20plan/Appendix%204a%20surface%20water%20DO%20PD.pdf

- water levels will not drop significantly even after prolonged pumping at maximum rate.

As with our groundwater sources, surface water sources are robust and yields are constrained by licence quantity not by water availability, even under drought conditions.

3.4.2 Water treatment

No thresholds have been identified for site wide services. The risk scores can be found in Appendix 3 of CCA 11[23].

3.4.3 Water networks

No thresholds have been identified for water networks. The risk scores can be found in Appendix 3 of CCA 11.

3.4.4 Wastewater treatment

No thresholds have been identified for wastewater treatment. The risk scores can be found in Appendix 3 of CCA 11.

3.4.5 Sludge

No thresholds have been identified for sludge. The risk scores can be found in Appendix 3 of CCA 11.

3.4.1 Site wide services

No thresholds have been identified for site wide services. The risk scores can be found in Appendix 3 of CCA 11.

3.5 Quantification assessment and analysis of risk likelihood and impacts

We are required to assess the climate change risks facing the operation of our business as part of our regular statutory and planning documents (listed below). As we are a provider of an essential service on which the public depends, we have a duty to ensure we will be able to supply clean safe drinking water under uncertain future climatic conditions. The supply of safe reliable drinking water is the core function of our business. Furthermore, we need to ensure that we manage demand and maintain asset robustness and resilience. We also need to conduct our business in a sustainable manner, strive to reduce costs while maintaining good corporate governance, price stability, consistency and continuity.

In CCA 11 we followed the UKCIP[24] decision making framework when evaluating the impacts of climate change on our business. In the reassessment of the risks our qualitative

[23]http://www.bournemouthwater.co.uk/Uploads/Docs/climate_change_adaptation_report_final_12_01_11.pdf

[24] Climate adaptation: Risk, uncertainty and decision-making UKCIP Technical Report

risk assessment has been carried out by relevant experts across the company. This was done by evaluating the impacts identified in the Water UK[25] study in terms of the UKCIP 09 climate projections. The highest scoring impacts on the company's various assets and the associated hazards were then cross referenced to company publications. This was done to ensure that the hazards identified in the risk assessment had been taken into account. All hazards and consequences identified are dealt with in the following documents:

- Water Resource Management Plan,
- Drought Plan,
- Business Plan,
- Company Risk Register
- Water Safety Plans.

There have been no changes to risks identified in CCA 11. Full details of the risk assessment can be found in Section 2 and Section 3 of CCA 11[26]. This was undertaken using the corporate risk assessment methodology described in the above references. A summary is provided in Table 7 below.

[25] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

[26] http://www.bournemouthwater.co.uk/Uploads/Docs/climate_change_adaptation_report_final_12_01_11.pdf

Table 7: Summary of climate change impacts and proposed actions to address these.

Business Function	Climate variable	Primary impact of climate variable	Thresholds above which this will affect the organisation	Likelihood of threshold being exceeded in the future (medium term 2020's) and confidence in the assessment	Potential impacts on organisation and stakeholders	Proposed action to mitigate impact	Timescale over which risks are expected to materialise and action is planned
Water Resources	Drought	Reduced availability of resource	None identified in the medium term to be held under review (assessed in company Water Resource Plan)	Unlikely. Medium level of confidence in the assessment of this risk	Reduced available supply. Changes in peak demands. Lower river levels. Lower groundwater levels. Lower yields from sources. Reduction in security of supply. Reduced borehole performance.	Company drought plan and Water Resources Management Plan	Long term post 2050
	Temperature rise	Increased demand	None identified in the medium term to be held under review (assessed in company water Resource Plan)	Unlikely. Medium level of confidence in the assessment of this risk.	Demand outstrips supply and changes in customer behaviour	Company drought plan and Water Resources Management Plan	Long term post 2050
	Flood	Surface flooding	None identified in the medium term to be held under review (assessed in company Business Plan)	Unlikely Medium level of confidence in the assessment of this risk	Loss of water resource assets. High intensity rainfall events causing reduced groundwater recharge due to compaction of upper layer of soil	Assessed in company Business plan. Schemes completed in AMP 5 to mitigate risks to parts of treatment works under threat from surface flooding.	Medium term post 2020 Flood defence for vulnerable parts of treatment works completed in AMP 5
	Sea level	Inundation	None identified to be held under review	Extremely unlikely Medium level of confidence in the assessment of this risk	Increase in the flood potential of rivers when high flows and tides coincide	None at present impact will be kept under review	Long term post 2050
Water	Drought	Reduced raw	None identified to be held	Unlikely Medium level of confidence in the	Low flows leading to sedimentation and blockages. Reduced raw water	None at present impact will be kept	Long term post

Quality		water quality	under review	assessment of this risk	volumes reducing dilution. Intermittent supply causing silts and debris being flushed from storage into the system. More inversions leading to greater cryptosporidium accumulation. Lower flow rates leading to deposition and reduced raw water quality.	under review	2050
	Temperature rise	Increased algal growth	None identified to be held under review	Possible. Medium level of confidence in the assessment of this risk	Increased algal growth and other biological issues	None at present impact will be kept under review	Medium term post 2020
	Flood	Reduced raw water quality	None identified to be held under review	Unlikely Medium level of confidence in the assessment of this risk	Increased runoff leading to higher sediment loads	None at present impact will be kept under review	Long term post 2050
	Sea level	Reduced raw water quality	None identified to be held under review	Extremely unlikely. Medium level of confidence in the assessment of this risk.	Inundation	None at present impact will be kept under review	Long term post 2050
Infrastructure	Drought	Increased burst mains	None identified to be held under review	Unlikely. Medium level of confidence in the assessment of this risk	Pipe failure due to de-pressurisation. Low river/groundwater below intake/pump levels	None at present impact will be kept under review	Long term post 2050
	Temperature rise	Increased asset deterioration	None identified to be held under review	Unlikely. Medium level of confidence in the assessment of this risk	Higher average and peak temperatures affect structures and buildings. Possible reductions in asset life and operational ability of assets. Ground movement leading to increased mains failures.	None at present impact will be kept under review	Long term post 2050
	Flood	Surface flooding	Risks identified in the PR09 business plan to be held under review	Unlikely. Medium level of confidence in the assessment of this risk	Loss of assets and service failure through direct flooding. Storm events leading to loss of power supply. Increased storm water leading to increased pump usage and accelerated deterioration. Higher flows posing risk to pipe bridges	Assessed in company Business plan. Schemes completed in AMP 5 to mitigate risks to parts of treatment works under threat from surface flooding.	Medium term post 2020 Flood defence for vulnerable parts of treatment works to be completed in AMP 5

	Sea level	Inundation	None identified to be held under review	Extremely unlikely. Medium level of confidence in the assessment of this risk.	Inundation of assets	None at present impact will be kept under review	Long term post 2050
Corporate Services	Drought	Financial	None identified to be held under review	Possible. Medium level of confidence in the assessment of this risk	Financial impact of dealing with drought	Company drought plan	Medium term post 2020
	Temperature rise	Working in extreme conditions	None identified to be held under review	Possible. Medium level of confidence in the assessment of this risk	Working in extreme conditions	None at present impact will be kept under review	Medium term post 2020
	Flood	Access to sites	None identified to be held under review	Unlikely. Medium level of confidence in the assessment of this risk	Access to sites	None at present impact will be kept under review	Long term post 2050
	Sea level	Migration of population	None identified to be held under review	Extremely unlikely Medium level of confidence in the assessment of this risk	Migration of population	None at present impact will be kept under review	Long term post 2050

4 Understanding uncertainties

We have a general idea of what conditions to expect however, projecting 50 plus years into the future presents us with a large degree of uncertainty. In order to get an idea of future conditions we have made a number of assumptions about future impacts facing the company. We acknowledge that these assumptions could change in light of new information and therefore we have mechanisms in place to allow for the assumptions used in the climate change adaption plan to be reviewed and updated. This will ensure that we remain flexible and resilient to potential future hazards facing the organisation.

4.1 Main uncertainties in the evidence, approach and method used to assess adaptation and the operation of the organisation

The main uncertainties faced by the company are linked to the large variations in future climate scenarios and the robustness of data used to analyse the effects of climate on operations.

4.1.1 Water resources

Protection against the risk of specified uncertainties relating to the ability to supply customers is built into the supply-demand balance by including a headroom allowance. Headroom is defined as a planning allowance that a prudent water company should take into account when developing plans to balance supplies and demands and to deliver its desired level of service. The allowance is termed target headroom, and is designed to cater for particular uncertainties in both demand-side and supply-side components of the water balance.

4.2 Evidence

The impacts of climate change on the company have been taken from the MWH-Water UK study[27] and expert analysis based on historic conditions to assign impact score to the risks. The Water UK study provides general impacts for all water companies and therefore gives a broad range of possible impacts that could be experienced by a water company. While expert opinion is also a subjective means of evaluating risk, these scores could therefore change in future.

Due to the impacts being assessed not being company specific there is also a possibility that localised impacts could arise that have not been covered in the risk assessment. Data relating to the effects of climatic conditions on operations are not robust across all areas of the business. Although key weather data is collected and monitored, in future we need to ensure that the effects of these conditions on all the areas of operation are recorded.

[27] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

4.3 Approach

Our approach to climate change adaptation allows climate change risk to be managed through multiple interventions over time. Large capital schemes require good data and need a high level of confidence that the solution will be successful and an efficient use of money. In certain cases, such as for very long life assets a more favourable solution sometimes requires a single intervention. However the uncertainty around the future conditions and current level of data quality constrains us to following a step by step approach to manage climate change risks.

4.4 Method

In section 5 of CCA 11[28] the method of assessing impacts is detailed. Our qualitative risk assessment has been carried out by relevant experts across the company. This was done by evaluating the impacts identified in the Water UK study in terms of the UKCIP 09 climate projections.

4.5 Operation of the organisation

We are a small and local company compared to most other water which does increase operational risk slightly. Due to the small size of the company there are key staff members across the organisation that hold valuable information and expertise that is vital to the carrying out of our functions. This is especially the case when determining the effects of extreme weather on various areas of the business.

This information needs to be recorded and stored in order that the organisation is less reliant on these members of staff. There is still scope to improve the way operational data is stored and managed with regards to the effects of extreme weather. Measures are being put in place to better manage company data.

4.6 Uncertainties in monitoring and evaluating climate risks

The work undertaken as part of the WRMP has shown that current future predicted conditions will not affect the company's ability to discharge its duty to customers. The uncertainties have not changed since CCA 11. The company remains well placed to deal with these based on the current level of understanding. The next round of water resources and business planning in 2019 will require new forecasts and assessments of climate change impacts and uncertainties.

[28] http://www.bournemouthwater.co.uk/Uploads/Docs/climate_change_adaptation_report_final_12_01_11.pdf

5 Details of actions: implemented and new

Company actions with regards to the impacts of climate change focus on the ability to discharge our duty of supply to customers. Our customer demand for water is declining and the assessment of our sources of water show that they are resilient and capable of supplying our needs well into the future. We are therefore in a position where the risk of customer demand for water exceeding the amount we can supply is extremely low.

Although we have a surplus, it is of the utmost importance that we continue to reduce demand for water. This is because our area of supply does at times experience very high demand over the summer. This puts strain on the environment especially as the high demand occurs during dry conditions.

By continuing our demand and network management activities detailed in the company business plan BP [29] we can ensure that high demand is kept under control. This will alleviate pressure on our supply system and the environment during times of water stress. It is also a way of ensuring sustainability of our operations.

In addition to water availability we have a duty to supply wholesome water of good quality. The BP outlines measures taken subsequent to CCA 11 by the company to ensure that water quality standards are met. These include the commissioning of UV filtration.

Surface flooding of certain infrastructure was identified as vulnerable prior to CCA 11. Previously supply infrastructure is designed to be resilient to floods of up to a 1 in 200 year magnitude. Schemes were completed in the AMP 5 period set to improve flood resilience to what is currently considered to be 1 in 1000 years for those assets identified as being vulnerable to flooding.

When the knowledge of future flooding scenarios becomes more accurate it is possible that this may need to be reassessed and new design standards or flood mitigation measures implemented. There are also possible site access implications. In future a review of the suitability of vehicles may be necessary.

We continue to improve the resilience of our systems and to improve our ability to cope with external shocks and failure. We have recently undertaken a scheme with one of our neighbouring water supply companies Wessex Water to increase the network linkage between the 2 Companies. This allows up to 15Ml/d of treated potable water to be transferred between the parties in an emergency or a supply deficit situation. Therefore reducing the risk and impact of a supply outage to our customers.

5.1 Mitigating climate change risks

5.1.1 Customers

We provide an essential public service to our customers. The way that our customers use water directly affects our response to extreme weather conditions. Customer side interventions form an integral part of our demand management strategy, therefore we are reliant on customers reducing their water usage to manage peak summer demand.

[29] http://www.bournemouthwater.co.uk/company-information/our-business-plan.aspx

Company metering policy has changed since CCA 11 however the loss in demand reduction resulting from decreased metering is offset by improvements in network management.

5.1.2 Suppliers

We have risk management procedures in place for the loss of essential suppliers; these are detailed in the Water Safety Plan and Company Risk Register. However we need to ensure that our key suppliers are also resilient to the effects of climate change to ensure that we can maintain our levels of service under all conditions and only resort to our other contingencies in the most extreme circumstances.

5.1.3 Employees and shareholders

Our employees and shareholders depend on the functioning of the business for their livelihood. The business in turn needs finance and manpower to carry out its functions. Both staff and shareholders need to be aware of the issues faced by the company with regards to dealing with climate change. The first two steps of our climate change adaptation plan implementation strategy involved raising awareness and organisational learning. Having staff and shareholders support in delivering on climate change adaptation strategy will ensure its success and therefore the continued functioning of our business through all future uncertainties. Progress has been made through the introduction of climate change risk as an item to be reviewed by the company environmental policy group at quarterly meetings. A full time role has also been created that handles the development and implementation of climate change adaptation across the business.

5.1.4 Government DEFRA and policy makers

We are an essential public service appointed by statute. It is therefore in the interest of both parties to ensure that we continue to provide our service as a failure to do so would reflect on the government and lead to widespread dissatisfaction among the electorate. All assessments subsequent to CCA 11 agree with the conclusion that under present forecasts the company sources are only limited by licence and are at low risk to climate change impacts.

5.1.5 Regulators

The water industry is heavily regulated, with much of what we do coming under close scrutiny. We need to ensure that we continue to meet our regulatory obligations into the future. As the effects of climate change become more widespread we predict that we will come under increasing pressure from our regulators to achieve the outputs that are set for us.

Our economic targets set by Ofwat will require sound evidence that we are performing in a sustainable efficient manner whilst the environmental regulators Natural England NE and the Environment Agency EA will expect us to operate in a manner that has the least negative impact on the environment.

Over and above these pressures we will also be required by the Drinking Water Inspectorate (DWI) to produce water to the highest possible standard. It is essential that we work together

with the various regulators to achieve all the regulatory outputs required of us, by doing so we will ensure that we maintain our world class service long into the future.

We need to ensure that we maintain open communications with our regulators and encourage our regulators to communicate with one another to guarantee that we are all working together to achieve the same end.

5.1.6 Impacts of this report on climate change management

By continuously reviewing the risks and assumptions around climate change we intend to identify risks before they become a problem. We view climate change risks in the same light as all risks facing the company. As a result of all strategic risks having regular reviews we can determine if a risk will reach a level where it is unacceptable to the company.

Due to the long term planning and resilient management required by our regulators climate change is already taken into account in many key areas of operation. This report serves as a means of ensuring that climate change adaptation is taken into account across all areas of operation, ensuring that we do not overlook any processes that at present are not affected by climatic conditions but could be affected in future.

6 Actions that address the impacts of climate change

As a responsible company we believe that ensuring resilience is the right course of action.

- Even though we have forecast that we will have sufficient water for the next 25 years we must do what we can to encourage its efficient use.
- We must also work in a manner that ensures our activities are effectively planned and managed so as to have the least possible impact on the environment.
- We must also take our customers' views into account when deciding on a course of action for managing operations.

6.1 Ensuring a continuous supply of clean water

As we have pointed out in the sections above, our sources of water are able to provide a continuous supply throughout the 25-year planning period. Our demand management policies will also ensure that we maintain this continuous supply of water in a cost-effective manner, with the least possible impact on the environment.

In addition to our metering activities, we constantly aim to improve the management of our assets. Over the past five years we have increased the amount of water mains renewals. This has the effect of both reducing leakage and making our network more resilient leading to fewer supply interruptions. Where it is cost effective and supported by our customers, we will continue to make improvements to the overall reliability of our system of assets so as to minimise the risk of failure for any reason. The company is trialling enhanced network management to enhance the efficiency of network operation. This will have further positive impacts on leakage and demand.

6.2 Prompt repair of leaks and minimisation of interruptions to supply

We have consistently kept our levels of leakage below the sustainable economic level of leakage (SELL). This is the level below which further leakage reduction becomes more expensive than the water that is lost. Although we are operating below the SELL, we aim to constantly improve our performance in this area. Our customers support this approach and therefore we aim to continue to reduce leakage.

- Reducing leakage has the benefit of allowing more water to be available for our customers and the environment. We have made significant progress in recent years in managing leakage across our area of supply through the following:
- The majority of the company's network of water mains is continuously monitored allowing for a quick response to leaks.
- Large water mains are inspected on a regular basis to check for signs of leakage.
- We have a dedicated team of leakage technicians who monitor performance of our network and respond as necessary using a variety of techniques to locate leaks.
- Our storage tanks are regularly inspected internally and leak tested.
- We monitor all metered customers for higher than normal usage, alert them if we notice any unusual increases in use, and offer customers free supply pipe repairs and subsidised supply pipe replacement if the leak is found to be coming from their supply pipe.

- As excessive pressure in water networks increases leakage, we actively manage the pressure of our network, reduce excessive pressure and therefore control leakage.

We continually assess ways of improving the proactive management of our network and increasing the efficiency of our activities to ensure that we provide a cost-effective, sustainable supply of water.

6.3 Managing demand

We have experienced a gradual but significant reduction in demand since the implementation of current metering policies in 2000. We attribute this to changes in customer attitudes and behaviour towards water use. This has been brought about by a combination of metering, water-efficiency activity and a general increase in awareness among members of our community of the need to use water in a more sustainable manner.

From our forecasts we anticipate a surplus well into the future and therefore do not propose to develop any new water resource options.

6.4 Communication and education

Changing behaviour is a critical factor in reducing customer demand. This can only be achieved through raising awareness and educating customers to use water in the most sustainable manner.

We have devised a water-efficiency strategy based around optional metering, enhanced communication and education activity with our customers. This is in addition to our current water-efficiency activities which include:

- Provision of free water-efficient devices.
- Gardening advice.
- Advice on how to self-audit.
- Schools education programme.
- Subsidised water butts.
- Non-household audits and online information.
- Community events.
- Online advice and tips.

6.5 Metering

Customers whose supply is metered generally use less water. A widely-accepted figure is that metered customers use around 10% less water than those without a meter.

Our metering policies include:

- Metering of all non-household properties.
- Metering of all new properties.
- Promoting active switching to metering.

These policies have been in place for a number of years and have been instrumental in managing demand. Since 2005, we have installed approximately 40,000 meters and the Figure 7 below illustrates the reduction in demand with the increase in the number of

metered properties during this time. Demand continues to decline even though the number of properties we supply grows each year. Subsequent to the 2014 Business plan we no longer meter customers on change of occupier. The negative impact on demand savings resulting from the reduction in metering will however be offset by improvements in leakage and network management. Additionally we believe that there will be a natural reduction in the number of properties that opt to be metered. This is because the properties that are most likely to be metered are now already on measured billing. We aim to have all properties that can be metered on measured billing by 2040.

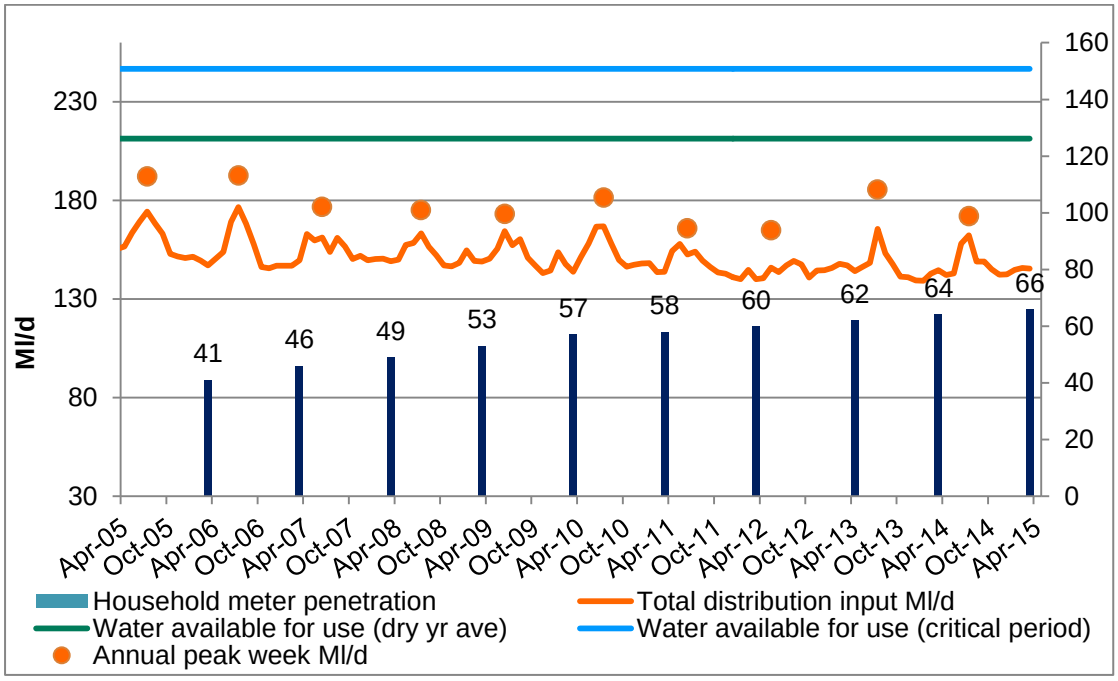

Figure 7: Actual demands and meter penetration.

Table 8: Summary of actions implemented to address the impacts of climate change.

Step	Activity	Responsible department/person	Action	Completed	Comment
1 Raising awareness	Ensure all staff are aware of the climate change impacts on the business and what is being done	Regulation	Produce a notice for all staff outlining our climate change adaptation plan. Ensure that staff are kept up to date of yearly reviews of the plan in company publications	Yes	On-going
1 Raising awareness	Ensure all customers are aware of the companies CCA strategy	Regulation	Provide an summary of the climate change adaptation strategy in customer publications	Yes	
2.Organisational learning	Ensure all key staff members are educated about the impacts of climate change and how it affects their area of operation	Regulation	Initiate and annual review meeting with heads of departments to review climate change adaptation report	Yes	Part of the annual review of climate change impacts
3 Changing standards and developing company policy	Ensure climate change adaptation is implemented into all risk, standards and key policy reviews	Executive	Change these processes and procedures to ensure CCA is taken into account	Partially	Climate change adaptation is part of the company environmental policy group
4. Data collection and monitoring	Formal yearly review of CCA plan	Regulation	Review CCA plan to ensure that all assumptions and actions are up-to-date.	Yes	Yearly reviews of climate change impacts carried out
4. Data collection and monitoring	Ensure climatic data is recorded and effects of conditions on areas of operation are noted	Heads of departments/Regulation	Initiate yearly departmental climate reports to go into a company climate change evidence base	Still to be implemented	
5 Creating working partnerships	Ensure key suppliers and customers are informed about our CCA strategy.	Corporate services	Provide access to CCA report and yearly updates	Still to be implemented	
5 Creating working partnerships	Ensure that other reporting authorities are aware of our CCA plan	Regulation	Publish CCA report on the South West Climate Change Adaptation mapping resource website	Partially	Work in progress with Climate South West

6.6 Benefits from actions

The Climate Change Adaptation Plan (CCA 11) is an iterative document. As has been pointed out we have now incorporated climate change adaptation into our corporate reporting structures, this will ensure that any climate change related issues are identified and the subsequent adaptation actions are closely monitored.

Due to the nature of climate change future scenarios will need to be updated when our understanding of these improves. Therefore continued monitoring of these scenarios in our yearly updates of the Climate Change Adaptation Plan will ensure the organisation remains flexible to changing conditions. Embedding climate change risk management into the organisation is a necessary means to ensure that the above mentioned flexibility is maintained.

By continuously reviewing the risks and assumptions around climate change we intend to identify risks before they become a problem. We view climate change risks in the same light as all risks facing the company. As a result of all strategic risks having regular reviews we can determine if a risk will reach a level where it is unacceptable to the company.

Due to the long term planning and resilient management required by our regulators climate change is already taken into account in many key areas of operation. The CCA 11 report and this update serve as a means of ensuring that climate change adaptation is taken into account across all areas of operation. This will ensure that we do not overlook any processes that at present are not affected by climatic conditions but could be affected in future as conditions and knowledge change.